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General Catalog Lightning Protection

General Catalog

Lightning Protection

SANKOSHA Corporation

SANKŌSHA

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Our total solution encompasses the three core businesses of lightning protection, Telecommunications and environmental countermeasures.

At Sankosha, we have worked to protect people and society from natural disasters through our core businesses of lightning protection, telecommunications and environmental countermeasures.
Not only in Japan, but around the globe, we at Sankosha continue to work with our customers to deliver safety and security to an advanced information society as the world's only comprehensive lightning protection company, through every kind of service, from lightning observation to lightning protection.

Lightning protection solutions

- SPD, GDT, semiconductor lightning protection elements
- Power supply SPD, lightning transformers
- Earthing enhancing compounds, earthing electrodes, lightning - proof cables
- Lightning protection consulting

TOTAL SOLUTION

Environmental countermeasure solutions

- Lightning strike positioning devices
- Lightning detection and observation devices
- Lightning and weather information
- Energy saving system products

Tele-communications network solutions

- Optical termination boards, optical closures
- MDF, IDF, terminal boards (TE products, R&M products)
- Control consoles
- Obstruction light systems

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Company Profile

Name	SANKOSHA Corporation
President	Masayoshi Ito
Founded	April, 1930
Paid-in Capital	¥975,000,000
Employees	884 (Group total)

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  □SANKOSHA HONG KONG LIMITED
  NO.2 Jiangnan Industry Park, Nanchun, Panyu, Guangzhou, China
  Phone:+86-20-34766826 FAX:+86-20-34769629

■Domestic Branches in JAPAN

□Sagami Techno Centre	1-1-12 Miyashimo Sagamihara-shi,Kanagawa	JAPAN
□Hokkaido Sales Branch	Sapporo-shi	JAPAN
□Tohoku Sales Branch	Sendai-shi	JAPAN
□Chubu Sales Branch	Nagoya-Shi	JAPAN
□Kansai-Sales Branch	Osaka-shi	JAPAN
□Chugoku Sales Branch	Hiroshima-shi	JAPAN
□Shikoku Sales Office	Takamatsu-shi	JAPAN
□Kyushu Sales Branch	Fukuoka-shi	JAPAN

Businesses

■Lightning protection
Manufacture and sales of SPD, GDT and semi-conductor lightning protection elements
Manufacture, sales and installation of power supply protective devices and lightning transformers
Manufacture, sales and installation of earthing enhancing compounds, earth electrodes, and lightning-proof cables
Lightning protection consulting

■Telecommunications network solutions
Manufacture, sales and installation of optical wiring boards, optical closures, MDF, and IDF
Sales and installation of TE and R&M products
Manufacture, sales and installation of control consoles
Manufacture, sales and installation for obstruction light systems

■Environmental countermeasures
Sales and installation of lightning strike positioning devices
Sales and installation of lightning detection and observation devices
Sales of lightning and weather information
Sales and installation for energy saving system devices

Construction business licences

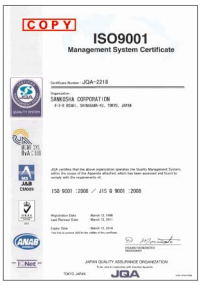
■Special construction
Electrical construction

■General construction
Construction work, electrical communications construction, building construction, etc.

Main customers

Central government ministries – organizations – local prefectures, cities and towns/ Electrical and gas companies/ oil companies – oil storage facilities/ Railroad companies – signal manufacturers/ Telecommunications companies – mobile telephone companies/ Manufacturers (electrical – telecommunications – general)/ Constructors (electrical – telecommunication)/ Hospitals – universities – trading companies – broadcasting – leisure

ISO accreditation



■March, 1998 Quality Management System ISO 9001 accredited
Registration No: JQA-2218

■October, 2002 Environmental Management System ISO 14001 accredited
Registration No: JQA-EM2683

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As experts in comprehensive lightning countermeasures, we

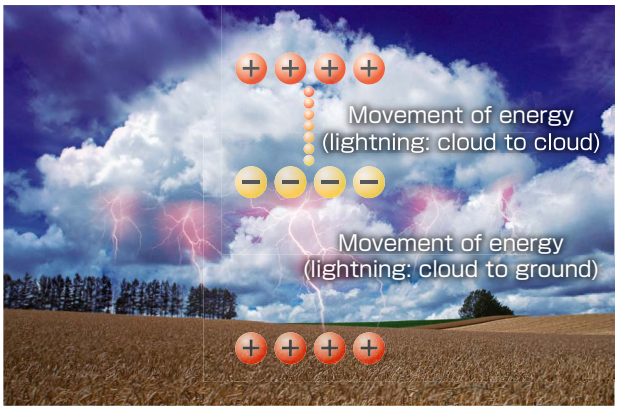
What is lightning?

◇ How lightning happens

Lightning is a natural phenomenon, similar to static electricity.

Lightning occurs when there are unstable atmospheric conditions. When cold air enters the upper atmosphere and there are updrafts caused by the earth's surface being heated by the sun, then thunderclouds will be formed. When the temperature inside the cloud is between minus 10°C and minus 20°C, droplets of ice are formed and collide with each other in the updrafts. When they collide, charge separation occurs and small light ice droplets become positively charged and are carried into upper atmosphere by updrafts.

The larger droplets become negatively charged and accumulate at lower levels due to the gravity. When the negative charge at the base of the cloud reaches a certain value as the thundercloud develops, electrical discharge occurs within the cloud and between the cloud and the surface of the earth. This is lightning. Since the release of energy takes place in an instant, it is accompanied by intense light (lightning) and sound (thunder).



◇ Summer lightning and winter lightning

Winter lightning can sometimes discharge more energy than summer lightning

Most lightning occurs in the summer (summer lightning), but it can also occur in winter, and is called winter lightning.

Compared to summer lightning, winter lightning forms in comparatively low thunderclouds, so lightning strikes tend to concentrate on buildings and structures. Also, the electrical discharge during these lightning strikes lasts for a comparatively long time, releasing a great amount of energy, with a tendency for greater lightning damage.

Example of summer lightning (downward discharge)

Example of winter lightning (upward discharge)

*Winter lightning is mostly upward discharge

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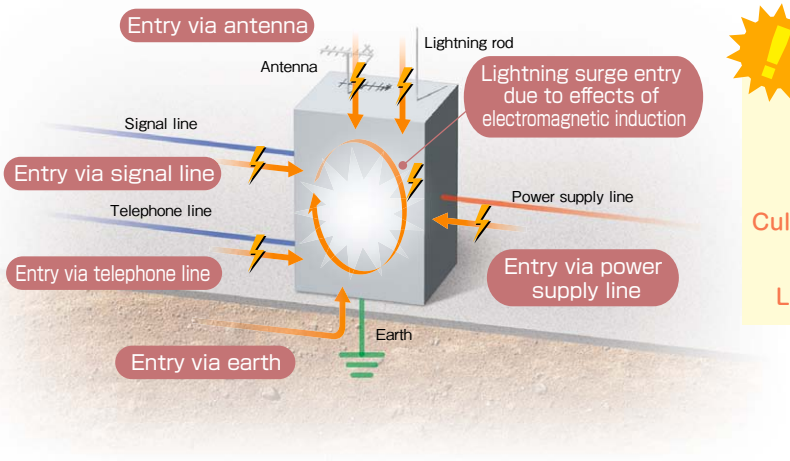
at Sankosha work to address our customers' diverse needs.

◇ Increased lightning damage

In the information society, communication equipment has become more compact because of the spread of digital communication equipment that uses many electronic parts and components, and it tends to be more vulnerable lightning than analogue equipment. In the ICT society, communication networks are spreading everywhere, and so are many types of communication cables. This means that there are many more entry routes for lightning, and a greater possibility of suffering lightning damage.
Lightning surge entry routes can vary greatly depending on the conditions, and this is why it is important to cover every imaginable entry route when planning lightning countermeasures.

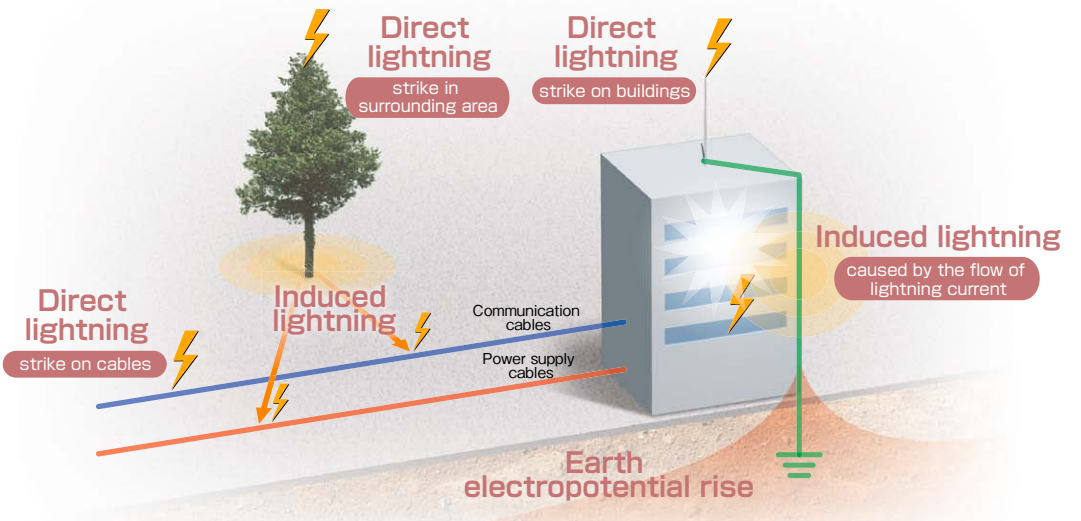


Human injury
Lifelines damage or cut
Public utility services stop
Production facilities damage stop
Cultural heritage sites damage or destruction
PC data damage or destruction
Lightning damage to ordinary households

Many other kinds of damage are possible!

◇ Direct lightning and induced lightning

Direct lightning is that lightning directly strikes buildings and other objects on the ground. When an extremely large lightning current is formed, it changes not only into electrical energy but also into heat and mechanical energy momentarily, and is discharged with explosive force, causing damage to various types of equipment and machinery.
Induced lightning is lightning surge (transient abnormally high voltage current) that is caused from communication and electrical power lines, and can enter via power supply lines, communication lines and earthing, etc. Most lightning damage is caused by induced lightning which destroys communication equipment and computers, and sometimes even power supplies, and therefore, the number of cases of lightning damage has risen dramatically in recent years.



Lightning can strike anywhere.
Strong magnetic fields and voltage are generated in the areas surrounding a lightning strike point, and can become the cause of induced lightning.

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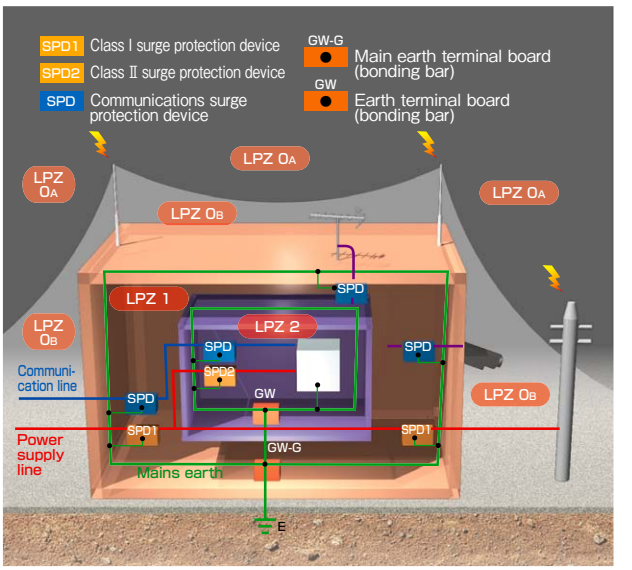
IEC lightning countermeasure overview

◇ Lightning Protection Zones (LPZ)

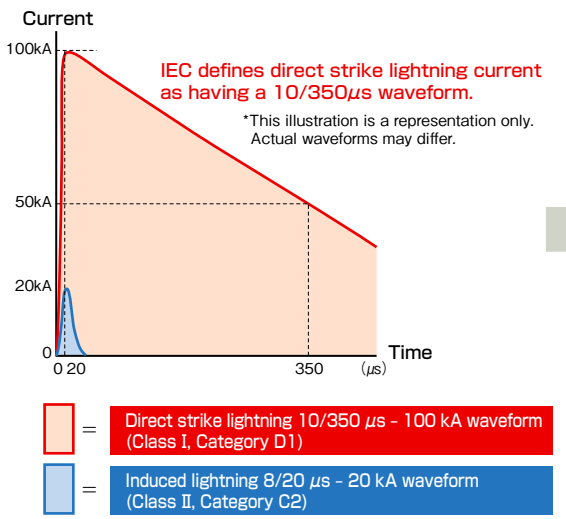
IEC classifies the different levels of lightning effect into Lightning Protection Zones (LPZ), and by installing suitable SPD at each zone boundary, the damage to equipment can be minimized.

Lightning Protection Zone (LPZ)			Lightning Protection Zones and SPD classes and categories	
External zone	LPZ 0A	A zone outdoors and outside the protection range of an external lightning protection system. When structures are struck directly by lightning, they may be subjected to the full lightning current.	LPZ 0A and the boundary between LPZ 0B and LPZ 1	Class Ⅰ,Ⅱ Category C2, D1
	LPZ 0B	A zone outdoors and within the protection range of an external lightning protection system. Structures are not struck by lightning directly, but may be subjected to non-attenuated lightning charge.		
Internal zone	LPZ 1	A zone indoors and within the protection range of an external lightning protection system. Structures may be subjected to partial direct lightning strikes, but the effects of the lightning current and electromagnetic fields are mitigated.	The boundary between LPZ1 and LPZ 2+	Class Ⅱ, Category C2
	LPZ 2～	A zone inside a building and where there is a need to mitigate the effects of lightning current and electromagnetic fields to an even greater extent than in LPZ1.		



◇ Protecting against direct lightning strikes

IEC defines direct strike lightning current as having a 10/350 μs waveform. Lightning energy is represented by the area of the waveform illustrated below. It can be seen that, compared against an inducted lightning current waveform (8/20 μs), this is an extremely large force of energy.



SPD performance marks (Classes, Categories)

	SPD performance mark samples	
	For direct lightning	For induced lightning
	For 10/350 μs lightning current Installed at LPZ 0/1 boundary	For 8/20 μs lightning current Installed at LPZ1/2 boundary
For low voltage power supplies	Class Ⅰ	Class Ⅱ
For communications - signal lines	Category D1	Category C2

・Class Ⅰ and Class Ⅱ are test grades for low voltage power supply SPD.
・Categories D1 and C2 are test grades for communications and signals (in addition, there are also Categories A, B, etc.)

◇ Setting of protection levels

IEC stipulates four protection levels (lightning countermeasure levels), according to the importance of the building and equipment and the degree of hazard.

Protection Level *1	Protection efficiency	Lightning current peak value (10/350μs)	Max. current to SPD (10/350μs) *2
Ⅰ	98%	200kA	100kA
Ⅱ	95%	150kA	75kA
Ⅲ	90%	100kA	50kA
Ⅳ	80%	100kA	50kA

*1 The protection level can be selected by the contractor after considering the lightning risks.

*2 Assuming 50% to earth, 50% to service line.

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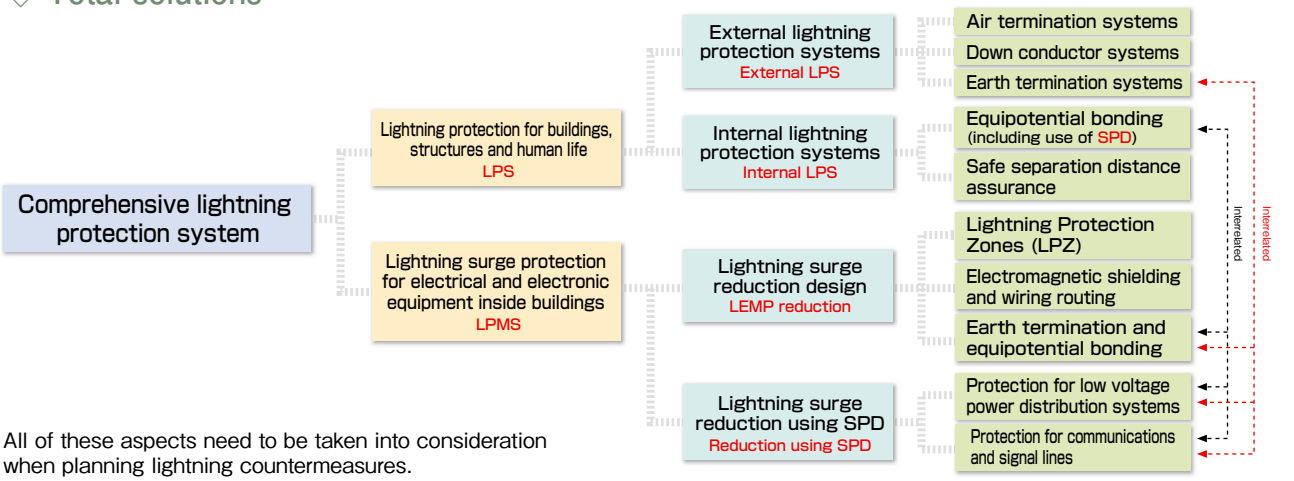
Comprehensive Lightning Countermeasure Systems

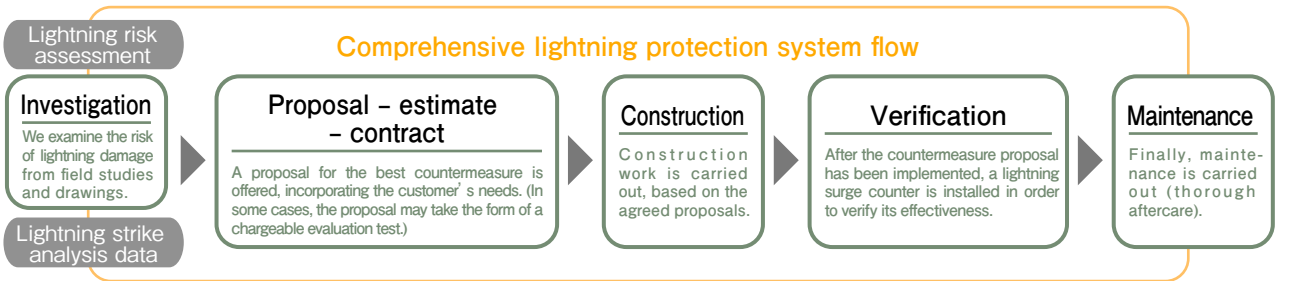
◇ Total solutions



All of these aspects need to be taken into consideration when planning lightning countermeasures.

◇ Comprehensive lightning protection system

As a comprehensive lightning protection company, Sankosha works to solve all kinds of problems caused by lightning strikes.



Lightning risk assessment

Our lightning risk diagnostic programs range from simple diagnoses to expert diagnoses. The simple diagnosis is available on CD ROM. Based on the customer's answers to approximately 20 questions, we prepare a diagnostic report.

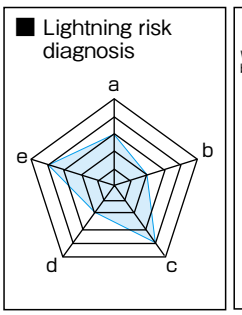
・Expert diagnosis

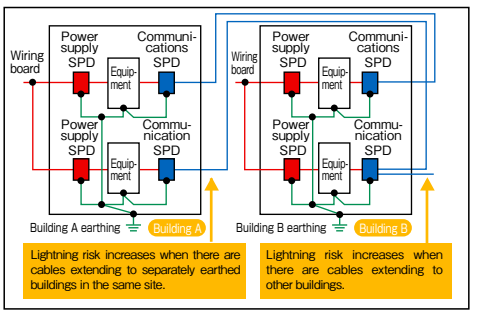
We ask the customer for information that shows the conditions of to the local environment, electrical plant and equipment, instrumentation, earthing systems, and management. Also, if equipment has been damaged or destroyed, the expert diagnosis will proceed more smoothly (where necessary, an on-site inspection will be conducted) with the manufacturer's equipment damage report. Based on the results of the diagnosis, we can determine the degree of lightning risk and propose the optimal countermeasures.

・Simple diagnosis

We examine five elements in order to assess lightning risk.

a. Local environmental conditions
b. Air terminating systems
c. Communications and control systems
d. Earth termination
e. Safety management systems





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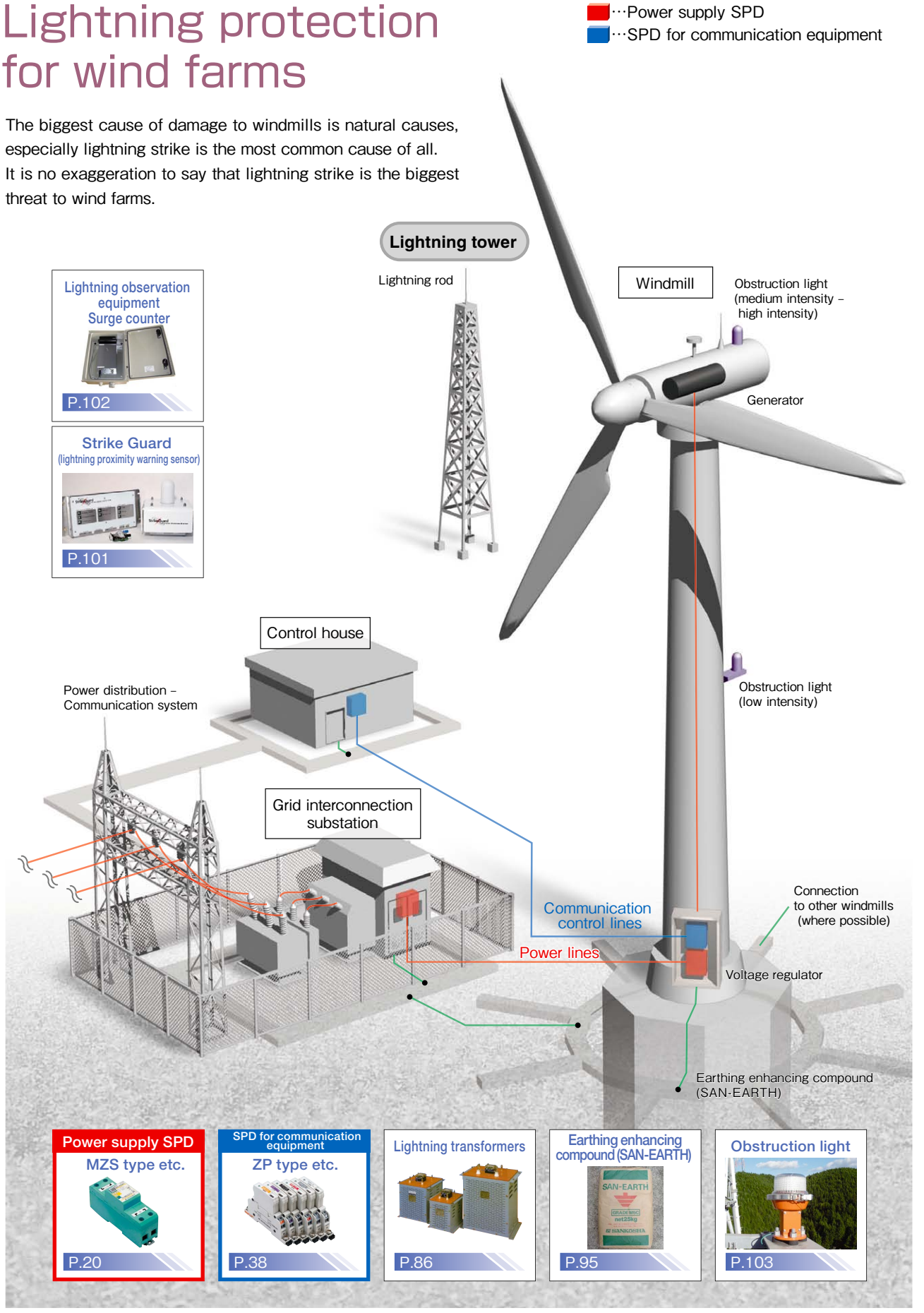
Lightning protection for wind farms

The biggest cause of damage to windmills is natural causes, especially lightning strike is the most common cause of all. It is no exaggeration to say that lightning strike is the biggest threat to wind farms.



Note: This lightning countermeasure diagram is for the purposes of showing the required SPD items, and does not necessarily represent an accurate lightning countermeasure. Please consult our experts for details on lightning protection systems.

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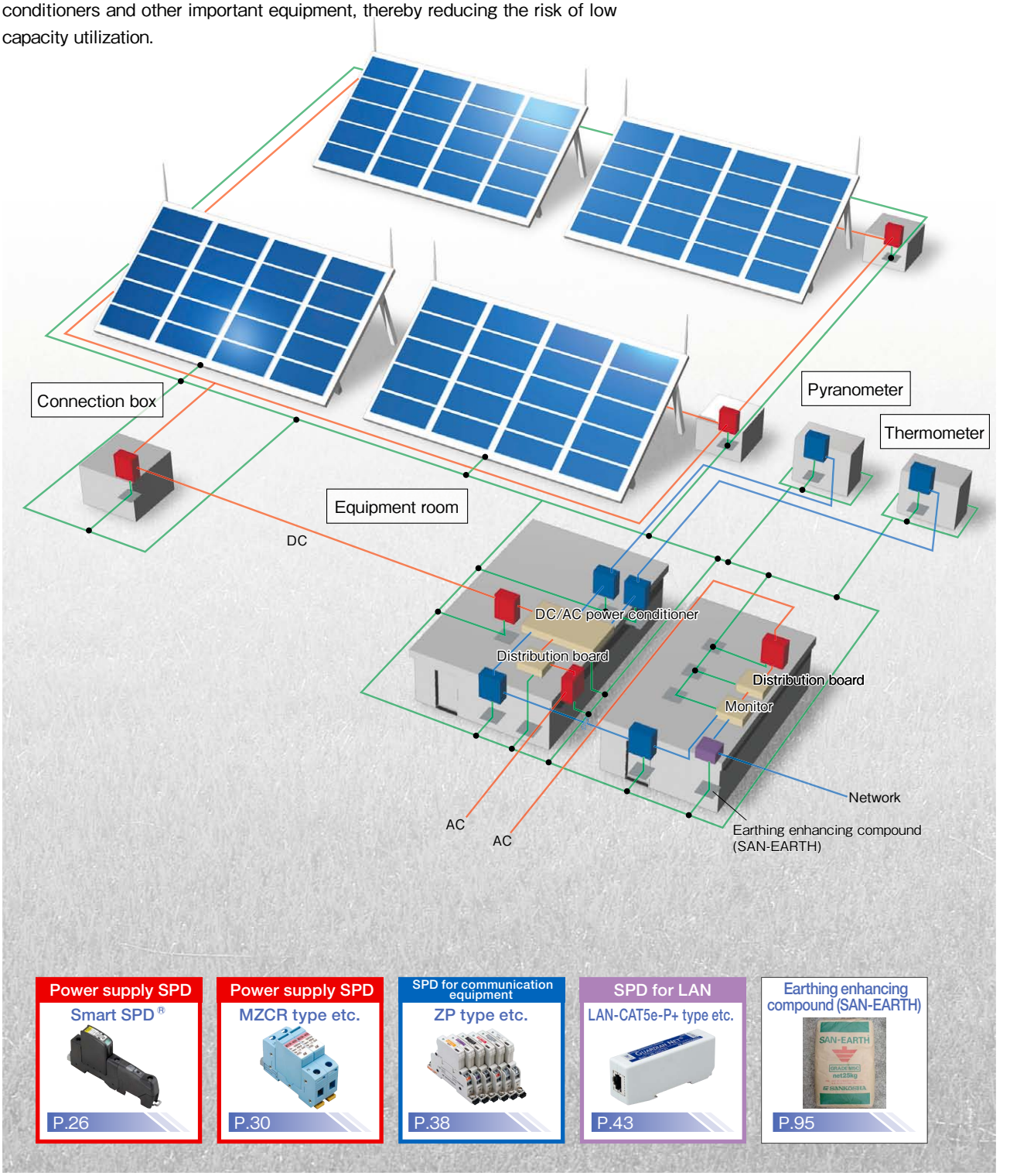
Lightning protection for solar power installations

···Power supply SPD
···SPD for communication equipment
···SPD for LAN

Solar power is attracting attention as a source of clean energy. However, solar power generating systems that are set up outdoors are prone to lightning damage, and lightning protection countermeasures are essential to their efficient operation. With solid technical skill that has won the industry's top share, Sankosha's countermeasures prevent damage from spreading to power conditioners and other important equipment, thereby reducing the risk of low capacity utilization.



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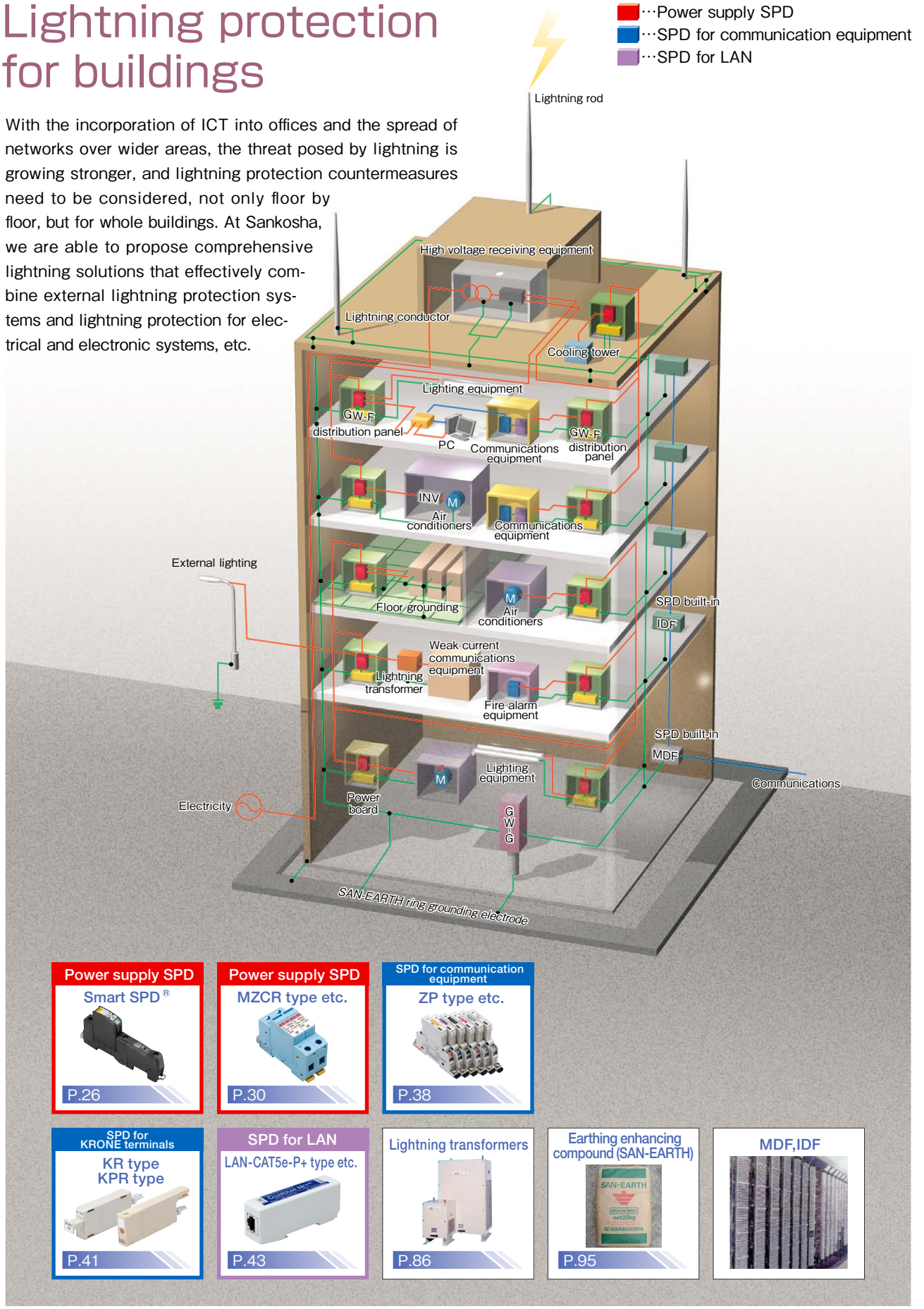
Lightning protection for buildings

With the incorporation of ICT into offices and the spread of networks over wider areas, the threat posed by lightning is growing stronger, and lightning protection countermeasures need to be considered, not only floor by floor, but for whole buildings. At Sankosha, we are able to propose comprehensive lightning solutions that effectively combine external lightning protection systems and lightning protection for electrical and electronic systems, etc.



Power supply SPD
Smart SPD®
P.26

Power supply SPD
MZCR type etc.
P.30

SPD for communication equipment
ZP type etc.
P.38

SPD for KRONE terminals
KR type
KPR type
P.41

SPD for LAN
LAN-CAT5e-P+ type etc.
P.43

Lightning transformers
P.86

Earthing enhancing compound (SAN-EARTH)
P.95

MDF,IDF

Note: This lightning countermeasure diagram is for the purposes of showing the required SPD items, and does not necessarily represent an accurate lightning countermeasure. Please consult our experts for details on lightning protection systems.

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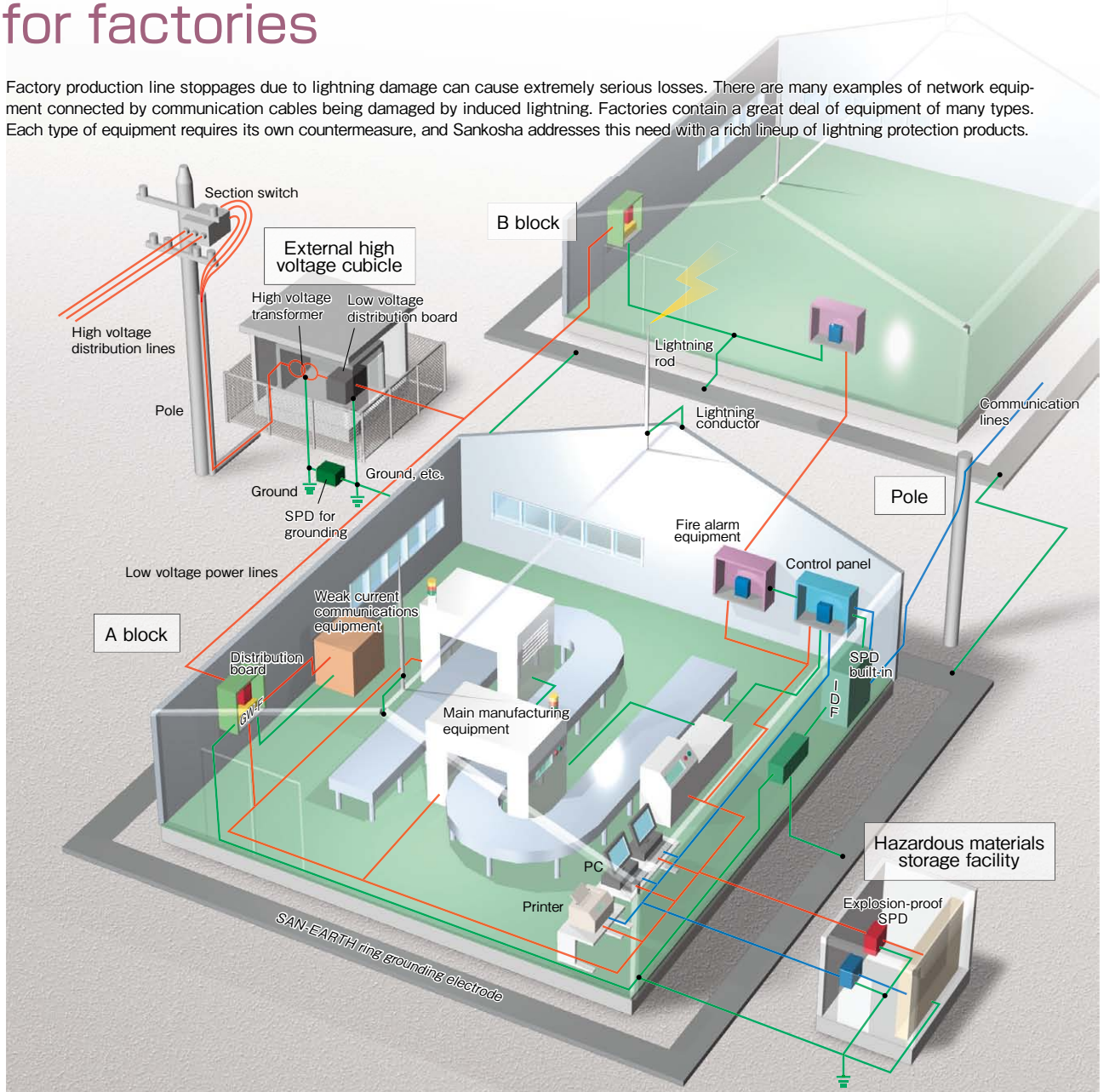
Lightning protection for factories

…Power supply SPD
…SPD for communication equipment

Factory production line stoppages due to lightning damage can cause extremely serious losses. There are many examples of network equipment connected by communication cables being damaged by induced lightning. Factories contain a great deal of equipment of many types. Each type of equipment requires its own countermeasure, and Sankosha addresses this need with a rich lineup of lightning protection products.



Power supply SPD
Smart SPD®
P.26

Power supply SPD
MZCR type etc.
P.30

SPD for communication equipment
ZP type etc.
P.38

SPD for KRONE terminals
KR type
KPR type
P.41

Explosion-proof SPD (for power supply)
EX-P type
P.57

Explosion-proof SPD (for communications)
EX-L type
P.57

Earthing SPD
P.59

Lightning transformers
P.86

Earthing enhancing compound (SAN-EARTH)
P.95

MDF,IDF

Note: This lightning countermeasure diagram is for the purposes of showing the required SPD items, and does not necessarily represent an accurate lightning countermeasure. Please consult our experts for details on lightning protection systems.

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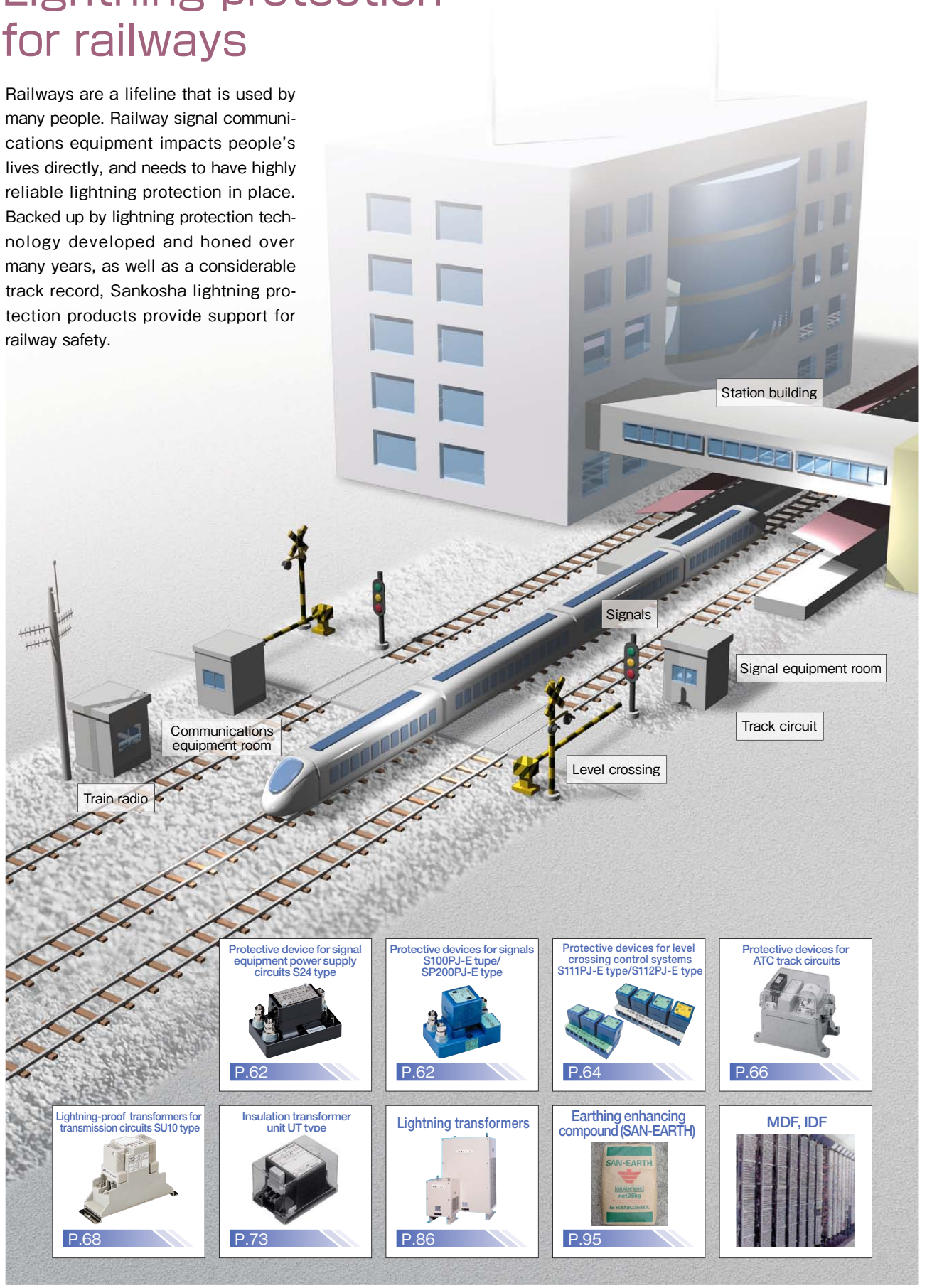
Lightning protection for railways

Railways are a lifeline that is used by many people. Railway signal communications equipment impacts people's lives directly, and needs to have highly reliable lightning protection in place. Backed up by lightning protection technology developed and honed over many years, as well as a considerable track record, Sankosha lightning protection products provide support for railway safety.



Note: This lightning countermeasure diagram is for the purposes of showing the required SPD items, and does not necessarily represent an accurate lightning countermeasure. Please consult our experts for details on lightning protection systems.

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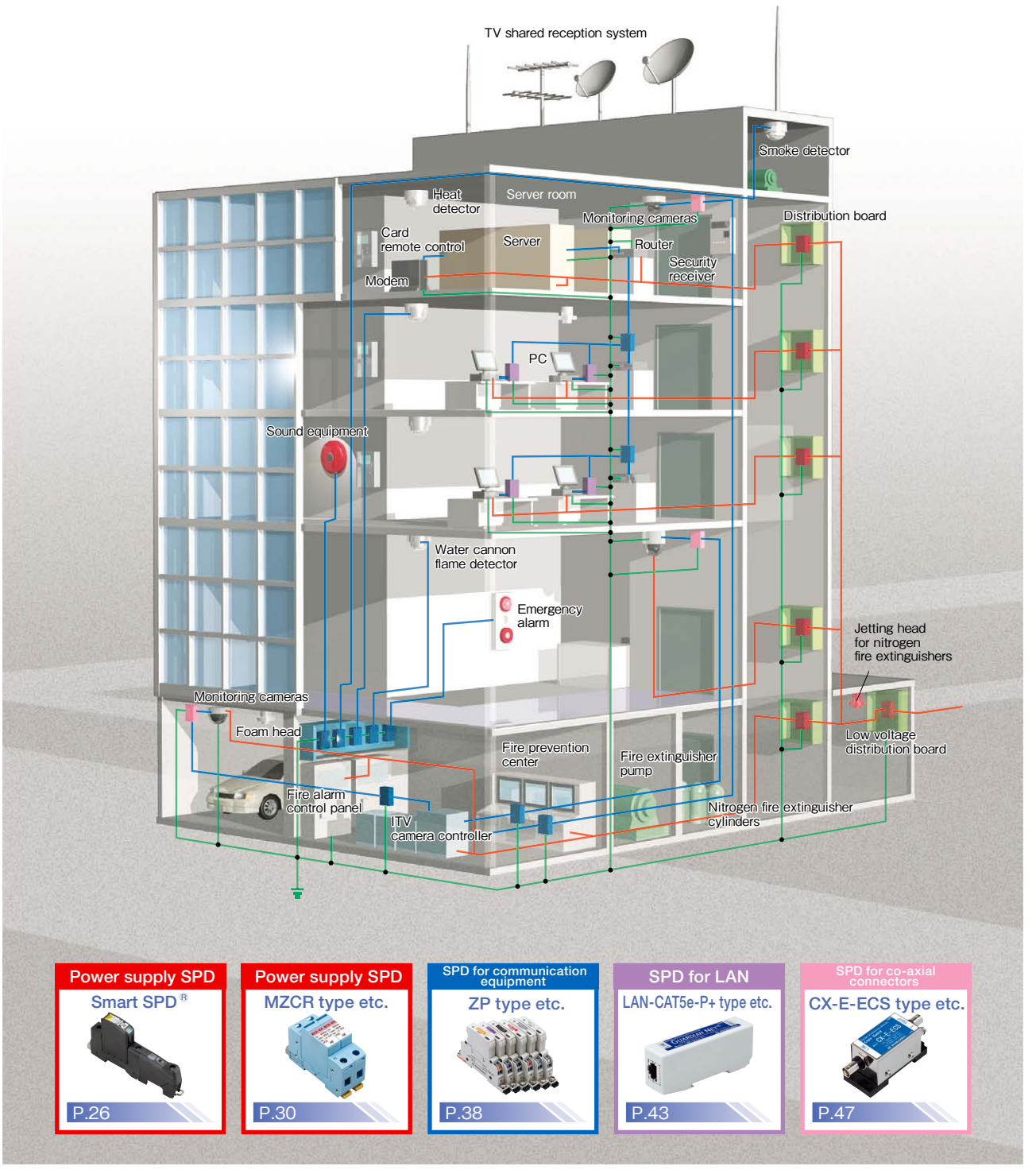
Lightning protection for fire prevention equipment

···Power supply SPD
···SPD for communication equipment
···SPD for LAN
···SPD for co-axial connectors

Fire and smoke alarms are essential equipment for our safety, and are mandatory in ordinary houses and social welfare facilities, etc. If this important equipment malfunctions due to lightning damage and generates an alarm at the wrong time, it can cause significant distress to the people in the building. By providing the ideal lightning protection solutions for fire prevention equipment, Sankosha continues to contribute to everyone's safety and security.



Note: This lightning countermeasure diagram is for the purposes of showing the required SPD items, and does not necessarily represent an accurate lightning countermeasure. Please consult our experts for details on lightning protection systems.

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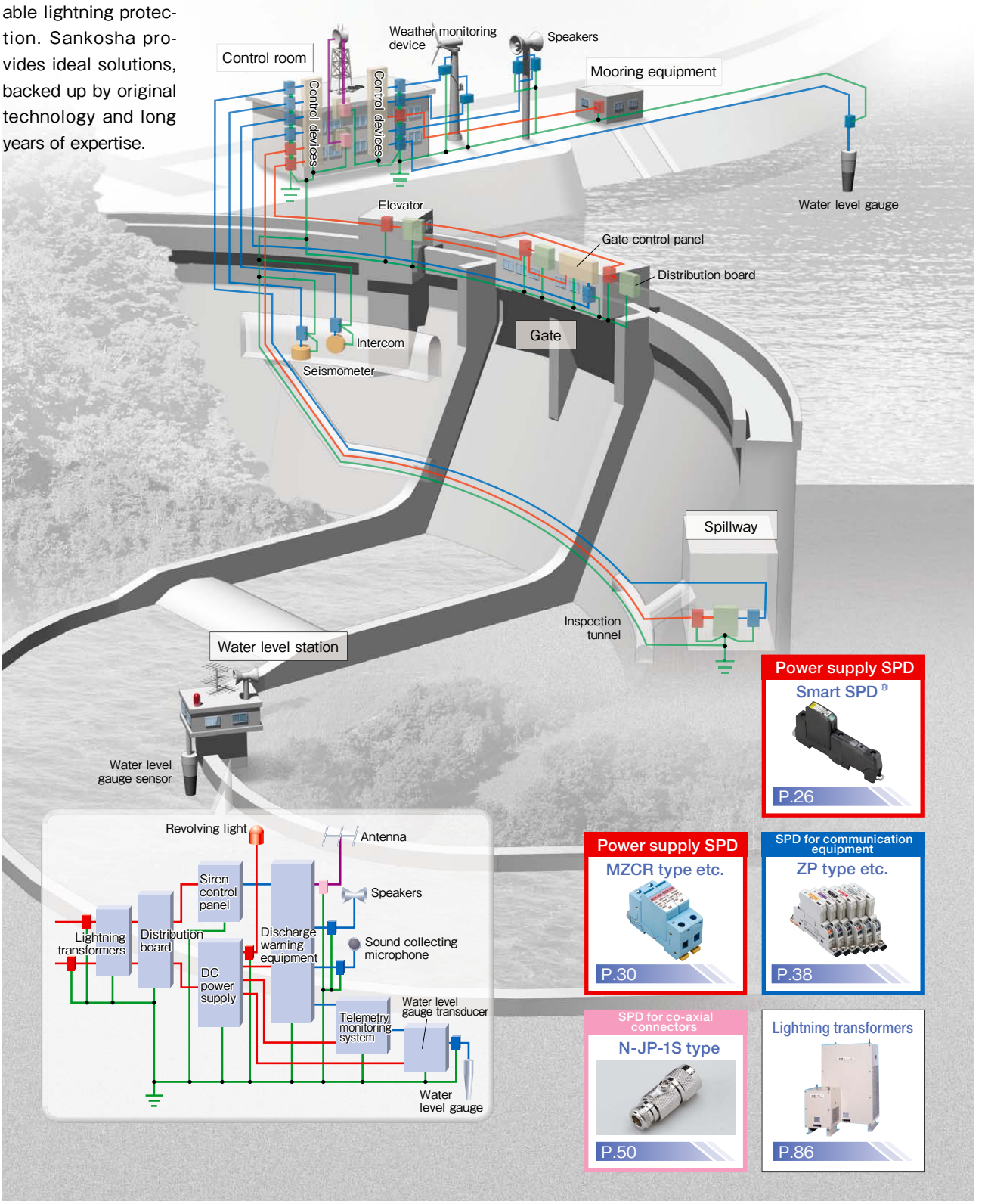
Lightning protection for dams

■…Power supply SPD
■…SPD for communication equipment
■…SPD for co-axial connectors

Dam facilities' networks are spread over wide areas and are considered highly vulnerable to lightning surges. In addition to preventing flooding in the event of heavy rain, dams also play an important role in the stable management of water resources. In order to ensure that these highly important public utilities continue to function properly, they need highly reliable lightning protection. Sankosha provides ideal solutions, backed up by original technology and long years of expertise.



Note: This lightning countermeasure diagram is for the purposes of showing the required SPD items, and does not necessarily represent an accurate lightning countermeasure. Please consult our experts for details on lightning protection systems.

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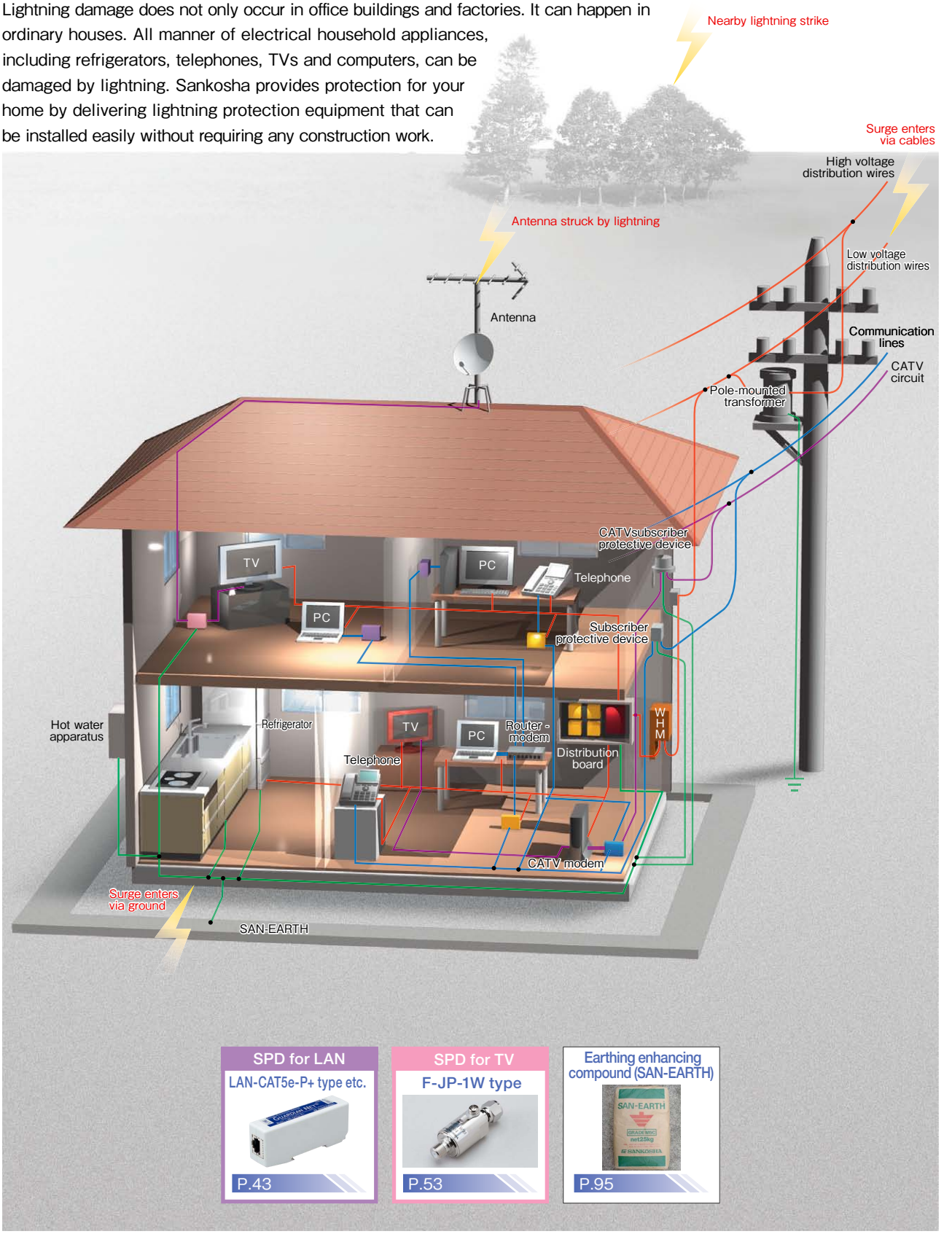
Lightning protection for houses

…SPD for LAN
…SPD for co-axial connectors
…Power supply SPD
…SPD for communication equipment

Lightning damage does not only occur in office buildings and factories. It can happen in ordinary houses. All manner of electrical household appliances, including refrigerators, telephones, TVs and computers, can be damaged by lightning. Sankosha provides protection for your home by delivering lightning protection equipment that can be installed easily without requiring any construction work.



SPD for LAN
LAN-CAT5e-P+ type etc.

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SPD for TV
F-JP-1W type

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Earthing enhancing compound (SAN-EARTH)

P.95

Note: This lightning countermeasure diagram is for the purposes of showing the required SPD items, and does not necessarily represent an accurate lightning countermeasure. Please consult our experts for details on lightning protection systems.

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Product lineup

Lightning protection products

P18～

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Power supply SPD IEC ClassII … 25
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Lightning observation products

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Solar power generated low light intensity obstruction light system …… 104

Optical communications

P105～

Optical termination box …… 105
Optical closure …… 108

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MZG-200 type

IEC Class Ⅰ/Ⅱ compliant

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Impulse sparkover current up to 50 kA (direct strike waveform 10/350 μs)
- Voltage protection level 1.5 kV or less
- DIN rail mountable (35 mm)

Applications

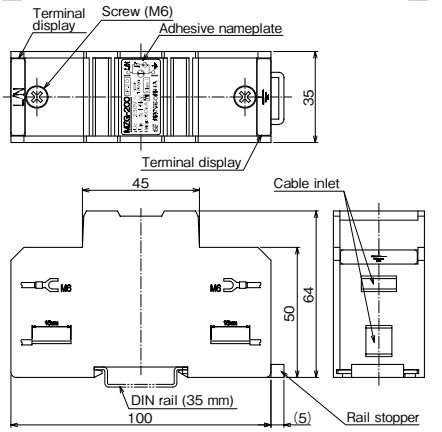
- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

■Characteristics

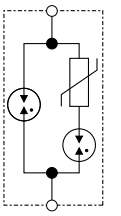
Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60 Hz) (Uc)	—	230V
Impulse current (Iimp)	10/350μs	50kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	1.5 kV or less

Dimensions: W35×D100×H64 (mm)
Mass: 250 (g)

■External view



■Circuit diagram



MZG-NPE type

IEC Class Ⅰ/Ⅱ compliant

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Impulse sparkover current up to 100 kA(direct strike waveform 10/350 μs)
- Voltage protection level 1.5 kV or less
- DIN rail mountable (35 mm)

Applications

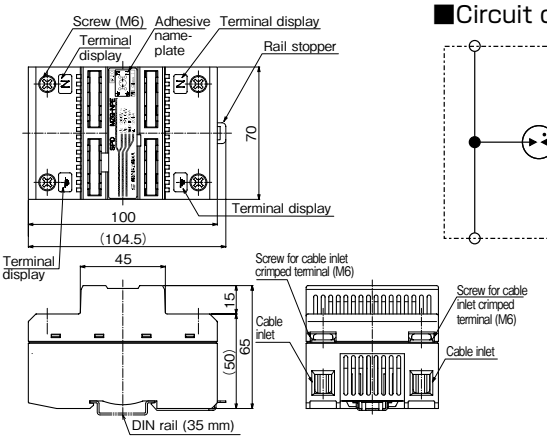
- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

■Characteristics

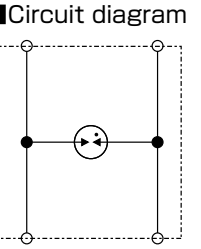
Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60 Hz) (Uc)	—	255V
Impulse current (Iimp)	10/350μs	100kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	1.5 kV or less

Dimensions: W70×D100×H65 (mm)
Mass: 490 (g)

■External view



■Circuit diagram



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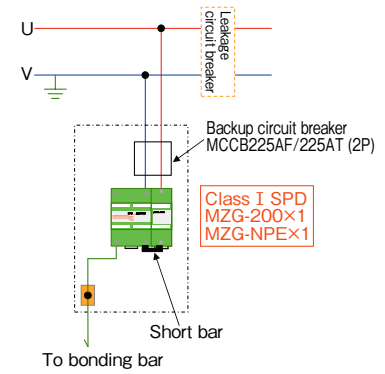
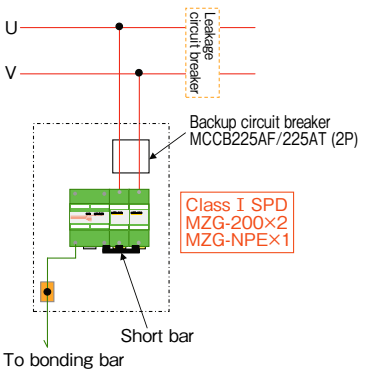
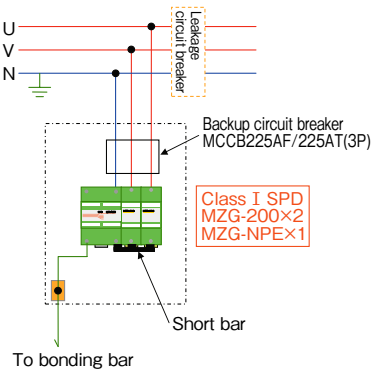
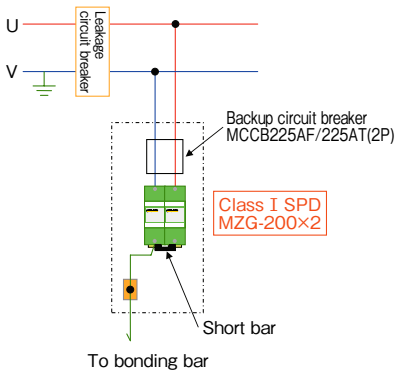
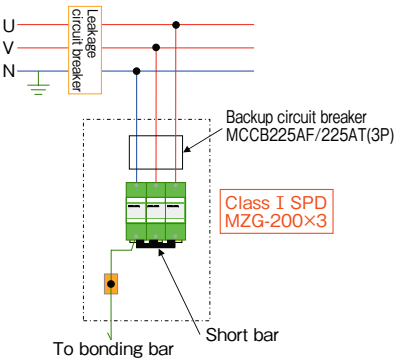
■Installation examples (MZG type)

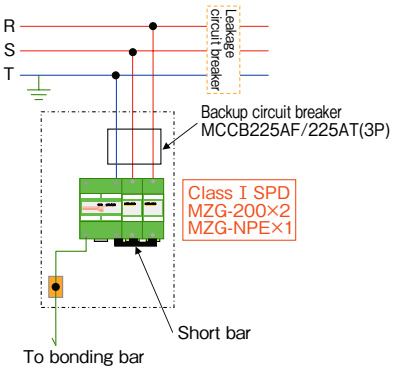
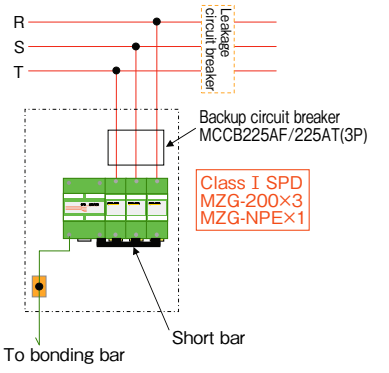
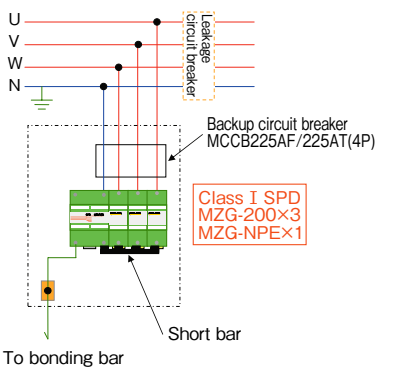
AC 100V/200V series (leakage circuit breaker on primary side, or no leakage breaker)

Single-phase two-wire with earthing	Single-phase two-wire with no earthing, or situation unclear	Single-phase three-wire with earthing
		

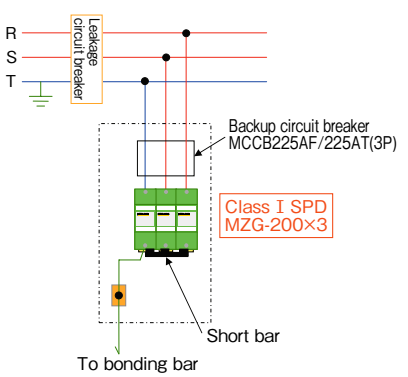
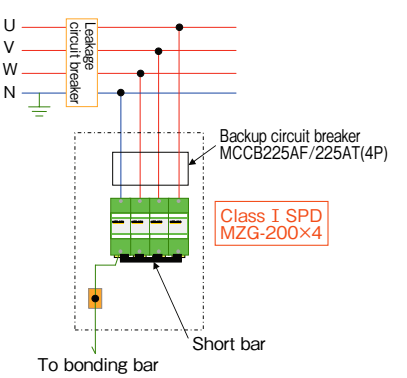
AC 100V/200V series (leakage circuit breaker on secondary side)

Single-phase two-wire with earthing/no earthing, or situation unclear	—	Single-phase three-wire with earthing
	——	

AC 200V series (leakage circuit breaker on primary side, or no leakage breaker)

Three-phase three-wire with earthing	Three-phase three-wire with no earthing, or situation unclear	Three-phase four-wire with earthing
		

AC 200V series (leakage circuit breaker on secondary side)

Three-phase three-wire with earthing/no earthing, or situation unclear	—	Three-phase four-wire with earthing
	——	

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MZS-200AV type

IEC ClassⅠ/Ⅱ compliant

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

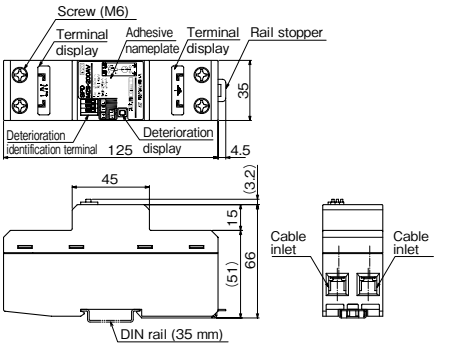
- Impulse sparkover current up to 25 kA (direct strike waveform 10/350 μs)
- Voltage protection level 1.5 kV or less
- High follow current shutoff ability
- Deterioration display function (warning contact output terminal attached)
- DIN rail mountable (35 mm)
- Certified explosion-proof products available (P57)

Applications

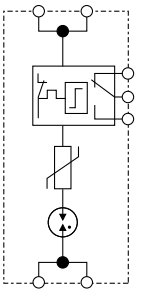
- Low voltage power supply circuits in switchboards and distribution boards (AC100 V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

Dimensions: W35×D125×H66 (mm)
Mass: 370 (g)

■External view



■Circuit diagram



■Characteristics

Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60Hz) (Uc)	—	230V
Impulse current (Iimp)	10/350μs	25kA
Maximum discharge current (Imax)	8/20μs	100kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	1.5 kV or less

MZS-NPE type

IEC ClassⅠ/Ⅱ compliant

Conforming standards

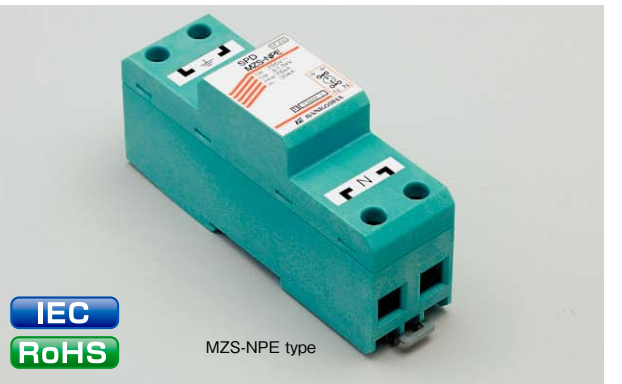
- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Impulse sparkover current up to 75 kA(direct strike waveform 10/350 μs)
- Voltage protection level 1.5 kV or less
- DIN rail mountable (35 mm)

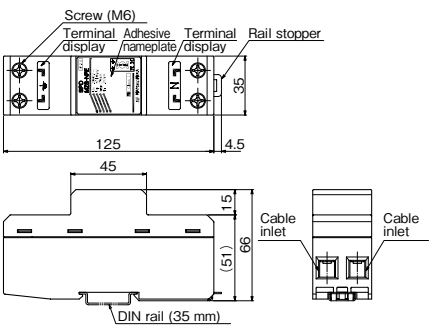
Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

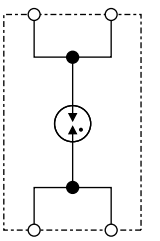


Dimensions: W35×D125×H66 (mm)
Mass: 290 (g)

■External view



■Circuit diagram



■Characteristics

Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60Hz) (Uc)	—	255V
Impulse current (Iimp)	10/350μs	75kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	1.5 kV or less

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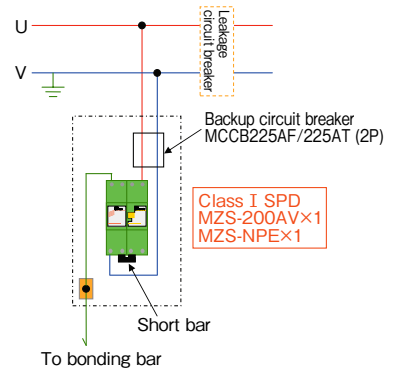
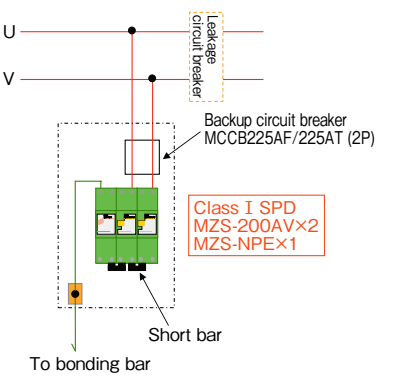
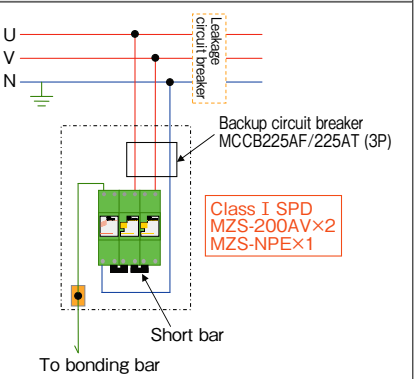
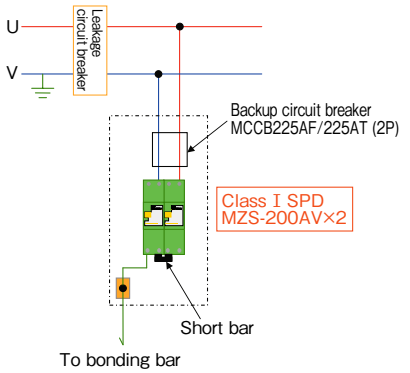
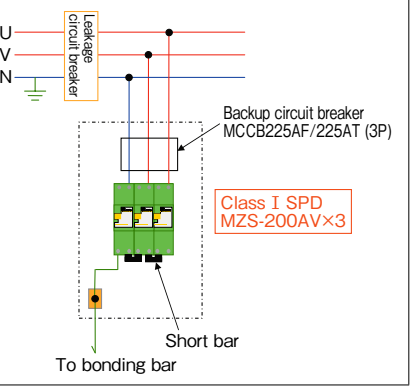
■Installation examples (MZS-200AV type)

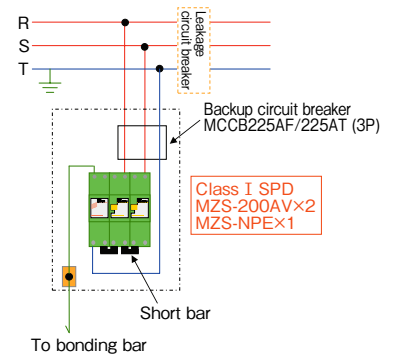
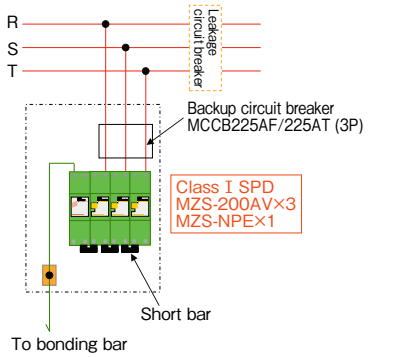
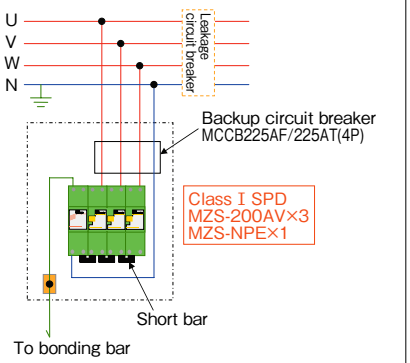
AC 100V/200V series (leakage circuit breaker on primary side, or no leakage breaker)

Single-phase two-wire with earthing	Single-phase two-wire with no earthing, or situation unclear	Single-phase three-wire with earthing
		

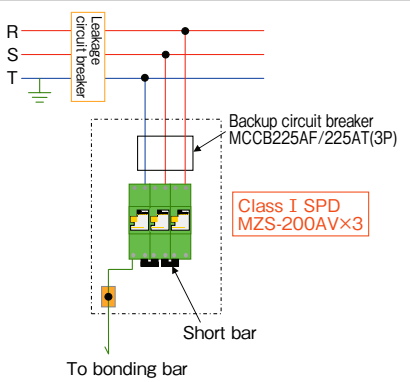
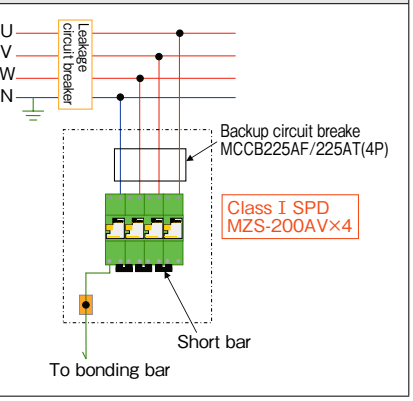
AC 100V/200V series (leakage circuit breaker on secondary side)

Single-phase two-wire with earthing/no earthing, or situation unclear	—	Single-phase three-wire with earthing
	——	

AC 200V series (leakage circuit breaker on primary side, or no leakage breaker)

Three-phase three-wire with earthing	Three-phase three-wire with no earthing, or situation unclear	Three-phase four-wire with earthing
		

AC 200V series (leakage circuit breaker on secondary side)

Three-phase three-wire with earthing/no earthing, or situation unclear	—	Three-phase four-wire with earthing
	——	

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MZS-400AV type

IEC Class I / II compliant

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Impulse sparkover current up to 25 kA(direct strike waveform 10/350 μs)
- Voltage protection level 2.5kV or less
- High follow current shutoff ability
- Deterioration display function (warning contact output terminal attached)
- DIN rail mountable (35 mm)

Applications

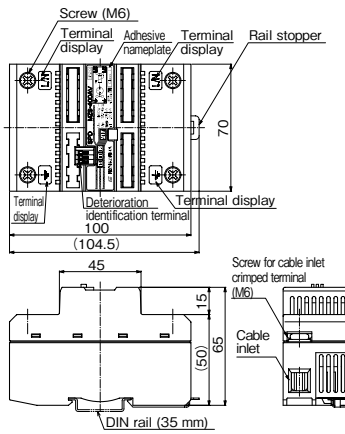
- Low voltage power supply circuits in switchboards and distribution boards (AC 400V)
- Power supply circuits in control equipment (AC 400V)

■Characteristics

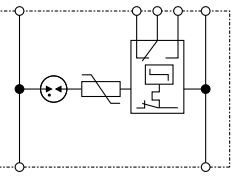
Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60Hz) (Uc)	—	460V
Impulse current (Iimp)	10/350μs	25kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	2.5kV or less

Dimensions: W70×D100×H65 (mm)
Mass: 460 (g)

■External view



■Circuit diagram



MZS-NPE400 type

IEC Class I / II compliant

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Impulse sparkover current up to 75 kA(direct strike waveform 10/350 μs)
- Voltage protection level 1.8 kV or less
- DIN rail mountable (35 mm)

Applications

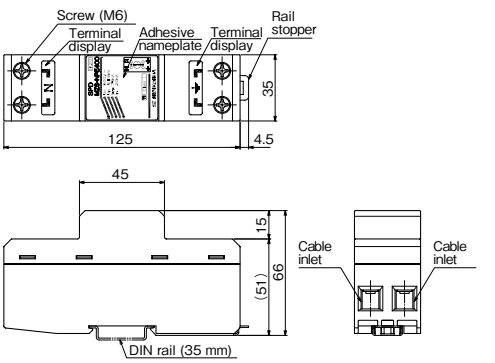
- Low voltage power supply circuits in switchboards and distribution boards (AC 400V)
- Power supply circuits in control equipment (AC 400V)

■Characteristics

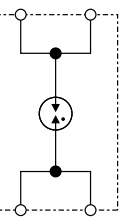
Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60Hz) (Uc)	—	500V
Impulse current (Iimp)	10/350μs	75kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	1.8 kV or less

Dimensions: W35×D125×H66 (mm)
Mass: 290 (g)

■External view



■Circuit diagram



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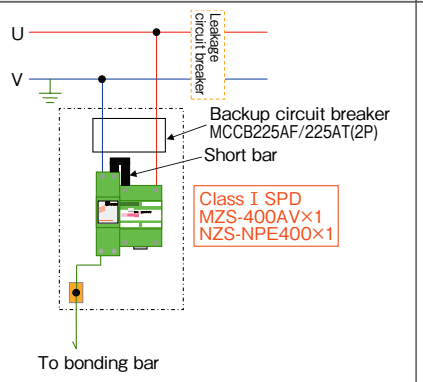
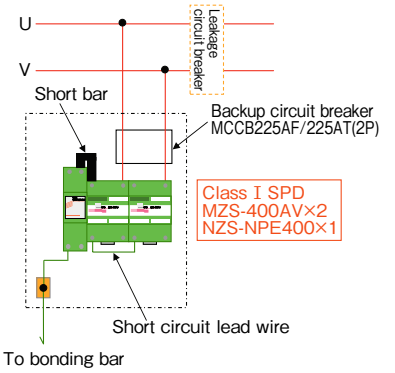
■Installation examples(MZS-400AV type)

AC 400V series (leakage circuit breaker on primary side, or no leakage breaker)

Single-phase two-wire with earthing



Single-phase two-wire with no earthing, or situation unclear



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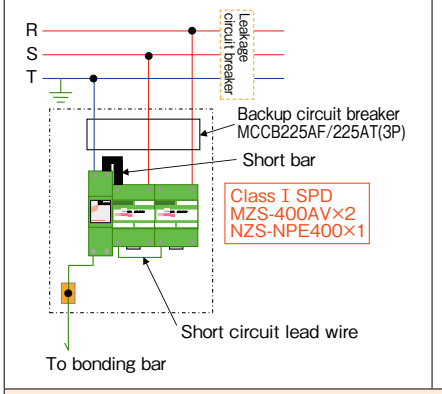
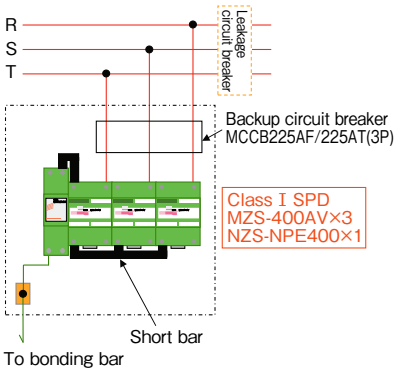
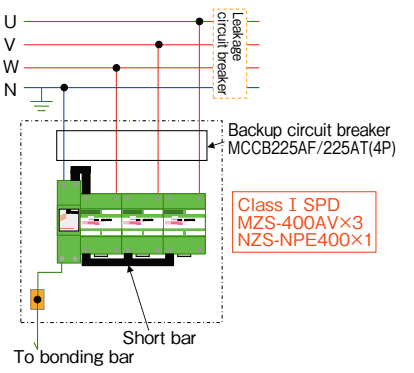
Three-phase three-wire with earthing



Three-phase three-wire with no earthing, or situation unclear

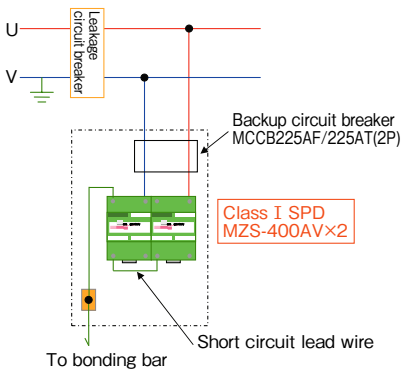


Three-phase four-wire with earthing

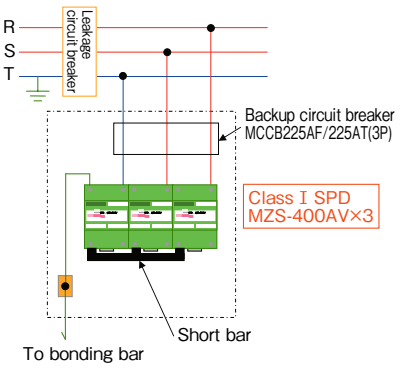


AC 400V series (leakage circuit breaker on secondary side)

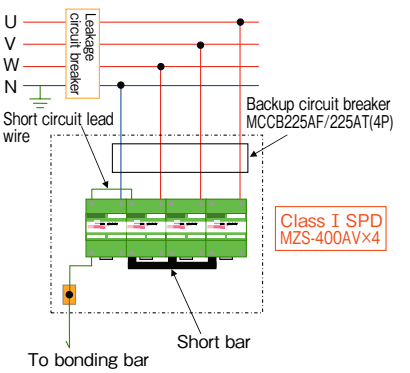
Single-phase two-wire with earthing/no earthing, or situation unclear



Three-phase three-wire with earthing/no earthing, or situation unclear



Three-phase four-wire with earthing



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MZS-300DC type
MZS-600DC type

IEC Class I compliant

Conforming standards

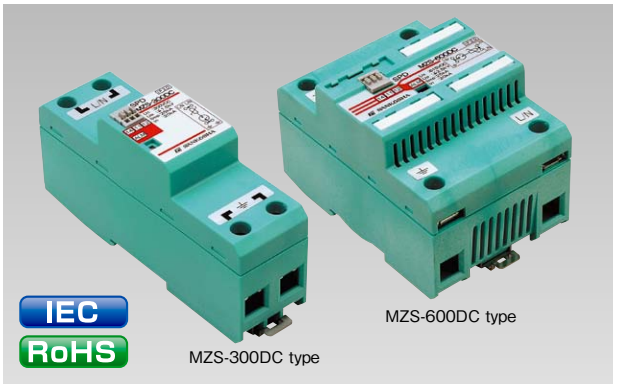
- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Deterioration display function (warning contact output terminal attached)
- DIN rail mountable (35 mm)

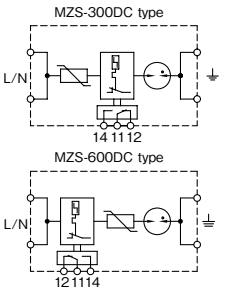
Applications

- Protects DC power supply circuits, such as power conditioning systems for solar power generation systems.

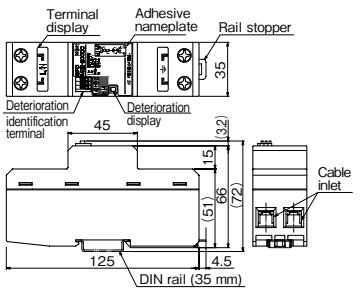


(MZS-300DC type) Dimensions: W35×D129.5×H72 (mm)
Mass: 370(g)
(MZS-600DC type) Dimensions: W70×D104.5×H69 (mm)
Mass: 460 (g)

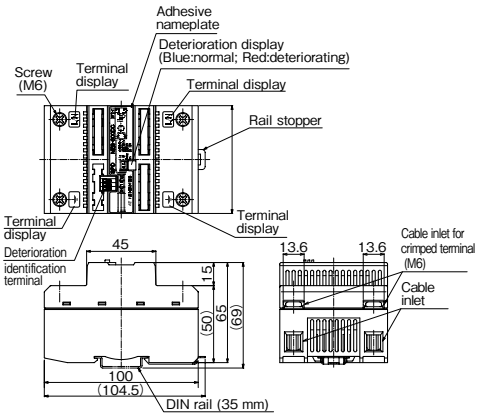
■Circuit diagram



■External view



MZS-300DC type

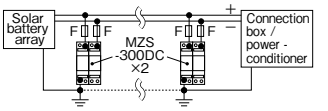


MZS-600DC type

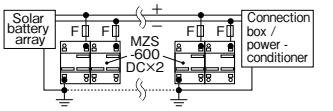
■Characteristics

Item	Measurement conditions	Performance	
		MZS-300DC	MZS-600DC
Maximum continuous operating voltage (50/60Hz) (Uc)	—	DC300V	DC615V
Impulse current (Iimp)	10/350μs	25kA	
Nominal discharge current (In)	8/20μs	20kA	
Voltage protection level (Up)	Based on IEC	1.5 kV or less	2.5 kV or less

■Installation examples



MZS-300DC type



MZS-600DC type

■Application and Performance of Power supply SPD IEC Class I

Item	Measurement conditions	Performance and Applications							
		MZG-200	MZG-NPE	MZS-200AV	MZS-NPE	MZS-400AV	MZS-NPE400	MZS-300DC	MZS-600DC
Applications		Low voltage power supply circuits in switchboards and distribution boards Power supply circuits in control equipment						Protects DC power supply circuits, such as power conditioningsystems for solar power generation systems.	
Test classitication	—	ClassI, II							
Maximum continuous operating voltage (Uc)	—	AC230V	AC255V	AC230V	AC255V	AC460V	AC500V	DC300V	DC615V
Impulse current (Iimp)	10/350μs	50kA	100kA	25kA	75kA	25kA	75kA	25kA	
Nominal discharge current (In)	8/20μs	20kA							
Voltage protection level (Up)	Based on IEC	1.5kV or less				2.5kV or less	1.8kV or less	1.5kV or less	2.5kV or less
Follow current shutoff rating (Ifi)	Uc=AC230V	3kA	—	50kA	—				
	Uc=AC460V	—				50kA	—		
	Uc=DC300V	—						50kA	—
	Uc=DC610V	—							50kA
Applicable wires	—	AWG10~4(5.5~22㎟)							
Deterioration display	—	—		Yes (Concavo: normal; Convex: deteriorating)	—	Yes (Blue : normal; Red: deteriorating)	—	Yes (Concavo: normal; Convex: deteriorating)	Yes (Blue : normal; Red: deteriorating)
Warning contact output terminal	—	—		Yes	—	Yes	—	Yes	
Operating environmental conditions	Rated operating temperature Rated operating humidity	-40℃~+70℃ 95% or less (no condensation)							

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Smart SPD® System

IEC Class Ⅱ compliant
By using Smart SPD「SMA-MZSR200JK1」with Smart SPD monitor「SMU-AC」, it can apply to remote monitoring via LAN.

Conforming standards

- IEC 61643-1compliant
- RoHS compliant

Features

- Maximum discharge current up to 40 kA(induction lightning waveform 8/20 μs)
- Lightning surge current measurement, Replacement recommendation display function
- Lightning surge information display function (3 phases-Small, Middle, Large with date, hours, minutes and seconds)
- Remote monitoring via LAN (for Windows PC)
- Deterioration display function (warning contact output terminal attached)
- DIN rail mountable (35 mm)

Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

■Characteristics

SMA-MZSR200JK1 type【Smart SPD® for systems】

Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60 Hz) (Uc)	—	AC275V
Maximum discharge current (Imax)	8/20μs	40kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	1.4kV or less

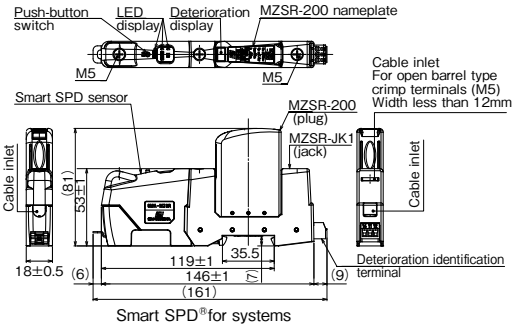
SMU-AC type【Smart SPD® monitor】

Item	Performance
Communication interface	LAN: 10BASE-T
No. of Smart SPD® connectable	50 (max.) (SMA-MZSR200 type)
Power supply	AC 100V to 220V (using AC adapter)

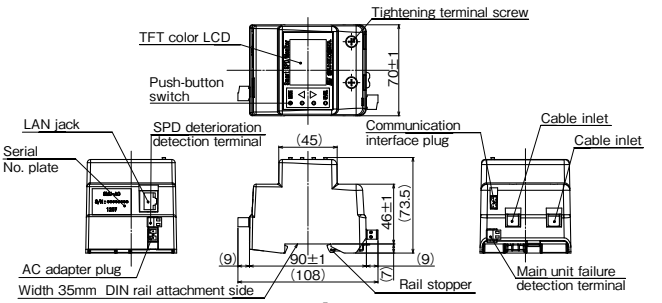
※Smart SPD System consists of the required number of "Smart SPD for systems" and one "Smart SPD monitor" as a set. Connection cables and grounding bars are optional and sold separately.

Smart SPD® System

■External view



Smart SPD®for systems



Smart SPD®monitor

MZSR-200JK1 type

IEC Class Ⅱ compliant

Conforming standards

- IEC 61643-1compliant
- RoHS compliant

Features

- Maximum discharge current up to 40 kA(induction lightning waveform 8/20 μs)
- Plug-in type
- Deterioration display function (warning contact output terminal attached)
- DIN rail mountable (35 mm)

Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

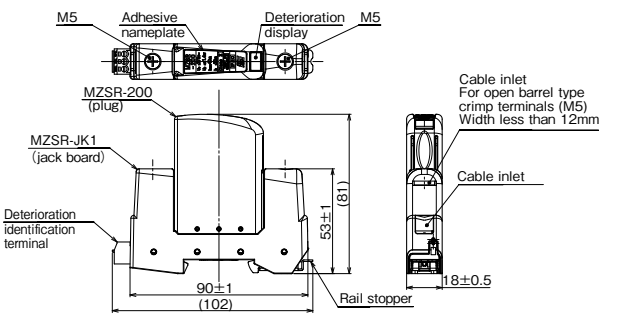
■Characteristics

Item	Measurement conditions	Performance
Maximum continuous operating voltage (50/60Hz) (Uc)	—	AC275V
Maximum discharge current (Imax)	8/20μs	40kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	1.4kV or less

MZSR-200JK1

Dimensions: W18×D102×H81 (mm)
Mass: 120 (g)

■External view



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Power supply SPD IEC Class Ⅱ

Smart SPD®
SMB-MZSR200JK1 type
SMB-MZSR400JK1 type
SMB-MZSR700DCJK1 type

IEC ClassⅡ compliant

Conforming standards

- IEC 61643-1compliant
- RoHS compliant

Features

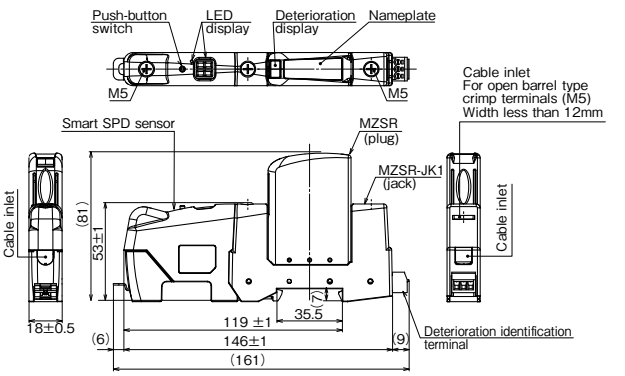
- Maximum discharge current up to 40 kA(induction lightning waveform 8/20 μs)
- Lightning surge current measurement, Replacement recommendation display function
- Lightning surge count display function
- Plug-in type
- Deterioration display function (warning contact output terminal attached)
- DIN rail mountable (35 mm)

Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

■External view

Dimensions: W18×D161×H81 (mm)
Mass: 180 (g)

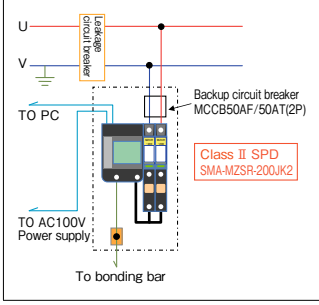
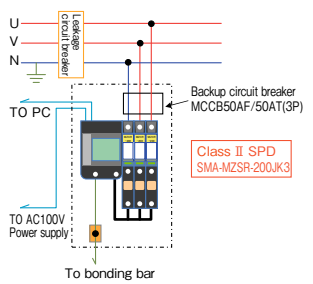
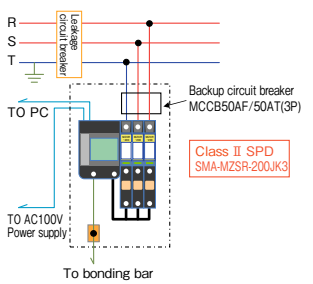
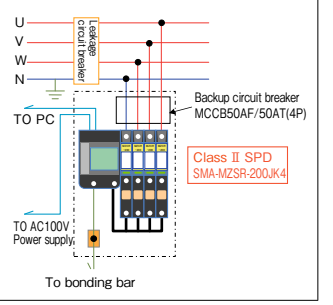


■Characteristics

Item	Measurement conditions	Performance		
		SMB-MZSR200JK1	SMB-MZSR400JK1	SMB-MZSR700DCJK1
Maximum continuous operating voltage (50/60Hz) (Uc)	—	AC275V	AC500V	DC700V
Maximum discharge current (Imax)	8/20μs	40kA		
Nominal discharge current (In)	8/20μs	20kA		
Voltage protection level (Up)	Based on IEC	1.4kV or less	2.5kV or less	

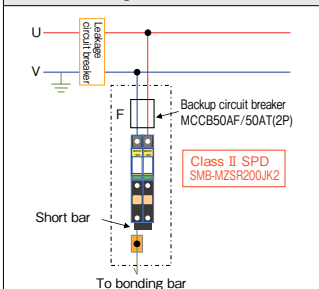
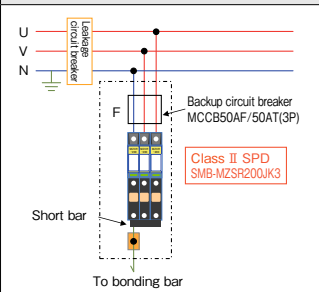
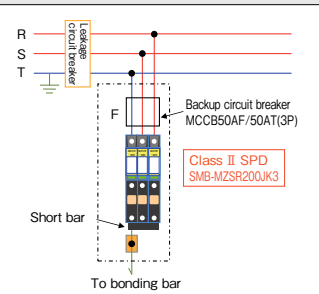
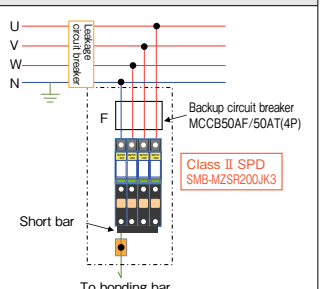
■Installation examples (Smart SPD® System)

AC 100V/200V series (leakage circuit breaker on secondary side)

Single-phase two-wire with eathing /no eathing ,or situation unclear	Single-phase three-wire with eathing	Three-phase three-wire with eathing /no eathing ,or situation unclear	Three-phase four-wire with eathing
			

■Installation examples (Smart SPD® SMB-MZSR200JK1)

AC 100V/200V series (leakage circuit breaker on secondary side)

Single-phase two-wire with eathing /no eathing ,or situation unclear	Single-phase three-wire with eathing	Three-phase three-wire with eathing /no eathing ,or situation unclear	Three-phase four-wire with eathing
			

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PMZ [ ] -200 type

IEC ClassⅡ compliant

Conforming standards

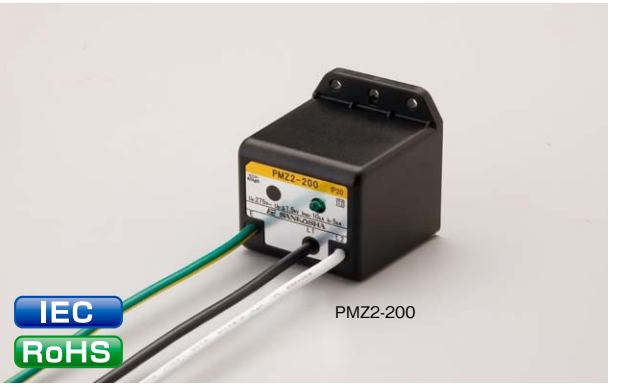
- IEC 61643-1 compliant
- RoHS compliant

Features

- Space saving design to put inside devices
- A single unit can provide protection across lines and grounds
- Built-in isolation function prevents overheating in the event of device deterioration
- Features highly visible LED display for deterioration and defect

Applications

- Features built-in PCS (power conditioning system), for solar power generation, etc.
- Built-in lighting panels, etc.

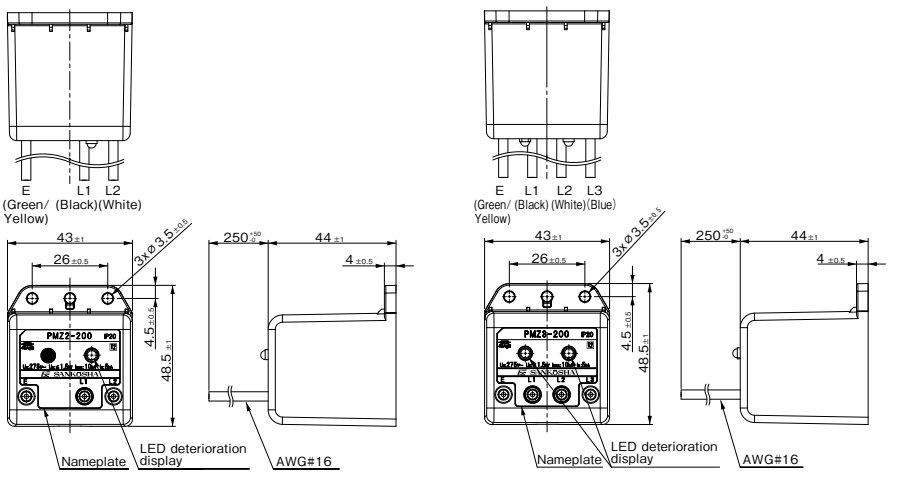


Dimensions: W43×D44×H48.5 (mm)
Mass: 85 (g)

■Characteristics

Item	Measurement conditions	Performance	
		PMZ2-200	PMZ3-200
Phase	—	Two-wire system (single-phase, two-wire)	Three-wire system (single-phase, three-wire)
Maximum continuous operating voltage (Uc)	(inter line, to ground)	AC275V	
Maximum discharge current (Imax)	8/20μs	10 kA (single wire)	
Nominal discharge current (In)	8/20μs	5 kA (single wire)	
Voltage protection level (Up)	8/20μs	1.5kV or less	
Impulse life	1kA, 8/20μs	500 times	

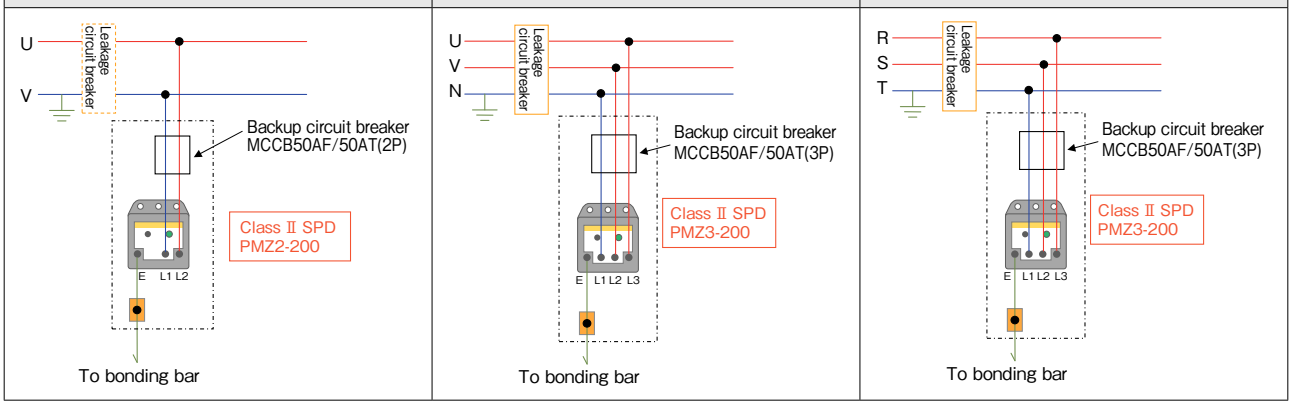
■External view



PMZ2-200 PMZ3-200

■Installation examples

AC100V/200V series (leakage circuit breaker on secondary side)



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MZE-100 type
MZE-200 type

IEC ClassⅡ compliant

Dimensions: W20×D75×H60 (mm)
Mass: 55 (g)

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

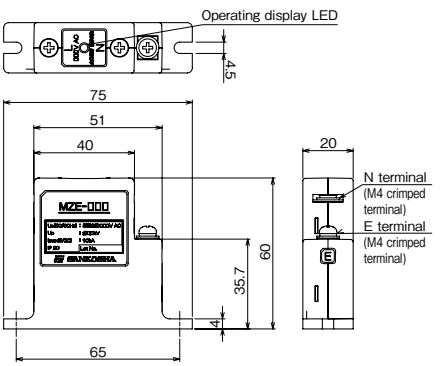
Features

- Maximum discharge current up to 10 kA(induction lightning waveform 8/20 μs)
- A single unit provides protection across single-phase two-wire circuits and to ground.
- Deterioration display function

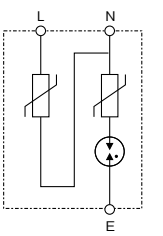
Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

■External view



■Circuit diagram



■Characteristics

Item	Measurement conditions	Performance	
		MZE-100	MZE-200
Maximum continuous operating voltage (50/60Hz) (Uc)	—	Single-phase two-wire AC 110V	Single-phase two-wire AC 230V
Maximum discharge current (Imax)	8/20 μs	10 kA (3 times)	
Nominal discharge current (In)	8/20μs	5kA	
Voltage protection level (Up)	Based on IEC	0.8 kV or less (inter line) 1.5 kV or less (to ground)	1.5 kV or less (inter line) 2.5 kV or less (to ground)

MZCRW-200JK [ ] type

IEC ClassⅡ compliant

Dimensions: W36×D98×H78 (mm)
Mass: 240 (g)

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

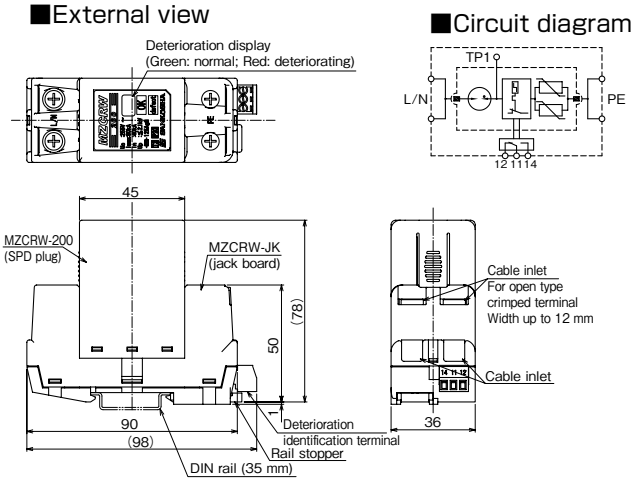
Features

- Maximum discharge current up to 80 kA (induction lightning waveform 8/20 μs)
- Deterioration display function (warning contact output terminal attached)
- Plug-in type
- DIN rail mountable (35 mm)

Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V)
- Power supply circuits in control equipment (AC 100V/200V)

■External view



■Circuit diagram

■Characteristics

Item	Measurement conditions	Performance
		MZCRW-200JK [ ]
Maximum continuous operating voltage (50/60Hz) (Uc)	—	AC255V
Maximum discharge current (Imax)	8/20μs	80kA
Nominal discharge current (In)	8/20μs	40kA
Voltage protection level (Up)	Based on IEC	2.1kV or less

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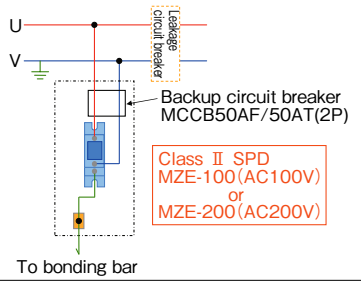
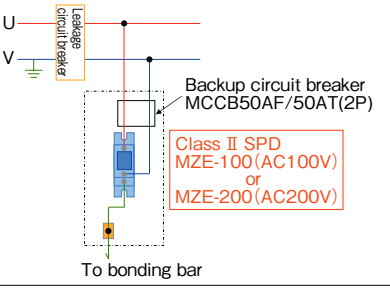
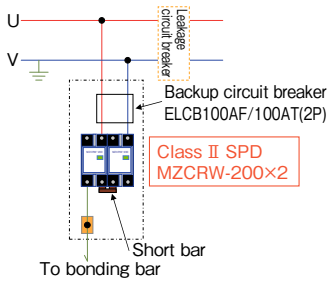
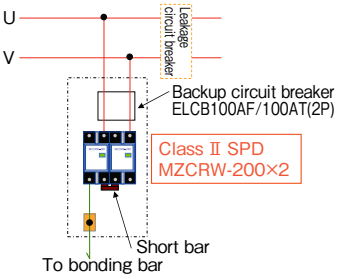
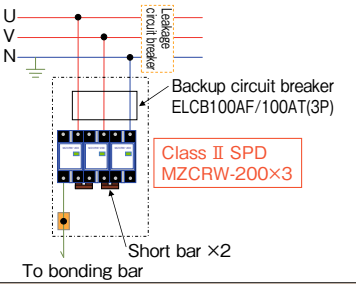
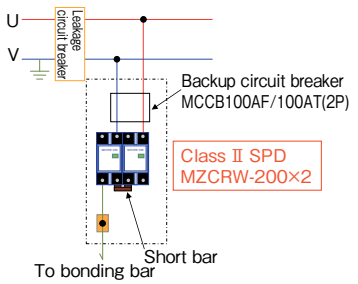
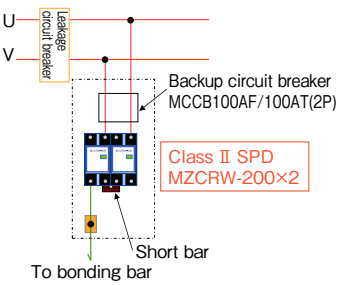
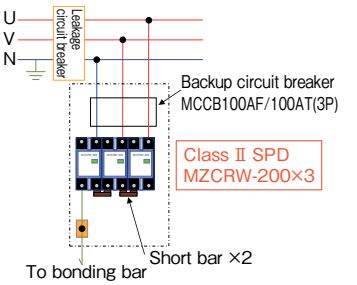
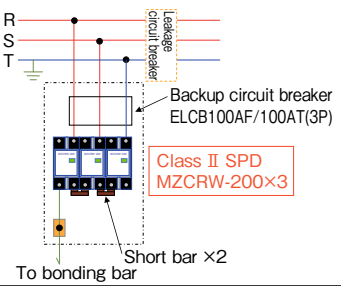
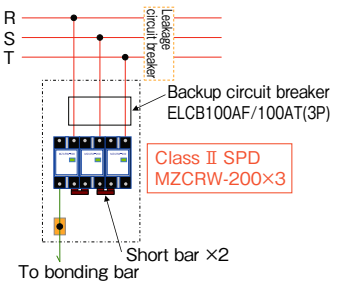
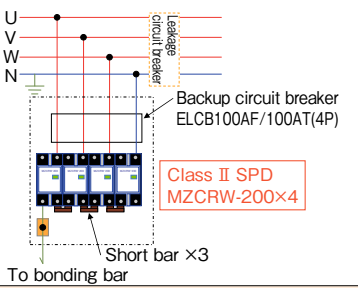
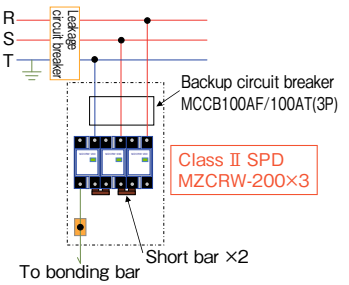
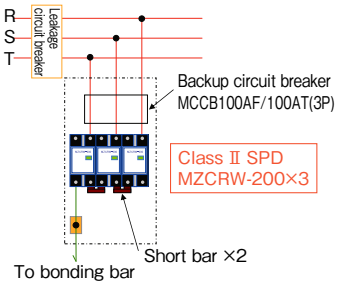
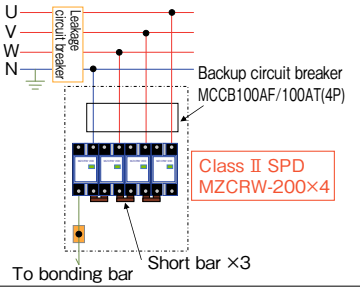
■Installation examples(MZE-100 type、MZE-200 type)

AC 100/200 (leakage circuit breaker on primary side, or no leakage breaker)	AC 100V/200V series (leakage circuit breaker on secondary side)	—
Single-phase two-wire with earthing/no earthing, or situation unclear	Single-phase two-wire with earthing/no earthing, or situation unclear	—
		——

■Installation examples(MZCRW-200JK type)

AC 100V/200V series (leakage circuit breaker on primary side, or no leakage breaker)		
Single-phase two-wire with earthing	Single-phase two-wire with no earthing, or situation unclear	Single-phase three-wire with earthing
		
AC 100V/200V series (leakage circuit breaker on secondary side)		
Single-phase two-wire with earthing	Single-phase two-wire with no earthing, or situation unclear	Single-phase three-wire with earthing
		

AC 200V series (leakage circuit breaker on primary side, or no leakage breaker)		
Three-phase three-wire with earthing	Three-phase three-wire with no earthing, or situation unclear	Three-phase four-wire with earthing
		
AC 200V series (leakage circuit breaker on secondary side)		
Three-phase three-wire with earthing	Three-phase three-wire with no earthing, or situation unclear	Three-phase four-wire with earthing
		

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Power supply SPD IEC Class Ⅱ

MZCR- [ ] JK [ ] type
MZCR- [ ] JK [ ] N type
MZCR- [ ] JK [ ] ARR type
MZCR- [ ] JK [ ] ARRN type

IEC Class Ⅱ compliant

Conforming standards

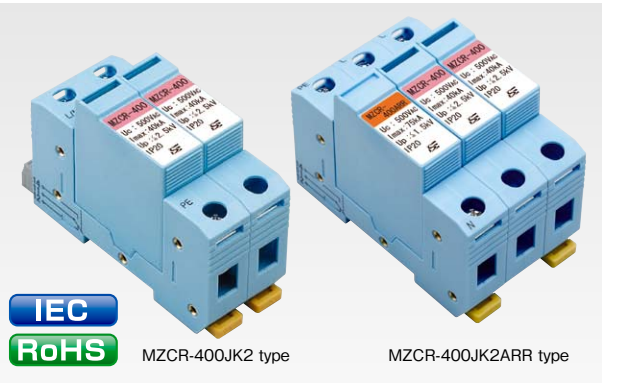
- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Maximum discharge current up to 40 kA (induction lightning waveform 8/20 μs)
- Deterioration display function (warning contact output terminal attached)
- Plug-in type
- DIN rail mountable (35 mm)
- Round type crimped terminal for M4 (width less than 12 mm) (N type)

Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V/400V)
- Power supply circuits in control equipment (AC 100V/200V/400V)



MZCR-400JK2 type　　MZCR-400JK2ARR type

(MZCR-200JK2N type) Dimensions: W36×D102×H64 (mm)
Mass: 250 (g)
(MZCR-400JK2ARR type) Dimensions: W54×D102×H64 (mm)
Mass: 340 (g)

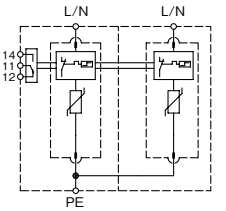
■Product type identification

MZCR – □□□ JK □□□

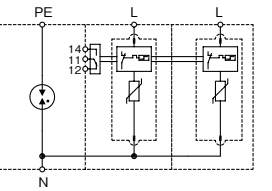
- 100: AC100
- 200: AC 100 and 200
- 400: AC 400
- None: Standard type / N: Screw terminal type
- None: No gap / ARR: gap
- 1~4: No. of linked SPD

■Circuit diagram

(E.g.: MZCR-200JK2 type)

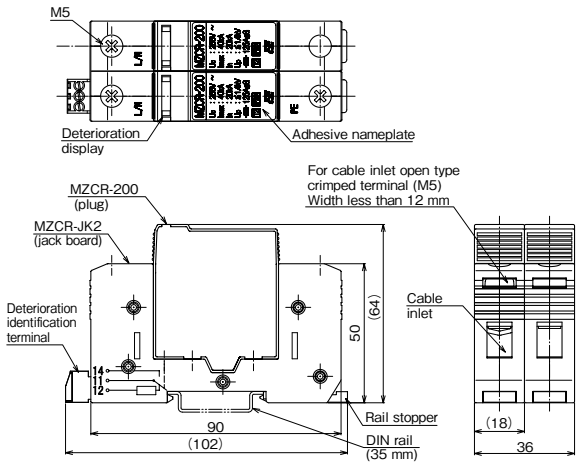


(E.g.: MZCR-400JK2ARR type)

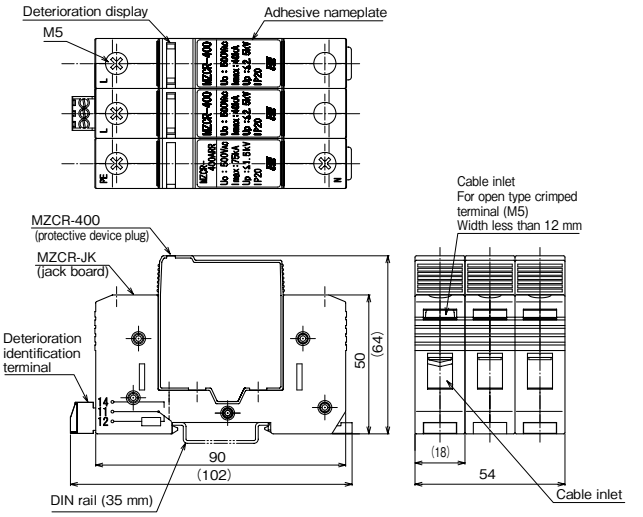


■External view

(E.g.: MZCR-200JK2 type)



(E.g.: MZCR-400JK2ARR type)



■Characteristics

Item	Measurement conditions	Performance				
		MZCR-100JK [ ] MZCR-100JK [ ]N	MZCR-200JK [ ] MZCR-200JK [ ]N	MZCR-200JK [ ] ARR MZCR-200JK [ ] ARRN	MZCR-400JK [ ] MZCR-400JK [ ]N	MZCR-400JK [ ] ARR MZCR-400JK [ ] ARRN
Maximum continuous operating voltage (50/60Hz) (Uc)	—	AC150V	AC255V		AC500V	
Maximum discharge current (Imax)	8/20μs	40 kA (each phase)		40 kA (each phase) 75 kA (N-PE phase)	40 kA (each phase)	40 kA (each phase) 75 kA (N-PE phase)
Nominal discharge current (In)	8/20μs	5kA(each phase)	20kA(each phase)	20 kA (each phase) 60 kA (N-PE phase)	20kA(each phase)	20 kA (each phase) 60 kA (N-PE phase)
Voltage protection level (Up)	Based on IEC	700 V or less	1.4 kV or less (each phase)	1.4 kV or less (each phase) 1 kV or less (N-PE phase)	2.5 kV or less (each phase)	2.5 kV or less (each phase) 1.5 kV or less (N-PE phase)

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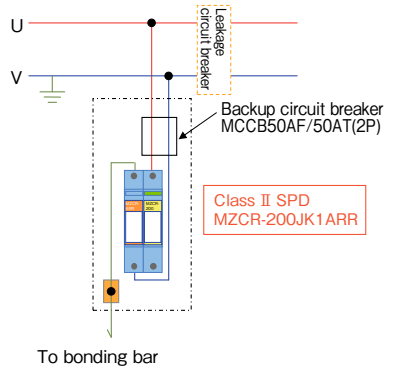
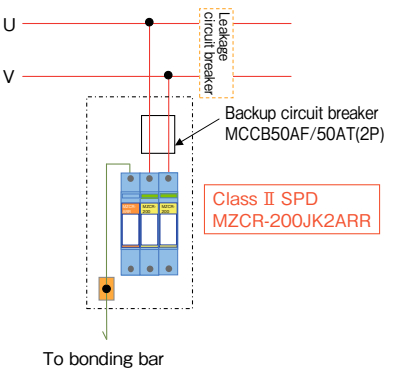
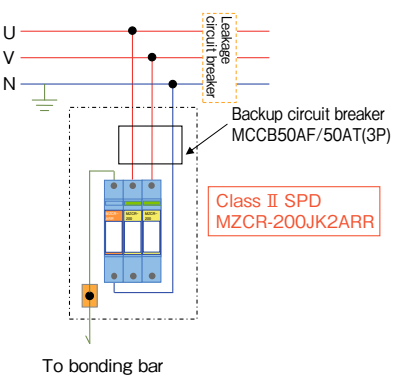
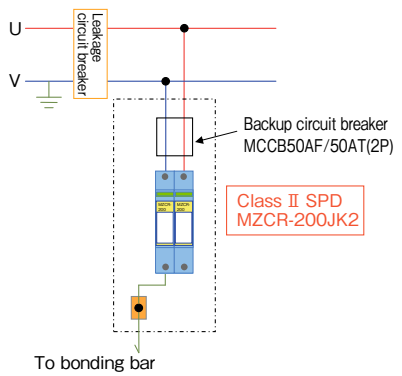
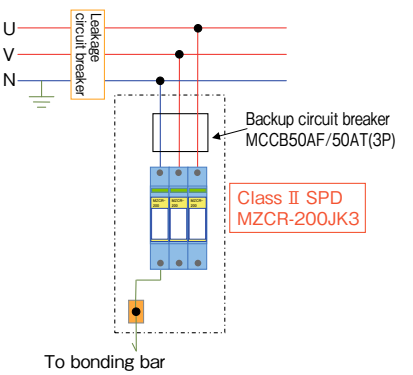
■Installation examples(MZCR-100JK [ ] type, MZCR-100JK [ ] ARR type, MZCR-200JK [ ] type, MZCR-200JK [ ] ARR type)

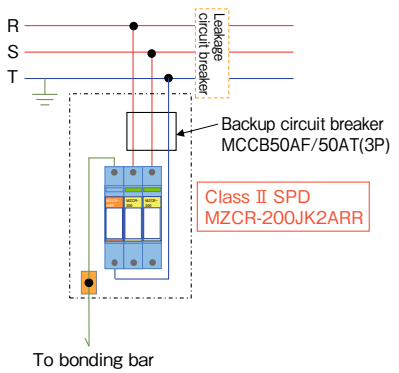
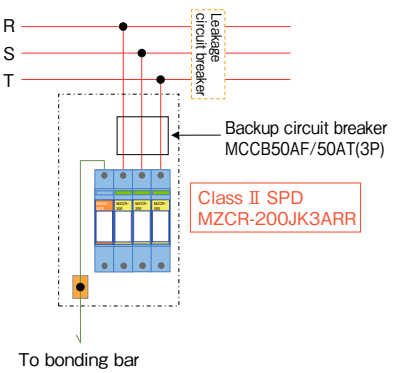
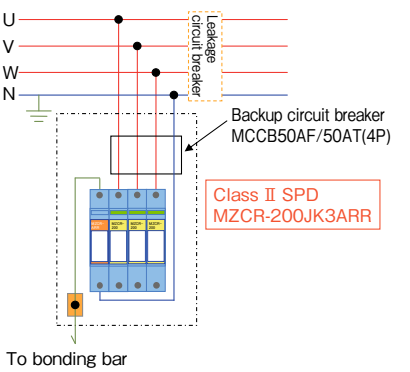
AC 100V/200V series (leakage circuit breaker on primary side, or no leakage circuit breaker)

Single-phase two-wire with earthing	Single-phase two-wire with no earthing, or situation unclear	Single-phase three-wire with earthing
		

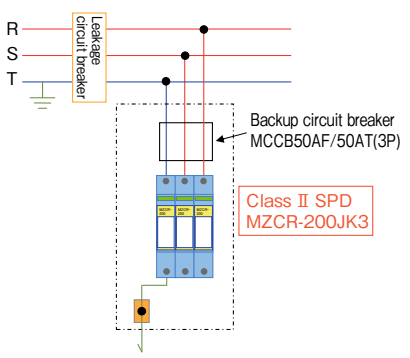
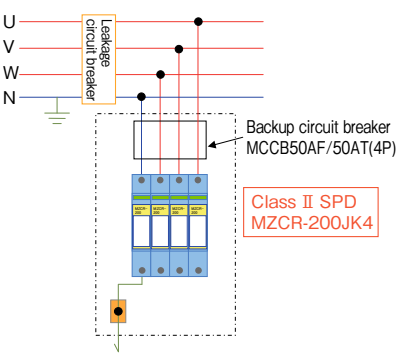
AC 100V/200V series (leakage circuit breaker on secondary side)

Single-phase two-wire with earthing/no earthing, or situation unclear	—	Single-phase three-wire with earthing
	——	

AC 200V series (leakage circuit breaker on primary side, or no leakage breaker)

Three-phase three-wire with earthing	Three-phase three-wire with no earthing, or situation unclear	Three-phase four-wire with earthing
		

AC 200V series (leakage circuit breaker on secondary side)

Three-phase three-wire with earthing/no earthing, or situation unclear	—	Three-phase four-wire with earthing
	——	

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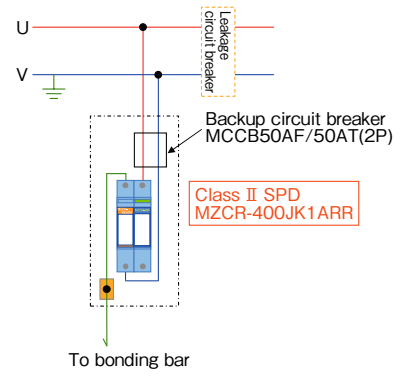
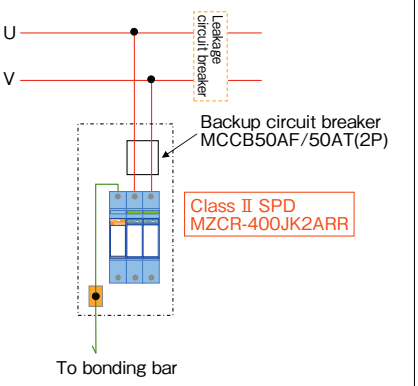
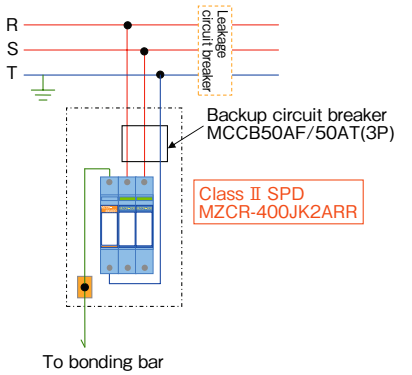
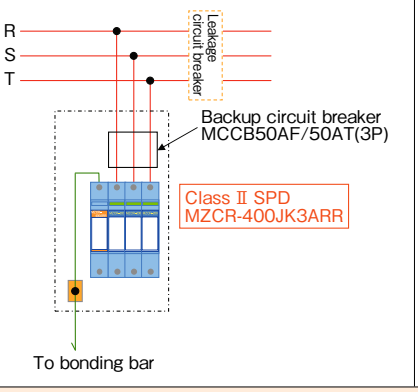
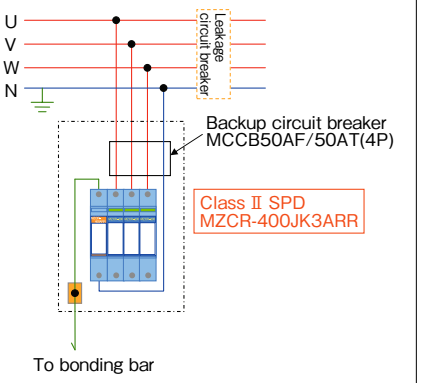
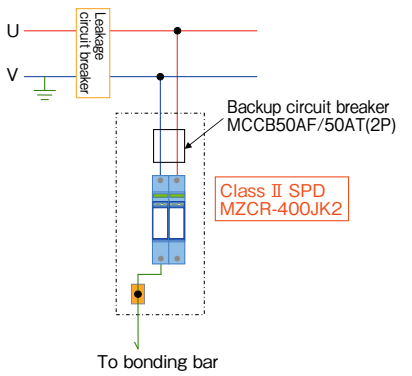
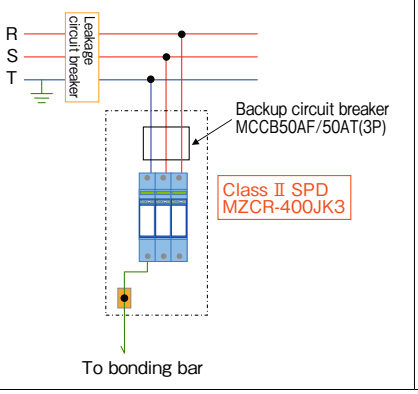
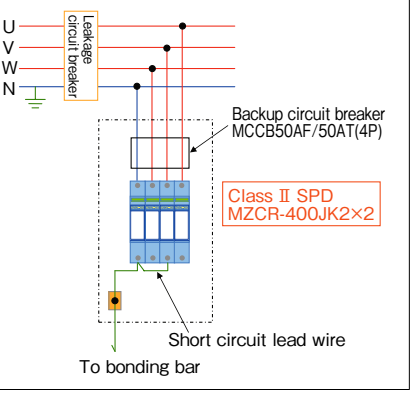
Power supply SPD IEC Class Ⅱ

■Installation examples (MZCR-400JK [ ] type, MZCR-400JK [ ] ARR type)

<table>
<tr><th colspan="3">AC 400V series (leakage circuit breaker on primary side, or no leakage breaker)</th></tr>
<tr><td>Single-phase two-wire with earthing</td><td>Single-phase two-wire with no earthing, or situation unclear</td><td>—</td></tr>
<tr><td> 
</td><td> 
</td><td>——</td></tr>
<tr><td>Three-phase three-wire with earthing</td><td>Three-phase three-wire with no earthing, or situation unclear</td><td>Three-phase four-wire with earthing</td></tr>
<tr><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><th colspan="3">AC 400V series (leakage circuit breaker on secondary side)</th></tr>
<tr><td>Single-phase two-wire with earthing/no earthing, or situation unclear</td><td>Three-phase three-wire with earthing/no earthing, or situation unclear</td><td>Three-phase four-wire with earthing</td></tr>
<tr><td> 
</td><td> 
</td><td> 
</td></tr>
</table>

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MZCR-700DCJK [ ] type
MZCR-700DCJK [ ] N type

IEC ClassⅡ compliant

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

Features

- Maximum discharge current up to 40 kA (induction lightning waveform 8/20 μs)
- Deterioration display function (warning contact output terminal attached)
- Plug-in type
- DIN rail mountable (35 mm)
- Round type crimped terminal for M4 (width less than 12 mm) (N type)

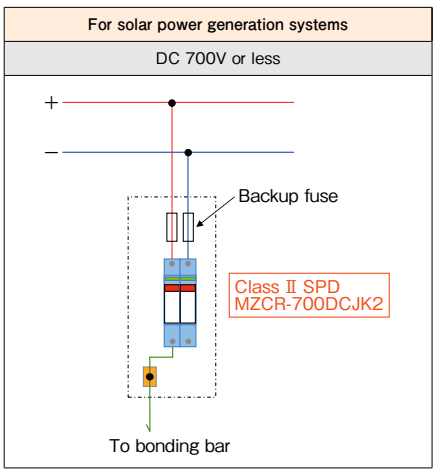
Applications

- Solar power generation system power supply circuits, etc

■Characteristics

Item	Measurement conditions	Performance
Maximum continuous operating voltage (Uc)	—	DC700V
Maximum discharge current (Imax)	8/20μs	40kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	Based on IEC	2.5 kV or less

■Installation examples



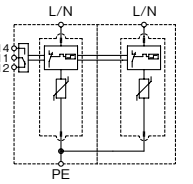
(MZCR-700DCJK2 type)
Dimensions: W36×D102×H64 (mm)
Mass: 250 (g)

■Product type identification

MZCR – 700DCJK □ □
- None: Standard type
- N: Screw terminal type
- 1-2: Number of linked SPD

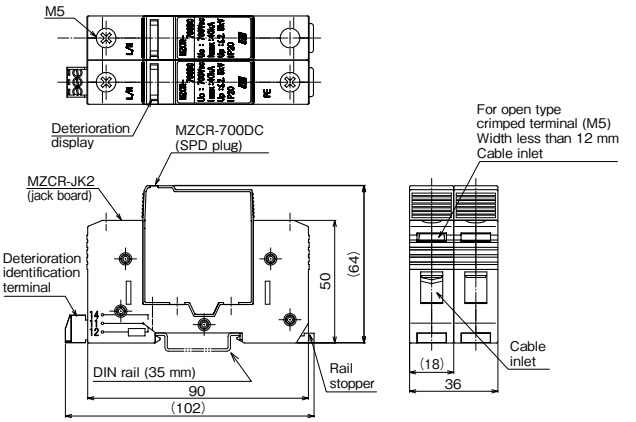
■Circuit diagram

(E.g.: MZCR-700DCJK2 type)

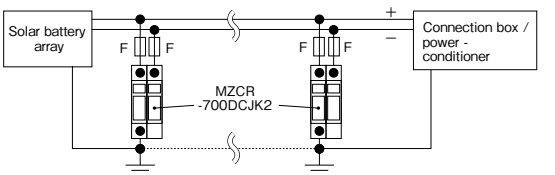


■External view

(E.g.: MZCR-700DCJK2 type)



■Installation examples



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MKY23-05 [ ] type
MKY23-20 [ ] type
MKY44-20 [ ] type
MKYS2 [ ] type
MKYS4 [ ] type

IEC ClassⅡ compliant

Conforming standards

- IEC 61643-1/IEC 62305-4compliant
- RoHS compliant

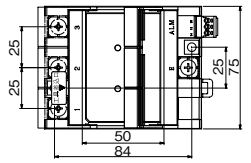
Features

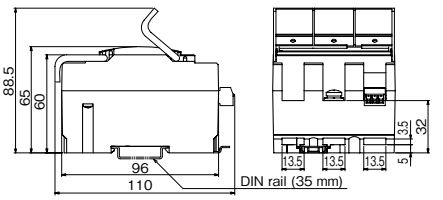
- 3-electrode dimensions, width 75mm (MKY23series, 44 series)
- 2-electrode dimensions, width 50mm (MKYS2series, S4series)
- A single unit provides protection across wires and to ground.
- Accommodates from single-phase two-wire up to three-phase three-wire(MKY23 series)
- Accommodates from single-phase two-wire up to three-phase four-wire(MKY44series, S2series, S4series)
- Deterioration display function (warning contact output terminal attached: S type)
- Easily installed into distribution boards
- Mountable on DIN rail, can be attached with articulated mounting plate or fixing screws.
- With retractable terminal covers for electric shock prevention

Applications

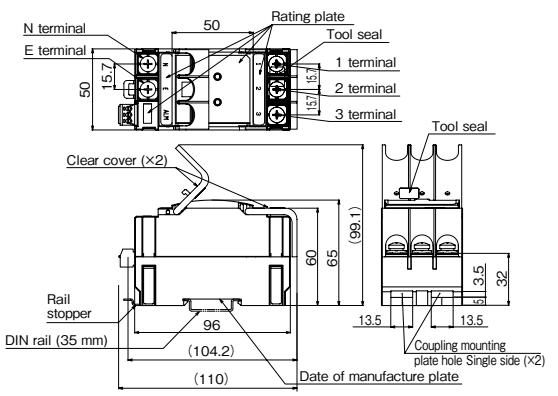
- Low voltage power supply circuits in switchboards and distribution boards (AC 100V/200V, 400V)

■External view





MKY23-05 [] type/MKY23-20 [] type/MKY44-20 [] type



MKYS2S type/MKYS4S type

(MKY23-05 [ ] type/MKY23-20 [ ] type) Dimensions: W75×D104.2×H65 (mm)
Mass: 300 (g)
(MKYS2 [ ] type) Dimensions: W50×D104.2×H65 (mm)
Mass: 200 (g)

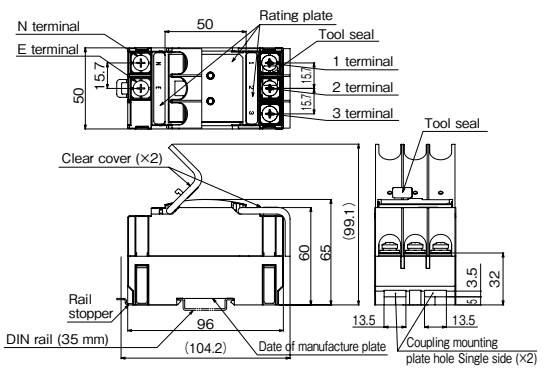
■Product type identification

MKY □ □ – □□ □

- Warning contacts: None: No contact output terminals; S: With contact output terminals
- Nominal discharge current (In): 05:5kA; 20:20kA
- 3: Single-phase・single-phase three-wire・three-phase three-wire; 4: Single-phase・single-phase three-wire・three-phase three/four-wire
- Maximum continuous operating voltage (Uc): 2:130V/250V AC; 4:510V AC

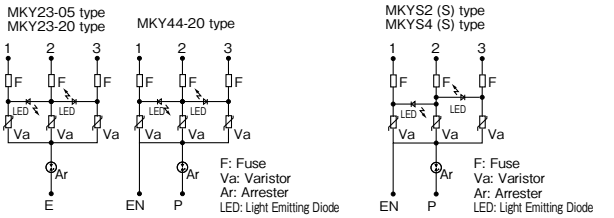
MKYS □ □

- Warning contacts: None: No contact output terminals; S: With contact output terminals
- Maximum continuous operating voltage (Uc): 2:130V/250V AC; 4:510V AC



MKYS2S type/MKYS4S type

■Circuit diagram



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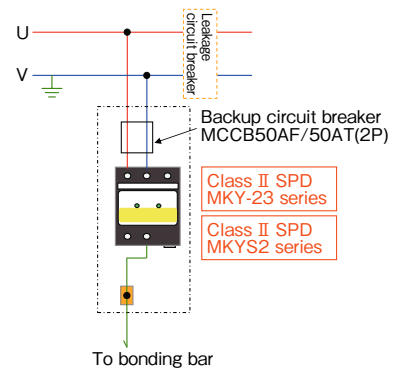
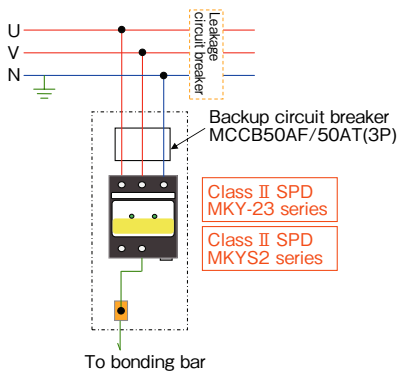
■Characteristics

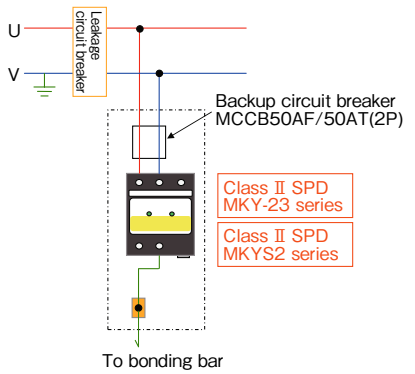
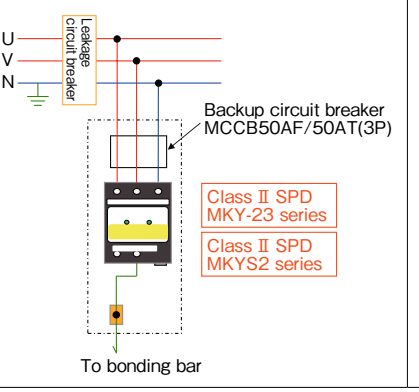
Item	Measurement conditions	Performance				
		MKY23-05 MKY23-05S	MKY23-20 MKY23-20S	MKY44-20 MKY44-20S	MKYS2 MKYS2S	MKYS4 MKYS4S
Maximum continuous operating voltage (50/60Hz) (Uc)	—	Single-phase two-wire AC 130V, 250V Single-phase three-wire AC 110V/220V Three-phase three-wire AC 250V	Single-phase two-wire AC 130V, 250V Single-phase three-wire AC 110V/220V Three-phase three-wire AC 250V	Three-phase three-wire AC 510V Three-phase four-wire AC 510V	Single-phase two-wire AC 130V, 250V Single-phase three-wire AC 110V/220V Three-phase three-wire AC 250V Three-phase four-wire AC 250V	Three-phase three-wire AC 510V Three-phase four-wire AC 510V
Maximum discharge current (Imax)	8/20μs	10 kA (3 times) (inter line, to ground)	40 kA (inter line, to ground)		20kA (inter line, to ground)	
Nominal discharge current (In)	8/20μs	5 kA (inter line, to ground)	20 kA (inter line, to ground)		10 kA (inter line, to ground)	
Voltage protection level (Up)	Based on IEC	1.3 kV or less (inter line) 1.5 kV or less (to ground)	1.5 kV or less (inter line) 1.5 kV or less (to ground)	2.5 kV or less (inter line) 2.5 kV or less (to ground)	1.3 kV or less (inter line) 1.5 kV or less (to ground)	2.4kV or less (inter line) 2.4 kV or less (to ground)

■Installation examples

AC 100V/200V series (leakage circuit breaker on primary side, or no leakage breaker)

Single-phase two-wire with earthing/no earthing, or situation unclear	Single-phase three-wire with earthing	—
		——

AC 100V/200V series (leakage circuit breaker on secondary side)

Single-phase two-wire with earthing/no earthing, or situation unclear	Single-phase three-wire with earthing	—
		——

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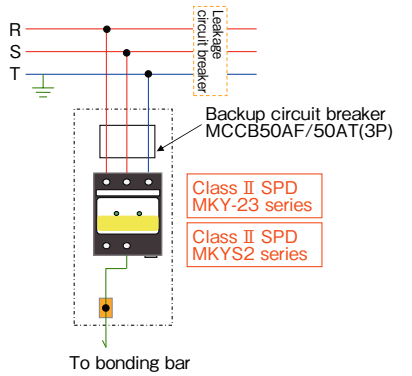
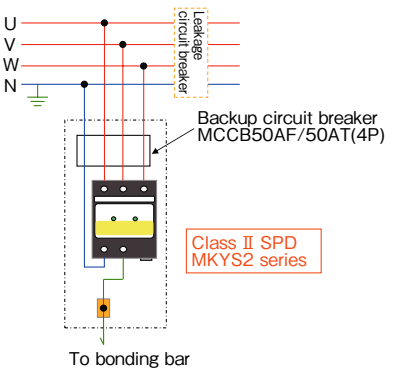
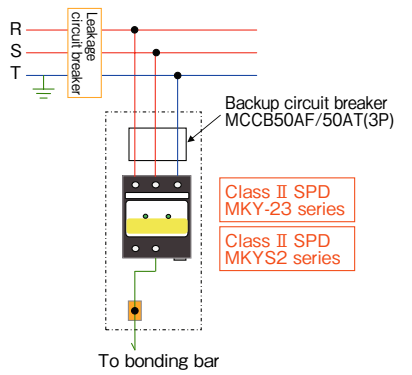
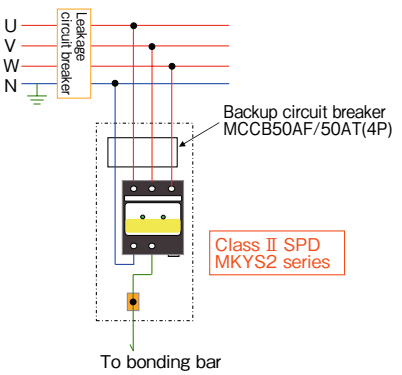
Power supply SPD IEC Class Ⅱ

■Installation examples

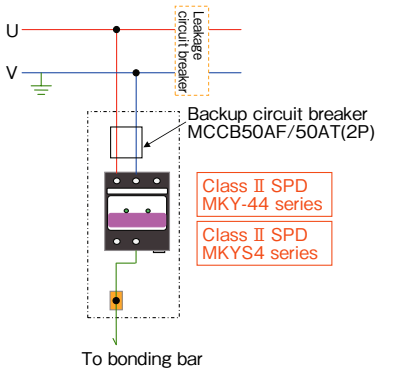
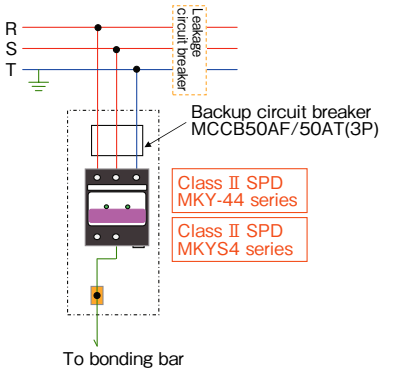
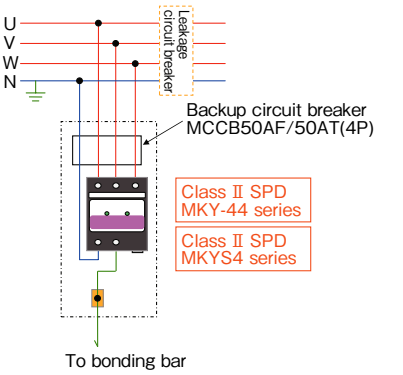
AC 200V series (leakage circuit breaker on primary side, or no leakage breaker)

Three-phase three-wire with earthing/no earthing, or situation unclear	Three-phase four-wire with earthing	—
		——

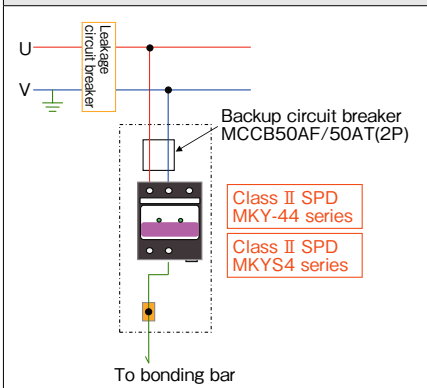
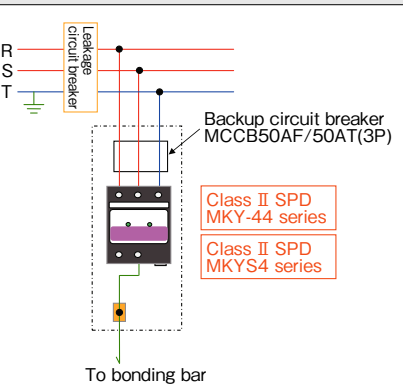
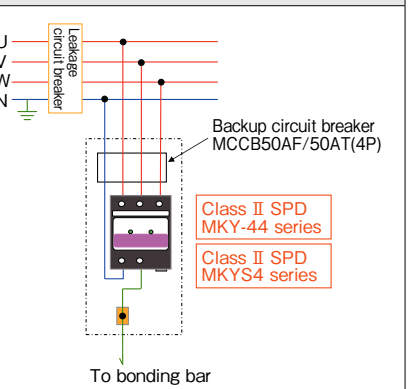
AC 200V series (leakage circuit breaker on secondary side)

Three-phase three-wire with earthing/no earthing, or situation unclear	Three-phase four-wire with earthing	—
		——

AC 400V series (leakage circuit breaker on primary side, or no leakage breaker)

Single-phase two-wire with earthing/no earthing, or situation unclear	Three-phase three-wire with earthing/no earthing, or situation unclear	Three-phase four-wire with earthing
		

AC 400V series (leakage circuit breaker on secondary side)

Single-phase two-wire with earthing/no earthing, or situation unclear	Three-phase three-wire with earthing/no earthing, or situation unclear	Three-phase four-wire with earthing
		

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Application and Performance of Power supply SPD IEC Class Ⅱ

Item	Measurement conditions	Performance and Applications									
		SmartSPD® SMA-MZSR 200JK1	MZSR-200JK1	SmartSPD® SMB-MZSR 200JK1	SmartSPD® SMB-MZSR 400JK1	SmartSPD® SMB-MZSR 700DCJK1	PMZ	MZE-100	MZE-200	MZCRW-200JK [ ]	MZCR-100JK[ ] MZCR-100JK [ ] N
Applications		Low voltage power supply circuits in switchboards and distribution boards Power supply circuits in control equipment									
Test classitication	—	ClassⅡ									
Maximum continuous operating voltage (Uc)	—	AC275V			AC500V	DC700V	AC275V	Single-phase two-wire AC110V	Single-phase two-wire AC230V	AC255V	AC150V
Maximum discharge current (Imax)	8/20μs	40kA					10kA	10kA (3 times)		80kA	40kA(each phase)
Nominal discharge current (In)	8/20μs	20kA					5kA			40kA	5kA(each phase)
Voltage protection level (Up)	Based on IEC	1.4kV or less			2.5kV or less		1.5kV or less	0.8 kV or less (inter line) 1.5 kV or less (to ground)	1.5 kV or less (inter line) 2.5 kV or less (to ground	2.1kV or less	700V or less
Applicable wires	—	AWG14~4(1.6~22mm^2)					AWG16	AWG14~10(2~5.5mm^2)		AWG14~8 (1.6~22mm^2)	AWG14~4 (1.6~22mm^2)(*)
Deterioration display	—	Yes (Green: normal; Red: deteriorating)					Yes (LED ON: normal; LED OFF: deteriorating)			Yes (Green: normal; Red: deteriorating)	
Warning contact output terminal	—	Yes					—			Yes	
Operating environmental conditions	Rated operating temperature Rated operating humidity	-25°C to +60°C 90% or less (no condensation)	-40°C to +80°C 90% or less (no condensation)	-25°C to +60°C 90% or less (no condensation)			-20°C to +70°C 90% or less (no condensation)			-40°C to +70°C 90% or less (no condensation)	

* For N type, please use AWG14~8(1.6~8mm^2)

Item	Measurement conditions	Performance and Applications									
		MZCR-200JK[ ] MZCR-200JK [ ] N	MZCR-200JK[ ] ARR MZCR-200JK [ ] ARRN	MZCR-400JK [ ] MZCR-400JK [ ] N	MZCR-400JK [ ] ARR MZCR-400JK [ ] ARRN	MZCR-700DCJK [ ] MZCR-700DCJK [ ] N	MKY23-05 MKY23-05S	MKY23-20 MKY23-20S	MKY44-20 MKY44-20S	MKYS2 MKYS2S	MKYS4 MKYS4S
Applications		Low voltage power supply circuits in switchboards and distribution boards Power supply circuits in control equipment				Solar power generation system power supply circuits, etc.	Low voltage power supply circuits in switchboards and distribution boards Power supply circuits in control equipment				
Test classitication	—	ClassⅡ									
Maximum continuous operating voltage (Uc)	—	AC255V		AC500V		DC700V	Single-phase two-wire AC130V、250V Single-phase three-wire AC110V/220V Three-phase three-wire AC250V		Three-phase three-wire AC510V Three-phase four-wire AC510V	Single-phase two-wire AC130V, 250V Single-phase three-wire AC110V/220V Three-phase three-wire AC250V Three-phase four-wire AC250V	Three-phase three-wire AC510V Three-phase four-wire AC510V
Maximum discharge current (Imax)	8/20μs	40kA(each phase)	40kA(each phase) 75kA(N-PE phase)	40kA(each phase)	40kA(each phase) 75kA(N-PE phase)	40kA	10 kA (3 times) (inter line, to ground)	40 kA (inter line, to ground)		20kA (inter line, to ground)	
Nominal discharge current (In)	8/20μs	20kA(each phase)	20kA(each phase) 60kA(N-PE phase)	20kA(each phase)	20kA(each phase) 60kA(N-PE phase)	20kA(each phase)	5 kA (inter line, to ground)	20 kA (inter line, to ground)		10 kA (inter line, to ground)	
Voltage protection level (Up)	Based on IEC	1.4kV or less (each phase)	1.4kV or less (each phase) 1.0kV or less (N-PE phase)	2.5kV or less (each phase)	2.5kV or less (each phase) 1.5kV or less (N-PE phase)	2.5kV or less	1.3 kV or less (inter line) 1.5 kV or less (to ground)	1.5 kV or less (inter line) 1.5 kV or less (to ground)	2.5 kV or less (inter line) 2.5 kV or less (to ground)	1.3 kV or less (inter line) 1.5 kV or less (to ground)	2.4kV or less (inter line) 2.4 kV or less (to ground)
Applicable wires	—	AWG14~4(1.6~22mm^2)(*)					AWG10~6(5.5~14mm^2)				
Deterioration display	—	Yes(Green: normal; Red: deteriorating)	Yes(except N-PE phase)(Green: normal; Red: deteriorating)	Yes(Green: normal; Red: deteriorating)	Yes(except N-PE phase)(Green: normal; Red: deteriorating)	Yes (Green: normal; Red: deteriorating)	Yes (LED ON: normal; LED OFF: deteriorating)				
Warning contact output terminal	—	Yes	Yes(except N-PE phase)	Yes	Yes(except N-PE phase)	Yes	Yes (MKY23-05S)	Yes (MKY23-20S)	Yes (MKY44-20S)	Yes (MKYS2S)	Yes (MKYS4S)
Operating environmental conditions	Rated operating temperature Rated operating humidity	-40°C to +70°C 90% or less (no condensation)					-20°C to +60°C 90% or less (no condensation)				

* For N type, please use AWG14~8(1.6~8mm^2)

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ZP-[ ] type
ZP-[ ]JKN type

IEC Category C2/D1 compliant

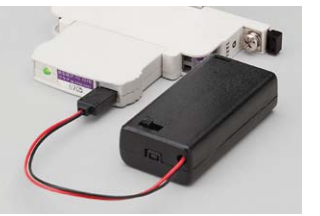
Conforming standards

- IEC 61643-21compliant
- RoHS compliant

Features

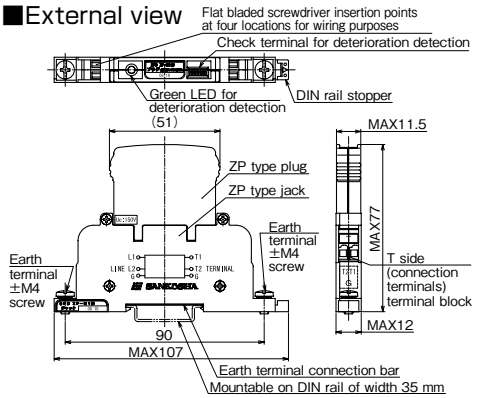
- Slim design enables space saving
- Plug-in type (circuit not broken by inserting or removing plug)
- DIN rail mountable (35 mm)
- Special tester (ZPT1 type) can be used to detect deterioration.
- Round type crimped terminal for M4 (N type)

Dimensions: W12×D107×H77 (mm)
Mass: 70 (g)

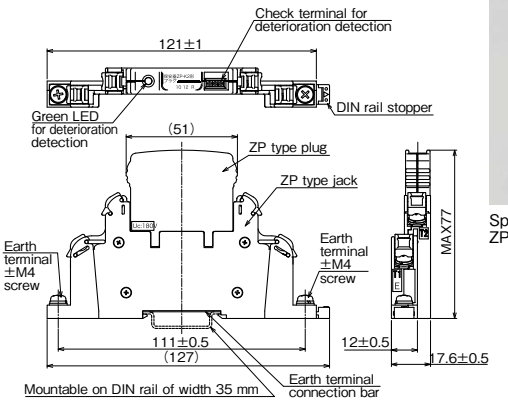


Special tester for deterioration detection
ZPT1 series (Batteries sold separately)

■External view



ZP-[ ] type



ZP-[ ]N type

■Applications/Characteristics

Item		Performance				
		ZP-A1	ZP-DC24	ZP-DC48	ZP-H2-H1	ZP-N1 ZP-N1JKN
Applications		Telephone line, ISDN line, ADSL line, xDSL line	DC 24V signal line, control circuit	DC 48V signal line, control circuit	RS422, RS485	Balanced circuit, wind speed meter, pyranometer, rain gauge, hygrometer
Maximum continuous operating voltage (Uc)		DC170V	DC27V	DC52V	DC5V	DC150V
Rated current		DC100mA	DC3A		DC100mA	DC3A
Series resistance		10Ω or less	—		5Ω±10%	—
Voltage protection level (Up)		1.0 kV or less	500V or less		50V or less	1.0 kV or less (to ground) 50V or less (inter line) * In case of balanced circuit
Impulse durability (two lines together)	Category C2 (8/20 μs)	10 kA (10 times)	4kA (10 times)		10kA (10 times)	4kA (10 times)
	Category D1 (10/350 μs)	2.5 kA (2 times)	1kA (2 times)		5kA (2 times)	1kA (2 times)
Operating environmental conditions	Rated operating temperature Rated operating humidity	-40°C to +70°C 96% or less (no condensation)				
Wiring method		Relay wiring (○), Suspended wiring (×)	Relay wiring (○), Suspended wiring (○)		Relay wiring (○), Suspended wiring (×)	Relay wiring (○), Suspended wiring (○)

Item		Performance				
		ZP-NM ZP-NMJKN	ZP-EN-1 ZP-EN1JKN	ZP-EN3 ZP-EN3JKN	ZP-K2 ZP-K2JKN	ZP-H3(06,12,24,48V) ZP-H3 24V JKN
Applications		Multi-core measurement line, disaster prevention monitoring board (multi-core), wind speed meter, platinum thermometer	Telephone line, ADSL, EPBX, xDSL	ISDN, xDSL, digital leased line	AC/DC 110V control circuit, relay circuit, speaker line	Instrumentation line, potentiometer, slow pulse, DC 4-20mA, RS232C, RS422, RS485
Maximum continuous operating voltage (Uc)		DC150V	DC170V	DC52V	DC180V AC140V	DC9V(06V)、DC13.5V(12V) DC27V(24V)、DC52V(48V)
Rated current		—	DC100mA		DC3A	DC400mA(06V)、DC100mA(12、24、48V)
Series resistance		—	10Ω or less		—	5Ω±10%
Voltage protection level (Up)		1.0 kV or less (to ground) 50V or less (inter line)	400V or less	200V or less	800V or less	80V or less (06V), 100V or less (12V), 120V or less (24V), 140V or less (48V)
Impulse durability (two lines together)	Category C2 (8/20 μs)	4kA (10 times)	10kA (10 times)		4kA (10 times)	10kA (10 times)
	Category D1 (10/350 μs)	1kA (2 times)	2.5kA (2 times)		1kA (2 times)	5kA (2 times)
Operating environmental conditions	Rated operating temperature Rated operating humidity	40°C to +70°C 96% or less (no condensation)				
Wiring method		Relay wiring (×), Suspended wiring (○)	Relay wiring (○), Suspended wiring (×)		Relay wiring (○), Suspended wiring (○)	Relay wiring (○), Suspended wiring (×)

* Applicable wires: 0.08 to 2.5 mm²

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ZPW-NMJKQ type
ZPW-NMJKN type

IEC Category C2/D1 compliant

Conforming standards

- IEC 61643-21 compliant
- RoHS compliant

Features

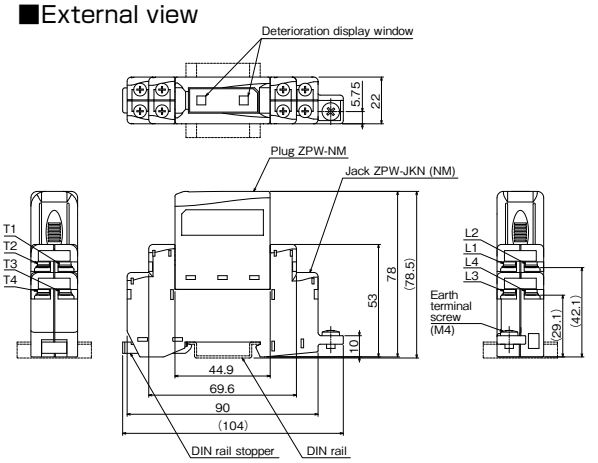
- Enabled for up to four-core wire
- Plug-in construction for excellent maintenance
- Plug insertion and removal without interception
- DIN rail mountable (35 mm)
- Deterioration display function

Applications

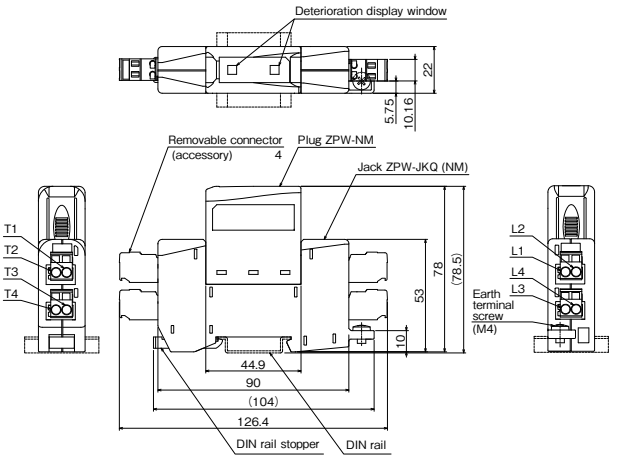
- Lightning protection for all kinds of meters, measurement lines, communication lines, fire prevention monitoring boards, etc.

(ZPW-NMJKN type) Dimensions: W22×D104×H78.5 (mm)
Mass: 160 (g)
(ZPW-NMJKQ type) Dimensions: W22×D126.4×H78.5 (mm)
Mass: 140 (g)

■External view



ZPW-NMJKN

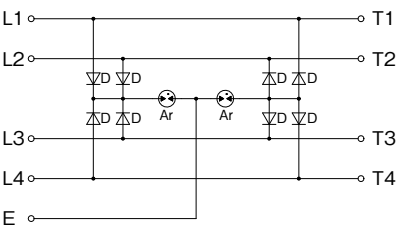


ZPW-NMJKQ

■Characteristics

Item			Performance
Maximum continuous operating voltage (Uc)	Across L-T		DC150V
Rated current	Across L-T		100mA
Voltage protection level (Up)	1.2/50μs·10kV 8/20μs·5kA	Across L-E	1,000V or less
		Across L terminals	50V or less
Impulse durability	Category C2 8/20μs 20kA (one-wire, 5.0 kA × 4)	Across L-E	10 times
	Category D1 10/350μs 2kA (one-wire, 5.0 kA × 4)	Across L-E	2 times

■Circuit diagram



■Recommended cables

Type	Cable or crimped terminal	
ZPW-NMJKN	Stranded-wire	M3 crimped terminal (crimped terminal width 6.6 mm or less) 0.5 to 2.63mm^2
	Solid-wire	M3 crimped terminal (crimped terminal width 6.6 mm or less) ϕ0.8 to 1.82mm
	AWG	M3 crimped terminal (crimped terminal width 6.6 mm or less) AWG20 to 14
ZPW-NMJKQ	Stranded-wire	0.5 to 2.5 mm^2 (maximum power cord insulator OD ϕ4.1 mm or less)
	Solid-wire	ϕ0.8 to 1.6 mm (maximum power cord insulator OD ϕ4.1 mm or less)
	AWG	AWG20 to 12 (maximum power cord insulator OD ϕ4.1 mm or less)

■Deterioration display function

Normal Deteriorated

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CLP-[ ]JK type
CLP-[ ]JKN type

IEC Category C2/D1 compliant

Conforming standards

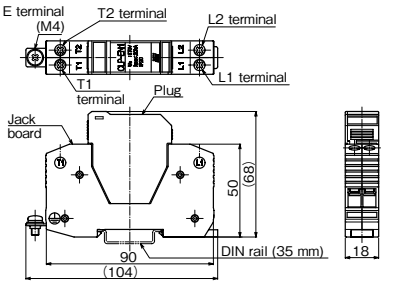
- IEC 61643-21compliant
- RoHS compliant
- CRCC approved (TB/T2311-2008,TB/T3074-2003) (CLP-H3b,c,d)

Features

- High withstand capacity suitable for multiple lightning zones
- Plug-in type
- DIN rail mountable (35 mm)
- Certified explosion-proof products available (P57)
- Round type crimped terminal for M3 (width less than 6.6 mm) (N type)

Dimensions: W18×D104×H68 (mm)
Mass: 100 (g)

External view

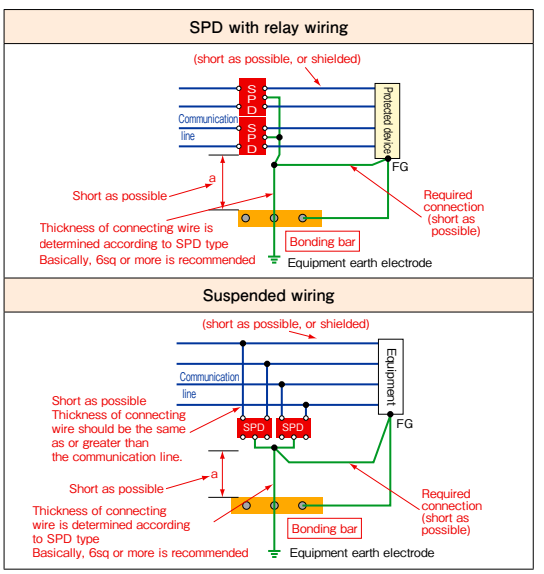


Applications/Main performance characteristics

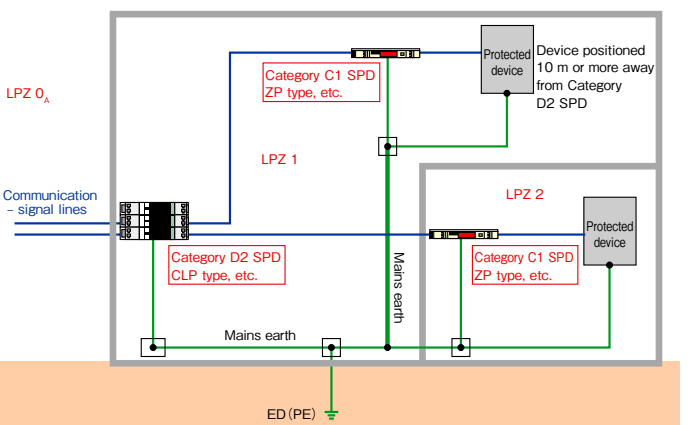
Item		CLP-EN1JK CLP-EN1JKN	CLP-EN3JK CLP-EN3JKN	CLP-K2JK CLP-K2JKN	CLP-K3JK	CLP-VA65JK CLP-VA65JKN	CLP-N1JK CLP-N1JKN	CLP-NMJK CLP-NMJKN	CLP-H3[] JK : a-d CLP-H3[] JKN : a-d
Applications		ADSL line, telephone line, EPBX, telemetry line	ISDN line, leased line, digital leased line	AC/DC 110V control circuit	Remote monitoring equipment	DC 12/24/48V power supply, remote monitoring equipment	Disaster prevention monitoring board, balanced circuit, teleconference, pyranometer, rain gauge, hygrometer	Multi-core measurement line, disaster prevention monitoring board (multi-core), wind speed meter, platinum thermometer	Fire alarm, wind speed meter, potentiometer, slow pulse
Maximum continuous operating voltage (Uc)		DC170V	DC52V	DC180V	DC250V	DC65V	DC52V	DC170V	a:DC9V b:DC13.5V c:DC27V d:DC52V
Rated current		DC100mA		DC3A		DC1A	DC3A		DC100mA
Series resistance		5Ω±10%		—					5Ω±10% (100mA)
Voltage protection level (Up)		400V or less	200V or less	1.3kV or less		330V or less	900V or less	1.0kV or less (L-E) 50V or less (L-L)	a: 40V or less b: 45V or less c: 60V or less d: 90V or less
Impulse durability	Category C2 (8/20μs)	10kA (10 times)		4kA (10 times)		10kA (10 times)			
	Category D1 (10/350μs)	5kA (2 times)		2kA (2 times)	1kA (2 times)	5kA (2 times)			
Operating environmental conditions	Rated operating temperature Rated operating humidity	-40°C to +70°C 96% or less (no condensation)							
Wiring method		Relay wiring (○), Suspended wiring (×)		Relay wiring (○), Suspended wiring (○)			Relay wiring (○), Suspended wiring (○)	Relay wiring (×), Suspended wiring (○)	Relay wiring (○), Suspended wiring (×)

Applicable wires: 0.3 to 5.5 mm²

Wiring method for SPD for communication and signal lines (1)



Wiring method for SPD for communication and signal lines (2)



Ideally, SPD should be installed at zone boundaries after LPZ design has been carried out.
If the distance between the SPD installation point and the protected device is 10 m or more, the installation of extra SPD would be an ideal solution.
For induced lightning countermeasures, SPD should be installed close to the protected device.

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KPR type
KR type

SPD for KRONE terminal
IEC Category C2/D1 compliant

Conforming standards

- IEC 61643-21compliant
- RoHS compliant

Features

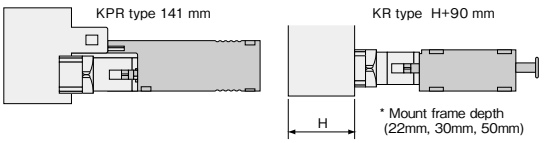
- Specially for use with the excellent operability LSA-PLUS (KRONE terminal)
- MDF/IDF can be manufactured with a combination of SPD and LSA-PLUS

(KPR- [ ] type) Mass: 20 (g)
(KR- [ ] type) Mass: 10 (g)

■Dimensions (mm)

KPR type	EN1-M, EN3-M, N1, H4S	W9.4×D26×H77(60)
	D1, A1	W9.4×D24×H51(37)
KR type	APS1, A1(T3), AS, A1	W9.1×D22.2×H74.5(59)

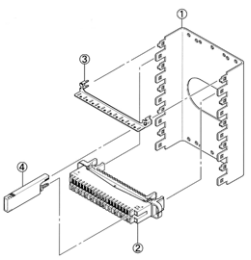
* Dimensions in parentheses ( ) represent height when mounted on Krone module

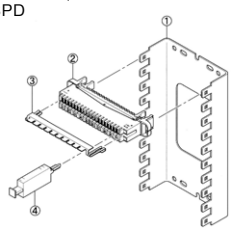


■SPD installation diagram

[When using mount frame]

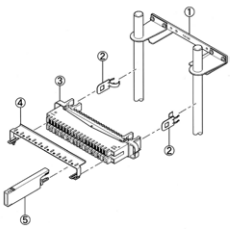
① Mount frame (Different for KPR and KR)
② LSA-PLUS switching terminal
③ Earth bar (Different for KPR and KR)
④ SPD

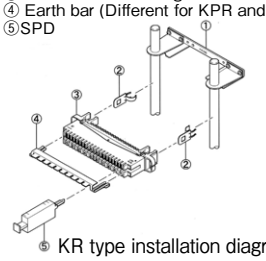

KPR type installation diagram


KR type installation diagram

[When using profile frame]

① Profile set
② Earth clip
③ LSA-PLUS switching terminal
④ Earth bar (Different for KPR and KR)
⑤SPD


KPR type installation diagram


KR type installation diagram

■Applications/Main performance characteristics

Item		Performance					
		KPR-EN1-M	KPR-EN3-M	KPR-D1	KPR-A1	KPR-N1	KPR-H4S
Applications		ADSL, TEL, alanog leased line	ISDN, digital leased line	Communication line, relay circuit	ADSL, TEL	Balanced circuit	Analog PBX
Maximum continuous operating voltage		DC170V	DC52V	DC170V		DC150V	DC170V
Rated current		DC100mA					
Series resistance/line		10Ω		—	6.5Ω	—	15Ω±20%
Insertion loss		DC-10MHz 1.0dB or less		0.3-3.4kHz 1.0dB or less			DC-150kHz 0.5dB or less
Voltage protection level (Up)		400V or less (1.2/50μs, 10kV)	200V or less (1.2/50 μs, 10kV)	1500V or less (1.2/50 μs, 10kV)		L-E: 1500V L-L:20V or less (1.2/50 μs, 10kV)	350V or less (10/200 μs, 5kV)
Maximum discharge current (Imax)	8/20μs	10kA		8kA			4kA
	10/350μs	—		1kA		—	
Impulse durability	Category C2 (8/20 μs)	5kA		—			2kA
	Category D1 (10/350 μs)	2.5kA		—			
Deterioration display		Yes (Pink: normal; Purple: deteriorating)		—			

Item		Performance			
		KR-APS1	KR-A1 (T3)	KR-AS	KR-A1
Applications		ADSL, TEL, ISDN			
Maximum continuous operating voltage		DC180V	DC180V	DC180V	DC170V
Rated current		DC100mA	DC120mA		DC120mA
Series resistance/line		10Ω		20Ω	
Insertion loss		DC to 5 MHz, 1.0dB or less	DC to 1 MHz, 0.7dB or less		DC to 150 kHz, 0.5dB or less
Voltage protection level(Up)		500V or less (1.2/50 μs, 10kV)	500V or less (1kV/μs)	300V or less (100V/μs)	700V or less (1kV/μs)
Maximum discharge current(Imax)	8/20μs	10kA		1.6kA	10kA
	10/350μs	5kA	2.5kA	—	
Impulse durability	Category C2 (8/20 μs)	10kA		0.5kA	2kA
	Category D1 (10/350 μs)	2.5kA		—	
Deterioration display		Yes (Pink: normal; Purple: deteriorating)		—	Yes (Pink: normal; Purple: deteriorating)

Note: APS1, A1 and A1 (T3) are also available without the deterioration display function.

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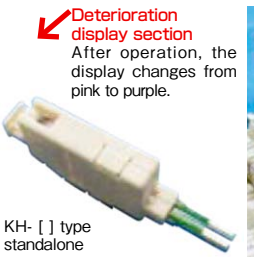
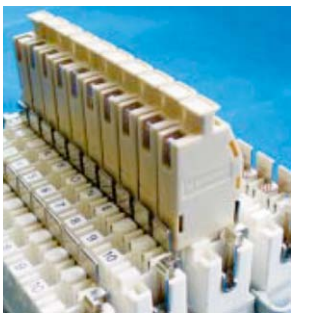
KH-[ ] type

Specially for use with induction lightning countermeasure KRONE terminals



KH- [ ] type standalone



Features

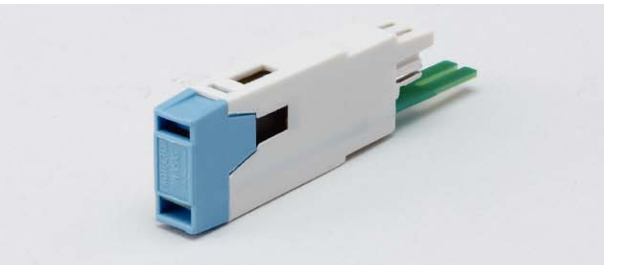
- Specially for use with KRONE high band modules
- MDF – IDF can be manufactured with a combination of SPD and high band modules
- KH-A1FS has a deterioration display function.

■Applications/Characteristics

Item	Performance	
	KH-A1FS	KH-AS
Applications	ADSL, TEL, ISDN, LAN (10BASE-T)	TEL, ISDN
Maximum continuous operating voltage	DC180V	
Rated current	120mA	
Series resistance/line	20Ω	
Insertion loss	DC to 30MHz, 1.0dB or less	DC to 2MHz, 1.0dB or less
Voltage protection level (Up)	700V(1kV/μs)	300V(100V/μs)
Maximum discharge current(Imax)	8/20μs·10kA	8/20μs·1.6kA
	10/350μs·1kA	—
Deterioration display	Yes (Pink: normal; Purple: deteriorating)	—

RM-VS type

SPD for R&M VS compact terminal



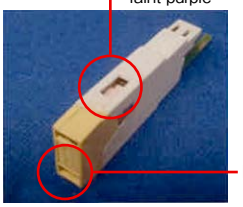
Features

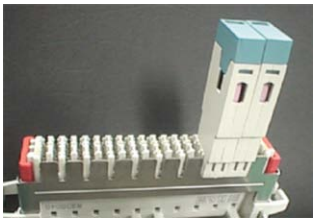
- SPD for R&M VS compact terminal to protect ordinary telephone lines and electronic exchanges from lightning
- Ultra-thin, with a thickness of just 7 mm, can be used in combination with super small terminals (VS compact terminal) to form a high density protective wiring board.

■Characteristics

Item	Performance	
	RM-VSA1FS	RM-VSAS
Applications	Ordinary telephone line	EPBX
DC discharge sparkover voltage	230V±20%	230V±30V
Impulse sparkover voltage	700V or less at 1kV/μs	300V or less at 100V/μs
Insulation resistance	100 MΩ or more at DC 100V	
Failsafe operation	Operate in short mode at single end 5A current. Then, the alarm display changes to purple.	—

■Alarm display





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LAN-CAT5e-P+ type (discharge type)
LAN-CAT5e-P type (discharge type)

IEC Category C2/D1 compliant

Dimensions: W22×D89×H39(mm)
Mass: 55(g)

Conforming standards

- UL standard acquired (E140906) (LAN-CAT5e-P type)
- IEC 61643-21compliant
- RoHS compliant

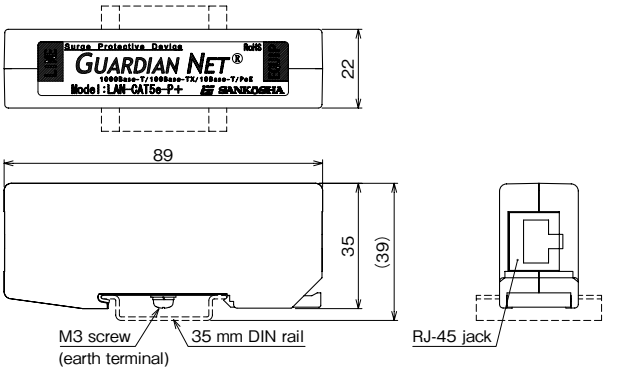
Features

- Uses discharge type circuits
- Gigabit Ethernet 1000BASE-T enabled
- PoE (IEEE802.3af) enabled,
- PoE Plus(IEEE802.3at) enabled (LAN-CAT5e-P+ type)
- DIN rail mountable (35 mm)
- Mountable on conductive DIN rail for batch earthing

Applications

- Gigabit Ethernet
- Network cameras
- Wireless LAN access points
- VoIP enabled telephones and servers
- Outdoors installed network devices

■External view



■Characteristics

Item		Performance	
		LAN-CAT5e-P+	LAN-CAT5e-P (UL)
Applicable lines	IEEE802.3	10BASE-T	
	IEEE802.3u	100BASE-TX	
	IEEE802.3ab	1000BASE-T	
	IEEE802.3af	PoE	
	IEEE802.3at	PoE Plus	—
Transmission loss		1.0dB or less	
Maximum continuous operating voltage	IEEE802.3af	DC60V (between PoE terminals) DC30V (between each line and the earth terminal)	
	IEEE802.3at		
Voltage protection level (Impulse dischage voltage)	To ground (1.2/50μs 10kV)	250V or less	
Impulse durability (Total of 8 cores)	Category C2(8/20μs)	5kA(10 times)	
	Category D1(10/350μs)	2.5kA(2 times)	

LAN-P60 type (discharge type)

Conforming standards

- RoHS compliant

Features

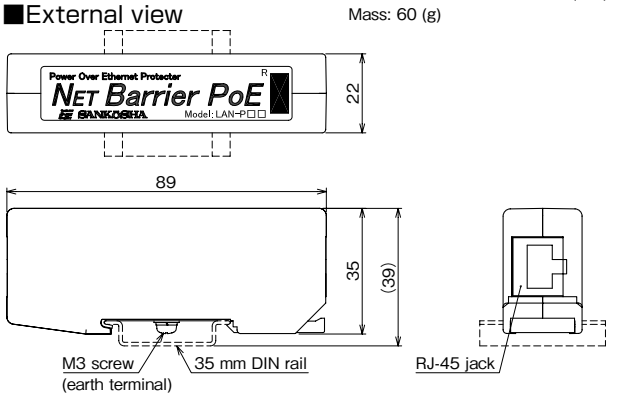
- Uses discharge type circuits
- Fast Ethernet 100BASE-TX enabled
- PoE (B method) enabled
- DIN rail mountable (35 mm)
- Mountable on conductive DIN rail for batch earthing

Applications

- Wireless LAN access points
- Network cameras
- VoIP enabled telephones and servers
- Outdoors installed network devices

Dimensions: W22×D89×H39 (mm)
Mass: 60 (g)

■External view



■Characteristics

Item		Performance
Applicable lines	IEEE802.3	10BASE-T
	IEEE802.3u	100BASE-TX
	IEEE802.3af	PoE (B method)
Transmission loss		3.0dB or less
Maximum continuous operating voltage	IEEE802.3af	DC60V (between PoE terminals) DC30V (between each line and the earth terminal)
Voltage protection level (Impulse dischage voltage)	To ground(1kV/μs)	150V or less
Impulse durability (Total of 8 cores)	Category C2 (8/20μs)	2kA (1 time)

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LAN-100BO type
(discharge type)

Conforming standards
- RoHS compliant

Features
- Uses discharge type circuits
- Fast Ethernet 100BASE-T enabled

Applications
- Network cameras
- Outdoors installed network devices

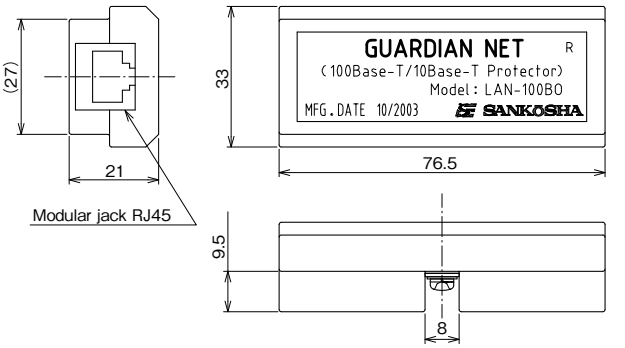
LAN-100BO type

Dimensions: W33×D76.5×H21 (mm)
Mass: 50 (g)

■Characteristics

Item		Performance
Applicable lines	IEEE802.3	10BASE-T
	IEEE802.3u	100BASE-TX
Transmission loss		3.0dB or less
Voltage protection level (Impulse dischage voltage)	To ground (10/700μs 1kV)	150V or less

■External view



LAN-1000BO type
(Combination: insulation-discharge type)

IEC Category C2/D1 compliant

Conforming standards
- UL standard acquired (E140906)
- IEC 61643-21compliant (earthing connection only)
- RoHS compliant

Features
- Uses insulation + discharge (combination) type circuit
- Gigabit Ethernet 1000BASE-T enabled
- Earth-free type not requiring earthing construction work and it protects equipment without earthing connections
- Impulse withstand voltage 1.5 kV or more
- DIN rail mountable (35 mm)
- Mountable on conductive DIN rail for batch earthing

Applications
- Gigabit Ethernet
- Network cameras
- Wireless LAN access points
- Outdoors installed network devices

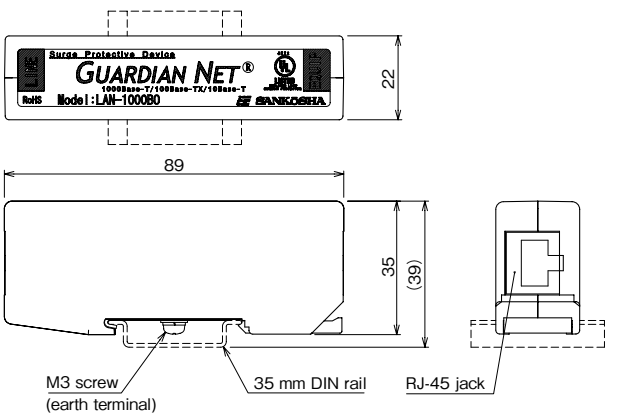
LAN-1000BO type

Dimensions: W22×D89×H39 (mm)
Mass: 50 (g)

■Characteristics

Item		Performance
Applicable lines	IEEE802.3	10BASE-T
	IEEE802.3u	100BASE-TX
	IEEE802.3ab	1000BASE-T
AC withstand voltage		1kV or more
Impulse withstand voltage	1.2/50μs	1.5 kV or more
Voltage protection level (Impulse dischage voltage)	To ground (1.2/50μs 2kV)	1kV or less
Impulse durability (Total of 8 cores)	Category C2 (8/20μs)	5kA (10 times)
	Category D1 (10/350μs)	2.5kA (2 times)

■External view



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LAN-100IS type
(insulation type)

LAN-100IS type

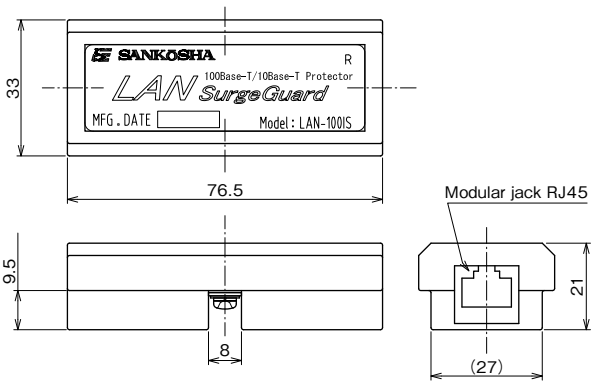
Dimensions: W33×D76.5×H21 (mm)
Mass: 50 (g)

Conforming standards
- RoHS compliant

Features
- Uses insulation type circuits
- Fast Ethernet 100BASE-T enabled
- Earth-free type not requiring earthing construction work or protecting equipment without earthing connections
- Impulse withstand voltage 5kV or more

Applications
- Network cameras
- Ordinary households (PCs, network devices)
- Outdoors installed network devices

■External view



■Characteristics

Item		Performance
Applicable lines	IEEE802.3	10BASE-T
	IEEE802.3u	100BASE-TX
Transmission loss		1.5dB or less
AC withstand voltage		3kV or more
Impulse withstand voltage		5kV or more

LAN-100ISL type
(insulation type)

LAN-100ISL type

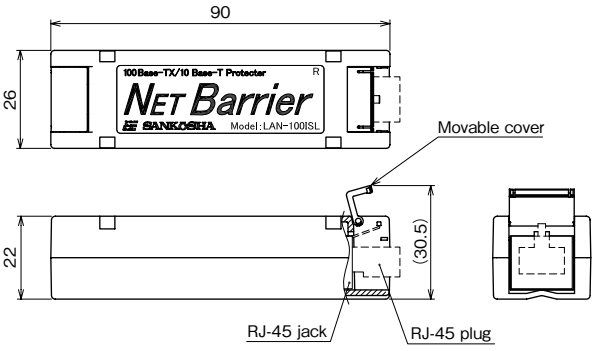
Dimensions: W26×D90×H22 (mm)
Mass: 60 (g)

Conforming standards
- Compliant with IEC60601-1 (Medical Electrical Equipment) for separation devices.
- RoHS compliant

Features
- Uses insulation type circuits
- Fast Ethernet 100BASE-TX enabled
- Earth-free type not requiring earthing construction work or protecting equipment without earthing connections
- Impulse withstand voltage 6kV or more

Applications
- Network cameras
- Medical equipment
- Outdoors installed network devices

■External view



■Characteristics

Item		Performance
Applicable lines	IEEE802.3	10BASE-T
	IEEE802.3u	100BASE-TX
Transmission loss		3.0 dB or less
AC withstand voltage		4 kV or more
Impulse withstand voltage		6 kV or more

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LAN-1000IS type
(insulation type)

Conforming standards
- RoHS compliant

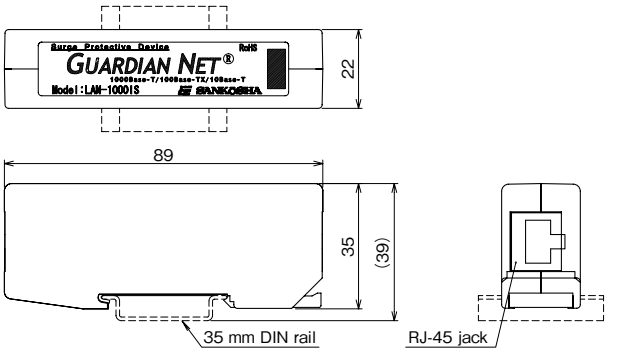
Features
- Uses insulation type circuits
- Gigabit Ethernet 1000BASE-T enabled
- Earth-free type not requiring earthing construction work or protecting equipment without earthing connections
- Impulse withstand voltage 5kV or more
- DIN rail mountable (35 mm)

Applications
- Gigabit Ethernet
- Network cameras
- Ordinary households (PCs, network devices)
- Outdoors installed network devices

LAN-1000IS type

Dimensions: W22×D89×H39 (mm)
Mass: 55 (g)

■External view



■Characteristics

Item		Performance
Applicable lines	IEEE802.3	10BASE-T
	IEEE802.3u	100BASE-TX
	IEEE802.3ab	1000BASE-T
Transmission loss		1.5 dB or less
AC withstand voltage		3 kV or more
Impulse withstand voltage	1.2/50μs	5kV or more

■Applications and Performance

Item		Applications and Performance						
		Discharge type			Combination: insulation - discharge type	Insulation type		
		LAN-CAT5e-P+ LAN-CAT5e-P	LAN-P60	LAN-100BO	LAN-1000BO	LAN-100IS	LAN-100ISL	LAN-1000IS
Applications		Gigabit Ethernet Network cameras Wireless LAN access points VoIP enabled telephones and servers Outdoors installed network devices	Wireless LAN access points Network cameras VoIP enabled telephones and servers Outdoors installed network devices	Network cameras Outdoors installed network devices	Gigabit Ethernet Network cameras Wireless LAN access points Outdoors installed network devices	Network cameras Ordinary households (PCs, network devices) Outdoors installed network devices	Network cameras Medical equipment Outdoors installed network devices	Gigabit Ethernet Network cameras Ordinary households (PCs, network devices) Outdoors installed network devices
Applicable lines	10BASE-T	○	○	○	○	○	○	○
	100BASE-TX	○	○	○	○	○	○	○
	1000BASE-T	○	–		○	–		○
PoE	IEEE802.3af	○	△(B method)	–				
	IEEE8023.at	LAN-CAT5e-P:— LAN-CAT5e-P+:○	–					
Transmission loss		1.0 dB or less※1	3.0 dB or less※1		3.0dB or less※2	1.5dB or less※2	3.0dB or less※2	1.5dB or less※2
Impulse durability (Total of 8 cores)	Category C2 (8/20μs)	5kA(10 times)	2kA(1 time)	–	5kA(10 times)	–		
	Category D1 (10/350μs)	2.5kA(2 times)	–		2kA(2times)	–		
Voltage protection level (Impulse dischage voltage)	To ground	250V or less (1.2/50μs 10kV)	150V or less (1kV/μs)	150V or less (10/700μs 1kV)	1kV or less (1.2/50μs 2kV)	–		
AC withstand voltage		–			1kV or more	3kV or more	4kV or more	3kV or more
Impulse withstand voltage		–			1.5kV or more	5kV or more	6kV or more	5kV or more
Maximum continuous operating voltage※3		DC60V (between PoE terminals) DC30V (between each line and the earth terminal)	DC60V (between PoE terminals) DC30V (between each line and the earth terminal)	–				
Rated current※3		LAN-CAT5e-P:500mA LAN-CAT5e-P+:600mA	–	500mA	–			
Operating environmental conditions	Rated operating temperature Rated operating humidity	-35℃ to +60℃ 90% or less (no condensation)				-20℃ to +60℃ 90% or less (no condensation)	-35℃ to +60℃ 90% or less (no condensation)	

※1 : Value in transmission frequency bandwidth of DC～100MHz
※2 : Value in transmission frequency bandwidth of 1MHz～100MHz
※3 : Based on IEEE802.3af and IEEE802.3at

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SPD for co-axial connectors

CX-E-ECS type

IEC Category C2/D1 compliant

Conforming standards

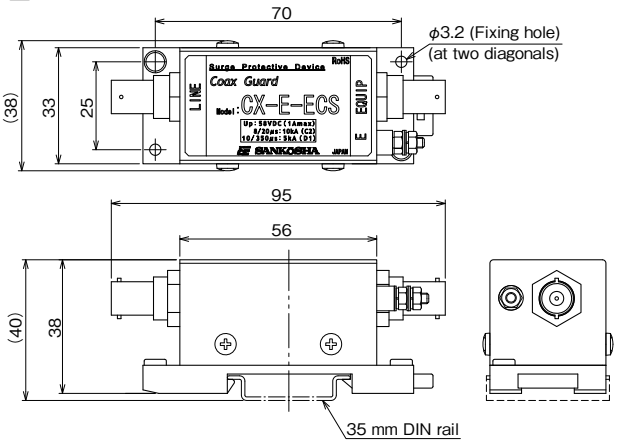
- IEC 61643-21compliant
- RoHS compliant

Applications

- Monitoring cameras (co-axial power supply OK)
- Data transmission devices

Mass: 125 (g)

■External view



■Characteristics

Item		Performance
Connector type		BNC(J-J)
Frequency bandwidth		DC to 30 MHz
Insertion loss		1.0dB or less
Maximum continuous operating voltage		DC58V
Impedance		50Ω／75Ω
Rated current		1A
Voltage protection level		500V or less (to ground) 250V or less (between conductors)
Impulse durability	Category C2 (8/20μs)	10kA (10 times)
	Category D1 (10/350μs)	5kA (2 times)

CX-H type

IEC Category C2/D1 compliant

Conforming standards

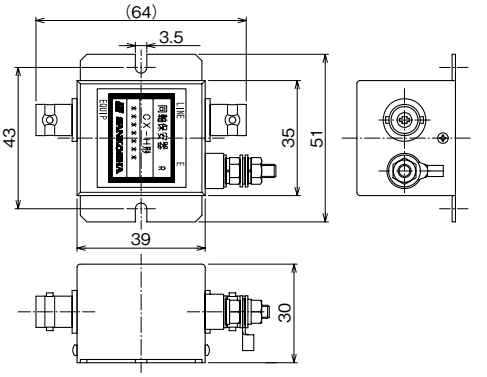
- IEC 61643-21compliant
- RoHS compliant

Applications

- Monitoring cameras

Mass: 92 (g)

■External view



■Characteristics

Item		Performance
Connector type		BNC(J-J)
Frequency bandwidth		DC to 10MHz
Insertion loss		0.5 dB or less
Impedance		75Ω
Voltage protection level		1kV (to ground) 110V (between conductors)
Impulse durability	Category C2 (8/20μs)	5 kA (10 times)
	Category D1 (10/350μs)	2.5 kA (2 times)

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SPD for co-axial connectors

CX-H-N type

Conforming standards
●RoHS compliant

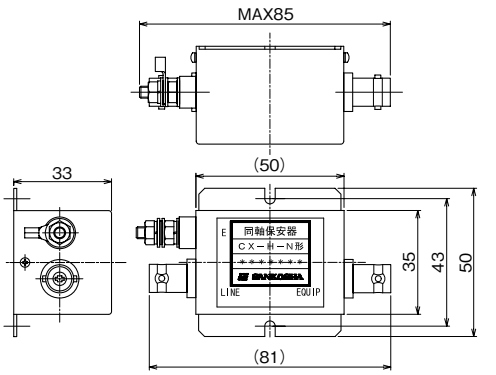
Applications
●Monitoring cameras

Mass: 100 (g)

■Characteristics

Item	Performance
Connector type	BNC(J-J)
Frequency bandwidth	DC to 10MHz
Insertion loss	0.5 dB or less
Impedance	50Ω/75Ω
Voltage protection level	15V or less (impulse protection level)

■External view



B-JP-1 type (50Ω and 75Ω)

IEC Category C2/D1 compliant

Conforming standards
●IEC 61643-21compliant
●RoHS compliant

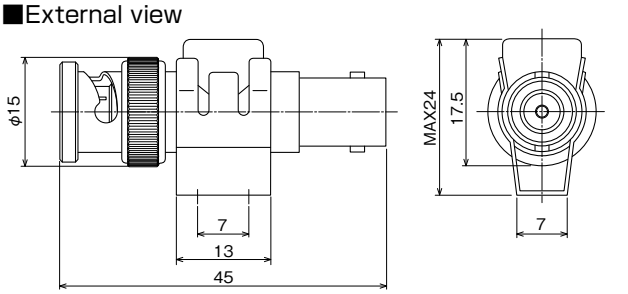
Applications
●Monitoring cameras
●Video signals

Mass: 24 (g)

■Characteristics

Item		Performance	
		B-JP-1(50Ω)	B-JP-1(75Ω)
Connector type		BNC type(P-J)	
Frequency bandwidth		DC to 1.6GHz	DC to 400MHz
V.S.W.R		1.1 or less (DC to 1GHz) 1.25 or less (1 to 1.6GHz)	1.1 or less
Insertion loss		0.2dB or less (DC to 1GHz) 0.3dB or less (1 to 1.6GHz)	0.2dB or less
Impedance		50Ω	75Ω
Permissible power		10W	50W
Voltage protection level		1.5 kV or less	
DC sparkover voltage		DC350V±20%	
Impulse durability	Category C2 (8/20μs)	5kA (10 times)	
	Category D1 (10/350μs)	1kA (2 times)	

■External view



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B-JP-7 type
B-JP-8 type

IEC Category C2/D1 compliant

Conforming standards

- IEC 61643-21compliant
- RoHS compliant

Applications

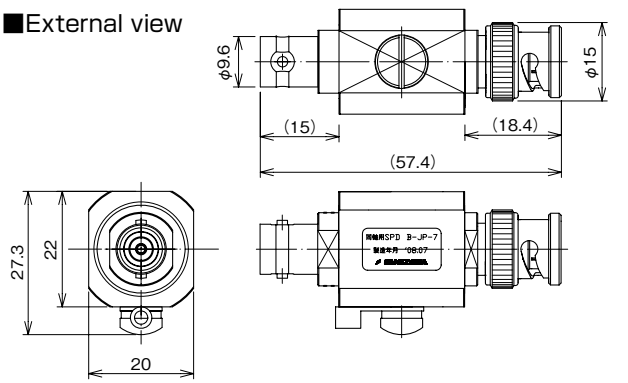
- Monitoring cameras

Mass: 74 (g)

■Characteristics

Item		Performance	
		B-JP-7	B-JP-8
Connector type		BNC type(P-J)	
Frequency bandwidth		DC to 1GHz	DC to 400MHz
V.S.W.R		1.2 or less	
Insertion loss		0.2dB or less	
Impedance		50Ω	75Ω
Permissible power		10W	50W
Voltage protection level		1.5 kV or less	
DC sparkover voltage		DC 180V or more	
Impulse durability	Category C2 (8/20μs)	20kA (10 times)	
	Category D1 (10/350μs)	2.5kA (2 times)	

■External view



N-JP-7 type
N-JP-8 type

(Permissible power 200W)

IEC Category C2/D1 compliant

Conforming standards

- IEC 61643-21compliant
- RoHS compliant

Applications

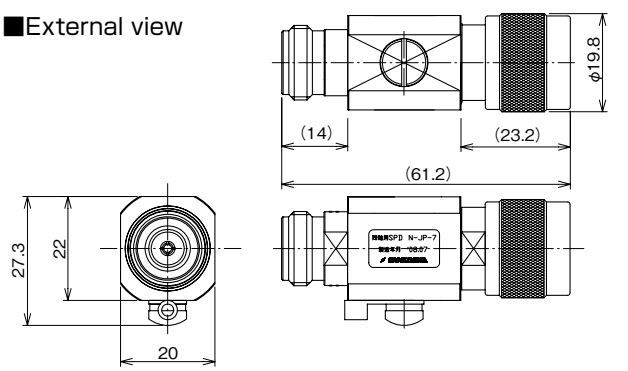
- Wireless communication devices
- Measuring instruments

Mass: 106 (g)

■Characteristics

Item		Performance	
		N-JP-7	N-JP-8
Connector type		N type(P-J)	
Frequency bandwidth		DC to 2.2GHz	
V.S.W.R		1.2 or less	
Insertion loss		0.2dB or less	
Impedance		50Ω	
Permissible power		10W	Rating: 100W/Max: 200W
Voltage protection level		700V or less	1.1kV or less
DC sparkover voltage		DC 180V or more	DC 400-600V
Impulse durability	Category C2 (8/20μs)	20kA (10 times)	
	Category D1 (10/350μs)	2.5kA (2 times)	

■External view



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SPD for co-axial connectors

N-JP-1 type

Conforming standards

●RoHS compliant

Applications

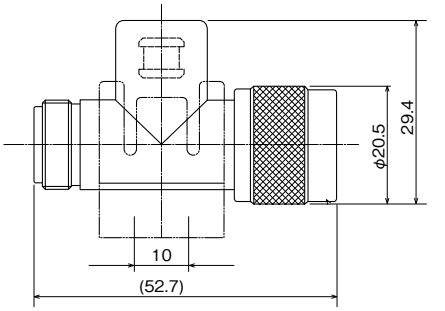
●Wireless communication devices
●Measuring instruments

Mass: 72 (g)

■Characteristics

Item		Performance
Connector type		N type(P-J)
Frequency bandwidth		DC to 1GHz
V.S.W.R		1.1 or less
Insertion loss		0.2dB or less
Impedance		50Ω
Permissible power		50W
Voltage protection level		1.5 kV or less
DC sparkover voltage		DC 350V±15%
Impulse discharge current	8/20μs	10kA (1 time)

■External view



N-JP-1S type

IEC Category C2/D1 compliant!

Conforming standards

●IEC 61643-21compliant
●RoHS compliant

Applications

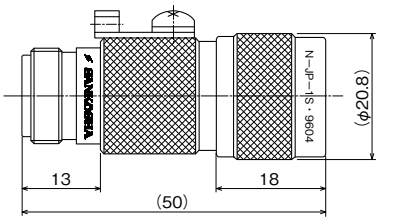
●Wireless communication devices
●Measuring instruments

Mass: 80 (g)

■Characteristics

Item		Performance
Connector type		N type(P-J)
Frequency bandwidth		DC to 3GHz
V.S.W.R		1.2 or less
Insertion loss		0.2dB or less
Impedance		50Ω
Permissible power		10W
Voltage protection level		700V or less
DC sparkover voltage		DC 120V or more
Impulse durability	Category C2 (8/20μs)	5kA (10 times)
	Category D1 (10/350μs)	2.5kA (2 times)

■External view



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SPD for co-axial connectors

N-JP-5 type
(Permissible power 60W)

Conforming standards
- IEC 61643-21 compliant
- RoHS compliant

Applications
- Wireless communication devices
- Measuring instruments

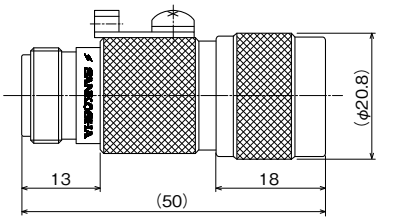
N-JP-5 type

Mass: 80 (g)

■Characteristics

Item		Performance
Connector type		N type(P-J)
Frequency bandwidth		DC to 3GHz
V.S.W.R		1.2 or less
Insertion loss		0.3dB or less
Impedance		50Ω
Permissible power		60W
Voltage protection level		700V or less
DC sparkover voltage		DC 200V or more
Impulse durability	Category C2 (8/20μs)	2kA(10 times)
	Category D1 (10/350μs)	5kA(1 time)

■External view



N-JP-6 type

Conforming standards
- RoHS compliant

Applications
- Wireless communication devices
- Measuring instruments

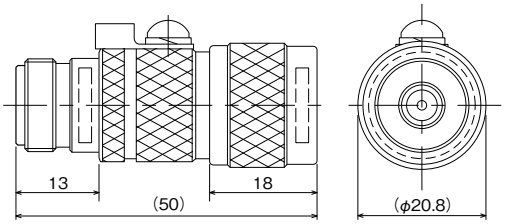
N-JP-6 type

Mass: 86 (g)

■Characteristics

Item		Performance
Connector type		N type(P-J)
Frequency bandwidth		4.7GHz-5.7GHz
V.S.W.R		1.2 or less
Insertion loss		0.5dB or less
Impedance		50Ω
Permissible power		10W
Voltage protection level		700V or less
DC sparkover voltage		DC 120V or more
Impulse discharge current	8/20μs	10kA (1 time)

■External view



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SPD for co-axial connectors

M-JP-1 type (50Ω and 75Ω)

Conforming standards

●RoHS compliant

Applications

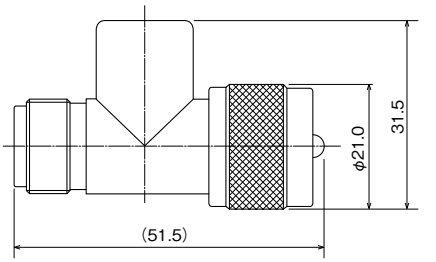
●Wireless communication devices
●Measuring instruments

Mass: 80 (g)

■Characteristics

Item		Performance	
		M-JP-1(50Ω)	M-JP-1(75Ω)
Connector type		M type(P-J)	
Frequency bandwidth		DC to 400MHz	DC to 30MHz
V.S.W.R		1.1 or less	
Insertion loss		0.2dB or less	
Impedance		50Ω	75Ω
Permissible power		50W	
Voltage protection level		1.5 kV or less	
DC sparkover voltage		DC 350V±15%	
Impulse discharge current	8/20μs	10kA (1 time)	

■External view



SMA-JP-1 type

Conforming standards

●RoHS compliant

Applications

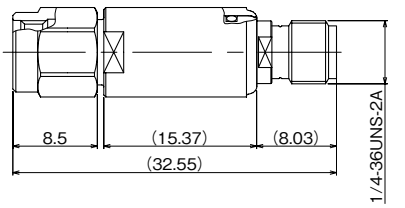
●Microwave wireless communication devices

Mass: 9.3 (g)

■Characteristics

Item		Performance
Connector type		SMA type(P-J)
Frequency bandwidth		DC to 3GHz
V.S.W.R		1.2 or less
Insertion loss		0.3dB or less
Impedance		50Ω
Permissible power		10W
Voltage protection level		700V or less
DC sparkover voltage		DC 120V or more
Impulse discharge current	8/20μs	10kA (1 time)

■External view



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SPD for co-axial connectors

F-JP-1W type

IEC Category C2/D1 compliant

Conforming standards

- IEC 61643-21compliant
- RoHS compliant

Applications

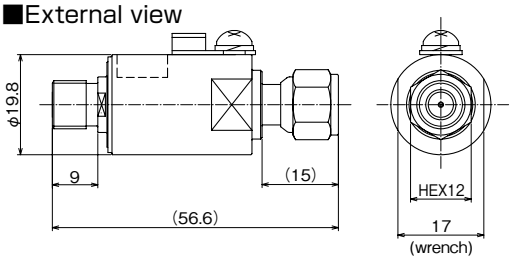
- CS, BS, TV tuners

Mass: 68 (g)

■Characteristics

Item		Performance
Connector type		F type(P-J)
Frequency bandwidth		DC to 3GHz
V.S.W.R		1.5 or less
Insertion loss		0.5dB or less
Impedance		75Ω
Permissible power		50W
Voltage protection level		700V or less
DC sparkover voltage		DC 200V or more
Impulse durability	Category C2 (8/20μs)	2kA (10 times)
	Category D1 (10/350μs)	1kA (2 times)

■External view



FT-ARR (60) type

Conforming standards

- RoHS compliant

Applications

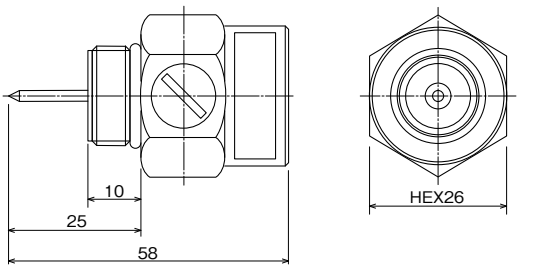
- For CATV amps

Mass: 102 (g)

■Characteristics

Item		Performance
Connector type		FT type
Frequency bandwidth		DC to 1GHz
V.S.W.R		1.2 or less
Insertion loss		0.2dB or less
Impedance		75Ω
Permissible power		10W
Voltage protection level		1.2kV or less
DC sparkover voltage		DC 180V or more
Impulse discharge current	8/20μs	10kA (1 time)

■External view



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SPD for co-axial connectors

TNC-JP-2 type

Conforming standards
●RoHS compliant

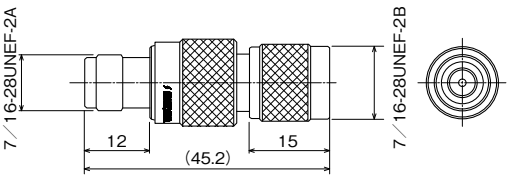
Applications
●Mobile telephone base stations
●Wireless LAN antennae
●Various kinds of communication devices

■Characteristics

Item		Performance
Connector type		TNC type(P-J)
Frequency bandwidth		DC to 3GHz
V.S.W.R		1.2 or less
Insertion loss		0.3dB or less
Impedance		50Ω
Permissible power		10W
Voltage protection level		700V or less
DC sparkover voltage		DC 120V or more
Impulse discharge current	8/20μs	10kA (1 time)

Mass: 42 (g)

■External view



TNC-JP-3 type

Conforming standards
●RoHS compliant

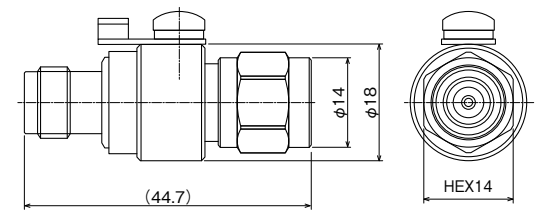
Applications
●Mobile telephone base stations
●Wireless LAN antennae
●Various kinds of communication devices

■Characteristics

Item		Performance
Connector type		TNC type(P-J)
Frequency bandwidth		DC to 3GHz
V.S.W.R		1.2 or less
Insertion loss		0.3dB or less
Impedance		50Ω
Permissible power		10W
Voltage protection level		700V or less
DC sparkover voltage		DC 120V or more
Impulse discharge current	8/20μs	10kA (1 time)

Mass: 46 (g)

■External view



TNC-JP-5 type

Conforming standards
●RoHS compliant

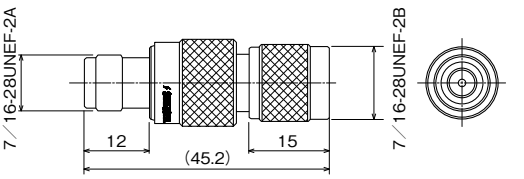
Applications
●Mobile telephone base stations
●Wireless LAN antennae
●Various kinds of communication devices

■Characteristics

Item		Performance
Connector type		TNC type(P-J)
Frequency bandwidth		DC to 3GHz
V.S.W.R		1.2 or less
Insertion loss		0.3dB or less
Impedance		50Ω
Permissible power		60W
Voltage protection level		700V or less
DC sparkover voltage		DC 200V or more
Impulse discharge current	8/20μs	5kA (1 time)

Mass: 42 (g)

■External view



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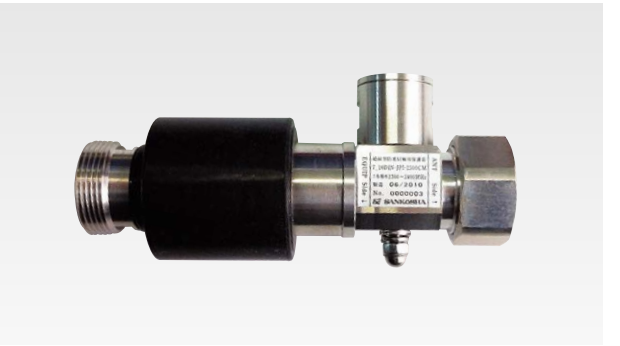
SPD for co-axial connectors [Stub]

7_16DIN-JPI-2000CTU type
7_16DIN-JPI-1800CTU type

These products are co-axial protective devices for the protection of various types of devices from abnormal voltage caused by lightning surges, etc., entering co-axial power supply systems.
Lightning surges entering via antennae pass through the high insulation non-invasive device side and are discharged to ground via the short stub.

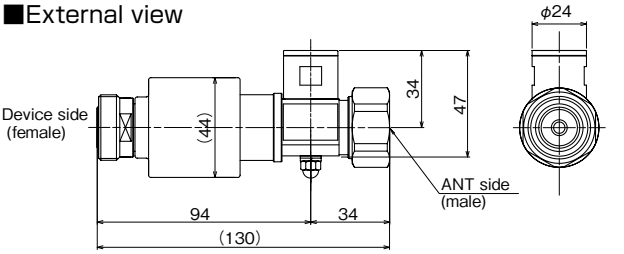


Mass: 500(g)

■Characteristics

Item		Performance	
		7_16DIN-JPI-2000CTU	7_16DIN-JPI-1800CTU
Frequency range		1920MHz to 2170MHz (1920MHz to 1980MHz/2110MHz to 2170MHz)	1755MHz to 1880MHz (1755MHz to 1785MHz/1850MHz to 1880MHz)
Characteristic impedance		50Ω	
Insertion loss (LOSS)		1.3dB or less	
Voltage standing wave ratio (VSWR)		1.20 or less	
Impulse discharge current	1.2/50μs	30kV or more	
Operating temperature range		-20℃to +60℃ 90% or less (no condensation)	-10℃to +60℃ 90% or less (no condensation)
Operating humidity range		30% to 90% (no condensation)	
Storage temperature – humidity		Operating temperature - humidity	
Input – output interface type		Device side: DIN7/16 (female) Antenna side: DIN7/16 (male)	

■External view



N-JP-2000 type

Applications

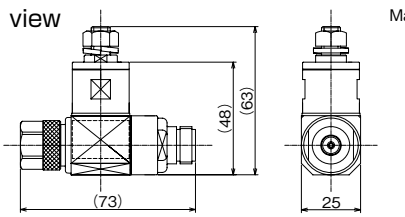
●Mobile telephone base stations

■Characteristics

Item	Performance
Connector type	N(P-J)
Frequency bandwidth	1940-2150MHz
V.S.W.R	1.2 or less
Insertion loss	0.1dB or less
Impedance	50Ω
Permissible power	300W or less
Voltage protection level	10V or less

Mass: 340 (g)

■External view



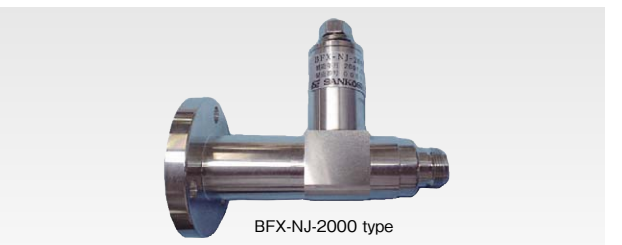
BFX-NJ-2000 type

Applications

●Mobile telephone base stations

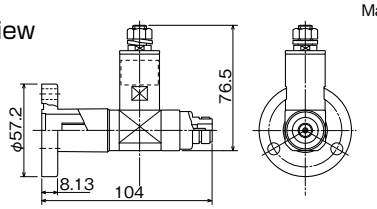
■Characteristics

Item	Performance
Connector type	BFX20D/NJ
Frequency bandwidth	1900-2200MHz
V.S.W.R	1.15 or less
Insertion loss	0.1dB or less
Impedance	50Ω
Permissible power	300W or less
Voltage protection level	10V or less



Mass: 480 (g)

■External view



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Application and Performance of SPD for co-axial connectors

Item		Performance and Applications						
		CX-E-ECS	CX-H	CX-H-N	B-JP-1(50Ω)	B-JP-1(75Ω)	B-JP-7	B-JP-8
Applications		Monitoring cameras (co-axial power supply OK) Data transmission devices	Monitoring cameras		Monitoring cameras Video signals		Monitoring cameras	
Connector type		BNC type (J-J)			BNC type (P-J)			
Frequency bandwidth		DC to 30MHz	DC to 10MHz		DC to 1.6GHz	DC to 400MHz	DC to 1GHz	DC to 400MHz
V.S.W.R		—			1.1 or less (DC-1GHz) 1.25 or less (1-1.6GHz)	1.1 or less	1.2 or less	
Insertion loss		1.0dB or less	0.5dB or less		0.2dB or less (DC-1GHz) 0.3dB or less (1-1.6GHz)	0.2dB or less		
Impedance		50Ω/75Ω	75Ω	50Ω/75Ω	50Ω	75Ω	50Ω	75Ω
Permissible power		—			10W	50W	10W	50W
Voltage protection level		500V or less (to ground) 250V or less (between conductors)	1kV (to ground) 110V (between conductors)	±15V or less (Impulse protection level)	1.5kV or less			
DC sparkover voltage		—			DC350V±20%		DC 180V or more	
Impulse durability	Category C2 (8/20μs)	10kA	5kA (10 times)	—	5kA (10 times)		20kA (10 times)	
	Category D1 (10/350μs)	5kA	2.5kA (2 times)	—	1kA (2 times)		2.5kA (2 times)	
Operating environmental conditions	Rated operating temperature Rated operating humidity	-35℃ to +60℃ 90% or less (no condensation)	-40℃ to +70℃ 90% or less (no condensation)	-20℃ to +60℃ 90% or less (no condensation)	-40℃ to +70℃ 90% or less (no condensation)			

Item		Performance and Applications									
		N-JP-7	N-JP-8	N-JP-1	N-JP-1S	N-JP-5	N-JP-6	M-JP-1(50Ω)	M-JP-1(75Ω)	SMA-JP-1	F-JP-1W
Applications		Wireless communication devices Measuring instruments								Microwave wireless communication devices	CS, BS, TV tuners
Connector type		N type (P-J)						M type (P-J)		SMA type (P-J)	F type (P-J)
Frequency bandwidth		DC to 2.2GHz		DC to 1GHz	DC to 3GHz		4.7GHz-5.7GHz	DC to 400MHz	DC to 30MHz	DC to 3GHz	
V.S.W.R		1.2 or less		1.1 or less	1.2 or less			1.1 or less		1.2 or less	1.5 or less
Insertion loss		0.2dB or less				0.3dB or less	0.5dB or less	0.2dB or less		0.3dB or less	0.5dB or less
Impedance		50Ω							75Ω	50Ω	75Ω
Permissible power		10W	200W	50W	10W	60W	10W	50W		10W	50W
Voltage protection level		700V or less	1.1kV or less	—	700V or less			—		700V or less	
DC sparkover voltage		DC 180V or more	DC 400-600V	DC 350V±15%	DC 120V or more	DC 200V or more	DC 120V or more	DC 350V±15%		DC 120V or more	DC 200V or more
Impulse durability	Category C2 (8/20μs)	20kA (10 times)		—	5kA (10 times)	2kA (10times)	—				2kA (10 times)
	Category D1 (10/350μs)	2.5kA (2 times)		—	2.5kA (2 times)	1kA (2times)	—				1kA (2 times)
Impulse discharge current	8/20μs	—		10kA (1 time)	—		10kA (1 time)				—
Operating environmental conditions	Rated operating temperature Rated operating humidity	-40°C to+70°C 90% or less (no condensation)		-20°C to +60°C 90% or less (no condensation)	-40°C to +70°C 90% or less (no condensation)	-30°C to +60°C 90% or less (no condensation)		-20°C to +60°C 90% or less (no condensation)			-40°C to +70°C 90% or less (no condensation)

Item		Performance and Applications							
		FT-ARR(60)	TNC-JP-2	TNC-JP-3	TNC-JP-5	7_16DIN-JPI-2000CTU	7_16DIN-JPI-1800CTU	N-JP-2000	BFX-NJ-2000
Applications		For CATV amps	Mobile telephone base stations, Wireless LAN antennae Various kinds of communication devices			Mobile telephone base stations			
Connector type		FT type	TNC type(P-J)			N type (P-J)			BFX20D/NJ
Frequency bandwidth		DC to 1GHz	DC to 3GHz			1920-2170MHz	1755-1880MHz	1940-2150MHz	1900-2200MHz
V.S.W.R		1.2 or less				1.3 or less		1.2 or less	1.15 or less
Insertion loss		0.2dB or less	0.3dB or less					0.1dB or less	
Impedance		75Ω	50Ω						
Permissible power		10W			60W	—		300W or less	
Voltage protection level		1.2kV or less	700V or less			—		10V or less	
DC sparkover voltage		DC 180V or more	DC 120V or more		DC 200V or more	—			
Impulse durability	Category C2 (8/20μs)	—							100kA
	Category D1 (10/350μs)	—							10kA
Impulse discharge current	8/20μs	10kA (1 time)			5kA (1 time)	30 kV(1.2/50μs)		50kA	—
Operating environmental conditions	Rated operating temperature Rated operating humidity	-20℃ to +60℃ 90% or less (no condensation)				-20℃ to +60℃ 90% or less (no condensation)	-10℃ to +60℃ 90% or less (no condensation)	-20℃ to +60℃ 90% or less (no condensation)	-40℃ to +85℃ 90% or less (no condensation)

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Explosion proof SPD

EX-P type (for power supplies)

IEC Class Ⅰ / Ⅱ compliant

Conforming standards

- Explosion proof certification No. TC19315 (only valid in Japan)
- IEC 61643-1compliant

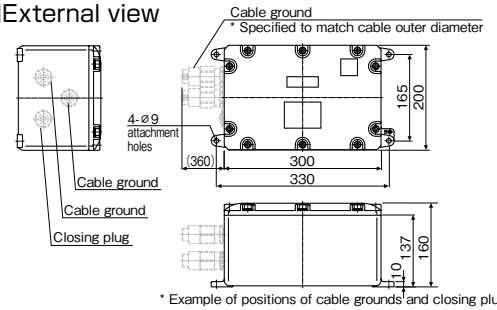
Features

- Used in explosion proof areas such as petro-chemical plants and heavy chemical engineering plants, etc.
- MZS-200AV series power supply SPD (IEC Class Ⅰ / Ⅱ compliant) mounted

Applications

- Used to protect AC 100V/200V, DC 100V power supply circuits in explosion proof areas
- Petro-chemical plants
- Petroleum storage facilities
- LPG gas facilities
- LNG plants
- Heavy chemical engineering plants

■External view



* Example of positions of cable grounds and closing plugs

Dimensions: W300×D200×H160 (mm)
Mass: 6.8 (kg)

■Characteristics

Item	Measurement conditions	Performance
Test class	IEC 61643-1	Class Ⅰ and Ⅱ
Maximum continuous operating voltage(Uc)	—	230V(50/60Hz)
Impulse current (Iimp)	10/350μs	25kA
Maximum discharge current (Imax)	8/20μs	100kA
Nominal discharge current (In)	8/20μs	20kA
Voltage protection level (Up)	—	1.5kV or less
Follow current shutoff rating	Uc=230V	50kA
Deterioration display	—	Concavo: normal; Convex: deteriorating
Warning contact output terminal	—	Yes
Operating environmental conditions	Rated operating temperature Rated operating humidity	-20℃~+60℃ 95% or less (no condensation)

EX-L [ ] type (for signaling)

IEC Category C2/D1 compliant

Conforming standards

- Explosion proof certification No. TC19314 (only valid in Japan)
- IEC 61643-1compliant

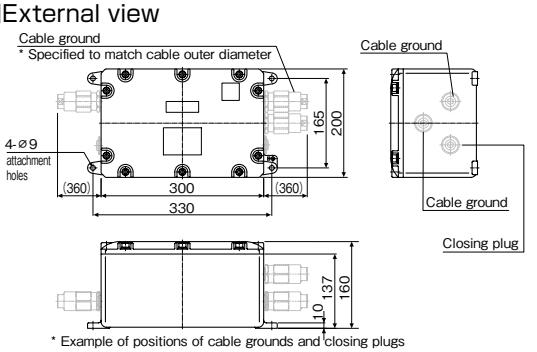
Features

- Used in explosion proof areas such as petro-chemical plants and heavy chemical engineering plants, etc.
- CLP-[ ] type communication signal SPD (IEC Category C2/D1 compliant) mounted

Applications

- Used for the protection of control circuits and communications signal circuits in explosion proof areas
- Petro-chemical plants
- Petroleum storage facilities
- LPG gas facilities
- LNG plants
- Heavy chemical engineering plants

■External view



* Example of positions of cable grounds and closing plugs

Dimensions: W300×D200×H160 (mm)
Mass: 6.7 (kg)

■Characteristics

Item	Measurement conditions	Performance				
		CLP-K2	CLP-N1	CLP-NM		CLP-H3(a,b,c,d)
Applicable circuit	—	Control circuit up to AC 110V	Transport line, measurement line, control circuits (for balanced circuits)			Applicable to 4-20 mA circuits and various circuit voltages (a=6V, b=12V, c=24V, d=48V)
Maximum continuous operating voltage (Uc)	—	DC180V	DC52V	DC170V		a DC9V b DC13.5V c DC27V d DC52V
Voltage protection level (Up)	1.2/50μs 10kV	1300V	900V	L-E	1000V	a 40V b 45V
				L-L	50V	c 60V d 90V
Impulse durability	Category C2 (8/20μs)	4kA (10 times)	5kA (10 times)	5kA (10 times)		10kA (10 times)
	Category D1 (10/350μs)	2kA (2 times)	2.5kA (2 times)	2.5kA (2 times)		5kA (2 times)
No. of SPD	Max. 6 can be mounted by a combination	Up to 4 in combination with K2, N1 and NM types				Up to 2 in combination with a-d type
Operating environmental conditions	Rated operating temperature Rated operating humidity	-20℃~+60℃ 95% or less (no condensation)				

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Explosion proof SPD

EX-[ ] P-[ ] type
(for communications)

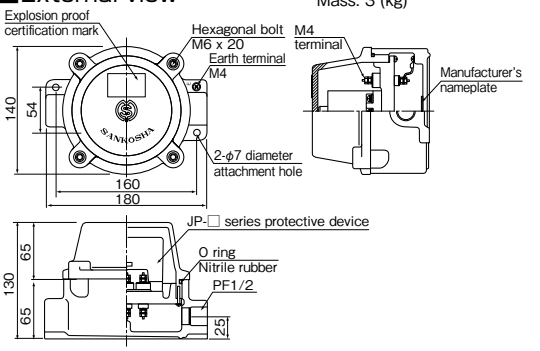
Conforming standards
- Explosion proof certification No. T51096 (only valid in Japan)

Features
- Used in explosion proof areas such as petro-chemical plants and heavy chemical engineering plants, etc.
- JP-[ ] type or AP-[ ] type protective device mounted

Applications
- Used for the protection of information lines, such as communication and control cables, in explosion proof areas
- General public telephone lines
- DC and AC power supply co-axial lines
- All circuits other than unbalanced circuits
- Multi-circuit multiplex lines
- Telemeter lines, etc.

Dimensions: W180×H130×φ140 (mm)
Mass: 3 (kg)

■External view



EX-SN-[ ] type
(for communications)

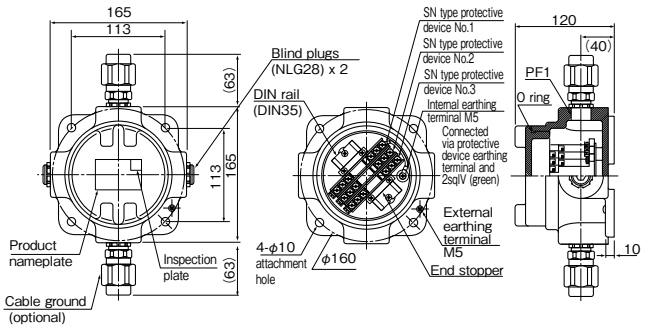
Conforming standards
- Explosion proof certification No. TC16896 (only valid in Japan)

Features
- Used in explosion proof areas such as petro-chemical plants and heavy chemical engineering plants, etc.
- SN-[ ] type protective device mounted

Applications
- Used for the protection of information lines, such as communication and control cables, in explosion proof areas
- General public telephone lines
- ADSL lines
- Telemeter lines
- RS422 circuits, RS485 circuits
- Transfer lines, measurement lines, control circuits, etc.

Dimensions: W165×D165×H120 (mm)
Mass: 4 (kg)

■External view



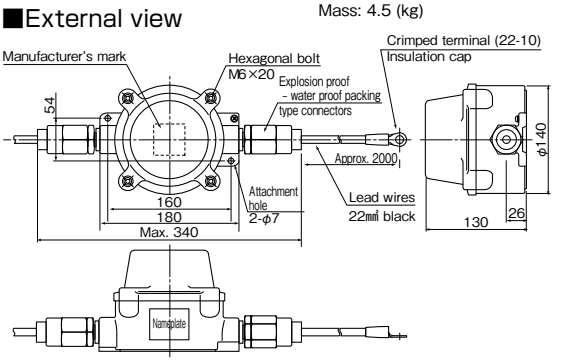
EX-Y49-450 type

Features
- Used in explosion proof areas such as gas facilities, etc.
- Y49-450 type protective device mounted

Applications
- Used for the protection of insulation couplings on pipelines, etc.

Dimensions: W180×D130×φ140 (mm)
Mass: 4.5 (kg)

■External view



■Characteristics

Item	Measurement conditions	Performance
DC sparkover voltage	100V/S	450V±90V
Impulse protection level	10/200μs, 3kV	1.5 kV or less
AC discharge current	5kA, 0.1s, 1 time	No destruction after powering ON
Impulse discharge current	8/20 μs, 100 kA, 1 time	No destruction after current applied

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MZG-EB type

Conforming standards
- RoHS compliant

Features
- Impulse current up to 100kA (direct strike waveform 10/350 μs)
- DIN rail mountable (35 mm)

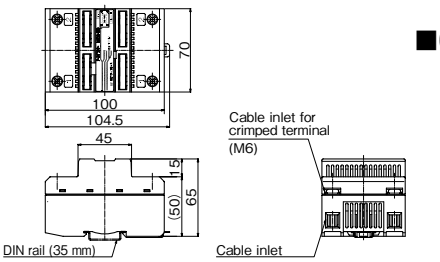
Applications
- Earth equipotentialization (eliminates electropotential difference)

Dimensions: W70×D100×H65 (mm)
Mass: 490 (g)

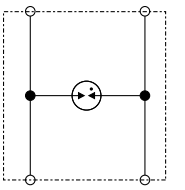
■Characteristics

Item	Measurement conditions	Performance
Impulse current (Iimp)	10/350μs	100kA
Nominal discharge current (In)	8/20μs	20kA
DC sparkover voltage	500V/s	700±160V
Insulation resistance	DC250V	100MΩ or more
Voltage protection level (Up)	Based on IEC	1.5kV

■External view



■Circuit diagram



MZS-EB type

Conforming standards
- RoHS compliant

Features
- Corresponds to IEC Class Ⅰ test
- Impulse current up to 75 kA (direct strike waveform 10/350 μs)
- DIN rail mountable (35 mm)

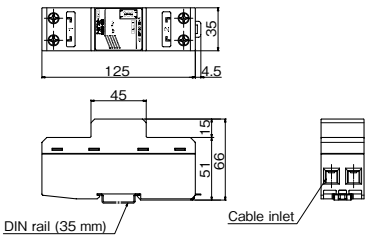
Applications
- Earth equipotentialization (eliminates electropotential difference)

Dimensions: W35×D125×H66 (mm)
Mass: 300 (g)

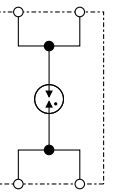
■Characteristics

Item	Measurement conditions	Performance
Impulse current (Iimp)	10/350μs	75kA
Nominal discharge current (In)	8/20μs	20kA
Leak current (I_{PE})	DC360V	20 μA or less
Voltage protection level (Up)	Based on IEC	1.5kV

■External view



■Circuit diagram



MZCR-EB type
MZCR-EBN type

Conforming standards
- RoHS compliant

Features
- Corresponds to IEC Class Ⅱ test
- Impulse current up to 10 kA (direct strike waveform 10/350 μs)
- DIN rail mountable (35 mm)
- Round type crimped terminal for M4 (width less than 12 mm) (EBN type)

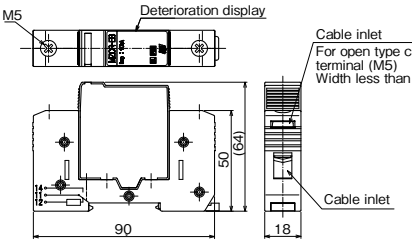
Applications
- Earth equipotentialization (eliminates electropotential difference)

Dimensions: W18×D90×H64 (mm)
Mass: 115 (g)

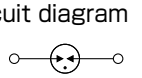
■Characteristics

Item	Measurement conditions	Performance
Impulse current (Iimp)	10/350μs	10kA
Nominal discharge current (In)	8/20μs	60kA
Insulation resistance	DC500V	100MΩ or more
Voltage protection level (Up)	Based on IEC	1kV

■External view



■Circuit diagram



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MZCR-S110 type
MZCR-S220 type
MZCR-S380 type
MZCR-S60 type

IEC Class Ⅱ compliant

(MZCR-S220 type) Dimensions: W36×D10 2×H64 (mm)
Mass: 250 (g)

Conforming standards

- IEC 61643-1 - IEC 62305-4
- RoHS compliant
- CRCC approved (TB/T2311-2008,TB/T3074-2003)

Features

- Discharge current up to 40kA (induced lightning waveform 8/20μs)
- Deterioration display function mounted (warning contact output terminal attached)
- Plug-in type
- DIN rail mountable (35mm)
- Round type crimped terminal for M4 (width less than 12mm)

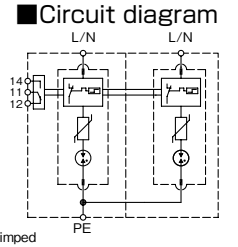
Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC60V/AC220V/AC380V)
- Power supply circuits in control equipment (AC60V/AC220V/AC380V)

■Characteristics

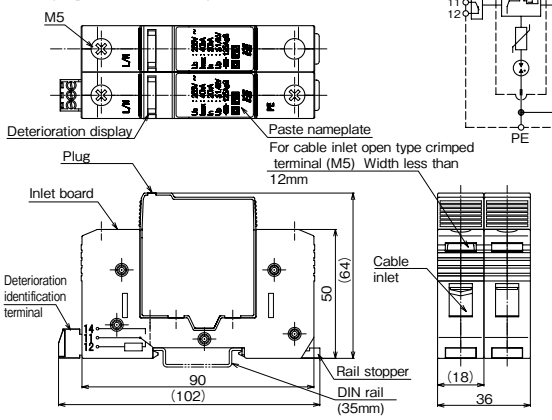
Item	Measurement conditions	Performance			
		MZCR-S110	MZCR-S220	MZCR-S380	MZCR-S60
Maximum continuous operating voltage (50/60Hz) (Uc)	—	AC130V	AC275V	AC420V	AC75V
Maximum discharge current (Imax)	8/20μs	40kA			
Nominal discharge current (In)	8/20μs	20kA			
Voltage protection level (Up)	Based on IEC	1.0kV or less	1.5kV or less		700V or less

■Circuit diagram



■External view

(E.g.: MZCR-S220)



MZPW-S275 type
MZPW-S385 type
MZPW-S75 type

IEC Class Ⅱ compliant

(MZPW-S275 type) Dimensions: W36×D102×H64 (mm)
Mass: 250(g)

Conforming standards

- IEC 61643-1 - IEC 62305-4 compliant
- RoHS compliant
- CRCC approved (TB/T2311-2008,TB/T3074-2003)

Features

- Discharge current up to 40kA (induced lightning waveform 8/20μs)
- Deterioration display function mounted (warning contact output terminal attached)
- Plug-in type
- DIN rail mountable (35mm)
- Round type crimped terminal for M4 (width less than 12mm)

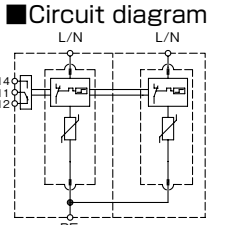
Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC60V/AC220V/AC380V)
- Power supply circuits in control equipment (AC60V/AC220V/AC380V)

■Characteristics

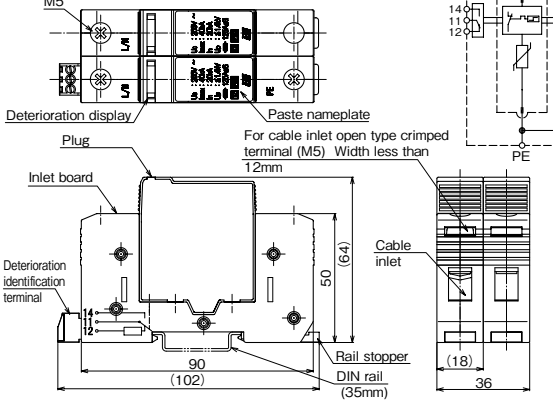
Item	Measurement conditions	Performance		
		MZPW-S275	MZPW-S385	MZPW-S75
Maximum continuous operating voltage (50/60Hz) (Uc)	—	AC275V	AC385V	AC75V
Maximum discharge current (Imax)	8/20μs	40kA		
Nominal discharge current (In)	8/20μs	20kA		
Voltage protection level (Up)	Based on IEC	1.0kV or less	1.5kV or less	700V or less

■Circuit diagram



■External view

(E.g.: MZPW-S275 type)



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MZCR-P220 type
MZCR-P380 type
MZCR-P24 type

IEC Class Ⅱ compliant

Conforming standards

- IEC 61643-1 - IEC 62305-4 compliant
- RoHS compliant
- CRCC approved (TB/T2311-2008,TB/T3074-2003)

Features

- Discharge current up to 40kA (induced lightning waveform 8/20μs)
- Deterioration display function mounted (warning contact output terminal attached)
- Plug-in type
- DIN rail mountable (35mm)
- Round type crimped terminal for M4 (width less than 12mm)

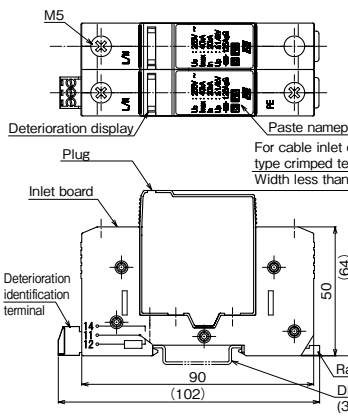
Applications

- Low voltage power supply circuits in switchboards and distribution boards (AC60V/AC220V/AC380V)
- Power supply circuits in control equipment (AC60V/AC220V/AC380V)

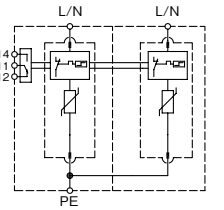
MZCR-P220 type

(MZCR-S220) Dimensions: W36×D102×H64 (mm)
Mass: 250 (g)

■External view
(E.g.: MZCR-P220 type)



■Circuit diagram



■Characteristics

Item	Measurement conditions	Performance		
		MZCR-P220	MZCR-P380	MZCR-P24
Maximum continuous operating voltage (50/60Hz) (Uc)	—	AC275V	AC510V	DC38V
Maximum discharge current (Imax)	8/20μs	40kA		10kA
Nominal discharge current (In)	8/20μs	20kA		1.5kA
Voltage protection level (Up)	Based on IEC	1.5kV or less	1.8kV or less	220V or less

Protective devices
A1 type
D1 type
D2 type

These protective devices are used to protect communication lines and devices in railroad plant and equipment from abnormal voltage due to lightning surge. The cable connection uses LSA-PLUS terminals, which have excellent workability and enable high density mounting. The protective devices are detachable in single line units.

D1 type

■Characteristics

Item	Performance		
	A1	D1	D2
Main applications	Analog line Protection of crossbar telephone switchboards and telephone equipment	Digital line Protection of EPBX and terminal equipment	Digital line Protection of PCM
Frequency bandwidth	DC to 200kHz	DC to 400kHz	DC to 2MHz
Working attenuation	1.0dB or less		
Crosstalk attenuation	70dB or more		
DC resistance	6.5Ω±20%	15Ω±20%	6Ω±20%
DC sparkover voltage	350V±70V		
Impulse protection level (10/200μs, 3kV applied)	800V or less		
Impulse discharge current (repeat)	10/200μs, 200A, 100 times		
AC life	AC10A, 0.1s, 10 times		
Insulation resistance	100MΩ or more at DC100V		
Dimensions (mm)	W9.4×D24×H51	W9.4×D26×H77	
Mass (g)	20		

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Protective devices (For signaling) S100 type S200 type S24-A type S24-B type

These protective devices use hermetic button type high performance 3-electrode ceramic arresters in combination with high quality ZNR varistors. They are compact but robust, and provide excellent surge protection along with good current withstand capacity.


S100 type
S100PJ-E type (Plug and Jack type)
S100PJ-T type (Plug and Jack type)
S200 type
S24-A type
S24-B type

Features

●Design registered: S100PJ type

■Characteristics

Item	Performance							
	S100	S100PJ-E	S100PJL	S100PJ-T	S200	S200PJ-E	S200PJL	S200PJ-T
Applications	AC circuit power supplies / Level crossing controllers (incl. H type)							
Rated circuit voltage	AC100V				AC200V			
Maximum permissible circuit voltage	AC210V,DC225V				AC255V			
Impulse protection level	750V or less (10/200μs, 3kV applied)				800V or less (10/200μs, 3kV applied)			
Impulse discharge current (repeat)	10/200μs, 800A, 300 times at 3 minute intervals							
Plug and Jack	—	○			—	○		
Deterioration display	—	○	—	○	—	○	—	○
Dimensions (mm)	W105×D60×H60	W60×D95×H70.5		W95×D60×H71	W105×D60×H60	W60×D95×H70.5		W95×D60×H71
Mass (g)	280	350		310	280	350		310

Item	Performance					
	S24-A	S24APJL	S24APJ-E	S24-B	S24BPJL	S24BPJ-E
Applications	DC circuits, Power supplies			DC circuits, General use		
Rated circuit voltage	DC24V			DC24V, Power supply circuit resistance: 10Ω or more		
Maximum permissible circuit voltage	DC35V			DC35V, Power supply circuit resistance: 10Ω or more		
Impulse protection level	750V or less (10/200μs, 3kV applied)					
Impulse discharge current (repeat)	10/200μs, 800A, 300 times at 3 minute intervals					
Plug and Jack	—	○		—	○	
Deterioration display	—		○	—		○
Dimensions (mm)	W105×D60×H63.5	W60×D95×H70.5		W105×D60×H63.5	W60×D95×H70.5	
Mass (g)	450	350		450	350	

Protective devices for power supplies (For AC480V) S480-S type

These protective devices protect equipment from irregular voltage caused by lightning surges, etc., occurring between lines in AC480V power supply circuits.

■Characteristics

Item	Performance
Rated circuit voltage	AC480V
Maximum permissible circuit voltage	AC550V
Impulse protection level	2kV or less (10/200μs, 3kV applied)
Impulse discharge current (repeat)	10/200μs, 500A, 200 times at 3 minute intervals


S480-S type

Dimensions: W105×D65×H60(mm)
Mass: 450(g)

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Protective devices for power supplies of level crossing equipment
F type
FN type

These protective devices are for use with the power supplies of level crossing equipment and are a combination of a rectifier input AC100V power supply and a DC24V protective device. The AC side has the same element configuration as the S100 type. The DC side comprises a B terminal connecting to a battery, an L terminal outputting externally to the level crossing control system, signal flares, etc., the intermittent relay of the device mounted in the instrument chassis, and an M terminal connecting to the alarm generator, etc.

Features

●Design registered: FN-PJ type

Applications

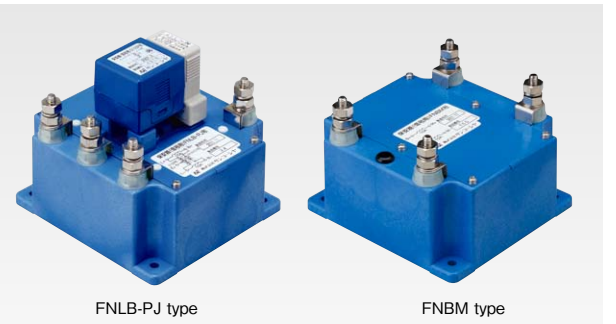
●Level crossing equipment power supplies (AC and DC)

■Characteristics

Item		Performance				
		F	FN	FN-PJ	FN-PJ-T	FNPJ-E
Rated circuit voltage	For AC	AC100V				
	For DC	DC24V				
Permissible circuit voltage	For AC	AC210V				
	For DC	DC225V				
DC inductance		1.5mH or more				
AC rated current		5A	10A			
Impulse protection level		750V or less (10/200μs, 3kV applied)				
Impulse discharge current (repeat)		10/200μs, 800A, 300 times at 3 minute intervals				
Plug and Jack		—		○		
Deterioration display		—			○	
Dimensions (mm)		W120×D250×H58.5	W250×D120×H130	W120×D154×H120		
Mass (kg)		2.5	5.4	3.7		

FNLB-PJ type (For external lines)
FNBM type (For internal lines)

These protective devices for level crossing equipment power supplies are available in F type and FN type. In recent years, the most common method of protecting AC power supplies is to use lightning transformers, with the result that AC power supply protective devices have become obsolete, and the protective device generally consists of a DC power supply unit only. Also, DC power supplies can be split into external line use and internal line use, making wiring separation easier. This means that increased power supply capacity in the instrument chassis can be covered by adding the internal line use FMBM type devices only.



Features

●Design registered: FNLB-PJ type, FNBM type

Applications

●For external line 10A use (FNLB-PJ type)
●For internal line 10A use (FNBM type)

■Characteristics

Item	Performance	
	FNLB-PJ	FNBM
Rated circuit voltage	DC24V	
Permissible circuit voltage	DC225V	
DC inductance	1.5mH or more	
AC rated current	10A	
Impulse protection level	750V or less (10/200μs, 3kV applied)	—
Impulse discharge current (repeat)	200μs, 800A, 300 times at 3 minute intervals	—
Plug and Jack	○	—
Dimensions (mm)	W120×D130×H112	W120×D130×H90

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Protective devices for level crossing control systems
S111 type
S112 type
S1112 type

●S111 type

These devices are used as lightning protection for open track circuits of railroad signal level crossing control systems (HO type). They are united and compact protective devices that have the same performance as the protective devices that conventionally exist separately on the DC 26V power supply, on the track and on the relay output.

●S112 type

These devices are used as lightning protection for closed track circuits of railroad signal level crossing control systems (HC type). They are united and compact protective devices that have the same performance as the S200 type protective device (for signaling) that conventionally exists separately on the AC 200V, 400Hz power supply side, the S100 type that is used on the track, and the S100 and S200 types that are used on the relay outputs.

●S1112 type

The S1112 type is a S112 type protective device (arrester) that has an additional track circuit protection element, making it a four element unit.

Features

●Design registered: S111 type, S112 type

■Characteristics(S112 type)

Item		Performance			
		S112	S112-PJ	S112PJL	S112PJ-E
Circuits		100V×2, 200V×1			
Rated circuit voltage	For 100V	AC100V at each circuit			
	For 200V	AC200V (50-400Hz)			
Permissible terminal voltage	For 100V	AC210V at each circuit			
	For 200V	AC255V (50-400Hz)			
Impulse protection level	For 100V	750V or less at each circuit (10/200μs, 3kV)			
	For 200V	800V or less (10/200μs, 3kV)			
Impulse discharge current (repeat)		10/200μs, 800A, 300 times at 3 minute intervals fort each circuit			
Plug and Jack		—	○		
Deterioration display		—	○	—	○
Dimensions (mm)		W125×D60×H45	W132×D64×H68	W132×D60×H68	
Mass (g)		370	700		

■Characteristics (S111 type)

Item	Performance			
	S111	S111-PJ	S111PJL	S111PJ-E
Circuits	100V×3			
Rated circuit voltage	AC100V at each circuit			
Permissible terminal voltage	AC210V at each circuit			
Impulse protection level	750V or less at each circuit (10/200μs, 3kV)			
Impulse discharge current (repeat)	10/200μs, 800A, 300 times at 3 minute intervals for each circuit			
Plug and Jack	—	○		
Deterioration display	—	○	—	○
Dimensions (mm)	W125×D60×H45	W132×D64×H68	W132×D60×H63	
Mass (g)	370	700		

■Characteristics (S1112 type)

Item		Performance		
		S1112	S1112PJL	S1112PJ-E
Citcuits		100V×3, 200V×1		
Rated circuit voltage	For 100V	AC100V at each circuit		
	For 200V	AC200V (50-400Hz)		
Permissible terminal voltage	For 100V	AC210V at each circuit		
	For 200V	AC255V (50-400Hz)		
Impulse protection level	For 100V	750V or less at each circuit (10/200μs, 3kV)		
	For 200V	800V or less (10/200μs, 3kV)		
Impulse discharge current (repeat)		10/200μs, 800A, 300 times at 3 minute intervals for each circuit		
Plug and Jack		—	○	
Deterioration display		—		○
Dimensions (mm)		W148×D60×H45	W177×D60×H68	
Mass (g)		390	850	

WAGO terminal protective devices
WP-K [ ] type
WP-K [ ]-[ ] type

The device mounts onto a main wiring board of the WAGO spring module and protects the equipment from abnormal voltage induced into the power supply circuits, etc.

■Characteristics

Item	Performance			
	WP-K1	WP-K2	WP-K1-2	WP-K2-2
Lines	1	2	1	2
Rated circuit voltage	AC110V, DC150V		AC200V	
Maximum permissible circuit voltage	AC240V, DC225V		AC275V, DC350V	
Impulse protection level	800V or less (10/200μs, 3kV applied)		1kV or less (10/200μs, 3kV applied)	
DC sparkover voltage	280V or more		550V±110V	
Clamping voltage	500V or less (10/200μs, 200A)		900V or less (10/200μs, 200A)	
Dimensions (mm)*	W50×D15×H50	W50×D25×H50	W50×D15×H50	W50×D25×H50
Mass (g)	25	42	26	42

* Excluding insert terminals

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Protective devices for electronic level crossing units

T-24 type
T-24A type
T-200 type
T-200A type
T200-E type
T200-AE type

These devices are installed between the electronic equipment and field equipment of electronic level crossing units, etc., and can be installed directly onto terminal boards in order to protect electronic equipment from lightning surges entering the cables.

Features

●Patented

■Characteristics

Item	Performance					
	T-24	T-24A	T-200	T-200A	T200-E	T200-AE
Terminal block JS [ ] type	○	—	○	—	○	—
Arrester terminal board (for terminal block)	○	—	○	—	○	—
For FT terminal block	—	○	—	○	—	○
Deterioration display	—				○	○
Nameplate color	Blue		Red		White	
Rated circuit voltage	DC24V		DC200V		DC200V AC200V	
Maximum permissible circuit voltage	AC65V		AC350V		DC350V(AC245V)	
DC sparkover voltage	350V±20% (100V/s)		470V±20%(100V/s)			
Impulse sparkover voltage	750V or less (10/200μs, 3kV)		800V or less (10/200μs, 3kV)			
Clamping voltage	150V or less (10/200μs, 200A)		900V or less (10/200μs, 200A)			
Maximum impulse discharge current	10/200μs - 1kA, 1 or more times					
Impulse discharge current (repeat) (DC sparkover voltage after a test)	10/200μs, 200A, 50 or more times at 1 minute interval (350V±25%)		10/200μs, 200A, 50 or more times at 1 minute interval (470V±25%)			
Insulation resistance (between terminals)	100MΩ or more at DC100V				100MΩ or more at DC250V	
Dimensions (protective devices only) (mm)	W11.4×D37×H44	W24×D52.5×H30.5	W11.4×D37×H44	W24×D52.5×H30.5	W11.4×D37×H44	W24×D52.5×H30.5
Mass (g)	20	25	20	25	20	25

Protective devices S-K2-1W type

This protective device for power supply circuits features protection for two lines in a single set, and this single unit can be used to provide protection for the AC100V line and the DC24V line.

Features

●Patented

■Characteristics

Item		Performance (per line)
Rated circuit voltage	AC (50/60Hz) effective value	110V
	AC	150V
Maximum permissible circuit voltage	AC (50/60Hz) wave peak	260V
	DC	225V
DC sparkover voltage		280V or more
Impulse protection level (L1-E, L2-E)		800V or less (10/200μs, 3kV applied)
Clamping voltage (L1-E, L2-E)		500V or less (10/200μs, 200A applied)
Line residual voltage (10/200μs, 3kV applied)		400V at 1μs, 200V or less at 300μs
Impulse discharge current (repeat)		10/200μs, 400A, 50 times
Maximum impulse discharge current		10/200μs, 1kA

Dimensions: W80×D45×H25(mm)
Mass: 80 (g)

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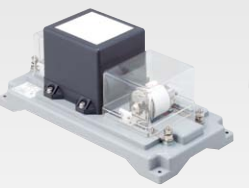
For Shinkansen signaling Unit type protective devices UP- [ ] type

These protective devices are used to protect Shinkansen ATC track circuits from abnormal voltage due to lightning surge.

UP-11K type
UP-11S type
UP-11SN type



UP-11CN type
UP-41 type
UP-41E type
UP-41W type
UP-41WN type

UP-3CN type
UP-3K type
UP-43 type
UP-43W type
UP-43WN type

■Characteristics

Item	Performance							
	UP-11CN	UP-11K	UP-11S	UP-11SN	UP-41	UP-41E	UP-41W	UP-41WN
Frequency characteristics	0.5-1.7kHz	0.5-1.0kHz	0.5-1.5kHz	0.5-1.7kHz	0.5-1.5kHz			
Operating level	40dBm×2 waves	40dBm×4 waves	40dBm×2 waves	40dBm×2 waves+46dBm	40dBm×4 waves			
Impedance ratio	600Ω: 270Ω	200Ω: 460Ω	600Ω: 350Ω	600Ω: 270Ω	600Ω: 350Ω			600Ω: 460Ω
Dimensions (mm)	W350×D170×H150	W190×D120×H180	W190×D120×H160	W190×D120×H180	W350×D170×H140		W350×D170×H150	
Mass (kg)	6.5	5.5	4.3	5.5	5.8			6.5

Item		Performance				
		UP-3CN	UP-3K	UP-43	UP-43W	UP-43WN
Frequency characteristics		0.5-1.5kHz				
Operating level	For transmission	40dBm×2 waves		40dBm×2 waves+43dBm	43dBm	40dBm×2 aves+43dBm
	For receiving	34dBm		34dBm×2 waves+40dBm	34dBm	34dBm×2 waves+40dBm
Impedance ratio	For transmission	18Ω: 270Ω, 28Ω: 270Ω, 38Ω: 270Ω				
	For receiving	100Ω: 350Ω				
Dimensions (mm)		W250×D170×H120				
Mass (kg)		4.6				

Protective devices for track circuits ST-[ ] type

These protective devices are used to provide protection for signaling cables and devices against abnormal voltage applied to track circuits.

ST-200 type
ST-300 type

ST-400 type
ST-500 type

ST-2500 type

■Characteristics

Item	Performance				
	ST-200	ST-300	ST-400	ST-500	ST-2500
Applications	Track circuits (excl. AF track circuits)	AF track circuits (excl. equipment concentration type)	AF track circuits (equipment concentration type)	100Hz, AF overlay track circuits (equipment concentration type)	Single track circuits
Discharge spark-over voltage	DC290V±50V	DC490V±70V	DC550V±100V	DC700V±100V	AC2-3kV
Impulse protection level	750V or less (10/200μs - 3kV applied)	800V or less (10/200μs - 3kV applied)	1.4kV or less (10/200μs - 3kV applied)	1.6kV or less (10/200μs - 3kV applied)	—
Repeat current withstand capacity	AC50A, 0.1s, 20 times at 3 minute intervals 10/200μs - 400A, 300 times at 3 minute interval		AC20A, 80s, 30 times at 10 minute intervals		Short circuit at AC2kA, 0.2s applied
Dimensions (mm)	W100×D20×H67		W60×D120×H73.5		ϕ48×180 (Length 1800: incl. lead wire)
Mass (g)	150		560		1300

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Protective devices for track circuits SW-300E type

These protective devices have a built-in deterioration display and are used for the protection of track circuits and power supply circuits, etc., from abnormal voltage caused by lightning surges, switching surges, etc.


SW-300E type

Dimensions: W100×D20×H80(mm)
Mass: 80(g)

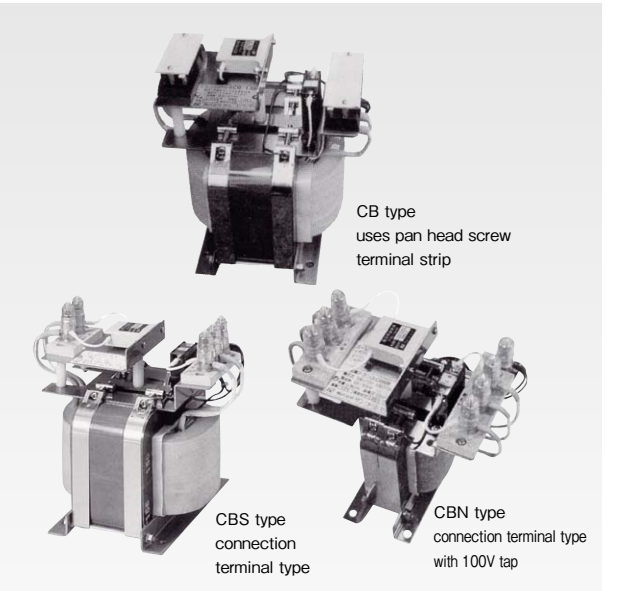
■Characteristics

Item	Performance
DC sparkover voltage	490±70V
Impulse sparkover voltage	800V or less (10/200μs, 3kV applied)
Clamping voltage	10/200μs, 200A, 725V or less (after 10μs)
Maximum impulse discharge current	10/200μs - 3kA
Impulse discharge current (repeat)	10/200μs, 500A, 200 times
DC sparkover voltage after an impulse life test	490±115V
Withstand voltage (each terminal to fitting)	AC7kV for 1 minute
Insulation resistance (L to E terminal and each terminal to fitting)	100MΩ or more (at DC250V)

Lightning transformer fitted with noise countermeasures, surge transfer rate 1/1000 or less

Clean barrier CB type CBS type CBN type

ME equipment is used in railway signaling CTC devices, signaling equipment such as electronic interlocking device ATS-P devices, electronic level crossing devices and other level crossing plant and equipment. These devices are lightning transformers with protective devices for inter-line protection, and also featuring high voltage shields, and are used to protect against lightning surge coming from the power supplies of such ME equipment, as well as avoiding the shutdown of machinery due to noise from the power supplies, and are highly effective in improving system reliability.


CB type
uses pan head screw
terminal strip

CBS type
connection
terminal type

CBN type
connection terminal type
with 100V tap

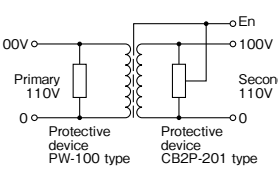
Features

- Utility model registration: Clean barrier CB type, CBS type, CBN type
- Lightning transformer fitted with noise countermeasures, surge transfer rate 1/1000 or less

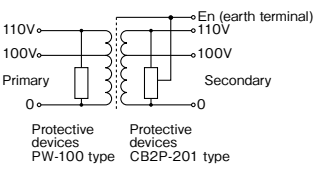
■Characteristics

Item		Performance
Capacity		0.75-20kVA
Frequency		50/60Hz
Withstand voltage	Impulse from primary to secondary and from primary to shield	1.2/50μs, 30kV, AC10kV for 1 minute
	Secondary to shield	AC3kV for 1 minute
Voltage ratio	CB,CBS	110V: 110V
	CBN	110V,100V: 110V,100V
Voltage fluctuation rate		5% or less
No. of phases		Single
Electrostatic shield		Provided
VA efficiency		90% or more
Insulation class		Class B
Limit of temperature rise		55℃ or less (ambient temperature 60℃)
Surge conversion rate		1/1000 or less
Insulation resistance	Primary to secondary and primary to shield, secondary to shield	100MΩ or more at DC100V

■Circuit diagram



CB type, CBS type



CBN type

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Protective devices for obstruction warning indicators TH-V5A-390 type

These protective devices can provide protection from abnormal voltage due to lightning surge, etc., for between two to four railway obstruction warning indicator controllers.

TH-V5A-390 type

Dimensions:W94×D50×H40(mm)
Mass:150(g)

■Characteristics

Item			Performance
Maximum permissible circuit voltage (B24 to C24 terminal)			DC31V
Protection level	Varistor C24 to B24 terminal, Between terminals 01, 02, 03, 04	Varistor voltage Current 1mA	39 (35~43) V
		Clamping voltage Current 20A	80V or less
		Maximum impulse discharge current	1 time at 8/20μs, 2kA (1 time at 200μs, 450A)
		Change in varistor voltage after a test	within ±10%
	Arrester tubes C24 to E terminal	DC sparkover voltage	1.1kV±220V
		Impulse sparkover voltage 10/200μs, 3kV applied	2kV or less
		Impulse discharge current (repeat)	10/200μs, 500A (for 1 minute), 200 times
		DC sparkover voltage after a test	1.1kV±300V
		Impulse discharge current withstand capacity	1 time at 10/200μs, 10kA
Withstand voltage		Each terminal to protective device mounting bracket	AC3kV (for 1 minute)

Lightning transformer for transmission circuits SU10L [ ] type SU10H [ ] type

These protective devices are used to provide protection for all kinds of equipment against abnormal voltage and current due to lightning surge, etc., applied across communication transmission circuits and the like.

SU10L「 」type

■Characteristics

Item	Performance					
	SU10L33	SU10L36	SU10L66	SU10H33	SU10H36	SU10H66
Impedance ratio	370Ω:370Ω	370Ω:600Ω	600Ω:600Ω	370Ω:370Ω	370Ω:600Ω	600Ω:600Ω
Operating frequency bandwidth	0.3-5kHz			1-20kHz		
Max. operating level	25dBm					
Working attenuation	0.5dB or less					
Withstand voltage	AC10kV, 1 minute, Impulse 1.2/50μs, 30kV					
Dimensions (mm)	W138×D48×H95					
Mass (g)	600					

Relay connectors with built-in protective devices

These are relay connectors with built-in protective devices, used in the connectors of cable connections as part of railway signaling equipment ATS-P ground antenna for its induced lightning countermeasures. Protective devices (Sankosha AV-11 type) is mounted inside of railway signaling waterproof relay connectors (JK3J G08PSH) made by Japan Aviation Electronics Industry.

■Characteristics

Item		Performance
DC sparkover voltage		400V±100V
Impulse sparkover voltage at 10/200μs, 3kV		800V or less
Clamping voltage at 10/200μs, 200A		550V or less
Impulse discharge current (repeat)		10/200μs, 200A, 50 times
Maximum impulse discharge current		10/200μs, 500A
Conduction between socket and pin	Core 1# and 5#	Conducted
Withstand voltage	Each pin to shell	AC1.5kV for 1 minute

Dimensions:φ40×150(mm)
Mass:250(g)

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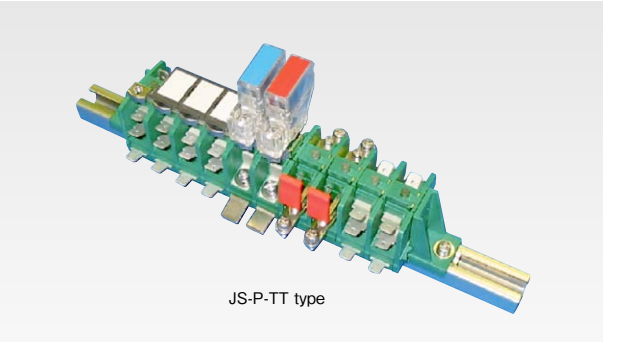
Terminal strips for signaling equipment chassis JS-[ ] type

Features

- Terminal strips with various functions are mounted on the same relay, enabling replacement and expansion core by core.
- Terminal types can be varied core by core.
- Retaining terminals used for better operability and the prevention of mis-wiring during line testing (retaining terminals for crimped and tab terminals)
- Using attachment rail and earth bars together for effective operability. Jointly produced with East Japan Railway Company.

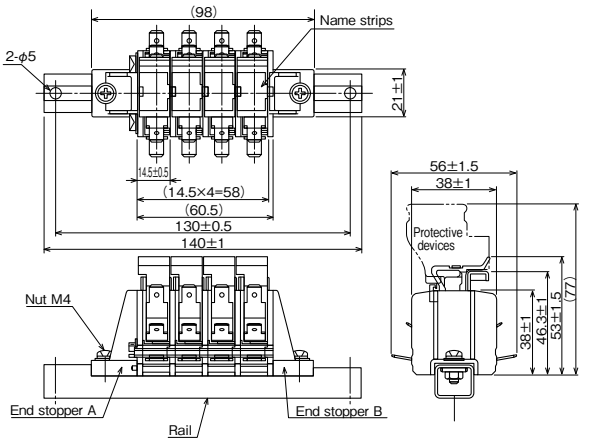


JS-P-TT type

■Types

Type	Terminal shape Figures in parentheses ( ) show number of terminals
JS-TT	tab (2) -tab (2)
JS-P-TT	tab (1) -tab (2)
JS-P-NT	screw (1) -tab (2)
JS-P-NN	screw (1)-screw (1)

■External view (JS-P-TT type)



■Characteristics

Item	Performance
Insulation resistance	10,000MΩ or more at DC500V
Withstand voltage	AC5kV applied for 1 minute
Impulse withstand voltage	1.2/50μs 6kV Positive and negative applied 3 times each
Rated insulation voltage	AC600V
Rated applicable wire	3.5㎟ or less (30A or less)

Protective devices for signal transmission circuits TS33S type TS36S type TS66S type

These devices are used as lightning surge countermeasures to protect the transmission branches of railway signaling CTC, temporary speed limiting apparatus, level crossing centralized monitoring devices, electronic blocking devices and other ME signaling equipment.

TS66S type

TS36S type

Dimensions: W110×D32×H57 (mm)
Mass: 260 (g)

■Characteristics

Item	Performance	
	Used as a discharge type	Used as an insulation type
Transmission frequency range	0.3-10kHz	
Signal level	20 dBm	
Impedance ratio (Track : Equipment)	(TS33S type) 370Ω: 370Ω	
	(TS36S type) 370Ω: 600Ω	
	(TS66S type) 600Ω: 600Ω	
Working attenuation	0.5dB or less (0.3-10kHz)	
DC sparkover voltage	280V or more	
Impulse protection level	Between earths/lines 50V or less at 10/200μs, 3kV applied	
AC protection level	Between earths/lines 50V or less at 50/60Hz, 500V applied	
Impulse discharge current (repeat)	400A (10/200μs), 100 times	
Maximum impulse discharge current	5kA (10/200μs)	
AC repeat current withstand capacity	20A, 0.1s (50/60Hz), 10 times	
AC current withstand capacity	20A, 1s (50/60Hz)	
Withstand voltage	Equipment to earth, Each terminal to mounting bracket AC (50/60Hz), 3kV for 1 minute	Equipment to earth, Each terminal to mounting bracket Track circuit to equipment AC (50/60Hz), 3kV for 1 minute

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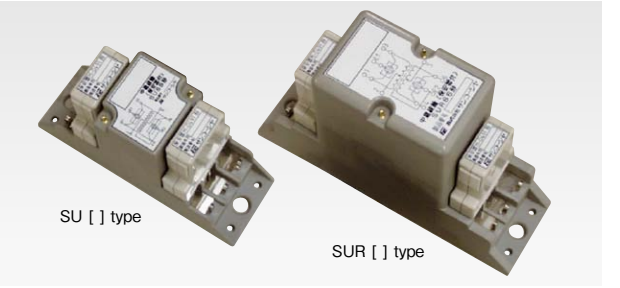
Relay coil
SU [ ] type
SUR [ ] type

This relay coil comes with protective device attached and is installed between communications equipment and between tracks in order to provide impedance adjustment and to mitigate the effects of induced voltage. The device protects humans and equipment from abnormal voltage that may be induced onto tracks of the relay coil.


SU [ ] type
SUR [ ] type

■Characteristics

Item		Performance					
		SU33 SUR33	SU36 SUR36	SU314 SUR314	SU66 SUR66	SU614 SUR614	SU1414 SUR1414
Transmission frequency		0.3-3.4kHz					
Impedance ratio (Ω) (terminals 1-3, 4-6)		370: 370	370: 600	1400: 370	600: 600	1400: 600	1400: 1400
Working attenuation		0.5dB or less (0.3-3.4kHz, test level 0dBm)					
Attenuation mismatch		15dB or more (0.3-3.4kHz, test level 0dBm)					
Winding unbalance voltage attenuation		80dB or more (1kHz)					
16Hz attenuation *Note: SUR [ ] type only		1.5dB or less [45V voltage applied per 600Ω on (1-2-3) terminal side, 2kΩ per 600Ω termination on the (4-5-6) terminal side]					
Core non-linear distortion Test frequency 1kHz	Test voltage (V)	3.9(±1%)			5(±1%)		7.7(±1%)
	Distortion attenuation (dB)	45.5 or more			50 or more		57.5 or more
Static capacity unbalance rate	(1-2-3-) terminals	100pF or less (test frequency 1kHz, non-measured terminal not earthed)					
	(4-5-6) terminals	100pF or less (test frequency 1kHz, non-measured terminal not earthed)					
Insulation resistance	(1-2-3)-(4-5-6) terminals	100MΩ or more (DC250V)					
	(1-2-3)-E terminals						
	(4-5-6)-E terminals						
Withstand voltage	(1-2-3)-(4-5-6) terminals	AC (50/60Hz) 750V (effective value) for 1 minute					
Protective devices mounted	(1,3)-E terminals	Protective device M-D491 type (for 36 and 614, no protective device between (4.6) and E terminal)					
	(4,6)-E terminals						
Dimensions (mm)		SU: W138×D48×H95 SUR: W180×D54×H126					
Mass (kg)	SU	0.6					
	SUR	2.0					

Insulation transformer (lightning proof type)
300S type

These are insulation transformers that are used for transmitting stations for approach warning systems of railway signaling TC type train, and feature the ability to protect primary side devices against lightning surges (reverse withstand voltage) from the secondary side of power supply systems.


300S type

Dimensions: W155×D180×H220(mm)
Mass: 7.0 (kg)

Features

●Used for transmitting stations for railway signaling TC type train approach warning systems

■Characteristics

Item		Performance
Capacity		300VA
Frequency		50 / 60Hz
Withstand voltage	Secondary to primary, secondary to shield	Impulse 1.2/50μs, 30kV, AC10kV for 1 minute
	Primary to shield	AC3kV for 1 minute
Voltage ratio		100V, 110V : 100V, 110V
Voltage fluctuation rate		5% or less
No. of phases		Single
Electrostatic shield		Provided
VA efficiency		93% or more
Insulation class		Class B
Limit of temperature rise		55°C or less (ambient temperature 60°C)
Surge conversion rate		1/1000 or less
Insulation resistance	Secondary to primary, secondary to shield Primary to shield	100MΩ or more when measured with an insulation-resistance tester

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Arrester tubes (for weak current)

These are highly reliable, high performance arrester tubes that are widely used in a variety of protective devices for railway standard signaling, communications and transforming, and provide protection for humans, weak current electrical devices, signal cables, communications cables and control cables against ground potential rise caused by abnormal voltage and substation failures, etc., caused by lightning surges induced into cables, etc.

Features

- Full compatibility with conventional tubes
- Low Impulse sparkover voltage
- Increased current withstand capacity
- Structurally robust
- The exposed electrode metal fittings of the conventional tube cases have been replaced with new insulated type cases, providing protection from electric shock during maintenance.

■Characteristics

Item		Performance							
		2Z122	2A231	2A291	2A431	2A491	2A611	2A701	2A801
DC discharge sparkover voltage		1,200V ±200V	230V ±40V	290V ±50V	425V ±60V	490V ±70V	610V ±90V	700V ±100V	800V ±120V
Impulse sparkover voltage 10/200μs, 3kV applied		≦2,800V	≦700V	≦750V		≦800V	≦1,000V	≦1,200V	≦1,400V
Current withstand capacity	Impulse discharge current 10/200μs	—	10,000A						
	AC discharge current 50/60Hz	5000A/0.1s	100A/1s	20A/10s	100A/1s	20A/10s	100A/1s		
Life	Impulse discharge current 10/200μs	—	500A 200 times	400A 300 times	500A 200 times	400A 300 times	500A 200 times		
	AC discharge current 50/60Hz	1,000A/0.3s 10 times	50A/0.1s 20 times						
	DC discharge spark-over voltage after a test	1,200V ±300V	230V ±60V	290V ±75V	425V ±85V	490V ±115V	610V ±130V	700V ±160V	800V ±180V
Transverse voltage 10/200μs 3kV applied		—							
Duration									
1μs/300μs									
DC holdover voltage		60V	80V		150V				
AC follow current 50/60Hz		10A	20A		40A			60A	
Service life 10/200μs 1000 times		AC1,000A 0.3s 50 times	500A	400A	500A	400A	500A		

Item		Performance							
		2B101	2B201	3B491	3B351A	3B351B	5C491	5C172	2C401CV
DC discharge spark-over voltage		100V ±20V	200V ±40V	490V ±90V	350V ±70V		490V ±90V	1700V ±570V	400V ±100V
Impulse sparkover voltage 10/200μs, 3kV applied		≦650V	≦750V	≦900V	≦800V		≦1,000V	≦2,600V	≦800V
Current withstand capacity	Impulse discharge current 10/200μs	2,500A		2,500A×2			1,000A×4		500A
	AC discharge current 50/60Hz	10A/1s		20A×2/1s	10A×2/1s		10A×4/1s		—
Life	Impulse discharge current 10/200μs	200A 100 times		200A×2 100 times			100A×2 100 times		200A 50 times
	AC discharge current 50/60Hz	10A/0.1s 10 times		40A×2/0.1s 10 times	10A×2/0.1s 10 times		10A×4/0.1s 10 times		—
	DC discharge spark-over voltage after a test	100V ±40V	200V ±60V	490V ±120V	350V±90V		490V ±120V	1,700V ±700V	400V ±150V
Transverse voltage 10/200μs 3kV applied		—		400V/200V				600V/ 200V	—
Duration									
1μs/300μs									
DC holdover voltage		60V	80V	150V					—
AC follow current 50/60Hz		5A	10A	20A					
Maximum permissible circuit voltage		—							DC255V
		—							AC180V
Service life 10/200μs 1000 times		200A		200A×2			100A×4		200A

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■Applications - Dimensions – mass table

Series name	Applications		Dimensions (mm)	Applicable holders - sockets	Lightning protective elements	External view
2Z122	Shinkansen communications circuits	CTC (main frame, external line side)	ϕ49 × W82	ST-400 type holder	Arrester 2-diode tube	
2B101	Shinkansen signal circuits	CTC (overhead or outer line), Shinkansen AF insulated track circuits, Shinkansen column No., signal coding transmission, signal flames (conventional lines)	ϕ23.5×H40	S-14 type sockets	Arrester 2-diode tube	
2B201	Shinkansen signal circuits	Shinkansen column No.(equipment room, equipment side)	ϕ23.5×H40		Arrester 2-diodetube	
3B491	Shinkansen signals, communication circuits, conventional line communication circuits	Shinkansen AF, MF track circuits (L side), additional track circuits, Shinkansen communication circuits (protective device rack), substation communication lines, ATS-S type ground antenna control relays	ϕ32.4×H79	GT 3-electrode arrester tubes holder	Arrester 3-electrode tubes	
3B351A	Conventional line communication circuits	Wiring boxes	W25×D32×H13	5-pair high insulation switching terminal boards H type	Arrester 3-electrode diode	
3B351B	Conventional line communication circuits	MDF	W24×D45×H11	111A Lightning protection spring	Arrester 3-electrode diode	
5C491	Conventional line, transformer circuits	Substation (outside)	ϕ32.4×H79	GT5-electrode arrester tubes holder	Arrester 5-diode tubes	
5C172	Conventional line, transformer circuits	Substation (inside)	ϕ32.4×H79		Arrester 5-diode tubes	
2C401CV	Shinkansen signal circuits	Train protection circuits, critical trouble detection circuit, train approach warning circuits (AC 100V lines)	ϕ23.5×H40	S-14 type socket	Arrester 2-diode tube + varistor	
2A231	Conventional line signal circuits communication circuits	Electronic exchange connecting grounds	W20×D64×H36	Arrester tubes holder (or with arrester tubes holder attachment plate)	Arrester 2-diode tube	
2A291	Shinkansen communication circuits	LCX train wireless relays	W20×D64×H36		Arrester 2-diode tube	
2A431	Shinkansen signal circuits	Shinkansen AF - MF track circuits (T side)	W20×D64×H36		Arrester 2-diode tube	
2A491	Shinkansen signal circuits	LCX train wireless relays	W20×D64×H36		Arrester 2-diode tube	
2A611	Shinkansen signal circuits	Shinkansen AF - MF track circuits (T side)	W20×D64×H36		Arrester 2-diode tube	
2A701	Shinkansen signal circuits	Dual frequency ATC track circuits (T side), divided frequency track circuits	W20×D64×H36		Arrester 2-diode tube	
2A801	Shinkansen signal circuits	Dual frequency ATC rack circuits (L side), 400V AC power supplies	W20×D64×H36		Arrester 2-diode tube	

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Insulation transformer unit UT10P66 type

Installed at the service wire points of carrier transmission system for substation remote monitoring equipment, communication breakers, etc., and used to protect humans from ground potential rise due to faults in substations, etc., and abnormal voltage caused by induced lightning surge in connecting lines, as well as preventing loss of insulation in equipment and lines.

UT10S11 type

Used to protect humans from abnormal voltage due to electropotential rise in the event of feeder circuit earth faults, and abnormal voltage caused by induced lightning surges on transmission circuits between ATS-P device code processing units and other signal transmission circuits, as well as preventing breakdown in equipment and lines.

UT10P66 type

Dimensions: W166×D116×H110(mm)
Mass: 3.1(kg)

■Characteristics

Item		Performance	
		UT10P66	UT10S11
Transmission frequency range		0.3-3.4kHz	3-9kHz
Signal level		10 dBm	
Impedance ratio Equipment : track		600Ω: 600Ω	150Ω: 150Ω
Impedance deviation		±10%	
Working attenuation		0.5 dB or less	0.7 dB or less
Withstand voltage	L1, L2-T1, T2	AC10kV for 1 minute Impulse 1.2/50μs, 25kV, 3 times	
	L1, L2-Es		
	T1, T2-Es	AC3kV for 1 minute	
Impulse protection level		50V or less at 10/200μs, 3kV applied between earths/lines	
AC protection level (L1-L2)		(AC500V applied) 50V or less	
Impulse life (L1-L2)		10/200μs, 400A, 100 times	10/200μs, 200A, 100 times
AC life (L1-L2)		AC (50/60Hz) applied 20A, 0.1s, 10 times	AC (50/60Hz) applied 10A, 0.1s, 10 times
Impulse discharge current withstand capacity (L1-L2)		10/200μs, 5kA	10/200μs, 2.5kA
AC current withstand capacity (L1-L2)		AC (50/60Hz) 20A, 1s	AC (50/60Hz) 10A, 1s
Insulation resistance	L1, L2-T1, T2	100MΩ or more at DC250V	100MΩ or more at DC250V
	L1, L2 to E		—
	L1, L2 to Es		100MΩ or more at DC250V
	T1, T2 to Es		

Protective devices (for power line) Number [ ] type

These protective devices are used in AC train lines for the protection of insulators in the event of insulator flashover, the prevention of platform ground potential rise, and the prevention of electropotential rise in substation earthing systems in the event of bus ground faults in AC substations.

■Characteristics

Item	Performance			
	No. 2 follow current prevention	No. 2	No. 3	No. 4
Applications	Stations within BT system electrified zone		Stations within AT system AC electrified zone	Substation
Discharge spark-over voltage	AC2.5kV±15%		AC2.5kV±20%	AC3kV±15%
Current withstand capacity	AC2kA, 0.4s, 2 times at 30 second intervals			AC3kA, 0.5s, 1 time
Discharge current	2kA			3kA
No. of electrodes	2		3	2
Withstand voltage	With electrodes removed, there must be no abnormality when commercial frequency AC 10V is applied across both terminals for one minute.			
Insulation resistance	1000MΩ or more across terminals when measured with an insulation-resistance tester	After separating electrodes by at least 0.5mm, 1000MΩ or more across terminals at DC 1kV.		
Dimensions (mm)	φ100×H140		φ200×H255	φ200×H255
Mass (kg)	1.5		5.0	—

No. 2

No. 2 gap arrester type

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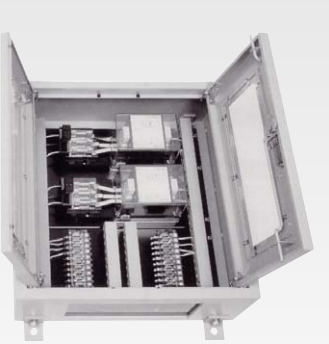
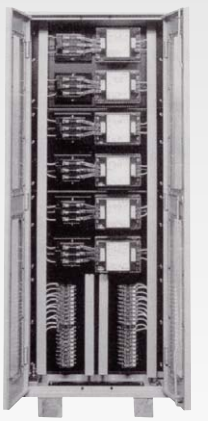
Insulation type protective devices for substation

These protective devices (insulation type) are installed at the service wire points of carrier transmission system substation remote monitoring equipment, communication breakers, etc., and used to protect humans from ground potential rise due to faults in substations, etc., and abnormal voltage caused by induced lightning surge in connecting lines, as well as preventing breakdown equipment and lines.



Wall attachment type



Free-standing type

■Characteristics

Item		Performance
Transmission frequency range		0.3-3.4kHz
Signal level		10dBm
Impedance ratio Track : Equipment		600Ω: 600Ω
Impedance deviation		±10%
Working attenuation		0.5dB or less (0.3-3.4kHz)
Withstand voltage	Track to equipment	AC (50/60Hz) 10kV, 1 minute and impulse 1.2/50μs, 25kV, 3 times
	Track to En	
	Equipment to EN	AC (50/60Hz) 3kV, 1 minute
Protection level (1) Voltage to ground (2) Line voltage	Impulse voltage 10/200μs 3kV and AC (50/60Hz) 500V applied between track and Ef	50V or less
Repeat current withstand capacity (Track to Ef)	Impulse discharge current	10/200μs, 400A, 100 times
	AC (50/60Hz)	20A, 0.1s, 10 times
Current withstand capacity (Track to Ef)	Impulse discharge current	10/200μs - 5kA
	AC (50/60Hz)	AC20A, 1s
Insulation resistance	Track to equipment	100MΩ or more (at DC250V)
	Track to Ef	
	Track to En	
	Equipmento to En	

Type	Lines	Shape	Width (mm)	Height (mm)	Depth (mm)
WI2	2	Wall attachment type	540	570	200
WI4	4	Wall attachment type	540	880	200
WI6	6	Wall attachment type	540	1330	200
WI8	8	Wall attachment type	540	1640	200
SI2	2	Free-standing type	540	620	200
SI4	4	Free-standing type	540	930	200
SI6	6	Free-standing type	540	1380	200
SI8	8	Free-standing type	540	1680	200

Protective device box, protective device rack

Protective device and terminal strip combinations can be housed in these boxes and rack. A wide variety of types are available in accordance with the planned usage and installation environment.

Protective device box (for ITV cameras)

Protective device rack (induction mitigation device rack for Shinkansen)

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Lightning protective elements
Ceramic arresters

These lightning protective elements utilize the electrical discharge phenomenon that occurs across the electrodes disposed within the ceramic arresters to inhibit surge voltage entering communication lines and signaling lines.

■Model identification

2-electrode tubes :

□ □ □ – □ □

- Terminal type
  - A : No lead wire
  - B : With lead wire (ϕ1.0, ϕ0.8)
  - C : With case
- Nominal DC sparkover voltage (V)
- Product type
- Outer diameter of arrester
  - 4 : 4mm 08 : 8mm
  - 05 : 5mm 20 : 20mm
  - 06 : 6mm 49 : 49mm
- Envelope type
  - Y : Standard type
  - SD : Surface mounted type

3-electrode element :

3 □ □-□ □ □ □

- Failsafe type
- Lead wire pitch type
  - 1 : 4.4±0.3
  - 3 : 5.0±0.3
- Terminal type
  - A : No lead wire
  - B : With lead wire (ϕ1.0)
  - BP : With lead wire (ϕ0.8)
  - J : With lead wire (ϕ1.0)
  - P : With lead wire (ϕ0.8)
- Nominal DC sparkover voltage (V)
- Product type and outer diameter
  - VJ : 8mm
  - VH : 8mm
  - 4 : 4mm
  - 06 : 6mm
  - 20 : 20mm
- Envelope type
  - Y : Standard type
  - SD : Surface mounted type
- No. of electrodes

■Caution when using ceramic arresters

When using stand-alone arresters in power supply circuits, it should be borne in mind that, even after the arrester has operated (and abnormal voltage has been eliminated), there may still be continued discharge of the connected supply voltage (follow current phenomenon).
In order to protect power supply circuits from abnormal voltage, please use our SPDs which do not generate follow current rather than stand-alone arresters.

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Lightning protective elements
Ceramic arrester tube types

Item		Performance - Application											
Tubes		2-electrode tubes								3-electrode tubes			
Size		—	φ5	φ6	φ8			φ20	φ49	—	φ6	φ8	
Model		SD4- [ ]	Y05-[ ]	Y06S-[ ] Y06SZ-[ ]	Y-[ ]	Y08SV-[ ]	Y08U-[ ] Y08UZ-[ ] U-[ ]	Y20-[ ]	Y49-[ ]L	3SD4-[ ]	3Y06-[ ]	3YVJ-[ ] 3J-[ ]	3YVH-[ ] 3H-[ ]
Applications		Communication lines Signaling lines						Railway signaling lines Large capacity signaling lines	Railway signaling lines Series capacitor protection Transformer withstand voltage protection	Communication lines Signaling lines			
UL		○	—	—	○	○	○	—	—	○	○	○	○
RoHS		○	○	○	○	○	○	○	○	○	○	○	○
Voltage (V)	75	○	—	—	—	—	○	—	—	○	—	—	—
	90	○	○	○	—	—	○	○	—	○	○	○	○
	100	—	—	○	—	—	—	—	—	—	—	—	—
	145	○	—	—	—	—	○	—	—	○	—	○	—
	150	—	—	—	—	—	—	—	—	—	—	—	○
	200	○	—	—	—	—	—	—	—	○	—	○	—
	230	○	○	○	—	—	○	○	○	○	○	○	○
	250	—	—	—	—	—	○	○	—	—	—	○	○
	300	—	—	—	—	—	○	—	—	—	—	○	—
	350	○	○	○	—	—	○	○	○	—	○	○	○
	400	—	—	—	—	—	○	—	—	—	—	○	○
	450	—	—	—	—	—	—	—	○	—	—	—	—
	470	—	—	—	—	—	○	—	—	—	—	—	—
	490	—	—	—	—	—	—	○	—	—	—	—	—
	500	—	—	—	—	—	—	—	—	—	—	○	○
	550	—	—	—	—	—	—	—	○	—	—	○	—
	600	—	○	—	—	—	○	—	—	—	—	—	—
	610	—	—	—	—	—	—	○	—	—	—	—	—
	700	—	—	—	—	—	—	○	○	—	—	—	—
	800	—	—	—	—	—	○	○	—	—	—	—	—
	930	—	—	—	—	—	—	—	○	—	—	—	—
	1000	—	—	—	—	—	○	—	○	—	—	—	—
	1100	—	—	—	—	—	—	○	—	—	—	—	—
	1200	—	—	—	—	—	—	○	○	—	—	—	—
	1300	—	—	—	—	—	—	○	—	—	—	—	—
	1400	—	—	—	—	—	—	—	○	—	—	—	—
	1500	—	—	—	○	—	—	—	—	—	—	—	—
	1600	—	—	—	—	—	—	○	—	—	—	—	—
	2100	—	—	—	○	—	—	—	—	—	—	—	—
	2700	—	—	—	—	○	—	—	—	—	—	—	—
	3000	—	—	—	○	○	—	—	—	—	—	—	—
	4000	—	—	—	○	—	—	—	—	—	—	—	—
	6000	—	—	—	○	—	—	—	—	—	—	—	—
	12000	—	—	—	—	—	—	—	○	—	—	—	—
A	No lead wire	○	○	○	○	○	○	○	—	○	○	○	○
B	With lead wire	—	○	○	○	○	○	○	—	—	—	○	—
C	With	— c	— a	— s	— e	—	—	○	—	—	—	—	—
BP	With lead wire (φ0.8)	—	—	—	—	—	—	—	—	—	—	○	—
J1	With lead wire (φ1.0)	—	—	—	—	—	—	—	—	—	—	○	○
P1	With lead wire (φ0.8)	—	—	—	—	—	—	—	—	—	○	○	○
L	With bracket	—	—	—	—	—	—	—	○	—	—	—	—
FS	Failsafe	—	—	—	—	—	—	—	—	—	○	○	○

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SD4-[ ] type

Conforming standards

- UL standard acquired (E140906)
- RoHS compliant

Features

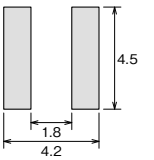
- Ultra compact surface mounted arrester
- Design registered

Dimensions: W3.5×D4.4×H4.4 (mm)
Mass: 0.3 (g)

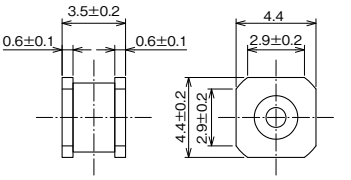
■Characteristics

Item	Conditions	Performance					
		SD4-75 UL	SD4-90 UL	SD4-145 UL	SD4-200 UL	SD4-230 UL	SD4-350
DC sparkover voltage	100V/s	75V±20%	90V±20%	145V±20%	200V±20%	230V±20%	350V±20%
Impulse sparkover voltage	100V/μs	≦500V				≦550V	≦650V
	1kV/μs	≦600V				≦650V	≦750V
Insulation resistance	DC50V	≧10,000MΩ			—		
	DC100V	—			≧10,000MΩ		
Electrostatic capacity	1MHz	≦0.5pF					
DC holdover characteristics	DC 52V	≦150ms		—			
	DC 80V	—		≦150ms	—		
	DC 135V	—			≦150ms		
Impulse discharge current	8/20μs, 2.5kA,	1 time				—	
	8/20μs 5kA	—				1 time	
AC discharge current	AC50Hz, 5A, 1s,	1 time					
Impulse life	8/20μs, 100A	1,000 times					

■Recommended land pattern
(Unit: mm)



■External view



Y05-[ ] type

Conforming standards

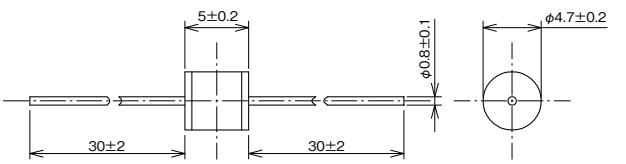
- RoHS compliant

Dimensions: W5×ϕ4.7 (mm)
Mass: 0.7 (g)

■Characteristics

Item	Conditions	Performance			
		Y05-90 [ ]	Y05-230 [ ]	Y05-350 [ ]	Y05-600 [ ]
DC sparkover voltage	100V/s	90V±20%	230V±20%	350V±20%	600V±20%
Impulse sparkover voltage	100V/μs	≦400V	—	≦650V	≦900V
	1kV/μs	≦500V	≦650V	≦750V	≦1,000V
Insulation resistance	DC50V	≧10,000MΩ	—		
	DC100V	—	≧10,000MΩ		—
	DC250V	—			≧10,000MΩ
Electrostatic capacity	1MHz	≦1.0pF			
DC holdover characteristics	DC52V	≦150ms			
Impulse discharge current	8/20μs 5kA	+5, -5 times			—
	8/20μs 2.5kA	—			+5, -5 times
Impulse life	10/1000μs 100A	300 times			
AC discharge current	AC 5A, 1s	5times	10 times		

■External view



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Y06S-[ ] type
Y06SZ-[ ] type

Dimensions: W4.3×φ6 (mm)
Mass: 0.7 (g)

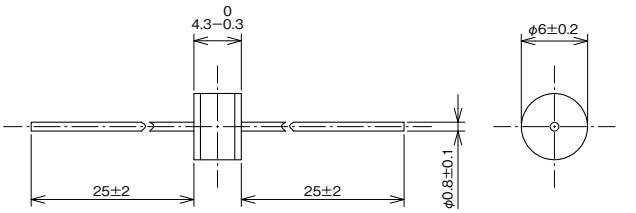
Conforming standards

●RoHS compliant

■Characteristics

Item	Conditions	Performance			
		Y06S-90 [ ]	Y06S-100 [ ]	Y06SZ-230 [ ]	Y06SZ-350 [ ]
DC sparkover voltage	100V/s	90V±20%	100V±20%	230±50V	350±70V
Impulse sparkover voltage	1kV／μs	≦700V			≦800V
	10／200μs 20kV	≦1,000V			
Insulation resistance	DC50V	≧10,000MΩ		—	
	DC100V	—		≧10,000MΩ	
Electrostatic capacity	1MHz	≦1.0pF			
Impulse life	10／200μs 100A	200 times		—	
	10／1000μs 100A	—		200 times	
AC discharge current	AC 3A, 1s (50Hz)	1 time		—	
	AC 5A, 1s	—		10 times	
Impulse discharge current	8/20μs, 3kA	1 time		—	
	10/200μs, 2kA	+1, -1 time		—	
	8/20μs, 5kA	—		+5, -5 times	

■External view



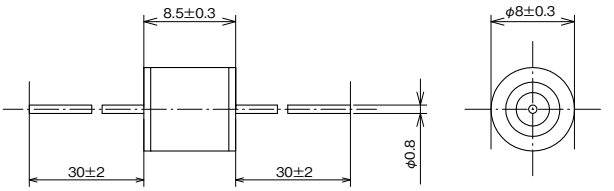
Y-[ ] type

Dimensions: W8.5×φ8 (mm)
Mass: 1.5 (g)

Conforming standards

●UL standard acquired (E328370)
●RoHS compliant

■External view



■Characteristics

Item	Conditions	Performance				
		Y-152[ ]	Y-212 [ ]	Y-302 [ ]	Y-402 [ ]	Y-602 [ ]
DC sparkover voltage	1kV/s	1,500V±300V	2,100V±400V	—		
	5kV/s	—		3,000V±600V	4,000V±800V	6,000V±1,200V
Impulse sparkover voltage	100V／μs	≦2,200V	—	≦4,000V	≦5,000V	≦8,000V
	10/200μs 3kV	—	≦3,000V	—		
Insulation resistance	DC500V	≧10,000MΩ		—		
	DC1000V	—		≧10,000MΩ		
Electrostatic capacity	1MHz	≦1.0pF				
Impulse discharge current	8/20μs, 3kA	+5, -5 times	—			
	8/20μs, 10kA	1 time	—	1 time	—	
	8/20μs, 1kA	—	2 times	+5, -5 times		
	8/20μs, 5kA	—			1 time	
Impulse life	10/1,000μs, 500A	10 times	—	10times		
	8/20μs, 100A	—	100 times	—		
AC discharge current	AC 1A, 1s	10 times	—	10 times		

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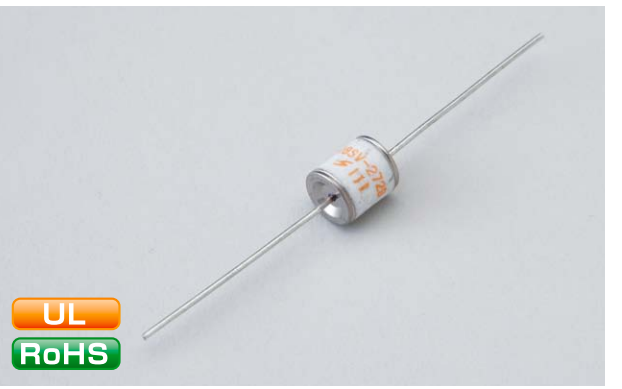
Y08SV-[ ] type

Conforming standards

- UL standard acquired (E328370)
- RoHS compliant

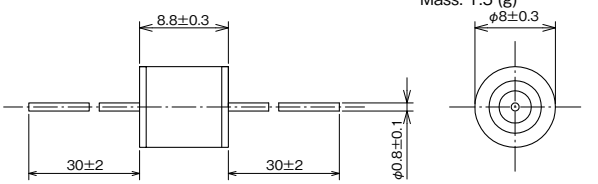


■Characteristics

Item	Conditions	Performance	
		Y08SV-272 [ ]	Y08SV-312 [ ]
DC sparkover voltage	5kV/s	2,430 - 3,000V	2,850 - 3,500V
Impulse sparkover voltage	1kV／μs	≦3,900V	≦3,700V
Insulation resistance	DC1000V	≧100MΩ	
Electrostatic capacity	1MHz	≦1.0pF	
Impulse discharge current	8/20μs, 3kA	+10, -10 times	
Impulse life	8/20μs, 100A	300 times	

■External view

Dimensions: W8.8×ϕ8 (mm)
Mass: 1.5 (g)



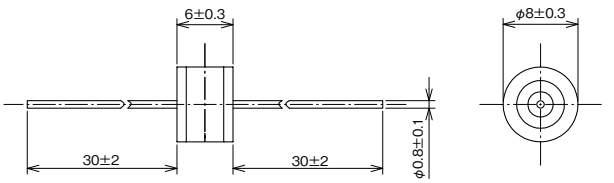
Y08U-[ ] type
Y08UZ-[ ] type
U-[ ] type

Conforming standards

- UL standard acquired (E328370) (U-[ ] type)
- RoHS compliant

■External view

Dimensions: W6×ϕ8 (mm)
Mass: 1.5 (g)



■Characteristics

Item	Conditions	Performance											
		Y08U-75 [ ]	Y08U-90 [ ]	Y08UZ-145 [ ]	Y08UZ-230 [ ]	Y08UZ-250 [ ]	Y08UZ-300 [ ]	Y08UZ-350 [ ]	Y08UZ-400 [ ]	Y08UZ-470 [ ]	Y08UZ-600 [ ]	Y08UZ-800 [ ]	Y08UZ-102 [ ]
		U-1 [ ] UL	U-2 [ ] UL	U-3 [ ] UL	U-4 [ ] UL	U-5 [ ] UL	U-6 [ ] UL	U-7 [ ] UL	U-8 [ ] UL	U-9 [ ] UL	U-10 [ ] UL	U-11 [ ] UL	—
DC sparkover voltage	100V/s	75V±20%	90V±20%	145V±15%	230V±15%	250V±15%	300V±15%	350V±15%	400V±15%	470V±15%	600V±15%	800V±15%	800-1,300V
Impulse sparkover voltage	100V/μs	≦500V			≦600V		≦700V				≦800V	≦1,000V	—
	1kV/μs	≦700V			≦750V	≦800V	≦850V				≦1,000V	≦1,200V	≦1,500V
Insulation resistance	DC50V	≧10,000MΩ			—								
	DC100V	—			≧10,000MΩ					—			
	DC250V	—								≧10,000MΩ			—
	DC500V	—											≧1,000MΩ
Electrostatic capacity	1MHz	≦1.0pF											≦2.0pF
DC holdover characteristics	DC 52V	≦150ms		—									
	DC 80V	—		≦150ms	—								
	DC 135V	—			≦150ms		—						≦150ms
	DC 150V	—					≦150ms						—
Impulse discharge current	8/20μs, 5kA	10 times											
	8/20μs, 10kA	1 time											—
Impulse life	10/1,000μs, 100A	—											300 times
	10/1,000μs, 500A	300 times				500 times							—
AC discharge current	AC 5A, 1s	—											5 times
	AC 10A, 1s	5 times				10 times							—

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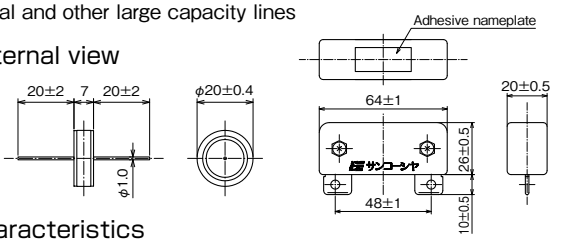
Lightning protective elements
Ceramic arrester : 2-electrode tubes

Y20-[ ] type

Conforming standards
●RoHS compliant

Features
●Best suited for lightning surge countermeasures for railway signal and other large capacity lines

■External view



(A type) Dimensions: W7×φ20 (mm)
Mass: 6.5 (g)

■Characteristics

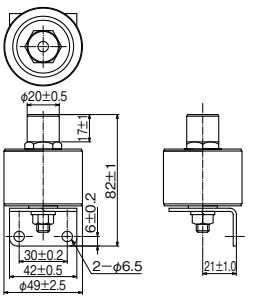
Item	Conditions	Performance											
		Y20-90	Y20-230	Y20-250	Y20-350	Y20-490	Y20-610	Y20-700	Y20-800	Y20-1100	Y20-1200	Y20-1300	Y20-1600
DC sparkover voltage	100V/s	90V±20V	230V±40V	250V±50V	350V±60V	490V±70V	610V±90V	700V±100V	800V±120V	1,100V±220V	1,200V±200V	1,300V±200V	1,550V±150V
Impulse sparkover voltage	10/200μs, 3,000V	≦700V		≦750V		≦800V	≦1,000V	≦1,200V	≦1,400V	≦2,000V	≦2,200V	≦2,400V	≦2,200V
Insulation resistance	DC50V	≧10,000MΩ	—										
	DC100V	—	≧10,000MΩ			—							
	DC250V	—				≧10,000MΩ							—
	DC500V	—											≧10,000MΩ
Electrostatic capacity	1MHz	≦5.0pF								—			
Maximum impulse discharge current	8/20μs, 20kA	1 time								—		1 time	—
	10/200μs, 10kA	1 time									—	1 time	—
Impulse life	10/200μs	500A, 1,000 times				400A, 1,000 times	500A, 1,000 times				—	500A, 1,000 times	—
AC discharge current	AC 50A, 0.1s	20 times											—
	AC 25A, 0.1s	—											20 times

Y49-[ ] L type

Conforming standards
●RoHS compliant

Features
●Large capacity arrester with maximum discharge current of 100kA
●Best suited for lightning surge countermeasures for railway signal, electrical power transmission and other large capacity lines

■External view



Dimensions: W66×φ49 (mm)
Mass: 300 (g)

■Characteristics

Item	Conditions	Performance									
		Y49-230L	Y49-350L	Y49-450L	Y49-550L	Y49-700L	Y49-930L	Y49-1000L	Y49-1200L	Y49-1400L	Y49-12kVL
DC sparkover voltage	100V/s	230V±20%	350V±20%	450V±90V	550V±100V	—					
	500V/s	—				700V±100V	930V±90V	1,000V±150V	1,200V±200V	1,400V±150V	—
	5kV/s	—									12kV±3kV
Impulse sparkover voltage	10/200μs 3kV	≦1,000V		≦1,500V		—			≦2,800V		—
Insulation resistance	DC100V	≧10,000MΩ		—							
	DC250V	—		≧1,000MΩ		≧100MΩ		—		≧100MΩ	—
	DC500V	—					≧10,000MΩ		—	≧10,000MΩ	—
	DC1000V	—									≧100MΩ
Electrostatic capacity	1MHz	≦10pF		—					≦10pF	—	
Impulse discharge current	8/20μs, 20kA	30 times		—							5 times
	10/200μs, 20kA	—		30 times		—					
AC discharge current	AC 15A, 80s	30 times		—							
	AC 1,000A, 0.3s	—		30 times		—			10 times	—	
	AC 20A, 80s	—			30 times	—				20 times	—
	AC 70A, 20s	—				20 times			—	20 times	—

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3SD4-[ ] type

Conforming standards

- UL standard acquired (E140906)
- RoHS compliant

Features

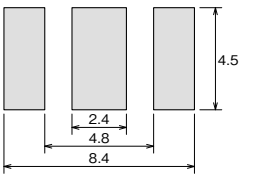
- Ultra compact surface mounted arrester

Dimensions: W7.2×D4.4×H4.4 (mm)
Mass: 0.6 (g)

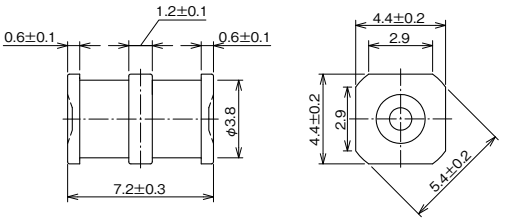
■Characteristics

Item	Conditions	Performance				
		3SD4-75	3SD4-90	3SD4-145	3SD4-200	3SD4-230
DC sparkover voltage	100V/s	75V±20%	90V±20%	145V±20%	200V±20%	230V±20%
Impulse sparkover voltage	100V/μs	≦500V				≦550V
	1kV/μs	≦600V				≦650V
Insulation resistance	DC50V	≧10,000MΩ			—	
	DC100V	—			≧10,000MΩ	
Electrostatic capacity	1MHz	≦1.0pF				
DC holdover characteristics	DC 52V	≦150ms		—		
	DC 80V	—		≦150ms	—	
	DC 135V	—			≦150ms	
Impulse discharge current	8/20μs, 2.5kA×2	1 time				—
	8/20μs, 5kA×2	—				1 time
AC discharge current	AC 5A 2, 1s	1 time				
Impulse life	8/20μs, 100A×2	1,000 times				

■Recommended land pattern (Unit: mm)



■External view



3Y06-[ ] type

Conforming standards

- UL standard acquired (E140906)
- RoHS compliant

Features

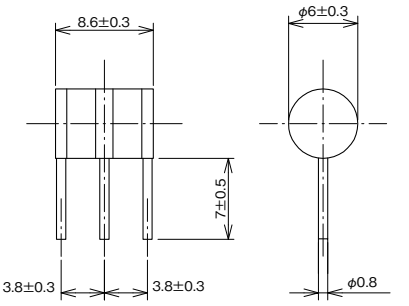
- With failsafe function

Dimensions: W8.6×φ6 (mm)
Mass: 1.3 (g)

■Characteristics

Item	Conditions	Performance		
		3Y06-90 [ ]	3Y06-230 [ ]	3Y06-350 [ ]
DC sparkover voltage	100V/s	90V±20%	230V±20%	350V±20%
Impulse sparkover voltage	1kV/μs	≦850V	≦700V	≦750V
Insulation resistance	DC50V	≧10,000MΩ	—	
	DC100V	—	≧10,000MΩ	
Electrostatic capacity	1MHz	≦3.0pF		
DC holdover characteristics	DC 52V	≦150ms	—	
	DC 135V	—	≦150ms	—
	DC 150V	—		≦150ms
Impulse discharge current	8/20μs, 2.5kA×2	+5, -5 times	—	+5, -5 times
	8/20μs, 5kA×2	—	+5, -5 times	—
	8/20μs, 10kA×2	—		1 time
AC discharge current	AC5A×2, 1s	5 times		
	AC10A×2, 1s	—		1 time
Impulse life	10/1000μs, 100A×2	100 times	300 times	100 times

■External view



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3YVJ-[ ] type
3J-[ ] type

Dimensions: W11.5×φ7.5 (mm)
Mass: 2.8 (g)

Conforming standards

- UL standard acquired (E140906) (3J-[ ] type)
- RoHS compliant

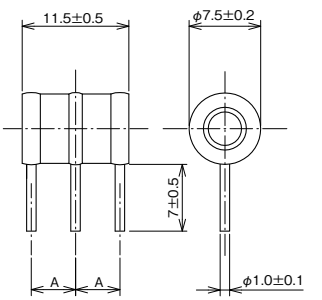
Features

- With failsafe function

■Characteristics

Item	Conditions	Performance									
		3YVJ-90 [ ]	3YVJ-145 [ ]	3YVJ-200 [ ]	3YVJ-230 [ ]	3YVJ-250 [ ]	3YVJ-260 [ ]	3YVJ-300 [ ]	3YVJ-350 [ ]	3YVJ-400 [ ]	3YVJ-550 [ ]
		3J-1 [ ] UL	3J-2 [ ] UL	—	3J-3 [ ] UL	3J-4 [ ] UL	—	3J-5 [ ] UL	3J-6 [ ] UL	3J-7 [ ] UL	—
DC sparkover voltage (L1-E)(L2-E)	100V/s	90V± 20%	145V± 20%	200V± 25%	230V± 20%	250V± 20%	260V± 20%	300V± 20%	350V± 20%	400V± 20%	550V± 20%
Impulse sparkover voltage (L1-E)(L2-E)	100V/μs	≦700V		≦500V				≦600V		≦700V	≦850V
	1kV/μs	≦850V		≦650V				≦750V		≦850V	≦1,000V
Insulation resistance	DC50V	≧10,000MΩ		—							
	DC100V	—		≧10,000MΩ							
Electrostatic capacity	1MHz	≦3.0pF									
DC holdover characteristics	DC 52V	≦150ms		—							
	DC 135V	—		≦150ms					—		
	DC 150V	—							≦150ms		
AC discharge current 50Hz (L1+L2-E)	AC 10A, 1s	10 times									
	AC130A, 9 cycles	1 time									
Impulse discharge current (L1-E)(L2-E)	8/20us, 10kA	10 times									
	8/20us, 20kA	1 time									
Impulse life (L1+L2-E)	10/1000μs, 400A	300 times								400 times	300 times

■External view



3YVH-[ ] type
3H-[ ] type

Dimensions: W10×φ8 (mm)
Mass: 2.6 (g)

Conforming standards

- UL standard acquired (E140906) (3H-[ ] type)
- RoHS compliant

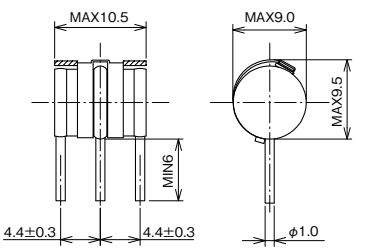
Features

- With failsafe function

■Characteristics

Item	Conditions	Performance						
		—	—	3YVH-230 [ ]	3YVH-250 [ ]	3YVH-350 [ ]	3YVH-420 [ ]	—
		3H-90 [ ] UL	3H-150 [ ] UL	3H-230 [ ] UL	3H-250 [ ] UL	3H-350 [ ] UL	3H-420 [ ] UL	3H-500 [ ] UL
DC sparkover voltage (L1-E)(L2-E)	100V/s	72-108V	120-180V	184-280V	200-300V	280-420V	300-500V	400-600V
Impulse sparkover voltage (L1-E)(L2-E)	1kV/μs	≦500V	≦600	≦700V		≦1,000V		≦1,200V
Insulation resistance	DC50V	≧10,000MΩ		—				
	DC100V	—		≧10,000MΩ				
Electrostatic capacity	1MHz	≦3.0pF						
DC holdover characteristics	DC 52V	≦150ms		—				
	DC 135V	—		≦150ms				
AC discharge current 50Hz (L1+L2-E9)	AC10A, 1s	10 times						
Impulse discharge current (L1-E)(L2-E)	8/20us, 10kA	10 times				—	10 times	
	8/20us, 20kA	—				10 times	—	
Impulse life (L1+L2-E)	10/1000μs, 200A	300 times						

■External view



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Lightning protective elements SSPD
(Solid-State Surge Protection Device)

Fast response speed semiconductor surge protective elements used for surge protection of electronic devices and circuits

SSPD
(Solid-State Surge Protection Device)

Conforming standards
- UL standard acquired (E140906)
- RoHS compliant

Features
- A single protective element provides the same protection level (3-electrode construction) across lines and to earth (L1-E, L2-E, L1-L2).
- Protection with high speed response of ns (nanosecond: 10^{-9} sec.) order.
- Excellent dv/dt characteristics

■3-electrode structure for optimal protection for communication lines

This is a three terminal device that is capable of providing effective surge protection with a single device.
With generally available 2-electrode elements, as illustrated in Fig. 2, three elements are needed to protect the lines, earths and across lines. However, SSPD can provide L1-E, L2-E, L1-L2 with the same level of protection with just a single element. (See Fig. 1)
This is a compact device that can provide line protection.

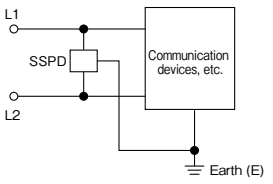


Fig. 1 Lightning surge protection by SSPD

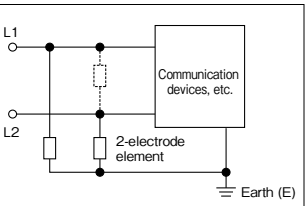
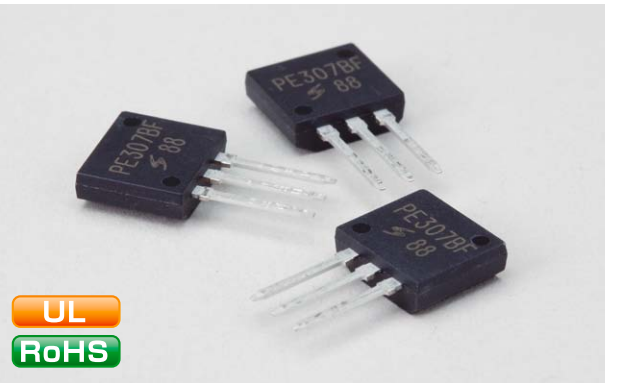
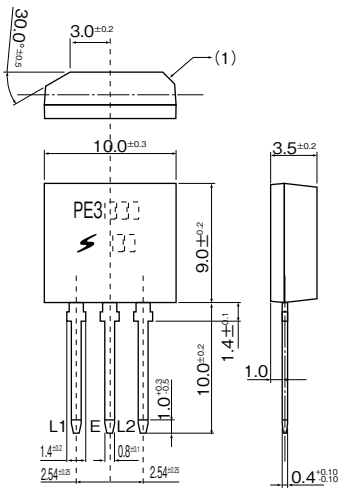


Fig. 2 Protection using 2-electrode elements



Dimensions: W10×D3.5×H19 (mm)
Mass: 0.9 (g)

■External view



■Model identification

PE3 □□ □ F

- F: RoHS compliant
- □: Shows surge current waveform 10/1000μs current withstand capacity
  - A : 200(A)
  - B : 150(A)
- □□: Specifies operating voltage when 100V/ms rise speed voltage is applied to this device
  - 24 : 200~270(V)
  - 15 : 125~195(V)
  - 10 : 85~120(V)
  - 07 : 60~110(V)
  - 05 : 40~ 75(V)

■Characteristics

Item	Conditions		Performance									
			PE305AF	PE307AF	PE310AF	PE315AF	PE324AF	PE305BF	PE307BF	PE310BF	PE315BF	PE324BF
Impulse discharge current	10/1000μs		200A					150A				
	10/200μs		400A					300A				
	8/20μs		800A					500A				
Standoff voltage			30V	50V	65V	120V	180V	30V	50V	65V	120V	180V
Breakdown voltage	100V/ms	MIN	40V	60V	85V	125V	200V	40V	60V	85V	125V	200V
	100V/ms	MAX	75V	110V	120V	195V	270V	75V	110V	120V	195V	270V
Impulse control voltage	100V/μs		90V	130V	130V	220V	300V	90V	130V	130V	220V	300V
Off-leak current			10μA									
DC holdover characteristics			150mA									
Electrostatic capacity	1MHz 1Vrms (DC30V)		150pF	—				100pF	—			
	1MHz 1Vrms (DC50V)		—	150pF				—	100pF			

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Fast response speed semiconductor surge protective elements used for surge protection of electronic devices and circuits

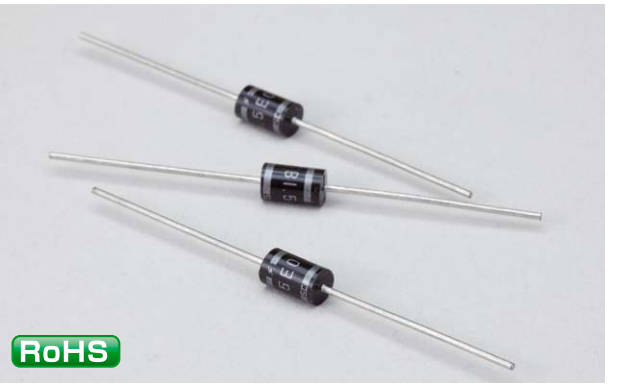
SP diode

Conforming standards

●RoHS compliant

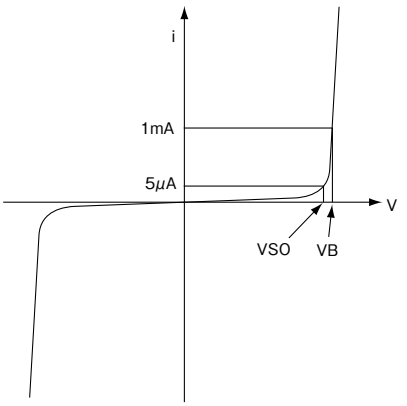
Features

●These are bipolar elements that can be fitted into any circuit, regardless of polarity.
●Protection with high speed response of ns (nanosecond: 10^{-9} sec.) order.
●Improved surge withstand capacity and low current leakage. Wide range of application.

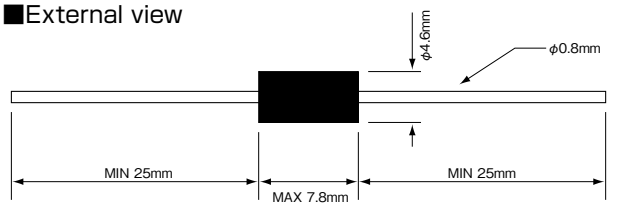


Mass: 0.7 (g)

■Voltage/ current characteristics



■External view



■Characteristics

Item	Conditions		Performance			
			B1.5E010	B1.5E016	B1.5E027	B2.8E036
Standoff voltage	—	MIN.	8.5V	12.5V	21.5V	29.0V
Maximum permissible power	For 10/1000μs	MIN.	1,500W			2,800W
Maximum allowed current	For 10/1000μs	MIN.	100A	68A	38A	56A
Clamp voltage	For Ipp	MIN.	—			
		TYP.	—			
		MAX.	15.0V	22.5V	38.0V	50.0V
Breakdown voltage	For 1mA	MIN.	9.0V	13.5V	23.5V	31.5V
		TYP.	10.0V	15.5V	27.0V	36.0V
		MAX.	11.0V	17.0V	30.0V	40.0V
Leak current	For Vso	MIN.	—			
		TYP.	—			
		MAX.	50μA	5μA		
Electrostatic capacity	For 100kHz	MIN.	—			
		TYP.	3,900pF	2,500pF	1,400pF	1,600pF
		MAX.	—			
Vb temperature coefficient		MIN.	—			
		TYP.	0.06%/℃	0.10%/℃	0.08%/℃	0.06%/℃
		MAX.	—			

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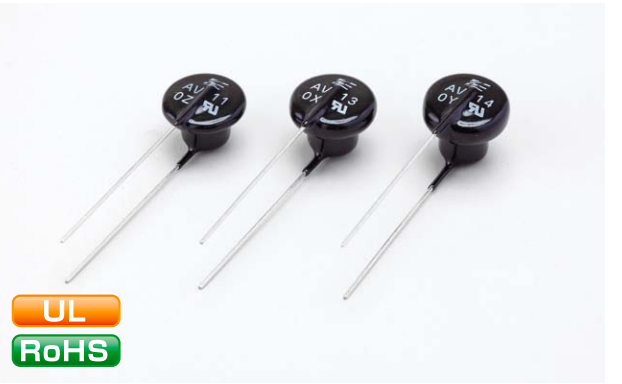
AV-11 type
AV-13 type
AV-14 type

Conforming standards

- UL standard acquired (E328370)
- RoHS compliant

Features

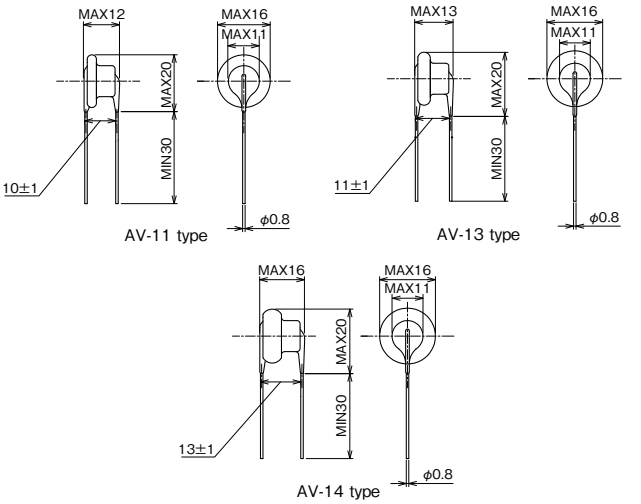
- Protection of low voltage power supply circuits of AC125V, 240V, 440V or less
- Compact element type allows for space-saving installation.



■Characteristics

Item	Performance		
	AV-11	AV-13	AV-14
Rated circuit voltage	AC125V	AC240V	AC440V
Impulse sparkover voltage	800V or less	1.2kV or less	2kV or less
	(10/200μs, 3kV applied)		
Impulse discharge current	4.5kA (8/20μs), 1 time		
Dimensions (mm)	W16×D12×H50	W16×D13×H50	W16×D16×H50
Mass (g)	4	5	6

■External view



AV3P-1 type
AV3P-2 type

Conforming standards

- UL standard acquired (E328370) (AV3P-1 type)
- RoHS compliant

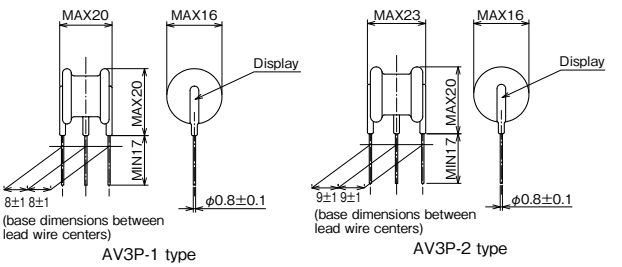
Applications

- Protection of low voltage power supply circuits of AC125V, 240V or less
- Compact element type allows for space-saving installation.
- 3-electrode configuration means that a single device can cover a single-phase two-wire type line.

■Characteristics

Item	Performance	
	AV3P-1 UL	AV3P-2
Rated circuit voltage	AC125V	AC240V
Impulse sparkover voltage	800V or less	1.2kV or less
	(10/200μs, 3kV applied)	
Impulse discharge current	9kA (8/20μs), 1 time	
Dimensions (mm)	W16×D20×H37	W16×D23×H37
Mass (g)	8	10

■External view



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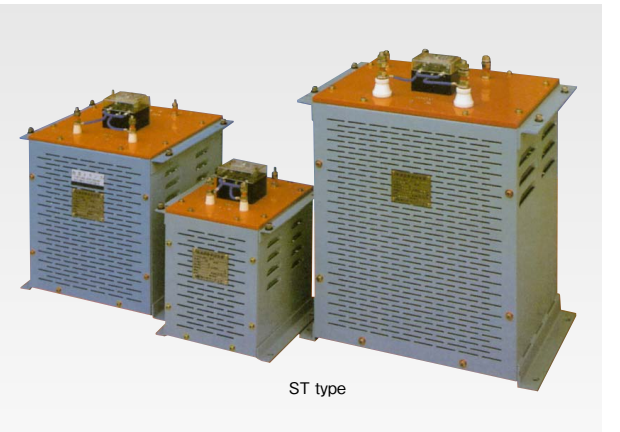
Lightning transformers

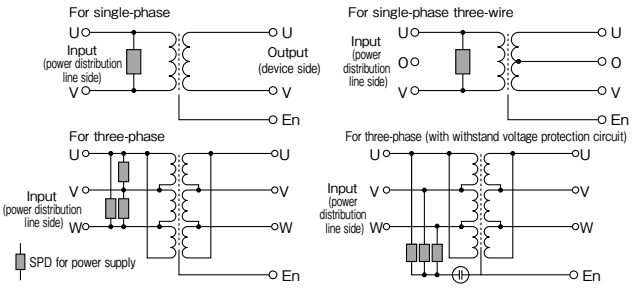
Lightning surge conversion rate less than 1/1000 high performance lightning transformers

ST type

Lightning transformers are used for surge protection of power supplies for low voltage power distribution equipment such as in equipment rooms, radio relay stations, mobile telephone base stations, etc.
The unit comprises a static electricity shielded high withstand voltage insulation transformer (protecting the earth) and a power supply SPD (protect between devices and the earth), proving effective shutout against induced lightning surge and earth potential rise.


ST type

■Circuit diagram



■Model identification

□ ST □ – □□□ □ □ □ □

Connection type	
Symbol	Type
1	Single-phase
3	Three-phase
4	Reverse V
5	Scott

AC withstand voltage		
Symbol	Primary	Secondary
1	10kV	3kV
2	3kV	10kV
3	3kV	3kV
4	10kV	10kV
5	15kV	3kV

Capacity			
Symbol	Capacity	Symbol	Capacity
501	500VA	153	15kVA
102	1kVA	203	20kVA
202	2kVA	253	25kVA
302	3kVA	303	30kVA
402	4kVA	353	35kVA
502	5kVA	503	50kVA
752	7.5kVA	753	75kVA
103	10kVA		

Input side Rated voltage	
Symbol	Voltage
1	100V
2	200V
4	400V
5	200V Single-phase three-wire (with center open terminal)
6	100/200V Single-phase three-wire (with neutral point terminal)

Output side Rated voltage	
Symbol	Voltage
1	100V
2	200V
4	400V
7	100/200V Single-phase three-wire

Other functions	
Symbol	Function
S	RP-200 type with SPD
R	S100, S200, S400–S type with SPD
G	with withstand voltage protection circuit (in combination with S type SPD)
P	with withstand voltage protection circuit (in combination with RP-200 type SPD)

Color	
Symbol	Color
1	7.5BG 6/1.5 Semi-gloss
2	7.5BG 6/1.5 Gloss
3	7.5BG 7/1.5 Semi-gloss
4	5Y 7/1 Semi-gloss
5	2Y 7.5/1 Semi-gloss
6	N 7 Semi-gloss
7	2.5B 6/3 Semi-gloss

■Characteristics

Item			Performance				Remarks
Input/output voltage			AC100V, AC200V, AC400V, AC100/200V				
Connection type (No. of phases)			Single-phase (two-wire,three-wire), three-phase three-wire (delta connection)				
Capacity		Single-phase	0.5-30kVA				Note 1
		Three-phase	1-75kVA				
Operating frequency			50Hz/60Hz				
Insulation resistance			100MΩ or more at DC500V				
Withstand voltage (*)	Input to output		AC10kV (for 1 minute) Impulse (1.2/50μs) 30kV				
	Input to earth						
	Output to earth		AC3kV (for 1 minute)				
Voltage fluctuation rate and efficiency	Single-phase	Capacity	0.5kVA or less	1-2kVA	3kVA	5kVA or more	
		Voltage fluctuation rate	5% or less	4% or less	3% or less		
		Efficiency	93% or more		95% or more		
	Three-phase	Capacity	7.5kVA or less		10kVA or more		
		Voltage fluctuation rate	3% or less		2% or less		
		Efficiency	95% or more		97% or more		
Insulation class		Single-phase	Class A 2kVA or less, Class B 3kVA or more				Note 2
		Three-phase	Class A 60kVA or less, Class B 75kVA or more				
Limit of temperature rise		Class A	55℃ or less				Resistance method with ambient temperature 40℃
		Class B	75℃ or less				
Lightning surge conversion rate			1/1000 or less				

Note 1: Products can be manufactured with other capacity besides standard one.
Note 2: Products can also be manufactured with insulation type H.
* Example of AC withstand voltage symbol 1.

■Dimensions - mass (For single-phase)

Capacity (kVA)	Dimensions (mm)							Mass (kg)
	A	B	a	b	H	H_0	D	
0.5	200	200	150	185	200	70	8.5	13
1	200	250	150	230	200	70	8.5	18
2	240	290	150	270	260	70	8.5	31
3	240	290	150	270	260	70	8.5	35
5	260	380	200	360	380	90	10.5	47
7.5	260	380	200	360	380	90	10.5	65
10	320	400	250	380	420	100	10.5	96
15	320	400	250	380	420	100	10.5	120
20	400	500	300	470	420	110	12.5	160
25	400	500	300	470	500	110	12.5	177
30	400	500	300	470	500	150	12.5	200

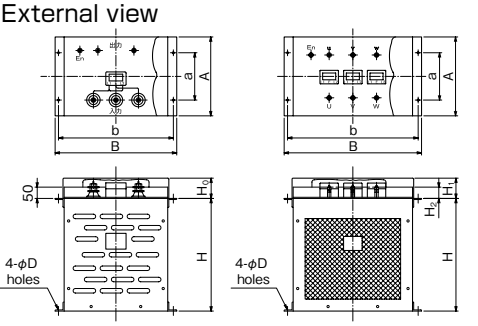
Dimensions of the non-standard type may differ from these.

■Dimensions - mass (For three-phase)

Capacity (kVA)	Dimensions (mm)								Mass (kg)
	A	B	a	b	H	H_1	H_2	D	
1	350	480	250	440	350	90	45	12	45
2	350	480	250	440	350	90	45	12	55
3	350	480	250	440	350	90	45	12	65
4	400	580	300	540	400	90	45	12	80
5	400	580	300	540	400	90	45	12	90
7.5	400	630	300	590	470	100	50	12	135
10	400	630	300	590	470	100	50	12	155
15	400	630	300	590	540	100	50	12	195
20	400	630	300	590	540	100	50	12	220
25	460	740	300	690	620	110	55	16	300
30	460	740	300	690	620	110	55	16	325
35	500	830	300	780	690	110	55	16	370
50	500	830	300	780	690	110	55	16	430
75	580	910	400	850	720	150	55	19	580

Dimensions of the non-standard type may differ from these.

■External view



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Lightning transformers

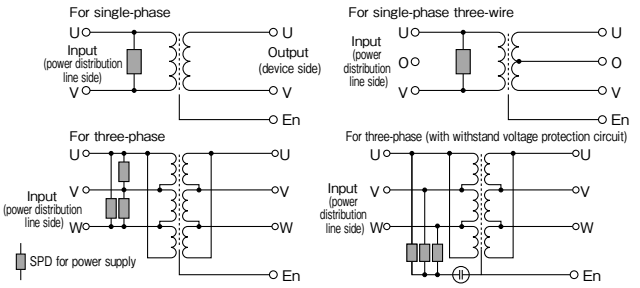
Lightning surge conversion rate less than 1/1000 high performance lightning transformers

STC type (cabinet type)

Lightning transformers are used for surge protection of power supplies for low voltage power distribution equipment such as in equipment rooms, radio relay stations, mobile telephone base stations, etc.
The unit comprises a static electricity shielded high withstand voltage insulation transformer (protecting the earth) and a power supply SPD (protect between devices and the earth), proving effective shutout against induced lightning surge and earth potential rise.


STC type

■Circuit diagram



■Model identification

□ STC □ – □□□ □ □ □ □

Connection type	
Symbol	Type
1	Single-phase
3	Three-phase
4	Reverse V
5	Scott

AC withstand voltage		
Symbol	Primary	Secondary
1	10kV	3kV
2	3kV	10kV
3	3kV	3kV
4	10kV	10kV
5	15kV	3kV

Capacity			
Symbol	Capacity	Symbol	Capacity
501	500VA	153	15kVA
102	1kVA	203	20kVA
202	2kVA	253	25kVA
302	3kVA	303	30kVA
402	4kVA	353	35kVA
502	5kVA	503	50kVA
752	7.5kVA	753	75kVA
103	10kVA		

Input side Rated voltage	
Symbol	Voltage
1	100V
2	200V
4	400V
5	200V Single-phase three-wire (with center open terminal)
6	100/200V Single-phase three-wire (with neutral point terminal)

Output side Rated voltage	
Symbol	Voltage
1	100V
2	200V
4	400V
7	100/200V Single-phase three-wire

Other functions	
Symbol	Function
S	RP-200 type with SPD
R	S100, S200, S400–S type with SPD
G	with withstand voltage protection circuit (in combination with S type SPD)
P	with withstand voltage protection circuit (in combination with RP-200 type SPD)

Color	
Symbol	Color
1	7.5BG 6/1.5 Semi-gloss
2	7.5BG 6/1.5 Gloss
3	7.5BG 7/1.5 Semi-gloss
4	5Y 7/1 Semi-gloss
5	2Y 7.5/1 Semi-gloss
6	N 7 Semi-gloss
7	2.5B 6/3 Semi-gloss

■Characteristics

Item			Performance			Remarks
Input/output voltage			AC100V, AC200V, AC400V, AC100/200V			
Connection type (No. of phases)			Single-phase (two-wire,three-wire), three-phase three-wire (delta connection)			
Capacity		Single-phase	0.5-30kVA			Note 1
		Three-phase	5-100kVA			
Operating frequency			50Hz/60Hz			
Insulation resistance			100MΩ or more at DC500V			
Withstand voltage (*)	Input to output		AC10kV (for 1 minute) Impulse (1.2/50μs) 30kV			
	Input to earth					
	Output to earth		AC3kV (for 1 minute)			
Voltage fluctuation rate and efficiency	Single-phase	Capacity	1kVA or less	2kVA	3kVA or more	
		Voltage fluctuation rate	5% or less	4% or less	3% or less	
		Efficiency	93% or more		95% or more	
	Three-phase	Capacity	7.5kVA or less	10-30kVA	40kVA or more	
		Voltage fluctuation rate	4% or less	3% or less	3% or less	
		Efficiency	94% or more	95% or more	96% or more	
Insulation class		Single-phase	Class B			Note 2
		Three-phase	Class B			
Limit of temperature rise			75℃ or less			Resistance method with ambient temperature 40℃
Lightning surge conversion rate			1/1000 or less			

Note 1: Products can be manufactured with other capacity besides standard one.
Note 2: Products can also be manufactured with insulation type H.
* Example of AC withstand voltage symbol 1.

■Dimensions - mass (For single-phase)

Capacity (kVA)	Dimensions (mm) H	W	D	A	B	Mass (kg)
0.5	400	300	300	260	260	30
1.0	400	300	300	260	260	50
2.0	450	350	400	360	310	60
3.0	450	350	400	360	310	70
5.0	650	500	500	400	460	130
7.5	650	500	500	400	460	150
10.0	800	550	550	450	500	175
15.0	800	550	550	450	500	200
20.0	800	550	550	450	500	250
25.0	900	650	600	500	600	280
30.0	900	650	600	500	600	300

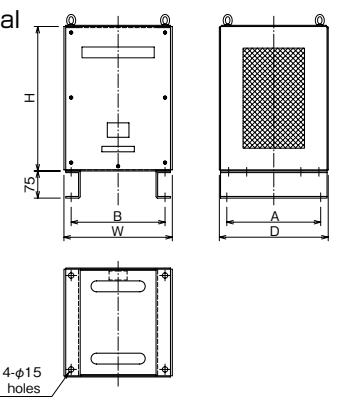
Dimensions of the non-standard type may differ from these.

■Dimensions - mass (For three-phase)

Capacity (kVA)	Dimensions (mm) H	W	D	A	B	Mass (kg)
5	600	550	450	350	500	105
7.5	600	550	450	350	500	140
10	800	600	450	350	550	165
15	800	600	450	350	550	195
20	800	600	450	350	550	240
30	900	700	500	400	650	305
40	900	700	500	400	650	385
50	900	700	500	400	650	425
75	1,000	800	600	500	750	540
100	1,000	800	600	500	750	630

Dimensions of the non-standard type may differ from these.

■External view



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Thin type lightning transformer for mounting on 19 inch rack

IT Thunder-guard transformer

The purpose of this device is to provide protection for equipment and power cables against abnormal voltage and current when lightning surges, etc., are applied to power supply circuits (single-phase two-wire). It is a thin type that can be neatly housed in a 19 inch rack.

Features

- Protects IT equipment from lightning surges.
- Impulse withstand voltage 30kV, lightning surge conversion rate 1/1000 or less
- 19 inch rack, can be attached to EIA/JIS racks.
- With overcurrent protection breaker
- Transformer capacity selectable from 0.5kVA / 1kVA / 2kVA / 3kVA
- LED goes out when SPD for power supply deteriorates.
- SPD module replaceable

■Characteristics

Item		Performance			
Input/output voltage		AC100V, 200V (single-phase) (selection)			
Capacity		0.5kVA/1kVA/2kVA/3kVA (selection)			
Operating frequency		50Hz/60Hz			
Insulation resistance		100MΩ or more at DC500V			
Withstand voltage	Input to output	AC10kV (for 1 minute) Impulse (1.2/50μs) 30kV			
	Input to earth				
	Output to earth	AC3kV (for 1 minute)			
Voltage fluctuation rate		0.5kVA	1-2kVA	3kVA	
		5% or less	4% or less	3% or less	
Efficiency		0.5-2kVA, 93% or more			
		3kVA, 95% or more			
Surge conversion rate		60dB or more (1/1000 or less)			
Noise filter function		40dB (symmetrical wave 1-10MHz)			
Mass		0.5kVA	1kVA	2kVA	3kVA
		15kg	22kg	32kg	38kg

*Specifications and performance can be customized.

IT Thunder-guard transformer

(500VA/1kVA type) Dimensions: W480×D430×H88(mm)
(2kVA/3kAV type) Dimensions: W480×D430×H132(mm)

■Model identification

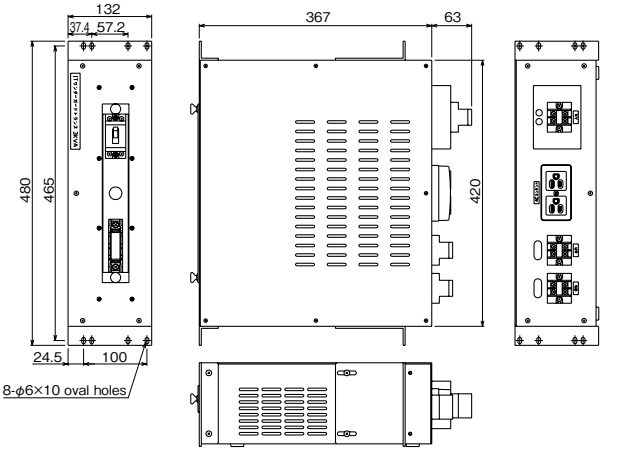
RC – □□ □□

Voltage ratio	
Symbol	Voltage ratio
11	100:100
21	200:100

Capacity	
Symbol	Capacity
05	0.5kVA
10	1kVA
20	2kVA
30	3kVA

E.g.: RC – 1105 = Voltage ratio/ 100: 100 Capacity/ 0.5KVA
RC – 2120 = Voltage ratio/ 200: 100 Capacity/ 2KVA

■External view



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Insulation transformer

For AC circuits

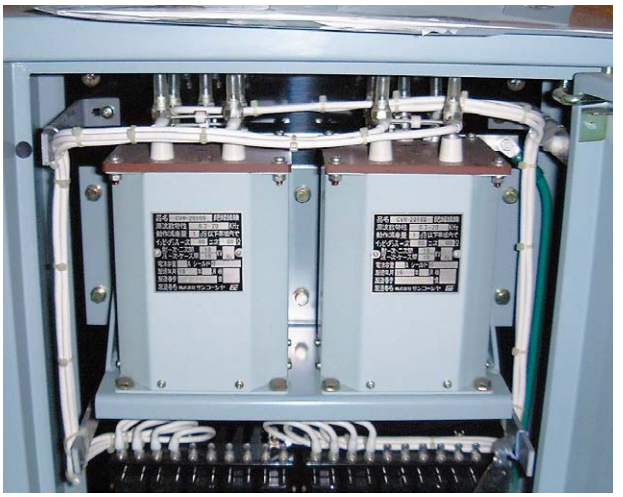
Insulation transformer

Insulation transformers are used for the surge protection across communication and control lines in locations such as in equipment rooms, radio relay stations, mobile telephone base stations, etc.
By insulating the device side and external line cable side, it provides effective shutout against induced lightning surge and earth potential rise.

■Characteristics

Item	Measurement conditions	Performance
		CVR-2010S
Applications	—	Monitoring and control lines
Withstand voltage	L to T, L to case	10kV
	T to case	3kV
Transmission frequency bandwidth	—	16Hz 0.3k-20kHz
Impedance	—	200Ω:200Ω 200Ω:600Ω 600Ω:600Ω

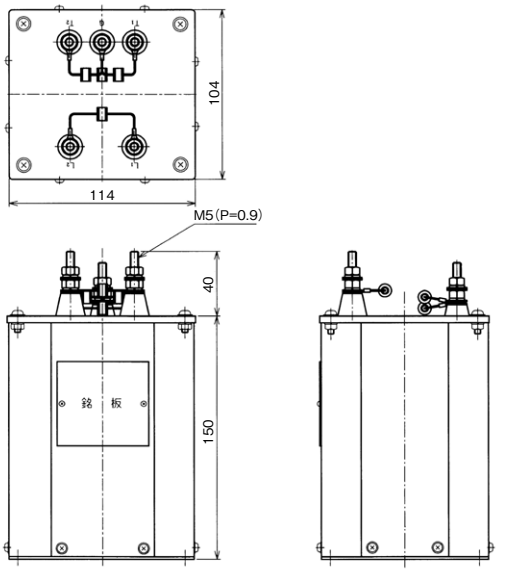
* Models are available with other withstand voltage, transmission frequency and impedance ratios besides those described above.



CVR-2010S

Dimensions: W114×D104×H190 (mm)
Mass: 4.5 (kg)

■External view



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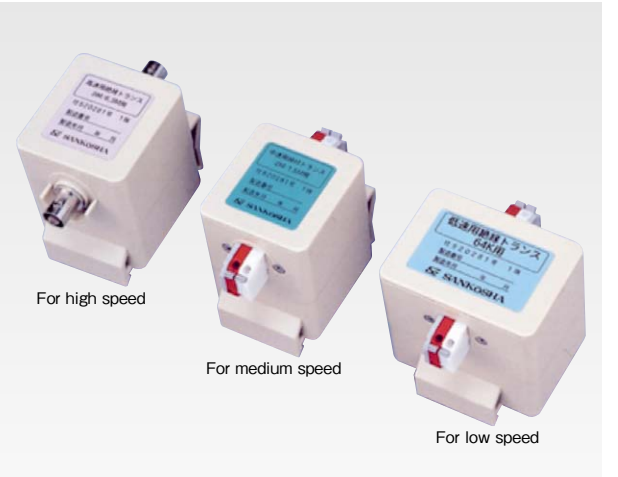
Insulation module

Countermeasure against abnormal between voltage floors in buildings

Insulation module

This insulation transformer module is used for the surge protection of communications equipment and devices installed on different floors of a building. The module comprises an insulation transformer that eliminates direct current flowing along metallic communication lines, and a distribution rack with an insulation transformer mounted on it.

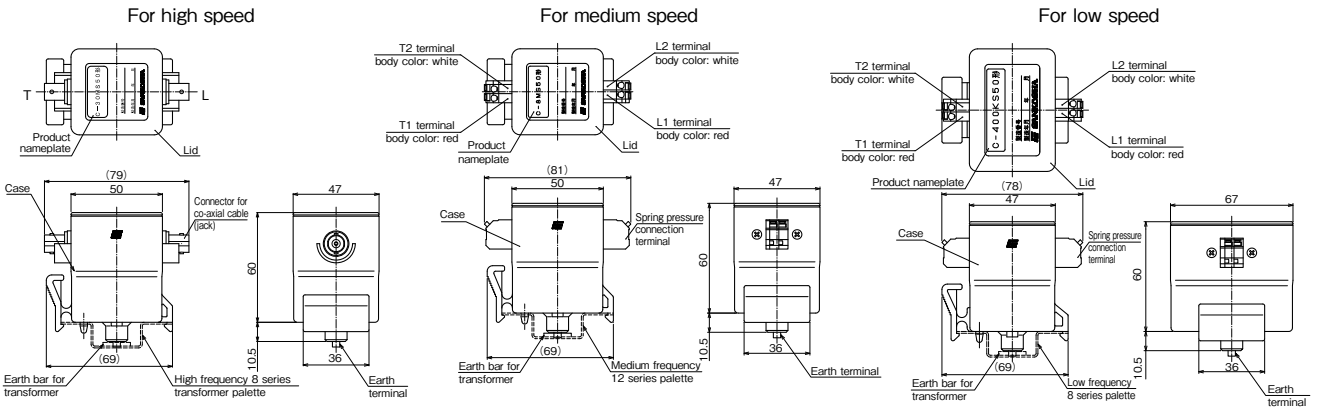


(For high speed) Dimensions: W79×D47×H70.5 (mm)/ Mass: 215 (g)
(For medium speed) Dimensions: W81×D47×H70.5 (mm)/ Mass: 210 (g)
(For low speed) Dimensions: W78×D67×H70.5 (mm)/ Mass: 295 (g)

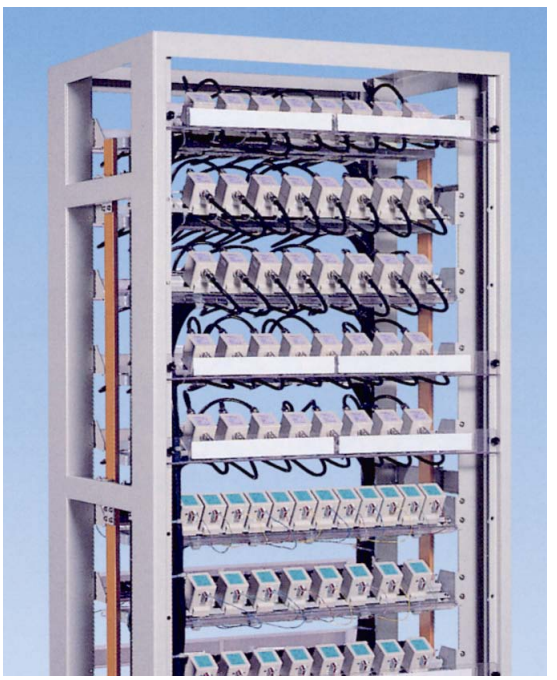
■Characteristics

Item	Performance						
	For high speed C-30MS50	For medium speed C-8MS50			For low speed C-400KS50		
Operating frequency bandwidth	100k-30MHz (≦0.5dB)	10k-8MHz (≦0.5dB)			500-400kHz (≦0.5dB)		
Balance	—	10kHz	2MHz	8MHz	500Hz	64kHz	400kHz
		≧85dB	≧50dB	≧45dB	≧85dB	≧60dB	≧50dB
Impedance	75Ω	110Ω					
Withstand voltage	1.2/50μs, 50kV						
Connector shape	BNC	Screwless			Screwless		

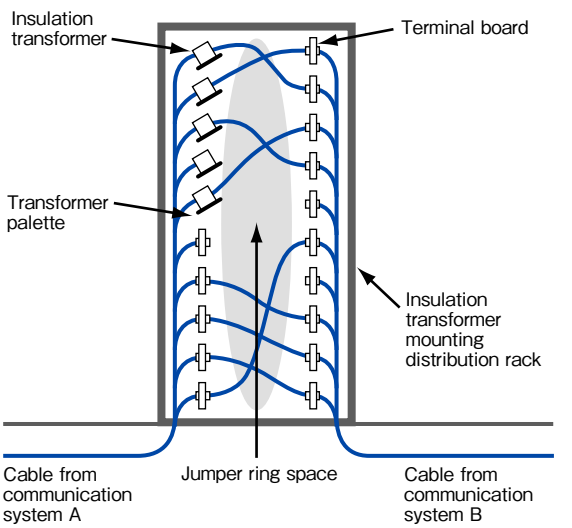
■External view



■Sample configuration: (1)



■Sample configuration: (2)



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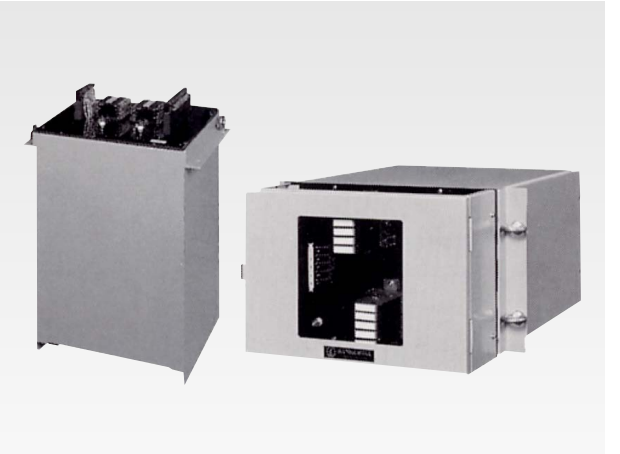
Neutralizing transformer

For DC circuits

Neutralizing transformer

Neutralizing transformers are used for induced lightning surge protection across communication and control lines in locations such as in equipment rooms, radio relay stations, mobile telephone base stations, etc. These devices insulate the device side and external line cable side, provide effective shutout against induced lightning surge and earth potential rise.



■Characteristics

Item	Measurement conditions	Performance
Maximum operating voltage	Induced voltage applied to each coil	3kV-25kV
Withstand voltage	Coil to case	Same as maximum operating voltage
	Coil to coil	3kV
Insulation resistance (at DC500V)	Coil to case	100MΩ or more
	Coil to coil	100MΩ or more
Coil resistance	Each coil	Less than 20Ω or 60Ω
Coil resistance deviation	Pair to pair	Less than 1Ω or 2.5Ω
Working attenuation	at 3.4kHz, 600Ω	1dB or less
Crosstalk attenuation	at 3.4kHz, 600Ω	60dB or more
Residual voltage (at maximum operating voltage)	Between communication coils	2V or less
	Communication coils to earth coils	20V or less
Earth coils excitation current	at maximum operating voltage	0.2A or less
16Hz attenuation	at 2kΩ load, 70V	0.5dB or less

■Model identification

□ N □ – □ □ □

- A:Vertical type / B:Horizontal type
- Coil resistance 2:20Ω or less / 6:60Ω or less
- No. of coils
- Maximum operating voltage (kV)
- Indicates neutralizing transformer
- Frequency 5:50Hz / 6:60Hz

■Dimensions - mass

Model	Standards		Outline dimensions (mm)						Outline weight (kg)
	Withstand voltage (kV)	Pairs	A type			B type			
			Width	Height	Depth	Width	Height	Depth	
6N3-036	3	1	275	260	180	275	180	260	28
6N3-076	3	3	310	415	205	310	205	415	58
6N3-116	3	5	335	415	220	335	220	415	67
6N3-216	3	10	435	420	270	435	270	420	100
5N6-076	6	3	445	575	295	445	295	575	170
5N6-116	6	5	510	595	330	510	330	595	210
5N6-216	6	10	630	595	395	630	395	595	305
6N6-076	6	3	420	545	250	420	250	545	132
6N6-116	6	5	500	545	280	500	280	545	165
6N6-216	6	10	580	545	330	580	330	545	220
5N10-076	10	3	500	595	410	500	410	595	280
5N10-116	10	5	530	595	430	530	430	595	340
5N10-216	10	10	670	595	510	670	510	595	450
6N10-076	10	3	455	585	340	455	340	585	215
6N10-116	10	5	530	595	380	530	380	595	270
6N10-216	10	10	630	590	440	630	440	595	365
6N25-076	25	3	780	840	540	—	—	—	780
6N25-116	25	5	850	840	580	—	—	—	880
6N25-216	25	10	995	840	670	—	—	—	1125

* Dimensions given above are dimensions without cover attached.
* Units with coil resistance of 20Ω or less are considerably larger than those listed in this table.

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For lightning surges

Surge neutralizing transformer

Surge neutralizing transformers are used for surge protection across communication and control lines in locations such as in equipment rooms, radio relay stations, etc. These devices insulate the device side and external line cable side, and provide effective shutout against induced lightning surge and earth potential rise.

■Characteristics

Item	Measurement conditions	Performance
Maximum operating voltage	Induced voltage applied to each coil	1.2/50μs, 30kV
Withstand voltage	Coil to coil	AC3kV, 1 minute 1.2/50μs, 30kV
	Coil to earth	
Insulation resistance	Coil to coil	500MΩ or more
	Coil to earth	
Working attenuation	600Ω termination	1.0dB or less (0.5dB or less for 16Hz)
Current capacity	—	3A, 1 minute / 30A, 1 minute
DC resistance	Each coil	60Ω or less
	Deviation at each pair	Within 5%
Crosstalk attenuation	—	60dB or more
Frequency characteristics	—	DC to 3.4kHz
Coiling	—	2 coils

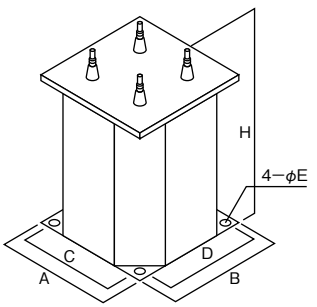
* AC withstand voltage 10kV type is also available for earth potential rise.

■Model identification

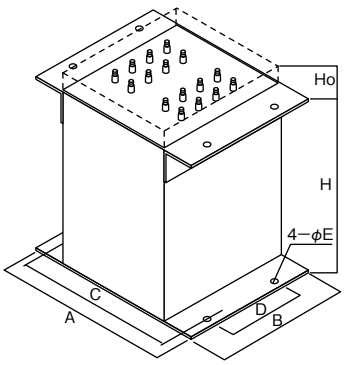
SN □ – □ □

- Coil resistance 6:60Ω or less
- No. of coils
- Maximum operating voltage (kV) 30:30kV
- Indicates surge neutralizing transformer

■Dimensions



A type



B type

Model	Dimensions (mm)							
	A	B	H	Ho	C	D	E	Shape
SN30-026	148	144	220	—	130	126	7	A
SN30-046	148	144	220	—	130	126	7	
SN30-066	220	170	220	—	205	100	7	B
SN30-086	340	230	380	50	320	150	9	
SN30-106	340	230	380	50	320	150	9	
SN30-126	400	280	345	50	375	200	9	
SN30-146	400	280	345	50	375	200	9	
SN30-166	400	280	345	50	375	200	9	
SN30-186	460	320	345	50	435	200	9	
SN30-206	460	320	345	50	435	200	9	

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Intelligent breaker

Features

- Installed on unmanned electrical facilities and service entrance of power supply lines where the maintenance is difficult to be carried out.
- Automatic recovery function when breaker is tripped.
- Lightning resistance
- Reduced maintenance costs.

■Characteristics

Item	Performance
Breaker	NFB, ELB
Rated capacity	50AF: 5AT-50AT 100AF: 60AT-100AT
Operating voltage	AC100V, AC200V (1φ2W, 1φ3W, 3φ3W)
Sensitive leakage current (ELB only)	Capacity of <60A: 30mA Capacity of ≧60A: 100mA
Automatic power on interval	Can be programmed as desired (instantaneous, 1 minute, 30 minutes, 60 minutes) Number of power on retries: no restriction (However, if the breaker is tripped 6 times within an eight hour period, the automatic power on function stops.)
Instantaneous detection	If the breaker is tripped again within a short period of time (about 3 seconds) with automatic power on, the automatic recovery function stops.
Impulse protection level	≦1,500V(1.2/50μs, 15kV applied) *Steel box type only
Impulse discharge current	8/20μs, 9kA (when arresters are used)
Withstand voltage	1.2/50μs 30kV (when arresters are not used)
Alarm contact	No-voltage contact "a" (contact capacity AC200V, 2A)
Shape	① Steel box type ② Plastic box type ③ Panel mount type ④ Stand-alone type
Other	Counter can be used to check number of automatic recovery operations (L display: 0 to 9 times or more) The controller (optional) can be used as intermittent detection function.

ISDN safety devices

Features

- Comprises neutralizing transformer, insulation transformer and filter.
- For ISDN line DC transmission.
- Protects ISDN lines from lightning surge.
- Prevents lightning surge from leaking out of communication lines.
- Can be adapted to cover different numbers of lines, such as 1 line, 2 lines, etc.

■Characteristics

Item	Performance
Operating frequency bandwidth	DC, 10k-400kHz
Impedance	110Ω
DC resistance	60Ω or less
Impulse withstand voltage	1.2/50μs, 30kV

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What is earthing?

Earthing is the electrical connection of machinery and equipment to the ground, via a conductor.
Equipment that is normally earthed would include various kinds of electrical appliances (for power supply, communications, signaling, wireless, etc.), lightning protection equipment (lightning rods, overhead ground wires, etc.) , and electric protection equipment, etc.
In order to earth something, electrical terminals need to be connected to the ground. Earth electrodes perform the role of electrical terminals, and a variety of earth electrodes can be installed, depending on economical and constructional situations.

Purpose of earthing

Earthing plays a very important role of protecting human operators against electric shock in the event of a lightning strike or malfunction of electrical equipment, and also protects the equipment against insulation breakdown.

1	2	3	4	5	6
Prevention of electric shock and fire due to leak current	Suppression of abnormal voltage	Prevention of electrostatic damage	Prevention of damage to communi-cations	Prevention of fire and damage due to lightning	Reliable operation of protection relay apparatus

Types and features of earthing installation

When starting earthing installation, it is necessary to plan carefully what kind of earth electrodes will need to be used in order to secure the required earth resistance. Each site will have its own restrictions due to the topography, area and buildings and structures, etc., and consideration also needs to be given to future construction plans. The table below shows some of the typical earthing installation methods that are currently in use, and describes the special features of each.

■ Representative earthing installation methods and their features

Type and classification of electrodes		Installation method	Features		
			Working area	Durability	Economy
Rod electrode	Rod insertion method	A simple method of inserting connected earthing rods into the ground.	Restricted	Good	Excellent
	Boring method	Method of inserting electrodes and conductive materials into bored holes.	Restricted	Excellent	Acceptable
Plate electrode	Earthing plate	Metal plates (90×90) are laid in the ground, horizontally or vertically.	Medium	Excellent	Good
	Conductive concrete strip electrode	SAN-EARTH conductive concrete is laid around the lead wires.	Medium	Excellent	Excellent
	SAN-FLEX wiring installation	Strip electrodes are installed in a combination of SAN-FLEX conductive coated wire and SAN-EARTH.	Medium	Especially excellent	Excellent
Buried earth		Bare wires are laid to a shallow depth.	Medium	Good	Good
Mesh earthing		Buried earth wires are laid in a mesh format to a shallow depth.	Large	Good	Good
Earth resistance reducing method	Conductive reducing material	Conductive materials are laid around buried earth or other earth electrodes.	Medium	Excellent	Good
	Electrolytic reducing material	Electrolytic solution (soil conditioner) is injected into the ground around the earth electrodes. Care needs to be taken with regard to the effect on humans, livestock and plants, etc.	Medium	Acceptable	Good

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Special features of SAN-EARTH Earthing Enhancing Compound

SAN-EARTH is a non-polluting earthing product whose main components are special carbon particles and cement. Moreover, because it is a good conductor, it provides stable and permanent earthing.

Excellent earthing effects

Because of its powdery, granular composition, SAN-EARTH is easily assimilated into soil and makes contact with the ground over a large effective area. SAN-EARTH delivers an excellent earthing effect that is not possible with conventional earth enhancing materials.

Simple and economic installation

In principle, M5C does not require water when being installed. Because roots and protruding rocks do not interfere with the installation, significant labor savings can be achieved. Also, the material can be freely installed on sloped sites and is ideally suited to all manner of earthing installation.

Corrosion prevention effect

There are many different causes of soil corrosion, but earth wires set in SANEARTH do not suffer from corrosion, in comparison with wires simply laid in the soil.

Non-pollution

SAN - EARTH is a very stable substance that does not leach into the ground or alter due to electrolysis, thus it provides non-polluting earthing.

SAN-EARTH types and applications

SAN-EARTH is available in three types, M1C, M5C, and B5C. The main applications and methods of installation of each type are as described below.

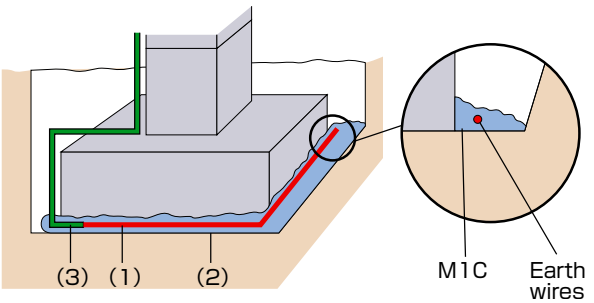
Type	Applications	Installation methods	Amount per bag
M1C	Pasting	Mixed with water into a paste consistency, then mortared onto concrete or bedrock, etc.	25kg
M5C	Scattering	Scattered in powder form.	25kg
B5C	Boring	Mixed with water into a liquid consistency and then injected by pump.	25kg

Earthing installation work using SAN-EARTH

SAN-EARTH M1C conductive concrete installation work

This is a simple installation method where the earth wires are laid in a trench around the outside of the foundations of a building or structure, and SAN-EARTH conductive concrete is installed so that the wires are covered. The basic installation method of SAN-EARTH M1C is shown in the illustrations below.

■ Basic construction method 1

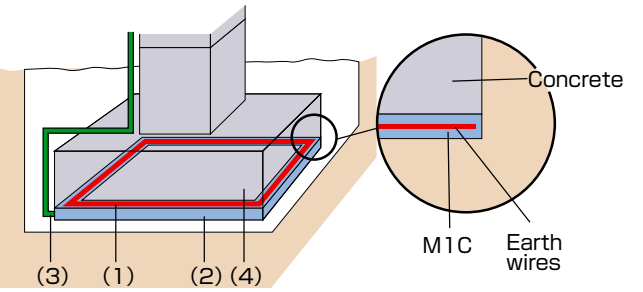


(1) Earth wires are laid in a trench around the outside of the foundations.

(2) SAN-EARTH conductive concrete is installed so that the wires are completely covered. SAN-EARTH M1C (25kg) is blended with approx. 7 liters of water.

(3) About 30cm of the covered part of the rising section of the earth wire is also embedded in the conductive concrete.

■ Basic construction method 2



(1) The earth wire is laid inside the foundations.

(2) SAN-EARTH conductive concrete is installed so that the wires are completely covered. SAN-EARTH M1C (25kg) is blended with approx. 7 liters of water.

(3) About 30cm of the covered part of the rising section of the earth wire is also embedded in the conductive concrete.

(4) When the SAN-EARTH mortar is dry, the next step of the process is to lay the foundation concrete.

■ Example of laying SAN-EARTH conductive concrete M1C

Laying SAN-EARTH M1C *One 25kg bag of M1C will cover approx. 3 meters (width 30cm)

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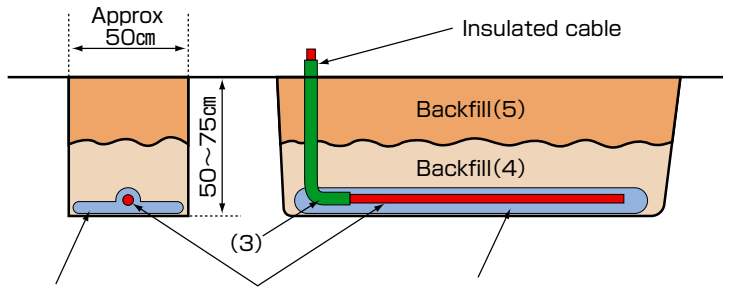
SAN-EARTH (M5C)

SAN-EARTH (M5C) absorbs the moisture in the surrounding soil and hardens naturally, making it ideal for installation in locations where it would be difficult to transport water.
Examples of how SAN-EARTH (M5C) is used in construction work are shown below.

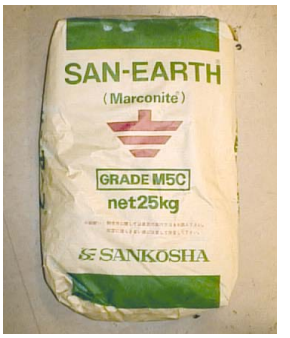
■ Basic construction method



(1) Lay earth wires.
(2) Scatter SAN-EARTH so that the earth wires are completely covered.
(Thickly around the earth wires, thinly at other locations)
(3) About 30cm of the covered part of the rising section of the earth wire is also embedded in SAN-EARTH.
(4) Carefully backfill with soil to a depth of around 10cm and tread down to compact it.
(5) Completely backfill with soil.

Note: If the earth wires are not completely covered with SAN-EARTH, they may corrode due to electropotential difference and the effect of electrolytic corrosion prevention will be lost.

■ Example of laying SAN-EARTH M5C



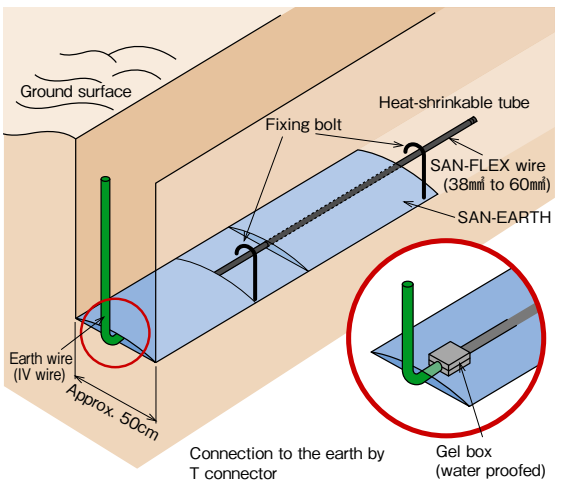
Laying SAN-EARTH M5C *One 25kg bag of M5C will cover approx. 3 meters (width 50cm) .

SAN-FLEX wire installation method (patented)

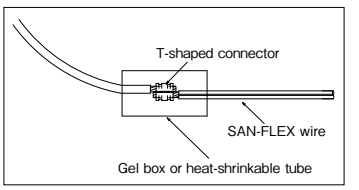
The SAN-FLEX wire installation uses SAN-FLEX wire (conductive coated wire) that enables long lasting earthing work in severe environments, such as railway tracks where direct current flows into the ground, or in coastal areas where there are tides, etc.

	Conventional methods	SAN-FLEX wiring installation method
Installation method	Generally using earthing rods or copper plates	SAN-FLEX wire (non-corroding) + SAN-EARTH (increase contact area)
Obtaining earth resistance	Contact surface area is small, making it difficult to obtain earth resistance.	Achieves reliable and stable earth resistance.
Life etc.	Life can be drastically shortened by soil and environmental conditions.	SAN-FLEX wires are used for the earth electrodes, providing long life with very little corrosion.

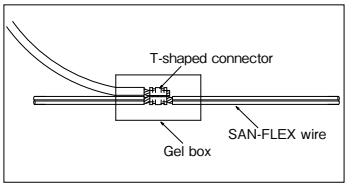
*Recommended product : SAN-EARTH M5C
*M5C: 25kg (one bag) will cover approx. 5m of installation. (width 50cm)



Connection of straight line section



Connection of split section



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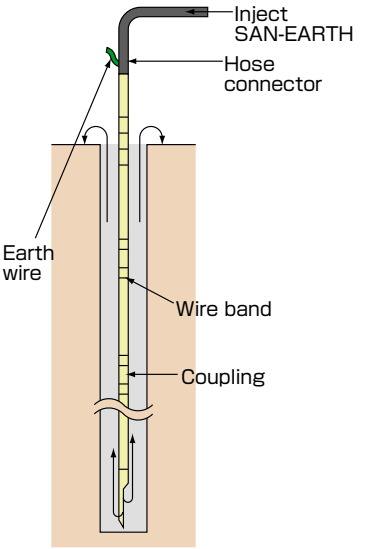
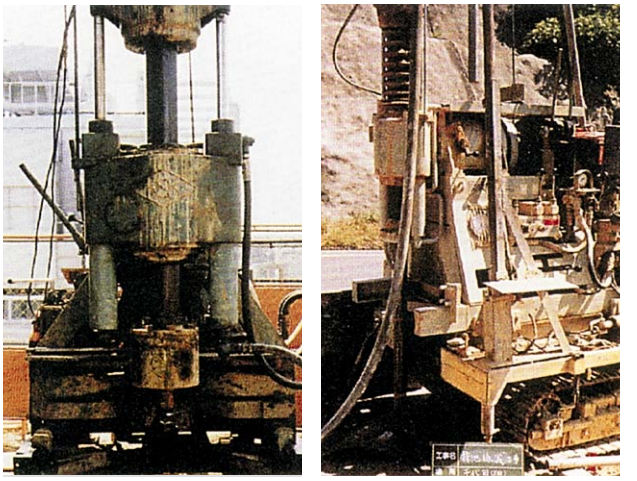
Deep-buried earthing method (boring method)

For locations where it is difficult to secure ground for earthing, such as power generation stations or substations, etc., the deep-buried earthing method (boring method), which uses the deep underground, is very effective. In the deep-buried earthing method, boring machines drill holes between 5 to 15cm diameter into the ground and electrodes are inserted into the holes. Compared with other installation methods, this method is able to achieve excellent earth resistance with relatively little work.
In Sankosha's Deep-buried earthing method there are the SAN-EARTH method and the SAN-FLEX method, depending on the earth electrode that is put in the ground.



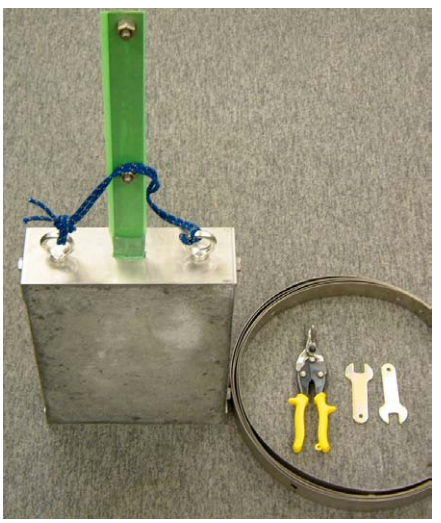
■ SAN-EARTH deep-buried earthing



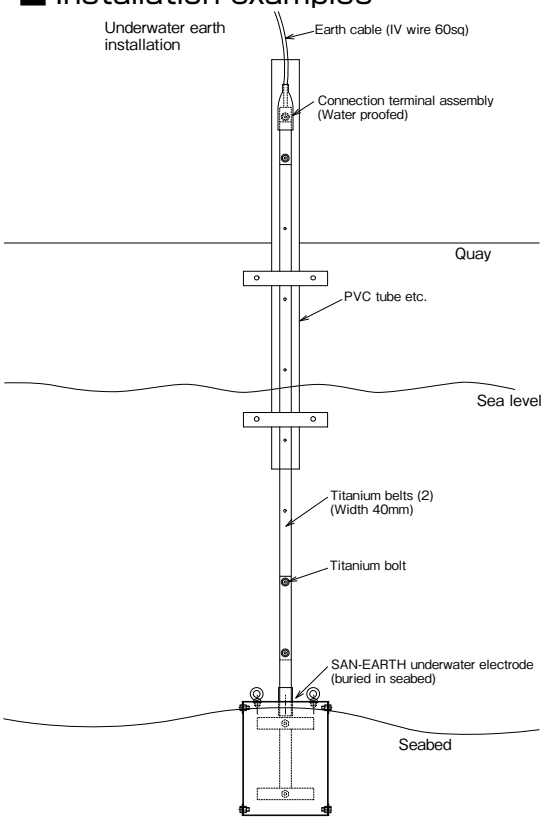
SAN-EARTH underwater electrodes (patented)

SAN-EARTH underwater electrodes use titanium for the electrodes and the conductive portion from underwater, and the earth electrodes are covered in the conductive concrete SAN-EARTH to form a single earthing unit. They come to the fore in obtaining earth resistance on cliffs where lighthouses are built and on sea-going facilities, etc.

	Conventional methods	SAN-EARTH underwater electrodes
Installation method	Earthing rods, copper wire and copper plate sare placed in the water.	Underwater electrodes are buried in the sea floor, and the earthing surface area increased by creating a block of SAN-EARTH.
Obtaining earth resistance	Can obtain around 10 Ω but unstable.	Good resistance of 1Ω or less can be obtained.
Life etc.	Earthing rods and copper plates can be washed away, and there is a danger of disconnection due to corrosion by seawater.	The SAN-EARTH block cannot be washed away, and provides long term stability.



■ Installation examples



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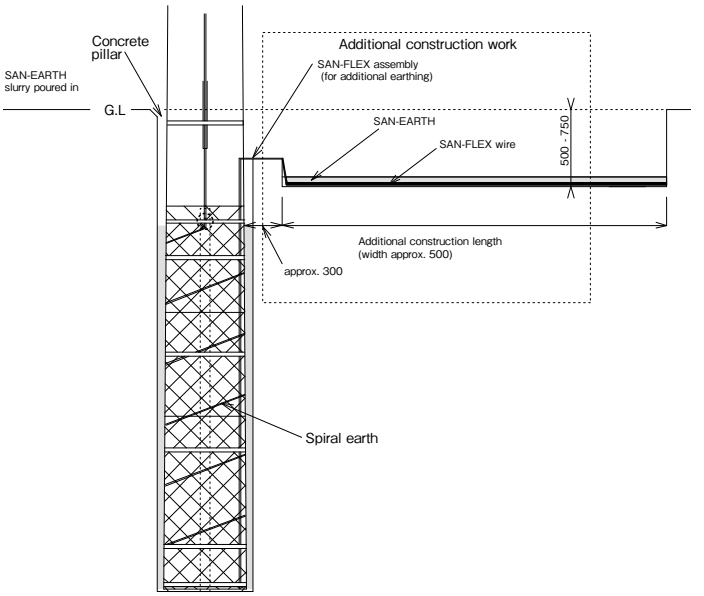
Spiral earth method

In spiral earth method, SAN-FLEX wire (conductive coated wire) is wrapped around a concrete pillar and it obtains the low earth resistance from the iron bars inside the concrete pillars. This method is suited for concrete pillars and FRP pillars, etc.

	Conventional methods	Spiral earth method
Installation method	Rods are inserted close to the pillars, but it is difficult to secure the space to insert multiple rods.	SAN-EARTH is poured into existing construction holes.
Obtaining earth resistance	In locations with high earth resistivity ratios (200Ω・m or over), it is difficult to achieve 100Ω resistance.	Even in locations with high earth resistivity ratios (200Ω・m or over), 100Ω resistance can be easily achieved.
Life etc.	In underground sites and coastal sites, the rods and connections are prone to corrosion and have a shorter lifespan.	SAN-FLEX wires are used for the earth electrodes, providing long life with very little corrosion.

■ Installation example



Home Earth

Home Earth is a revolutionary new earth installation method that uses SAN-FLEX wire (conductive coated wire) and SAN-EARTH. In sites where it has traditionally been difficult to insert earth rods into the ground, such as housing foundations and other sites where the ground is hard, this method involves simply laying the earth electrodes and SAN-EARTH between the concrete and the ground.

Features

● Simple installation

This is an easy installation method that simply involves laying SAN-EARTH.

● Long life earthing

The SAN-FLEX wire of earth electrodes are completely corrosion-proofed, highly corrosion resistant and long lasting.

● Environmentally friendly

The SAN-EARTH that is spread around the earth electrodes is a non-polluting product with many years of proven track record.

(SAN-EARTH M1C × 2kg)

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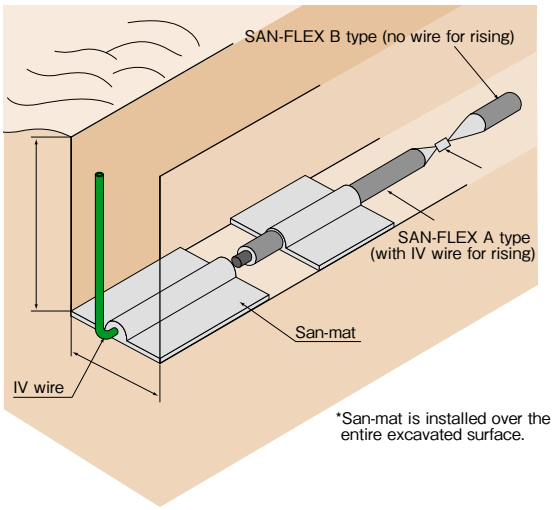
Other installation methods

SAN-FLEX kit method

The SAN-FLEX kit earthing installation method involves a combination of SAN-FLEX wire (conductive coated wire) covered with carbon breeze and San-mat that enables long lasting earthing work in severe environments, such as railway tracks where direct current flows into the ground, or in coastal areas where there are tides, or mountain installations where it is difficult to bring in materials.

	Conventional methods	SAN-FLEX kit method
Installation method	Generally using earthing rods or copper plates	SAN-FLEX wire (non-corroding) + SAN-EARTH installation work (increased contact area)
Obtaining earth resistance	Contact surface area is small, making it difficult to obtain earth resistance.	Achieves reliable and stable earth resistance.
Life etc.	Life can be drastically shortened by soil and environmental conditions.	SAN-FLEX wires are used for the earth electrodes, providing long life with very little corrosion.

The SAN-FLEX kit is available in A type, with connected IV wire's rising section, and B type for connection. (Photograph shows A type.)

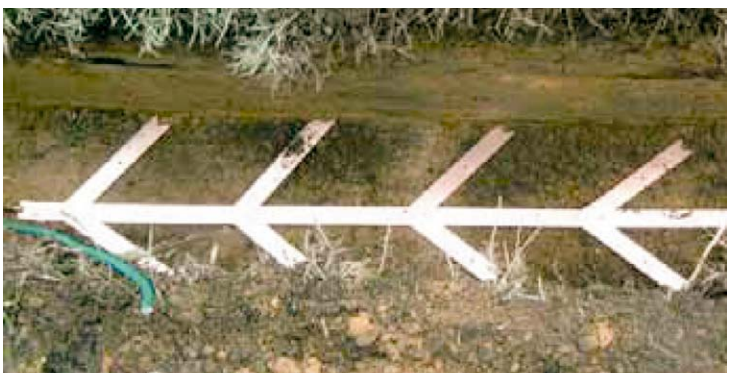


Feathered earth (patented)

With a feathered earth, vanes spread out on either side of a metal strip, it steadily reduces earth resistance and surge impedance. The pointed tips of the vanes promote the smooth discharge of electricity into the soil. They are particularly effective in reducing surge impedance from power transmission towers and in earthing wind power facilities.

	Conventional methods (rod type earths)	Feathered earth
Installation method	The product is covered with sharp needles, making handling and installation dangerous.	Stainless steel plates (SUS304) combinations are safe for handling and installation.
Obtaining earth resistance	Same as for earth rods. Difficult to reduce surge impedance.	Wider contact surface area means lower value is achievable. Surge impedance can be lowered.
Life etc.	Corrosion of earth is affected by soil and environmental conditions.	Stainless steel (SUS304) is used providing long life with very little corrosion.

Feathered earth



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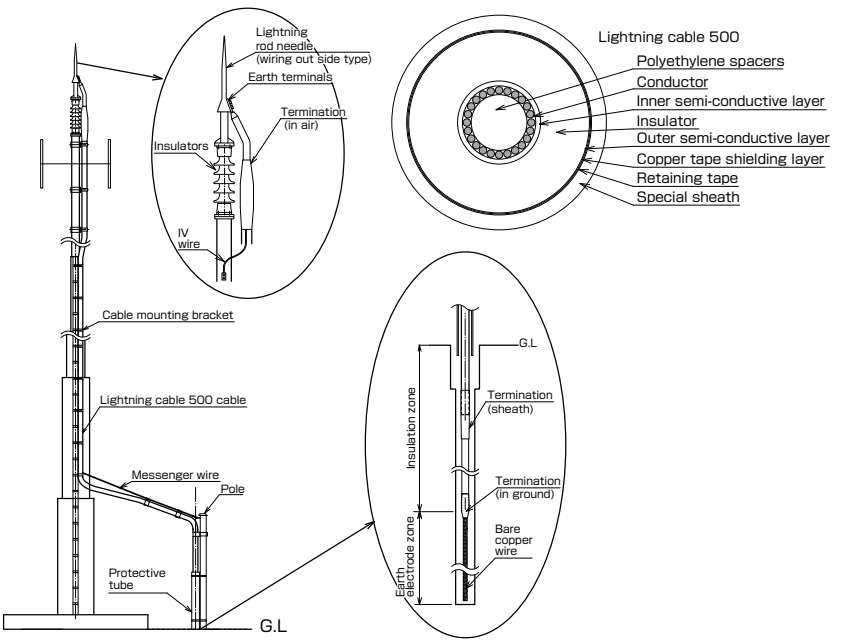
Lightning protection system 500 (patented)

Lightning protection system 500 provides highly effective protection against equipment damage due to direct lightning strikes on wireless relay stations and wireless base stations, and against lightning reflux current caused by direct lightning strikes. It is a direct strike protection system whereby insulators are used to isolate lightning rods and other air terminating sections from towers and buildings, lightning current is conducted downwards by highly insulated lightning cables (Sankosha product), and lightning current caused by direct lightning strikes is diverted through earths bored deep into the ground and discharged away from the surface.

	Conventional method (ordinary lightning rods)	Lightning protection system 500
Lightning rod	Contacts tower or building	Lightning rod isolated from tower or building by insulators
Lightning current route	Flows through iron frame of tower or building to foundations, and may enter equipment via feeder lines.	Lightning current flows to highly insulated lightning cables, and induced current to feeder line is reduced.
Down-conductor	Down-conductors are connected directly to towers and buildings, so practically all of the lightning current passes through the structure.	Highly insulated lightning cables have very high withstand voltage, making it difficult for current to flow to the tower or building.
Electropotential rise on ground surface	Electropotential rise causes lightning current to flow outside, potentially causing lightning damage.	Current is diverted to deep underground, keeping ground surface earth potential rise very low.

■ Installation example



Highly insulated lightning cable

Integrated lightning rod

For fall prevention

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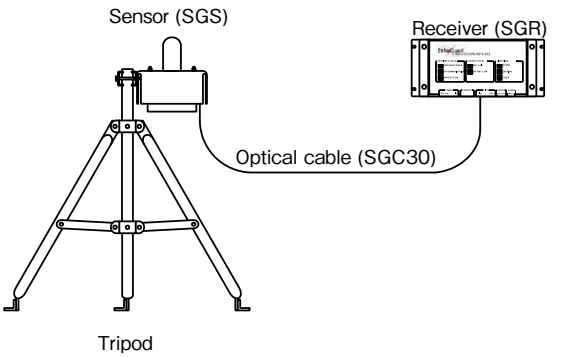
Strike guard (lightning approach warning device)

When lightning occurs, lightning current flows and light (lightning) and magnetic fields (electromagnetism) are released. Strike guard detects this light and magnetic field and estimates the closeness of the lightning using its waveform identification function. (Overhead: 0-8km, close: 8-16km, far: 16-32km) Also, since the device detects lightning based on simultaneous light and magnetic field, it will not react to noise (no mis-operation).



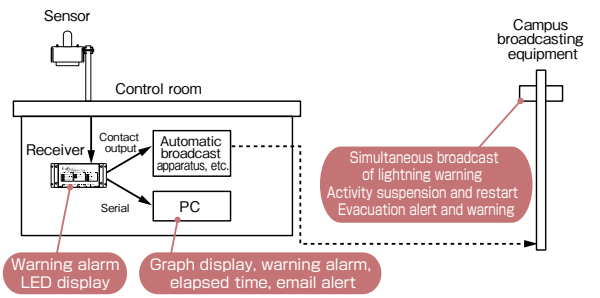
Features

- Can be installed in almost any location.
- Installation work is extremely simple.
- Battery operated sensors.
- Sensors connected via optical cables.
- Firmly detects dangerous lightning

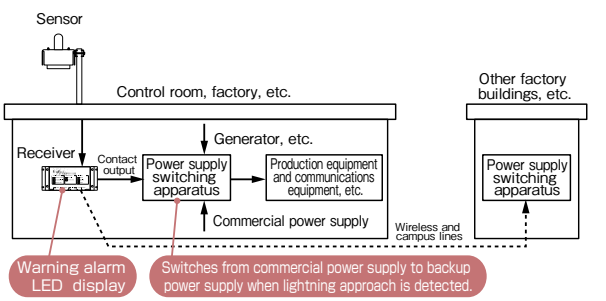
Installed on the fence of a building roof

Installed on the side of a wind turbine

Example of operation in golf courses and amusement parks



Example of operation in manufacturing plants and communications facilities



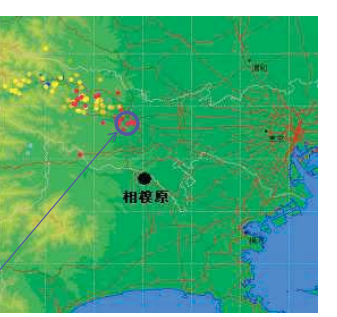
■ When lightning occurs, the distance and the degree of danger depend on the season and the terrain, but the following definitions are generally used.

- If lightning is within 32km (far), there is a risk of overhead lightning within 30 to 60 minutes.
- If lightning is within 16km (close), there is a risk of overhead lightning within 15 to 30 minutes.
- If lightning is within 8km (overhead), there is an imminent risk of overhead lightning.
- If 30 minutes have elapsed since the last lightning occurrence, the risk of overhead lightning is slight.

Strike guard lightning and rain alert status on July 7, 2005

Data received	Data content	<32km	<16km	<8km
15:44:56 07/07/05	Overhead	●	●	●
15:49:38 07/07/05	Far	●		
15:57:11 07/07/05	Far	●		
15:58:56 07/07/05	Far	●		
15:59:29 07/07/05	Far	●		
16:00:23 07/07/05	Far	●		
16:01:40 07/07/05	Far	●		

When the lightning continued to approach and lightning occurred in the vicinity of Hachioji (distance, approx. 14km), the alert display read "Overhead (distance within 8km)" .



Lightning strike conditions as of 15: 48 (JLDN data)
●0–10 ●10–20 ●20–30
●30–40 ●40–50 ●50–60 minutes before

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Surge counter SC301A type

When lightning strikes a communications tower or similar, this device can detect the lightning current and count when the current exceeds a given level. Both the outdoor detection unit and indoor receiving unit are insulated with fiber optic cable. The indoor receiver can send accumulated data to a PC, and can be programmed to issue an alarm when a count is made.

Features

Model	Applications
R-0	A sensor is fitted to a lightning conductor or tower's leg and measures lightning surge current. When lightning surge current flows into the conductor, the sensor detects this and records and stores the time and current peak value into the internal memory (max. 200 records). Automatic time correction is available with GPS clock (optional).
R-3	The basic functions of this model are the same as those of R-0. R-3 are equipped with an optical signal output so when lightning is detected, a signal can be sent to the indoor relay unit via a fiber optic cable. The indoor relay unit is equipped with contact output terminal, which operates for only about 15 seconds when lightning is detected. If the customer has an alarm network, this contact can detect lightning.

Characteristics

		R-0	R-3
Sensor	Sensor type	Divided type CT, Rogowski Coil	
	Sensor inner diameter	Select from split type CT: ϕ125, or Rogowski coil: ϕ300 *1	
Main unit (outdoor detection unit)	Measurement current range	0.5kA to 40kA (standard) *2	
	Frequency bandwidth	1kHz to 500kHz	
	Measurement accuracy	Accuracy ±10% or less (up to 2.0kA, ±0.2[kA])	
	A/D resolution	10 bit	
	Trigger level	+side 0.5kA, −side 0.5kA	
	Trigger time interval	Approx. 1sec	
	Recorded data	No. of records, date and time, current peak, polarity	
	Record data q'ty	200 records	
	Data display	Recorded data can be displayed on device LCD.	
	Time accuracy	Internal clock speed approx. ±4sec/ day With optional GPD clock, ±1sec/ day or less	
	Power supply	Main unit−single 3.6V lithium battery (two batteries for GPS clock)	
	Battery life	Approx. 2 years (may be shorter, depending upon operation frequency)	
	Water proofing	IP3 equivalent (rainproof type)	
	Guaranteed operating range	Temp.: −10℃ to +50℃, Humidity: 85% or less (no condensation)	
Relay control unit power supply: (R-3 type)		—	DC24V, DC48V (standard) *3
Fiber optic cable length		—	Within 50m *4

*1: The inner diameter of the Rogowsky coil can be changed according to the installation conditions (please enquire when ordering) .
*2: The current detection range can be changed (please enquire when ordering) .
*3: This can be changed according to the installation conditions (please enquire when ordering) .
*4: May change according to the installation conditions. (Please enquire when ordering.)

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Small, light, and long-life obstruction light using LED

OM-6C type medium light intensity obstruction light (red)

OM-6C type medium light intensity obstruction light (red) uses ultra-bright LED as its light source to provide greater conservation of electric power, a smaller and lighter body and a longer life, compared to the conventional light bulb system.

Mass: approx. 11 (kg)

Features

●Super long life (25,000 hours)
Using an LED as the light source enables the light's life to be extended. This allows reduction in maintenance and inspection when the lights are installed in high and dangerous locations, and also cuts down on maintenance labor costs.

●Small and light (less than 11kg)

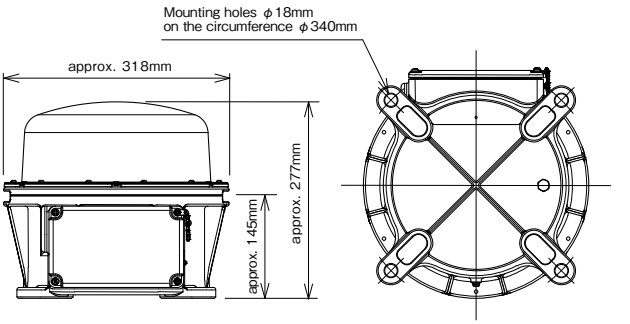
●Low power consumption
By using ultra-bright LED, this product only uses 1/25 of electric power compared to the conventional light-bulb system light.

●Visibility
The flickers of LED are similar to those of light bulbs to give natural visibility.

■Characteristics

Item	Performance
Light source	Ultra-bright LED
Flood light	Emission with afterglow which is similar to light bulbs
Maximum luminosity	2000 cd (candela) ±25%
Rated input voltage	AC 100 V±10%
Effective power	35W±20%
Operating temperature	-30℃ to +50℃
Storage temperature	-30℃ to +60℃
Maximum wind speed	90 m/sec
Rated life	25,000 hours

■External view



Longer life obstruction light using LED

OM-3C type low intensity obstruction light

OM-3C type low light intensity obstruction light uses LED as their light source, giving them longer life, low power consumption and compact size.

Mass: approx. 2.5 (kg)

Features

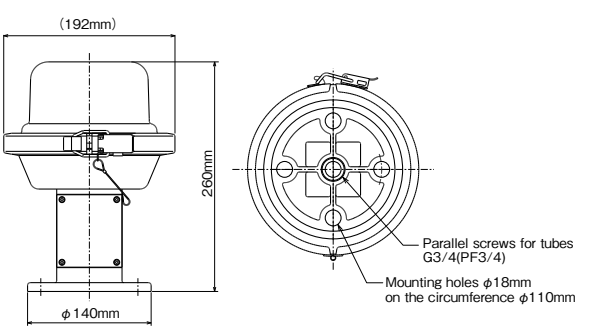
● Super long life (25,000 hours)
Using an LED as the light source enables the light's life to be extended. This allows a reduction in maintenance and inspection when the lights are installed in high and dangerous locations, and also cuts down on maintenance labor costs.

● Low power consumption
By using ultra-bright LED, this product is able to achieve low power consumption of less than 10W.

■Characteristics

Item	Performance
Light source	Ultra-bright LED
Flood light	Red fixed light
Maximum luminosity	32 cd (candela) or more
Rated input voltage	AC100V
Effective power	10W or less
Operating temperature	-30℃ to +45℃
Storage temperature	-30℃ to +50℃
Maximum wind speed	90 m/sec
Rated life	25,000 hours

■External view



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Obstruction Light that utilizes electrostatic induction from electrical power lines

OM-3B type low intensity obstruction light

(Electrostatic induction method: SI method)

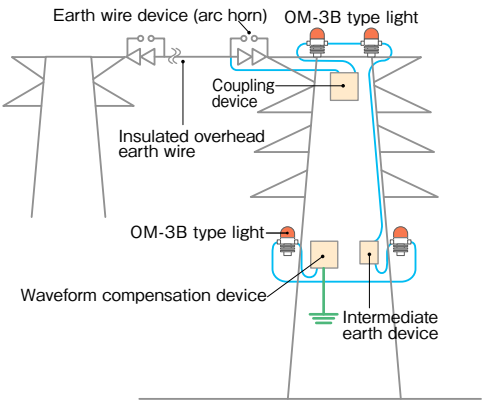
When overhead earth wires are partially insulated, electrostatically induced power can be drawn from power lines by the capacitance between the power lines and the insulated overhead ground wires (I GW). Obstruction light that uses electrical power obtained in this way as their power source are called electrostatic induction method obstruction light. In the electrostatic induction method, insulating the overhead ground wires makes it easy to extract electrical power, making it possible to install obstruction light in locations where it would be difficult to lay power lines, such as riverbeds and mountainous regions. Also, since the electrostatic induction method does not involve any connection to power lines, it is a safe method that does not allow general users to be affected by irregular voltage resulting from lightning strikes on towers, etc. Using power electrostatically induced from power lines to light obstruction light is extremely effective in saving energy, reducing installation costs and providing long life lighting.

Mass: approx. 8 (kg)

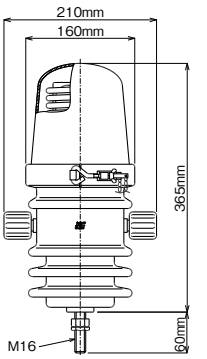
■Characteristics

Item	Performance
Light source	Red neon tube
Flood light	Red fixed light
Maximum luminosity	32 cd (candela) or more
Rated current	20mA
Frequency	50 Hz or 60Hz
Rated life	5,000 hours or more

■Sample configuration of electrostatic induction method



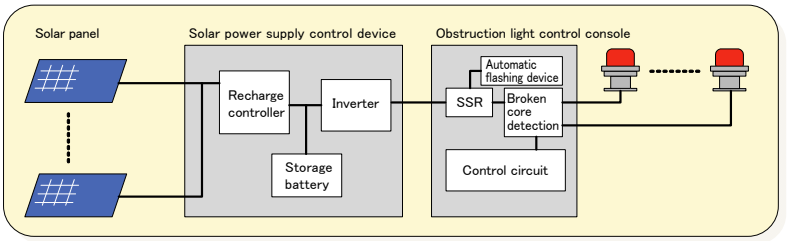
■External view



Solar power generated low light intensity obstruction light system

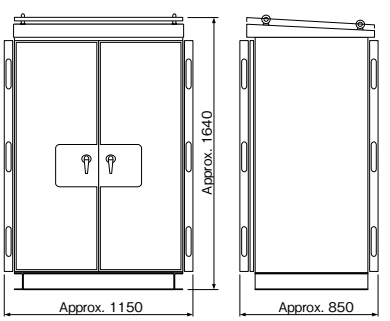
This system uses energy obtained from solar panels to power energy-saving OM-3C obstruction light.
The system can be installed in mountainous regions and other locations where there is no commercial power supply available.

■system configuration



■Power supply control device installation example

■Solar power supply control device external view (example)



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Optical termination box

Optical patch panel with max. 100 ports contained in 2U size

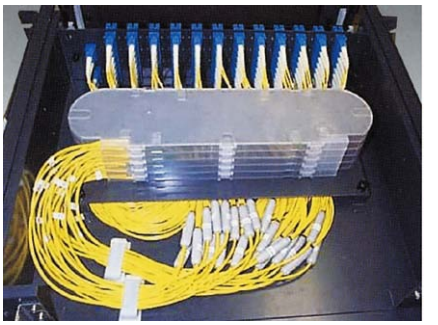
High density optical termination box (for 19 inch rack)

High density optical patch panel

Features

- With 2U, 100 port high density housing can be achieved.
- Can be used for up to 48,80 fibers. By removing the adapter, any number of fiber wires can be accommodated.
- Internal wiring enabled
  Pre-wiring is available on request, 4 core ribbon fiber pigtail code with SC wired through to fuse tray.
- EIA, JIS available
  The device can be adapted to comply with either EIA or JIS standards by replacing the plackets at both ends.

Dimensions: W482.6×D465×H88.1 (mm)



■Characteristics

Item		Performance
Maximum capacity	4 ribbon fiber	100 fibers
Connection type		Fusing + adapter
Connection adapter		Max.SC×100
Connection fiber tray		Max.5
No. of inlet cables	Trunk cable	1
	Cords	6
Applicable cable outer diameter		to ϕ20
Installation location		19 inch rack

Optical termination box featuring integrated optical adapter and fusing tray, enabling high density mounting

High density optical termination box SOD type

Features

- Lightweight (synthetic resin) and easy to install.
- Cables can be installed in up-down configuration.
- Optical connectors are basically SC type, but SC2 and MU (double capacity) are also available.
- The tray already has connector conversion fibers built-in, so there is no need for a conversion cord and no work involved in storing them. Core wires can accommodate SPC, APC polishing.
- Tray modules can be expanded.

■Characteristics

Item		Performance		
		SOD-40S	SOD-48S	SOD-100S
Maximum capacity	4 ribbon fiber	40	48	100
Connection type		Fusing + adapter	Fusing + adapter	Fusing + adapter
Connection adapter		SC×40	SC×48	SC×100
Tray modules		10	12	25
No. of cable inlets	Optical cable	2	2	2
	Cords	*10	*12	*25
Applicable cable outer diameter		–	–	–
Installation location		Mounted on inner wall	Mounted on inner wall	Mounted on inner wall
Dimensions (mm)		W400×D100×H375	W400 ×D100×H375	W400×D100×H750

*No. of 4 fiber FO cords
*Described types are representative. Other connection types, etc. can be manufactured on request.

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Optical termination box SOT type

Photograph shows SOT-2A.

Features

- Lightweight (synthetic resin) and easy to install.
- Max. 48 fiber fusing type also available.
- Couplers can be stored.
- Key attached type also available.
- Drop cable type also available.

■Characteristics

Item		Performance		
		SOT-12S	SOT-12A	SOT-12C
Maximum capacity	Single fiber	12	12	12
	2·4 ribbon fiber	24.48	24.48	24.48
Connection type		Fusing	Fusing + adapter	Fusing
Connection adapter		–	SC×12	–
Connection fiber tray		6	6	6
No. of cable inlets	Optical cable	1	1	1
	Cords	12	12	12
Applicable cable outer diameter		–	–	–
Installation location		Mounted on inner wall	Mounted on inner wall	Mounted on inner wall
Dimensions (mm)		W160×D75×H235	W330×D75×H330	W160×D75×H235
Remarks		–	–	Couplers can be stored.

*Described types are representative. Other connection types, etc. can be manufactured on request.

Optical termination box QM type

Dimensions: W210×D80×H310 (mm)

Features

- Lightweight (synthetic resin) and easy to install.
- Cables can be installed in up-down configuration.
- SC adapter can be attached.
- Optical coupler can be attached.
- Drop cable type also available.

■Characteristics

Item		Performance
Maximum capacity	Optical cable	48 fibers
	Drop	16 fibers
Connection type		Fusing
Connection adapter		–
Connection fiber tray		6
No. of cable inlets	Optical cable	8
	Drop	16
Applicable cable outer diameter		–
Installation location		Mounted on inner wall

*Described types are representative. Other connection types, etc. can be manufactured on request.

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Compact optical termination box SOH type

Dimensions: W140×D40×H170 (mm)

Features

- Lightweight (synthetic resin) and easy to install.
- Compact optical termination box with drop cable inlet.

■Characteristics

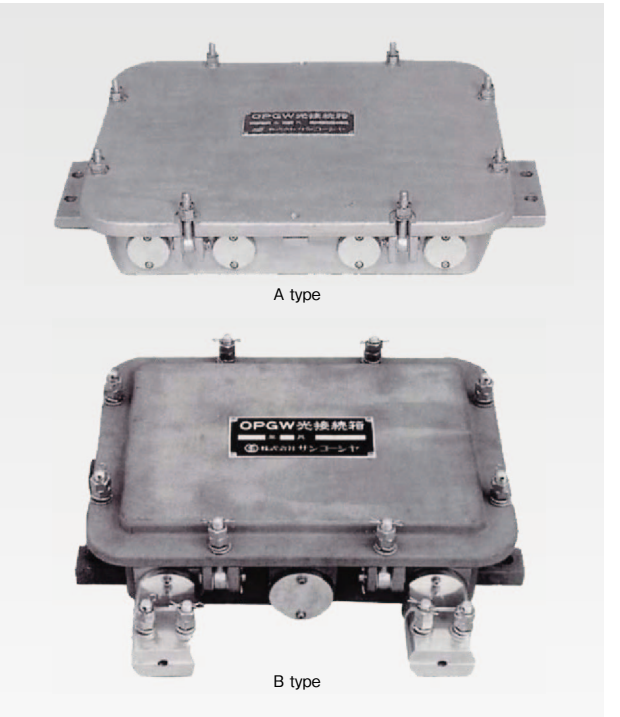
Item		Performance
Maximum capacity		Connector connection SC4 fiber Fusing only : 8 fiber (2 fiber･Single fiber drop)
Connection type		Fusing + adapter
Connection adapter		max. SC×4
No. of cable inlets	Inner wire: Drop, and parallel cords	4
	Outer wire: Drop, and parallel cords	8
Applicable cable outer diameter		—
Installation location		Mounted on inner wall

*Described types are representative. Other connection types, etc. can be manufactured on request.

OPGW connection box with superior durability and water proofing

OPGW Optical termination box

This termination box is used with optical fiber ground wires (OPGW). It can be directly attached to electricity pylons and is completely waterproof and has superior durability.
Also, the product can come in a variety of shapes, depending on where it is to be installed.



A type

B type

(A type) Dimensions: W580×D120×H495 (mm)
(B type) Dimensions: W450×D130×H350 (mm)

■Characteristics

Item	Performance	
	A type	B type
Maximum capacity	60 fibers	18 fibers
No. of cable inlets	OPGW, or OP cables 4	OPGW, or OP cables 3
Installation location	Outdoor tower	Outdoor tower

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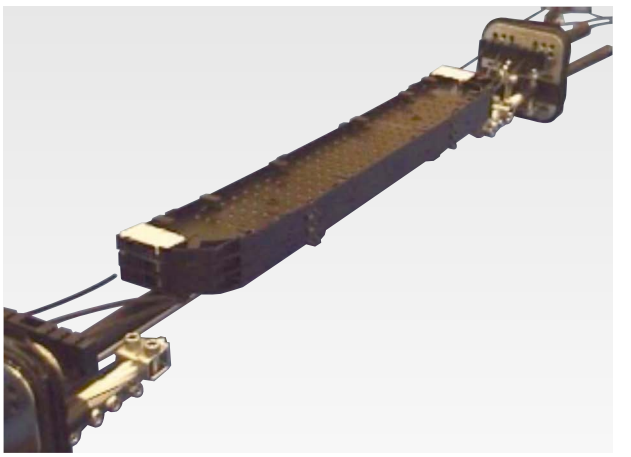
Optical closure

This closure offers excellent operability and economical benefits, and also comes in drop cable type. Draw-down by drop cables for FTTH, etc. is available.

FH type closure



(FH-MC-OL) Dimensions: W1150×D120×H110 (mm)
(FH-MC-O) Dimensions: W870×D120×H110 (mm)

■Characteristics

Item		Performance
Maximum capacity	Optical cable	200 fibers (4 ribbon fiber: 40 fibers/tray) 80 fibers (2 ribbon fiber) 60 fibers (single fiber)
	Drop cable	32 fibers (2 ribbon fiber) 16 fibers (single fiber)
Connection fiber tray		Max 5
No. of cable inlets		Trunk cable 2 (1 each side) + 4 branches (2 each side) Drop 24 (12 each side)
Applicable cable outer diameter		Trunk cable: ϕ8 to ϕ23 Branches: ϕ8 to ϕ17 Drop: 2.5×4.2mm or less
Installation location		Overhead
Applicable temperature range		-20℃ to +60℃
Water proofing		IEC 60529 IPX 4

With these closures, drop cables can be connected together via FTTH, providing superior operability and economy.

D type closure

Dimensions: W360×D27×H24 (mm)

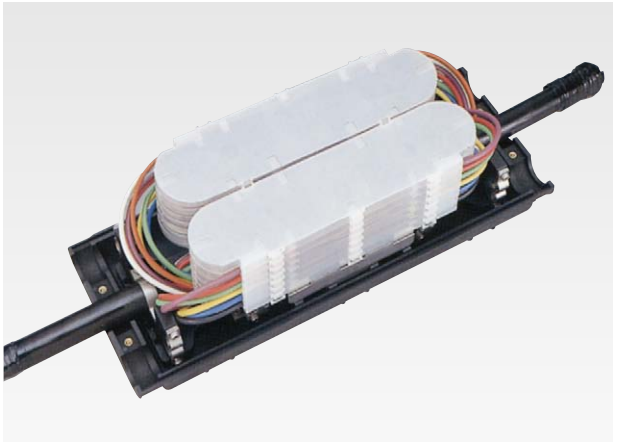
Features

- Compact and lightweight
- Mechanical splice connection possible.

■Characteristics

Item	Performance
Maximum capacity	8 fibers (up to two connections)
Connection fiber tray	None
No. of cable inlets	2 (1 each side)
Applicable cables	Drop cable
Installation location	Overhead
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 4
Tensile strength	After closure assembly: 686N (70kgf) Tension speed: 10mm/ min.

Y model closure



Dimensions: W500 × D192 × H190

Features

- Large capacity type
- Through-connection (slot cutting) enabled
- Can house optical couplers
- Flood sensor can be installed

■Characteristics

Item	Performance
Maximum capacity	1120 fibers (8 ribbon fiber: 80 fibers/tray) 560 fibers (4 ribbon fiber) 448 fibers (2 ribbon fiber) 168 fibers (single fiber: 12 fibers/tray)
Connection fiber tray	Max. 14 (11mm thick) 7×2 rows
No. of cable inlets	6 (3 each side)
Applicable cable outer diameter	ϕ8 to ϕ33
Installation location	Overhead, underground
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC C 0920 protection class 7

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Optical closure

With these closures, drop cables can be connected together via FTTH, providing superior operability and economy.

FD type closure

■Characteristics

Item		Performance
Maximum capacity	FD-MC-01	54 fibers (single fiber) 108 fibers (2 ribbon fiber) 216 fibers (4 ribbon fiber)
	FD-MC-02	36 fibers (single fiber) 72 fibers (2 ribbon fiber) 144 fibers (4 ribbon fiber)
Connection fiber tray	FD-MC-01	Max. 5
	FD-MC-02	Max. 3
No. of cable inlets	FD-MC-01	Trunk cable drop 2 Branches drop 32
	FD-MC-02	Trunk cable round type cables 2 Branches drop 32
Applicable cable outer diameter		Round type cables: ϕ8 to ϕ15 Drop cable: 2.5×4.2nm or less
Installation location		Overhead
Applicable temperature range		-20℃ to +60℃
Water proofing		IEC 60529 IPX 4

Dimensions: W300×D60×H183 (mm)

C type closure

Features

- ●Compact type
- ●Through connection (slot disconnection) available.
- ●Optical couplers can be stored.
- ●Water inundation sensor can be mounted.
- ●Tray storage for each slot.

■Characteristics

Item	Performance
Maximum capacity	160 fibers (4 ribbon fiber: 20 fibers/tray) 128 fibers (2 ribbon fiber)
Connection fiber tray	Max. 8
No. of cable inlets	4 (2 each side)
Applicable cable outer diameter	ϕ8 to ϕ23
Installation location	Overhead, underground
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 7

Dimensions: W350×D155×H150 (mm)

C type closure (multi-fiber)

Features

- ●Compact, high capacity type
- ●Through connection (slot disconnection) available.
- ●Optical couplers can be stored.
- ●Water inundation sensor can be mounted.
- ●Tray storage for each slot.

■Characteristics

Item	Performance
Maximum capacity	260 fibers (4 ribbon fiber: 20 fibers/tray)
Connection fiber tray	Max. 13
No. of cable inlets	4 (2 each side)
Applicable cable outer diameter	ϕ10 to ϕ23
Installation location	Overhead, underground
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 7

Dimensions: W350×D155×H220 (mm)

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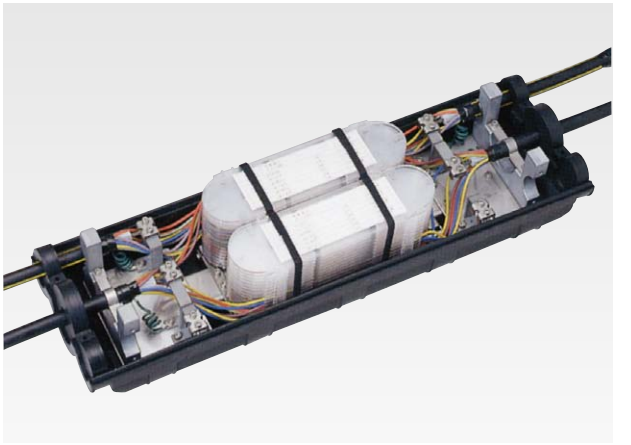
G type closure



Dimensions: W700×D210×H146 (mm)

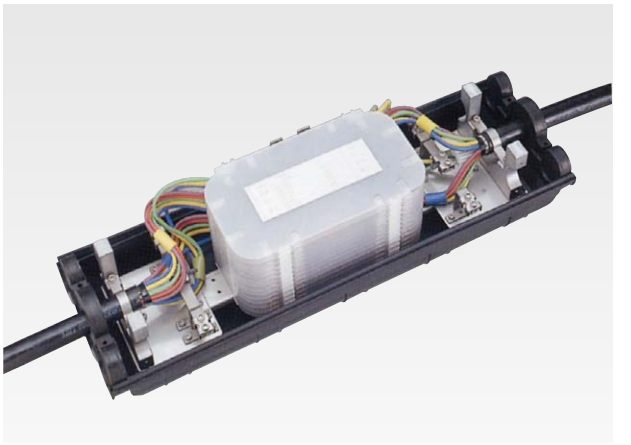
Features

- Through connection (slot disconnection, slot no disconnection) available.
- Optical couplers can be stored.
- Water inundation sensor can be mounted.
- Tray storage for each slot.

■Characteristics

Item	Performance
Maximum capacity	600 fibers (4 ribbon fiber: 20 fibers/tray) 480 fibers (2 ribbon fiber)
Connection fiber tray	30 (6 mm thick) 15×2 rows
No. of cable inlets	6 (3 each side)
Applicable cable outer diameter	ϕ8 to ϕ33 (central hole ϕ10 to ϕ53)
Installation location	Overhead, underground
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 7

G type closure (1000 fibers)



Dimensions: W700×D210×H190 (mm)

Features

- Connection for 1000 or more fibers available.
- Through connection (slot disconnection, slot no disconnection) available.
- Optical couplers can be stored.
- Tray storage type for each slot.

■Characteristics

Item	Performance
Maximum capacity	1040 fibers (8 ribbon fiber) 1040 fibers (4 ribbon fiber: 80 fibers/tray)
Connection fiber tray	Max. 13 (10mm)
No. of cable inlets	6 (3 each side)
Applicable cable outer diameter	ϕ8 to ϕ33 (central hole ϕ10 to ϕ53)
Installation location	Overhead, underground
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 7

S type closure

Dimensions: W600×D140×H140 (mm)

Features

- Through connection (slot disconnection, slot no disconnection) available.
- Optical couplers can be stored.
- Water inundation sensor can be mounted.
- Tray storage for each slot.

■Characteristics

Item	Performance
Maximum capacity	260 fibers (4 ribbon fiber: 20 fibers/tray) 208 fibers (2 ribbon fiber)
Connection fiber tray	13 (6 mm thick)
No. of cable inlets	4 (2 each side)
Applicable cable outer diameter	ϕ8 to ϕ33
Installation location	Overhead, underground
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 7

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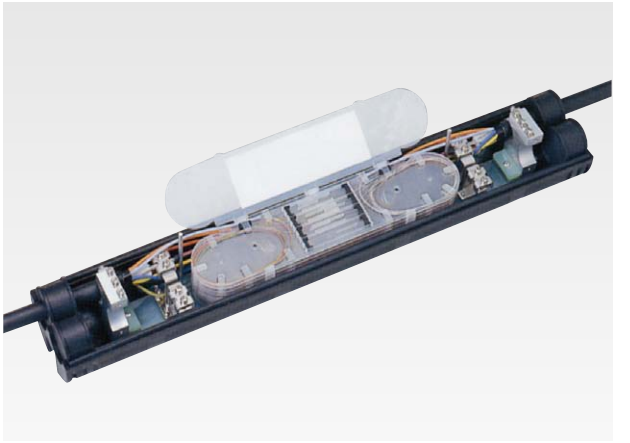
M type closure

Features

- Through connection (slot disconnection, slot no disconnection) available.
- Optical couplers can be stored.
- Water inundation sensor can be mounted.
- Tray storage for each slot.

■Characteristics

Item	Performance
Maximum capacity	260 fibers (4 ribbon fiber: 20 fibers/tray) 208 fibers (2 ribbon fiber)
Connection fiber tray	13 (6 mm thick)
No. of cable inlets	4 (2 each side)
Applicable cable outer diameter	ϕ8 to ϕ33
Installation location	Overhead, underground
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 7



Dimensions: W700×D118×H118 (mm)

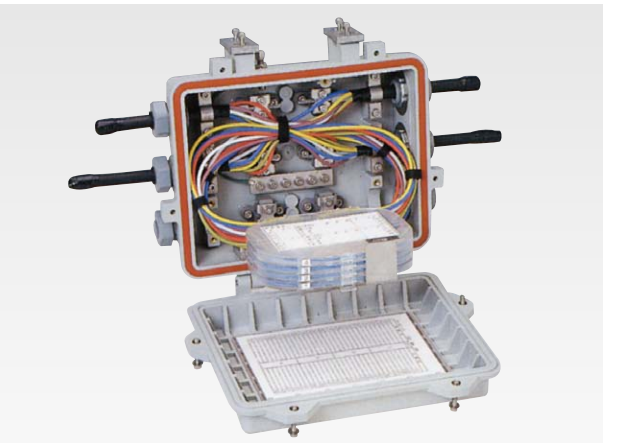
B type closure

Features

- Cable inlet section is connector type.
- Water inundation sensor can be mounted.
- Tray storage for each slot.

■Characteristics

Item	Performance
Maximum capacity	100 fibers (4 ribbon fiber: 20 fibers/tray) 80 fibers (2 ribbon fiber)
Connection fiber tray	Max. 5
No. of cable inlets	6 (3 each side)
Applicable cable outer diameter	Trunk cable: ϕ8 to ϕ21
Installation location	Overhead
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 4



Dimensions: W270×D210×H110 (mm)

T type closure

Features

- Through connection available. (slot disconnection type)
- Cable inlet section is connector type.
- Optical couplers can be stored.
- Tray storage for each slot.

■Characteristics

Item	Performance
Maximum capacity	100 fibers (4 ribbon fiber: 20 fibers/tray) 80 fibers (2 ribbon fiber)
Connection fiber tray	Max. 5 (1 through-core tray)
No. of cable inlets	6 (3 each side)
Applicable cable outer diameter	Connector section: ϕ8 to ϕ17 Through cable: ϕ8 to ϕ21
Installation location	Overhead
Applicable temperature range	-20℃ to +60℃
Water proofing	IEC 60529 IPX 4

Dimensions: W270×D210×H130 (mm)

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Basic information about lightning-1

1. How lightning happens

It was the German Winkler and the American Franklin that first expressed the notion that lightning was a release of electricity in the atmosphere. Franklin's famous kite experiment took place in 1752 (from: http: //www.ushistory.org/franklin/info/timeline.htm). Today, some 260 years later, thanks to the research of many people, we know much about the phenomenon that is lightning, but there is still much that we do not know.

1.1 Types of lightning

There are different types of lightning, depending on the cause of the lightning, but there are usually three main types.
In fact, lightning is often caused by a combination of factors, rather than a single factor.

(1) Heat lightning
Strong sunlight in midsummer produces hot air near the surface of the ground. This can result in updrafts which produce heat lightning.

(2) Frontal thunderstorms
When lightning is caused by the collision of a cold air mass with a warm air mass, this is called a frontal thunderstorm. The lightning that occurs when warm air is pushed upwards by cold air is called cold front lightning, and the lightning that occurs when warm air rises alongside the cold air of the lower strata is called cold front lightning (Figs. 1 and 2).

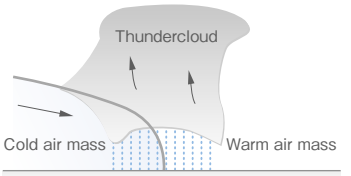

Figure1. Frontal thunderstorm (cold front thunderstorm)

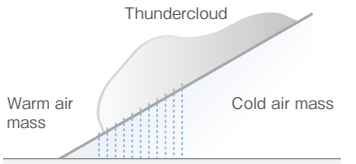

Figure2. Frontal thunderstorm (Warm front thunderstorm)

(3) Cyclonic thunderstorms
Cyclonic thunderstorms happen when there are updrafts in areas of low atmospheric pressure and near the center of typhoons and the like.

1.2 How thunderclouds occur

One of the most common features of clouds that produce lightning is the presence of strong updrafts extending to an altitude of several kilometers. The upper ranges of these updrafts reach altitudes where the temperature has fallen to below minus 20°C. Temperatures of minus 20°C occur in the Japanese summer at between 7 and 8 kilometers above the ground. In Hokuriku area in Japan, in winter, these temperatures occur at between 3 and 5 kilometers above the ground.
In the Japanese summer, heat lightning occurs in clouds whose tops are at between 8 and 16km high, and in winter in the north in clouds whose tops are between 4 and 6km high. In summer, in order for updrafts to occur, there needs to be hot and humid air near the ground, with a comparatively cold air mass above it. Summer days with strong sunshine are likely to cause heat lightning, and particularly when a cold front moves across the Japanese archipelago, heavy thunderstorms can occur. Also, spring lightning in winter along the Japan Sea coast, a great temperature difference is generated between the cold air mass coming from Siberia and the air temperature close to the surface of the sea, causing frequent lightning in the snow clouds during November and December.

1.3 How thunderclouds form, grow and then disperse

Thunderclouds are large cloud masses with a diameter of several kilometers. These are called cells. In fact, a thundercloud is very rarely only one cell, and usually comprises a cluster of several cells, and has a very complex overall structure.
Figure 3 shows a model that demonstrates how a single cell develops and eventually disperses.

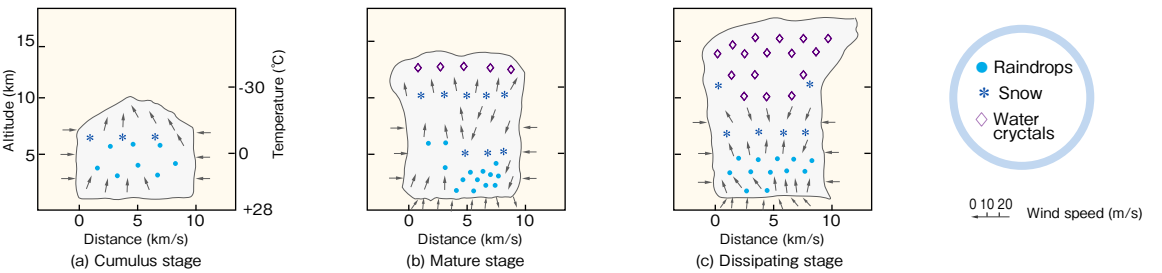

Figure 3 Thundercloud formation process

Cells in the cumulus stage are observed as vertically developing clouds that can attain a diameter of between 5 and 10 kilometers within 10 to 15 minutes, with a height of between 7 and 9 kilometers.
All of the air currents inside the cloud are updrafts. Cloud droplets grow within the cloud and large droplets of water and ice are formed and the cell continues to enlarge. This is the beginning of the mature stage, and clouds in this form are called cumulonimbus. Part of the cloud is dragged downwards by precipitation, creating downdrafts. During the mature stage, convection occurs due to the action of the updrafts and downdrafts.
The updrafts are as strong as the upper layer, reaching speeds of up to 30m/s. The top of the cloud can often be as high as around 12 kilometers, and some have been as high as 16 kilometers. Lightning discharge is most common during this period. The mature period can last between 15 to 30 minutes, after which the updrafts begin to fade away, leaving only the downdrafts. The cloud then enters the dissipating stage. The rain becomes weaker than in the mature stage, and stops after about 20 minutes.

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Basic information about lightning-2

2. Structure of thunderclouds

2.1 Electrical charge distribution in thunderclouds

Figure 4 shows the electrical charge distribution inside a thundercloud in its mature stage. The positive charge is distributed widely at the top of the cloud, while the negative charge is distributed vertically, in a column.
Also, there are positive charges distributed locally near the base of the cloud.

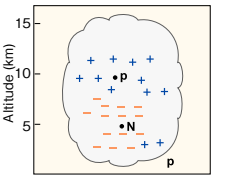


Fig. 4 Electrical charge distribution inside a thundercloud

2.2 Summer thunderclouds and winter thunderclouds

In winter, because the temperatures are low, thunderclouds form at relatively low altitudes of several kilometers, with the base of the thundercloud close to the ground. Close to the ground, the speed of rising air is affected by the ground surface and may be 5m per second or lower. Since this is lower than the 11m per second falling speed of the negatively charged graupel, which quickly falls to earth as soon as it is charged, it remains in the cloud for only a short period of time. Since it is difficult for negatively charged particles to build up in the cloud base, there is a great deal of positive discharge. Also, since the cloud base is quite low, upward discharge is often observed.

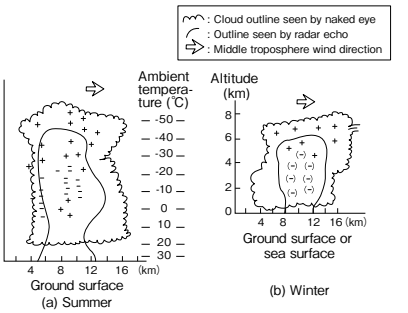


Figure 5. Summer and winter mature stage thundercloud sell charge distribution
(Kitagawa: From IEEJ Joint Research Materials on Discharge and High Voltage ED-90-134)

Basic information about lightning-3

3. Lightning discharge

The positively charged and negatively charged particles in a thundercloud separate, with the positively charged particles mainly in the upper portion of the cloud, and the negatively charged particles in the lower layers. When sufficient charge has accumulated, the limit is reached and the insulation in the air can hold out no longer. An electrical discharge occurs in order to neutralize the conditions. The discharge of positive and negative charge that occurs in the thundercloud at this point is called cloud discharge. The discharge between the electrical charge (mainly negative) in the cloud base and the charge induced in the ground surface is a ground discharge, and this is called cloud to cloud lightning.
In either case the electrical discharge is very large and the electropotential difference between the two poles just before the discharge can be anywhere from 100 million to 1 billion volts, with a charge neutralization of about 10 Coulomb (Source: representative values for lightning current parameters (logarithmic normal) taken from JIS Z 9290-4 table JB.1EC62305-1-CIGR), and a discharge path of up to several tens of kilometers.

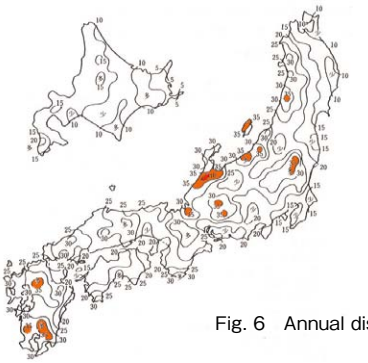
Basic information about lightning-4

4. Lightning quantities

4.1 Thunderstorms

(1) Regional distribution of thunderstorm days

A map that shows where thunderstorm days have occurred is known as an IKL map (isokeraunic level map). Figure 6 shows an IKL map of Japan. The map shows the thunderstorm days occurring over a period of one year, on a regional grid with longitude and latitude divided every 15 degrees. Areas of frequent thunderstorms in Japan are the Hokuriku region, the mountain areas of northern Kanto, the areas around the Suzuka mountain range of the Kinki region, and those parts of Kita-Kyushu around the Hita basin.



Frequent lightning areas in Japan

- Hokuriku	30 to 40 days
- Eastern Kanto	30 to 35 days
- Kita Kyushu	25 to 35 days

Fig. 6 Annual distribution of thunderstorm days (1954 to 1963)

(2) Density of lightning strikes to ground

One example of the relationship between IKL and the density of lightning strikes to ground Ng (number of lightning strikes to ground per square kilometer in one year) is shown in the following equation (1).

$$Ng = 0.1 \times IKL \text{ (strikes/ km}^2\text{/ year)} \quad (1)$$

(3) Monthly and hourly occurrence of thunderstorms

In Japan, thunderstorms occur most frequently in the months of July and August. Most of these are summer heat lightning. Hourly statistics show that summer heat lightning occurs mostly between the hours of 2pm and 4pm. Frontal thunderstorms that occur as the seasons change, and winter lightning in the Hokuriku region, do not exhibit any particular time characteristics.

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Lightning surge occurrence and size-1

1. Lightning strikes

Lightning strikes to earth occur with the density expressed in the equation (1), above. There are no organized statistics that show exactly where lightning strikes occur, but tall towers, power transmission cables, lightning rods placed on tall buildings and structures and tall trees are often struck, as are people hillwalking or in wide open spaces such as sports fields and golf links, etc.

1.1 Lightning strikes to power transmission line

IIt has been proven that there is a correlation between power line lightning strike rates and IKL (number of thunderstorm days per year).
And, as shown in the figure 7, according to various statistics on the size of the lightning current, there are reports ranging from 5kA to 200kA.
Most of the lightning current is negatively charged, with wave peak lengths often between 2 and 4μs, and mostly within a 1 to 20μs range.
Wave tail lengths fall within a 10 to 100μs range.

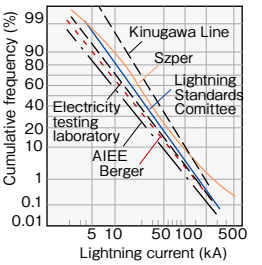


Fig. 7 Comparison of lightning current cumulative frequency distribution curves

1.2 Site surface area and lightning strike frequency

According to US statistics, for 30 thunderstorm days, in other words IKL30, there are on average four lightning strikes per year per square kilometer on flat ground.
Figure 8 shows various IKL as parameters of surface area and annual lighting strikes, given this rate of lightning.

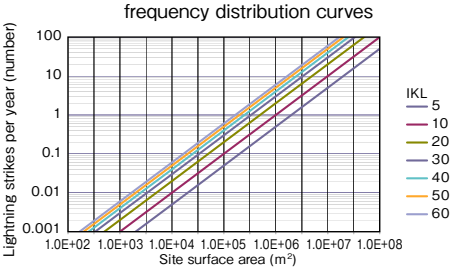


Fig. 8 Correlation between surface area and lightning strikes

Lightning surge occurrence and size-2

2. Induced lightning

Impulse voltage that is induced into overhead lines and other conductors after lightning discharge from cloud to ground or cloud to cloud is called induced lightning.

2.1 Induced lightning in communication lines

Koga et al.[*1] measured lightning surge voltage V induced onto communication lines in NTT's Utsunomiya region and showed the correlation between V and N, the cumulative occurrences of lightning surge voltage in excess of V per line, per single thunderstorm day, on subscriber terminals and station terminals, as per Figure 9. From the relationship illustrated in Figure 9, we can express the cumulative occurrences of lightning surge voltage in excess of V on subscriber terminals [times/ per line/ per thunderstorm day] Ns in the following equation..

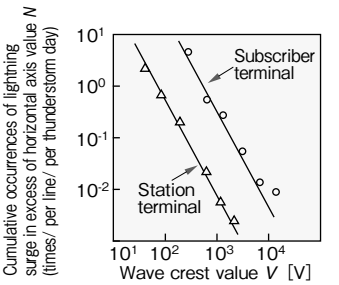


Figure 9 Occurrence distribution for lightning surge voltage on subscriber line systems

$$Ns = 0.6 \times 10^{5} V^{-1.8} \quad (2)$$

Also, the cumulative occurrences of lightning surge voltage in excess of V on station terminals [times/ per line/ per thunderstorm day] No can be expressed in the following equation.

$$No = 0.36 \times 10^{4} V^{-1.8} \quad (3)$$

For example, from the equation for subscriber terminals (2), the occurrences per thunderstorm day per line where V = 500V or more is Ns ≒ 0.83, and the occurrences per thunderstorm day per line where V = 3Kv or more is Ns ≒ 0.033. If we then look at IKL = 35 regions with frequent lightning, we find the annual numbers of lightning strikes are 29 and 1.16, respectively.

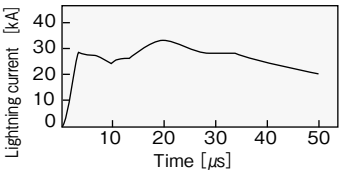
2.2 Induced lightning on power transmission lines and distribution lines[*2]

(1) Induced lightning on power transmission lines

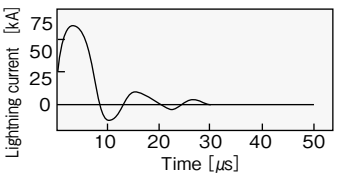
If there is a lightning discharge in the vicinity of power transmission lines, lightning can be induced onto the power transmission lines, from whence it will run to the substation. The size of the lightning surge is proportional to the size of the electrical field generated by the lightning, and the height of the power transmission lines above the ground. According to measurements taken so far, induced lightning voltage can be as high as 400V, but is mostly 100kV or less.
The waveform is a gentle one, with a crest front of between 20 to 30μs, and wave tail length of between 50 to 200μs.

(2) Induced lightning on distribution lines[*3]

Induced lightning on distribution lines has been measured using induced lightning surge automatic measurement apparatus. According to these measurements, if the strike current of a lightning strike around 200m in the vicinity of distribution lines is of the order of several tens of thousands of amperes, then an induced lightning voltage of between 60 to 100kV may occur on the distribution lines. Figure 10 shows the waveform of a direct lightning strike, compared with that of an induced lightning surge.



(a) Lightning current waveform of direct strike on chimney at Fukui Thermal Power Plant



(b) Induced lightning voltage waveform from phase conductor on chimney of distribution power lines

Fig. 10 Lightning current waveform compared to induced lightning waveform

*(1) Koga et al.: Lightning surge waveform characteristics appearing on communication line terminals, Journal of IEICE (B), J64-B, 7, 627/634 (July, 1981)
(2) Fujita: Lightning damage design for super high voltage substations Electrical Field Technology June, 1981
(3) Mitani: Recent lightning observation and results Electrical Review July, 1981

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Explanation of terms-1

1. Waveforms of impulse test voltage and current based on rules

1.1 Lightning impulse test voltage waveforms

The lightning full impulse-voltage waveforms prescribed by JEC-202 are as shown in Figure 11.

(1) Virtual zero time
This refers to the point where a straight line connecting the 30% crest point and 90% crest point in a wave front intersects the time axis.

(2) Wave front duration
This refers to the value obtained by dividing by 0.6, the time between the 30% wave crest and the 90% wave crest in a wave front. (see Fig. 11)

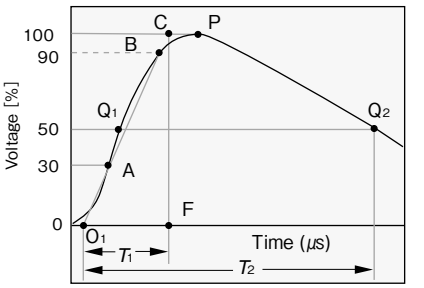
(3) Effective wave front steepness
Obtained by dividing the wave crest by the wave front duration.

(4) Wave tail duration
In the case of single polarity lightning impulse voltage, this refers to the time between virtual zero time and the half wave height point in a wave tail (see Fig.11), and in the case of oscillating lightning impulse voltage, the time between virtual zero time and the half wave height point in the first half wave tail.

(5) Test voltage waveform display
The following symbols are used to display the lightning impulse voltage waveform of the wave front T1 (μs) and wave tail T2 (μs).

$$\pm T_1 / T_2 \ (\mu s)$$

The plus and minus signs indicate the polarity of the voltage.
The standard lightning impulse voltage used in lightning impulse voltage tests is a ±1.2/50μs single polarity full waveform voltage.



T_1 : Wave front duration T_2 : Wave tail duration
O_1 : Virtual zero time Q_1,Q_2 : Half wave height point
P : Wave crest $\overline{CF}$: Crest value
Fig. 11 Conventions of displaying impulse voltage

1.2 Impulse test current waveforms

The lightning full impulse current waveforms prescribed by JEC-202 are as shown in Figure 12.

(1) Virtual zero time
This refers to the point where a straight line connecting the 10% crest point and 90% crest point in a wave front intersects the time axis.

(2) Wave front duration
This refers to the value obtained by dividing by 0.8, the time between the 10% wave crest and the 90% wave crest in a wave front. (See Fig. 12)

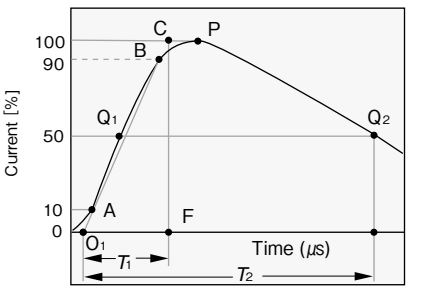
(3) Effective wave front steepness
Obtained by dividing the wave crest by the wave front duration.

(4) Wave tail duration
In the case of single polarity impulse current, this refers to the time between virtual zero time and the half wave height point in a wave tail (see Fig. 12), and in the case of oscillating lightning impulse current, the time between virtual zero time and the half wave height point in the first half wave tail.

(5) Test current waveform display
The following symbols are used to display the impulse current waveform of the wave front T1 (μs) and wave tail T2 (μs).

$$\pm T_1 / T_2 \ (\mu s)$$

The plus and minus signs indicate the polarity of the current.
The standard impulse currents used in impulse current tests are±8/20μs and ±4/10μs.



T_1 : Wave front duration T_2 : Wave tail duration
O_1 : Virtual zero time Q_1,Q_2 : Half wave height point
P : Wave crest $\overline{CF}$: Crest value
Fig. 12 Conventions of displaying impulse current

1.3 Protective device impulse test voltage and current waveforms

In impulse tests on communications protective devices, in addition to the standard waveforms, the ±10/700μs and ±10/1000μs long tailed waveforms, for when induced lightning surge on communication lines is envisaged, and others, are specified.

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Explanation of terminology-2

2.Related terminology

Type of terminology	Explanation of terminology
Surge Protective Device (SPD)	Surge Protective Device: SPD This device is used to suppress excess voltage and to shunt surge current. Each device has one or more non-linear element built in. They are also known as protective devices, lightning arresters, surge protectors, etc.
Gas discharge tubes (GDT)	Discharge tubes designed to protect equipment and human beings from excess voltage by discharging into a sealed envelope, rather than into air gaps. Also known as arrester tubes.
Nominal discharge current In	Crest current value of 8/20μs current waveform flowing to SPD. Used in Class Ⅱ test SPD classification and in Class Ⅰ test and Class Ⅱ test SPD pre-processing.
Impulse current Iimp	Current crest value Ipeak and charge Q, tested in accordance with operating duty test procedures. Used to classify the SPD in Class Ⅰ test.
Maximum discharge current Imax	8/20 waveform current crest value flowing to SPD, with size according to Class Ⅱ testing operating duty test sequence. Imax is greater than In.
Maximum continuous operatingvoltage Uc	Maximum effective value or DC voltage that can be continuously applied to SPD in protect mode. Equivalent to rated voltage.
Follow current If	Supplied from power supply system, this is current that continues to flow to the SPD after the impulse current discharge has finished. Follow current is clearly different from continuous operating current Ic.
Rated load current IL	Maximum effective value or DC current that can be continuously applied to a load connected to an output being protected by SPD.
Voltage protection level Up	When the voltage across terminals is to be restricted, this is the parameter that specifies the performance of the SPD to be selected from the recommended value list. This value must be greater than the maximum measured limiting voltage. The maximum values measured between terminals.
Insertion loss (dB)	This is the loss that is generated when an SPD is inserted into a transmission system. This loss is the ratio between the power supplied to the load side before the SPD is inserted into the transmission system, and the power supplied after SPD insertion. It's usually measured by dB.
Series resistance (Ω)	This is the value of the resistance between the line terminals of the protective device and the equipment terminals (L1 – T1, L2 – T2).
DC sparkover voltage (V)	This is the voltage which starts the discharge (an electrical connection is made) when a gradually rising DC voltage is applied.
Impulse sparkover voltage (V)	This is the voltage which starts the discharge (an electrical connection is made) when a specific rising impulse voltage is applied.
Withstand voltage (V)	Refers to the upper limit of voltage that can be applied to a components for a specified time without destroying its insulation. There is an AC withstand voltage and an impulse withstand voltage.
Working attenuation (dB)	Refers to the attenuation of electrical signals resulting from the addition of a protective device.
Crosstalk attenuation (dB)	Across two or more lines, crosstalk is the phenomenon where the signals from one line leak onto other lines, electrostatically or electromagnetically coupled. The ratio between the magnitude of the transmitted signal and the signal leaked onto the transmission terminal side is called near-end crosstalk attenuation. The ratio between the magnitude of the transmitted signal at the receiving terminal side and the signal leaked onto the receiving terminal side is called far-end crosstalk attenuation.
Return loss (dB)	Refers to the level of rebound wave (echo) generated at the characteristic impedance mismatch point at telecommunication cable contacts, etc. Allows the level of characteristic impedance mismatch within cables and at cable connections to be viewed.
Impedance (Ω)	Refers to the impedance of transmission characteristics measurement. Telecommunications transformers read "Line side xxΩ, Device side xxΩ".
Impedance ratio (Ω)	Used in telecommunications transformers. Expressed as "Line side xxΩ, Device side xxΩ".
Leakage current (μA)	Current that flows when maximum line voltage is applied to a protective device.
Earth-free system	A system wherein earthing is not considered necessary because the lightning current flows from the telecommunication lines to the power supply lines, or in reverse.
Frequency bandwidth (Hz)	The frequency bandwidth that a protective device can use.
V.S.W.R.	When travelling waves are reflected at a contact with different impedances, the travelling waves are affected by the returning waves and a composite wave is generated on the line. This is called a standing wave. The ratio of the standing wave maximum voltage (Vmax) to minimum voltage (Vmin) is called the Voltage Standing Wave Ratio (VSWR). In the case of no reflection, VSWR is 1, and the smaller this value becomes, the less reflection there is.
Contact resistance (Ω)	Resistance generated at the connectors and other contacts of a protective device.
Line voltage (V)	This is voltage that is generated across T1 – T2 due to operating differences among protective elements when SPD begin to operate, triggered by irregular voltage to earth caused by unbalanced lines.
Permissible power (W)	Maximum permissible power that can be passed through co-axial lightning arresters.

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AD-57/13.03