http://www.tokaikonetsu.co.jp

Product Lineup

Heating Elements

EREMA heating elements
EREMA igniters (EIG)
Conductive ceramic far-infrared heaters

RECRYTE TN (Si_3N_4 ceramic material)

Protection tubes and dip tubes
Stalks
Parts for use in equipment for aluminum applications

RECRYTE (SiC ceramic high-temperature material)

Roller material for industrial furnaces
Protection tubes and liner tubes
Saggers and crucibles
High-temperature-resistant structural materials

Industrial Furnaces

Electric furnaces
Gas furnaces
Automatic control system and power-saving equipment
Engineering

Refractories

Silicon carbide refractories (DIALITE)
Refractories made of silicon carbide bonded to silicon nitride (DC-N)
Fused alumina refractories (DALMITE)
High-temperature-resistant insulating refractories (DALMITE)
High-purity alumina refractories (DALMITE)

Ceramic Resistors

Carbon-based resistors (AS and ASW)
Silicon-metal-based resistors (SP and SPW)

Tokai Konetsu Kogyo Co., Ltd.

■Head Office
3F, Aoyama Bldg., 1-2-3, Kitaaoyama,
Minato-ku, Tokyo 107-0061, Japan
Phone: +81-3-5772-8211 (main line); Fax: +81-3-5772-8266

■Kyoto Branch Office
3F, Imon Meiji Yasuda Seimei Bldg., 566-1, Toraya-cho,
Karasumaoike-sagaru, Nakagyo-ku, Kyoto 604-8171, Japan
Phone: +81-75-253-6211 (main line); Fax: +81-75-253-6277

■Factory
Miyagi Prefecture (Shibata-machi)

10/1 MR(15.02)

EREMA Resistors

Ceramic Resistors

TOKAIKONETSU

Tokai Konetsu Kogyo Co., Ltd.

CONTENTS

EREMA Resistors

Since 1930, we have been manufacturing and selling silicon carbide resistors. Our products have been widely accepted for years by customers in broadcasting equipment and electric power equipment industries.
In 1961, we started manufacturing ceramic resistors through a technical collaboration with the Carborundum Company, U.S.A. Since then, we have been contributing toward improving technology and capabilities in a wide range of fields, including electronics, communications, electric power, and radio.
EREMA resistors—ceramic resistors sintered at high temperatures—deliver superior performance, even in demanding applications where other resistors would prove inadequate. EREMA resistors are ideal for downsizing your equipment and for use in protective circuits or other circuits that require high reliability.

Features of EREMA Resistors

(1) High reliability with no disconnection
(2) High withstand voltage
(3) Compact, yet usable for high-power applications
(4) Non-inductive
(5) Usable at high temperatures
(6) Thermally and chemically stable
(7) Usable in water, water vapor, and oil

JQA-2026
Sendai Factory

EREMA resistors do not contain
the six substances restricted
by the RoHS Directive (2011/65/EU directive)
above the specified threshold levels,
and are exempt from the restrictions.

1 Points to Remember When Using EREMA Resistors

EREMA ceramic resistors, which are widely used for high-voltage and high-power applications, are available in various models with different features. It is important to choose a resistor that fits your application requirements.

1. Points to Remember - Common to EREMA Resistors

To maximize the performance of EREMA ceramic resistors, please follow the instructions below.

(a) Resistors are used under various electrical conditions. Ensure the operational reliability and safety, and perform a trial run as needed before using resistors.

(b) For applications that require high reliability (when using resistors with consumer, medical, power, or nuclear equipment, or an accelerator, for example), contact our sales division to let us know your electrical requirements so that you can use resistors safely.

(c) If resistors are used at an ambient temperature exceeding 40°C, or are exposed to heat radiation by the periphery, reduce the rated power according to the characteristic curve. Generally, we recommend using the resistor at 50% or less of the rated power.

(d) Separate consideration should be given to impulse voltage, transient voltage, intermittent overloading, and pulse loading. Contact our sales division if your application involves applying a high voltage for a short time, intermittent overloading, or pulse loading. Do not design a circuit and determine the power level based only on normal electrical conditions or average power.

(e) Using resistors in an environment with high levels of corrosive gases, dust, humidity, condensation, or salt air, or under other adverse conditions may result in degraded insulation, increased resistance, or corroded terminals. Check the operating environment before use.

(f) The ASH resistors and the C-type terminals for the AS and SP resistors have their terminals secured by lead-free soldering (with a melting point of 217°C). Therefore, make sure that the terminal temperature does not exceed 150°C.

(g) Store resistors at room temperature in a location with low humidity.

(h) When assembling and securing several resistors, use spacers or something similar to ensure that the resistors have the same length to prevent offset loading.

(i) Dropping or bumping EREMA resistors, which are made of ceramic, can result in chips, internal cracks, or breakages, impairing their properties. Therefore, take a special care when handling.

2. Voltage Reduction Ratio with Impulse Waveform

Withstand voltage will change with time constant or wave tail duration on the basis of the standard impulse voltage. Fig.1 represents the withstand voltage reduction ratio versus time when withstand voltage with 1.2/50 µs waveform is defined as 100%. The larger the time constant, or the longer the wave tail duration, the lower the withstand voltage. We recommend considering the voltage reduction ratio and setting a safety factor.

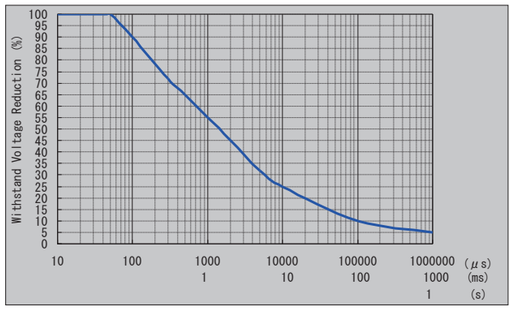


Fig. 1: Voltage Reduction with Impulse Waveform

3. Power Derating with Plural Resistors Combined Together

AS, SP resistors, when used in plural, will exert the influence of radiation heat each other. The reduction ratio shown in Fig.2 is to be noted.

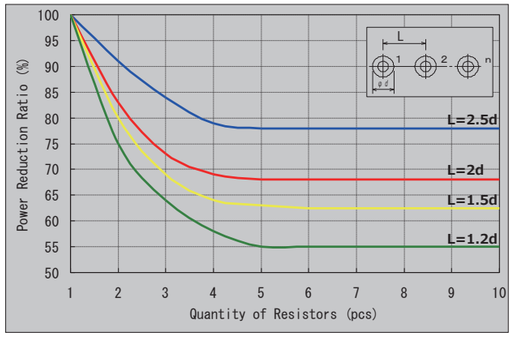


Fig. 2: Power Derating with Resistors Combined

2 AS and ASH Resistors

The AS and ASH resistors have large heat capacities, high resistance to impulse voltage, and superior durability. They are non-inductive resistors best suited for the following applications.

Applications

- Impulse voltage generators
- Charging/discharging of capacitors
- X-ray generators
- Protection of electrostatic precipitators
- Protection of rectifiers
- Dummy loads
- High-frequency circuits
- Surge absorption
- Disconnectors and grounding resistors
- Fusion devices
- Accelerators
- Distributors
- Other high-voltage circuits

Characteristics (typical values)

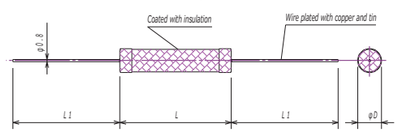
Item	Characteristic Value
Maximum operating temperature	250℃
Temperature coefficient	−0.15～−0.01%/℃
Withstand voltage (1.2/50 μs)	See Fig. 7.
Rate of change of resistance when current is applied (rated time of 500 h)	+15% or less
Short-time overloading (10 times × 5 sec)	±2% (MAX)
Short-time injection capacity	90J/cm^3
Bulk specific gravity	2.20～2.65
Specific heat	630J/(kg·K)
Thermal expansion coefficient	5～7×10^{-6} (/℃)

Standard Specifications for AS and ASH Models

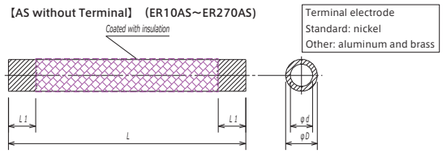
Model	Rated Power (W)	Dimensions(mm)				Cross Sections (cm^2)	Effective Length (cm)	Volume (cm^3)	Resistance Value Range (Ω)	Maximum Operating Impulse Voltage (kV)※1 1.2/50 μs	Allowable Energy Injected (J)	Unit Weight (g)
		ϕD	ϕd	L	L1							
ER2AS	2	4.5±1.0	—	20±1	38±2	0.13	1.4	0.18	10～56000	3.5	14	0.6
ER3AS	3	8.5±1.0	—	25±1	38±2	0.50	1.8	0.90	10～18000	4.5	80	3
ER5AS	5	8.5±1.0	—	40±1	38±2	0.50	3.3	1.66	10～33000	9	140	5
ER10AS	10	14±0.5	8	60±1	10±2	1.04	3.4	3.52	18～22000	20	370	16
ER20AS	20	14±0.5	8	80±1	10±2	1.04	5.4	5.60	27～27000	30	560	22
ER30AS	30	20±0.8	14	100±1	13±2	1.60	6.8	10.9	22～22000	35	1060	42
ER50AS	50	20±0.8	14	200± 2	15±2	1.60	16.4	26.3	47～56000	70	2450	85
ER80AS	80	25±1.0	18	250± 2	22±2	2.36	20	47.3	47～47000	80	4360	157
ER100AS	100	25±1.0	18	300± 2	22±2	2.36	25	59.1	56～100000	100	5430	188
ER150AS	150	40±1.3	28	300± 2	22±2	6.41	25	160	27～27000	100	14760	510
ER270AS	270	50±1.5	38	450±2	25±3	8.29	39.4	327	22～22000	160	29850	989
ER20ASH	20	12±0.2	10±0.5	200±2	19±0.1	0.79	15.35	12.1	10～100000	85	1300	39
ER40ASH	40	12±0.2	10±0.5	300±2	19±0.1	0.79	25.35	19.9	20～170000	100	2000	60
ER60ASH	60	16±0.2	14±0.5	400±2	19±0.1	1.54	35.35	54.4	10～120000	150	5500	158
ER80ASH	80	16±0.2	14±0.5	500±3	19±0.1	1.54	45.35	69.8	15～150000	185	7000	199

- The ER2AS to ER5AS models come with lead wires.
- Upon request, we will attach a standard terminal to any of the ER10AS to ER270AS models. (For details, see "Standard Mounting Terminals" on page 14.)
- All the ASH models are solid and come with terminal fittings.
- ※1 The maximum operating impulse voltage varies depending on the resistance value. See Fig. 7 for details.
- Note: If using your resistor in oil, be sure to ask us to apply an oil-resistant coating (with a maximum operating temperature of 85°C) to the resistor.

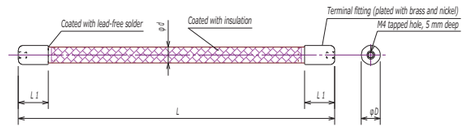
【AS with Lead Wires】 (ER2AS～ER5AS)



【AS without Terminal】 (ER10AS～ER270AS)



【ASH】 (ER20ASH～ER80ASH)Note: Provided with fittings



Characteristic Data

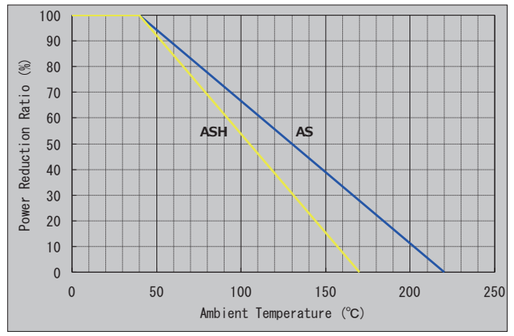


Fig. 3: Derating Curves for AS and ASH

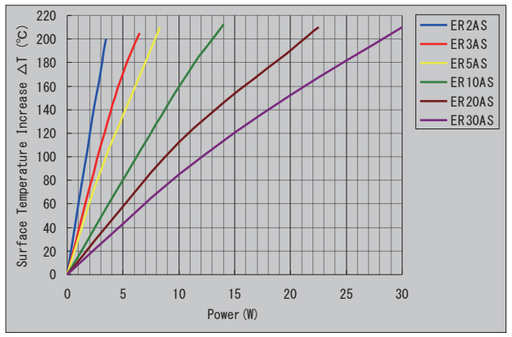


Fig. 4: Surface Temperature Increase vs. Power for AS (1)

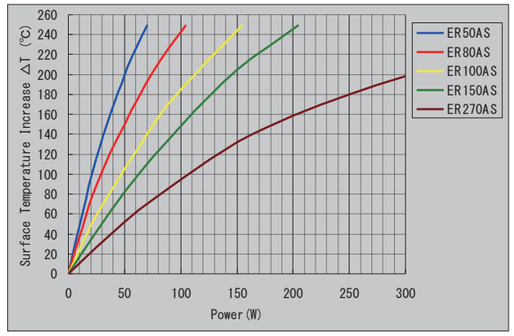


Fig. 5: Surface Temperature Increase vs. Power for AS (2)

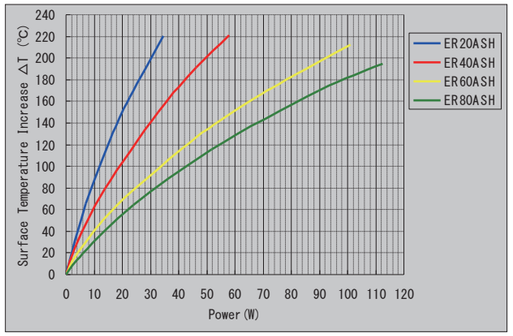


Fig. 6: Surface Temperature Increase vs. Power for ASH

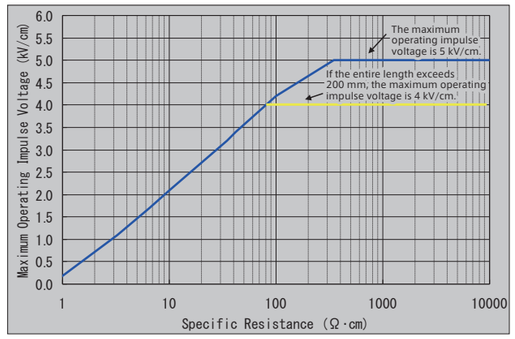


Fig. 7: Impulse Withstand Voltage vs. Specific Resistance (12/50 μs, in air)

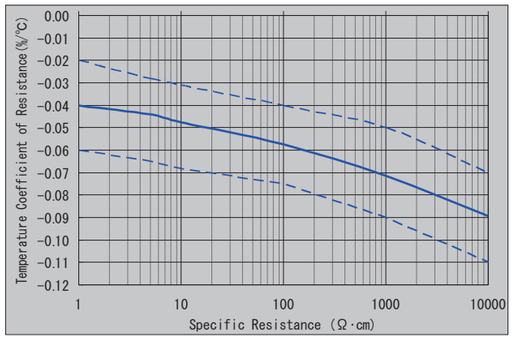


Fig. 8: Temperature Coefficient of Resistance vs. Specific Resistance (room temperature to 200°C)

Notes on Using the AS and ASH Resistors

- The AS and ASH resistors have hygroscopic characteristics, which result in increased resistance. To minimize the increase in resistance, store resistors at room temperature in an environment with no moisture absorption.
- The resistance tends to increase gradually as voltage is applied. To use resistors for long periods of time, you need to set load conditions that ensure the surface temperature of the resistor does not exceed 100℃.
- Under high-voltage conditions, the resistance will decrease at a specific resistance of 2000 Ω•cm or higher. Check the operating conditions before use.
- The voltage coefficients of the AS and ASH resistors tend to vary significantly depending on the specific resistance and applied voltage. Check the operating conditions when using resistors for voltage division, measurement, or other applications where the resistance value matters when voltage is applied.
- Under high impulse voltage conditions, the electrode on resistors can spark at 100 Ω or less. Contact us for information about our resistors with anti-discharge protection or a modified electrode structure.
- Be aware that using a resistor with an inner diameter in oil will cause its resistance to increase by about 5% to 20% from the initial amount due to the level of sealing between the resistor and the electrode and other factors. For applications in oil, we recommend using an ASH.

3 SP Resistors

The SP resistors are highly resistant to heat, compact, yet capable of withstanding high power. Additionally, these resistors are solid, which means they provide superior frequency characteristics and high resistance to overloading. Furthermore, the SP resistors can be used in water, which makes them ideal for use in high-frequency circuits and for other applications that require a large current.

Applications

- Power supply circuits
- Dummy loads
- Circuits for protecting against parasitic oscillation
- PT protection
- High-frequency circuits
- Accelerators
- Other high-current circuits
- Ultrasonic devices
- Other applications: far-infrared heaters, microwave absorbers

Characteristics (typical values)

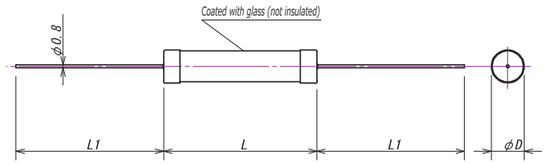
Item	Characteristic Value
Normal operating temperature	300℃
Maximum operating temperature	350℃
Temperature coefficient	±0.15%/℃
Withstand voltage (1.2/50 μs)	0.5kV/cm
Rate of change of resistance when current is applied (rated time of 500 h)	±10%
Short-time overloading (10 times × 5 sec)	±2% (MAX)
Short-time injection capacity	70J/cm^3
Bulk specific gravity	2.0～2.4
Specific heat	630J/(kg·K)
Thermal expansion coefficient	3～5×10^{-6} (/℃)

Standard Specifications for SP Models

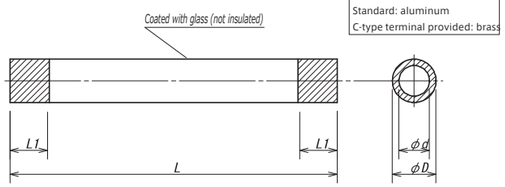
Model	Rated Power (W)	Dimensions(mm)				Cross Sections (cm^2)	Effective Length (cm)	Volume (cm^3)	Resistance Value Range (Ω)	Maximum Operating Impulse Voltage (kV)※1 1.2/50 μs	Allowable Energy Injected (J)	Unit Weight (g)
		ϕD	ϕd	L	L1							
ER3SP	3	4.5±1.0	—	20±1	38±2	0.13	1.4	0.18	1.0～390	0.5	11	0.5
ER5SP	5	8.5±1.0	—	25±1	38±2	0.50	1.8	0.90	1.0～150	0.5	63	3
ER10SP	10	8.5±1.0	—	40±1	38±2	0.50	3.3	2.01	1.0～270	1	110	4
ER20SP	20	14±0.5	8	60±1	10±2	1.04	4	6.22	0.33～220	2	290	14
ER30SP	30	14±0.5	8	80±1	10±2	1.04	6	7.67	0.47～230	3	430	19
ER50SP	50	20±0.8	14	100±1	13±2	1.60	7.4	11.9	0.47～270	4	830	36
ER100SP	100	20±0.8	14	200±2	15±2	1.60	17	27.2	1.0～680	8.5	1900	72
ER150SP	150	25±1.0	18	250±2	22±2	2.36	20.6	48.7	0.82～520	10	3400	133
ER200SP	200	25±1.0	18	300±2	22±2	2.36	25.6	60.5	1.0～680	12.5	4240	160
ER300SP	300	40±1.3	32	300±2	22±2	4.52	25.6	116	0.56～330	12.5	8100	305
ER500SP	500	50±1.5	40	450±2	25±2	7.07	40	283	0.56～330	20	19800	716

- The ER3SP to ER10SP models come with lead wires.
- Upon request, we will attach a standard terminal to any of the ER20SP to ER500SP. (For details, see "Standard Mounting Terminals" on page 14.)

【SP with Lead Wires】 (ER3SP～ER10SP)



【SP without Terminal】 (ER20P～ER500SP)



Terminal electrode
Standard: aluminum
C-type terminal provided: brass

Standard Specifications for SPT

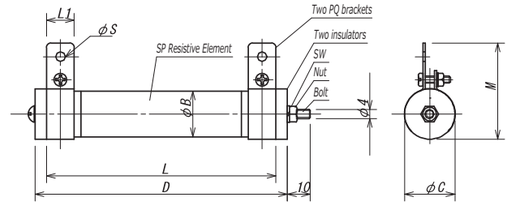
Model	Rated Power (W)	Dimensions(mm)								Maximum Operating Impulse Voltage (kV)※1 1.2/50 μs
		ϕB	L	L1	D	ϕC	ϕS	M	E	
ER20SPT	20	14	60	9	70	16	3.2	31	10	2
ER30SPT	30	14	80	9	90	16	3.2	31	10	3
ER50SPT	50	20	100	12	110	22	4.2	42	10	4

Standard Specifications for SPY

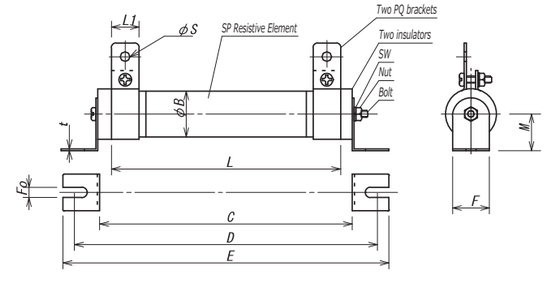
Model	Rated Power (W)	Dimensions(mm)											Maximum Operating Impulse Voltage (kV)※1 1.2/50 μs
		ϕB	L	L1	ϕS	C	E	D	F	F0	M	t	
ER20SPY	20	14	60	9	3.2	70	103	90	16	4.2	16	0.8	2
ER30SPY	30	14	80	9	3.2	90	123	110	16	4.2	16	0.8	3
ER50SPY	50	20	100	12	4.2	110	143	130	16	4.2	16	0.8	4
ER100SPY	100	20	200	12	4.2	210	243	230	16	4.2	16	0.8	6
ER150SPY	150	25	250	21	5.2	262	315	300	26	6	26	1.0	6 ※2
ER200SPY	200	25	300	21	5.2	312	365	350	26	6	26	1.0	6 ※2
ER300SPY	300	40	300	21	5.2	320	380	360	40	10	40	1.5	6 ※2

Note: These resistors are designed to withstand up to 6 kV (1.2/50 μs) because the insulators have a dielectric breakdown voltage of 10 kV (1.2/50 μs).

【SPT Attached Vertically】



【SPY Attached Horizontally】



Characteristic Data

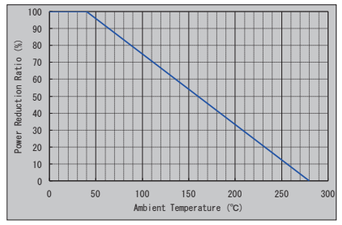


Fig. 9: Derating Curve

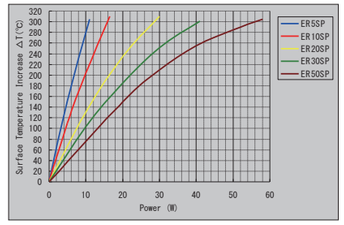


Fig. 10: Surface Temperature Increase vs. Power (1)

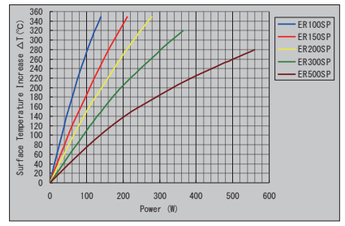


Fig. 11: Surface Temperature Increase vs. Power (2)

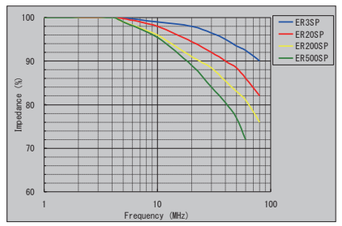


Fig. 12: Frequency Characteristics

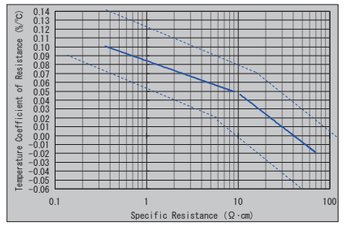


Fig. 13: Temperature Coefficient of Resistance vs. Specific Resistance (room temperature to 200°C)

Notes on Using the SP Resistors

- The SP resistors are susceptible to surge voltage. We recommend using them at about 50% (0.25 kV/cm) of the maximum operating impulse voltage.
- The SP resistors can be used in oil or water as are. For water-cooled applications, we will attach a brass electrode. Use pure water with a resistivity of 1 MΩ•cm or higher (an electrical conductivity of 1 μS/cm or lower) as the cooling water.
- The dielectric strength decreases at a high surface temperature greater than or equal to 300°C.
- Install SPY or SPT resistors in a vibration-free location.
- The SPY and SPT resistors include insulators. Overtightening the screws can cause breakage. We recommend that the tightening torque be 0.3 N•m for M3 screws, and 0.4 N•m for M4 screws.

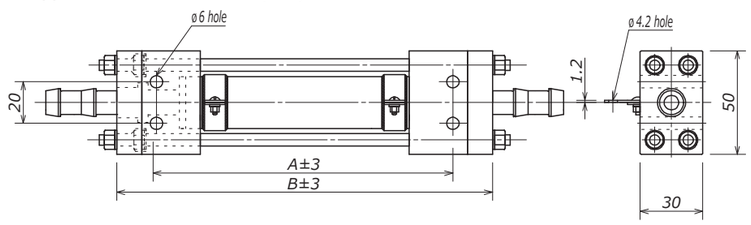
4 Direct Water-Cooled Resistors (W)

Our direct water-cooled resistors include an SP resistor. They are compact, non-inductive, free from wire breakage, resistant to overloading and impulse current, and durable under high-power conditions. These features make them ideal as protective resistors, especially for use with thyristors. As with water-cooled thyristors, these resistors are designed to be cooled by water to enable their compact bodies to withstand high power while minimizing any increase in temperature.

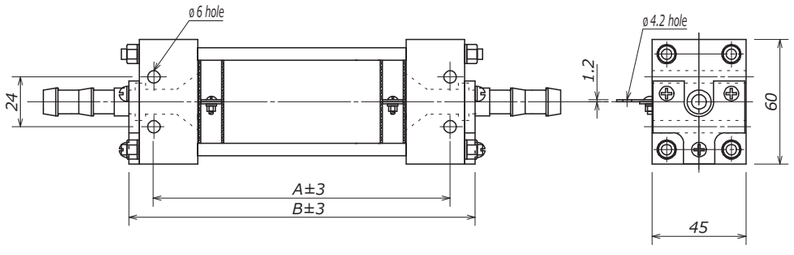
Standard Specifications for WD

Model	Hose Joint	Rated Power (W)	Specified Maximum Power (W)	Dimensions(mm)		Resistance Value Range (Ω)
				A	B	
W-500DN	SUS	350	500	142	180	1 ~ 100
W-1000DN	SUS	750	1000	142	166	1 ~ 100
W-1600DN	SUS	1200	1600	247	271	1 ~ 100

【Appearance and Dimensions (mm) of W-500DN】



【Appearance and Dimensions (mm) of W-1000DN/W-1600DN】



Notes on Using the Direct Water-Cooled Resistors (W)

- A 1/2" diameter SUS hose is used as standard to attach to the direct water-cooled resistors. Upon request, we can offer other hose joint.
- Use pure water with a resistivity of 1 MΩ•cm or higher (an electrical conductivity of 1 μS/cm or lower) as the cooling water.
- Keep the water pressure at 0.59 MPa or lower.
- Use 4-mm-diameter bolts to attach these resistors. Tighten the bolts at about 0.5 N•m.
- Use a worm gear hose clamp, and tighten it at 1 to 1.5 N•m.
- Allow water to flow at a rate of at least 5 ℓ/min. Do not interrupt the flow. We recommend installing a safety circuit.
- Mount the resistor vertically, and allow water to flow from the bottom to the top. (The same applies to the simultaneous use of several resistors.)
- Keep the surge voltage at 1800 V or lower (250 V/cm for the effective length of the resistor).

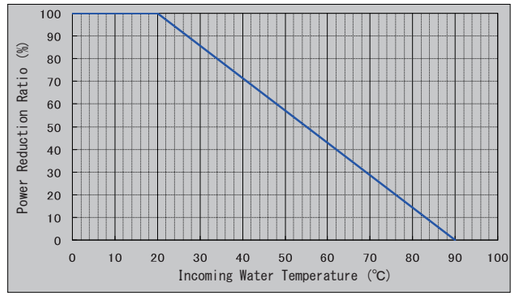


Fig. 14: Derating Curve for Direct Water-Cooled Resistors

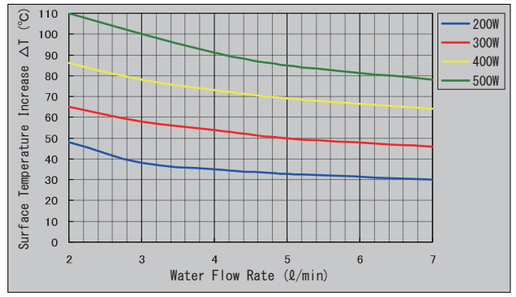


Fig. 15: Surface Temperature Rise vs. Water Flow Rate Curves (W-500DN)

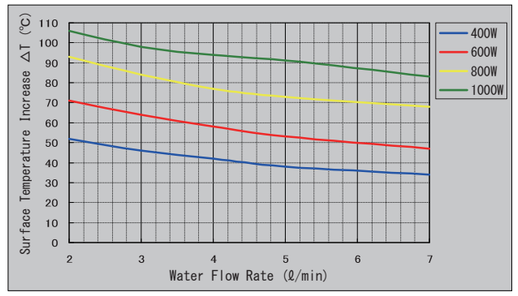


Fig. 16: Surface Temperature Increase vs. Water Flow Rate (W-1000DN)

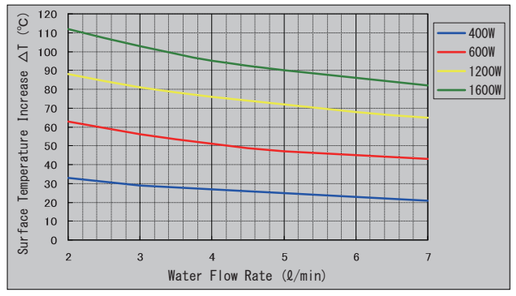


Fig. 17: Surface Temperature Increase vs. Water Flow Rate (W-1600DN)

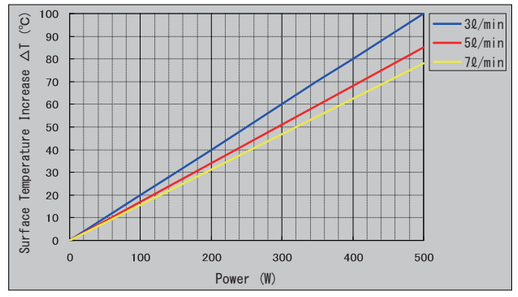


Fig. 18: Surface Temperature Increase vs. Power (W-500DN)

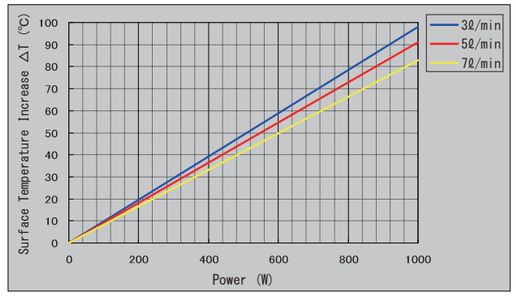


Fig. 19: Surface Temperature Increase vs. Power (W-1000DN)

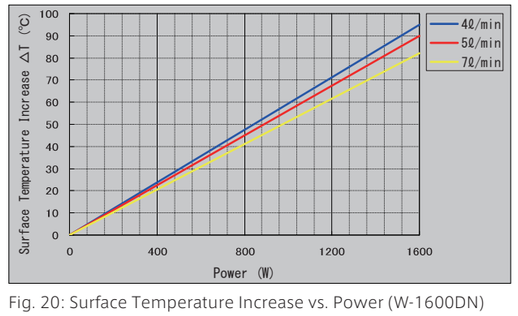
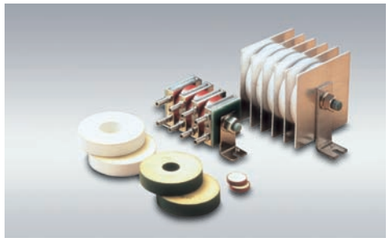


Fig. 20: Surface Temperature Increase vs. Power (W-1600DN)

5 Disc Resistors (ASW and ASD)

The ASW and ASD models are disc resistors—the only ones available in Japan—that we have developed using our unique technology. These resistors deliver superior performance in high-voltage, high-current circuits, and are best suited for the following applications.



Applications

- Opening and closing of SF6 gas circuit breaker
- Impulse voltage generator control
- Discharging of capacitors
- On-load tap changers for transformers
- Surge absorption
- Neutral grounding resistors (NGR)
- Other high-voltage, high-current circuits

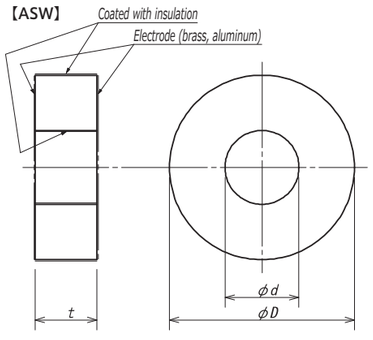
Characteristics (typical values)

Item	Characteristic Value
Maximum operating temperature	250℃
Bulk specific gravity	2.6
Specific heat	790J/(kg·K)
Thermal conductivity	1.2W/m·K
Temperature coefficient	-0.08～-0.04%/℃
Thermal expansion coefficient (/°C)	$4.5 \sim 6.5 \times 10^{-6}$
Allowable energy injected	300J/cm³
Contact pressure	0.2～0.3MPa

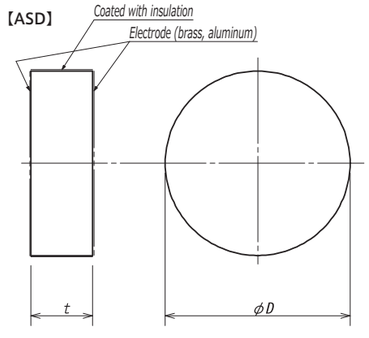
Standard Specifications for ASW and ASD

Model	Dimensions(mm)			Cross Sections (cm²)	Volume (cm³)	Resistance Value Range (Ω)	Allowable Energy Injected (kJ)	Unit Weight (g)
	ϕD	ϕd	t					
ASW7525	75±1.5	30±1.5	25±0.5	37.1	93	0.5 ～ 120	27.6	241
ASW9525	95±1.5	30±1.5	25±0.5	63.8	160	0.3 ～ 80	47.0	415
ASW11025	110±1.5	30±1.5	25±0.5	88.0	220	0.2 ～ 60	65.5	572
ASW12025	120±1.5	30±1.5	25±0.5	106.0	265	0.2 ～ 50	79.5	689
ASW12725	127±1.5	33±1.5	25±0.5	118.1	295	0.2 ～ 45	88.5	768
ASW15025	150±2	34±2	25±0.5	167.6	419	0.15 ～ 30	120.0	1090
ASD4025	40±1.5	–	25±0.5	12.6	31	1.6 ～ 300	9.0	82
ASD6025	60±1.5	–	25±0.5	28.3	71	0.7 ～ 150	21.0	184
ASD7525	75±1.5	–	25±0.5	44.2	110	0.45 ～ 110	33.0	287
ASD9525	95±1.5	–	25±0.5	70.9	177	0.3 ～ 70	52.5	461

【ASW】



【ASD】



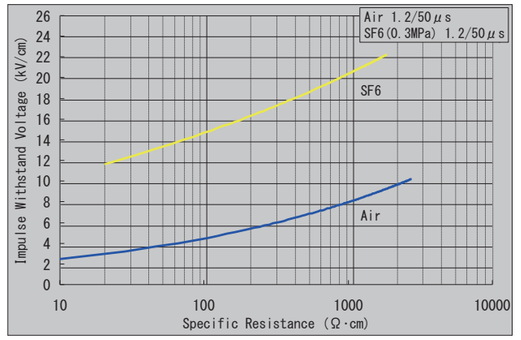


Fig. 21: Impulse Withstand Voltage vs. Specific Resistance (1.2/50 μs)

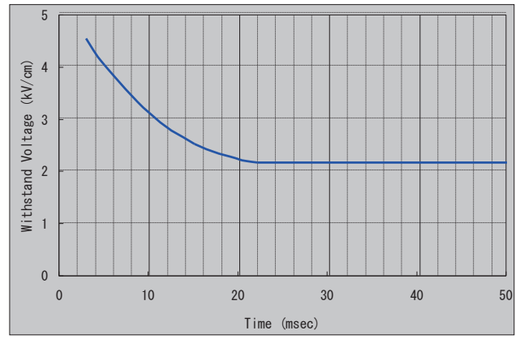


Fig. 22: Withstand Voltage vs. Time

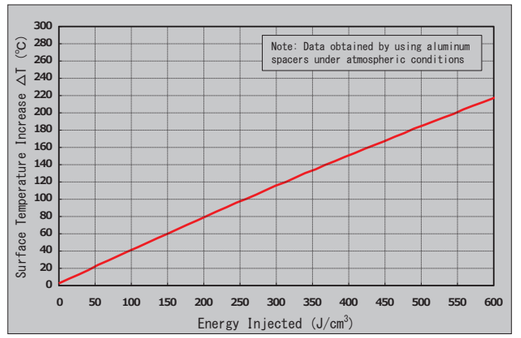


Fig. 23: Relationship Between Energy Injected and Surface Temperature Increase

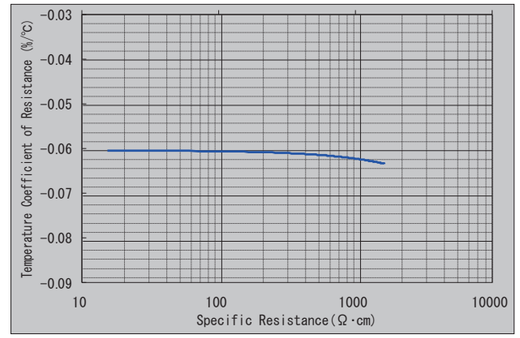


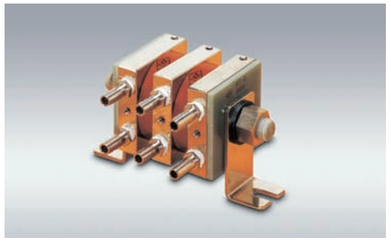
Fig. 24: Temperature Coefficient of Resistance vs. Specific Resistance (room temperature to 200°C)

Notes on Using the ASW and ASD Resistors

- The ASW and ASD resistors have hygroscopic characteristics, which result in increased resistance. To minimize the increase in resistance, store resistors at room temperature in an environment with no moisture absorption.
- When using a resistor that has been stored for extended periods of time, allow it to dry at 100°C to 120°C for at least about 8 hours before use.
  Also, allow your set of metal terminal components to dry at 40°C for at least 48 hours before use.
- The contact pressure is given as a rough guide. The resistors may break due to an overtightened spring, offset load, or other factors.
- The surface area of the resistive element is so small for its weight that it is unsuitable for continuous use.
- If your application involves applying intermittent impulse voltage, we will design a resistor with a radiator fin attached to it to suit your needs.

6 Indirect Water-Cooled Resistors (WD)

The WD models are disc resistors that utilize an indirect water-cooling method. In this method, water flows through water-cooling sections provided on both sides of the resistor to allow it to cool. With the remarkable development of various high-power circuits that utilize semiconductors, there is a growing demand for compact and large-capacity non-inductive resistors. The WD resistors can be connected in series or parallel to suit the voltage and current being applied.



Applications

- Surge absorption for high-frequency thyristor inverters
- Load resistors for high-voltage circuits
- Damping resistors for fusion devices
- Other large-capacity load resistors

Characteristics (typical values)

Item	Characteristic Value
Maximum operating temperature	150℃
Normal operating temperature	80℃
Dimensions of resistive element	ϕ75×ϕ20×t15(mm)
Specific heat of resistive element	500～750J/(kg·K)
Thermal conductivity of resistive element	1.2W/m·K
Temperature coefficient of resistive element	-0.04～-0.08%/℃
Thermal expansion coefficient of resistive element	$4.5 \sim 6.5 \times 10^{-6}$
Allowable energy injected	10 kJ per element
Allowable current	800A(MAX.)
Allowable voltage	10kV (MAX.)
Loss of cooling water pressure (3 ℓ/min)	2 kPa per cooling box

Features

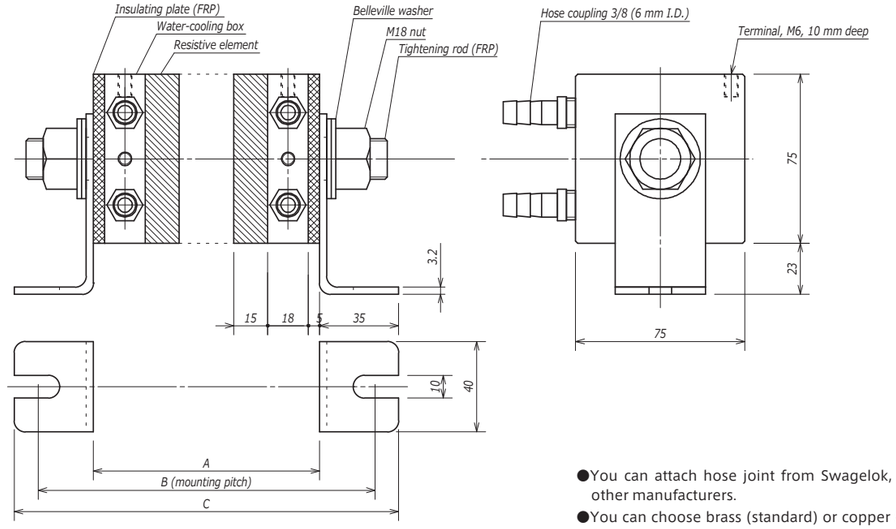
(1) No water leakage
(2) Non-inductive
(3) High absorption energy
(4) High withstand voltage (See "Notes on Using the Indirect Water-Cooled Resistors (WD).")
(5) Mounting foot insulated from the element
(6) High rated short-time power of 500 W per element
(7) Large cross-sectional area of the element allows a large current to be applied.

Standard Specifications for WD

Model	Rated Power (W)	Number of Elements	Dimensions(mm)			Resistance Value Range (Ω)	Allowable Energy Injected (kJ)
			A	B	C		
WD-1	350	1	61	110	131	0.5 ～ 20	10
WD-2	700	2	94	143	164	1 ～ 40	20
WD-3	1050	3	127	176	197	1.5 ～ 60	30
WD-4	1400	4	160	209	230	2 ～ 80	40
WD-5	1750	5	193	242	263	2.5 ～ 100	50

Notes on Using the Indirect Water-Cooled Resistors (WD)

- Keep the flow rate of the cooling water at 3 ℓ/min or higher, and the water pressure at 0.59 MPa or lower.
- When using the standard hose joint, attach a hose with an inner diameter of 3/8 inches. Use a hose clamp, and tighten it at 1 to 1.5 N•m.
- Use pure water with a resistivity of 1 MΩ•cm or higher (an electrical conductivity of 1 μS/cm or lower) as the cooling water.
- Do not use these resistors in an environment with high humidity. If the resistor has absorbed moisture, remove the hose and other parts and then allow the resistor to dry at 40°C for at least 48 hours.
  ＊Applying a direct current to a resistor that has absorbed moisture can cause electrolytic corrosion, resulting in abnormal resistance. Check the resistor before use.
- The withstand voltage of the standard assembly products is about 10 kV, regardless of the number of resistors included, due to the withstand voltage limits of the insulating plate (FRP). Each of the resistors can withstand the voltage specified in Fig. 21. Upon request, we will increase the withstand voltage by changing the assembly structure.



- You can attach hose joint from Swagelok, Junkosha, Nitta Moore, or other manufacturers.
- You can choose brass (standard) or copper (to which joint are brazed) for the material of the water cooling box.

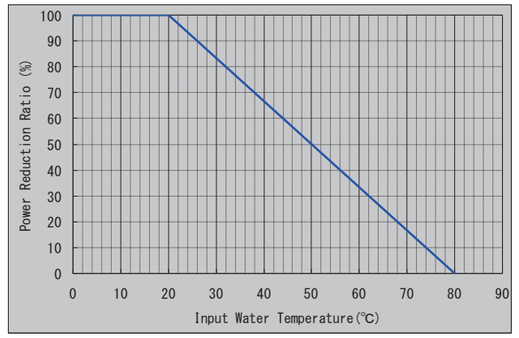


Fig. 25: Derating Curve

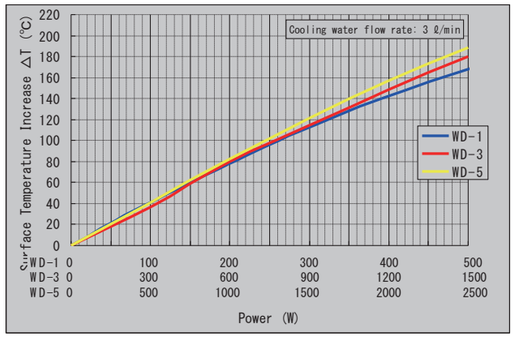


Fig. 26: Surface Temperature Increase vs. Load Power

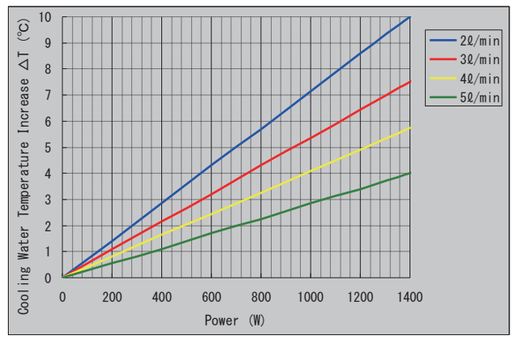


Fig. 27: Cooling Water Temperature Increase vs. Load Power by Water Flow Rate (WD-2)

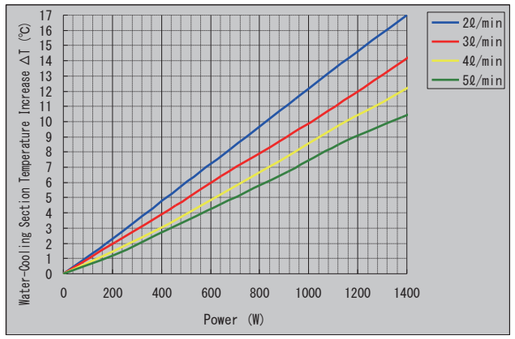


Fig. 28: Water-Cooling Section Temperature Increase vs. Load Power by Water Flow Rate (WD-2)

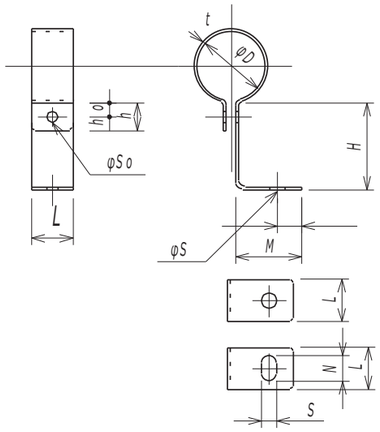
7 Standard Terminals

For EREMA AS and SP resistors, we offer three types of standard terminals, which also serve as electrodes. Upon request, we will attach one of the standard terminals to EREMA resistors.

QL-Type Standard Terminal Clips

Material: brass C2801 (plated with nickel)

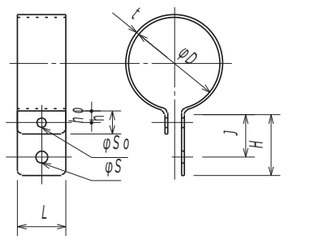
Type No.	Resistor Type		Fixed Pitch for Terminal Attachment (mm)	Dimensions(mm)										
				ϕD	L	H	h	h0	M	ℓ	ϕS	ϕS0	N	t
QL-14	ER10AS	ER20SP	51	14	9	18	8	4	15	5	4.4	3.2	—	0.8
	ER20AS	ER30SP	91											
QL-20 (elongated hole)	ER30AS	ER50SP	88	20	12	25	8	4	19	7	4.4	3.2	8	0.8
	ER50AS	ER100SP	188											
QL-25	ER80AS	ER150SP	229	25	21	32	9	4.5	22	8	5.4	4.2	—	1.0
	ER100AS	ER200SP	279											
QL-40	ER150AS	ER300SP	279	40	21	40	10	5	28	11	6.4	4.2	—	1.2
QL-50	ER270AS	ER500SP	426	50	24	40	10	5	28	11	6.4	4.2	—	1.2



PQ-Type Standard Terminal Clips

Material: brass C2801 (plated with nickel)

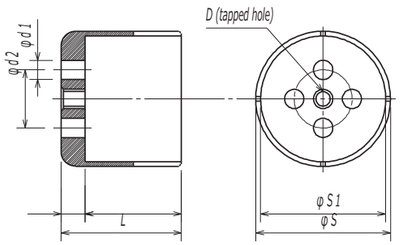
Type No.	Resistor Type		Fixed Pitch for Terminal Attachment (mm)	Dimensions(mm)								
				ϕD	L	H	h	h0	J	ϕS	ϕS0	t
PQ-14	ER10AS	ER20SP	51	14	9	16	8	4	12	3.2	3.2	0.8
	ER20AS	ER30SP	91									
PQ-20	ER30AS	ER50SP	88	20	12	20	8	4	14	4.2	3.2	0.8
	ER50AS	ER100SP	188									
PQ-25	ER80AS	ER150SP	229	25	21	26	9	4.5	18.5	5.4	4.2	1.0
	ER100AS	ER200SP	279									
PQ-40	ER150AS	ER300SP	279	40	21	28	10	5	20	5.2	4.2	1.2
PQ-50	ER270AS	ER500SP	426	50	24	28	10	5	20	5.2	4.2	1.2



C-Type Standard Terminal Caps

Material: brass, C3604, low cadmium content of 75 ppm or less (plated with nickel)

Type No.	Resistor Type		Fixed Pitch for Terminal Attachment (mm)	Dimensions(mm)							
				L	ℓ1	ℓ2	D	d1	d2	ϕS	ϕS1
C-14	ER10AS	ER20SP	70	13	5	8	M4	3	8	16	15
	ER20AS	ER30SP	90								
C-20B	ER30AS	ER50SP	110	16	5	11	M4	3	10	22	21
C-20A	ER50AS	ER100SP	210	18	5	13	M4	3	10	22	21
C-25	ER80AS	ER150SP	260	25	5	20	M4	4	12	28	26
	ER100AS	ER200SP	310								
C-40	ER150AS	ER300SP	320	30	10	20	M8	6	18	42	41
C-50	ER270AS	ER500SP	470	33	10	20	M8	8	24	52	51

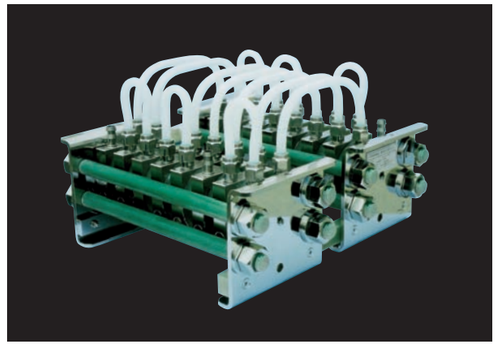


Notes on the Standard Terminals

- Loose bracket can cause a spark or burn out. Make sure that the terminal is firmly secured.
- When attaching your resistor to a terminal, tighten the screws at the specified torque. Overtightening can deform the terminal.
- Make sure that your resistor is not wobbling when securing it to a terminal. Failure to do so can break the terminal or resistor due to torsion.
- Do not store any of these terminals in an environment with corrosive gases or excessive humidity. The terminals, which are made of brass, may cause stress corrosion cracking due to their material properties. If this happens, we will offer you terminal made of a different material.
- When using your resistor in a location exposed to excessive vibration, check the terminal.
- To transfer a power distribution board or something similar with your resistor secured to it, pack the distribution board while taking anti-vibration measures to prevent any excessive impact to the resistor.
- When securing C-type terminal, be careful that it is not placed under tensile stress.
- C-type standard terminal should be secured to a resistor by lead-free soldering (with melting point of 217°C). Therefore, make sure that the terminal temperature does not exceed 150°C.

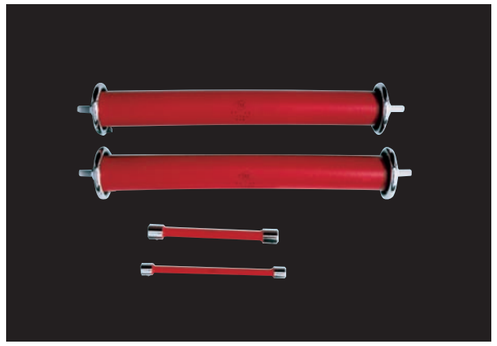
8 Assembly Products

Based on the expertise we have built up for years, we have been manufacturing various assembly products to meet a wide range of users' needs. Here we introduce some of the assembly products by application, which we hope will be convenient for you.



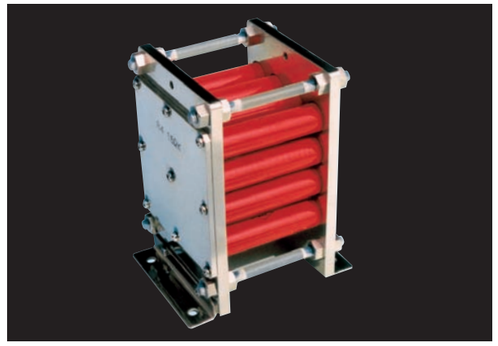
1. Water-cooled resistor for use in a snubber circuit for a large-capacity GTO thyristor

Model WS-14
Power capacity: 14 kW (flow rate of 6 ℓ/min)



2. Set of resistors for preventing terminal sparks

Model AS
Three types are available: ϕ14, ϕ40 × ϕ28, and ϕ50 × ϕ38

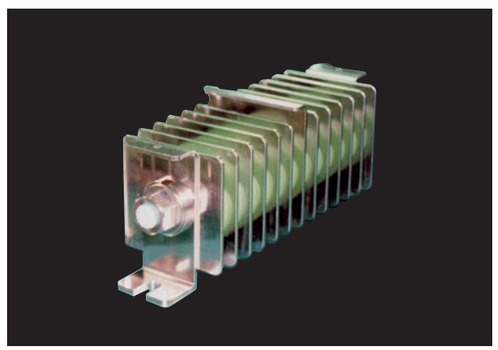


3. Control and discharge resistor for lightning surge generators

Model AS
Current: 7500 A max.
Allowable energy injected: 4 kJ

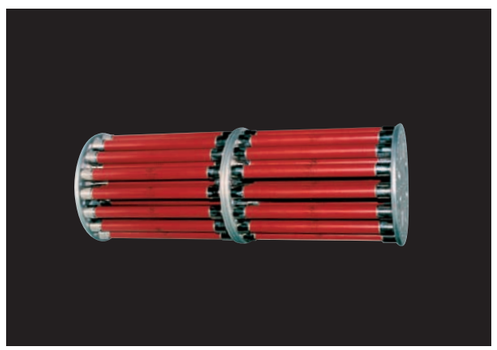
4. Capacitor discharge resistor

ASW7525, 10 elements connected in series
Housed in an insulating pipe
Allowable energy injected: 135 kJ



5. Load resistor

ASW12725, 12 elements connected in series per assembly
Radiator fin attached
Allowable energy injected: 550 kJ per assembly



6. Resistor for protecting transformers

ER100AS, 2S30P connected
Allowable energy injected: 180 kJ

Calculation Formulas

●Calculation of Specific Resistance

Specific resistance ρ (Ω•cm) = resistance (Ω) × sectional area (cm^2) / effective length of the resistor (cm)

●Calculation of Energy

Energy injected (J) = [voltage (V)]^2 / resistance (Ω) × voltage application time (sec)
= resistance (Ω) × [current (A)]^2 × voltage application time (sec)

●Calculation of Capacitor Energy

Energy injected (J) = 1/2 × capacitance (F) × [voltage (V)]^2
Time constant τ (sec) = capacitance (F) × resistance (Ω)

●Calculation of Coil Energy

Energy injected (J) = 1/2 × inductance (H) × [current (A)]^2
Time constant τ (sec) = inductance (H) / resistance (Ω)

●Simplified Formula for Determining the Increase in the Surface Temperature of a Resistor

Temperature Rise from Energy Injection
△T (°C) = energy injected (J) / [specific heat (J/(kg•K)) × volume of the resistor (cm^3) ×bulk specific gravity / 1000]

memo