NTC THERMISTOR-INRUSH CURRENT LIMITING DEVICES

Joyin NTC Thermistor(JNR)devices are made of a specially formulated metal oxide ceramic material which is capable of suppressing high inrush current surges.
JNR devices,being of relatively high resistance,shall limit the inrush current for 1～2 seconds during which time the device decreased in resistance substantially to a point where its voltage drop is negligible.The devices are especially useful in power supplies(see FigA)because of the extremely low impedance of the capacitor being charged,of which the
bridge is usually subjected to an exceedingly high current surge at turn-on point.

FEATURES

- High inrush current restriction effect.
- Small power loss in stationary state.
- (Normally 1W or less than 50W power.)
- High thermal and electrical stability.
- Wide selection of electrical characteristics.

APPLICATION

As shown in Fig.B, the current surge can be eliminated by placing a NTC thermistor in series with a filament string.Yet,if the resistance of one NTC thermistor does not provide sufficient inrush current limiting functions for your application, two or more may be used in series or in separate legs of the supply circuit(Fig.A).Be noticed,the thermistor can not be used in parallel since one unit will tend to conduct nearly all the current available.Thus,JNR thermistor may be used in the AC (point A1 or A2) or the DC(point D1 or D2)locations in the circuit.(See Fig.A)
The resistance of NTC thermistor is designed higher than the total resistance of filaments when the circuit is turned on.
As current begins flowing,the thermistor shall immediately "self-heat".Then,in 1～ 2 seconds,its resistance will be reduced to a minimun and become insignificant to the total resistance of a circuit circuit.With the same concept,current surges in electric motors can be held to minimum.Fig.C shows a typical DC motor's turn on surge before and after the application of a JNR thermistor to the circuit.

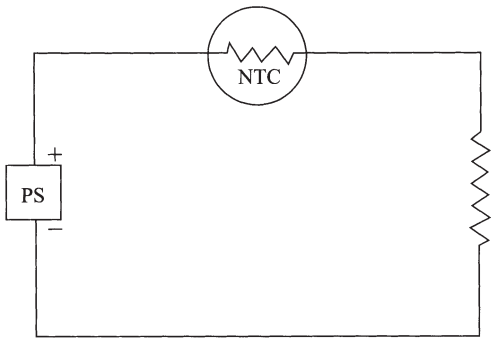


Fig.B

NTC THERMISTOR CHARACTERISTICS

To choose for application or take as referable parameters,the NTC thermistors are usually decided by the following three fundamental characteristics:

Temperature-Resistance Characteristic:
The resistance value of NTC thermistor is decreased while The ambient temperature or itself temperature is increased. (See Fig.D)

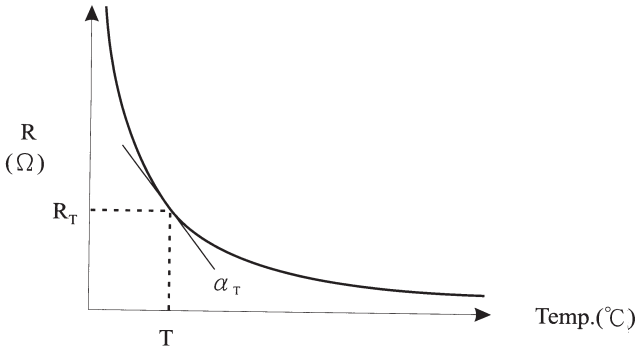


Fig.D

- Nominal resistance at 25℃(Ω)R_{25}
- Zero-power resistance (Ω)R_T
- Tolerance on the resistance nominal
  $\triangle R_{25}/R_{25}$=15%(L),20%(M)
- Material constant(Sensibility index)(^{0}k) β
- Temperature coefficient of resistance(%/℃) α_T

Voltage-Current Characteristic:

When operating in small current(see fig.E),due to very low power is unable to make the NTC thermistor self-heated, so its resistance value is thus maintained constant and displayed with a linear curve (in conformity with ohm-law V/R=I). if the current is increased,the NTC thermistor will follow Joule-efficiency(P=V× I)and make itself self-heated that results in a resistance value decreasing and thus displays with a status of "voltage descending while current increased."

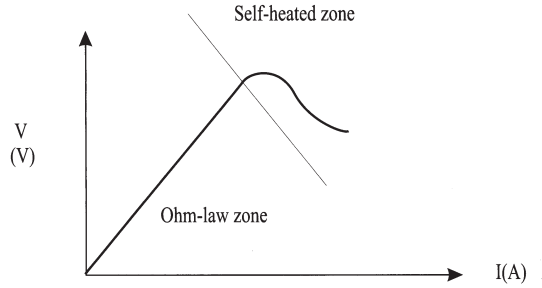


Fig.E

- Thermal dissipation coefficient(mW/℃) δ
- Maximum steady-state current(A)Imax.
- Resistance at maximum current(Ω)$R_{Imax.}$

Temperature-Time Characteristic:

As shown in Fig.F which explains the time needed to reach the thermal equilibrium of NTC components with the environment .

This characteristic depends on two important parameters.

If a step change in temperature is applied to a component e.g. from high(T_1)to low (T_0) temperature,the energy lost (δ (T-T_0)dt)

by the component (-HdT)is equal to the energy dissipated by it.

-HdT= δ (T-T_0)dt

This equation yields:T-T1=(T_0T_1)×$e^{-t/t}$, τ =H/ δ

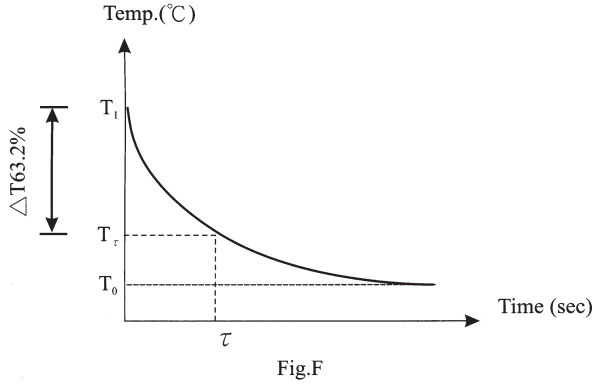


Fig.F

DERATING CURVE OF SURGE CURRENT LIMITING THERMISTOR

The maximum power of thermistor will decrease with the change of ambient temperature.
(See Fig.G)

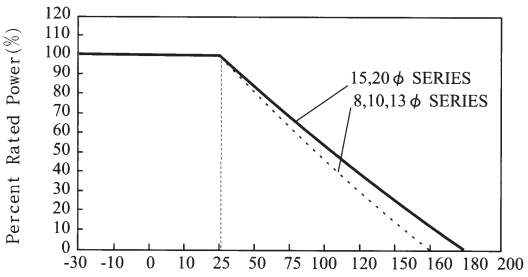


Fig. G

PARAMETERS DEFINITION

Thermistor

A thermistor is a thermally sensitive resistor of which its primary function is to exhibit a change in resistance accompanying with a change in itself temperature.

Negative Temperature Coefficient(NTC)Thermistor

NTC thermistor is a thermistor of which the zero-power resistance decreases while itself temperature is increased.

Inrush current

Inrush current is the initial surge of current that results when power is firstly applied to a load having a low starting impedance,such as a discharged capacitor,a cold lamp filament,or a stopped motor,etc.

Inrush currnt limiter

Specially designed and constructed NTC thermistor may be used as an inrush current limiter.JOYIN inrush current limiter(JNR)is available in a wide range of current handling and zero-power resistance value combinations.

Zero-power resistance(R_t)

The zero-power resistance is the direct current resistance value of a thermistor measured at a specified temperature "T" with a power dissipation by the thermistor low enough that any further decrease in power will result in less than 0.1 percent change in resistance.

Maximum steady-state current(Imax.)

The Maximum steady-state current is the rating of the maximum current,normally expressed in amperes(A),allowable to be conducted by an inrush limiting NTC thermistor for an extended period of time.

Resistance at maximum current(RImax.)

The resistance at maximum current is the approximate resistance of an inrush current limiting thermistor,expressed in ohms(Ω),when it is conducting its rated maximum Steady-state current.

Thermal dissipation coefficient(δ)

The thermal dissipation coefficient is the ratio,normally expressed in milliwatts per degree C(mW/℃),at a specified ambient temperature,of a change in power dissipation in a thermistor to the resultant body temperature change.(δ =VXI/△T)

Thermal time Constant(τ)

The thermal time constant is the time required for a thermistor to change 63.2 percent of total difference between its initial and final body temperature when subjected to a step function change in ambient temperature under zero-power condition and is normally expressed in second.

Material constant(β)

The material constant of a NTC thermistor is a measure of its resistance at one temperature compared to its resistance at a different temperature It's value may be calculated by the formula shown below and is expressed in degrees kelvin(^{O}K). The reference temperature used in this formula for determining material constant rating of JOYIN thermistor is 298.15oK and 323.15^{O}K β $=Ln(R_1/R_2)/(\frac{1}{T_1}-\frac{1}{T_2})$

Temperature coefficient of resistance(α_T)

The temperature coefficient of resistance is the ratio at a specified temperature T,of the rate of change of zero-power resistance with temperature to the zero-power resistance of the thermistor The temperature coefficient is commonly expressed in percent per degree C(%/℃). α =1/R dR/dT

Surge energy:

Surge energy is the maximum energy of pulses.

The thermistor is capable of tolerating surge energy more than 1000 times with the resistance changing rage within ±10%. This energy varies with voltage and capacitance.

Storage temperature range:-40 to+125℃

Operatingtemperature rabge:-30 to+125℃

NOTE:"WARNING□

- The JNR thermistor shall not be touched by hand at the large power consumption for preventing burns.
- The JNR thermistor shall not be operated beyond the specified "Maximum Current "in the catalog.
- The JNR thermistor shall not be operated and stored under following environmental condition.
  a.To be exposed directly to water or drop of water.
  b.To be exposed directly to oil,gasoline or organic solvent and/or atmospheres of them.
  c.Under condition of deoxidized or corrosive atmospheres such as chlorine, hydrogen sulfide,
  sulphur oxide and craked gas from vinyl chloride……etc.

HOW TO ORDER BY PART NUMBER:

JNR 08 S 050 M 6 5 Y AW

Joyin NTC Thermistor

Element Size(disc dia.)
- 08:Φ8mm
- 10:Φ10mm
- 13:Φ13mm
- 15:Φ15mm
- 20:Φ20mm

Series

S:For inrush current limiting

Resistance of thermistor at 25℃

0R7 : 0.7Ω	1R3 : 1.3Ω	2R5 : 2.5Ω
030 : 3Ω	050 : 5Ω	080 : 8Ω
100 : 10Ω	250 : 25Ω	470 : 47Ω
121 : 120Ω	221 : 220Ω	

Tolerance

L: ± 15%
M: ± 20%

Lead Diameter
- 6:0.6 ± 0.05mm
- 8:0.8 ± 0.05mm
- 1:1.0 ± 0.05mm

Lead Spacing
- 5:5.0mm
- 7:7.5mm
- 1:10mm

Lead Style

Y:Y-TYPE(vertical kink)
P:P-TYPE(straight lead)

* Special lead styles are available upon request

Lead Length /Packing Method

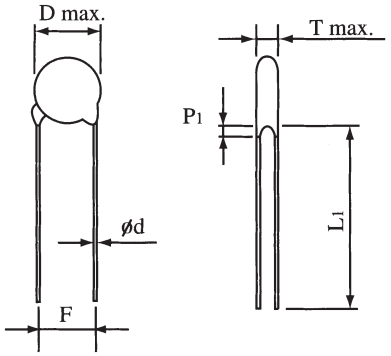
50:5 ± 0.5mm(bulk) for shearing lead
U4:24mm min. (Bulk) for kink lead
U5:25mm min. (Bulk) for straight lead
AW:Ammo (H_0:16mm) for kink lead
AY:Ammo (H_0:20mm) for straight lead
RW:Reel(H_0:16mm) for kink lead
RY:Reel (H_0:20mm) for straight lead

* Special lead length/ packing method are available upon request

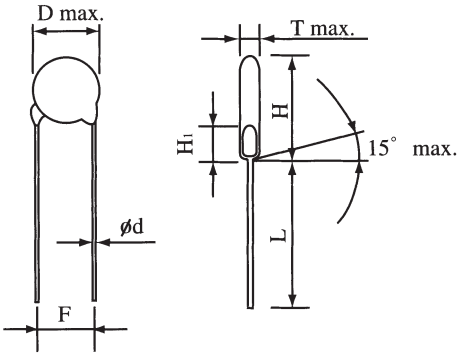
Dimension Table

unit:mm

Diameter	8Φ	10Φ	13Φ	15Φ	20Φ
D max	10	12	15	17.5	23
d±0.05	0.6	0.6/0.8	0.8	0.8	0.8/0.1
F±1.0	5.0	5.0/7.5	7.5	7.5	7.5/10.0
H max.	13.5	17	20	22.5	28.0
H1max	3.5	5	5	5	5
L1min	25.0	25.0	25.0	25.0	25.0
p1max	3.5	3.5	3.5	3.5	3.5
L min	24.0	24.0	24.0	24.0	24.0



P Type (straight leads)



Y Type (vertical kink)

Max.Thickness (T)

Part No.	8Φ	10Φ	13Φ	15Φ	20Φ
0R7M	--	--	--	--	5.0
1R3M	--	--	--	5.0	5.5
2R5M	--	--	5.0	5.0	5.0
030M	--	5.0	--	6.0	--
040M	--	5.0	--	5.0	6.0
050M	4.0	5.0	5.0	5.0	6.0
060L	4.0	5.0	5.0	5.0	6.5
070L	--	5.5	5.0	5.0	--
080L	4.5	6.0	5.0	6.0	5.0
100L	5.0	5.0	5.5	6.5	5.5
120L	--	5.0	6.0	7.0	--
150L	4.0	5.0	--	5.0	--
160L	--	5.0	6.5	5.0	--
180L	5.0	--	--	--	--
200L	5.0	6.0	5.0	5.0	--
220L	5.0	6.0	--	--	--
250L	--	6.0	5.0	5.5	--
400L	--	--	--	6.0	--
470L	--	--	--	--	--
500L	--	5.0	--	5.0	--
800L	--	5.5	--	5.0	6.0
121L	--	6.5	--	5.5	--
221L	--	--	--		

RATING AND CHARACTERISTICS

Φ8mm

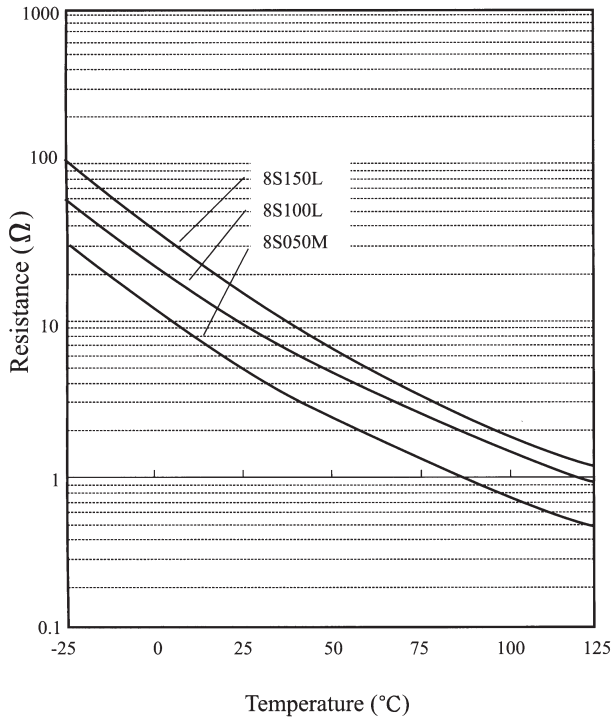
Part Number	Resistance at 25℃		Imax.	RImax.	Thermal dissipation coefficient	Thermal time constant	Material constant β (±10%)
	(Ohms)	Tolerance	(Amps)	(Ω)	(mW/℃)	(sec.)	(^{O}K)
JNR08S050M65□△△	5	±20%	3.0	0.200	9	36	2750
JNR08S060L65□△△	6	±15%	3.0	0.210	9	36	
JNR08S080L65□△△	8		3.0	0.245	9	36	
JNR08S100L65□△△	10		3.0	0.270	9	38	
JNR08S150L65□△△	15		2.0	0.505	12	36	3000
JNR08S180L65□△△	18		2.0	0.550	12	36	
JNR08S200L65□△△	20		2.0	0.600	12	36	
JNR08S220L65□△△	22		2.0	1.110	12	36	

• For application required ratings not shown, contact application engineering.

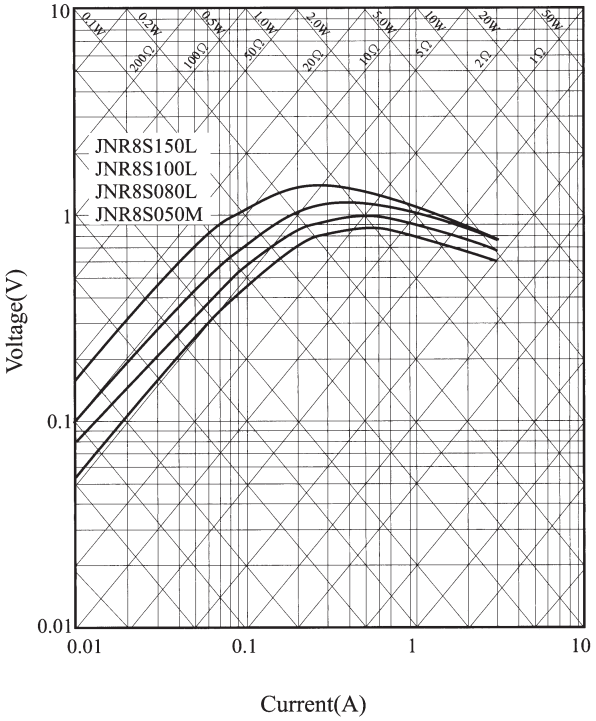
□ :Lead Style (please refer to page 140)
Y: vertical kink (standard)
P: straight leads

△△:Lead Lenght / Packing Method (Please refer to page 139 for the detail codes)

R-T CHARACTERISTIC CURVE-8Φ



V-I CHARACTERISTIC CURVE-8Φ



RATING AND CHARACTERISTICS

Φ10mm

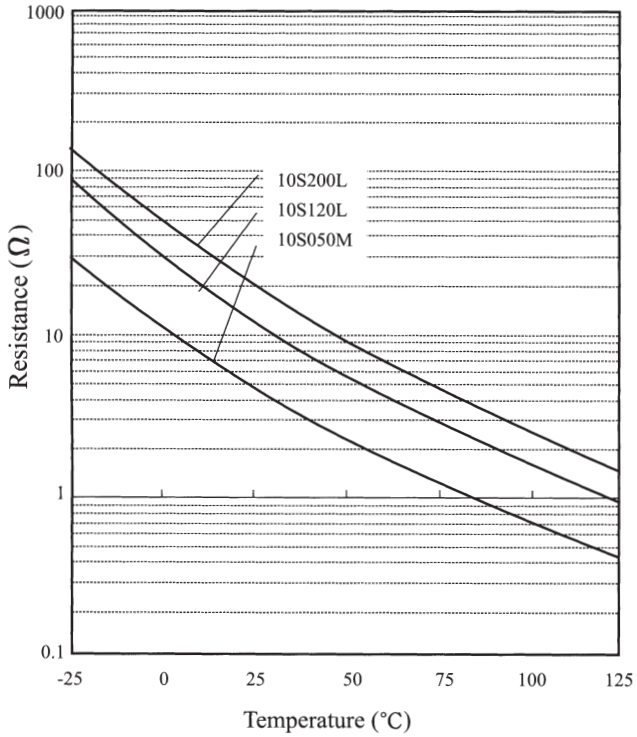
Part Number	Resistance at 25℃ (Ohms)	Tolerance	Imax. (Amps)	RImax. (Ω)	Thermal dissipation coefficient (mW/℃)	Thermal time constant (sec.)	Material constant β (±10%) (°K)
JNR10S2R5M87□△△	2.5	±20%	5.0	0.100	10	41	2750
JNR10S030M87□△△	3		5.0	0.130	10	41	
JNR10S040M87□△△	4		4.0	0.153	10	43	
JNR10S050M87□△△	5		4.0	0.176	10	45	
JNR10S060L87□△△	6	±15%	3.0	0.243	10	45	
JNR10S070L87□△△	7		3.0	0.290	11	45	
JNR10S080L87□△△	8		3.0	0.303	10	43	
JNR10S100L87□△△	10		3.0	0.270	11	45	3000
JNR10S120L87□△△	12		2.0	0.340	11	48	
JNR10S160L87□△△	16		2.0	0.400	12	50	
JNR10S200L87□△△	20		2.0	0.615	12	53	
JNR10S250L87□△△	25		2.0	0.635	12	53	
JNR10S500L87□△△	50		2.0	0.708	10	47	3300
JNR10S800L87□△△	80		1.0	2.070	12	49	
JNR10S121L87□△△	120		1.0	2.295	10	51	3600

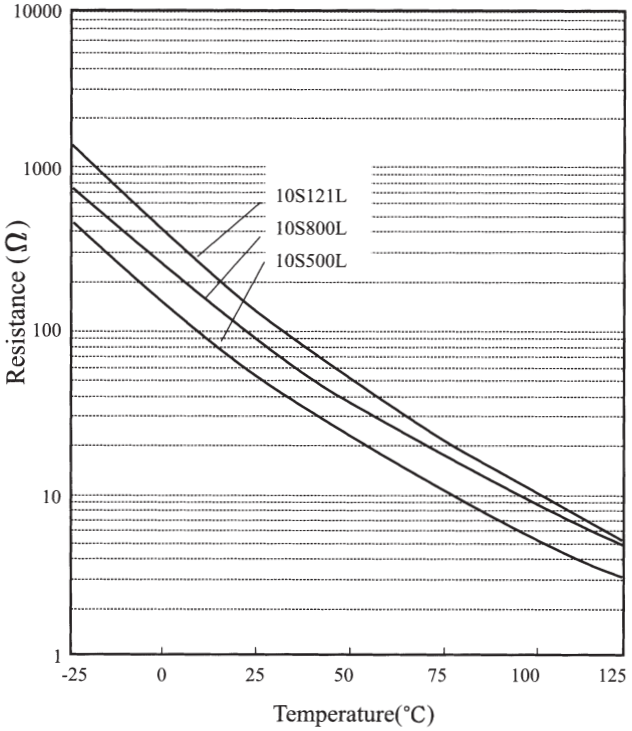
• For application required ratings not shown, contact application engineering.

□ :Lead Style (please refer to page 140)
Y: vertical kink (standard)
P: straight leads

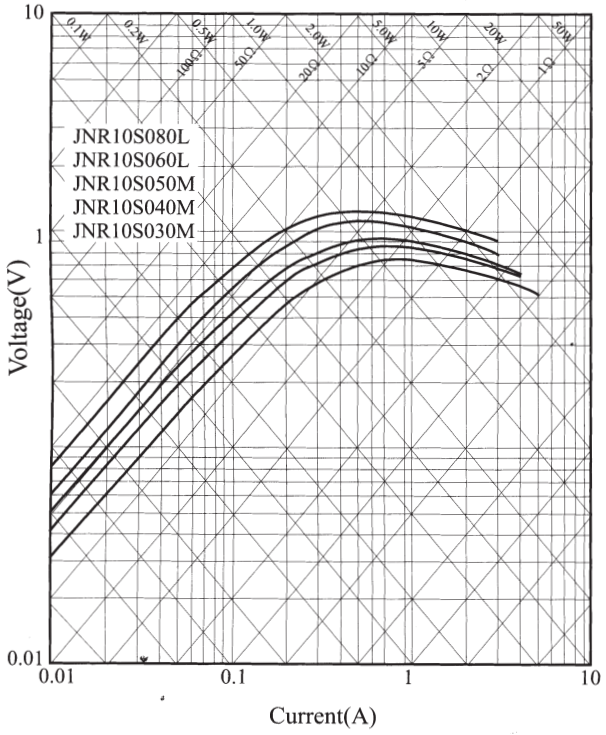
△△:Lead Lenght / Packing Method (Please refer to page 139 for the detail codes)

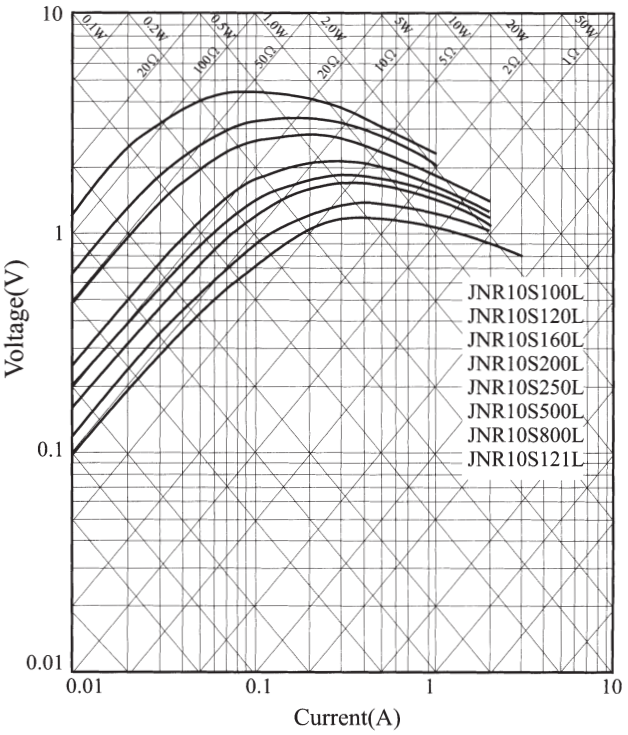
R-T CHARACTERISTIC CURVE-10Φ





V-I CHARACTERISTIC CURVE-10Φ





RATING AND CHARACTERISTICS

Φ13mm

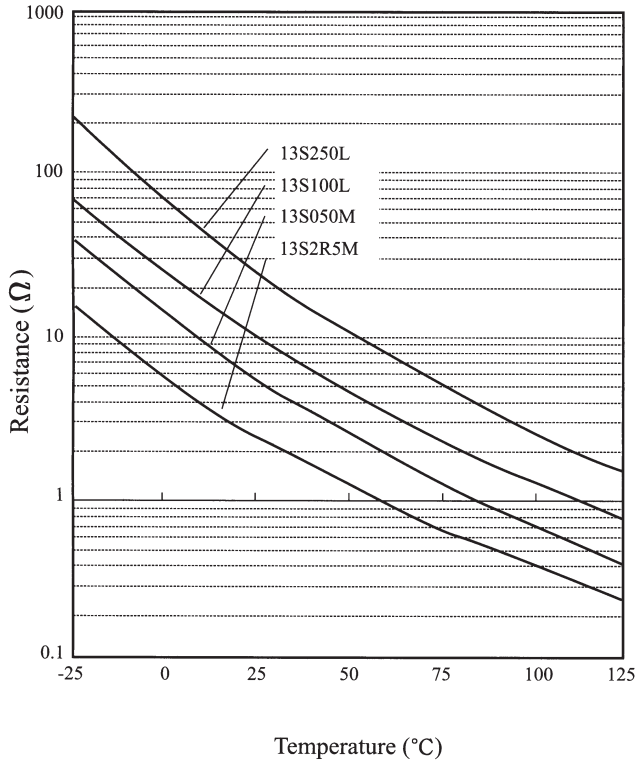
Part Number	Resistance at 25℃		Imax.	RImax.	Thermal dissipation coefficient	Thermal time constant	Material constant β (±10%)
	(Ohms)	Tolerance	(Amps)	(Ω)	(mW/℃)	(sec.)	(^{O}K)
JNR13S2R5M87□△△	2.5	±20%	6.0	0.094	14	65	2750
JNR13S050M87□△△	5		5.0	0.115	13	63	3000
JNR13S060L87□△△	6	±15%	5.0	0.142	13	64	
JNR13S070L87□△△	7		4.0	0.173	13	64	
JNR13S080L87□△△	8		4.0	0.188	14	65	
JNR13S100L87□△△	10		4.0	0.210	15	65	
JNR13S120L87□△△	12		3.0	0.353	16	66	
JNR13S160L87□△△	16		3.0	0.386	16	68	
JNR13S200L87□△△	20		3.0	0.313	14	65	3300
JNR13S250L87□△△	25		2.0	0.368	15	68	

• For application required ratings not shown, contact application engineering.

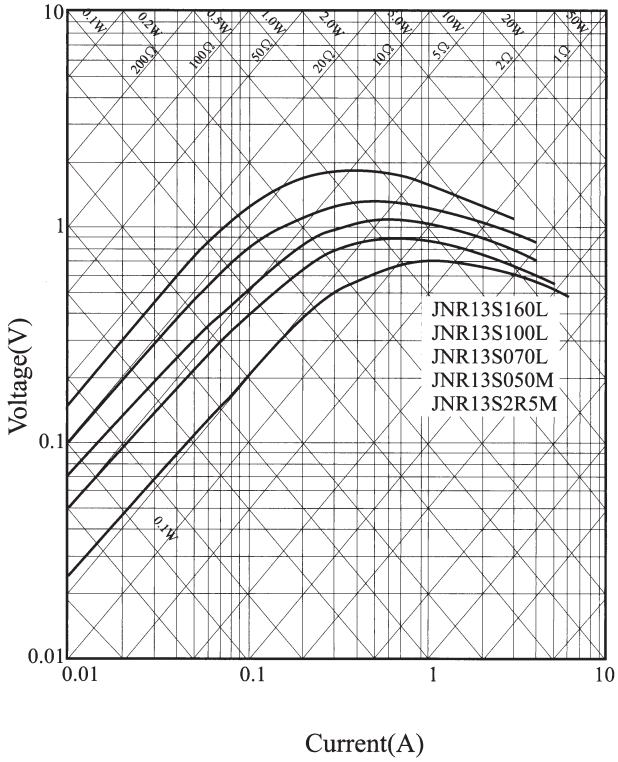
□ :Lead Style (please refer to page 140)
Y: vertical kink (standard)
P: straight leads

△△:Lead Lenght / Packing Method (Please refer to page 139 for the detail codes)

R-T CHARACTERISTIC CURVE-13Φ



V-I CHARACTERISTIC CURVE-13Φ



RATING AND CHARACTERISTICS

Φ15mm

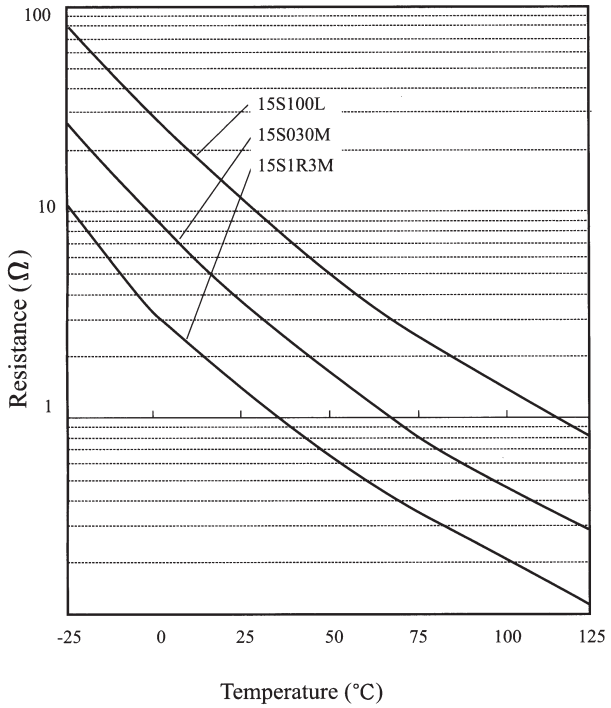
Part Number	Resistance at 25℃ (Ohms)	Tolerance	Imax. (Amps)	RImax. (Ω)	Thermal dissipation coefficient (mW/℃)	Thermal time constant (sec.)	Material constant β (±10%) (°K)
JNR15S1R3M87□△△	1.3	±20%	8.0	0.061	20	55	2750
JNR15S2R5M87□△△	2.5		8.0	0.083	18	58	
JNR15S030M87□△△	3		7.0	0.107	18	62	3000
JNR15S040M87□△△	4		6.0	0.112	18	70	
JNR15S050M87□△△	5		6.0	0.125	19	72	
JNR15S060L87□△△	6	±15%	5.0	0.139	19	74	
JJNR15S070L87□△△	7		5.0	0.148	19	76	
JNR15S080L87□△△	8		5.0	0.156	20	78	
JNR15S100L87□△△	10		5.0	0.178	20	80	
JNR15S120L87□△△	12		4.0	0.238	21	82	
JNR15S150L87□△△	15		4.0	0.190	17	74	3300
JNR15S160L87□△△	16		4.0	0.231	17	74	
JNR15S200L87□△△	20		4.0	0.290	20	76	
JNR15S250L87□△△	25		3.0	0.368	21	77	
JNR15S400L87□△△	40		3.0	0.437	22	82	
JNR15S470L87□△△	47		3.0	0.483	23	85	
JNR15S800L87□△△	80		2.5	0.684	18	75	3600
JNR15S121L87□△△	120		2.0	1.106	19	81	
JNR15S221L87□△△	220		1.0	3.020	20	103	

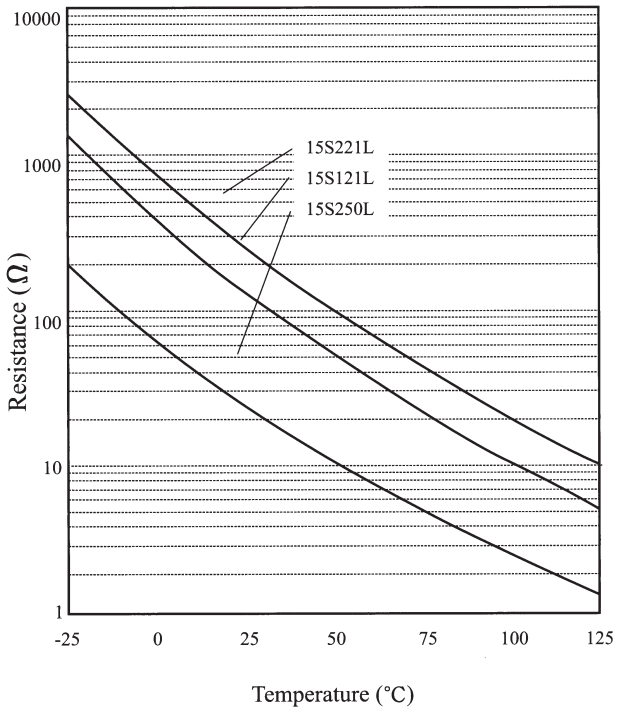
• For application required ratings not shown, contact application engineering.

□ :Lead Style (please refer to page 140)
Y: vertical kink (standard)
P: straight leads

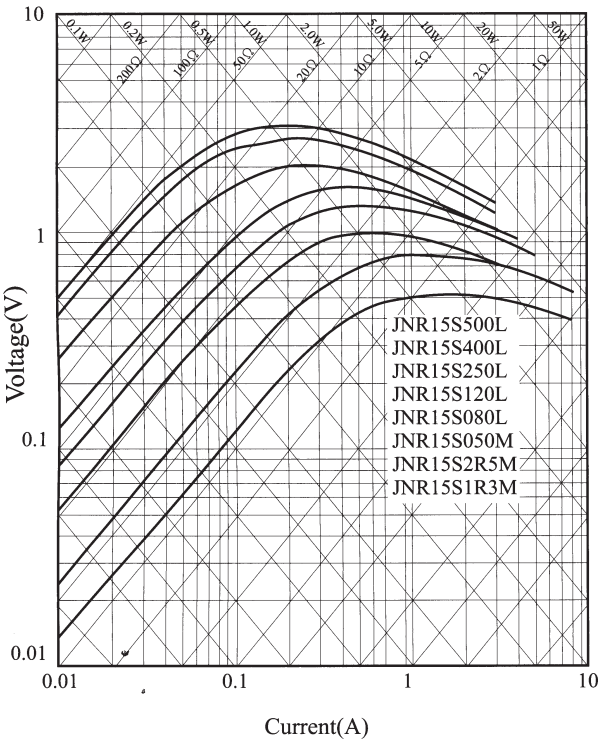
△△:Lead Lenght / Packing Method (Please refer to page 139 for the detail codes)

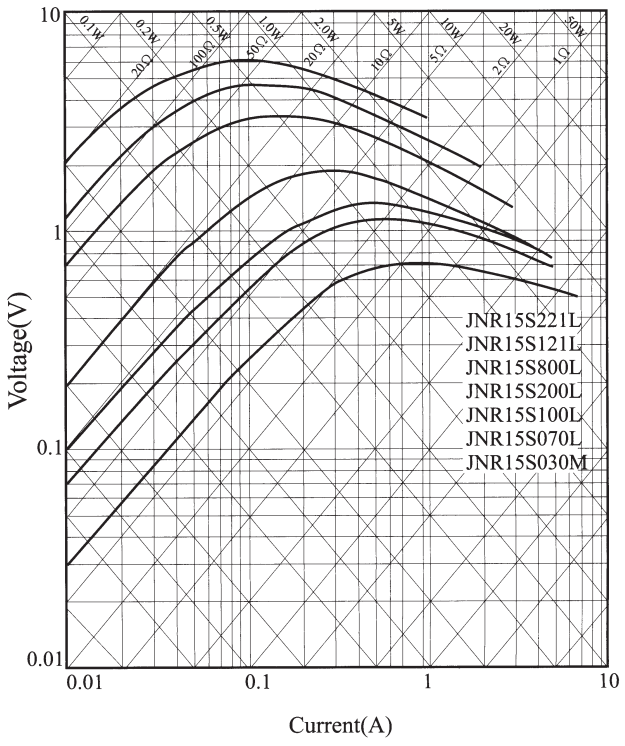
R-T CHARACTERISTIC CURVE-15Φ





V-I CHARACTERISTIC CHART-15Φ





RATING AND CHARACTERISTICS

Φ20mm

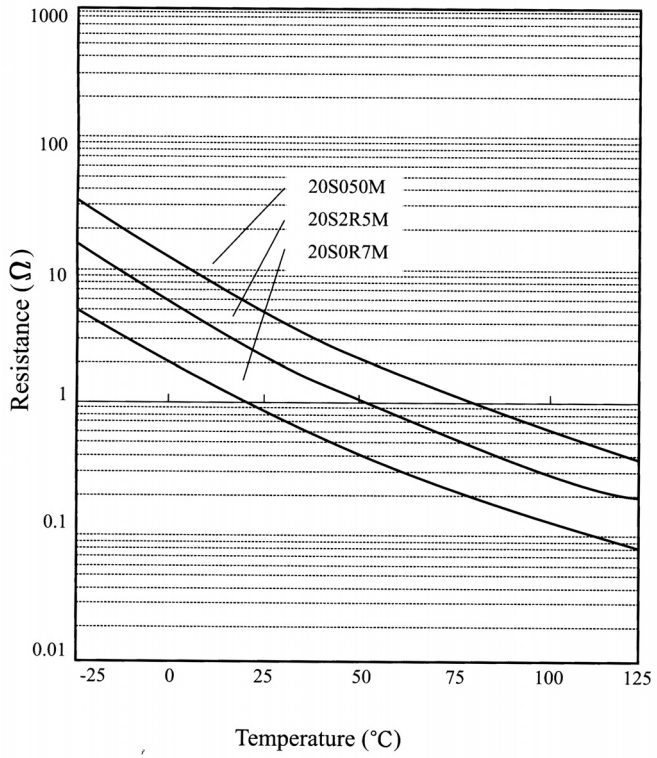
Part Number	Resistance at 25℃		Imax.	RImax.	Thermal dissipation coefficient	Thermal time constant	Material constant β (±10%)
	(Ohms)	Tolerance	(Amps)	(Ω)	(mW/℃)	(sec.)	(^{O}K)
JNR20S0R7M11□△△	0.7	±20%	12.0	0.032	25	98	2750
JNR20S1R3M11□△△	1.3		8.0	0.061	25	104	
JNR20S2R5M11□△△	2.5		10.0	0.063	20	98	3000
JNR20S050M11□△△	5		7.0	0.108	24	112	
JNR20S060L65□△△	6	±15%	6.0	0.141	24	115	
JNR20S100L65□△△	10		6.0	0.136	23	98	3300
JNR20S120L65□△△	12		5.0	0.174	25	98	
JNR20S121L65□△△	120		2.0	1.215	24	103	3600

• For application required ratings not shown, contact application engineering.

□ :Lead Style (please refer to page 140)
Y: vertical kink (standard)
P: straight leads

△△:Lead Lenght / Packing Method (Please refer to page 139 for the detail codes)

R-T CHARACTERISTIC CURVE-20Φ



V-I CHARACTERISTIC CURVE-20Φ