Metal oxide varistors

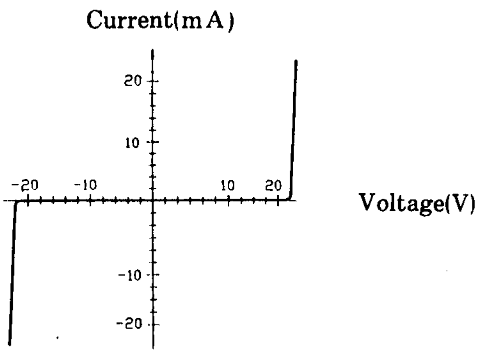
JVR ZINC OXIDE VARISTORS

Zinc oxide varistor is a voltage dependent resistor with symetrical voltage-current characteristics that is designed to protect all kinds of electronic devices or elements from switching and induced lightening surges. Its non linear exponent characteristic with broad using range and mass production is gradually being used by various level of electric engineering.

FEATURES

* Fast response time.
* Low leakage current.
* Excellent voltage ratio.
* Wide voltage & energy ratio.
* Low standby power and no follow-on current.
* High performance in surge current handling capability.
* High performance in clamping voltage characteristics.

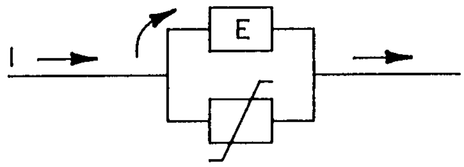
V-I Characteristics of varistor



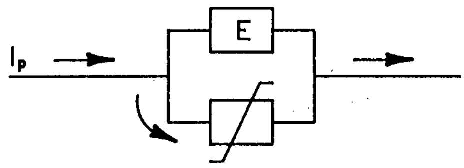
APPLICATIONS

* IC, diode, Transistor, thyristor, triae, and other semiconductor protection.
* Suppression of main-borne transients in consumer electronics and industrial electronics.
* Suppression of internally-generated spikes in electronics circuit.
* Surge protection in communication, measuring and controller electronics.
* Surge protection in electronic home appliances and gas and petroleum appliances.
* Relay and electromagnetic valve surge absorption.

The varistor's rest state has a high impedance (several megohms) in relation to the component to be protected and does not change the characteristics of the electric circuit. In the presence of transient voltage (over the breakdown voltage of varistor), the varistor then has a low impedance (a few ohms) and short circuits, i.e. the assembly E to be protected.



Rest State



Protective State

PARAMETERS DEFINITION

* **Varistor Voltage (breakdown voltage):**
  The varistor voltage is the voltage across the varistor measured at a specified current Ic (0.1mA or 1mA) of specified duration.

* **Maximum operating voltage:**
  The Maximum operating voltage corresponds to the rest state of the varistor, the rest state voltage offers a low leakage current in order to limit the power consumption of the protected device and not to disturb the circuit to be protected.

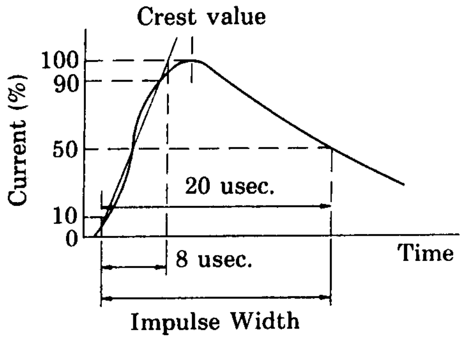
* **Non linear exponent (α):**
  The varistor voltage-current characteristic is defined by the equation: $I=KV^{\alpha}$ Where K is a constant dependent on geometry, and α is the non linear exponent. We usually take two point (V_1,I_1), (V_2,I_2) to estimate the value of α.

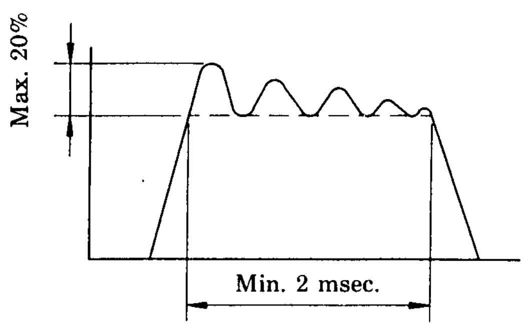
  $$\alpha=\frac{\log I_1/I_2}{\log V_1/V_2}$$

  In which I_1 and I_2 are the current value corresponding to the voltage value V_1 and V_2.

* **Maximum clamping voltage:**
  Maximum clamping voltage is the maximum voltage Vp between two terminals with the specified standard impulse current Ip. (8×20usec.) The voltage value is an indication on the protective function of the varistor.

* **Withstanding surge current:**
  Withstanding surge current is the maximum peak current for the varistor with the specified standard impulse current (8×20usec.) applied one time or two times and corresponding to a permissible variation of 10% in the varistor voltage change.





* **Energy**
  Maximum energy from one or a burst of pulses. It is the value within the varistor change of ±10% when one impulse of 2msec is applied.

  $E=Vm\times Im\times T$

  E : Energy
  Vm: Max. clamping voltage at Im.
  Im : Max. allowable single surge current of 2ms. (rectangular wave form)
  T : Duration of surge current (2ms.)

* **Rated power**
  The maximum power that can be applied within the specified ambient temperature.

* **Capacitance**
  The capacitance of varistor is the typical value measured between the varistor terminals at specified frequency.

* **Pulse lifetime rating**
  This is expressed as the maximum allowable number of impulse currents applied. 8/20 μs impulse current (or 2ms square-wave) is applied at prescribed interval. This curve also provides for derating current as required with repetitive pulsing.

SOURCE OF SURGE VOLTAGE

* Direct lightening surges.
* Surge voltage by grounding fault.
* From magnetic induction.
* Induced lightening surges.
* Surge voltage by switching operation.
* From electrostatic induction.

MECHANICAL & ENVIRONMENTAL TESTING

* **Terminal Pull Strength**
After gradually applying the load specified below and keeping the unit fixed for ten seconds, the terminal shall be visually examined for any damage. The requirement is no outstanding damage.

Terminal diameter	Loading weight in pull strength	Loading weight in bending strength
0.6mm (0.024″)	0.5kg (1.1lbs.)	0.25kg (0.55lbs.)
0.8mm (0.031″)	1.0kg (2.2lbs.)	0.5kg (1.1lbs.)
1.0mm (0.039″)	2.0kg (4.4lbs.)	1.0kg (2.2lbs.)

* **Terminal Bending Strength**
The unit shall be secured with its terminal kept vertical and the weight specified above be applied in the axial direction. The terminal shall gradually be bent by 90° in one direction, then 90° in the opposite direction, and again back to the original position, no outstanding damage of the terminal is the requirement for this testing.

* **Vibration**
Subjected to simple harmonic motion of 0.75mm amplitude 1.5mm maximum total excursion between limits of 10-55 Hz. Frequency scan shall be traversed in one minute. This motion shall then be applied for period of two hours in each of three mutually perpendicular directions. Thereafter, the unit shall be visually examined and meet the requirement of no outstanding damage.

* **Solderablilty**
After dipping the terminal to a depth of approximately 3mm from the body in a soldering bath of 260°C for three seconds, the terminal shall be visually examined.

* **Resistance to Soldering Heat**
The terminal shall be dipped into a soldering bath with temperature of 350°C to a point of 3mm from the body of the unit and then be held there for three sec. The change of Vb should meet the requirement of △Vb/Vb less than ±10%. And no outstanding damage in mechanical.

* **High Temperature Storage**
The specimen shall be subjected to 125°C for 1000 hours in a thermostatic bath without load and then stored at room temperature and humidity for one to two hours. The change of Vb shall be measured and meet the requirement of △Vb/Vb less than ±10%.

* **Himidity**
The specimen shall be subjected to 40°C, 90 to 95% R.H. for 1000 hours without load and then stored at room temperature and humidity for one to two hours. The change of Vb shall be measured and meet the requirement of △Vb/Vb less than ±10%.

* **Thermal Shock**
The temperature cycle is repeated five times with (1) −25°C keeping 30 minutes then (2) 85°C keeping 30 minutes and then stored at room temperature and humidity for one to two hours. The change of Vb as well as mechanical damage shall be examined and meet the requirement of △Vb/Vb less than ±10%.

* **High Temperature Operation**
After being continuously applied the maximum allowable voltage at 85°C for 1000 hours, the specimen shall be stored at room temperature and humidity for one to two hours. The change of Vb shall meet the requirement of △Vb/Vb less than ±10%.

* **Surge Life**
The change of Vb shall be measured under △Vb/Vb less than ±10% after the impulse listed below is applied 10,000 times continuously with the interval of 10 second at room temperature.

JVR-05N180K~JVR-05N680K with 0.5A, 2 msec.
JVR-07N180K~JVR-07N680K with 1.5A, 2 msec.
JVR-10N180K~JVR-10N680K with 50A, 8×20 usec.
JVR-14N180K~JVR-14N680K with 75A, 8×20 usec.
JVR-20N820K~JVR-20N112K with 200A, 8×20 usec.
JVR-05N820K~JVR-05N471K with 20A, 8×20 usec.
JVR-07N820K~JVR-07N471K with 50A, 8×20 usec.
JVR-10N820K~JVR-10N112K with 100A, 8×20 usec.
JVR-14N820K~JVR-14N112K with 150A, 8×20 usec.

GENERAL CHARACTERISTICS

* Storage temperature : −40°C, +125°C
* Max. operating temperature : +85°C
* Max. working surface temp. : +115°C
* Max. response time : 25 nsec.
* Voltage coefficient temp. : −0.05%/°C
* Insulation resistance(at 500V) : Over 1000MΩ

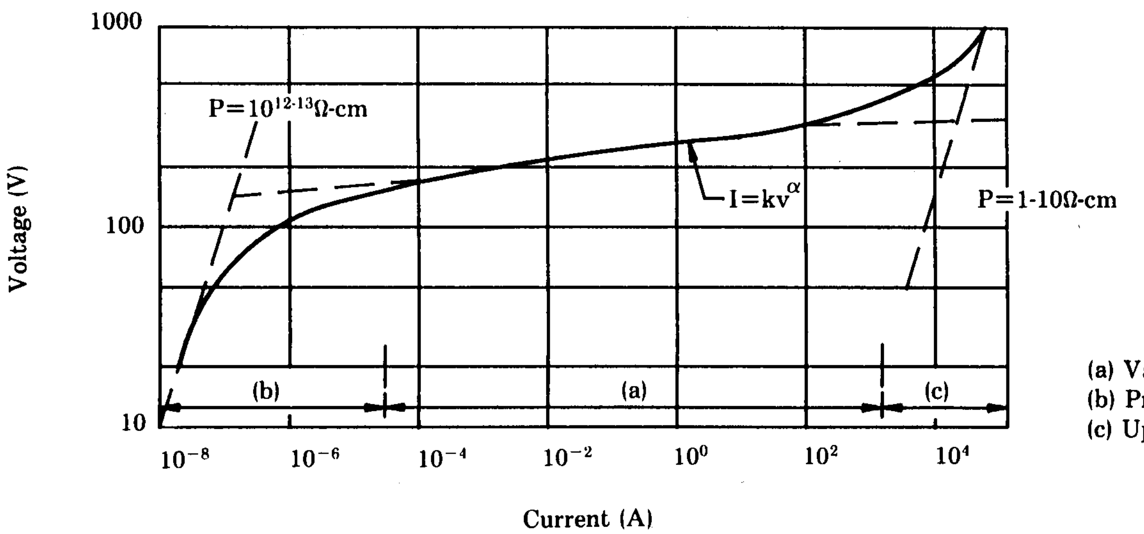
HOW TO SELECT JVR VARISTOR

* To identify the source and route of surge.
* To decide the connection method of varistor.
* To decide varistor voltage and max. clamping voltage.
* To decide surge current waveform by caculation from surge voltage and surge impedance.
* To check whether the withstanding surge current and surge life of varistor is sufficient or not.
* To check the variation of electric power of protected device.
* To check whether the max. energy and engrgy life of varistor is enough or not.
* To check the relation:

Max. withstanding voltage of protected device > Max. clamping voltage of varistor > The real clamping voltage occurred > Breakdown voltage of varistor > Operating voltage of protected device.

* To check whether the loss of capacitance of varistor in operating condition.
* To check whether the problem caused by loss current of leakage.
* To check the connection method of varistor.
* To check the condition of varistor overload.
* To check any other problems by various operating conditions.
* To test and to verify by real practice.
* To check the connection of the grounding wire.

CURRENT-VOLTAGE CHARACTERISTICS

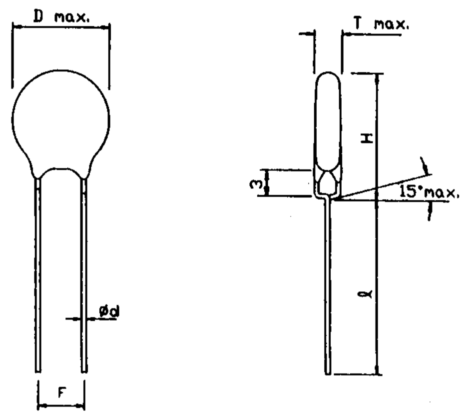


(a) Varistor action region
(b) Pre-breakdown region
(c) Upturn region

DIMENSION OF COMPONENT

Dimension Table measure : m/m

Dim.(ϕ)	5ϕ	7ϕ	10ϕ	14ϕ	20ϕ
D max.	6.5	8.4	11.5	15.6	21.8
d (±0.02)	0.6	0.6	* 0.6/0.8	0.8	1.0
F (±1.0)	5.0	5.0	* 5.0/7.5	7.5	10.0
H max.	11.0	12.0	15.5	20.5	28.0
ℓ min.	25.0	25.0	25.0	25.0	25.0



VARISTOR TABLE

Varistor Part No.	Maximum Allowable Voltage		Varistor Voltage V 1mA		Maximum Clamping Voltage	Withstanding Surge Current		Rated Wattage	Energy 10/1000us	Typical Capacitance	Dimensions	
	ACrms (V)	DC (V)	(V)	Tolerance Min - Max	V 10A (V)	1 Time (A)	2 Times (A)	(W)	(J)	1 KHz (PF)	D Max	T
JVR-7N180K	11	14	18	16 - 20	36 (1)	250	125	0.02	1.2	3,500	7ø	3.4
JVR-7N220K	14	18	22	20 - 24	43 (1)	250	125	0.02	1.4	2,800	7ø	3.6
JVR-7N270K	17	22	27	24 - 30	53 (1)	250	125	0.02	1.7	2,200	7ø	3.8
JVR-10N270K	17	22	27	24 - 30	53(1)	500	250	0.05	3.5	4,800	10ø	4.2
JVR-10N330K	20	26	33	30 - 36	65 (1)	500	250	0.05	4.4	4,200	10ø	4.4
JVR-7N470K	30	38	47	42 - 52	93 (1)	250	125	0.02	3.0	1,150	7ø	3.9
JVR-10N560K	35	45	56	50 - 62	110 (1)	500	250	0.05	7.0	2,900	10ø	4.6
JVR-7N820K	50	65	82	74 - 90	135	1200	600	0.25	5.5	930	7ø	3.3
JVR-14N820K	50	65	82	74 - 90	135	4500	2500	0.6	22.0	3,900	14ø	3.9
JVR-7N121K	75	100	120	108 - 132	200	1200	600	0.25	8.0	670	7ø	3.5
JVR-10N151K	95	125	150	135 - 165	250	2500	1250	0.4	22.0	1,300	10ø	4.3
JVR-10N221K	140	180	220	198 - 242	360	2500	1250	0.4	31.0	360	10ø	4.2
JVR-14N221K	140	180	220	198 - 242	360	4500	2500	0.6	62.0	710	14ø	4.3
JVR-7N241K	150	200	240	216 - 264	395	1200	600	0.25	16.8	150	7ø	3.8
JVR-10N241K	150	200	240	216 - 264	395	2500	1250	0.4	33.5	330	10ø	4.3
JVR-14N241K	150	200	240	216 - 264	395	4500	2500	0.6	67.0	650	14ø	4.4
JVR-20N241K	150	200	240	216 - 264	395	6500	4000	1.0	134	1,400	20ø	4.9

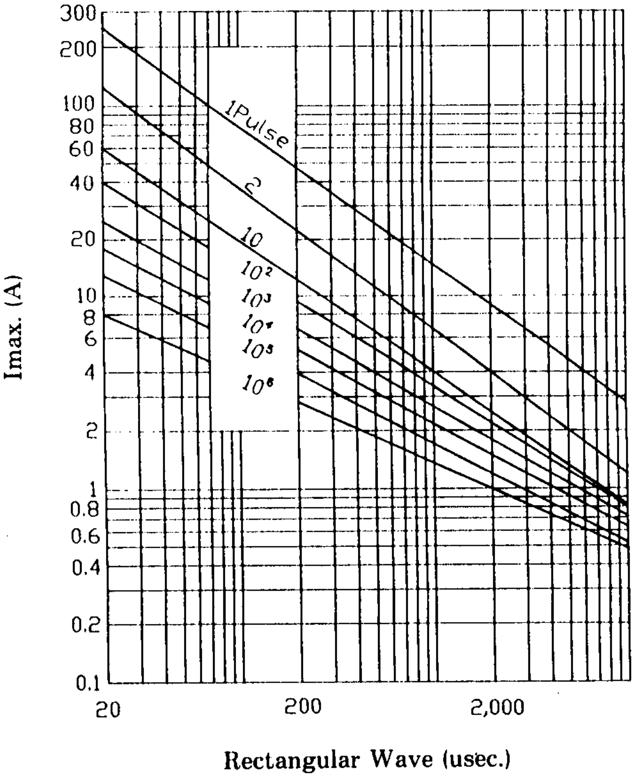
(1) The clamping voltage is tested with current 2.5A.

VARISTOR TABLE

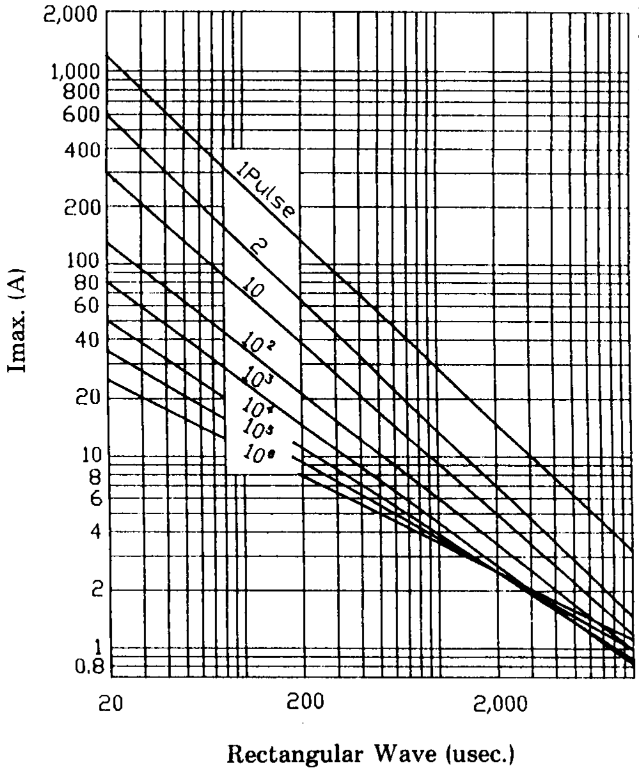
Varistor Part No.	Maximum Allowable Voltage		Varistor Voltage V 1mA		Maximum Clamping Voltage	Withstanding Surge Current		Rated Wattage	Energy 10/1000us	Typical Capaci-tance	Dimensions	
	ACrms (V)	DC (V)	(V)	Tolerance Min - Max	V 10A (V)	1 Time (A)	2 Times (A)	(W)	(J)	1 KHz (PF)	D Max	T
JVR-7N271K	175	225	270	247 - 303	455	1200	600	0.25	19.8	135	7ø	3.9
JVR-20N271K	175	225	270	247 - 303	455	6500	4000	1.0	158	1,350	20ø	5.0
JVR-7N361K	230	300	360	324 - 396	595	1200	600	0.25	26.0	105	7ø	4.4
JVR-10N361K	230	300	360	324 - 396	595	2500	1250	0.4	52.0	240	10ø	4.9
JVR-14N361K	230	300	360	324 - 396	595	4500	2500	0.6	104.0	480	14ø	5.0
JVR-7N391K	250	320	390	351 - 429	650	1200	600	0.25	30.0	100	7ø	4.5
JVR-20N391K	250	320	390	351 - 429	650	6500	4000	1.0	240	1,100	10ø	5.6
JVR-7N431K	275	350	430	387 - 473	710	1200	600	0.25	33.0	90	7ø	4.7
JVR-10N431K	275	350	430	387 - 473	710	2500	1250	0.4	66.0	190	10ø	5.2
JVR-14N431K	275	350	430	387 - 473	710	4500	2500	0.6	132.0	420	14ø	5.3
JVR-20N431K	275	350	430	387 - 473	710	6500	4000	1.0	264	1,050	10ø	4.3
JVR-7N471K	300	385	470	423 - 517	775	1200	600	0.25	35.0	85	10ø	4.9
JVR-14N471K	300	385	470	423 - 517	775	4500	2500	0.6	140.0	390	14ø	5.5
JVR-14N681K	420	560	680	612 - 748	1,120	4500	2500	0.6	172.0	260	14ø	6.5
JVR-20N681K	420	560	680	612 - 748	1,120	6500	4000	1.0	344	820	20ø	7.0
JVR-14N751K	460	615	750	675 - 825	1,240	4500	2500	0.6	180.0	230	14ø	6.8
JVR-20N781K	485	640	780	702 - 858	1,290	6500	4000	1.0	368	700	20ø	7.5

PULSE LIFETIME RATINGS

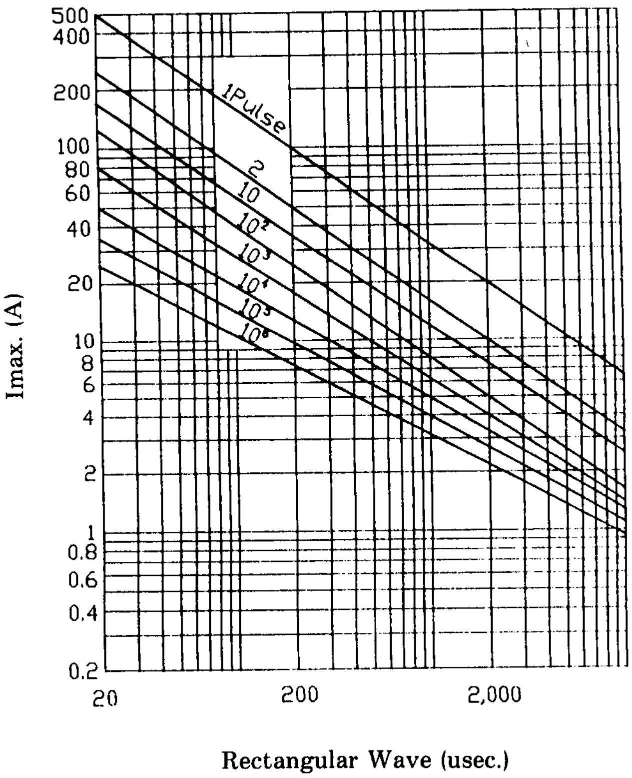
JVR-7N180K ~ JVR7N680K



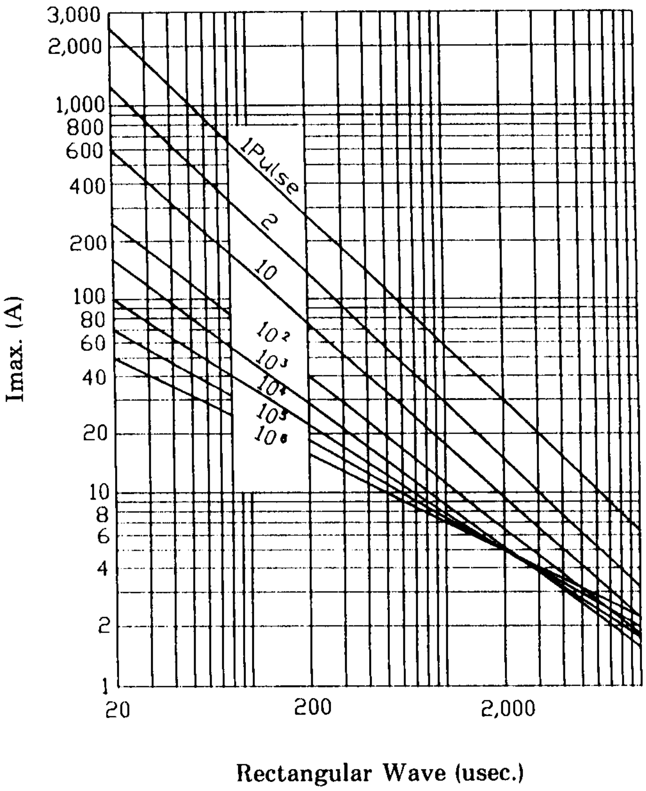
JVR-7N820K ~ JVR7N471K



JVR-10N180K ~ JVR-10N680K

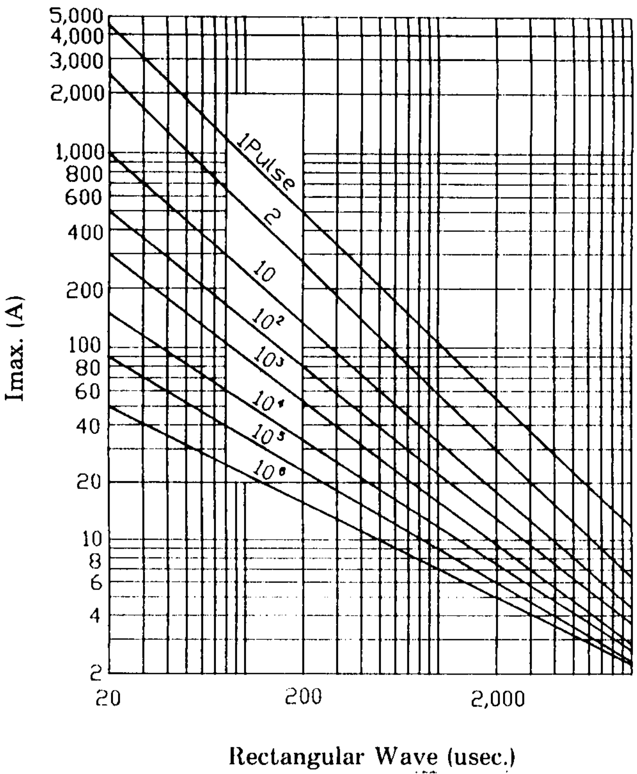


JVR-10N820K ~ JVR-10N471K

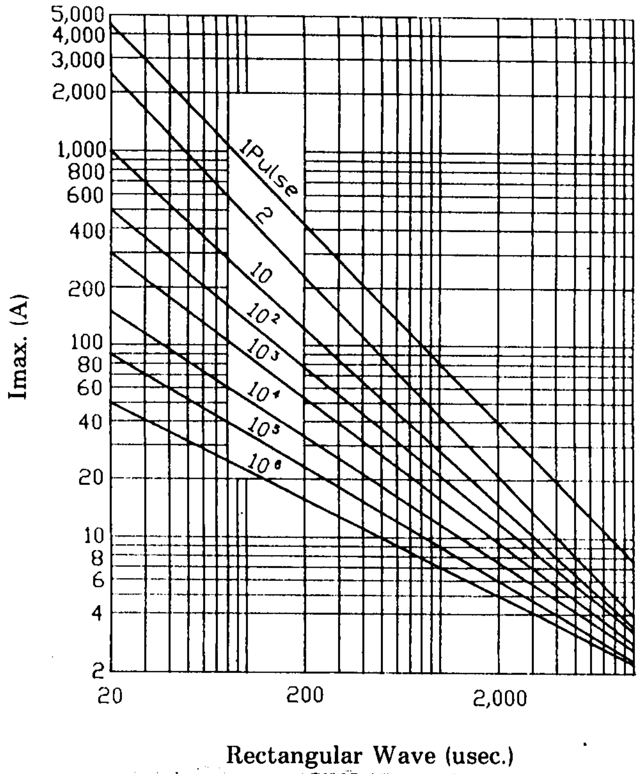


PULSE LIFETIME RATINGS

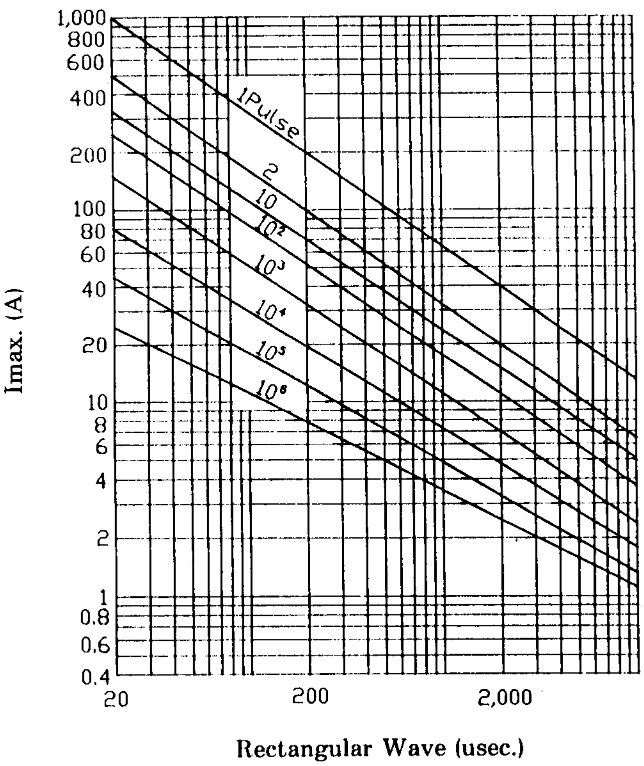
JVR-14N820K ~ JVR-14N471K



JVR-14N561K ~ JVR-14N112K

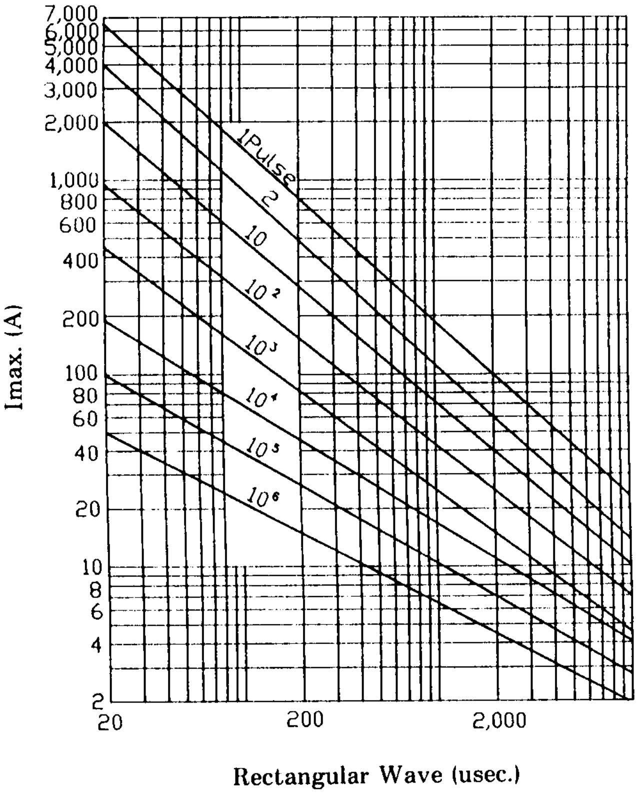


JVR-14N180K ~ JVR-14N680K

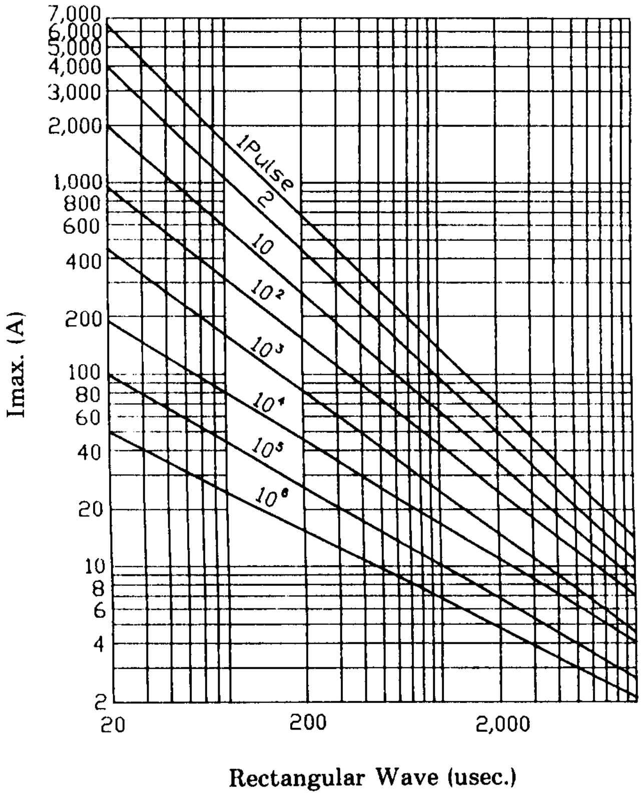


PULSE LIFETIME RATINGS

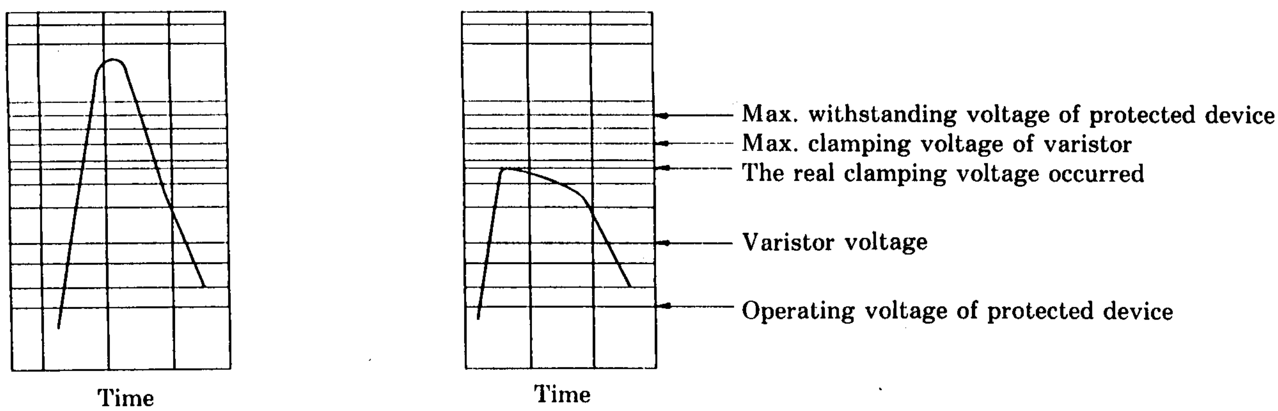
JVR-20N820K ~ JVR-20N471K



JVR-20N561K ~ JVR-20N112K

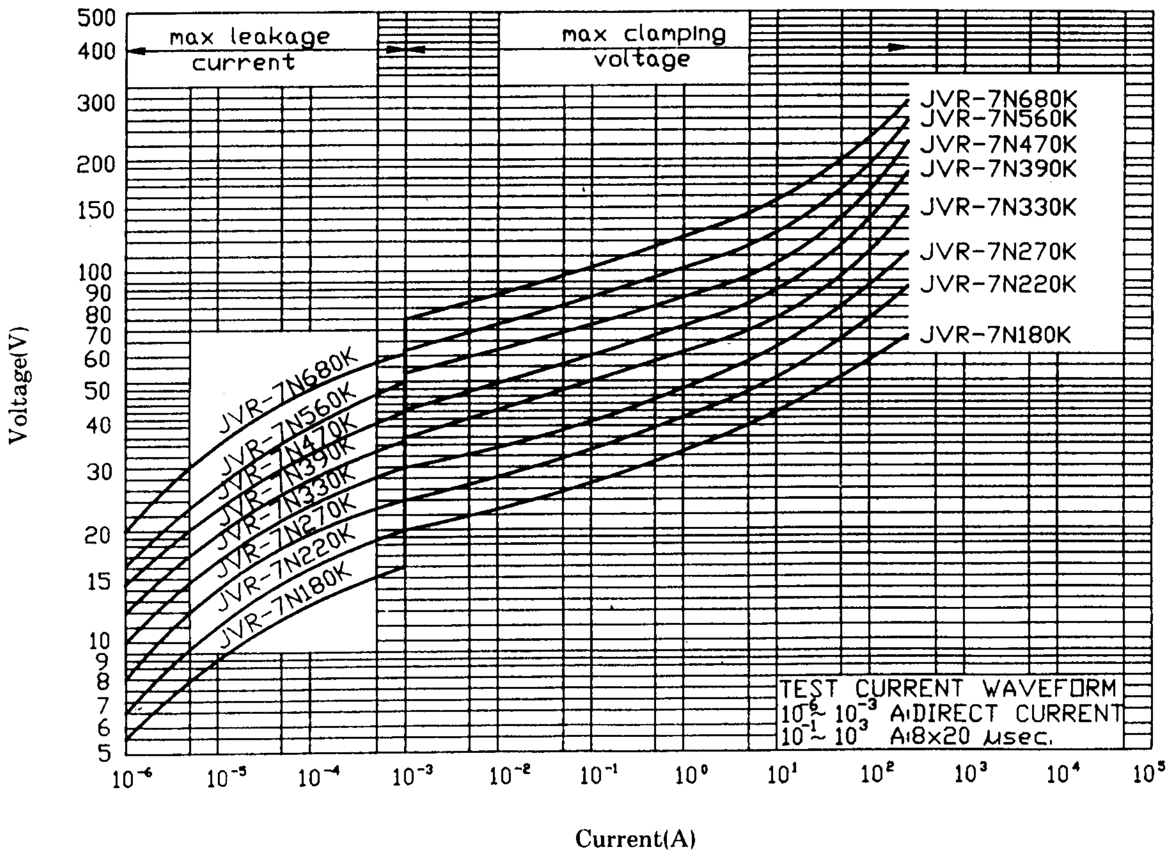


Surge suppression of varistor

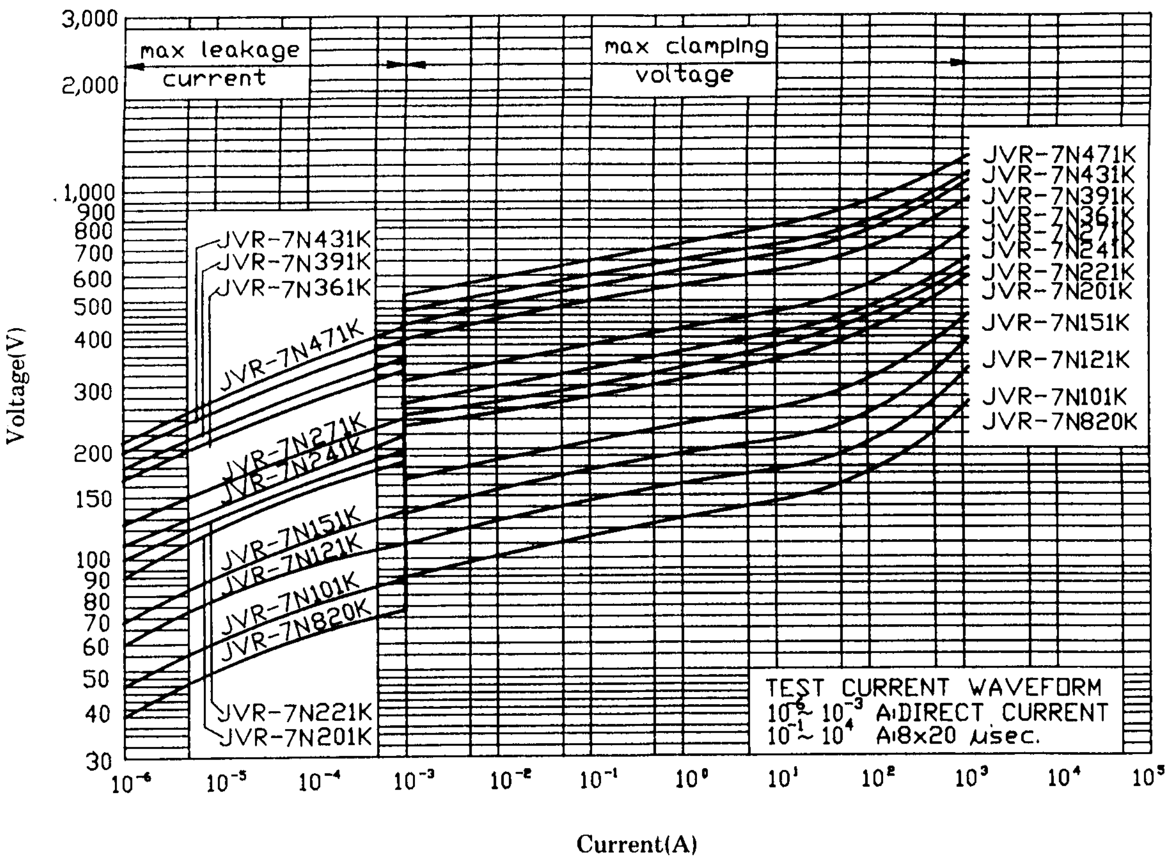


V-I CHARACTERISTIC CURVE

JVR-7N180K ~ JVR7N680K

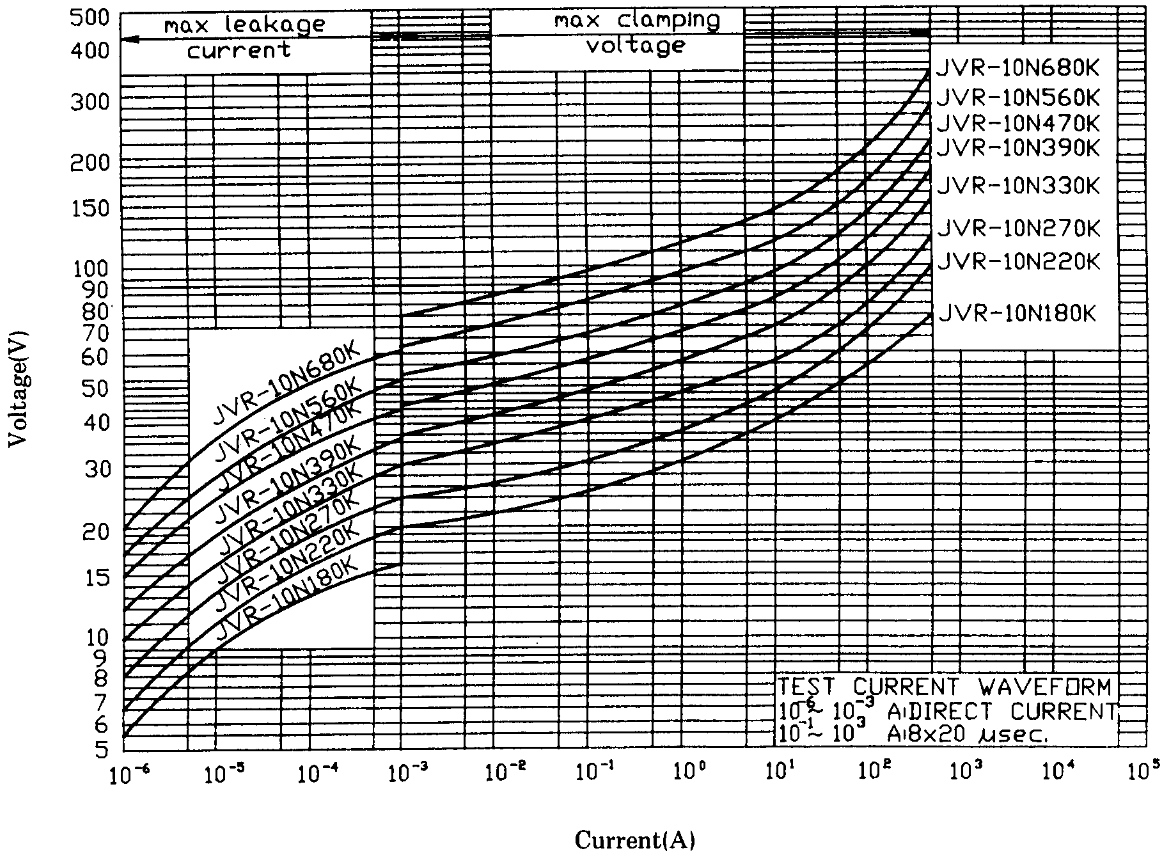


JVR-7N820K ~ JVR7N471K

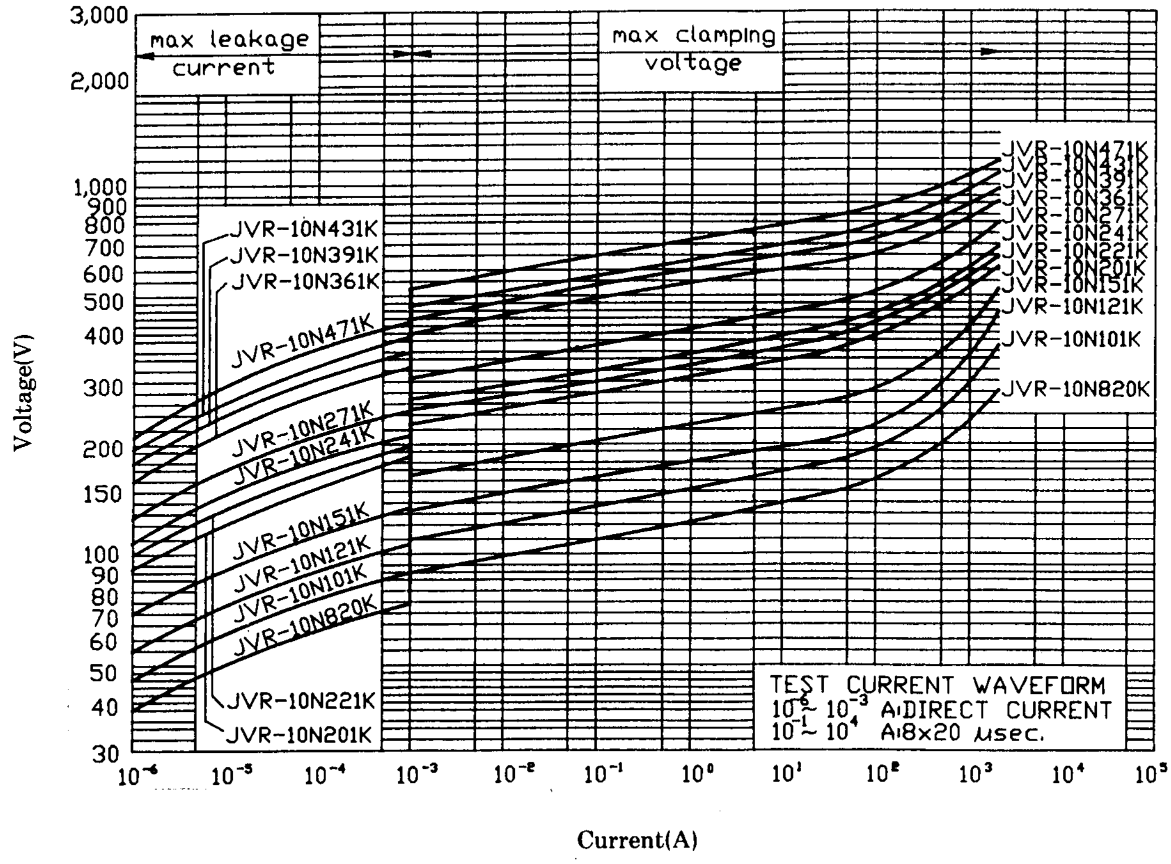


V-I CHARACTERISTIC CURVE

JVR-10N180K ~ JVR-10N680K

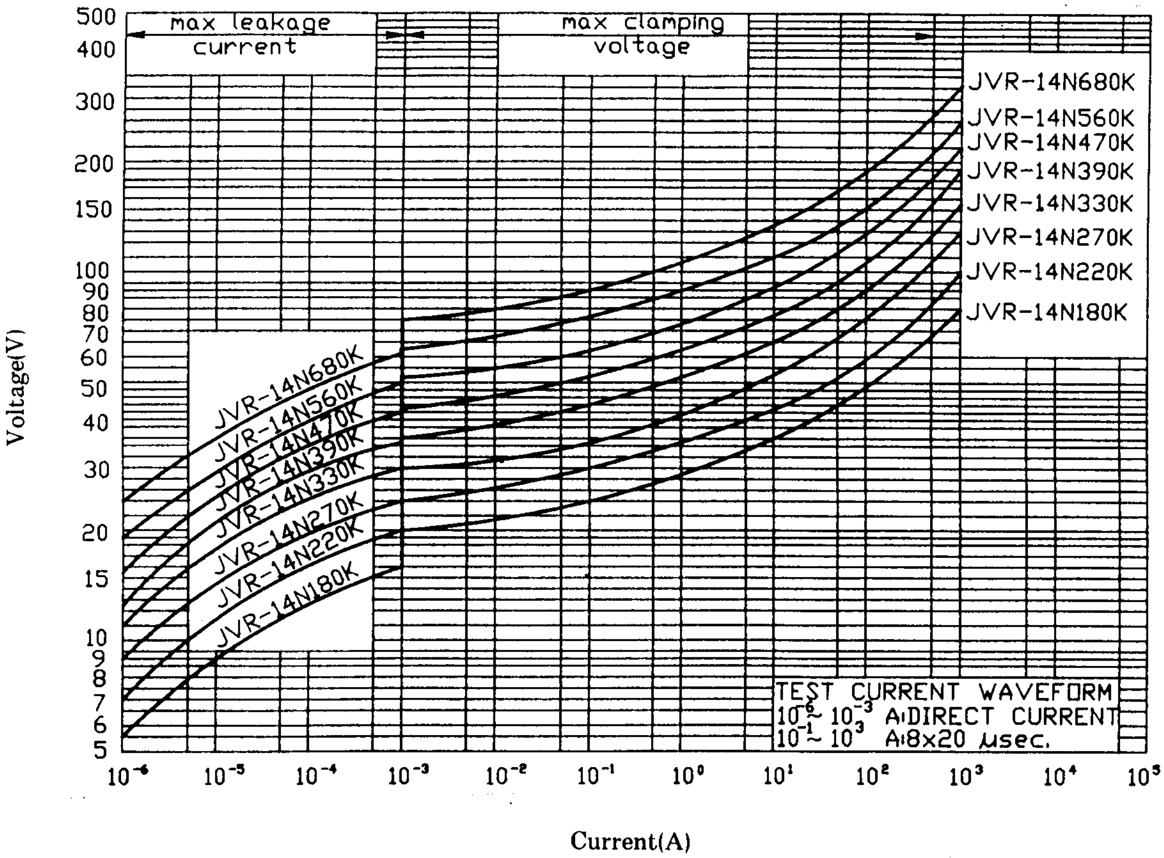


JVR-10N820K ~ JVR-10N471K

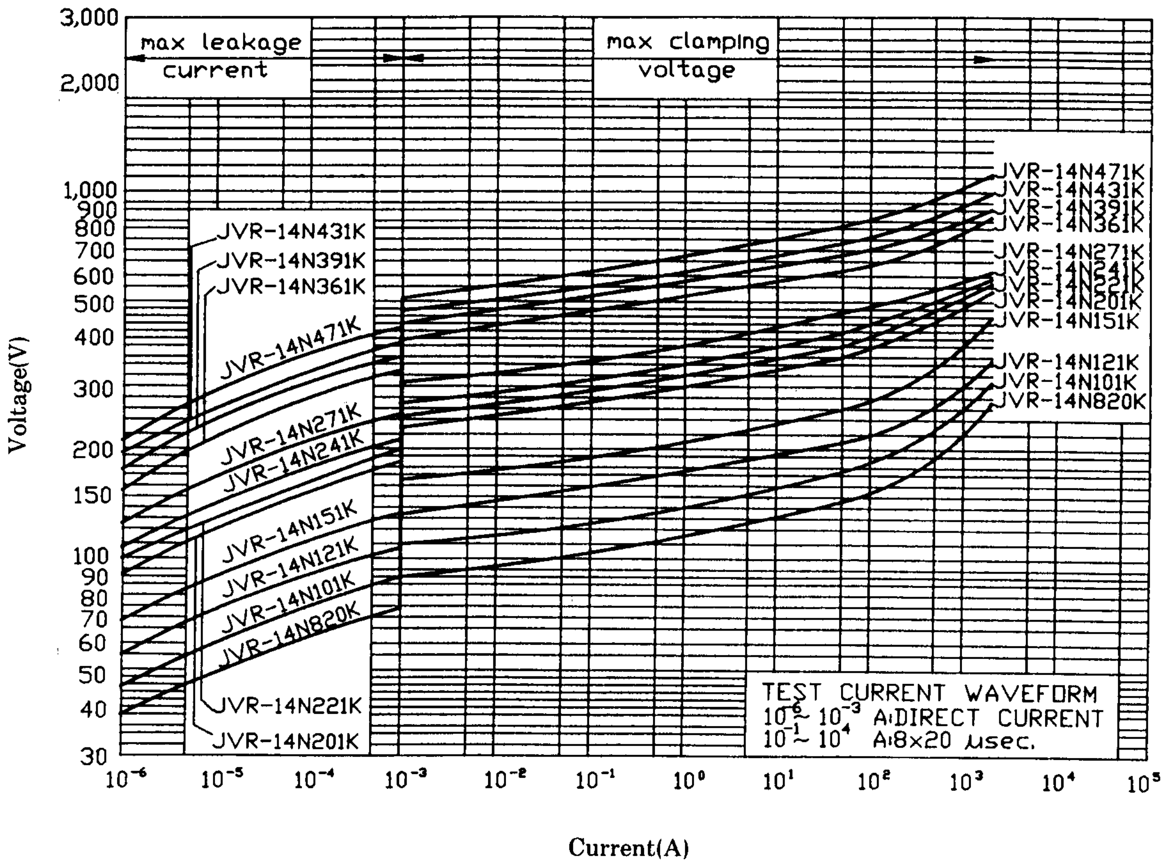


V-I CHARACTERISTIC CURVE

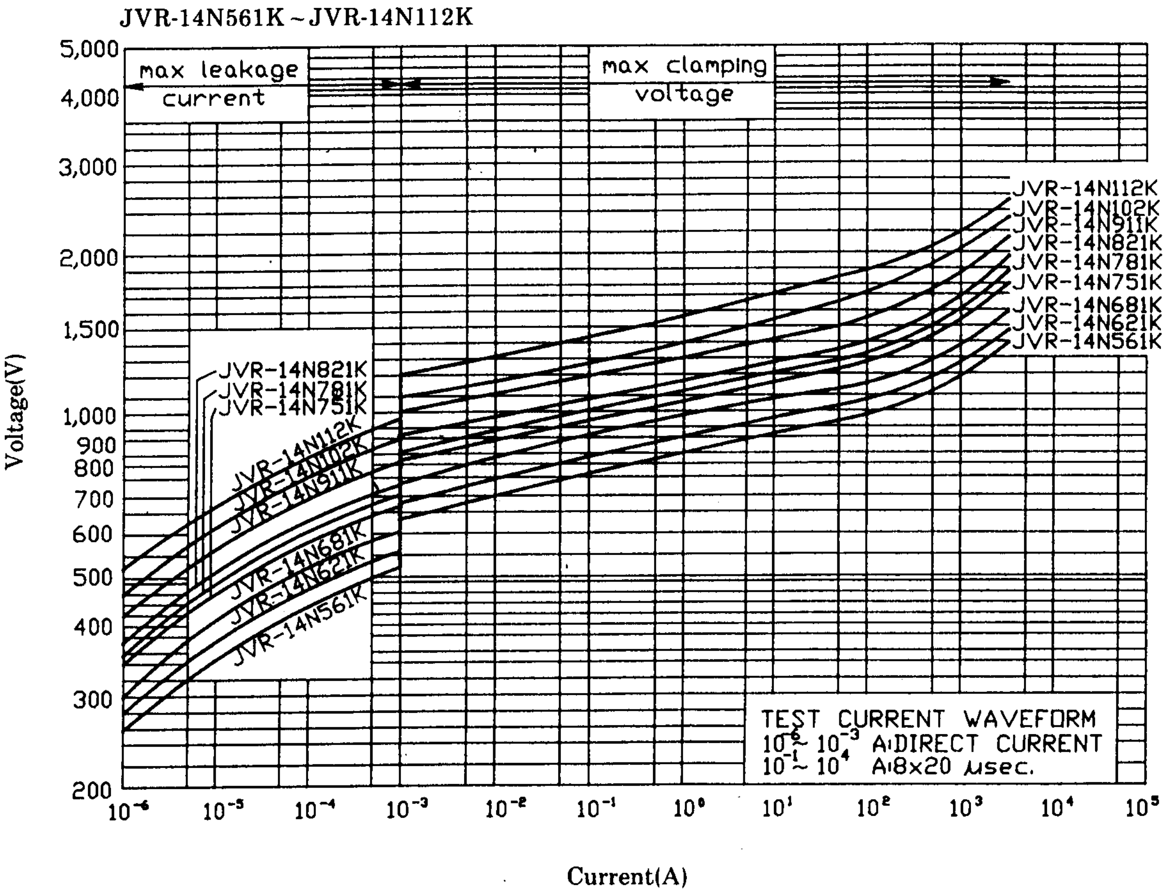
JVR-14N180K ~ JVR-14N680K



JVR-14N820K ~ JVR-14N471K

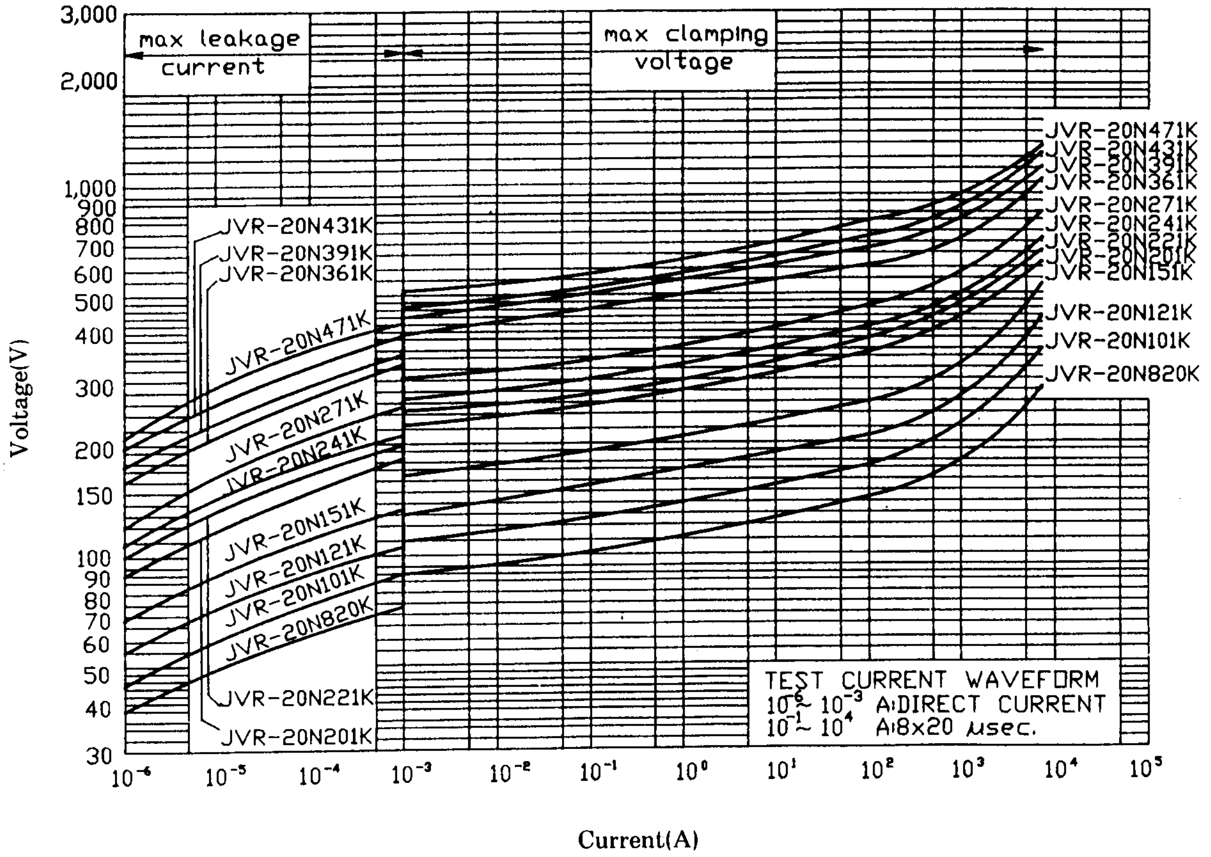


V-I CHARACTERISTIC CURVE

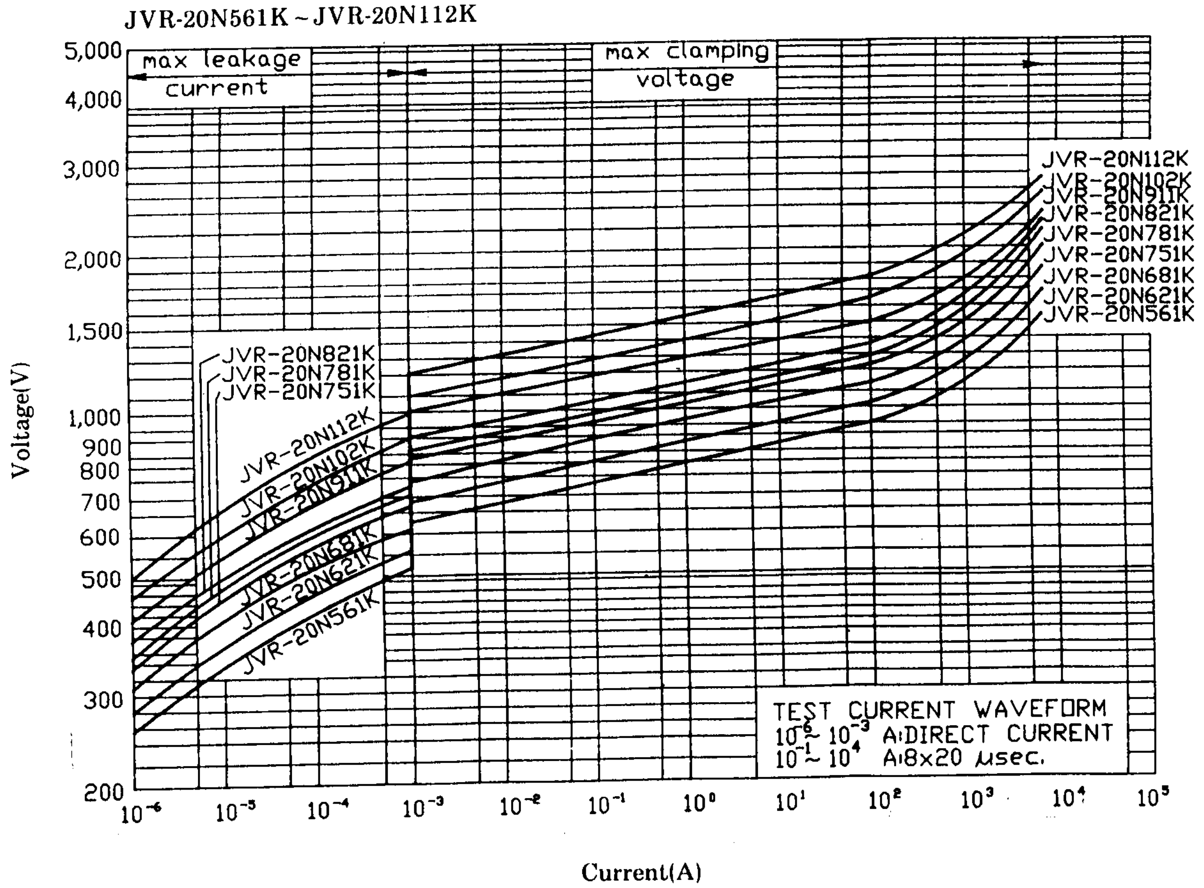


V-I CHARACTERISTIC CURVE

JVR-20N820K ~ JVR-20N471K



JVR-20N561K ~ JVR-20N112K



EXAMPLES OF APPLICATION

*** Varistor voltage selection in line circuit**

Power supply voltage	Type
100V AC	JVR-□□N201K JVR-□□N221K JVR-□□N241K JVR-□□N271K
200V AC	JVR-□□N391K JVR-□□N431K JVR-□□N471K
12V DC	JVR-□□N220K
48V DC	JVR-□□N390K

*** Varistor voltage selection in line and ground circuit**

Power supply voltage	Type
100V AC, 200V AC	JVR-□□N431K JVR-□□N471K JVR-□□N751K to JVR-□□N112K

*** Varistor voltage selection in switching circuit protection**

Power supply voltage	Type
12V AC	JVR-□□N220K
24V DC	JVR-□□N390K
100V DC	JVR-□□N151K
100V AC	JVR-□□N201K JVR-□□N241K JVR-□□N221K JVR-□□N271K

*** Varistor voltage selection in telecommunication circuit protection**

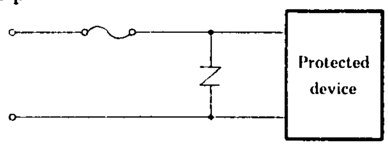
Power supply voltage	Type
12V DC	JVR-□□N220K JVR-□□N820K to JVR-□□N112K
24V DC	JVR-□□N390K JVR-□□N820K to JVR-□□N112K

*** Applicable fuse compare to varistor**

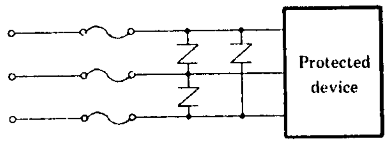
Varistor	5 ϕ	7 ϕ	10 ϕ	14 ϕ	20 ϕ
Fuse (A)	1 to 2	2 to 3	3 to 5	3 to 10	5 to 15

*** Line Circuit**

AC/DC single-phase circuit

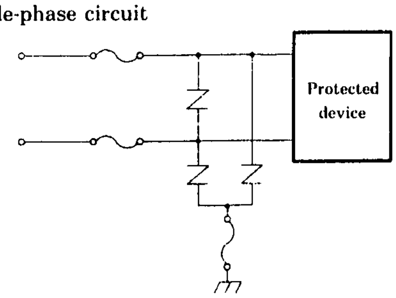


AC three-phase circuit

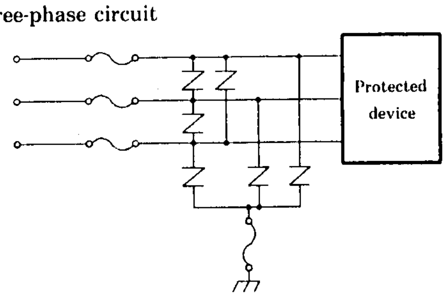


*** Line and Ground**

AC/DC single-phase circuit

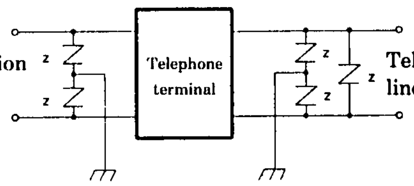


AC three-phase circuit



*** Telecommunication Circuit Protection**

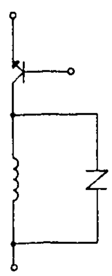
Communication line



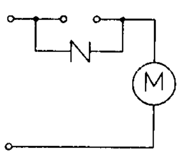
Telephone line

*** Switching Circuit Protection**

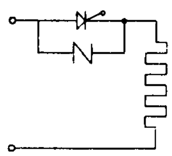
Relay protection



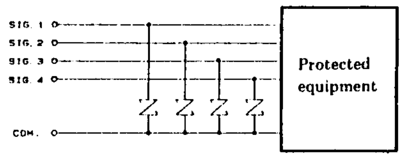
Spark elimination



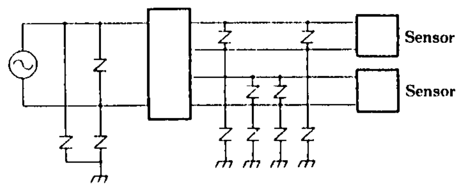
Semiconductor protection



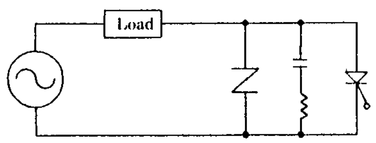
Surge protection of signal line



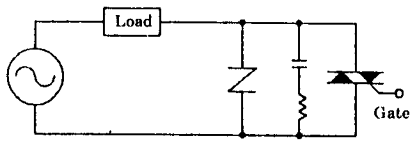
Fire alarm system



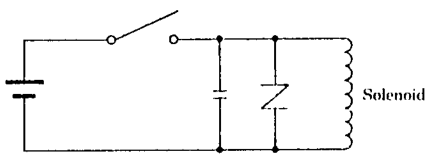
Thyristor protection



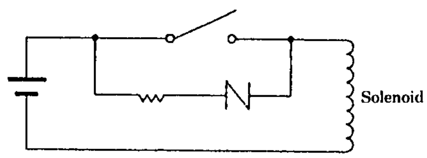
Triac protection



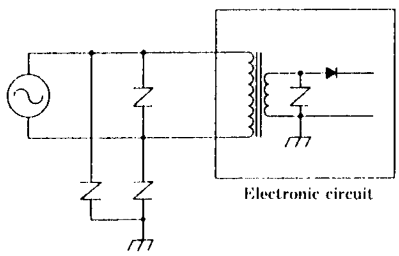
Solenoid



Contact protection



Stove, boiler



Brake, clutch