

MOV Metal Oxide Varistors

Leaded varistors, TMOV-G High Surge , 20 Shell series

Series/Type: VCRR20E*K*105S**

Ordering code: VCRR20E*K*105S**

Date: January 2020

Version: 1

Construction

- The built-in temperature fuse of the varistor is connected in series with the GDT and comes with a lead wire
- Coating: filled with epoxy resin and coated with a flame-retardant shell, with a fire rating upgraded to UL 94 V-0
- Terminals: tinned wire

Features

- TMOV-G integrated surge protection device, with internal integrated thermal trip mechanism TCO, varistor MOV, and gas discharge tube GDT connected in series. GDT ignites first during surge impact, while MOV performs voltage clamping; The end of the surge relies on the MOV impedance lifting to extinguish the GDT arc and suppress the continuous current of the power frequency. When MOV undergoes aging, deterioration, and abnormal heating, the built-in thermal release mechanism will activate, mechanically cutting off the main circuit, and the device will enter a safe open circuit failure mode; Optional remote signaling alarm pin output fault status, mainly used for common mode surge protection of AC power supply L-PE and N-PE.

Approvals

- UL Certificate:E531647
- TUV Certificate:B1199670002
- CQC Certificate :CQC23001399121

Delivery mode

- Bulk (standard), taped versions on reel or in Ammo pack upon request
- For further details refer to chapter "Taping, packaging and lead configuration" for leaded varistors.

General technical data

Climatic category	to IEC 60068-1	40/85/56	
Operating temperature	to IEC 61051	-40 ... +130	°C
Storage temperature		-40 ... +125	°C
Electric strength	to IEC 61051	≥ 2.5	kV _{RMS}
Insulation resistance	to IEC 61051	≥ 100	MΩ

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Electrical specifications and ordering codes

Maximum ratings ($T_A = 85\text{ }^{\circ}\text{C}$)

Ordering code	UL Volts VAC(V)	Recommended MCOV VAC [V]	UL MCOV VAC[V]	Withstanding Surgecurrent (1.2/50_8/20 μs 40 time	Platform Voltage 1000V/us	Peak Voltage V1000V/us	Wmax (10/1000us) [J]
VCRR20E820K1105S	50	55	70	10KV/5KA	≤ 150	≤ 710	56
VCRR20E820K2105S	50	60	70	10KV/5KA	≤ 150	≤ 1020	56
VCRR20E101K1105S	65	70	85	10KV/5KA	≤ 180	≤ 710	70
VCRR20E101K2105S	65	75	85	10KV/5KA	≤ 180	≤ 1020	70
VCRR20E121K1105S	75	80	100	10KV/5KA	≤ 210	≤ 710	85
VCRR20E121K2105S	75	90	100	10KV/5KA	≤ 210	≤ 1020	85
VCRR20E151K1105S	95	100	120	10KV/5KA	≤ 270	≤ 710	106
VCRR20E151K2105S	95	115	120	10KV/5KA	≤ 270	≤ 1020	106
VCRR20E181K1105S	115	120	150	10KV/5KA	≤ 320	≤ 710	130
VCRR20E181K2105S	115	135	150	10KV/5KA	≤ 320	≤ 1020	130
VCRR20E201K1105S	130	140	170	10KV/5KA	≤ 350	≤ 710	140
VCRR20E201K2105S	130	145	170	10KV/5KA	≤ 350	≤ 1020	140
VCRR20E221K2105S	140	150	185	10KV/5KA	≤ 390	≤ 1020	155
VCRR20E221K3105S	140	170	185	10KV/5KA	≤ 390	≤ 1320	155
VCRR20E241K2105S	150	160	200	10KV/5KA	≤ 430	≤ 1020	168
VCRR20E241K3105S	150	180	200	10KV/5KA	≤ 430	≤ 1320	168
VCRR20E271K2105S	175	190	230	10KV/5KA	≤ 480	≤ 1020	190
VCRR20E271K3105S	175	210	230	10KV/5KA	≤ 480	≤ 1320	190
VCRR20E301K2105S	190	200	250	10KV/5KA	≤ 530	≤ 1020	210
VCRR20E301K3105S	190	230	250	10KV/5KA	≤ 530	≤ 1320	210
VCRR20E331K2105S	210	220	280	10KV/5KA	≤ 580	≤ 1020	228
VCRR20E331K3105S	210	250	280	10KV/5KA	≤ 580	≤ 1320	228
VCRR20E361K2105S	230	240	300	10KV/5KA	≤ 640	≤ 1020	255
VCRR20E361K3105S	230	270	300	10KV/5KA	≤ 640	≤ 1320	255
VCRR20E391K2105S	250	260	330	10KV/5KA	≤ 690	≤ 1020	275
VCRR20E391K4105S	250	310	330	10KV/5KA	≤ 690	≤ 1800	275
VCRR20E431K3105S	275	300	360	10KV/5KA	≤ 760	≤ 1320	305
VCRR20E431K4105S	275	330	360	10KV/5KA	≤ 760	≤ 1800	305
VCRR20E471K3105S	300	320	390	10KV/5KA	≤ 830	≤ 1320	350
VCRR20E471K4105S	300	360	390	10KV/5KA	≤ 830	≤ 1800	350
VCRR20E511K3105S	320	340	420	10KV/5KA	≤ 986	≤ 1320	360
VCRR20E511K4105S	320	390	420	10KV/5KA	≤ 900	≤ 1800	360
VCRR20E561K3105S	350	370	460	10KV/5KA	≤ 986	≤ 1320	366
VCRR20E561K4105S	350	420	460	10KV/5KA	≤ 990	≤ 1800	366
VCRR20E621K3105S	385	400	510	10KV/5KA	≤ 1100	≤ 1320	372
VCRR20E621K4105S	385	460	510	10KV/5KA	≤ 1100	≤ 1800	372
VCRR20E681K3105S	420	440	550	10KV/5KA	≤ 1200	≤ 1320	382
VCRR20E681K4105S	420	520	550	10KV/5KA	≤ 1200	≤ 1800	382
VCRR20E751K3105S	460	480	600	10KV/5KA	≤ 1320	≤ 1320	410
VCRR20E751K4105S	460	560	600	10KV/5KA	≤ 1320	≤ 1800	410

¹⁾ **Note:** Nominal discharge current is the specification defined in UL1449 4th edition and tested with 8/20 μs current waveform

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Characteristics (T_A=25 °C):

Ordering code	GDT Voltage V1ma [V]	MoV _V (1 mA) [V]	ΔV _V (1 mA) [%]	Max clamping voltage		C _{typ} (1 kHz) [pF]
				V _c [V]	I _c [A]	
VCRR20E820K1105S	90(72~108)	82	±10	135	50	2400
VCRR20E820K2105S	350(280~420)	82	±10	135	50	2400
VCRR20E101K1105S	90(72~108)	100	±10	165	50	2000
VCRR20E101K2105S	350(280~420)	100	±10	165	50	2000
VCRR20E121K1105S	90(72~108)	120	±10	200	50	1700
VCRR20E121K2105S	350(280~420)	120	±10	200	50	1700
VCRR20E151K1105S	90(72~108)	150	±10	250	50	1300
VCRR20E151K2105S	350(280~420)	150	±10	250	50	1300
VCRR20E181K1105S	90(72~108)	180	±10	300	50	1100
VCRR20E181K2105S	350(280~420)	180	±10	300	50	1100
VCRR20E201K1105S	90(72~108)	200	±10	340	50	700
VCRR20E201K2105S	350(280~420)	200	±10	340	50	700
VCRR20E221K2105S	350(280~420)	220	±10	360	50	640
VCRR20E221K3105S	600(480~720)	220	±10	360	50	640
VCRR20E241K2105S	350(280~420)	240	±10	395	50	580
VCRR20E241K3105S	600(480~720)	240	±10	395	50	580
VCRR20E271K2105S	350(280~420)	270	±10	455	50	520
VCRR20E271K3105S	600(480~720)	270	±10	455	50	520
VCRR20E301K2105S	350(280~420)	300	±10	500	50	480
VCRR20E301K3105S	600(480~720)	300	±10	500	50	480
VCRR20E331K2105S	350(280~420)	330	±10	550	50	450
VCRR20E331K3105S	600(480~720)	330	±10	550	50	450
VCRR20E361K2105S	350(280~420)	360	±10	595	50	430
VCRR20E361K3105S	600(480~720)	360	±10	595	50	430
VCRR20E391K2105S	350(280~420)	390	±10	650	50	390
VCRR20E391K4105S	1000(800~1200)	390	±10	650	50	390
VCRR20E431K3105S	600(480~720)	430	±10	710	50	370
VCRR20E431K4105S	1000(800~1200)	430	±10	710	50	370
VCRR20E471K3105S	600(480~720)	470	±10	775	50	320
VCRR20E471K4105S	1000(800~1200)	470	±10	775	50	320
VCRR20E511K3105S	600(480~720)	510	±10	845	50	290
VCRR20E511K4105S	1000(800~1200)	510	±10	845	50	290
VCRR20E561K3105S	600(480~720)	560	±10	925	50	260
VCRR20E561K4105S	1000(800~1200)	560	±10	925	50	260
VCRR20E621K3105S	600(480~720)	620	±10	1025	50	240
VCRR20E621K4105S	1000(800~1200)	620	±10	1025	50	240
VCRR20E681K3105S	600(480~720)	680	±10	1120	50	230
VCRR20E681K4105S	1000(800~1200)	680	±10	1120	50	230
VCRR20E751K3105S	600(480~720)	750	±10	1240	50	220
VCRR20E751K4105S	1000(800~1200)	750	±10	1240	50	220

2) *Please refer to the suffix code

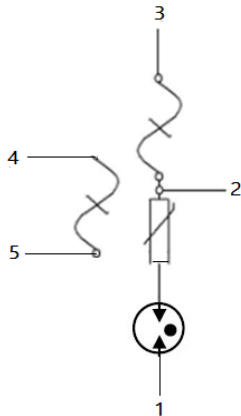
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Schematic Diagram



P2.P3.P4 pin can be used as a monitoring pin, optional

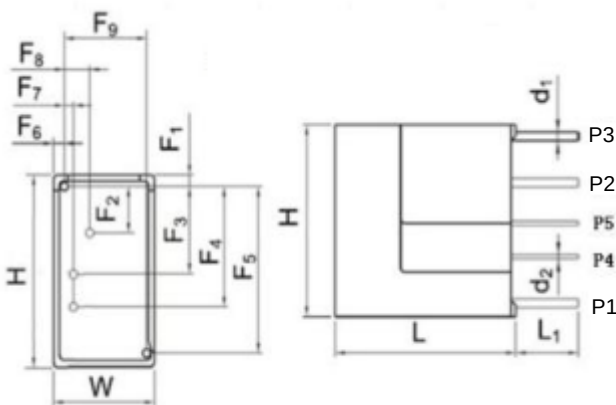
Weight

Nominal diameter mm	V _{RMS} V	Weight g
20	50...460	7.5...55

Different voltage levels result in differences in weight.

E type

Dimensional drawings



Dimensions

VN	L±1.0	L1±1.0	w±1.0	H±1.0	d±0.05	F1±0.5	F2±0.5	F3±0.5	F4±0.5	F5±0.5	F6±0.5
820-121	23.2	8.0	9.1	22.8	1.05	1.4	5.5	10.3	14.3	19.8	1.4
151-271	23.2	8.0	9.5	22.8	1.05	1.4	5.5	10.3	14.3	19.8	1.4
301-471	23.2	8.0	11	22.8	1.05	1.4	5.5	10.3	14.3	19.8	1.4
511-681	23.2	8.0	12	22.8	1.05	1.4	5.5	10.3	14.3	19.8	1.4
751-821	23.2	8.0	13	22.8	1.05	1.4	5.5	10.3	14.3	19.8	1.4

F7±0.5	F8±0.5	F9±0.5
1.2	3.3	6.7
1.2	3.3	7.1
1.2	3.3	8.6
1.2	3.3	9.6
1.2	3.3	10.6

2) *Please refer to the suffix code.

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Reliability data

Test	Test methods/conditions	Requirement
Varistor voltage	The voltage between two terminals with the specified measuring current applied is called V_V (1 mA _{DC} @ 0.2 ... 2 s).	To meet the specified value
Clamping voltage	The maximum voltage between two terminals with the specified standard impulse current (8/20 μ s) applied.	To meet the specified value
Endurance at upper category temperature	1000 h at UCT After having continuously applied the maximum allowable AC voltage at UCT ± 2 °C for 1000 h, the specimen shall be stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of V_V shall be measured.	$ \Delta V/V (1 \text{ mA}) \leq 10\%$
Surge current derating, 8/20 μ s	10 surge currents (8/20 μ s), unipolar, interval 30 s, amplitude corresponding to derating curve for 10 impulses at 20 μ s	$ \Delta V/V (1 \text{ mA}) \leq 10\%$ (measured in direction of surge current) No visible damage
Surge current derating, 2 ms	10 surge currents (2 ms), unipolar, interval 120 s, amplitude corresponding to derating curve for 10 impulses at 2 ms	$ \Delta V/V (1 \text{ mA}) \leq 10\%$ (measured in direction of surge current) No visible damage
Electric strength	IEC 61051-1, test 4.9.2 Metal balls method, 2500 VRMS, 60 s The varistor is placed in a container holding 1.6 $\pm$ 0.2 mm diameter metal balls such that only the terminations of the varistor are protruding. The specified voltage shall be applied between both terminals of the specimen connected together and the electrode inserted between the metal balls.	No breakdown

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Test	Test methods/conditions	Requirement
Climatic sequence	The specimen shall be subjected to: a) dry heat at UCT, 16 h, IEC 60068-2-2, test Ba b) damp heat, 1st cycle: 55 °C, 93% r. H., 24 h, IEC 60068-2-30, test Db c) cold, LCT, 2 h, IEC 60068-2-1, test Aa d) damp heat, additional 5 cycles: 55 °C/25 °C, 93% r. H., 24 h/cycle, IEC 60068-2-30, test Db. Then the specimen shall be stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of V_V shall be measured. Thereafter, insulation resistance R_{ins} shall be measured at $V = 500$ V.	$ \Delta V/V (1 \text{ mA}) \leq 10\%$ $R_{ins} \geq 100 \text{ M}\Omega$
Rapid change of temperature	IEC 60068-2-14, test Na, LCT/UCT, dwell time 30 min, 5 cycles	$ \Delta V/V (1 \text{ mA}) \leq 5\%$ No visible damage
Damp heat, steady state	IEC 60068-2-78, test Ca The specimen shall be subjected to 40 ± 2 °C, 90 to 95% r. H. for 56 days without load / with 10% of the maximum continuous DC operating voltage V_{DC}. Then stored at room temperature and normal humidity for 1 to 2 h. Thereafter, the change of V_V shall be measured. Thereafter, insulation resistance R_{ins} shall be measured at $V = 500$ V (insulated varistors only).	$ \Delta V/V (1 \text{ mA}) \leq 10\%$ $R_{ins} \geq 100 \text{ M}\Omega$

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Test	Test methods/conditions	Requirement
Solderability	IEC 60068-2-20, test Ta, method 1 with modified conditions for lead-free solder alloys: 245 °C, 3 s: After dipping the terminals to a depth of approximately 3 mm from the body in a soldering bath of 245 °C for 3 s, the terminals shall be visually examined.	The inspection shall be carried out under adequate light with normal eyesight or with the assistance of a magnifier capable of giving a magnification of 4 to 10 times. The dipped surface shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pinholes or un-wetted or de-wetted areas. These imperfections shall not be concentrated in one area.
Resistance to soldering heat	IEC 60068-2-20, test Tb, method 1A, 260 °C, 10 s: Each lead shall be dipped into a solder bath having a temperature of 260 ±5 °C to a point 2.0 to 2.5 mm from the body of the specimen, be held there for 10 ±1 s and then be stored at room temperature and normal humidity for 1 to 2 h. The change of VV shall be measured and the specimen shall be visually examined.	$ \Delta V/V (1 \text{ mA}) \leq 5\%$ No visible damage
Tensile strength	IEC 60068-2-21, test Ua1 After gradually applying the force specified below and keeping the unit fixed for 10 s, the terminal shall be visually examined for any damage. Force for wire diameter: 0.6 mm = 10 N 0.8 mm = 10 N 1.0 mm = 20 N	$ \Delta V/V (1 \text{ mA}) \leq 5\%$ No break of solder joint, no wire break

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Test	Test methods/conditions	Requirement
Vibration	IEC 60068-2-6, test Fc, method B4 Frequency range: 10 ... 55 Hz Amplitude: 0.75 mm or 98 m/s ² Duration: 6 h (3 · 2 h) Pulse: sine wave After repeatedly applying a single harmonic vibration according to the table above. The change of V _V shall be measured and the specimen shall be visually examined.	ΔV/V (1 mA) ≤5% No visible damage
Bump	IEC 60068-2-29, test Eb Pulse duration: 6 ms Max. acceleration: 400 m/s ² Number of bumps: 4000 Pulse: half sine	ΔV/V (1 mA) ≤5% No visible damage
Fire hazard	IEC 60695-11-5 (needle flame test) Severity: vertical 10 s	5 s max.

Note:

UCT = Upper category temperature

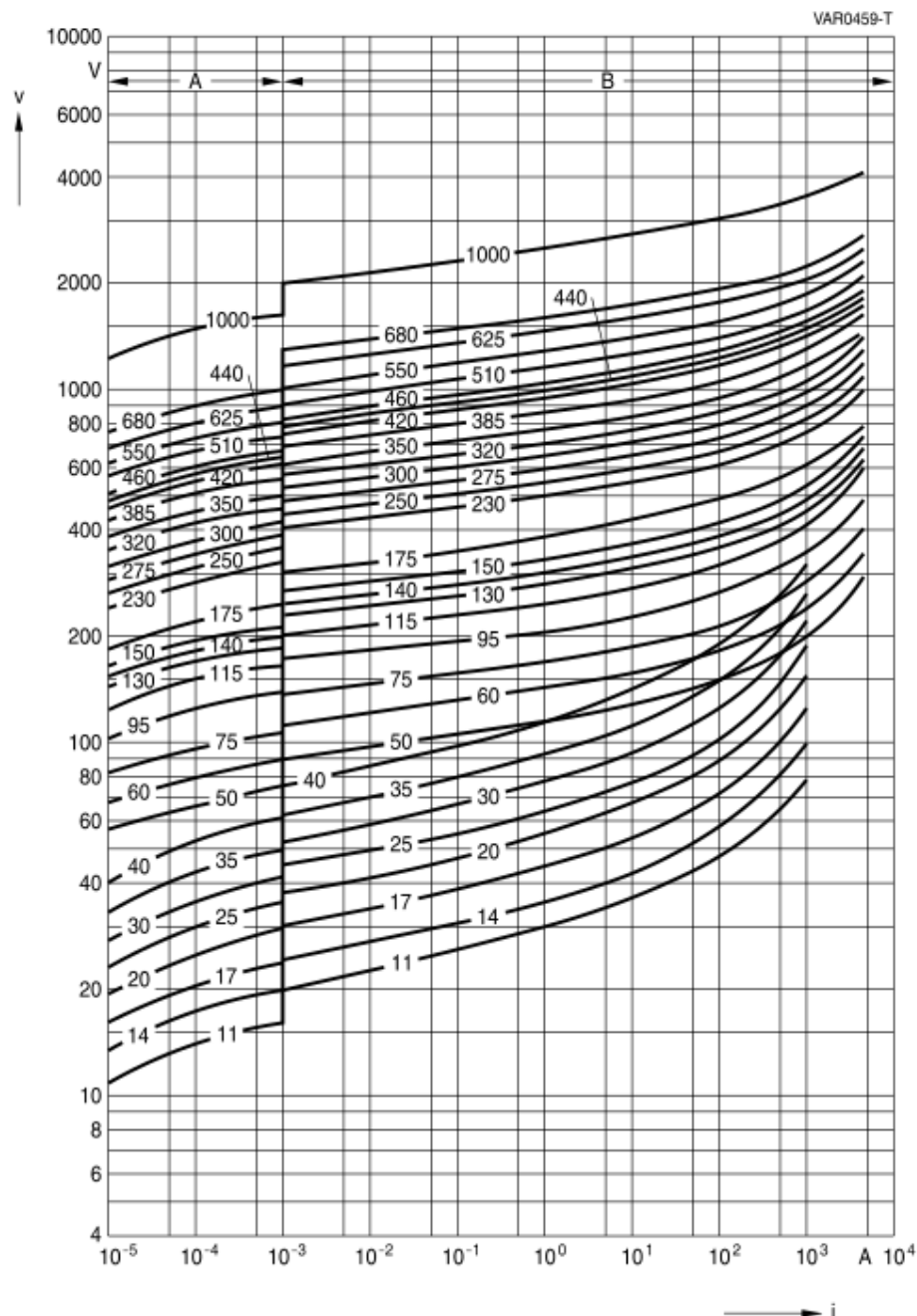
LCT = Lower category temperature

R_{ins} = Insulation resistance

v/i characteristics

$v = f(i)$ - for explanation of the characteristics refer to "General technical information".

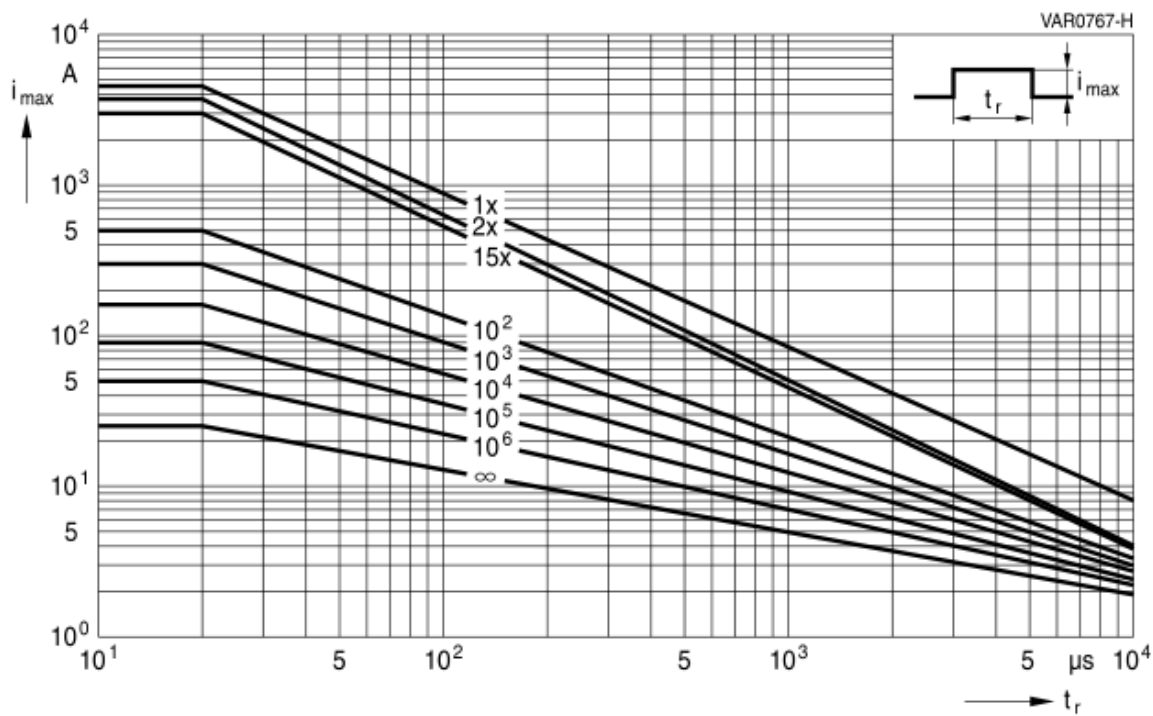
A = Leakage current, B = Protection level } for worst-case varistor tolerances



Derating curves

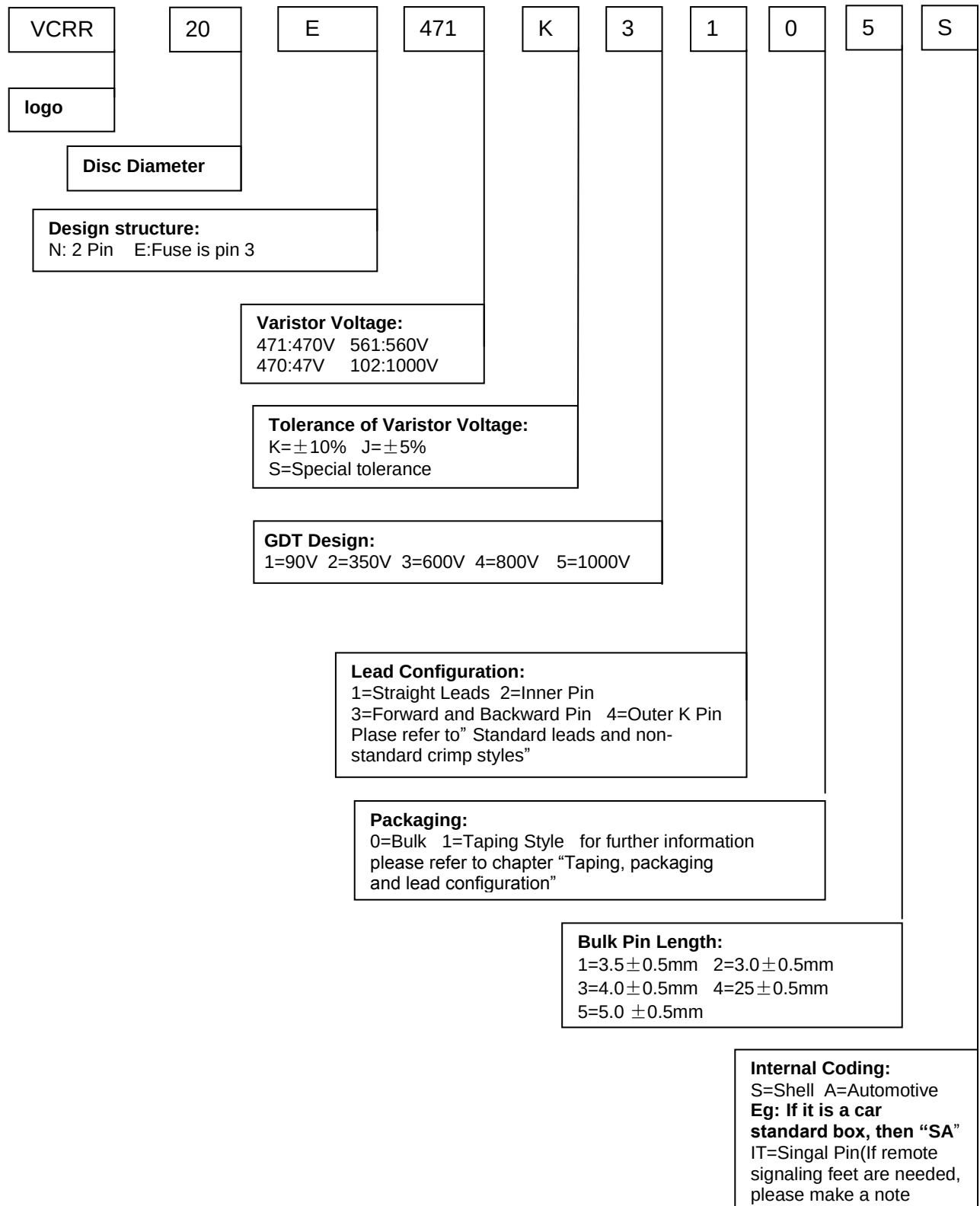
Maximum surge current $i_{\max} = f(t_r, \text{pulse train})$

For explanation of the derating curves refer to "General technical information",



Taping, packaging and lead configuration

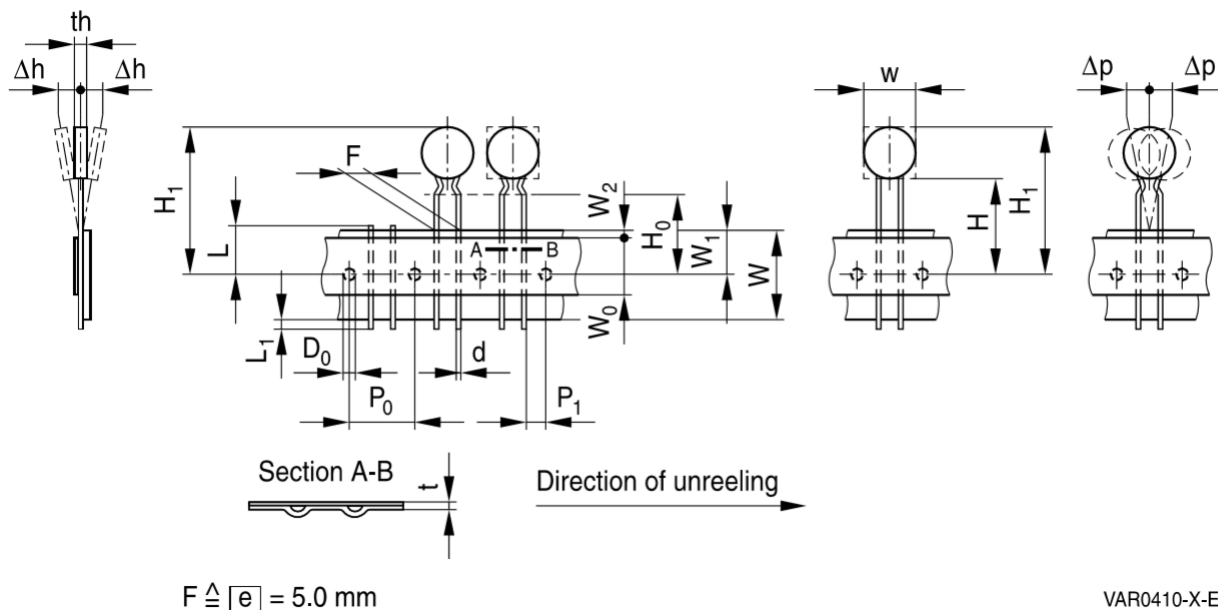
1 JORDUN Electronics ordering code system for leaded varistors



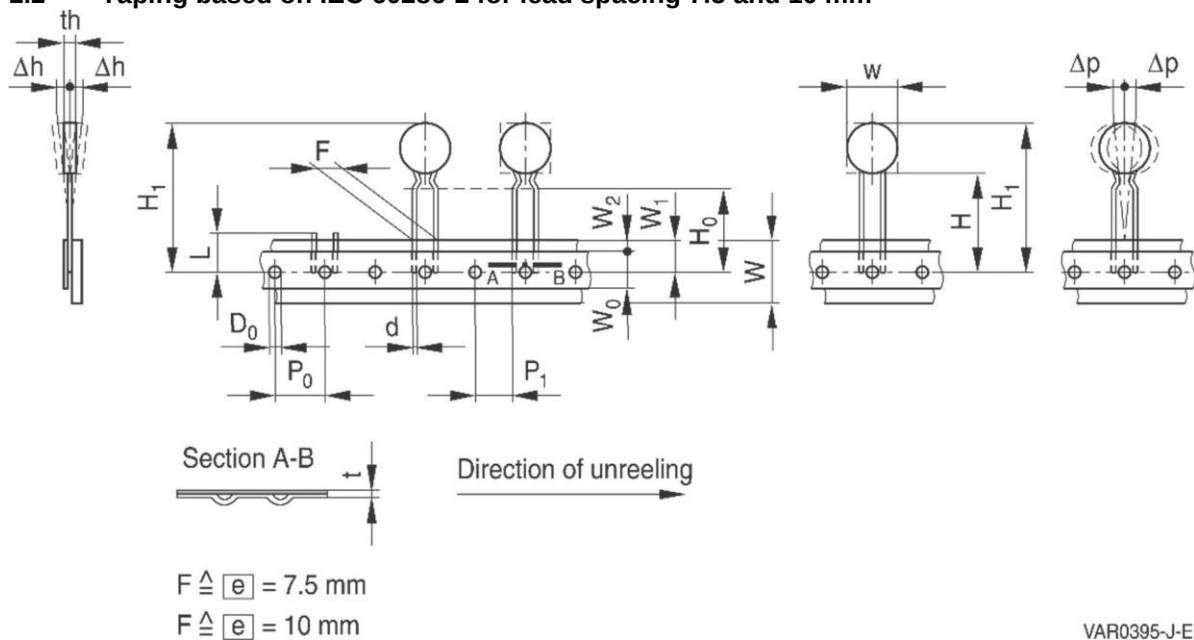
2 Taping and packaging of leaded varistors

Tape packaging for lead spacing $\boxed{e}$ = 5 fully conforms to IEC 60286-2, while for lead spacings $\boxed{e}$ = 7.5 and 10 the taping mode is based on this standard.

2.1 Taping in accordance with IEC 60286-2 for lead spacing 5.0 mm



2.2 Taping based on IEC 60286-2 for lead spacing 7.5 and 10 mm



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2.3 Tape dimensions (in mm)

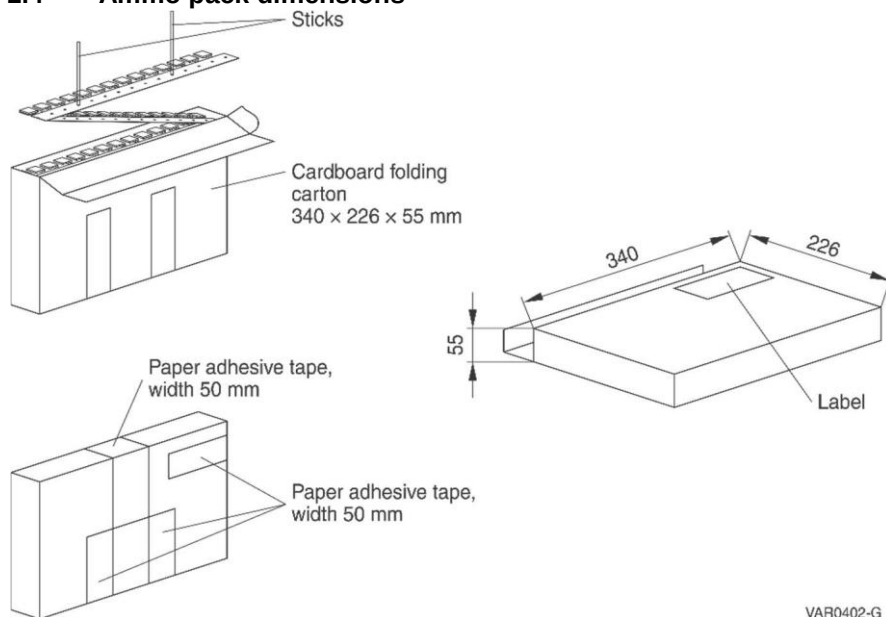
Symbol	$e = 5.0$	Tolerance	$e = 7.5$	Tolerance	$e = 10.0$	Tolerance	Remark*
w th d	0.6	max. max. ± 0.05	0.8	max. max. ± 0.05	1.0	max. max. ± 0.05	see tables in each series under "Dimensions "
P ₀	12.7	± 0.3	12.7 ¹⁾	± 0.3	12.7	± 0.3	± 1 mm/20 sprocket holes
P ₁	3.85	± 0.7	8.95	± 0.8	7.7	± 0.8	
F	5.0	± 10	7.5	± 0.8	10.0	± 0.8	measured at top of compo- nent body
Δh	0	± 2.0	depends on s		depends on s		
Δp	0	± 1.3	0	± 2.0	0	± 2.0	
W	18.0	± 0.5	18.0	± 0.5	18.0	± 0.5	Peel-off force ≥ 5 N
W ₀	5.5	min.	11.0	min.	11.0	min.	
W ₁	9.0	± 0.5	9.0	$+0.75/-0.5$	9.0	$+0.75/-0.5$	
W ₂	3.0	max.	3.0	max.	3.0	max.	
H	18.0	$+2.0/-0$ ± 0.5	18.0	$+2.0/-0$ ± 0.5	18.0	$+2.0/-0$ ± 0.5	2) 3)
H ₀	16.0		16.0		16.0		
	(18.0)		(18.0)				
H ₁	32.2	max.	45.0	max.	45.0	max.	
D ₀	4.0	± 0.2	4.0	± 0.2	4.0	± 0.2	without lead
t	0.9	max.	0.9	max.	0.9	max.	
L	11.0	max.	11.0	max.	11.0	max.	
L ₁	0.5	max.					

1) Taping with P₀ = 15.0 mm upon request

2) Applies only to uncrimped types

3) Applies only to crimped types (H₀ = 18 upon request)

2.4 Ammo pack dimensions



2.5 Quantities Per Packaging

Part No	Voltage	Bulk		Ammo Packing(Taping)	
		Bag	Carton	Box	Carton
7D	181-821	1000	12000	1000	10000
10D	180-182	500	6000	1000	10000
14D	180-182	500	6000	800	8000
20D	180-182	250	3000	----	----
20E	820-112	100	600	----	----

3 Lead configuration

Straight leads are standard for disk varistors. Other lead configurations as crimp style or customerspecific lead wire length according to 3.1, 3.2, 3.3 and 3.4 are optional. Crimped leads (non-standard) are differently crimped for technical reasons; the individual crimp styles are denot-ed by consecutive numbers (S, S2 through S5) as shown in the dimensional drawings below.

The crimp styles of the individual types can be seen from the type designation in the ordering tables.

3.1 Standard leads and non-standard crimp styles

The basic dimensions in figure 1 to 5 are valid for types with either round or square (EnergetiQ series) component head

**Standard,
straight leads**

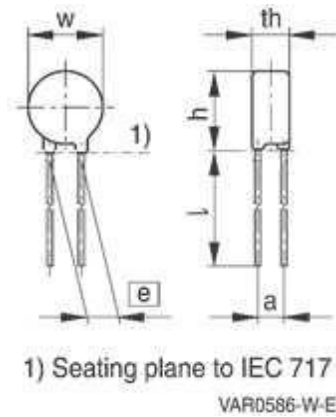


Figure 1

**Non-standard,
crimp style S2**

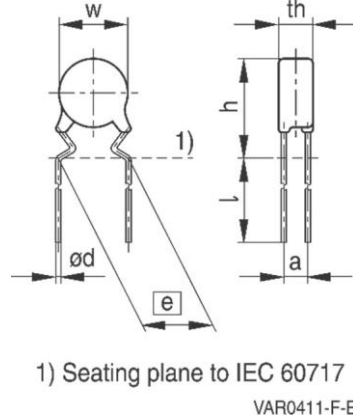


Figure 2

**Non-standard,
crimp style S3**

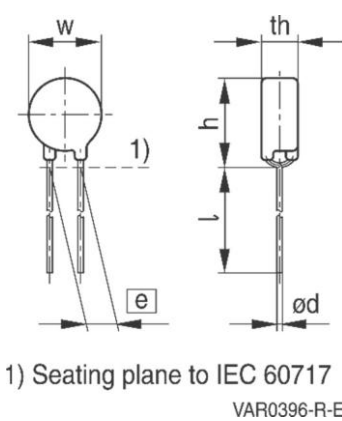
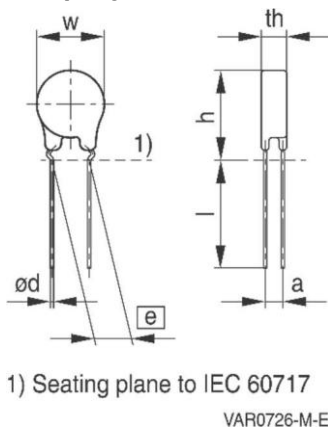


Figure 3

**Non-standard,
crimp style S5**



Figure

3.2 Trimmed leads (non-standard)

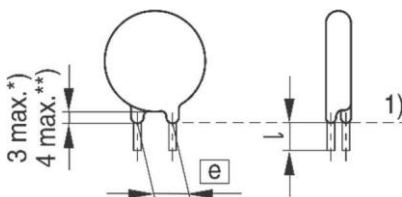
Varistors with cut leads available upon request.

Lead length tolerances:

Straight leads ± 0.8 mm

Crimped leads ± 0.5 mm

Minimum lead length 3.0 mm



1) Seating plane to IEC 60717

*) For round component head

**) For EnergetiQ series, square component head

VAR0642-U-E

Cautions and warnings

General

1. JORDUN Electronics metal oxide varistors (MOV) are designed for specific applications and should not be used for purposes not identified in our specifications, application notes and data book* unless otherwise agreed with JORDUN Electronics during the design-in-phase.
2. Ensure suitability of MOV through reliability testing during the design-in phase. The MOV should be evaluated taking into consideration worst-case conditions.
3. For applications of MOV in line-to ground circuits based on various international and local standards there are restrictions existing or additional safety measures required.

Storage

1. Store MOV only in original packaging. Do not open the package prior to processing.
2. Recommended storage conditions in original packaging:

Storage temperature:	-25 °C ... +45 °C
Relative humidity:	<75% annual average, <95% on maximum 30 days a year.
Dew precipitation:	Is to be avoided.
3. Avoid contamination of an MOV's during storage, handling and processing.
4. Avoid storage of MOVs in harmful environments that can affect the function during long-term operation (examples given under operation precautions).
5. The MOV type series should be soldered after shipment from JORDUN ELECTRONIC within the time specified.

MOV-J,N,T	24 months
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Handling

1. MOVs must not be dropped.
2. Components must not be touched with bare hands. Gloves are recommended.
3. Avoid contamination of the surface of MOV electrodes during handling, be careful of the sharp edge of MOV electrodes.

Soldering (where applicable)

1. Use rosin-type flux or non-activated flux.
2. Insufficient preheating may cause ceramic crack*.

3. Rapid cooling by dipping in solvent is not recommended.
4. Complete removal of flux is recommended.
5. Temperatures of all preheat stages and the solder bath must be strictly controlled especially for T series

Mounting

1. Potting, sealing or adhesive compounds can produce chemical reactions in the MOV ceramic that will degrade the component's electrical characteristics.
2. Overloading MOVs may result in ruptured packages and expulsion of hot materials. For this reason the MOVs should be physically shielded from adjacent components.

Operation

1. Use MOVs only within the specified temperature operating range
2. Use MOVs only within the specified voltage and current ranges.
3. Environmental conditions must not harm the MOVs. Use MOVs only in normal atmospheric conditions. Avoid use in the presence of deoxidizing gases (chlorine gas, hydrogen sulfide gas, ammonia gas, sulfuric acid gas, etc), corrosive agents, humid or salty conditions, Avoid contact with any liquids and solvents.

Symbols and terms

Symbol	Term
C	Capacitance
C_{typ}	Typical capacitance
i	Current
i_c	Current at which $V_{c, max}$ is measured
I_{leak}	Leakage current
i_{max}	Maximum surge current (also termed peak current)
I_{max}	Maximum discharge current
I_n	Nominal discharge current to UL 1449
LCT	Lower category temperature
L_{typ}	Typical inductance
P_{max}	Maximum average power dissipation
R_{ins}	Insulation resistance
R_{min}	Minimum resistance
T_A	Ambient temperature
t_r	Duration of equivalent rectangular wave
UCT	Upper category temperature
v	Voltage
V_{clamp}	Clamping voltage
$V_{c, max}$	Maximum clamping voltage at specified current i_c DC operating voltage
V_{DC}	Maximum jump start voltage
V_{jump}	Maximum voltage
V_{max}	Operating voltage
V_{op}	AC operating voltage, root-mean-square value
V_{RMS}	Root-mean-square value of max. DC operating voltage incl. ripple current
$V_{RMS, op, max}$	Super imposed surge voltage
V_{surge}	Varistor voltage
V_V	Tolerance of varistor voltage
ΔV_V	
W_{LD}	Maximum load dump
W_{max}	Maximum energy absorption
	Lead spacing

All dimensions are given in mm.

The commas used in numerical values denote decimal points.

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