

Metal Oxide Varistor: TVR-M Series

Dip Type Varistor for 48Vdc Architecture of Vehicle's Electrical Systems



■ Feature

1. Designed for 48Vdc architecture of vehicle's electrical systems
2. Superior resistance to cyclic temperature
3. High operating temperature range up to 125 °C
4. Agency approval: UL, TUV, CQC
5. AEC-Q 200 qualified
6. First UL 1449A approval part in the world



■ Recommended Applications

1. 48Vdc automotive devices
2. Telecom infrastructure devices
3. Industrial power and devices

■ Part Number Code

T	V	R	1	0	1	5	1	K	L			Q	0	0	M
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
↓			↓		↓		↓	↓	↓			↓			↓
Product Type			Body Size		Varistor Voltage (V _{1mA})		Tolerance of V _{1mA}		Packaging			Optional Suffix			
TVR	THINKING Varistor TVR Series		10	Φ10mm	820	82x10 ⁰ V=82V		K	±10%	AR	Tape & reel packing (hole pitch:12.7mm)		M	Varistor for automotive applications (When internal control code is used)	
		14	Φ14mm	151	15x10 ¹ V=150V		L	±15%	ER	Tape & reel packing (hole pitch:15.0mm)					
		20	Φ20mm				M	±20%	AB	Tape & ammo box packing (hole pitch:12.7mm)					
									EB	Tape & ammo box packing (hole pitch:15.0mm)					
								Appearance		C	Bulk & cut lead (followed by the codes of 2 leaded length)		Internal Control Code		
								L	Straight lead, silicon coating	Blank	Bulk				
								W	Outer kink lead, silicon coating						
													Q00~QZZ		

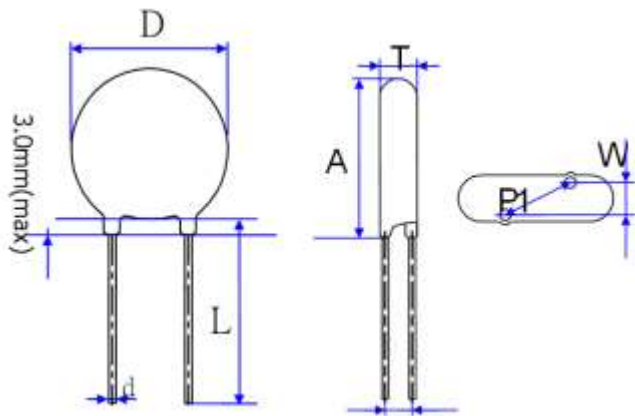
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■ Structure & Dimensions

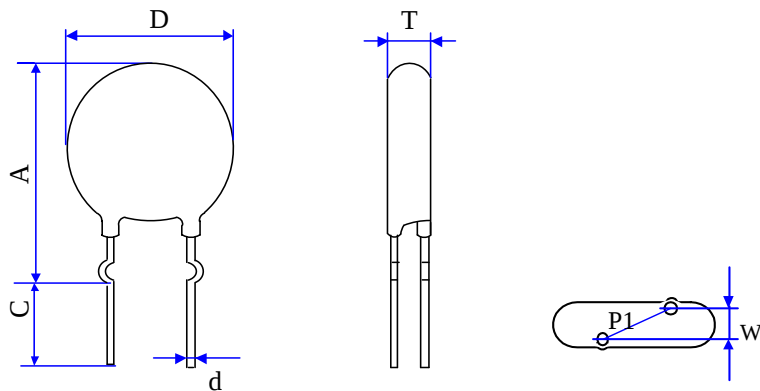
● L Type (Straight Lead)



(Unit: mm)

Series	Dmax.	Amax.	Lmin	$\Phi d \pm 0.02$	$P1 \pm 1.0$	T & W
TVR10-M	14.4	15.0	26.5	0.8	7.5	Please refer to Electrical Characteristics Table
TVR14-M	18.0	18.5	26.5	0.8	7.5	
TVR20-M	24.0	25.5	22.5	1.0	10.0	

● W Type (Outer Kink Lead)



(Unit: mm)

Series	Dmax.	Amax.	Cmin	$\Phi d \pm 0.02$	$P1 \pm 1.0$	T & W
TVR10-M	14.4	20.0	20	0.8	7.5	Please refer to Electrical Characteristics Table
TVR14-M	18.0	22.5	20	0.8	7.5	

Note: Size of C is customized, and tolerance of cut lead product is ± 0.5 (Please refer to minimal size in the chart above if customers do not request). Popular minimal size of cut lead products is 3.5 ± 0.5 mm.

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■ Electrical Characteristics

For 48Vdc Architecture of Vehicle's Electrical Systems

Part No.	Varistor Voltage (@ 1mA DC)	Max. Continuous Voltage		Max. Clamping Voltage (8/20μs)		Max. Surge Current (8/20μs)	Rated Power	Max. Energy (10/1000μs)	Dimension		
	V _{1mA}	V _{ac}	V _{dc}	V _P	I _p	I _{max}	P	W _{max}	T _{min}	T _{max}	W±1
	(V)	(V)	(V)	(V)	(A)	(A)	(W)	(J)	(mm)		
TVR10820-M	82±10%	50	65	135	25	3500	0.4	14	2.56	5.34	1.6
TVR10101-M	100±10%	60	85	165	25	3500	0.4	17	2.58	5.35	1.7
TVR10121-M	120±10%	75	100	200	25	3500	0.4	20	2.6	5.36	1.8
TVR10151-M	150±10%	95	125	250	25	3500	0.4	25	2.63	5.37	1.9
TVR10181-M	180±10%	115	150	300	25	3500	0.4	31	2.8	4.8	1.6
TVR14820-M	82±10%	50	65	135	50	6000	0.6	28	2.96	5.34	1.6
TVR14101-M	100±10%	60	85	165	50	6000	0.6	35	2.98	5.35	1.7
TVR14121-M	120±10%	75	100	200	50	6000	0.6	42	3.0	5.36	1.8
TVR14151-M	150±10%	95	125	250	50	6000	0.6	53	3.03	5.37	1.9
TVR14181-M	180±10%	115	150	300	50	6000	0.6	67	2.8	4.8	1.6
TVR20820-M	82±10%	50	65	135	100	10000	1.0	56	3.36	5.74	1.8
TVR20101-M	100±10%	60	85	165	100	10000	1.0	70	3.38	5.75	1.9
TVR20121-M	120±10%	75	100	200	100	10000	1.0	85	3.4	5.76	2.0
TVR20151-M	150±10%	95	125	250	100	10000	1.0	106	3.43	5.77	2.1
TVR20181-M	180±10%	115	150	300	100	10000	1.0	127	3.2	5.2	1.8

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■ Agency Approval

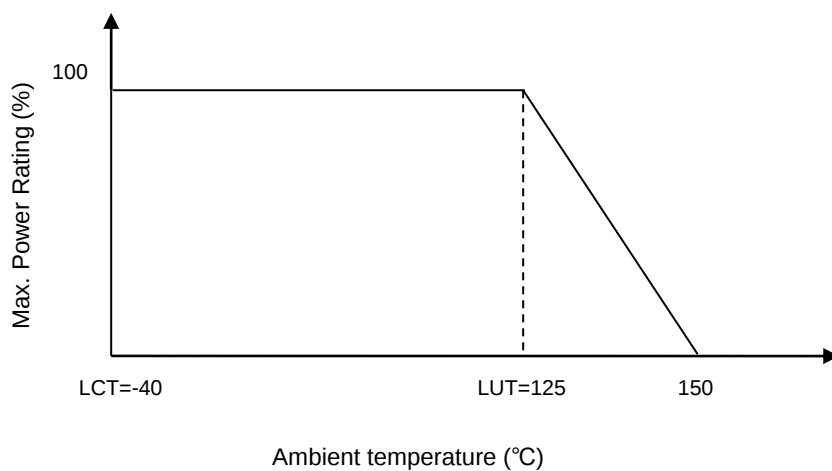
Certified Model No.	Agency				
	UL 1449A	UL1449 5 th & cUL	EN/IEC 61051-1, IEC 61051-2, IEC 61051-2-2	IEC 60950-1 Annex Q IEC 62368-1 Annex G.8.1 IEC 62368-1 Annex G.8.2	GB/T10193-1997 GB/T10194-1997
	E510434 Surge-protective Devices for Use in Electric Vehicles	E314979	J 50259116 J 50405420		TVR10-M CQC13001090356 CQC13001090357 TVR14-M CQC15001128796 CQC15001128834 TVR20-M CQC15001128792 CQC15001128793
TVR10820-M	√	√			√
TVR10101-M	√	√			√
TVR10121-M	√	√			√
TVR10151-M	√	√			√
TVR10181-M		√			√
TVR14820-M	√	√			√
TVR14101-M	√	√			√
TVR14121-M	√	√			√
TVR14151-M	√	√			√
TVR14181-M		√	√		√
TVR20820-M	√	√			√
TVR20101-M	√	√			√
TVR20121-M	√	√			√
TVR20151-M	√	√			√
TVR20181-M		√		√	√

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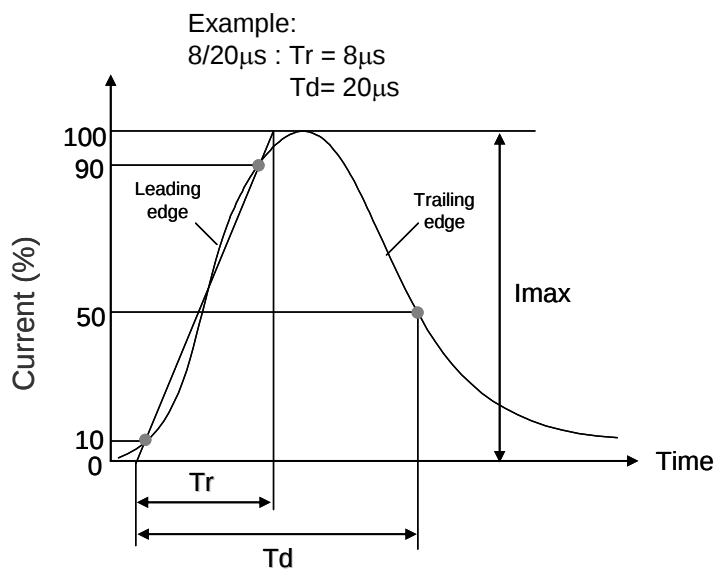
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■ Power Derating Curve



■ Surge Current Standard Waveform



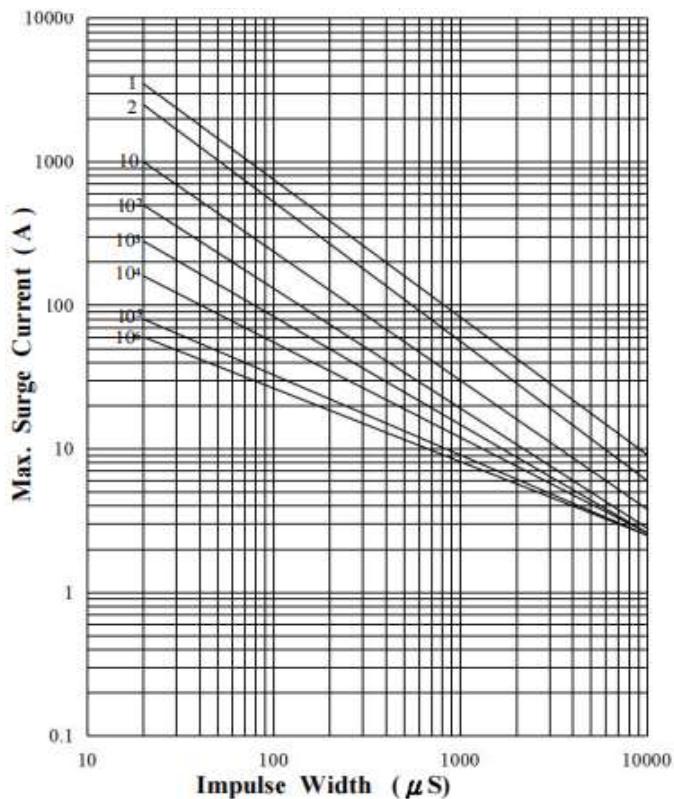
Metal Oxide Varistor: TVR-M Series

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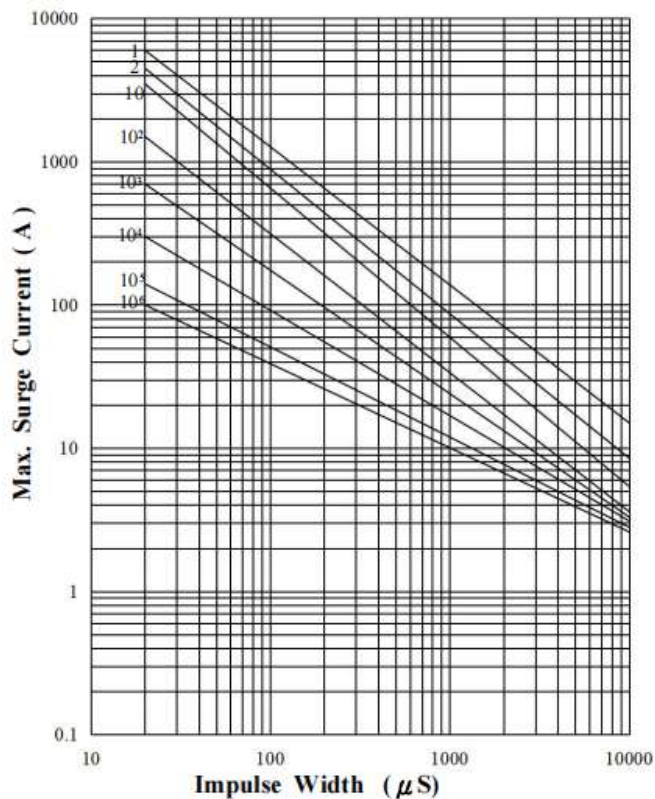


■ Max. Surge Current Derating Curves

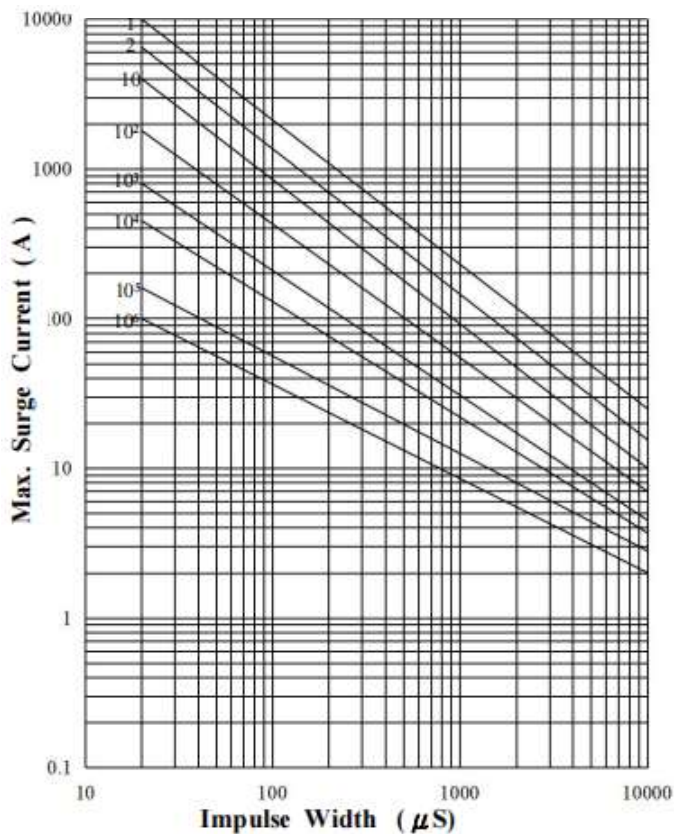
TVR10820-M to TVR10181-M



TVR14820-M to TVR14181-M



TVR20820-M to TVR20181-M



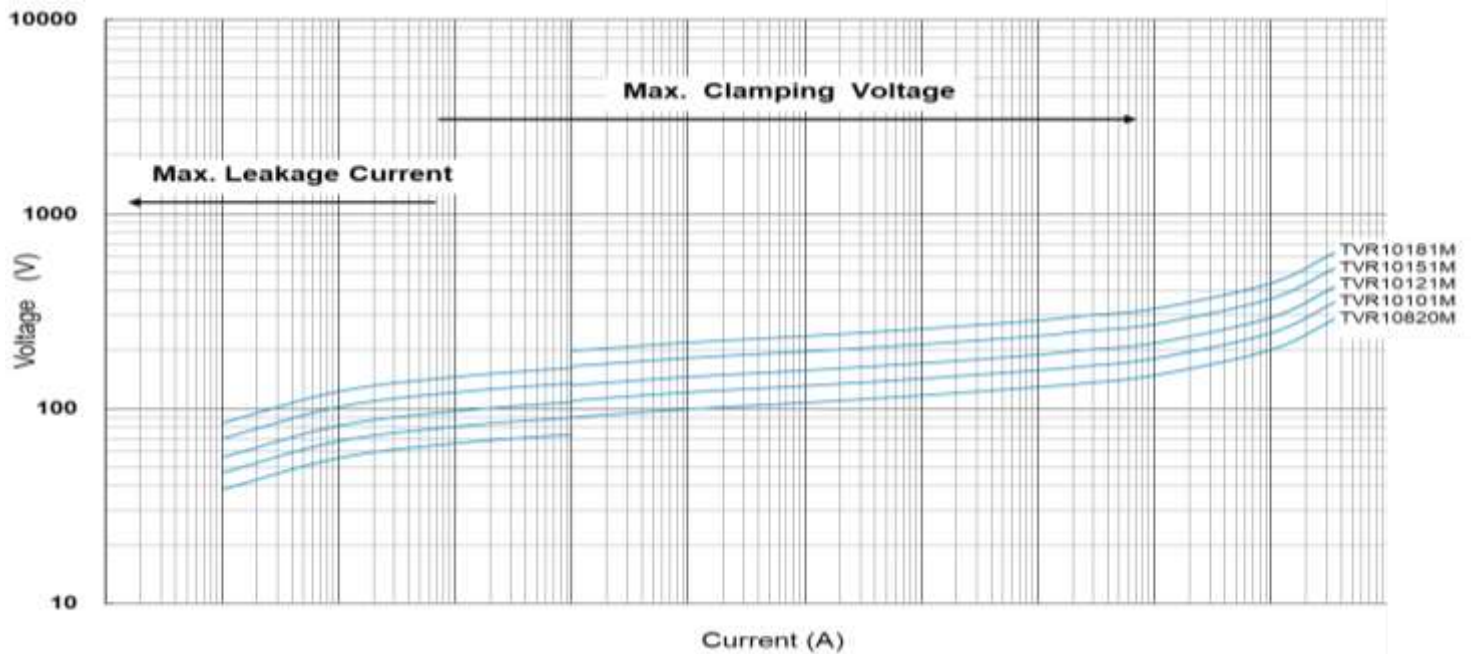
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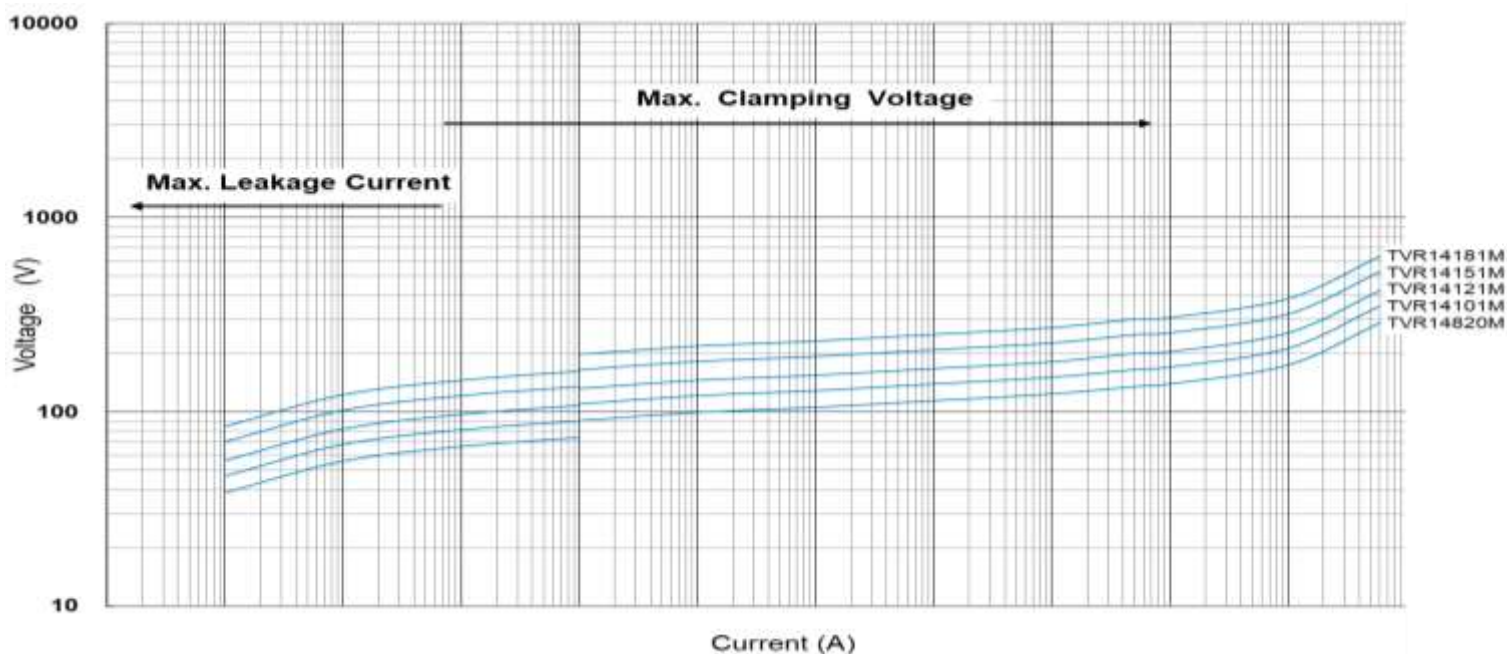


■ Max. Leakage Current and Max. Clamping Voltage Curves

Max. Leakage Current and Max. Clamping Voltage Curves (TVR10820M to TVR10181M)



Max. Leakage Current and Max. Clamping Voltage Curves (TVR14820M to TVR14181M)



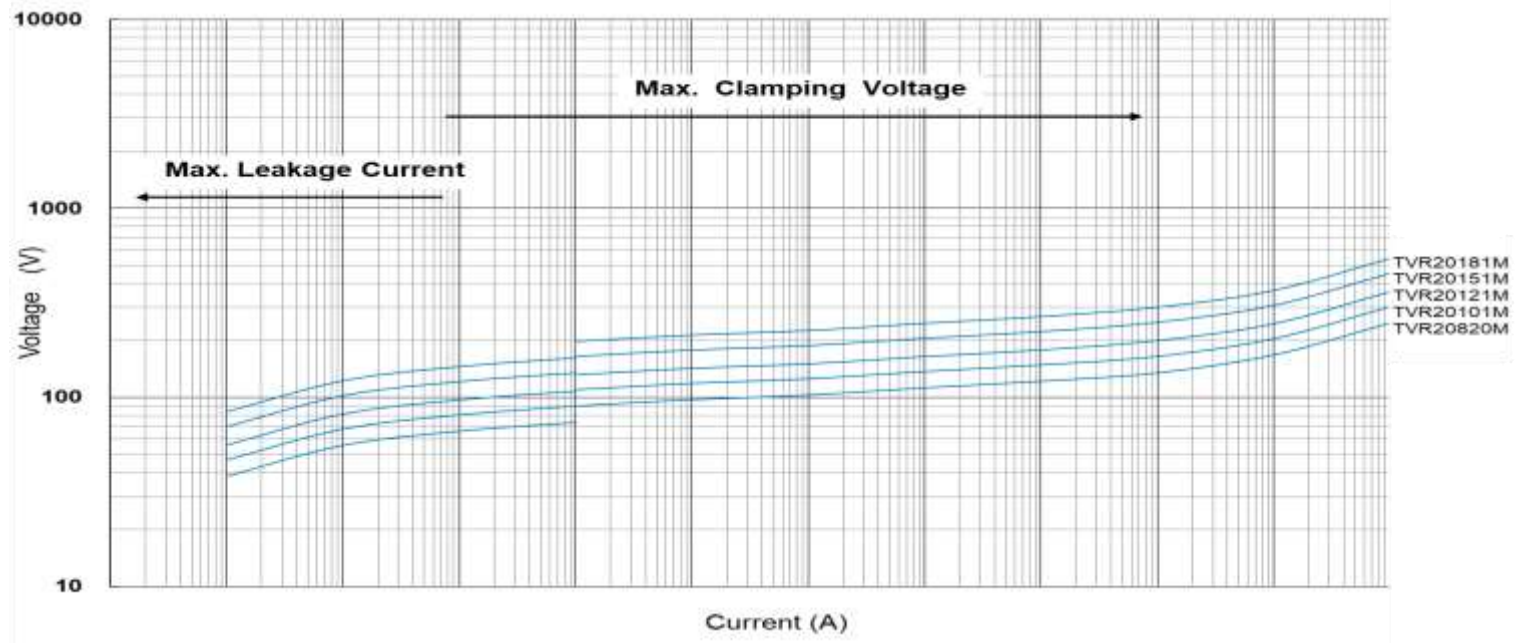
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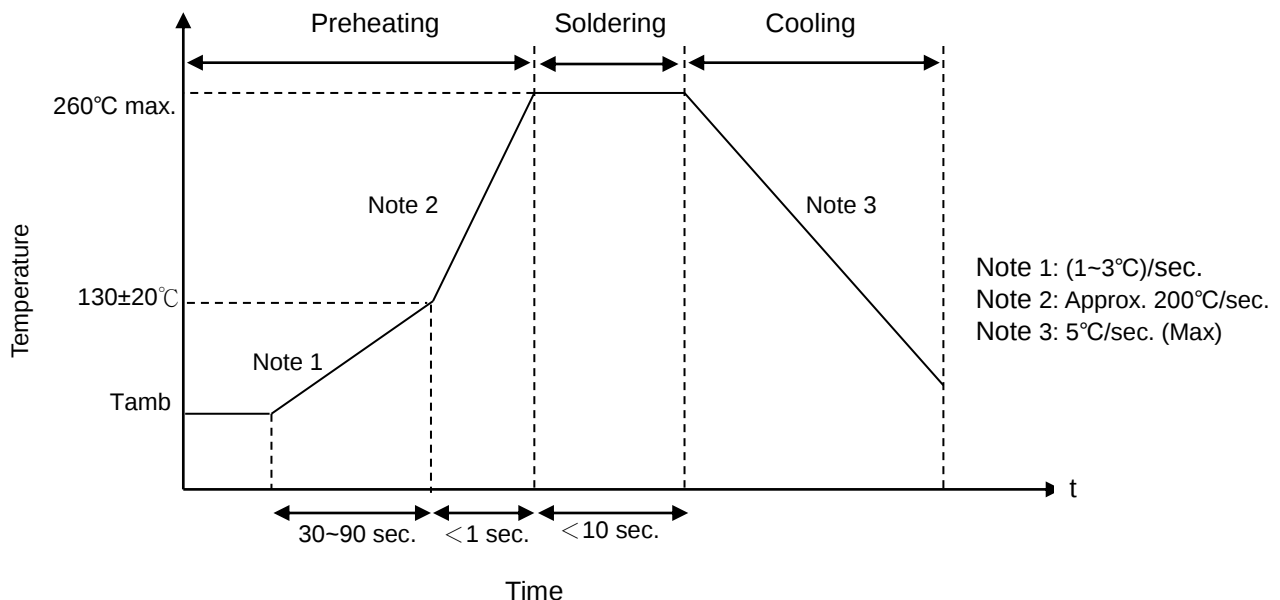
■ Max. Leakage Current and Max. Clamping Voltage Curves

Max. Leakage Current and Max. Clamping Voltage Curves (TVR20820M to TVR20181M)



■ Soldering Recommendation

● IR-reflow Soldering Profile



● Recommended Reworking Conditions with Soldering Iron

Item	Conditions
Temperature of Soldering Iron-tip	360°C (max.)
Soldering Time	3 sec (max.)
Diameter of Soldering Iron-tip	2 mm (min.)

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■ Reliability (based on AEC-Q200 Rev-D)

Item	Standard	Test conditions / Methods	Specifications
Varistor Voltage	Specification Standard	The voltage between two terminals with the specified measuring current applied is called varistor voltage.	To meet the specified value
Clamping Voltage	Specification Standard	The maximum voltage between two terminals with the specified standard impulse current (8/20μs) applied	To meet the specified value
High Temperature Exposure (Storage)	MIL-STD-202 Method 108	Test temp.: 150 +3/-0°C Duration: 1000 h Unpowered Measurement at 24±2 hours after test conclusion.	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Resistance to Soldering Heat	MIL-STD-202 Method 210	No pre-heat of samples. Temperature: 260 ±5°C, Time: 10 ±1 s Immersion and emersion rate 25mm/s ±6 mm/s Number of heat cycles: 1	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Vibration	MIL-STD-202 Method 204	Acceleration: 5 g's Sweep time: 20 min Frequency range: 10 to 2000 Hz 3×12 cycles	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Solderability	J-STD-002	245±5°C, 5 +0/-0.5sec	At least 95% of terminal electrode is covered by new solder
Terminal Strength	MIL-STD-202 Method 211	1. Pull test (2.27 kg) 2. Wire-lead bend test (227 g) Duration of the applied forces: 10 ±1sec	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Biased Humidity	MIL-STD-202 Method 103	Test temp.: 85°C Rel. humidity of air: 85% Duration: 1000 h Test Power Bias at 85%(+5%/-0%) of rated varistor voltage Measurement at 24±2 hours after test conclusion	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Operational Life	MIL-STD-202 Method 108	Test temp.: 125 +3/-0°C Duration: 1000 h Test Power: Bias at 85% (+5%/-0%) of rated varistor voltage	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Temperature Cycling	JESD22 Method JA-104	Lower test temp. : -40 +0/-10°C Upper test temp. : 125 +15/-0°C Soak time at lower or upper temp. : 15 min Transfer time: 5 mins Cycle time: 2 Cycles/hr Number of cycles: 1000 Measurement at 24±2 hours after test conclusion.	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Mechanical Shock	MIL-STD-202, Method 213	Peak value 100g's half sine waveform Normal duration (D): 6ms In 3 directions perpendicularly intersecting each other (total 18 times)	No visible damage $\Delta V_{1mA}/V_{1mA}$ ≤10% $\Delta V_{clamp}/V_{clamp}$ ≤10%
Resistance to solvents	MIL-STD-202 Method 215	Add aqueous wash chemical- OKEM Clean or equivalent. Do not use banned solvents	No visible damage
8/20μS Surge Current Derating	IEC 61051-1	8/20μs waveform, 10 surge currents, unipolar, interval 30 secs	$\Delta V_{1mA}/V_{1mA}$ ≤ 10% No visible damage

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■ Package

● Taping Specification

L Type (Straight Lead)

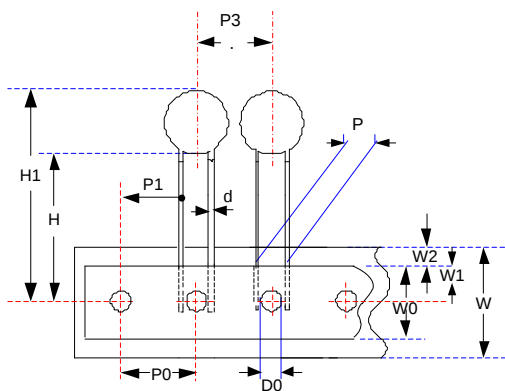


Figure A

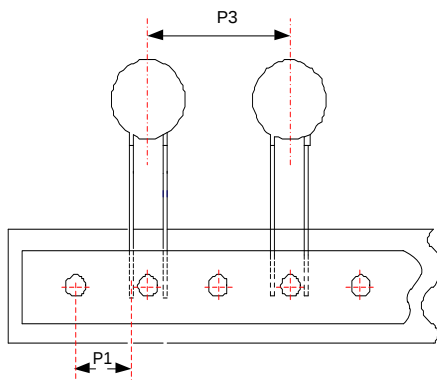


Figure B

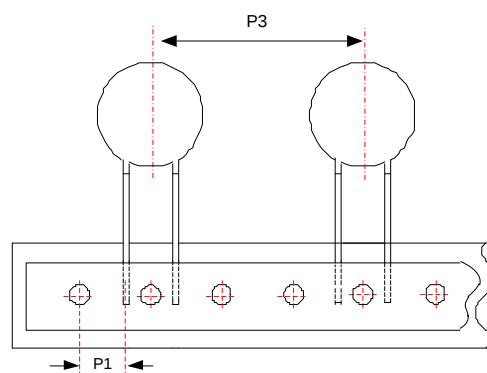


Figure C

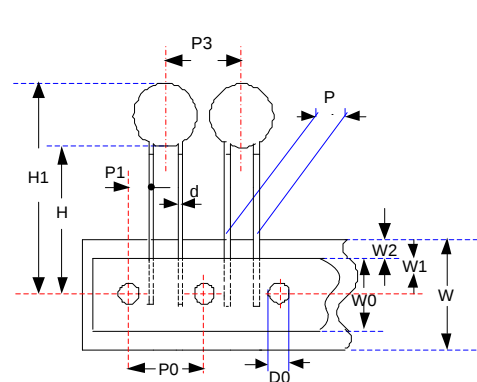


Figure D

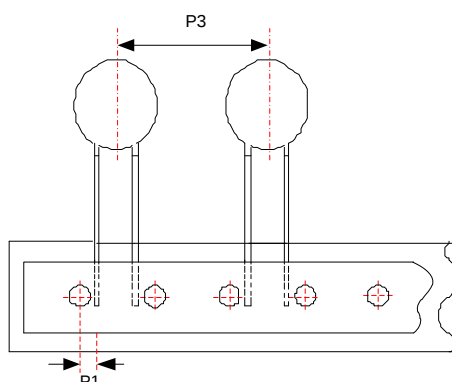
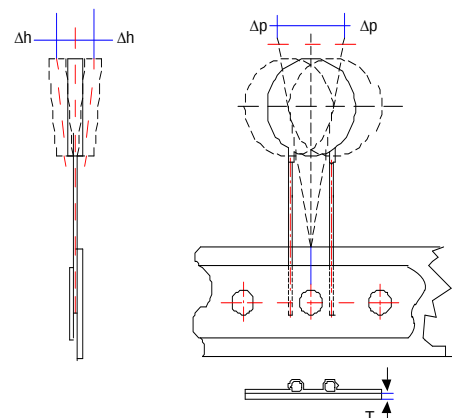


Figure E



(Unit: mm)

Taping Code	Body Size	P ₀	P	P ₃	P ₁	H	H ₁	d	W ₀	W ₁	W ₂	W	ΔP	Δh	D ₀	T	Figure
		±0.3	±1	±1	±1	+2/-0	Max.	±0.02	±1	+0.75/-0.5	Max	+1/-0.5	Max.	Max.	±0.2	±0.2	
A (P ₀ :12.7)	10-M	12.7	7.5	12.7	8.55	18	33.5	0.8	12	9	3	18	1	2	4	0.6	A
	14-M	12.7	7.5	25.4	8.55	18	38	0.8	12	9	3	18	1	2	4	0.6	B
	20-M	12.7	10.0	25.4	7.20	18	40.5	1.0	12	9	3	18	1	2	4	0.6	C
E (P ₀ :15.0)	10-M	15	7.5	15.0	3.35	18	33.5	0.8	12	9	3	18	1	2	4	0.6	D
	14-M	15	7.5	30.0	3.35	18	38	0.8	12	9	3	18	1	2	4	0.6	E
	20-M	15	10.0	30.0	9.50	18	40.5	1.0	12	9	3	18	1	2	4	0.6	B

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■ Quantity

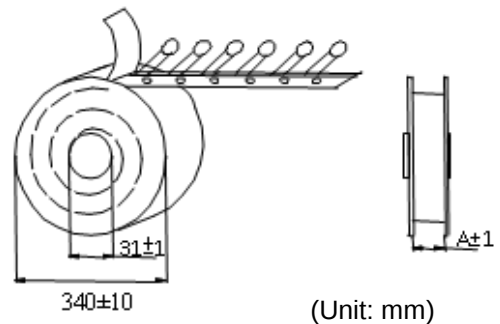
● Bulk Packing

Series	Quantity of Straight Lead Type (pcs/bag)	Quantity of Cut Lead Type (pcs/bag)	Quantity of Kink Lead Type (pcs/bag)
TVR10(820-181)-M	200	200	200
TVR14(820-181)-M	100	100	100
TVR20(820-181)-M	Box Packing: 640	50	50

● Reel Packing

First Reel Packing

Series	A (mm)	Quantity (pcs/reel)
TVR10(820~181)-M	55	750
TVR14(820~181)-M		750
TVR20(820~181)-M		500

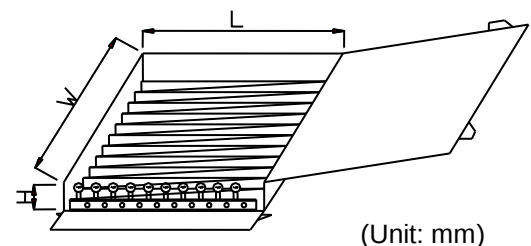


Second Reel Packing

Series	A (mm)	Quantity (pcs/reel) P0=12.7mm	Quantity (pcs/reel) P0=15mm
TVR10(820~181)-M	46	1,000	1,000
TVR14(820~181)-M	46	750	750
TVR20(820~181)-M	55	500	500

● Ammo Packing

Series	Quantity (pcs/box) P0=12.7mm	Quantity (pcs/box) P0=15.0mm
TVR10(820~181)-M	900	800
TVR14(820~181)-M	500	450
TVR20(820~181)-M	350	300



Series	W±5	L±5	H±5
TVR05 ~ TVR20-M	345	275	55

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■ Warehouse Storage Conditions of Products

- Storage Conditions:
 1. Storage Temperature: $-10^{\circ}\text{C} \sim +40^{\circ}\text{C}$
 2. Relative Humidity: $\leq 75\% \text{RH}$
 3. Thermistors must be kept away from sunlight and stored in a non-corrosive atmosphere.
- Period of Storage: 1 year