

Metal Oxide Varistor : TVT Series



Thermally Protected Varistor Series

■ Features

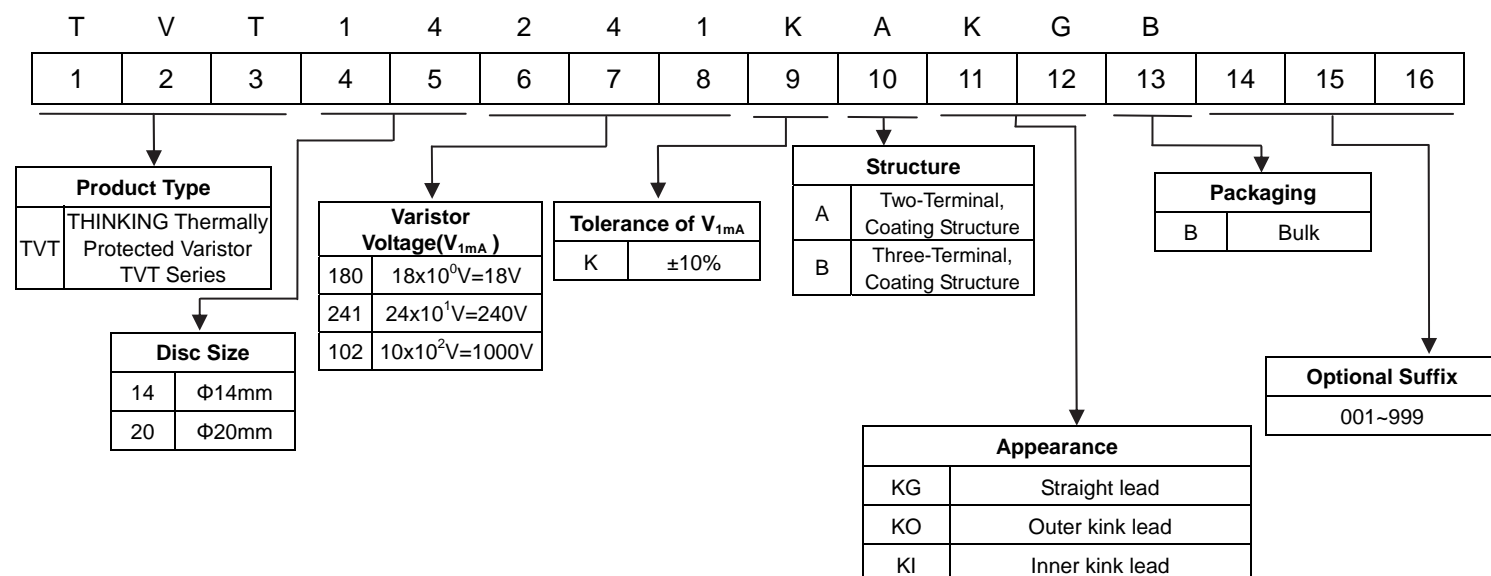
1. RoHS compliant
2. Halogen-free series are available
3. Two-Terminal or Three-Terminal thermally protected metal oxide varistor, Three-Terminal type is available for failure indication.
4. Body size: 14, 20 mm
5. Working voltage: 130Vac ~ 750Vac
6. Operating temperature range : -40°C ~ +85°C
Storage temperature range : -40°C ~ +110°C
7. Patent: US 7,453,681
8. Agency approval:
- TVT14 and TVT20 Series: UL1449 3rd & cUL/ TUV
9. UL1449 3rd SPD Type: Type 4 Assemblies
10. Meets UL 1449 3rd 39.4 limited current abnormal over- voltage test.
11. TVT14 and TVT20 Series meet IEC 60950-1 Annex Q requirement
12. Suitable for wave flow soldering



■ Recommended Applications

1. TVSS modules
2. Uninterruptible power supplies
3. Power supplies
4. Lighting products
5. Communication products
6. Smart meter
7. Photovoltaic industry

■ Part Number Code



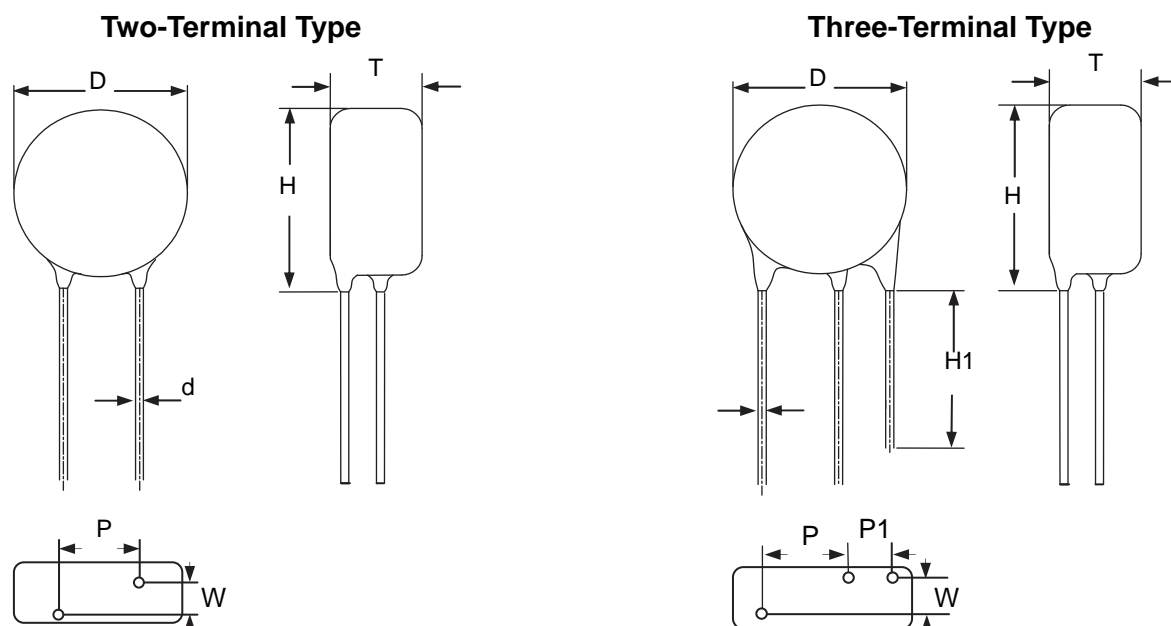
Metal Oxide Varistor : TVT Series



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■ Structure and Dimensions

● TVT14 ~ TVT20 Series



(Unit: mm)

Series	Lead Type	D	P	P1	H	H1	d	W	Tmax
TVT14201~122	Two-Terminal	15.5~18.5	7.5±1	--	18.5~24	--	0.8±0.05	Please Refer to Electrical Characteristics	
TVT14201~122	Three-Terminal	15.5~18.5	7.5±1	4.0~6.0	18.5~24	7.0~18	0.8±0.05		
TVT20201~681	Two-Terminal	19.5~23.5	7.5±1	--	21.5~27	--	0.8±0.05		
TVT20751~122							1.0±0.05		
TVT20201~681	Three-Terminal	19.5~23.5	7.5±1	4.0~6.0	21.5~27	12.5~18	0.8±0.05		
TVT20751~122							1.0±0.05		

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■ Electrical Characteristics

14mm Series

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)	Reference Capacitance @1KHz	Dimension	
	V _{1mA}	V _{AC(rms)}	V _{DC}	V _P	I _P	I _{max}	P	W _{max}	C _p	T _{max}	W±1.0
	(V)	(V)	(V)	(V)	(A)	(KA)	(W)	(J)	(pF)	(mm)	
TVT14201	200 (180~220)	130	170	340	50	6	0.6	77	700	8.8	3.0
TVT14221	220 (198~242)	140	180	365	50	6	0.6	86	640	8.9	3.1
TVT14241	240 (216~264)	150	200	395	50	6	0.6	94	580	9.1	3.3
TVT14271	270 (243~297)	175	225	455	50	6	0.6	110	520	9.3	3.5
TVT14301	300 (270~330)	195	250	500	50	6	0.6	118	480	9.0	3.2
TVT14331	330 (297~363)	215	275	550	50	6	0.6	127	450	9.1	3.3
TVT14361	360 (324~396)	230	300	595	50	6	0.6	137	430	9.3	3.5
TVT14391	390 (351~429)	250	320	650	50	6	0.6	154	390	9.5	3.6
TVT14431	430 (387~473)	275	350	710	50	6	0.6	170	370	9.2	3.4
TVT14471	470 (423~517)	300	385	775	50	6	0.6	192	320	9.3	3.5
TVT14511	510 (459~561)	320	410	845	50	6	0.6	209	290	9.5	3.7
TVT14561	560 (504~616)	350	450	930	50	6	0.6	220	260	9.7	3.9
TVT14621	620 (558~682)	395	510	1025	50	6	0.6	231	240	10.0	4.1
TVT14681	680 (612~748)	420	560	1120	50	6	0.6	242	230	10.3	4.4
TVT14751	750 (675~825)	465	615	1240	50	6	0.6	247	220	10.6	4.7
TVT14781	780 (702~858)	485	640	1290	50	6	0.6	260	200	10.1	4.3
TVT14821	820 (738~902)	510	670	1355	50	6	0.6	270	180	10.2	4.5
TVT14911	910 (819~1001)	550	745	1500	50	6	0.6	280	170	10.6	4.8
TVT14951	950 (855~1045)	575	765	1570	50	6	0.6	290	160	10.7	4.9
TVT14102	1000 (900~1100)	625	825	1650	50	6	0.6	305	150	10.9	5.1
TVT14112	1100 (990~1210)	680	895	1815	50	6	0.6	340	140	11.2	5.4
TVT14122	1200 (1080~1320)	750	980	2000	50	6	0.6	350	130	11.6	5.8

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20mm Series



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)	Reference Capacitance @1KHz	Dimension	
	V _{1mA}	V _{AC(rms)}	V _{DC}	V _P	I _P	I _{max}	P	W _{max}	C _p	T _{max}	W±1.0
	(V)	(V)	(V)	(V)	(A)	(KA)	(W)	(J)	(pF)	(mm)	
TVT20201	200 (180~220)	130	170	340	100	10	1.0	140	1460	10.2	3.0
TVT20221	220 (198~242)	140	180	365	100	10	1.0	155	1320	10.3	3.1
TVT20241	240 (216~264)	150	200	395	100	10	1.0	170	1200	10.5	3.3
TVT20271	270 (243~297)	175	225	455	100	10	1.0	190	1100	10.7	3.5
TVT20301	300 (270~330)	195	250	500	100	10	1.0	205	1000	10.4	3.2
TVT20331	330 (297~363)	215	275	550	100	10	1.0	215	950	10.5	3.3
TVT20361	360 (324~396)	230	300	595	100	10	1.0	225	900	10.7	3.5
TVT20391	390 (351~429)	250	320	650	100	10	1.0	240	800	10.9	3.6
TVT20431	430 (387~473)	275	350	710	100	10	1.0	270	700	10.6	3.4
TVT20471	470 (423~517)	300	385	775	100	10	1.0	350	620	10.7	3.5
TVT20511	510 (459~561)	320	410	845	100	10	1.0	386	530	10.9	3.7
TVT20561	560 (504~616)	350	450	930	100	10	1.0	400	480	11.1	3.9
TVT20621	620 (558~682)	395	510	1025	100	10	1.0	425	450	11.4	4.1
TVT20681	680 (612~748)	420	560	1120	100	10	1.0	455	440	11.7	4.4
TVT20751	750 (675~825)	465	615	1240	100	10	1.0	509	420	12.0	4.7
TVT20781	780 (702~858)	485	640	1290	100	10	1.0	515	400	11.5	4.3
TVT20821	820 (738~902)	510	670	1355	100	10	1.0	475	390	11.6	4.5
TVT20911	910 (819~1001)	550	745	1500	100	10	1.0	509	360	12.0	4.8
TVT20951	950 (855~1045)	575	765	1570	100	10	1.0	530	340	12.1	4.9
TVT20102	1000 (900~1100)	625	825	1650	100	10	1.0	560	330	12.3	5.1
TVT20112	1100 (990~1210)	680	895	1815	100	10	1.0	610	310	12.6	5.4
TVT20122	1200 (1080~1320)	750	980	2000	100	10	1.0	620	290	13.0	5.8



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■ Safety Approvals

Part No.	Agency		
			
	UL1449 3 rd & cUL: E314979	J 50179371	IEC60950-1 2 nd Annex Q
TVT14201-□	√	√	√
TVT14221-□	√	√	√
TVT14241-□	√	√	√
TVT14271-□	√	√	√
TVT14301-□	√	√	√
TVT14331-□	√	√	√
TVT14361-□	√	√	√
TVT14391-□	√	√	√
TVT14431-□	√	√	√
TVT14471-□	√	√	√
TVT14511-□	√	√	√
TVT14561-□	√	√	√
TVT14621-□	√	√	√
TVT14681-□	√	√	√
TVT14751-□	√	√	√
TVT14781-□	√	√	√
TVT14821-□	√	√	√
TVT14911-□	√	√	√
TVT14951-□	√	√	√
TVT14102-□	√	√	√
TVT14112-□	√	√	√
TVT14122-□		√	√

Part No.	Agency		
			
	UL1449 3 rd & cUL: E314979	J 50179389	IEC60950-1 2 nd Annex Q
TVT20201-□	√	√	√
TVT20221-□	√	√	√
TVT20241-□	√	√	√
TVT20271-□	√	√	√
TVT20301-□	√	√	√
TVT20331-□	√	√	√
TVT20361-□	√	√	√
TVT20391-□	√	√	√
TVT20431-□	√	√	√
TVT20471-□	√	√	√
TVT20511-□	√	√	√
TVT20561-□	√	√	√
TVT20621-□	√	√	√
TVT20681-□	√	√	√
TVT20751-□	√	√	√
TVT20781-□	√	√	√
TVT20821-□	√	√	√
TVT20911-□	√	√	√
TVT20951-□	√	√	√
TVT20102-□	√	√	√
TVT20112-□	√	√	√
TVT20122-□		√	√

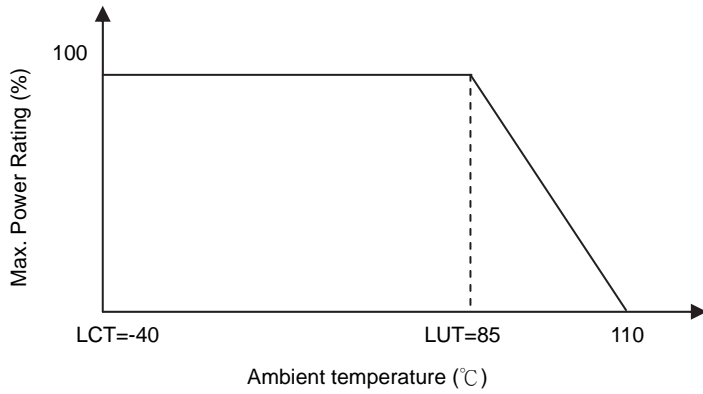
□ is the code for Two -Terminal or Three -Terminal type.

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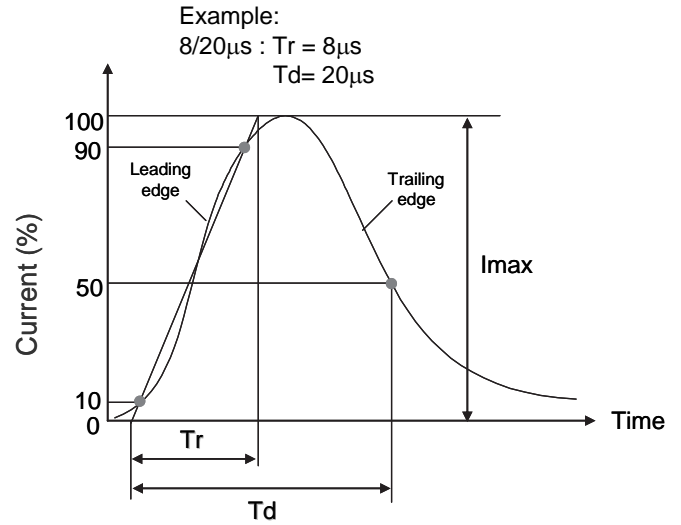


Thermally Protected Varistor Series

Power Derating Curve

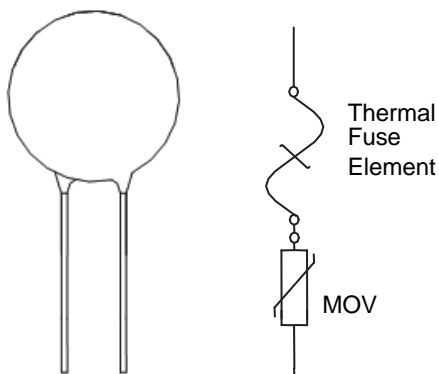


Surge Current Standard Waveform

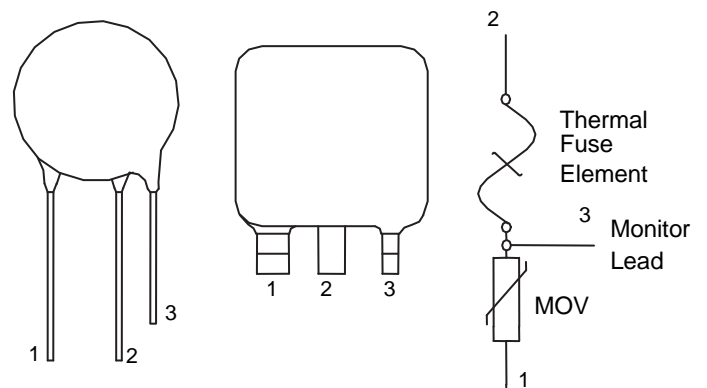


Lead Configuration

Two -Terminal Type



Three -Terminal Type



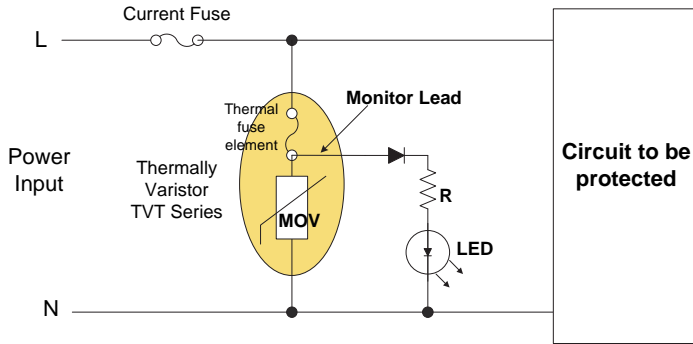
Metal Oxide Varistor : TVT Series



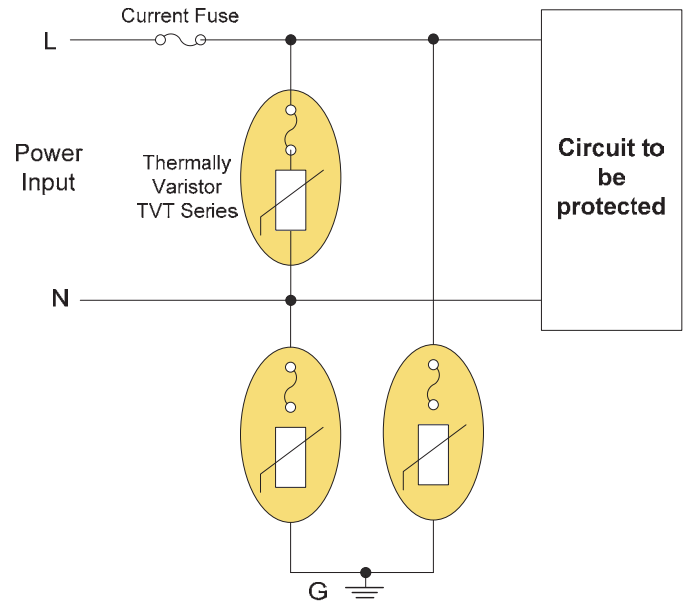
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■ Typical Application Circuit

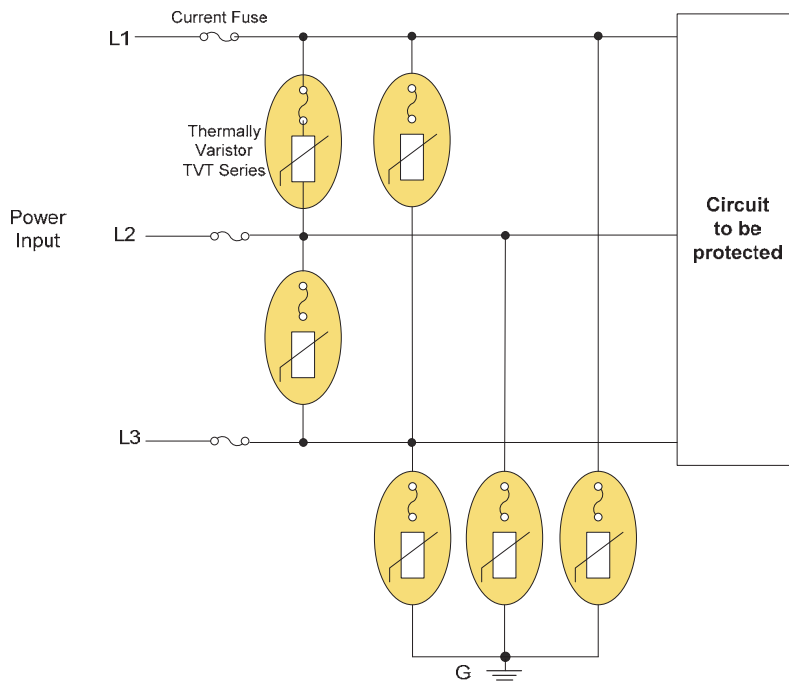
Signal Phase: Line to Line



Signal Phase: Line to Line & Line to Ground



Three Phase: Line to Line & Line to Ground



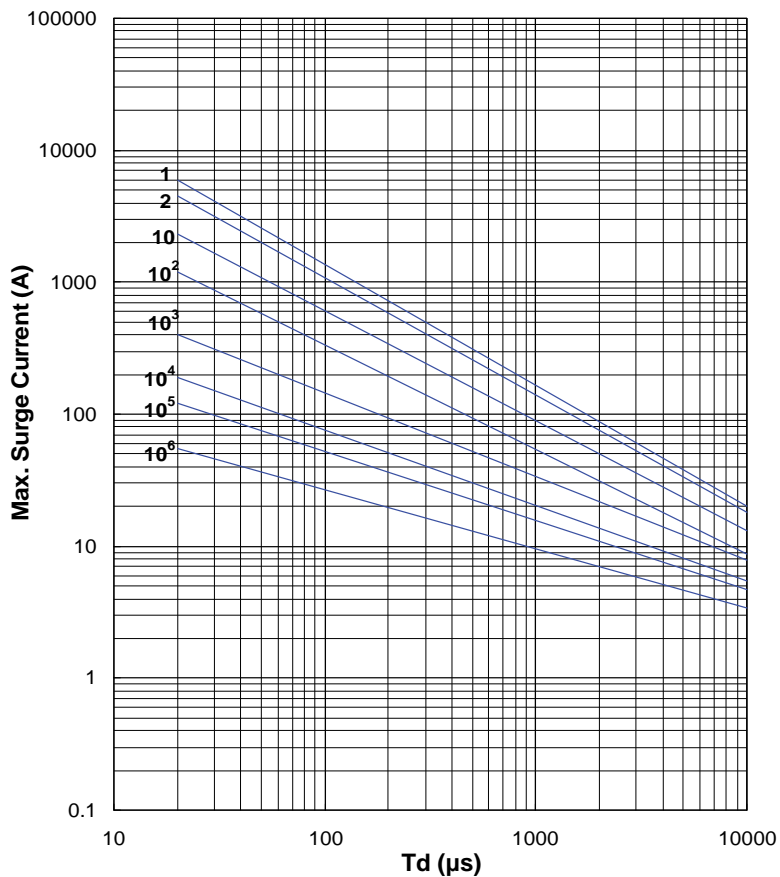
Metal Oxide Varistor : TVT Series



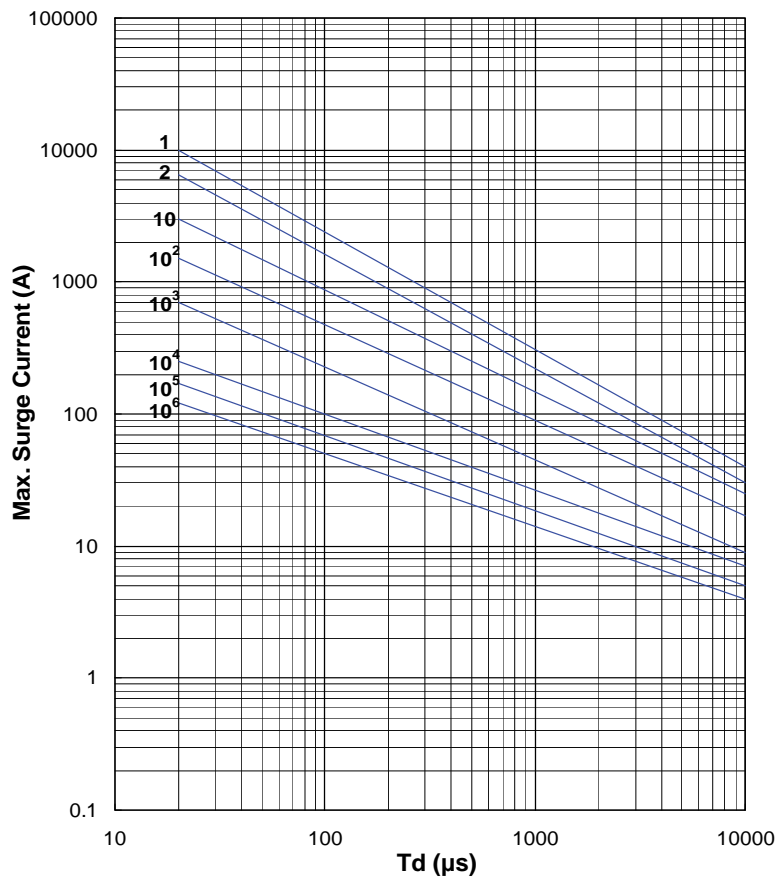
Thermally Protected Varistor Series

■ Max. Surge Current Derating Curves

TVT14201 ~ TVT14112



TVT20201 ~ TVT20112



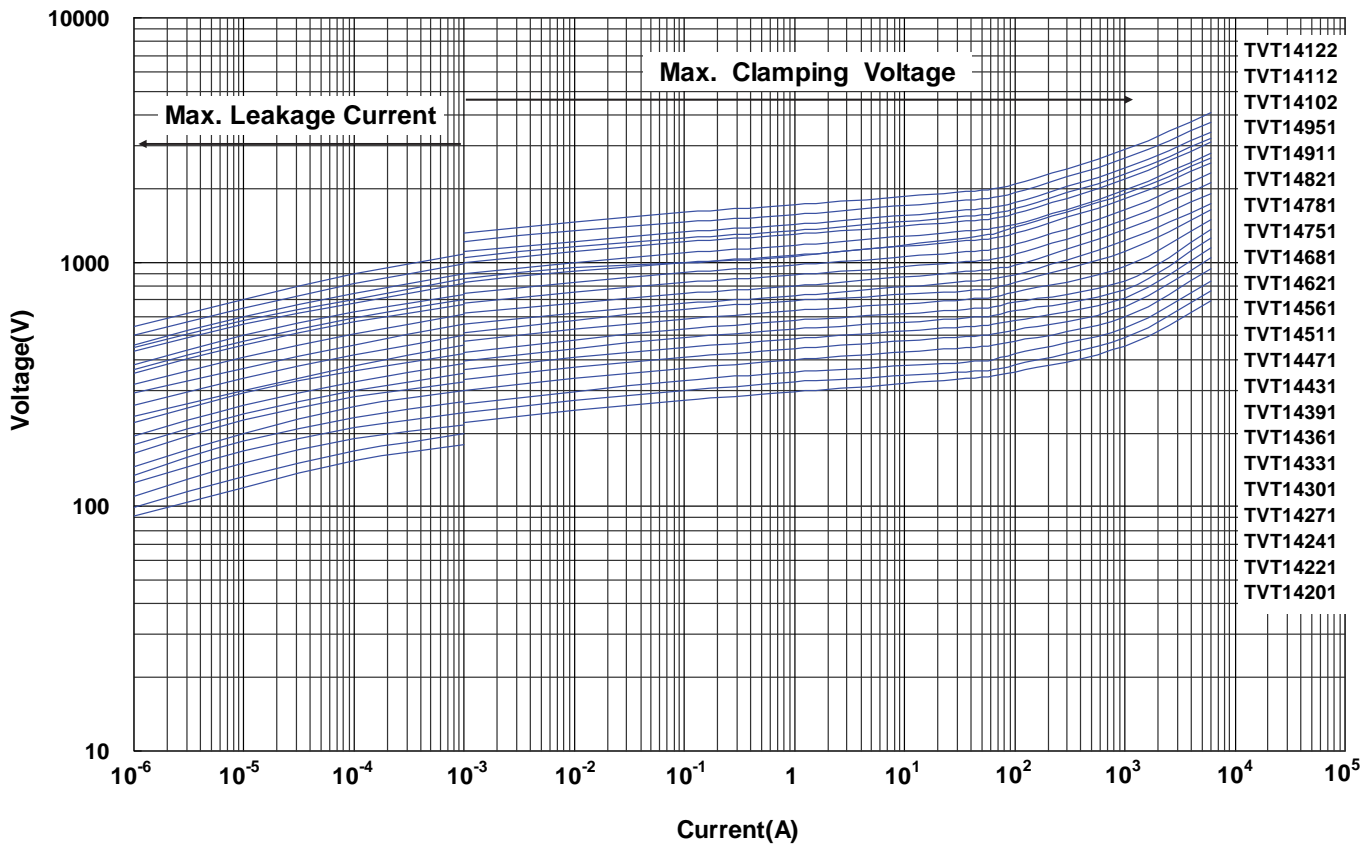
Metal Oxide Varistor : TVT Series



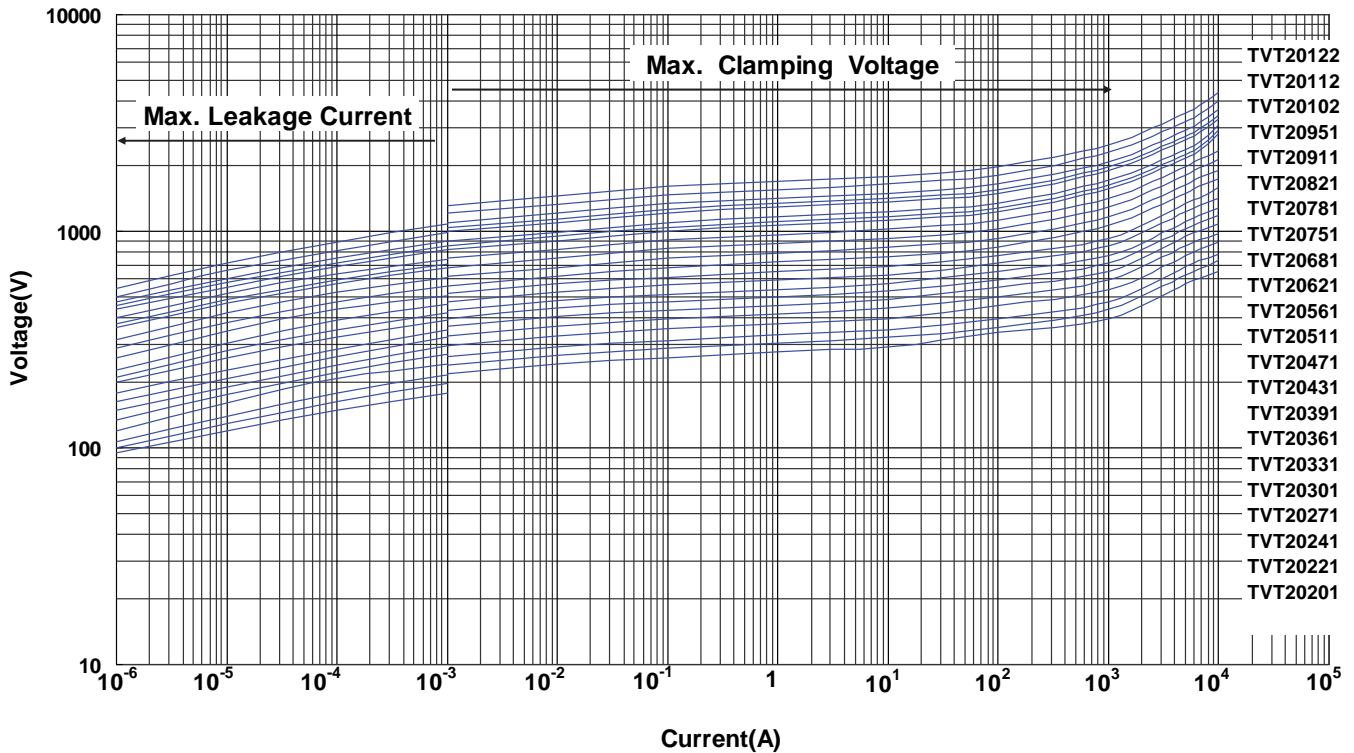
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■ Max. Leakage Current and Max. Clamping Voltage Curves

Max. Leakage Current and Max. Clamping Voltage Curves (TVT14201 ~ TVT14122)



Max. Leakage Current and Max. Clamping Voltage Curves (TVT20201 ~ TVT20122)



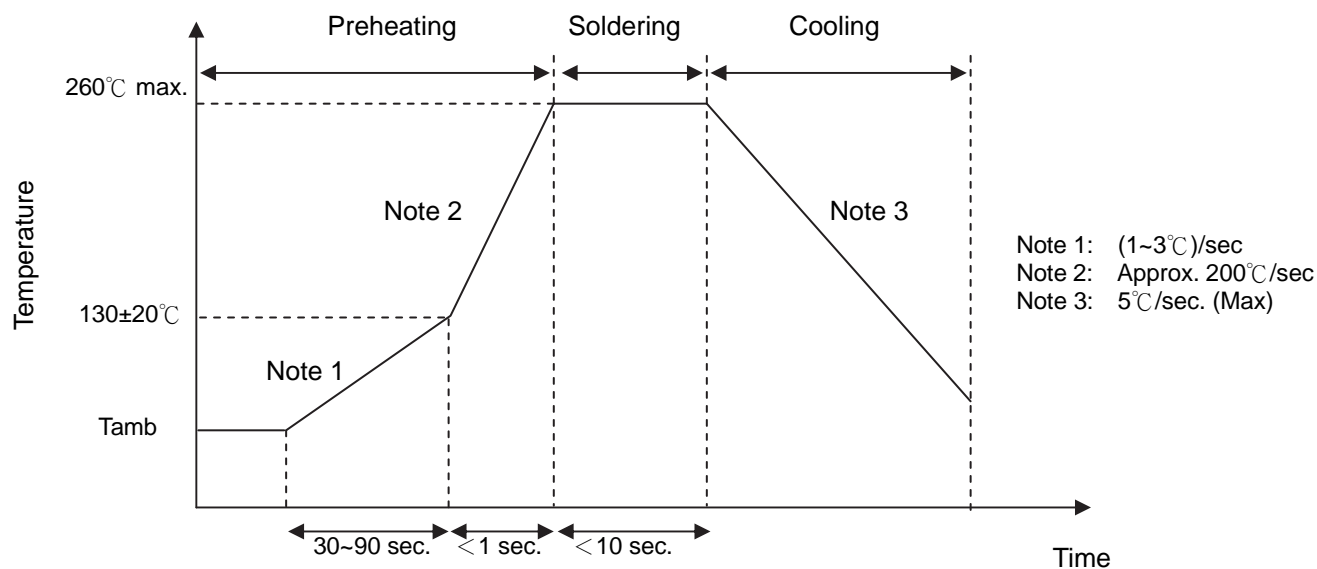
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Thermally Protected Varistor Series

■ Soldering Recommendation

● Wave Soldering Profile



● Recommended Reworking Conditions With Soldering Iron

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

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■ Reliability

Item	Standard	Test Conditions / Methods	Specifications															
Tensile Strength of Terminals	IEC 60068-2-21	<p>Gradually apply the specified force and keep the unit fixed for 10±1 sec.</p> <table border="1"> <thead> <tr> <th>Terminal diameter (mm)</th> <th>Terminal cross-sectional area (mm²)</th> <th>Force (Kg)</th> </tr> </thead> <tbody> <tr> <td>0.5<d≤0.8</td> <td>0.2<S≤0.5</td> <td>1.0</td> </tr> <tr> <td>0.8<d≤1.25</td> <td>0.5<S≤1.2</td> <td>2.0</td> </tr> <tr> <td>1.25<d</td> <td>1.2<S</td> <td>4.0</td> </tr> </tbody> </table>	Terminal diameter (mm)	Terminal cross-sectional area (mm ²)	Force (Kg)	0.5<d≤0.8	0.2<S≤0.5	1.0	0.8<d≤1.25	0.5<S≤1.2	2.0	1.25<d	1.2<S	4.0	$ \Delta V_{1mA}/V_{1mA} \leq 5\%$ No visible damage			
Terminal diameter (mm)	Terminal cross-sectional area (mm ²)	Force (Kg)																
0.5<d≤0.8	0.2<S≤0.5	1.0																
0.8<d≤1.25	0.5<S≤1.2	2.0																
1.25<d	1.2<S	4.0																
Bending Strength of Terminals	IEC 60068-2-21	<p>Hold specimen and apply the force specified below to each lead. Bend the specimen to 90°, and then return to the original position. Repeat the procedure in the opposite direction.</p> <table border="1"> <thead> <tr> <th>Terminal diameter (mm)</th> <th>Terminal cross-sectional area (mm²)</th> <th>Force (Kg)</th> </tr> </thead> <tbody> <tr> <td>0.5<d≤0.8</td> <td>0.2<S≤0.5</td> <td>0.5</td> </tr> <tr> <td>0.8<d≤1.25</td> <td>0.5<S≤1.2</td> <td>1.0</td> </tr> <tr> <td>1.25<d</td> <td>1.2<S</td> <td>2.0</td> </tr> </tbody> </table>	Terminal diameter (mm)	Terminal cross-sectional area (mm ²)	Force (Kg)	0.5<d≤0.8	0.2<S≤0.5	0.5	0.8<d≤1.25	0.5<S≤1.2	1.0	1.25<d	1.2<S	2.0	$ \Delta V_{1mA}/V_{1mA} \leq 5\%$ No visible damage			
Terminal diameter (mm)	Terminal cross-sectional area (mm ²)	Force (Kg)																
0.5<d≤0.8	0.2<S≤0.5	0.5																
0.8<d≤1.25	0.5<S≤1.2	1.0																
1.25<d	1.2<S	2.0																
Vibration	IEC 61051-1	Frequency range: 10 ~ 55 Hz Amplitude: 0.75mm or 98 m/s ² Direction: 3 mutually perpendicular directions, 2 hrs each.	$ \Delta V_{1mA}/V_{1mA} \leq 5\%$ No visible damage															
Solderability	IEC 60068-2-20	245±3°C , 3±0.3 sec	At least 95% of terminal electrode is covered by new solder															
Resistance to Soldering Heat	IEC 60068-2-20	260±3°C , 10±1 sec	$ \Delta V_{1mA}/V_{1mA} \leq 5\%$ No visible damage															
High Temperature Storage	IEC 60068-2-2	110±5°C x 1000± 24 hrs	$ \Delta V_{1mA}/V_{1mA} \leq 5\%$ No visible damage															
Damp Heat, Steady State	IEC 60068-2-78	a. 40±2°C, 90 ~ 95 % RH, 1344 hrs b. 40±2°C, 90 ~ 95 % RH, at 10%Vdc, 1344 hrs	$ \Delta V_{1mA}/V_{1mA} \leq 10\%$ No visible damage Insulation Resistance ≥ 100MΩ															
Rapid Change of Temperature	IEC 60068-2-14	The conditions shown below shall be repeated 5 cycles <table border="1"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> <th>Period (minutes)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>-40±3</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>Room temperature</td> <td>5±3</td> </tr> <tr> <td>3</td> <td>85±2</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>Room temperature</td> <td>5±3</td> </tr> </tbody> </table>	Step	Temperature (°C)	Period (minutes)	1	-40±3	30±3	2	Room temperature	5±3	3	85±2	30±3	4	Room temperature	5±3	$ \Delta V_{1mA}/V_{1mA} \leq 5\%$ No visible damage
Step	Temperature (°C)	Period (minutes)																
1	-40±3	30±3																
2	Room temperature	5±3																
3	85±2	30±3																
4	Room temperature	5±3																
Endurance at Upper Category Temperature	IEC 61051-1	85±2°C, 1000±24 hrs at V _{DC} or V _{rms} (Max. Continuous Voltage)	$ \Delta V_{1mA}/V_{1mA} \leq 10\%$ No visible damage															
8/20µs Surge Life	IEC 61051-1	8/20µs waveform, 10 surge currents, unipolar, interval 30 secs, amplitude corresponding to max. surge current derating curves for 20µs.	$ \Delta V_{1mA}/V_{1mA} \leq 10\%$ No visible damage															
10/1000µs Surge Life	IEC 61051-1	10/1000µs waveform, 10 surge currents, unipolar, interval 2 mins, amplitude corresponding to max. surge current derating curves for 1000µs.	$ \Delta V_{1mA}/V_{1mA} \leq 10\%$ No visible damage															
Operating Duty Cycle Test	UL 1449 3 rd	6KV/3KA 1.2/50µs+8/20µs combination waveform with Vac(@ Deg 90) for 15 times. Interval time between tests is 60 secs. (For TVT14 and TVT20 series test only)	$ \Delta V_p/V_p \leq 10\%$ No visible damage															

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■ Reliability

Item	Standard	Test Conditions / Methods	Specifications						
Limited Current Abnormal Overvoltage Test	UL 1449 3 rd	Test voltage: refer to UL 1449 3 rd Table 39.1 Short current condition: <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Series</th> <th>Short Current (Isc , A)</th> </tr> </thead> <tbody> <tr> <td>TVT14</td> <td>0.125A, 0.5A, 2.5A, 5A</td> </tr> <tr> <td>TVT20</td> <td>0.5A, 2.5A, 5A, 10A</td> </tr> </tbody> </table> Each of four previously untested TVT samples to be connected to an ac power supply having an open circuit voltage equal to Uoc. The power supply is to incorporate a series variable resistor that can be adjusted to obtain the short-circuit values (Isc) respectively. The four samples are to be energized for 7 hrs, or until current to, or body temperature attain equilibrium, or until the sample becomes disconnected from the ac supply.	Series	Short Current (Isc , A)	TVT14	0.125A, 0.5A, 2.5A, 5A	TVT20	0.5A, 2.5A, 5A, 10A	No flame
Series	Short Current (Isc , A)								
TVT14	0.125A, 0.5A, 2.5A, 5A								
TVT20	0.5A, 2.5A, 5A, 10A								
Voltage Proof	IEC 61051-1	Metal balls method, 2500 V _{ac} 1 min	No visible damage						
Varistor Voltage Temp. Coefficient	Specification Standard	$\frac{V_{1mA @ 85^{\circ}C} - V_{1mA @ 25^{\circ}C}}{V_{1mA @ 25^{\circ}C}} \times \frac{1}{60} \times 100\% (\% / ^{\circ}C)$ $\frac{V_{1mA @ -40^{\circ}C} - V_{1mA @ 25^{\circ}C}}{V_{1mA @ 25^{\circ}C}} \times \frac{1}{65} \times 100\% (\% / ^{\circ}C)$	-0.05 ≤ T _c ≤ 0.05 (%/°C)						

■ Packaging

● Bulk Packing

Series	Quantity (pcs/bag)
TVT14	50
TVT20	25

■ Warehouse Storage Conditions of Products

- Storage Conditions:
 1. Storage temperature: -10°C ~ +40°C
 2. Relative humidity: ≤ 75%RH
 3. Keep away from corrosive atmosphere and sunlight.
- Period of Storage: 1 year