

Metal Oxide Varistor : TVT Type

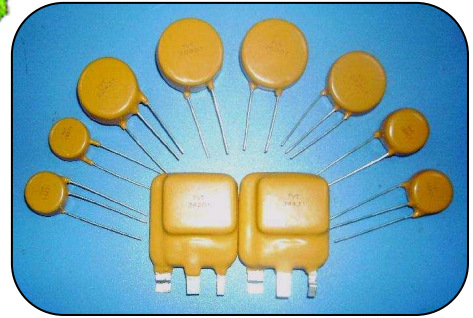


Thermally Protected Varistor Series

■ Features



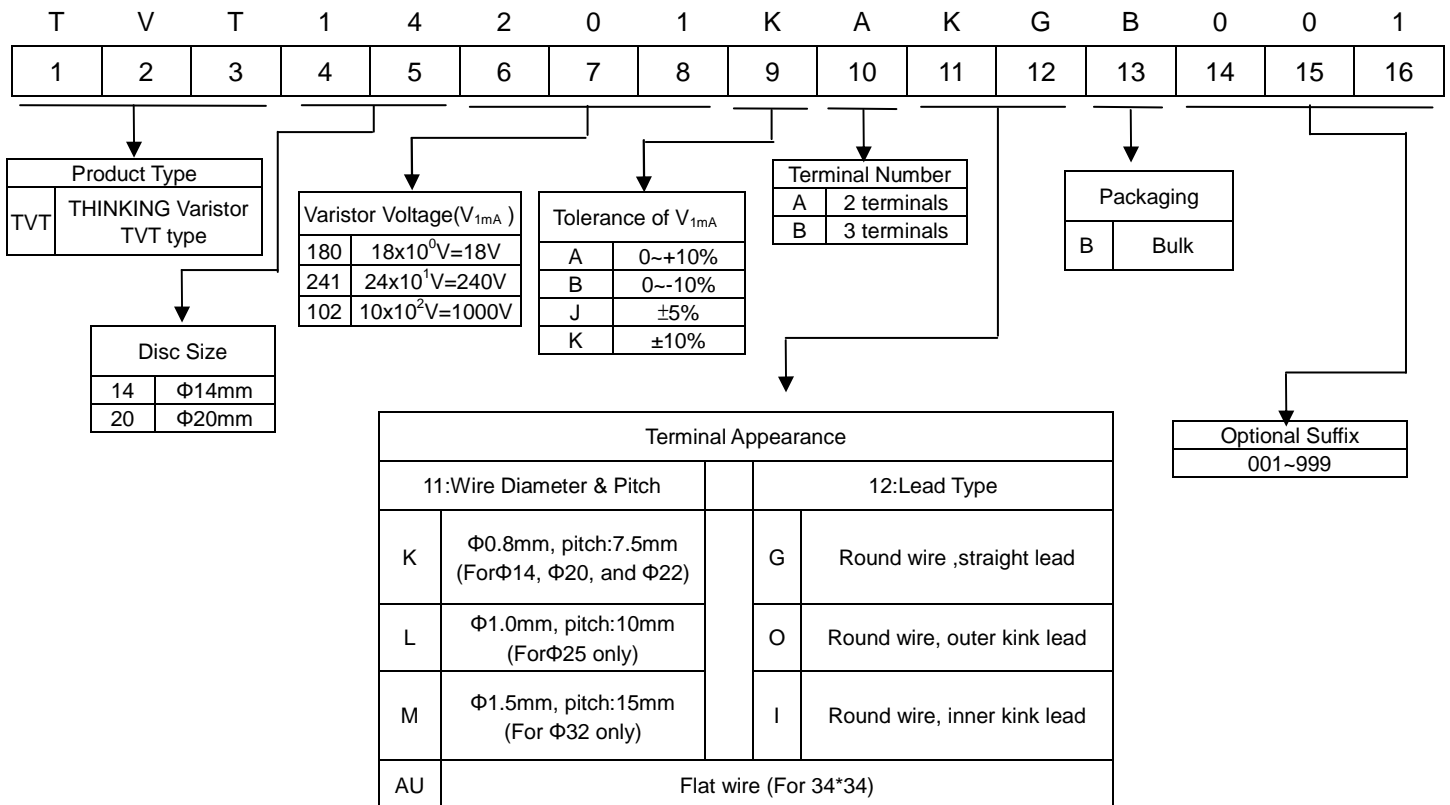
1. RoHS compliant
2. 2 leaded or 3 leaded thermally protected metal oxide varistor,
Three-leaded version available for indication purposes.
3. Body size: 14 and 20 mm in diameter
4. Working voltage: 130 ~ 750 Vac
5. Patent: US 7,453,681
6. Agency approval:
 - UL& cUL 1449 3rd: TVT14201~TVT14112, TVT20201~TVT20112
 - TUV: TVT14201~TVT14122, TVT20201~TVT20122
7. Meets UL 1449 3rd test item 39.4 abnormal over- voltage test (10A, 5A, 2.5A, 0.5A and 0.125A).



■ Recommended Applications

1. TVSS modules
2. Uninterruptible power supplies
3. Power supplies
4. Lighting products
5. Communication products

■ Part Number Code



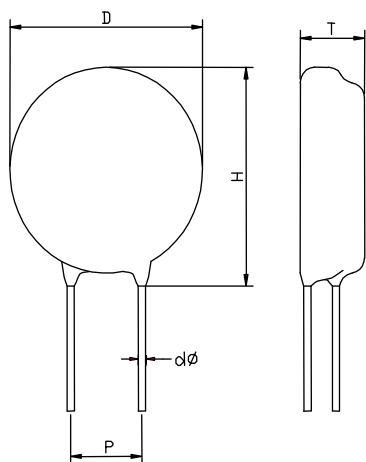
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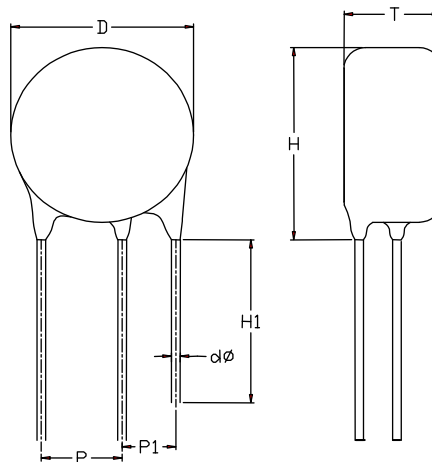
Thermally Protected Varistor Series

■ Structure and Dimensions

Two-Terminal Type



Three-Terminal Type



Series	Lead Type	D	P	P1	H	H1	dΦ	Tmax
TVT14	Two terminals	15.5~19.5	6.5~8.5		18.5~22		0.75~0.85	Please Refer to Electrical Characteristics
TVT14	Three terminals	15.5~19.5	6.5~8.5	4.0~6.0	18.5~22	7.0~18	0.75~0.85	
TVT20	Two terminals	19.5~23.5	6.5~8.5		21.5~27		0.75~0.85	
TVT20	Three terminals	19.5~23.5	6.5~8.5	4.0~6.0	21.5~27	12.5~18	0.75~0.85	

■ Electrical Characteristics

Part No.	Varistor Voltage (@1mA DC)	Max. Continuous Voltage		Max. Peak Current (8/20μs)		Max. Clamping Voltage		Max. Energy		Typical Capacitance @1KHZ	Rated Power	Thickness
		V _{AC(rms)}	V _{DC}	1 _{time}	2 _{times}	V _P	I _P	10/1000μs	2ms			
		(V)	(V)	(A)	(A)	(V)	(A)	W _{max} (J)				
TVT14201	200(180~220)	130	170	6000	4500	340	50	77	55	700	0.6	8.0
TVT20201	200(180~220)	130	170	10000	6500	340	100	140	100	1460	1	10.3
TVT14221	220(198~242)	140	180	6000	4500	365	50	86	62	640	0.6	8.1
TVT20221	220(198~242)	140	180	10000	6500	365	100	155	110	1320	1	10.4
TVT14241	240(216~264)	150	200	6000	4500	395	50	94	68	580	0.6	8.2
TVT20241	240(216~264)	150	200	10000	6500	395	100	170	120	1200	1	10.5
TVT14271	270(243~297)	175	225	6000	4500	455	50	110	80	520	0.6	8.4
TVT20271	270(243~297)	175	225	10000	6500	455	100	190	135	1100	1	10.7
TVT14301	300(270~330)	195	250	6000	4500	500	50	118	85	480	0.6	8.6
TVT20301	300(270~330)	195	250	10000	6500	500	100	205	145	1000	1	10.9
TVT14331	330(297~363)	215	275	6000	4500	550	50	127	90	450	0.6	8.8
TVT20331	330(297~363)	215	275	10000	6500	550	100	215	155	950	1	11.1

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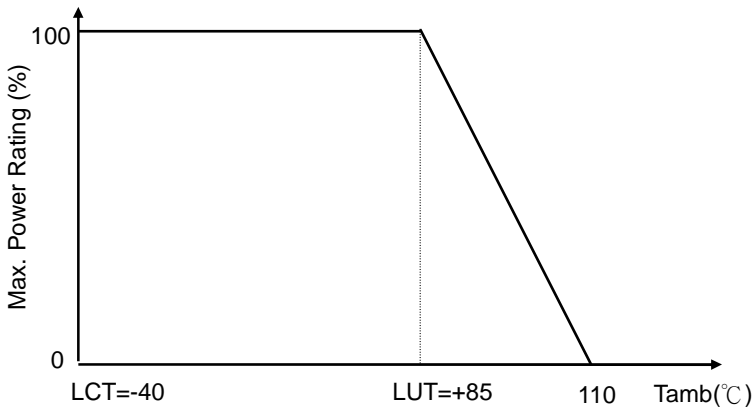
Part No.	Varistor Voltage (@1mA DC)	Max. Continuous Voltage		Max. Peak Current (8/20 μ s)		Max. Clamping Voltage		Max. Energy		Typical Capacitance @1KHZ	Rated Power	Thickness
		$V_{AC(rms)}$	V_{DC}	I_{1time}	I_{2times}	V_P	I_P	10/1000 μ s	2ms			
	V_{1mA} (V)	(V)	(V)	(A)	(A)	(V)	(A)	W_{max} (J)		C (pF)	P (W)	T_{max} (mm)
TVT14361	360(324~396)	230	300	6000	4500	595	50	137	98	430	0.6	9.0
TVT20361	360(324~396)	230	300	10000	6500	595	100	225	160	900	1	11.3
TVT14391	390(351~429)	250	320	6000	4500	650	50	154	110	390	0.6	9.2
TVT20391	390(351~429)	250	320	10000	6500	650	100	240	170	800	1	11.5
TVT14431	430(387~473)	275	350	6000	4500	710	50	170	120	370	0.6	9.5
TVT20431	430(387~473)	275	350	10000	6500	710	100	270	192	700	1	11.8
TVT14471	470(423~517)	300	385	6000	4500	775	50	192	138	320	0.6	9.8
TVT20471	470(423~517)	300	385	10000	6500	775	100	350	250	620	1	12.1
TVT14511	510(459~561)	320	410	6000	4500	845	50	209	150	290	0.6	10.2
TVT20511	510(459~561)	320	410	10000	6500	845	100	386	275	530	1	12.5
TVT14561	560(504~616)	350	450	6000	4500	930	50	220	158	260	0.6	10.6
TVT20561	560(504~616)	350	450	10000	6500	930	100	400	285	480	1	12.9
TVT14621	620(558~682)	395	510	6000	4500	1025	50	231	165	240	0.6	11.0
TVT20621	620(558~682)	395	510	10000	6500	1025	100	425	305	450	1	13.3
TVT14681	680(612~748)	420	560	6000	4500	1120	50	242	172	230	0.6	11.4
TVT20681	680(612~748)	420	560	10000	6500	1120	100	455	325	440	1	13.7
TVT14751	750(675~825)	465	615	6000	4500	1240	50	247	175	220	0.6	11.0
TVT20751	750(675~825)	465	615	10000	6500	1240	100	509	365	420	1	14.1
TVT14781	780(702~858)	485	640	6000	4500	1290	50	260	180	200	0.6	11.1
TVT20781	780(702~858)	485	640	10000	6500	1290	100	515	350	400	1	14.4
TVT14821	820(738~902)	510	670	6000	4500	1355	50	270	192	180	0.6	11.3
TVT20821	820(738~902)	510	670	10000	6500	1355	100	475	340	390	1	14.6
TVT14911	910(819~1001)	550	745	6000	4500	1500	50	280	200	170	0.6	11.6
TVT20911	910(819~1001)	550	745	10000	6500	1500	100	509	365	360	1	14.9
TVT14951	950(855~1045)	575	765	6000	4500	1570	50	290	210	160	0.6	12.0
TVT20951	950(855~1045)	575	765	10000	6500	1570	100	530	380	340	1	15.3
TVT14102	1000(900~1100)	625	825	6000	4500	1650	50	305	218	150	0.6	13.4
TVT20102	1000(900~1100)	625	825	10000	6500	1650	100	560	400	330	1	15.7
TVT14112	1100(990~1210)	680	895	6000	4500	1815	50	340	242	140	0.6	14.3
TVT20112	1100(990~1210)	680	895	10000	6500	1815	100	610	435	310	1	15.9
TVT14122	1200(1080~1320)	750	980	6000	4500	2000	50	350	260	130	0.6	14.6
TVT20122	1200(1080~1320)	750	980	10000	6500	2000	100	620	450	290	1	16.3

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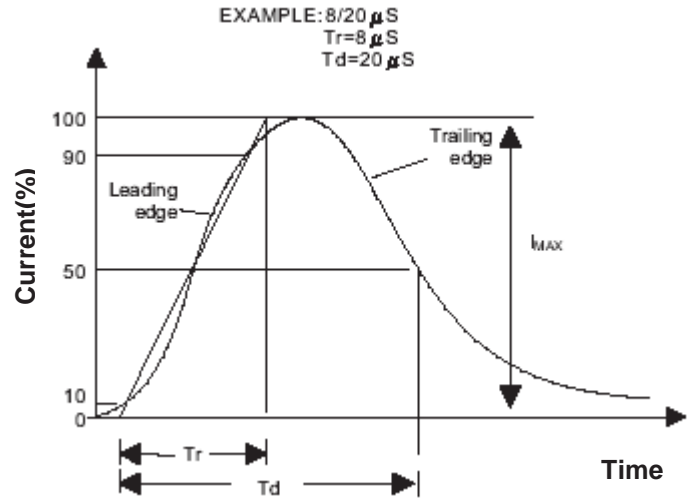


Thermally Protected Varistor Series

Operating Temperature vs. Power Derating Curve

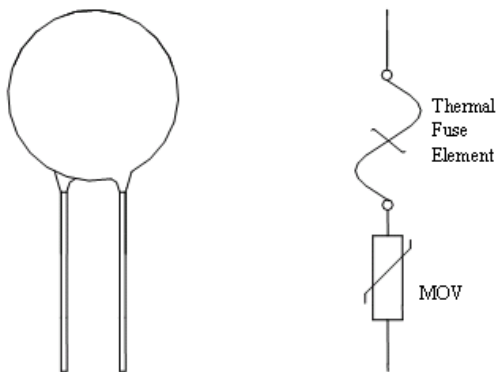


Surge Current Standard Waveform

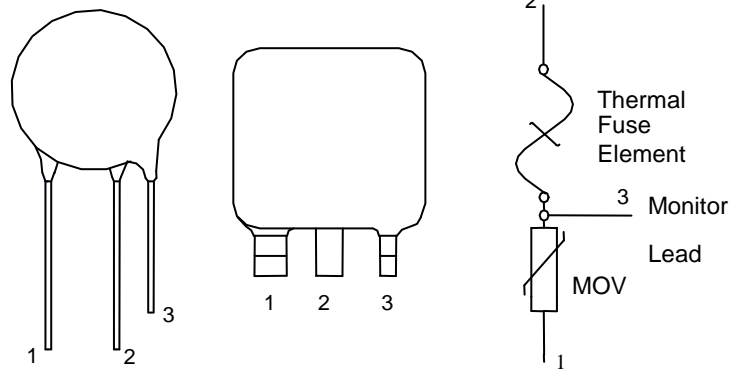


Lead Configuration

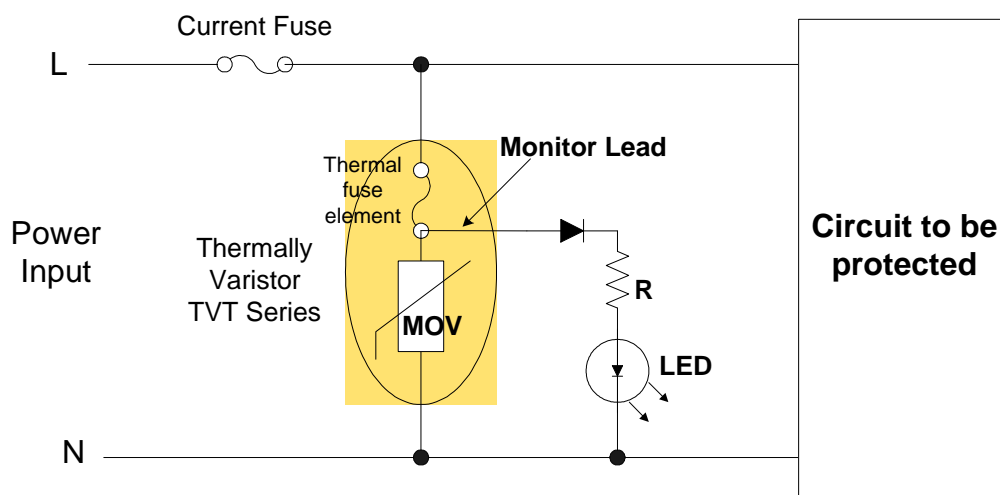
Two-leaded type



Three-leaded type



Typical Application Circuit

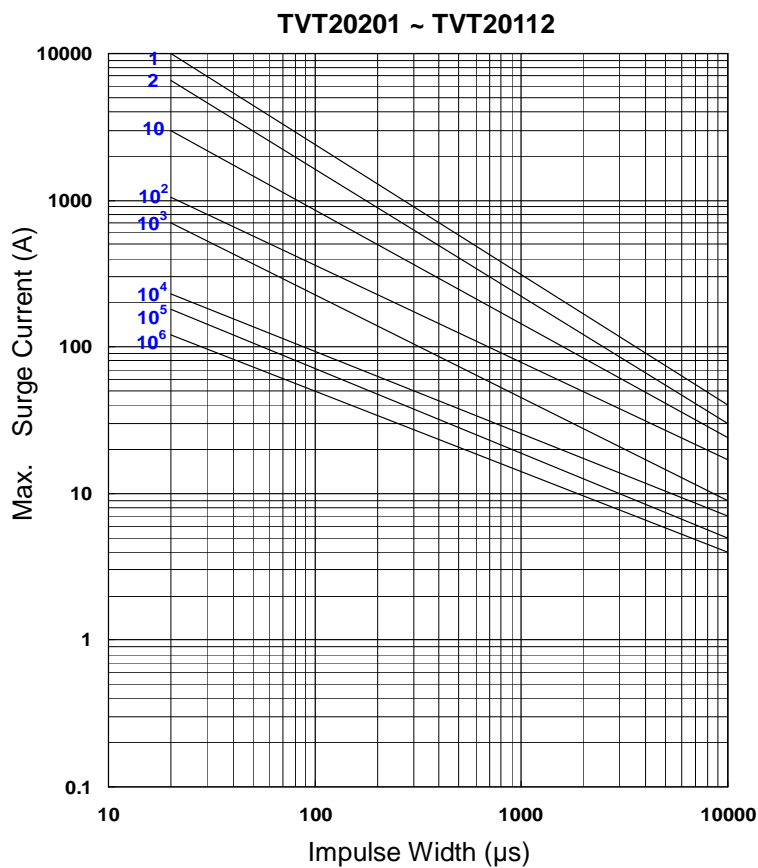
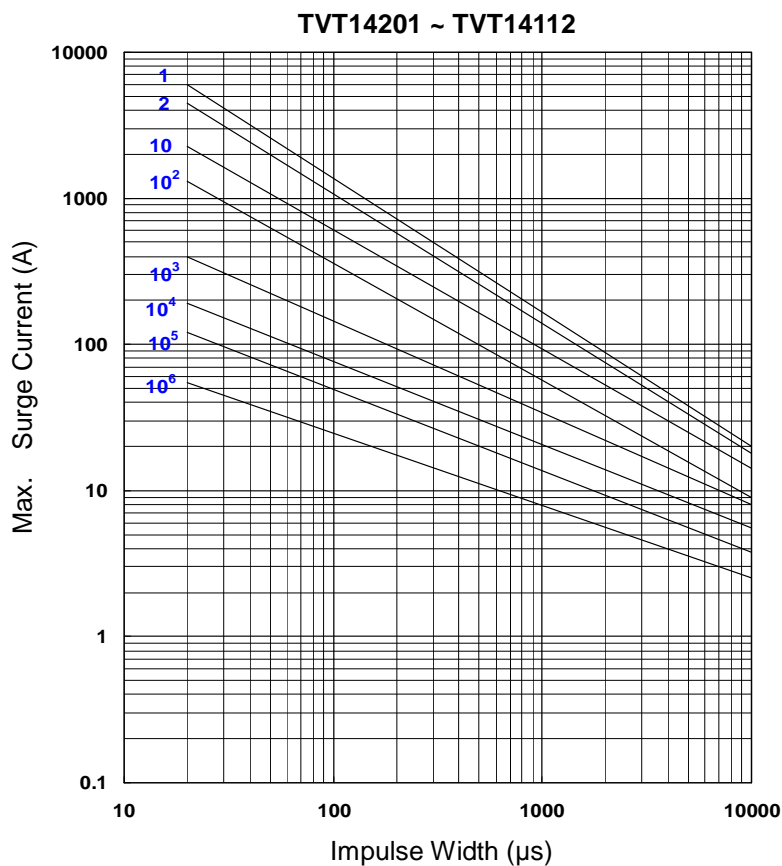


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■ Max. Surge Current Derating Curves

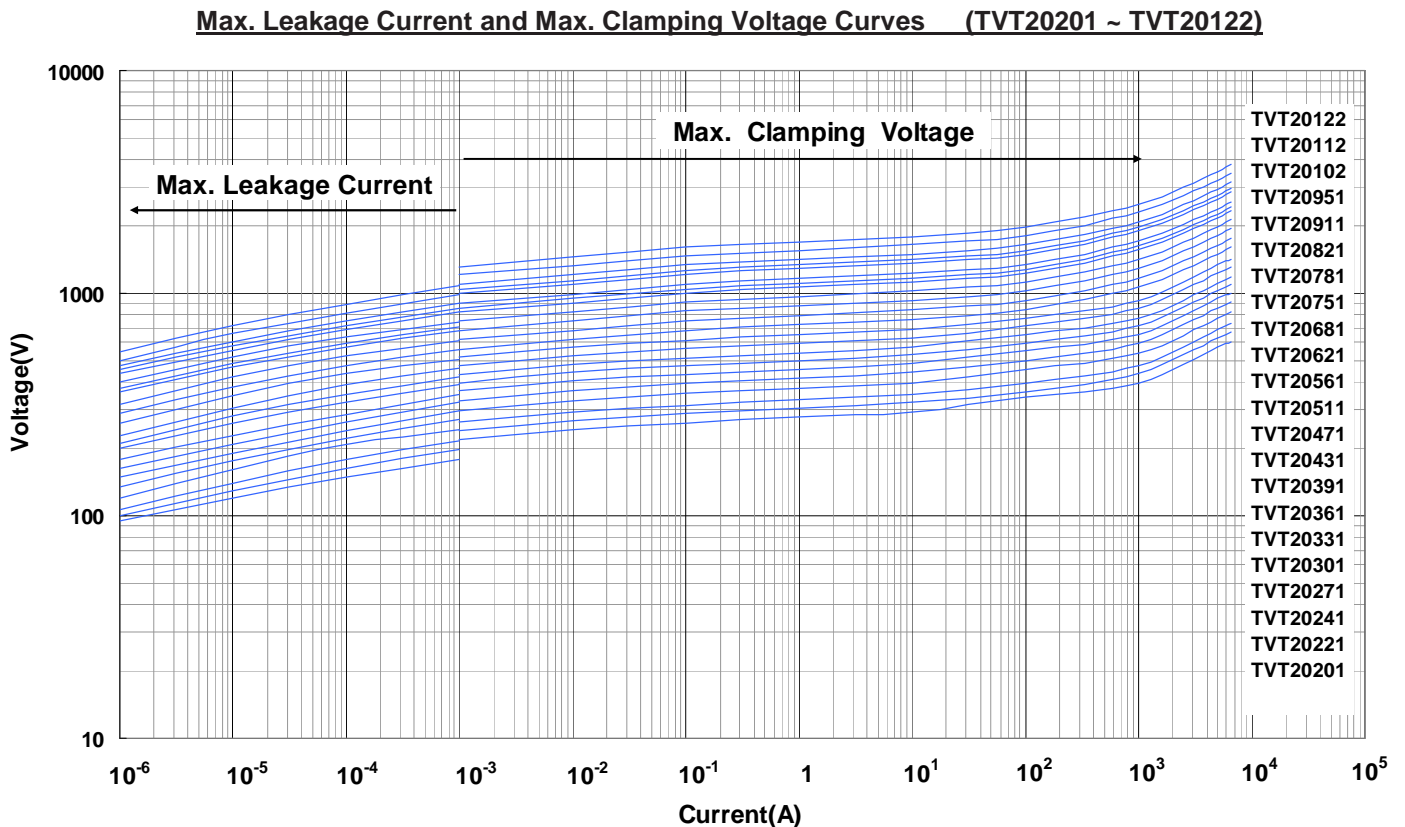
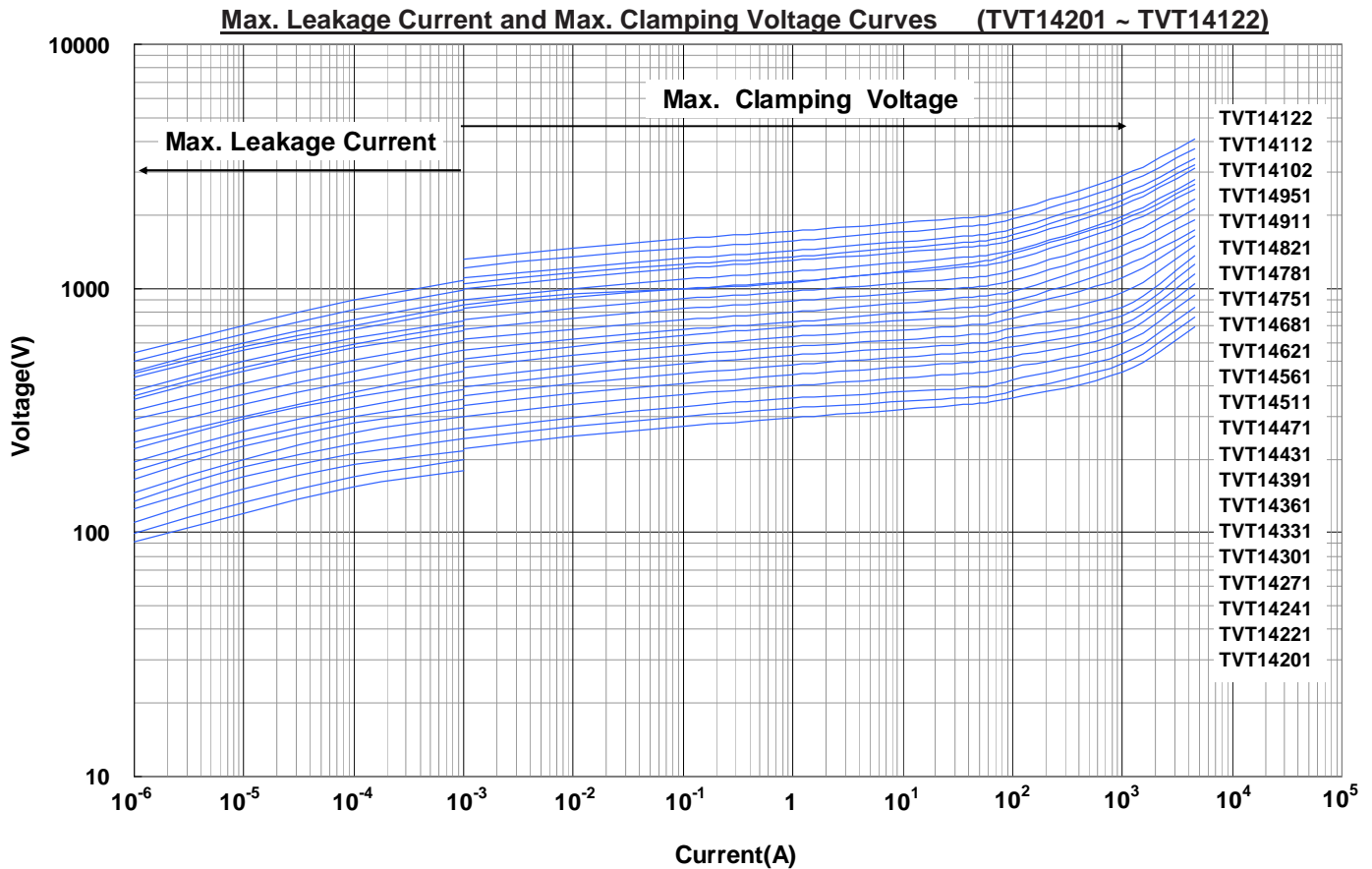


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■ Max. Leakage Current and Max. Clamping Voltage Curves



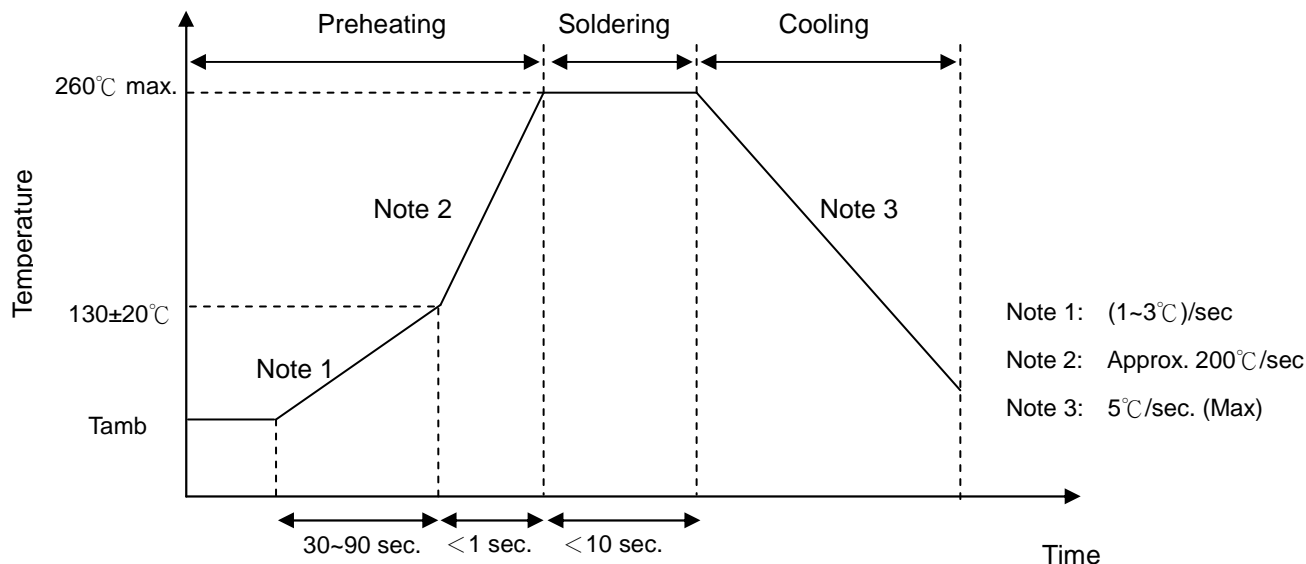
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■ Soldering Recommendation

● 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	IEC60068-2-21	<p>Gradually applying the force specified and keeping the unit fixed for 10±1 sec.</p> <p>For TVT14~TVT32 Series</p> <table border="1"> <thead> <tr> <th>Terminal diameter (mm)</th> <th>Force (Kg)</th> </tr> </thead> <tbody> <tr> <td>0.5<d≤0.8</td> <td>1.0</td> </tr> <tr> <td>0.8<d≤1.25</td> <td>2.0</td> </tr> <tr> <td>1.25<d</td> <td>4.0</td> </tr> </tbody> </table> <p>For TVT34 Series</p> <table border="1"> <thead> <tr> <th>Terminal cross-sectional area (mm²)</th> <th>Terminal diameter (mm)</th> <th>Force (Kg)</th> </tr> </thead> <tbody> <tr> <td>0.5<S≤1.2</td> <td>0.8<d≤1.25</td> <td>2.0</td> </tr> <tr> <td>1.2<S</td> <td>1.25<d</td> <td>4.0</td> </tr> </tbody> </table>	Terminal diameter (mm)	Force (Kg)	0.5<d≤0.8	1.0	0.8<d≤1.25	2.0	1.25<d	4.0	Terminal cross-sectional area (mm ²)	Terminal diameter (mm)	Force (Kg)	0.5<S≤1.2	0.8<d≤1.25	2.0	1.2<S	1.25<d	4.0	No visible damage ΔV/V _{1mA} ≤5%			
Terminal diameter (mm)	Force (Kg)																						
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1.2<S	1.25<d	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°, then return to the original position. Repeat the procedure in the opposite direction.</p> <p>For TVT14~TVT32 Series</p> <table border="1"> <thead> <tr> <th>Terminal diameter (mm)</th> <th>Force (Kg)</th> </tr> </thead> <tbody> <tr> <td>0.5<d≤0.8</td> <td>0.5</td> </tr> <tr> <td>0.8<d≤1.25</td> <td>1.0</td> </tr> <tr> <td>1.25<d</td> <td>2.0</td> </tr> </tbody> </table> <p>For TVT34 Series</p> <table border="1"> <thead> <tr> <th>Terminal cross-sectional area (mm²)</th> <th>Terminal diameter (mm)</th> <th>Force (Kg)</th> </tr> </thead> <tbody> <tr> <td>0.2<S≤0.5</td> <td>0.5<d≤0.8</td> <td>0.5</td> </tr> <tr> <td>0.5<S≤1.2</td> <td>0.8<d≤1.25</td> <td>1.0</td> </tr> <tr> <td>1.2<S</td> <td>1.25<d</td> <td>2.0</td> </tr> </tbody> </table>	Terminal diameter (mm)	Force (Kg)	0.5<d≤0.8	0.5	0.8<d≤1.25	1.0	1.25<d	2.0	Terminal cross-sectional area (mm ²)	Terminal diameter (mm)	Force (Kg)	0.2<S≤0.5	0.5<d≤0.8	0.5	0.5<S≤1.2	0.8<d≤1.25	1.0	1.2<S	1.25<d	2.0	No visible damage ΔV/V _{1mA} ≤5%
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0.5<S≤1.2	0.8<d≤1.25	1.0																					
1.2<S	1.25<d	2.0																					
Vibration	IEC 1051-1	<p>Frequency range: 10 ~ 55 Hz Amplitude: 0.75mm or 98 m/s² Direction: 3 mutually perpendicular directions, 2hrs each.</p>	ΔV/V _{1mA} ≤5% No visible damage																				
Solderability	IEC 60068-2-20	235±5°C , 2±0.5 sec	At least 95% of terminal electrode is covered by new solder																				
Resistance to Soldering Heat	IEC 60068-2-20	260±5°C , 5±1 sec	ΔV/V _{1mA} ≤ 5 % No visible damage																				
High Temperature Storage	IEC60068-2-2	110±5°C x 1000± 24 hrs	ΔV/V _{1mA} ≤ 5 %																				
Damp Heat, Steady State	IEC 60068-2-3	<p>a. 40±2°C , 90 ~ 95 % RH, 1344 hrs b. 40±2°C , 90 ~ 95 % RH, at 10%Vdc, 1344 hrs</p>	ΔV/V _{1mA} ≤ 10% No visible damage																				
Rapid Change of Temperature*1	IEC 60068-2-14	<p>The conditions shown below shall be repeated 5 cycles</p> <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	ΔV/V _{1mA} ≤ 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																					

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IEC61051-4.20

Item	Standard	Test Conditions / Methods	Specifications								
Endurance at Upper Category Temperature	IEC61051-4.20	85±2°C, 1000±24 hrs at V _{DC} or V _{rms} (Max. Allowable Voltage)	ΔV/V _{1mA} ≤ 10 % R ≥ 1000MΩ No visible damage								
Low Temperature Storage (Optional)	CECC42000	-40±5°C, 1000±24 hrs	ΔV/V _{1mA} ≤ 5%								
8/20μs Surge Life	CECC42000	8/20 μs waveform, 10,000 surge currents, unipolar, interval 10 secs amplitude corr. to max. Surge current derating curves for 20 μs.	ΔV/V _{1mA} ≤ 10 % No visible damage								
Varistor Voltage Temp. Coefficient	Specification Standard	$\frac{V_{1mA} \text{ at } 85^{\circ}\text{C} - V_{1mA} \text{ at } 25^{\circ}\text{C}}{V_{1mA} \text{ at } 25^{\circ}\text{C}} \times \frac{1}{60} \times 100 (\% / ^{\circ}\text{C})$	-0.05 ≤ T _c ≤ 0 (% / °C)								
Voltage Proof	IEC61051	Metal balls method, 2500 V _{ac} 1 min	No visible damage								
Limited current abnormal overvoltage test	UL1449 3rd	<p>Test voltage:</p> <table border="1"> <thead> <tr> <th>Varistor voltage</th> <th>Test Voltage (V)</th> </tr> </thead> <tbody> <tr> <td>201-391</td> <td>240 Vac</td> </tr> <tr> <td>431-621</td> <td>480 Vac</td> </tr> <tr> <td>681-122</td> <td>600 Vac</td> </tr> </tbody> </table> <p>Each test voltage is applied with a short circuit current of 0.5A, 2.5A, 5A and, 10A respectively across the varistor.</p> <p>The power supply is to incorporate a series variable resistor that can be adjusted to obtain the short-circuit current.</p>	Varistor voltage	Test Voltage (V)	201-391	240 Vac	431-621	480 Vac	681-122	600 Vac	<p>The varistor must be energized for 7 hours, or until the varistor becomes disconnected from the AC Line.</p> <p>The cheesecloth draped on the varistor shall not be charring, glowing, or flaming. There are no any live parts to be accessibility after testing.</p>
Varistor voltage	Test Voltage (V)										
201-391	240 Vac										
431-621	480 Vac										
681-122	600 Vac										

■ Packaging

- 14 and 20 mm :

Bulk Packing

Disc Size (mm)	Quantity (PCS/ Bag)
14Φ	50
20Φ	20

■ 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.

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■ Cross Reference

● Dimensions : 14mm

THINKING : The part no. A is for 2- leaded structure and B is for 3- leaded structure.

Littelfuse : The part no. E is for 2- leaded structure and M is for 3- leaded structure.

EPCOS : 3- Leaded structure series only.

Walsin : The part no. B is for 2- leaded structure and C is for 3- leaded structure.

Size(mm)	Vac(rms)	THINKING	Littelfuse	EPCOS	Walsin
14	130	TVT14201K(A/B)	TMOV14RP130(E/M)	ETFV14K130E2	FSR201K(B/C)14ES
14	140	TVT14221K(A/B)	TMOV14RP140(E/M)	ETFV14K140E2	FSR221K(B/C)14ES
14	150	TVT14241K(A/B)	TMOV14RP150(E/M)	ETFV14K150E2	FSR241K(B/C)14ES
14	175	TVT14271K(A/B)	TMOV14RP175(E/M)	ETFV14K175E2	FSR271K(B/C)14ES
14	195	TVT14301K(A/B)	TMOV14RP200(E/M)	--	FSR311K(B/C)14ES
14	215	TVT14331K(A/B)	--	ETFV14K210E2	FSR331K(B/C)14ES
14	230	TVT14361K(A/B)	TMOV14RP230(E/M)	ETFV14K230E2	FSR361K(B/C)14ES
14	250	TVT14391K(A/B)	TMOV14RP250(E/M)	ETFV14K250E2	FSR391K(B/C)14ES
14	275	TVT14431K(A/B)	TMOV14RP275(E/M)	ETFV14K275E2	FSR431K(B/C)14ES
14	300	TVT14471K(A/B)	TMOV14RP300(E/M)	ETFV14K300E2	FSR471K(B/C)14ES
14	320	TVT14511K(A/B)	TMOV14RP320(E/M)	ETFV14K320E2	FSR511K(B/C)14ES
14	350	TVT14561K(A/B)	--	ETFV14K350E2	FSR561K(B/C)14ES
14	395	TVT14621K(A/B)	TMOV14RP385(E/M)	ETFV14K385E2	FSR621K(B/C)14ES
14	420	TVT14681K(A/B)	TMOV14RP420(E/M)	ETFV14K420E2	FSR681K(B/C)14ES
14	465	TVT14751K(A/B)	TMOV20RP460(E/M)	--	--
14	485	TVT14781K(A/B)	--	--	--
14	510	TVT14821K(A/B)	--	--	--
14	550	TVT14911K(A/B)	--	--	--
14	575	TVT14951K(A/B)	--	--	--
14	625	TVT14102K(A/B)	--	--	--
14	680	TVT14112K(A/B)	--	--	--
14	750	TVT14122K(A/B)	--	--	--

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Thermally Protected Varistor Series

- Dimensions : 20mm

THINKING : The part no. A is for 2- leaded structure and B is for 3- leaded structure.

Littelfuse : The part no. E is for 2- leaded structure and M is for 3- leaded structure.

EPCOS : 3- Leaded structure series only.

Walsin : The part no. B is for 2- leaded structure and C is for 3- leaded structure.

Size(mm)	Vac(rms)	THINKING	Littelfuse	EPCOS	Walsin
20	130	TVT20201K(A/B)	TMOV20RP130(E/M)	ETFV20K130E2	FSR201 K(B/C)20ES
20	140	TVT20221K(A/B)	TMOV20RP140(E/M)	ETFV20K140E2	FSR221 K(B/C)20ES
20	150	TVT20241K(A/B)	TMOV20RP150(E/M)	ETFV20K150E2	FSR241 K(B/C)20ES
20	175	TVT20271K(A/B)	TMOV20RP175(E/M)	ETFV20K175E2	FSR271 K(B/C)20ES
20	195	TVT20301K(A/B)	TMOV20RP200(E/M)	--	FSR311 K(B/C)20ES
20	215	TVT20331K(A/B)	--	ETFV20K210E2	FSR331 K(B/C)20ES
20	230	TVT20361K(A/B)	TMOV20RP230(E/M)	ETFV20K230E2	FSR361 K(B/C)20ES
20	250	TVT20391K(A/B)	TMOV20RP250(E/M)	ETFV20K250E2	FSR391 K(B/C)20ES
20	275	TVT20431K(A/B)	TMOV20RP275(E/M)	ETFV20K275E2	FSR431 K(B/C)20ES
20	300	TVT20471K(A/B)	TMOV20RP300(E/M)	ETFV20K300E2	FSR471 K(B/C)20ES
20	320	TVT20511K(A/B)	TMOV20RP320(E/M)	ETFV20K320E2	FSR511 K(B/C)20ES
20	350	TVT20561K(A/B)	--	ETFV20K350E2	FSR561 K(B/C)20ES
20	395	TVT20621K(A/B)	TMOV20RP385(E/M)	ETFV20K385E2	FSR621 K(B/C)20ES
20	420	TVT20681K(A/B)	TMOV20RP420(E/M)	ETFV20K420E2	FSR681 K(B/C)20ES
20	465	TVT20751K(A/B)	--	----	FSR751 K(B/C)20ES
20	485	TVT20781K(A/B)	--		FSR781K(B/C)20ES
20	510	TVT20821K(A/B)	TMOV20RP510(E/M)	--	FSR821 K(B/C)20ES
20	550	TVT20911K(A/B)	TMOV20RP550(E/M)	--	FSR911 K(B/C)20ES
20	575	TVT20951K(A/B)	TMOV20RP575(E/M)	--	FSR951K(B/C)20EL
20	625	TVT20102K(A/B)	TMOV20RP625(E/M)	--	FSR102 K(B/C)20ES
20	680	TVT20112K(A/B)	--	--	FSR112 K(B/C)20ES
20	750	TVT20122K(A/B)	TMOV20RP750(E/M)	--	FSR122K(B/C)20EL