



# PolySwitch Resettable Devices

## Telecommunications & Networking Devices

PolySwitch devices for telecommunication and networking applications were initially designed over ten years ago to meet the growing demand for resettable overcurrent protection. These product families help provide protection against power cross and power induction surge as defined in ITU, Telcordia, and UL. Available in chip, surface-mount, and radial-leaded configurations, PolySwitch devices help improve the reliability of customer premise and network equipment world wide.



### Benefits

- Many product choices give engineers more design flexibility
- Compatible with high volume electronics assembly
- Assist in meeting regulatory requirements
- Improved line balance
- Applicable for legacy POTS and modern digital communications equipment

### Features

- RoHS compliant
- Resettable overcurrent protection
- Surface-mount, radial-leaded, and chip form factors
- Fast time-to-trip
- Agency recognition: UL, CSA, TÜV
- Resistance sorted and matched devices available
- Low parasitic capacitance/flat impedance with frequency

### Applications

- Modems
- Phone sets
- Fax machines
- Phone wall outlets
- Alarm systems
- PBX systems
- MDF modules
- Analog and digital line cards
- T1/E1 equipment
- xDSL modems and splitters
- Powered ethernet systems
- VoIP (Voice over IP equipment)
- LAN, WAN equipment
- Customer premise equipment
- Access network hardware

**Protection Application Guide for Telecommunications and Networking Devices\***

To use this guide, follow the steps below:

1. Select your equipment type from the guide below.
2. Select the type of protection depending on the agency and regional specifications in the second column.
3. Select the form factor for your application.
4. Use the Agency Specification/ PolySwitch Device Selection Guide on the next page to select a specific part number for each application based on the agency requirements.
5. Parts with fast time-to-trip or low resistance are available. Please consult a Raychem Circuit Protection product representative.

Application	Region/ Specification	Overcurrent Protection			Overvoltage Protection
		Form Factor			SiBar Thyristor Surge Protectors†
		Radial-leaded	Surface-mount	Chip	
<b>Customer Premises equipment</b>	<b>North America</b>	TRF600-150	TS600-170F		TVBxxx(N/R)SA-L,
<b>IT equipment</b>	TIA-968-A (formerly FCC Part 68), UL 60950		TS600-200F		TVBxxx(N/M)SB-L, or TVAxix(N/R)SA-L
Analog modems, V.90 modems, ISDN modems, xDSL modems, ADSL splitters, phone sets, fax machines, answering machines, caller ID, internet appliances, PBX systems, POS terminals, wall plugs	<b>Europe/Asia/ South America</b>	TRF250-120	TS250-130F		TVBxxx(N/R)SA-L
	ITU K.21	TRF250-120T	TSV250-130F		TVAxix(N/R)SA-L
		TRF250-145			
		TRF250-180			
		TRF250-183			
<b>Access network equipment (†)</b>	<b>North America</b>	TRF600-160	TS600-170F		TVBxxx(N/M/R)SC-L
Remote terminals, line repeaters, multiplexers, cross-connects, WAN equipment	Telcordia GR-1089		TS600-200F TSM600-250F TSM600-400F†† FT600-1250**		
	<b>Europe/Asia/ South America</b>	TRF250-120	TS250-130F		TVBxxx(N/R)SA-L
	ITU K.45	TRF250-145	TSV250-130F		TVAxix(N/R)SA-L
		TRF250-120T			
		TRF250-180			
		TRF250-183			
<b>Central office switching equipment (†)</b>	<b>North America</b>	TRF600-160	TSM600-250F		TVBxxx(N/M/R)SC-L
Analog/POTS linecards, ISDN linecards, xDSL modems, ADSL/VDSL splitters, T1/E1 linecards, multiplexers, CSU/DSU, servers	Telcordia GR-1089		TSM600-170F TSM600-200F FT600-1250** TSM600-400F††		
	<b>Europe/Asia/ South America</b>	TRF250-120	TS250-130F		TVBxxx(N/R)SA-L
	ITU K.20	TRF250-145	TSV250-130F		TVAxix(N/R)SA-L
		TRF250-120T			
		TRF250-180			
		TRF250-183		TCF250-180	
<b>Primary protection modules (†)</b>	<b>North America</b>	TRF250-180			N/A
MDF modules, Network Interface Devices (NID)	Telcordia GR-974				
	<b>Europe/Asia/ South America</b>	TRF250-120T	TS250-130F	TCF250-120T	TVBxxx(N/M/R)Sx-L
	ITU K.20	TRF250-145T	TSV250-130F	TCF250-145T	
		TRF250-145		TCF250-180	
<b>Short-haul/intrabuilding communications equipment (†)</b>	<b>North America</b>	TRF250-120	TS250-130F		TVBxxx(N/R)SA-L
LAN equipment, VoIP cards, cable telephony NIUs, wireless local loop handsets	Telcordia GR-1089 intrabuilding	TRF250-145	TSL250-080F		TVAxix(N/R)SA-L
		TRF250-120T	TSV250-130F		
	<b>Europe/Asia/ South America</b>	TRF250-120	TS250-130F		TVBxxx(N/R)SA-L
	ITU K.21	TRF250-145	TSV250-130F		TVAxix(N/R)SA-L
		TRF250-180			
		TRF250-183			
<b>LAN intrabuilding power cross protection</b>			TSL250-080F		TVBxxx(N/R)SA-L
LAN equipment, VoIP cards, IP phones					TVAxix(N/R)SA-L
<b>IEEE 802.3 Power over LAN protection</b>			decaSMDC050F/60-2‡‡		N/A
Powered ethernet switches and terminals, IP phones, wireless LAN base stations, microcellular base stations, VoIP cards					
<b>Cable telephony powering system</b>		BBRF550***			N/A
Power passing taps		BBRF750***			

\* This list is not exhaustive. Tyco Electronics welcomes our customers' input for additional application ideas for PolySwitch resettable devices.

† For improved line balance in these applications, resistance-matched parts are recommended.

‡ For more information on Raychem Circuit Protection SiBar thyristor surge protectors, refer to the SiBar product section on page 37.

\*\* FT600-1250 are surface mount telecom fuse devices. FT600-0500 and FT600-2000 reference also available. See FT600 section on page 100.

†† Helps meet GR-1089 issue 3. Consult Raychem Circuit Protection for meeting GR-1089 issue 4.

‡‡ For details on decaSMDC050F/60-2, see surface-mount devices section on page 109.

\*\*\* For details on BBRF series, see radial-leaded devices section on page 125.

## Agency Specification/PolySwitch Selection Guide for Telecommunications and Networking Devices

Use the guide below to select the PolySwitch devices which are typically used in your application. The following pages contain the specifications for the part numbers recommended below. PolySwitch devices assist telecommunication equipment in meeting the applicable protection requirements of these industry specifications. Refer to individual agency specifications for test procedures and circuit schematics. Users should independently evaluate the suitability of, and test each product for their application.

Family	Product*	Lightning	Power Cross	
<b>TCF250</b>	<b>TCF250-145T</b>	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω	
	<b>TCF250-180</b>		ITU K.20/21/45 – 600V <sub>AC</sub> , 600Ω	
	<b>TCF250-120T</b>			
<b>TRF250</b>	<b>TRF250-080U</b>	ITU K.20 – 1.0kV 10/700µs	ITU K.20 – 230V <sub>AC</sub> , 10Ω ITU K.20 – 600V <sub>AC</sub> , 600Ω	
	<b>TRF250-110U</b>	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω	
	<b>TRF250-120</b>	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 600V <sub>AC</sub> , 600Ω	
	<b>TRF250-120T</b>			
	<b>TRF250-120U</b>			
	<b>TRF250-120UT</b>			
	<b>TRF250-145</b>			
	<b>TRF250-145U</b>			
	<b>TRF250-180</b>			
	<b>TRF250-180US</b>			
	<b>TRF250-183</b>			
	<b>TS250/TSV250</b>	<b>TSV250-130F</b>	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω
		<b>TS250-130F</b>	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 600V <sub>AC</sub> , 600Ω
<b>TSL250</b>	<b>TSL250-080F</b>	Telcordia GR-1089 Intrabuilding – Surge 1 & 2	Telcordia GR-1089 Intrabuilding – 120V <sub>AC</sub> , 25A ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω	
<b>TRF600</b>	<b>TRF600-150</b>	TIA-968-A (formerly FCC Part 68)	UL60950, 3rd Ed. – 600V <sub>AC</sub> , 40A	
	<b>TRF600-160</b>	Telcordia GR-1089 – Level 1 and 2, issue 2‡	Telcordia GR-1089 – 600V <sub>AC</sub> , 60A	
<b>TS600</b>	<b>TS600-170F</b>	TIA-968-A (formerly FCC Part 68)	UL60950, 3rd Ed. – 600V <sub>AC</sub> , 40A	
	<b>TS600-200F-RA</b>	Telcordia GR-1089 – Level 1 and 2, issue 2‡	Telcordia GR-1089 – 600V <sub>AC</sub> , 60A	
<b>TSM600</b>	<b>TSM600-250F</b>	TIA-968-A (formerly FCC Part 68)	UL60950, 3rd Ed. – 600V <sub>AC</sub> , 40A	
	<b>TSM600-250F-RA</b>	Telcordia GR-1089 – Level 1 and 2, issue 2‡	Telcordia GR-1089 – 600V <sub>AC</sub> , 60A	
	<b>TSM600-400F</b>	TIA-968-A (formerly FCC Part 68) Telcordia GR-1089, issue 3	UL60950, 3rd Ed. – 600V <sub>AC</sub> , 40A Telcordia GR-1089 – 600V <sub>AC</sub> , 60A	
<b>FT600**</b>	<b>FT600-0500</b>	TIA-968-A - Type A & B	UL60950, 600V <sub>AC</sub> , 40A	
	<b>FT600-1250</b>	TIA-968-A - Type A & B	UL60950, 3rd Ed. – 600V <sub>AC</sub> , 40A	
	<b>FT600-2000</b>		Telcordia GR-1089 – 600V <sub>AC</sub> , 60A	

\* Applies to all products which share the same prefix.

† Tested with 230V gas discharge tube primary protector.

‡ May require additional series resistor to help telecommunication equipment pass Surge 3 (1kV, 10/1000µs).

\*\* See FT600 section on page 100.

**Table T1** Product Series: Size, Current Rating, Voltage Rating, Typical Resistance for Telecommunications and Networking Devices

	TCF250	TRF250	TS250	TSV250	TSL250	TS600 TSM600	TRF600
<b>Voltage Rating (V)†</b> (Operating/Interrupt)	60/250	60/250	60/250	60/250	80/250	60/600	60/600
<b>Specification</b>	ITU	ITU	ITU	ITU	Telcordia GR-1089 Intrabuilding	UL60950 Telcordia GR-1089	UL60950 Telcordia GR-1089
<b>Hold Current (A)</b>							
0.080	—	17.0Ω	—	—	8.0Ω	—	—
0.100	—	—	—	—	—	—	—
0.110	—	7.0Ω	—	—	—	—	—
0.120	10.5Ω	6.0-9.5Ω	—	—	—	—	—
0.130	—	—	8.0-10.5Ω	5.5Ω	—	—	—
0.140	—	—	—	—	—	—	—
0.145	7.0Ω	4.3-5.0Ω	—	—	—	—	—
0.150	—	—	—	—	—	—	8.0Ω
0.160	—	—	—	—	—	—	5.5-7.0Ω*
0.170	—	—	—	—	—	11.0Ω	—
0.180	1.4Ω	1.5Ω‡	—	—	—	—	—
0.183	—	0.8-2.0Ω‡	—	—	—	—	—
0.200	—	—	—	—	—	8.5Ω	—
0.250	—	—	—	—	—	3.0-3.5Ω*	—
0.300	—	—	—	—	—	—	—
0.400	—	—	—	—	—	1.1Ω	—
0.550	—	—	—	—	—	—	—
0.750	—	—	—	—	—	—	—

\* These devices have a maximum operating voltage of 250V

† Voltage Rating for telecommunications and networking devices is dependent upon the nature of the fault conditions. See telecom fuses section on page 100.

‡ These devices have a maximum operating voltage of 100V

### Voltage Ratings for Telecommunications and Networking Devices

For Raychem Circuit Protection telecommunications devices (TCF, TRF, TSx series) there are two applicable voltage ratings. These are **V<sub>Max</sub> Operating** and **V<sub>Max</sub> Interrupt**. To help understand the nature of these two different voltage ratings, the following definitions are provided:

**V<sub>Max</sub> Operating** : For telecommunications devices this is the voltage we have used to obtain component recognition under UL1434. Most Raychem Circuit Protection devices (TCF, TRF, TSx) are certified at 60V but can withstand higher V<sub>max</sub>. TRF600-160 and TSM600 product families are certified at 250V but can withstand higher V<sub>Max</sub>. Interrupt conditions as noted above.

**V<sub>Max</sub> Interrupt** : Under specified conditions this is the highest voltage that can be applied to the device at the maximum current. Devices have been designed to trip safely under higher power level cross conditions, as listed above, to assist equipment in meeting the appropriate industry conditions.

**Table T2 Thermal Derating for Telecommunications and Networking Devices [Hold Current (A) at Ambient Temperature (°C)]**

Part Number	Maximum Ambient Temperature								
	-40°C	-20°C	0°C	20°C	40°C	50°C	60°C	70°C	85°C
<b>Chip* — 60/250V</b>									
<b>TCF250</b>									
TCF250-120T	0.186	0.165	0.143	0.120	0.099	0.088	0.077	0.066	0.050
TCF250-145T	0.225	0.199	0.172	0.145	0.119	0.106	0.093	0.080	0.060
TCF250-180**	0.269	0.240	0.211	0.180	0.153	0.138	0.123	0.109	0.087
<b>Radial-leaded* — 60/250V</b>									
<b>TRF250</b>									
TRF250-080U	0.124	0.110	0.095	0.080	0.066	0.059	0.051	0.044	0.033
TRF250-110U	0.171	0.151	0.131	0.110	0.091	0.081	0.071	0.061	0.046
TRF250-120	0.186	0.165	0.143	0.120	0.099	0.088	0.077	0.066	0.050
TRF250-145	0.225	0.199	0.172	0.145	0.119	0.106	0.093	0.080	0.060
TRF250-180**	0.279	0.247	0.213	0.180	0.147	0.131	0.115	0.099	0.074
TRF250-180US**	0.279	0.247	0.213	0.180	0.147	0.131	0.115	0.099	0.074
<b>NEW</b> TRF250-183**	0.284	0.251	0.217	0.183	0.149	0.133	0.117	0.101	0.075
<b>Surface† — 80/250V</b>									
<b>TSL250</b>									
TSL250-080F	0.124	0.110	0.095	0.080	0.066	0.059	0.051	0.044	0.033
<b>Surface* — 60/250V</b>									
<b>TS250/TSV250</b>									
TS250-130F	0.208	0.182	0.156	0.130	0.104	0.091	0.078	0.065	0.045
TSV250-130F	0.208	0.182	0.156	0.130	0.104	0.091	0.078	0.065	0.045
<b>Radial-leaded‡ — 60/600V</b>									
<b>TRF600</b>									
TRF600-150	0.233	0.206	0.178	0.150	0.124	0.110	0.096	0.083	0.062
TRF600-160	0.249	0.219	0.190	0.160	0.132	0.117	0.103	0.088	0.066
<b>Surface‡ — 60/600V</b>									
<b>TSM600/TSM600</b>									
TSM600-170F	0.264	0.230	0.200	0.170	0.140	0.125	0.109	0.094	0.070
TSM600-200F-RA-B-0.5	0.310	0.275	0.238	0.200	0.165	0.147	0.128	0.110	0.083
TSM600-250F	0.400	0.350	0.300	0.250	0.198	0.170	0.140	0.117	0.083
TSM600-250F-RA	0.400	0.350	0.300	0.250	0.198	0.170	0.140	0.117	0.083
TSM600-400F	0.640	0.560	0.480	0.400	0.320	0.270	0.230	0.190	0.130

\* 60/250V products are designed to help equipment pass ITU recommendations (K.20, K.21, etc) and Telcordia GR-1089 Intra-building power cross.

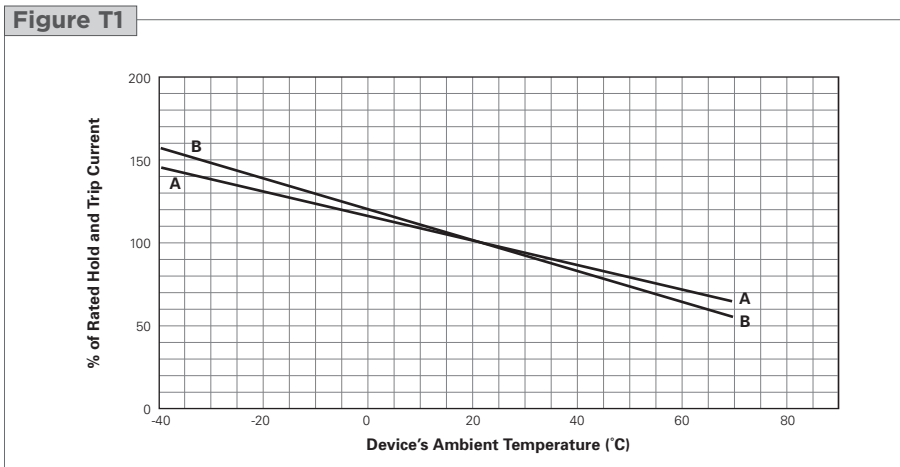
† 80/250V products are designed to help equipment pass Telcordia GR-1089 Intra-building power cross (120V<sub>AC</sub>/25A).

‡ 60/600V products are designed to help equipment pass UL60950, TIA-968-A (formerly FCC Part 68) and GR1089 specifications.

\*\* Product is not currently available in a resistance matched or sorted option.

**Figure T1 Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]**

- A = TCF250-180
- B = All other TCF, TRF, TSx, TSM series devices



**Table T3 Electrical Characteristics for Telecommunications and Networking Devices**

Part Number	I <sub>H</sub> (A)	I <sub>T</sub> (A)	V <sub>Max</sub> Operating (V <sub>DC</sub> )	V <sub>Max</sub> Interrupt (V <sub>RMS</sub> )	I <sub>Max</sub> (A)	P <sub>D</sub> TYP (W)	Time-to-trip (s)		R <sub>Min</sub> (Ω)	R <sub>Max</sub> (Ω)	R <sub>1</sub> Max (Ω)
							(A)	(s)			
<b>Chip* — 60/250V</b>											
<b>TCF250</b>											
TCF250-120T	0.120	0.240	60	250	3.0	1.0	1.0	1.20 max	6.3	12.0	18.0
TCF250-145T	0.145	0.290	60	250	3.0	1.0	1.0	1.50 nom	5.0	9.0	14.0
TCF250-180**	0.180	0.650	60	250	3.0	0.8	1.0	15.50 nom	1.0	2.2	4.0
<b>Radial-leaded* — 60/250V</b>											
<b>TRF250</b>											
TRF250-080T	0.080	0.160	60	250	3.0	0.6	0.35	4.00 max	15.0	22.0	33.0
TRF250-080U	0.080	0.160	60	250	3.0	0.6	0.35	4.00 max	14.0	20.0	33.0
TRF250-110U	0.110	0.220	60	250	3.0	1.0	1.00	0.75 nom	5.0	9.0	16.0
TRF250-120	0.120	0.240	60	250	3.0	1.0	1.00	1.50 nom	4.0	8.0	16.0
TRF250-120T	0.120	0.240	60	250	3.0	1.0	0.35	0.70 nom	7.0	12.0	16.0
TRF250-120T-RA	0.120	0.240	60	250	3.0	1.0	1.00	1.20 nom	7.0	9.0	16.0
TRF250-120T-RC	0.130	0.260	60	250	3.0	1.0	1.00	3.00 nom	5.4	7.5	14.0
TRF250-120T-RF	0.120	0.240	60	250	3.0	1.0	1.00	0.90 nom	6.0	10.5	16.0
TRF250-120T-R1	0.120	0.240	60	250	3.0	1.0	1.00	1.00 nom	6.0	9.0	16.0
TRF250-120T-R2	0.120	0.240	60	250	3.0	1.0	1.00	0.75 nom	8.0	10.5	16.0
TRF250-120U	0.120	0.240	60	250	3.0	1.0	1.00	1.00 nom	6.0	10.0	16.0
TRF250-120UT	0.120	0.240	60	250	3.0	1.0	1.00	0.70 nom	7.0	12.0	16.0
TRF250-145	0.145	0.290	60	250	3.0	1.0	1.00	2.50 nom	3.0	6.0	14.0
TRF250-145-RA	0.145	0.290	60	250	3.0	1.0	1.00	2.50 nom	3.0	5.5	12.0
TRF250-145-RB	0.145	0.290	60	250	3.0	1.0	1.00	2.00 nom	4.5	6.0	14.0
TRF250-145T	0.145	0.290	60	250	3.0	1.0	1.00	1.50 nom	5.4	7.5	14.0
TRF250-145U	0.145	0.290	60	250	3.0	1.0	1.00	2.00 nom	3.5	6.5	14.0
TRF250-180**	0.180	0.650	100	250	10.0	1.5	3.00	0.50 nom	0.8	2.2	4.0
TRF250-180US**	0.180	0.650	100	250	10.0	1.4	3.00	0.50 nom/2.0 max	0.8	2.2	4.0
<b>NEW</b> TRF250-183**	0.183	0.685	100	250	10.0	0.9	3.00	0.55 nom/1.8 max	0.8	2.2	3.4
<b>Surface† — 80/250V</b>											
<b>TSL250</b>											
TSL250-080F	0.080	0.160	80	250	3.0	1.2	1.0	0.80 nom	5.0	11.0	20.0
<b>Surface* — 60/250V</b>											
<b>TS250/TSV250</b>											
TS250-130F	0.130	0.260	60	250	3.0	1.1	1.0	0.90 nom	6.5	12.0	20.0
	—	—	60	600	1.0	—	—	—	—	—	—
TS250-130F-RA	0.130	0.260	60	250	3.0	1.1	1.0	1.40 nom	6.5	9.0	15.0
	—	—	60	600	1.0	—	—	—	—	—	—
TS250-130F-RB	0.130	0.260	60	250	3.0	1.1	1.0	0.70 nom	9.0	12.0	20.0
	—	—	60	600	1.0	—	—	—	—	—	—
TS250-130F-RC	0.130	0.260	60	250	3.0	1.1	1.0	1.10 nom	7.0	10.0	17.0
	—	—	60	600	1.0	—	—	—	—	—	—
TSV250-130F	0.130	0.260	60	250	3.0	1.5	1.0	2.00 nom	4.0	7.0	12.0††
<b>Radial-leaded‡ — 60/600V</b>											
<b>TRF600</b>											
TRF600-150	0.150	0.300	250	600	3.0	1.0	1.0	1.40 nom	6.0	10.0	17.0
TRF600-150-RB	0.130	0.260	250	600	3.0	1.0	1.0	1.00 nom	9.0	12.0	22.0
TRF600-160	0.160	0.320	250	600	3.0	1.0	1.0	7.50 nom	4.0	10.0	18.0
TRF600-160-RA	0.160	0.320	250	600	3.0	1.0	1.0	9.50 nom	4.0	7.0	16.0
TRF600-160-R1	0.160	0.320	250	600	3.0	1.0	1.0	9.00 nom	4.0	8.0	17.0
<b>Surface‡ — 60/600V</b>											
<b>TSM600/TSM600</b>											
TS600-170F	0.170	0.400	60	600	3.0	2.5	1.0	10.00 nom	4.0	9.0	18.0
TS600-200F-RA-B-0.5	0.200	0.400	60	600	3.0	2.5	1.0	12.00 nom	4.0	7.5	13.5
TSM600-250F	0.250	0.860	250	600	3.0	2.0	3.0	0.80 nom	1.0	3.5	7.0
TSM600-250F-RA	0.250	0.860	250	600	3.0	2.0	3.0	1.00 nom	1.0	3.0	5.0
TSM600-400F	0.400	1.000	250	600	3.0	2.0	3.0	5.0 nom/14.0 max	0.5	1.5	2.0

**Notes:**

- I<sub>H</sub> : Hold current: maximum current device will pass without interruption in 20°C still air.
- I<sub>T</sub> : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.
- V<sub>Max</sub> Interrupt : Maximum voltage that can be safely placed across a device in its tripped state under specified fault conditions.
- I<sub>Max</sub> : Maximum fault current device can withstand without damage at rated voltage.
- P<sub>D</sub> : Power dissipated from device when in the tripped state in 20°C still air.
- R<sub>Min</sub> : Maximum resistance of device as supplied at 20°C unless otherwise specified.
- R<sub>1</sub>Max : Measured one hour post-trip or post-reflow at 20°C.

\* 60/250V products are designed to help equipment pass ITU recommendations (K.20, K.21, etc) and Telcordia GR-1089 Intra-building power cross.

† 80/250V products are designed to help equipment pass Telcordia GR-1089 Intra-building power cross (120V<sub>AC</sub>/25A).

‡ 60/600V products are designed to help equipment pass UL60950, TIA-968-A (formerly FCC Part 68) and GR1089 specifications.

\*\* Product is not currently available in a resistance matched or sorted option.

†† R<sub>1</sub>Max measured 1 hour post-trip, or 24 hours post-reflow at 20°C.

Figure T2

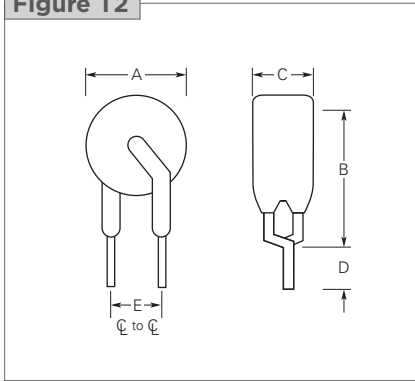


Figure T3

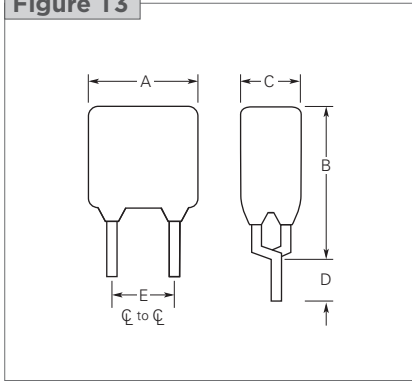


Figure T4

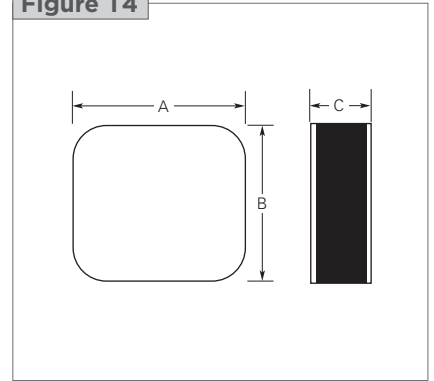


Figure T5

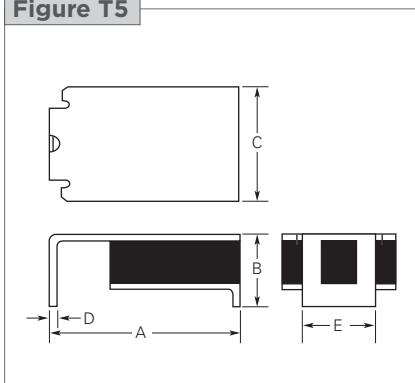


Figure T6

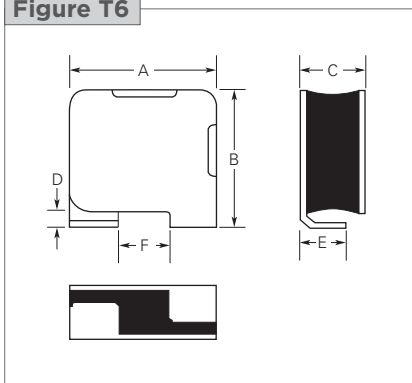


Figure T7

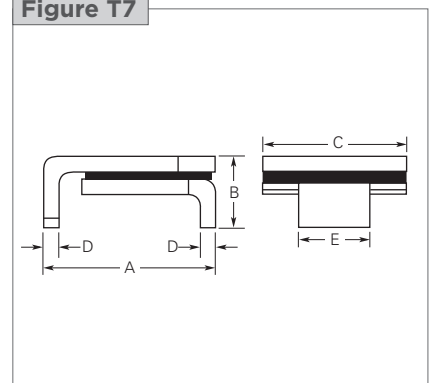


Figure T8

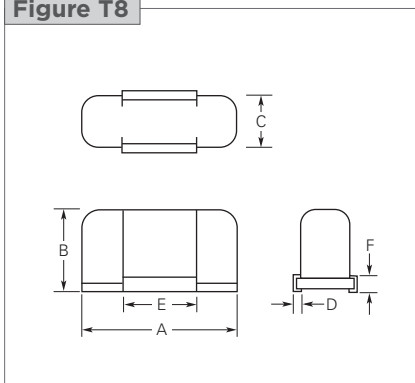


Figure T9

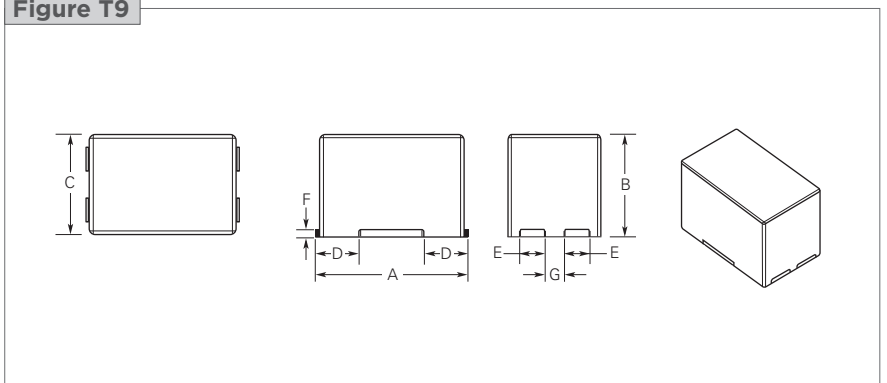


Figure T10

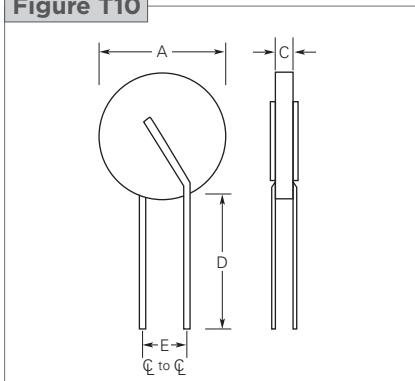


Figure T11

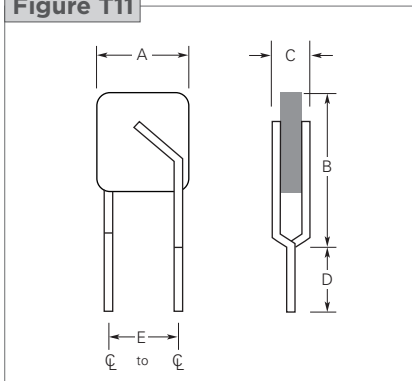
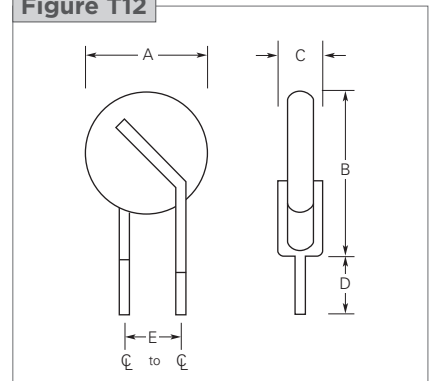


Figure T12



**Table T4 Dimensions for Telecommunications and Networking Devices in Millimeters (Inches)**

Part Number	A		B		C		D		E		F		G		Figure
	min	max	min	max	min	max	min	max	min	max	min	max	min	max	
<b>TCF 60/250V*</b>															
TCF250-120T	5.4 (0.213)	5.6 (0.221)	5.4 (0.213)	5.6 (0.221)	2.0 (0.079)	2.3 (0.091)	—	—	—	—	—	—	—	—	T4
TCF250-145T	5.4 (0.213)	5.6 (0.221)	5.4 (0.213)	5.6 (0.221)	2.0 (0.080)	2.5 (0.100)	—	—	—	—	—	—	—	—	T4
TCF250-180	6.9 (0.270)	7.1 (0.280)	6.9 (0.270)	7.1 (0.280)	1.3 (0.050)	1.6 (0.060)	—	—	—	—	—	—	—	—	T4
<b>TRF250 60/250V*</b>															
TRF250-080T	—	5.8 (0.228)	—	9.9 (0.390)	—	4.6 (0.181)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T2
TRF250-080U	—	4.8 (0.189)	—	9.3 (0.366)	—	3.8 (0.150)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T12
TRF250-110U	—	5.33 (0.210)	—	9.4 (0.370)	—	3.8 (0.150)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T12
TRF250-120	—	6.5 (0.256)	—	11.0 (0.433)	—	4.6 (0.181)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T3
TRF250-120U	—	6.0 (0.236)	—	10.0 (0.394)	—	3.8 (0.150)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T11
TRF250-145	—	6.5 (0.256)	—	11.0 (0.433)	—	4.6 (0.181)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T3
TRF250-145U	—	6.0 (0.236)	—	10.0 (0.394)	—	3.8 (0.150)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T11
TRF250-180	—	9.0 (0.354)	—	12.0 (0.412)	—	3.8 (0.150)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T2
TRF250-180US	—	8.1 (0.319)	—	—	—	3.0 (0.118)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T10
<b>NEW</b> TRF250-183	—	7.5 (0.290)	—	10.5 (0.410)	—	4.1 (0.160)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T2
<b>TSL250 80/250V†</b>															
TSL250-080F	6.7 (0.265)	7.9 (0.310)	2.7 (0.110)	3.7 (0.145)	4.8 (0.190)	5.3 (0.210)	0.2 (0.008)	0.4 (0.015)	2.5 (0.100)	3.1 (0.120)	—	—	—	—	T7
<b>TS250/TSV250 60/250V*</b>															
TS250-130F	8.5 (0.335)	9.4 (0.370)	—	3.4 (0.135)	—	7.4 (0.290)	0.3** (0.011)	—	3.8** (0.150)	—	—	—	—	—	T5
TSV250-130F	—	6.1 (0.240)	—	6.9 (0.270)	—	3.2 (0.126)	0.56 (0.022)	—	—	1.9 (0.075)	1.6 (0.065)	2.3 (0.091)	—	—	T6
<b>TRF600 60/600V‡</b>															
TRF600-150	—	9.0 (0.354)	—	12.5 (0.492)	—	4.6 (0.180)	4.7 (0.185)	—	5.0 (0.197)	—	—	9.0 (0.354)	—	—	T3
TRF600-160	—	16.0 (0.630)	—	12.6 (0.496)	—	6.0 (0.236)	4.7 (0.185)	—	5.0** (0.197)	—	—	10.0 (0.394)	—	—	T3
<b>TS600/TSM600 60/600V‡</b>															
TS600-170F	18.29 (0.720)	19.43 (0.765)	11.56 (0.455)	12.32 (0.485)	7.24 (0.285)	8.26 (0.325)	1.65 (0.065)	2.41 (0.095)	9.91 (0.390)	10.41 (0.410)	1.52 (0.060)	2.29 (0.090)	—	—	T8
TS600-200F-RA	18.29 (0.720)	19.43 (0.765)	11.56 (0.455)	12.32 (0.485)	7.24 (0.285)	8.26 (0.325)	1.65 (0.065)	2.41 (0.095)	9.91 (0.390)	10.41 (0.410)	1.52 (0.060)	2.29 (0.090)	—	—	T8
TSM600-250F	17.00 (0.671)	17.60 (0.690)	11.20 (0.440)	11.70 (0.460)	10.40 (0.410)	11.20 (0.440)	4.80 (0.187)	5.20 (0.203)	2.50 (0.099)	2.80 (0.111)	0.60 (0.022)	1.0 (0.038)	2.2 (0.087)	3.1 (0.122)	T9
TSM600-250F-RA	17.00 (0.671)	17.60 (0.690)	11.20 (0.440)	11.70 (0.460)	10.40 (0.410)	11.20 (0.440)	4.80 (0.187)	5.20 (0.203)	2.50 (0.099)	2.80 (0.111)	0.60 (0.022)	1.0 (0.038)	2.2 (0.087)	3.1 (0.122)	T9
TSM600-400F	17.00 (0.671)	17.60 (0.690)	11.20 (0.440)	11.70 (0.460)	10.40 (0.410)	11.20 (0.440)	4.80 (0.187)	5.20 (0.203)	2.50 (0.099)	2.80 (0.111)	0.60 (0.022)	1.0 (0.038)	2.2 (0.087)	3.1 (0.122)	T9

\* 60/250V products are designed to help equipment pass ITU specifications (K.20, K.21, etc) and Telcordia GR-1089 Intrabuilding power cross.

† 80/250V product designed to help equipment pass Telcordia GR-1089 Intrabuilding power cross (120V<sub>ac</sub>/25A).

‡ 60/600V products are designed to help equipment pass UL 60950, TIA-968-A (formerly FCC Part 68) and Telcordia GR-1089 specification.

\*\* Indicates dimension is typical, not minimum.

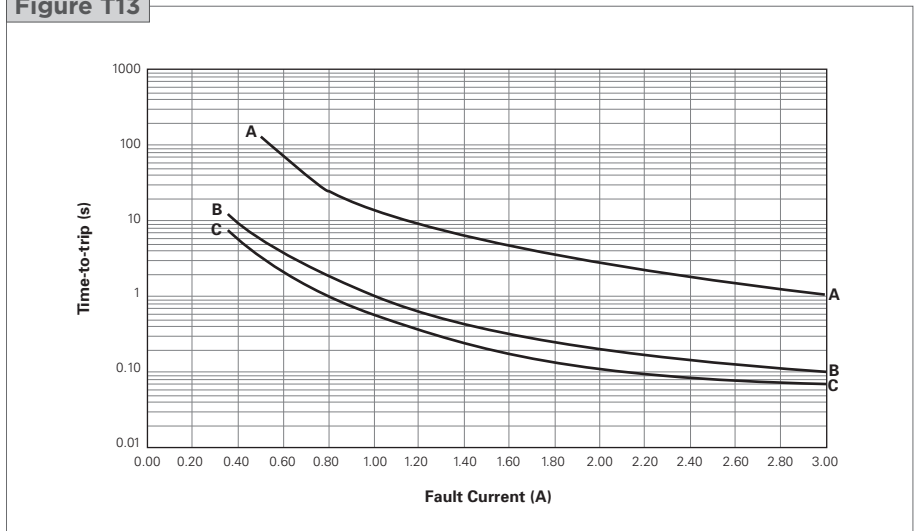


**Figure T13-T16** Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices

**TCF250**

- A = TCF250-180
- B = TCF250-145T
- C = TCF250-120T

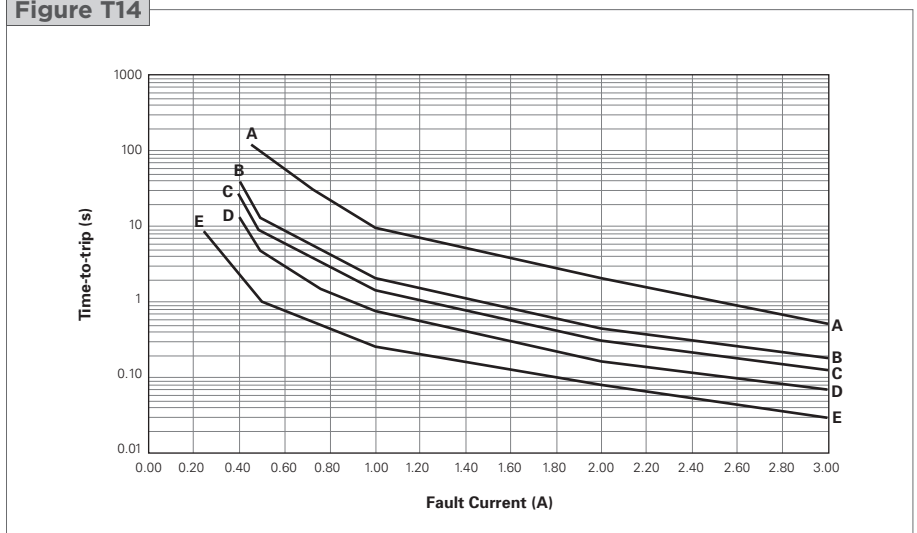
**Figure T13**



**TRF250**

- A = TRF250-180/183
- B = TRF250-145/145U
- C = TRF250-120/120U
- D = TRF250-110U/120UT/120T
- E = TRF250-080T/080U/080US

**Figure T14**



**TS250/TSV250/TSL250**

- A = TSV250-130F
- B = TS250-130F
- C = TSL250-080F

**Figure T15**

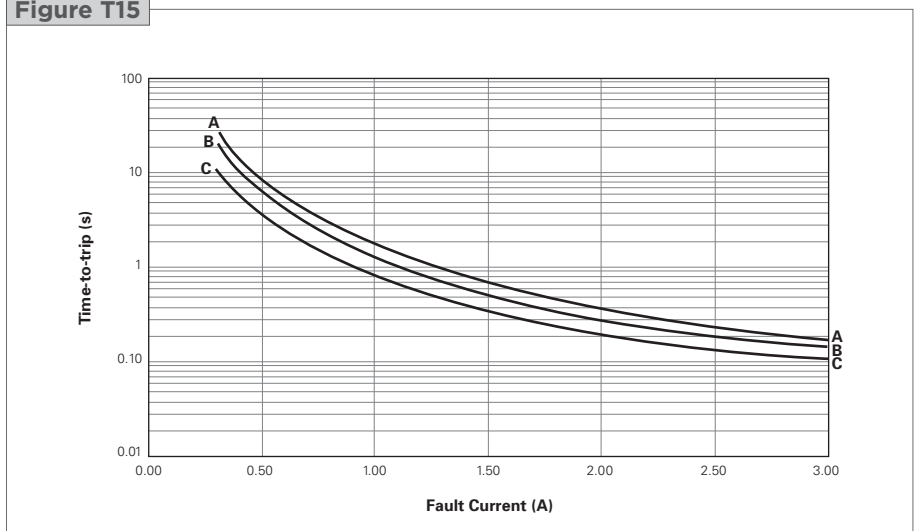


Figure T13-T16

## Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices

... Cont'd

**TRF600/TS600/TSM600**

- A = TSM600-250F
- B = TS600-170F/200F
- C = TRF600-160
- D = TRF600-150
- E = TSM600-400F

Figure T16

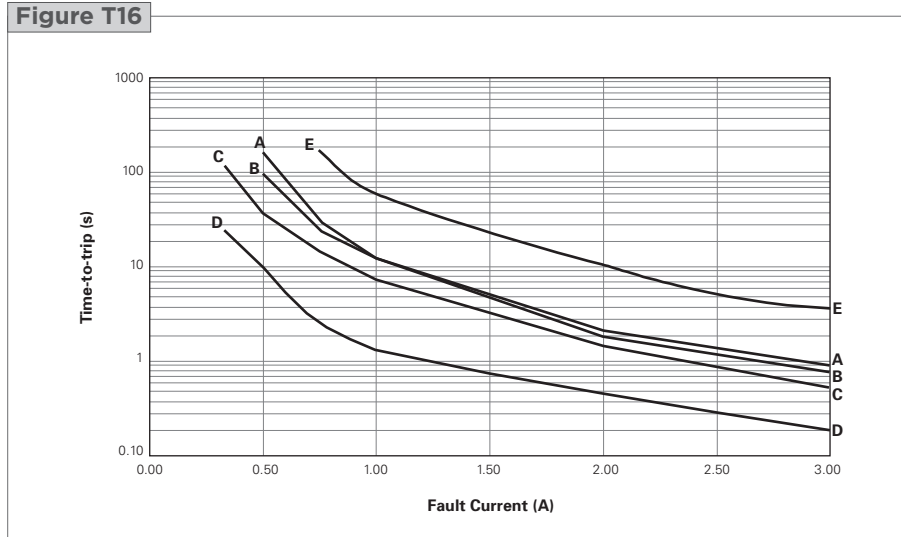


Table T5

## Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices

(Operating temperature range for all listed products is -40°C to 85°C)

**TCF250\***
**Physical Characteristics**

Terminal material	Nickel foil
-------------------	-------------

**Environmental Specifications**

Test	Conditions
Passive aging	60°C, 1000 hours
	85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
Thermal shock	125°C, -55°C (10 times)
Solvent resistance	MIL-STD-202, Method 215F

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**TRF250\***
**Physical Characteristics**

Lead material	Tin plated copper, 22AWG
Insulating material	Cured epoxy polymer
Flammability	per IEC 695-2-2 Needle Flame Test for 20s
Soldering characteristics	ANSI/J-STD-002, Category 3
Solder heat withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: can withstand 10 seconds at 260°C±5°C

**Note:** Devices are not designed to be placed through a reflow process.

**Environmental Specifications**

Test	Conditions
Passive aging	60°C, 1000 hours
	85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
Thermal shock	125°C, -55°C (10 times)
Solvent resistance	MIL-STD-202, Method 215F

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

(Operating temperature range for all listed products is -40°C to 85°C)

**TS250\*/TSV250\*/TSL250†**

**Physical Characteristics**

Terminal material	Tin plated brass, Nickel under plating
Soldering characteristics	EIC 60008-2-58

**Environmental Specifications**

Test	Conditions
Passive aging	60°C, 1000 hours
	85°C, 1000 hours
Humidity aging	85°C, 85% RH, 500 hours
Thermal shock	125°C, -55°C (10 times)
Solvent resistance	MIL-STD-202, Method 215F

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**TRF600‡**

**Physical Characteristics**

Lead material	Tin plated copper, 22AWG
Insulating material	Cured epoxy polymer**
Flammability	per IEC 695-2-2 Needle flame test for 20s
Soldering characteristics	ANSI/J-STD-002, Category 3
Solder heat withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: can withstand 10 seconds at 260°C±5°C

**Note:** Devices are not designed to be placed through a reflow process. Contact Raychem Circuit Protection product representative for TR600 series devices that are compatible with this process.

**Environmental Specifications**

Test	Conditions
Passive aging	60°C, 1000 hours
	85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
Thermal shock	125°C, -55°C (10 times)
Solvent resistance	MIL-STD-202, Method 215F

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**TS600‡**

**Physical Characteristics**

Terminal material	Tin-plated brass
Insulating material	Nylon resin (UL94V-0), 1000V dielectric rating
Flammability	IEC 695-2-2 Needle Flame Test for 20s
Soldering characteristics	ANSI/J-STD-002, Category 3
Solder heat withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A

**Environmental Specifications**

Test	Conditions
Passive aging	60°C, 1000 hours
	85°C, 1000 hours
Humidity aging	85°C, 85% RH, 1000 hours
Thermal shock	125°C, -55°C (10 times)
Solvent resistance	MIL-STD-202, Method 215F

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

**Table T5 Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices**

... Cont'd

(Operating temperature range for all listed products is -40°C to 85°C)

**TSM600†**
**Physical Characteristics**

Terminal material	Tin-plated brass
Insulating material	Nylon resin (UL94V-0), 1000V dielectric rating
Flammability	IEC 695-2-2 Needle Flame Test for 20s
Soldering characteristics	ANSI/J-STD-002, Category 3
Solder heat withstand	IEC-STD 68-2-20, Test Tb, Section 5 Method 1A

**Environmental Specifications**

Test	Conditions
Lead material	Tin-plated brass
Case material	Nylon resin (UL94 V-0), 1000 V dielectric rating
Lead solderability	IEC 60068-2-58, Method 7
Solder heat withstand	IEC-STD 68-2-20, Test Tb, Section 5, Method 1A
Solvent resistance	MIL-STD-202, Method 215J
Flammability rating	IEC 695-2-2 Needle Flame Test for 20s
Storage humidity	Per IPC/JEDEC J-STD-020A Level 2a

**Note:** Storage conditions: 40°C max., 70% RH max., devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

\* 60/250V products are designed to help equipment pass ITU recommendations (K.20, K.21, etc) and Telcordia GR-1089 Intra-building power cross.

 † 80/250V product designed to help equipment pass Telcordia GR-1089 Intra-building power cross (120V<sub>AC</sub>/25A).

‡ 60/600V products are designed to help equipment pass UL 60950, TIA-968-A (formerly FCC Part 68) and Telcordia GR-1089 specification.

\*\* Excluding TRF600-150

**Table T6 Packaging and Marking Information for Telecommunications and Networking Devices**

Part Number	Bag Quantity	Tape & Reel Quantity	Standard Package Quantity	Part Marking	Agency Recognition
<b>Chip* — 60/250V</b>					
<b>TCF250</b>					
TCF250-120T	2,500	—	10,000	—	—
TCF250-145T	2,500	—	10,000	—	—
TCF250-180	2,500	—	10,000	—	UL
<b>Radial-leaded* — 60/250V</b>					
<b>TRF250</b>					
TRF250-080U	500	—	10,000	—	UL, CSA, TÜV
TRF250-080U-2	—	1,500	7,500	—	UL, CSA, TÜV
TRF250-080T	500	—	10,000	08F	UL, CSA, TÜV
TRF250-110U	500	—	10,000	—	UL, CSA, TÜV
TRF250-110U-2	—	1,500	7,500	—	UL, CSA, TÜV
TRF250-120	500	—	10,000	20F	UL, CSA, TÜV
TRF250-120-2	—	1,500	7,500	20F	UL, CSA, TÜV
TRF250-120T	500	—	10,000	20F	UL, CSA, TÜV
TRF250-120T-2	—	1,500	7,500	20F	UL, CSA, TÜV
TRF250-120U	500	—	10,000	20F	UL, CSA, TÜV
TRF250-120U-2	—	1,500	7,500	20F	UL, CSA, TÜV
TRF250-120UT	500	—	10,000	20F	UL, CSA, TÜV
TRF250-145	500	—	10,000	45F	UL, CSA, TÜV
TRF250-145-2	—	1,500	7,500	45F	UL, CSA, TÜV
TRF250-145-RA	500	—	10,000	45F	UL, CSA, TÜV
TRF250-145U	500	—	10,000	45F	UL, CSA, TÜV
TRF250-145U-2	—	1,500	7,500	45F	UL, CSA, TÜV
TRF250-180	500	—	10,000	80F	UL, CSA, TÜV
TRF250-180-2	—	1,500	7,500	80F	UL, CSA, TÜV
TRF250-180US	500	—	10,000	—	UL, CSA, TÜV
<b>NEW</b> TRF250-183	500	—	10,000	83F	UL, CSA, TÜV
<b>NEW</b> TRF250-183-2	—	1,500	7,500	83F	UL, CSA, TÜV

RoHS compliant, ELV compliant

**Table T6 Packaging and Marking Information for Telecommunications and Networking Devices ... Cont'd**

Part Number	Bag Quantity	Tape & Reel Quantity	Standard Pack Quantity	Part Marking	Agency Recognition
<b>Surface† — 80/250V</b>					
<b>TSL250</b>					
TSL250-080F-2	—	1,500	7,500	T08	UL, CSA, TÜV
<b>Surface* — 60/250V</b>					
<b>TS250/TSV250</b>					
TS250-130F-2	—	1,500	7,500	T13	UL, CSA, TÜV
TSV250-130F-2	—	1,200	6,000	T13V	UL, CSA, TÜV
<b>Radial-leaded‡ — 60/600V</b>					
<b>TRF600</b>					
TRF600-150	500	—	10,000	150F	UL, CSA, TÜV
TRF600-150-2	—	1,500	7,500	150F	UL, CSA, TÜV
TRF600-160	500	—	10,000	160F	UL, CSA, TÜV
TRF600-160-2	—	600	3,000	160F	UL, CSA, TÜV
<b>Surface‡ — 60/600V</b>					
<b>TS600/TSM600</b>					
TS600-170F-2	—	300	900	T20	UL, CSA
TS600-200F-RA-2	—	300	900	T20	UL, CSA
TSM600-250F-2	—	200	1,000	TSM600	UL, CSA
TSM600-250F-RA-2	—	200	1,000	TSM600	UL, CSA
TSM600-400F-2	—	200	1,000	TSM600	UL

\* 60/250V products are designed to help equipment pass ITU recommendations (K.20, K.21, etc) and Telcordia GR-1089 Intra-building power cross.

† 80/250V product designed to help equipment pass Telcordia GR-1089 Intra-building power cross (120V<sub>AC</sub>/25A).

‡ 60/600V products are designed to help equipment pass UL 60950, TIA-968-A (formerly FCC Part 68) and Telcordia GR-1089 specifications.

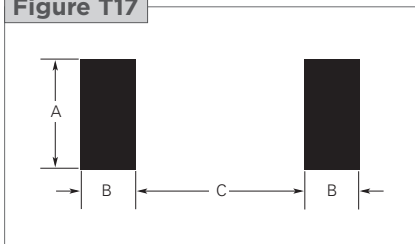
**Agency Recognition for Telecommunications and Networking Devices**

UL	File # E74889	
CSA	File #78165C	
TÜV	Per IEC60730-1	Certificate # for individual products available upon request.

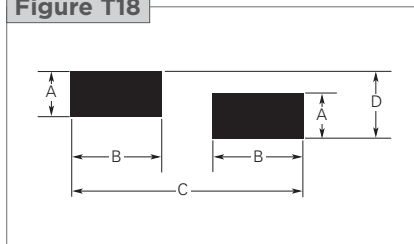
**Table T7 Recommended Pad Layouts for Surface-mount Telecommunications and Networking Devices in millimeters (inches) Nominal**

Device	A	B	C	D	E	F	G	Figure
TS250 (All)	4.60 (0.180)	1.80 (0.070)	6.10 (0.240)	—	—	—	—	T17
TSV250-130F	2.29 (0.090)	2.41 (0.095)	6.35 (0.250)	3.43 (0.135)	—	—	—	T18
TSL250-080F	3.60 (0.140)	1.80 (0.070)	5.50 (0.220)	—	—	—	—	T17
TS600 (All)	10.42 (0.410)	3.30 (0.130)	3.35 (0.132)	—	—	—	—	T17
TSM600	5.20 (0.205)	17.80 (0.701)	5.54 (0.218)	6.75 (0.266)	2.08 (0.082)	3.12 (0.123)	8.39 (0.331)	T19

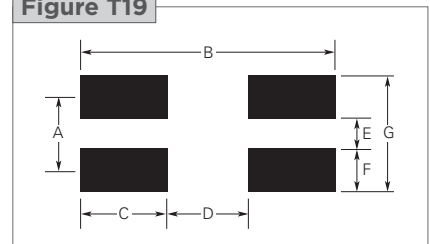
**Figure T17**



**Figure T18**



**Figure T19**



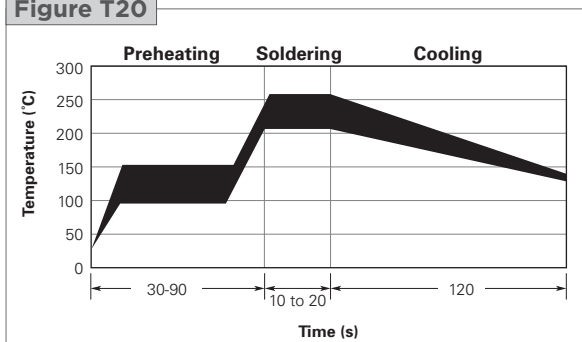
## Solder Reflow and Rework Recommendations for Telecommunications Surface-mount Devices

### Solder Reflow

- Recommended reflow methods: IR, vapor phase oven, hot air oven.
- Surface-mount devices are not designed to be wave soldered to the bottom side of the board.
- Recommended maximum paste thickness of 0.25mm (0.010 in).
- Devices can be cleaned using standard industry methods and solvents.

### Rework

- If a device is removed from the board, it should be discarded and replaced with a new device.

**Figure T20**


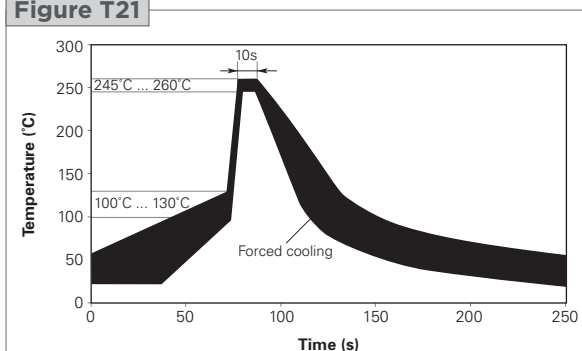
## Wave Soldering and Rework Recommendations for Telecommunications Radial-leaded Devices

### Recommended Wave Soldering

- Soldering temperature profile  
Temperature characteristic at component terminal with dual wave soldering

### Rework

- If a device is removed from the board, it should be discarded and replaced with a new device.

**Figure T21**

**Table T8 TRF250/TRF600 Tape and Reel Specifications for Telecommunications and Networking Device**

TRF250/TRF600 devices are available in tape and reel packaging per EIA 468-B standard. See Figures T22 and T23 for details.

Dimension Description	EIA Mark	IEC Mark	Dimension (mm)	Tolerance
Carrier tape width	W	W	18	-0.5/+1.0
Hold down tape width	W <sub>4</sub>	W <sub>0</sub>	5	Minimum
Top distance between tape edges	W <sub>6</sub>	W <sub>2</sub>	3	Maximum
Sprocket hole position	W <sub>5</sub>	W <sub>1</sub>	9	-0.5/+0.75
Sprocket hole diameter	D <sub>0</sub>	D <sub>0</sub>	4	±0.2
Abcissa to plane (straight lead)	H	H	18.5	±3.0
Abcissa to plane (kinked lead)*	H <sub>0</sub>	H <sub>0</sub>	16	-0.5/+0.6
Abcissa to top	H <sub>1</sub>	H <sub>1</sub>	32.2	Maximum
Overall width w/lead protrusion	—	C <sub>1</sub>	43.2	Maximum
Overall width w/o lead protrusion	—	C <sub>2</sub>	42.5	Maximum
Lead protrusion	L <sub>1</sub>	I <sub>1</sub>	1.0	Maximum
Protrusion of cut-out	L	L	11	Maximum
Protrusion beyond hold down tape	I <sub>2</sub>	I <sub>2</sub>	Not specified	—
Sprocket hole pitch	P <sub>0</sub>	P <sub>0</sub>	12.7	±0.3
Device pitch: TRF250	—	—	12.7	—
Device pitch: TRF600	—	—	25.4	—
Pitch tolerance	—	—	20 consecutive	±1
Tape thickness	t	t	0.9	Maximum
Tape thickness with splice*	t <sub>1</sub>	—	2.0	Maximum
Splice sprocket hole alignment	—	—	0	±0.3
Body lateral deviation	Δh	Δh	0	±1.0
Body tape plane deviation	Δp	Δp	0	±1.3
Lead spacing plane deviation	ΔP <sub>1</sub>	P <sub>1</sub>	0	±0.7
Lead spacing*	F	F	5.08	±0.6

**Table T8 TRF250/TRF600 Tape and Reel Specifications for Telecommunications and Networking Device**

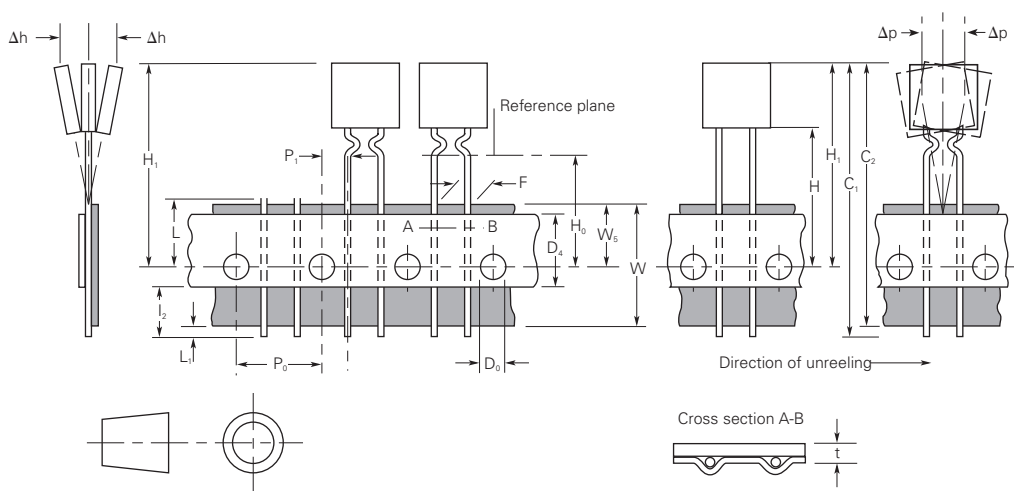
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TRF250/TRF600 devices are available in tape and reel packaging per EIA 468-B standard. See Figures T22 and T23 for details.

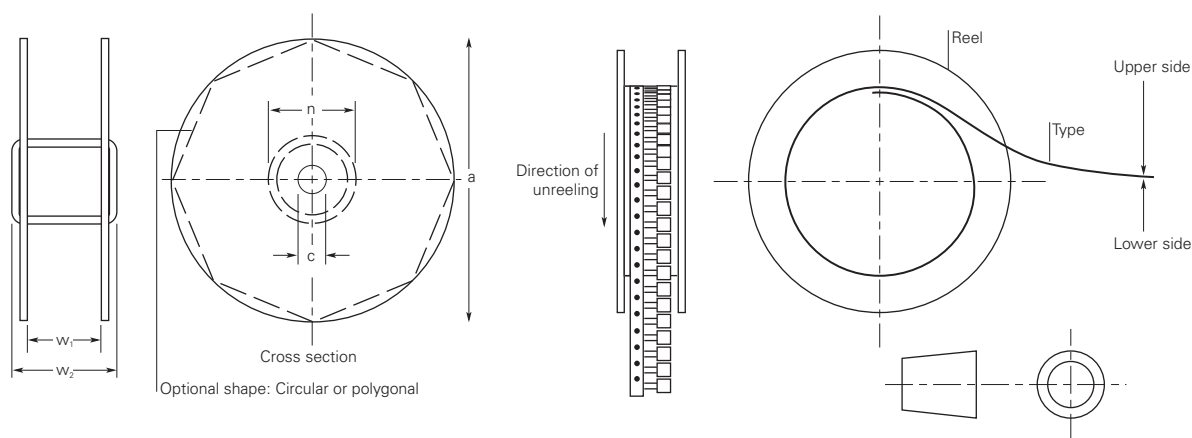
Dimension Description	EIA Mark	IEC Mark	Dimension (mm)	Tolerance
Reel width	$w_2$	w	56	Maximum
Reel diameter	a	d	370	Maximum
Space between flanges less device	$w_1$	—	4.75	$\pm 3.25$
Arbor hole diameter	c	f	26	$\pm 12.0$
Core diameter	n	h	80	Maximum
Box	—	—	56/372/372	Maximum
Consecutive missing pieces*	—	—	3 maximum	—
Empty places per reel*	—	—	Not specified	—

\* Differs from EIA specification.

**Figure T22 EIA Referenced Taped Component Dimensions for TRF Devices**



**Figure T23 Reel Dimensions for TRF Devices**



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**Table T9 TS Tape and Reel Specifications for Telecommunications and Networking Devices**

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T24 and T25 for details.

TS250/TSL250/TSV250							
Dimension Description	EIA Mark	TS250		TSV250		TSL250	
		Dimension(mm)	Tolerance(mm)	Dimension(mm)	Tolerance(mm)	Dimension(mm)	Tolerance(mm)
Carrier tape width	W	16	±0.30	16.0	±0.3	16	±0.3
Sprocket hole pitch	P <sub>0</sub>	4.0	±0.10	4.0	±0.1	4.0	±0.10
	P <sub>1</sub>	12.0	±0.10	8.0	±0.1	8.0	±0.10
	P <sub>2</sub>	2.0	±0.10	2.0	±0.1	2.0	±0.10
	A <sub>0</sub>	6.9	±0.23	5.5	±0.1	5.5	±0.10
	B <sub>0</sub>	9.6	±0.15	6.2	±0.1	7.9	±0.10
	B <sub>1 MAX.</sub>	12.1	—	8.0	—	9.2	—
Sprocket hole diameter	D <sub>0</sub>	1.5	-0/+0.1	1.55	±0.05	1.55	±0.05
	F	7.5	±0.10	7.5	±0.10	7.5	±0.10
	E <sub>1</sub>	1.75	±0.10	1.75	±0.10	1.75	±0.10
	E <sub>2 MIN.</sub>	14.25	—	—	—	—	—
Tape thickness	T <sub>MAX.</sub>	0.4	—	0.45	—	0.35	—
Tape thickness with splice cover tape thickness	T <sub>1 MAX.</sub>	0.1	—	0.1	—	0.1	—
Reel dimensions	K <sub>0</sub>	3.4	±0.15	7.0	±0.1	3.70	±0.10
	Leader min.	300	—	390	—	390	—
	Trailer min.	300	—	160	—	160	—
Reel diameter	A max.	340	—	340	—	340	—
Core diameter	N min.	50	—	50	—	50	—
Space between flanges less device	W <sub>1</sub>	16.4	-0/+2.0	16.4	-0/+2.0	16.4	-0/+2.0
Reel width	W <sub>2 MAX.</sub>	22.4	—	22.4	—	22.4	—

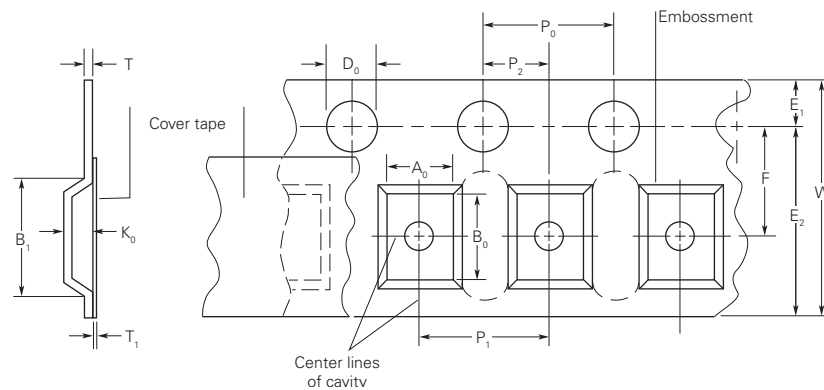
TS600			
Dimension Description	EIA Mark	Dimension (mm)	Tolerance
Carrier tape width	W	32	±0.3
Sprocket hole pitch	P <sub>0</sub>	4.0	±0.1
	P <sub>1</sub>	16	±0.1
	P <sub>2</sub>	2.0	±0.1
	A <sub>0</sub>	10	±0.1
	B <sub>0</sub>	19.2	±0.1
	B <sub>1 max.</sub>	21.6	—
Sprocket hole diameter	D <sub>0</sub>	1.5	-0/+1.0
	F	14.2	±0.1
	E <sub>1</sub>	1.75	±0.1
	E <sub>2 min.</sub>	28.4	±0.1
Tape thickness	T <sub>max.</sub>	0.50	±0.5
Tape thickness with splice	T <sub>1 max.</sub>	0.1	—
Reel Dimensions	K <sub>0</sub>	13.2	±0.1
	Leader min.	390	—
	Trailer min.	160	—
Reel diameter	A max.	360	—
Core diameter	N min.	50	—
Space between flanges less device	W <sub>1</sub>	32.4	-0/+2.0
Reel width	W <sub>2 max.</sub>	40	—



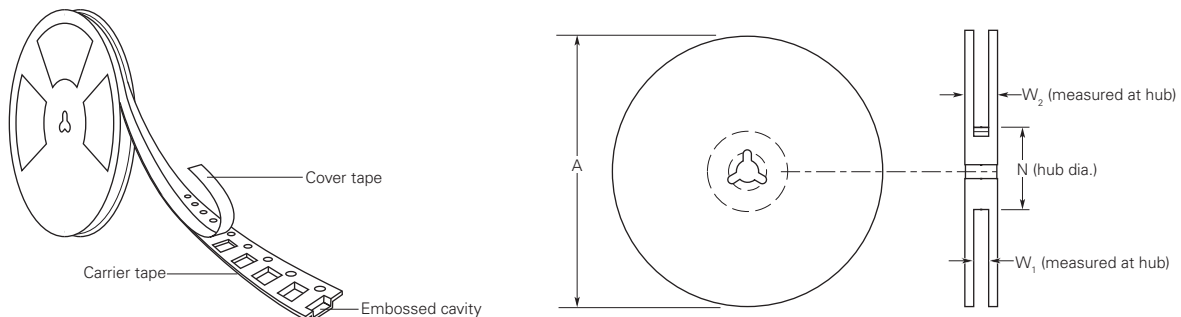
**TSM600**

Dimension Description	EIA Mark	Dimension (mm)	Tolerance
Carrier tape width	W	32	±0.3
Sprocket hole pitch	P <sub>0</sub>	4.0	±0.1
	P <sub>1</sub>	24	±0.1
	P <sub>2</sub>	2.0	±0.1
	A <sub>0</sub>	11.2	±0.1
	B <sub>0</sub>	17.8	±0.1
	B <sub>1 max.</sub>	23.45	
Sprocket hole diameter	D	1.5	-0/+1.0
	F	14.2	±0.1
	E <sub>1</sub>	1.74	±0.1
	E <sub>2 min.</sub>	28.4	±0.1
Tape thickness	T max.	0.5	±0.5
Tape thickness with splice	T <sub>1 max.</sub>	0.1	
	K <sub>0</sub>	11.9	±0.1
	Leader min.	390	
	Trailer min.	160	
<b>Reel Dimensions</b>			
Reel diameter	A max.	360	
Core diameter	N min.	50	
Space between flanges less device	W <sub>1</sub>	32.4	-0/+2.0
Reel width	W <sub>2 max.</sub>	40	

**Figure T24 EIA Referenced Taped Component Dimensions for TS Devices**



**Figure T25 EIA Referenced Reel Dimensions for TS Devices**



## Resistance-sorted and Resistance-matched Devices

Most TCF, TRF and TS devices are available in resistance-sorted and/or resistance-matched versions.

### Resistance-sorted Devices

Resistance-sorted devices (part number suffix “Rx”, where x = 1, 2, A, B, C, F etc.) are supplied with resistance values that are within specified segments of the device’s full range of resistance.

#### Feature

- Narrow resistance range.

#### Benefits

- Greater flexibility for design engineers.
- Lower resistance devices can allow for increased loop length on line card designs.
- Higher resistance devices may provide greater protection by offering faster time-to-trip.

### Resistance-matched Devices

Resistance-matched devices are supplied such that all parts in one particular package (or reel) are within  $0.5\Omega$  of each other ( $1.0\Omega$  for TRF250-080T devices). Individual matched packages are supplied from the full resistance range of the specified device.

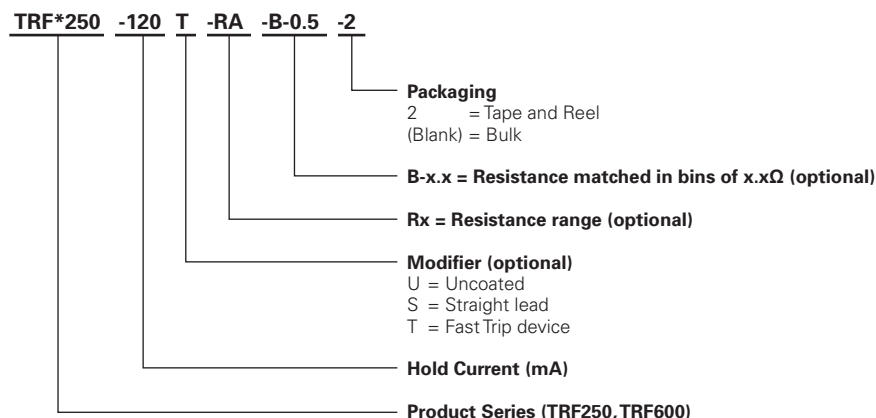
#### Feature

- Tighter resistance balance between any two parts in a package.

#### Benefits

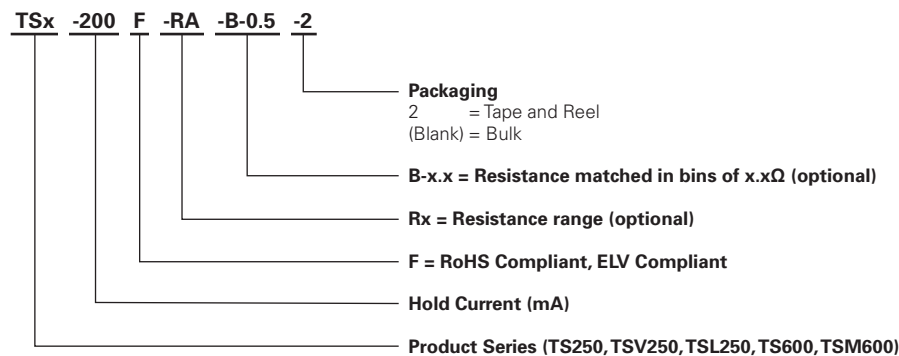
- Resistance-matched devices may reduce the tip-ring resistance differential, reducing the possibility of line imbalance.

## Part Numbering System for Radial-leaded Telecommunications and Networking Devices

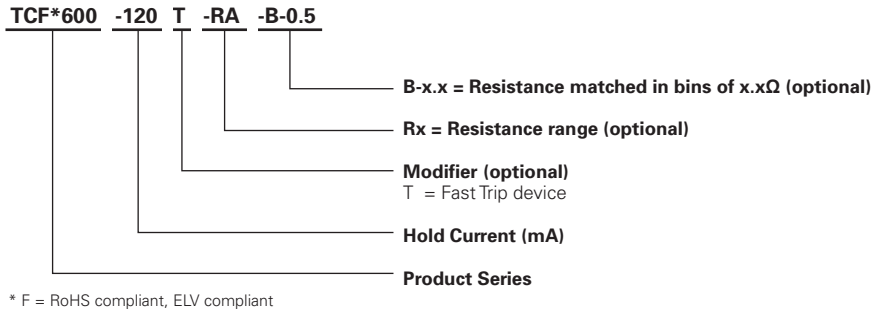


\* F = RoHS compliant, ELV compliant

## Part Numbering System for Surface-mount Telecommunications and Networking Devices



## Part Numbering System for Chip Telecommunications and Networking Devices



### Warning :

- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- The devices are intended for protection against occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicon based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- Operation in circuit with a large inductance can generate a circuit voltage ( $L di/dt$ ) above the rated voltage of the PolySwitch resettable device.