

PolySwitch Resettable Devices

Telecommunications and 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

Target Applications

- | | | |
|----------------------|---------------------------------|----------------------------------|
| • Modems | • PBX systems | • Powered ethernet systems |
| • Phone sets | • MDF modules | • VoIP (Voice over IP equipment) |
| • Fax machines | • Analog and digital line cards | • LAN, WAN equipment |
| • Phone wall outlets | • T1/E1 equipment | • Customer premise equipment |
| • Alarm systems | • xDSL modems and splitters | • 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 your Raychem Circuit Protection representative.

Application	Region/ Specification	Overcurrent Protection			SiBar Thyristor Surge Protectors‡
		Form Factor	Surface-mount	Chip	
		Radial-leaded			
Customer Premises equipment	North America	TRF600-150	TS600-170F		TVBxxxSA-L,
IT equipment	TIA-968-A (formerly FCC Part 68), UL 60950		TS600-200F		TVBxxxSB-L, or TVAxXXSA-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	Europe/Asia/ South America	TRF250-120 TRF250-120T TRF250-145 TRF250-180	TRF250-130F TSV-130F		TVBxxxSA-L TVAxXXSA-L
Access network equipment (†)	North America	TRF600-160	TS600-170F TS600-200F TSM600-250F FT600-1250** TSM600-400F††		TVBxxxSC-L
Remote terminals, line repeaters, multiplexers, cross-connects, WAN equipment	Telcordia GR-1089				
	Europe/Asia/ South America	TRF250-120 TRF250-145 TRF250-120T TRF250-180	TS250-130F TSV250-130F		TVBxxxSA-L TVAxXXSA-L
Central office switching equipment (†)	North America	TRF600-160	TSM600-250F TSM600-170F TSM600-200F FT600-1250** TSM600-400F††		TVBxxxSC-L
Analog/POTS linecards, ISDN linecards, xDSL modems, ADSL/VDSL splitters, T1/E1 linecards, multiplexers, CSU/DSU, servers	Telcordia GR-1089				
	Europe/Asia/ South America	TRF250-120 TRF250-145 TRF250-120T TRF250-180	TS250-130F TSV250-130F		TVBxxxSA-L TVAxXXSA-L
Primary protection modules (†)	North America	TRF250-180			N/A
MDF modules, Network Interface Devices (NID)	Telcordia GR-974				
	Europe/Asia/ South America	TRF250-120T TRF250-145T TRF250-145	TS250-130F TSV250-130F	TCF250-120T	TVBxxxSx-L
Short-haul/intrabuilding communications equipment (†)	North America	TRF250-120	TS250-130F		TVBxxxSA-L
LAN equipment, VoIP cards, cable telephony NIUs, wireless local loop handsets	Telcordia GR-1089	TRF250-145 intrabuilding TRF250-120T	TSL250-080F TSV250-130F		TVAxXXSA-L
	Europe/Asia/ South America	TRF250-120 TRF250-145 TRF250-180	TS250-130F TSV250-130F		TVBxxxSA-L TVAxXXSA-L
LAN intrabuilding power cross protection			TSL250-080F		TVBxxxSA-L TVAxXXSA-L
LAN equipment, VoIP cards, IP phones					
IEEE 802.3 Power over LAN protection			SMD050-2018F		N/A
Powered ethernet switches and terminals, IP phones, wireless LAN base stations, microcellular base stations, VoIP cards					
Cable telephony powering system		BBRF550			N/A
Power passing taps		BBRF750			

Notes: * This list is not exhaustive. Raychem Circuit Protection 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 33.
** FT600-1250 are surface mount Telecom fuse devices. FT600-0500 and FT600-2000 reference also available. See FT600 section on page 85.
†† Helps meet GR-1089 issue 3

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
TCF250	TCF250-145T	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 230V _{AC} , 10Ω
	TCF250-180		ITU K.20/21/45 – 600V _{AC} , 600Ω
	TCF250-120T		
TRF250	TRF250-080U	ITU K.20 – 1.0kV 10/700µs	ITU K.20 – 230V _{AC} , 10Ω ITU K.20 – 600V _{AC} , 600Ω
	TRF250-110U	ITU K.20/21/45 – 1.5kV 10/700µs	ITU K.20/21/45 – 230V _{AC} , 10Ω
	TRF250-120	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 600V _{AC} , 600Ω
	TRF250-120T		
	TRF250-120U		
	TRF250-120UT		
	TRF250-145		
	TRF250-145U		
	TRF250-180		
	TRF250-180US		
	TSV250	TSV250-130F	ITU K.20/21/45 – 1.5kV 10/700µs
TS250	TS250-130F	ITU K.20/21/45 – 4.0kV 10/700µs†	ITU K.20/21/45 – 600V _{AC} , 600Ω
TSL250	TSL250-080F	Telcordia GR-1089 Intrabuilding – Surge 1 & 2	Telcordia GR-1089 Intrabuilding – 120V _{AC} , 25A ITU K.20/21/45 – 230V _{AC} , 10Ω
TR600	TRF600-150	TIA-968-A (formerly FCC Part 68)	UL60950, 3rd Ed. – 600V _{AC} , 40A
	TRF600-160	Telcordia GR-1089 – Level 1 and 2, issue 2‡	Telcordia GR-1089 – 600V _{AC} , 60A
TS600	TS600-170F	TIA-968-A (formerly FCC Part 68)	UL60950, 3rd Ed. – 600V _{AC} , 40A
	TS600-200F-RA	Telcordia GR-1089 – Level 1 and 2, issue 2‡	Telcordia GR-1089 – 600V _{AC} , 60A
TSM600	TSM600-250F	TIA-968-A (formerly FCC Part 68)	UL60950, 3rd Ed. – 600V _{AC} , 40A
	TSM600-250F-RA	Telcordia GR-1089 – Level 1 and 2, issue 2‡	Telcordia GR-1089 – 600V _{AC} , 60A
	TSM600-400F	TIA-968-A (formerly FCC Part 68)	UL60950, 3rd Ed. – 600V _{AC} , 40A
		Telcordia GR-1089, issue 3	Telcordia GR-1089 – 600V _{AC} , 60A
FT600**	FT600-0500	TIA-968-A - Type A & B	UL60950, 600V _{AC} , 40A
	FT600-1250	TIA-968-A - Type A & B	UL60950, 3rd Ed. – 600V _{AC} , 40A
	FT600-2000		Telcordia GR-1089 – 600 V _{AC} , 60A

Notes: * 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 telecom surface-mount fuse section page 85.

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

	TCF250	TRF250	TS250	TSV250	TSL250	TS600	TRF600	BBRF	RXEF	SMD,midSMD miniSMDC
Voltage Rating (V)*** (Operating/Interrupt)	60/250	60/250	60/250	60/250	80/250	60/600	60/600	99	60 72††	60
Specification	ITU	ITU	ITU	ITU	Telcordia GR-1089 Intrabuilding	UL60950 Telcordia GR-1089	UL60950 Telcordia GR-1089	Cable Taps		
Hold Current (A)										
0.080	—	17.0Ω	—	—	8.0Ω	—	—	—	—	—
0.100	—	—	—	—	—	—	—	—	3.5Ω	—
0.110	—	7.0Ω	—	—	—	—	—	—	—	—
0.120	10.5Ω	6.0-9.5Ω	—	—	—	—	—	—	—	—
0.130	—	—	8.0-10.5Ω	5.5Ω	—	—	—	—	—	—
0.140	—	—	—	—	—	—	—	—	—	4.0Ω
0.145	7.0Ω	4.3-5.0Ω	—	—	—	—	—	—	—	—
0.150	—	—	—	—	—	—	8Ω	—	—	—
0.160	—	—	—	—	—	—	5.5-7.0Ω‡	—	—	—
0.170	—	—	—	—	—	11.0Ω	—	—	4.3Ω	—
0.180	1.4Ω	1.5Ω†††	—	—	—	—	—	—	—	—
0.200	—	—	—	—	—	8.5Ω	—	—	2.3Ω††	—
0.250	—	—	—	—	—	3-3.5Ω‡	—	—	1.6Ω††	—
0.300	—	—	—	—	—	—	—	—	—	—
0.400	—	—	—	—	—	—	1.1Ω††	—	—	—
0.550	—	—	—	—	—	—	—	1.05Ω	—	—
0.750	—	—	—	—	—	—	—	0.58Ω	—	—

†† These devices have a maximum operating voltage of 72V

‡‡ 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 86.

††† These devices have a maximum operating voltage of 100V

Voltage Ratings for Telecommunications and Networking Devices

For Raychem Circuit Protection telecommunications devices (TC, TGC, TCF, TRx, TSx series) there are two applicable voltage ratings. These are **V_{max} Operating** and **V_{max} Interrupt**. To help understand the nature of these two different voltage ratings the following definitions are provided:

max Operating: For telecommunications devices this is the voltage we have used to obtain component recognition under UL1434. Most Raychem Circuit Protection devices (TGC, TCF, TRFx, TSx) are certified at 60V but can withstand higher V_{max}. TR600-160 and TSM600 product families are certified at 250V but can withstand higher V_{max}. Interrupt conditions as noted above.

max 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
Chip*—60/250V									
TCF250									
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
Radial-leaded*—60/250V									
TRF250									
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
Surface†—80/250V									
TSL250									
TSL250-080F	0.124	0.110	0.095	0.080	0.066	0.059	0.051	0.044	0.033

* 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 products are designed to help equipment pass Telcordia GR-1089 Intrabuilding power cross (120V_{AC}/25A).

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

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

... **Cont'd**

Part Number	Maximum Ambient Temperature								
	-40°C	-20°C	0°C	20°C	40°C	50°C	60°C	70°C	85°C
Surface*—60/250V									
TS250/TSV250									
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
Radial-leaded†—60/600V									
TRF600									
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
Surface‡—60/600V									
TS600/TSM600									
TS600-170F	0.264	0.230	0.200	0.170	0.140	0.125	0.109	0.094	0.070
TS600-200F-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
New TSM600-400F	0.640	0.560	0.480	0.400	0.320	0.270	0.230	0.190	0.130
Radial-leaded—90V									
BBRF**									
BBRF550	0.850	0.750	0.650	0.550	0.450	0.400	0.350	0.300	0.220
BBRF750	1.150	1.000	0.900	0.750	0.610	0.550	0.480	0.410	0.300
Radial-leaded—60/72V									
RXEF**									
RXEF010	0.160	0.140	0.110	0.100	0.080	0.072	0.067	0.050	0.040
RXEF017	0.260	0.230	0.210	0.170	0.140	0.120	0.110	0.090	0.070
RXEF020	0.310	0.270	0.240	0.200	0.160	0.140	0.130	0.110	0.080
RXEF025	0.390	0.340	0.300	0.250	0.200	0.180	0.160	0.140	0.100
RXEF030	0.470	0.410	0.360	0.300	0.240	0.220	0.200	0.160	0.120
Surface—60V									
SMD, midSMD**									
SMD030F	0.44	0.39	0.32	0.30	0.26	0.23	0.19	0.18	0.15
SMD030F-2018	0.48	0.42	0.35	0.30	0.24	0.21	0.17	0.15	0.10
SMD050F-2018	0.86	0.77	0.70	0.55	0.48	0.43	0.38	0.36	0.26
Surface—60V									
miniSMD**									
miniSMDC014F	0.23	0.20	0.17	0.14	0.11	0.10	0.09	0.07	0.05

* 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 products are designed to help equipment pass Telcordia GR-1089 Intrabuilding power cross (120V_{AC}/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.

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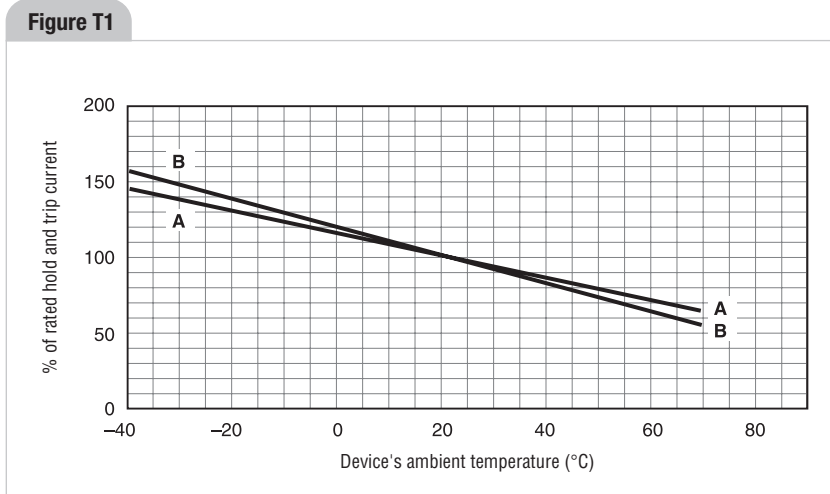
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Figure T1 - Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

A = TCF250-180
 B = All other TCF
 TRFx, TSx, TSMx
 series devices



For thermal derating of BBRF and RXEF series devices, see radial-leaded product section.
 For SMD, midSMD, miniSMD series, see surface-mount product section.

Table T3 - Electrical Characteristics for Telecommunications and Networking Devices

Part Number	I_H (A)	I_T (A)	$V_{Max\ Operating}$ (V_{DC})	$V_{Max\ Interrupt}$ (V_{RMS})	I_{Max} (A)	Pd_{TYP} (W)	Time-to-Trip (A) (s)		R_{Min} (Ω)	R_{MAX} (Ω)	$R_{1\ Max}$ (Ω)	Figure for Dimension
Chip*—60/250V												
TCF250												
TCF250-120T	0.120	0.240	60	250	3.0	1.0	1.0	1.20 max	6.3	12.0	18.0	T4
TCF250-145T	0.145	0.290	60	250	3.0	1.0	1.0	1.50 nom	5.0	9.0	14.0	T4
TCF250-180	0.180	0.500	60	250	3.0	1.0	1.0	15.00 nom	0.8	2.0	4.0	T4
Radial-leaded*—60/250V												
TRF250												
TRF250-080T	0.080	0.160	60	250	3.0	1.0	0.35	4.00 max	15.0	22.0	33.0	T2
TRF250-080U	0.080	0.160	60	250	3.0	1.0	0.35	4.00 max	14.0	20.0	33.0	T2
TRF250-110U	0.110	0.220	60	250	3.0	1.0	1.0	0.75 nom	5.0	9.0	16.0	T2
TRF250-120	0.120	0.240	60	250	3.0	1.0	1.0	1.50 nom	4.0	8.0	16.0	T3
TRF250-120T	0.120	0.240	60	250	3.0	1.0	1.0	0.70 nom	7.0	12.0	16.0	T3
TRF250-120T-RA	0.120	0.240	60	250	3.0	1.0	1.0	1.20 nom	7.0	9.0	16.0	T3
TRF250-120T-RC	0.130	0.260	60	250	3.0	1.0	1.0	3.00 nom	5.4	7.5	14.0	T3
TRF250-120T-RF	0.120	0.240	60	250	3.0	1.0	1.0	0.90 nom	6.0	10.5	16.0	T3
TRF250-120T-R1	0.120	0.240	60	250	3.0	1.0	1.0	1.00 nom	6.0	9.0	16.0	T3
TRF250-120T-R2	0.120	0.240	60	250	3.0	1.0	1.0	0.75 nom	8.0	10.5	16.0	T3
TRF250-120U	0.120	0.240	60	250	3.0	1.0	1.0	1.00 nom	6.0	10.0	16.0	T3
TRF250-120UT	0.120	0.240	60	250	3.0	1.0	1.0	0.70 nom	7.0	12.0	16.0	T3
TRF250-145	0.145	0.290	60	250	3.0	1.0	1.0	2.50 nom	3.0	6.0	14.0	T3
TRF250-145-RA	0.145	0.290	60	250	3.0	1.0	1.0	2.50 nom	3.0	5.5	12.0	T3
TRF250-145-RB	0.145	0.290	60	250	3.0	1.0	1.0	2.00 nom	4.5	6.0	14.0	T3
TRF250-145T	0.145	0.290	60	250	3.0	1.0	1.0	1.00 nom	5.4	7.5	14.0	T3
TRF250-145U	0.145	0.290	60	250	3.0	1.0	1.0	2.00 nom	3.5	6.5	12.0	T3
TRF250-180	0.180	0.650	100	250	10.0	1.5	3.0	0.5 nom	0.8	2.2	4.0	T2
TRF250-180US	0.180	0.650	100	250	10.0	1.4	3.0	0.5 nom/2.0 max	0.8	2.2	4.0	T12
Surface*—80/250V												
TSL250												
TSL250-080F	0.080	0.160	80	250	3.0	1.2	1.0	0.80 nom	5.0	11.0	20.0	T9

Table T3 - Electrical Characteristics for Telecommunications and Networking Devices

Cont'd

Part Number	I _H (A)	I _T (A)	V _{Max Operating} (V _{DC})	V _{Max Interrupt} (V _{RMS})	I _{Max} (A)	Pd _{TYP} (W)	Time-to-Trip (A)	(s)	R _{Min} (Ω)	R _{MAX} (Ω)	R _{1 Max} (Ω)	Figure for Dimension
Surface*—60/250V												
TS250/TSV250												
TS250-130F	0.130	0.260	60	250	3.0	1.1	1.0	0.9 nom	6.5	12.0	20.0	T6
	—	—	60	600	1.0	—	—	—	—	—	—	—
TS250-130F-RA	0.130	0.260	60	250	3.0	1.1	1.0	1.4 nom	6.5	9.0	15.0	T6
	—	—	60	600	1.0	—	—	—	—	—	—	—
TS250-130F-RB	0.130	0.260	60	250	3.0	1.1	1.0	0.7 nom	9.0	12.0	20.0	T6
	—	—	60	600	1.0	—	—	—	—	—	—	—
TS250-130F-RC	0.130	0.260	60	250	3.0	1.1	1.0	1.1 nom	7.0	10.0	17.0	T6
	—	—	60	600	1.0	—	—	—	—	—	—	—
TSV250-130F	0.130	0.260	60	250	3.0	1.5	1.0	2.0 nom	4.0	7.0	12.0 ^{††}	T7
Radial-leaded*												
TRF600												
TRF600-150	0.150	0.300	60	600	3.0	1.0	1.0	1.4 nom	6.0	10.0	17.0	T3
TRF600-150-RB	0.130	0.260	250	600	3.0	1.0	1.0	4.5 nom	9.0	12.0	22.0	T3
TRF600-160	0.160	0.320	250	600	3.0	1.0	1.0	7.5 nom	4.0	10.0	18.0	T3
TRF600-160-RA	0.160	0.320	250	600	3.0	1.0	1.0	9.5 nom	4.0	7.0	16.0	T3
TRF600-160-R1	0.160	0.320	250	600	3.0	1.0	1.0	9.0 nom	4.0	8.0	17.0	T3
Surface†—60/600V												
TS600/TSM600												
TS600-170F	0.170	0.400	60	600	3.0	2.5	1.0	10.0 nom	4.0	9.0	18.0	T10
TS600-200F-RA-B-0.5	0.200	0.400	60	600	3.0	2.5	1.0	12.0 nom	4.0	7.5	13.5	T10
TSM600-250F	0.250	0.860	250	600	3.0	2.0	3.0	0.8 nom	1.0	3.5	7.0	T11
TSM600-250F-RA	0.250	0.860	250	600	3.0	2.0	3.0	1.0 nom	1.0	3.0	5.0	T11
New TSM600-400F	0.400	1.000	250	600	3.0	2.0	3.0	4.0 nom/14.0 max	0.5	1.5	2.0	T11
Radial-leaded**—99V												
BBRF												
BBRF550	0.550	1.1	—	99	20.0	1.5	1.6	60 max	0.80	1.3	1.95	T2
BBRF750	0.750	1.5	—	99	20.0	1.7	2.0	60 max	0.40	0.75	1.20	T2
Radial-leaded**—60,72V												
RXEF												
RXEF010	0.100	0.200	—	60 ^{††}	40.0	0.38	0.50	4.0 max	2.50	4.50	7.50	T2
RXEF017	0.170	0.340	—	60 ^{††}	40.0	0.48	0.85	3.0 max	3.30	5.21	8.00	T2
RXEF020	0.200	0.400	—	72 ^{††}	40.0	0.41	1.00	2.2 max	1.83	2.75	4.40	T2
RXEF025	0.250	0.500	—	72 ^{††}	40.0	0.45	1.25	2.5 max	1.25	1.95	3.00	T2
RXEF030	0.300	0.600	—	72 ^{††}	40.0	0.49	1.50	3.0 max	0.88	1.33	2.10	T2
Surface**—60V												
SMD, midSMD												
SMD030F	0.300	0.600	—	60 ^{††}	10.0	1.5	1.5	3.0 max	1.20	3.00	4.8	T9
SMD030-2018F	0.300	0.800	—	60 ^{††}	20.0	0.7	1.5	1.5 max	0.50	1.40	2.3	T8
SMD050-2018F	0.550	1.200	—	57	10.0	1.0	2.5	5.0 max	0.20	—	1.0	T8
Surface**—60V												
miniSMD												
miniSMD014F	0.140	0.340	—	60 ^{††}	10.0	0.6	1.5	0.15 max	1.5	4.0	6.0	T5

Notes:

- * 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 products are designed to help equipment pass Telcordia GR-1089 Intrabuilding power cross (120V_{AC}/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.
- †† Voltage rating for these products is V_{max operating} (V_{DC})
- ‡‡ R_{1max} measured 1 hour post-trip, or 24 hours post-reflow at 20°C.
- I_H = Hold current: maximum current device will pass without interruption in 20°C still air.
- I_T = Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.
- V_{MAX} Interrupt = Maximum voltage that can be safely placed across a device in its tripped state under specified fault conditions.
- I_{MAX} = Maximum fault current device can withstand without damage at rated voltage.
- P_d = Power dissipated from device when in the tripped state in 20°C still air.
- R_{1MAX} is measured one hour post-trip or post-reflow at 20°C.
- R_{MAX} = Maximum resistance of device as supplied at 20°C unless otherwise specified.

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Figures T2-T12 - Dimension Figures for Telecommunications and Networking Devices

Figure T2

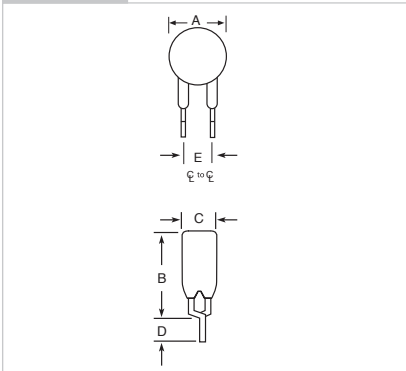


Figure T3

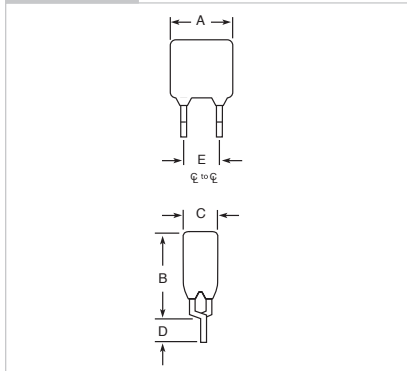


Figure T4

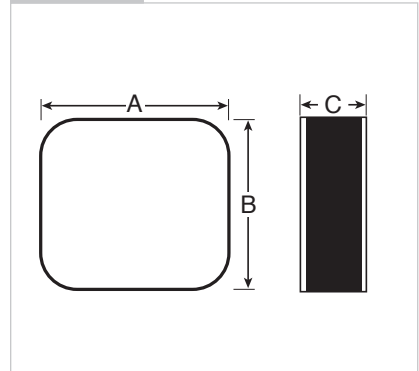


Figure T5

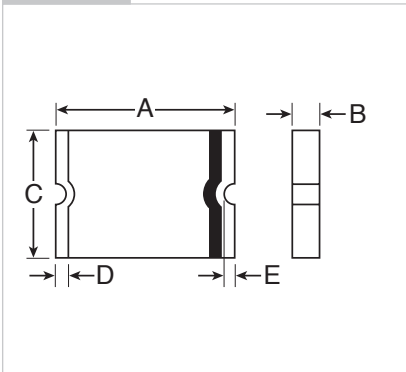


Figure T6

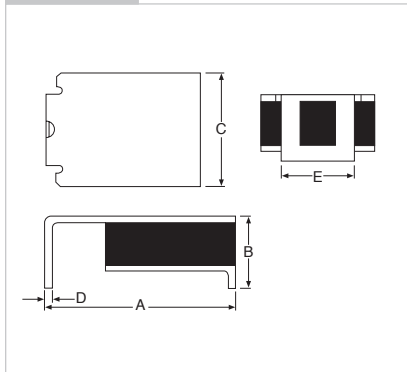


Figure T7

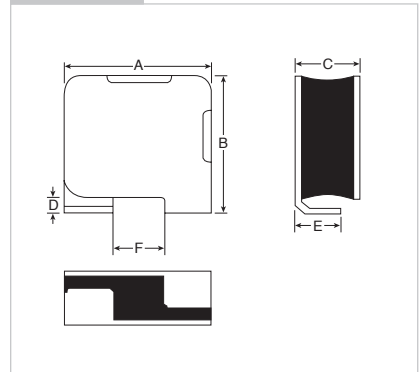


Figure T8

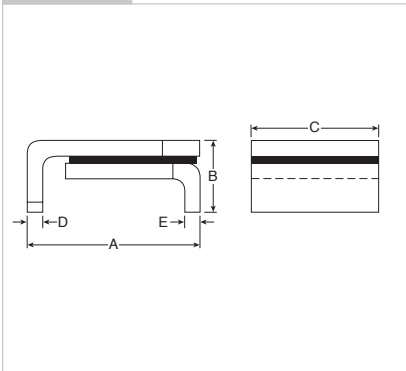


Figure T9

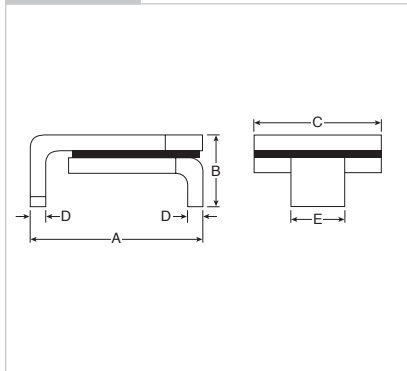


Figure T10

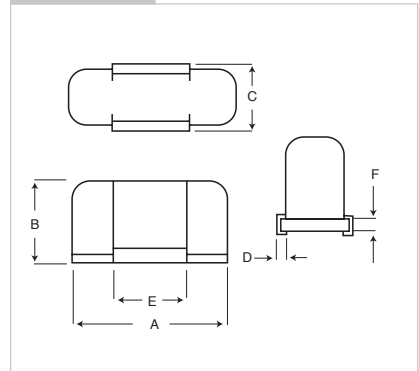


Figure T11

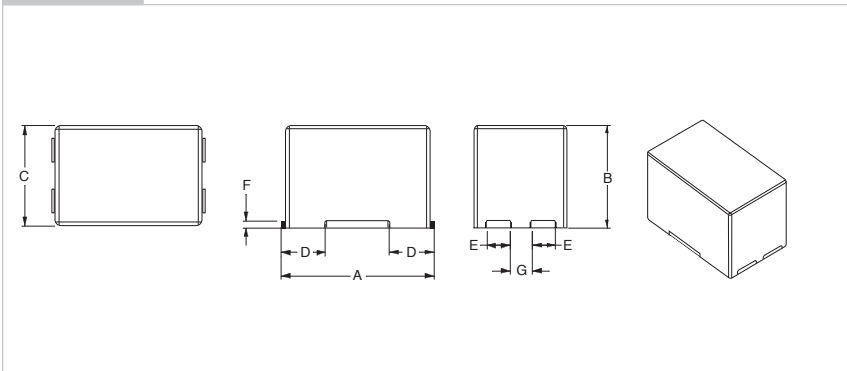


Figure T12

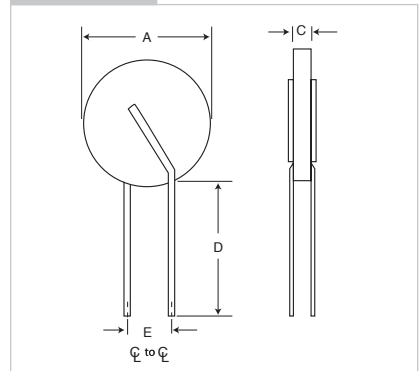


Table T4 - Dimensions for Telecommunications and Networking Devices in Millimeters (Inches)

Part Number	Dimension														Figure
	A		B		C		D		E		F		G		
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
TCF-60/250V* 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	9.8 (0.386)	10.4 (0.410)	6.1 (0.242)	6.6 (0.260)	2.0 (0.080)	2.5 (0.100)	—	—	—	—	—	—	—	—	T4
TRF250-60/250V* 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)	—	—	—	—	—	T2
TRF250-110U	—	5.3 (0.210)	—	9.4 (0.370)	—	3.8 (0.150)	4.7 (0.185)	—	5.0** (0.197)	—	—	—	—	—	T2
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)	—	—	—	—	—	T3
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)	—	—	—	—	—	T3
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)	—	—	—	—	—	T12
TSL250-80/250V† 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)	—	—	—	—	T9
TS250/TSV250-60/250V* 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)	—	—	—	—	—	T6
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)	—	—	T7
TRF600-60/600V‡ 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)	—	—	—	—	—	T3
TSM600/TSM600-60/600V‡ TSM600-170F	18.2 (0.720)	19.4 (0.765)	11.5 (0.455)	12.3 (0.485)	7.2 (0.285)	8.3 (0.325)	1.6 (0.065)	2.4 (0.095)	9.9 (0.390)	10.4 (0.410)	1.5 (0.060)	2.3 (0.090)	—	—	T10
TSM600-200F-RA	18.2 (0.720)	19.4 (0.765)	11.5 (0.455)	12.3 (0.485)	7.2 (0.285)	8.3 (0.325)	1.6 (0.065)	2.4 (0.095)	9.9 (0.390)	10.4 (0.410)	1.5 (0.060)	2.3 (0.090)	—	—	T10
TSM600-250F	—	17.6 (0.69)	—	11.7 (0.46)	—	11.2 (0.44)	—	5.2 (0.20)	—	2.8 (0.11)	0.6 (0.02)	—	2.0 (0.080)	—	T11
TSM600-250F-RA	—	17.6 (0.69)	—	11.7 (0.46)	—	11.2 (0.44)	—	5.2 (0.20)	—	2.8 (0.11)	0.6 (0.02)	—	2.0 (0.080)	—	T11
New TSM600-400F	—	17.6 (0.69)	—	11.7 (0.46)	—	11.2 (0.44)	—	5.2 (0.23)	—	2.8 (0.111)	—	1.0 (0.038)	—	1.0 (0.038)	T11
BBRF-90V BBRF-550	—	10.9 (0.43)	—	14.0 (0.55)	—	3.6 (0.14)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	—	—	—	—	T2
BBRF-750	—	11.9 (0.47)	—	15.5 (0.61)	—	3.6 (0.14)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	—	—	—	—	T2
RXEF-60, 72V RXEF010	—	7.4 (0.29)	—	11.6 (0.46)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	—	—	—	—	T2
RXEF017	—	7.4 (0.29)	—	12.7 (0.50)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	—	—	—	—	T2
RXEF020	—	7.4 (0.29)	—	11.7 (0.46)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	—	—	—	—	T2
RXEF025	—	7.4 (0.29)	—	12.7 (0.50)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	—	—	—	—	T2
RXEF030	—	7.4 (0.29)	—	12.7 (0.50)	—	3.0 (0.12)	7.6 (0.30)	—	4.3 (0.17)	5.8 (0.23)	—	—	—	—	T2
midSMD-60V SMD030F	6.73 (0.265)	7.98 (0.314)	—	3.18 (0.125)	4.8 (0.19)	5.44 (0.214)	0.56 (0.022)	0.71 (0.028)	0.56 (0.022)	0.71 (0.028)	2.16 (0.085)	2.41 (0.095)	—	—	T9
SMD030-2018F	4.72 (0.186)	5.44 (0.214)	—	1.78 (0.070)	4.22 (0.166)	4.93 (0.194)	0.25 (0.010)	0.36 (0.014)	0.25 (0.010)	0.36 (0.014)	0.30 (0.012)	0.46 (0.018)	—	—	T8
SMD050-2018F	4.72 (0.186)	5.44 (0.214)	—	1.78 (0.070)	4.22 (0.166)	4.93 (0.194)	0.25 (0.010)	0.36 (0.014)	0.25 (0.010)	0.36 (0.014)	0.30 (0.012)	0.46 (0.018)	—	—	T8
miniSMD-60V miniSMDC014F	4.37 (0.172)	4.73 (0.186)	0.635 (0.025)	0.89 (0.035)	3.07 (0.121)	3.41 (0.134)	0.30 (0.012)	—	0.25 (0.010)	0.50 (0.020)	—	—	—	—	T5

Notes: * 60/250V products are designed to help equipment pass ITU specifications (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_{AC}/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.

Figures T13-T18 - Typical Time-to-trip Curves at 20°C for Telecommunications and Networking Devices

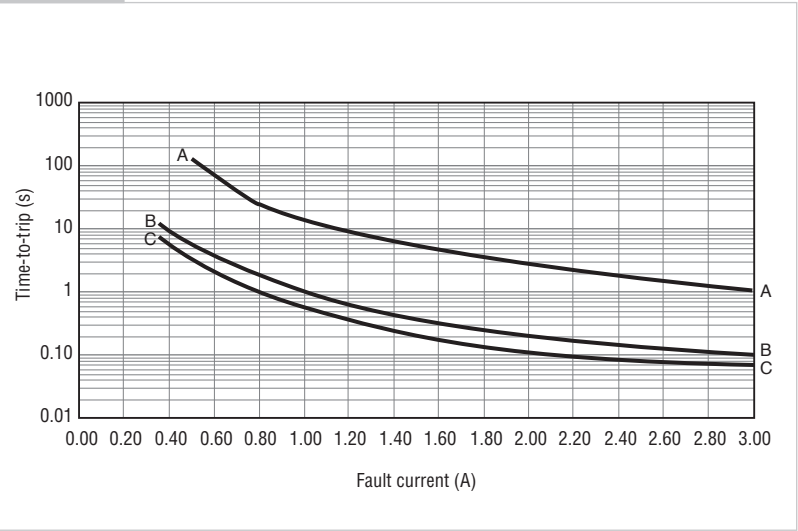
TCF250

A = TCF250-180

B = TCF250-145T

C = TCF250-120T

Figure T13



TRF250

A = TRF250-180

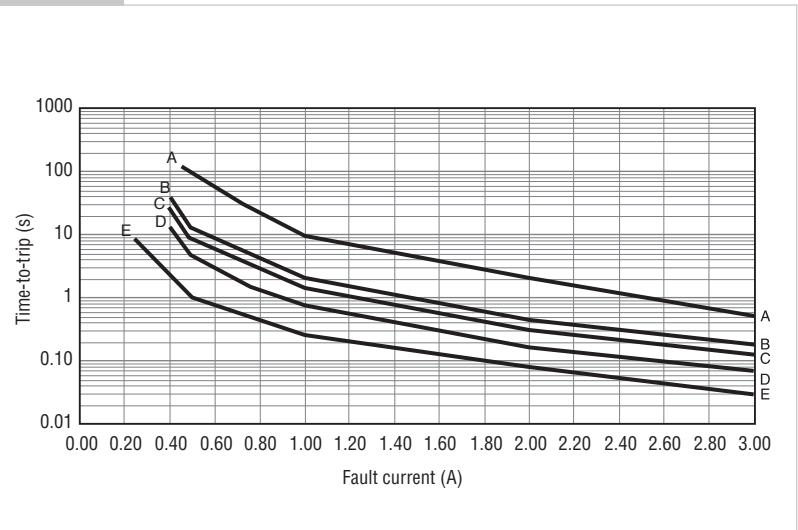
B = TRF250-145/145U

C = TRF250-120/120U

D = TRF250-110U/120UT/120T

E = TRF250-080T/080U/080US

Figure T14



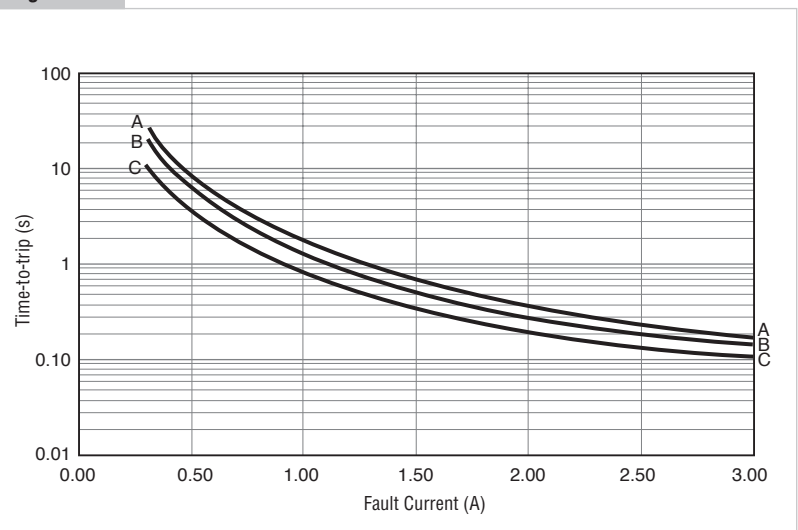
TS250/TSV250/TSL250

A = TSV250-130F

B = TS250-130F

C = TSL250-080F

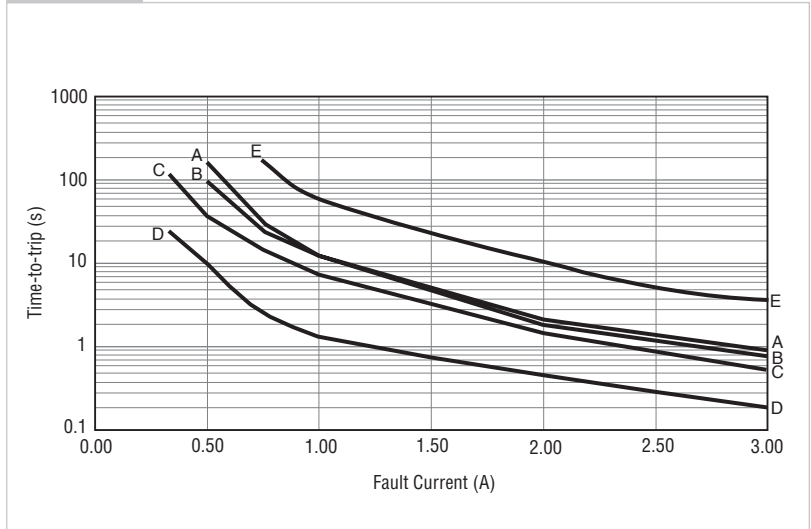
Figure T15



TRF600/TS600/TSM600

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

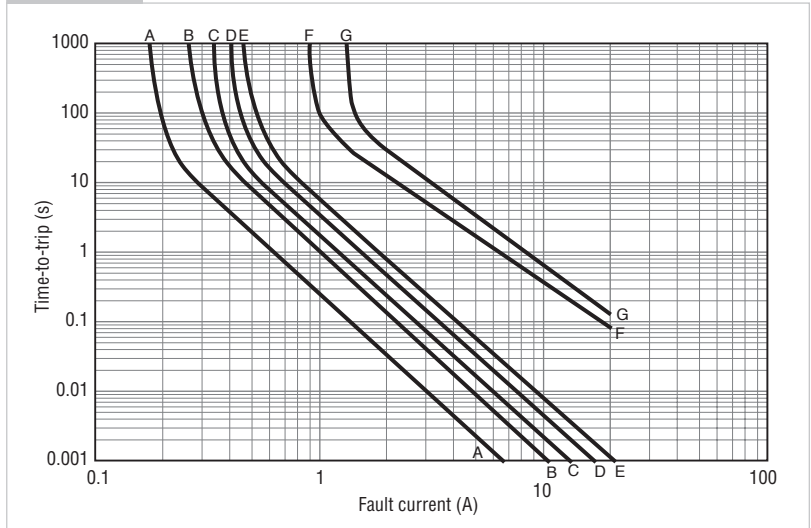
Figure T16



RXEF/BBRF

- A = RXEF010
- B = RXEF017
- C = RXEF020
- D = RXEF025
- E = RXEF030
- F = BBRF550
- G = BBRF750

Figure T17



SMD/miniSMDC/midSMD

- A = miniSMDC014 & miniSMDC014F
- B = SMD030-2018F
- C = SMD030F
- D = SMD050-2018F

Figure T18

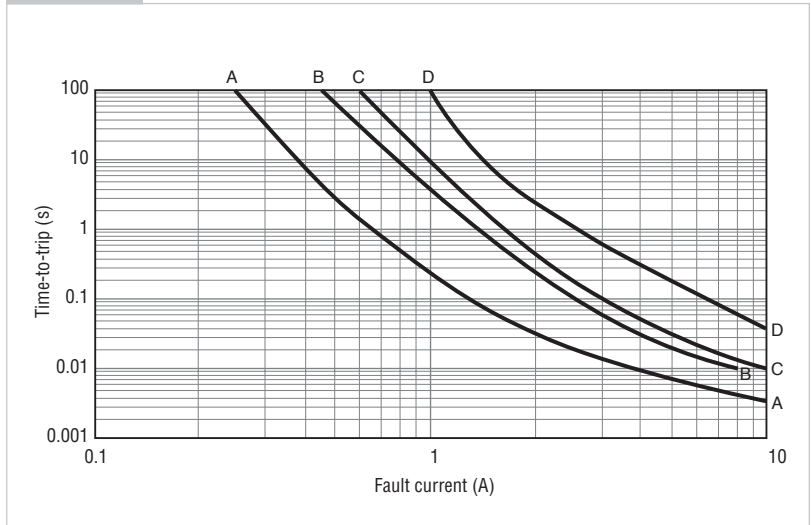


Table T5 - Physical Characteristics and Environmental Specifications for Telecommunications and Networking Devices**

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

TCF250*
Physical Characteristics

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

TCF250*
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.

TRF250*
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.

TS250*/TSV250*/TSL250†
Physical Characteristics

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

TS250*/TSV250*/TSL250†
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 your Raychem Circuit Protection representative for TR600 series devices that are compatible with this process.

* 60/250V products are designed to help equipment pass ITU specifications (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_{AC}/25A).

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

** For physical and environmental characteristics of RXEF, see the radial-leaded product section. For SMD, midSMD, and miniSMD series, see surface-mount product section.

†† Excluding TRF 600-150

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)

**TRF600[‡]
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

**TS600[‡]
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.

**TSM600
Environmental Specifications**

Lead material	Tin-plated brass
Case material	Nylon resin (UL94 V-0), 1000 V dielectric rating
Lead solderability	IEC60068-2-58, 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 20 s
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.

**BBRF
Physical Characteristics**

Lead material	Tin/lead-plated copper, 0.52mm ² (20AWG), ø 0.81mm (0.032 in.)
Soldering characteristics	Solderability per ANSI/J-STD-002 Category 3
Solder heat withstand	per IEC-STD 68-2-20, Test Tb, Method 1a, condition b; can withstand 10 seconds at 260°C ± 5°C
Insulating material	Cured, flame-retardant epoxy polymer; meets UL 94V-0

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

**BBRF
Environmental Specifications**

Test	Conditions	Resistance Change
Passive aging	70°C, 1000 hours	±5%
	85°C, 1000 hours	±5%
Humidity aging	85°C, 85% RH, 1000 hours	±5%
Thermal shock	85°C, -40°C (10 times)	±5%
Solvent resistance	MIL-STD-202, Method 215F	No change

* 60/250V products are designed to help equipment pass ITU specifications (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_{AC}/25A).

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

** For physical and environmental characteristics of RXEF, see the radial-leaded product section. For SMD, midSMD, and miniSMDC series, see surface-mount product section.

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

Part Number	Bag Quantity	Tape & Reel Quantity	Standard Package	Part Marking	Agency Recognition
Chip*—60/250V					
TCF250					
TCF250-120T	2,500	—	10,000	—	—
TCF250-145T	2,500	—	10,000	—	—
TCF250-180	2,500	—	10,000	—	—
Radial-led*—60/250V					
TRF250					
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
Surface†—80/250V					
TSL250					
TSL250-080F-2	—	1,500	7,500	T08	UL, CSA, TÜV
Surface*—60/250V					
TS250/TSV250					
TS250-130F-2	—	1,500	7,500	T13	UL, CSA, TÜV
TSV250-130F-2	—	1,200	6,000	T13V	UL, CSA, TÜV
Radial-led*—60/600V					
TRF600					
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
Surface†—60/600V					
TS600/TSM600					
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
New TSM600-400F-2	—	200	1,000	TSM600	UL (CSA pending)
Radial-led**—90V					
BBRF					
BBRF550	500	—	10,000	B550	UL, CSA
BBRF550-2	—	1,500	7,500	B550	UL, CSA
BBRF750	500	—	10,000	B750	UL, CSA
BBRF750-2	—	1,500	7,500	B750	UL, CSA
Radial-led**—60, 72V					
RXEF					
RXEF010	500	—	10,000	X010	UL, CSA, TÜV
RXEF010-2	—	3,000	15,000	X010	UL, CSA, TÜV
RXEF017	500	—	10,000	X017	UL, CSA, TÜV
RXEF017-2	—	2,500	12,500	X017	UL, CSA, TÜV
RXEF020	500	—	10,000	X020	UL, CSA, TÜV
RXEF020-2	—	3,000	15,000	X020	UL, CSA, TÜV
RXEF025	500	—	10,000	X025	UL, CSA, TÜV
RXEF025-2	—	3,000	15,000	X025	UL, CSA, TÜV
RXEF030	500	—	10,000	X030	UL, CSA, TÜV
RXEF030-2	—	3,000	15,000	X030	UL, CSA, TÜV

Notes:

- * 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_{AC}/25A).
- ‡ 60/600V products are designed to help equipment pass UL 60950, TIA-968-A (formerly FCC Part 68) and Telcordia GR-1089 specifications.
- ** Product is not currently available in a resistance-matched or resistance sorted option.

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

Part Number	Bag Quantity	Tape & Reel Quantity	Standard Package	Part Marking	Agency Recognition
Surface**—60V					
☑ SMD, midSMD					
SMD030F-2		2,000	10,000	030	UL, CSA, TÜV
SMD030-2018F-2		4,000	20,000	A03	UL, CSA, TÜV
SMD050-2018F-2		4,000	20,000	A05	UL, CSA
Surface**—60V					
☑ miniSMD					
miniSMDC014F-2		2,000	10,000	14	UL, CSA, TÜV

Notes:

- * 60/250V products are designed to help equipment pass ITU specifications (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_{AC}/25A).
- ‡ 60/600V products are designed to help equipment pass UL 60950, TIA-968-A (formerly FCC Part 68) and Telcordia GR-1089 specifications.
- ** Product is not currently available in a resistance-matched or resistance sorted option.

Agency Recognition for Telecommunications and Networking Devices

UL File # E74889

CSA File #78165C

TÜV Per IEC60730-1 Certificate # for individual products available upon request.

For agency recognition information on BBRF and RXEF series, see radial-leaded product section. For SMD, midSMD and miniSMDC series, see surface-mount product section.

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

Device	A	B	C	D	E	F	G	Figures for Dimensions
TS250 (All)	4.6 (0.18)	1.8 (0.07)	6.1 (0.24)	—	—	—	—	T19
TSV250-130F	2.29 (0.09)	2.41 (0.095)	6.35 (0.25)	3.43 (0.135)	—	—	—	T20
TSL250-080F	3.6 (0.14)	1.8 (0.07)	5.5 (0.22)	—	—	—	—	T19
TS600 (All)	10.42 (0.410)	3.30 (0.130)	3.35 (0.132)	—	—	—	—	T19
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)	T21
SMD030-2018F	4.6 (0.18)	1.5 (0.06)	3.4 (0.13)	—	—	—	—	T19
SMD030F	3.1 (0.12)	2.3 (0.09)	5.1 (0.20)	—	—	—	—	T19
SMD050-2018F	4.6 (0.18)	1.5 (0.06)	3.4 (0.13)	—	—	—	—	T19
miniSMDC014F	3.15 (0.124)	1.78 (0.07)	3.45* (0.136*)	—	—	—	—	T19

Figure T19

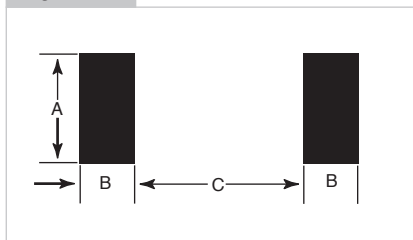


Figure T20

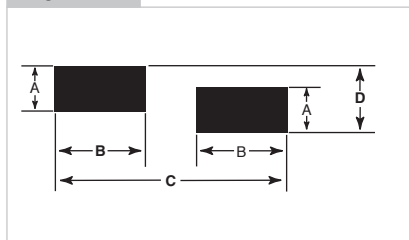
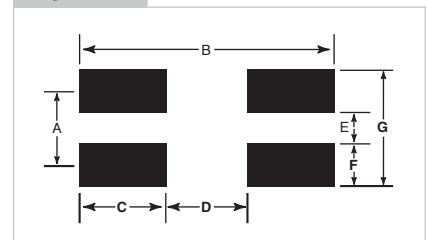


Figure T21



Solder Reflow and Rework Recommendations for Telecommunications and 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 (with the exception of miniSMDC014F).
- 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 T22

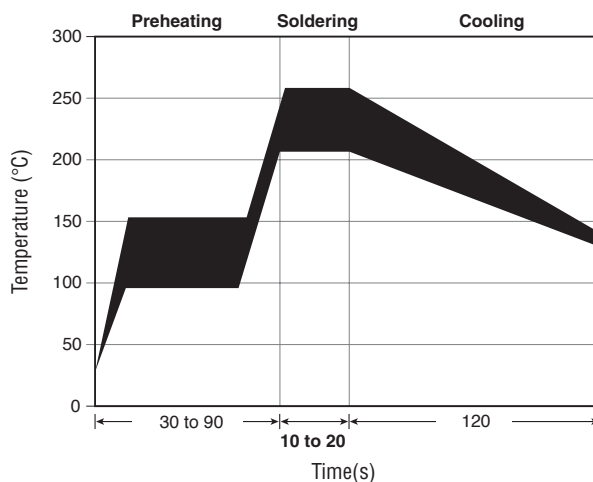


Table T8 - TRF250/TRF600 Tape and Reel Specifications for Telecommunications and Networking Device

TRF250/TRF600 devices are available in tape and reel packaging per EIA 468-B standard. See Figures T23 and T24 for details.

Dimension Description	EIA Mark	IEC Mark	Dimensions (mm)	Tolerance
Carrier tape width	W	W	18	-0.5/+1.0
Hold down tape width	W ₄	W ₀	5	Minimum
Top distance between tape edges	W ₆	W ₂	3	Maximum
Sprocket hole position	W ₅	W ₁	9	-0.5/+0.75
Sprocket hole diameter	D ₀	D ₀	4	±0.2
Abcissa to plane (straight lead)	H	H	18.5	±3.0
Abcissa to plane (kinked lead)*	H ₀	H ₀	16	-0.5/+0.6
Abcissa to top	H ₁	H ₁	32.2	Maximum
Overall width w/lead protrusion	—	C ₁	43.2	Maximum
Overall width w/o lead protrusion	—	C ₂	42.5	Maximum
Lead protrusion	L ₁	I ₁	1.0	Maximum
Protrusion of cut-out	L	L	11	Maximum
Protrusion beyond hold down tape	I ₂	I ₂	Not specified	—
Sprocket hole pitch	P0	P0	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 ₁	—	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 ₁	P ₁	0	±0.7
Lead spacing*	F	F	5.08	±0.6
Reel width	w ₂	w	56	Maximum
Reel diameter	a	d	370	Maximum
Space between flanges less device	w ₁	—	4.75	±3.25
Arbor hole diameter	c	f	26	±12.0
Core diameter	n	h	80	Maximum
Box	—	—	56/372/372	Maximum
Consecutive missing pieces*	—	—	3 maximum	—
Empty places per reel*	—	—	Not specified	—

Note: *Differs from EIA specification.

Figure T23 - EIA Referenced Taped Component Dimensions for TRF Devices

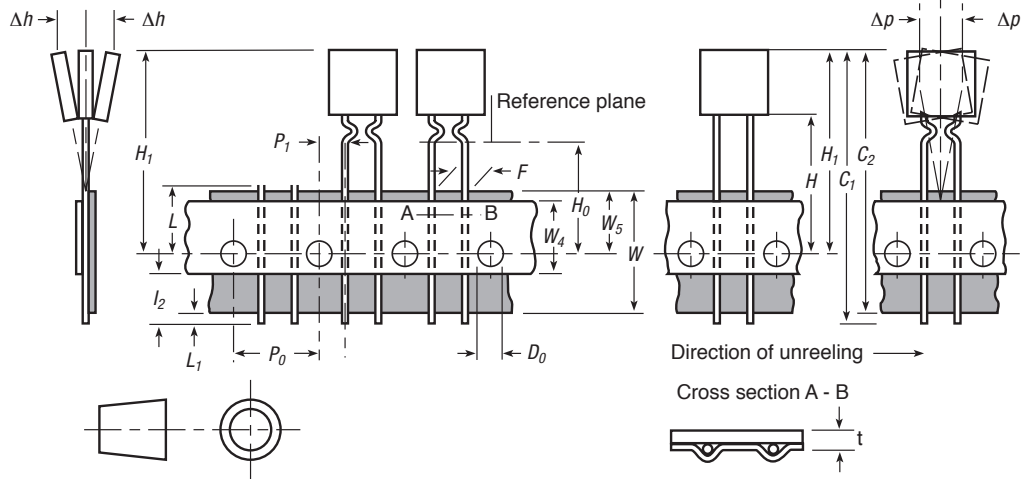


Figure T24 - Reel Dimensions for TRF Devices

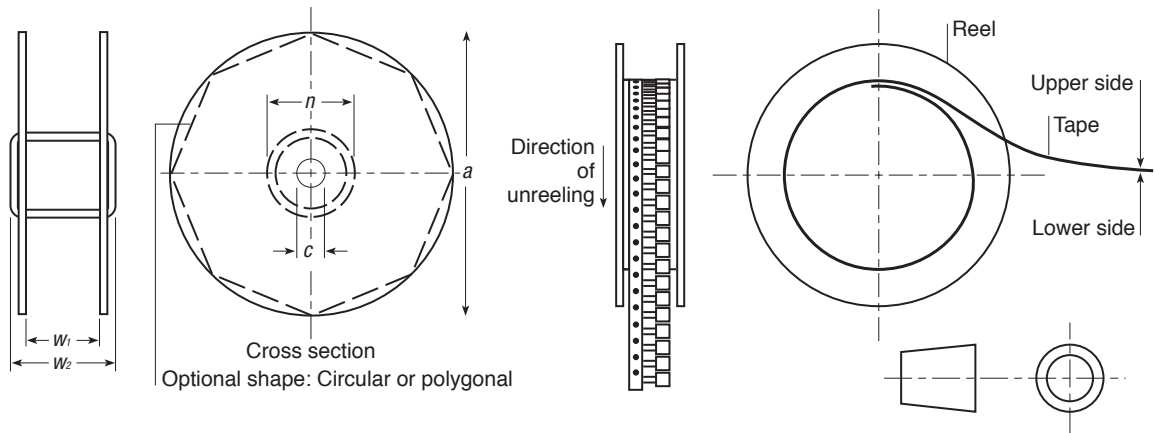


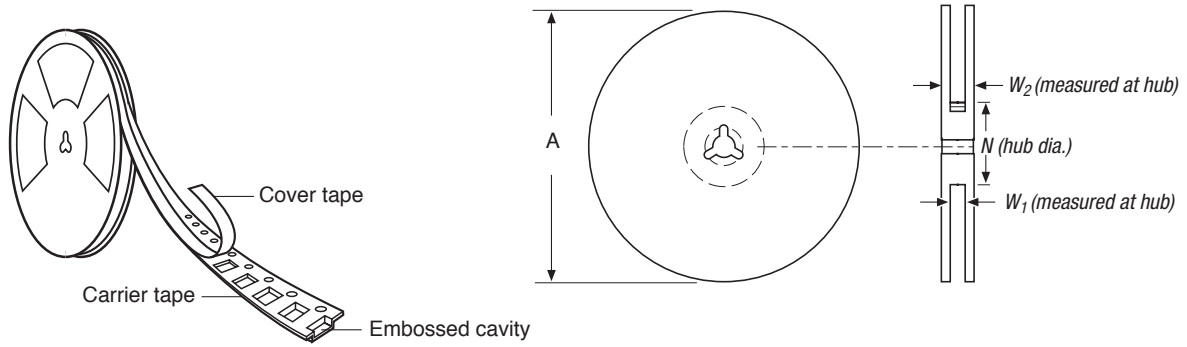
Table T9 - TS Tape and Reel Specifications for Telecommunications and Networking Devices

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T25 and T26 for details.

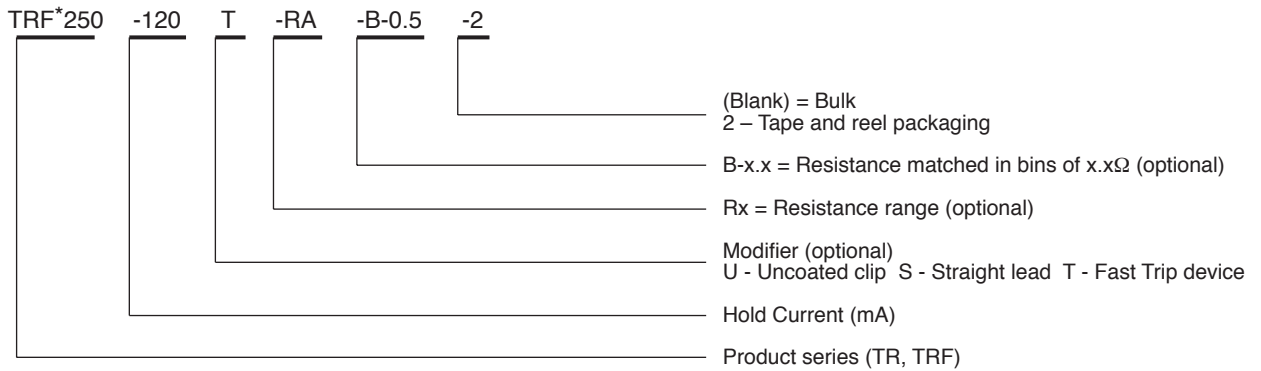
TS250/TSL250/TSV250

Dimension Description	EIA MARK	TS250 Dimension(mm)	Tolerance(mm)	TSV250 Dimension(mm)	Tolerance(mm)	TSL250 Dimension(mm)	Tolerance(mm)
Carrier tape width	W	16	±0.3	16	±0.3	16	±0.3
Sprocket hole pitch	P ₀	4.0	±0.10	4.0	±0.1	4.0	±0.10
	P ₁	12.0	±0.10	8.0	±0.1	8.0	±0.10
	P ₂	2.0	±0.10	2.0	±0.1	2.0	±0.10
	A ₀	6.9	±0.23	5.5	±0.1	5.5	±0.10
	B ₀	9.6	±0.15	6.2	±0.1	7.9	±0.10
Sprocket hole diameter	B _{1 MAX.}	12.1	—	8.0	—	9.2	—
	D ₀	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 ₁	1.75	±0.10	1.75	±0.10	1.75	±0.10
Tape thickness	E _{2 MIN.}	14.25	—	—	—	—	—
	T _{MAX.}	0.4	—	0.45	—	0.35	—
Tape thickness with splice cover tape thickness	T _{1 MAX.}	0.1	—	0.1	—	0.1	—
	K ₀	3.4	±0.15	7.00	±0.1	3.70	±0.10
	Leader min.	300	—	390	—	390	—
Trailer min.	300	—	160	—	160	—	
Reel dimensions							
Reel diameter	A max.	340	—	340	—	340	—
Core diameter	N min.	50	—	50	—	50	—
Space between flanges less device	W ₁	16.4	-0/+2.0	16.4	-0/+2.0	16.4	-0/+2.0
Reel width	W _{2 MAX.}	22.4	—	22.4	—	22.4	—

Figure T26 - EIA Referenced Reel Dimensions for TS Devices

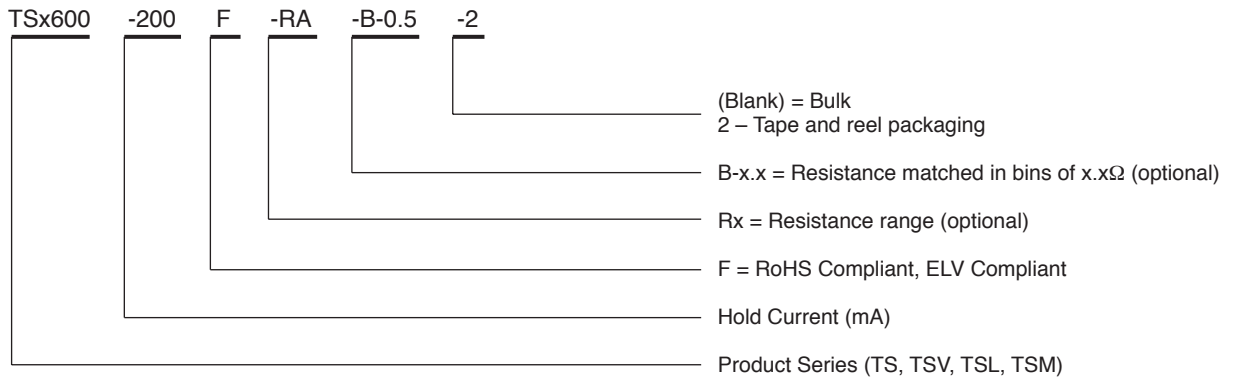


Part Numbering System for Radial-leaded Telecommunications and Networking Devices

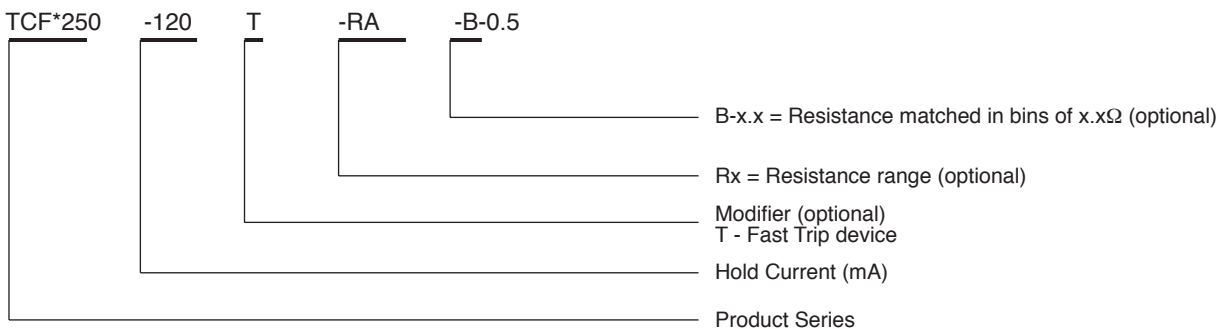


*F = RoHS compliant, ELV compliant

Part Numbering System for Surface-mount Telecommunications and Networking Devices



Part Numbering System for Chip Telecommunications and Networking Devices



*F = RoHS compliant, ELV compliant

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 0.5Ω of each other (1.0Ω 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.

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 ($L \frac{di}{dt}$) above the rated voltage of the PolySwitch resettable device.

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