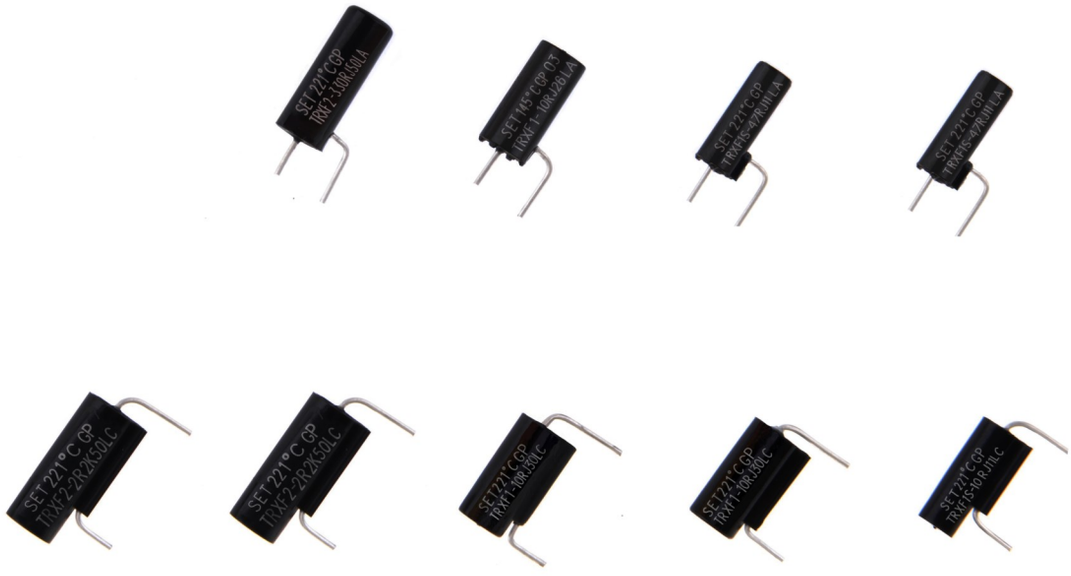
Thermal-link & Fusing Resistor (TRXF)

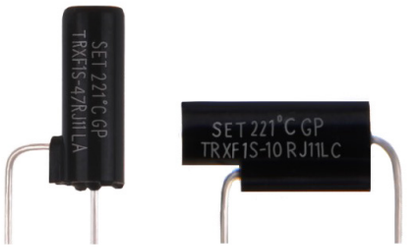


FEATURES AND BENEFITS

- PATENTED PRODUCT
- CERTIFIED PRODUCT
- MINIATURIZED PRODUCT
- RoHS & REACH COMPLIANT
- OVER TEMP. PROTECTION
- SURGE PROTECTION
- INRUSH CURRENT PROTECTION
- SMALL FAULT CURRENT PROTECTION
- SHORT CIRCUIT PROTECTION
- POOR CONTACT PROTECTION

TRXF

TRXF Overview

Page	P383 - P384					
Shape						
Structure	Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
Resistance Range	1.0 Ω - 600 Ω		0.27 Ω - 800 Ω		0.27 Ω - 1000 Ω	
Rated Power	1 W(S)		1 W		2 W	
Dimensions	Φ3.6 mm × 11.0 mm		Φ4.8 mm × 11.0 mm		Φ4.8 mm × 13.5 mm	
	The forming modes and length of lead wires can be customized.					
Rated Functioning Temp.	145 °C, 150 °C, 221 °C					

Applications

SMPS Products

Type	Illustration	Page
Power Adapter		P368 - P369
Lamp		P368 - P369
Smoke Alarm		P368 - P369

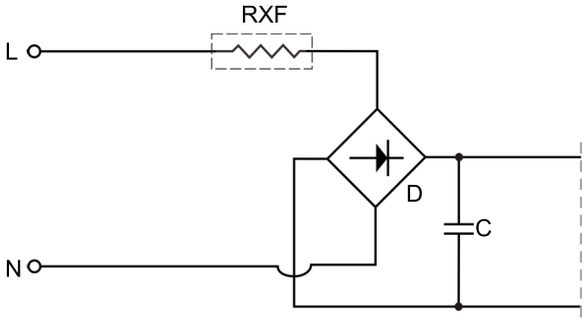
RC Voltage-reducing Products

			
Coffee Machine	Oven	Electric Grill	Electric Fan
			Others
Fluorescent Lamp	Electric Toothbrush Adapter	Egg Steamer	Electric Pressure Cooker, Milk Warmer, etc.

Applications in SMPS

Application Comparison (RXF vs. TRXF)

Hidden Danger



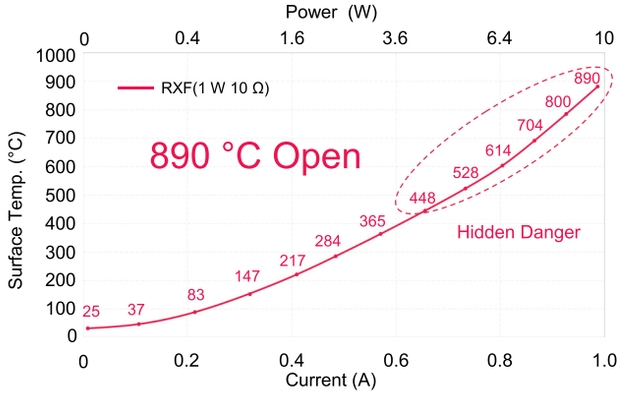
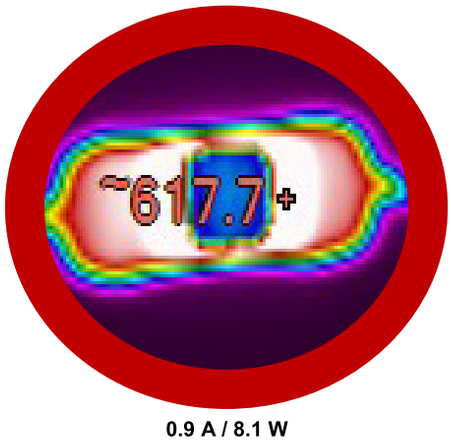


Fig. 1 Surface Temp. Curve of RXF (For Reference Only)

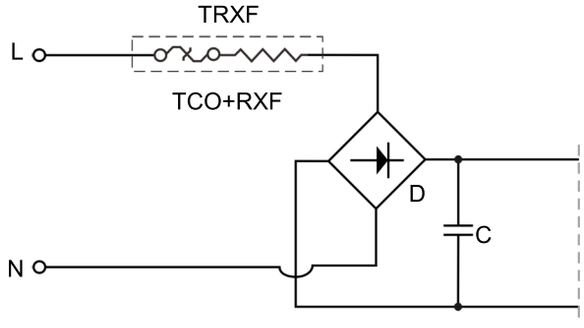
Note: Measuring with Thermometer



0.9 A / 8.1 W

Note: Measuring with FLUKE Infrared Meter（iT27, -20 °C to 600 °C）

Safety



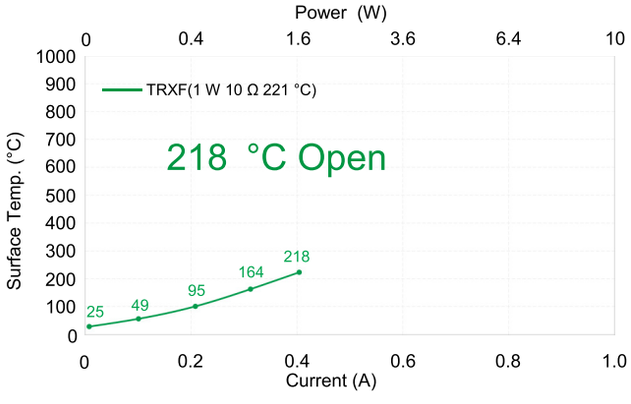
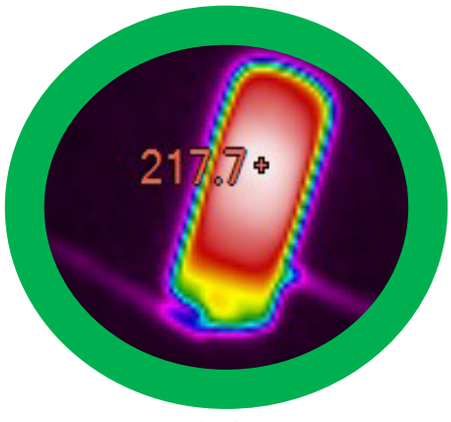


Fig. 2 Surface Temp. Curve of TRXF (For Reference Only)

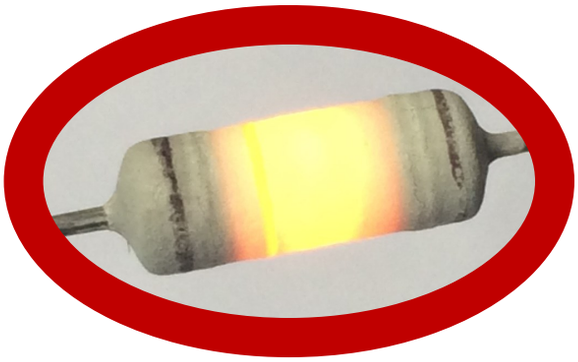
Note: Measuring with Thermometer



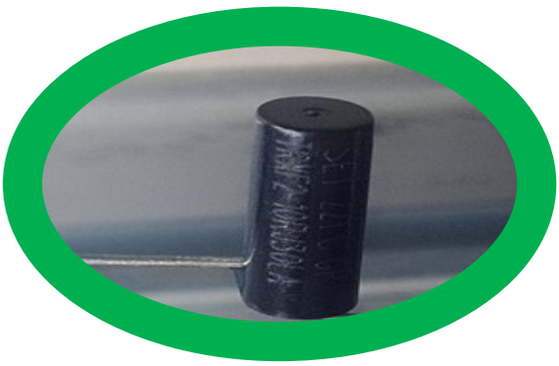
0.4 A / 1.6 W

Note: Measuring with FLUKE Infrared Meter（iT27, -20 °C to 600 °C）

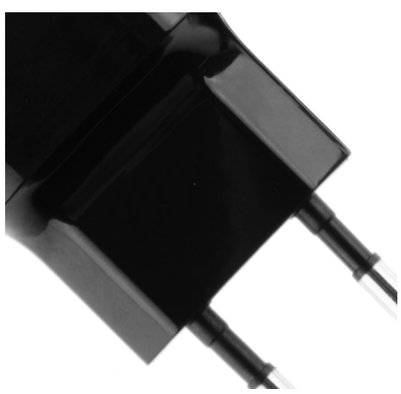
Application Comparison (RXF vs. TRXF)



Risk of Fire

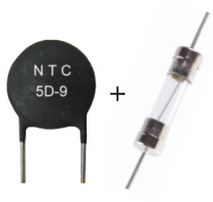


Safety



TRXF

Comparison for SMPS Applications

Protective Component		Short Circuit Protection	Small Fault Current Protection	Surge Protection	Inrush Current Protection	Poor Contact Protection
Fuse		Common	Good	**Poor**	Common	**Poor**
		Anti-explosion Capacity (264 Vac)	No Fire Risk	/	/	/
NTC+Fuse		Common	Good	Common	Hot State - Common, Cold State - Good	**Poor**
		Anti-explosion Capacity (264 Vac)	No Fire Risk	/	/	/
RXF		Common	**Poor**	Good	Good	**Poor**
		Anti-explosion Capacity (264 Vac)	Fire Risk	⩾2 kV	/	Fire Risk
TRXF		**Excellent**	**Excellent**	**Good**	**Good**	**Good**
		Good Anti- explosion Capacity (264 Vac)	**No Fire Risk**	**⩾2 kV**	/	**No Fire Risk**

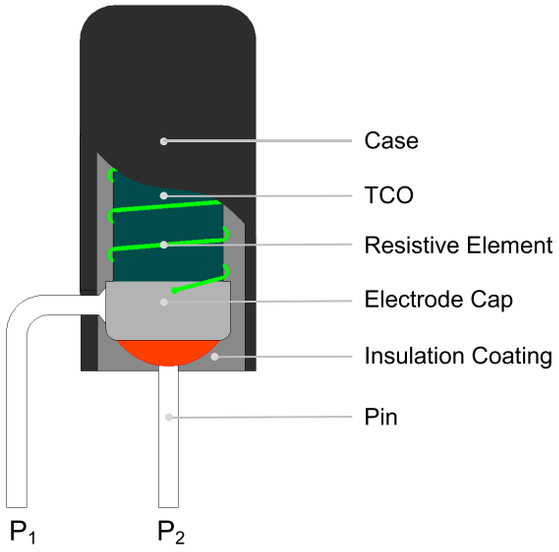
Thermal-link & Fusing Resistor (TRXF)

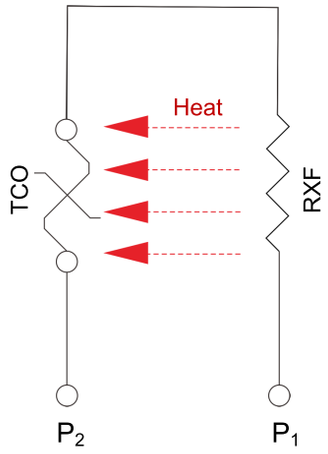
SETfuse

Product Description

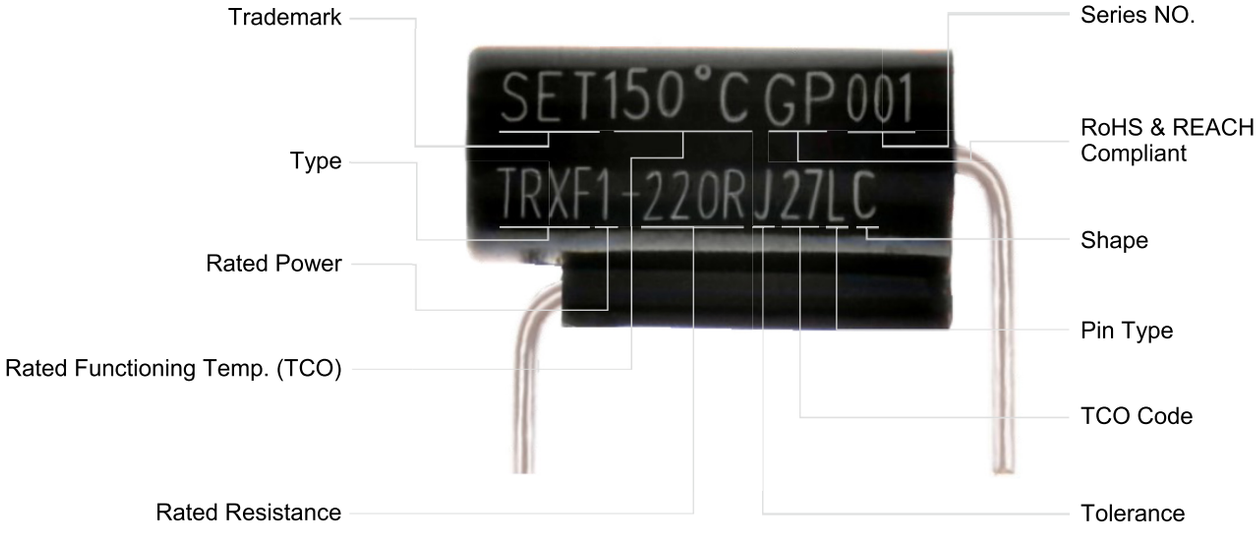
SET's Thermal-link & Fusing Resistor (TRXF) is an unique type of Power Resistor, with Over Temp. and Over Current Protections. The Thermal-link (TCO) is placed through the core of Fusible Wirewound Resistor (RXF) and in series with RXF. TRXF has the same physical size as ordinary RXF as well as large fault current protection. Besides, TRXF can effectively solve the hidden danger of continuous abnormal heat that ordinary RXF may cause when small fault current happens.

Structure & Operating Principle





Marking



Patents

Name	Region	Category	Patent NO.
A Device that Combines Thermal-link and Resistor	China	Utility Model	ZL 201020697438.7
	United States	Invention Patent	US 9240300

TRXF

Agency Information

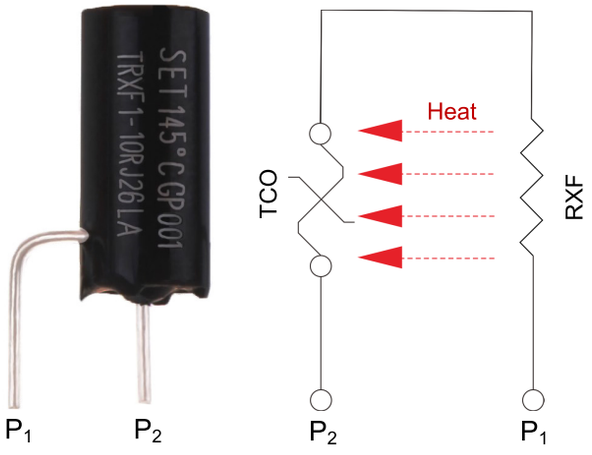
Agency Information		Standards	File NO.
	UL	UL 1412	E324712
	CUL	UL 1412	E324712
	TUV	IEC 60065	R50279979
	CQC	SJ 2865	CQC15001126561 CQC15001126562 CQC15001126563

Designed to Standards

Standards	Region	Standards Name
IEC 60115-1	IEC	*Fixed Resistors for Use in Electronic Equipment*
IEC 60065	IEC	*Audio, Video and Similar Electric Apparatus – Safety Requirements*
UL 60691	United States	*Thermal-Links – Requirements and Application Guide*
UL1412	United States	*Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances*
GB 9816	China	《热熔断体的要求和应用导则》[1]
GB/T 17626.5	China	《电磁兼容试验和测量技术浪涌(冲击)抗扰度试验》[2]
GB/T 5729	China	《电子设备用固定电阻器总规范》[3]
SJ 2865	China	《电子元件详细规范》[4]

Note:
[1]: Equaled with UL 60691 *Thermal-Links – Requirements and Application Guide*
[2]: Equaled with IEC 61000-4-5 *Testing and Measurement Techniques - Surge Immunity Test*
[3]: Equaled with IEC 60115-1 *Fixed Resistors for Use in Electronic Equipment*
[4]: Translated into *Detail Specification for Electronic Components*

Operating Principle



Instruction:

$R_{RXF} \geqslant 100 R_{TCO}$

R_{RXF}: the resistance value of RXF

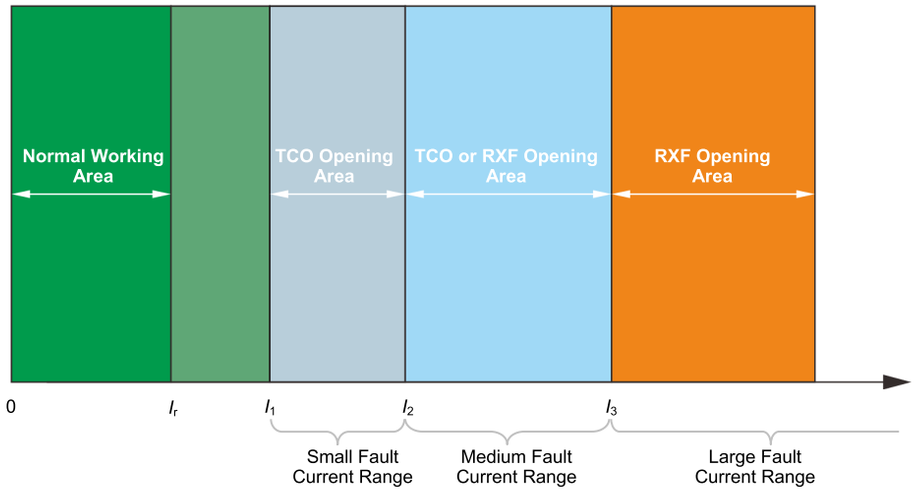
R_{TCO} : the resistance value of TCO

$T_{RXF} \geqslant 5 T_{TCO}$

The Fusing Temp. of RXF (T_{RXF}): 1200 °C to 1500 °C

The Fusing Temp. of TCO (T_{TCO}): 145 °C to 221 °C

Fault Current Protection Illustration



$I < I_r$, TRXF works normally.

Small Fault Current Protection

At small fault current, $I_1 < I < I_2$, TCO senses the heat that generated by RXF, when the TCO reaches the fusing temp., TCO opens the circuit quickly. In this case, RXF keeps intact and TCO opens.

Medium Fault Current Protection

At medium fault current, $I_2 < I < I_3$, RXF opens in a short time because of much heat generated, meanwhile, RXF conducts its residual heat to TCO. In this case, both RXF and TCO open.

Large Fault Current Protection

At large fault current, such as short circuit, $I > I_3$, RXF opens instantly but TCO keeps intact because the fusing time of RXF is too short to generate enough heat. In this case, RXF opens and TCO keeps intact.

Note: I_r is Rated Current , $I_r = \sqrt{P/R}$.

TRXF

Key Features

Over Temp. Protection

Model	TCO Code	T_f (°C)	Fusing Temp. of TCO (°C)
TRXF1S-xxxx07Lx	07	145	140±2
TRXF1-xxxx26Lx	26		
TRXF2-xxxx46Lx	46		
TRXF1S-xxxx08Lx	08	150	145±2
TRXF1-xxxx27Lx	27		
TRXF2-xxxx47Lx	47		
TRXF1S-xxxx11Lx	11	221	218±2
TRXF1-xxxx30Lx	30		
TRXF2-xxxx50Lx	50		

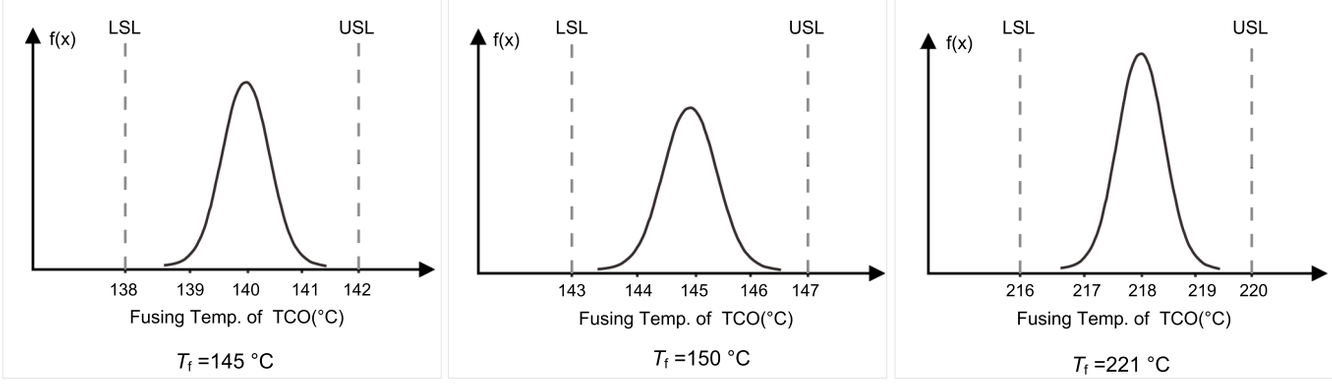
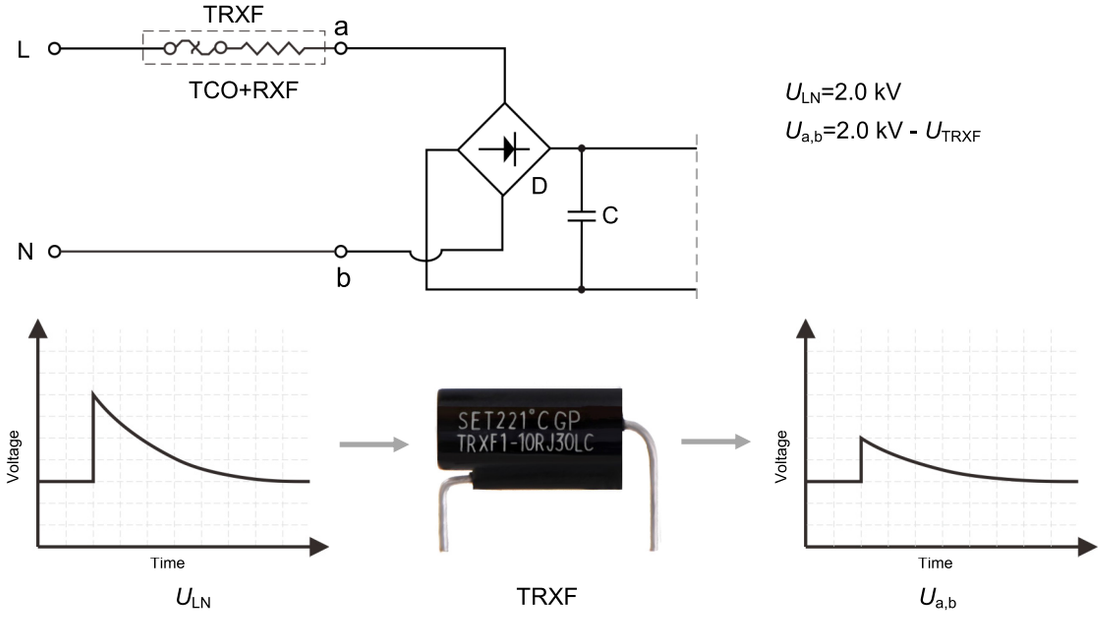


Fig. 3 Fusing Temp. of TCO Distribution

Surge Protection Level

For some TRXF models, the combination wave generator (1.2/50 μs, 8/20 μs, 2 Ω) is used to generate 2.0 kV open circuit voltage to impact the terminals of product for 40 times at 1 min interval, TRXF shall not open after test.



Inrush Current Protection Level

For most TRXF models, they are able to withstand more than 10,000 times inrush current impact without opening. The test circuit is shown as Fig.4 of P375.

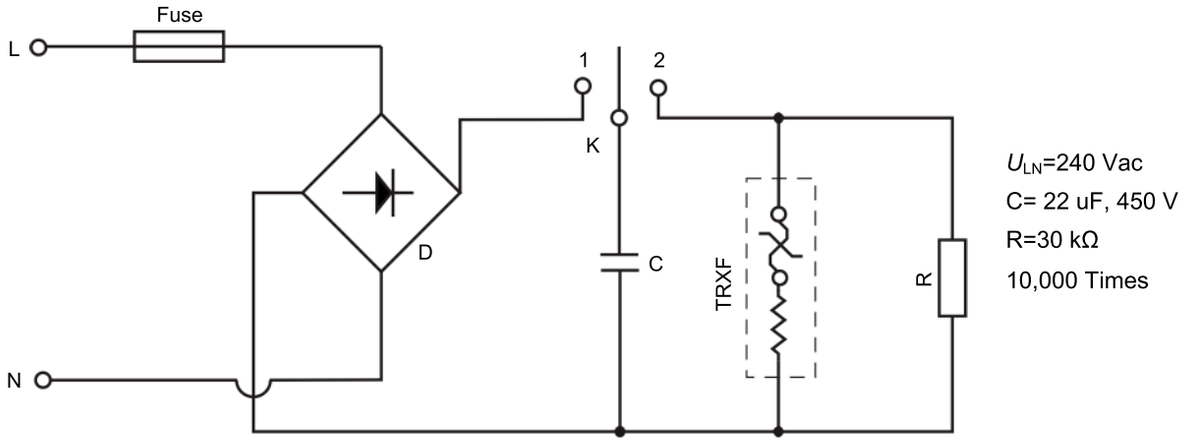


Fig. 4 Inrush Current Test Circuit

Small Fault Current Protection

The surface temp. of TRXF is always at a lower level, when small fault current happens to the device, TRXF is able to open the circuit timely without additional damage.

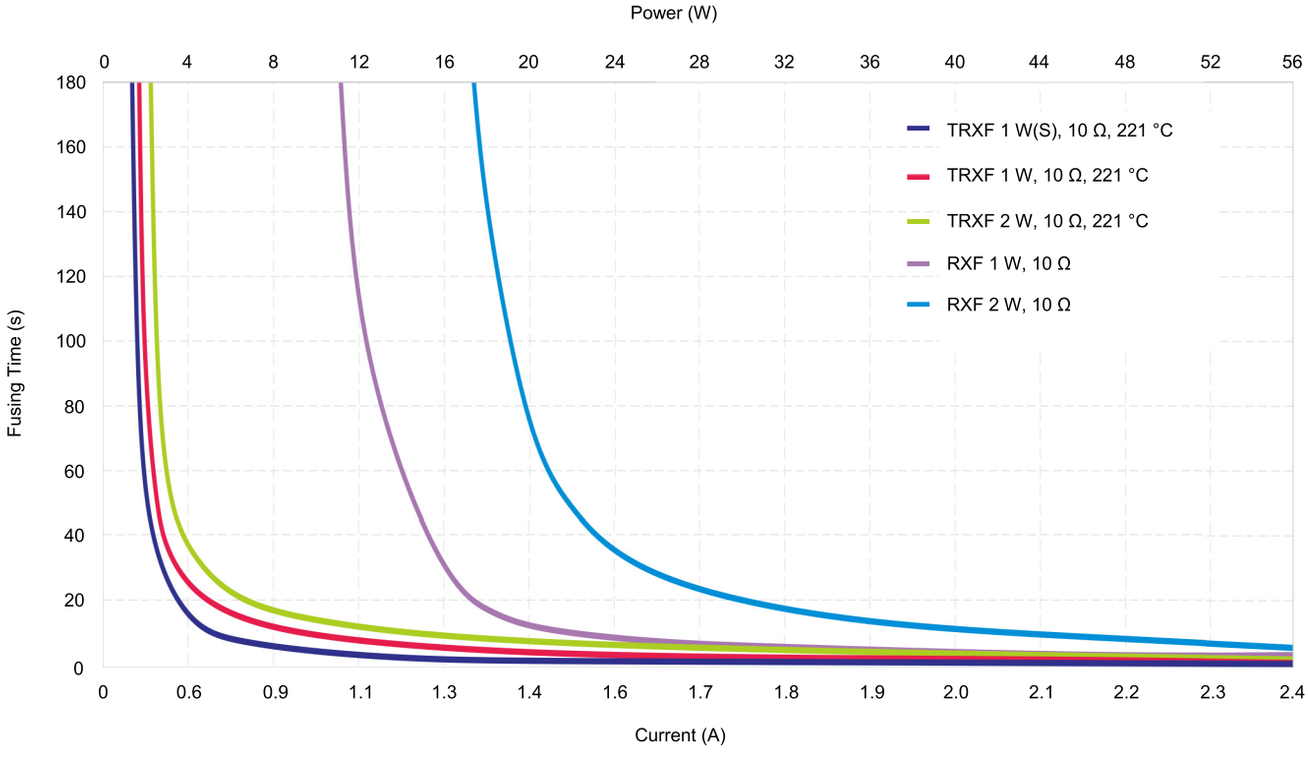


Fig. 5 Fusing Time Curve of TRXF & RXF Comparison (For Reference Only)

Excellent Short Circuit Protection

For some TRXF models, when 264 Vac short circuit voltage is applied to the two terminals, TRXF is able to open immediately without evident explosion sound or electric spark.

Product Type	Before 264 Vac Short Circuit Test	After 264 Vac Short Circuit Test	Test Phenomenon
1 W 10 Ω RXF			**Evident Explosion Sound and Electric Spark**
1 W 10 Ω 221 °C TRXF			**No Evident Explosion Sound or Electric Spark**

Poor Contact Protection

In SMPS, when poor contact happens between plug and socket, due to the influence of capacitor, continuous inrush current would happen, which may burn the circuit board. If a TRXF is installed at the circuit input, the TRXF's resistive element would heated under continuous inrush current, and transfer to the inside TCO, when reaching to the fusing temp. of TCO, TCO opens the circuit.

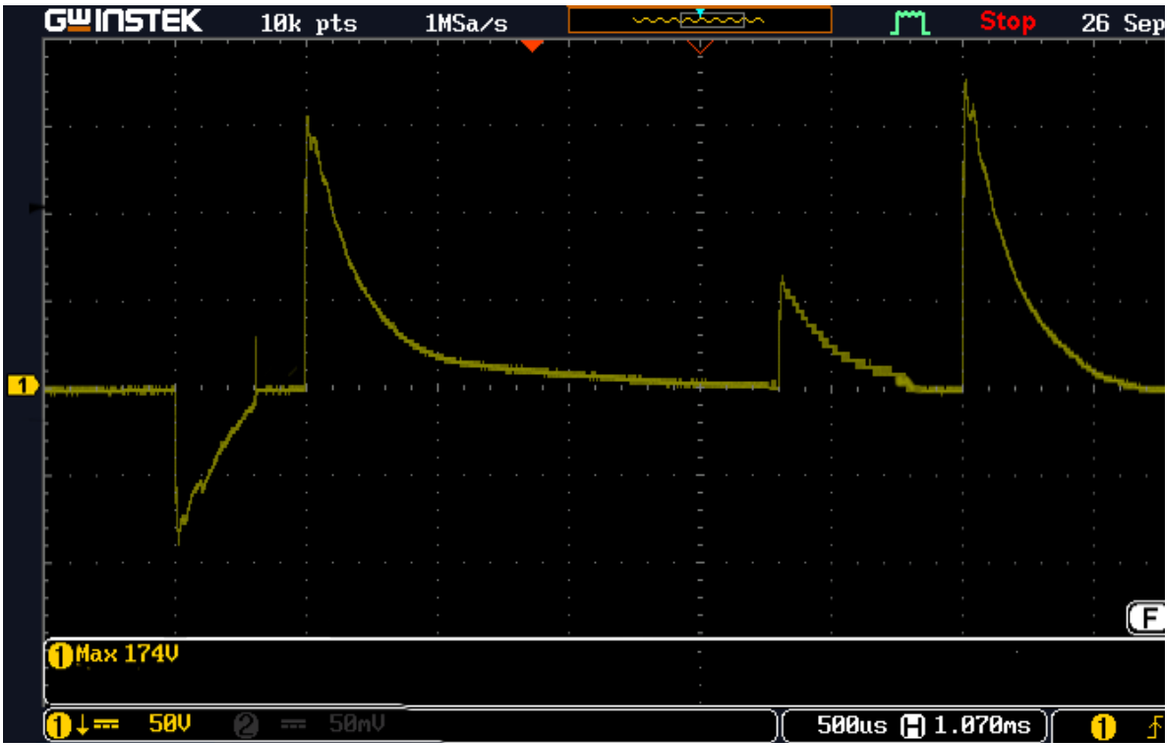


Fig.6 Voltage Waveform of TRXF at Poor Contact Status

Fusing Characteristics

Compared with RXF, TRXF can open effectively at lower power multiples to protect the circuit timely.

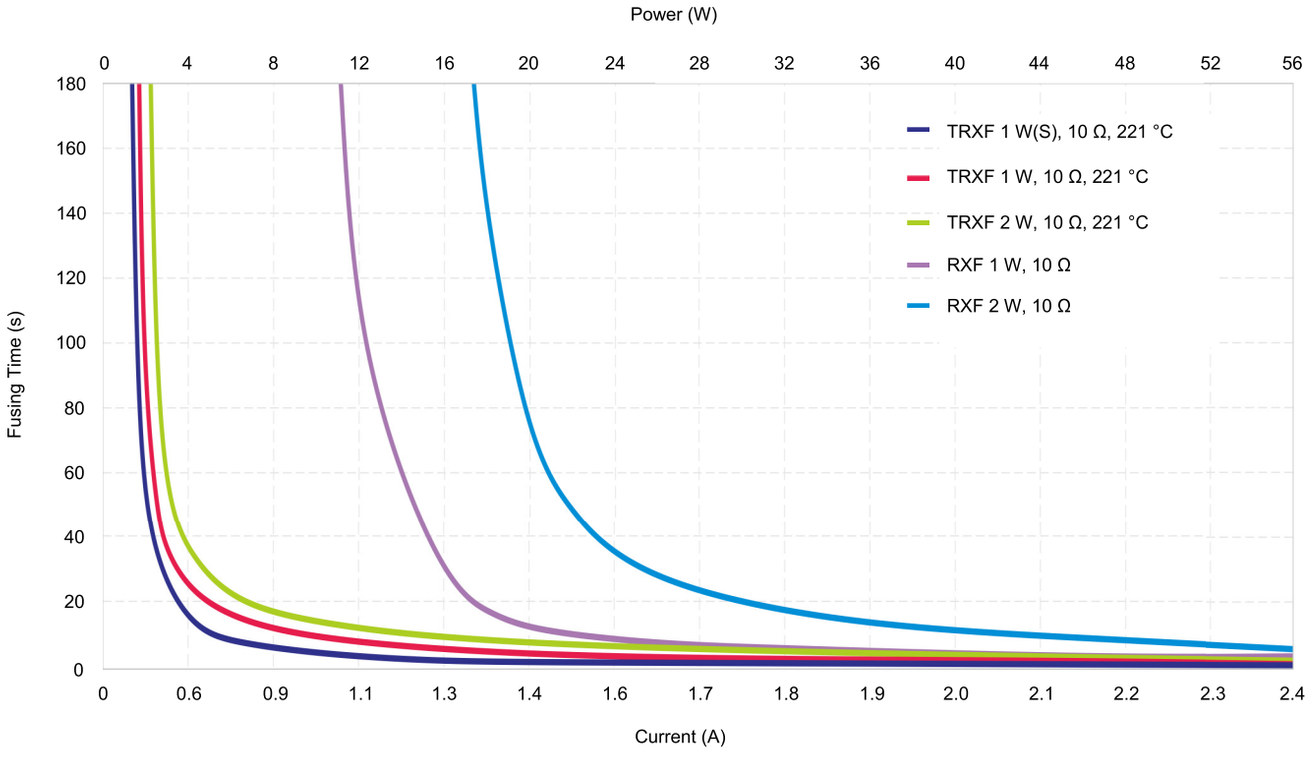


Fig. 7 Fusing Time Curve of TRXF & RXF Comparison (For Reference Only)

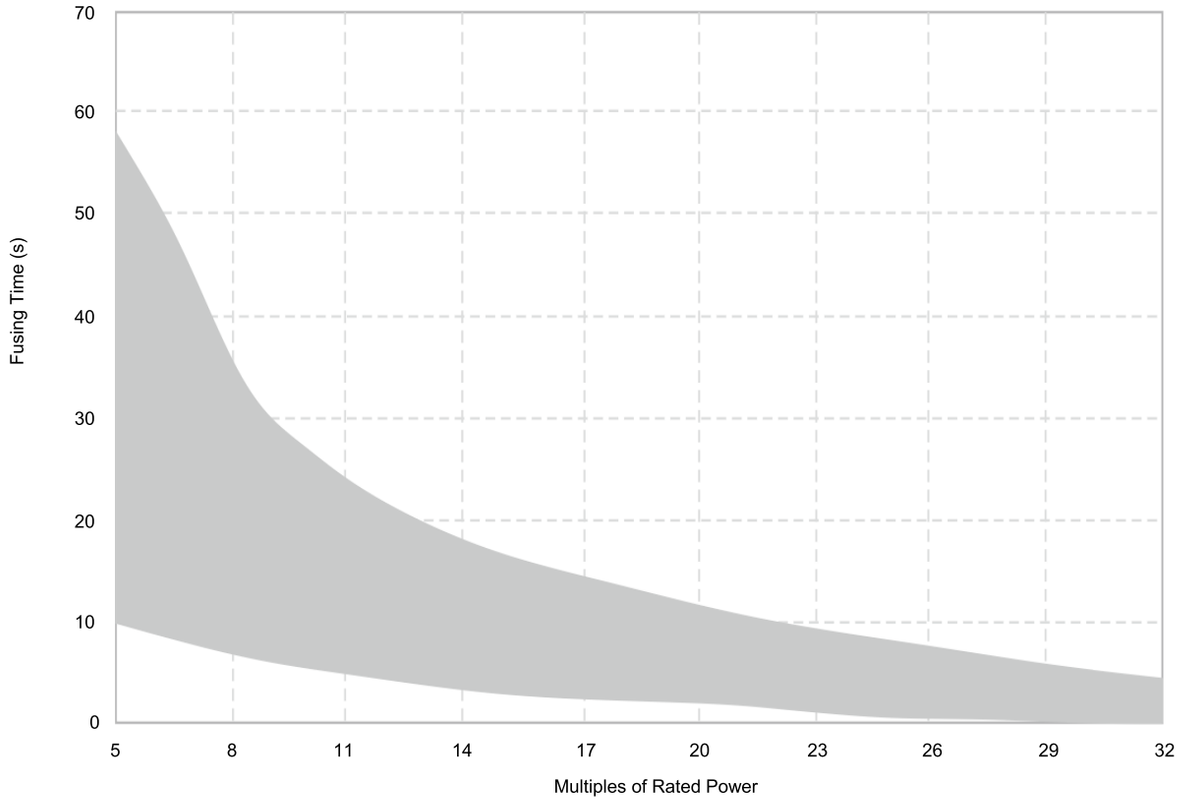


Fig. 8 Fusing Time Curve of TRXF 1 W 221 °C (For Reference Only)

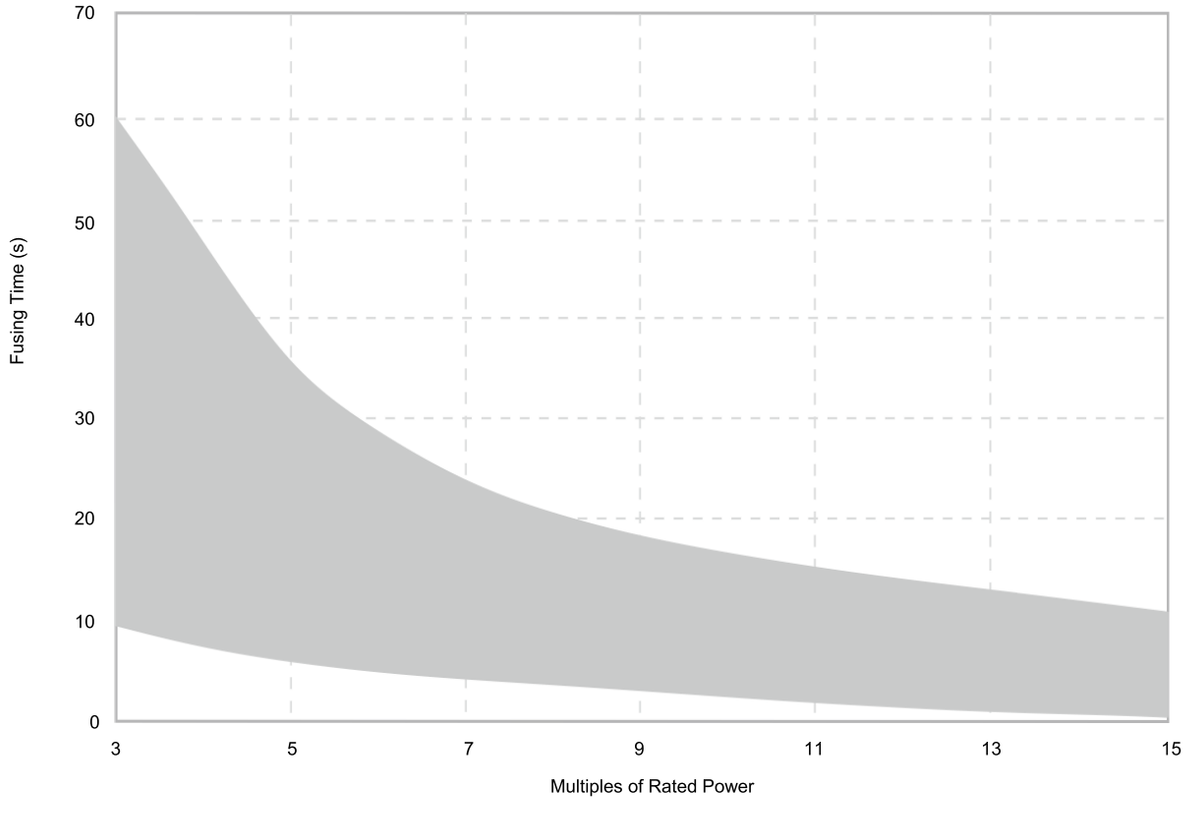


Fig. 9 Fusing Time Curve of TRXF 2 W 221 °C (For Reference Only)

Glossary

Rated Resistance

Resistance value for which the resistor has been designed, and which is generally used for denomination of the resistor.

—(IEC 60115-1)

Temp. Coefficient of Resistance

Relative variation of resistance between two given temperatures divided by the difference in the temp. producing it.

—(IEC 60115-1)

Rated Voltage

The d.c. or a.c. r.m.s. voltage calculated from the square root of the product of the rated resistance and the rated dissipation.

—(IEC 60115-1)

Temp. Characteristics

Relative to the reference temp. 20 °C, within the specified temp. range between the category temp. resistance maximum reversible change.

—(IEC 60115-1)

Visible Damage

Damage, perceptible with suitable magnification, which is likely to affect the usability of the component for its intended purpose.

—(IEC 60115-1)

Fusing Characteristics

When overload is applied, the resistor's resistance significantly increases, and the current through the resistor drops below 1/50 of the initial test current, it is called fusing. The time from applying overload to resistor fusing is called fusing time. This is fusing characteristics.

—(SJ 2865)

Rated Functioning Temp. (T_f)

The temp. of the Thermal-link which causes it to change its state of conductivity with a detection current up to 10 mA as the only load.

—(IEC 60691)

Thermal-link

Thermal-link / Thermal Cutoff (TCO): known as thermal fuse. All the names are the same in this context, functioning once only, non-resettable.

—(IEC 60691)

Part Number System

TRXF 1 - 4R7 J 30 L A

Type
TRXF

Rated Power (W)	
1S	1
1	1
2	2

Rated Resistance (Ω)
R47=0.47
4R7=4.7
47R=47
470R=470

Tolerance (%)	
J	±5
K	±10

TCO Code					
TRXF1S		TRXF1		TRXF2	
Code	TCO Model	Code	TCO Model	Code	Model
07	V6(145 °C)	26	H6(145 °C)	46	B6(145 °C)
08	V7(150 °C)	27	H7(150 °C)	47	B7(150 °C)
11	V31(221 °C)	30	H31(221 °C)	50	B31(221 °C)

Pin Type
L:2 Pins

Shape
A:Round
C:Ω Shape or V Shape

Note: Refer to P 40 to P 42 for TCO Model Specifications .

SET's TRXF is a circuit protection component which is sensitive for current and temp. , when the current or temp. exceeds a predetermined value, TRXF would open via the inside resistive element or inside TCO to protect the circuit. Therefore, corrected selection is quite important for the product life and performance. The selection guide of TRXF follows the below rules:

Shape and Dimensions

SET's TRXF is a unique power resistor, whose shapes, dimensions and lead forming modes are shown as P383 to P384. a bit different from RXF, designers may choose suitable products according to the PCB **space** and **installation mode.**

Power

To ensure product life, 10% to 50% of the rated power is recommended.

Fusing Characteristic

The fusing time curves of common TRXF are shown as P376 to P377. If they can not meet your requirement, customization is available.

I^2t Value

In SMPS device, due to the influence of capacitor, an obvious inrush current happens when turning on or off the device. To avoid the device failure caused by the earlier failure of TRXF due to the inrush current, I^2t should follow the Tab.1.

Normally, the greater the power is, the better the withstanding capacity of inrush current is. If the PCB space is enough, relatively greater power TRXF is recommended.

100,000 pluses : Pluses I^2t=22% of Average Melting I^2t
10,000 pluses : Pluses I^2t=29% of Average Melting I^2t
1,000 pluses : Pluses I^2t=38% of Average Melting I^2t
100 pluses : Pluses I^2t=48% of Average Melting I^2t

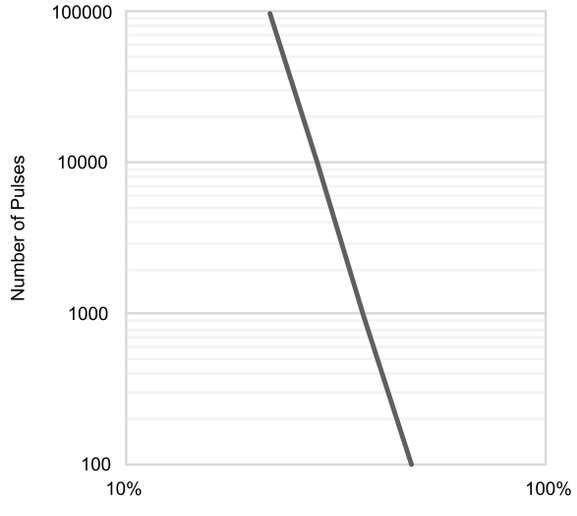
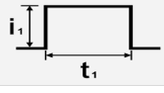
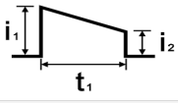
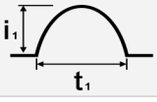
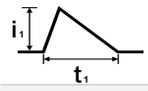
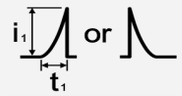
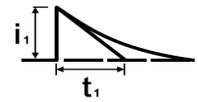


Fig. 10 Pulse I^2t / Average Melting I^2t

Note: Time interval (≥10 s) is requested between pulses to ensure fully heat dissipation.

Tab.1 I^2t Value

NO.	Waveform	I^2t (A^2s)
A		$I^2t=i_1^2t_1$
B		$I^2t=(1/3)(i_1^2+i_1i_2+i_2^2)t_1$
C		$I^2t=(1/2)i_1^2t_1$
D		$I^2t=(1/3)i_1^2t_1$
E		$I^2t=(1/5)i_1^2t_1$
F		$I^2t=(1/2)i_1^2t_1$

Ambient Temp.

When the Ambient Temp. exceeds 25 ºC, the rated power value declines as the following curve.

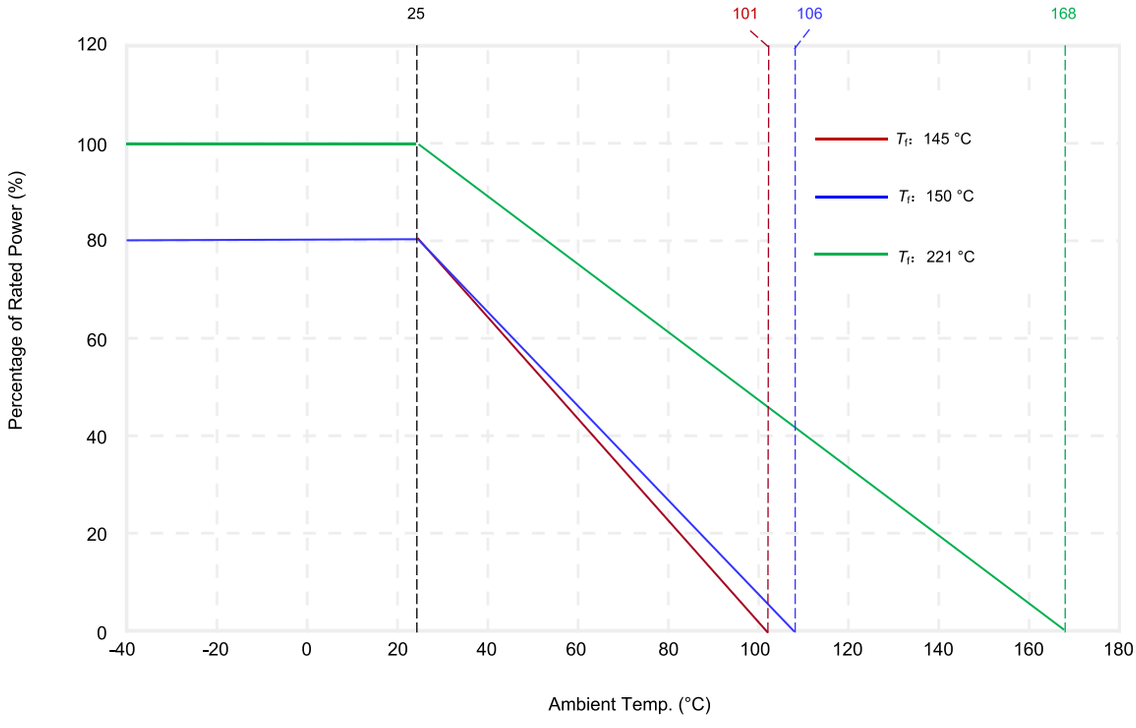


Fig. 11 Rated Power Derating Curve of TRXF 1 W (For Reference Only)

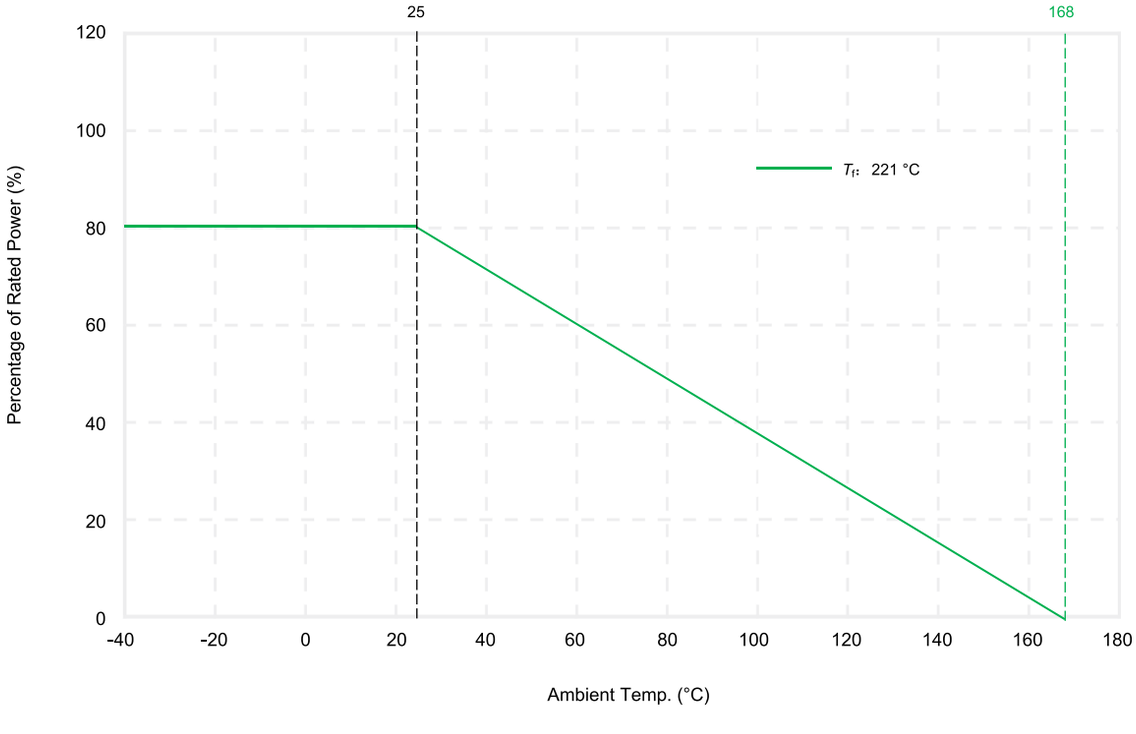


Fig. 12 Rated Power Derating Curve of TRXF 2 W (For Reference Only)

TRXF

ATTENTION

Inspection

Cold Resistance Test

1. If product TCR is no less than 350 (10^{-6}/°C), and the test ambient temp. is during 15 °C to 35°C, the measured resistance value shall be corrected as the relative resistance value under 25 °C according to TCR formula.

2. Resistance Measurement (4-terminal test)

Usage

1. Do not touch the resistor body or pins directly when power is on, to avoid burn or electric shock.

2. When air pressure is from 80 kPa to 106 kPa, The relative altitude shall be 2000 m to -500 m.

Replacement

As TRXF is a non-resettable product, for safety sake, please use the same type of TRXF for replacement.

Storage

Please store the resistor without high temp., high humidity or corrosive gas. To avoid reducing the solderability of the lead wire, please use them up within 1 year after receiving the goods.

Installation

Mechanical Stress

Do not apply mechanical stress to the resistor body during or after the installation.

Soldering Parameters

Wave Soldering Parameters

The Wave Soldering Parameters are for reference only, before TRXF is for practice usage, relative validation is recommended.

TRXF

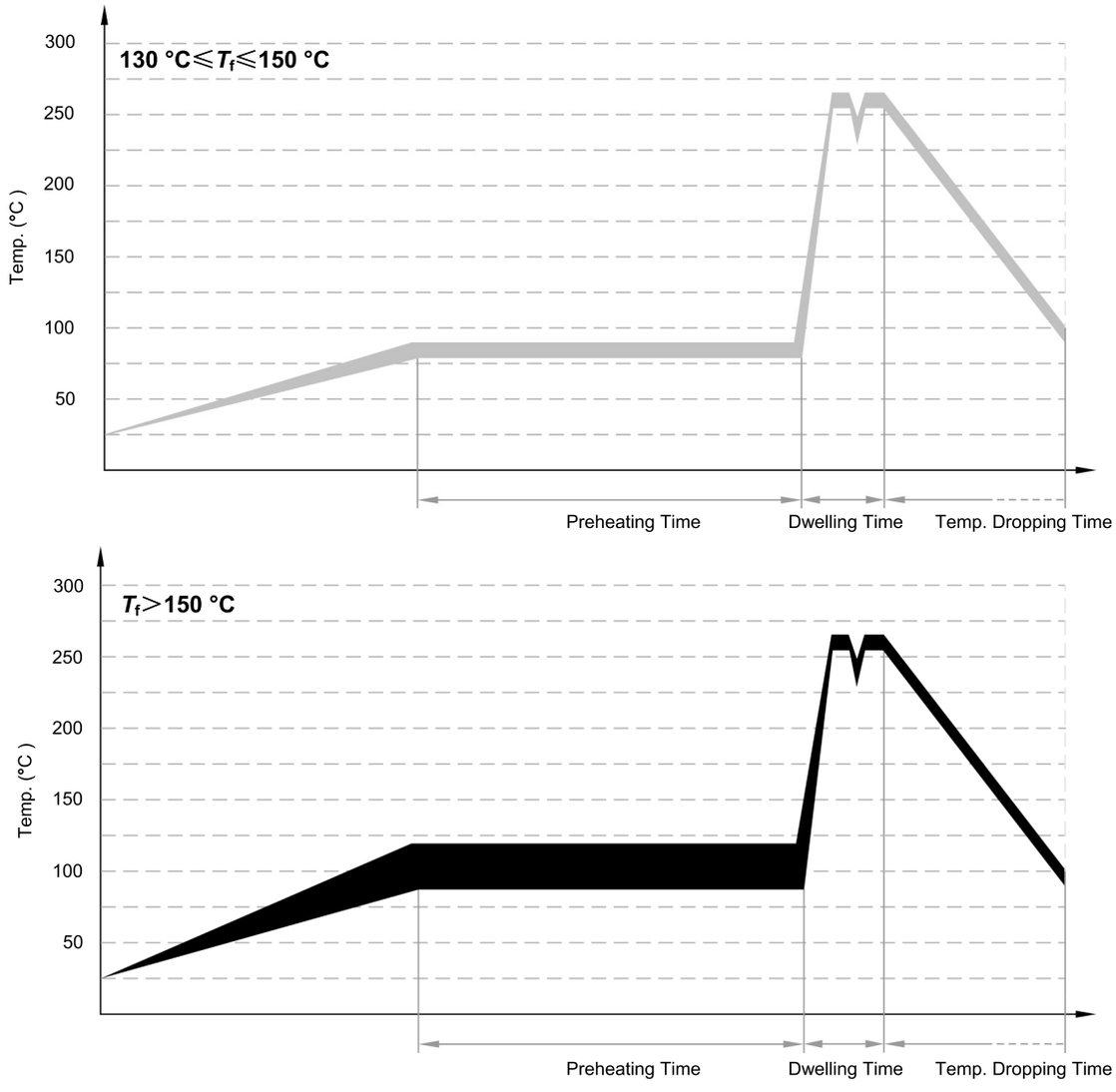


Fig. 13 Wave Soldering Curve

Items	Temp. (°C)		Time (s)
Preheating	130 °C≤T_f≤150 °C	T_f>150 °C	60 - 100
	80 - 90	90 - 120	
Dwelling	260±5	260±5	4 - 5

Recommended Hand-solder Parameters

Solder Iron Temp.: (350±5) °C

Heating Time: t ≤2 s (130 °C≤T_f≤150 °C) / t ≤3 s (T_f>150 °C)

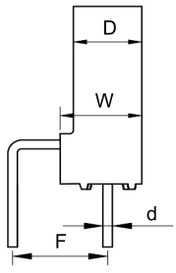
Installation Position

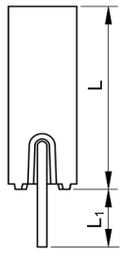
Do not install TRXF on the place which may often suffer severe vibration.

Shape and Dimensions

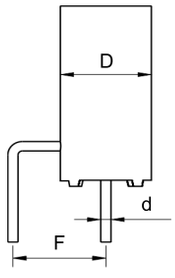
Vertical Installation – 2 Pins

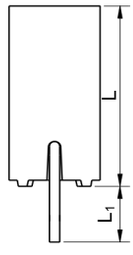
TRXF1S Series





TRXF1 & TRXF2 Series





Dimensions

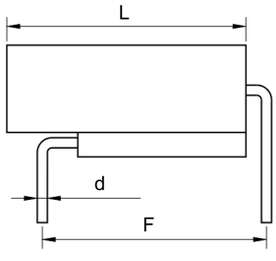
Unit (mm)

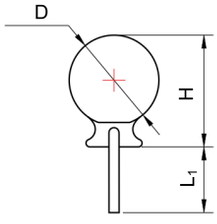
Series	Rated Power (W)	L	L_1[a]	W	D	d	F[a]
TRXF1S	1	11.0 Max.	3.5±0.5	4.5±0.3	Φ3.6±0.2	Φ0.50±0.05	5.0±0.5
TRXF1	1	11.0 Max.	3.5±0.5	—	Φ4.8±0.2	Φ0.54±0.05	5.0±0.5
TRXF2	2	13.5 Max.	3.5±0.5	—	Φ4.8±0.2	Φ0.54±0.05	5.0±0.5

[a]: F", "L_1" and the bending mode of lead wires can be customized as required.

Horizontal Installation – 2 Pins

Ω Shape





Dimensions

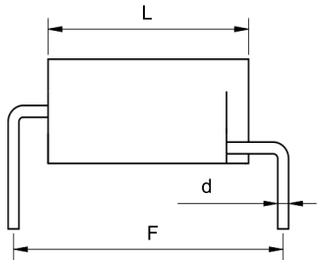
Unit (mm)

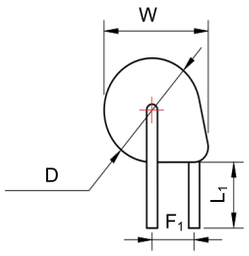
Series	Rated Power (W)	L	L_1[a]	H	D	d	F[a]
TRXF1S	1	11.0 Max.	3.5±0.5	4.8±0.2	Φ3.6±0.2	Φ0.50±0.05	10.0±0.5
TRXF1	1	11.0 Max.	3.5±0.5	6.0±0.2	Φ4.8±0.2	Φ0.54±0.05	10.0±0.5
TRXF2	2	13.5 Max.	3.5±0.5	6.0±0.2	Φ4.8±0.2	Φ0.54±0.05	10.0±0.5

[a]: "F", "L_1"and the bending mode of lead wires can be customized as required.

TRXF

V Shape





Dimensions

Unit (mm)

Series	Rated Power (W)	L	L_1[a]	W	D	d	F[a]	F_1[a]
TRXF1	1	11.0 Max.	3.5±0.5	6.0±0.2	Φ4.8±0.2	Φ0.54±0.05	15.0±0.5	2.10±0.50
TRXF2	2	13.5 Max.	3.5±0.5	6.0±0.2	Φ4.8±0.2	Φ0.54±0.05	15.0±0.5	2.25±0.50

[a]:"F", "L_1"and the bending mode of lead wires can be customized as required.

Typical Application Parameters

Model	Rated Power	Rated Resistance	T_f of TCO	Surge	Short Circuit Voltage	I^2t	Main Application
	(W)	(Ω)	(°C)	(kV)	(Vac)	(A^2s)	
TRXF1S-2R0K11LA(C)	1	2.0	221	1.2	264	0.609	Power Adapter
TRXF1S-3R3K11LA(C)	1	3.3	221	1.3	264	0.251	Power Adapter, LED Lamp
TRXF1S-5R1J11LA(C)	1	5.1	221	1.5	264	0.345	Power Adapter, LED Lamp
TRXF1S-10RJ11LA(C)	1	10	221	1.8	264	0.457	Power Adapter, LED Lamp
TRXF1S-22RJ11LA(C)	1	22	221	2.0	264	0.237	LED Lamp
TRXF1S-100RJ11LA(C)	1	100	221	2.0	264	0.035	LED Lamp
TRXF1-2R2K30LA(C)	1	2.2	221	1.3	264	1.533	Power Adapter,
TRXF1-3R3J30LA(C)	1	3.3	221	1.8	264	1.298	Power Adapter, LED Lamp
TRXF1-5R1J30LA(C)	1	4.7	221	2.0	264	0.507	Power Adapter, LED Lamp
TRXF1-10RJ30LA(C)	1	10	221	2.5	264	0.327	Power Adapter, LED Lamp
TRXF1-22RJ30LA(C)	1	22	221	2.5	264	0.350	LED Lamp
TRXF1-100RJ30LA(C)	1	100	221	2.5	264	0.092	LED Lamp
TRXF2-2R2K50LA(C)	2	2.2	221	1.5	264	1.620	Power Adapter
TRXF2-3R3J50LA(C)	2	3.3	221	2.0	264	2.618	Power Adapter, LED Lamp
TRXF2-5R1J50LA(C)	2	5.1	221	2.5	264	0.678	Power Adapter, LED Lamp
TRXF2-10RJ50LA(C)	2	10	221	3.5	264	0.520	Power Adapter, LED Lamp
TRXF2-22RJ50LA(C)	2	22	221	3.0	264	0.693	LED Lamp
TRXF2-100RJ50LA(C)	2	100	221	3.0	264	0.076	LED Lamp

TRXF

Specifications

Series	RXF			T_f of TCO	Agency Approvals			
	Rated Power	Rated Resistance	Tolerance		UL	CUL	TUV	CQC
	(W)	(Ω)	(%)	(°C)				
TRXF1S	1	1.0 - 600	±5, ±10	145,150, 221	●	●		●
TRXF1	1	0.27 - 0.47	±5, ±10	145,150, 221	●	●		●
		0.47 - 800	±5, ±10				●	
TRXF2	2	0.27 - 2.0	±5, ±10	145,150, 221	●	●		●
		2.0 - 1000	±5, ±10				●	

Performance Tests

Mechanical Performances Tests

Items	Test Conditions	Performance Requirements
Tensile Test	A lead or terminal withstand 10 N × 60 s	No Visible Damage ΔR≤±(1%R+0.05 Ω)
Twist Test	Twist 180° × 2 times	No Visible Damage ΔR≤±(1%R+0.05 Ω)

Environmental Tests

Item	Test Condition	Performance Requirement
Temp. Cycle	1. - 55 °C: 30 min 2. Room Temp.: (10 - 15) min 3. 85 °C: 30 min 4. Room Temp.:(10 - 15) min 5. 5 Cycles of Step1 to Step 4	ΔR≤±(2%R+0.05 Ω)

Electrical Performances Tests

Items	Test Conditions	Performance Requirements
Temp. Coefficient of Resistance (TCR)	$TCR=\frac{(R_2-R_1)}{R_1(T_2-T_1)}\times 10^6$ R_1: Resistance Value at 25 °C R_2: Resistance Value at 125 °C T_1: 25 °C, T_2: 125 °C	Within Specified Value
Short-time Overload	2.5U_r × 5 s	Legible Marking, No Visible Damage ΔR≤±(2%R+0.05 Ω)

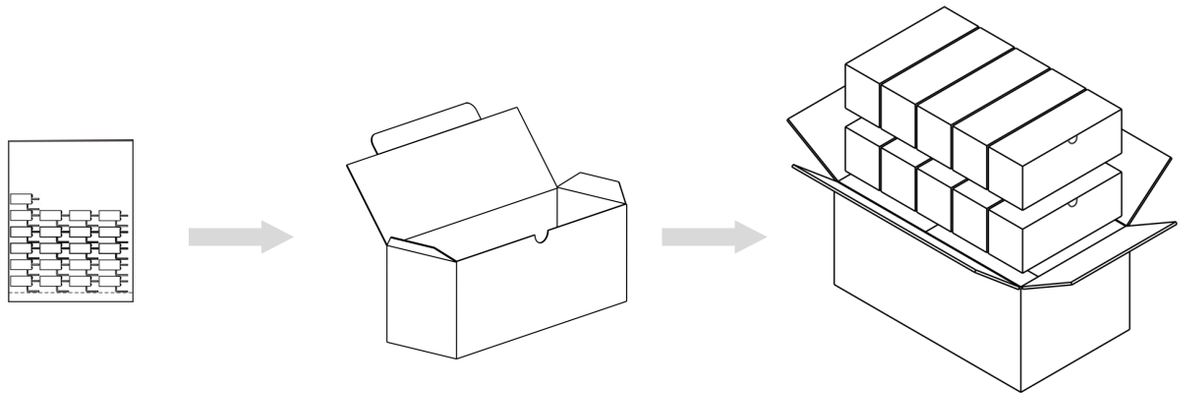
See Next Page

TRXF

Insulation Resistance	Foil Method: Apply 500 Vdc between lead wire and the metal foil.	Insulation Resistance≥1000 MΩ
Voltage Proof	Foil Method: Apply 900 Vac × 1 min between pin and the metal foil.	No Breakdown or Flashover
Solderability	Solder Bath (non-activated flux) Scaling Powder: 25% Rosin Alcohol Depth of Immersion (From the seating plane or component body):2.0 mm +0/-0.5 mm Time of Immersion: (2.5±0.5) s	Soldering Area≥95%
Surge Test	Combination Wave Generator (1.2/50 μs, 8/20 μs, 2 Ω), 10 Times, 1 min Interval	Resistor shall not open after the test.
Short Circuit Test	Fusing resistor at both lead terminals of the test voltage is applied directly.	No Evident Explosion Sound or Electronic Spark
Fusing Test	Apply test current to the resistor (constant current source).	Fusing Time of TCO≤60 s
Fusing Temp. (T_F)	Silicone oil bath: Temp. rise rate is 0.3 °C/min to 0.5 °C/min, detection current ≤10 mA.	T_f= 221 °C, T_F=(218±2) °C; T_f= 150 °C, T_F=(145±2) °C; T_f= 145 °C, T_F=(140±2) °C; T_f: Rated Functioning Temp. T_F: Fusing Temp.

TRXF

Packaging Information



Small Packaging Bag　　Inner Packaging Box　　Outer Packaging Carton

Items	Dimensions (mm)	Q'TY
Small Packaging Bag	85 × 135	100 PCS
Inner Packaging Box	255 × 88 × 98	20 Bags
Outer Packaging Carton	480 × 280 × 220	10 Boxes