

PTC thermistors as inrush current limiter

PTC thermistor in housing

Series/Type:	J252
Ordering code:	B59252J0140B020
Date:	2021-07-14
Version:	a

Applications

- Inrush current limiter (charging resistor) for smoothing and DC link capacitors
- To replace high-power fixed resistors for capacitor charging
- Discharge resistor for DC link capacitors



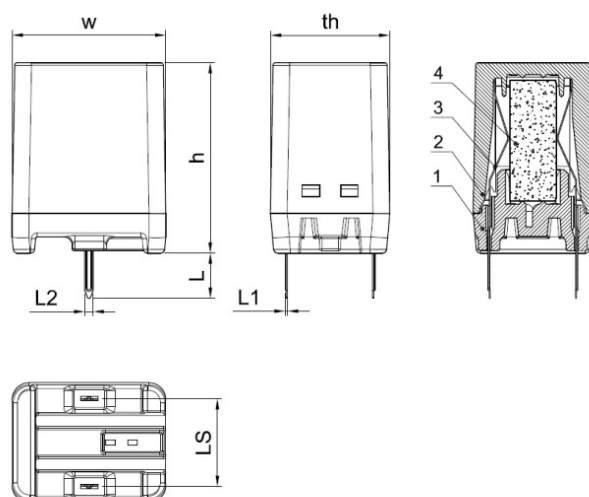
Features

- Self-protecting in case of malfunction of short-circuit relay or internal short circuit of capacitor
- Encased thermistor disk with clamp contacts for high reliability
- For high pulse currents and a high number of operating cycles
- Inrush current limiters are not damaged when directly connected to $V_{\max}$ even without additional current limitation
- Flame-retardant plastic case, case material UL-listed
- Sn-plated lead-free solder pins
- Manufacturer's logo, type designation and date code YYWW on laser-printing
- RoHS-compatible

Delivery mode

- Parts on plastic trays in carton box

Dimensional drawings



	Min.	Nom.	Max.	Unit
w	17.5	18.0	18.5	mm
th	13.5	14.0	14.5	mm
h	21.7	22.2	22.7	mm
LS	9.50	10.0	10.5	mm
L	3.10	3.50	3.90	mm
L1			0.40	mm
L2	0.80	1.00	1.20	mm

	Material
1 Base	PBT+30%GF
2 Cap	PBT+30%GF
3 Spring terminal	Stainless steel 1.4310 (tin area with nickel base layer)
4 PTC thermistor	Barium titanate;

General technical data

Parameter	Symb.	Min.	Nom.	Max.	Unit	Remark
Maximum operating voltage	$V_{\max}$			780	V_{RMS}	$T_A = -40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$
DC link voltage	V_{link}			1100	V_{DC}	$T_A = -40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$
Rated resistance @ $25\text{ }^{\circ}\text{C}$	R_{25}	350	500	650	Ω	$T_A = 25\text{ }^{\circ}\text{C} \pm 0.1\text{ }^{\circ}\text{C}$
Reference temperature (typ.)	T_{ref}		140		$^{\circ}\text{C}$	
Thermal capacity (typ.)	C_{th}		2.3		J/K	
Thermal time constant (typ.)	T_{th}		150		s	
Operating cycles (charging)	N_c	100k				$V = V_{\text{link,max}}$
Operating cycles (malfunction)	N_m	100				$V = V_{\text{link,max}}$
Operating temperature range	T_{op}	-40		125		$V = 0$
Operating temperature range	T_{op}	-40		85		$V = V_{\text{link,max}}$

Specification for $T_A = 25\text{ }^{\circ}\text{C}$

Calculation of the number of required PTC elements

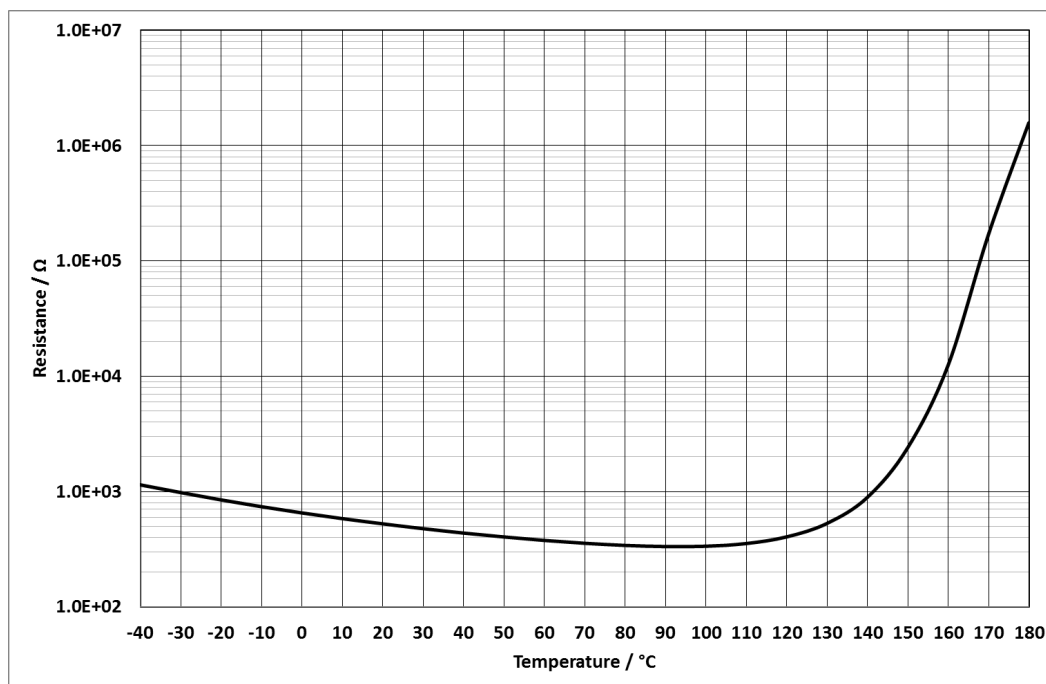
Number of required PTC elements (connected in parallel) as function of capacitance and charging voltage of smoothing or DC link capacitor:

$$N \geq \frac{k * C * V^2}{2 * C_{th} * (T_{ref} - T_{A,max})}$$

K	K factor K = 1 for DC source K = 0.96 for 3-phase bridge rectifier K = 0.76 for single phase bridge rectifier
N	Number of required PTC thermistors connected in parallel
C	Capacitance of smoothing or DC link capacitor in F
V	Charging voltage of capacitor in V
C _{th}	Heat capacity in J/K
T _{ref}	Reference temperature of PTC in °C
T _{A,max}	Expected maximum ambient temperature in °C

In case of large N values the resulting resistance of the parallel PTC network might be too low for effective limitation of the charging current. In this case a combination of series and parallel connected PTC thermistors can be used.

Typical R/T-characteristic (low signal measurement)



Reliability data

Test item	Testing method / Description	$ \Delta R_{25}/R_{25} $
High temperature exposure	MIL-STD-202, Method 108 1000 h at max. operating temperature +125 °C (V = 0) Measurement at 24 +/- 2 hours after test	≤ 20%
Temperature cycling	JESD22 Method JA-104 1000 cycles, -55 °C to +125°C, Dwell time = 30 min at each temperature extreme, 1 min max. transition time. Measurement at 24 +/- 2 hours after test conclusion.	≤ 25%
Biased humidity	Mil-STD-202, Method 103 1000 h 85 °C/85%RH, V = 0.05*V _{max} (10% rated power) Measurement at 24+/-2 hours after test conclusion	≤ 20%
Operational life	MIL-STD-202, Method 108 1000 h at max. operating temperature + 85 °C, V = V _{max} Measurement at 24+/-2 hours after test conclusion	≤ 20%
Terminal strength	MIL-STD-202, Method 211 After gradually applying the force 2.27 kg and keep the unit fixed for 10 s, the terminal shall be visually examined for any damage	Terminal no visible damage
Resistance to solvents	MIL-STD-202, Method 215 Note: Add Aqueous wash chemical - OKEM clean or equivalent Do not use banned solvents.	Marking visible
Mechanical shock	MIL-STD-202-213 condition C Amplitude = 1,000 m/s ² , duration = 6 ms, 3 pulses per axis (6 directions)	≤ 5%
Vibration	MIL-STD-202 Method 204 f = from 10 up to 2000 Hz h = 0.75 mm respective a = 50 m/s ² d = 3 * 2 h (3 directions, 2 h/direction)	≤ 5%
Resistance to soldering heat	MIL-STD-202 Method 210 Condition B No pre-heat of samples. T = 260 +/- 3 °C, Duration = 10 s	≤ 20 %
ESD	AEC-Q200-002 or ISO/DIS10605 150 pF / 330 Ohm; 8 kV contact discharge, polarity +/-; 10 pulses in each polarity	≤ 5 %
Solderability	J-STD-002 Electrical test not required. Magnification 50 x. Conditions Solder material : Sn96.5Ag3Cu0.5 Solder bath, T = 245 +/- 3 °C, duration 3 s	Continuous solder coating with coverage ≥ 95%

Packaging

500 pieces per box in tray packaging

Tray

Material: Polystyrol

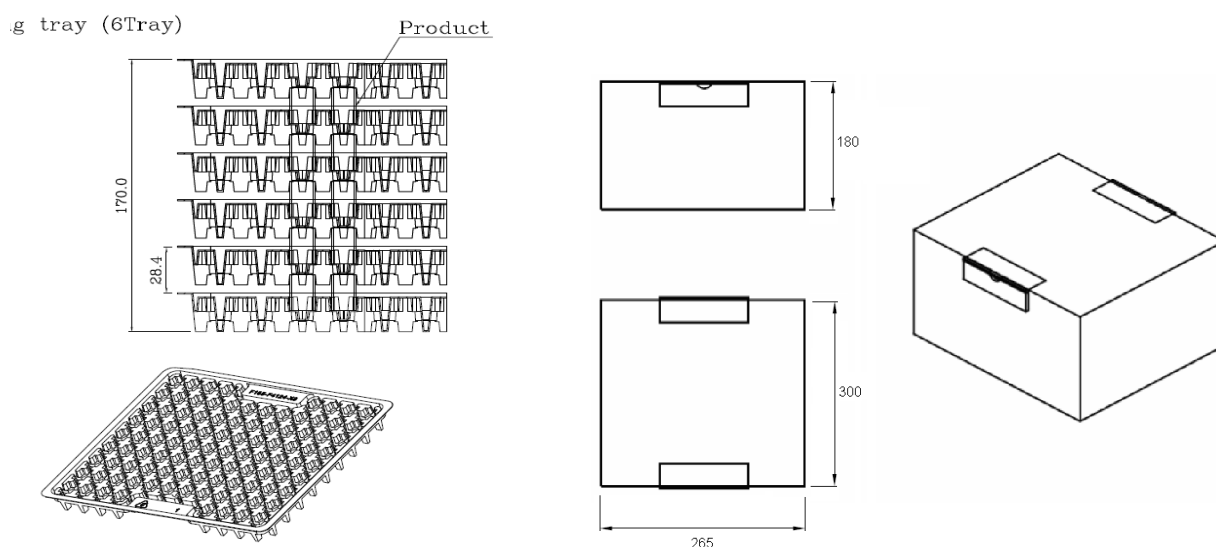
Unit: 100 pieces per tray

Carton

Material: Cardboard

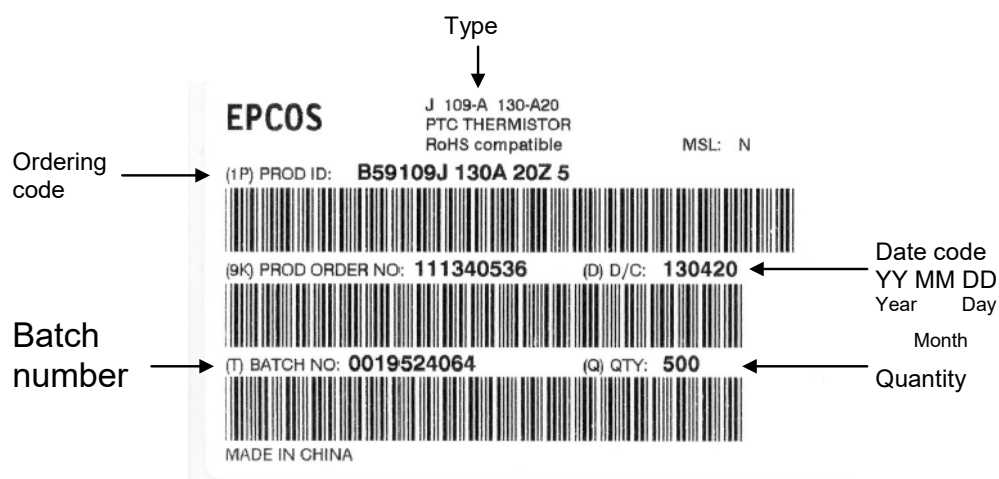
Unit: 5 trays per box, stacked with 1 tray as cover

Dimensional drawing



Dimensions in mm

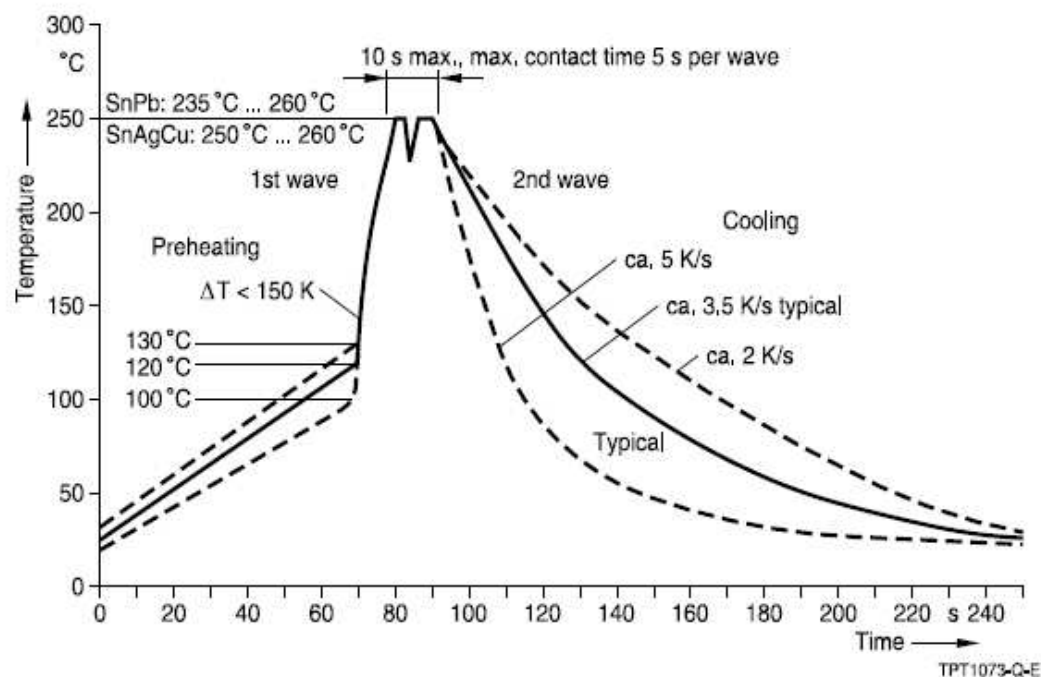
Labelling (example)



Soldering Instructions

Wave soldering

Recommended temperature profile for wave soldering following IEC 61760-1. Applicable for leaded PTCs and selected SMD PTCs (case sizes 3225 and 4032).



Cautions and warnings

General

- TDK Electronics thermistors are designed for specific applications and should not be used for purposes not identified in our specifications, application notes and data books unless otherwise agreed with TDK Electronics during the design-in-phase.
- Ensure suitability of thermistor through reliability testing during the design-in phase. The thermistors should be evaluated taking into consideration worst-case conditions.

Storage

- Store thermistors only in original packaging. Do not open the package prior to processing.
- Storage conditions in original packaging: storage temperature -25°C ... +45°C, relative humidity ≤75% annual mean, maximum 95%, dew precipitation is inadmissible.
- Avoid contamination of thermistors surface during storage, handling and processing.
- Avoid storage of thermistor in harmful environment with effect on function on long-term operation (examples given under operation precautions).
- Use thermistor within the following period after delivery:
 - Through-hole devices (housed and leaded PTCs): 24 months
 - Motor protection sensors, glass-encapsulated sensors and probe assemblies: 24 months
 - Telecom pair and quattro protectors (TPP, TQP): 24 months
 - Leadless PTC thermistors for pressure contacting: 12 months
 - Leadless PTC thermistors for soldering: 6 months
 - SMDs in EIA sizes 3225 and 4032, and for PTCs with metal tags: 24 months
 - SMDs in EIA sizes 1210 and smaller: 12 months

Handling

- PTCs must not be dropped. Chip-offs must not be caused during handling of PTCs.
- The ceramic and metallization of the components must not be touched with bare hands. Gloves are recommended.
- Avoid contamination of thermistor surface during handling.

Soldering (where applicable)

- Use rosin-type flux or non-activated flux.
- Insufficient preheating may cause ceramic cracks.
- Rapid cooling by dipping in solvent is not recommended.
- Complete removal of flux is recommended.
- Standard PTC heaters are not suitable for soldering.

Mounting

- Electrode must not be scratched before/during/after the mounting process.
- Contacts and housing used for assembly with thermistor have to be clean before mounting. Especially grease or oil must be removed.
- When PTC thermistors are encapsulated with sealing material, the precautions given in chapter "Mounting instructions", "Sealing and potting" must be observed.
- When the thermistor is mounted, there must not be any foreign body between the electrode of the thermistor and the clamping contact.
- The minimum force and pressure of the clamping contacts pressing against the PTC must be 10 N and 50 kPa, respectively. In case the assembly is exposed to mechanical shock and/ or vibration this force should be higher in order to avoid movement of the PTC during operation.
- During operation, the thermistor's surface temperature can be very high. Ensure that adjacent components are placed at a sufficient distance from the thermistor to allow for proper cooling at the thermistors.
- Ensure that adjacent materials are designed for operation at temperatures comparable to the surface temperature of thermistor. Be sure that surrounding parts and materials can withstand this temperature.
- Avoid contamination of thermistor surface during processing.

Operation

- Use thermistors only within the specified temperature operating range.
- Use thermistors only within the specified voltage and current ranges.
- Environmental conditions must not harm the thermistors. Use thermistors only in normal atmospheric conditions. Avoid use in deoxidizing gases (chlorine gas, hydrogen sulfide gas, ammonia gas, sulfuric acid gas etc), corrosive agents, humid or salty conditions. Contact with any liquids and solvents should be prevented.
- Be sure to provide an appropriate fail-safe function to prevent secondary product damage caused by abnormal function (e.g. use VDR for limitation of overvoltage condition).

This listing does not claim to be complete, but merely reflects the experience of TDK Electronics.

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