

PTC thermistors for overcurrent protection

Leaded disks, coated, 12 V, 24 V

Series/Type: B599*5

Date: February 2012

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C935 ... C995

Applications

- Overcurrent protection
- Short circuit protection

Features

- Lead-free terminals
- Marking: Type, manufacturer's logo, reference temperature in °C and date code YYWW (except B59995C*)
- Low resistance
- For rated currents of up to 1.8 A
- UL approval to UL 1434 for V_{max} = 15 V and V_R = 12 V (file number E69802)
- Qualification based on AEC-Q200, Rev. D (except: B59935C* and B59995C*)
- RoHS-compatible

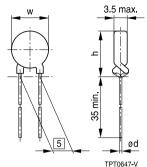
Options

- Leadless disks and leaded disks without coating available on request
- Thermistors with diameter w ≤11.0 mm are also available on tape (to IEC 60286-2)

Delivery mode

- Cardboard strips (standard)
- Cardboard tape reeled or in Ammo pack on request

Dimensional drawing



Dimensions (mm)

Type W_{max} h_{max} $\emptyset d$ C935 22.0 25.5 0.6 C945 17.5 21.0 0.6 C955 13.5 17.0 0.6 C965 11.0 14.5 0.6 C975 9.0 12.5 0.6 C985 6.5 10.0 0.6 C995 4.0 7.5 0.5

General technical data

Max. operating voltage	(T _A = 60 °C)	V_{max}	30	V DC or V AC
Rated voltage		V _R	12, 24	V DC or V AC
Switching cycles		N	100	
Reference temperature	(typ.)	T _{ref}	120	°C
Tolerance of R _B	() ,	ΔR_{B}	±25	%
Operating temperature range	(V = 0)	Top	-40/+125	°C
Operating temperature range	$(V = V_{max})$	Top	-40/+85	°C



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Electrical specifications and ordering codes

Туре	I _R	Is	I _{Smax}	I _r	R _R	R_{min}	Approvals	Ordering code
			$(V = V_{max})$	(typ.)				
				$(V = V_{max})$				
	mA	mA	Α	mA	Ω	Ω	7/2	
C935	1800	3600	10.0	170	0.3	0.2	Χ	B59935C0120A070
C945	1300	2600	8.0	115	0.45	0.3	X	B59945C0120A070
C955	850	1700	5.5	80	0.8	0.5	X	B59955C0120A070
C965	600	1200	4.3	70	1.2	0.7	X	B59965C0120A070
C975	450	900	3.0	60	1.8	1.1	X	B59975C0120A070
C985	250	500	1.0	45	4.6	2.7	X	B59985C0120A070
C995	120	240	0.7	25	13	7.8	X	B59995C0120A070

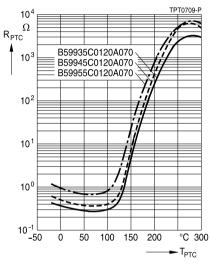
Reliability data

Test	Standard	Test conditions	$ \Delta R_{25}/R_{25} $
Electrical endurance,	IEC 60738-1	Room temperature, I _{Smax} ; V _{max}	< 25%
cycling		Number of cycles: 100	, .
Electrical endurance,	IEC 60738-1	Storage at V _{max} /T _{op,max} (V _{max})	< 25%
constant		Test duration: 1000 h	
Damp heat	IEC 60738-1	Temperature of air: 40 °C	< 10%
		Relative humidity of air: 93%	
		Duration: 56 days	
		Test according to IEC 60068-2-78	
Rapid change	IEC 60738-1	$T_1 = T_{op,min} (0 \text{ V}), T_2 = T_{op,max} (0 \text{ V})$	< 10%
of temperature		Number of cycles: 5	
		Test duration: 30 min	
		Test according to IEC 60068-2-14, test Na	
Vibration	IEC 60738-1	Frequency range: 10 to 55 Hz	< 5%
		Displacement amplitude: 0.75 mm	
		Test duration: 3 × 2 h	
		Test according to IEC 60068-2-6, test Fc	
Shock	IEC 60738-1	Acceleration: 390 m/s ²	< 5%
		Pulse duration: 6 ms; 6 × 4000 pulses	
Climatic sequence	IEC 60738-1	Dry heat: $T = T_{op,max}(0 \text{ V})$	< 10%
		Test duration: 16 h	
		Damp heat first cycle	
		Cold: $T = T_{op,min}(0 \text{ V})$	
		Test duration: 2 h	
		Damp heat 5 cycles	
		Tests performed according to	
		IEC 60068-2-30	

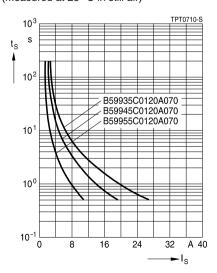
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Characteristics (typical)

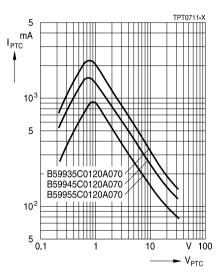
PTC resistance R_{PTC} versus PTC temperature T_{PTC} (measured at low signal voltage)



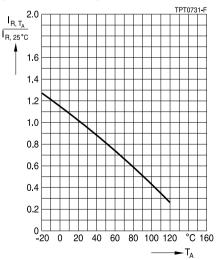
Switching time t_S versus switching current I_S (measured at 25 °C in still air)



PTC current I_{PTC} versus PTC voltage V_{PTC} (measured at 25 °C in still air)



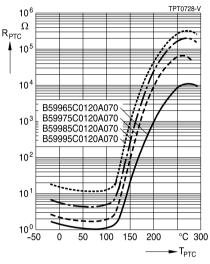
Rated current I_R versus ambient temperature T_A (measured in still air)



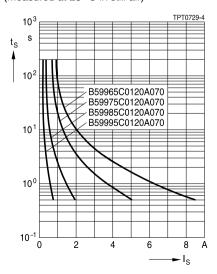
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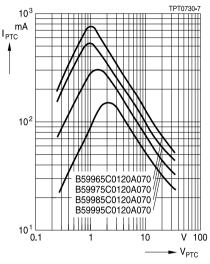
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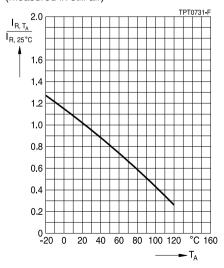
Switching time t_S versus switching current I_S (measured at 25 °C in still air)



PTC current I_{PTC} versus PTC voltage V_{PTC} (measured at 25 °C in still air)



Rated current I_R versus ambient temperature T_A (measured in still air)





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Cautions and warnings

General

- EPCOS 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 EPCOS 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 before storage.
- 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 0402, 0603, 0805 and 1210: 12 months

Handling

- PTCs must not be dropped. Chip-offs must not be caused during handling of PTCs.
- 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.



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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 of the clamping contacts pressing against the PTC must be 10 N.
- 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).



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Symbols and terms

A Area

C Capacitance
C_{th} Heat capacity
f Frequency
Current

 $\begin{array}{lll} I_{\text{max}} & & \text{Maximum current} \\ I_{\text{R}} & & \text{Rated current} \\ I_{\text{res}} & & \text{Residual current} \\ I_{\text{PTC}} & & \text{PTC current} \\ I_{\text{res}} & & \text{Residual current} \end{array}$

 $I_{r,oil}$ Residual currrent in oil (for level sensors) $I_{r,air}$ Residual currrent in air (for level sensors) I_{RMS} Root-mean-square value of current

I_S Switching current

I_{Smax} Maximum switching current LCT Lower category temperature

N Number (integer)

N_c Operating cycles at V_{max}, charging of capacitor

N_f Switching cycles at V_{max}, failure mode

P Power

P₂₅ Maximum power at 25 °C

P_{el} Electrical powerP_{diss} Dissipation power

R_G Generator internal resistance

Resistance at 25 °C

 $\begin{array}{lll} R_{\text{min}} & & \text{Minimum resistance} \\ R_{\text{R}} & & \text{Rated resistance} \\ \Delta R_{\text{R}} & & \text{Tolerance of R}_{\text{R}} \\ R_{\text{P}} & & \text{Parallel resistance} \\ R_{\text{PTC}} & & \text{PTC resistance} \\ R_{\text{ref}} & & \text{Reference resistance} \\ R_{\text{S}} & & \text{Series resistance} \end{array}$

Resistance matching per reel/ packing unit at 25 °C

 ΔR_{25} Tolerance of R_{25} T Temperature

t Time

 R_{25}

 T_A Ambient temperature t_a Thermal threshold time



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 $\begin{array}{ll} T_{\text{C}} & \text{Ferroelectric Curie temperature} \\ t_{\text{E}} & \text{Settling time (for level sensors)} \end{array}$

 T_R Rated temperature T_{sense} Sensing temperature T_{op} Operating temperature T_{PTC} PTC temperature T_{ext} Response time

T_{ref} Reference temperature

T_{Rmin} Temperature at minimum resistance

t_s Switching time

T_{surf} Surface temperature

UCT Upper category temperature

 $\begin{array}{ll} \text{V or V}_{\text{el}} & \text{Voltage (with subscript only for distinction from volume)} \\ \text{V}_{\text{c/max}} & \text{Maximum DC charge voltage of the surge generator} \end{array}$

V_{E,max} Maximum voltage applied at fault conditions in protection mode

V_{RMS} Root-mean-square value of voltage

 $\begin{array}{lll} V_{\text{BD}} & & \text{Breakdown voltage} \\ V_{\text{ins}} & & \text{Insulation test voltage} \\ V_{\text{link,max}} & & \text{Maximum link voltage} \\ V_{\text{max}} & & \text{Maximum operating voltage} \end{array}$

V_{max.dvn} Maximum dynamic (short-time) operating voltage

V_{meas} Measuring voltage

V_{meas,max} Maximum measuring voltage

V_□ Rated voltage

V_{PTC} Voltage drop across a PTC thermistor

 α Temperature coefficient Δ Tolerance, change δ_{th} Dissipation factor

τ_{th} Thermal cooling time constant

λ Failure rate

e Lead spacing (in mm)

Abbreviations / Notes

SMD Surface-mount devices

* To be replaced by a number in ordering codes, type designations etc.

+ To be replaced by a letter

All dimensions are given in mm.

The commas used in numerical values denote decimal points.



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