

# **PTC thermistors for overcurrent protection in telecom applications**

Leaded disks

**Series/Type:**

Date: July 2017

© EPCOS AG 2017. Reproduction, publication and dissemination of this publication, enclosures hereto and the information contained therein without EPCOS' prior express consent is prohibited.

EPCOS AG is a TDK Group Company.

## Overcurrent protection for telecom

### Leaded disks

#### Applications

- Overcurrent protection for telecom applications
- Suitable for line card applications e.g. POTS, access networks, customer premises equipment (CPE) or integrated voice data (IVD)

#### Features

- Compliant with ITU-T standards
  - basic-level lightning surges (10/700  $\mu$ s)
  - basic-level power induction (600 V, 1 A, 0.2 s)
  - power contact criteria A/B (230 V, 15 min.)
- Matching available with narrow resistance tolerance
- Tight resistance matching maintained after switching
- Negligible resistance drift after soldering or switching
- Marking: Type, manufacturer's logo, reference temperature in  $^{\circ}$ C and date code YYWW
- UL approval to UL 1434 (file number E69802) for B59154U1135B140, B59184C1120B153 and B59184C1130A151
- RoHS-compatible

#### Options

- Alternative tolerances and resistances on request

#### Delivery mode

- Taped on reel: Cardboard tape, 360-mm reel, taping to IEC 60286-2
- Bulk: In plastic bags

#### General technical data

Maximum fault voltage <sup>1)</sup>		$V_{F,max}$	245	V AC
Max. operating voltage		$V_{max}$	135	V AC
Operating temperature range	( $V = 0$ )	$T_{op}$	-20/+125	$^{\circ}$ C
Operating temperature range	( $V = V_{max}$ )	$T_{op}$	0/+70	$^{\circ}$ C

1) The maximum fault voltage  $V_{F,max}$  is the highest voltage that is permitted to be applied across the PTC thermistor in protection mode.

## Overcurrent protection for telecom

### Leaded disks

#### Electrical specifications and ordering codes

Type	$R_R$ $\Omega$	$\Delta R_R$ %	$R_{25,match}$ (per packing unit) $ R_1 - R_2 _{max}$ $\Omega$	$I_R$ @ 25°C mA	$I_R$ @ 70°C mA	$I_S$ @ 25°C mA	$I_{Smax}$ A	Ordering code
C1098	6	±17	No	185	110	440	3.0	B59098C1100B051
C1084	20.8	±20	1	80	40	240	3.0	B59084C1080B140
U1154	50	±15	1	65	45	150	2.5	B59154U1135B140
C1172	50	±15	3	95	63	250	2.0	B59172C1130A151
C1184	50	±15	1.0	90	60	190	2.5	B59184C1120B153
C1184	50	±15	1.0	100	60	210	2.5	B59184C1130A151
C1173	55	±15	3.0	90	60	210	2.5	B59173C1130A151
C1183	55	±15	3	115	90	270	3.0	B59183C1160A140

#### Switching times and ordering codes

Type	$R_R$ $\Omega$	$t_s$ (typ.) @ $I_{Smax}$ s	$t_s$ (typ.) @ 1 A s	$t_s$ (typ.) @ 500 mA s	Ordering code
C1098	6	1.5	14.0	70.0	B59098C1100B051
C1084	20.8	0.06	0.5	2.0	B59084C1080B140
U1154	50	0.05	0.3	1.1	B59154U1135B140
C1172	50	0.25	1.7	6.0	B59172C1130A151
C1184	50	0.06	0.8	3.1	B59184C1120B153
C1184	50	0.08	1.1	4.0	B59184C1130A151
C1173	55	0.09	1.3	5.0	B59173C1130A151
C1183	55	0.25	2.3	9.0	B59183C1160A140

## Overcurrent protection for telecom

### Leaded disks

#### Dimensional drawings <sup>1)</sup>

Figure 1

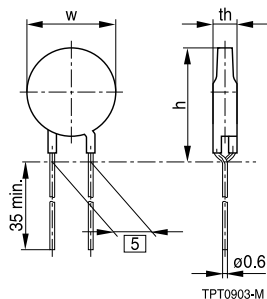
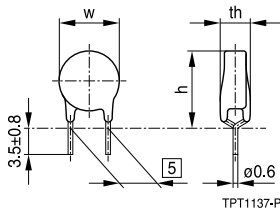


Figure 2



1) The lead length stated in the dimensional drawing refers to the untaped version. For dimensions of the taped version, see chapter "Taping and packing".

#### Dimensions in mm

Type	$R_R$ $\Omega$	$w_{max}$ mm	$h_{max}$ mm	$th_{max}$ mm	Figure	Packaging	Ordering code
C1098	6	13.0	17.0	5.0	Figure 1	Taped on reel	B59098C1100B051
C1084	20.8	7.5	4.0	10.5	Figure 2	Bulk	B59084C1080B140
U1154	50	6.0	10.0	4.0	Figure 2	Bulk	B59154U1135B140
C1172	50	8.0	11.0	5.5	Figure 1	Taped on reel	B59172C1130A151
C1184	50	9.0	12.5	4.5	Figure 1	Taped on reel	B59184C1120B153
C1184	50	9.0	13.0	4.5	Figure 1	Taped on reel	B59184C1130A151
C1173	55	8.0	11.0	5.5	Figure 1	Taped on reel	B59173C1130A151
C1183	55	9.5	13.0	6.0	Figure 2	Bulk	B59183C1160A140

## Overcurrent protection for telecom

### Leaded disks

#### Reliability data

Test	Standard	Test conditions	$ \Delta R_{25}/R_{25} $
Electrical endurance, cycling	IEC 60738-1	Room temperature, $I_{Smax}$ ; $V_{max}$ Number of cycles: 10	< 20%
Electrical endurance, constant	IEC 60738-1	Storage at $V_{max}$ and $T_{op,max}$ (@ $V_{max}$ ) Test duration: 1000 h	< 25%
Damp heat	IEC 60738-1	Temperature of air: 40 °C Relative humidity of air: 93% Duration: 56 days Test according to IEC 60068-2-78	< 10%
Rapid change of temperature	IEC 60738-1	$T_1 = T_{op,min}$ (0 V), $T_2 = T_{op,max}$ (0 V) Number of cycles: 5 Test duration: 30 min Test according to IEC 60068-2-14, test Na	< 10%
Vibration	IEC 60738-1	Frequency range: 10 to 55 Hz Displacement amplitude: 0.75 mm Test duration: 3 × 2 h Test according to IEC 60068-2-6, test Fc	< 5%
Shock	IEC 60738-1	Acceleration: 400 m/s <sup>2</sup> Pulse duration: 6 ms; 6 × 5000 pulses	< 5%
Climatic sequence	IEC 60738-1	Dry heat: $T = T_{op,max}$ (0 V) Test duration: 16 h Damp heat first cycle Cold: $T = T_{op,min}$ (0 V) Test duration: 2 h Damp heat 5 cycles Tests performed according to IEC 60068-2-30	< 10%

## Overcurrent protection for telecom

### Leaded disks

#### ITU performance overview and fault conditions

	Test no.	ITU K20		ITU K21		ITU K45	
		Basic test level	Enhanced test level	Basic test level	Enhanced test level	Basic test level	Enhanced test level
Power induction	1	A	A	A	A	A	A
	2	B	C	B	C	B	C
Power contact	3	D	E	D	E	D	E
Lightning surge	4	F	G	G	G	G	G
	5	H	H	H	I	H	H

Power induction	A	600 V AC, R = 600 Ω, t = 0.2 s, criteria A
	B	600 V AC, R = 600 Ω, t = 1.0 s, with GDT, criteria A
	C	1500 V AC, R = 200 Ω, t = 2.0 s, with GDT, criteria A
Power contact	D	230 V AC, t = 15 min, R = 10 ... 1000 Ω, criteria B
	E	230 V AC, t = 15 min, R = 10, 20, 40, 80, 1000 Ω, criteria B, R = 160, 300, 600 Ω, criteria A
Lightning surge	F	$V_{c(max)} = 1.0$ kV, R = 25 Ω, t = 10/700 μs, without GDT, criteria A
	G	$V_{c(max)} = 1.5$ kV, R = 25 Ω, t = 10/700 μs, without GDT, criteria A
	H	$V_{c(max)} = 4.0$ kV, R = 25 Ω, t = 10/700 μs, with GDT, criteria A
	I	$V_{c(max)} = 6.0$ kV, R = 25 Ω, t = 10/700 μs, with GDT, criteria A

**Note: Use a GDT (gas discharge tube) with adequate electrical properties in order to ensure reliable operation at enhanced test levels (power induction, lightning surge).**

Criteria A: no damage, function must be fulfilled.

Criteria B: no fire hazard.

## Overcurrent protection for telecom

### Leaded disks

#### Additional tests and test conditions

##### For type C1172:

Enhanced test condition to K.20 power induction	600 V <sub>AC</sub> , R = 600 Ω, t = 0.5 s, without GDT, criteria A (no damage, function must be fulfilled)
Enhanced test condition to K.20 single port, lightning	V <sub>c(max)</sub> = 2500 V, t = 1.2/50 μs, R = 2 Ω, without GDT, criteria A (no damage, function must be fulfilled) Number of cycles: 500

##### For type C1173:

Enhanced test condition to K.20 power induction	600 V <sub>AC</sub> , R = 600 Ω, t = 0.5 s, without GDT, criteria A (no damage, function must be fulfilled)
Enhanced test condition to K.20 single port, lightning	V <sub>c(max)</sub> = 4 kV, t = 10/700 μs, R = 40 Ω, without GDT, criteria A (no damage, function must be fulfilled)

##### For type C1183:

GR1089 Second level intra building AC power fault	120 V <sub>AC</sub> (50 Hz), short circuit current 25 A, t = 15 min, criteria A (no damage, function must be fulfilled)
Enhanced test condition to K.20 power induction	600 V <sub>AC</sub> , R = 600 Ω, t = 1 s, without GDT, criteria A (no damage, function must be fulfilled)
Enhanced test condition to K.20 single port, lightning	V <sub>c(max)</sub> = 4 kV, t = 10/700 μs, R = 40 Ω, without GDT, criteria A (no damage, function must be fulfilled)

##### For type C1184:

Enhanced test condition to K.20 power induction	600 V <sub>AC</sub> , R = 600 Ω, t = 0.5 s, without GDT, criteria A (no damage, function must be fulfilled)
Enhanced test condition to K.20 power contact	230 V <sub>AC</sub> , t = 15 min., R = 10 ... 1000 Ω, criteria A (no damage, function must be fulfilled)

##### For type U1154:

GR1089 Second level intra building AC power fault	120 V <sub>AC</sub> (50 Hz), short circuit current 25 A, t = 15 min, criteria A (no damage, function must be fulfilled)
Enhanced test condition to GR1089 first level intra building lightning surge for multi-pair ports	V <sub>c(max)</sub> = ±2.25 kV (each polarity 1 application), t = 2/10 μs, R <sub>G</sub> = 2 Ω, R = 12 Ω, criteria A (no damage, function must be fulfilled)

## Overcurrent protection for telecom

### Leaded disks

## 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 prior to processing.
- Storage conditions in original packaging: storage temperature  $-25\text{ }^{\circ}\text{C} \dots +45\text{ }^{\circ}\text{C}$ , relative humidity  $\leq 75\%$  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.



## Overcurrent protection for telecom

### Leaded disks

#### 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 EPCOS AG.

#### Display of ordering codes for EPCOS products

The ordering code for one and the same EPCOS product can be represented differently in data sheets, data books, other publications, on the EPCOS website, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products.** Detailed information can be found on the Internet under [www.epcos.com/orderingcodes](http://www.epcos.com/orderingcodes)

## Overcurrent protection for telecom


### Leaded disks

#### Symbols and terms

Symbol	Term
A	Area
C	Capacitance
$C_{th}$	Heat capacity
f	Frequency
I	Current
$I_{max}$	Maximum current
$I_R$	Rated current
$I_{res}$	Residual current
$I_{PTC}$	PTC current
$I_r$	Residual current
$I_{r,oil}$	Residual current in oil (for level sensors)
$I_{r,air}$	Residual current 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
$P_{25}$	Maximum power at 25 °C
$P_{el}$	Electrical power
$P_{diss}$	Dissipation power
$R_G$	Generator internal resistance
$R_{min}$	Minimum resistance
$R_R$	Rated resistance @ rated temperature $T_R$
$\Delta R_R$	Tolerance of $R_R$
$R_P$	Parallel resistance
$R_{PTC}$	PTC resistance
$R_{ref}$	Reference resistance
$R_S$	Series resistance
$R_{25}$	Resistance at 25 °C
$R_{25,match}$	Resistance matching per reel/ packing unit at 25 °C
$\Delta R_{25}$	Tolerance of $R_{25}$

## Overcurrent protection for telecom

### Leaded disks

T	Temperature
t	Time
T <sub>A</sub>	Ambient temperature
t <sub>a</sub>	Thermal threshold time
T <sub>C</sub>	Ferroelectric Curie temperature
t <sub>E</sub>	Settling time (for level sensors)
T <sub>R</sub>	Rated temperature @ 25 °C or otherwise specified in the data sheet
T <sub>sense</sub>	Sensing temperature
T <sub>op</sub>	Operating temperature
T <sub>PTC</sub>	PTC temperature
t <sub>R</sub>	Response time
T <sub>ref</sub>	Reference temperature
T <sub>Rmin</sub>	Temperature at minimum resistance
t <sub>S</sub>	Switching time
T <sub>surf</sub>	Surface temperature
UCT	Upper category temperature
V or V <sub>el</sub>	Voltage (with subscript only for distinction from volume)
V <sub>c(max)</sub>	Maximum DC charge voltage of the surge generator
V <sub>F,max</sub>	Maximum voltage applied at fault conditions in protection mode
V <sub>RMS</sub>	Root-mean-square value of voltage
V <sub>BD</sub>	Breakdown voltage
V <sub>ins</sub>	Insulation test voltage
V <sub>link,max</sub>	Maximum link voltage
V <sub>max</sub>	Maximum operating voltage
V <sub>max,dyn</sub>	Maximum dynamic (short-time) operating voltage
V <sub>meas</sub>	Measuring voltage
V <sub>meas,max</sub>	Maximum measuring voltage
V <sub>R</sub>	Rated voltage
V <sub>PTC</sub>	Voltage drop across a PTC thermistor
α	Temperature coefficient
Δ	Tolerance, change
δ <sub>th</sub>	Dissipation factor
τ <sub>th</sub>	Thermal cooling time constant
λ	Failure rate
	Lead spacing (in mm)

## Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed**.
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet ([www.epcos.com/material](http://www.epcos.com/material)). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order. We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
6. Unless otherwise agreed in individual contracts, **all orders are subject to the current version of the "General Terms of Delivery for Products and Services in the Electrical Industry" published by the German Electrical and Electronics Industry Association (ZVEI)**.

## Important notes

7. The trade names EPCOS, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, ExoCore, FilterCap, FormFit, LeaXield, MiniBlue, MiniCell, MKD, MKK, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, ThermoFuse, WindCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at [www.epcos.com/trademarks](http://www.epcos.com/trademarks).