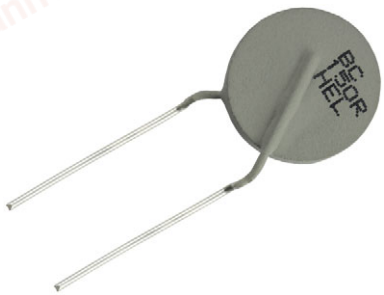
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PTC Thermistors, Inrush Current Limiter High Energy



LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models

QUICK REFERENCE DATA		
PARAMETER (1)	VALUE	UNIT
Resistance at 25 °C (R_{25}) (2)	75 to 1500	Ω
Switching temperature (typical)	160 to 170	°C
Maximum inrush current	10 to 30	A
Maximum AC voltage (2)	350 to 700	V_{RMS}
Maximum DC voltage (2)	500 to 1000	V_{DC}
Maximum peak voltage (3)	4000	V_P
Maximum energy at 25 °C (typical)	300	J
Operating temperature range	-40 to 105	°C
Storage temperature range	-40 to 175	°C
Dissipation factor (typical)	20	mW/K
Thermal time constant (1) (typical, still air cooling)	155	s
Weight	5.7	g

Notes

(1) Definitions, measurements, and tests are made in accordance with standard IEC 60738-1 “Thermistors - Directly heated positive temperature coefficient” and AEC-Q200 stress test qualification for passive components

(2) Other resistance values and maximum operating voltages available on request.
Matched resistance values available on request

(3) Maximum peak voltages are based on 8/20 µs pulses that can be applied with limited none-switching energy

FEATURES

- Higher energy absorption levels up to **300** J
- High number of inrush-power cycles: > 100 000 cycles
- Highly resistant against non-switching peak-powers of up to 25 kW
- Can handle high direct voltage up to 1000 V
- Self protecting in case of overload with no risk of over-heating
- AEC-Q200 qualified
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb e3 RoHS COMPLIANT

APPLICATIONS

Inrush current limiting and load-dump resistor in:

- AC/DC and DC/DC converters
- Energy dump and DC-Link circuits
- Emergency discharge circuits
- OBC, Battery charging equipment
- Motor drives
- Welding equipment

PTCEL thermistors have resistance values that can change instantly based on the applied voltage levels and varying body temperatures.

DESCRIPTION

These directly heated ceramic-based doped barium titanate thermistors have a positive temperature coefficient and are primarily intended for inrush current limiting and overload protection. They consist of a homogeneous high energy ceramic with increased switching temperature, soldered between two tinned CCS wires and coated with a UL 94 V-0 compliant high temperature silicone lacquer. The body is marked with the logo, cold resistance value, HEL on one side and date code on the opposite side.

MOUNTING

Important mounting and handling instructions, see:

www.vishay.com/doc?29223

By soldering in any position.

Not intended for potting or sealing.

Maximum surface temperature in case of overload can reach 210 °C.

PACKAGING

PTCEL thermistors are available in 200 pieces individually packed in layered PET trays or tape on reel 500 pieces.

For technical questions, contact: nlr@vishay.com

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ELECTRICAL DATA AND ORDERING INFORMATION

PART NUMBER (1)	R_{25} (Ω)	R_{25} TOL. (%)	$V_{MAX.}$ (V_{RMS})	$V_{LINK\ MAX.}$ (V_{DC})	$R_{MIN.}$ < 1.5 V_{DC} (Ω)	I_{HOLD} AT 25 °C (mA)	C_{th} (J/K) (3)	ENERGY 1 CYCLE AT 25 °C (J) (3)	τ_{th} (s) (3)	LEAD PITCH F (mm) (2)
PTCEL67R750LxE	75	30	350	500	35	144	2.6	300	155	10.0
PTCEL67R151NxE	150	30	460	650	65	102	2.6	300	155	10.0
PTCEL67R251SxE	250	30	600	850	105	79	2.6	300	155	10.0
PTCEL67R501TxE	500	30	700	1000	200	56	2.6	300	155	10.0
PTCEL67R501TxE305	500	30	700	1000	200	56	2.6	300	155	7.5
PTCEL67R102UxE	1000	30	700	1000	380	40	2.6	300	155	10.0
PTCEL67R152UxE	1500	30	700	1000	570	32	2.6	300	155	10.0

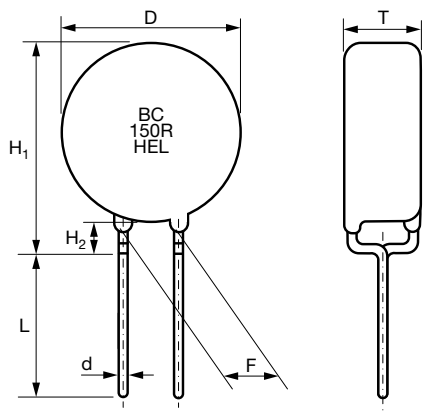
Notes

(1) Replace the x by B for bulk or T for tape and reel

(2) Standard lead wire pitch F on the high energy series is 10.0 mm

(3) Typical values for information, are temperature or mounting dependent

OUTLINE AND DIMENSIONS



COMPONENT DIMENSIONS in millimeters			
SYMBOL	PTCEL67		
D	16.5 max.		
d	0.8 ± 0.05		
H_1	20 max.		
H_2	3 ± 1		
T	7.5 max.		
F (1)	5.0 ± 0.8	7.5 ± 0.8	Standard 10.0 ± 0.8
L (2)	20 min.	18 min.	16 min.

Notes

(1) F pitch = see “Electrical Data and Ordering Information” table for available wire pitch part numbers

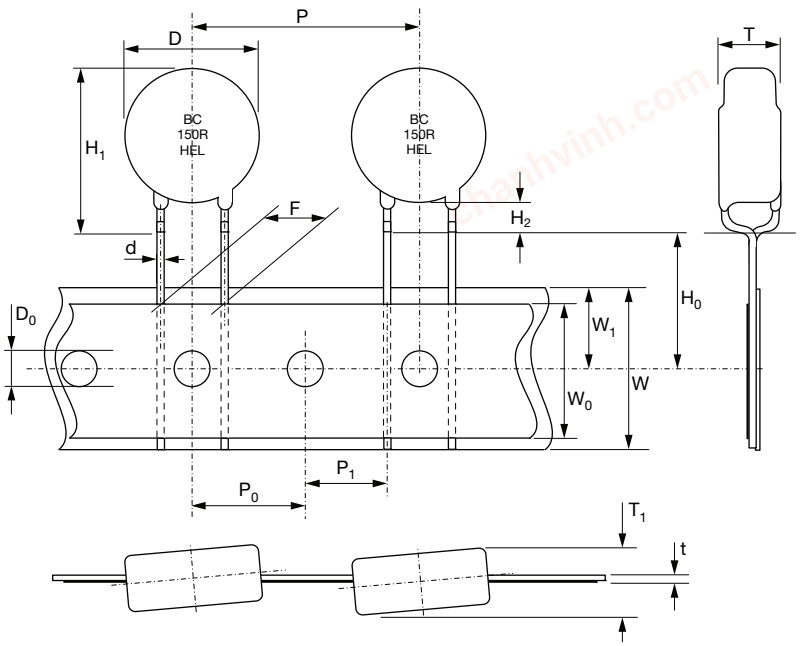
(2) L lead length corresponds to available wire pitch part numbers

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TAPE AND REEL DIMENSIONS

Taping on reel with F = 7.5 mm and 10.0 mm wire pitch, spacing paper tape and foam separator tape used on reel.



DIMENSIONS in millimeters (standard cardboard tape W 18 mm according IEC 60286-2)		
SYMBOL	**PARAMETER**	**VALUE**
D	Body diameter	See bulk dimensions
d	Lead diameter	See bulk dimensions
D_0	Feed hole diameter	4.0 ± 0.3
P	Component pitch	25.4 ± 1.0
P_1	Feed hole center to lead center	
	67R type *TE	7.7 ± 0.7
	67R type *TE3xx	8.95 ± 0.7
P_0	Feedhole pitch	12.7 ± 0.3
F	Lead center to lead center distance (between component and tape)	
	67R type *TE (feedhole between leads)	10.0 +0.5/-0.2
	67R type *TE3xx (feedhole between leads)	7.5 +0.5/-0.2
H_0	Lead wire clinch height	16.0 ± 0.5
H_2	Component bottom to seating plane	3.0 ± 1.0
H_1	Component top to seating plane	See bulk dimensions
T	Body thickness	See bulk dimensions
T_1	Total thickness	T + 1.0 max.
t	Total tape thickness	1.7 max.
W	Tape width	18.0 ± 0.5
W_0	Hold down tape width	10 min.
W_1	Hole position	9.0 ± 0.5

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REQUIRED NUMBER OF PTC THERMISTORS TO LIMIT CURRENT AND ABSORB ENERGY

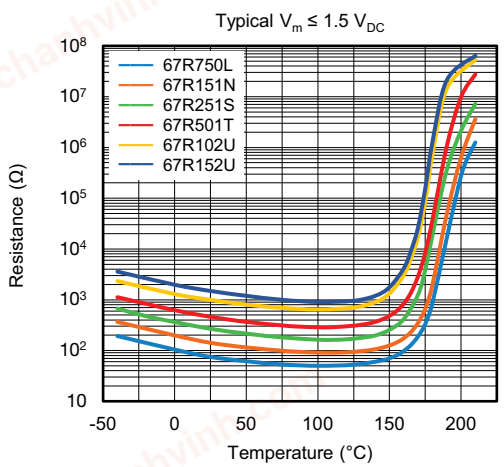
By using several PTC's in a series / parallel network, the maximum current limitation and absorbed energy levels can be further optimized. For homogeneous current and energy distribution it is recommended to combine only PTCEL of the same size and nominal resistance value. Energy absorption per PTC in a network depends on current distribution in the network and as such on the individual PTC resistance value. PTCEL thermistors might be used in a series connection to further lower the inrush current, but not to increase the maximum allowed voltage levels. PTCEL thermistors placed in series should have matched resistance values to divide the energy equally. Following formula may be used to calculate the minimum number of PTCEL thermistors of the same size and matched resistance value that are required in a DC link or other capacitor bank application to properly charge or discharge a given amount of non-repetitive energy without follow current. The formula is valid for one charge or discharge operation within cool down period of at least 5 times the thermal time constant and for which the T_{PTC} equals the T_{amb} before a consecutive operation. To make a better evaluation of which PTCEL type and how many parts would be needed for a specific circuit and operating mode, it is advisable to use the available SPICE models and simulate the circuit application.

$$N \geq \frac{K \times C \times V^2}{2 \times C_{th} \times (T_{sw} - T_{amb})}$$

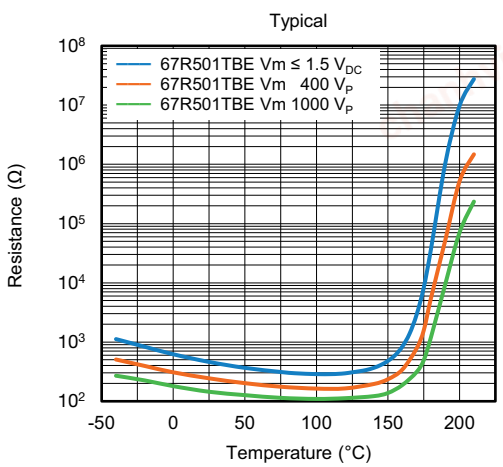
Notes

- N is the number of PTCEL required in the network
- C is the total capacitor value to charge or discharge in F
- V is the maximum DC voltage on the capacitor C
- C_{th} is the thermal capacity of one PTC in [J/K] (see table)
- T_{sw} is the minimum switching temperature of the PTCEL (155 °C)
- T_{amb} is the maximum ambient temperature at which the PTC needs to operate
- K is the factor that determines the charging operation mode
  K = 1 for DC charging or discharging
  K = 0.96 for 3-phase rectified charging
  K = 0.76 for single phase rectified charging

RESISTANCE VS. TEMPERATURE



RESISTANCE VS. TEMPERATURE PULSED

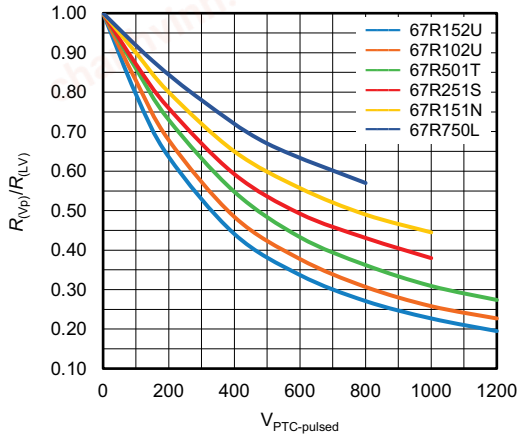


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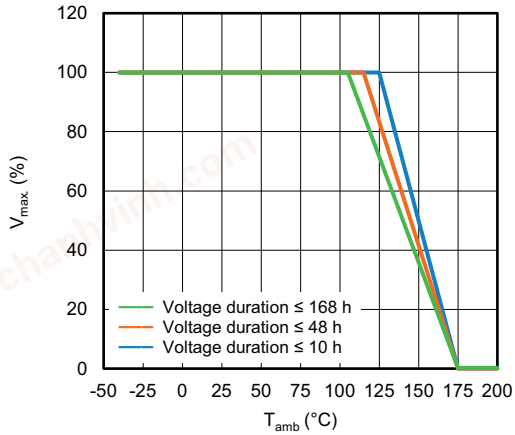
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PTC RESISTANCE UNDER PULSED VOLTAGE



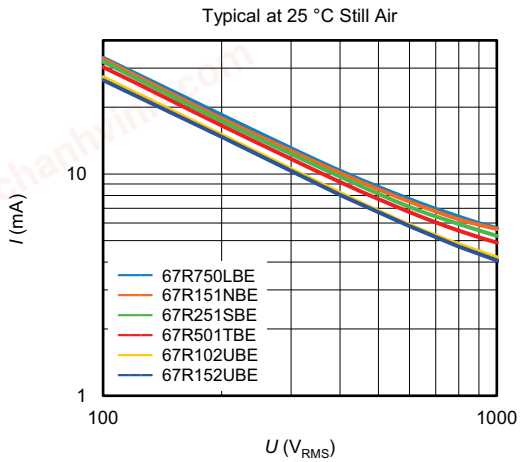
$V_{max.}$ DERATING VS. T_{amb}



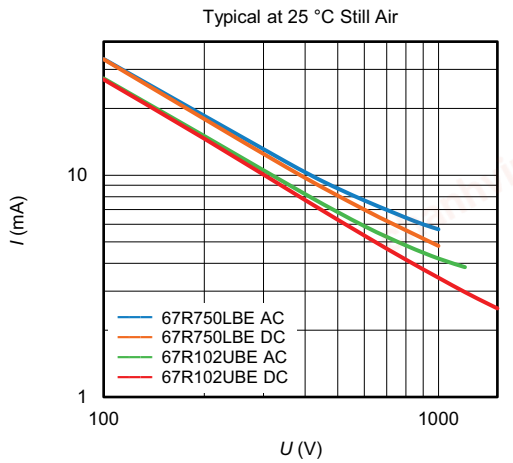
Notes

- The minimum PTC resistance values under (pulsed) voltage are depending on actual minimum resistance value in the temperature range of 100 °C to 120 °C. The actual voltage dependency effect or $R_{(VP)}/R_{(LV)}$ ratio of ceramic PTC is depending on its resistance values at low voltage ($R_{(LV)}$). The different curves represent the influence of (pulsed) voltage related to some typical PTC resistance values at any temperature below 150 °C. A PTC resistance value $R_{(LV)}$ can be taken from the Resistance vs Temperature graphs and multiplied by a corresponding ratio to estimate the (minimum) resistance value and determine a maximum peak current at a defined voltage. Actual peak currents that could be reached at certain voltage levels can be more precisely evaluated by using the available SPICE models
- Also check the graph “Resistance vs. temperature pulsed” to see the typical resistance to voltage dependency effect on a PTCEL67R501TBE

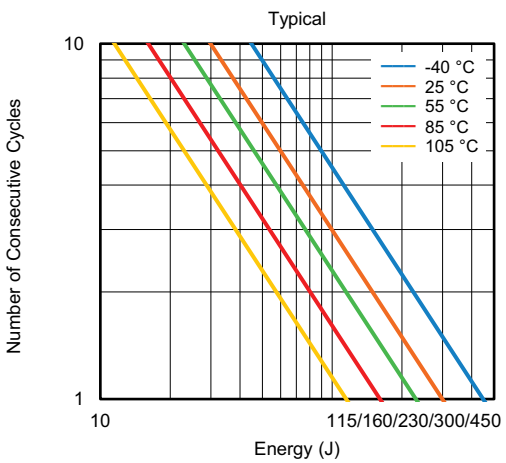
RESIDUAL CURRENT VS. VOLTAGE



RESIDUAL CURRENT VS. VOLTAGE AC / DC



CONSECUTIVE ENERGY CYCLES AT DIFFERENT T_{amb} FOR PTCEL67



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