

EPCOS Product Brief 2019

PTC Inrush Current Limiters

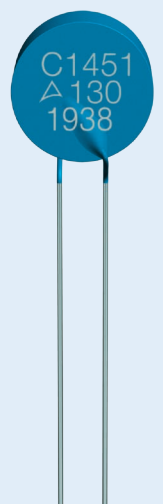
Self-Protecting PTC Resistors

High inrush currents are encountered whenever electrical equipment such as drive systems, inverters or power supplies are turned on. Because excessive inrush currents can damage or destroy the sensitive components such as the rectifier in a power supply or blow the fuse, for example, protection measures are needed.

PTC inrush current limiters (ICLs) are able to offer more reliable protection especially at demanding temperature and power conditions. As an added benefit, EPCOS PTC ICLs also provide protection in case of short circuits.

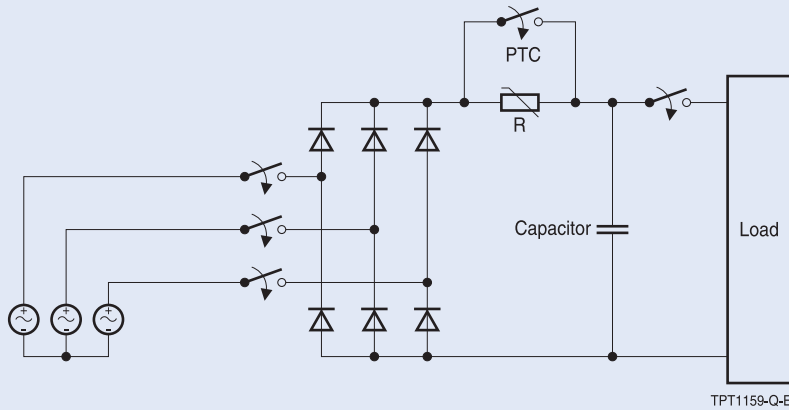
Typical applications

- Variable speed drives for
 - industrial drives (500 W up to 50 kW)
 - household appliances such as washing machines, dishwashers, air-conditioners, refrigerators
 - heat circulation pumps
- SMPS (switch mode power supplies) for
 - servers, data centers
 - telecom base stations
 - welding machines
- On-board chargers for EVs or PHEVs
- Charging and discharging of DC link capacitors in hybrid and electrical vehicles



PTC Inrush Current Limiters

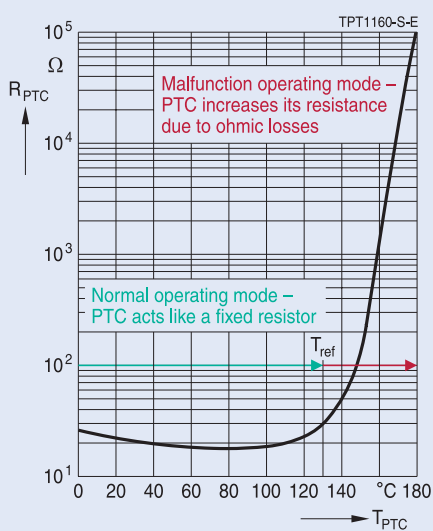
The key function of PTC ICLs is to reduce the inrush current during the charging process. Once the DC link capacitors are sufficiently charged, the PTC ICL is bypassed, as shown in the figure below.



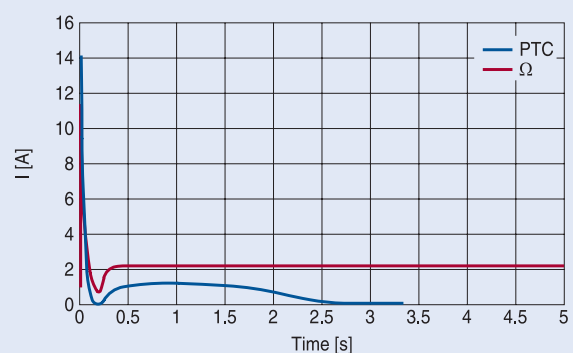
In normal operating mode the PTC ICL functions like a fixed resistor. In case of malfunction operation, the resistance of the PTC ICL increases dramatically due to ohmic losses and thus reduces the malfunction current significantly and protects the semiconductors in the circuit.

This technical feature of PTC ICLs is extremely advantageous in case of malfunctions compared to fixed resistors. The figure below shows the current flow of a fixed resistor compared to that of a PTC ICL. The current of the PTC ICL drops dramatically after 0.05 seconds. By contrast, the current continues to flow constantly through the fixed resistor and heats it up.

PTC resistance R_{PTC} versus PTC temperature T_{PTC}



Malfunction current using a PTC ICL (blue curve) and a fixed resistor (red curve)



PTC Inrush Current Limiters

Features

PTC ICLs have built-in advantages for the following failure modes:

- Short circuit of capacitor
- Current limiting element not bypassed during normal operation (failure of switching element)

PTC ICLs act as self-protecting elements in all of the above failure modes. The typical applications for PTC ICLs as replacements for fixed resistors are:

- Variable speed drives for
 - industrial drives (500 W up to 50 kW)
 - household appliances such as washing machines, dishwashers, air-conditioners, refrigerators
 - heat circulation pumps
- SMPS (switch mode power supplies) for
 - servers, data centers
 - telecom base stations
 - welding machines
- On-board chargers for EVs or PHEVs
- Charging and discharging of DC link capacitors in hybrid and electrical vehicles

TDK offers a broad range of EPCOS PTC ICLs for single phase or 3 phase systems.



Leaded disks, coated, $V_{max} = 260 \text{ V AC}$ up to 560 V AC

General technical data

Operating cycles at V_{max}	(charging of capacitor)	N_c	> 100.000	cycles
Switching cycles at V_{max}	(failure mode)	N_f	> 100	cycles
Operating temperature range	($V = 0$)	T_{op}	-40/+125	°C
Operating temperature range	($V = V_{max}$)	T_{op}	-20/+85	°C

Electrical specification and ordering codes

Type	V_{max}	$V_{link,max}$	R_R	ΔR_R	T_{ref} (typ.)	C_{th}	τ_{th}	Circuit diagram	Approvals			Ordering code
	V AC	V DC	Ω	%	°C	J/K	s				AEC-Q200	
C770	260	370	70	±25	120	0.4	70	2	–	–	–	B59770C0120A070
C771	260	370	120	±25	120	0.6	80	2	–	–	–	B59771C0120A070
C772	260	370	150	±25	120	0.6	80	2	–	–	–	B59772C0120A070
C750	280	400	25	±25	120	1.0	100	2	●	●	●	B59750C0120A070
C751	280	400	50	±25	120	1.4	120	2	●	●	–	B59751C0120A070
C752	280	400	80	±25	120	1.4	120	2	●	●	–	B59752C0120A070
C1451	440	620	56	±25	130	2.1	100	1, 2, 3	●	●	●	B59451C1130B070
C753	440	620	120	±25	120	1.4	120	1, 2, 3	●	●	–	B59753C0120A070
C754	440	620	150	±25	120	1.4	120	1, 2, 3	●	●	–	B59754C0120A070
C773	440	620	500	±25	120	0.6	80	1, 2, 3	–	–	–	B59773C0120A070
C774	440	620	1100	±25	115	0.6	80	1, 2, 3	–	–	–	B59774C0115A070
C1412	480	680	120	±25	130	2.1	100	1, 2, 3	●	●	●	B59412C1130B070
C755	560	800	500	±25	115	1.4	120	1, 2, 3	–	–	–	B59755C0115A070

PTC Inrush Current Limiters



PTC thermistors in housing, $V_{max} = 280 \text{ V AC up to } 560 \text{ V AC}$

Electrical specifications and ordering codes

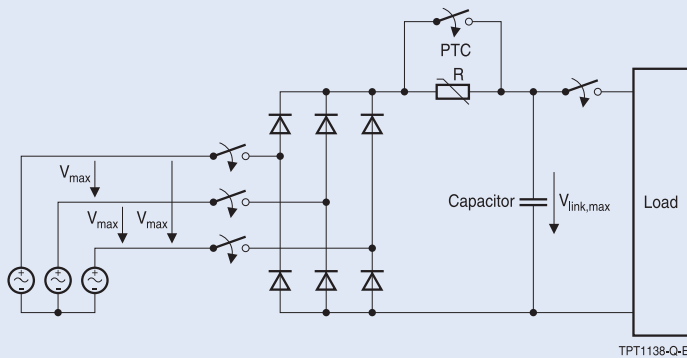
Type	V_{max}	$V_{link,max}$	R_R	ΔR_R	$T_{ref} \text{ (typ.)}$	$C_{th} \text{ (typ.)}$	$\tau_{th} \text{ (typ.)}$	Circuit diagram	Approvals			Ordering code
	V AC	V DC	Ω	%	C	J/K	s				AEC-Q200	

PBT plastic case, preferred types for new designs

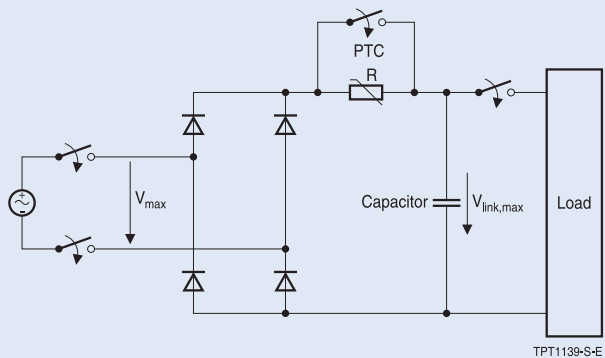
J213	280	400	33	25	130	1.1	140	2	●	●	●	B59213J0130A020
J215	280	400	22	25	130	2.3	150	2	●	●	●	B59215J0130A020
J217	440	620	56	25	130	2.3	150	1, 2, 3	●	●	●	B59217J0130A020
J219	560	800	100	25	130	2.3	150	1, 2, 3	●	●	●	B59219J0130A020

Circuit diagrams

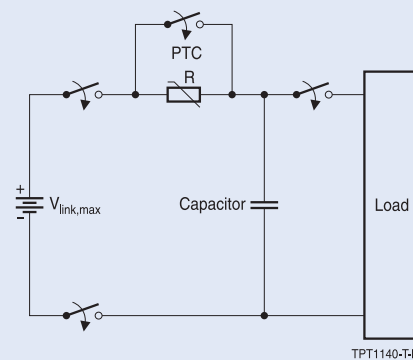
① Three phases circuit



② Single phase circuit



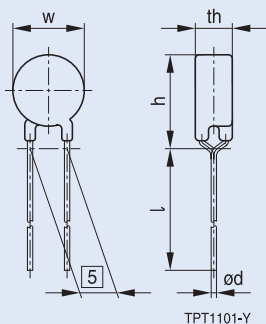
③ DC circuit



PTC Inrush Current Limiters



Dimensional drawing for leaded disks

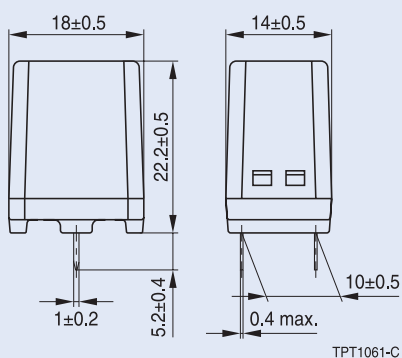


Dimensions in mm

Type	w _{max}	h _{max}	I _{min}	th _{max}	ød
C1412	16.0	20.5	35	8.0	0.8
C1451	16.0	20.5	35	8.0	0.8
C750	13.0	18.0	35	5.5	0.6
C751	13.0	18.0	35	7.5	0.6
C752	13.0	18.0	25	7.5	0.6
C753	13.0	18.0	25	7.5	0.6
C754	13.0	18.0	25	7.5	0.6
C755	13.0	18.0	35	7.5	0.6
C758	13.0	18.0	35	7.5	0.6
C770	9.0	13.5	25	7.5	0.6
C771	9.0	13.5	25	7.5	0.6
C772	9.0	13.5	25	7.5	0.6
C773	9.0	13.5	25	7.5	0.6
C774	9.0	13.5	25	7.5	0.6

Dimensional drawing for PTC thermistors in housing

Type J213, J215, J217 and J219



Dimensions in mm

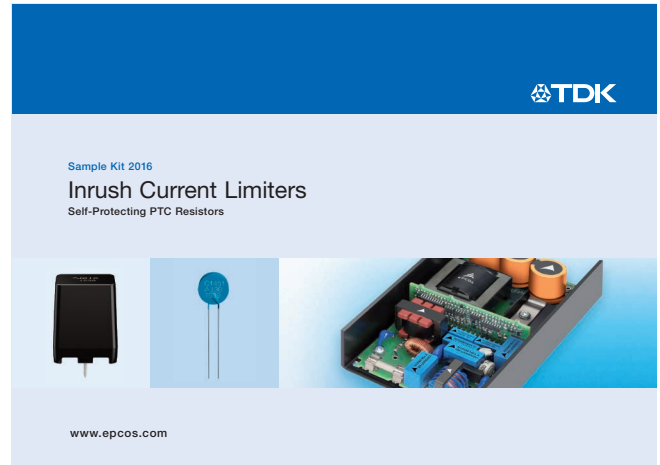
PTC Inrush Current Limiters

Sample kit

Features

- 11 different PTC inrush current limiters as self-protecting PTC resistors
- In housing or as leaded disks with coating
- 3 samples per ordering code
- Plastic box dimensions 23 × 16 cm

Ordering code: B59006Z0999A099



The PTC thermistors in this sample kit are designed to limit inrush currents in various kinds of equipment, e.g. in inverters for air-conditioners, industrial drives or welding machines. They can also be used to replace power resistors to actively discharge capacitors, e.g. in the inverters for electric vehicles.

Their special feature is that - even without additional current limitation - they can not be damaged when directly connected to V_{max} .

Content of the sample kit

Type	V_{max} V AC	$V_{link,max}$ V DC	R_R Ω	ΔR_R %	T_{ref} (typ.) $^{\circ}C$	C_{th} J/K	Ordering code
In phenolic resin plastic case							
J215	280	400	22	± 25	130	2.3	B59215J0130A020
J217	440	620	56	± 25	130	2.3	B59217J0130A020
J219	560	800	100	± 25	130	2.3	B59219J0130A020
Leaded disks, coated							
C750	280	400	25	± 25	120	1.0	B59750C0120A070
C751	280	400	50	± 25	120	1.4	B59751C0120A070
C1451	440	620	56	± 25	130	2.1	B59451C1130B070
C753	440	620	120	± 25	120	1.4	B59753C0120A070
C1412	440	620	120	± 25	130	2.1	B59412C1130B070
C754	440	620	150	± 25	120	1.4	B59754C0120A070
C773	440	620	500	± 25	120	0.6	B59773C0120A070
C755	560	800	500	± 25	115	1.4	B59755C0115A070

Structure of ordering codes: The ordering code for one and the same product can be represented differently in data sheets, data books, other publications and the website of TDK Electronics, 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.tdk-electronics.tdk.com/orderingcodes.

Important information: 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. We expressly point out that these statements cannot be regarded as binding statements about the suitability of our products for a particular customer application. It is incumbent on the customer to check and decide whether a product is suitable for use in a particular application. This publication is only a brief product survey which may be changed from time to time. Our products are described in detail in our data sheets. The *Important notes* (www.tdk-electronics.tdk.com/ImportantNotes) and the product-specific *Cautions and warnings* must be observed. All relevant information is available through our sales offices.