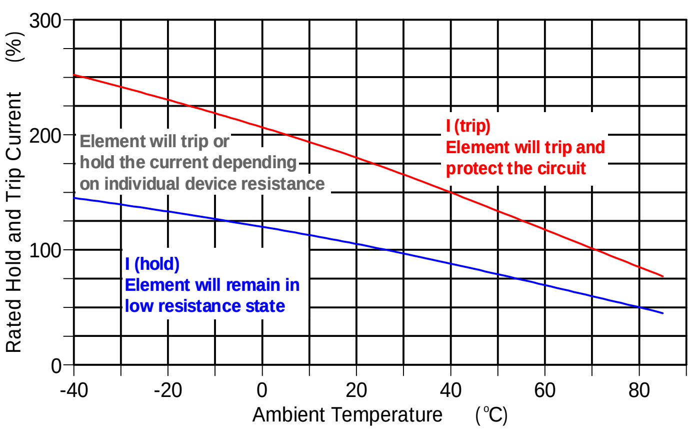
GENERAL INFORMATION

A polymeric PTC (positive temperature coefficient) overcurrent protector is an element circuited in series with the device to be protected. The PTC element protects the circuit by changing from a low-resistance to a high-resistance state in response to an overcurrent. This performance is called "tripping" of the overcurrent protection element. The PTC element generally displays a resistance much lower than the electrical circuit it is protecting, and normally has little or no influence on the normal performance of the circuit. In response to an overcurrent condition, there is a sharp increase in resistance of the PTC element ('tripping'), reducing current flow in the circuit to a value that can be safely sustained.

Hold Current

The hold current (also known as permissible continuous operating current; $I_{c20°C}$) is the highest steady-state current that the resettable protector will hold for an indefinite period of time under specified ambient conditions without turning from the low to the high resistance state. The hold current of the overcurrent protection element used to protect the electrical circuit is typically greater than the normal operating current.

Since these overcurrent protection elements are thermally activated, any change in the ambient temperature will influence their performance. Any rise in ambient temperature will decrease the hold current as well as the trip current. A reduction in ambient temperature will increase the trip current as well as the hold current.



De-rating of Hold and Trip Currents *Figure 14*

The 'heat transfer' environment of the resettable protector can also influence the performance of the element. Generally, by increasing the 'heat transfer' into the surrounding environment the following parameters will subsequently be augmented:

- the power dissipation that may be generated in that element
- the time to trip for the element (The impact will be greater at longer trip times where the effect of 'heat transfer' is more significant.)
- the hold current of the element

The opposite will occur if the 'heat transfer' from the element is decreased.

Trip Current

The trip current (I_T) is the lowest current to cause the element to trip (under specified conditions).

Maximum Interrupt Current

The maximum interrupt current (better known as "breaking" capacity; (I_F) is the highest permissible fault current to trip these resettable protectors safely under specified conditions. If the voltage drop across the resettable protector in its tripped state is lower than its rated voltage, then the maximum interrupting current is increased (see "rated voltage").

Rated Voltage

The rated voltage (V_{rat}) is the maximum voltage drop across the resettable protector under typical fault conditions. In many circuits, this is close to the operating voltage of the protected circuit.

Power Dissipation

The power dissipation (P_V) is the power dissipated by a resettable protector in its tripped state. The power dissipation is the product of the current then passing through the element and the voltage drop in the tripped state.

Initial Resistance

The initial resistance (R_{Imin} and R_{Imax}) is the resistance of the resettable protector under specified conditions (i.e. 20°C) before connection into a circuit.

Post Trip Resistance

The post trip resistance ($R_{pt\ 1\ max}$) is the resistance of the resettable protector at room temperature one hour after the element has been tripped for the first time, under specified conditions. After a longer time period the resistance will decrease to a value between the post trip and initial resistance, since the element is cooling down.

Trip Time

The trip time or time to trip (t_t) is the time required to trip the resettable protector after the onset of a fault current. The trip time depends upon the value of the fault current and the ambient conditions. Higher fault currents and/or higher temperatures result in shorter trip times.

For low fault currents, for example 2 to 3 times the hold current, most resettable protectors will trip slowly since there is a significant loss of heat to the environment. This is due to the fact that a substantial share of the power generated in the element is not retained by it, and therefore it does not increase the device temperature to the expected extent (non adiabatic trip event). Under these conditions, the heat transfer to the environment will play a significant role in determining the time to trip of the resettable protector. Greater heat transfer will result in longer trip times.

At high fault currents, for example 10 times the hold current, the trip time of a resettable protector is much lower because most of the power generated in the element is retained and thus increases the element temperature (adiabatic trip event). Under these conditions, the heat transfer to the environment is less significant in determining the trip time of the resettable protector.

As tripping is a dynamic event, it is difficult to precisely anticipate the change in trip time, since a change in the heat transfer coefficient is often accompanied by a change in the thermal mass around the resettable protector.

Under certain conditions the overcurrent protection element will automatically reset and return to normal operation. Automatic resetting can be very useful for applications where the voltage can be varied during operation.

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Leakage Current

When the over-current protection element is latched in its high resistance state, the amount of current allowed to pass through the resettable protector (called leakage current) is just a fraction of the fault current.

UL's Conditions of Acceptability

UL's Conditions of Acceptability for overcurrent protection devices include the following statements:

These elements provide overcurrent protection and have been evaluated for use in safety applications where a device is needed to limit the current to avoid any harm to the equipment i.e., risk of fire, electric shock, or even injury to persons.

These elements have undergone 6000 cycle endurance testing (appropriate for manual reset devices, since de-energizing is required to reset the PTC). However, they are not designed for applications where they are routinely caused to trip.

Selection Guide

Select the resettable protector considering maximum ambient temperature and normal operating current of the protected circuit.

Compare the resettable protector rated voltage and maximum interrupt (fault) current with the electrical circuit data to ensure that these parameters do not exceed the element ratings.

Check the resettable protector's trip time to be sure it will protect the electrical circuit in acordance with time and overcurrent requirements.

Verify that the ambient temperature in that circuit is within the resettable protectors operating temperature range.

Verify that the resettable protector dimensions fit the space requirements in the application.

Independently evaluate and test the suitability and performance of the resettable protector in the application.

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