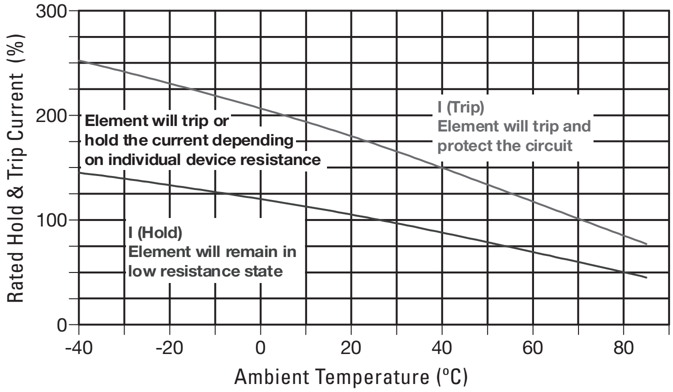
General Information

A polymeric PTC (positive temperature coefficient) overcurrent protector is an element placed in series with the device or assembly 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 function is called "tripping" of the overcurrent protection device. 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 (tripping) of the PTC element, 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 fuse will hold for an indefinite period of time under specified ambient conditions without transitioning from the low to the high resistance state. The hold current is typically greater than the normal operating current.

Since these resettable fuses 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.



Derating of Hold and Trip Currents *Figure 14*

The *heat transfer* environment of the resettable fuse can also influence its operating characteristics. Generally, by increasing the *heat transfer* into the surrounding environment the following parameters will subsequently be augmented:

- the power dissipation that may be generated within the resettable fuse
- the time-to-trip for the resettable fuse (the impact will be greater at longer trip times where the effect of *heat transfer* is more significant)
- the hold current of the resettable fuse

Trip Current

The trip current (I_T) is the lowest current to cause the resettable fuse to trip under specified conditions. Performance curves on the data sheets are provided plotting the trip or fault current vs. the time-to-trip.

Maximum Interrupt Current

The maximum interrupt current (better known as "breaking" capacity; (I_F) is the highest permissible fault current to trip these resettable fuses safely under specified conditions. If the voltage drop across the resettable fuse 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_{Rated}) is the maximum voltage drop across the resettable fuse 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 fuse in its tripped state. The power dissipation is the product of the current 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 fuse under specified conditions (i.e. 20 °C) before connection into a circuit.

Trip Time

The trip time or time-to-trip (t_t) is the time required to trip the resettable fuse 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 ambient temperatures result in shorter trip times.

For low fault currents, for example 2 to 3 times the hold current, most resettable fuses 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 fuse is not retained, and therefore it does not increase the device temperature to the expected value (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 fuse. 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 fuse is much lower because most of the power generated within the fuse is retained within the components and thus increases its temperature (adiabatic trip event). Under these conditions, the heat transfer to the environment is less significant in determining the trip time.

Since 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 fuse.

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

Leakage Current

When the resettable fuse is latched in its high resistance state, the amount of current allowed to pass through it is just a fraction of the fault current. This parameter is referred to as leakage current.

UL's Conditions of Acceptability

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

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

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

Selection Guide

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

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

Check the resettable fuse'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 the circuit is within the resettable fuse's operating temperature range.

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

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