Introduction

Overview

Selectivity

Several fuses are usually connected in series in one system. And when things get serious, selectivity ensures that only the faulty electrical circuit of a system is switched off and not the entire operational process.

Siemens fuses of operational class gG at an operational voltage of up to 400 V AC and a ratio of 1:1.25 are interselective, i.e. from rated current level to rated current level. This is achieved by means of the considerably smaller spread of ±5 % of the time/current characteristics, which far exceeds the demand for a ratio of 1:1.6 specified in the standard.

It is therefore possible to use smaller conductor cross-sections due to the lower rated currents.

Operational classes

Fuses are categorized according to function and operational classes. The first letter defines the function class and the second the object to be protected:

1st letter

a ≙ Partial range protection
(accompanied fuses):
Fuse links that carry currents at least up to their rated current and can switch currents above a specific multiple of their rated current up to their rated breaking current.

g ≙ Full range protection
(general purpose fuses):
Fuse links that can continuously carry currents up to at least their specified rated current and can switch currents from the smallest melting current through to the breaking current. Overload and short-circuit protection.

2nd letter

G ≙ Cable and line protection (general applications)

M ≙ Switching device protection in motor circuits (for protection of motor circuits)

R ≙ Semiconductor protection/thyristor protection (for protection of rectifiers)

L ≙ Cable and line protection (in acc. with the old, no longer valid DIN VDE)

B ≙ Mine equipment protection

Tr ≙ Transformer protection

The designations "slow" and "quick" still apply for DIAZED fuses. These are defined in IEC/CEE/DIN VDE.

In the case of "quick" characteristics, the fuse blows in the breaking range faster than those of the gG operational class.

In the case of DIAZED fuse links for DC railway network protection, the "slow" characteristic is particularly suitable for switching off direct currents with greater inductance. Both characteristics are also suitable for the protection of cables and lines.

Full range fuses (gG, gR, quick, slow) reliably break the current in the event of non-permissible overload and short-circuit currents.

Partial range fuses (aM, aR) exclusively serve short-circuit protection.

The following operational classes are included in the product range:

gG (DIN VDE/IEC) ≙ Full range cable and line protection

aM (DIN VDE/IEC) ≙ Partial range switching device protection

aR (DIN VDE/IEC) ≙ Partial range semiconductor protection

gR (DIN VDE/IEC) ≙ Full range semiconductor protection

gS (DIN VDE/IEC) ≙ Full range semiconductor protection and cable and line protection

Quick (DIN VDE/IEC/CEE) ≙ Full range cable and line protection

Slow (DIN VDE) ≙ Full range cable and line protection

gL/gG operational class

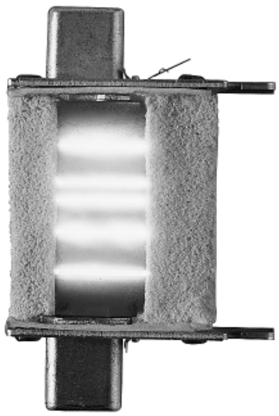
These days, many Siemens fuses bear the mark "gL/gG operational class". These fuses mark the transitional period between the no longer valid DIN VDE regulation (gL operational class) and the new international standard (gG operational class). However, all future, fuses will no longer bear the mark "gL operational class".

Breaking capacity

A key feature of these fuses is their high rated breaking capacity with the smallest footprint. The basic demands and circuit data for tests – voltage, power factor, actuating angle etc.– are specified in both national (DIN VDE 0636) and international (IEC 60269) regulations.

However, for a constant failsafe breaking capacity, from the smallest non-permissible overload current through to the highest breaking current, a number of quality characteristics need to be taken into account when designing and manufacturing fuse links. These include the design of the fuse element with regard to dimensions and punch dimension and its position in the fuse body, as well as its compressive strength and the thermal resistance of the body. The chemical purity, particle size and the density of the quartz sand also play a key role.

The rated breaking capacity for AC voltage for NEOZED- and the majority of DIAZED fuses – is 50 kA AC, and in the case of LV HRC fuses, it is even 120 kA AC.



Faster arcing and precise arc quenching are the requirements for a reliable breaking capacity.

Current limiting

As well as a failsafe rated breaking capacity, the current-limiting effect of a fuse link is of key importance for the cost effectiveness of a system. In the event of short-circuit breaking by a fuse, the breaking current continues to flow through the network until the fuse link is switched off. However, the breaking current is nerely limited by the system impedance.

The simultaneous melting of all the bottlenecks of a fuse element produce a sequence of tiny partial arcs that ensure a fast breaking operation with strong current limiting. The current limiting is also strongly influenced by the production quality of the fuse – which in the case of Siemens fuses is extremely high. For example, an LV HRC fuse link, size 2 A to 224 A, limits a breaking current with a possible r.m.s. value of approximately 50 kA to a let-through current with a peak value of approx. 18 kA. This strong current limitation provides constant protection for the system against excessive loads.

Assignment of cable and line protection

When assigning fuses to cable and line protection in the event of an overload, according to DIN VDE 0100 Part 430, the following conditions must be met:

(1) $I_B \leq I_n \leq I_z$ (rated current rule)

(2) $I_2 \leq 1.45 \times I_z$ (tripping rule)

I_B: Operational current of the electrical circuit

I_n: Rated current of the selected protective device

I_z: Permissible current carrying capacity of the cable or line under specified operating conditions

I_2: Tripping current of the protective device under specified operating conditions ("conventional test current").

These days, the factor 1.45 has become an internationally accepted compromise of the protection and utilization ratio of a line, taking into account the breaking behavior of the protective device (e.g. fuse).

According to the supplementary requirements for DIN VDE 0636, Siemens fuse links of gG operational class comply with the following conditions:

"Load breaking switching with $I_2 = 1.45 \times I_n$ during conventional test duration under special test conditions according to the aforementioned supplementary requirements of DIN VDE 0636".

This therefore permits direct assignment.

Rated power dissipation

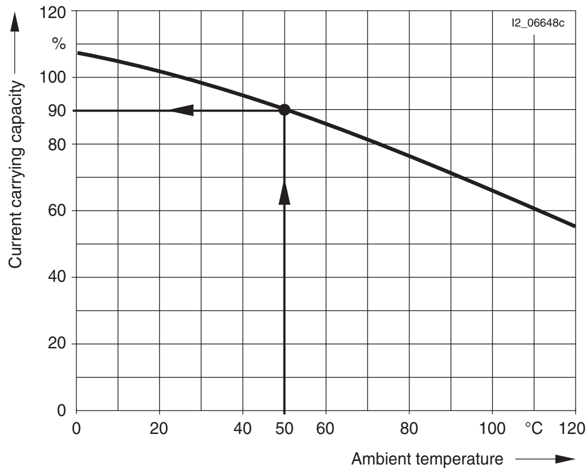
The cost effectiveness of a fuse depends largely on the rated power dissipation (power loss). This should be as low as possible and have low self-heating. However, when assessing the power loss of a fuse, it must also be taken into account that there is a physical dependence between the rated breaking capacity and the rated power dissipation. On the one hand, fuse elements need to be thick in order to achieve the lowest possible resistance value, on the other, a high rated breaking capacity requires the thinnest possible fuse elements in order to achieve reliable arc quenching.

Siemens fuses have the lowest possible rated power dissipation while also providing the highest possible load breaking reliability.

These values lie far below the limit values specified in the regulations. This means low temperature rises, reliable breaking capacity and high cost effectiveness.

Load capability with increased ambient temperature

The time/current characteristics of the NEOZED/DIAZED/LV HRC fuse links refer to the ambient temperature of 20 °C ±5 °C according to DIN VDE 0636. If higher ambient temperatures are used (see diagram) a lower load capability must be used. For example, at an ambient temperature of 50 °C, an LV HRC fuse link is required that can handle 90 % of the rated current. While the short-circuit behavior is not influenced by an increased ambient temperature, it is influenced by overload and operation at rated value.



Influence of the ambient temperature on the load capability of NEOZED, DIAZED and LV HRC fuses of gG operational class with natural convection in the distribution board.