Power Distribution

Application: direct current network

How to ensure protection isolated from earth in direct current applications up to 500 V

"Direct current has been used for a long time, and in many fields. It offers major advantages, in particular immunity to electrical interference. The circuit breaker installed in an electrical network is designed to prevent any danger or damage associated with electrical hazards, overloads, short circuits and isolated faults, for loads and people."

Solution

This solution illustrates the use of the Acti 9 product range for the direct current application:
- with isolation from earth
- up to 500 V.

Choosing the rating

The thermal tripping curve of a circuit breaker is the same in direct current as in alternating current (50/60 Hz).
Choose a circuit breaker with a rating (In) less than or equal to the current (Iz) allowed to pass through the cable.

Choosing the curve

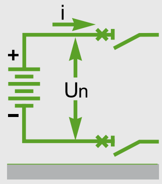
The magnetic tripping threshold must be:
- Higher than the inrush currents due to loads (motors, capacitors, etc.).
- Lower than the short-circuit current at the installation point.

Choosing the breaking capacity

The choice of circuit breaker with respect to breaking

> Series connection

Series connection of the poles, by dividing the voltage per pole, optimizes the circuit breaking performance for high-voltage networks.
Series connection of the poles of a circuit breaker used in direct current therefore makes it possible to:
- Divide the network voltage by the number of poles.
- Have the rated current for each pole.
- Have the circuit breaker's breaking capacity for all the poles.



How does it work ?

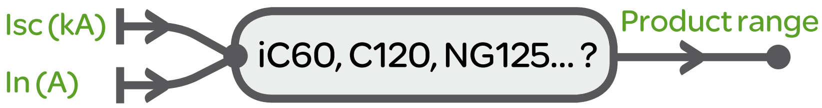
> **The performance levels shown in the tables correspond to the most critical faults according to the network configuration.**
Breaking on one pole.
Fault between polarity and earth (Fault A).

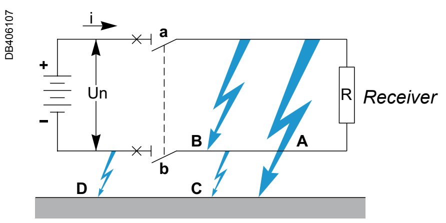
> **Select the circuit breaker corresponding to the network:**
- the circuit breaker(s) to be installed is/are identified based on the rating and short-circuit current,
- the type of connection (number of poles, position relative to the load, isolation of polarities) is indicated according to the voltage.

Choosing circuit breakers for distribution isolated from earth

The following tables show the number of poles connected in series according to the DC network voltage, and the circuit breaking performance of our circuit breaker range.

Breaking capacity for a maximum voltage per pole of: 60 V DC for the iC60 offers and 125 V DC for the C120 and NG125 offers





The figure shows a source in IT system with a second fault (D) on the negative polarity.

Fault condition analysis

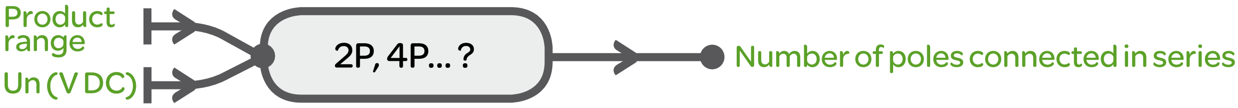
Fault	Fault current (max.)	Voltage	Poles involved in breaking	Breaking characteristics
A	Low	Low	a	No breaking needed
A and D	Id (1)	Un	a	Id at Un on the poles connected to the positive polarity
B	Isc	Un	a + b	Isc at Un on all the poles connected in series
C	Low	Low	b	No breaking needed

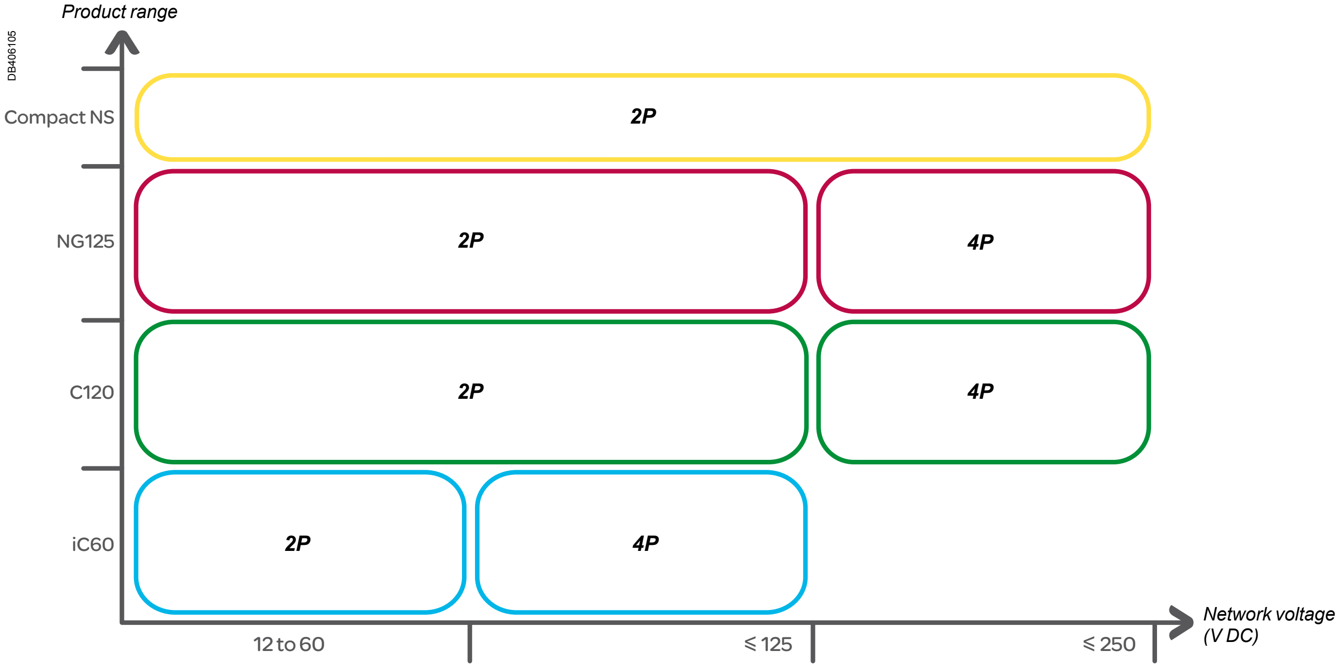
Isc: presumed short-circuit current.
Un: rated network voltage.

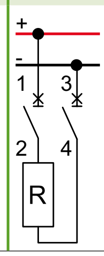
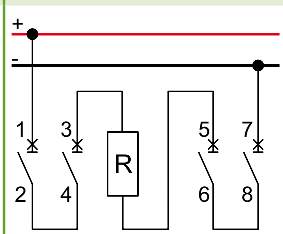
(1) Fault current values acceptable according to the installation rules.
- *If Isc < 10 kA: fault current ⩽ 0.15 Isc.*
- *If Isc > 10 kA: fault current ⩽ 0.25 Isc.*

> The circuit-breaker poles must be distributed symmetrically over the two polarities.

Obviously, this connection provides isolation.





Isolation	Number of poles and connection diagram	
	2P	4P
Required or not		

R: Receiver.

Conclusion

This earthing system is dedicated to high continuity of service applications, such as hospital loads and operating theatre lighting. It is more expensive and must be continuously monitored. Our solution is compliant in the case of circuits with momentary current direction reversal.

+ You will find the complete DC technical advice on the catalogue page CA908006. This document also covers lightning and earth leakage protection.

Example

Ue: 250 V DC
Isc: 35 kA
In: 80 A

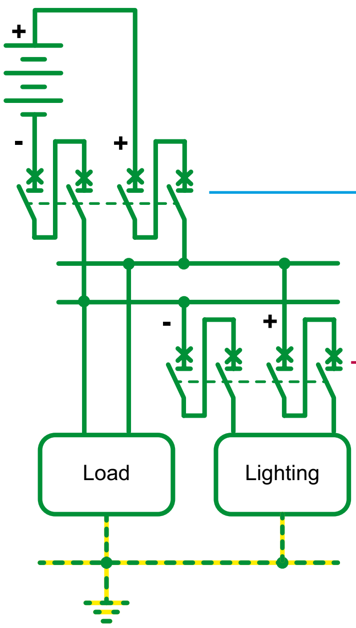
Earthing system isolated from the earth.

In a direct current distribution system, powered by a rectifier/charger of voltage 250 V DC isolated from the earth:

- **First level**: the battery outgoing feeder of:
- permissible current **Iz = 88 A**,
- operating current **Ib = 75 A**,
- short-circuit current **Isc = 35 kA**.

- **Second level**: a "LED" lighting outgoing feeder of:
- permissible current **Iz = 12 A**,
- operating current **Ib = 8 A**,
- short-circuit current **Isc = 35 kA**.

> Which circuit breakers should be installed to protect?



Total selectivity (or discrimination) solution

Type	Number of poles	Rating
NG125H	4P	80 A

- No high current peak: curve B.
- Connection: 2 poles on "+" and 2 poles on "-".
- Isolation required: provided by the 4 poles.

Type	Number of poles	Rating
NG125H	4P	10 A

- High current peak "LED": curve D.
- Connection: 2 poles on "+" and 2 poles on "-".
- Isolation required: provided by the 4 poles.