

Topic: **RCD (FI-Protective switch)**

If personal protection is required during installation of the system, drive converters must be protected according to EN 50178 as follows:

- 1-phase drive converters by RCD type A (pulse-current sensitive FI's) or type B (all-current sensitive FI's)
- 3-phase drive converters (with B6 bridge-connected rectifier) by RCMA's with separation (preferred used) or RCD's type B (all-current sensitive FI's)

The tripping current should be 300mA or more, in order to avoid a premature triggering of the drive converter by discharge currents (about 200mA).

Dependent on the load, the length of the motor cable and the use of a radio interference filter, substantially higher leakage currents can occur.

The connection instructions from the manufacturer and the valid local requirements must be observed. Dependent on the available mains form (TN, IT, TT) further protective measures are required in accordance with VDE Part 410 (part 4, chapter 41).

For example, with TN-mains this protection is made with overcurrent protective devices, with IT-mains it is insulation monitoring with a pulse-code measuring method. A protective separation can be used with all mains forms as long as the required power and cable lengths permit this. The person setting up the unit must present proof of compatibility before installing the inverter!

Residual and leakage currents

Both, residual and leakage currents can have several frequency components at the same time which are different to the mains frequency (50 Hz). The RCD can not differ between residual and leakage currents and evaluates them equally. By way tripping can occur if the sum of all leakage currents exceed the tripping threshold of the RCD, although there is no residual current in the electric system.

1-phase operated drive converters

For 1-phase operated drive converters with integrated EMC filter, the filter capacitors are switched from L to PE and from N to PE. This causes considerable 50 Hz leakage currents. When using several drive converters, the system builder must ensure that the drive converters are distributed evenly to the phase conductors L1, L2 and L3 for compensation of the leakage currents. A tripping of the RCD can be normally avoided by way.

3-phase operated drive converters

3-phase operated drive converters can generate a rectified residual current in error case. In case of a rectified residual current caused by the B6-circuit in the input of the drive converter, a conventional RCD type A would not trigger, because there is no time-varying magnetization in the summation current transformer of the RCD. However, this is necessary for energy transfer to the tripping relay of the RCD. Depending on the height, the residual current causes a premagnetisation of the transformer core instead, and increases thereby the tripping threshold of the RCD. In worst case the RCD would not trigger under these conditions. Tripping of the RCD type B is guaranteed if the residual current is high enough.

Insulation fault at the input of the drive converter

If a ground fault occurs at the input of the drive converter, a pure sinusoidal 50 Hz residual current is flowing. Tripping of the RCD occurs if the residual current is high enough.

Insulation fault at the DC link capacitor

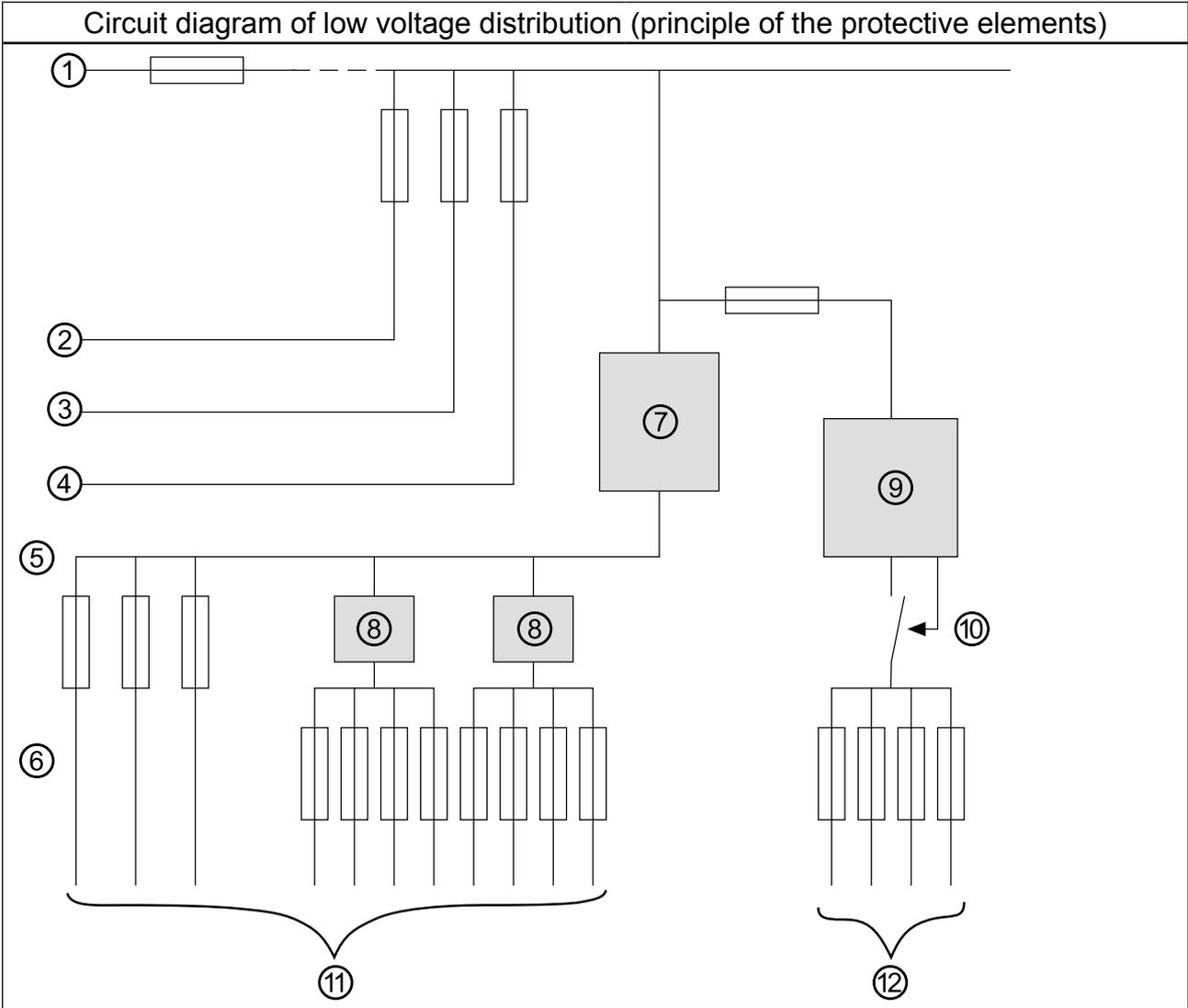
If there is an insulation fault from the plus pole of the DC link capacitor to the housing of the frequency inverter, e.g. due to dirt or moisture, a nearly smooth residual current is flowing. Tripping of the RCD type B is guaranteed if the residual current is high enough.

Insulation fault on the motor connection cable

A residual current is flowing if an insulation fault occurs due to a defective motor feed cable.

The residual current contains:

- Output frequency
- Switching frequency of the drive converter
- Harmonics which are generated by the input-side six-pulse bridge rectification of the drive converter



1	Mains	
2	to further sub-distributions	Outlet 1
3		Outlet 2
4		Outlet 3
5	Level 1	
6	Level 2	
7	RCD type A	
8	RCD type A sel. T	
9	RCMA/ RCD type B	
10	Isolator according to EN 60947-2	
11	To further consumers that do not prevent the tripping of the FI.	
12	To the consumers not compatible with FI.	



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