White Paper

Surge protection for frequency converters

Contents

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A frequency converter typically consists of a rectifier, d.c. link, inverter and control electronics (Figure 1).
At the inverter input, a single-phase a.c. voltage or three-phase line-to-line a.c. voltage is converted into a pulsating d.c. voltage and is fed into the d.c. link which also serves as an energy storage system (buffer).
Capacitors in the d.c. link and earthed L-C sections in the mains filter may cause problems with upstream residual current protective devices (RCDs). These problems are often incorrectly associated with surge arresters. They are, however, caused by temporary fault currents of the frequency converter which are sufficiently high to trip sensitive RCDs. This can be prevented by using an impulse-current-resistant residual-current-operated circuit-breaker which is available with a discharge capacity of 3 kA (8/20 µs) and higher for a tripping current $I_{\Delta n}$ = 30 mA.
The inverter provides a pulsed output voltage via the control electronics. The higher the pulse frequency of the control electronics for pulse width modulation, the more similar the output voltage is to a sine wave. However, with each pulse a voltage peak occurs that is superimposed on the fundamental wave. This voltage peak reaches values of more than 1200 V (depending on the frequency converter). The better the simulation of the sine wave, the better the run and control performance of the motor. This in turn means that voltage peaks occur more frequently at the output of the frequency converter.
When selecting surge arresters, the maximum continuous operating voltage U_c must be observed. It indicates the maximum operating voltage a surge protective device may be connected to. Owing to the voltage peaks that occur during the operation of frequency converters, arresters with a high U_c value must be used. This prevents "artificial ageing" as a result of gradual arrester heating during "normal operation" and the associated voltage peaks.
If surge arresters are heated, their service life is reduced and they are thus disconnected from the installation to be protected.
The high pulse frequency at the output of the frequency converter causes field-based interference. To avoid that other sys-

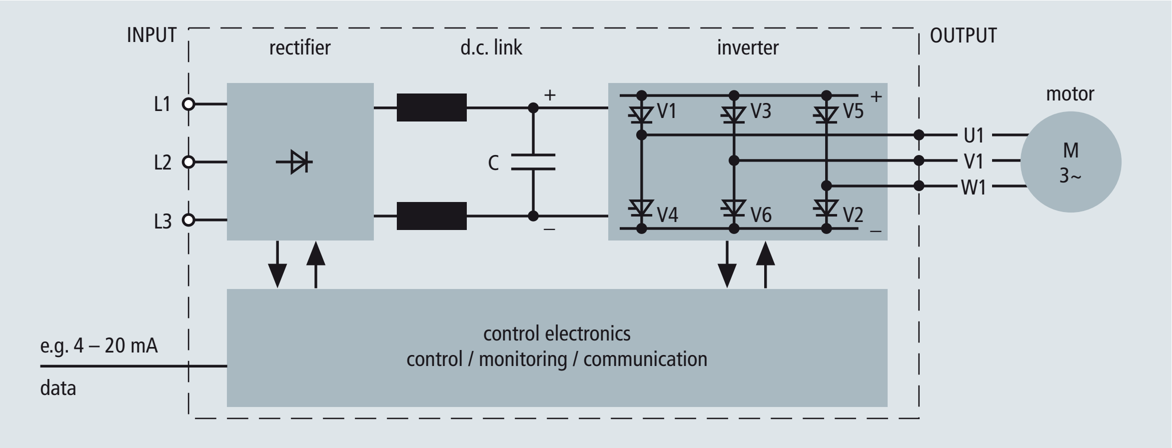


Figure 1 Basic principle of a frequency converter

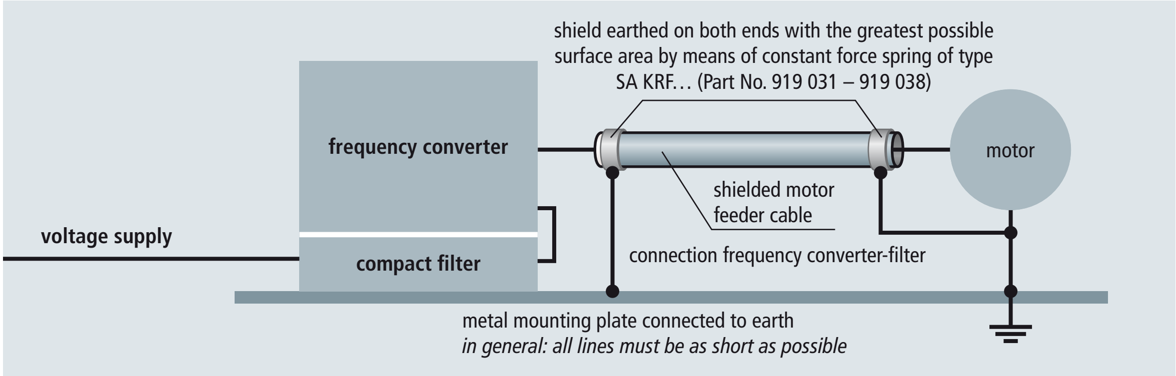
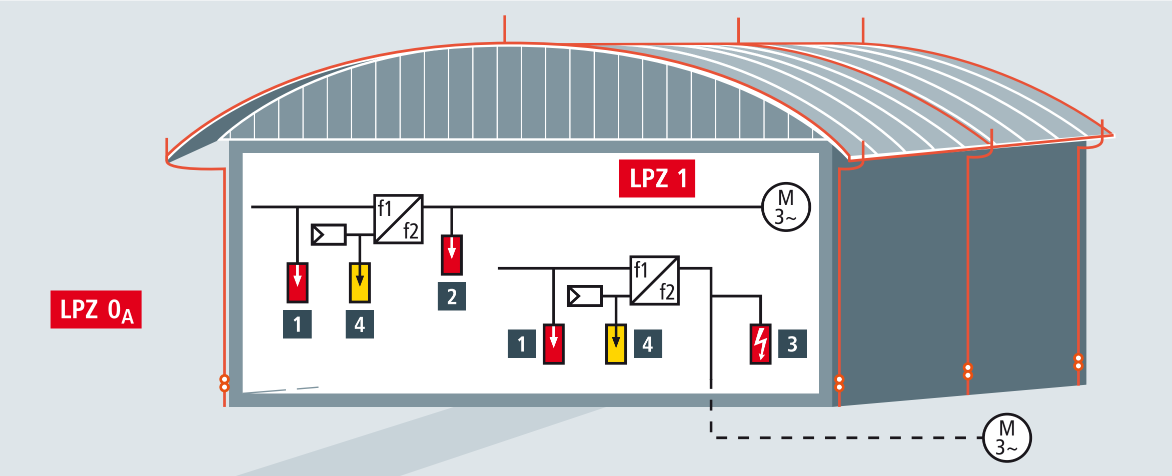


Figure 2 EMC-compatible shield connection of the motor feeder cable

tems are interfered with, shielded cable routeing is required. The shield of the motor feeder cable must be earthed on both ends, namely at the frequency converter and at the motor. To this end, large-area contact with the shield must be provided, preferably by constant force springs (Figure 2), to fulfil EMC requirements. Intermeshed earth-termination systems, namely the connection of the earth-termination system of the frequency converter to that of the drive motor, reduce potential differences between the different parts of the installation, thus preventing equalising currents from flowing through the shield.

When integrating the frequency converter into the building automation, all evaluation and communication interfaces must be connected to surge protective devices to prevent surge-related system failure. Figure 3 shows an example of the controller interface 4 – 20 mA.



No.	Surge protective device		Part No.
1	DEHNguard modular	DG M TNS 275 (TN-S system)	952 400
	DEHNguard modular	DG M TT 275 (TT system)	952 310
2	DEHNguard S	DG S WE 600	952 077
3	DEHNbloc Maxi	DBM 1 760 FM (3 items)	961 175
	+ DEHNguard S	DG S WE 600	+ 952 077
4	BLITZDUCTOR XT	BXT ML2 BE S 24 (e.g. 4 – 20 mA)	920 224
	+ BLITZDUCTOR XT base part	BXT BAS	+ 920 300

Figure 3 Frequency converter with drives in LPZ 0_A or LPZ 1

Surge Protection
Lightning Protection
Safety Equipment
DEHN protects.

DEHN + SÖHNE
GmbH + Co.KG.

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