

Product Brief 2019

3-Line Active Filter LeaXield

For Leakage Current Compensation

The individual components in variable-speed drives cause earth leakage currents that cumulatively result in the tripping of the RCD. As a result, RCDs are either not usable or only, with substantial additional outlay. TDK presents the upgraded EPCOS LeaXield™ active leakage current filter, a unique and economical solution for the minimization of earth leakage currents over a broad spectral range in variable speed drives. This permits the use of RCDs and consequently increases the plant availability.

Benefits

- Minimization of earth leakage currents up to 1 A
- High leakage current compensation in the frequency range of 150 Hz to 30 kHz
- Compact design
- Minimal installation outlay, no external power supply required
- Increased plant availability



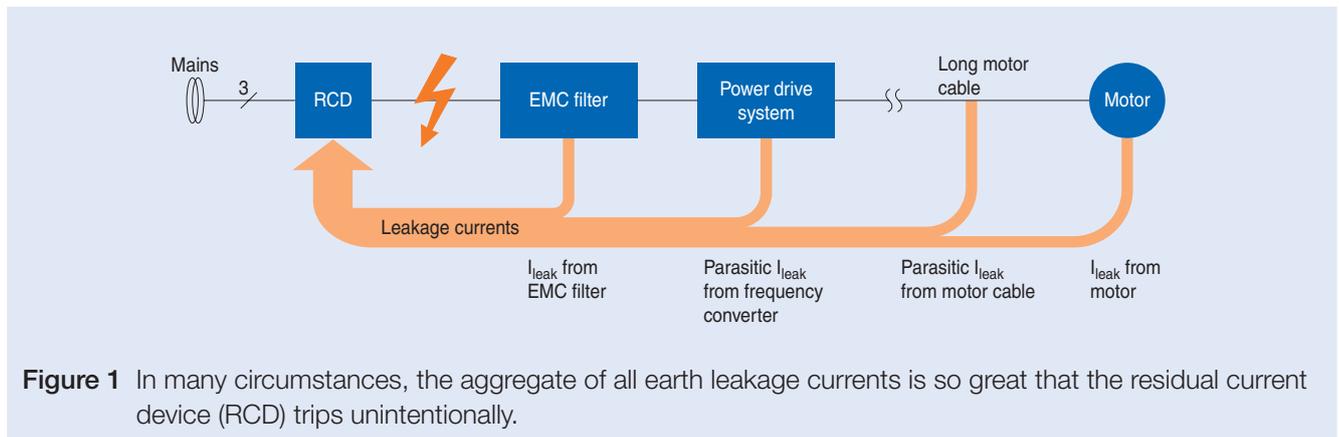
3-Line Active Filter LeaXield

Drastically reducing earth leakage currents and increasing plant availability

Variable-speed drives are used in industrial installations for a variety of tasks, e.g. in machine tools, pumps, compressors and conveyance systems.

A complete drive system consists of an EMC input filter, the frequency converter and the motor. An equally important component that is often neglected when considering the system is the shielded cable between converter and motor which can often exceed 200 meters in length. The individual components cause earth leakage currents that cumulatively may result in an unintended tripping of the RCD (**Figure 1**).

A significant problem of variable-speed drives are the earth leakage currents generated during operation – in particular by the frequency converter. The level of these currents depends on the EMI capacitors and the parasitic capacitances to earth, the commutation of the B6 rectifier circuit and the switching cycles of the power semiconductors. In many circumstances, the aggregate of the earth leakage currents exceeds the RCD's tripping threshold.



Until now, there has not been a comprehensive solution for dealing with the different causes of leakage currents. Attempts are often made to vary the overall capacitance to earth in the system. By switching off the filter capacitor in the converter, for example, it is possible to reduce the 150 Hz portion of the leakage current. This does however mean that in many cases the electromagnetic compatibility is no longer guaranteed. If, on the other hand, the capacitances of the Y-capacitors in the EMC filter are reduced, the proportion of the clock-frequency leakage current will increase despite the lower 50 Hz leakage current.

Although the use of an isolating transformer offers a technical solution, cost and installation space restrictions sometimes render this impossible. Doing without the RCD is by no means an alternative, because this is a safety risk and harbors considerable potential for hazards and accidents. The methods described are unsatisfactory in both technical and economic terms.

LeaXield sets new standards for the reduction of leakage currents

The EPCOS LeaXield module has been developed in order to compensate leakage currents in a 3-phase TN system. The module is inserted in the circuit between the RCD and the EMC line filter.

Figure 2 shows the circuit diagram. To measure the residual current across the three phases, a current sensor is integrated in the LeaXield. By means of an operation amplifier, a correspondingly 180° phase-shifted current with identical amplitude is then generated, which is capacitively coupled to the respective phases.

This way, the leakage currents are fed back into the system by means of the current sink thus created. This prevents them from flowing through the RCD and tripping it unintentionally.

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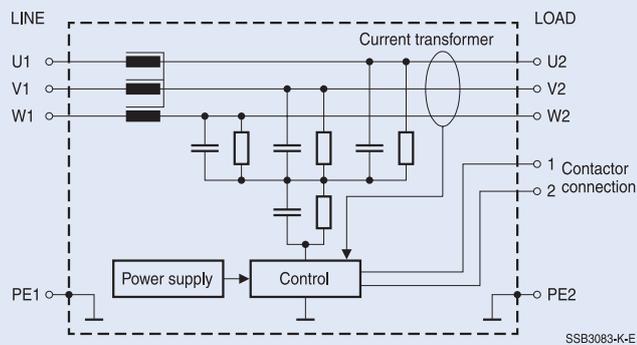


Figure 2 A 180° phase-shifted current is capacitively coupled to the respective phases. By means of the current sink thus created, the leakage currents are returned to the source. With the optional contactor connections, the LeaXield module is already in steady-state before the leakage current flows.

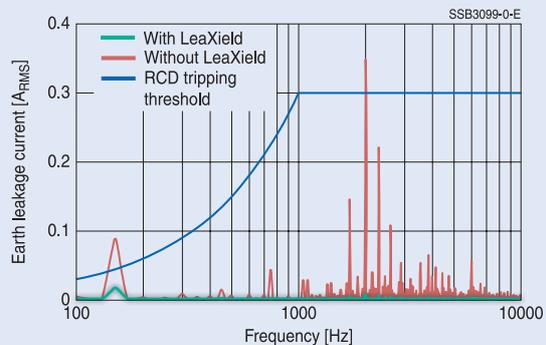
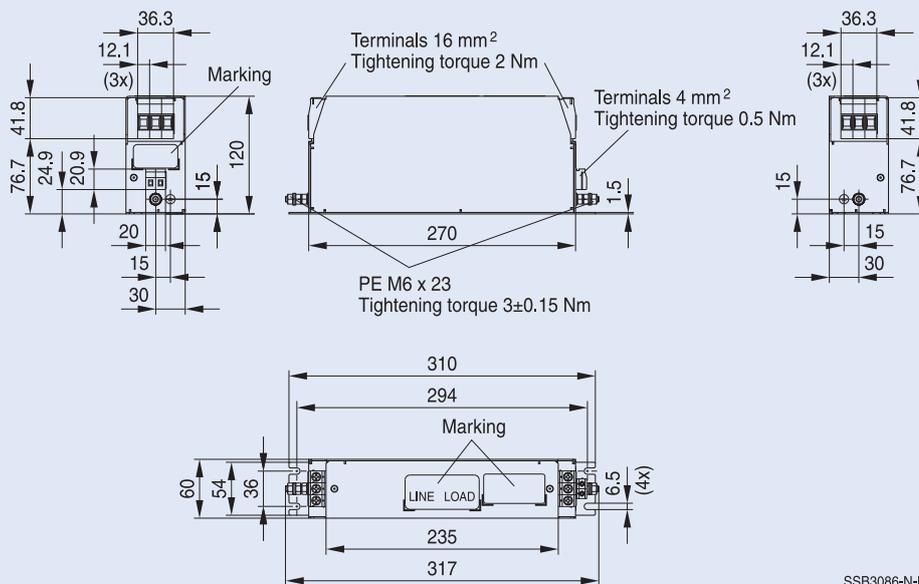


Figure 3 The unfiltered leakage currents (red) are dramatically attenuated (green) by using the LeaXield and fall well below the RCD tripping threshold (blue). This prevents an unintentional tripping of the RCD. LeaXield can compensate for earth leakage currents of up to 1 A. The compensation effect extends over a wide frequency range from 150 Hz to about 30 kHz as shown in this figure.

Dimensional drawing



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Thanks to its compact dimensions of just 270 × 60 × 119 mm, LeaXield is also ideal for retrofitting into existing systems. Furthermore, as no external voltage supply is necessary for operation, the installation costs are low. For the first time, therefore, LeaXield offers a compact and cost-effective solution for the compensation of leakage currents across a broad frequency range. This permits the use of a residual current device and consequently raises the plant availability.

Electrical data	
Mains connection	
Rated voltage V_R	305/530 V AC (50 Hz)
Minimum operating voltage V_{min}	208/360 V AC (50 Hz)
Rated current I_R	50 A
Rated frequency f_R	50 Hz
Typical contact resistance R_{typ}	1.0 m Ω
Overload capability (thermal)	1.5 • I_R for 3 min per hour or 2.5 • I_R for 30 s per hour
Test voltage line to line for 2 s V_{test}	1770 V DC
Test voltage line to case for 2 s V_{test}	1500 V DC
Contactor connection	
Maximum voltage V_{max}	24 V DC / 250 V AC
Maximum current I_{max}	2 A
Leakage current compensation	
Maximum leakage current $I_{LK-LOAD}$ (Peak value)	1 A
Frequency range	150 Hz to 30 kHz
General data	
Rated temperature T_R	50 °C
Degree of protection (IEC 60529)	IP 20
Climatic category (IEC 60068-1)	25/100/21
Ordering code	B84233A1500R000
Conformity	CE
Mechanical data	
Terminal mains connection	16 mm ² / 2 Nm
Terminal contactor connection	4 mm ² / 0.5 Nm
PE connection	Ring cable lug M6 / 3 Nm
Weight	ca. 1.6 kg

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