

Application Note to EMC-compliant connection of motor cables with split protective conductor and/or reduced ground conductor cross-section

Area of application

- ÖLFLEX® SERVO FD zeroCM and ÖLFLEX® SERVO zeroCM
- 3+3-core, earth-symmetrical versions, such as ÖLFLEX® SERVO 2YSLCY-JB, ÖLFLEX® SERVO 9YSLCY-JB, ÖLFLEX® SERVO 2XSLCH-JB and ÖLFLEX® SERVO 2XSLCY-JB

The intended use of these cables is the connection between frequency inverter and electric motor. They are not intended for general electrical installations such as power supply or power distribution systems.

Beneficial effect

The zeroCM® technology is based on a special stranding technique that eliminates magnetic coupling and reduces capacitive coupling to a minimum. The use of these cables demonstrably reduces low-frequency and high-frequency leakage currents on the frequency inverter as well as in the entire system environment. Among other things, this enables the use of longer cable installation lengths within the electromagnetic compatibility limits set by the drive manufacturer.

With the capacitance-optimized motor cables with 3+3-core versions, the low-frequency magnetic coupling is cancelled out at the star points of the cable due to the earth-symmetrical design. As the magnetic coupling increases with the load current due to the principle, these cables are particularly suitable for large power classes or connected loads.

Earthing concept (protective conductor)

What all the above-mentioned cables have in common is that the earthing concept is made up of the (summed) cross-section of the ground conductor(s) and the specified cross-section (data sheet) of the braided shield. The braided shield has three functions:

- Shielding of electromagnetic fields from or to adjacent structures
- Low-impedance feedback path for high-frequency interference currents
- In addition to the inner, insulated ground conductor(s) as an additional protective conductor

The braided shield and ground conductor thus form a low-impedance secondary short-circuit circuit. For the safety of the system, it is important that the circuit breaker (or the protective device/overcurrent detection of the frequency inverter) trips before the line is thermally damaged. Therefore, the cable must be able to drive the fault current if an insulation fault occurs - the above-mentioned cables fulfil this condition when connected correctly.

Connection

The correct connection of motor cables with 3+3-core versions is described in the DKE announcement *Connection of split protective conductors in lines or cables* (DKE/K 226, DKE/K 225, DKE UK 221.1 16.01.2023) [1].

"If a protective conductor is symmetrically divided into several individual conductors when using a line or cable, these individual conductors must always be considered together for the function as one protective conductor. They may therefore be connected together to a protective conductor connection point designed and approved for this purpose by the manufacturer" [1].

In addition, the following points must be observed to ensure the effectiveness of all lines and trouble-free operation:

1. The braided shield and all ground conductors of the motor cable must be brought together at the respective cable end with the lowest possible impedance. It is essential to ensure that all components are connected at both ends. The ground conductor should be fitted with a suitable cable lug or wire end ferrule, connected as short as possible at both ends and, especially in the case of a third ground conductor, of the same length.
2. The shield of the motor cable should not be connected to the main earthing rail of the control cabinet, but directly to the frequency inverter. The braided shield should be connected directly to the bonding rail/lead plate/terminal of the inverter output using a grounding clamp of a suitable size that makes contact all round (standard inverters already have a suitable shield connection terminal for this purpose).
3. When connecting the shield to the motor terminal board, the EMC cable gland (e.g. SKINTOP® MS-M BRUSH or SKINTOP® MS-SC-M) and cable shield must be installed correctly on the terminal board box in accordance with the manufacturer's instructions. In the case of a surface-mounted terminal box, this must be connected internally to the ground connection of the motor stator with low resistance using a sufficiently dimensioned flat ribbon earth electrode.
4. The motor cable must be routed from the motor to the inverter without intermediate clamping.
5. The installation length should be limited to the cable length actually required.

Literature

- [1] P. Täubl, "Connection of split protective conductors in wires or cables," Jan. 2023. accessed on: June 11, 2024 [Online]. Available at: <https://www.dke.de/de/arbeitsfelder/industry/normenhinweise/anschluss-aufgeteilter-schutzleiter>