LINE CHOKES

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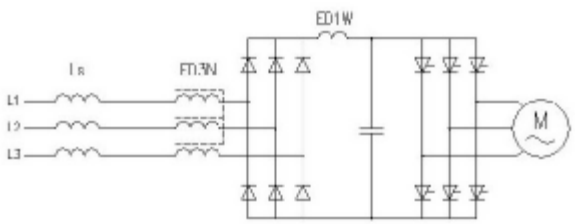
The supply network can be affected by non-linear receivers that cause distortions of the sinusoidal voltage course and thereby, the growth of losses and operational disturbances in other machines and devices supplied from the network. The ED1N single-phase chokes and ED1N three-phase chokes are manufactured by the ELHAND TRANSFORMATORY Company from Lubliniec.

The line chokes are usually applied in the plant low-voltage networks supplying many converting drive systems. In these applications, they execute many tasks, e.g. limiting harmonics propagation, muffling commutation overvoltages and, in case of short circuit, minimising the value of the short circuit current and current derivative.

Line chokes basic functions

The low-power thyristor converters systems may be supplied directly from the network without an individual transformer. In such circumstances, it is necessary to use line chokes of type ED1N and ED3N in the line between the supply network and the converter (drawing 1). These chokes protect the converter itself and the supply network [1,2].



Drawing 1 simplified diagram of a converter supplying a squirrel-cage motor

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Controlled rectifiers and inverters generate a series of harmonics in the network, which strongly deform the course of voltage sinusoid and cause the growth in power losses in all the machines and devices supplied from the network.
The ED1N and ED3N line chokes limit the propagation of higher harmonics in the network and muffle the commutation overvoltages created while connecting thyristors. By applying line chokes, mutual disturbance of converters during commutation is weakened.
The thyristors of converter systems frequently need to be protected to ensure the restraint of the forward current increase by the time the pnpn structure is switched over to the conduction state. The easiest method for carrying out this task is to install line chokes.

When selecting a relevant choke, attention should be paid to the mutual induction dependencies of L_{ED3N} network that should meet the following condition (1).

$$L_{ED3N} \geq \frac{U_{Tm}}{(di_T/dt)} - L_S \quad (1)$$

where: U_{Tm} – the largest possible value of blocking voltage on the moment preceding switching over the thyristor in the given system; $(di_T/dt)_{crit}$ – critical steepness of the thyristor forward current growth; L_S – network and source substitute induction.

If we get the result $L_{ED3N} \leq 0$ from the dependency (1), it means that it is unnecessary to install the line chokes since the network induction limits the value of the current derivative sufficiently. There is a concept for protecting thyristors that applies to special saturable chokes. However, such solutions create a deformation in the initial run of the load current, which in many cases is not permitted. [2].
The practical manner of determining the technical parameters of line chokes is to assume a permissible voltage drop on the

choke (2) that should exceed a few percent of the network rated voltage

$$U_L = 2pfL_{ED3N}I \quad (2)$$

where: I – load rated current, f – network voltage frequency, L_{ED3N} – line choke induction.

The line choke rated current is a forced parameter by the converter system and its load. Knowing the current value, we may thus – by using the dependency (2) – determine the choke induction, assuming a few percent voltage drop.
One should also make sure that the magnetic core characteristics made it impossible for the line choke to come to the state of saturation through the whole range of the receiver's expected currents.

Line chokes structure

The line chokes are manufactured in two versions: single-phase ED1N and three-phase ED3N. Moreover, depending on environmental conditions in which the chokes are to operate, it is possible to produce them in naval and land version. Rated currents, dependent on the systems' powers and with which the chokes operate, fit into the range from a few to a few hundred amperes (860A). The line chokes induction ranges between tens of microhenries to over ten millihenries.
The core is made of electromagnetic silicon sheets with of a thickness between 0.25 and 0.5 mm. The sheets fittings, being the respective core elements, may be spliced or welded, depending on the manufacturing version of the choke. Most line chokes windings are coiled in frames with round winding wire. The chokes operating in strong-current systems have the windings made of rolled formed wire, often with ducts to facilitate cooling.
The core, as well as windings placed on it, undergoes the process of vacuous impregnation, which is significantly more effective than the traditional impregnating dip. The vacuous impregnation ensures the reliability of the line chokes produced in harsh environmental conditions and also results in reducing the power losses. Furthermore, the chokes are equipped with instrumentation comprising terminals and cable tips, angle plates and transportation grips.
The tests, carried out at the electrical test station on the basis of the norms currently in force, are the final production stage of the line chokes. The objective of the final tests is to eliminate all possible defects in the product.
The quality assurance system, meeting the requirements set out in the PN-ISO-9002 norm, implemented in the *ELHAND TRANSFORMATORY* Company, permits the highest quality and repeatability of technical parameters in the transformers, chokes and power supplies produced and an efficient and professional customer service.

Bibliography

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