APPLICATION NOTE:
IT EARTHING SYSTEM

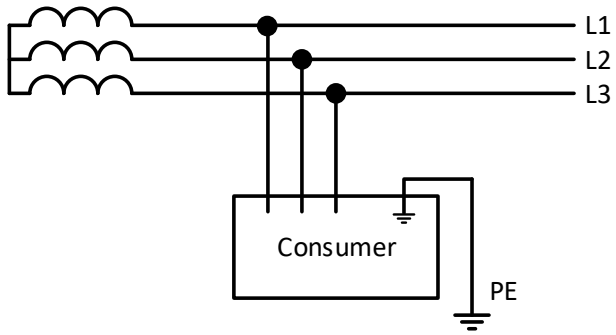
Elektro-Automatik

Table of contents

1. Preamble

Electric power systems can have different earthing systems. There is a significant number of transformers connected the public power grid which are installed to adapt the supply voltage for local grids. Thus, in order to explain the different earthing systems, it has become prevalent to consider the three-phase supply after the last transformer.

This document focuses the **IT earthing system** or short **IT system**, from french "isolé terre" (isolated ground). The star point of the supplying transformer in an IT system has no direct connection to earth, i. e. it's not grounded. It means, the outer conductors of the three-phase supply have no potential against ground. The consumers are only wired to the three phases and perhaps neutral, in case unsymmetrical load is expected. The local electric power system has a ground electrode which is connected to the bodies (here: metal housings or enclosures) of the electric devices (consumers) and this connection is called the same as with other earthing systems: PE. This figure shall depict the IT system:



IT system

Figure 1

The IT system has been created to keep devices operating in case of a single fault. Single fault means, that any of the three outer conductors is allowed to have a short-circuit to PE without the requirement to shut down the entire plant. There will be no danger of life for a person being in physical contact to the body of the faulty device, because the residual current is very low due to the high impedance against ground. Standards demand the installation and use of an insulation monitor device (IMD) for the IT system, which in such a situation of short-circuit to PE will emit a warning signal. This IMD, if not already existing in or on the electric device, has to be installed by the operator in proximity of the device.

Only in case of a very improbable double fault, like when two outer conductors have a short-circuit to PE at the same time, the plant must be shut down immediately. This can either be accomplished by overcurrent protection devices, RCDs or an instant voltage limitation to below 50 V, initiated by a special supervision hardware. The IT system is hence primarily used in critical applications which shall not be interrupted, such as glass production or operating rooms.

2. Our devices in the IT earthing system

2.1 Single phase device with ground conductor

2.1.1 Electric strength and creeping distance

Devices of this category must have an electric strength of at least as high as the outer conductor voltage when operated on a three-phase supply. Our device's electric strength doesn't comply.

2.1.2 Electric noise

The electric noise will increase, because leakage capacitors against PE on the primary AC side are practically ineffective. It might even become necessary to protect the electric system against the increased interference by installation of additional filters or similar measures.

2.1.3 Noise immunity

The noise immunity remains unaltered.

2.1.4 Conclusion

Can only be realized in a single phase IT system, if the increased noise is acceptable and a proper insulation monitor is installed which can detect leakage capacitances. The leakage current in the IT system has to be so low that the touch voltage remains below 50 V in case of a single fault.

2.2 Three phase device with ground conductor

2.2.1 Electric strength and creeping distance

In this category the electric strength between outer conductor and PE is defined at 500 V. It means, that with a slight supply voltage derating in the upper range electric strength and creeping distance of our devices are sufficient.

2.2.2 Electric noise

The electric noise can increase, because the leakage capacitors are almost ineffective if the load is unsymmetrical, as it will be with device models which contain one or two power stages, while models with three power stages compensate the unsymmetrical effect. The absence of a grounded star point is non-critical here.

2.2.3 Noise immunity

The noise immunity remains unaltered.

2.2.4 Conclusion

Our devices can be operated on an IT system, as long as the phase-to-phase voltage doesn't exceed 500 V_{AC}. An increased noise emission is expected, thus it's required to check in individual cases if unproblematic operation is possible. It's furthermore required to install an insulation monitor which can detect leakage capacitances. Last, but not least, the touch voltage which comes from the sum of leakage currents in the IT system must also remain below 50 V in case of a single fault.

2.3 Reaction of the devices in the unearthed electric system

No reaction expected.

3. Market observations

The problems arising from an increased noise emission along with the resulting leakage currents through the Y capacitors are commonly known. It's recommended to use external filters which ideally are without Y capacitors, like the example in Figure 2.

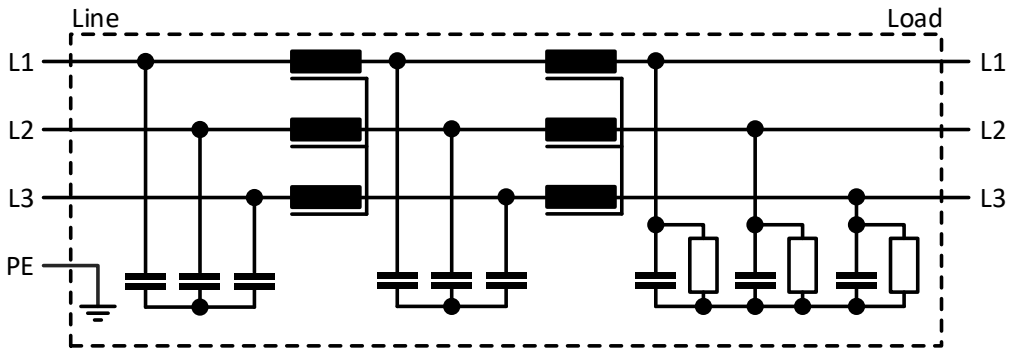


Figure 2 - EMI filter example

4. Conclusions for the 9000 and 10000 series

Single phase devices with PE conductor are only allowed to be operated on a single phase IT system. Additionally, the operator of the IT system must evaluate the impact of the increased noise emission. The default insulation monitor has to be one that is capable of detecting leakage capacitances. Furthermore, the operator also has to ensure, that in case of a single fault occurrence in the mesh the touch voltage remains low enough that it would never exceed 50 V.

For three-phase devices it's mandatory for the operator to ensure the phase-to-phase voltage can never exceed 500 V. Similar to single phase models, the operator of the IT system must evaluate the chance of an increased noise emission if models are operated which don't have a balanced phase current. The default insulation monitor has to be one that is capable of detecting leakage capacitances. As a general measure the operator also has to ensure, that in case of a single fault occurrence in the mesh the touch voltage remains low enough that it would never exceed 50 V.

5. Possible problems during operation

5.1 Conduction-bound emissions can lead to malfunctions in the customer plant

To avoid these unwanted emissions and the resulting malfunctions, either an isolating transformer installed just for our device would be an option or the use of a special line filter for IT systems (see Figure 2).

5.2 The leakage current in the first fault occurrence is too high

For example, with medical equipment. In this case, the operation of the device wouldn't be allowed without either applying a modification to the device or, what's simpler, to install a dedicated isolating transformer.

Elektro-Automatik

support@elektroautomatik.com www.elektroautomatik.com +49 (02162) 3785-0