

Isolation Transformer & its Application in Medical Instruments

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ABSTRACT

This research includes the basic introduction to the concept of isolation transformers. This paper also covers the advantages, disadvantages and applications of isolation transformer. This paper focuses mainly on the applications of isolation transformer in medical instruments.

Keywords: Isolation transformer, representation of isolation transformer, nature and applications, medical applications.

1.INTRODUCTION

An isolation transformer basically has a 1:1 ratio of primary and secondary windings. It is used to transfer AC electrical power from a source to other electrical equipment and thereby isolates the electrical equipment from the source for safety. Isolation transformer allows the transfer of only the AC components in the signal and blocks the DC components, to pass from one circuit to the other. Isolation transformers are useful to reduce electrical noise in instruments which are sensitive in nature like medical instruments and to protect against electrical shock to the person using the equipment, to reduce harmonic distortion, etc [1]. The transfer of ac electrical power from the source to the electrical equipment connected to the load side is only due to linking of magnetic field between the two windings, as there is no electrical connection between them [2].

2.REPRESENTATION OF ISOLATION TRANSFORMER

Isolation transformer is represented as shown below in figure.1.

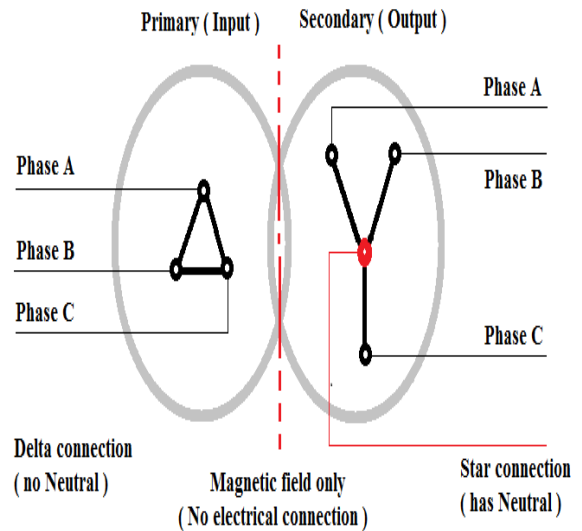


Fig.1 Wiring diagram of Isolation transformer

The primary winding of the isolation transformer is delta connected while the secondary winding is star connected, for optimising power quality. The secondary winding introduces a neutral point in the secondary circuit or load circuit due to the star connection [1]. There is no electrical connection between the two windings, only magnetic field is present. The primary winding has no neutral connection hence the neutral connection present at the secondary side has no electrical connection to any neutral on the primary. So the secondary circuit or load circuit has a floating voltage with respect to the primary. The equipment connected to the secondary circuit may face various hazards like insulation failure, fire, etc., due to the floating voltage. Therefore to avoid such accidents the neutral of the secondary circuits is grounded by directly connecting it to the existing neutral connection [3].

3.NATURE AND APPLICATIONS OF ISOLATION TRANSFORMER



Fig.2 Isolation transformer [5]

Isolation transformer has many advantages as it suppresses the noise to the equipment, it reduces surges and harmonics, provides high insulation resistance and provides electro-magnetic and electro-static shielding. The main advantage is that the person using the equipment is safe from electric shocks, which may be fatal [4]. The disadvantages associated with the isolation transformer are the circuit losses, physical size of the transformer and its cost [1]. The isolation transformer finds applications in computers, communication instruments, analytic instruments, mobile power solutions, surge protector, medical instruments and medical grade UPS system [4][5].

4.ISOLATION TRANSFORMER FOR MEDICAL APPLICATIONS

Isolation transformer is installed in the areas of medical use by connecting them with the medical electrical equipment and non-medical electrical equipment, to provide safety to the patients and also the persons operating the equipment [6]. Medical electrical equipment is any instrument which is used to diagnose, monitor, analyze, operate and comfort a disease or disorder in patients [8].



Fig.3 Medical instruments

The equipment employed in the patient vicinity and areas of medical use should follow the EEC guidelines of medical products. The medical electrical equipment needs isolation transformer so that if a supply power has a large leakage current, the equipment may be damaged and can be fatal for the patients and the person operating the equipment. The equipment also should always display a precise measurement of various parameters associated with the medical calculations. An isolated power supply system ensures the electrical safety of the equipment improves the power supply quantity and also monitors the power supply for the safety of the individuals in the medical vicinity [7]. For general consideration for safety of equipment, the isolation transformer for an operating voltage upto 250 V should possess a high dielectric strength of 4 kV or more, the minimum creepage and clearance should be 10 mm, the insulation temperature of transformer should be minimum 130°C and the leakage current should not exceed 30 μ A. This is necessary to meet the general medical standards [9]. EN 60601 is a family of standards which covers the safety, performance and the compatibility of electrical medical equipment with the system [10]. The standard BS EN 60601 defines two types of medical isolation transformer as Type 'F' and Type 'B' Medical isolation transformers. The type 'F' transformer is earth free i.e. the

secondary of this transformer is not earthed. While connecting it to the power system, it must be physically insulated from the earth having a leakage current below 5mA. As the transformer secondary is earth free, it must be tested for any fault permanently and any insulation failure to the earth must be alarmed to the designated staff as it can be fatal to the patients and persons in the vicinity. The type 'B' transformer has its secondary earthed and acts like a main supply to the system. This type of transformers are used for devices in patients vicinity where the natural earth leakage current might cause tripping of supply causing problems to the patients [11].

5.CONCLUSION

This research paper deals with the basic introduction and representation of isolation transformer. The nature and applications of isolation transformer are also briefly discussed. Isolation transformers are a must for sensitive instruments which are used for monitoring, measuring and analysing various parameters according to its applications. Isolation transformers are very useful in the various medicals applications thereby ensuring safety of the patients and the person in contact with the medical instruments in the medical vicinity.

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