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Multipulse AC–DC Converters for Improving Power Quality: A Review

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Abstract: **In today's world, undoubtedly semiconductor components are involved in every instrument right from toys to big control devices of big machinery. The use of semiconductor devices introduces harmonics in the system currently minimum 15% harmonics is observed for LT customer. The harmonics in distribution system gets propagated to transmission and generation system. The presence of harmonic in system causes maloperation of the protective devices resulting in power failure. In this paper review of three phase multipulse AC-DC converter(MPC) is presented. MPC are used for improvement of power quality for reduction of harmonics in ac mains and ripples in dc output.**

Keywords: **Power quality, harmonics reduction, multipulse DC-AC converters etc.**

1. INTRODUCTION

Semiconductor devices AC-DC converters are invariably used in almost all electrical, electronics and instrumentation applications. In industry the use of solid state devices is very important to control the motor speed and torque. In HVDC transmission only powwisble because of solid state high power converters at both end. Other major applications of solid state devices are power supplied, UPS and SMPS. The converters used for rectifier application fare of three phase type and it produces harmonics in system and it results in poor power factor, distribution of ac voltage distortion and it may also cause poor power factor and it may also contain ripples. To avoid this problems several many national and international laws are made. The laws made by IEEE and IEC are necessary to follows while making any semiconductor power electronic components. In general to avoid this problem installation of filter is recommended. Harmonic f filters can be of active, passive or hybrid type used can select this on basic of economic considerations. The filter is been developed from small to large capacity of power quality problems of ac-dc converters. By considering future installations, it is preferred to modify the converter structure at design stage either using active or passive wave shaping of input currents. The various techniques are used for improvement converters systems are well mentioned in this paper. The active filtering technique ac-dc converters is widely used in a various applications. In case of passive wave shaping technique of these converters is taken into consideration and it is proven as simple and economic method of improvement in power quality in few of the applications. The passive wave shaping technique is based on magnetic in three phase ac systems and it is corresponded to the development of systems are knows as multipulse or multiphase ac-dc converters(MPCs). The various technique has been developed and demonstrated the applications of multipulse converters. Different topologies of multipulse concverters are demonstrated in fig.1

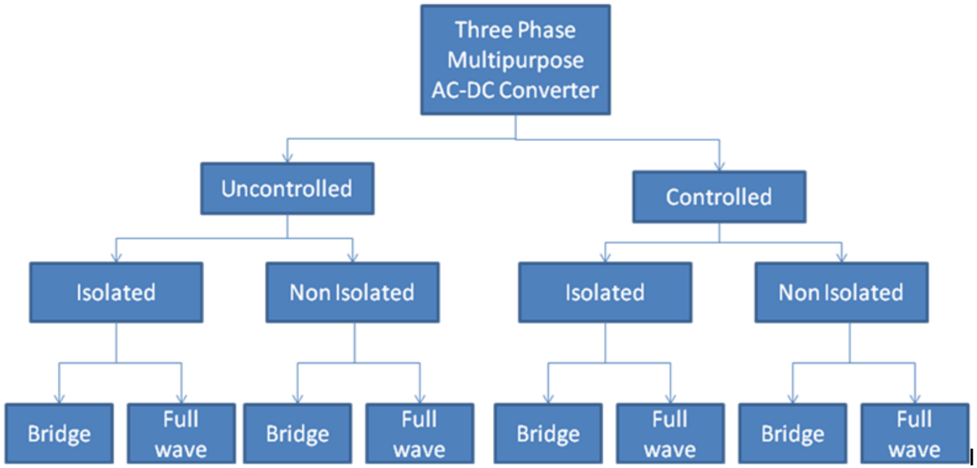

Fig.1. Classification of three-phase multipulse ac–dc converters.

2. CONVERTER TOPOLOGIES

Unidirectional AC-DC Converters:

12 Pulse AC-DC converters:

These 12 pulse unidirectional converters are normally used for isolated and nonisolated circuit topologies depending upon voltage levels on the input ac mains and dc output. If there is requirement of lower voltage for electroplating applications in thatcase isolated topologies are more preferred and isolated multiwinding transformer is utilized before connecting it to diode rectifier. If the case of voltage level difference in between input and output is large, then use of non isolated topologies are proven to be good. Use of through different types of autotransformers are used for reduction in size, cost, losses and weight in the magnetic field before it is connecting to system by using uncontrolled diode rectifiers. For further understanding multipulse converters are broadly classified Isolated unidirectional 12-pulse AC–DC converters and Nonisolated unidirectional 12-pulse AC–DC converters.

Isolated unidirectional 12-pulse AC–DC converters:

As mentioned earlier if the voltage levels has significant difference then isolated multiwinding transformers are used before it is connected to rectifiers. However, it can be further classified as full and bridge type of converters. For choosing the transformer connection the type of bridge configuration is taken into consideration. To further investigate multipulse converters are classified as star or tapped polygon transformer secondary type of inverters for creation of 12 pulse twelve phases for feeding full wave diode rectifiers. Above two types multiplulse converters possesses some advantages and some disadvantages. Both the type of converters produces same type of performance.

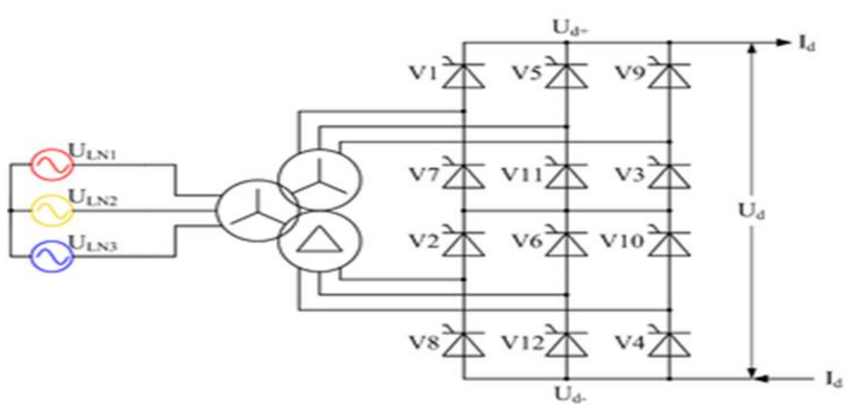

Fig.2. Topology of 12 pulse Isolated unidirectional 12-pulse AC–DC converters

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Nonisolated unidirectional 12-pulse AC–DC converters:

Where input ac and output dc is very close then the there is no requirement of isolation then the nonisolated systems are used. This type of converters are also further classified as full wave and bridge type of converters. It offers very good advantage of reduction in weight and volume, lossed in magnetic field, cost and size. Because of this many advantages of this type of converters are widely used. The operating of this type of converters is very easy and high efficiency and reduction in harmonics as compared to isolated system as there is no need of transformer.

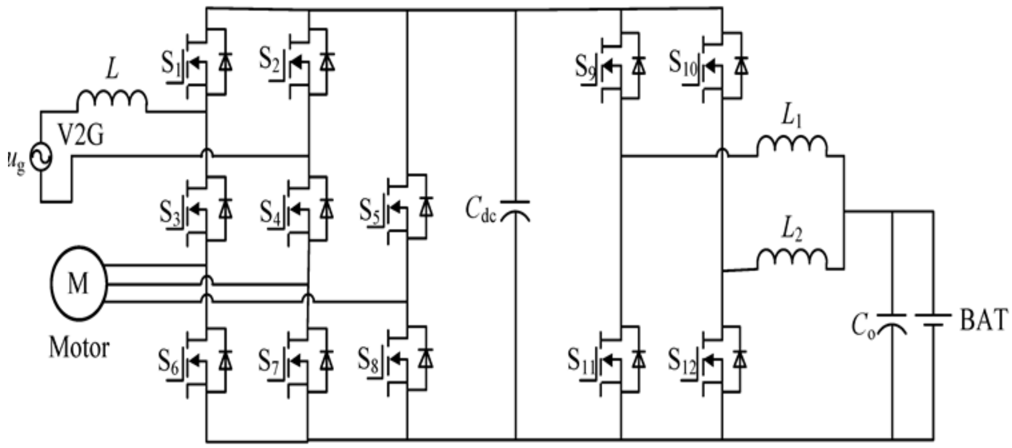

Fig.3. Topology of 12 pulse non isolated unidirectional 12-pulse AC–DC converters

18 pulse AC-DC Converters.

The main of the 18 pulse converters is to achieve reduction in harmonics and minimum value of output voltage ripples. These type of converters are mainly used in two configuration as stated in fig.1. isolated and non isolated type.

Isolated unidirectional 18 pulse AC-DC converter:

These type of converters are used for providing a isolation These are used to provide isolation between input ac mains and dc loads with varying configurations. These 18-pulse converters are also further subclassified as full-wave and bridge configurations.

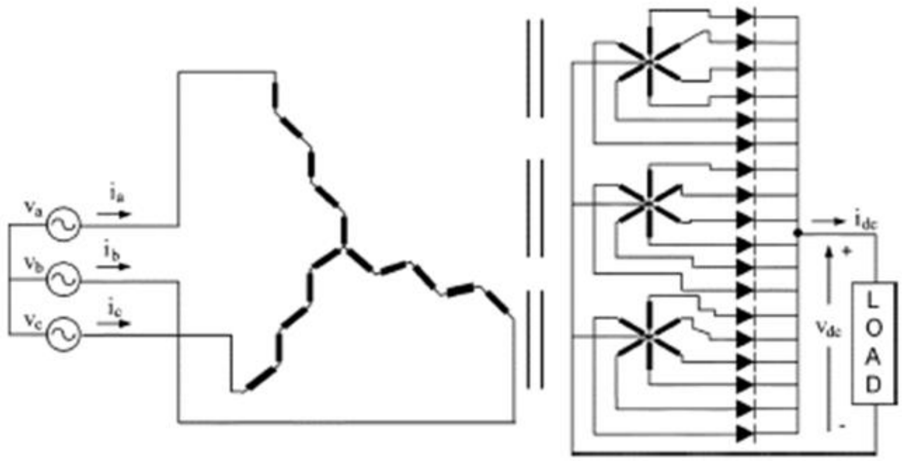

Fig. 4. Three-phase unidirectional full-wave 18-pulse ac–dc converter using zigzag/triple double-star isolation transformer

In fig.4. 18 pulse AC-DC converter is shown with three isolated transformers for zigzag primary winding for secondary windings are connected in series and two double star transfoermers are used for feeding 18 diodes for full wave configuration. For return path of current star point of star connection is used or in some cases three double star transformers may get interconnected together. In this configuration, series-connected zigzag primaries result in proper current sharing with the 18-pulse in the dc output and close to sinusoidal currents in the ac mains.

3. CONCLUSION

A comprehensive review of MPCs has been presented to explore a wide spectrum of different configurations of multipulse ac–dc converters. A broad classification of MPCs in several categories is expected to be good guidelines for easy selection of an appropriate converter for a specific application. These MPCs can be considered better alternatives for power quality improvement because of an inherent integrated converter with simple construction, reduced size of magnetics, and enhanced reliability due to lower components count compared to other means of power quality improvement. These converters improve the power quality at both ends, i.e., input ac mains and dc output load. Moreover, the use of these MPCs results in less noise, low EMI and RFI, low switching losses, and low cost due to the use of simple devices. It is hoped that this glimpse of multipulse ac–dc converters and their performance will be a useful reference to the designers, users, manufacturers, and researchers working on ac–dc converters dealing with power quality issues.

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