**A SIMULATION OF THREE-PHASE TO FIVE PHASE POWER CONVERTING TRNASFORMER**

1Ashutosh Kumar Singh, 2Mahesh Watt, 3Prof. Mrs.S.S.Ambekar

1,2,8th Sem , Electrical Eng. KDKCE, Nagpur,3Asso.Prof & Head, Electrical Dept. KDKCE, Nagpur

1ashutosh90123@gmail.com, 2wattmahesh15@gmail.com

**ABSTRACT**:- Multiphase (more than three-phase electric power) electric drive system is the focus of an important research in the last decade. Multiphase power transmission system is also investigated in the literature because multiphase transformers are needed at the input of rectifiers. In the multiphase power transmission and multiphase rectifier systems, the number of phases investigated is a multiple of three. However, the variable speed multiphase drive system considered in the literature are mostly of five, seven, nine, eleven, twelve, and fifteen phases. Such multiphase drive systems are always supplied from power electronic converters. In contrast, this paper proposes technique to obtain five-phase output from three-phase supply system using special transformer connections. Thus, with the proposed technique, a pure five-phase sine-wave voltage/current is obtained, which can be used for motor testing purposes. In addition, a five-phase power transmission and rectifier system may benefit from the proposed connection scheme. Complete design of the proposed solution is presented. simulation is presented in the paper.

***Index Terms*—converting transformer, multiphase drive systems, multiphase system, multiphase transmission, three-to-five phase.**

**I. INTRODUCTION**

Focus of research on multiphase system are initiated due to their inherent advantage over three-phase system. The applicability of multiphase systems is explored in electric power generation transmission and utilization. The research on five phase transmission systems was initiated due to rising cost of transmission, environmental issues, and various strict licensing laws. Multi-phase transmission lines can provide the same power capacity with a lower line voltage and smaller towers as compared to a standard double circuit three-phase line. The dimension of the multi-phase smaller towers may also lead to the reduction of magnetic fields and Electromagnetic interference. The present work on multiphase power generation investigates an asymmetrical six-phase (two set of stator windings with 30*◦* phase displacement) induction generator configuration as a solution for the use in renewable energy systems. Ward and Harer proposed multiphase motor drives. Since the beginning of this century due to enhancement in semiconductor device and signal processors technologies the research on multiphase drive system increase.

 It is to be emphasized here that ac/dc/ac converters generally supply the multiphase motors. Thus, the focus of the current research on multiphase electric drives is limited to the modelling and controlling of the power converters. Little effort is being made to develop static transformation system to change the phase number from three-to-*n*-phase (where *n >* 3 and odd). An exception is where a new type of transformer is presented, which is three-to-five-phase system.

 Normally, no-load test, blocked rotor, and load tests are performed on a motor to determine its parameters. Although the supply used for multiphase motor drives obtained from multiphase inverters could have more current ripples, there are control methods available to lower the current distortion below 1%, based on application and requirement. The machine parameters obtained using a PWM inverter may not provide the correct value. Thus, a pure sinusoidal supply system is required to feed the motor for better analysis. Accordingly, this paper proposes a special transformer connection scheme to obtain a balanced

Three-to-five-phase supply with sinusoidal waveforms. The expected application areas of the proposed transformer are the electric power transmission system, power electronic converters (ac–dc and ac–ac), and the multiphase electric drive system. The fixed three-phase voltage and fixed frequency available in grid power supply can be transformed to fixed voltage and fixed frequency five-phase output supply. Furthermore, the output magnitude may be made variable by inserting a three-phase autotransformer at the input side. In this paper, the input and output supply can be arranged in the following manners:

1) Input star, output star.

2) Input star, output polygon.

3) Input delta, output star.

4) Input delta, output polygon.

Since input is a three-phase system the windings are connected in usual manner. The output/secondary side star connection is discussed in the following sections. The polygon output connection may be derived following a similar approach.

**II. WINDING ARRANGEMENT FOR FIVE PHASE STAR OUTPUT**

In this we take three separate cores. Each carrying one primary and three secondary coils, except in one core where only two secondary coils are used. Six terminals of primaries are connected in such a way that resulting in star and/or delta connections and the 16 terminals of secondaries are connected in a different fashion resulting in star or polygon output. The connection scheme of secondary windings to obtain a star output is illustrated in Fig. and the corresponding phasor diagram is illustrated in Fig. The construction of output phases with requisite phase angles of 72 between each phase is obtained using appropriate turn ratios. The turn ratios are different in each phase. The choice of turn ratio is the key in creating the requisite phase displacement in the output phases. The input phases are designated with letters “X” “Y”, and “Z” and the output are designated with letters “A”, “B”, “C”, “D”, and “E”. As illustrated in Fig, the output phase “A” is along the input phase “X”. The output phase “B” results from the phasor sum of winding voltage “c6c5 ” and “b1b2 ”, the output phase “C” is obtained by the phasor sum of winding voltages “a4a3 ” and “b3b4 ”. The output phase “D” is obtained by the phasor addition of winding voltages “a4a3 ” and “c1c2 ” and similarly output phase “E” results from the phasor sum of the winding voltages “c3c4 ” and “ b6b5”. In this way, five phases are obtained. The transformation from three to five and vice-versa is further obtained by using the relation given in the below equation

* FOR THE OUTPUT (STAR)

****

* FOR THE INPUT STAR

****

****

****

**Fig1. Proposed Transformer Winding Arrangement (Star-Star)**

****

**Fig2. Phasor diagram for star-star connection**

|  |  |  |
| --- | --- | --- |
| **Primary** | **Secondary** | **Turns ratio** |
| **Phase-X** | **a1a2** | **1** |
| **a3a4** | **0.47** |
| **Phase-Y** | **b1b2** | **0.68** |
| **b3b4** | **0.858** |
| **b5b6** | **0.24** |
| **Phase-Z** | **c1c2** | **0.68** |
| **c3c4** | **0.858** |
| **c5c6** | **0.24** |

**Table1. for turns ratio of star-star connection**



**Fig3. simulation for five phase star-star output**

**III. WINDING ARRANGEMENT FOR FIVE PHASE**

**POLYGON OUTPT**

 Six terminals of primaries are connected in an appropriate manner resulting in star connections and the 16 terminals of secondary are connected in a different fashion resulting in polygon output. The connection scheme of secondary windings to obtain a polygon output is illustrated. The construction of output phases with requisite phase angles of 72° between each phase is obtained using appropriate turn ratios. The turn ratios are different in each phase.

****

**Fig4. Proposed Transformer Winding Arrangement (Star-Polygon)**

****

**Fig5. Proposed Transformer Secondary Winding Connection (Star-Polygon)**

**1V. CONCLUSION**

This paper proposes a new transformer connection scheme to transform the three-phase grid power to a five-phase output supply. The input and outputs are arranged in four different fashions in order to obtain five-phase balanced output. The connection schemes and the phasor diagram along with the turn ratios are illustrated.

The proposed connection scheme can be used in drive applications and may also be further explored to be utilized in multiphase power transmission systems. The Fault tolerance is improved and less voltage ripples are found in the output. This transformation is applicable reliably in Multiphase power transmission system, bulk power transfer and in Five-phase permanent magnet generator systems for wind turbine applications. It is employed in Ship propulsion traction for both hybrid, electric hybrid vehicles and Electric aircraft.

**REFERENCES**

1. Shaikh moinodddin ,Atif Iqbal ,Haitham abu-rub, M-rizwam khan and sk.Moin ahamed”three phase to seven phase power converting transformer”,ieee transaction on energy conversion,vol.27,no-3,pp.757-766,September 2012
2. E.E.Ward andH.Harer,“Preliminary investigation of an inverter-fed5-phase induction motor,” Proc. Inst. Elect. Eng*.*, vol. 116, no. 6, 2005
3. D. Basic, J. G. Zhu, and G. Boardman, “Transient performance study of brushless doubly fed twin stator generator,” IEEE Trans. EnergyConvers*.*,vol. 18, no. 3, pp. 400–408, Jul. 2003.
4. G. K. Singh, “Self excited induction generator research- a survey, ”Elect.Power Syst*.* Res*.*, vol. 69, pp. 107–114, 2004.
5. O. Ojo and I. E. Davidson, “PWM-VSI inverter-assisted stand-alone dual stator winding induction generator,” IEEE Trans Ind.Appl*.*, vol.36, no. 6, pp. 1604–1611, Nov./Dec. 2000.
6. T.l.landers,r.jricheda,e.krizakas.” High phase order economics :constructing a new transmission line ,”ieee transactionon power delivery,vol.13,no.4,1998