International Seminar On Non-Conventional Energy Sources for Sustainable Development of Rural Areas,
IJAERD- International Journal of Advance Engineering & Research Development
e-ISSN: 2348-4470, p-ISSN:2348-6406
Impact Factor: 4.72, DOI:10.21090/ijaerd

Simulation and Modelling of Three phases to five phases Transformer Connection

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Abstract —*In today's electrical world due to ever increasing of demand of more power it is necessary to supply it to a certain voltage level economically, which restricts it to a certain value. There is a need to obtain multiphase supply from the available three phase supply due to its inherent advantages. Moreover there are other limitations on utilization side as well. Now days multiphase systems are being thought of as a solution for the problem and research in this field is picking up pace. Since the three-phase supply is available from the grid, there is a need to develop a static phase transformation system to obtain a multiphase supply from the available three-phase supply. Special Transformer connection Technique are used to convert Three- phase supply to Five-phase supply. Connection method is used in applications requiring fixed voltage and fixed frequency supply. This model can be simulated by using 'MATLAB' software.*

Keywords- *Multiphase system, Multiphase transmission line, Three-to-Five phases, MATLAB Software*

Multiphase systems are the focus of research recently due to their inherent advantages. The applicability of multiphase systems is explored in electric power generation, transmission, and utilization. The research on more than three phase transmission system was initiated due to the rising cost of right of way for transmission corridors and environmental issues. Five phase transmission lines can provide the same power capacity with a lower phase-to-phase voltage and smaller, more compact towers compared to a standard double-circuit three-phase line. These paper proposing a novel phase transformation system which converts an available three-phase supply to an output five-phase supply. The research on multiphase generators has started recently. The first proposal was given by Ward and Harrer way back in 1969 and since then, the research was slow and steady until the end of the last century. 5-phase and 7-phase system is found to produce less ripple with a higher frequency of ripple in an ac–dc rectifier system. Increasing the number of phases certainly enhances the complexity of the system. Special Transformer Connection technique are used to transform three phase supply to five phase supply. Major advantages of using a multi-phase machine instead of a three phase machine are higher torque density, greater efficiency and reduced torque pulsations. The machine parameters obtained by using the pulse width-modulated (PWM) supply may not provide the precise true value. Thus, a pure sinusoidal supply system available from the utility grid is required to feed the motor.

The input and output of supply can be arranged in the following manner -

1. Input star, output star.
2. Input star, output polygon.
3. Input delta, output star.
4. Input delta, output polygon.

Winding arrangement of proposed transformer connection-

The connection of output phases with phase angle 72° between each other is obtaining using appropriate turn ratios. The turn rations are different in each phase.

Let the input phases are designated with letter "X", "Y" and "Z".
The output phases are designated with letter "A", "B", "C", "D" and "E".
Phaser diagram of the transformer connection is shown below-
The input phases are in phase difference of -120° with each other.
$Vx<0°$
$Vy<120°$
$Vz<-120°$

In other word
$Vx = Vmax.Sin(wt)$
$Vy = Vmax.Sin(wt+2\pi/3)$
$Vz = Vmax.Sin(wt-2\pi/3)$

The output phase "A" is along the input phase "X".

The output phase "B" is in 72° phase difference with phase "A".
The output phase "C" is in 72° phase difference with phase "B".
The output phase "D" is in 72° phase difference with phase "C".
The output phase "E" is in 72° phase difference with phase "D".

The output voltages are in 72° phase difference-
Va = Vmax.Sin(wt)
Vb = Vmax.Sin(wt+2π/5)
Vc = Vmax.Sin(wt+4π/5)
Vd = Vmax.Sin(wt-2π/5)
Ve = Vmax.Sin(wt-4π/5)

It is balanced three phase input and five phase output.
The input waveform of three phase supply is shown below-

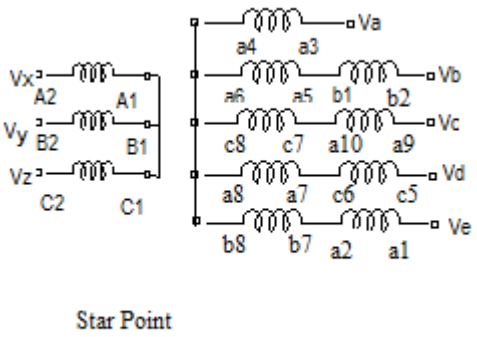
Above waveform shows the output waveform of five phase.
It is conclude that the input three phase supply can be transform into five phase output voltage by using a special connection of transformer at is expected that the connection scheme can be used in drives applications and may also be further explored to be utilized in multi-phase power transmission system.

APPLICATION

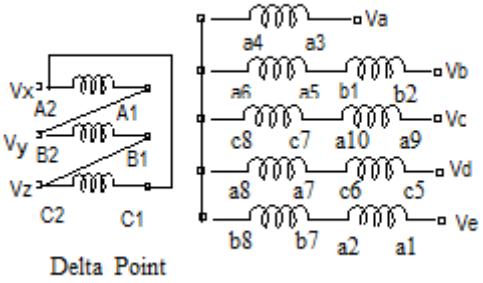
This transformer connection will applicable in multi-phase transmission system and five phase permanent magnet generator system for wind turbine application.

CONCLUSION

The three phase grid supply can be transform to five phase output supply by using a new transformer connection. The phaser diagram of the transformer connection is shown. A five phase induction motor under loaded condition is used to prove the viability of the transformation system.It is expected that the connection scheme can be used in drives applications and may also be further explored to be utilized in multi-phase power transmission system.



Star Point



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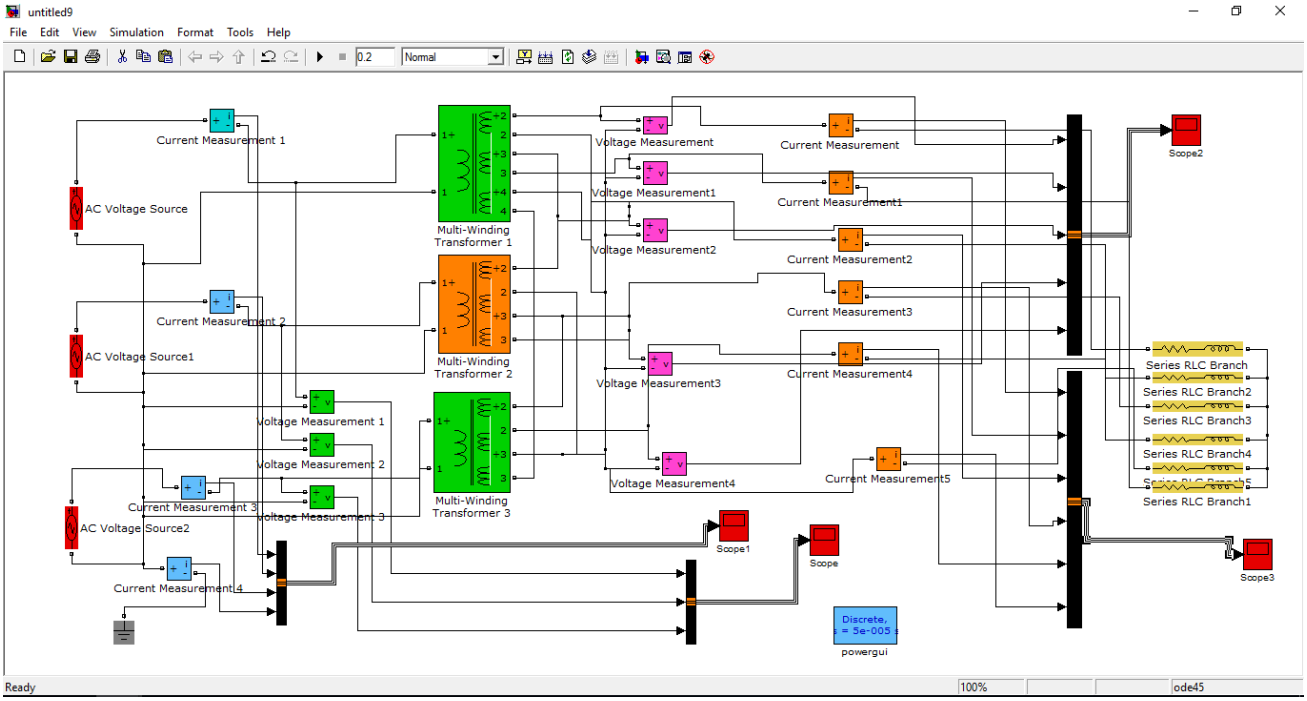
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File Edit View Simulation Format Tools Help
Current Measurement 1
AC Voltage Source
Multi-Winding Transformer 1
Voltage Measurement
Current Measurement
Scope2
Voltage Measurement1
Current Measurement1
Voltage Measurement2
Current Measurement2
Current Measurement 2
AC Voltage Source1
Multi-Winding Transformer 2
Current Measurement3
Voltage Measurement3
Current Measurement4
Series RLC Branch
Series RLC Branch2
Series RLC Branch3
Series RLC Branch4
Series RLC Branch1
Voltage Measurement 1
Voltage Measurement 2
Voltage Measurement 3
Multi-Winding Transformer 3
Voltage Measurement4
Current Measurement5
Current Measurement 3
AC Voltage Source2
Scope1
Scope
Scope3
Current Measurement4
Discrete,
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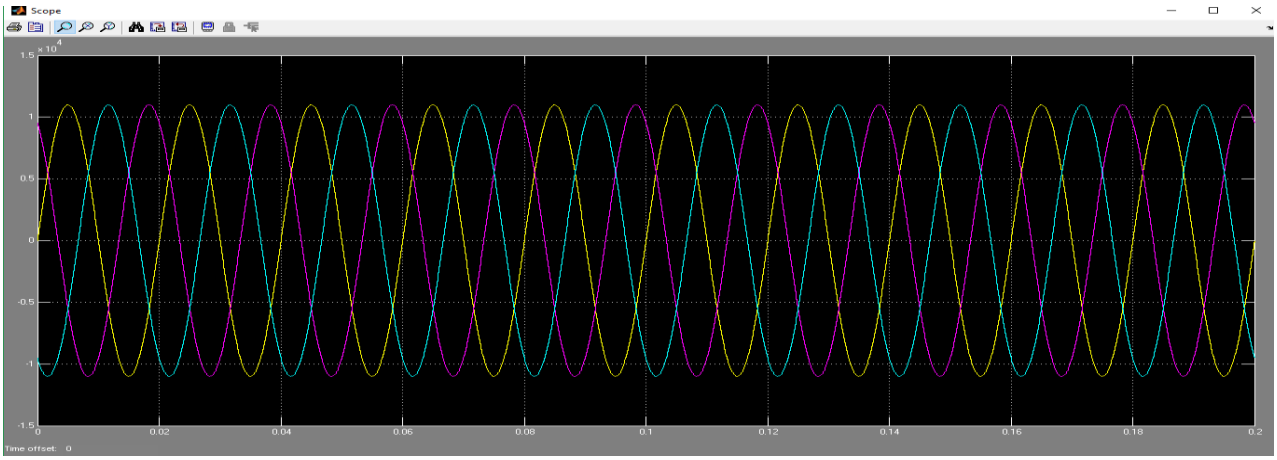
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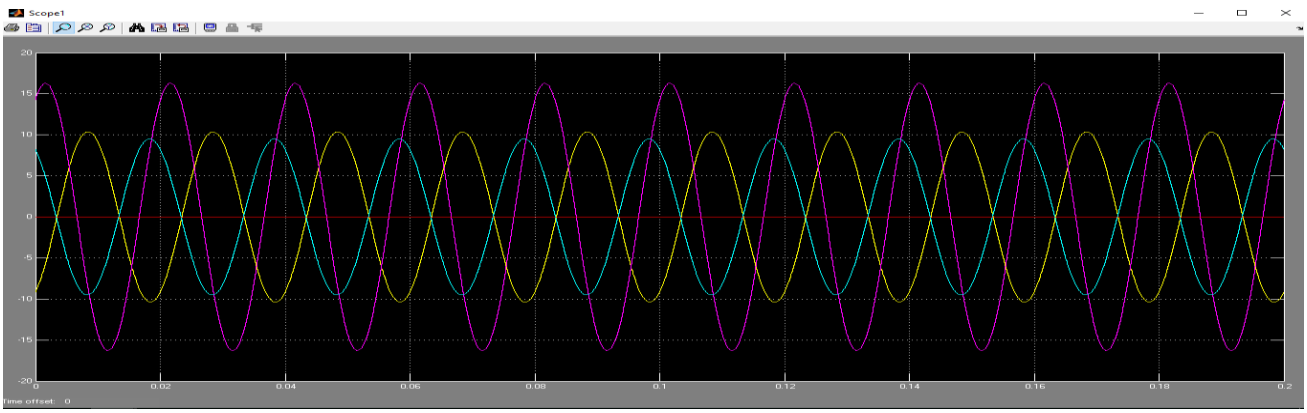
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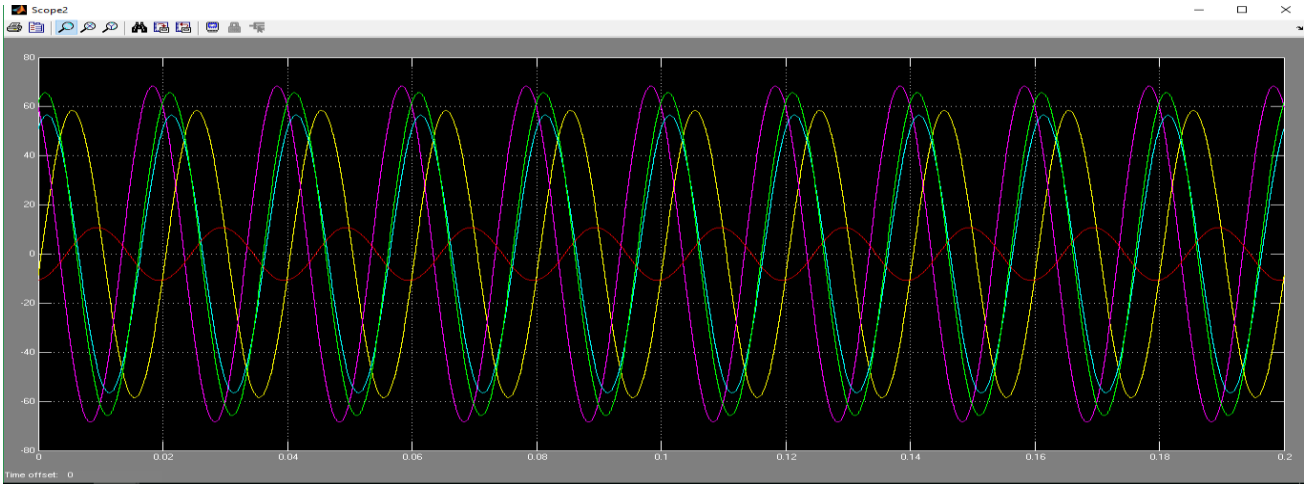
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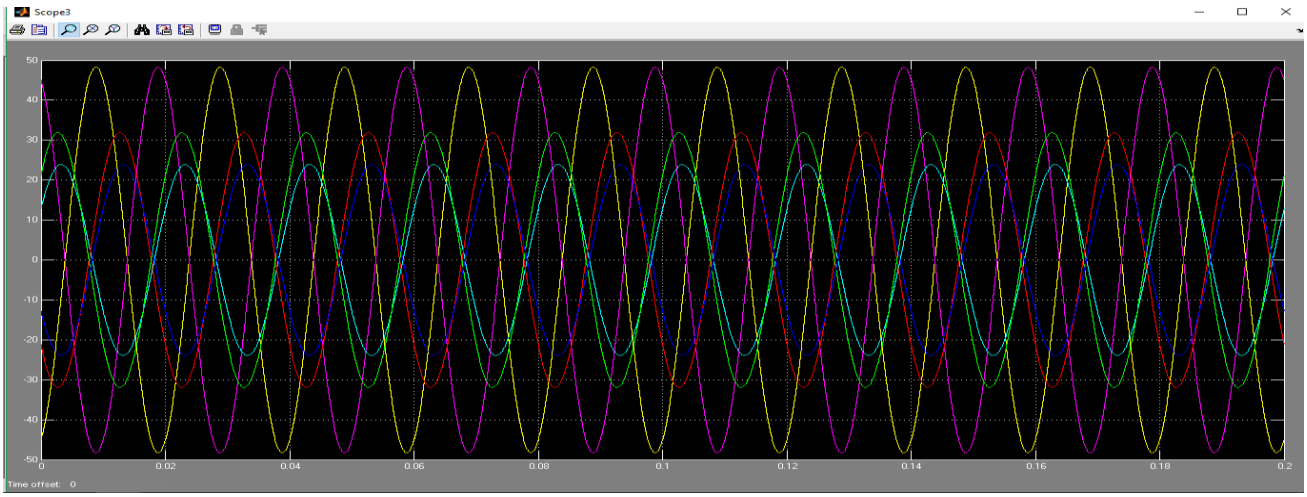
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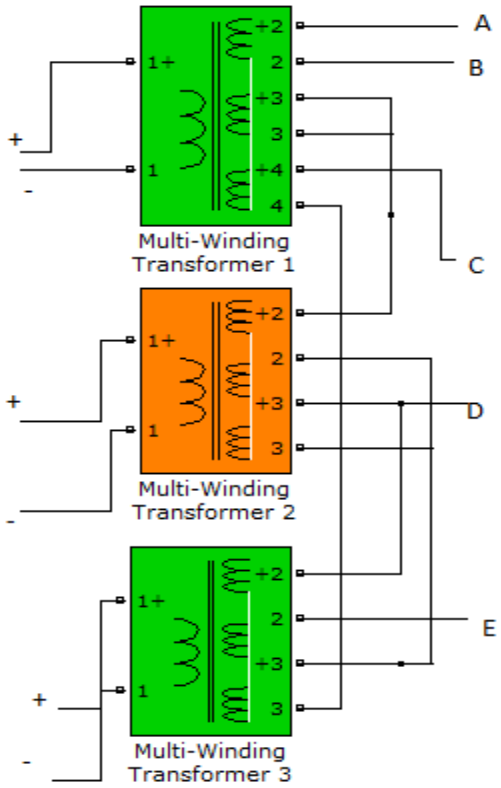
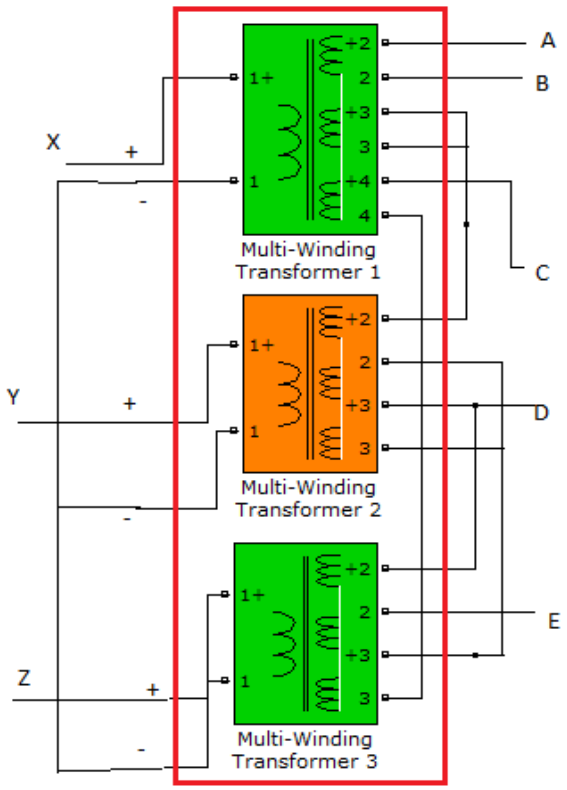

A
B
C
D
E
+2
2
+3
3
+4
4
1+
1
+
-
Multi-Winding
Transformer 1
Multi-Winding
Transformer 2
Multi-Winding
Transformer 3


A
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4
Multi-Winding
Transformer 1
Multi-Winding
Transformer 2
Multi-Winding
Transformer 3