DESIGN AND ANALYSIS OF SCOTT CONNECTED TRANSFORMER

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Abstract: **Day by day as the need of the electricity conversion increases, it is necessary for the development of the country to fulfill the demand of the electricity for the human comfort. Generally three phase supply system is the main cause of unbalanced voltage in electric high speed railway system. In this paper we are going to design a scott connected transformer to reduce pulsation in voltage and current.According to the principal of transformer, it is a static device that transfers of energy from one circuit to another circuit. A current carrying coil produces a varying magnetic flux. This flux induces varying electromotive force across second coil of transformer. Electrical energy transfer from one coil of transformer to another coil without mechanical connection. In 1831 discovered Faraday's law of electromagnetic induction. To reduce the problem of unbalanced power we are going to use methodology of Scott transformer which shows 50% tap of one single phase transformer(Main transformer) is connected to 86.6% tap of the other single phase transformer(teaser transformer).**

***Keywords*: S.W.G.; Standard Wire Gauge, VA; Voltage Ampere, Hz;hartz**

1.INTRODUCTION

A Scott transformer is a circuit which converts three phase power supply to two phase power supply with 90 degree phase shift. It also gives two different single phase systems. The Scott three phase transformer was invented by A Westinghouse Engineer Charles F. Scott in the late 1890's to bypass Thomas Edison's more expensive rotary converter there by permit to two phase generator generator plant to derive three phase motors.We are going to design the small model Scott-T connected transformer which has three phase input terminal and two phase- four wire output terminal to reduce unbalanced voltage and current. For obtain constant and pure power supply for various commercials applications.The scott transformer is used in industrial furnaces with balanced power supply. The scott transformer is also used in railway traction system with unbalanced load . this is the large application of scott transformer . here we designed the scott connected transformer to converting three phase power to two phase power supply with 50 Hz frequency. Small single phase induction motor has stating system of capacitor. Capacitor creates 90 degree phase shift to run induction motor. Its efficient to common being. This Scott transformer also creates 90 degree phase shift so there is also possible to run induction motor with scott transformer creates 90 degree phase shift to run induction motor. Its efficient to common being. This Scott transformer also creates 90 degree phase shift so there is also possible to run induction motor with scott transformer.

2. LITERATURE SURVEY

1.phase differences and simulation of the transformer.
Scott Transformer for Ac/Dc/Ac Power Supply- Journal of Applied Sciences Research, 8(7): 3371-3381, 2012 ISSN 1819-544X Mona F. Moussa phase differences and simulation of the transformer.

2. The parameter analysis and their formulae.
A Mathematical Tool for 3 phase to 2 phase Conversion (Scott Connection) For Unbalanced Load-International Journal of Engineering Studies. Research India Publications Paper code: 28471 - IJES -Anuradha S Deshpande

3. Simulation and testing the circuit and software.
Scott transformer power flow model in autotransformer traction feeding system kritsada mongkoldee, 2tosaphol ratniyomchai, 3thanatchai kulworawanichpong school of electrical engineering, institute of engineering, suranaree university of technology.

3. CIRCUIT DIAGRAM

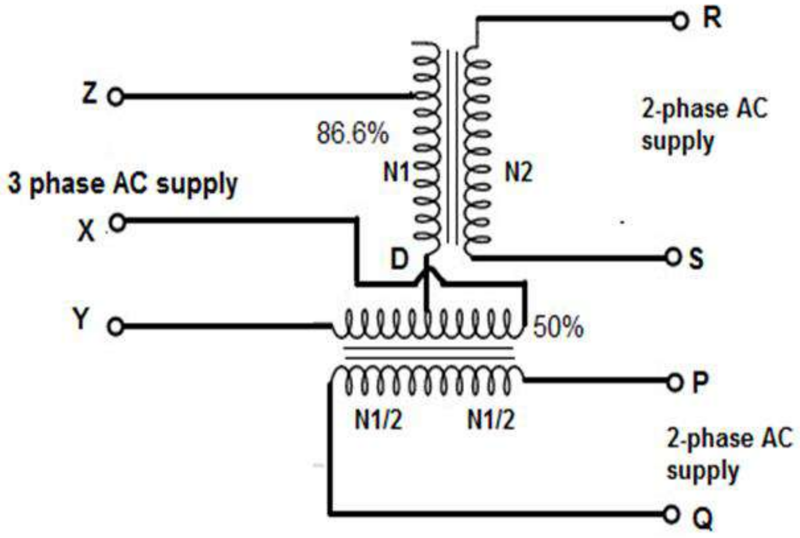


Fig.(1) circuit diagram of scott connected transformer

4. CALCULATION FOR DESIGNING OF SCOTT CONNECTED TRANSFORMER

Step 1: Given parameter

72VA, 24V,3A, 50Hz primary and 72VA, 24V,3A 50Hz secondary

$$\text{Turns ratio}=T_e=\frac{V_1}{V_2}=\frac{I_2}{I_1}=\frac{N_1}{N_2}=K$$

$$T_e=\frac{I_1}{I_2}=\frac{3.33}{3}=1.11$$

Step 2: Selection of core size

For designing isolated transformer turns ratio is 1.

$$\text{Maximum Flux}=\phi_m=\frac{E_t}{4.44FT_e}$$

$$=\frac{1}{4.44\times50\times1.11}$$

$$\phi_m=4.058\times10^{-3}Wb$$

Net Core Area $(A_c)=\frac{\phi_m}{B_m}$

$$A_c=4.058\times10^{-3}mm^2$$

$$B_m=maximum\ flux\ density=1$$

Gross Core Area$=A_{ge}=\frac{A_c}{K_s}$

$$A_{ge}=\frac{4.058\times10^{-3}}{0.9}$$

$$A_{ge}=4.509\times10^{-3}\,Wb/mm^2$$

K_s is stacking factor.

Width of centre limb=A=$\sqrt{A_{ge}}$

A=$\sqrt{4.509 \times 10^{-3}}$

A=0.0671mm

Step 3: Selection of number of turns of primary and secondary of transformer winding

$$N_p = V_P \times T_e$$

$$N_p = 24 \times 1.11$$

$$N_p = 255 \text{ turns}$$

And

$$N_s = V_s \times T_e \times 1.05$$

$$N_p = 268 \text{ turns}$$

Step 4: selection of wire size of primary and secondary

$$I_P = I_s = \frac{\text{Output ratings(VA)}}{\eta V_P}$$

$$I_P = 3.33A$$

Area of primary=$A_P = A_s = \frac{I_P}{\delta}$

$$A_P = \frac{3.33}{2.3} = 1.44mm^2$$

Diameter of bare sized conductor=-$\sqrt{\frac{4}{\pi}A_P}$

=1.833mm=d

s.w.g. =15

Diameter of laminated size=1.82+0.42=2.24mm=d_1

Also secondary have same size so same sized copper wire is required.

Step 6: Step factor

S_{fp} =0.8$(\frac{d}{d_1})^2$

$$S_{fp} = 0.563$$

$$S_{fs} = 0.563$$

Step 6: Window Area

$$\text{Window area of primary} = \frac{N_P A_P}{S_{fp}}$$

$$= \frac{255 \times 1.44}{0.56}$$

$$= 655.71mm^2$$

Window area for secondary=0.8$(\frac{N_s A_s}{S_{fs}})$

$$=0.8(\frac{268 \times 1.44}{0.56})$$

$$=551.31mm^2$$

Window area= $A_{w=}H_w \times W_w$

The Scott transformer is primary 3phase three wire system and secondary have 2 phase four wire system. Therefore teaser transformer is tapped 86.6% of their winding.

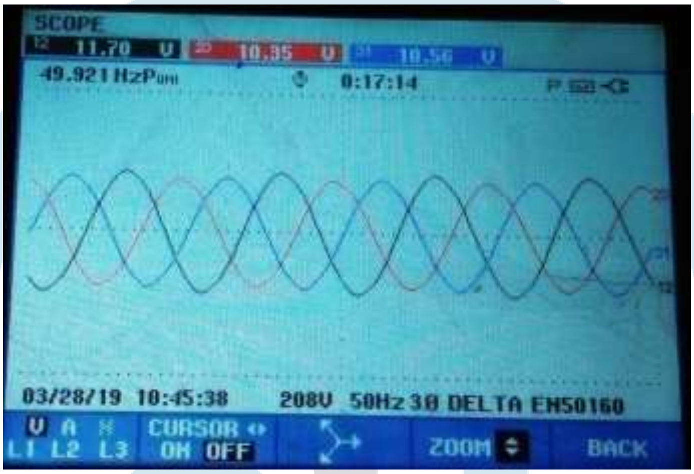
Therefore teaser transformer tapping=220.83=221 turns.

And, main transformer is tapped with 50% of their winding. Therefore main transformer tapping=127.5 turns.

5.ANALYSIS OF SCOTT TRANSFORMER DESIGN

The Scott transformer is designed to obtaining 90^0 phase shift wave length.

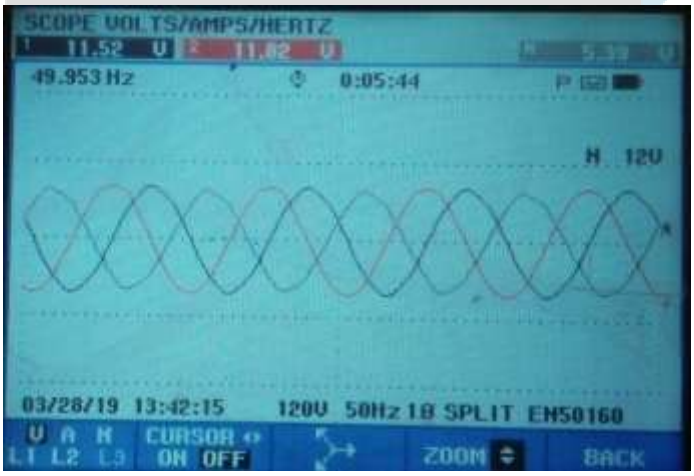
5.1 Primary voltage wave of Scott transformer:



Fig(2). wave form of input of Scott transformer

The Scott transformer required 12V three phase power supply required. Primary side R, Y and B have 120^0 phase shift of voltage supply is shows in the above fig. (1). this is three phase three wire supply.

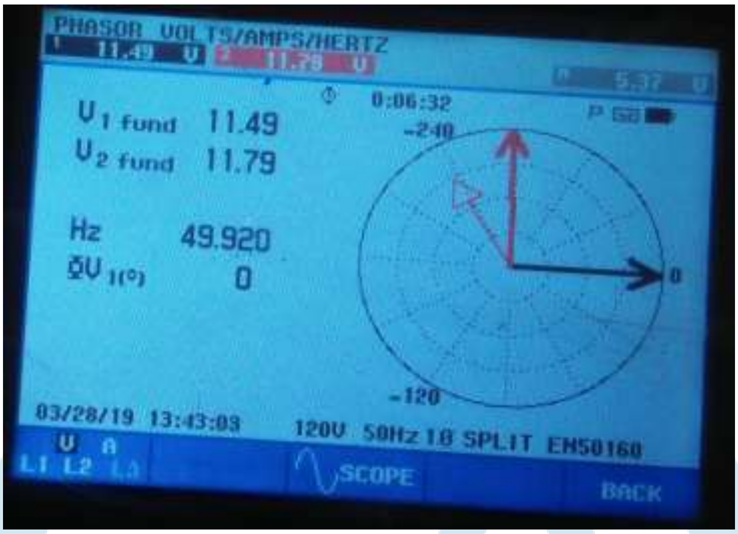
5.2 Secondary voltage wave of Scott transformer:



Fig(3). 90^0 *phase shift of secondary side of scott transformer*

The output of teaser and main transformer have 90 degree phase shift of voltage between them. This is two phase four wire system. Neutral point of main and teaser transformer is is connected and we got 90 degree phase shift.

5.3 Phasor diagram of scott transformer*:*



Fig(4): phasor diagram of Scott connected transformer

6. RESULT

We designed Scott transformer for creating the phase shift between the voltage supply is 〖90〗^0.

7.CONCLUSION

In this paper, we will study the Scott transformer design layout and building hardware . After that study we will find out the output of this transformer and analysis of their phase shift.

REFERENCES

[1] Scott Transformer for Ac/Dc/Ac Power Supply- Journal of Applied Sciences Research, 8(7): 3371-3381, 2012 ISSN 1819-544X.

[2] A Mathematical Tool for 3 phase to 2 phase Conversion (Scott Connection) For Unbalanced Load-International Journal of Engineering Studies. ISSN 0975-6469 Volume 6, Number 1 (2014), pp. 63-70 © Research India Publications. Anuradha Deshapande.

[3] A study on effect of Scott transformer for three phase unbalance reduction in three phase middle voltage distribution lines Arab Academy for Science and Technology and Maritim Transport, basic and applied science department, faculty of engineering, Miami, P.O. Box:1029, Alexandria, Egypt.

[4] Scott transformer power flow model in autotransformer traction feeding system kritsada mongkoldee, osaphol ratniyomchai, 3thanatchai kulworawanichpong school of Electrical Engineering, Institute of Engineering, Suranaree University of Techonology

[5] A Probabilistic Analysis on the Harmonic Cancellation Characteristics of the Scott transformer Hooman Erfanian MAZIN, Joey GALLANT Department of Electrical and computer Engineering, University of alberta, Edmonton, Canada.