Modeling and Control of a Multiport Power Electronic Transformer using Relay Tap Changer

Prof. Neelam Labhade[1], Sonawane Akshay Dinkar[2], Patil Swapnaja Sunil[3], Pandhawale Smita Shivaji[4]
[1, 2, 3, 4] Department of Electronics and Telecommunication
[1, 2, 3, 4] JSPM's Imperial College of Engineering and Research, Wagholi, Pune

Abstract- *After the introduction of current, the on-load faucet ever-changing (OLTC) regulators are wide used. They offers a decent regulation of the output voltage in presence of enormous variations of the input voltage with typical interval from many milliseconds to many seconds. Earlier mechanical style of on load faucet changers were employed in business. However they'd various limitations and disadvantages like arcing, high maintenance, service prices and slow reaction times. So as to decrease these limitations and disadvantages, electronic (or solid-state) tap-changers were developed. the continual growth of power semiconductor devices, like the insulated gate bipolar semiconductor (IGBT)Intr, Triac, Thyristor has allowed the event of quick operational On Load faucet ever-changing regulators that is additionally useful in fixing different issues within the ac mains, like flicker and numerous noises gift in it. The key plan within the solid-state-assisted faucet changer is that solid-state switches that operates throughout the tap-changing method rather than mechanical switches that helps in reducing the arcing phenomena throughout the tap-changing method.. The management strategy is Microcontroller-based, that is more depends on programming. The experimental results demonstrate that the quick OLTC is ready to correct many disturbances of the ac mains besides, the long period in variation in time is way less than the one comparable to the older regulators. The most application of a tap-changer regulator is to manage the amplitude of the output voltage. The key objective of the controller within the tap-changer system is to reduce the fluctuation and disturbances of voltage amplitude with relation to the reference voltage. The controller should regulate the voltage inside a given vary.*

Keywords- On load tap changer, power electronic transformer, microcontroller, multi winding transformer

I. INTRODUCTION

This project proposes a multiport power electronic electrical device (PET) topology with multi-winding medium frequency electrical device (MW-MFT) isolation beside the associated modeling analysis and management theme. The power balance at the various ports is controlled victimization the multi-winding transformer's common flux linkage. The potential applications of the projected multiport PET ar high power traction systems for locomotives and electrical multiple units (EMU), marine propulsion, wind generation and utility grid distribution applications. The complementary plane figure equivalent circuit modeling of a MW-MFT is conferred. The present and power characteristics of the virtual circuit branches and therefore the multi- ports with general-phase-shift (GPS) management aredelineated. The overall current and power analysis for the multiple active bridge (MAB) isolation units is investigated. Power decoupling ways, as well as nonlinear resolution for Power equalizationare projected. The zero-voltage-switching (ZVS) conditions for the MAB are mentioned. Management ways as well as soft-switching-phase-shift (SSPS) management and voltage equalization management supported the ability decoupling calculations ar delineated. Simulations and experiments ar conferred to verify the performance of the projected topology and management algorithms.

II. LITERATURE SURVEY

The thought of power physical science electrical device is understood already over twenty years. There area unit varied papers written concerning power physical science transformers.

[1] C. Rajesh conferred the paper. This paper proposes a brand new standard versatile power electronic electrical device (FPET). The projected FPET is versatile enough to fulfill future wants of power electronic centralized systems. The most feature of the FPET is that the freelance operation of modules every of that contains one port. Every port is thought-about as input or output, as a result of duplex power flow is provided. The modules area unit connected to a standard dc link that facilitates energy transfer among modules furthermore as ports. Therefore, a multiport system is developed, that the ports will operate severally. This advantage is very important for applications, wherever input and output voltages area unit completely different in several parameters. A comparison study is dole out to clarify the professionals and cons of expandable FPET. Additionally, the activity results of a laboratory epitome area unit conferred to verify the capabilities of FPET in providing completely

different output waveforms and dominant load aspect reactive power.

[2] Roasto,I. conferred in his paper summary of the ability physical science electrical device technology in terms of sensible grids is conferred the knowledge collected is assessed and arranged.

[3] during this paper, Konstantinos Tsakalis same, within the last decade, the sensible Grid construct has drawn the eye of researchers and business as a possible answer to the challenges that the complete electrical system is facing because of the expansion in load, the increasing penetration of renewables and therefore the preparation of the distributed generation at the patron finish. The power-electronics-based electrical device, or alleged SST, is one in all the key elements of the FREEDM distribution system. Additionally to serving as a daily distribution electrical device, the SST provides ports for the right integration of distributed energy resources (DER) and distributed energy storage (DES), so enhancing the responsibleness of the distribution system [3]. In addition, the SST allows the implementation of distributed intelligence through a secure communication network (COMM) to confirm stability and best operation of the distribution system. Another vital element of the FREEDM distribution system is that the Fault Identification Device (FID), that could be a quick protection device deployed to modify Intelligent Fault Management (IFM).

III. SYSTEM ARCHITECTURE

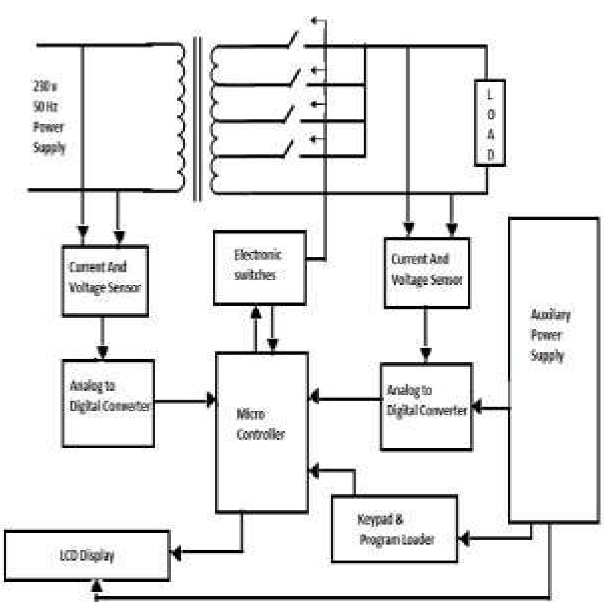

Fig 3. 1. Block Diagram

Description:

The block diagram for Power Electronics based Multiport Transformer using Solid-State On Load Tap Changer is as shown in above diagram. There are n no. of windings on both sides of the transformer. Also, there are various switches on both side of the transformer. The functioning of the the various blocks as explained below:

Current and Voltage Sensor:

The current and voltage sensors are present on both side i.e. in input side and the output side. Current and voltage sensors sense the values of current and voltage on both side and measured it. It shows the different values in both the side of the transformer. It is useful for the calculation of the voltage drop on output side. The current and voltage values are displayed on the Lcd display.

Analog to Digital Converter:

As microcontroller understand the digital values, this analog to digital converter is connected in it. It converts the analog values into digital form and sends it to Microcontroller. This ADC is connected to both side i.e, input and output side.

Electronic Static Switches:

The Electronic static switches are used to select the single or multiple output terminals. This operates the terminal to be work on output side or load side in the circuit.

Microcontroller:

For the smooth and sharp output, this microcontroller is used in this circuit. Microcontroller operates all the circuit. Using programing, we can able to change the working of this microcontroller. Also, we can change the output using some connections and coding.

Program Loader:

This program loader is used to write a program. We can able to change this program or reinstallation of the program using this program loader.

Keyboard:

This keyboard is used to type program and which is connected to the program loader.

Auxiliary Power Supply Board:

This auxiliary power supply board is an external power supply. This auxiliary power supply board an external supply to the various components such as Microcontroller, Analog to Digital Converter, Keyboard, program loader, LCD display.

LCD Display:

This LCD displays values of input supply, output supply, voltage drop at the output side. This LCD directly connected to the Microcontroller and which works on the auxiliary power supply.

IV. SIMULATION RESULT

Multiport power electronic transformer is simulated using MATLAB Simulink model. Three loads are connected to secondary windings of PET transformer.

A. When 3 loads are connected:

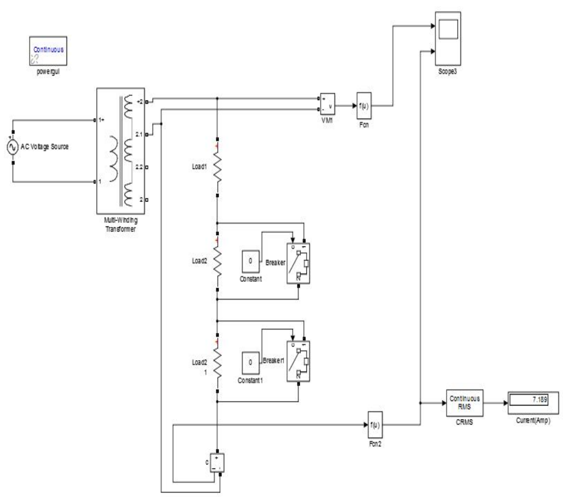

Fig 4.1.1 Simulink Model when 3 loads are connected

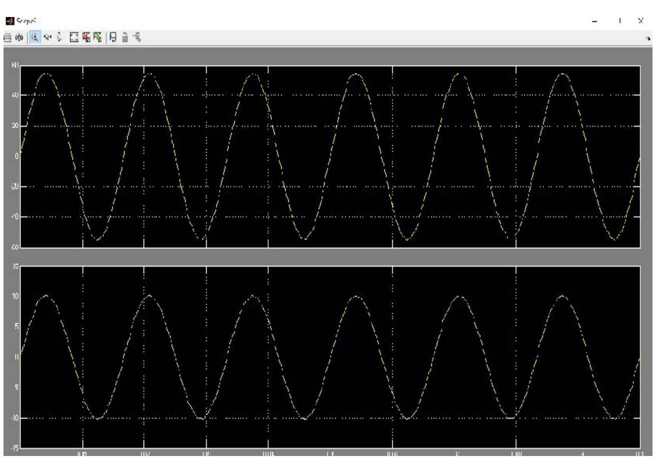

Fig 4.1.2 Simulation Result when 3 loads are connected

When three loads are connected i.e. it is having high resistance current flowing through the loads is minimum i.e. approximately 7 A as shown in fig. 4.1.1. And the result of this Simulink model is as shown in Fig. 4.1.2.

B. When 2 loads are connected:

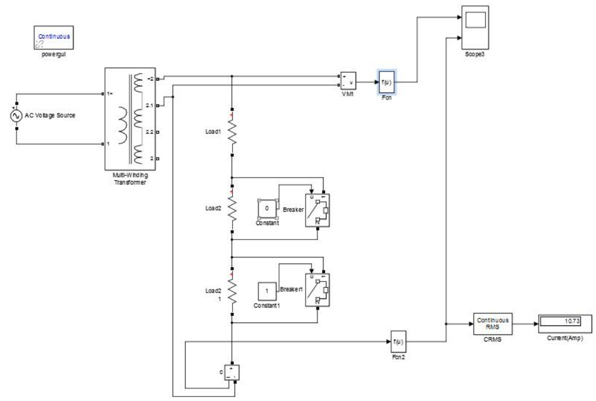

Fig 4.2.1 Simulink Model when 2 loads are connected

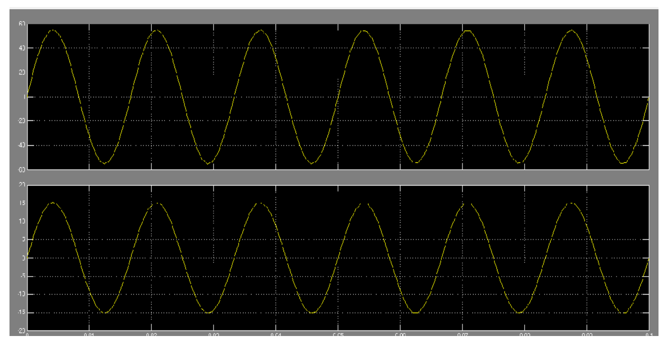

Fig 4.2.2 Simulation Result when 2 loads are connected

When two loads are connected then current flowing through it is approximately 10 A. The Simulink model for 2 loads are connected is as shown in Fig 4.2.1. The result of this Simulink model is as shown in Fig 4.2.2.

C. When 1 load is connected:

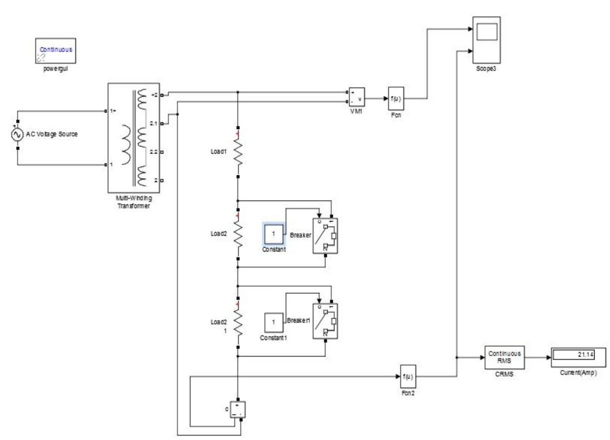

Fig 4.3.1 Simulink Model when 1 load is connected

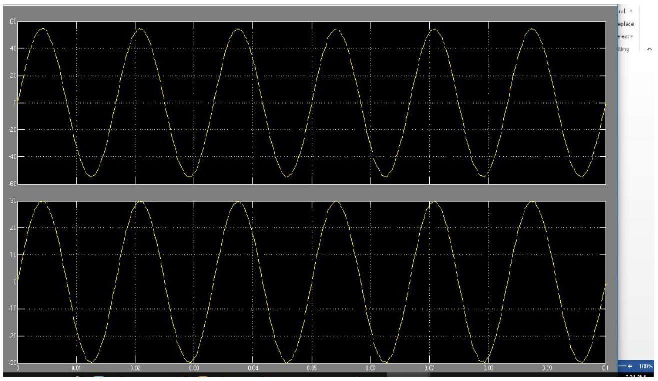

Fig 4.3.2 Simulation Result when 1 load is connected

When only one load is connected, current flowing through it is approximately 21 A. Current value is high when load resistance is low. The Simulink model for 1 load is connected is as shown in Fig. 4.3.1. The simulation result is as shown in Fig. 4.3.2.

V. CONCLUSION

In this project we have conclude that, any variation at the output voltage of the distribution transformer will be sensed by the microcontroller and compare with the reference value as per the program. This will produce appropriate command to trigger the appropriate pair of antiparallel thyristor for change in the suitable tapping of transformer. The system stability is improved, because of quick response. Because of static devices, maintenance cost is reduced due to elimination of frequent sparking. Output voltage can be regulated in the range of ±5V of nominal voltage.

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