Improvement Of 12 and 18 Pulse Converters with Delta - Differential Connections

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***Abstract*— This work acquaints an examination with deference with the progression of multi beat converters. A general explanation for the affiliation (Δ) for both 12 and 18-beats is gotten and depicts the yield voltages on the discretionary windings, dependent upon the voltage reference from the fundamental. These summed up enunciations licenses picking unmistakable extents amongst information and yield voltages and as result a perfect task point for the converter can be figured. Considering Δ-related converters the perfect point happens when the appealing focus of the autotransformer frames 18% and 17% of the yield control for 12 and 18-beats, independently. For Y-related converters the perfect point happens when the kVA rating is 13% and 18% for 12 and 18-beats, independently. In perspective of these comes to fruition alluring segments can be registered and laid out provoking a remarkable weight and volume decline and besides to cut down costs and adversities. Finally an examination is made to upgrade the kVA rating of the transformers for 12 and 18 beats converters.**

Keywords – autotransformer, differential connection, multi pulse converter, reduction of harmonics.

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1. INTRODUCTION

As of late, the consonant substance in the air conditioner mains have been the critical subject in talks identified with Power Quality [1]. This is because of high aggregate symphonious bending (THD) in light of the fact that the current depleted from non-direct loads, as to state controlled and uncontrolled converters, thyristor controlled reactors, electric circular segment broiler in modern offices

furthermore, converters that incorporate capacitive channels. These types of gear are provided by AC control sources and present issues concerning symphonious infusion, low power factor and high THD.

The nearness of consonant parts isn't attractive in light of the fact that it brings about losing for both service organizations and end clients of power. A few impacts of consonant levels are: increment of iron and cooper misfortunes in windings of electrical engines, generators and influence transformers, changes in torque and appearance of mechanical vibrations in engines and generators, higher measure mistakes in enlistment based electrical meters, breaking down of electronic gadgets and others. In the most recent decades, a few converters topologies were upgraded to diminish THD. As per the power Converter topologies, they can be grouped, as detached or uncontrolled converters, which offer awesome unwavering quality and strength, and dynamic or controlled converters, which force high power factor, decreased weight and volume.

This last topology as a rule speaks to complex hardware prompting higher costs when contrasted with uncontrolled converters. Half and half converters are likewise conceivable, and plan to consolidate great properties of both dynamic and aloof converters. Multi beat converters, which can be dynamic, detached or half breed, are an awesome system for decreasing current symphonious levels in control mains. These converters introduce just the k•P±1 consonant segments, where k = , 2, 3… and P is the beat number, and more often than not include at least one three-stage six-beat rectifiers [2-4]. A 12-beat converter is gotten by methods for two 30° moved six-beat rectifiers. For 18-beat converter, three 20° moved 9-beat rectifiers are utilized. These converters can likewise be named separated and non-disengaged. Detached converters Present extraordinary heartiness, yet additionally incredible weight and volume as the primary transformer forms the aggregate power required y the heap, at the recurrence of the mains, which is more often than not as low as 50.

To diminish physical measurements of attractive components and result in a more appealing converter, differential autotransformer-based topologies can be proposed. These are called non-detached converters [5]. The differential association of windings in a three-stage autotransformer permits making three-stage adjusted subsystems appropriately moved. The essential side of the autotransformer, associated in Y or Δ, is provided by the air conditioner mains. In autotransformer-based topologies just a little piece of the power required to the heap is prepared by the center of the transformer.

Accordingly, it is conceivable to have a noteworthy lessening in weight and volume of the converter [6]. This work presents comes about that intend to streamline Y and Δ-differential associated converters, prompting lighter and littler types of gear. Through vector charts that relate info and yield voltage and furthermore finished all windings of the autotransformer, trigonometric articulations are acquired and can be summed up for Y and Δ-differential associations, speaking to each of the 12 and 18-beat differential associations [7].

The turn proportion and extremity of all windings that form the autotransformer can be resolved utilizing the acquired general articulations. In addition, it is conceivable to pick the plentifulness of the yield voltage as an element of info voltage, and the other way around. The two voltages can accept any positive down to earth esteems. Voltage levels and trademark points are balanced through turn proportions.

Thinking about the articulations, the fundamental parameters for reenactment were computed. Recreations were completed changing the DC yield voltage from 100 V to 900 V and keeping input line-to-line voltage 220 V rms. After the reenactments it is conceivable to decide the connection between the information obvious power and the heap control (kVA/kW), which implies the power prepared in the center of the autotransformer can be examined.

In this manner, it is doable to look an activity run for every one of converter topologies so as to accomplish diminished size and volume of attractive components. Numerical investigation and recreation comes about for 12 and 18-beat converters are displayed in the accompanying segments, considering both Y and Δ-differential associations.

II. GENERALIZED CONNECTIONS

Analysis of winding voltages for Δ connections

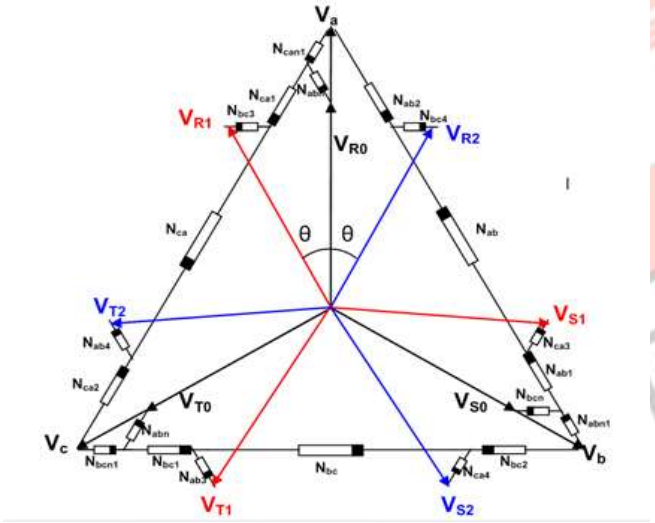
Figure 1 exhibits a schematic depiction of all windings to get the tasteless affiliation that grants making all Δ-related 12 and 18-beat converters. The figure too symbolizes the three-organize fundamental voltage system (Vab, Vbc what's more, Vca) and the discretionary stage moved structures, (VR1, VS1 what's more, VT1) with a +θ° edge, (VR2, VS2 and VT2) with a - θ° edge, and (VRN, VSN and VTN) in arrange with the basic voltages. The θ edge chooses the task in 12 (15°) or 18 (20°) beats [9].

Figure 2 shows the vector framework of the voltages over Nca1 and Nbc3 windings for the Δ-differential affiliation. The assistant voltage Vx is assessed between the unprejudiced and the normal reason for the two helper windings (Nca1 and Nbc3). The edge α describes the voltage heading Vx, assessed from the reference voltage Va.

The voltages over the assistant windings can be sure or negative, so it can get three conditions. The first is the place Vca1 and Vbc3 are sure, for this circumstance α varies from θ° to 90° and the voltage VR1 is reliably lower than the reference voltage (Va). The second condition is when Vca1 is certain and Vbc3 is negative, for this circumstance, the vectors are shown included in figure 4, α changes in the region of 0° and θ° what's more, the yield voltage VR1 can be lower, equal or more unmistakable than the reference.

The third and the last case is the place Vca1 2009 Brazilian Power Electronics Conference, Bonito (MS) - Brazil - ISSN 2175-8603 902 besides, Vbc3 are negative. For this circumstance, α is in the region of 0° and - 30° besides, VR1 is more vital than the data voltage. The triangle addressed by voltages Vca01 and Vabn is relied upon to the additional winding for only 18-beat structure.

Through trigonometric relations for each case, it is possible to find a single verbalization that depicts the yield voltages on the discretionary windings depending upon the voltage reference (fundamental) and the edges θ and α. This verbalization is given by (3).



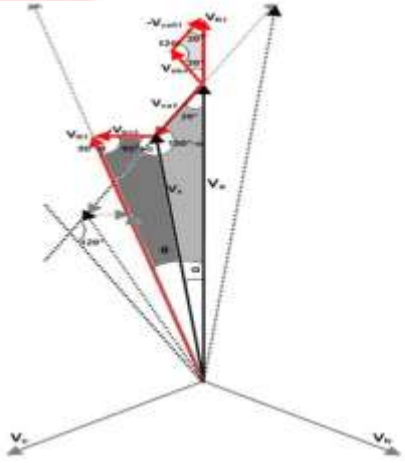


Fig. 2.1 Vector diagram and winding description for Δ-differential connections[3]. Fig. 2.2 Vector Diagram.

The 18-beat structure needs two extra optional windings to create a third three-stage framework, in stage with the essential and the AC mains. Condition (4) characterizes the size voltage through the optional windings Nan and Nan1.

Figure 3 shows the 12-pulse Δ-differential converter supplying loads.

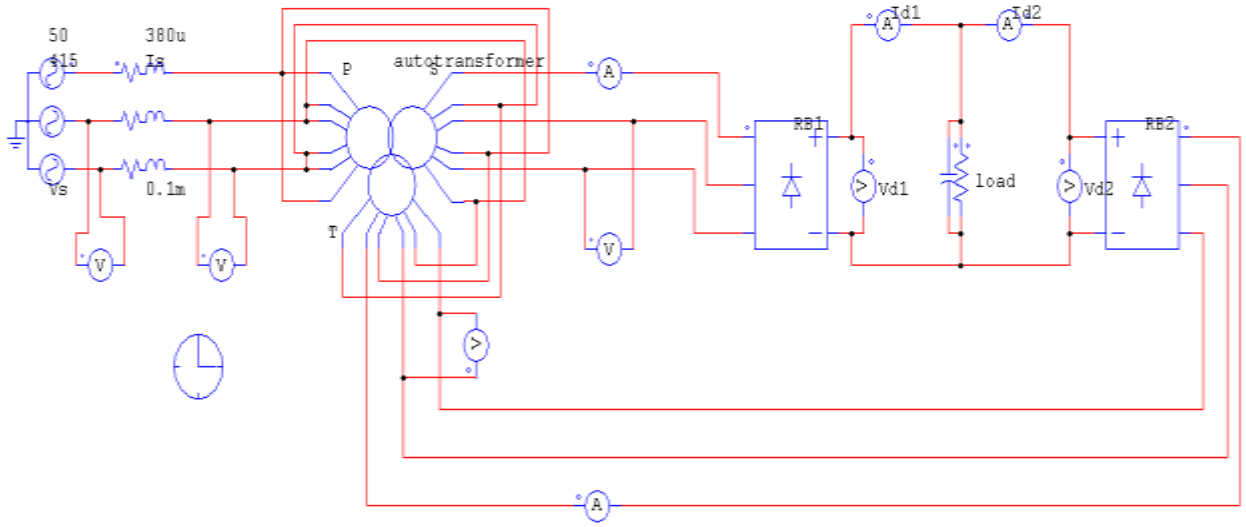


Fig. 3. 12-pulse Δ-differential converter.

The kVA rating of the autotransformer as a component of the turn proportions is appeared in figure 4. The more alluring area is the point at which the kVA rating is underneath half of the heap control. The best purpose of this realistic happens when the autotransformer process almost 18% of the heap control.

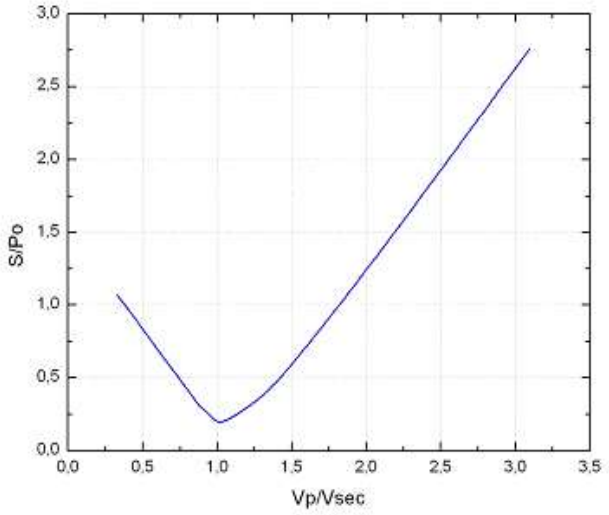


Fig. 4. Turn ratios versus kVA rating of the autotransformer with 12-pulse Δ-differential connection.

For this 12-pulse Δ-differential connection designed to operate in optimal point (the lower kVA rating is 18%), the DC output voltage is approximately 300 V. Figure 12 shows the rectified voltage and the voltage across the primary and secondary windings of the autotransformers for this optimum point.

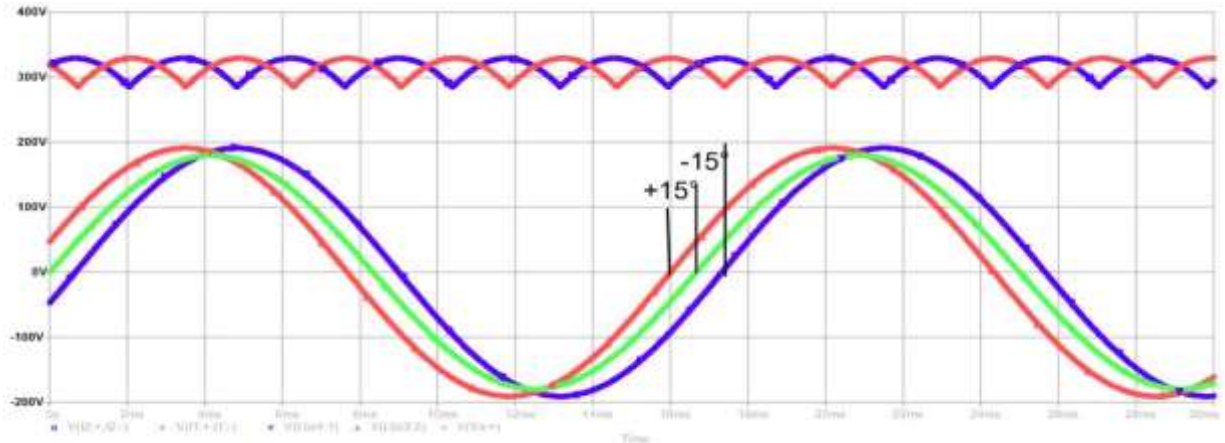


Fig. 5. Simulation results of the rectified voltages[5]

Figure 6 shows the voltage and current in one phase of the AC mains. In figure 14 is the Harmonic spectrum of the line current.

To 12-pulse differential converters, the total harmonic distortion is 14.5% and the power factor is 0.98.

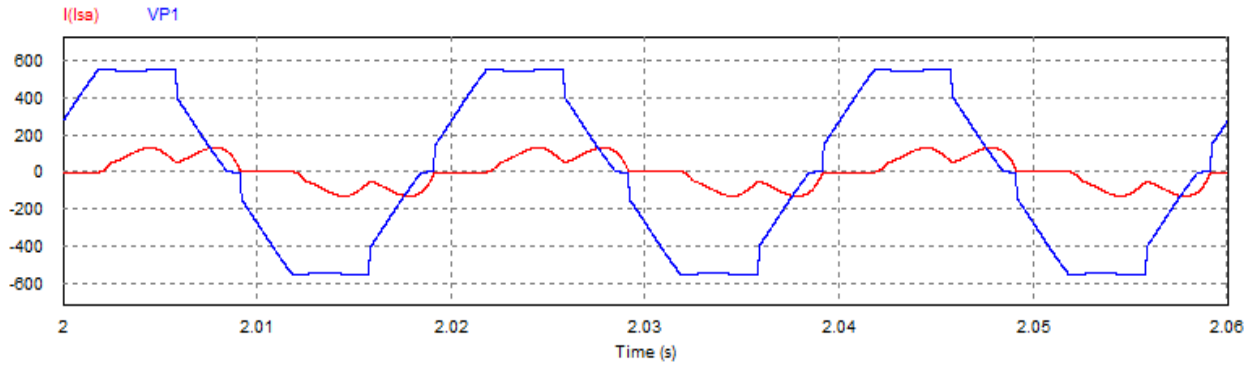


Fig. 6. Voltage and current in one phase of the AC mains.

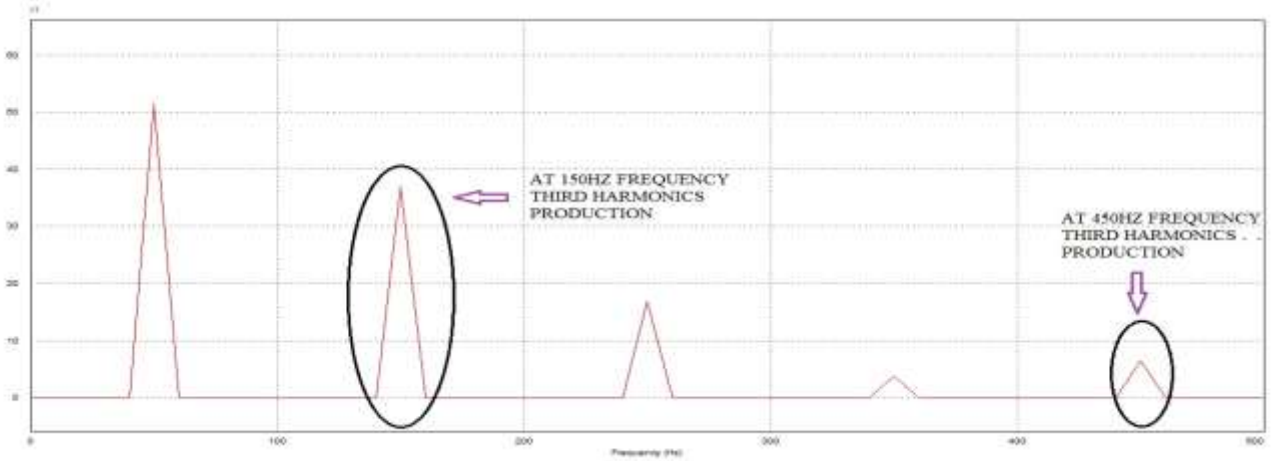


Fig. 7. Harmonic spectrum of the line current.

B. 18-pulse Converters [13, 14]

Figure 8 demonstrates the 18-beat Δ-differential converter, with three indistinguishable burdens. Figure 9 demonstrates the relationship between kVA rating and the swing proportions to the 18-beat Δ- differential converter. The evident energy of the essential side is the same of (9), the optional power is communicated by (12), and the successful kVA and the heap control are figured by (7) and (8), separately.

The best point occurs when the autotransformer process near 17% of the load power, as shown in figure 9

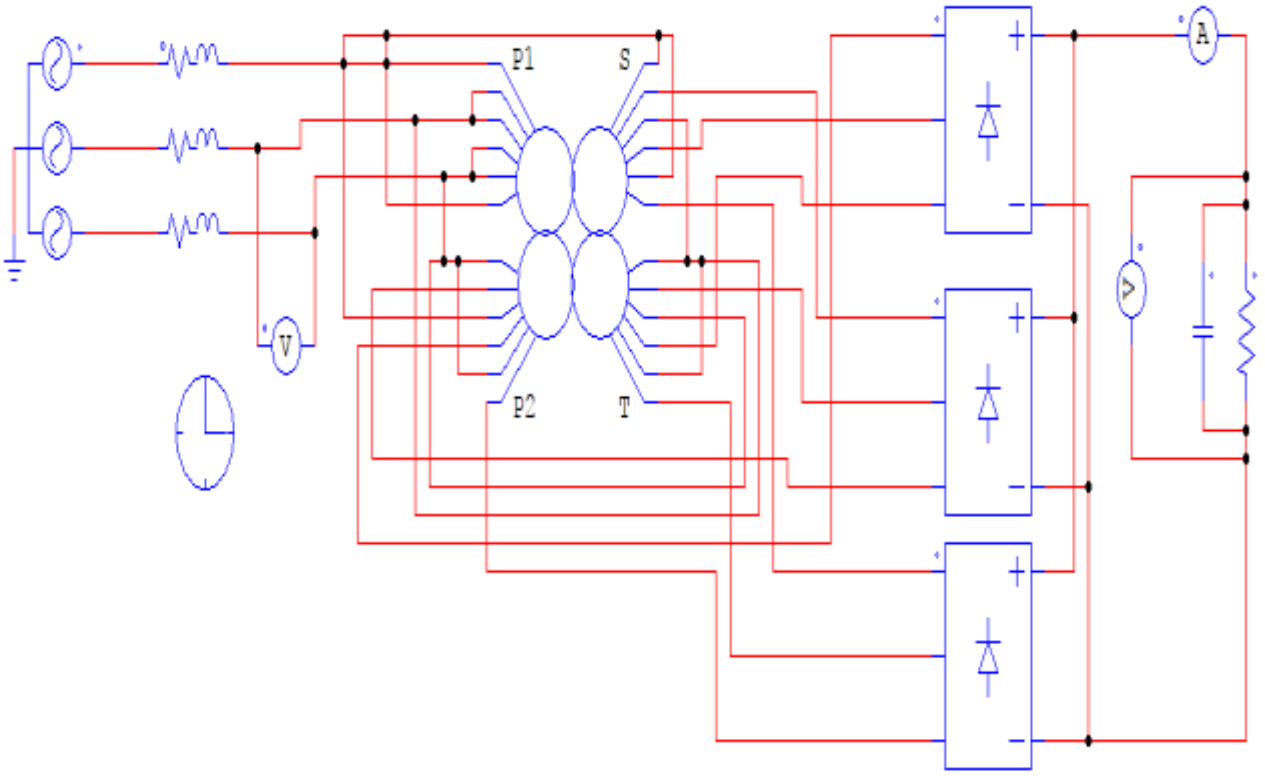


Fig. 8. 18-pulse Δ-differential converter.

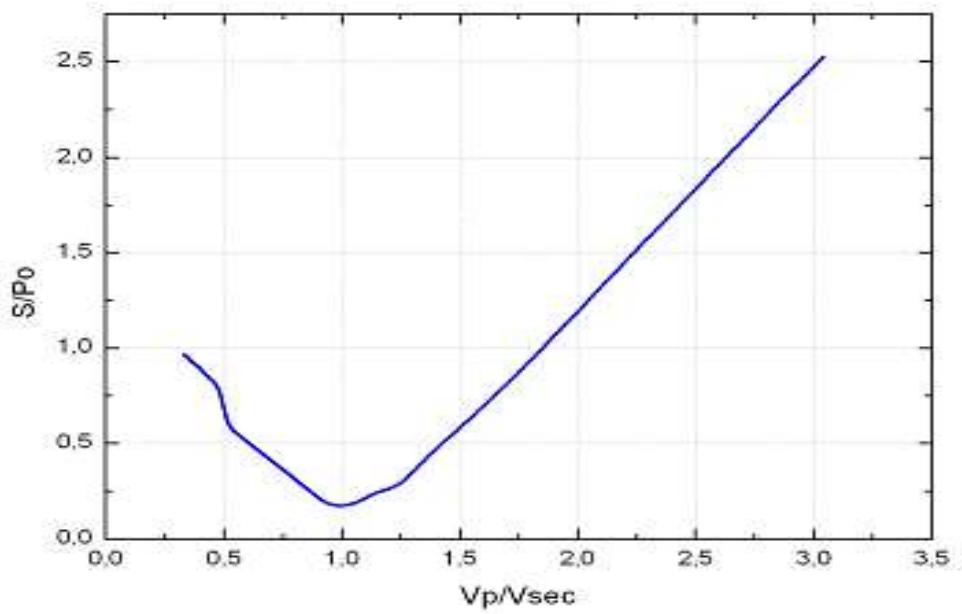


Fig. 9. Turn ratios versus kVA rating of the autotransformer with 18-pulse Δ-differential connection.[1]

The simulations are performed for the optimum point. The average voltage at this point is 300 V. Figure 10 shows the rectified and secondary voltages.

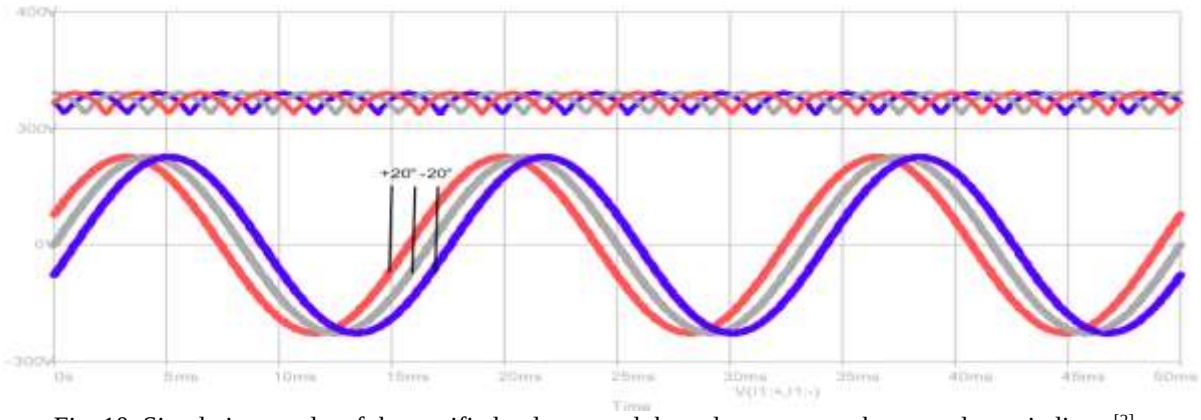


Fig. 10. Simulation results of the rectified voltages and the voltages across the secondary windings.[2]

Figure 11 illustrates the voltage and current in one phase of the AC mains. The harmonic pectrum of the line urrent is shown in figure 24. The harmonic components are k·18 ± 1 (k = 1, 2, 3 ...).

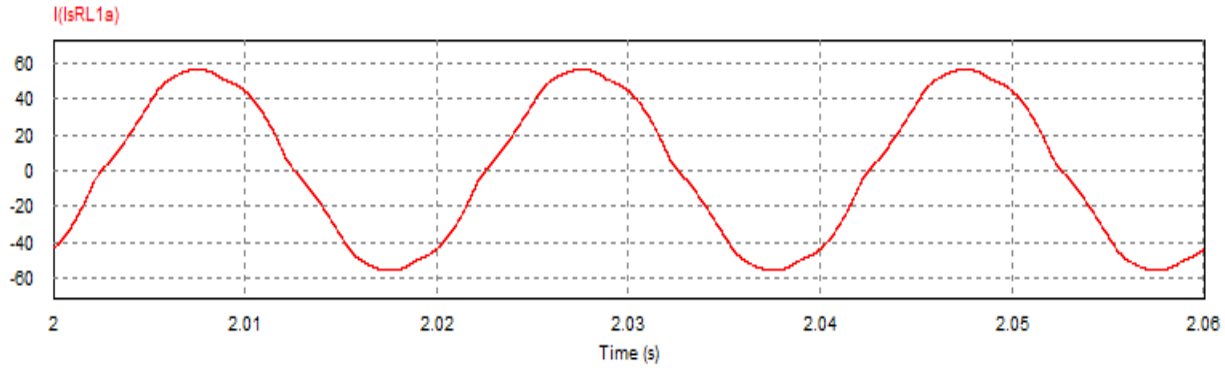


Fig. 11. Voltage and current in one phase of the AC mains.

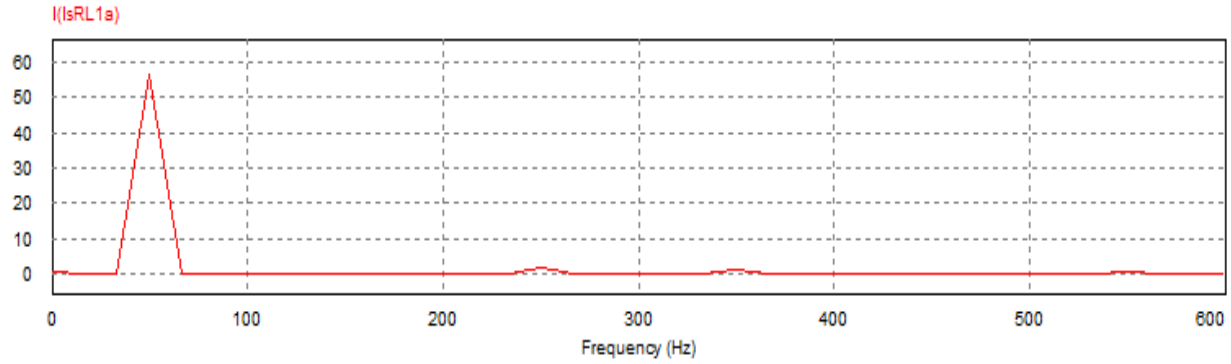


Fig. 12. Harmonic spectrum of the line current.

III. CONCLUSION

This work demonstrates the speculation of Δ- differential associations of 12 and 18-beats utilizing auto transformer. Through scientific investigation, from the triangles that relate voltage vectors, a general articulation is found to depict the operation of auto transformers for any estimations of info and yield voltage. The utilization of 12 and 18 beat converters enhances the power factor by diminishing the symphonious substance of the line current. Besides, these converters diminish the adequacy and increment the recurrence of the corrected voltage swell. Through designs it is conceivable to perceive an area where the power prepared by the auto transformer is less than half of the required load control. This locale is of extraordinary enthusiasm for decreasing weight and volume of the converter. For Δ-differential associations of 12 and 18 beats an ideal point was built up, where the relationship between the forces was the most minimal, i.e. the handled power was as low as could be expected under the circumstances. The

12-beat converter introduced an aggregate symphonious twisting of 14.5% and 0.98 power factor. For the 18-beat converter THD is 9.45% and 0.99 power factor.

Table no.4.1. analysis of harmonics pulse wise[3]

Category	6-Pulse	12-Pulse	18-Pulse
Current THD	30 – 35 %	6.5– 9.5 %	4.5– 5 %
Power factor	0.92 – 0.95	0.97 – 0.98	0.98 – 0.99
Efficiency	96.5 – 97.5 %	97.0 – 98.0 %	97.5 – 98.0 %

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