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Simulation of Vienna Rectifier to Enhance Power Quality By Reduce THD

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***Abstract*-This paper proposed Vienna rectifier which overcome many limitation and reduce harmonics from input mains supply. Vienna rectifier reduce the blocking voltage stress across the semiconductor to reduce the conduction losses and give low total harmonics distortion <5%. Hence improve the power quality and gives unity power factor from supply side.**

***Keywords*- Main Network, Power Electronics, Rectifier, Total Harmonic Distortion, Power Factor Correction.**

I. INTRODUCTION

The AC-DC conversion is used increasingly in a wide diversity of applications: power supply for microelectronics, household-electric appliances, electronic ballast, battery charging, DC-motor drives, power conversion, etc. AC-DC converters can be classified between topologies working with low switching frequency (line commutated) and other circuits, which operate with high Switching frequency.

The simplest line-commutated converters use diodes to transform the electrical energy from AC to DC. The use of thyristors allows for the control of energy flow. The main disadvantage of these naturally commutated converters is the generation of harmonics and reactive power [1], [2]. Harmonics have a negative effect in the operation of the electrical system and therefore, an increasing attention is paid to their generation and control [3], [4]. In particular, several standards have introduced important and stringent limits to harmonics that can be injected to the power supply [5], [6], [7]. One basic and typical method to reduce input current harmonics is the use of multi pulse connections based on transformers with multiple windings. An additional improvement is the use of passive power filters. In the last decade active filters have been introduced to reduce the harmonics injected to the mains [8], [9], [10].

Another conceptually different way of harmonics reduction is the so-called Power Factor Correction (PFC). In these converters, power transistors are included in the power circuit of the rectifier to change actively the waveform of the input current, reducing the distortion [11]. These circuits reduce harmonics and consequently they improve the power factor, which is the origin of their generic name of PFC. Several PFC topologies like Boost and Vienna rectifiers [12], [13], [14], [15], are not regenerative and are suited for applications where power is not fed back to the power supply. However, there are several applications where energy flow can be reversed during the operation. Examples are: locomotives Downhill conveyors, cranes, etc. In all these applications, the line side converter must be able to deliver energy back to the power supply this paper present the Vienna rectifier for power quality improves. In this paper present the simulation of Vienna rectifier that is gives better result.

II. OVER VIEW OF VIENNA RECTIFIER

There is growing awareness about line pollution and deteriorating power factor due to all pervading inductive and non-linear loads. Utilities are as much concerned as the users. Passive power factor correction techniques are neither convenient nor economical; they need bulky components and are not adaptive to changing needs. Although many solutions were offered for power factor correction. As all high Power equipments derive electrical power from supply mains, incorporating an active Phase PFC front end can contribute significantly in improving overall power factor and reducing line pollution. In addition to lowering power bill to the consumers, improved power factor also contributes towards conservation of energy and helps in reducing air pollution, by virtue of less fossil fuel required for generating same amount of electrical power [16]. Thus Vienna rectifier gives better power factor and other resultant effects are lower I2R losses, steadier terminal Voltages, released system capacity and reduced cable & switchgear sizes. Active PFC front ends also help meet the IEEE 519-92, IEC-555 and European EN 61000-3-2 standards for allowable harmonic contents of mains.

Vienna rectifier gives various advantage application and limitation they are-

A. Advantages of Vienna Rectifier-

1) Its a boost type PFC with continuous sinusoidal input current and unidirectional power flow.

2) It needs only active switches, i.e. MOSFETS.

3) It is Operational even in presence of unbalanced mains or only two phases.

4) Total switching losses are reduced by a factor of six, assuming switching Frequency below 50 KHz.

5) Any malfunction in control circuit does not manifest itself in short circuit of output or PFC front end.

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6) Sinusoidal input currents with Power Factor = 0.997, THD<5% and overall efficiency > 97% are obtainable with current designs.

B. Applications of Vienna Rectifier-

A number of industrial, telecom and computing equipments are used Salient amongst them are

1) A.C. and D.C Drives.
2) Telecommunication Power Supplies.
3) Uninterruptible Power Supplies.
4) Air Conditioning Units.
5) Computer Installations.
6) Power supplies for all industrial uses such as welding, surface treating, motion .control, large appliances and process control.
7) R.F. Transmitters and Radar Transmitters and repeater stations. [18]

C. Limitation of Vienna Rectifier

1) Unidirectional power flow.

III. OPERATION OF VIENNA RECTIFIER

Vienna Rectifier as shown in Figure.1 was originally developed at the Technical University Vienna. It comprises a semiconductor switch, say, a MOSFET in each phase leg of a 1-Phase diode bridge. By adjusting the width of the pulse that turns ON the MOSFET, corresponding line current is forced to be sinusoidal and in phase with the Voltage. When the MOSFET is turned ON the corresponding phase is connected, via the line inductor, to the center point between the output capacitors. The phase current rises, through the MOSFET, during that pulse period, charging the capacitor. When the MOSFET is turned off, current tapers through the diode half bridge (upper or lower depending on direction of the current flow) [17].

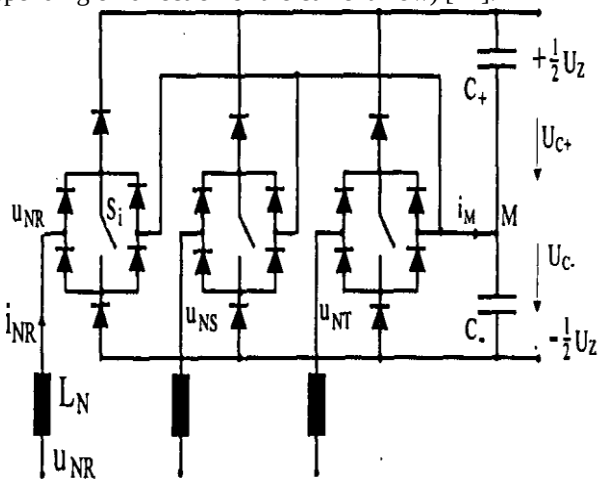

Fig.1 Structure of the power circuit of Vienna rectifier

IV.SIMULATION OF VIENNA RECTIFIER

Vienna rectifier is a combination of a boost DC/DC converter series with a single-phase rectifier provides a new topology. It's a single-phase; single-switch rectifier. It can be seen as a diode bridge rectifier with an integrated boost converter. The Vienna rectifier is useful wherever six switch converters are used for achieving sinusoidal mains current and controlled output voltage, when no energy feedback from load into the mains is required. The Vienna rectifier comprises a semiconductor switch in each phase leg of 1- phase Diode Bridge. It is a highly efficient method of high current, single-phase AC/DC conversion and is very useful for achieving unity power factor correction.

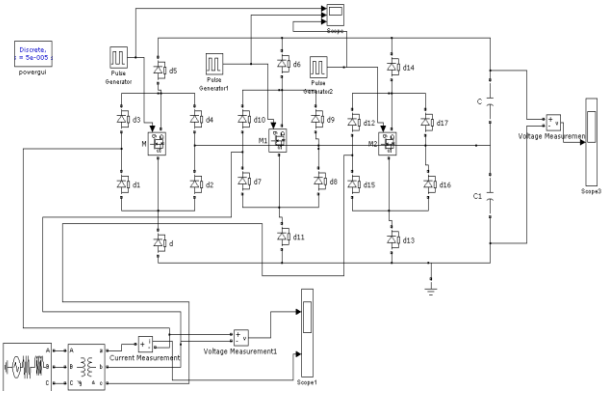

Fig.2 simulation model of Vienna rectifier

V.SIMULATION AND RESULT

Object of this paper to reduce the input current harmonics and give the unity power factor on supply side shows FFT analysis gives Input side THD is 1.53% and unity power factor in case of single phase Vienna rectifier. And three phases Vienna gives better result voltage harmonics is 0.26% and current harmonics is 0.13%, and unity power.

***A. Input Side Voltage Waveform and Analysis Text Font of Entire Document*-Vienna rectifier gives 0.26% THD.**

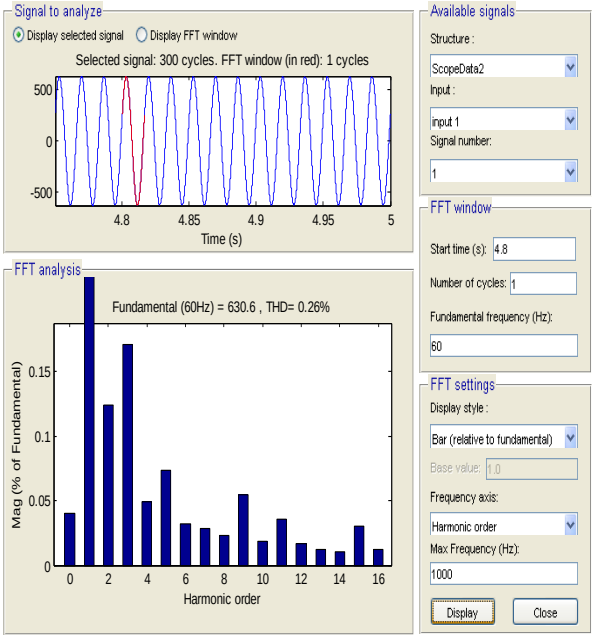

Fig .3 THD Analysis of three phase Vienna rectifier

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B. Input side current waveform and THD analysis- Vienna Rectifier gives 0.13% THD

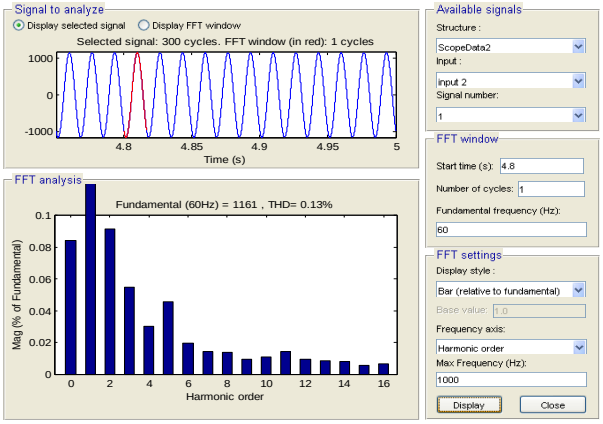

Fig .4 THD Analysis of three phase Vienna rectifiers

***C. Output voltage*- Vienna Rectifier gives ripple free voltages**

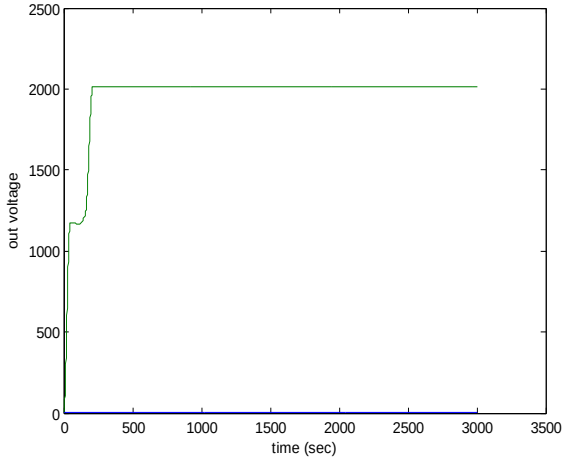

Fig 5 output voltage waveform of three phase Vienna rectifier

VI. CONCLUSION

Utilization of Vienna rectifiers eliminates the problems caused by using of controlled rectifiers uncontrolled rectifiers The Vienna rectifier can assert itself for its good behavior in many applications. The rectifier would be controlled in order to consume the current that contains all harmonics, as the device, its negative effect should be suppressed. The current consumed by the rectifier would be in the opposite phase to the current consumed by the device, so the harmonics consumption from supply should be created. Measured properties of the realized one phase thyristor rectifier and Vienna rectifier were compared. The thyristor rectifiers due to their phase control load supply grid with higher harmonics and consume reactive power. These side effects of phase control cannot be ignored and must be suppressed or compensated. The modern way is to apply the rectifier with pulse width modulation instead of the thyristor rectifier. Vienna rectifier produce input side THD 0.13% and controlled, and Vienna rectifier give unity power factor and higher efficiency

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