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Appropriate Single-Phase To Three-Phase Drive System

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ABSTRACT: This paper provides single-segment to 3-phase with dc-link converters with parallel rectifier and collection inverter forreduction within the enter modern and discount of the output voltage processed by means of the rectifier circuit and inverter circuitrespectively. On this paper we proposed higher answer for single phase to three segment drive system by way of employing 2parallel single phase rectifier stages, a three-segment inverter level. Parallel converters may be used to improve the powercapability, reliability, efficiency and redundancy. An isolation transformer isn't always used for the discount of circulatingcurrents among exceptional converter degrees. It is an vital objective within the machine design. The entire comparisonbetween the comprehensive version of proposed converter and popular configurations will be supplied in this work.simulation of this version might be finished through the use of matlab/ simulink.

KEYWORDS: AC-DC-AC power converter, drive system, parallel Converter, Fault Identification System(FIS).

I. INTRODUCTION

Maximum electricity conversion packages consist of an AC-to-dcconversion degree right now following the AC supply. Thedc output acquired after rectification is eventually usedfor similarly levels. Thereby an ac to dc converter hasbecome an critical a part of typically all the electronicequipments. Mainly, it's miles used as an interface betweenutility and most of the power electronic equipments[1].those electronic equipments additionally shape a chief part of loadon the software. Two elements that offer a quantitativemeasure of the power excellent in an electrical device arepower component (PF) and overall Harmonic Distortion (THD).the amount of beneficial electricity being fed on with the aid of anelectrical system is predominantly decided via the PF of thesystem. Commonly, to convert line frequency ac to dc, a linefrequency diode bridge rectifier is used. To reduce theripple inside the dc output voltage, a suitable filter out capacitorand/or an inductor is used at the rectifier output[2]-[3]. Butdue to these reactive additives, the modern-day drawn by way of thisconverter is peaky in nature, very plenty differed from asinusoidal form. This input cutting-edge is rich in lower orderharmonics. Additionally, as electricity electronics equipments areincreasingly being used in power conversion, they inject loworder harmonics into the software. Due to the presence ofthese harmonics, the full harmonic distortion is high whenso many converters are prepare in a massive electronicsystem. Additionally, the enter electricity element becomespoorer. Due to the risks related to lowpower component and harmonics, utilities enforces (in somecountries) harmonic standards and guidelines which willlimit the amount of present day distortion allowed into the software.looking into the severe effects generated through conventionalconverters, the simple diode rectifiers ought to no longer be used.there is a need to reap rectification at near unitypower aspect and occasional input modern distortion.

Several answers had been proposed whenthe goal is to deliver three-segment motors fromsingle-section ac mains [8]–[16]. It's far quite common tohave handiest a single-section power grid in residential,commercial, manufacturing, and in particular in rural regions,at the same time as the adjustable speed drives may also request a threephase energy grid. Single-segment to a few-segment ac–dc–ac conversion generally employs a full-bridge topology,which means in ten power switches, as shown infig.1.

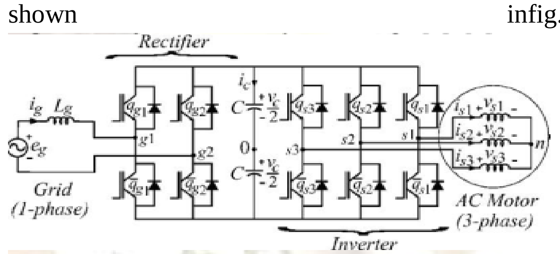

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Fig. 1.Conventional single-phase to three-phase drive system.

This converter is denoted here as conventionaltopology. In this paper, a single-phase to three-phasedrive system composed of two parallel single-phaserectifiers and a three-phase inverter is proposed, asshown in Fig. 2.

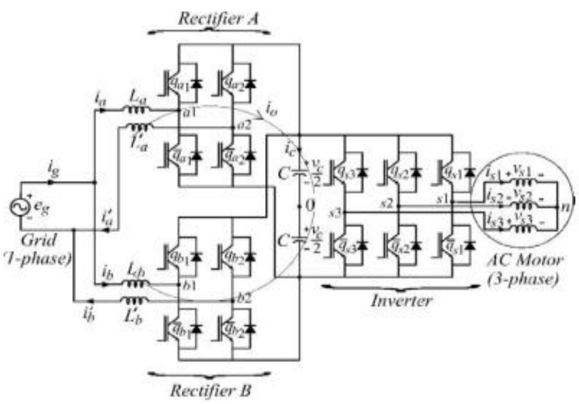
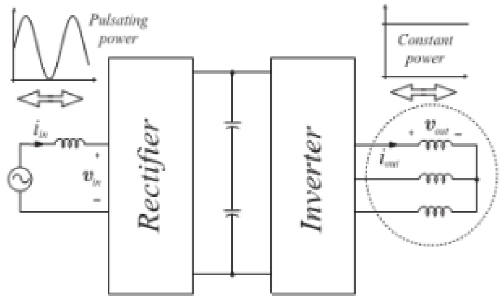


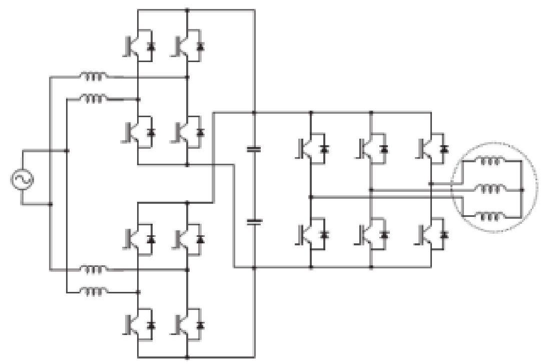
Fig.2. Proposed single-phase to three-phase drivesystem.

The proposed gadget is conceived to perform in which the single-phase software grid is the specific alternative to be had. in comparison to the traditional topology, the proposed machine allows: to lessen the rectifier transfer currents; the total harmonic distortion (THD) of the grid cur-hire with same switching frequency or the switching frequency with equal THD of the grid modern-day; and to growth the fault tolerance characteristics. In addition, the losses of the proposed device may be decrease than that of the traditional counterpart. The aforementioned benefits justify the initial investment of the proposed device, because of the increase of wide variety of switches.

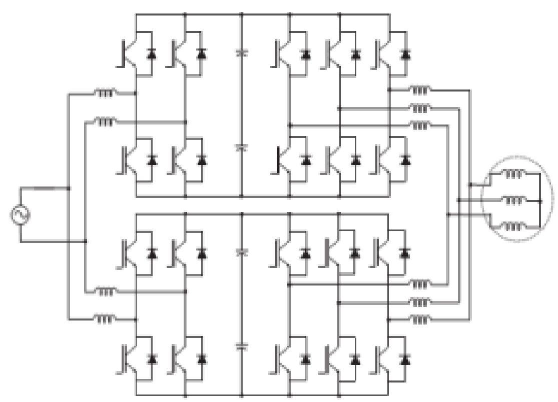
Fig 3. indicates the single-phase to three-section powerconversion with parallel configuration.some other importantcharacteristic discovered within the single-section to 3-phasepower converters that also has been considered in thispaper is the irregular distribution of power losses amongthe switches of the converter, as discovered in Fig. 4.It means that, for a 600 V 50A elegance of insulated gatebipolar transistor (IGBT), 63% of the whole lossesmeasured in the single-section to 3-phase converter isconcentrated in the rectifier circuit, whilst the rest 37% isobserved in the inverter circuit. With those numbers, it ispossible to degree the stress by using transfer, which means thateach rectifier transfer is answerable for 15.7% of the totalconverter losses, while each inverter transfer is responsiblefor simplest 6.1%. The loss in step with switch offers an importantparameter concerning the possibilities of failures in thepower converters.



(a)



(b)



(c)

Fig. 3. Single-phase to three-phase power conversion. (a)Type of power processed by rectifier and inverter circuits.(b) Solution employed in [15]. (c) Solution employed in[16]

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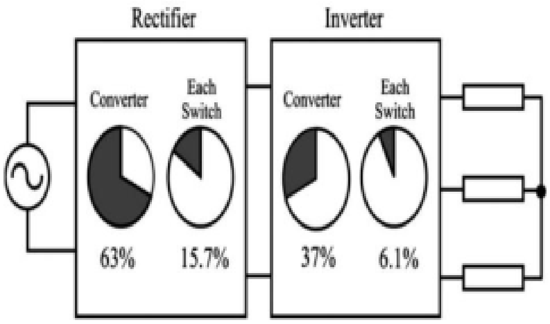

Fig. 4. Converter power losses distribution in both rectifier and inverter units:63% in the rectifier circuit and 37% in the inverter one. Power losses in eachswitch of the rectifier (15.7%) and inverter (6.1%).

II. SYSTEM MODEL

This section will present the model of the proposedconfiguration. Such a configuration is constituted by a where p = d/dt and symbols like r and l represent theresistances and inductances of the input inductors. Thecirculating current io can be defined from ia and i' a or iband i'b i.e.

$$i_0 = i_a - i_a' = -i_b + i_b'$$

$$V_a = e_s - [r_a + r_a' + (I_a + I_a')p]i_a + (r_a' + I_a'p)$$

$$V_b = e_s - [r_b + r_b' + (I_b + I_b')p]i_b + (r_b' + I_b'p)i_0$$

$$\begin{aligned} V_0 = -[r_a' + r_b' + (I_a' + I_b')p]i_0 \\ - (r_a - r_a' + (I_a + I_a')p]i_a \\ + [r_b + r_b' + (I_b + I_b')p]i_b \end{aligned}$$

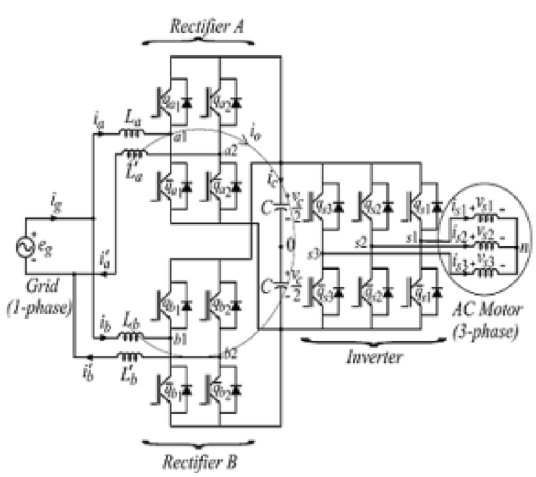

Fig. 5.Proposedsingle-phase to three-phase drive system.

To avoid the circulating current, the following threeapproaches are used commonly

i. Isolation. In this approach, the overall parallel systemis bulky and costly because of additional powersupplies or the ac line-frequency transformer.

ii. High impedance. They cannot prevent a lowfrequency circulating current.

iii. Synchronized control. This approach is not suitablefor modular converter design. When more convertersare in parallel, the system becomes very complicatedto design and control.

In this proposed method the system is designed to reducethe circulating current (I_o). From fig.5.the followingequations can be derived for the front end rectifier.

$$\begin{aligned} V_{a10} - V_{a20} = e_s - (r_a + I_a p)i_a - (r_a' + I_a'p)i_a' \\ V_{b10} - V_{b20} = e_s - (r_b + I_b p)i_b - (r_b' + I_b'p)i_b' \\ V_{a10} - V_{b10} = (r_a + I_a p)i_a - (r_b + I_b p)i_b \end{aligned}$$

In this ideal case, the circulating current can be reduced to zero imposing

$$V_0 = V_{a10} + V_{a20} - V_{b10} - V_{b20} = 0$$

when$I_a = 0$ then $I_a = I_a'$ and $I_b = I_b'$ and the system model reduced to the model given by

$$\begin{aligned} V_a + \frac{V_0}{2} = e_s - 2(r_s + I_s'p)i_a \\ V_b + \frac{V_0}{2} = e_s - 2(r_s' + I_s'p)i_b \\ V_0 = 2(r_s' + I_s'p)i_0 \\ V_{ab} = \frac{V_a + V_b}{2} = e_s - (r_s' + I_s'p)i_a \\ V_a - \frac{V_0}{2} = e_s - 2(r_s' + I_s'p)I_a' \\ V_b - \frac{V_0}{2} = e_s - 2(r_s' + I_s'p)I_b' \\ V_a = e_s - 2(r_s + I_s'p)i_a \\ V_b = e_s - 2(r_s' + I_s'p)i_b \end{aligned}$$

III. CONTROL STRATEGY

The gating signals are obtained by comparing polevoltages with one (vt1), two (vt1 and vt2) or more highfrequency triangular carrier signals. In the case of doublecarrier approach, the phase shift of the

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two triangularcarrier signals (vt1 and vt2) is 1800. The parameter µchanges the place of the voltage pulses related to vaand vb.When vx* = vx*min (µ = 0) orvx* = vx*max (µ = 1) areselected, the pulses are placed in the beginning or in theend of half period (Ts) of the control block diagram of Fig.2, highlighting the control of the rectifier. To control thedc-link voltage and to guarantee the grid power factorclose to one. Additionally, the circulating current io in therectifier of the proposed system needs to be controlled.

In this way, the dc-link voltage vc is adjusted to itsreference value v c* using the controller Rc, which is astandard PI type controller. This controller provides theamplitude of the reference grid current Is*. To controlpower factor and harmonics in the grid side, theinstantaneous reference current Is* must be synchronizedwith voltage e.g., as given in the voltage-oriented control(VOC) for three-phase system. This is obtained via blocksge-ig, based on a PLL scheme Fig 6. The referencecurrents I a*and ib* are obtained by making ia* = ib* = Is*/2, which means that each rectifier receives half of the gridcurrent. The control of the rectifier currents isimplemented using the controllers indicated by blocks Raand Rb. These current controllers define the inputreference voltages va*and vb*. The homo polar current ismeasured (io) and compared to its reference (io* = 0). Theerror is the input of PI controller Ro, that determines thevoltage vo*. The motor there-phase voltages are suppliedfrom the inverter (VSI). Block VSI-Ctr indicates theinverter and its control. The control system is composed ofthe PWM command and a torque/flux control strategy(e.g., field-oriented control or volts/hertz control)

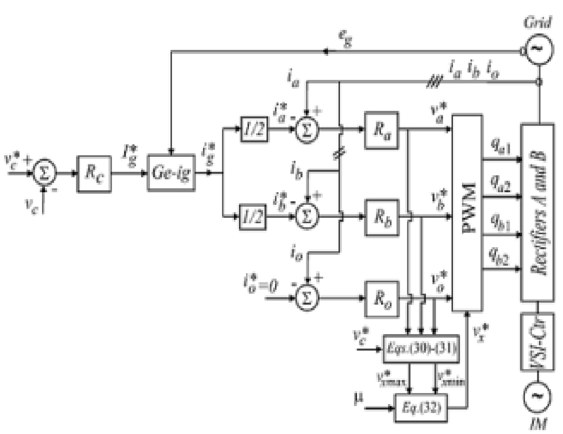

Fig. 6. Control block diagram

IV. SIMULATION RESULTS

The simulink models of the Proposed converter system, its control strategy and fault diagnosis is also carried out.The simulation results were obtained with the grid- andmachine-phase voltages equal to 127 Vrms, dc-link voltageof 225 V, capacitance of 2200 µF, and input inductor filterswith resistance and inductance given respectively by 0.1Ωand 2.6 mH. The load power was of 5 kVA.

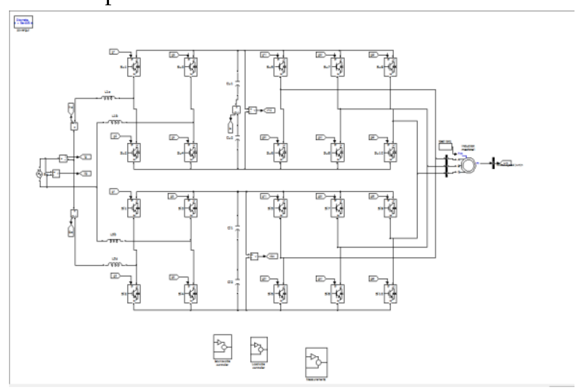

Fig 7 MATALB/SIMULINK diagram of proposed system

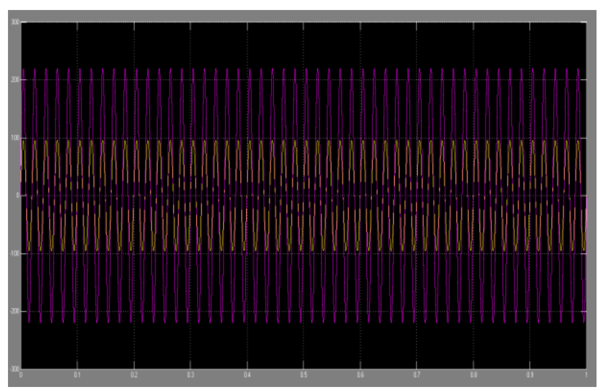

Fig 8 voltage and current of the grid,

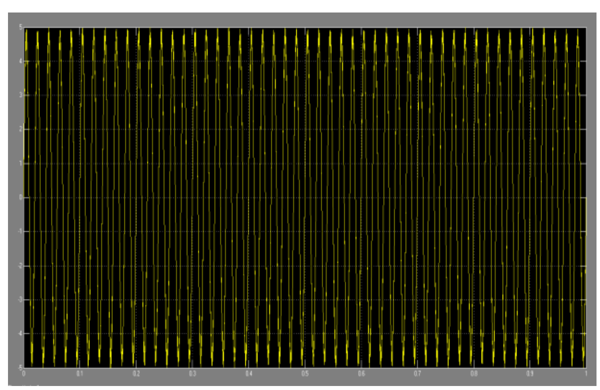

Fig 9 input current of the converter 1

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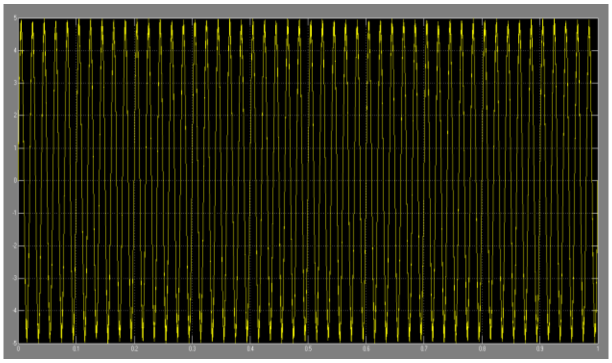

Fig 10 input current of the converter 2

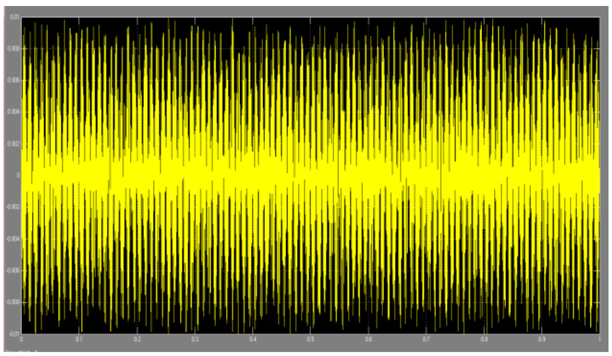

Fig 11 circulating current

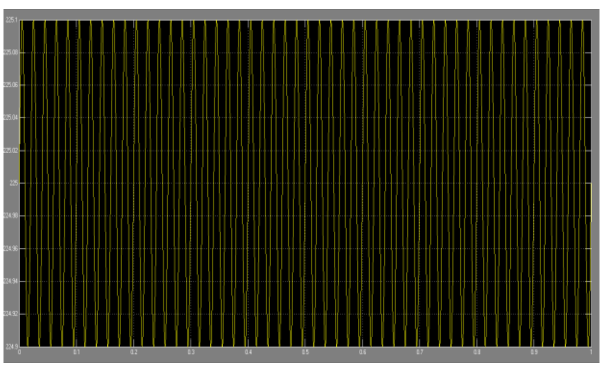

Fig 12 dc-link voltage in C12

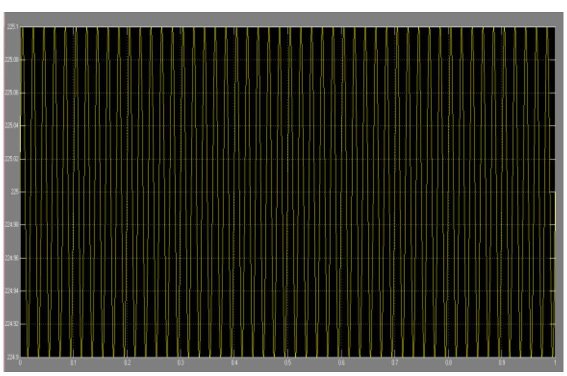

Fig 13 dc-link voltage in C34

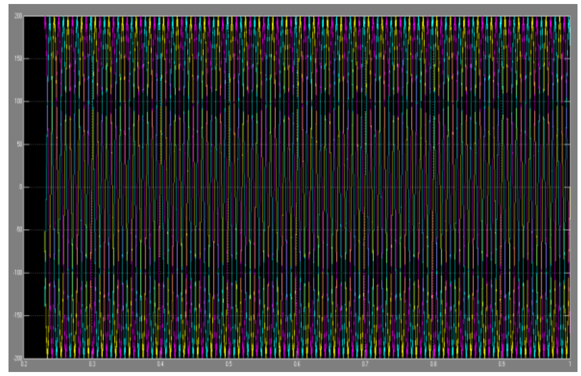

Fig 14 load currents

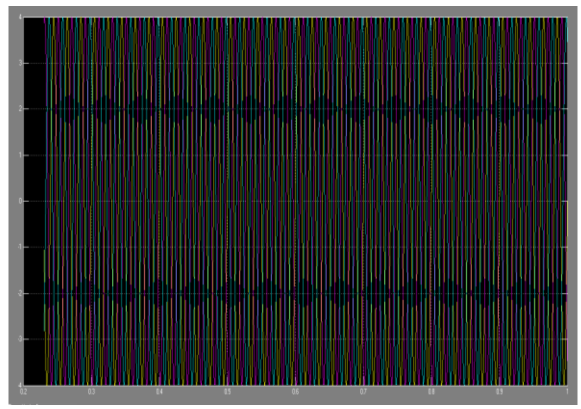

Fig 15 load voltages

V. CONCLUSION

A single-phase to 3-section power gadget composed of parallel single-section rectifiers, a three-segment inverter and an induction motor became proposed. The systemcombines two parallel rectifiers without the use oftransformers. The gadget version and the manipulate approach,including the PWM method, had been developed. Thecomplete contrast between the proposed and standardconfigurations has been accomplished in this paper.as compared to the conventional topology, the proposedsystem lets in to lessen the rectifier switch currents, thethd of the grid modern-day with equal switching frequency orthe switching frequency with same THD of the gridcurrent and to boom the fault tolerance traits.similarly, the losses of the proposed system may additionally belower than that of the traditional counterpart. The initialinvestment of the proposed device (because of excessive number ofsemiconductor gadgets) can not be taken into consideration a drawback,specially considering the state of affairs in which the citedadvantages justify such initial funding.

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