HYBRID REFERENCE FRAME CONTROL OF AC-DC CONVERTER

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Abstract: *General three phase systems consist of rectifier, along with dc link and an invertor. The conventional converters behave as non-linear load which draws non-sinusoidal input ac currents. These currents leading to low input power factor. Mains voltage distorted by harmonic currents which is caused due to voltage drop across the line inductance. Controlling of ac-dc converter using hybrid reference frame model will decrease the harmonic distortion of voltage and current waveforms at point of coupling. The control model uses both stationary reference frame and synchronous reference frame techniques. This model is designed and tested using MATLAB/Simulink and simulation results are analyzed.*

Keywords: Ac-Dc converter, Stationary reference frame, Synchronous reference frame, Hybrid reference frame, Harmonic distortion

I. Introduction:

Three-phase ac-dc-ac voltage hardened frameworks comprising of a front-end rectifier, a dc join with a capacitor, and an inverter are generally utilized as a part of engine drive, on-line UPS, and conveyed era frameworks. The ordinary converters carry on as nonlinear burden which draws non-sinusoidal info AC streams prompting low information power variable. The voltage drop over the line inductance because of the symphonious streams contorts the mains voltage at the information which can be a state of basic coupling to different burdens. However, a PWM controlled front-end rectifier has ability of dc voltage help and direction, information power Factor Correction(PFC), and info current symphonious control.

The control techniques utilized in dynamic correction incorporates voltage based strategies and current based strategies. The essential circles required with reference era in Voltage oriented control (VOC) uses control of synchronous casing (dq qualities) of line voltage and current for getting steady DC voltage and UPF operation with help of PLL and PI controllers. The virtual flux based arranged control (VFOC) is like VOC expect for the way that here a virtual flux vector (φL) which is time vital of line voltage vector V and 90° uprooted from voltage vector is assessed from line voltage vector and used to figure the space vector reference to PWM piece. For control of dynamic force iq part of line current is contrasted and reference esteem and for UPF operation the id segment is compelled to zero rather than the standard VOC plan In voltage based direct power control (DPC) direct decoupled control of dynamic furthermore, responsive force is conceivable without utilizing voltage sensors by utilizing the DC join voltage data to appraise dynamic and reactive power drawn from electrical cable. In this manner free power control is conceivable furthermore for UPF operation the reactive power is compelled to zero utilizing suitable controller like PI controller. The virtual flux based direct power (VF-DPC) control gauges line voltage as total of converter info voltage and line reactance voltage drop and after that from these assessed voltages ascertain dynamic and reactive power parts in stationary reference field. It is a mix of VF-OC and DPC conspires consequently have favorable circumstances of both control calculations. The current control incorporates hysteresis control or resilience band control where current is restricted inside an upper and lower limit or a band and controlling converter parameters. The direct current control strategies are characterized based on the reference outlines used to speak to the space vector which controls the PWM. Synchronous casing liner control utilizations Park's change (dq-change) and changes over three phase AC sign to dq reciprocals which requires a phase edge, of picked recurrence ordinarily removed by phase locked loop(PLL) so that framework voltage phase point as reference for the synchronous edge. Stationary casing straight current control is like synchronous edge control what's more, here current blunder between αβ outline amounts will serve as contribution to the PI controller, while the yield signal from PI controller will be changed back to three phase signal which will be the contribution to pulse width modulator (PWM) for creating converter's door signals utilizing fitting control. Prescient control is a calculation which utilizes the aftereffects of past changing cycles to forward appraisal both the future network voltage and future burden current. The customary prescient current calculation has poor execution under part parameter varieties. The mistake between the real and model channel inductance may bring about current motions. This paper investigations and talks about in insight about displaying, advancement and examination changed stationary reference outline control of PWM rectifiers where framework info invulnerable to changes in lattice impedance and matrix recurrence. Current control is accomplished utilizing relative full (PR) controller which is much more better than the ordinary PI controller. PR controllers encourage free control of dynamic and reactive power exchange from the lattice. A Phase Lock Loop (PLL) proposed in all control plans in writing for network recurrence recognition is dispensed with by getting recurrence data for casing transformations from basic space vector variable based math figuring. The area 2 of this paper expounds about demonstrating and working of the proposed control took after by segment 3 which talks about the recreation aftereffects of the plan and area 4 proposes couple of future patterns feasible for the control calculations talked about in different segments.

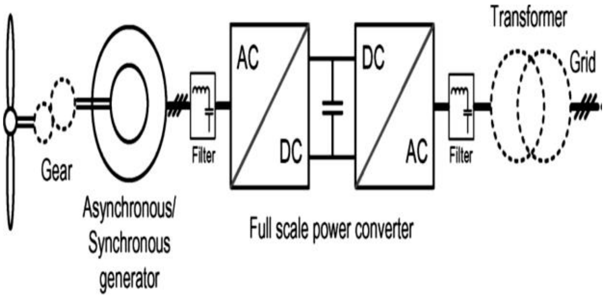


Fig-1: General block diagram of integrated system

II. Generalized Control Method

This paper proposes the Stationary reference outline control along with synchronous reference frame. This control embraces another way to deal with era of current reference for UPF operation of PWM rectifier. The plan is executed by controlling AC side control variables in particular PCC voltage, PCC current and yield DC voltage. Air conditioning amounts are detected and changed over into stationary reference outline arranges (αβ amounts) which are time fluctuating signs with settled tomahawks. The genuine info side dynamic and responsive force (P and Q) is figured from stationary directions of detected PCC voltage (Vα, Vβ) and PCC current (Iα, Iβ) according to conditions (1) and (2)

$$P=V\alpha I\alpha+V\beta I\beta \quad (1)$$

$$Q=V\alpha I\beta+V\beta I\alpha \quad (2)$$

and after that contrasted and references for getting size data required for era of current reference. The DC side yield voltage is likewise kept up in the control. The greatness data of current reference (Id* and Iq*) are changed over into stationary reference outline organizes (Iα*and Iβ*) with phase data ascertained from detected PCC voltage. The conditions (3) and (4) portray extraction of phase data of PCC voltage

$$\sin\theta = V\beta/\sqrt{v_\alpha^2+v_\beta^2} \quad (3)$$

$$\cos\theta= V\alpha/\sqrt{v_\alpha^2+v_\beta^2} \quad (4)$$

stationary facilitates accordingly the present reference created will take after the period of PCC voltage precisely hence making power conveyance from AC to DC side at UPF. In this manner the control disposes of necessity of any PLL for extraction of phase data from line voltage as saw in other ordinary control methodologies found in writing.

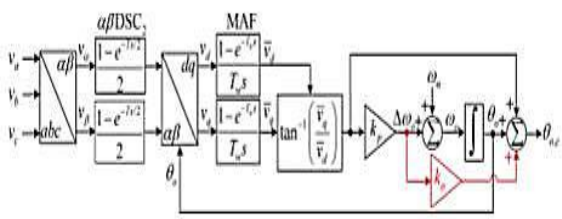


Fig.2: Schematic diagram for phase angle extraction

Fig.2.demonstrates the little flag model, in which the elements of the αβDSC administrator is demonstrated by its synchronous reference outline identical, i.e., the dq-outline DSC (dqDSC) administrator. This model is extremely valuable for examining the security and tuning its parameters. The methodology of the deduction of the model is not displayed here for curtness; in any case, its exactness is assessed in the accompanying.

This lessens computational complexities, prerequisite of extra equipment for phase estimation and so on with enhanced inspecting rate of variables. Utilization of PR controllers for diminishing enduring state mistake of time shifting αβ amounts which gives preferable tuning and execution over routine PI controllers. The exchange capacity of PR controller is given by condition (5)

$$G_{PR}(s) = K_p + K_r.S/S^2+\omega^2 \qquad (5)$$

Where Kp is corresponding increase, Kr is resonant parameter and ω is resonant frequency. The controller has unending increase at resonant frequency ω and immaterial addition at all different frequencies so the αβ variables have preferred symphonious insusceptibility over ordinary synchronous reference outline control with PI controllers.PR controllers with resounding frequencies of higher request of major can likewise be utilized for symphonious remuneration which enhances the execution of proposed control when sustaining profoundly non straight loads drawing symphonious streams.

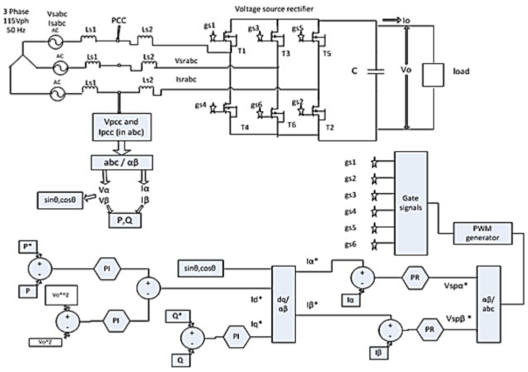


Fig-3: Generalized control diagram for generation of gate signals

III. Simulation Results:

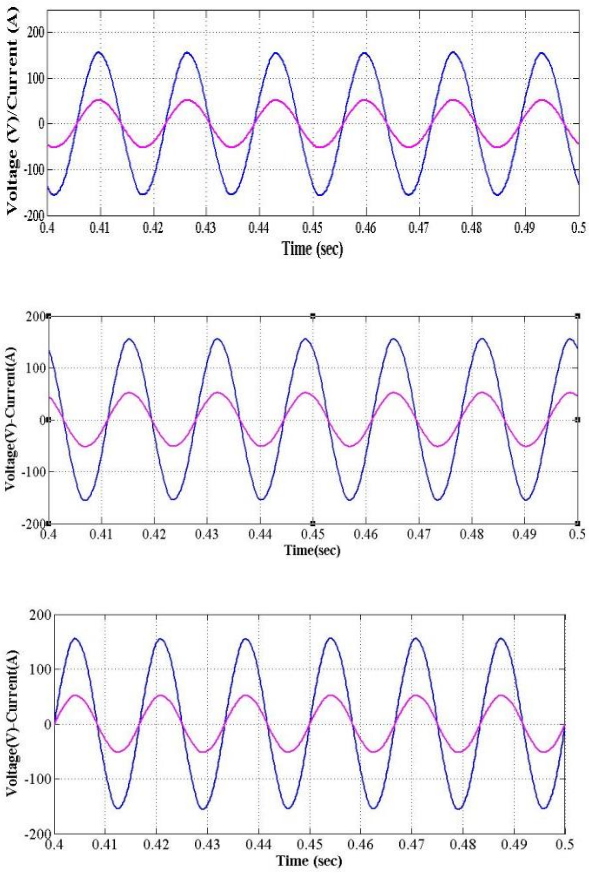


Fig-4: PCC voltage and current waveform vs time.

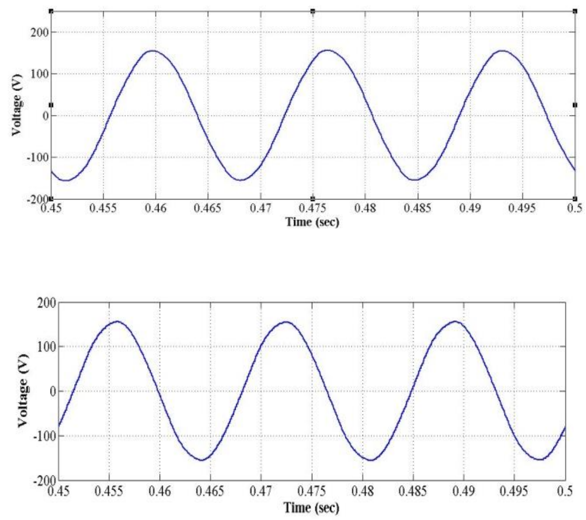


Fig-5: Waveforms of Alpha beta components of PCC voltage vs time

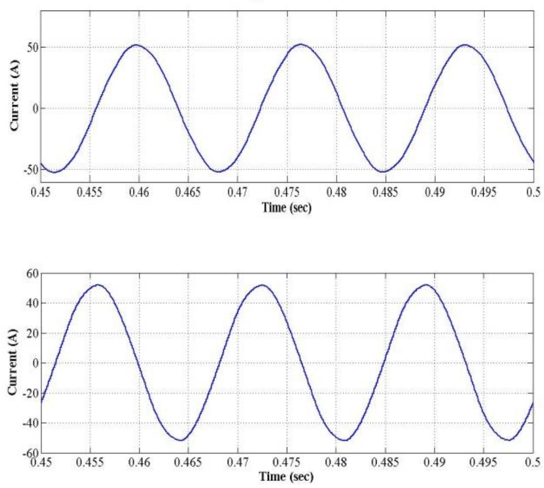


Fig-6: Alpha beta components of PCC current vs time

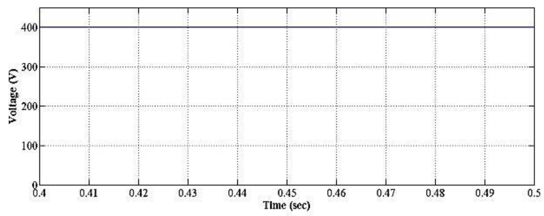


Fig-7: Output DC voltage (Vo) vs time

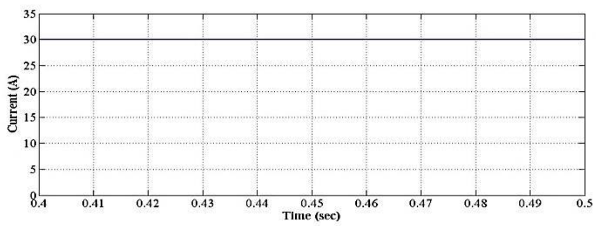
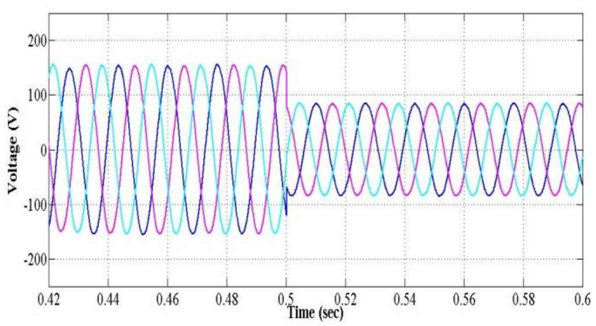


Fig-8: Output DC current (Io) vs time



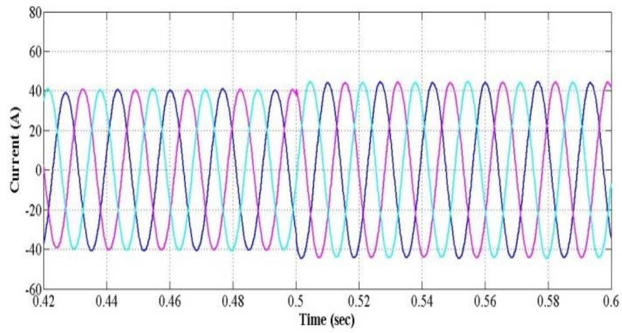


Fig-9: PCC voltage and current for step change in source voltage

3.1. THD comparisons:

S.No.	Domain	Existing method THD	Proposed method THD
1.	PCC Voltage and current during steady state.	Voltage = 18.91%, Current = 19.04%.	Voltage = 0.95%, Current = 0.95%.
2.	PCC voltage & current during Step change in source voltage.	Voltage = 1.21%, Current = 2.46%.	Voltage = 1.00%, Current = 1.00%.

Table-1: THD comparison

IV. CONCLUSION

Different generally utilized control procedures for PWM converters are condensed to sum things up and another idea of control in stationary edge with easier control and diminished equipment is proposed. The stationary reference outline control for UPF AC-DC converter is a changed adaptation of straight stationary edge current control wherein the AC side control variables are changed into stationary edge time shifting amounts for control and since the phase data can be ascertained utilizing fundamental vector variable based math idea. The recreation consequences of proposed control are examined in the paper. The proposed control plan is another way to deal with more straightforward and proficient control of PWM converters.

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