Hysteresis Controlled KY-Boost Converter Inverter System with Grid Connection

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Abstract: -Newly, "_KY-BoostConverter(KYBC)" has been outspreaded as a-substitute between PV-system &AC-load. DC-level is enhanced using KY-BC &its yield is applied to a DC-Motor. The KYBC is exploited to escalate the voltage-gain. Simulink-models are developed for open loop and closed loop Current Mode Controlled-PR-PR(Proportional Resonant) and PI-HC(proportional integral-Hysteresis-controller) based KYBC-TPI systems. This effort mainly compares the time-responses of Current Mode Controlled (CMC)-PR-PR and CMC-PI-HC based KYBC-TPI systems. The investigations indicate that the response of PI-HC based KYBCTPI system has better response than PR-PR based KYBCTPI system.

Keywords: *Boost converter, KY boost converter, Proportional Resonant Control, Hysteresis Controller*

I. INTRODUCTION

This task focuses on sun powered energy since related relevance's had gotten progressively significant. Practically speaking, a KY-boost converter was normally associated with photovoltaic (PV) board yield, and it is conceivable to move the force straightforwardly to DC/AC power lattice through its association with a 3phase inverter as appeared in Fig.1.1. With hardly any parts, such a PV-generation framework permits the ingested energy to be utilized by innumerable apparatuses which were associated with the force network.

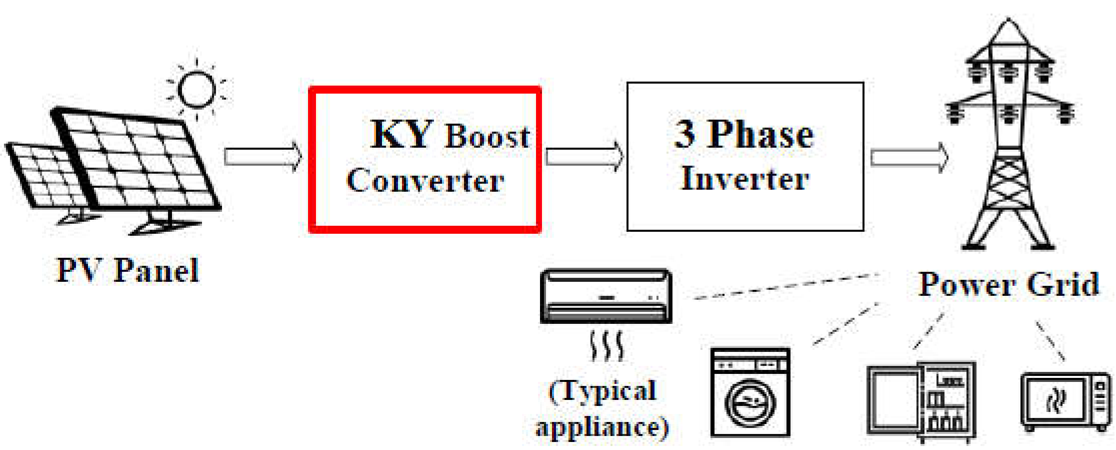


Fig. 1.1 Typical PVgeneration-framework with KYboost-converter

Late examination of the undertaking was centered around structuring a DC-DC support converter with low yield voltage swell, quick transient reaction, and high-power proficiency by receiving another geography called KY-boost-converter [1-4]. Conventional inductor based-boost-converter produced throbbing current in yield, which causes high voltage swell. In outcome, huge force misfortune had showed up. KY converter produced constant yield current, which makes it predominant than customary geography as far as voltage swell level and force effectiveness.

Advances in power gadgets &energy stockpiling gadgets had quickened infiltration of the conveyed generation utilizing sustainable power sources into electric power-generation systems[2-5]. The vast-majority of this generation-unit had DC-yield and so as to deliver-higher AC-voltage from the DC-yield-voltage, they should had a DC-DC-boost-converter and a-DC-AC -inverter. -Among the accessible-DC-DC-BC-geographies, FBCwas the most appealing one for high force-generation.

This brief of KY incorporated circuit (IC) for low force applications began with the structure and usage of a PWMcontrolled under consistent conduction mode (CCM) [6]. This, was trailed by the structure of a completely incorporated PWM controlled KY converter IC with irregular conduction mode (DCM) [6]. The KY converter planned [6], [7] center around light burden/substantial burden current condition as it were. Along these lines, the profound light-load (reserve mode) activity of the KY converter ought to be considered and researched, which was the focal point of this brief.

KY converters [8], [9] conveyed persistent yield current, prompting low yield voltage swells. Its conduct was like that of the buck converter, thus additionally demonstrating great burden transient reaction. The KY-like converter IC had likewise been executed [8], where versatile slant generator with hysteresis voltage correlation strategies was proposed to improve productivity and transient reaction. In any case, investigation of the force stage was not adequate to control ideal structure of the coordinated converter.

In enlistment engine drives, hysteresis current control was broadly used to control the three stage inverter because of its effortlessness in structure and usage [13-14]. The working idea of hysteresis current control in IM drives can be envisioned by considering three stage current originating from the engine and contrast them and the reference flows created from the input controller. The correlation yield was taken care of into hysteresis controller to deliver changing heartbeat to be applied to the inverter [15-16]. The execution of fixed band hysteresis current controller for inverter had been normally utilized which variable exchanging recurrence related with such strategies. The variable exchanging recurrence can deliver sounds bends to the flows just as influence the heap current to not fit the predefined band.

The above works do not report KY-BOOST converter based 3phase inverter with CMC-PR-PR and PI-HC controller. The above literatures do not report current- mode control of KYBCTPIS system. Hence, this work deals with the comparison of KY-BOOST converter based 3phase inverter-system with CMC-PR-PR and PI-HC controllers.

II. PROPOSED SYSTEM

Block diagram of open loop KY Boost converter is appeared in Fig 1.2. Block diagram of KYBCTPIS with CMC-PR-PRC and PI-Hysteresis controller is shown in Fig 1.3.

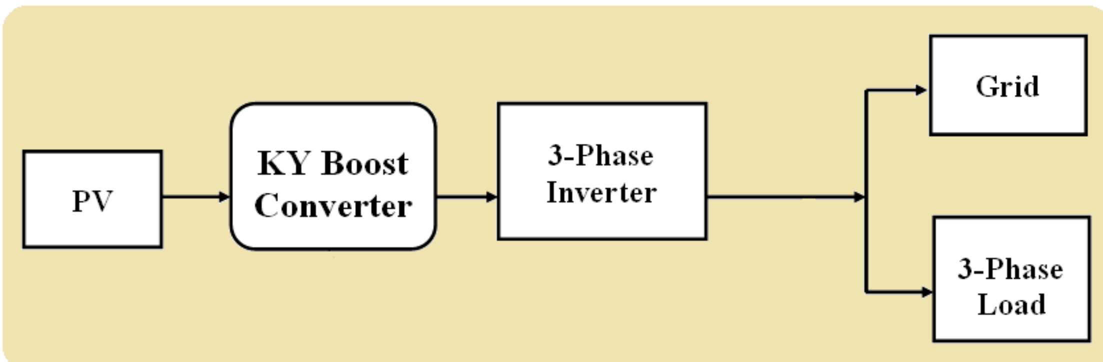


Fig 1.2 Block diagram of open loop KY Boost converter

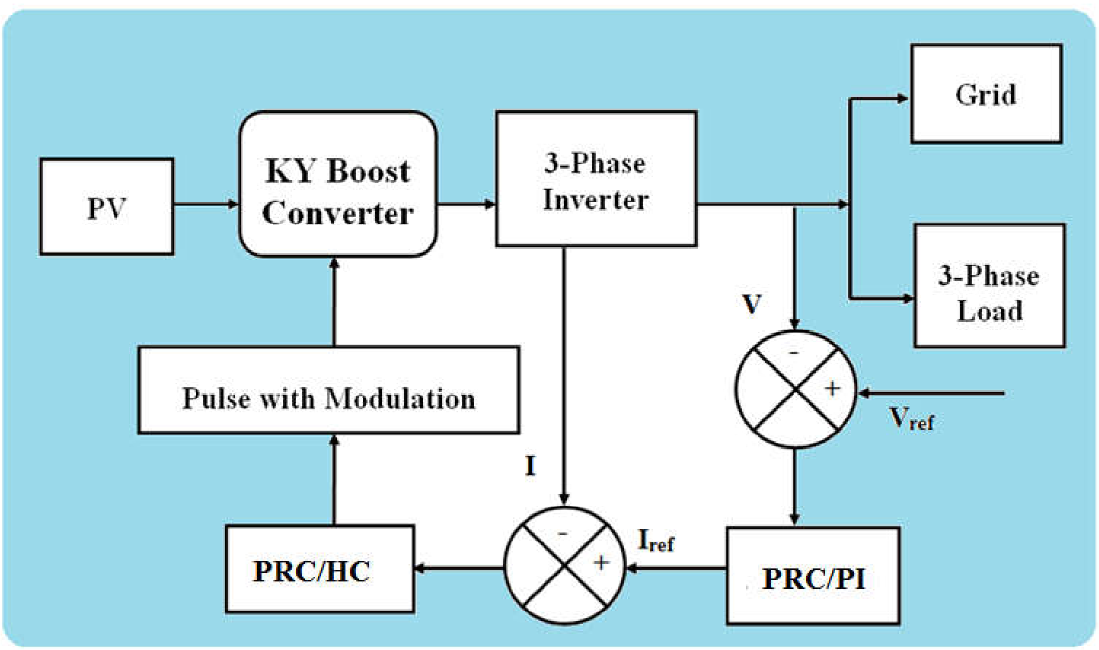
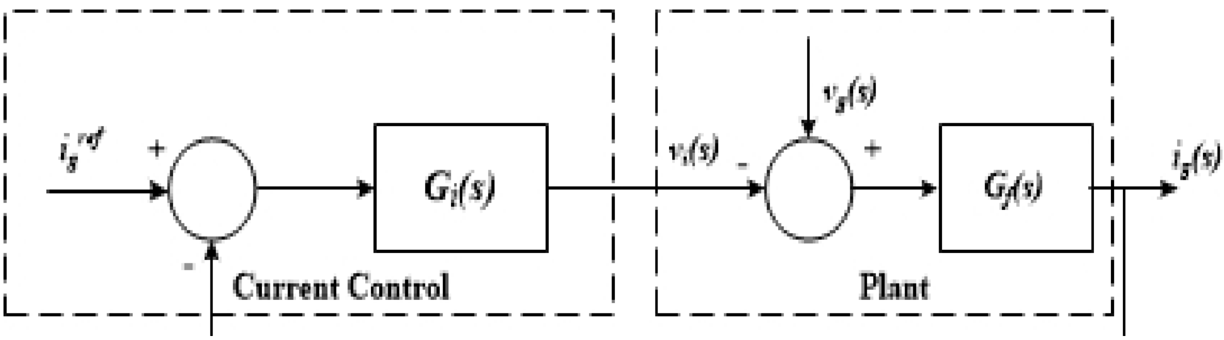


Fig 1.3 Block diagram of KYBCTPIS with CMC-PR-PRC and PI-Hysteresis controller

III. CONTROL TECHNIQUES

a). Proportional Resonant Control

So as to control the framework current a solitary stage criticism current-circle is utilized. The model of the current control and the plant are outlined in Fig. 2.1 As space-vector hypothesis can't be applied to the single-stage voltage source inverter, the controller structure and demonstrating of the framework is impossible in dq-outline. Along these lines controller ought to have the option to follow single-stage sinusoidal current reference straightforwardly.



Figu2.1 Block-diagram of current-controller

The exchange capacity of the LCL-channel is just spoken to by plant Gf(s), which is given as follows:

$$G_f\ (s) = \frac{sC_fR_d+1}{s^3L_lL_g\ C_f+s^2C_fR_d(L_l+L_g)+s(L_l+L_g)} \text{.................. (1)}$$

There is in every case consistent state extent and stage mistake exists while following a sinusoidal sign utilizing Proportional Integral (PI) control. This would evacuate consistent state mistake while following a sinusoidal sign. The PR controller Gi(s) is in the structure:

$$G_i\ (s) = K_p + \frac{K_is}{s^2+2\delta\omega_0s+\omega_0^2} \text{.............................. (2)}$$

Here Kp and Ki are the-relative &integral-gain separately, δ is the damping factor, ω_0is power recurrence of the lattice voltage. The interminable addition of PR-control is less in sum by damping factor δ to build the data transmission and in this way elements of the framework stays stable.

b). Hysteresis Controller

The hysteresis control approach, being basic and quick reaction, creates every leg exchanging signal for an inverter. The hysteresis controller delivers a sign if the blunder between the reference signal and estimated signal surpasses certain cutoff points as outlined in Fig 2.2. The upsides of the controller are exceptionally straightforward, simple usage practically speaking, and high unique reactions. It additionally has an inborn current insurance.

The test of the control approach is to control swell in the yield current consequently decreasing absolute consonant bending (THD), which may not be satisfactory.

Regardless, hysteresis controllers encounters a turning repeat dependent on the modification list, M, of the enhancer. All other basic kinds of self-faltering modulators experience the ill impacts of this wonders too.

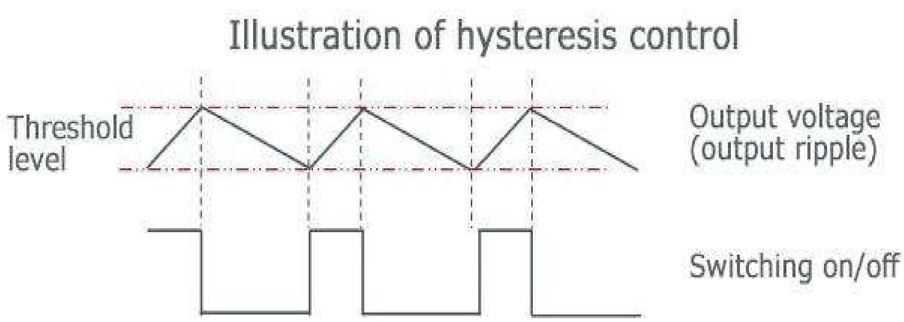


Fig 2.2 Hysteresis Controller

IV. SIMULATION RESULTS

a). Open loop KYBCTPIS with source disturbance

Figure 3 outlines the Circuit diagram of open loop KYBCTPIS with source disturbance.

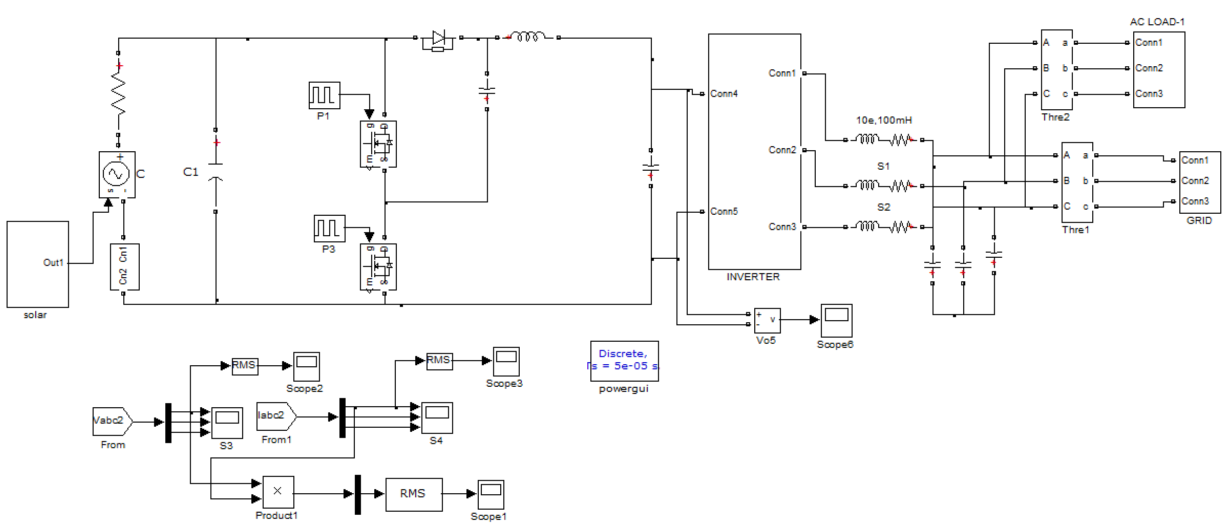
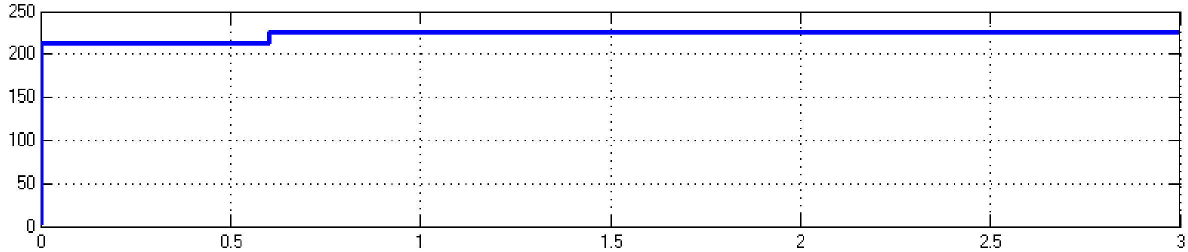
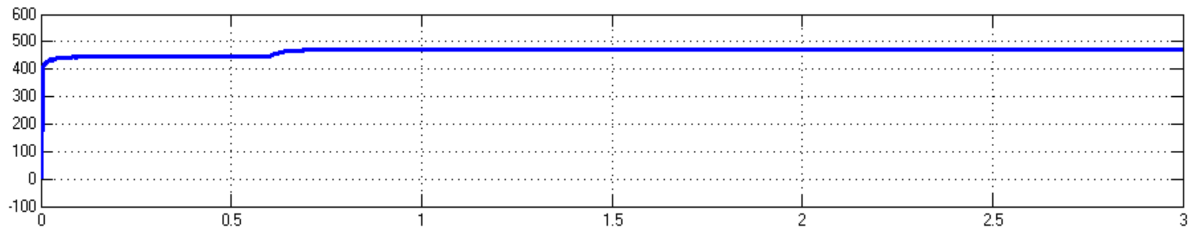


Figure 3. Circuit diagram of open loop KYBCTPIS with source disturbance

-Voltage across PV is appeared in Figu4 &its value is 225Volts. –Voltage-across KY boost converter with disturbance is shown in Fig5& its value is 490 Volts.



Figur4. –Voltage-across-PV-with-source-disturbance



Figu5.-Voltage-across-KYboost-converter-with-source-disturbance

Output voltage across RL –Load with disturbance is delineated in Figure 6 and its value is 450 Volts. RMS voltage across RL –load with disturbance is appeared in Figure 7 and its value is 293.49 Volts.

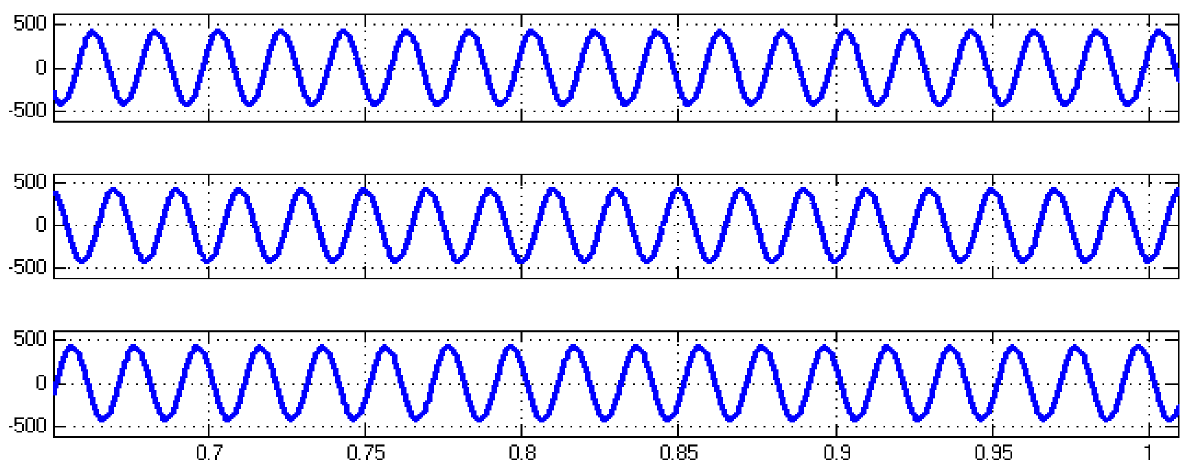


Figure 6 Voltage across RL –Load with source disturbance

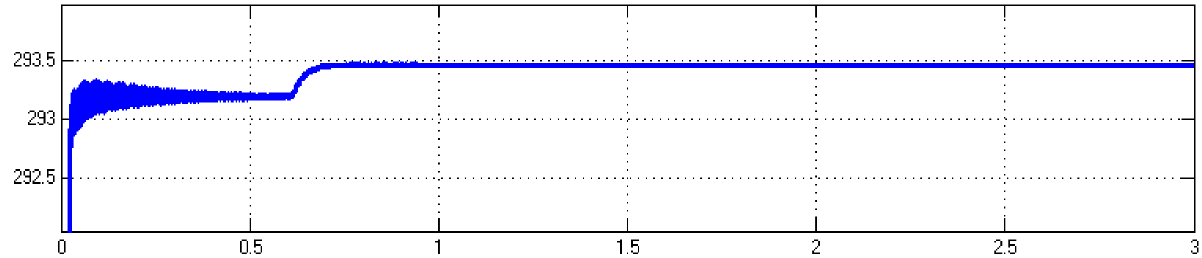


Figure 7 RMS Voltage across RL –load with source disturbance

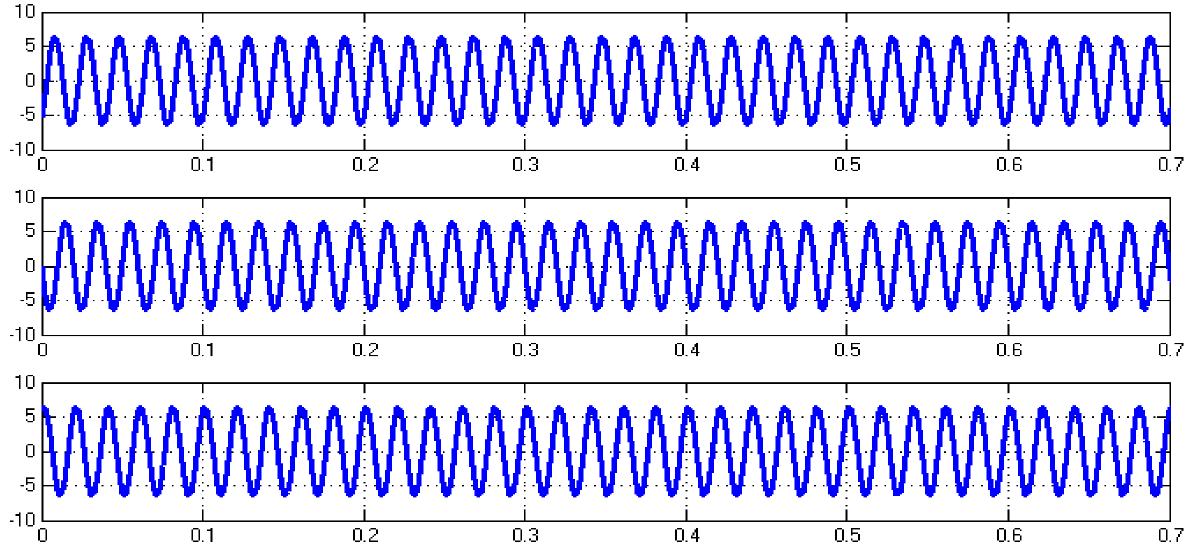


Figure 8 Current through RL-Load with source disturbance

Current through RL-Load with source-disturbance is appeared in Figure 8and its value is 7.5 A. Output power is shown in Figure 9 and its value is 946 W.

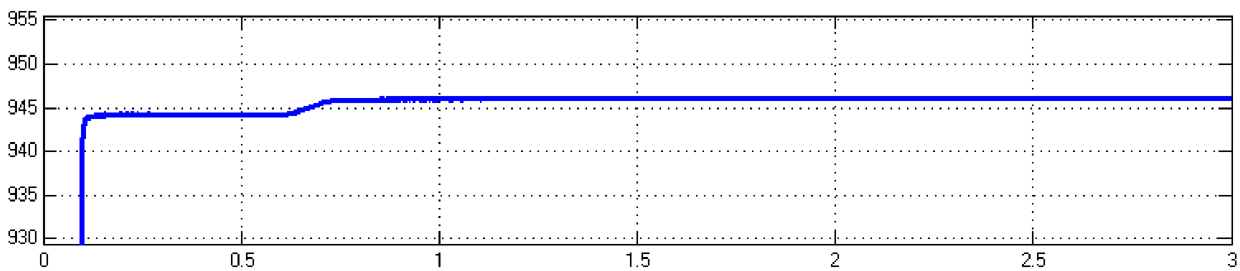


Figure 9 Output power with source disturbance

b). KYBCTPIS with CMC-PR-PR controller

Circuit diagram of KYBCTPIS with CMC-PR-PR controller is appeared in Figure 10. -Yieldvoltage is evaluated with reference-yield voltage to provide the error-signal. The obtained current signal is again related with reference current to get PWM signal for KY-boost-converter. This error signal is coursed by the PR to sustain the output voltage constant and diminish the steady state errors.

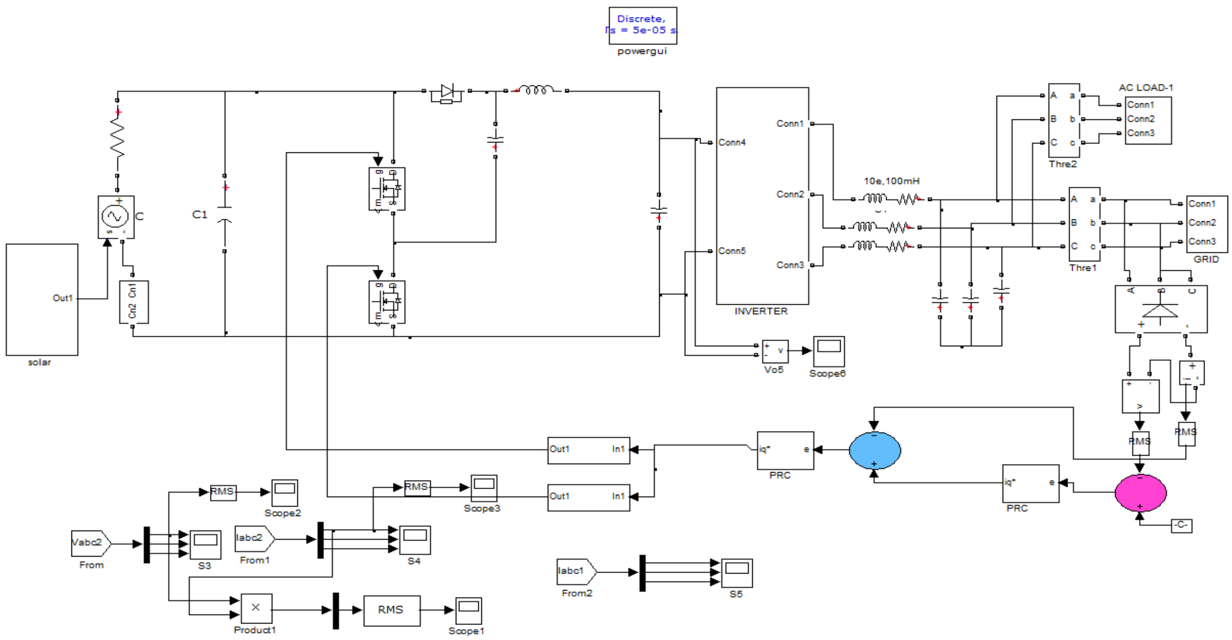


Figure 10 Circuit diagram of KYBCTPIS with CMC-PR-PR controller

Voltages across PV are shown in Figure 11 and its value is 225 Volts. Voltage across KY boost converter of KYBCTPIS with CMC- PR-PR controller is shown in Figure 12 and its value is 460 Volts.

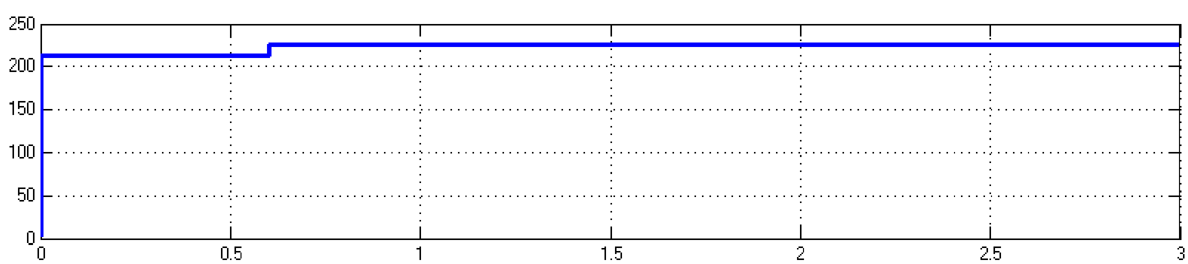


Figure 11 Voltages across PV with CMC-PR-PR controller

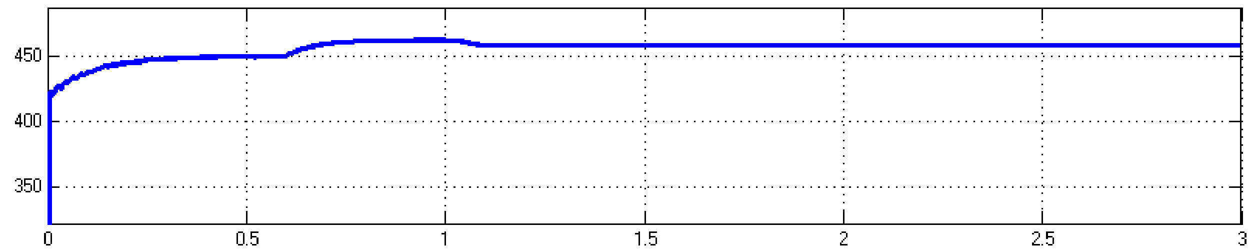


Figure 12 Voltage across KY boost converter with CMC-PR-PR controller

Voltage across RL –Load of KYBCTPIS with CMC- PR-PR controller is appeared in Figure 13 and its value is 490 Volts.

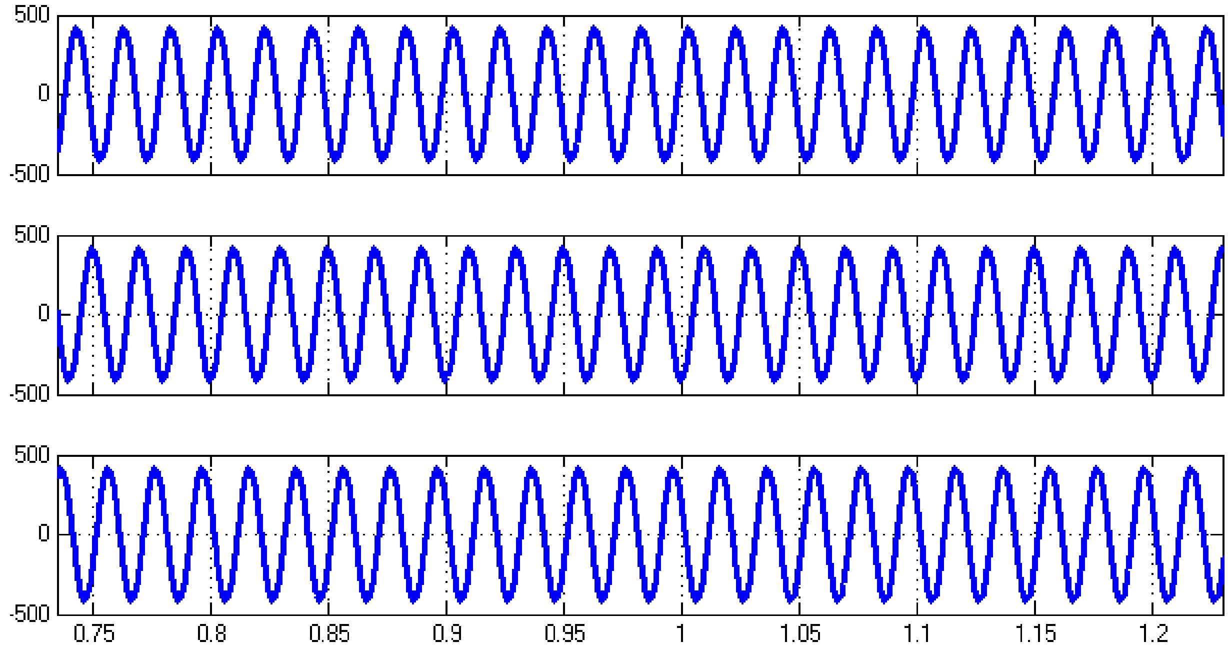


Figure 13 Voltage across RL –Load with CMC-PR-PR controller

RMS voltage across RL –load of KYBCTPIS with CMC- PR-PR controller is delineated in Figure 14 and its value is 293.33 Volts.

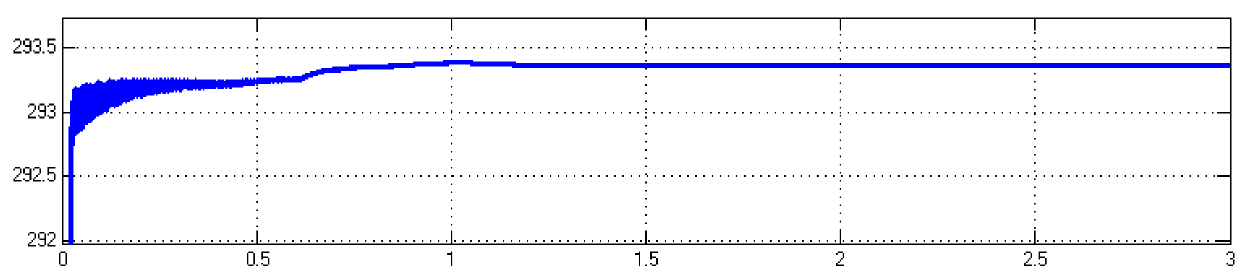


Figure 14 RMS voltage across RL –load with CMC-PR-PR controller

Current through RL-Load of KYBCTPIS with CMC- PR-PR controller is shown in Figure 15 and its value is 6.5 A. The current THD of KYBCTPIS with CMC- PR-PR controller is shown in Fig 16. Output power of KYBCTPIS with CMC- PR-PR controller is delineated in Figure 17 and its value 945 W.

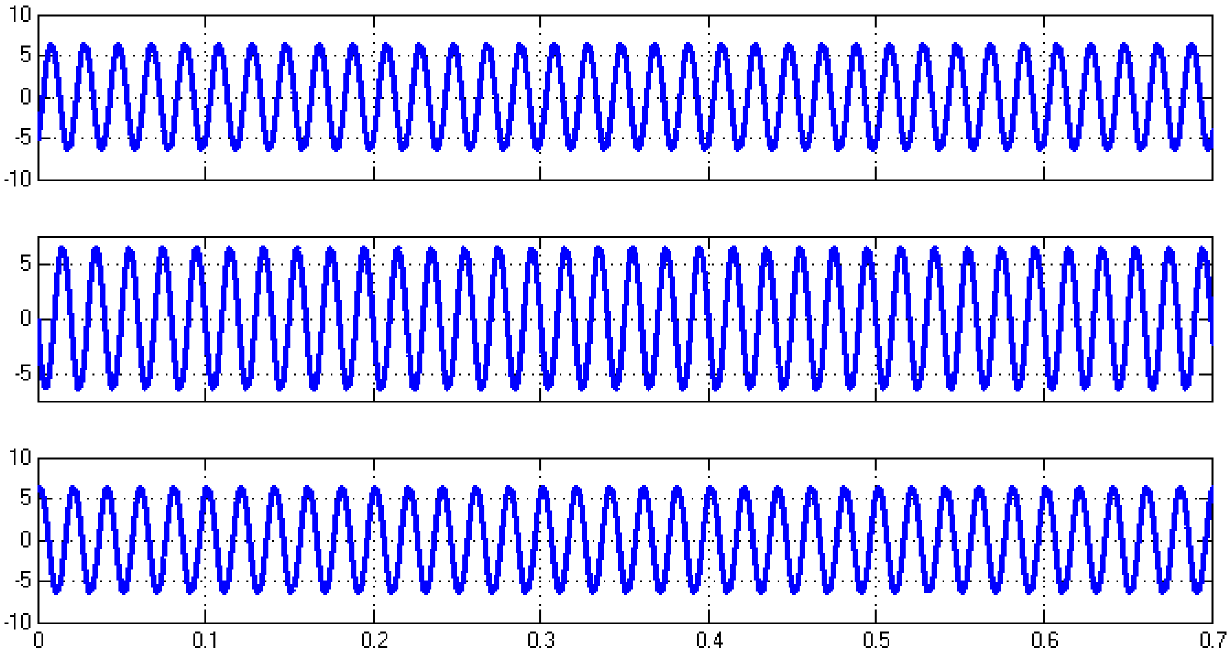


Figure 15 Current through RL-Load with CMC-PR-PR controller

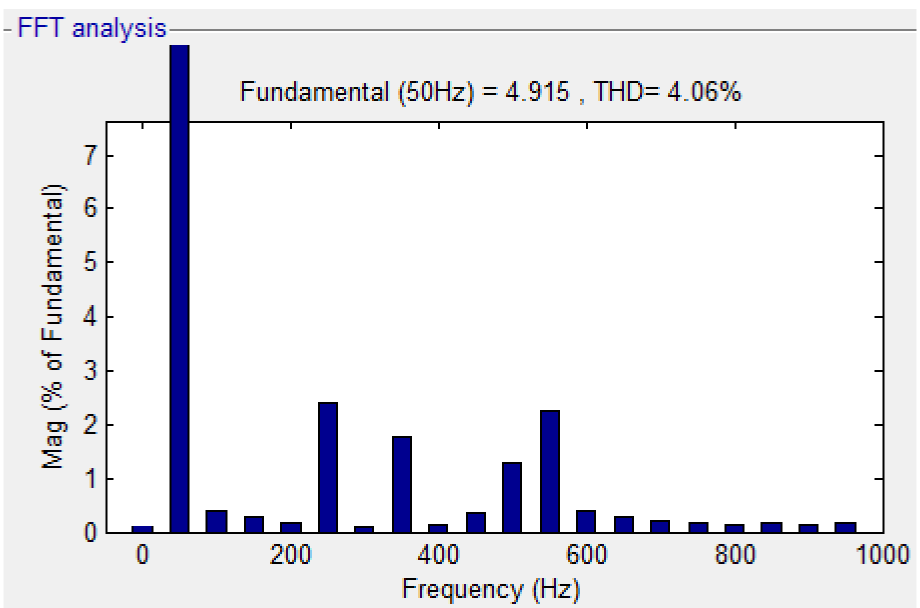


Figure 16 Current THD with CMC-PR-PR controller

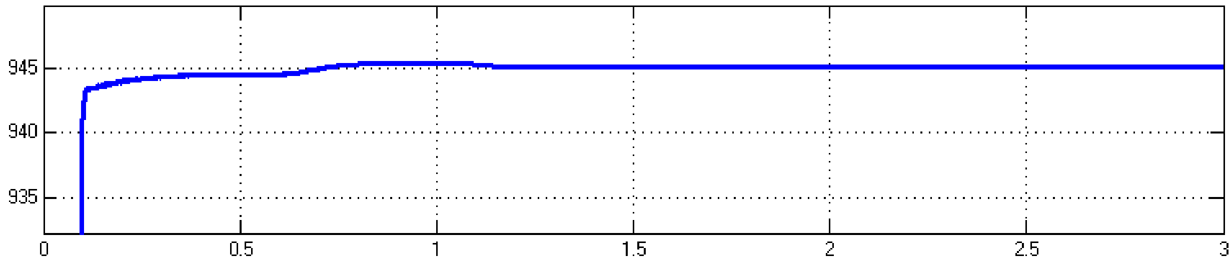


Figure 17 Output power with CMC-PR-PR controller

c). KYBCTPIS with CMC-Hysteresis controller

Circuit diagram of KYBCTPIS with CMC--Hysteresis controller shown in Figure 18. The obtained current signal is again related with reference current to get PWM signal for KY-boost-converter. This error signal is coursed by the PI and HC to sustain the output voltage constant and diminish the settling time.

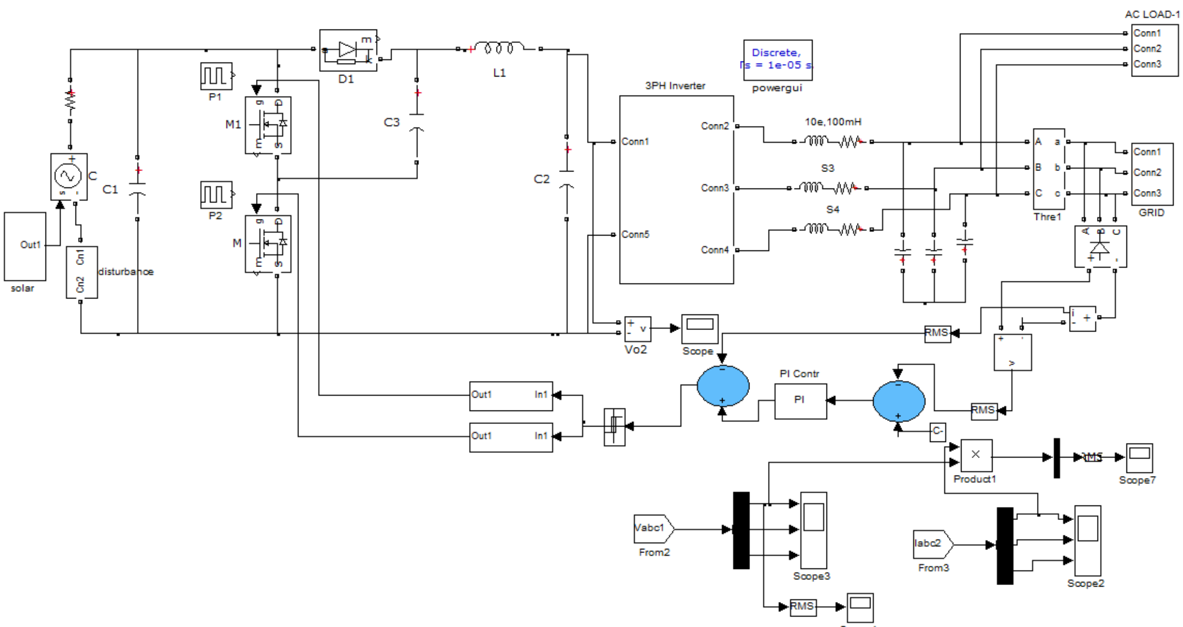


Figure 18 Circuit diagram of KYBCTPI system with -Hysteresis controller

Voltages across PV are shown in Figure 19 and its value is 225 Volts.

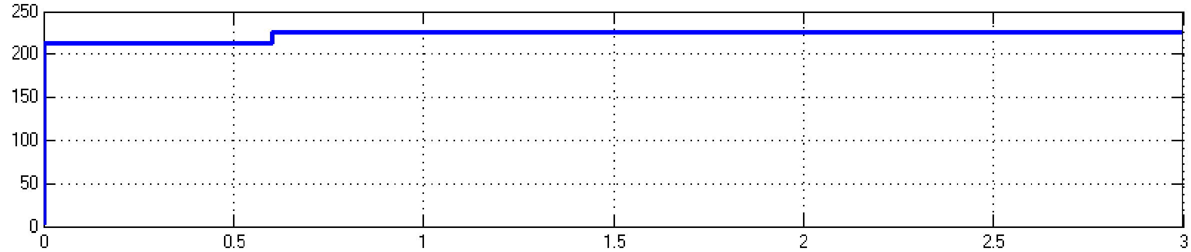


Figure 19 Voltages across PV

Voltage across KY boost converter with CMC- PI-Hysteresis controller is appeared in Figure 20 and its value is 455Volts.

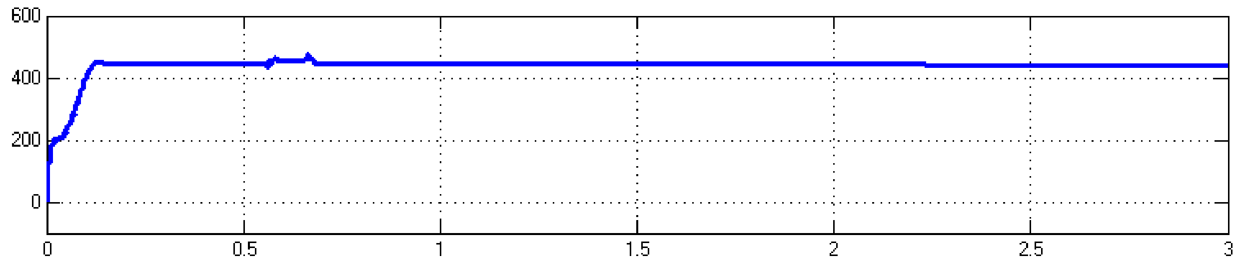


Figure 20 Voltage across KY boost converter with CMC- PI-Hysteresis controller

Output voltage across RL –Load of KYBCTPIS with CMC- PI-Hysteresis controller is delineated in Figure 21 and its value is 450 Volts.

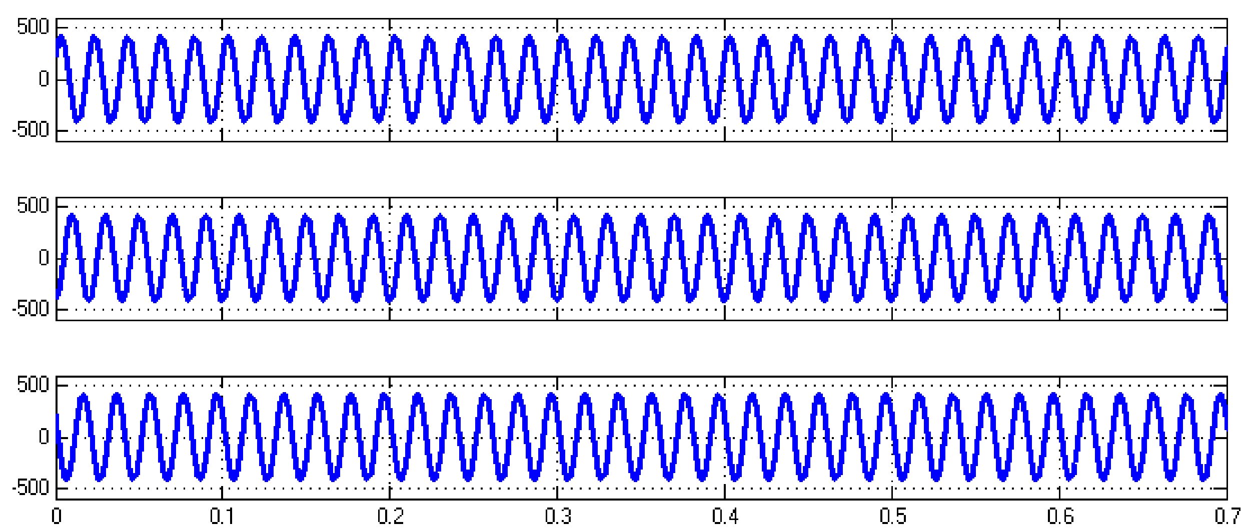


Figure 21 Voltage across RL –Load of KYBCTPI system with CMC-PI- Hysteresis controller

RMS voltage across RL –load of KYBCTPIS with CMC- PI-Hysteresis controller is appeared in Figure 22 and its value is 293.4 Volts.

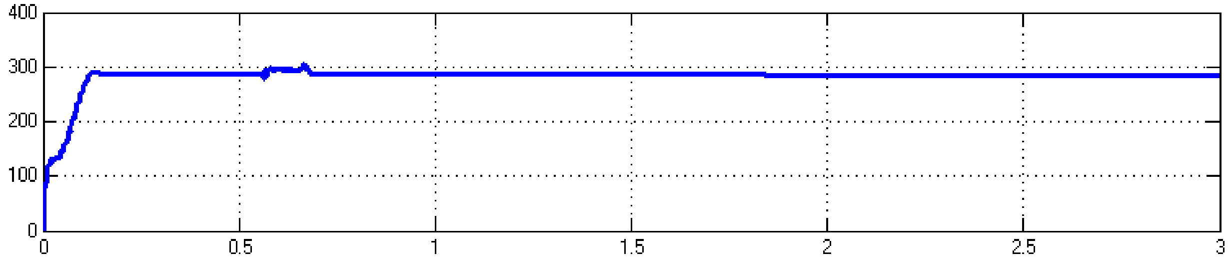


Figure 22 RMS voltage across RL –load of KYBCTPI system with CMC- PI-Hysteresis controller

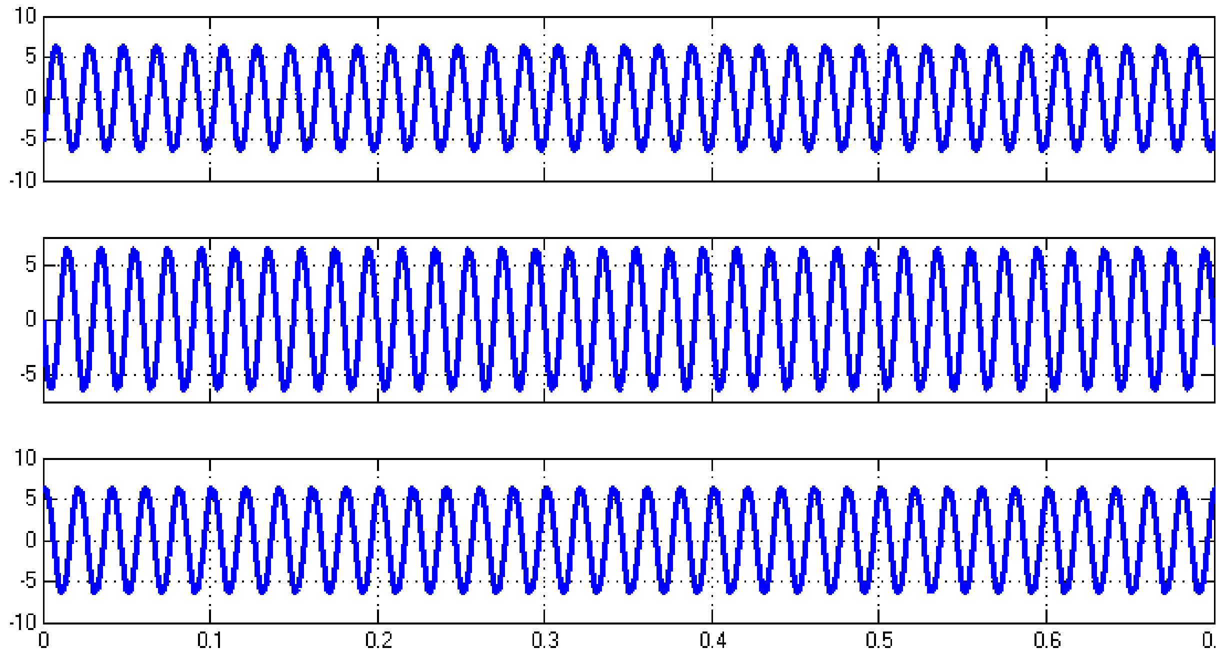


Figure 23 Current through RL-Load of KYBCTPI system with CMC- PI-**Hysteresis controller**

Current through RL-Load of KYBCTPIS with CMC- PI-Hysteresis controller is shown in Figure 23 and its value is 7A. Output current THD of KYBCTPIS with CMC- PI-Hysteresis controller is shown Fig 24. The output power of KYBCTPIS with CMC- PI-Hysteresis controller is shown in figure 25 and its value is 945 W.

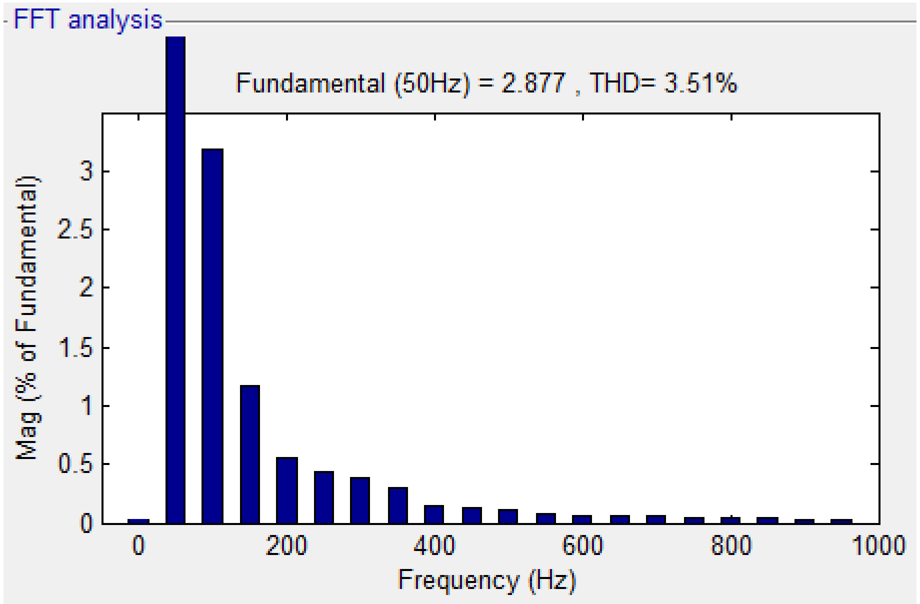


Figure 24 Current THD of KYBCTPI system with CMC-PI-Hysteresis controller

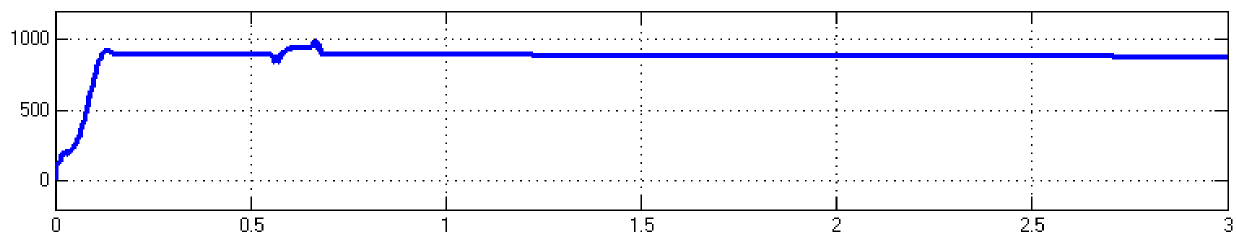


Figure 25 Output power of KYBCTPI system with CMC-PI-Hysteresis controller

Figure 26 outlines the Barchar Comparsion Time Domain Parameters using PR-PR and PI-Hysteresis controller. Figure 27 outlines the Barchat Comparsion output current THD using PR-PR and PI- Hysteresis controller.

Comparsion of Time Domain Parameters using PR-PR-PI-Hysteresis control is given in Table-1. Comparsion of output current THD is given in Table-2.

By using PI-HC, the rise time is reduced from 0.78Sec to 0.57Sec; peak time is reduced from 0.89Sec to 0.63Sec; settling time is reduced from 1.15Sec to 0.68Sec; Steady state error is redcued from 1.1V to 0.8V;Current THD is reduced from 4.06% to 3.51%. Hence, the outcome represents that the KYBCTPI system with CMC-PI-HC is superior to KYBCTPI system with CMC-PR-PR controller.

Table-1

Comparsion Time Domain Parameters using PR-PR and PI-Hysteresis controller

Controller	Rise time (s)	Peak time (s)	Setting time (s)	Steady state error(V)
PR-PR	0.78	0.89	1.15	1.1
PI-HC	0.57	0.63	0.68	0.8

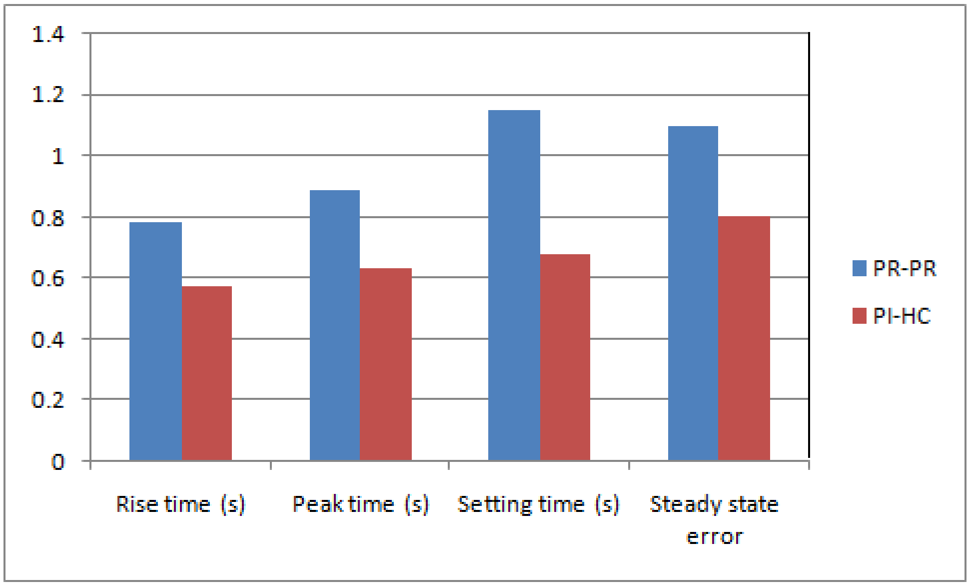


Figure 26. Barchar Comparsion Time Domain Parameters using PR-PR and PI-Hysteresis controller

Table-2

Comparsion of output current THD

Controllers	Current THD (%)
PR-PR	4.06

PI-HC	**3.51**

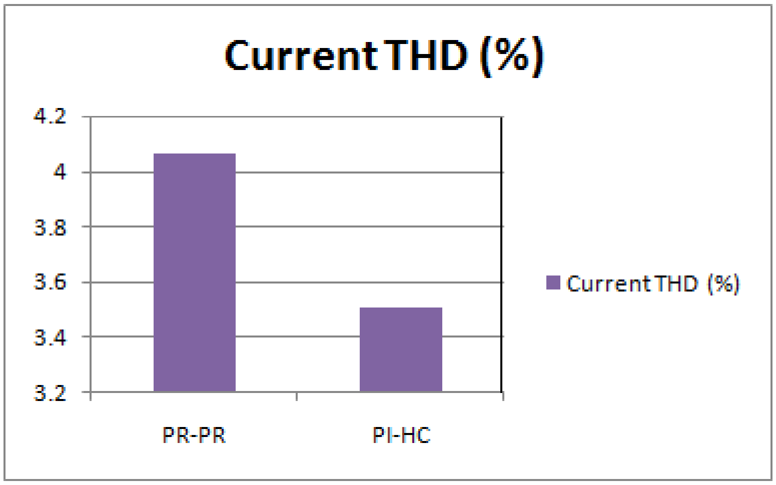


Figure 27 Barchat Comparsion output current THD using PR-PR and PI- Hysteresis controller

V. CONCLUSIONS

Closed loop Current Mode Controlled-PR-PR (Proportional Resonant) and PI-HC(proportional integral-Hysteresis-controller) based KYBC-TPI systems are simulated using Matlab simulink. The outcomes are compared in terms of settling time and steady state error. By using PI-HC, the rise time is reduced from 0.78Sec to 0.57Sec; peak time is reduced from 0.89Sec to 0.63Sec; settling time is reduced from 1.15Sec to 0.68Sec; Steady state error is redcued from 1.1V to 0.8V;Current THD is reduced from 4.06% to 3.51%. Hence, the outcome represents that the KYBCTPI system with CMC-PI-HC is superior to KYBCTPI system with CMC-PR-PR controller.

The present work deals with comparison of KYBCTPIS with CMC-PR-PR and -HC controllers. KY boost converter based TPIS with CMC –FL-FL controllers can be done in Future.

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