Performance analysis of boost converter for various temperatures

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Abstract

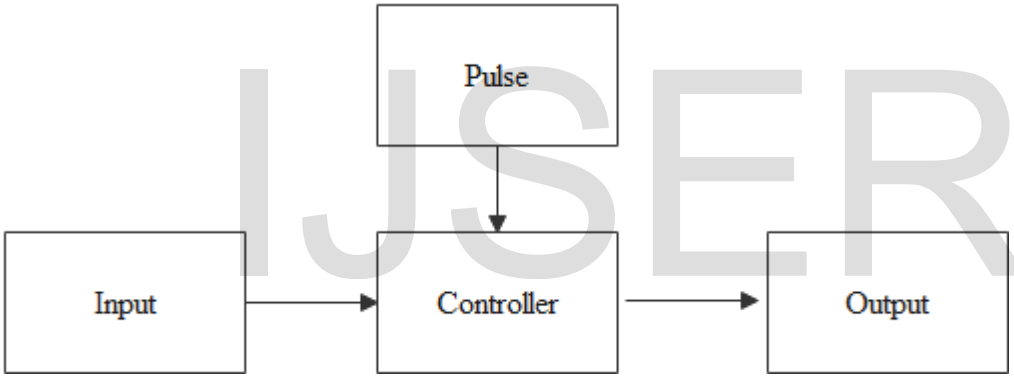
Solar energy is one of the fast developing renewable energy source in Indian electricity nowadays. Energy from solar can be converted by two categories as solar thermal and solar electric. Worldwide growth of photovoltaic is strongly varies by country .Solar electric can be commonly known as photo voltaic. Photo voltaic systems uses solar panel and the solar thermal uses the thermal energy for energy conversion. In solar electric conversion the sunlight is directly converted in to electricity. The large value of solar energy available appealing source of electricity. This research study deals with the performance analysis of boost converter of solar panel voltage with various temperatures. The analysis is done by varying the temperature from lower temperature level to standard temperature range of the photovoltaic panel. For boosting the panel voltage closed loop controller is used. Proportional Integral Derivative controller is used as closed loop controller for boosting the output. The boosted output voltage is verified for various temperature conditions with standard irradiance. The need of providing boost converter for boosting the voltage is that in the low radiation period maximum required power can be obtained.

Keywords: Energy, Photovoltaic, Temperature, Solar electric, Boost,Irradiance,Radiation

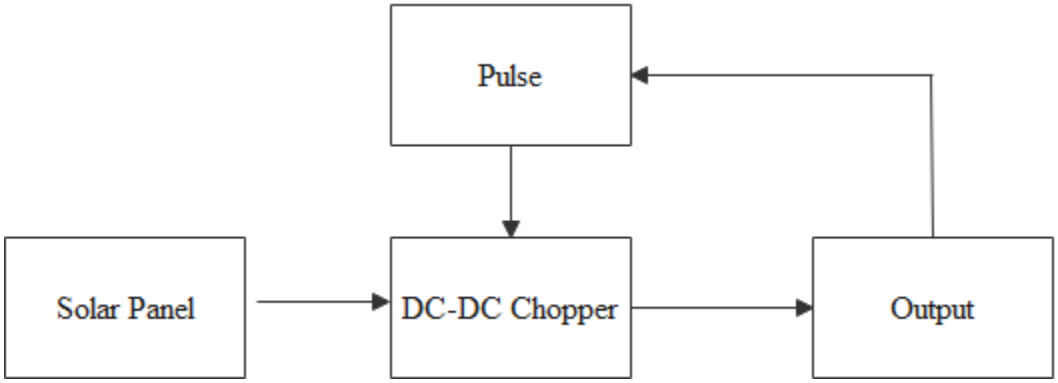
1. Introduction

Recently, India has achieved 5th rank in the world in solar power deployment. In solar power, capacity has increased by more than 11 times in the last five years from 2.6 GW in March 2014 to 28.18 GW in March 2019. With technological improvements, economy of scale and reduction in solar cell/ module prices solar tariff in India is now competitive and has achieved grid parity [1] .It is envisaged by Government of India to generate 175 GW electricity from the renewable energy sources by 2022 under Jawaharlal Nehru National Solar Mission.[2] Based on past years review and photovoltaic installations in the year 2014, the major five leading countries identified are China, Japan, USA, Germany and UK. These five countries altogether accounted for 80% of photovoltaic installations in 2014. [3] Policies, investment, and supports (such as research funding) from various governmental and non-governmental organizations for solar technologies have helped build up a solid foundation for the exploitation of this renewable energy system.[4]

2. Proposed system



3. Block diagram



3.1 Photovoltaic Module

A PV module consists of solar cell circuits sealed in an environmentally protective laminate and are the fundament building blocks of PV system. Generally sizes from 60W to 170W. Usually a number of PV modules are arranged in series and parallel to meet the energy requirement [5]. Here 200 W PV made module is connected parallel to get 1200 W for grid tie-up. Usually PV module is a string of series or Parallel connected with 36 cells at the minimum.

3.2 The Boost DC-DC Converter

A boost converter is used also as an electronic power DC-DC device interfacing the solar panel and the load to perform good matching. [6]

Specification Parameter of Boost converter is shown in Table 1. The values of L and C are selected and the boost output depends on this value

Table: 1

Specification Parameter of Boost converter

Frequency	25Khz
Duty Ratio	40%
Cboost	200 µF
Lboost	150 µH

3.3 Proportional– integral– derivative controller

A proportional– integral– derivative controller (PID controller) is a control loop feedback mechanism (controller) used in to provide Pulse for DC-DC chopper.

4. Simulation results

Simulation results for the various temperature variation against standard irradiance is tabulated in table: 2

Table: 2

Variation of Temperature with Irradiance

Sl no	Temperature	Irradiance	Ipv	vpv	Ppv	Boost Ipv	Boost Vpv	Boost Ppv
1	10	1000	38.28	32.12	1230	29.78	44.68	1331
2	15	1000	38.03	31.03	1180	29.21	43.82	1280
3	25	1000	37.3	28.88	1077	28.16	42.25	1190

4.1 Simulated output

From the simulated result the table: 1 shows that if the temperature is reduced the boosted output from the solar panel is high .So it is said that to have the maximum output from the PV panel Weather conditions such as (Temperature and Irradiance) are more important.

Figure: 1 Closed Loop Controller of Boost Converter

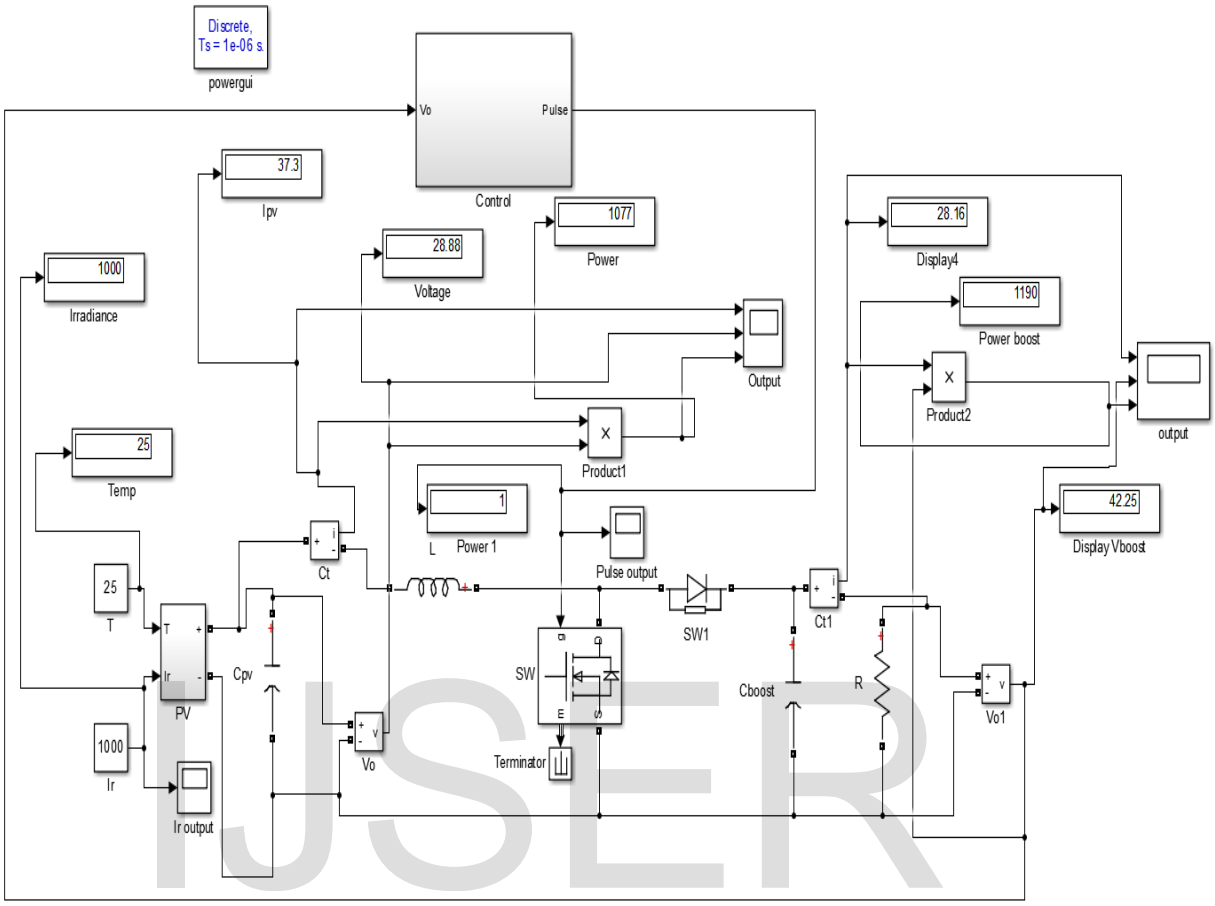


Figure:2

PV output

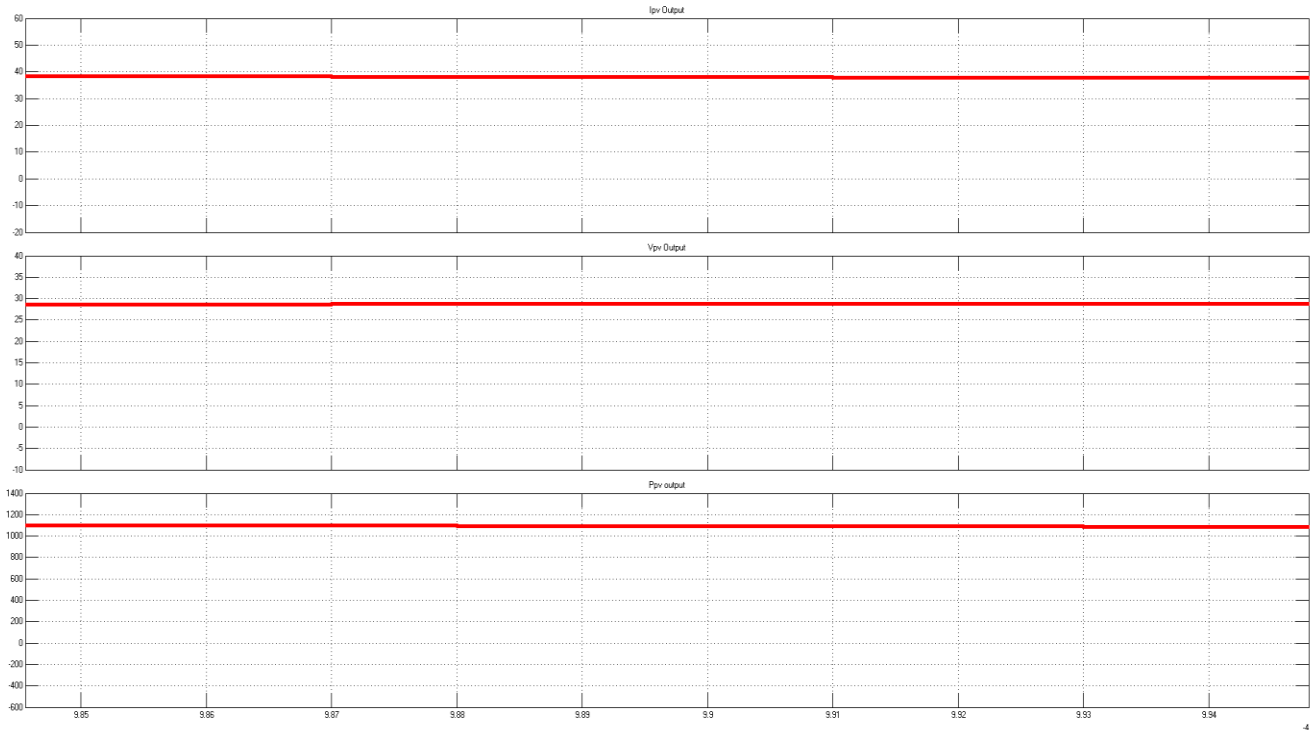
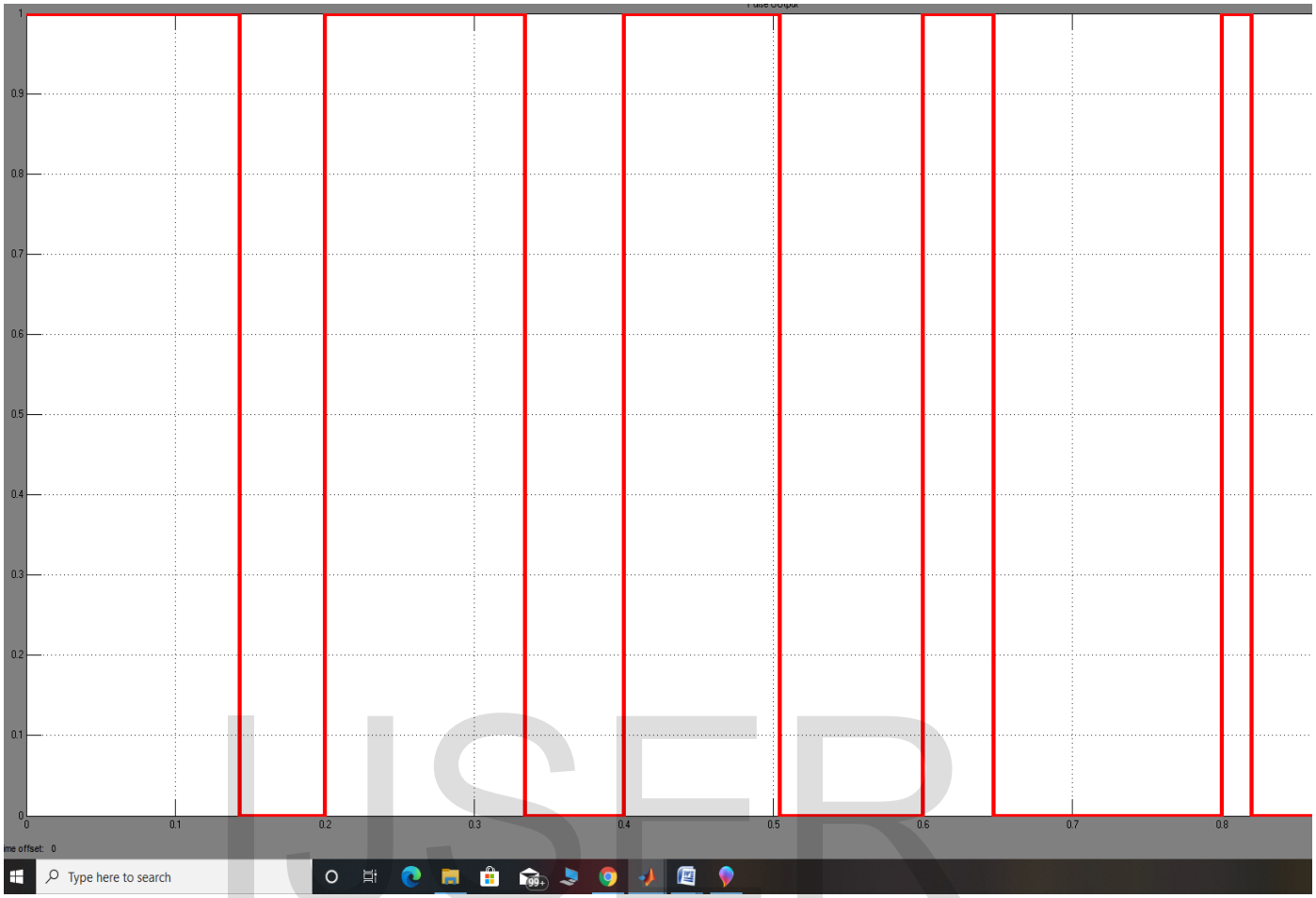


Figure: 3

Boost output

Figure:4

Pulse output



5. Conclusion

The research study shows that as temperature increases the solar Ipv, Vpv values are reduced and comparatively the boost output voltage is also reduced .For long life of the photovoltaic panel the weather conditions such as (Temperature and Irradiance) must be limited.

Future enhancement

Instead of PID controller other closed loop controller such as fuzzy controller, Mat lab function Fuzzy and other Mppt techniques integrated for obtaining the boost output.

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