iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** VI **Month of publication:** June 2023

DOI: https://doi.org/10.22214/ijraset.2023.54197

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue VI Jun 2023- Available at www.ijraset.com

Hardware Design and Simulation of Boost Converter Suitable for PV Applications

Ch. Leela Krishna[1], N. Sreeja Reddy[2], Ch. Supraja[3], M. Smitika[4], B. Shreya Yadav[5], B. Aishwarya[6], T. Bhargavi[7]
[1]*Assistant Professor, Electrical & Electronics Engineering Department, G. Narayanamma Institute of Technology and Science, Hyderabad, India*
[2, 3, 4, 5, 6, 7]*Electrical & Electronics Engineering Department G.Narayanamma Institute of Technology and Science Hyderabad, India*

Abstract: ***In order to power today's most advanced electronic devices efficiently and quickly produce extremely useful devices through software interfacing, new techniques must be developed as the size, utility, and complexity of these devices rise. In order to step-up DC voltages, the boost converter that is the focus of this paper will be modelled. The pulse width modulation pulses that are applied to power switches are produced by the Arduino. The software runs on the microcontroller and includes a boot loader for common programming languages. C is the programming language used. As a result, creating PWM triggering signals is less complicated. Instead of using traditional methods, an efficient feedback system is used, depending on the application, to obtain the desired DC voltages. Even though using a linear regulator is the simplest way to control the DC supply voltage, they are less efficient in terms of power consumption and have fewer uses. With the right feedback, Arduino-based DC converters have a high efficiency (95%) rate.***

Keywords: Boost converter, Arduino UNO, Pulse Width Modulation.

I. INTRODUCTION

New requirements, such as those for longer-lasting batteries, small, reasonably priced systems, more vibrant full-color visuals, and greater duration talk times for cell phones, emerged as the market for portable electronics grew over time. The cost of consuming power has increased as a result of increased demand on the power system. To meet these needs, engineers have consistently been working to develop efficient conversion methods, which has prompted the official establishment of the multidisciplinary area of power electronics. However, it should come as no surprise that given the unusual convergence of the three main categories of electrical engineering—electronics, power, as well as control—this new field has presented challenges.

There are three types of converters

1) AC-AC converter
2) DC-DC converter
3) AC-DC converter

A direct current, or DC, source's electrical voltage level is altered by an electronic circuit called a direct current-to-direct current converter. It also goes by the name "Chopper." This specific type of power converter. For portable electronics that are powered mostly by batteries, such laptops, desktop computers, and cell phones, DC to DC converters have to be used. DC-to-DC converters typically also regulate the output voltage. Simple charge pumps that double the input voltage by two or three are an exception, as are high-efficiency light-emitting sources of power, a type of DC-to-DC converter that controls the electrical current flowing through the lightbulbs. Modern electronics require power supply that are compact, reliable, and effective. There are linear power regulators, which rely on ineffective voltage or current division for operation. Most applications are created at low power levels. At excessive power levels where switches have a on and off state, switching regulators are used. Modern power electronic switches are capable of operating at high frequencies. High operating frequencies enable faster dynamic reactions to sudden changes in load current. For DC-DC power conversion, such higher-frequency electronic power processors are employed.

DC-DC converters perform the primary tasks:

a) It transforms Direct Current input voltage to Direct Current output voltage.
b) It isolates the source from the load.
c) It can control the output voltage in relation to the load.
d) It can lower the dc output voltage's ac voltage ripple.

©IJRASET: All Rights are Reserved

The two primary types of DC-DC converters are resonant and soft switching and hard switching pulse width modulated (PWM) converters.

In this article, we discuss PWM dc to dc converters, which have gained widespread use over the past few decades and are applicable to all power levels.

II. BOOST CONVERTER

A boost converter, also known as a step-up converter, is a Direct Current power to Direct Current power converter that lowers current while raising the voltage from the supply it receives to its output (load). It belongs to the group of switched-mode power sources (SMPS) that at the very least consists of a transistor and a diode, as well as one or both of the capacitors, inductors, or both as energy storage devices. Filters made of capacitors are typically added to the source (supply-side filter) and output (load side filter) of such a converter to reduce voltage ripple. Any suitable DC power source, including solar panels, battery-operated rectifiers, and DC generators, can be used to power the boost converter.

The process of "step up conversion" is one approach to change a particular DC voltage into another DC voltage. When the output voltage of a DC to DC converter exceeds the source voltage, it is referred to as a boost converter. A boost converter is also referred to as a step-up converter since it "steps up" the input voltage. The output current is smaller than the source current because power conservation law dictates that P=U*I..



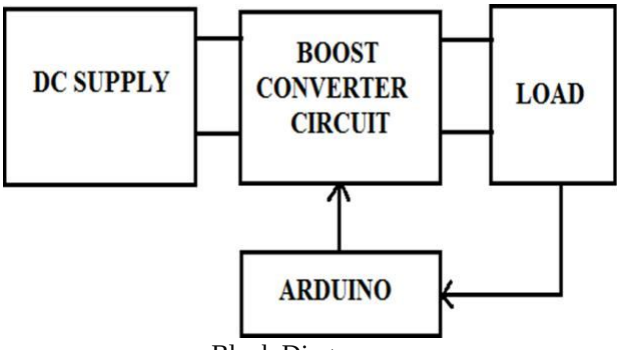
Boost Converter

III. METHODOLOGY

The boost converter's output voltage is monitored and the PWM signals used to power semiconductor switches are generated by Arduino. The Arduino package is a single-board microcontroller with an open-source hardware board that is straightforward. The software runs on the microcontroller and includes a boot loader for common programming languages. C is the programming language used.

This package simplifies the process of producing PWM triggering signals. Based on the usage of a reliable control method, the Arduino circuit board can be employed for monitoring the output voltage. The proposed method makes use of an Arduino to provide switch pulses, and an open loop is used to regulate the boost converter's output voltage.

A direct current source, most frequently a battery, powers the boost converter. The boost converter subsequently raises the input voltage and supplies it to the load. The boost converter's semiconductor switch needs to be activated by a pulse, which is generated by the Arduino UNO.



Block Diagram

IV. COMPONENTS

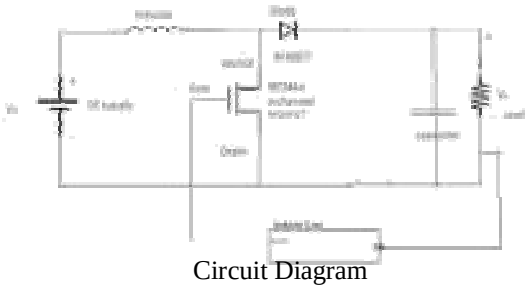
The converter's electrical input is provided by a dc source. In accordance with the duty cycle of the PWM pulses generated by the Arduino board, the boost converter generates a voltage output that is higher than the input voltage. This project used a MOSFET-based chopper kit.

The values of inductor and capacitor are calculated by the following formulae.

$$= \frac{(-)}{}$$

$$\frac{}{} =$$

Where D is the duty cycle which is taken a 0.5. After the calculation the values of inductor and capacitor are L=60mH and C=200 µF



Circuit Diagram

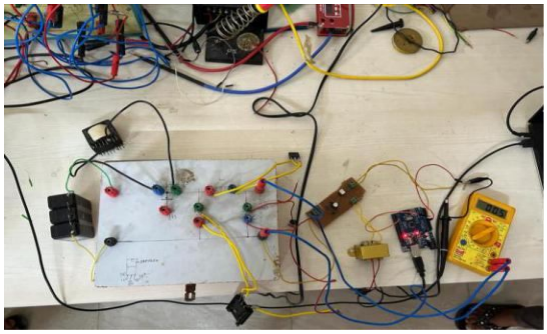
V. WORKING

As an input voltage, a regulated device or a battery-powered dc voltage rectifier may be utilized. The Arduino is connected to the driver circuit on the boost converter's output, or load, side. The driver circuit is connected to the MOSFET's gate.

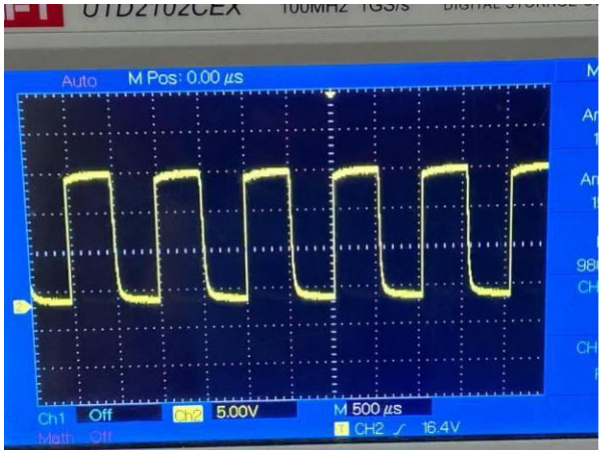
A reference voltage, required voltage, or desired voltage that must be obtained from the boost converter circuit will be compared to the load or output voltage. Through a multiplier known as a proportional controller, the actuating or error signal is amplified or increased proportionally. Pin 3 from the PWM pins is used to trigger the MOSFET using a Pulse Width Modulated (PWM) actuating signal from the Arduino using the command "Analogwrite(pin,duty cycle)".

Negative feedback circuit refers to the setup used to sense the load voltage and produce PWM pulses for delivering them to the gate of MOSFETs. This is how a feedback controller circuit using an Arduino is set up.

VI. HARDWARE RESULTS



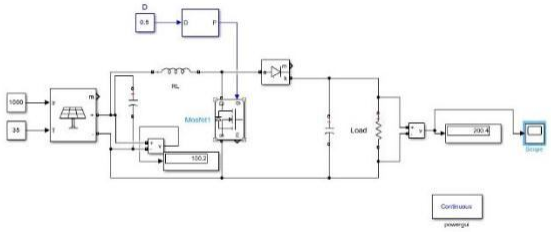
Hardware implementation



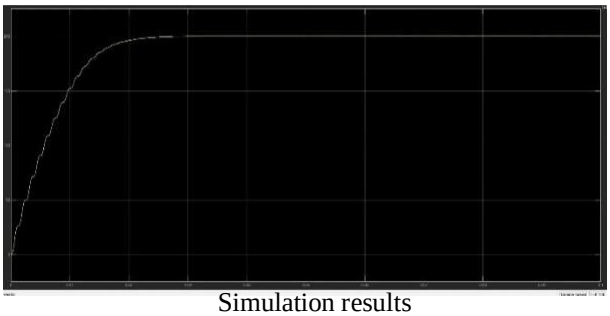
Pulses given to the gate terminal of MOSFET

VII. SIMULATION AND RESULTS

A fourth-generation programming language and multi-paradigm mathematical computing environment are also features of MATLAB. You can alter matrices, plot functions and data, put algorithms into practice, create user interfaces, and collaborate with programs written in a variety of languages, such as C, C++, C#, Java, and Python.



Simulation diagram



Simulation results

VIII. CONCLUSION

The boost Converter, a reliable step-up converter, is used in numerous electronic devices. Arduino is utilized to model and simulate it. constructing a closed-loop model and successfully using it in simulation.

In conclusion, a boost converter, also known as a DC-DC converter, increases the electrical voltage of a DC source of power. High efficiency, small size, and a wide range of output voltages are just a few of its advantages.

However, there are some disadvantages, such as the potential for voltage ripple, EMI, and noise issues.

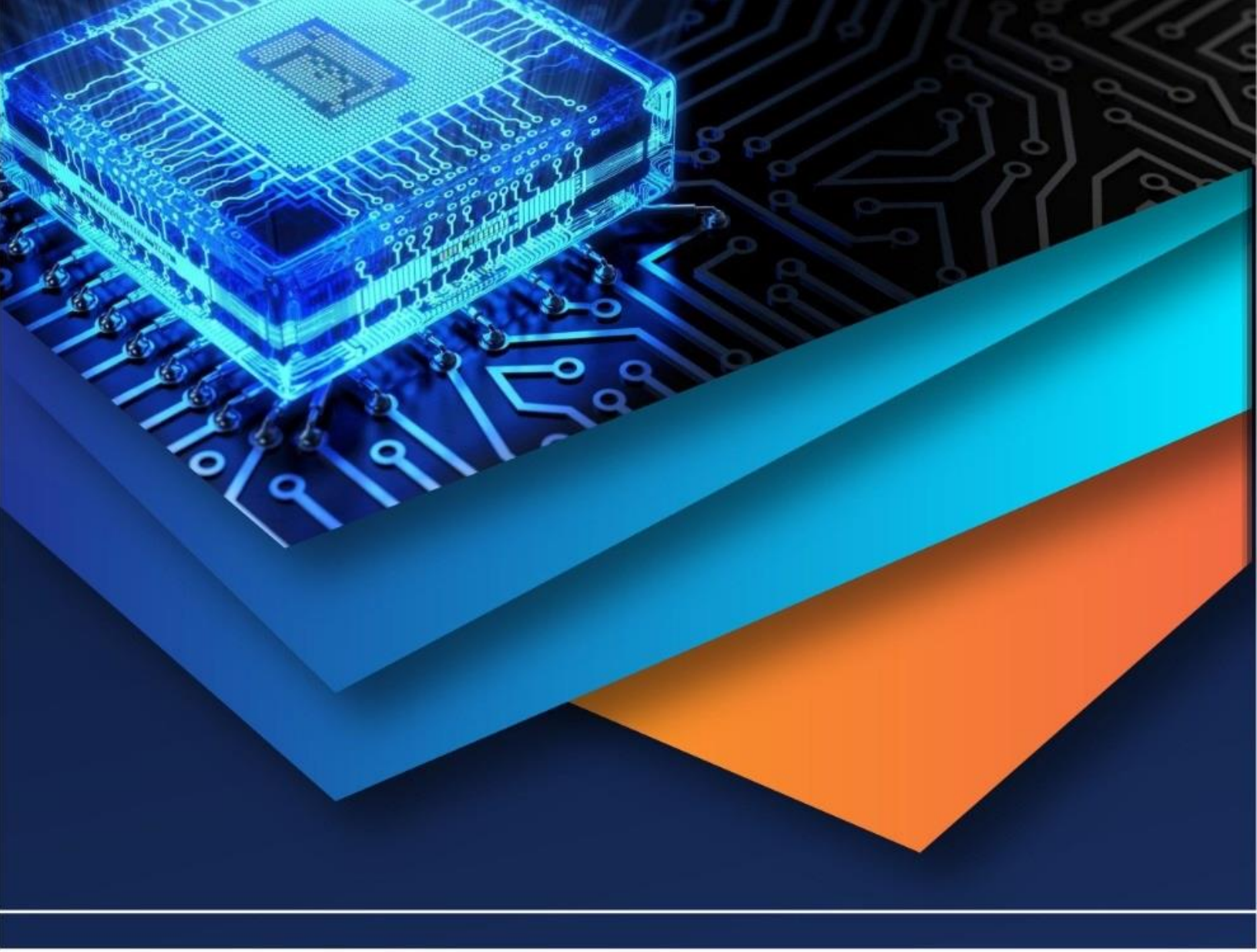
These converters are utilized in a wide range of applications, including power factor correction, solar energy sources, LED illumination, electric vehicles, and wireless charging. A necessary and adaptable component of modern electronic systems is the boost converter.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

REFERENCES

[1] "Complete Digital Control Method For PWM DC- DC Boost Converter," Christian Kranz. Power Electronics Specialist Conference, PESC '03. 2003,pp: 951 - 956 vol.2.
[2] "Design Of PI Controllers For DC-To-DC Power Supplies Via Extended Linearization," Sira-Ramirez,H., 1990 Int. J. Control, 51(3): 601-620.
[3] Kumar, J. Sai, and Tikeshwar Gajpal. "A Multi Input DC-DC Converter for Renewable Energy Applications." (2016).
[4] "Design And Simulation Of Dc/Dc Boost Converter" Dr. Adel A. Elbaset, MiniaUniversity, Dr. B. M. Hasaneen Winter December 23, 2008.
[5] "Power Electronics" by M.H. Rashid and P.S Bimbhra

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)