DC–DC Buck Converter (LM2596-ADJ) – PCB Design Report

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Project Title: Regulated DC–DC Buck Converter
Software Used: KiCad
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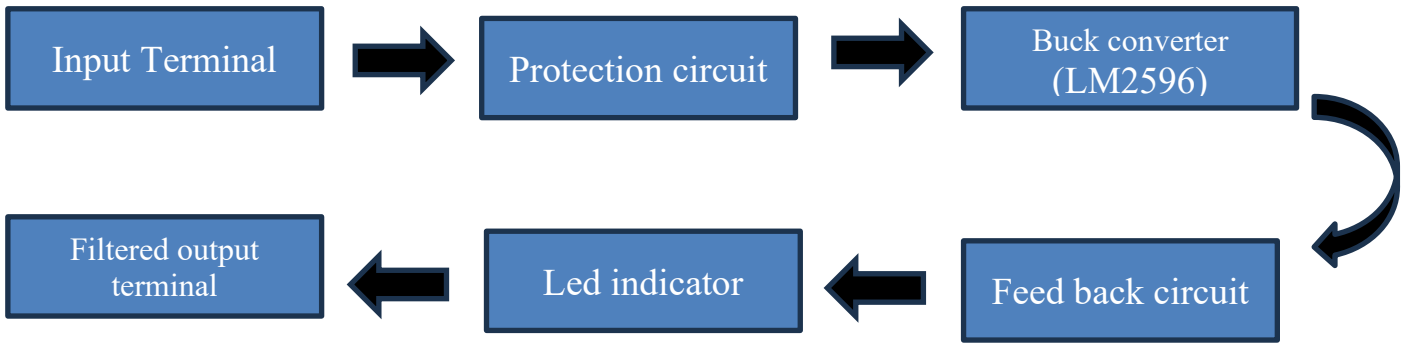
1. Objective

To design and implement a DC–DC Buck Converter circuit that converts a higher DC voltage to a lower regulated DC voltage using the LM2596 Adjustable Regulator IC, and to develop its PCB layout with proper protections and filtering.

2. Introduction

A buck converter is a switching voltage regulator that steps down a higher DC voltage to a lower level efficiently using an inductor, diode, and capacitor. Unlike linear regulators, buck converters achieve higher efficiency by controlling energy transfer using pulse-width modulation (PWM).

3. Block Diagram



The DC–DC buck converter consists of the following blocks:

1. Input terminal with protection circuit (fuse and reverse diode).
2. Main LM2596 regulator block.
3. Inductor, diode, and capacitor for filtering.
4. Feedback resistor network.
5. Output terminal with LED indicator.

4.Working Principle

The LM2596-ADJ IC regulates the output voltage through PWM control. The inductor (L1) stores energy during the ON cycle and releases it during the OFF cycle, maintaining continuous current at the output. The feedback resistors (R1 and R2) set the output voltage according to:
Vout = 1.23 × (1 + R1 / R2)
For R1 = 10k ohm and R2 = 2k ohm , the output voltage[v0 = 7.38 V].

5.Input and Output Specifications

Parameter	Symbol	Typical Value	Remarks
Input Voltage	VIN	9 – 24 V DC	Recommended Range
Output Voltage	VOUT	7.38 V DC	Adjustable
Output Current	IOUT	Up to 1 A	Depends on Heatsinking
Efficiency	□	80–90%	Depends on VIN, VOUT

5.Components Used

S.No	Component	Value / Part No	Quantity
1	LM2596S-ADJ	Adjustable Regulator IC	1
2	L1	100 µH, 2A	1
3	D2	1N5822	1
4	C1	100 µF, 35V	1
5	C2, C3	220 µF, 100 µF, 20V	2
6	R1, R2	10kΩ, 2kΩ	2
7	D3	LED	1
8	R3	470Ω	1
9	D1	1N4004	1
10	F1	1A Fuse	1
11	J1, J2	2-pin Screw Terminal 5.08mm	2
12	Mounting Holes	3.2mm	4

6.PCB Design

A 2-layer PCB was designed using KiCad. The top layer carries power and signal traces, while the bottom layer acts as a ground plane. Power traces are 1.5 mm wide to handle 1 A current. Thermal reliefs are applied to improve soldering, and four 3.2 mm mounting holes are added for mechanical fixing.

7.Applications

- Embedded controller power supplies
- Robotics and automation
- Arduino/ESP32 regulated supplies
- Battery-based systems

8.Conclusion

The DC–DC Buck Converter designed using the LM2596-ADJ IC successfully converts higher DC voltage (9–24 V) to a stable 7.38 V output. It demonstrates efficient step-down voltage conversion with good thermal management and clean PCB design suitable for embedded applications.