**PROJECT DETAILS**

Vin = ~24v

Vout= ~5v

Iin = 1A

Components:

* output

capacitor : 47uF, 10V

inductor = 150uH

diode= basic p-n junction

MOSFET= IRZL44N ( n-channel )

Resistance=110ohm

* PWM ( IC 555 )

Feedback bias: R1=10k ohm ; R2=1k ohm

Potentiometer resistance= 4.7k ohm

Capacitor = C1=2nF ; c2=10nF

Output resistance connected to PWM=47ohm

Battery = 9V

Description of the Components:

This is a step-down (buck) converter with an input of 24V and an output of 5V:

1. Power Supply (BT2 - 24V)

This is the input voltage source, providing 24V DC to the circuit. The goal of this circuit is to step down this voltage to 5V at the output.

2. 555 Timer IC (U1 - LM555xMN)

The 555 timer is used here to generate a PWM signal that controls the switching of the MOSFET (Q1), which regulates the step-down process.

Key pin descriptions:

Pin 1 (GND): Ground connection.

Pin 2 (TRIG): Trigger input, controls the timing cycle.

Pin 3 (OUT): This pin outputs the PWM signal which drives the MOSFET.

Pin 4 (RESET): Tied high to keep the timer active.

Pin 5 (CV - Control Voltage): Usually connected to a capacitor (like C1) to stabilize the internal reference voltage.

Pin 6 (THR - Threshold): Works with the capacitor and resistor network to control the timing.

Pin 7 (DIS - Discharge): Discharges the timing capacitor.

Pin 8 (VCC): Connected to the input voltage (9V) to power the 555 timer.

3. Resistors (R1, R2, R3, R4, RV1)

R1 (10kΩ)

R2 (47Ω)

R3 (1kΩ): Potentiometer

RV1 (4.7kΩ - Potentiometer): Used to adjust the output voltage.

4. Capacitors (C1, C2, C3)

C1 (2.2nF): Stabilizes the control voltage (CV) pin of the 555 timer, improving overall timing accuracy.

C2 (10nF): Timing capacitor, working with resistors (R1 and R3) to set the frequency of the PWM signal.

C3 (470µF): Large output filter capacitor that smooths the output voltage (5V) by filtering out high-frequency noise.

5. Diodes (D1, D2, D3)

D1 (Generic Diode): Provides flyback protection by directing current during the switching cycle, preventing voltage spikes that could damage components.

D2 (Generic Diode): Ensures that the input voltage is clamped at 24V, providing over-voltage protection.

D3 (Generic Diode): Part of the rectification process, ensures that current flows in the proper direction through the inductor.

6. MOSFET (Q1 – IRZL44N)

The N-channel MOSFET is used as a switch, driven by the PWM signal from the 555 timer. It controls the charging and discharging of the inductor (L1), stepping down the input voltage from 24V to 5V. The duty cycle of the PWM determines the output voltage.

7. Inductor (L1 - 150µH)

The inductor stores energy when the MOSFET is ON and releases it when the MOSFET is OFF, allowing for the conversion of 24V input to a lower 5V output. It plays a critical role in the step-down process.

8. Output Voltage (5V)

The output is designed to provide a stable 5V DC, which is stepped down from the 24V input by the switching action of the MOSFET and the energy storage in the inductor along with the resistor (R4=110Ω).

Overall Circuit Operation:

This circuit works as a step-down (buck) converter:

* The 555 timer generates a PWM signal to control the MOSFET.
* The MOSFET switches on and off rapidly, allowing the inductor to convert the 24V input into a lower 5V output.
* The capacitors smooth the output, and the diode ensures that the input voltage doesn’t exceed the limit.

The potentiometer (RV1) allows fine-tuning of the output voltage by adjusting the duty cycle of the PWM signal.