LED VOLTMETER CIRCUIT USING IC 741

ECT 301 LINEAR INTEGRATED CIRCUITS

COURSE PROJECT REPORT

BACHELOR OF TECHNOLOGY
IN
ELECTRONICS AND COMMUNICATION ENGINEERING

ACADEMIC YEAR 2022-2026

SUBMITTED BY
SARIGA R (NSS22EC104)
SHARAN KKRISHNAN M (NSS22EC109)
SUHAIR K (NSS22EC118)

TO

DR. BINU. G. S

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
NSS COLLEGE OF ENGINEERING, PALAKKAD
KERALA

CONTENTS

ABSTRACT

This LED voltmeter circuit, built with 741 IC op-amps, functions as a visual voltage level indicator by illuminating LEDs according to the input voltage. The input voltage, adjustable via a potentiometer (RV1), is fed into a series of comparators formed by the op-amps. A voltage divider network of resistors (R1-R4) provides distinct reference voltages to the non-inverting inputs of each op-amp (U1 to U4). These reference voltages establish the threshold levels that the input voltage must surpass to activate each op-amp. As the input voltage increases and crosses each reference level, the output of the corresponding op-amp goes high, switching on a specific pair of LEDs (D1-D8) connected to that op-amp. This way, the LEDs light up in sequence as the input voltage rises, visually indicating the voltage level. Current-limiting resistors (R5-R9) are placed in series with the LEDs to protect them from excessive current. Overall, this circuit provides a straightforward method for visually assessing voltage levels.

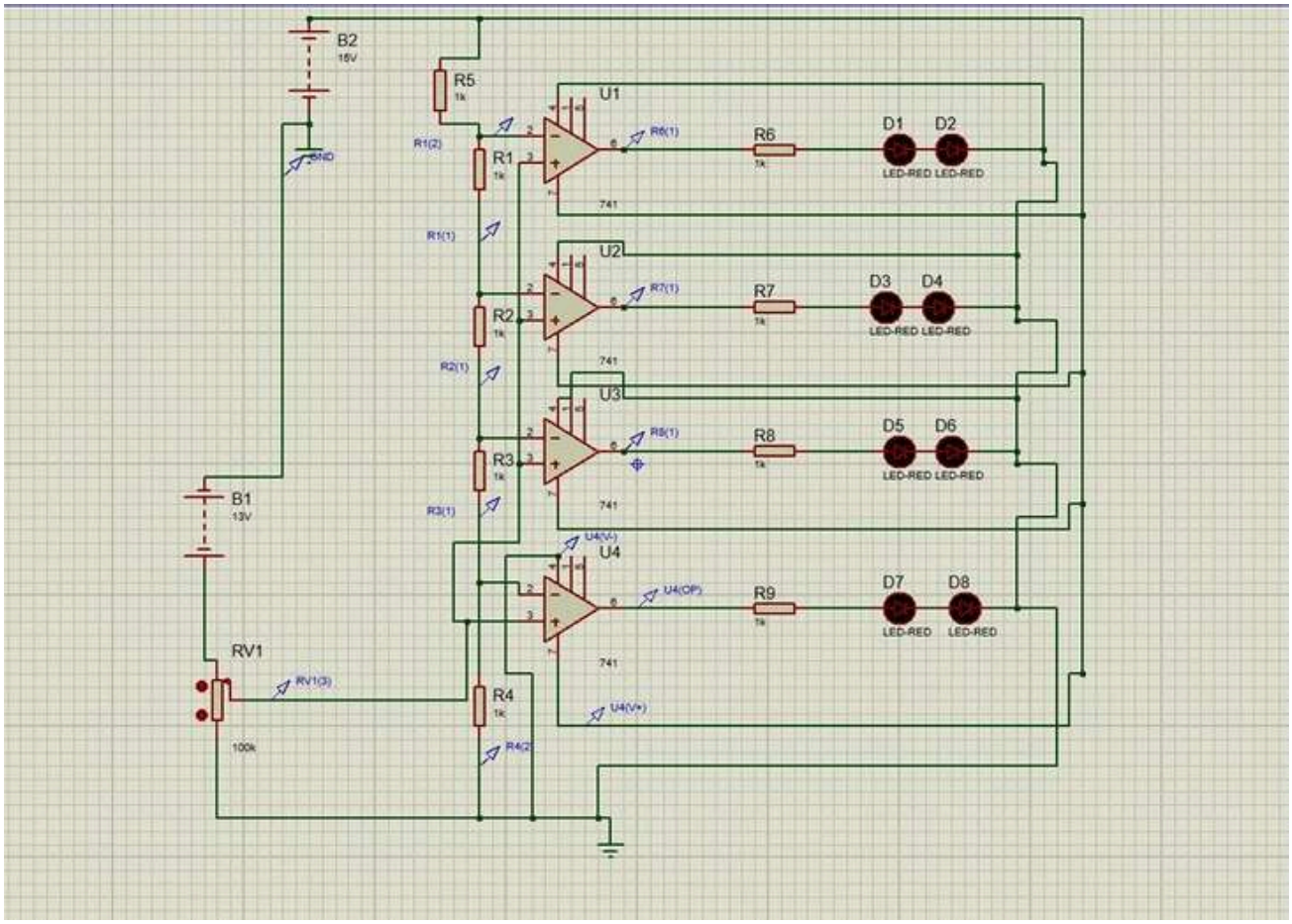
INTRODUCTION

This LED voltmeter circuit is a straightforward and efficient way to visually represent voltage levels using a series of LEDs and op-amp comparators. Designed with 741 IC operational amplifiers, the circuit uses each op-amp as a comparator that switches on specific LEDs based on the input voltage level. By adjusting the input voltage with a potentiometer, the circuit can indicate different voltage ranges by illuminating LEDs in sequence, providing a clear visual display. This type of circuit is commonly used in basic electronics projects, educational demonstrations, and applications where a quick, visual indication of voltage is helpful. The simplicity of the design makes it an excellent project for learning about op-amps, voltage dividers, and LED displays.

WORKING MECHANISM

The working mechanism of this LED voltmeter circuit revolves around the use of 741 IC op-amps as comparators, which detect specific voltage levels and light up corresponding LEDs to indicate these levels. The input voltage, adjusted by a potentiometer, is supplied to each op-amp's inverting input. A series of resistors forms a voltage divider network that provides different reference voltages to the non-inverting inputs of each op- amp. When the input voltage exceeds a reference voltage, the corresponding op-amp's output switches to a high state, allowing current to flow through a pair of LEDs. These LEDs are connected with current-limiting resistors to prevent excessive current flow, ensuring that only the LEDs corresponding to the current voltage range light up. As the input voltage rises and crosses each threshold level, the respective LEDs illuminate in sequence, visually representing the voltage level. This mechanism provides a simple yet effective method for voltage level indication, making it useful for educational purposes and applications that require an easy-to-read visual display of voltage.

CIRCUIT DIAGRAM



COMPONENTS REQUIRED

Power Supply (B1 and B2) The circuit is powered by two

different voltage
sources: B1 (13V) and B2 (15V). B1 supplies the main input voltage, which can be varied using a potentiometer (RV1) to test different voltage levels. B2 provides a stable 15V that powers the op-amps and establishes the reference voltage levels for comparison.

Potentiometer (RV1)

A 100k ohm potentiometer (RV1) is used to vary the input voltage manually. By adjusting RV1, the input voltage fed to the op-amps can be increased or decreased, allowing the user to see which LEDs light up at specific voltage thresholds. This makes RV1 essential for controlling the input voltage and testing the circuit's response.

Voltage Divider Network (Resistors R1, R2, R3, and R4)

Resistors R1, R2, R3, and R4 form a voltage divider network that supplies each op-amp with a distinct reference voltage. These reference voltages represent the thresholds for each op-amp. As the input voltage (from RV1) reaches each reference level, the respective op-amp triggers, causing the associated LEDs to light up. This network essentially defines the voltage levels that need to be reached to activate each LED indicator.

Operational Amplifiers (U1, U2, U3, and U4)

The 741 IC op-amps (U1, U2, U3, and U4) function as voltage comparators. Each op-amp receives the input voltage at its inverting input and a specific reference voltage at its non-inverting input. When the input voltage surpasses the reference voltage, the op-amp output goes high, allowing current to flow through the LEDs connected to that op-amp. Each op-amp is responsible for activating a particular pair of LEDs, corresponding to a specific voltage level.

LEDs (D1 to D8)

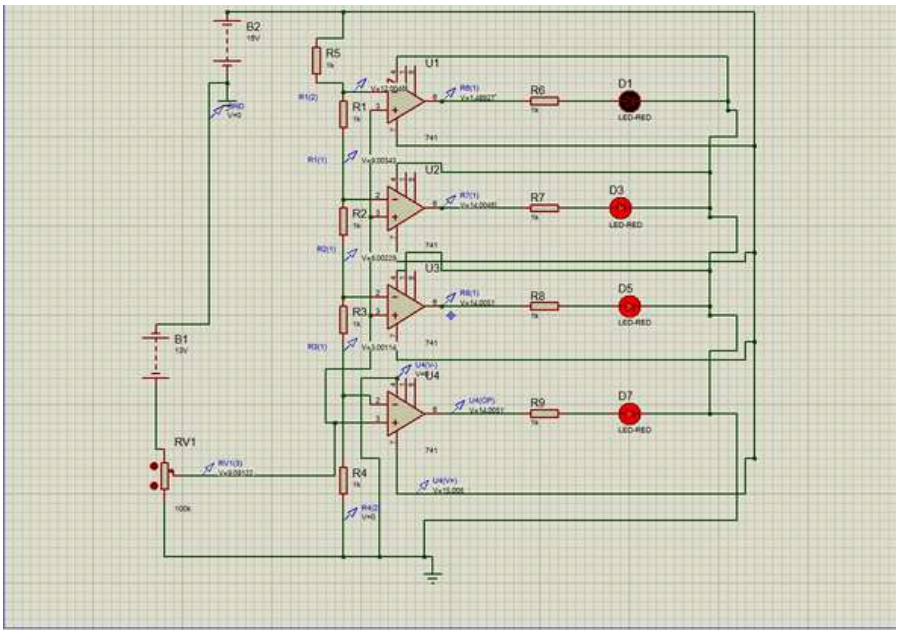
The LEDs (D1 to D8) act as visual indicators for different voltage levels. They are connected in pairs to each op-amp output. When an op-amp output goes high, it completes the circuit for the connected LEDs, allowing them to illuminate. This sequence of LEDs lighting up gives a visual representation of the input voltage level, with each pair of LEDs indicating a different voltage threshold.

Current-Limiting Resistors (R5 to R9)

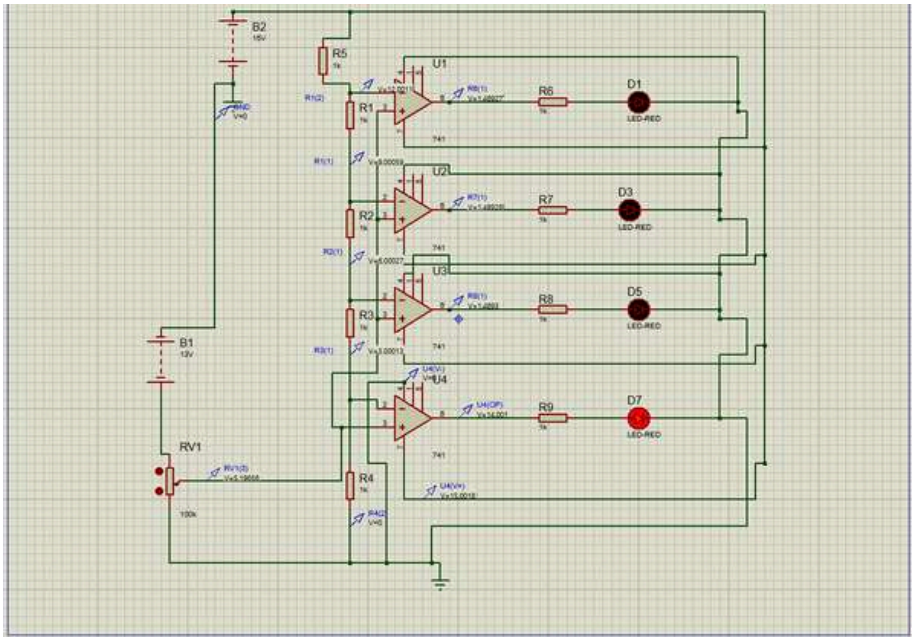
Resistors R5 to R9 are placed in series with each pair of LEDs to limit the current flowing through them, protecting the LEDs from potential damage due to excessive current. By limiting the current, these resistors ensure that the LEDs operate safely within their rated current range, thus prolonging their lifespan and maintaining consistent brightness.

RESULT

SIMULATION RESULT



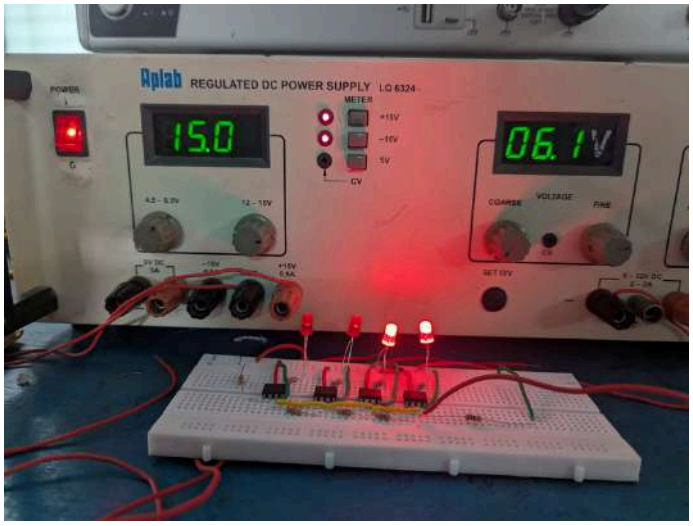
When input voltage is >= 9v



When input voltage is >= 3v

HARDWARE RESULT

- Input voltage >=6v



- Input voltage >= 9v

- Input voltage >= 12v