Lodz University
of Technology

EQUIPMENT DESIGN AND MATERIAL ENGINEERING

FINAL PROJECT

8 LEDs VU-METER

Student:
Strocchia Raffaele 258703

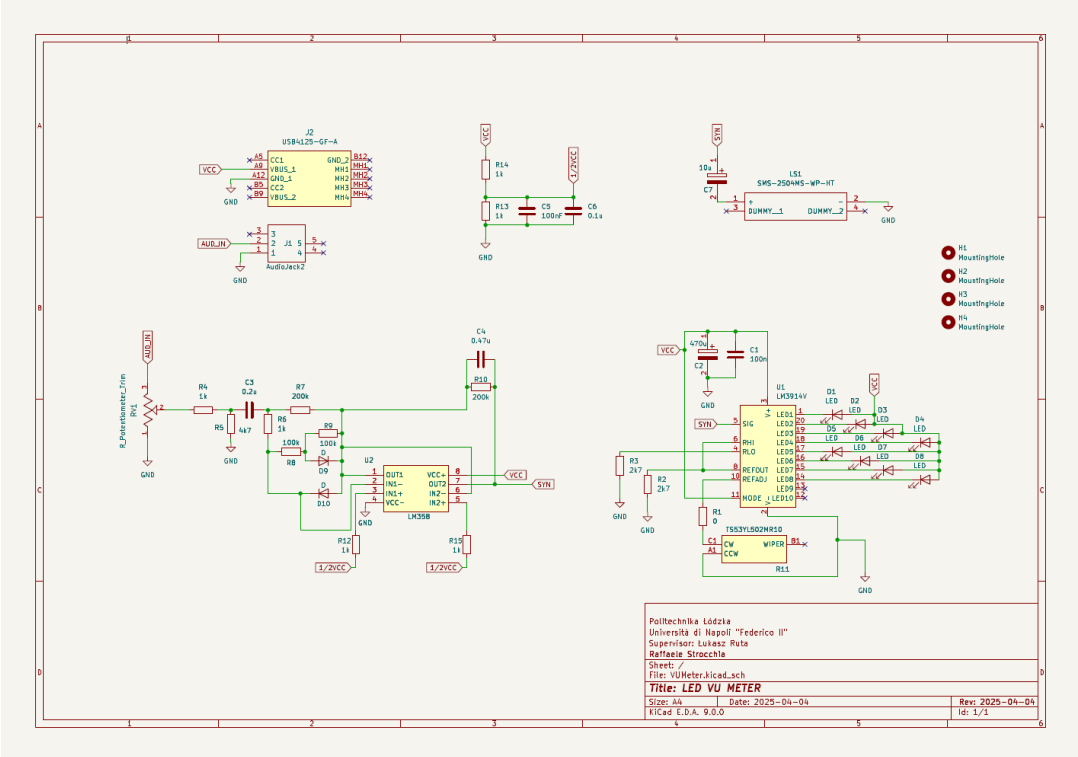
ADVISOR:
Łukasz Ruta

2025

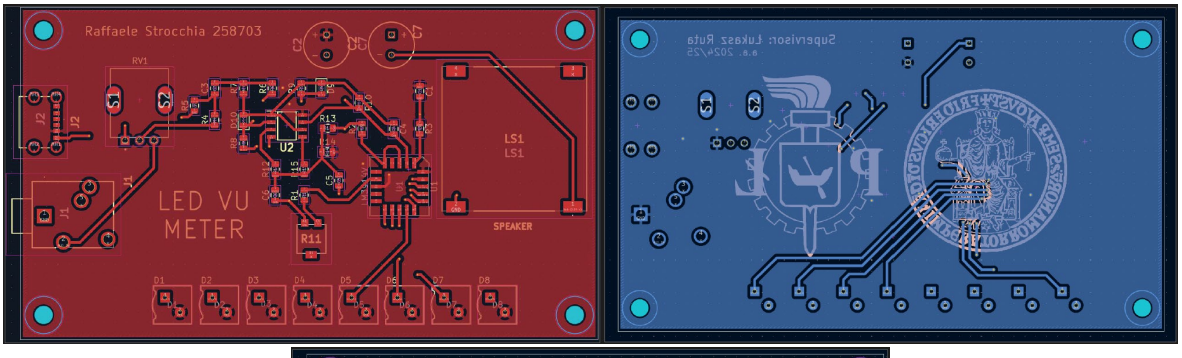
INTRODUCTION

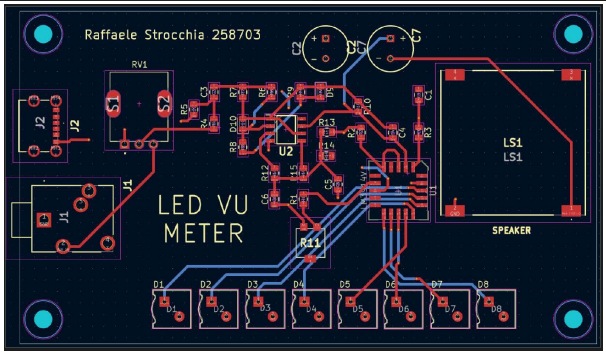
The project consists of the realisation of an LED VU Meter, i.e. a visual indicator of the level of an audio signal by means of an LED scale. It was developed with the aim of acquiring skills in analogue electronics, PCB design and the use of micro-components. The project was realised through the use of KiCad software and simulated with LTSpice.

SCHEMATIC



PCB DESIGN





COMPONENTS USED

The designed circuit operates in several sections, each with a specific role. Component list:

N.	Name	Value	Quantity	Note
1	C1, C5, C6	100 nF	3	Capacitor
2	C3	0.2 uF	1	Capacitor
3	C4	0.47 uF	1	Capacitor
4	C2	470 uF	1	Electrolytic Capacitor
5	C7	10 uF	1	Electrolytic Capacitor
6	R1,R2,R3	2k7 Ω	3	Resistance
7	R4,R6,R12,R13,R14,R15	1k Ω	6	Resistance
8	R5	4k7 Ω	1	Resistance
9	R7,R10	200k Ω	2	Resistance
10	R8,R9	100k Ω	2	Resistance
11	D1,D2,D3,D4	-	4	LED
12	D5,D6	-	2	LED
13	D7,D8	-	2	LED
14	D9,D10	-	2	Diode
15	J1	-	1	Audio Jack
16	J2	-	1	USB-C
17	LS1	-	1	Speaker
18	U1	LM3914V	1	10-channel LED driver
19	U2	LM358	1	Dual op amp
20	RV1	-	1	Potentiometer
21	R11	-	1	Potentiometer

CIRCUIT OPERATION

First, with the input audio signal, which is taken from an external source via the J1 jack connector. Since audio signals are generally weak and alternating (AC), it is necessary to condition them so that they can be interpreted by the LM3914V. This task is performed by the amplification and filtering section based on the LM358 operational amplifier (U2). The signal passes through an RC coupling network (consisting of capacitors and resistors), which filters and stabilises it, before it is amplified. The output of the LM358 then provides a direct voltage (DC) proportional to the instantaneous amplitude of the audio signal.

This voltage is then supplied to the input of the integrated circuit LM3914V (U1), a linear driver that controls the switching of the LEDs. The LM3914 compares the input voltage with an internal reference and activates 1 to 8 LEDs (D1-D8) depending on the signal level. In this design, the device is configured in bar mode, so all LEDs up to the maximum level are lit progressively, providing an immediate visual representation of the signal volume.

The sensitivity of the VU meter can be adjusted using the RV1 trimmer, which modifies the LM3914's reference value (via the RHI, RLO and REFOUT pins), allowing the circuit to be adapted to audio signals with different amplitudes.

The entire system is powered via a USB port (J2) that provides the +5V needed for operation. Various capacitors (such as C2, C4, C5 and C7) filter and stabilise the power supply, reducing noise and interference.

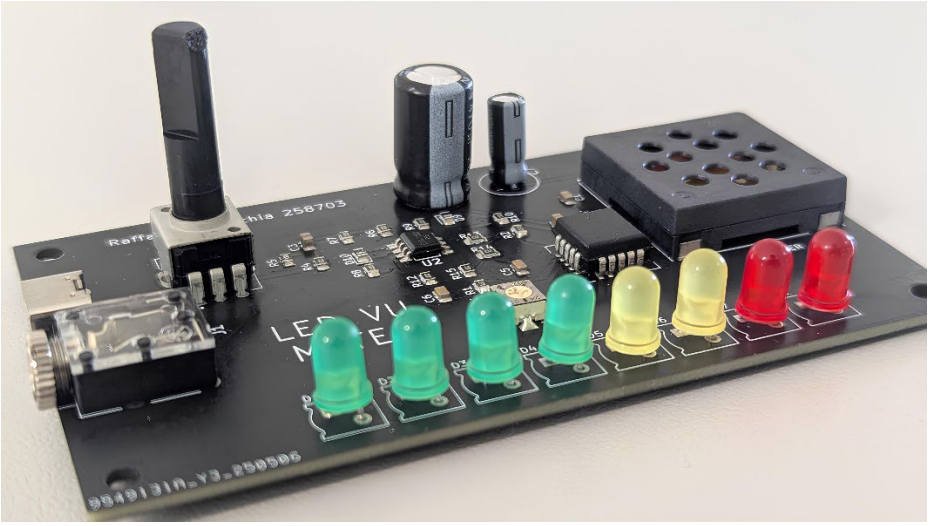
Finally, the circuit also includes a loudspeaker (LS1), which can be used to listen to the output audio signal. However, the presence of the speaker is not indispensable for the operation of the VU Meter but can serve as an accessory element.

SOLDERING PHASE: BST-863

The soldering process utilizing a heat pump necessitates observance to the maximum temperature limits to which a component can be exposed. To ensure proper operation, the BST-863 must be set to a maximum temperature of 400°C.

From time to time, a small amount of soldering paste (Sn96.5/Ag3.0/Cu0.5) must be applied to the pads of the component to be soldered. Once the designated temperature is reached, the heat pump is positioned near the components requiring soldering. At this stage, the solder paste will begin to attract the component toward the solder pads, undergoing a visible transformation from a dull gray to shiny. If the component does not properly align, precision adjustments can be made using tweezers. This procedure should be repeated for each component placed on the PCB.

Upon completion, the heat pump should be removed, allowing the components and the PCB to cool before further handling.



TESTING

The PCB was powered with a type-c cable, thus imposing a voltage of 5 V. The audio signal was input via the 3.5 mm AUX connector. After an initial adjustment of the potentiometers placed on the PCB, it was possible to achieve resistance values such that the value of the input audio signal could be correctly displayed (by means of the LEDs lighting up).

A further simulation was performed by removing the type-c connector and applying an input voltage of less than 5V. In this case, better control of the LEDs' luminous intensity was noted, which lays the foundation for future studies on circuit design with reduced power supply values or improved conditioning circuitry.