

60-dB LED VU Meter

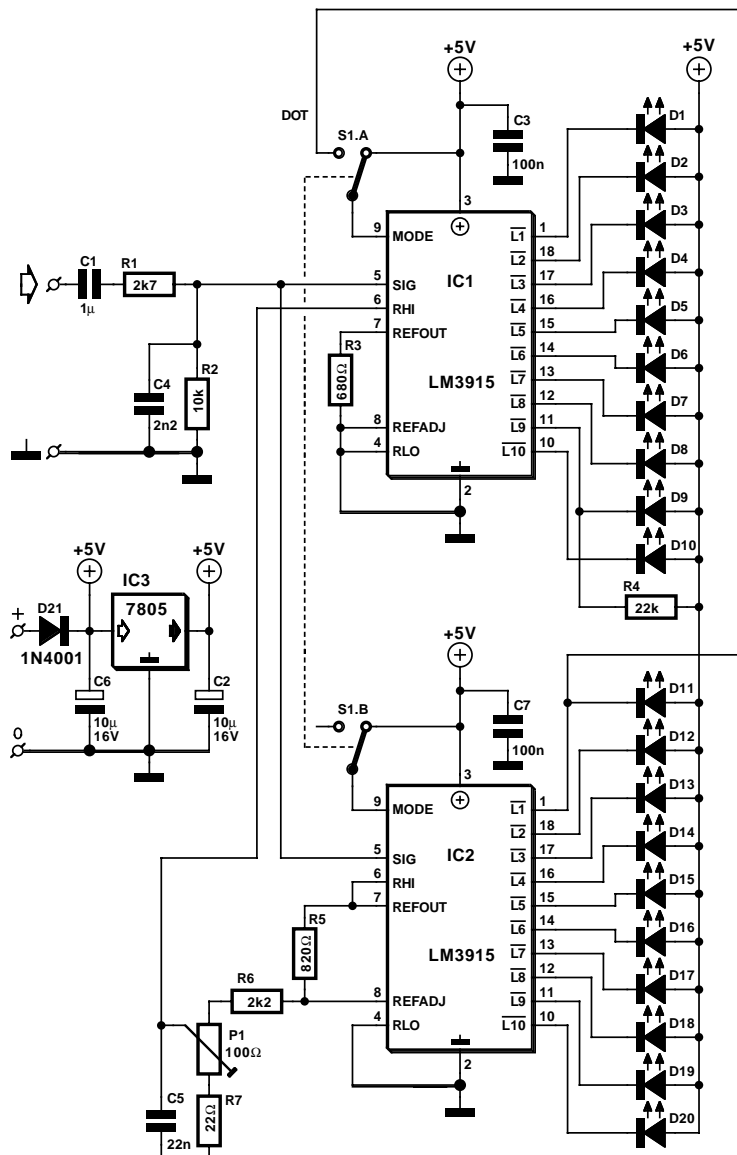
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Most of the analogue audio media, including radio broadcasting, stick within 60 dB dynamic boundaries. This VU Meter was designed to be used as a desktop instrument with home audio appliances, so it has its own power supply. Driven by an AC musical signal taken directly from low impedance loudspeaker connectors, i.e. in parallel with loudspeakers, and having linear frequency response, it covers 60 dB dynamic range in 3 dB steps using 20 LEDs in a bargraph. Low component count and simplicity enable the circuit to be housed in a small box or behind a transparent shield like a small acrylic desktop photo holder.

The LM3915 IC from National Semiconductor senses voltage levels and drives 10 LEDs, providing a logarithmic 3 dB/step analogue display, and so covering a 30 dB range. LED current drive is programmable and regulated. The IC contains adjustable voltage reference source and an accurate 10-step 22-kΩ voltage divider array. A ground referenced, ±35V-proof input buffer amplifier, capable of sensing down to ground, is driving 10 comparators referenced to the voltage divider. Applying an additional resistor in series with the input raises input protection to ±100 V. Two LM3915N (IC1 and IC2) are cascaded here to achieve a total dynamic range of 60 dB. R5 programs the LEDs current on IC2 while network R5-R6-P1-R7 sets the reference voltage that determines the full-scale input signal level of IC2. In this case it is set to 5.0V. The full scale level of IC1 is derived from this reference and shifted 30 dB below that of IC2. It is precisely preset using the P1, with R3 programming the LED current supplied by IC1. The value of R3 is smaller than R5 to compensate for IC2's internal voltage divider which is connected in parallel with the reference voltage source in IC2. The adapted value of R3 ensures that there is no difference in LED brightness between IC1 and IC2.

The audio signal to be measured arrives at pins 5 of IC1 and IC2 via C1-R1-R2-C4. R1 and R2 form a voltage divider and C4 is added for RF suppression. With R1 at 2.7 kΩ as shown in the schematic, full-scale indication is reached at 6.4 V_{rms} (which equals 10 W across 4 Ω). Depending on the output



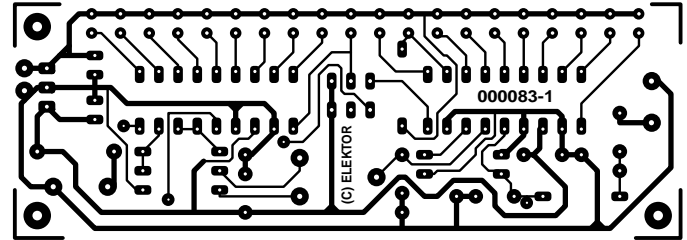
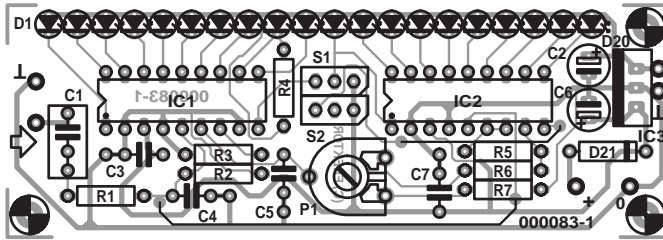
power of your amplifier, suitable values for R1 and C4 may be selected from **Table 1**. As the VU-meter input is connected across the loudspeaker, power, *P*, and voltage, *U*, equate like

$$P = U^2 / Z$$

where *Z* is the loudspeaker impedance in ohms. Each lower

Table 1.

Loudspeaker	4 Ω	4 Ω	4 Ω	8 Ω	8 Ω	8 Ω	16 Ω	16 Ω	16 Ω
Power	10 W	50 W	100 W	10 W	50 W	100 W	10 W	50 W	100 W
R1	2.7 kΩ	18 kΩ	30 kΩ	6.8 kΩ+1.1 kΩ	30 kΩ	47 kΩ	15 kΩ	47 kΩ	68 kΩ+2.2 kΩ
C4	2.2 nF	470 pF	330 pF	1 nF	330 pF	330 pF	470 pF	330 pF	270 pF



COMPONENTS LIST

Resistors:

R1 = 2k Ω 7 (see text)
 R2 = 10k Ω
 R3 = 680 Ω
 R4 = 22k Ω
 R5 = 820 Ω
 R6 = 2k Ω
 R7 = 22 Ω
 P1 = 100 Ω

Capacitors:

C1 = 1 μ F 63V (MKS, MKC)
 C2, C6 = 10 μ F 16V radial
 C4 = 2nF2 (see text)
 C3, C7, C9 = 100nF
 C5 = 22nF

Semiconductors:

IC1, IC2 = LM3915N
 IC3 = LM7805
 D1-D20 = LED

order LED in the chain indicates 50% power or 70.71% voltage of the first higher LED.

The threshold for LED #1 is just 7.0mV, so both noise and internal buffer and comparator offset voltages may influence the readout at the very low end of the LED bargraph (first few LEDs). Capacitors C4 and C5, proper wiring and correct PCB layout should help to maintain a good degree of noise immunity.

For a stereo version of the VU meter the metering circuits shown here should be duplicated. The power supply has already been dimensioned for a stereo version. A mains adaptor with an output voltage of about 8 Vdc is an inexpensive and safe way to power the circuit. The LED voltage is reduced to +5.0 V by regulator IC3 in order to keep the power dissipation of IC1 and IC2 within safe limits.

A double-pole switch, S1, allows the readout to be switched to 'dot' mode instead of 'bar graph'.

Although its artwork is shown here, the printed circuit board designed for the LED VU meter is not available ready-made. IC3 needs no heatsinking.

The VU meter requires only one, simple adjustment. Connect a DVM to pin 6 of IC1 and adjust preset P1 to see 158 mV (5.0 V / 31.62), that is, -30 dB relative to the voltage present on pins 7 and 8 of IC2.

Finally, this VU meter must not be used with BTL type of audio amplifiers which could be found in some car radio receivers but only with common-ground type of amplifiers.