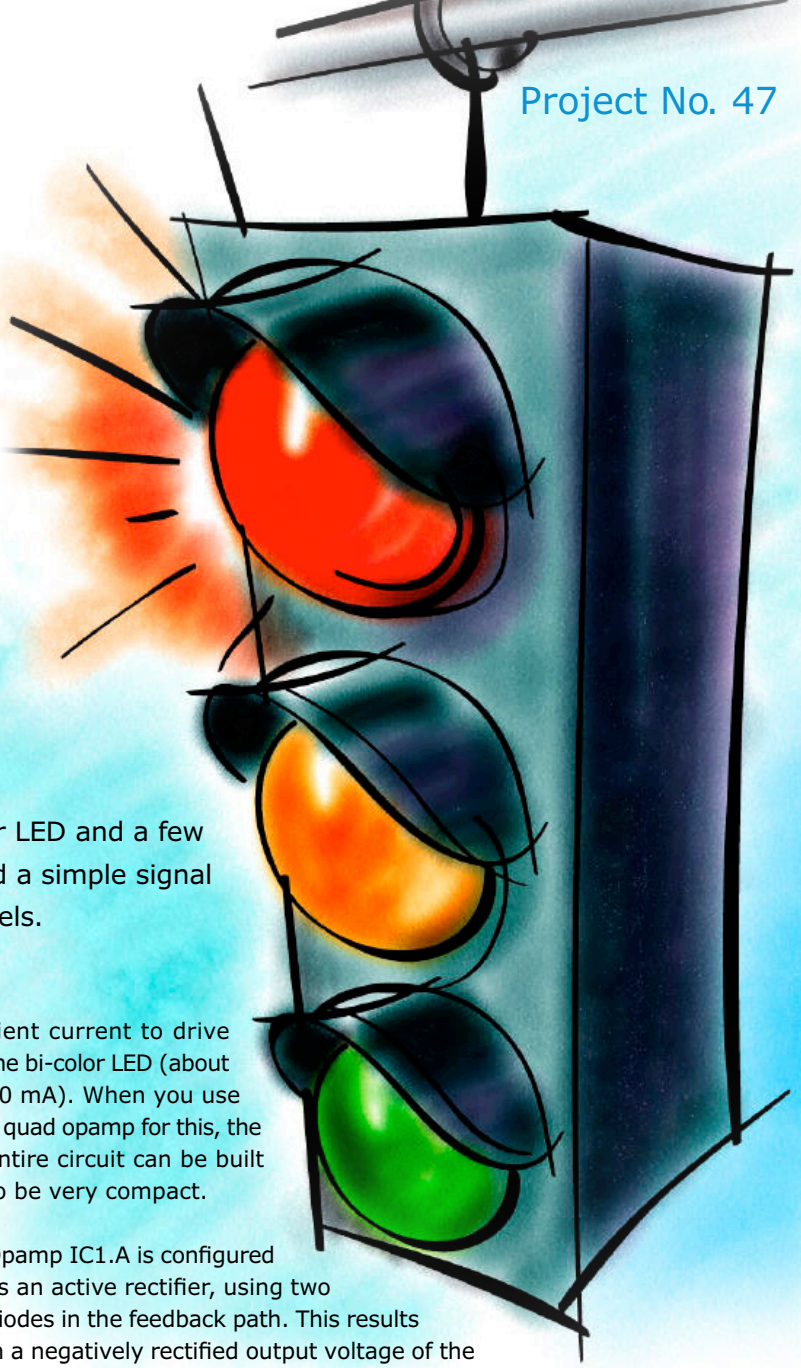
Compact Signal Level Meter

With bi-color LED



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With the help of a quad opamp, a bi-color LED and a few passive components you can quickly build a simple signal level meter which has three detection levels.

In Elektor's October 2014 edition I spotted an article on page 28 describing a dot-display-driver [1]. This circuit reminded me of a design that I have used for decades whenever the need arises. The first occasion for this design was an existing device to which different type of microphones were to be connected. Despite the different sensitivities of the various microphones the levels of the output signals had to be always the same. This piece of equipment had naturally no spare space available for additional meters to allow the correct signal level to be set, but there was sufficient space however to accommodate a (bi-color) LED.

The circuit depicted here uses the three different colors on a bi-color LED to indicate when 3 voltage levels are exceeded. When the (line-)level is much too low no LED is tuned on. At the first level the green LED lights up. At the second level the red LED turns on as well and forms together with the green LED the color yellow. Finally at the third (highest) level the green LED is switched off and only the red LED remains lit.

Circuit

The circuit is built around four opamps. These do not have any special requirements. They do however have to be suitable for a symmetrical power supply voltage of ±12 V and the outputs have to be able to source sufficient current to drive the bi-color LED (about 20 mA). When you use a quad opamp for this, the entire circuit can be built to be very compact.

Opamp IC1.A is configured as an active rectifier, using two diodes in the feedback path. This results in a negatively rectified output voltage of the input signal. This rectified signal is subsequently filtered by the combination of R5/C1, but such that small peaks are still clearly visible on the LED. The signal is then compared by the remaining 3 opamps IC1.B, C and D to three reference voltages which are supplied by a voltage divider comprising R6 through R9. When the measured voltage exceeds the level at the node of R6/R7 then the output of IC1.B will switch state and the green LED in LED1 will light up.

When the measured voltage increases beyond the level at node R7/R8 then IC1.C will also change over and the red LED in LEDs will also turn on, which results in a yellow/orange color. As the voltage increases further still, it will exceed the level at node R8/R9 and the output of IC1.D will become low (the non-inverting and inverting inputs of this opamp are reversed with respect to the other two). This pulls the non-inverting input of IC1.B

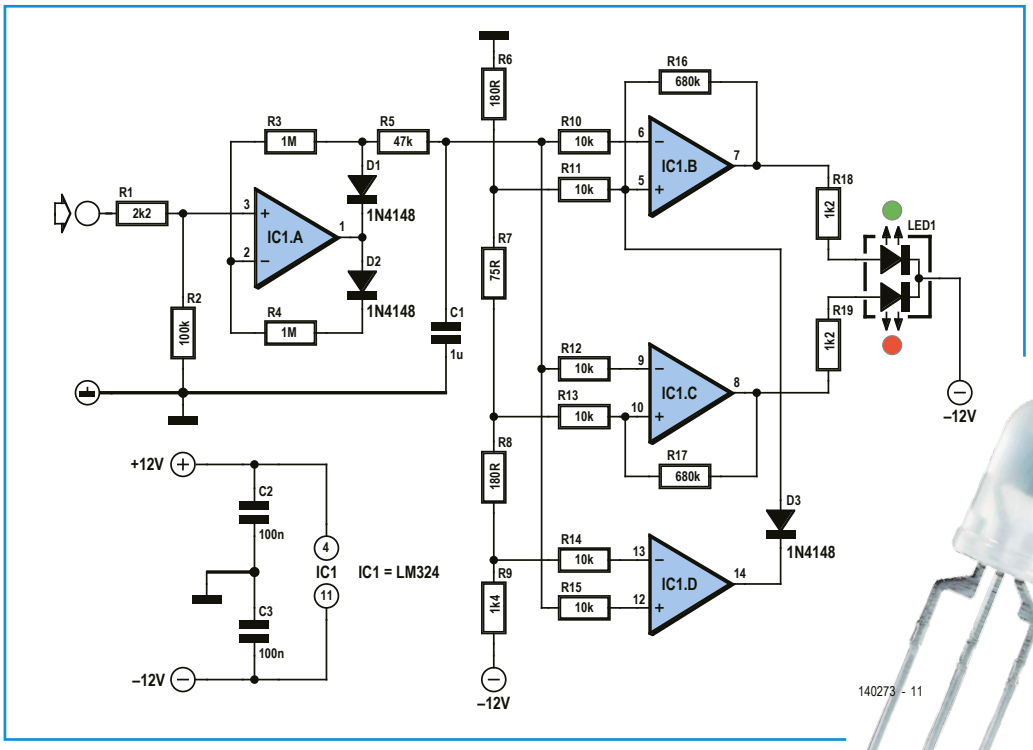

Figure 1.
The schematic for the signal level meter is quite simple by design.

low via diode D3, which causes the green LED to be switched off and now only the red LED remains on.

Resistors R16 and R17 around IC1.B and IC1.C provide a small amount of hysteresis so that these opamps do not flash erratically when the signal level hovers around the thresholds. The three switching thresholds can be calculated as follows:

V_{green} = R6 / R_{tot} × 12
V_{yellow} = (R6 + R7) / R_{tot} × 12
V_{red} = (R6 + R7 + R8) / R_{tot} × 12
where R_{tot} = R6 + R7 + R8 + R9

With the indicated resistance values the switching points are about 100, 140 and 240 mV.
The circuit is easily built on a small piece of prototyping board when using a quad opamp. Depending on the point in the equipment where the measured signal is to be tapped off, it may be necessary to add a coupling capacitor to the input of the signal level meter. The current consumption is about 50 mA when both of the LEDs in the bi-color LED are lit up.

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Web Link

[1] www.elektor-magazine.com/140111