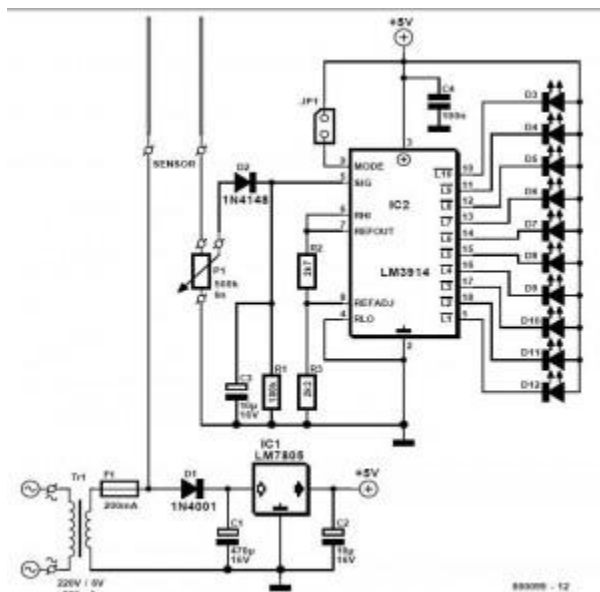


## Soil Moisture Tester

When plants are not watered enough they simply die. In any case, too much neglect usually has fatal consequences. Cactuses seem to survive such a careless treatment the longest and we have to admit that these are the only plants that manage to survive at our offices.

The circuit described here might be very simple, but it's a very useful soil moisture tester. Two electrodes are stuck in the soil and the moisture level is shown on an LED display. The LEDs have been arranged into three colours: green LEDs indicate that the soil is damp, yellow LEDs that it's getting a bit dry and red LEDs warn that immediate action is required!

## Soil moisture tester circuit diagram



A quick look at Figure 2 is enough to ascertain that the full circuit is barely more complex than the block diagram. It's only really the supply that is extra. Even this is very simple, consisting of only a small mains transformer rated at 6 V/200 mA, a single rectifier and smoothing capacitor (D1/C1) and a voltage regulator which provides a stable +5 V. The AC supply fed to the electrodes is obtained in a very simple manner: by taking it from the supply just before the rectifier.

The preset used to set the sensitivity can be found as P1. D2, R1 and C3 rectify the moisture dependent AC signal, which is then fed to pin 5 of IC2, the heart of the circuit. This IC used here is an old favourite, the LM3914 bargraph display driver. This 18-pin IC converts an analogue input to drive a 10-LED (linear) display. The IC contains 10 comparators, which each are connected to a reference voltage via a precision resistor network. The inverting inputs of the comparators are connected to the analogue input via a buffer stage. The LEDs are driven directly by the comparator outputs.

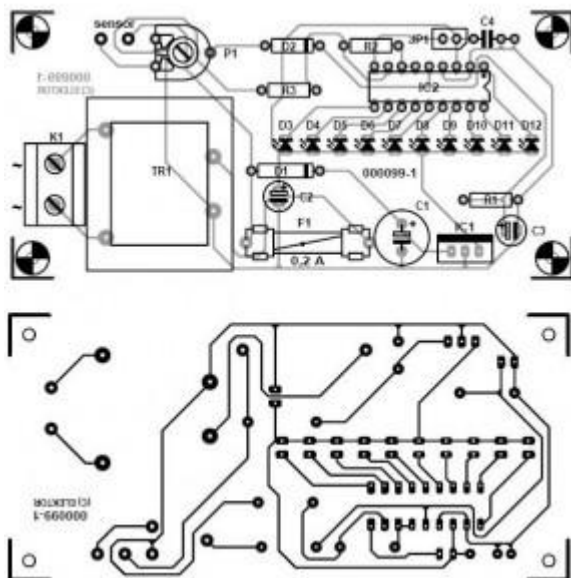
Pin 9 is used to set the display to bar-mode or dot-mode. In the first case JP1 should be shorted, in the second it can be left open circuit. Obviously the dot-mode gives the least current consumption of the IC. Potential divider R2/R3 sets the reference voltage. The total value of both resistors also determines the brightness of the LEDs.

## Moisture tester construction

Due to the small number of components used, it's unlikely that the construction of the tester will give you sleepless nights. Start the construction with the lowest components (resistors); that tends to be easiest. You should preferably use a socket for IC2. Take care that you get the polarity right for the diodes, [electrolytic capacitors](#) (C1, C2 and C3) and the LEDs (short leg = cathode).

The small mains transformer (Tr1) is mounted onto the PCB last. Make sure that you use a sound and well isolated cable (with a strain-relief) between the mains and the primary of Tr1. Carefully check the finished PCB before applying mains power and never work on the circuit when it's plugged into the mains!

## Moister measure PCB layout



The circuit should be mounted in a safe plastic case, with a label stuck on the bottom, stating the mains voltage and the value of the fuse. A pair of sockets for banana plugs is mounted on the case for the connection to the electrodes.

The electrodes are made from two lengths of stiff, isolated copper wire, about 10 cm long and 1 mm thick. 4 cm of insulation is removed from the ends, which are then tinned. This is to prevent the copper wire from oxidising. The connection between the electrodes and the circuit could be made with two lengths of flexible stranded cable.

## Moisture tester calibration and usage

Once the supply has been switched on and the electrodes have been connected, the tester is as good as ready for use. But first preset P1 needs to be adjusted. All you need for this is a glass of tap water. The electrodes are inserted into the glass of water and should be kept between 1 and 2 cm apart. This corresponds to the maximum moisture level, so we have to adjust P1 until the top green LED (D3) just lights up and D4 just extinguishes. When the electrodes are removed from the water, you should see one of the red LEDs (D10, D11, D12) light up.

Since this absolute maximum level will not occur very often, the tester could be calibrated more practically. A pot plant should be watered liberally, after which the electrodes are inserted into the soil, again keeping them between one and two cm apart. P1 is then adjusted until one of the green LEDs lights up. You will probably find many opportunities to check that one of the three red LEDs lights up when testing a plant that hasn't been watered for three weeks. And that's it!

After the previous description it should be clear how the tester should be used. The electrodes should always be kept the same distance apart (between one and two cm), perhaps using a spacer, and the tinned ends should always be completely inserted into the soil.

### COMPONENTS LIST

#### Resistors:

R1 = 100k $\Omega$

R2 = 2k $\Omega$

R3 = 2k $\Omega$

P1 = 500k $\Omega$  preset H

#### Capacitors:

C1 = 470 $\mu$ F 16V radial

C2,C3 = 10 $\mu$ F 16V radial

C4 = 100nF

#### Semiconductors:

D1 = 1N4001

D2 = 1N4148

D3,D4,D5 =LED, green

D6-D9 = LED, yellow

D10,D11,D12 = LED, red

IC1 = LM7805

IC2 = LM3914-N

#### Miscellaneous:

Tr1 = mains transformer, secondary 6 V 200mA ( e.g., Monacor/Monarch VTR-1106)

F1 =fuse, 200 mA, with PCB mount holder

JP1 = short-circuiting jumper

K1 = 2-way PCB terminal block, lead pitch 7.5mm

<http://electroschematics.com/761/soil-moisture-tester/>