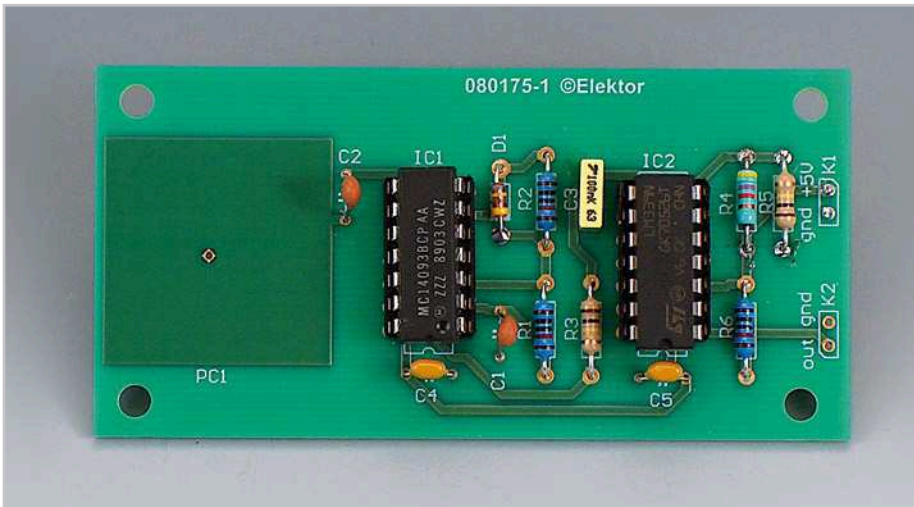


Simple Capacitive Touch Sensor



Wim Abuys

Capacitive touch sensors are based on the electrical capacitance of the human body. When, for example, a finger comes close to the sensor, it creates a capacitance to Earth with a value of 30 to 100 pF. This effect can be used for proximity detection and touch-controlled switching.

Capacitive switches have clear advantages compared to other types of touch switches (for example 50 Hz or 60 Hz detection or resistance detection), but are often more

complex to implement. Manufacturers such as Microchip have in the past designed specialist ICs for this purpose. However, it is still possible to design a reliable capacitive detector and/or switch using only a limited number of standard components.

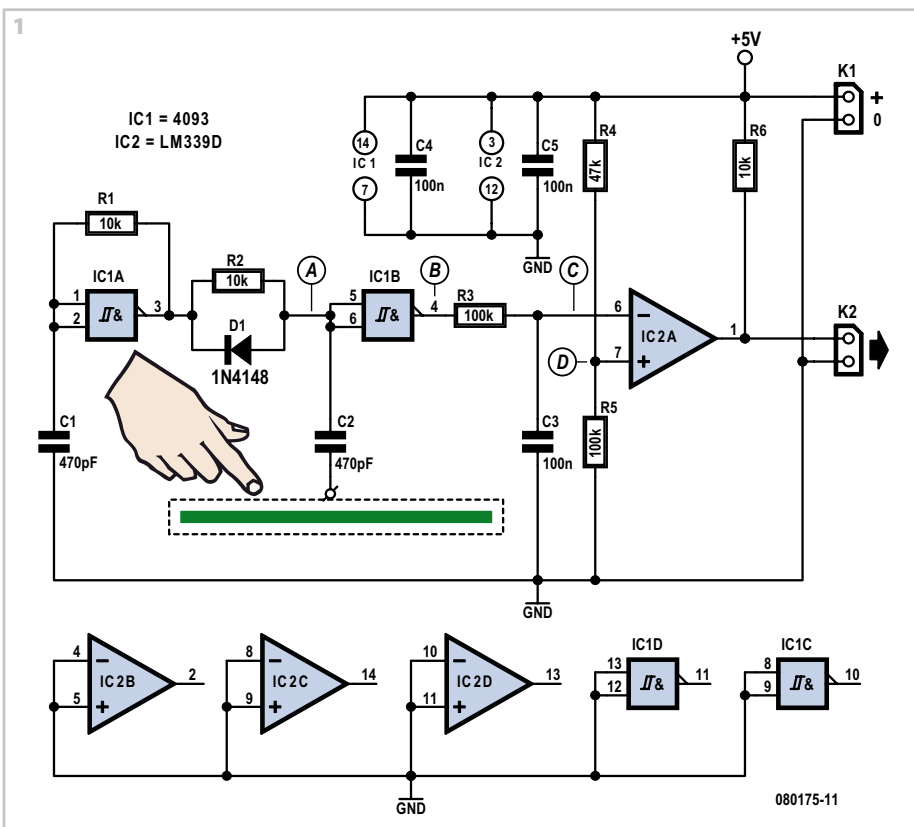
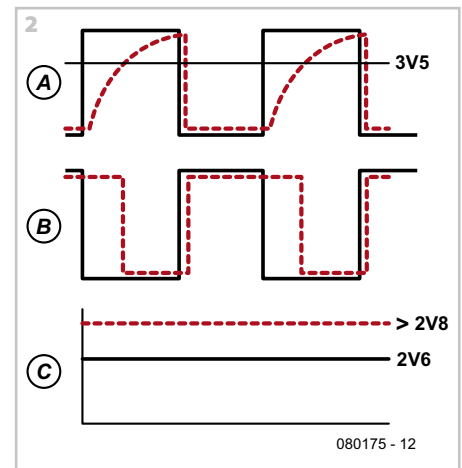
In this design we detect the change in the pulsewidth of the signal when the contact is touched. In **Figure 1** the following stages can be recognised, from left to right:

- a square-wave generator with a frequency of 300 kHz, using a Schmitt trigger

IC (CD4093);

- an RC network with a flyback diode, followed by a Schmitt trigger/contact plate with an isolation capacitor of 470 pF;
- an RC network that converts the change in pulsewidth into a voltage. This voltage is about 2.9-3.2 V when the plate is touched (and 2.6 V when it isn't touched);
- an LM339 comparator is used to compare the voltage at point C with a reference voltage (D). The latter is set to about 2.8 V using a potential divider.

As long as the contact plate is touched the output of the circuit will be active. To make the operation of the circuit clearer we have



shown the signals at various points in **Figure 2**. The dotted line represents the signal when the plate is touched, the solid line when it isn't touched.

The reference voltage at D has to be set up once via potential divider R4/R5 (change the value of R4). The required value is strongly dependent on the surface area of the contact plate (this is usually a few square centimetres). Larger surfaces increase the capacitance and the voltage at C will therefore be greater when the plate isn't touched. The reference voltage at D should then be set closer to 3.4 V. The touch sensor can therefore also be made to work with larger areas (such as the complete metal enclosure of a device).

The circuit only works when a connection for higher frequencies (300 kHz) is made to Earth in some way. The circuit therefore doesn't work in battery-powered systems without a connection to Earth. In many systems without a direct connection to Earth there is sufficient parasitic capacitance to the mains Earth. In some cases it will be necessary to add an extra capacitor

COMPONENTS LIST

Resistors

R1,R2,R6 = 10k Ω
 R3,R5 = 100k Ω
 R4 = 47k Ω

Capacitors

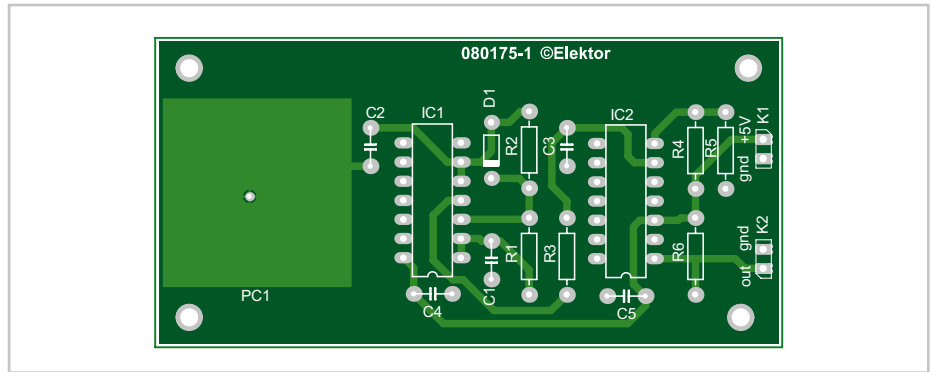
C1,C2 = 470pF
 C3,C4,C5 = 100nF

Semiconductors

D1 = 1N4148
 IC1 = 4093
 IC2 = LM339D

Miscellaneous

K1,K2 = 2-way pinheader
 PCB, ref. 080175-1 from www.thepcbshop.com



>3-4 kV (i.e. a Class Y capacitor).
 The output signal can be used in various ways to switch on systems. The addition of an extra Schmitt trigger to the output is recommended in many cases, especially if the output connects to a digital input.

Downloads

The layout for the printed circuit board is available from the Elektor Electronics website as a free download; ref. 080175-1.zip.

(080175-1)

between the mains Earth and the Ground of the circuit. To comply with safety regulations this capacitor should be rated for

TV Muter

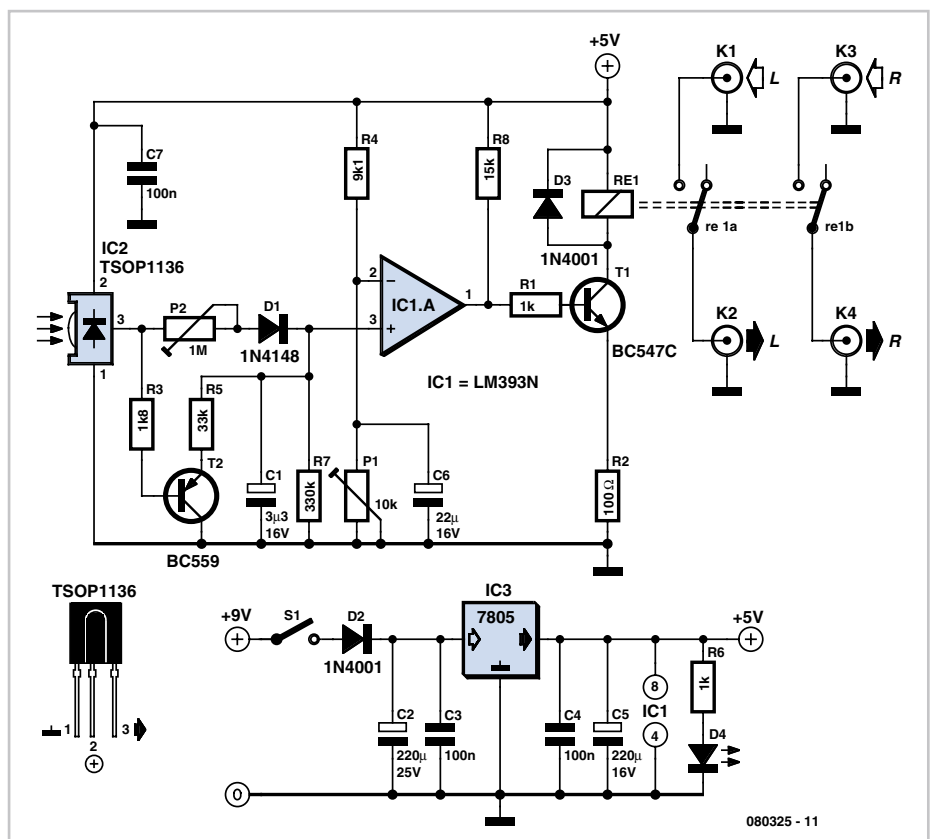
Michael Hölzl

Many households are still graced by tube-type television sets. If you want to connect one of these large tellies to your stereo system to improve the sound quality, this is usually not a problem because there are plenty of SCART to Cinch adapters available in accessory shops.

However, with some sets your pleasure is spoiled by the fact that the audio outputs of the SCART connector are not muted during channel switching. This can sometimes lead to nasty signal spikes, which can cause the loudspeakers of your stereo system to emit irritating popping and cracking noises. In such cases it is a good idea to fit your system with a mute circuit.

Fortunately, the right time to activate the mute circuit is defined by the fact that the happy zapper presses buttons on the remote control to switch channels, and the remote control emits IR signals. There are even inexpensive ready-made IR receiver modules available, such as the TSOP1136 used here, which produce trains of active-low pulses in response to such signals.

About the circuit: when no IR signal is present, a capacitor is charged via P2 and a diode. IC1 is a comparator that compares this IR voltage (applied to its non-inverting input on pin 3) to a voltage applied to its



other input on pin 2. This reference voltage, which can be adjusted with P1, determines the switching threshold of the comparator. If IC2 receives an IR signal, T2 conducts, and as a result the voltage on C1 drops rapidly

below the threshold level set by P1. This causes T1 to change from its previous 'on' state to the 'off' state. As a result, the relay drops out and the audio link to the stereo system is interrupted for the duration of