# DIY KIT 8. LIGHTALARM

Protect your medicine cabinet, cash drawer or lolly cupboard with this light alarm. It will sound as soon as the drawer is opened and light falls on the Darlington phototransistor. It may be connected remotely at the end of two pieces of wire. The output alarm may be redesigned to activate a relay or triac. The kit is a light alarm which will detect **very** low levels of light. It will not work as well as your eye in detecting light because the human eye is the most sensitive light detector there is. But it comes close. For best results have the MAL12 pointed in the direction which light will come

The kit is constructed on a single-sided printed circuit board (PCB). Protel Autotrax was used to design it.

The circuit uses an MAL12 Darlington, or Super-alpha pair of phototransistors. (The MAL12 replaced the MEL12 in 1998 which was discontinued.) It is typically ten times more sensitive than a normal phototransistor. And a phototransistor is typically 100 times more sensitive than a photodiode. (But the frequency of response is different - something we are not concerned with that here.)

All three devices are optosensors; they are electronic devices which alter their electrical characteristics in the presence of light (which may or may not be in the visible range.) In dark conditions the resistance of these devices is high; typically several megohms. In light conditions the resistance falls to typically 30 ohms in bright sunlight. Many practical uses of this property are possible. The circuit diagram shows that the circuit consists of three main stages:

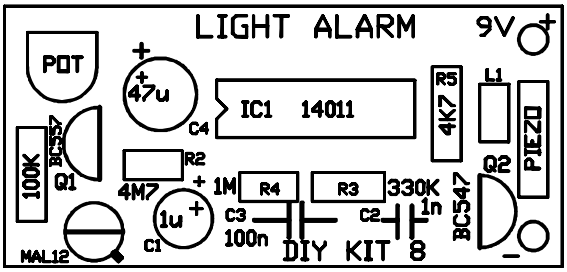
**1. Front detector.** In dark conditions the MAL12 is virtually an open circuit. No current flows through the potentiometer into the base of the transistor. Thus the transistor is OFF and the logic level on the input line to the 14011 is LOW. The potentiometer gives some control over sensitivity.

**2. The 14011 and the tank circuit.** The 14011 is a quad (there are 4 of them), 2 input, NAND gate. It is wired up to oscillate when the input to it goes high, that is the BC557 transistor turns on after light is detected by the MAL12. The oscillating output from the 14011 turns the BC547 on and off. When it is ON the tank circuit (the choke and the piezo buzzer) charges up. When the transistor turns OFF the piezo (which acts as a capacitor) discharges into the choke and makes a 'click' as it does so. Once the piezo is discharged the magnetic field around the choke starts to collapse and recharge the piezo, and the cycle repeats. This is called 'ringing'. Of course there are some resistive losses and the amplitude of the oscillation is slightly less with every cycle. However, the ringing does not decay away completely before the transistor turns on again and recharges the tank circuit fully.

3. After the alarm has been operating and it is put back into dark conditions again then alarm will continue to sound for about 3 - 5 seconds. This is due to the 1uF capacitor & 4M7 resistor which keep the input to the 14011 HIGH. When the voltage falls below about 30% of the rail voltage (9V) the oscillator turns off. To decrease the delay reduce R2.

**Assembly.** Assembly is straight forward and components may be added to the PCB in any order. It is generally good practice to add the lowest height components first. Only one resistor lies flat on the circuit board. The other three stand upright to save space.

**NOTE:** please use the 4M7 resistor for R2 as shown in the top overlay shown here. Do not use the 4K7 as shown on the PCB itself. You will get a proper 5 second delay after the light is removed and the sound will be better. (Throw




away the extra 4K7 resistor provided.)

## COMPONENTS

| | | |
|---|---|---|
| Resistors, 5%, 1/4 watt: | | |
| 4K7 yellow violet red | R5 | 1 |
| 100K brown black yellow | R1 | 1 |
| 330K orange orange yellow | R3 | 1 |
| 1M brown black green | R4 | 1 |
| 4M7 yellow violet green | R2 | 1 |
| Trimpot | P1 | 1 |
| | | |
| Capacitors: | | |
| 1nF mylar | C2 | 1 |
| 1uF 50V ecap | C1 | 1 |
| 10mH inductor from 3L, EC46-103K | | 1 |
| 47uF ecap | C4 | 1 |
| 100nF mylar | C3 | 1 |
| 9V battery snap | | 1 |
| 14011 IC | IC1 | 1 |
| 14 pin IC socket | | 1 |
| BC557 | Q1 | 1 |
| BC557 | Q2 | 1 |
| MAL12 | | 1 |
| Piezo buzzer | | 1 |
| Kit 8 PCB | | 1 |

**If it does not work:** Poor soldering is the most likely reason. Check all solder joints carefully under a good light. Next check that all components are in their correct position on the PCB. Thirdly, follow the track with a voltmeter to check the potential differences at various parts of the

# DIY KIT 8. LIGHTALARM

circuit. Check no pins are bent up on the IC. Is the battery flat.

Go through the connections of the IC to determine the LOW/HIGH levels as the input is HIGH and LOW. Change some of the component values - the 1M, 100nF, 330K and 1nF - and notice how the frequency and tone of the alarm changes. Notice how robust the circuit is; the value of the components may vary by several orders of magnitude or more and still give an acceptable alarm.

Replace the Darlington by an LDR - a light dependent resistor. The LDR is the most well known optosensor. Note how the unit is now less sensitive to light. You can experiment with different audio output devices to find which is best. Sound transducers tend to 'croak' before they start to ring loudly. Piezo buzzers are about the best audio output device.

For other DIY Electronics kits see our website at;

**http://kitsrus.com**