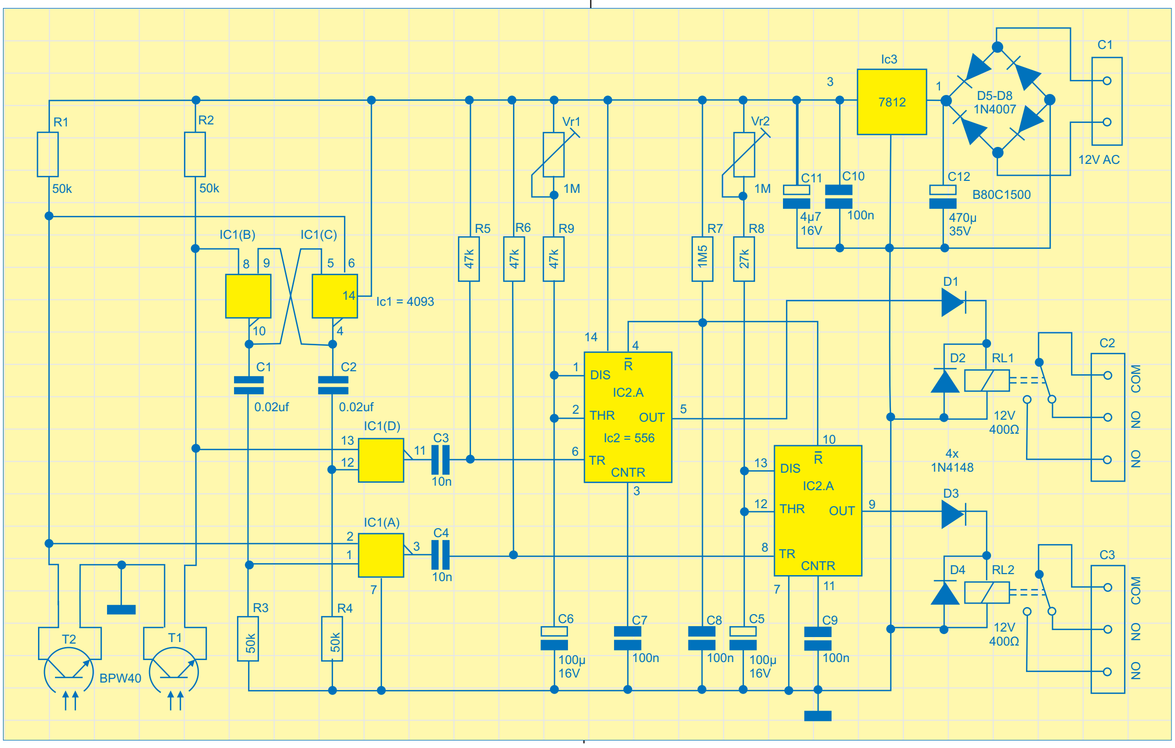
Direction-Sensitive Light Barrier

MUDIT AGARWAL

EM TESTED

SAJAG

The light barrier is based on a flip-flop made from the four NAND gates of a 4093 IC, each of which has two Schmitt-trigger inputs. Two of the inputs (pins 6 and 8) are connected to identical phototransistors (T1 and T2) and collector resistors, and in the quiescent state when the phototransistors are illuminated and thus conducting, they remain Low. Both gate outputs (pins 4 and 10 are then High. If a vehicle now blocks one of the phototransistors the signals on the input and output of around 10 ms appears at the input of gate IC1bor Ic1a. The time constants are determined by the timing networks . A High level is required on the other gate input to allow the pulse to pass through the gate, only one of these two pulses can proceed further to act as a trigger signal for the subsequent timer stage. The two identically configured timers of the 556 dual timer IC function as monostable multivibrators, and thus act as pulse stretchers. Each of them drives an output relay with



gate IC1d change levels. The output of gate IC1c is not affected by this, even though its 'internal' input (pin 9) goes low. If the vehicle also blocks T2 as well, nothing changes until it has travelled past T1. When that happens, the pin 4 output goes High again, but the pin 10 output toggles Low. When the vehicle has finally passed both phototransistors, pin 10 also goes back to the High level. The flip-flop is then restored to its original state. Phototransistors T1 and T2 must be arranged such that when a vehicle passes by, at first only one of them is blocked, them both, and finally only the other one. This means that the distance between the phototransistors must always be less than the length of the vehicle. When an output level changes, a pulse with a duration of switchover contacts. The time constants of the monostables can be varied over the range of 3–170s using the adjustment networks VR1/R9/C6 and VR2/R8/C5, independent of the supply voltage. RC network R7/C8 ensures that the two timers are in the quiescent state (outputs Low) after power is switched on. Freewheeling diodes D2 and D4 are essential with inductive loads; they bypass the counter-EMFs generated by the relay coils. D1 and D3 keep the voltage across the freewheeling diodes away from the timer outputs. If you want to have a visual operation indicator, D1 and D3 can be replaced by red LEDs with a voltage drop of 1.6–2.0 V. As the circuit dissipates a fair amount of power, a small heat sink is recommended for the fixed voltage regulator(Ic3), to keep it from overheating.