Wireless Intruder Alarm

JOY MUKHERJI

The wireless intruder alert system presented here incorporates a passive infra-red (PIR) movement sensor and 433MHz ready-made radio frequency (RF) transmitter and receiver modules. Should anyone break into your home, vehicle, property or warehouse, the motion sensor detector will detect the intrusion by determining changes in infra-red energy patterns and sound an alarm through the receiver unit. It can be used to monitor a location remotely up to hundred metres away.

Circuit and working

The circuit is divided into two sections, that is, the transmitter section and the receiver section. The transmitter section, as shown in Fig. 1, is built around PIR motion-sensor detector module HC-SR501 connected across CON2 through CON5, 433MHz transmitter module (TX1), encoder HT12E (IC1), transistors 2N2222 (T1), 2N3906 (T2) and BFG135 (T3), and a few other components. When the PIR detects motion, its output goes high (3.3V) for three seconds. Transistors T1 and T2 conduct, and the circuit starts transmitting. Encoder IC1 generates eight address bits and four data bits, and employs amplitude shift keying (ASK) for modulation.

Data pins AD8 through AD11 of IC1 are left open (1111). Address pins A0 through A7 are set to 10110100 via DIP switch DIP1. The programmed address and data are transmitted serially via ultra-high frequency (UHF) radio-waves. The UHF frequency is better at penetrating physical barriers like walls and buildings. The address of the transmitter has to match the address of

Test Points

Test point	Details
TP0, TP3	0V (GND)
TP1, TP4	12V
TP2	Train of pulse
TP5	5V
TP6	4-5V when sensor HC-SR501 senses motion

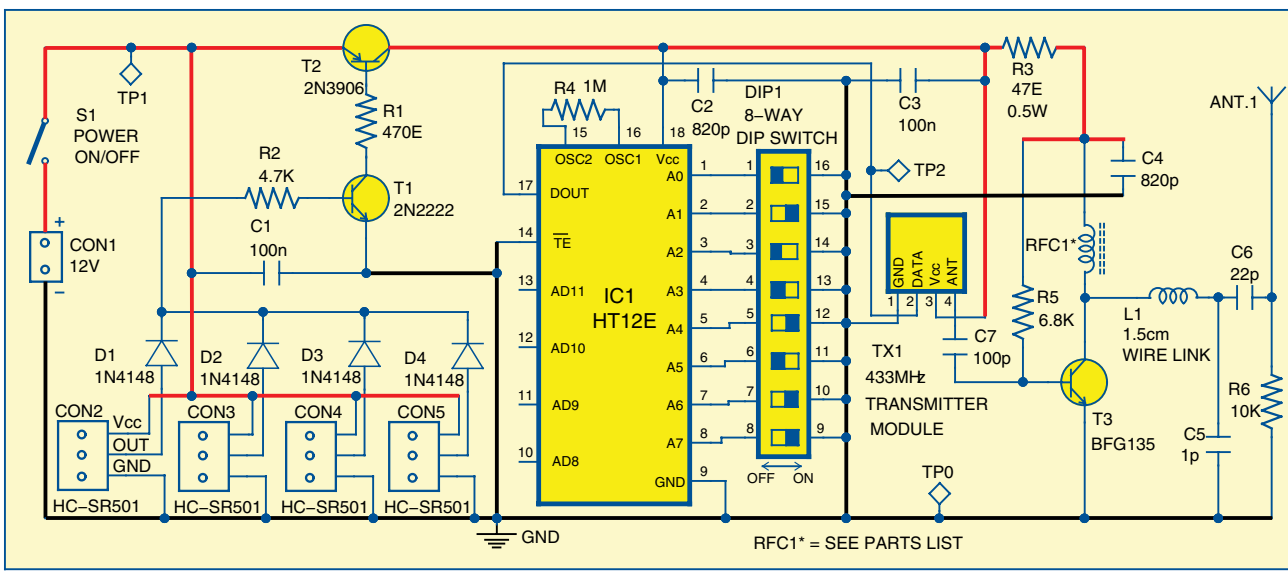

Fig. 1: Circuit diagram of the transmitter section of the wireless intruder alarm

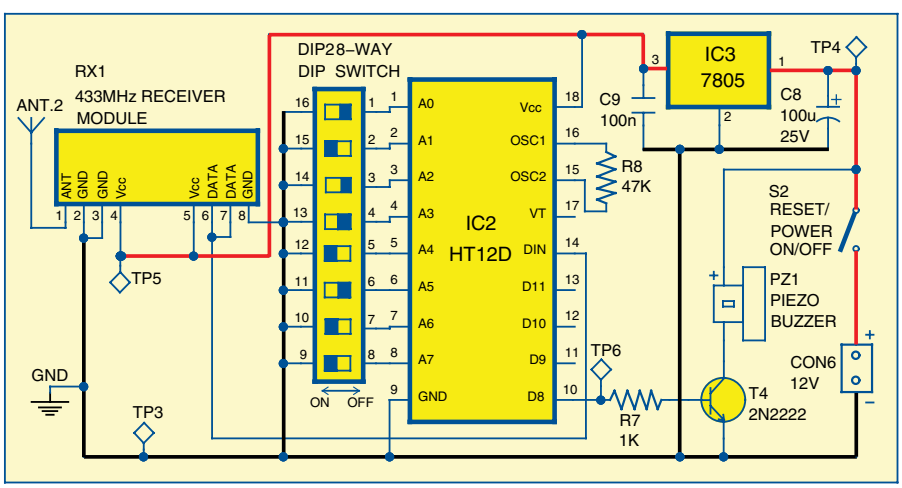

Fig. 2: Circuit diagram of the receiver section of the wireless intruder alarm

PARTS LIST

Semiconductors:

IC1	- HT12E encoder
IC2	- HT12D decoder
IC3	- 7805, 5V voltage regulator
T1, T4	- 2N2222 npn transistor
T2	- 2N3906 pnp transistor
T3	- BFG135 npn transistor
D1-D4	- 1N4148 signal diode

Resistors (all 1/4-watt, ±5% carbon, unless stated otherwise):

R1	- 470-ohm
R2	- 4.7-kilo-ohm
R3	- 47-ohm, 0.5W
R4	- 1-mega-ohm
R5	- 6.8-kilo-ohm
R6	- 10-kilo-ohm
R7	- 1-kilo-ohm
R8	- 47-kilo-ohm

Capacitors:

C1, C3, C9	- 100nF ceramic disk
C2, C4	- 820pF ceramic disk
C5	- 1pF ceramic disk
C6	- 22pF ceramic disk
C7	- 100pF ceramic disk
C8	- 100µF, 25V electrolytic

Miscellaneous:

TX1	- 433MHz transmitter module
RX1	- 433MHz receiver module
CON1, CON6	- 2-pin terminal connector
CON2-CON5	- 3-pin connector
S1, S2	- On/off switch
PZ1	- Piezo buzzer
RFC1	- 6 turns, 28SWG on TV balun core
L1	- 1.5cm wire link (jumper)
ANT.1, ANT.2	- 17.5cm-long wire
DIP1, DIP2	- 8-way DIP switch
	- HC-SR501 PIR motion sensor
	- 18-pin IC bases (2)
	- 12V regulated power supplies/12V batteries (2)

the receiver for successful transmission of address and data.

The RF power from TX1 module is boosted by transistor T3, which is biased for linear class A operation. Wire link L1, and capacitors C5 and C6 match the collector impedance to that of a 17.5cm quarter-wave wire antenna.

The receiver section, as shown in Fig. 2, consists of an ASK AM superhetrodyne receiver module 433MHz (RX1), decoder HT12D (IC2), 5V voltage regulator 7805 (IC3), piezo buzzer (PZ1) and a few other components. The coded signal transmitted by the transmitter is received by RX1 module and decoded by decoder IC2.

When the received address bits match 10110100 (as set by DIP2), data pins 10 to 13 go high (1111). Pin 10 is used to turn-on piezo buzzer PZ1 via transistor T4. Once activated, the output remains latched and the alarm sounds continuously. Reset the alarm by turning S2 off and on.

The circuit allows outputs of multiple motion sensors to be connected to CON2 through CON5 to cover an entire area in a continuous fashion and to make sure that there are no blind spots. Most PIR sensors are sensitive to hand movements up to a distance of about 3.05m (10-ft), arm and upper torso movements up to 6.1m (20-ft) and full-body movements up to about 12.2m (40-ft). Ultrasonic sensors are somewhat more sensitive to movement and can be used here.

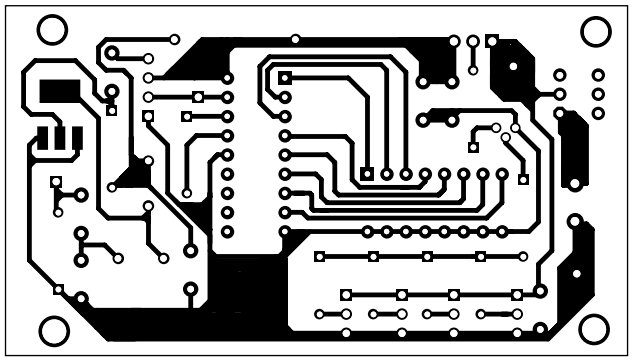

Fig. 3: An actual-size PCB layout of the transmitter section

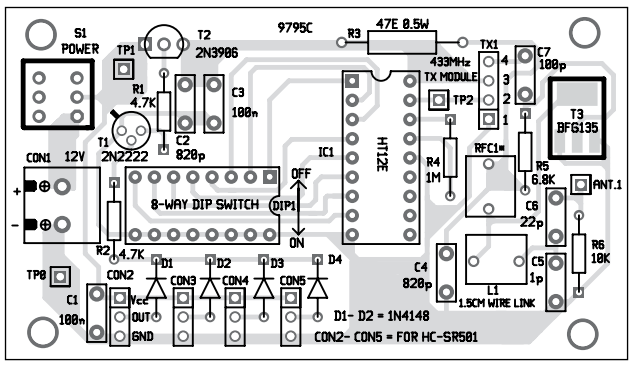

Fig. 4: Component layout of the transmitter section

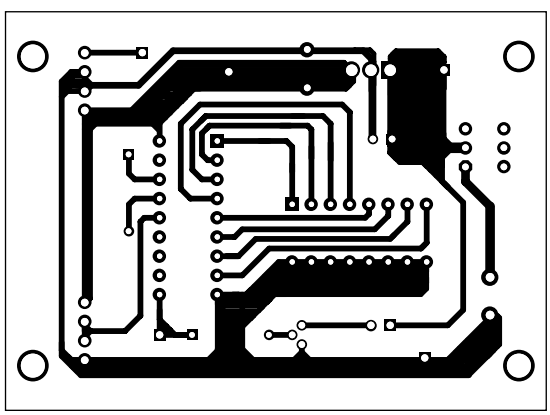

Fig. 5: An actual-size PCB layout of the receiver section

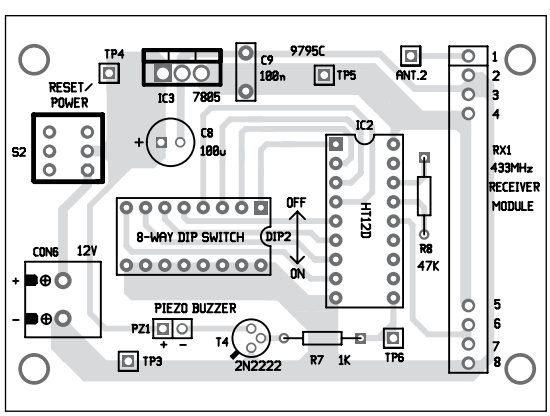

Fig. 6: Component layout of the receiver section

Construction and testing

An actual-size, single-side PCB of the transmitter section is shown in Fig. 3 and its component layout in Fig. 4. Similarly, an actual-size, single-side PCB of the receiver section is shown in Fig. 5 and its component layout in Fig. 6.

After assembling the circuit on a PCB, enclose these in two separate plastic boxes.

Both circuits work off 12V regulated power supply. Refer the test points table for checking the voltages at various points before using the circuit. ●

The author is an electronics hobbyist and a small-business owner in Albany, New York, USA. His interests include designing radio frequency circuits