INFRARED BASED INTRUDER DETECTOR

Ruchi Bhatia

Infrared Based Intruder Detector

Here is a circuit of an intruder detector, which is based on the principle of having a transmitter to produce a beam of radiation and a receiver to detect it. If an intruder comes between the transmitter and receiver, the beam is broken and the alarm sounds. We use a beam of infrared radiation, which is invisible to the eye. This makes it impossible for the intruder to notice the beam and avoid breaking it.

Transmitter Circuit Description:

The transmitter consists of an NE555 timer IC configured as an astable multivibrator, a Darlington pair transistor amplifier, and two IR LEDs. The block diagram of the transmitter is shown in Figure 1. The circuit diagram of the transmitter is shown in Figure 2. The transmitter requires a 9-volt power supply.

The NE555 timer requires only two timing resistors R1 and R2 and one time capacitor C3. Timing resistors R1 and R2 determine the frequency of operation of IC2. In this configuration IC2 operates at 20 KHz.

The driver amplifier is a Darlington pair transistor amplifier selected for its high input impedance, its high current gain, and its low output impedance. Transistors T1 and T2 form the Darlington pair amplifier. Resistor R3 limits the current flow into the base of T1. The Darlington pair amplifier amplifies the low current output of the timer to a high-enough current to drive the IR LEDs. Resistor R4 limits the current flow through the IR LEDs, D4 and D5.

TIL906-1 IR LEDs were chosen because they have a high relative output power. This is very important if a long range is required.

A power-on indicator may be included with the transmitter. It consists of LED D3 and a current limiting resistor, R5.

FIG. 1: Block diagram of the transmitter.

Receiver Circuit Description:

The receiver consists of an IR phototransistor and a high-gain low-noise amplifier. It also contains decoding circuit, latch and transistor switch. The decoder IC3 is tone decoder LM567 IC.

Tone Decoder IC:

The tone decoder LM567 is primarily used as a frequency decoder. It provides a low output when an input signal within the pass-band is present. The LM567 contains an I-phase detector, a Q-phase detector, a VCO and a transistor switch. The VCO determines the center frequency of the LM567 tone decoder. The center frequency of the band and output delay of the LM567circuit are independently determined by external

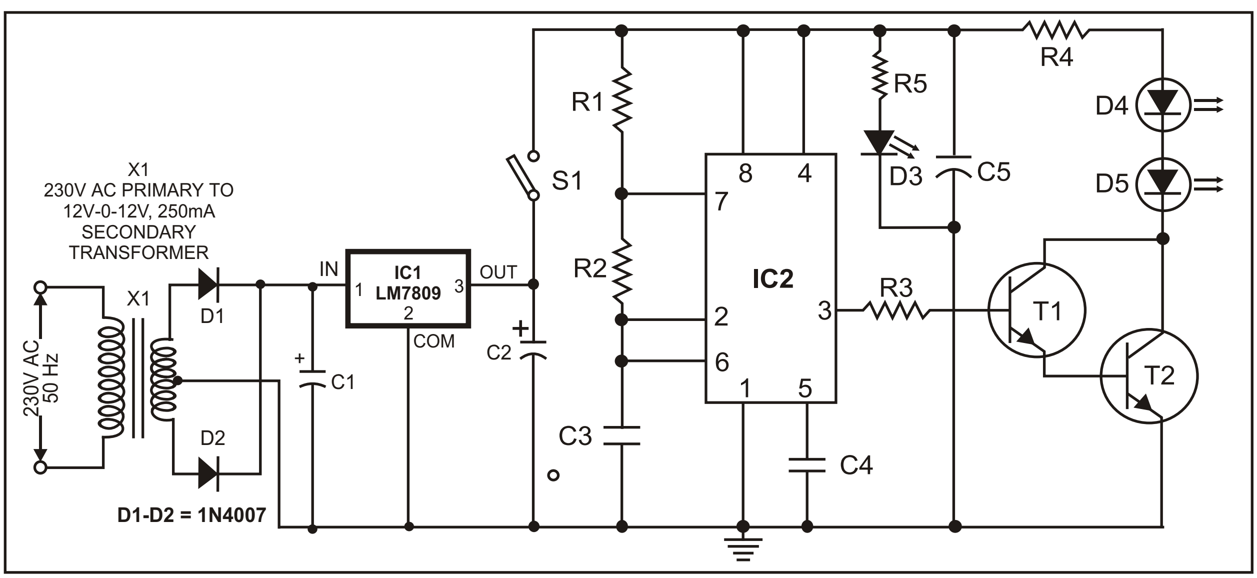


FIG. 2: Circuit diagram of the transmitter.

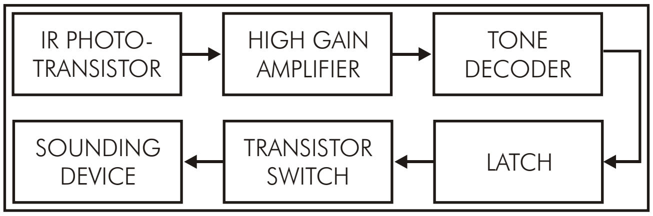
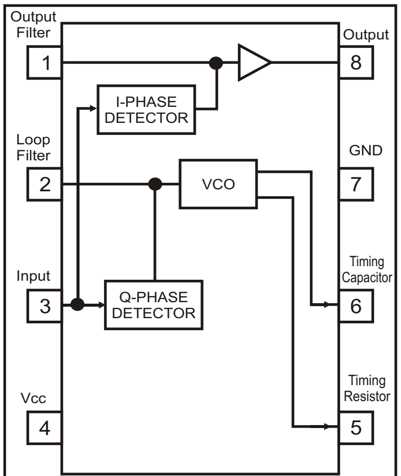


Fig. 3: Block diagram of the receiver.

components. It can be set to detect any



Schematic and Pin assignment of the LM567 IC.

input frequency between 0.01Hz and 500KHz. It rejects out of band signals and noise. It has a logic compatible output that can sink 100 mA of current.

The block diagram of the receiver is shown in Figure 3. The circuit diagram of the receiver is shown in Figure 4. The receiver requires a 5-volt power supply.

The IR phototransistor, T3 detects the infrared signals of the transmitter. The signal output of the phototransistor is very small, a millivolt or less.

The high-gain amplifier amplifies the small signal to a level of 5 volts, enough to be detected by the decoder IC3. The high-gain amplifier consists of three common-emitter transistor amplifiers in cascade. Transistors T4-T6 and associated components form the high-gain amplifier. The common-emitter stage has relatively high impedance and a high voltage gain.

The decoder IC3 is tuned to the same frequency of operation as the transmitter by adjusting preset VR1. If the frequency being received is accurate, logic low output appears at pin 8. The transistor T7 inverts the output of the tone decoder. The output of the tone decoder is high when no signal or a signal of an incorrect frequency is detected. Thus, as long as the beam is not interrupted, the output from pin 8 is low and hence the output at x is high. Interruption of

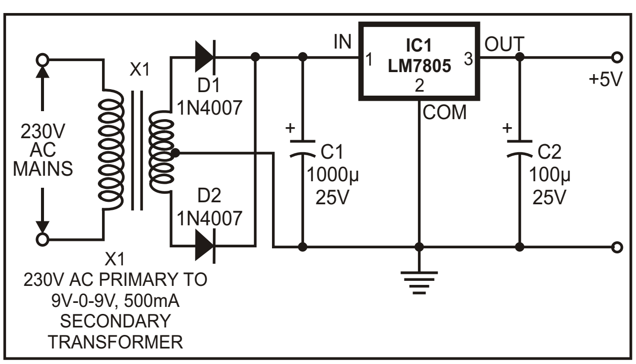


Fig. 5: Circuit diagram of the power supply for the receiver.

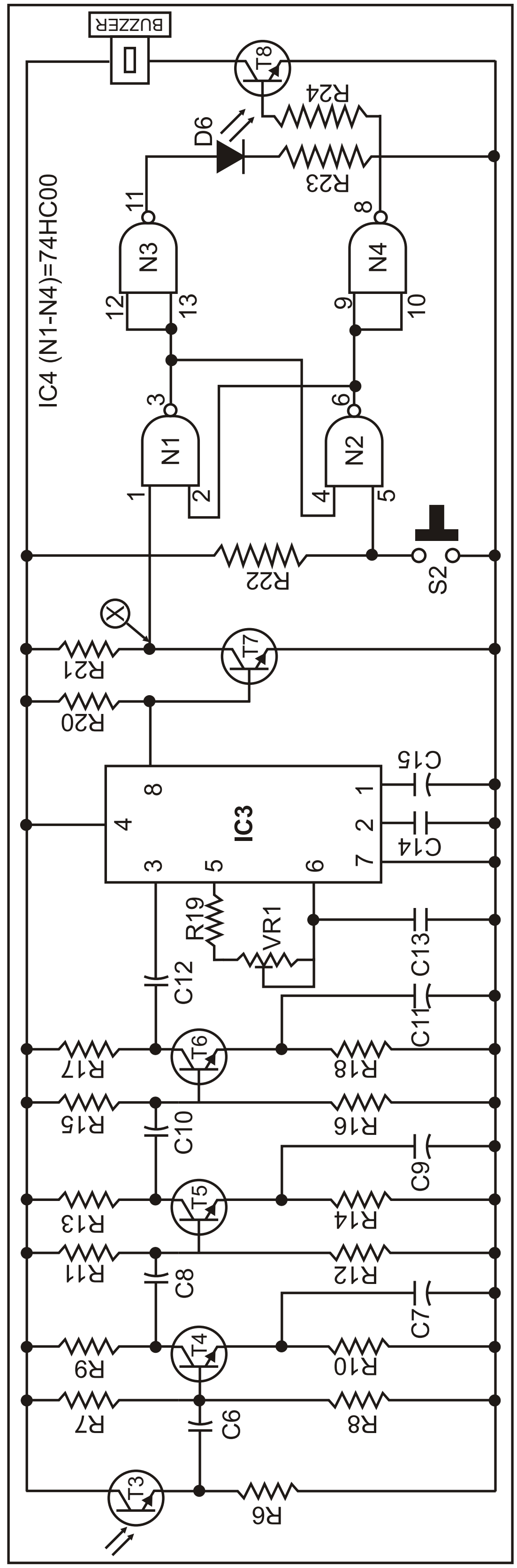


FIG. 4: Circuit diagram of the receiver.

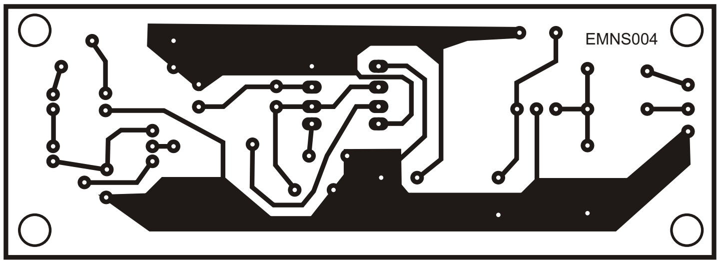


Fig. 6: Actual - size, solder-side PCB layout for the transmitter unit.

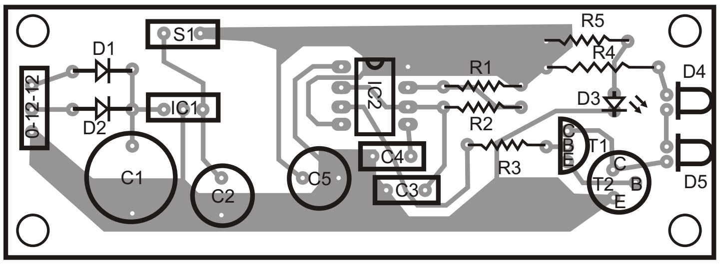


Fig. 7: Component layout for the PCB.

SEMICONDUCTORS		
IC1	7809	Positive Voltage Regulator +9V
IC2	NE555	Single Timer
IC3	LM567	Tone Decoder
IC4	74HC00	Quad 2-Input NAND Gate
T1, T7	BC548	npn Transistor
T2, T8	SL100	
T3	IR Photo Transistor	
T4-T6	2N2222A	
D1,D2	1N4007	
D3, D6	LED RED	
D4,D5	IR LED	
RESISTORS		
R1,R3,R5,R20	1K	
R2		3.3K
R4		47ohms, 2W
R6		120 ohms
R7,R11,R15	82K	
R8, R12, R16	22K	
R9, R13,R17,	1.2K	
R10, R14,R18	100 ohms	
R19		8.2K
R21,R22		10K
R23,R24		470ohms
VR1		5K Preset
CAPACITORS		
C1		1000µF/25V
C2		100µF/25V
C3,C4		0.01µF
C5		470µF/25V
C6-C11		10µF
C12		0.47µF
C13		0.0047µF
C14		1µF
C15		2.2µF
MISCELLANEOUS		
X1		0-12V, 250mA Transformer
B1		Buzzer

is high. Interruption of the beam or saturation of T3 with a strong continuous source of infrared makes the output from pin 8 high and hence the output at x low. The LM567 timing components are capacitor C13 and resistors VR1 and R19.

A low output at x is detected by the flip-flop consisting of two cross-coupled gates of IC4. Two further gates are used as buffers to drive an LED and a transistor respectively. Normally the inputs to the flip-flop are high. Pin 5 is held high by R22 but pressing S2 causes a brief low input which resets the flip-flop. In this state its output at pin 3 is low. This is inverted by the buffer gate N3, so the output at pin 11 is high and the LED (D6) is ON. This indicates that the device is in readiness. The output at pin 6 is always the opposite to that at pin 3. When S2 (reset) is pressed, the output at pin 6 is high, giving a low outputat pin 8, so that T8 is off.

When the beam is interrupted, the low logic at X causes the flip-flop to change state. It becomes set; pin 3 goes high, pin 11 goes low and the LED is off. At the same time, pin 6 goes low, pin 8 goes high and T8 is on. Current flows through the buzzer and it start sounding. It continues to sound, even if the beam is restored, until somebody presses S2 to reset the flip-flop.

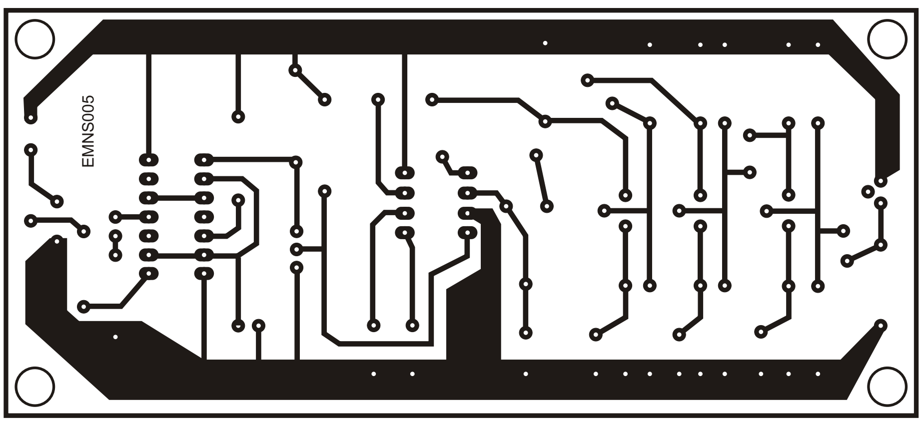


Fig. 8: Actual - size, solder-side PCB layout for the receiver unit.

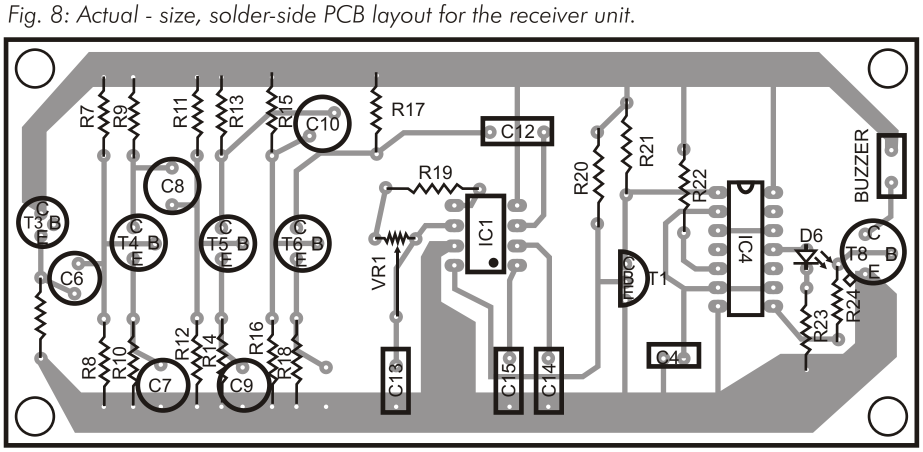


Fig. 9: Component layout for the PCB.