Module 900 (versions A/B): Burglar Alarm

Laboratory Outline

In this module, you will use the infrared emitter/sensor combination from your kit to implement a type of burglar alarm. If completing version A, you must work in the lab and have a TA check your oscilloscope display to receive credit. If completing version B, the entire project may be completed at home and the working device then checked by your TA to receive credit.

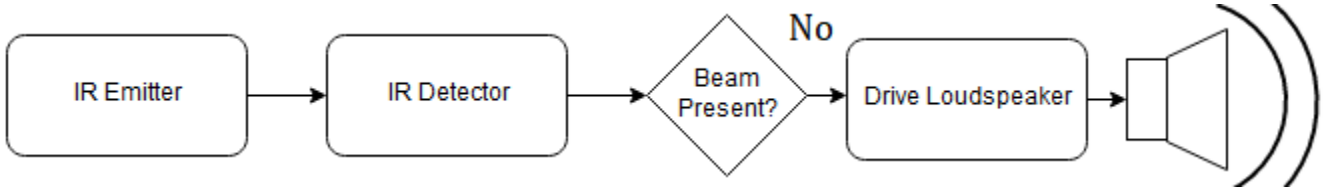


***Figure 1**: Block diagram of an Infrared burglar alarm.*

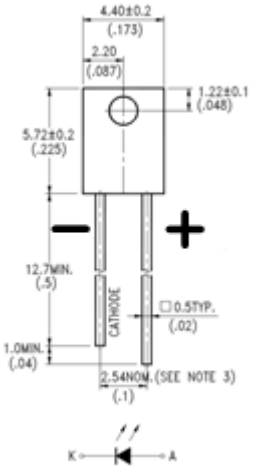
Prerequisites

- Reading a datasheet, practical experience bread-boarding, and (for version B) placing an IC on a breadboard.

Parts Needed

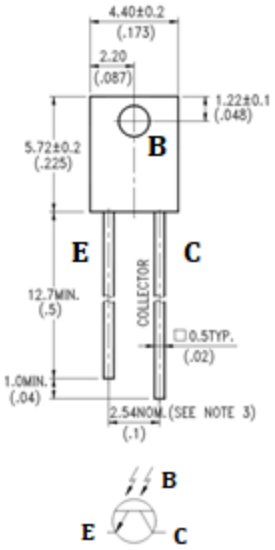
- Two current-limiting resistors ($100 - 700\ \Omega$), and a $10\ k\Omega$ pull-up resistor.
- Infrared Emitter and Detector
- BJT transistor (npn)
- Small loudspeaker
- A fixed-voltage supply (battery, for version B)
- A function generator's square wave output (for version A)
- The 40106 Schmitt-trigger inverter (for version B)

Notes:



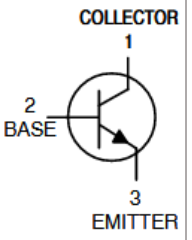
ABSOLUTE MAXIMUM RATINGS AT TA=25℃

PARAMETER	MAXIMUM RATING	UNIT
Power Dissipation	75	mW
Peak Forward Current (300pps, 10 μ s pulse)	1	A
Continuous Forward Current	50	mA
Reverse Voltage	5	V
Operating Temperature Range	-40℃ to + 85℃	
Storage Temperature Range	-55℃ to + 100℃	
Lead Soldering Temperature [1.6mm(.063") From Body]	260℃ for 5 Seconds	



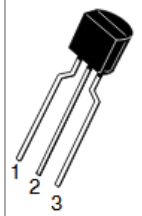
ABSOLUTE MAXIMUM RATINGS AT TA=25℃

PARAMETER	MAXIMUM RATING	UNIT
Power Dissipation	100	mW
Collector-Emitter Voltage	30	V
Emitter-Collector Voltage	5	V
Operating Temperature Range	-40℃ to + 85℃	
Storage Temperature Range	-55℃ to + 100℃	
Lead Soldering Temperature [1.6mm(.063") From Body]	260℃ for 5 Seconds	



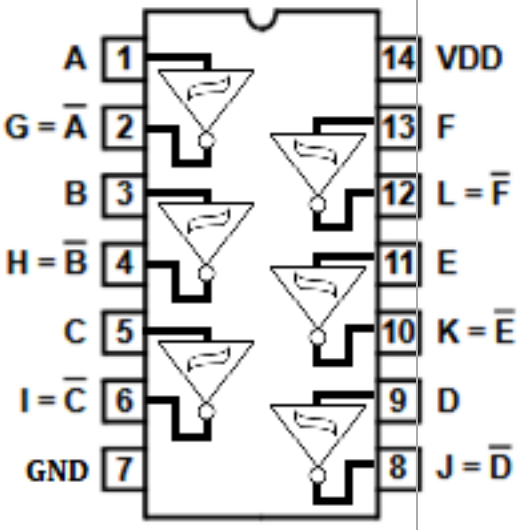
TO-92
CASE 29
STYLE 17

STRAIGHT LEAD
BULK PACK



BENT LEAD
TAPE & REEL
AMMO PACK

CD40106BMS
TOP VIEW



Notes:

Version A (must be done in lab)

Build the following circuit. Note that the "long lead" of the infrared emitter is the anode (+) side of the diode, and that the long lead of the infrared emitter is the collector. There is no lead for the base on the detector's transistor as it is set "high" by the presence of infrared light at its "lens". Use the rechargeable NiMH battery to supply V_{CC}. Set the function generator to produce **a 0-to-8-volt, 500 Hz square wave**. There are portions of relevant datasheets on the back side of this paper. The IR emitter and detector must face each other and be not more than two centimeters separated with the small lenses *facing each other*.

Turn on the oscilloscope and press the Default Setup button. Use ***only*** the horizontal and vertical scale adjustments and the trigger and meas menus to complete today's task.

Use the oscilloscope to view both voltages V_1 and V_2 while the IR beam is unbroken and then broken.

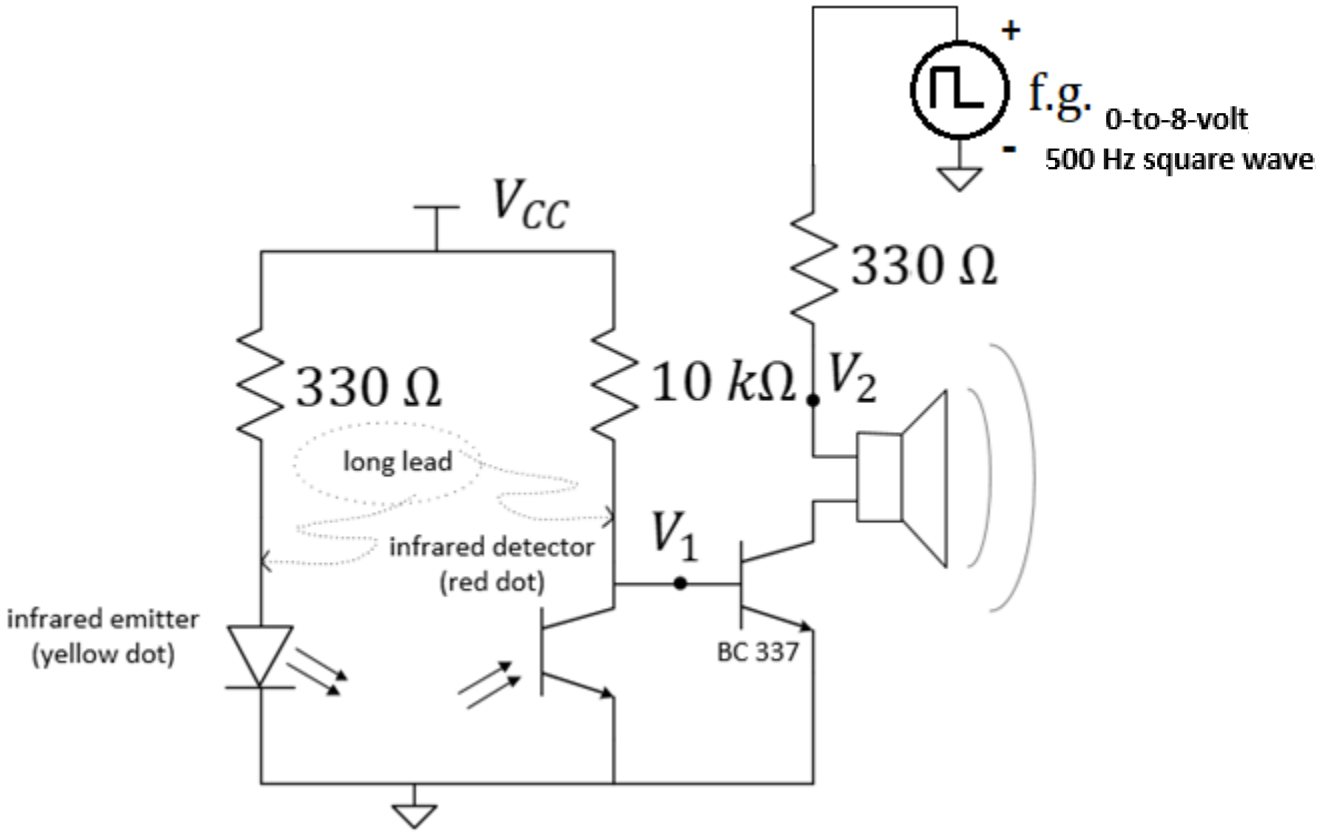


Figure 2: *An infrared-detector circuit.*

Did you forget how to set the f.g. to "High Z" mode? No matter. Use the oscilloscope to adjust the settings until you have a 0-to-8-volt reading!

A transistor can often be used to provide a current boost needed to drive a component with low resistance like this loudspeaker.

The "coin sorter" lab in ECE120 *Intro to Computing* uses an infrared emitter/detector combination to detect the size of coins rolling down an incline.

Notes:

Version B (may be mostly built at home, then checked by TA)

Build the circuit of Figure 2 by following the instructions of version A, but without the function generator and without the oscilloscope measurements. You are to replace the function generator with the oscillator circuit as shown in Figure 3. Do not neglect the feedback wire of the third inverter returning to the input of the first inverter. Supply your own 9-V battery source.

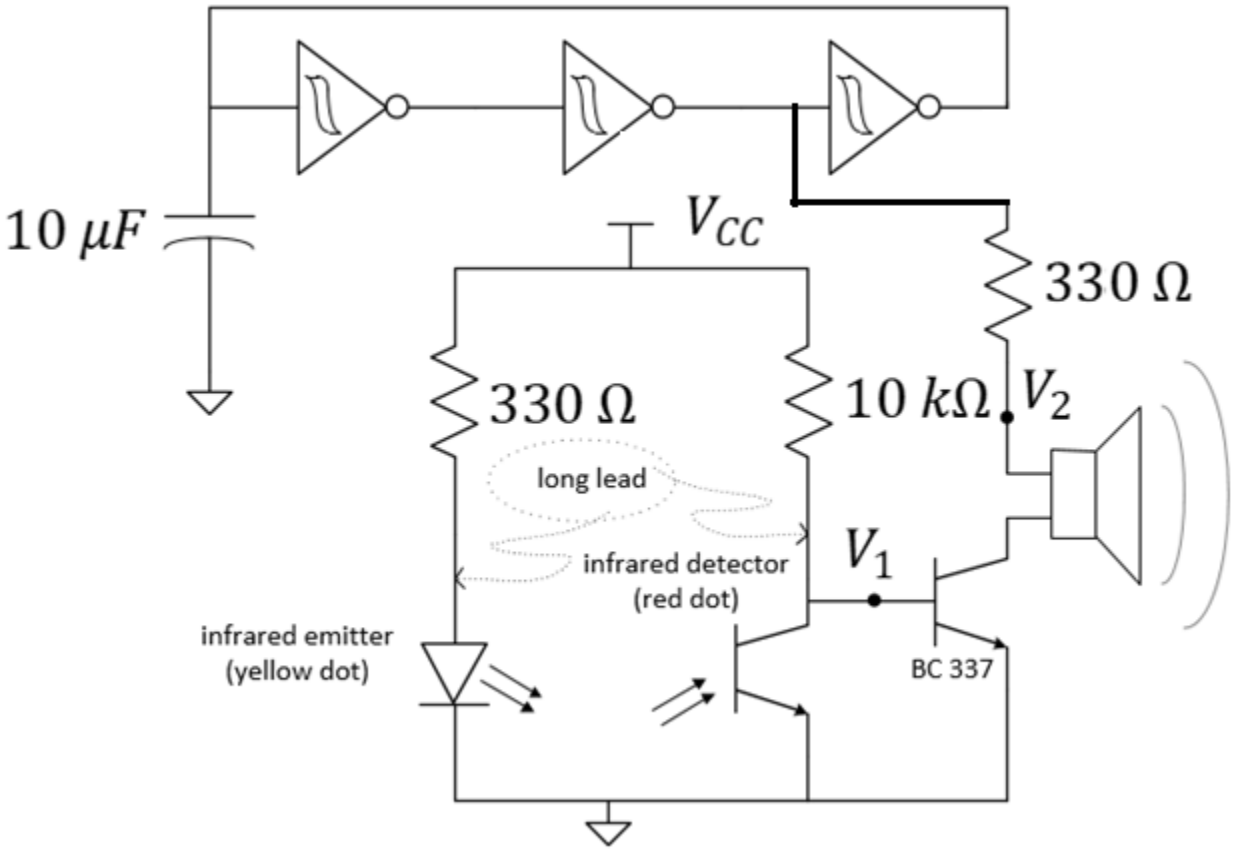


Figure 3: *A self-contained infrared-detector circuit.*

The sound level will be very low. Let your TA evaluate your circuit in open lab or at your next laboratory session.

Feel free to adjust the value of the capacitor to change the tone of the alarm!

Explore More!

Points awarded: _____

Name: _____

Net ID: _____

es: _____

Learning Objectives (version A)

- Ability to map a circuit design onto the breadboard in a functional and clean manner.
- Ability to use the oscilloscope and to recover traces after alteration.
- Ability to troubleshoot problems that occur during a build.

Learning Objectives (version B)

- Ability to map a circuit design onto the breadboard in a functional and clean manner.
- Ability to troubleshoot problems that occur during a build.

Question 1: Measure the frequency and duty cycle of V_2 when the IR beam is broken.

Question 2: Let your TA know you are ready for evaluation.