HC-SR04 User Guide

1. Ultrasonic Distance Measurement Principles

The transmitter emits a 8 bursts of an directional 40KHz ultrasonic wave when triggered and starts a timer. Ultrasonic pulses travel outward until they encounter an object, The object causes the the wave to be reflected back towards the unit. The ultrasonic receiver would detect the reflected wave and stop the stop timer. The velocity of the ultrasonic burst is 340m/sec. in air. Based on the number of counts by the timer, the distance can be calculated between the object and transmitter The TRD Measurement formula is expressed as: $D = C \times T$ which is know as the time/rate/distance measurement formula where D is the measured distance, and R is the propagation velocity (Rate) in air (speed of sound) and T represents time. In this application T is devided by 2 as T is double the time value from transmitter to object back to receiver.
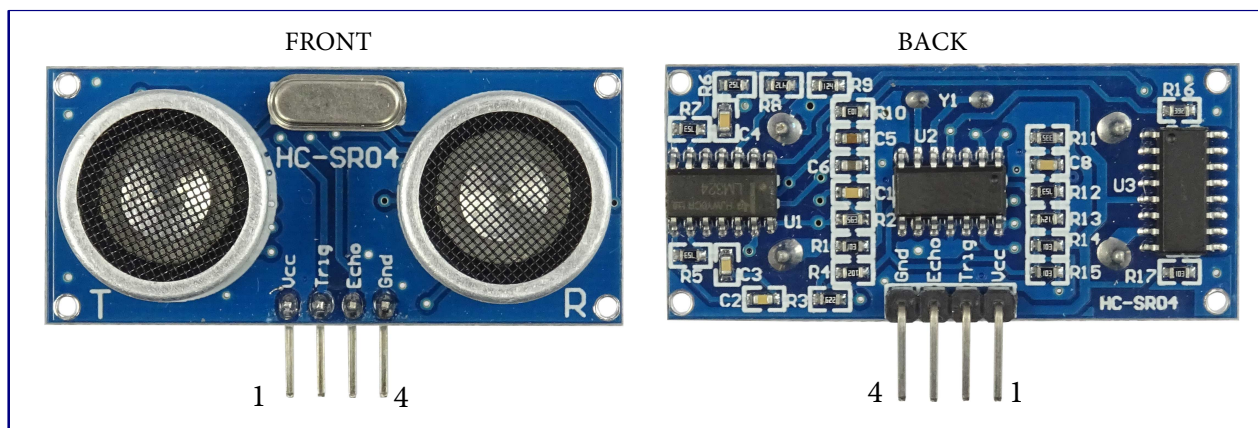
2. Product Features

Features
- Stable performance (Xtal.)
- Accurate distance measurement
- High-density SMD Board
- Close Range (2cm)

Uses
- Robotics barrier
- Object distance measurement
- Level detection
- Security systems
- Vehicle detection/avoidance

3. Product Views

FRONT   BACK

4. Module Pin Asignments

	Pin Symbol	Pin Function Description
1	VCC	5V power supply
2	Trig	Trigger Input pin
3	Echo	Receiver Output pin
4	GND	Power ground

5. Electrical Specifications

WARARNING
Do Not connect Module with Power Applied! Always apply power after connecting Connect "GND" Terminal first

Electrical Parameters	HC-SR04 Ultrasonic Module
Operating Voltage	5VDC
Operating Current	15mA
Operating Frequency	40KHz
Max. Range	4m
Nearest Range	2cm
Measuring Angle	15 Degrees
Input Trigger Signal	10us min. TTL pulse
Output Echo Signal	TTL level signal, proportional to distance
Board Dimensions	1-13/16" X 13/16" X 5/8"
Board Connections	4 X 0.1" Pitch Right Angle Header Pins

6. Module Operation

Set Trig and Echo Low to initalize module. Place a minimum 10us High level pulse to "Trigger" (module will automatically send eight 40KHz acoustic bursts). At the same time, Gate the microcontroller timer to start timing.
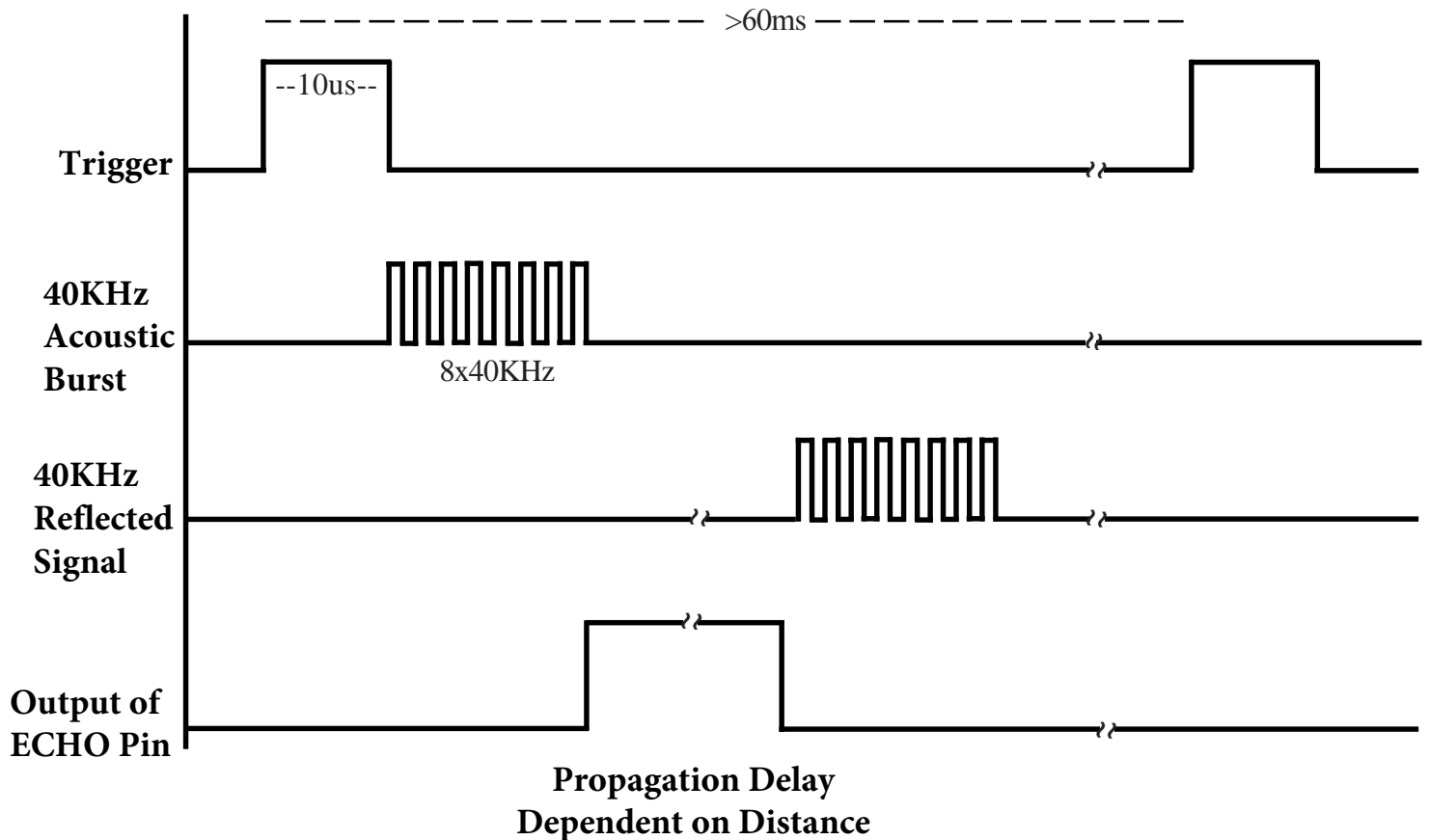
Wait to capture the rising edge output of ECHO port to stop the timer. Now read the time of the counter, which is the ultrasonic propagation time in the air. According to the formula: Distance = (ECHO high level time X ultrasonic velocity (Speed of Sound in air 340m/sec) / 2, you can calculate the distance to the obstacle.

For best results and maximum range, the Object should be larger than $0.5M^2$, the nearer the target object, the smaller it may be.
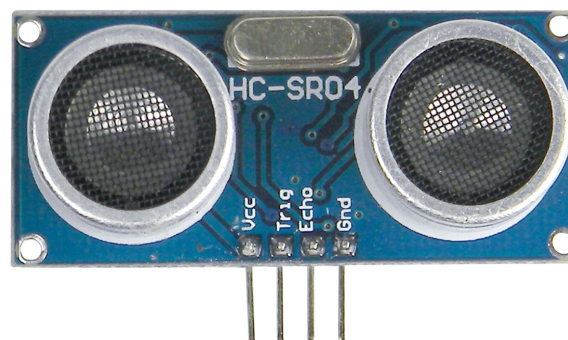
7. ModuleTiming

HC-SR04 ULTRASONIC MODULE

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                    — — — — — — — — — — — >60ms — — — — — — — — —
                 ┌──────┐                                          ┌──────┐
  Trigger ───────┘--10us--└──────────────────────────────~~───────┘      └──────
                        ┌┐┌┐┌┐┌┐┌┐┌┐┌┐┌┐
  40KHz  ───────────────┘└┘└┘└┘└┘└┘└┘└┘└─────────────────~~───────────────────────
  Acoustic
  Burst              8x40KHz
                                                  ┌┐┌┐┌┐┌┐┌┐┌┐┌┐┌┐
  40KHz  ──────────────────────────────~~─────────┘└┘└┘└┘└┘└┘└┘└┘└──~~─────────────
  Reflected
  Signal
                                     ┌──────~~──────┐
  Output of ─────────────────────────┘              └──────────────~~─────────────
  ECHO Pin
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Propagation Delay
Dependent on Distance

Trigger 10us min. start measurement from microcontroller.
      Max Rep. Rate: 60ms
ECHO Output pulse to microcontroller, width is the time from last of 8 40KHz bursts to detected reflected signal (microcontroller Timer gate signal)
      Distance in cm = echo pulse width in uS/58
      Distance in inch = echo pulse width in uS/148