

# Ultrasonic Driver document

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2015

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This document describes the embedded software design for  
the handling the Ultrasonic sensor HC-SR04.

Version 1.0

### *Revision History*

Date	Version	Description	Author	Role
27/5/2015	1.0	Document creation	Ibrahim Mostafa	Junior ES Engineer

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## 1 Introduction

### 1.1 Purpose

The purpose of this document is to describe the detailed design for the handling with Ultrasonic Sensor HC-SR04 and how it works.

### 1.2 Definitions, Acronyms, and Abbreviations

Ultrasonic                      Sound wave beyond the human hear ability which is 20Hz- 20KHZ

### 1.3 References

Item	Name	link
[1]	HC-SR04Users_Manual	
[2]	HC-SR04_Ultrasonic_Module_User_Guide	

### 1.4 Overview

The HCSR04 ultrasonic sensor uses sonar to determine distance to an object like bats or dolphins do. It offers excellent noncontact range detection with high accuracy and stable readings in an easy-to-use package. From 2cm to 400 cm or 1" to 13 feet. It operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with ultrasonic transmitter and receiver module.

### 1.5 Folders and files structure

Wavecom Fastrack module was implemented by two files: EF\_UltraSoinc.c and EF\_UltraSoinc.h .

### 1.6 Features

- Stable performance
- Accurate distance measurement
- High-density
- Small blind

### 1.7 Applications

- Robotics Barrier
- Object distance measurement
- Level detection
- Public security
- Parking detection

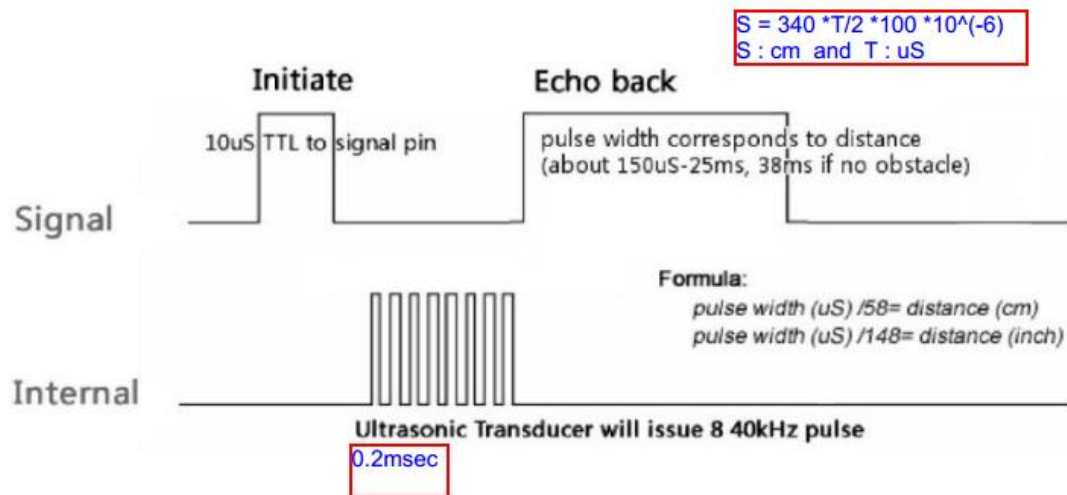
## 2 Detailed Design

### 2.1 Operation

The timing diagram of HCSR04 is shown. To start measurement, Trig of SR04 must receive a pulse of high (5V) for at least 10us, this will initiate the sensor will transmit out 8 cycle of ultrasonic burst at 40kHz and wait for the reflected ultrasonic burst. When the sensor detected ultrasonic from receiver, it will set the Echo pin to high (5V) and delay for a period (width) which proportion to distance. To obtain the distance, measure the width (Ton) of Echo pin.

Time = Width of Echo pulse, in uS (micro second)

- Distance in centimeters = Time / 58
- Distance in inches = Time / 148
- Or you can utilize the speed of sound, which is 340m/s



#### Note:

- Please connect the GND pin first before supplying power to VCC.
- Please make sure the surface of object to be detect should have at least 0.5 meter<sup>2</sup> for better performance.

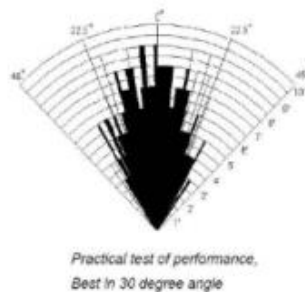
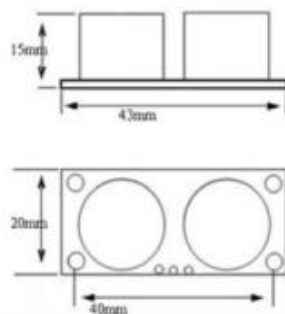
### 2.2 Ultrasonic HC-SR04 layout and Limitations:

- Effectual Angle: <15°
- Ranging Distance: 2cm – 400 cm/1" 13ft
- Resolution: 0.3 cm
- Measuring Angle: 30 degree
- Trigger Input Pulse width: 10uS

Parameter	Min	Typ.	Max	Unit
Operating Voltage	4.50	5.0	5.5	V
Quiescent Current	1.5	2	2.5	mA
Working Current	10	15	20	mA
Ultrasonic Frequency	-	40	-	kHz



VCC = +5VDC  
 Trig = Trigger input of Sensor  
 Echo = Echo output of Sensor  
 GND = GND



### 3 Driver Functions

#### 3.1 EF\_UltraSonic\_Init

<i>Format</i>	void EF_UltraSonic_Init();
<i>Description</i>	This function used to Initialize UltraSonic Sensor: -Timer Initialize

	-LCD Initialize -Trigger Initialize -Echo Initialize (Polling on flag or Interrupt based) -Test led Initialize
<i>Argument</i>	None
<i>Return value</i>	None

### 3.2 EF\_UltraSonic\_GetDistance

<i>Format</i>	U16_t EF_UltraSonic_GetDistance ();
<i>Description</i>	This function used to trigger the sensor then get the distance between UltraSonic Sensor and any barrier front of this Sensor. if Echo is Interrupt based, ISR will print the number on LCD else you need to print it in main.c file.
<i>Argument</i>	Void.
<i>Return value</i>	Distance_cm from any barrier front of UltraSonic Sensor if Interrupt based return 1 and ISR will calculate it and print in LCD