11/9/2020

SMART HELMET

FOR UNDERGROUND MINING

Rahul Lal

PROJECT REPORT FOR ECE IN DIPLOMA ENGINEERING

TITLE PAGE

SMART HELMET FOR UNDERGROUND MINING

By

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A comprehensive project report has been submitted in partial fulfillment of the requirements for the degree of

Diploma Engineering

in

ELECTRONICS & COMMUNICATION ENGINEERING

Under the supervision of

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Senior Professor

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DATE 9th Nov 2020

Government Polytechinic Ahmedabad

ELECTRONICS AND COMMUNICATION

CERTIFICATE

This is to certify that the dissertation entitled "Smart Helmet for Underground Mining" has been carried out by Rahul Lal (186170311037) under my guidance in fulfillment of DIPLOMA Engineering in Electronics and Communication (5&6th semester) of Gujarat Technical University, Ahmedabad during the academic year 2020-2021.

Date:_____HOD:_____Faculty:_____

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ACKNOWLEDGEMENT

I would like to thank all my teammates for their help in completing the project report, but my foremost appreciation goes to my friend Farhan Mansuri and R B Shah sir. I would also like to thank Mrs. Asha madam our project guide for helping in format of this report and perfecting our simple project to a unique level project. The appreciation also goes to Robert E kahn and Vinton Cerf as they are the inventors of internet and without internet this project would have been never possible. My teammates very kind and generous for giving their 100% in project either its research or the hardware selection. At last I would like to give my appreciation to my family for being patient while completion of my work and not disturbing me to fulfill my project report in my desired way.

Yours truly,
Rahul Lal

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ABSTRACT

A smart helmet is a special idea which makes mining and construction work feel safer than before. This helmet will bring chutzpah in the workers while going inside the mine. This smart helmet has a great feature of detecting toxic gases. It can also show details of temperature, humidity, distance, GPS tracking and warning switch or alert switch which will help to show which worker is in panic condition.

This smart helmet system is loaded with sensors like gas sensor, temperature sensor, humidity sensor, then there is laser module for distance measurement, GPS module to track location and to control all these sensors we are using Arduino as an microcontroller and a OLED display to show all essential details like temperature, humidity, distance to the workers inside the mine.

CHAPTER 1

INTRODUCTION

The propose of this project is to ensure that the worker always know what is happening surrounding them as well as the one from the outside can know their location.

when the worker enters the mine, the smart helmet starts analyzing the surrounding environment of the worker.

There is a LED which will change its color as per the current gas levels of the surroundings of the workers:

(1) LED will be green if the all the gas levels are normal as per the setter.

(2) LED will turn yellow if there is a slight change in the gas levels.

(3) LED will turn red if there is a sudden change in the toxic or any flammable gas above the set level which will be a danger sign to the workers.
The levels of all the gasses can be seen on the OLED display by the worker all the time.

To make mining even more safe we used GPS module in which we can see live location of worker who is working inside the mine.

Every analog information from all sensors will be received by the microcontroller. Here we are using Arduino as a microcontroller, and then all essential data will be shown on the OLED screen.

If worker need help or any panic situation arises then worker can use emergency switch which is placed at right side of helmet. When worker press this switch then alert signal will go to admin of workers who will be outside of the mine, then they can easily send help to the worker who is in a panic situation or condition.

CHAPTER 2

LITERATURE SURVERY/REVIEW

This project is a total idea from our head, but when researched on google about if something like this exists and we found out that a similar project does exists but not quite as of ours, it was just a helmet with one gas sensor and also with a very impractical physical configuration. So, after finding out about this we did a lot research about the problems of a worker working inside the mine and did advancements in out project. We also spoke to one of the engineers at the coal mine in West Bengal to understand the difficulties inside a mine. As for the physical configuration we did take inspiration from other smart helmet available like Jarvis helmet as well as science fiction movies and animated cartoons. This idea started to ping in our head as we acknowledged and learnt that there is no advancement or evolution in a mine workers helmet.

What we have done in this project is that we have put a lot of sensors as per the requirements in the mine onto the helmet.

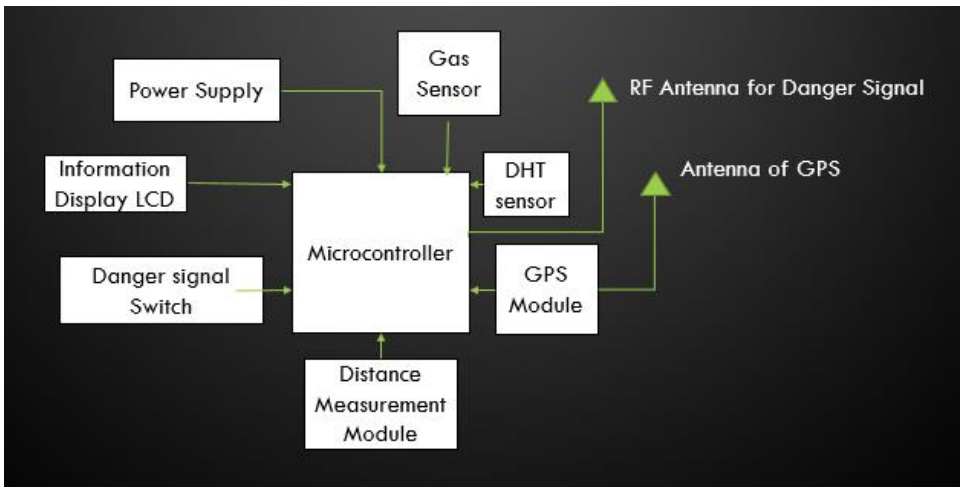
There was two or three similar project which we see on internet, but they are just focused on bike riders any one of them was not focused on problems of mine workers, so this project is never done before.

CHAPTER 3

PROJECT BLOCK DIAGRAM, WORKING, CPMPONENT LIST, HARDWARE AND DESCRIPTION

Block diagram

Helmet Side



Admin side

Working

The working of this helmet is very simple as you can also see from the above block diagram. The sensors gather the data from its surroundings and shows it on the OLED display to the workers. The analog data from the analog sensors converted into digital form by the built-in ADC in the Arduino board. As for the alerting mechanism whenever the switch in the helmet for alert will be pressed it will generate a pulse that will be transmitted via antenna to the admin outside the mine. The danger signal sent will be received through our very own hand made receiver using the same HC-12 transceiver circuit on the admin side. GPS module works on the satellite technology which will show the exact longitude and latitude which will be sent to the admin via the HC-12 to admin who by using node MCU will be able to see exact location on BLYNK app . The microcontroller will be programmed with the Arduino IDE as per the requirement of the microcontroller to control all other sensors.

Component list

(1) Normal workers helmet which is used at construction side
(2) high luminous LED light
(3) LASER module
(4) Temperature and humidity sensor DHT 22
(5) gas sensor-MQ9
(6) Ultrasonic sensor
(7) LI-PO battery’s
(8) OLED display
(9) Arduino nano
(10) jumper wires
(11) multicore wires
(12) red and yellow LED’s
(13) GPS module
(14) HC-12 Transceiver module

Hardware and description

workers helmet:

This is a construction helmet in which we will be implementing all the hardware. This is a construction grade helmet which can also be used for mining purpose.

High luminous LED:

This is a construction grade LED light which we will be using with construction helmet. It consumes very less power and provides significant amount of light.

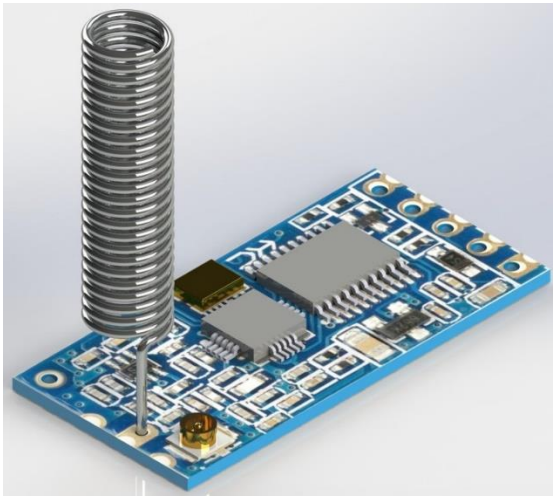
MQ-9:

This is MQ-9 Carbon Monoxide, Methane, and LPG Gas Sensor Module that can be used to sense Carbon Monoxide and Methane Gas. Sensitive material of the MQ9 gas sensor is SnO2, which with lower conductivity in clean air.

It makes detection by the method of cycle high and low temperature and detect CO when the low temperature (heated by 1.5V). The sensor's conductivity is higher along with the gas concentration rising.

When at high temperature (heated by 5.0V), it detects Methane, Propane, etc. combustible gas and cleans the other gases adsorbed under low temperature.

HC-12 Transceiver module:



The HC-12 module is one of the latest in RF modules. This module uses the transceiver from Richtech Limited. This transceiver IC operates at 433.4MHz to 473MHz and has many new features.

The HC-12 is a half-duplex 20 dBm (100 mW) transmitter paired with a receiver that has -117 dBm (2×10^{-15} W) sensitivity at 5000 bps.

Paired with an external antenna, these transceivers can communicate up to and possibly slightly beyond 1 km

Wireless Transceiver Antenna and add some extra pipelines, buffers, and an auto-retransmit feature.

This board features a reverse polarized SMA connector for maximum **RF** range. And there is PA and LNA circuit on board, with the external antenna it can reach longer distance compared with one without these parts.

This module comes with a helix **antenna** , with a 5Kbps baud rate on open-air it can reach the 1.8 kilometers communication distance.

OLED display:

This 1.3″ I2C OLED Display is an OLED monochrome 128×64 dot matrix display module with I2C Interface. It is perfect when you need an ultra-small display.

Comparing to LCD, OLED screens are way more competitive, which has a number of advantages such as high brightness, self-emission, high contrast ratio, slim outline, wide viewing angle, wide temperature range, and low power consumption. It is compatible with any 3.3V-5V microcontroller, such as Arduino.

LASER module:

The LASER MODULE 650NM 5V head is composed of a light-emitting tube, condenser lens, and adjustable copper sleeve and it is assembled when delivered, the focal length of the lens is adjusted glued by strong glue stick, which can work directly after connecting to a 5V DC power supply.

Laser Diode Module is a breadboard friendly, low cost having the wavelength of 650nm and operating voltage of 5V.

Ultrasonic sensor:

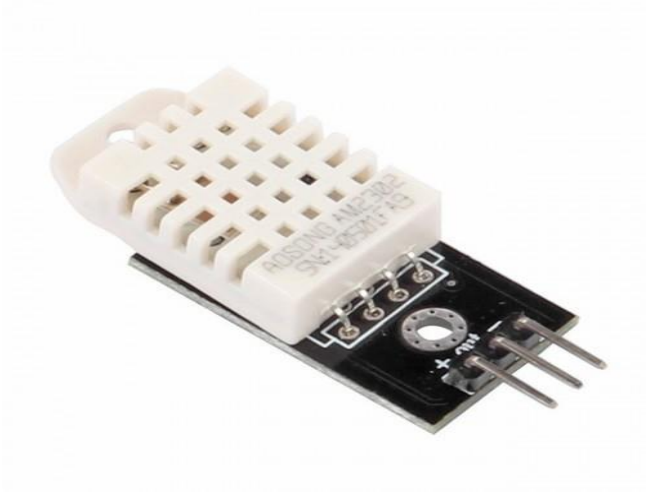
This HC-SR04-Ultrasonic Range Finder is a very popular sensor which is found in many applications where it requires to measure distance and detect the objects.

The module has two eyes like projects in the front which form the Ultrasonic transmitter and Receiver. The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object like bats or dolphins do.

This Ultrasonic Sensor module is a transmitter, a receiver and a control circuit in one single pack!! It has a very handy and compact construction. It offers excellent range accuracy and stable readings in an easy-to-use package. Its operation is not affected by sunlight or black material like Sharp rangefinders are. (although occasionally soft materials like cloth can be difficult to detect).

The *Trigger* and the *Echo* pins are the I/O pins of this module and hence they can be connected to the I/O pins of the microcontroller/Arduino. When the receiver detects return wave the *Echo* pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

Temperature and humidity sensor DHT 22:



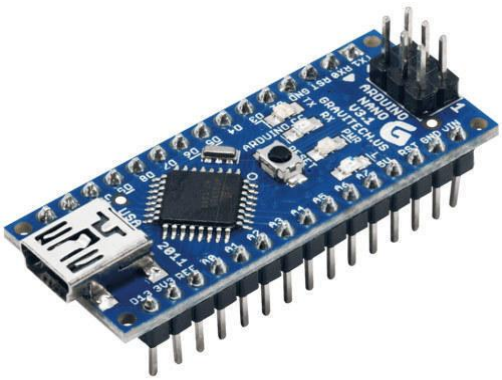
The DHT22 Digital Temperature and Humidity Sensor Module AM2302 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin.

It's fairly simple to use but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using its library, sensor readings can be up to 2 seconds old.

GPS module:

The UBlox NEO-M8M GPS Module with Ceramic Active Antenna series of concurrent GNSS modules is built on the high performing u-Blox M8 GNSS engine in the industry proven NEO form factor.
The NEO-M8M is optimized for cost-sensitive applications, while NEO-M8N/M8Q provides the best performance and easier RF integration. The NEO-M8N offers high performance also at low power consumption levels. The future proof NEO-M8N includes an internal Flash that allows future firmware updates. This makes NEO-M8N perfectly suited to industrial and automotive applications.
The u-Blox NEO-M8 modules can also benefit from the u-box AssistNow assistance service. The Online service provides GNNS broadcast parameters, e.g. ephemeris, almanac plus time or rough position to reduce the receiver's time to first fix significantly and improve acquisition sensitivity. The extended validity of AssistNow Offline data (up to 35 days) and AssistNow Autonomous data (up to 6 days) provide faster acquisition after a long time.

Arduino nano:



This Arduino Nano is Original Arduino Nano Board. It is a breadboard-friendly board based on the ATmega328P from Arduino officials made in Italy. It has the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack and works with a Mini-B USB cable instead of a standard one.

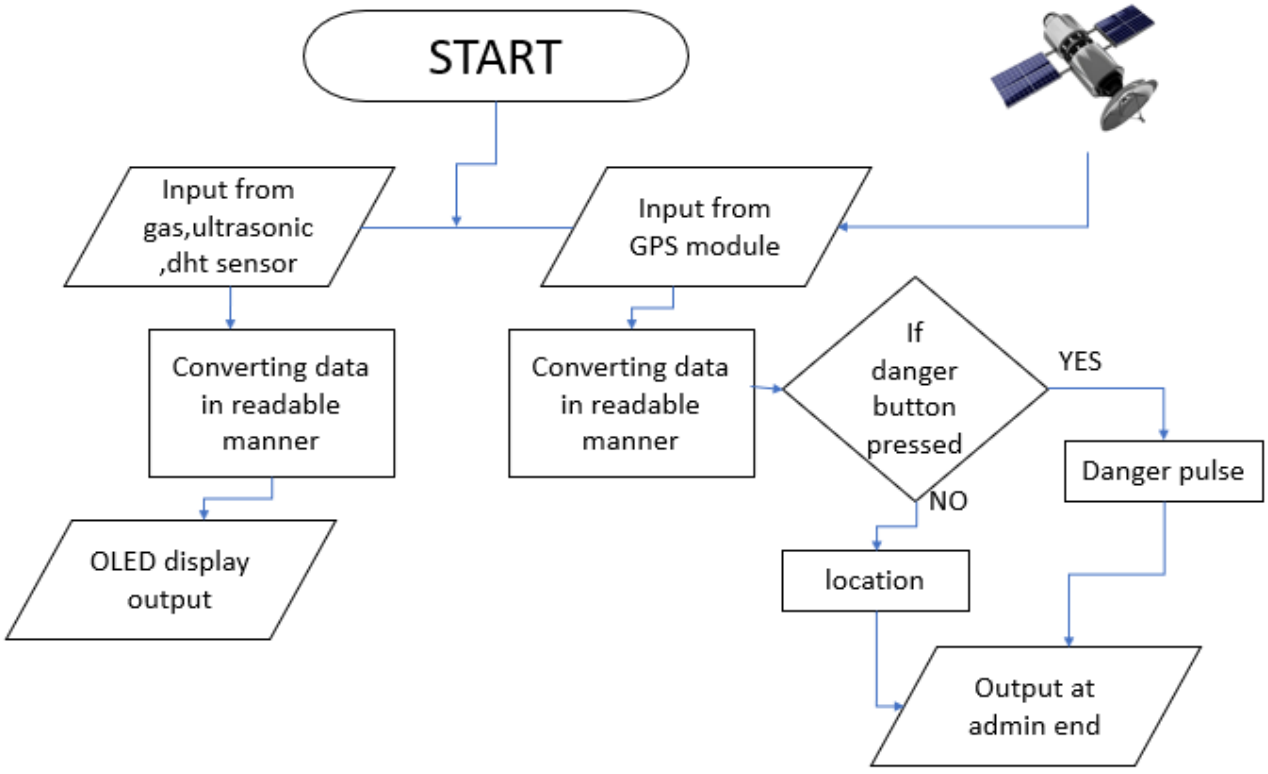
Original Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is the smallest, complete, and breadboard friendly. It has everything that Diecimila/Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The Nano is automatically sensing and switch to the higher potential source of power, there is no need for the power select jumper.
Nano's got the breadboard-ability of the Boarduino and the Mini USB with a smaller footprint than either, so users have more breadboard space. It has got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, GND on one top, power, and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It is two layers, which makes it easier to hack and more affordable.

Chapter 4
SOFTWARE, FLOW CHART

Software

We will be using the Arduino IDE for programming the microcontroller in order to manage and control the other all sensors

Flow chart



CHAPTER 5

FUTURE WORK PLAN (FOR SEMESTER VI)

The future work plan for semester 6 will be that we will be doing the physical configuration of our smart helmet and the integration of the circuits and different modules. While doing the physical configuration work we might be facing many different types of problem like configuration failure or might have problem with generating the real time outputs as it is the most essential part of our project (i.e. generating real time output) and checking if the battery lasts our desired time if not we have to change the battery with a larger capacity battery. We will be tackling all these types of problem in our project. The programming work will also be done in semester 6 as we do not have the hardware right now to program it. Testing will also be conducted during that time in all conditions to ensure that it is fully functional.

REFRENCES

Haven’t used in reference just google.com and ads.
while https://www.circuito.io/app?components=512,11021 this website was very useful for wiring checking and for component checking

BIBILOGRAPHY

https://www.youtube.com/watch?v=f6dZUQBPzN8

https://www.google.com/

https://www.google.com/imghp?hl=EN

https://datasheetspdf.com/

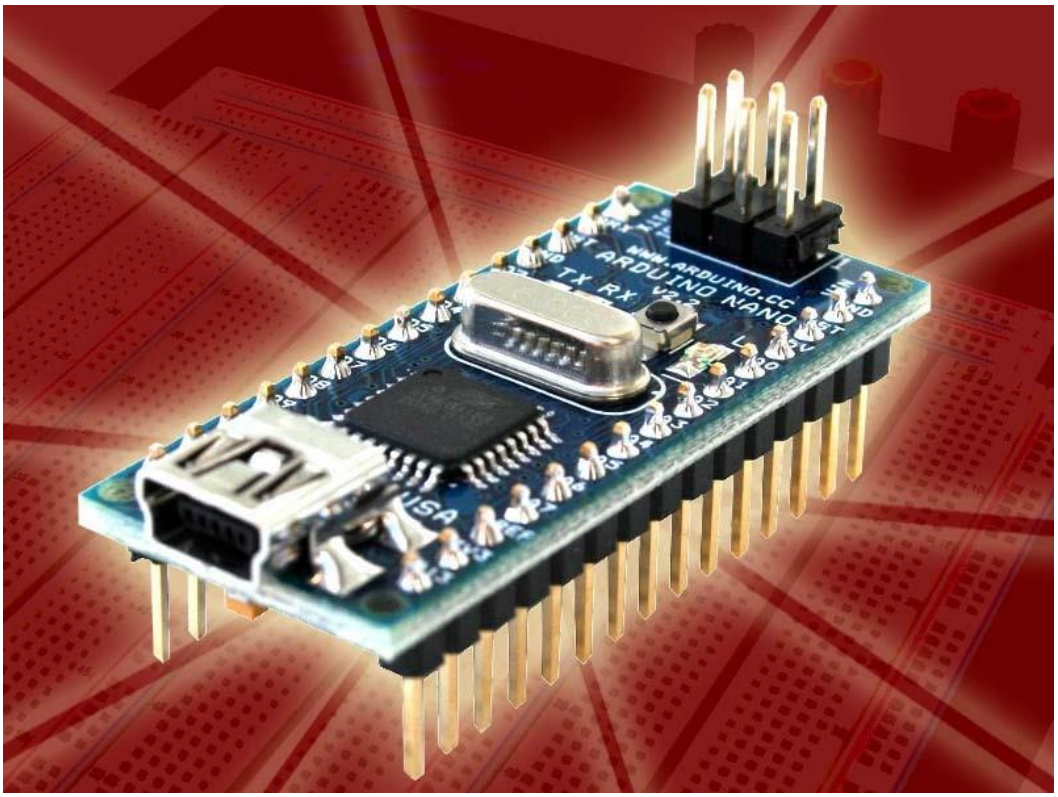
https://www.circuito.io/app?components=512,11021

APPENDIX-I

DATASHEET OF ARDUINO NANO:

Arduino Nano (V2.3)

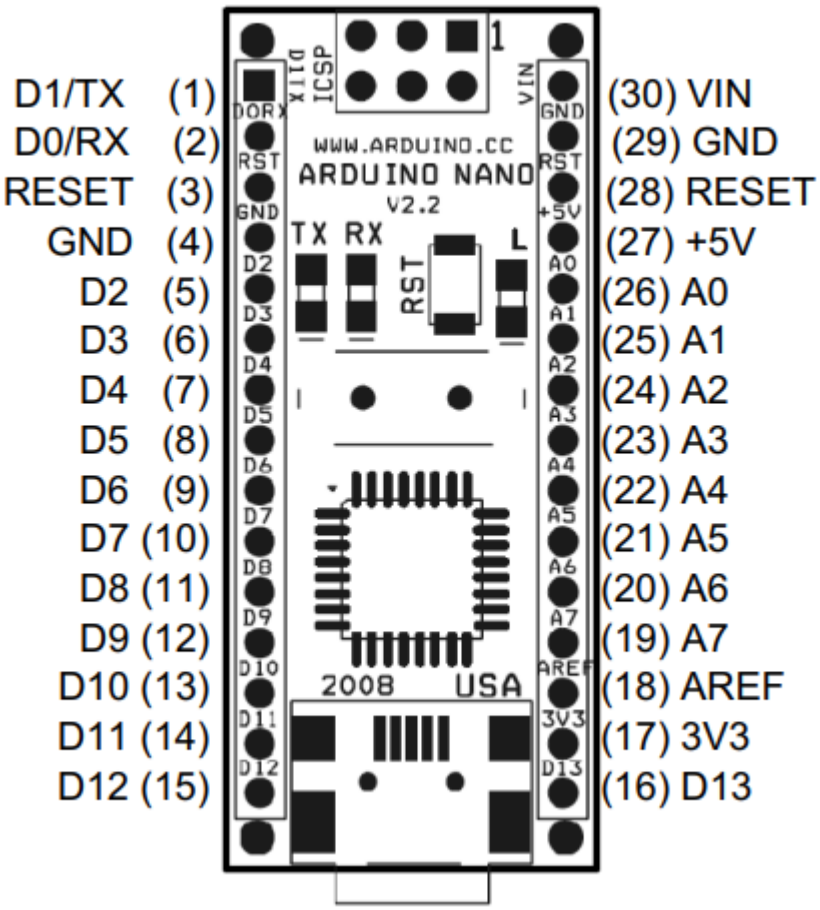
User Manual



More information:

www.arduino.cc Rev. 2.3

Arduino Nano Pin Layout



Pin No.	Name	Type	Description
1-2, 5-16	D0-D13	I/O	Digital input/output port 0 to 13
3, 28	RESET	Input	Reset (active low)
4, 29	GND	PWR	Supply ground
17	3V3	Output	+3.3V output (from FTDI)
18	AREF	Input	ADC reference
19-26	A7-A0	Input	Analog input channel 0 to 7
27	+5V	Output or Input	+5V output (from on-board regulator) or +5V (input from external power supply)
30	VIN	PWR	Supply voltage

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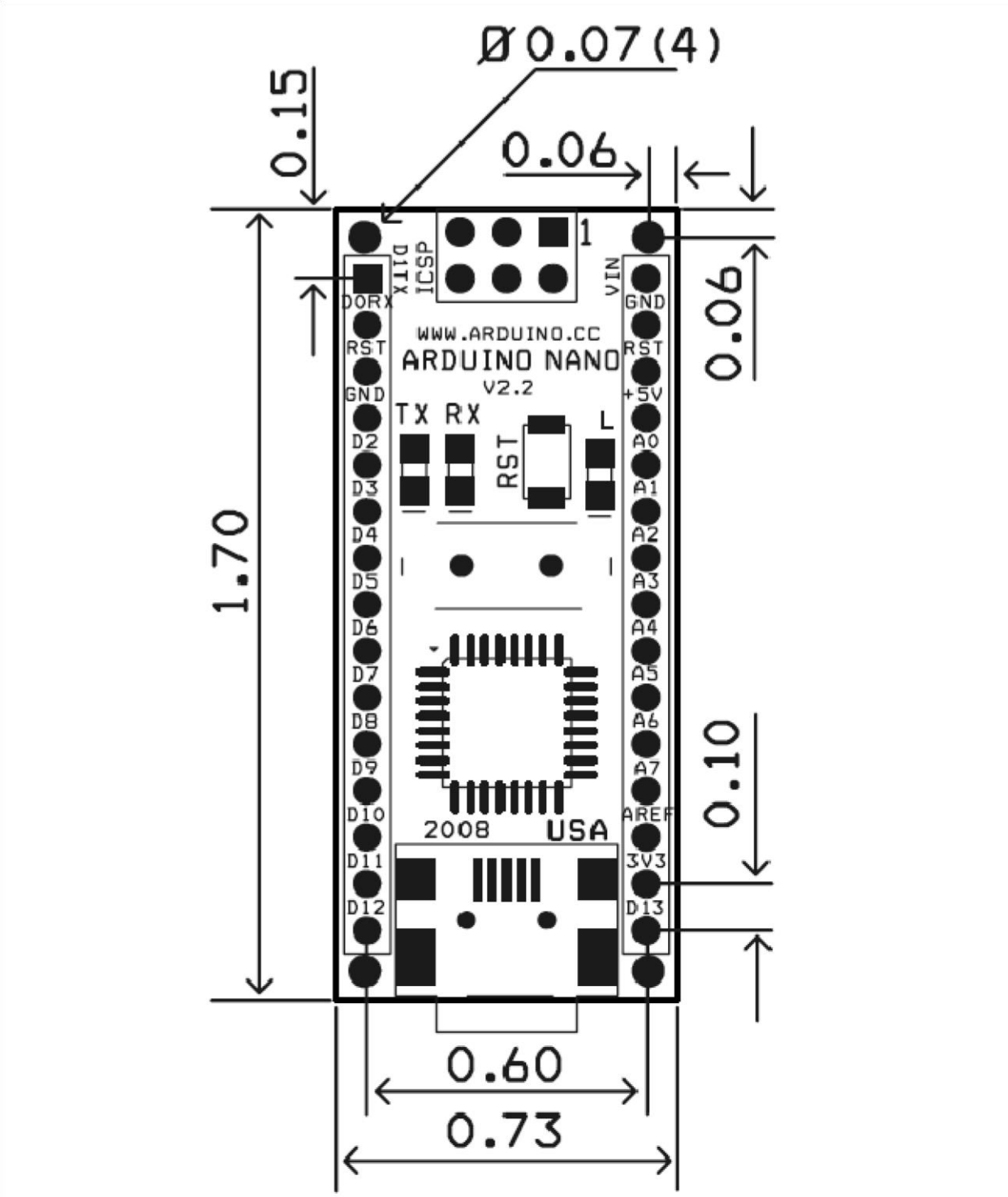
Arduino Nano Mechanical Drawing


Ø0.07(4)
0.15
0.06
0.06
1.70
0.10
0.60
0.73
WWW.ARDUINO.CC
ARDUINO NANO
V2.2
TX RX
RST
2008
USA
ALL DIMENTIONS ARE IN INCHES

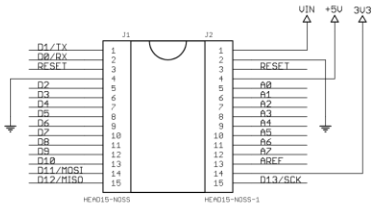
!

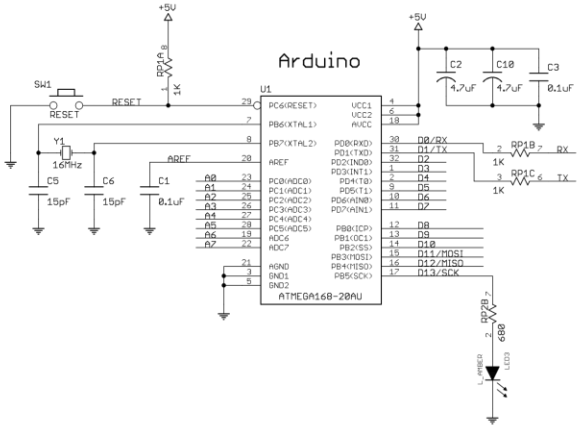
Arduino Nano Bill of Material

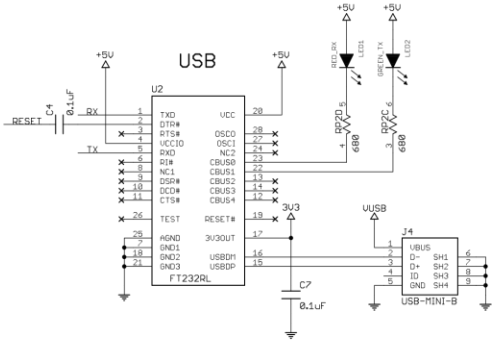
Item!Number!	Qty.!	Ref.!Dest.!	Description!	Mfg.!P/N!	MFG!	Vendor!P/N!	Vendor!
1!	5!	C1,C3,C4,C7,C9!	Capacitor,!0.1uF!50V!10%! Ceramic!X7R!0805!	C0805C104K5RACTU!	Kemet!	80"C0805C104K5R!	Mouser!
2!	3!	C2,C8,C10!	Capacitor,!4.7uF!10V!10%! Tantalum!Case!A!	T491A475K010AT!	Kemet!	80"T491A475K010!	Mouser!
3!	2!	C5,C6!	Capacitor,!18pF!50V!5%! Ceramic!NOP/COG!0805!	C0805C180J5GACTU!	Kemet!	80"C0805C180J5G!	Mouser!
4!	1!	D1!	Diode,!Schottky!0.5A!20V!	MBR0520LT1G!	ONSemi!	863"MBR0520LT1G!	Mouser!
5!	1!	J1,J2!	Headers,!36PS!1!Row!	68000"136HLF!	FCI!	649"68000"136HLF!	Mouser!
6!	1!	J4!	Connector,!Mini"B!Recept! Rt.!Angle!	67503"1020!	Molex!	538"67503"1020!	Mouser!
7!	1!	J5!	Headers,!72PS!2!Rows!	67996"272HLF!	FCI!	649"67996"272HLF!	Mouser!
8!	1!	LD1!	LED,!Super!Bright!RED! 100mcd!640nm!120degree! 0805!	APT2012SRCPRV!	Kingbright!	604"APT2012SRCPRV!	Mouser!
9!	1!	LD2!	LED,!Super!Bright!GREEN! 50mcd!570nm!110degree! 0805!	APHCM2012CGCK"F01!	Kingbright!	604"APHCM2012CGCK!	Mouser!
10!	1!	LD3!	LED,!Super!Bright!ORANGE! 160mcd!601nm!110degree! 0805!	APHCM2012SECK"F01!	Kingbright!	04"APHCM2012SECK!	Mouser!
11!	1!	LD4!	LED,!Super!Bright!BLUE! 80mcd!470nm!110degree! 0805!	LTST"C170TBKT!	Lite"On!Inc!	160"1579"1"ND!	Digikey!
12!	1!	R1!	Resistor!Pack,!1K!+/"5%! 62.5mW!4RES!SMD!	YC164"JR"071KL!	Yageo!	YC164J"1.0KCT"ND!	Digikey!
13!	1!	R2!	Resistor!Pack,!680!+/"5%! 62.5mW!4RES!SMD!	YC164"JR"07680RL!	Yageo!	YC164J"680CT"ND!	Digikey!
14!	1!	SW1!	Switch,!Momentary!Tact! SPST!150gf!3.0x2.5mm!	B3U"1000P!	Omron!	SW1020CT"ND!	Digikey!

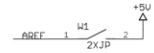
15!	1!	U1!	IC,!Microcontroller!RISC! 16kB!Flash,!0.5kB!EEPROM,! 23!I/O!Pins!	ATmega168"20AU!	Atmel!	556"ATMEGA168"20AU!	Mouser!
16!	1!	U2!	IC,!USB!to!SERIAL!UART!28! Pins!SSOP!	FT232RL!	FTDI!	895"FT232RL!	Mouser!
17!	1!	U3!	IC,!Voltage!regulator!5V,! 500mA!SOT"223!	UA78M05CDCYRG3!	TI!	595"UA78M05CDCYRG3!	Mouser!
18!	1!	Y1!	Cystal,!16MHz!+/"20ppm! HC"49/US!Low!Profile!	ABL"16.000MHZ"B2!	Abracon!	815"ABL"16"B2!	Mouser!

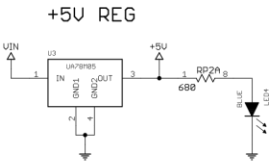
Arduino Nano Schematic

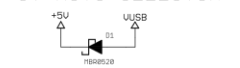


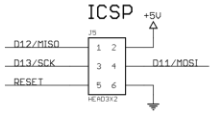


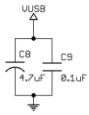












v2.3 - Modify FT232RL to use +5V	
TITLE: Arduino Nano	
Document Number:	REV: 2.3
Date: 6/26/2008 8:35:54 PM	Sheet: 1/1

DATASHEET OF HC-SR04:

HC-SR04 Ultrasonic Sensor

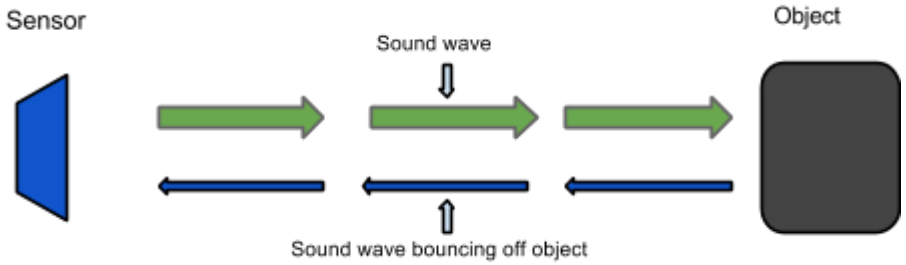
Elijah J. Morgan Nov.
16 2014

The purpose of this file is to explain how the HC-SR04 works. It will give a brief explanation of how ultrasonic sensors work in general. It will also explain how to wire the sensor up to a microcontroller and how to take/interpret readings. It will also discuss some sources of errors and bad readings.

1. **How Ultrasonic Sensors Work**
2. **HC-SR04 Specifications**
3. **Timing chart, Pin explanations and Taking Distance Measurements**
4. **Wiring HC-SR04 with a microcontroller**
5. **Errors and Bad Readings**

1. How Ultrasonic Sensors Work

Ultrasonic sensors use sound to determine the distance between the sensor and the closest object in its path. How do ultrasonic sensors do this? Ultrasonic sensors are essentially sound sensors, but they operate at a frequency above human hearing.



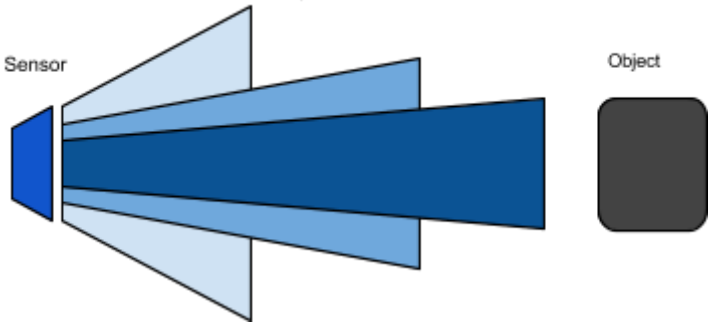
The sensor sends out a sound wave at a specific frequency. It then listens for that specific sound wave to bounce off of an object and come back (Figure 1). The sensor keeps track of the time between sending the sound wave and the sound wave returning. If you know how fast something is going and how long it is traveling you can find the distance traveled with equation 1.

Equation 1. $d = v \times t$

The speed of sound can be calculated based on the a variety of atmospheric conditions, including temperature, humidity and pressure. Actually calculating the distance will be shown later on in this document.

It should be noted that ultrasonic sensors have a cone of detection, the angle of this cone varies with distance, Figure 2 show this relation. The ability of a sensor to detect an object also depends on the objects orientation to the sensor. If an object doesn't present a flat surface to the sensor then it is possible the sound wave will bounce off the object in a way that it does not return to the sensor.

Figure 2



2. HC-SR04 Specifications

The sensor chosen for the Firefighting Drone Project was the HC-SR04. This section contains the specifications and why they are important to the sensor module. The sensor modules requirements are as follows.

- Cost
- Weight
- Community of hobbyists and support
- Accuracy of object detection
- Probability of working in a smoky environment
- Ease of use

The HC-SR04 Specifications are listed below. These specifications are from the Cytron Technologies HC-SR04 User's Manual (source 1).

- Power Supply: +5V DC
- Quiescent Current: <2mA
- Working current: 15mA
- Effectual Angle: <15º
- Ranging Distance: 2-400 cm
- Resolution: 0.3 cm
- Measuring Angle: 30º
- Trigger Input Pulse width: 10uS
- Dimension: 45mm x 20mm x 15mm
- Weight: approx. 10 g

The HC-SR04's best selling point is its price; it can be purchased at around $2 per unit.

3. Timing Chart and Pin Explanations

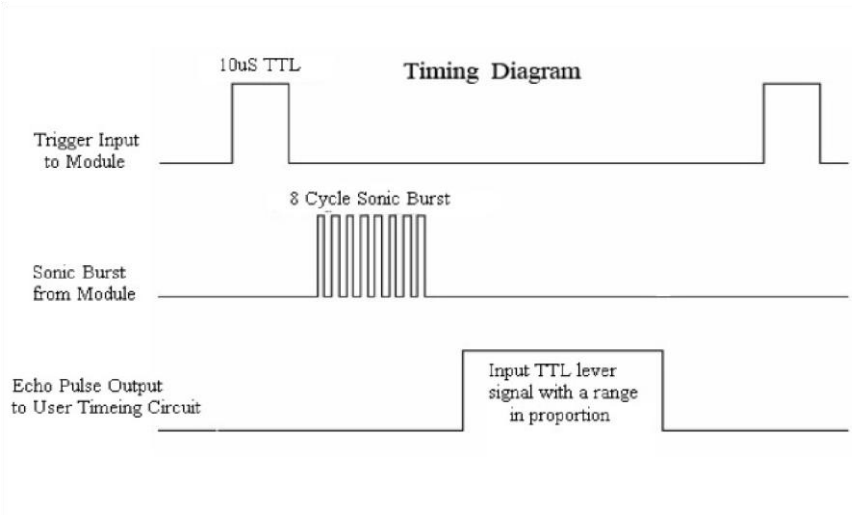
The HC-SR04 has four pins, VCC, GND, TRIG and ECHO; these pins all have different functions. The VCC and GND pins are the simplest -- they power the HC-SR04. These pins need to be attached to a +5 volt source and ground respectively. There is a single control pin: the TRIG pin. The TRIG pin is responsible for sending the ultrasonic burst. This pin should be set to HIGH for 10 µs, at which point the HC-SR04 will send out an eight cycle sonic burst at 40 kHZ. After a sonic burst has been sent the ECHO pin will go HIGH. The ECHO pin is the data pin -- it is used in taking distance measurements. After an ultrasonic burst is sent the pin will go HIGH, it will stay high
until an ultrasonic burst is detected back, at which point it will go LOW.

Taking Distance Measurements

The HC-SR04 can be triggered to send out an ultrasonic burst by setting the TRIG pin to HIGH. Once the burst is sent the ECHO pin will automatically go HIGH. This pin will remain HIGH until the the burst hits the sensor again. You can calculate the distance to the object by keeping track of how long the ECHO pin stays HIGH. The time ECHO stays HIGH is the time the burst spent traveling. Using this measurement in equation 1 along with the speed of sound will yield the distance travelled. A summary of this is listed below, along with a visual representation in Figure 2.

1. Set TRIG to HIGH
2. Set a timer when ECHO goes to HIGH
3. Keep the timer running until ECHO goes to LOW
4. Save that time
5. Use equation 1 to determine the distance travelled

Figure 3
Source 2



Source 2

To interpret the time reading into a distance you need to change equation 1. The clock on the device you are using will probably count in microseconds or smaller. To use equation 1 the speed of sound needs to determined,which is 343 meters per second at standard temperature and pressure. To convert this into more useful form use equation 2

to change from meters per second to microseconds per centimeter. Then equation 3 can be used to easily compute the distance in centimeters.

Equation 2. *Distance* = 17S0p.e1e5d *m* × M10e0t ecrms × 117e06.1 µ5S *m* × 58.7c7m2 µS

Equation 3. *Distance* = ti5m8e = µsµ/csm = *cm*

4. Wiring the HC-SR04 to a Microcontroller

This section only covers the hardware side. For information on how to integrate the software side, look at one of the links below or look into the specific microcontroller you are using.

The HC-SR04 has 4 pins: VCC, GND, TRIG and ECHO.

1. VCC is a 5v power supply. This should come from the microcontroller
2. GND is a ground pin. Attach to ground on the microcontroller.

3. TRIG should be attached to a GPIO pin that can be set to HIGH
4. ECHO is a little more difficult. The HC-SR04 outputs 5v, which could destroy many microcontroller GPIO pins (the maximum allowed voltage varies). In order to step down the voltage use a single resistor or a voltage divider circuit. Once again this depends on the specific microcontroller you are using, you will need to find out its GPIO maximum voltage and make sure you are below that.

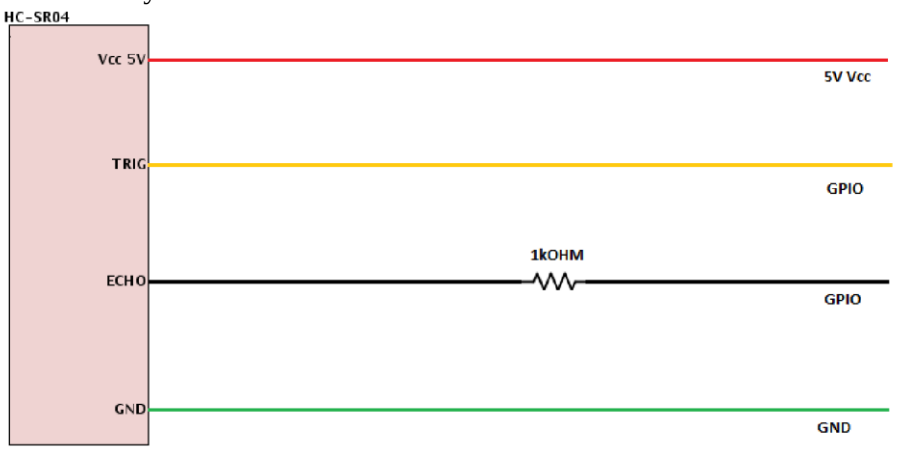
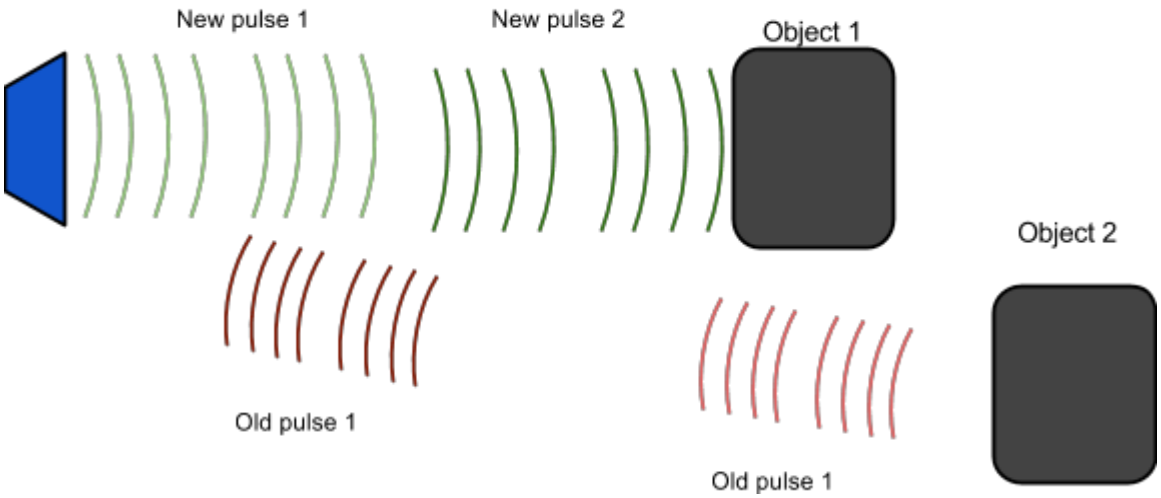


Figure 4

5. Errors and Bad Readings

Ultrasonic sensors are great sensors -- they work well for many applications where other types of sensors fall short. Unfortunately, they do have weaknesses. These weaknesses can be mitigated and worked around, but first they must be understood. The first weakness is that they use sound. There is a limit to how fast ultrasonic sensors can get distance measurements. The longer the distance, the slower they are at reporting the distance. The second weakness comes from the way sound bounces off of objects. In enclosed spaces it is possible, if not probable that there will be unintended echos. The echos can very easily cause false short readings. In Figure 2 a pulse was sent out. It bounced off of object 1 and returned to the sensor. The distance was recorded and then a new pulse was sent. There was another object farther away, so that when the new pulse reaches object 1, the first signal will reach the sensor. This will cause the sensor to think that there is an object closer than is actually true. The old pulse is smaller than the new pulse because it has grown weaker. The longer the pulse exists the weaker it grows until it is negligible. If multiple sensors are being used, the number of echos will increase along with the number of errors. There are two main ways to reduce the number of errors. The first is to provide shielding around the sensor. This prevents echos coming in from angle outside what the sensor should actually pick up. The second is to reduce the frequency at which pulses are sent out. This gives more time for the echos to dissipate.



Works Cited

Source 1.
"HC-SR04 User's_Manual." *docs.google.* Cytron Technologies, May 2013 Web. 5 Dec. 2009.
<https://docs.google.com/document/d/1Y-yZnNhMYy7rwhAgyL_pfa39RsB-x2qR4vP8s aG73rE/edit>

Source 2.
"Attiny2313 Ultrasonic distance (HR-SR04) example." *CircuitDB.* n.a. 7 Sept. 2014
Web. 5 Dec. 2014. <http://www.circuitdb.com/?p=1162>

Links

These are not formatted; you will need to copy and paste them into your web browser.

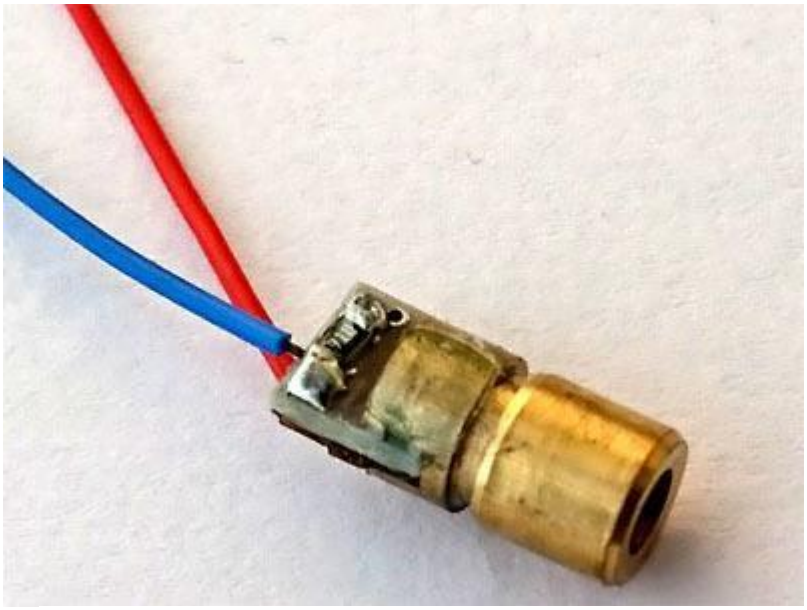
Want to learn about Ultrasonic Sensors in general?
http://www.sensorsmag.com/sensors/acoustic-ultrasound/choosing-ultrasonic-sensor-prox
imity-or-distance-measurement-825

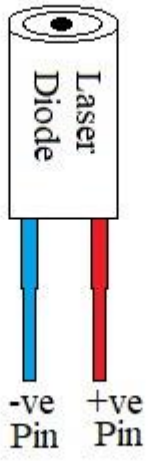
All about the HC-SR04

- http://www.circuitdb.com/?p=1162
- http://www.micropik.com/PDF/HCSR04.pdf
- http://randomnerdtutorials.com/complete-guide-for-ultrasonic-sensor-hc-sr04/
- http://www.ezdenki.com/ultrasonic.php
  (^fantastic tutorial, explains a lot of stuff)
- http://www.elecrow.com/hcsr04-ultrasonic-ranging-sensor-p-316.html (^ this one has some cool charts)

DATASHEET OF LASER DIODE:
Laser Diode (650nm)

20 November 2017 - 0 Comments





Laser Diode (650nm)

2 Pin laser diode pinout

[Click the image to enlarge it]

Features

- RoHS (Restriction of Hazardous Substances) Compliant
- Quality level is high
- Cost is economical
- Wavelength from 635 nm to 660 nm
- Rise and fall time is 0.5ns
- Package available:- TO-18(dia. 5.6mm), TO-5 (dia. 9 mm)

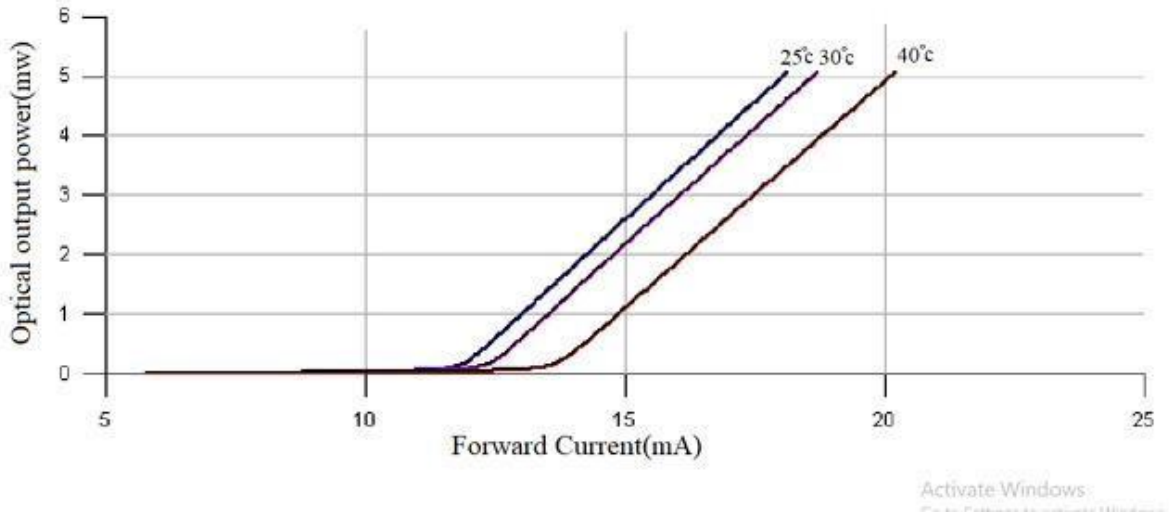
Technical Specification

- Operating Temperature:- -10〜+40 ℃
- Storage Temperature:- -15〜+85 ℃
- Output power (Po):- 5 mW
- Normal and maximum operating voltage is 2.2 and 2.7 respectively
- Threshold current in minimum, normal and maximum condition are 15, 20 and 30mA
- Operating current is 65 to 80mA
- Beam Angle deviation:-
- For both parallel and perpendicular condition its between -3 to 3 degree
- Beam divergence:-
- For parallel condition it's between 8 to 12 degree
- For perpendicular condition it's between 23 to 32 degree

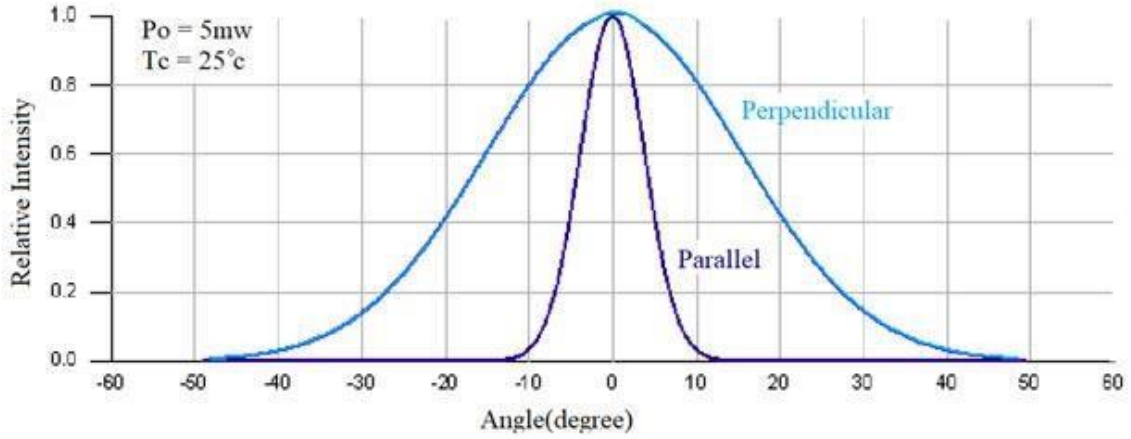
Characteristics Curves

1.Temperature Effect on Operation of Laser Diode

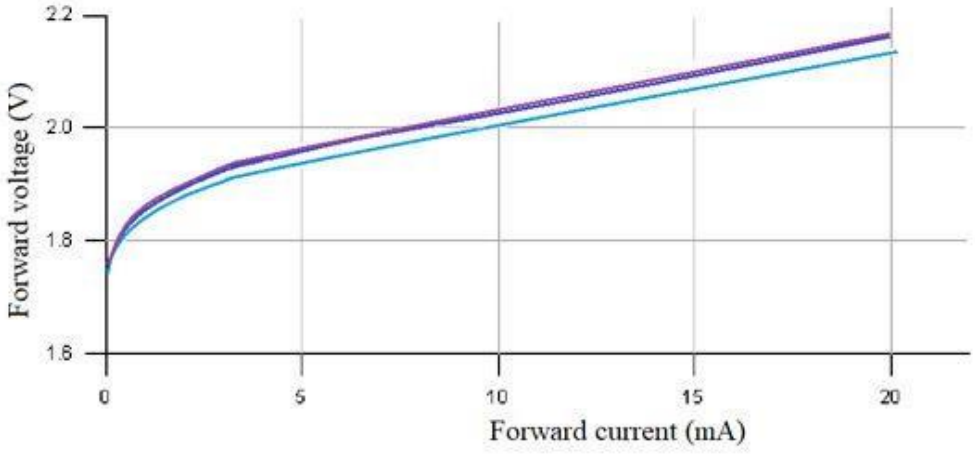
This graph is between Optical output power v/s forward current. It's clear from the graph that laser output will only be visible if obtained above the threshold value of the laser diode. Before the threshold value the output of the laser diode is zero. After the threshold value the output of laser diode increase with slightly increase in forward voltage. The **effect of temperature in the operation of Laser Diode** is shown in graph below:



2.Laser Beam Divergence in parallel and perpendicular plane

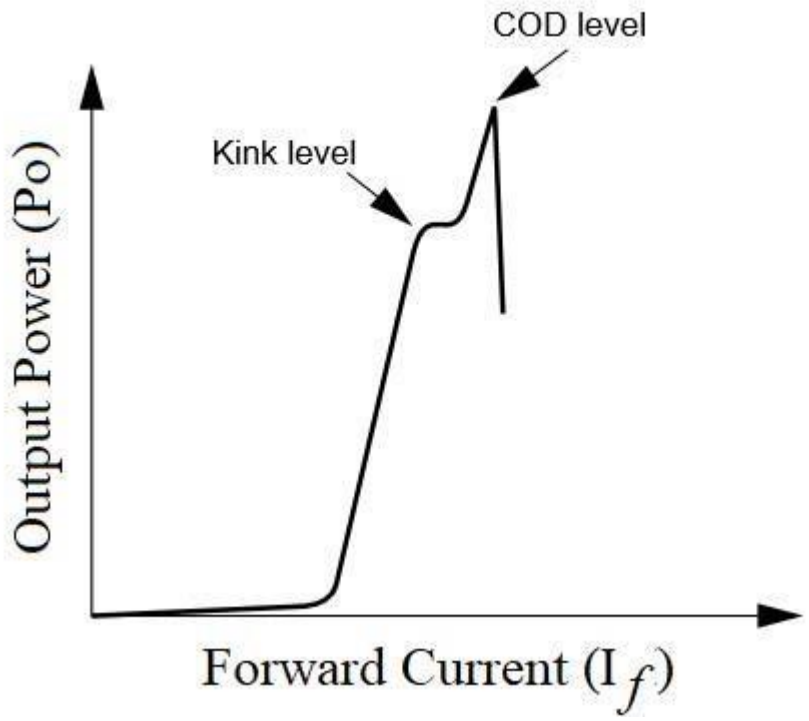


3.Forward voltage v/s Forward current



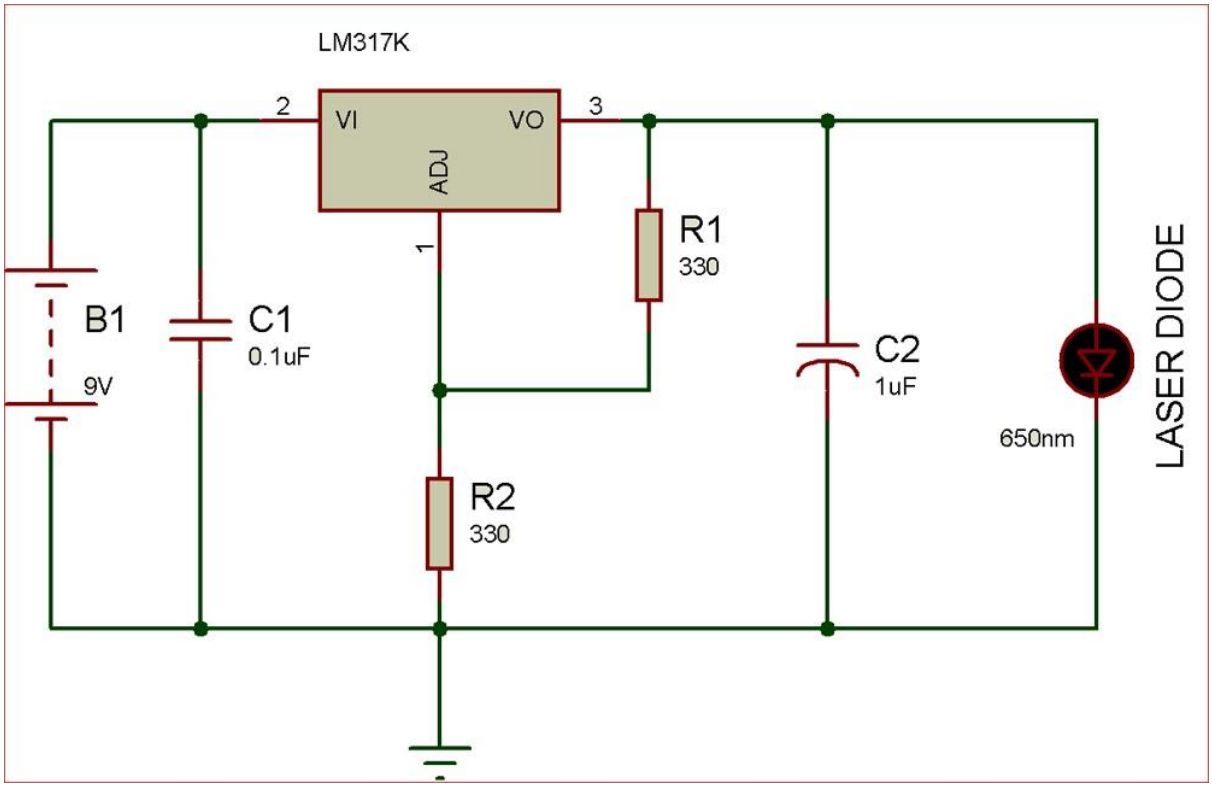
4.Output Power v/s Forward Current

If the direction of moving current is forward and the output is continuously increasing, after the kink level the laser face a sudden breakdown which is the COD (Catastrophic Optical Damage) level. At this level due to high optical density the crystal at the face of diode melts. At the time of manufacturing of Red lasers a special care is taken to avoid surge like static electricity and increase in current, because in red laser the oscillation is occur with the low power of 2 to 3 mW even after the breakdown. As the element is damaged the laser gets damaged or not able to work.



How to use a Laser Diode?

If we want to operate a **Laser diode** then we must have **laser diode driver circuit**. As it helps in limiting current then supply it to laser diode. A laser diode can only work properly with the help of this circuit, if we directly connect it to the supply, because of having more current it will damage and if the value of current is low then the laser diode will not operate. Laser Diode driver circuit helps in providing a correct value of current to operate the laser diode. For making a laser diode driver circuit we need a few no. of components like resistor, capacitor and a voltage regulator IC.

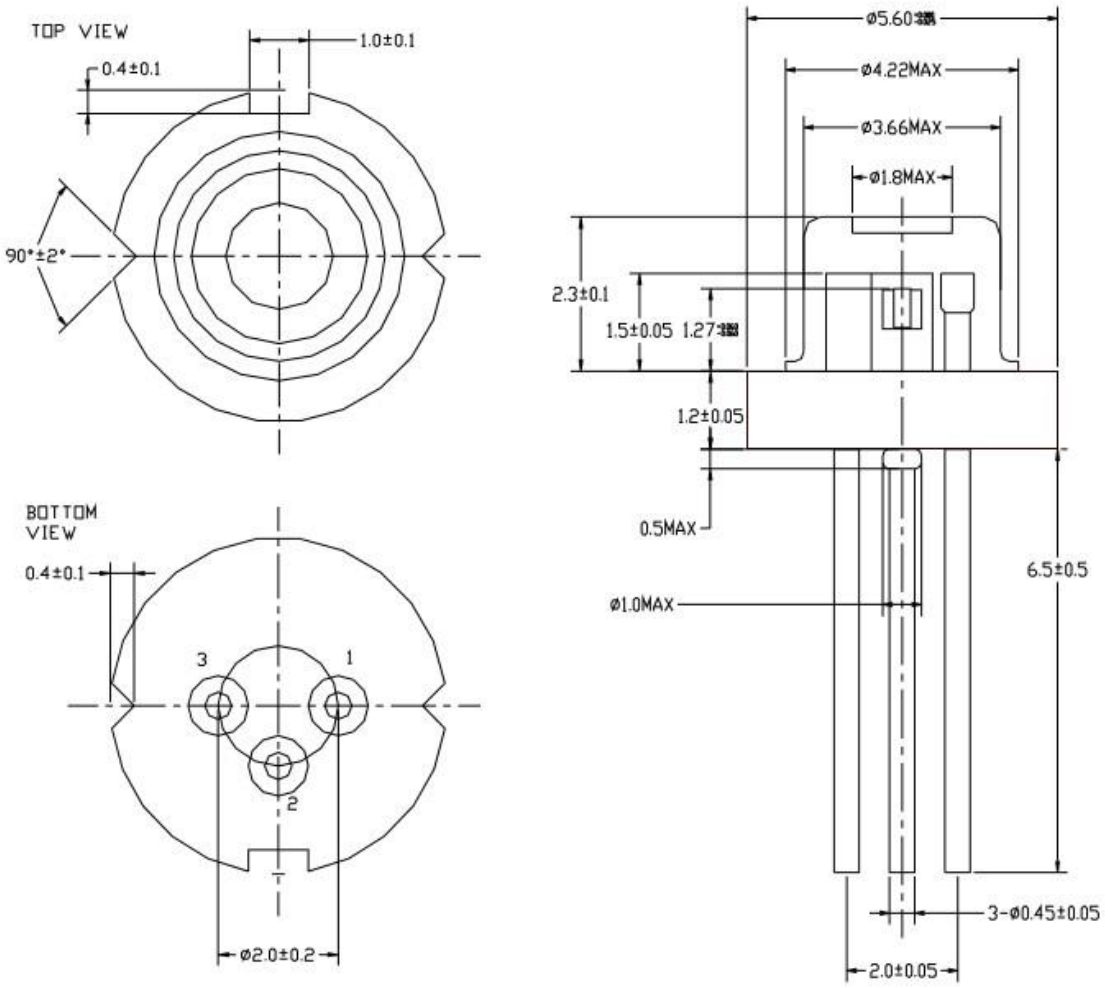


The first capacitor in the circuit filter the High-frequency noise from the DC supply. The second capacitor works as power load balancer used to filter the fluctuating signals of output voltage. And a voltage regulator IC is used to provide a fix output voltage and we can adjust the output voltage by changing the value of resistor. You can use a potentiometer instead of resistor (R2) to adjust the intensity of laser light.

Applications

- **Industrial applications:** Engraving, cutting, scribing, drilling, welding, etc.
- **Medical applications:** to remove unwanted tissues, diagnostics of cancer cells using fluorescence, dental medication.
- Telecommunication
- Military application
- Data storage

2D-Model


TOP VIEW
1.0±0.1
0.4±0.1
90°±2°
BOTTOM
VIEW
0.4±0.1
3
1
2
ø2.0±0.2
ø5.60
ø4.22MAX
ø3.66MAX
ø1.8MAX
2.3±0.1
1.5±0.05
1.27
1.2±0.05
0.5MAX
ø1.0MAX
6.5±0.5
3-ø0.45±0.05
2.0±0.05

DATASHEET OF MQ-9:

TECHNICAL DATA MQ-9 GAS SENSOR

FEATURES

* High sensitivity to carbon monoxide and CH_4, LPG.
* Stable and long life

APPLICATION

They are used in gas detecting equipment for carbon monoxide and CH_4, LPG in family and industry or car.

SPECIFICATIONS

A. Standard work condition

Symbol	Parameter name	technical condition	Remark
Vc	circuit voltage	5V±0.1	AC or DC
V_H (H)	Heating voltage (high)	5V±0.1	AC or DC
V_H (L)	Heating voltage (low)	1.4V±0.1	AC or DC
R_L	Load resistance	Can adjust	
R_H	Heating resistance	33Ω ±5%	Room temperature
$T_{H(H)}$	Heating time (high)	60±1 seconds	
$T_{H(L)}$	Heating time (low)	90±1 seconds	
Ps	Heating consumption	Less than 340mw	

b. Environment conditions

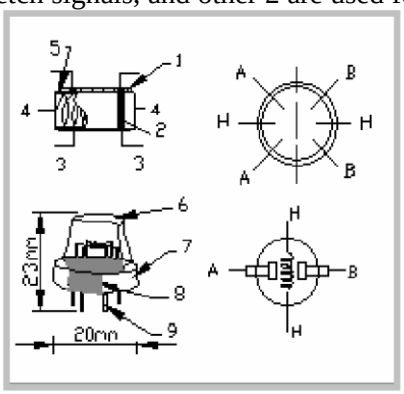
Symbol	Parameters	Technical conditions	Remark
Tao	Using temperature	-20℃…+50℃	
Tas	Storage temperature	-20℃…+50℃	Advice using scope
RH	Relative humidity	Less than 95%RH	
O_2	Oxygen concentration	21%(stand condition) the oxygen concentration can affect the sensitivity characteristic	Minimum value is over 2%

c. Sensitivity characteristic

symbol	Parameters	Technical parameters	Remark
Rs	Surface resistance Of sensitive body	2-20k	In 100ppm Carbon Monoxide
a (300/100ppm)	Concentration slope rate	Less than 0.5	Rs (300ppm)/Rs(100ppm)
Standard working condition	Temperature -20℃±2℃ relative humidity 65%±5% RL:10KΩ ±5%		
	Vc:5V±0.1V VH:5V±0.1V VH:1.4V±0.1V		
Preheat time	No less than 48 hours	Detecting range:20ppm-2000ppm carbon monoxide 500ppm-10000ppm CH_4 500ppm-10000ppm LPG	

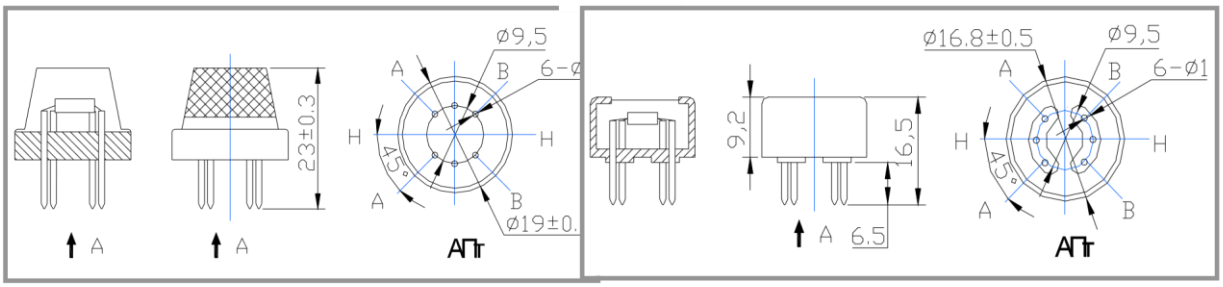
D. Structure and configuration, basic measuring circuit

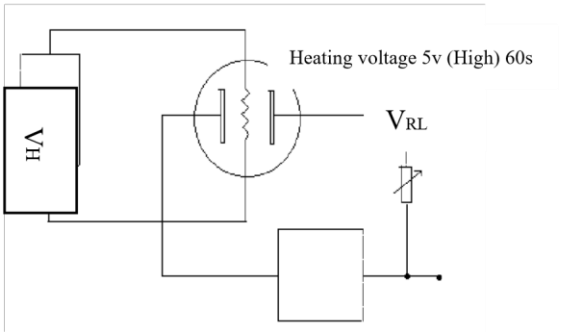
Structure and configuration of MQ-9 gas sensor is shown as Fig. 1 (Configuration A or B), sensor composed by micro AL_2O_3 ceramic tube, Tin Dioxide (SnO_2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-9 have 6 pins ,4 of them are used to fetch signals, and other 2 are used for providing heating current.



	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Tube Pin	Copper plating Ni

Fig.1





Standard circuit:

As shown in Fig 2, standard measuring circuit of MQ-9 sensitive components consists of 2 parts. one is heating circuit having time control function (the high voltage and the low voltage work circularly). The second is the signal output circuit, it can accurately respond changes of surface resistance of the sensor.

Electric parameter measurement circuit is shown as Fig.2

E. Sensitivity characteristic curve

Fig.3 is shows the typical sensitivity characteristics of

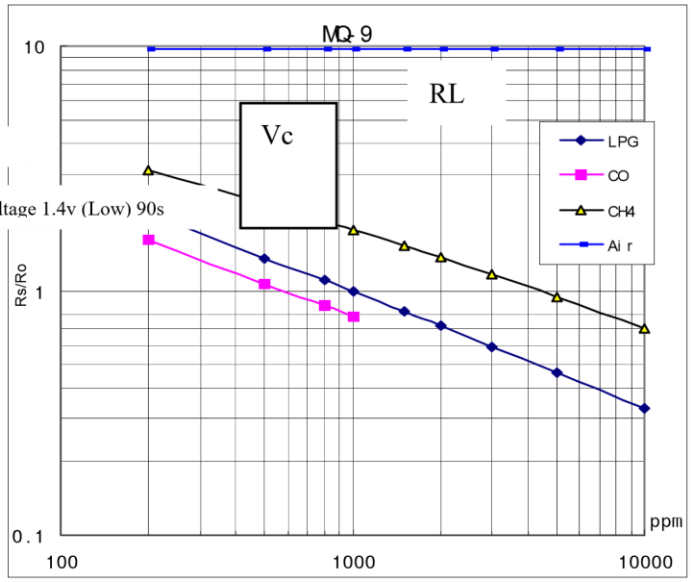


Fig.2

Heating voltage 1.4v (Low) 90s

Fig.3 sensitivity characteristics of the MQ-9

the MQ-9 for several gases.
in their: Temp: 20℃、
Humidity: 65%、
O_2 concentration 21%
RL=10kΩ
Ro: sensor resistance at 1000ppm LPG in the clean air.
Rs: sensor resistance at various concentrations of gases.

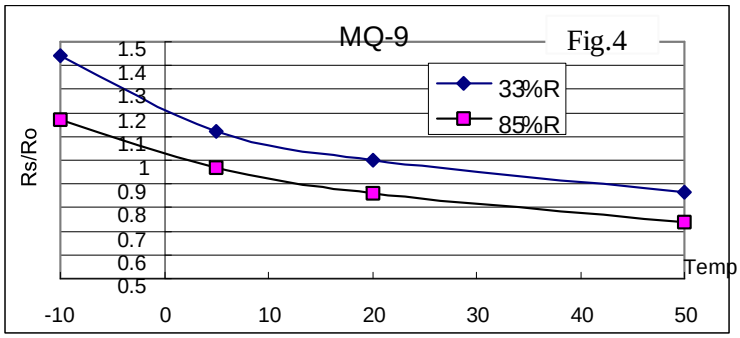


Fig.4 is shows the typical dependence of the MQ-9 on temperature and humidity.
Ro: sensor resistance at 1000ppm LPG in air at 33%RH and 20degree.
Rs: sensor resistance at 1000ppm LPG at different temperatures and humidities.

OPERATION PRINCIPLE

. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

Rs\RL = (Vc-VRL) / VRL

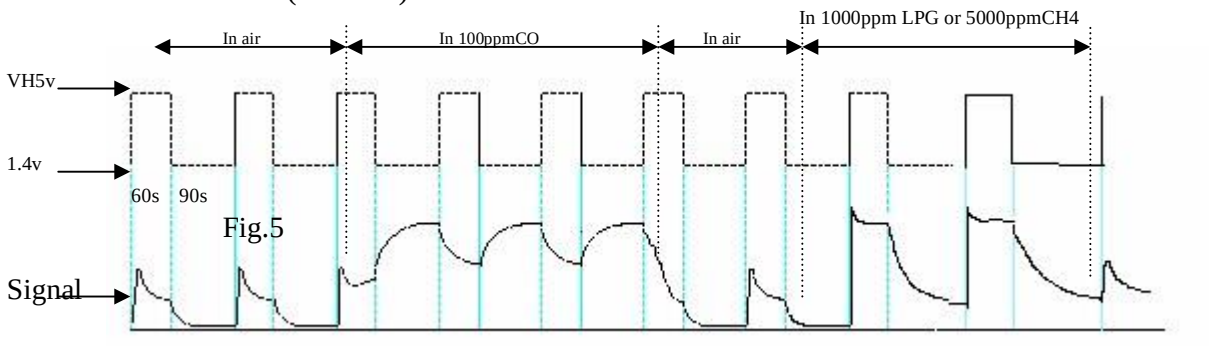


Fig.5

Fig. 5 shows alterable situation of RL signal output measured by using Fig. 2 circuit output signal when the sensor is shifted from clean air to carbon monoxide (CO) or CH_4, output signal measurement is made within one or two complete heating period (2.5 minute from high voltage to low voltage).

Sensitive layer of MQ-9 gas sensitive components is made of SnO_2 with stability, So, it has excellent long term stability. Its service life can reach 5 years under using condition.

SENSITVITY ADJUSTMENT

Resistance value of MQ-9 is difference to various kinds and various concentration gases. So, When

using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 200ppm and 5000ppm CH_4 or 1000ppm LPG concentration in air and use value of Load resistance that(R_L) about 20 KΩ (10KΩ to 47 KΩ).

When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

The sensitivity adjusting program:

a. Connect the sensor to the application circuit.

b. Turn on the power, keep time of preheating through electricity is over 48 hours.

c. Adjust the load resistance RL until you get a signal value which is respond to a certain carbon monoxide concentration at the end point of 90 seconds.

d. Adjust the another load resistance RL until you get a signal value which is respond to a CH_4 or LPG concentration at the end point of 60 seconds .