

HAZARDOUS GAS DETECTION IN COAL MINES

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Abstract - In coal mines there square measure such a big amount of venturous gases that square measure gift displaces the mandatory gas to support the human life, so it's necessary to develop such a technology to live the extent of the harmful gases therein atmosphere that facilitate U.S.A. to save lots of the lifetime of men that square measure operating in such atmosphere. Every device has its own advantage and operating. Some device square measure higher for sensing the gases and a few square measure uses for the ignitable gases detection. The paper enumerates the in operation principle, working, procedure and application of various varieties of harmful and ignitable gases in venturous areas.

Key Words: Gas device, applied science

1. INTRODUCTION

In underground coal pit there are a unit powerful operating condition and unsafe setting attributable to that a lot of accidents and large loss of properties happens. These accidents have style of causes, explosive rise of gases like methane series, CO, dioxide, dioxide, oxygen, chemical element sulfide, chemical element owing to the presence of those entire gases short chemical element for coal pit employee to breadth. Thus so as for triple-crown growth of coal mining trade and for safety of employees it's necessary to develop technologies and realize the ways in which so as to form space dangerous free.

To maintain the atmosphere within accurately the primary and for many steps is often observance the amount of gases. This essentially offers and rough plan to the relating to long and short term trending info and provides the first info or the warning against each dangerous areas wherever the miners ordinarily works. This warning prevents the manual laborer to travel to the risky areas alternatively safety is assured

1.1 Hazardous areas

Dangerous locations or the area unit as are the places wherever fireplace or explosion might exist due following reasons:

1- Flammable gases.

2- Inflammable liquid-produced vapors.

3- Combustible liquid-produced vapors.

4- Flammable dusts and burnable fibers/flying.

1.2 Combustible gases

The Combustible gases are the gases which will burn once mixed with gas and ignite. Typically, most combustion reactions involve the burning of organic materials containing carbon and gas. Combustion reactions are essential to life, and are exploited to come up with power, to supply heat to run motors and in several different ways that.

Some flammable gases are:

- Carbon oxide (CO),
- Hydrogen (H₂),
- Carbon oxide (CO₂),
- Methane (CH₄),
- Water vapor (H₂O)–from coal and water, air and/or gas

2. Abbreviations

Toxic gases are harmful in lower ranges over an extended amount of your time and in higher ranges for shorter amount of your time. Totally different countries has its own TLVs i.e. threshold price limit for toxic gases so as to advance the employee protection.

Units

TLV of a chemical substance could be a level to that it's believed an employee may be exposed day when day for operating lifespan while not adverse effects.

There are 3 varieties of TLVs

1-Time weighted average (TWA):

TWA is employed to calculate a staff daily exposure to a dangerous substance or agent, averaged to associate degree 8hrs workday, taking into consideration the typical level of the substance or agent and therefore the time spent within the space.

2-Short term exposure limits (STEL):

STEL is that the acceptable average exposure over a brief amount of your time typically quarter-hour as long because the time weighted average isn't exceeded. STEL could be a term utilized in activity health, industrial hygiene and pharmacology.

3- Ceiling Limit (CL):

The concentration that ought to not be exceeded at any time. This can be relevant for the foremost deadly substances or people who turn out an instantaneous botheration impact

Table -1: List of gases and there hazardous effect

Table 1: List of gases and their hazardous limits in underground mines [2]

Name of gas	Flammability limits in air (%)	Guideline for TLVs	Hazards
Oxygen		>19.5%	Oxygen deficiency, may cause explosive mixtures with reactive gases
Nitrogen		CL = 81,000 ppm	Inert
Methane	5 to 15	At 1% isolate electricity, at 2% remove personnel.	Explosion
Carbon dioxide		TWA = 0.5%, STEL = 3.0%, CL = 1.5%	Promotes increased rate of respiration
Carbon monoxide	12.5 to 74.5	TWA = 0.005%, STEL = 0.04%, CL = 200 ppm	Highly toxic; explosive
Sulphur dioxide		TWA = 2 ppm, STEL = 5 ppm, CL = 10 ppm	Very toxic; irritant to eyes throat and lungs
Nitric oxide		TWA = 50 ppm	Oxidizes rapidly to NO ₂
Nitrous oxide		TWA = 50 ppm	Narcotic (laughing gas)
Nitrogen dioxide		TWA = 3 ppm, CL = 5 ppm	Very toxic; throat and lung irritant; pulmonary infections
Hydrogen sulphide	4.3 to 45.5	TWA = 10 ppm, STEL = 15ppm, CL = 15ppm	Highly toxic; irritant to eyes and respiratory tracts; explosive
Hydrogen	4 to 74.2		Highly explosive

Gas detection sensors:

The basic perform of gas sensor to detect the presence of varied gases at intervals areas usually as apart of safety systems. Relying upon the concentration of gas these sensors provides direct response if the concentration exceeds the threshold limit worth .It will sound associate degree alarm to close personal and additionally offer totally different indications like increasing the ventilations, switch off the facility provide.

MQ2 sensor :[5]

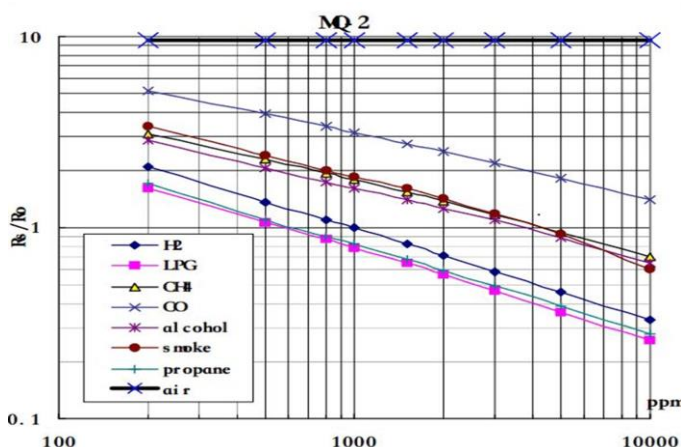


Chart -1: Sensitivity characteristics of MQ2

MQ2 is that the gas detection detector, it is module useful for gas discharge detection. It’s applicable for police work the H₂, LPG, CH₄, CO, Alcohol, and Smoke. Owing to its high

sensitivity and fast latency, measurement could also be taken as presently as potential.

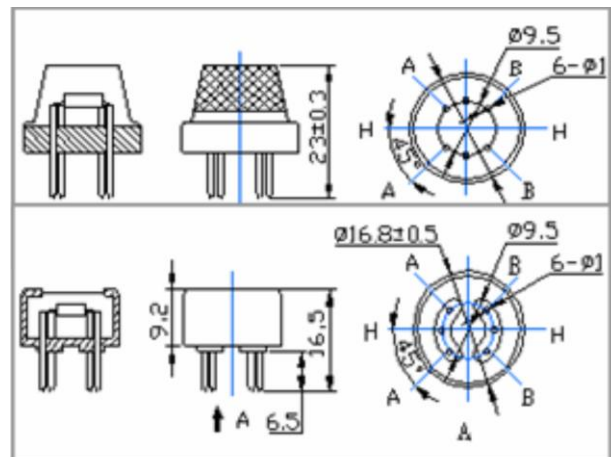


Fig -1: MQ2 Sensor

Character Configuration:

- *Good sensitivity to inflammable gas in wide range
- * High sensitivity to LPG, fuel and number one
- * Long life and low value
- * Straight forward drive circuit

Application:

- * Domestic gas discharge detector
- * Industrial inflammable gas detector
- * Movable gas detector

MQ135 sensor:[3]

SEM MQ135 gas device has high sensitivity to ammonia, sulfide and aromatic hydrocarbon. The sensitivity material of MQ135 gas device is SnO₂ that with lower conduction in clean air.

It’s used for encompassing setting toxic gas detection device. Apply these to ammonia, aromatic hydrocarbon and different harmful gases its testing concentration vary is regarding ten to 1000ppm .

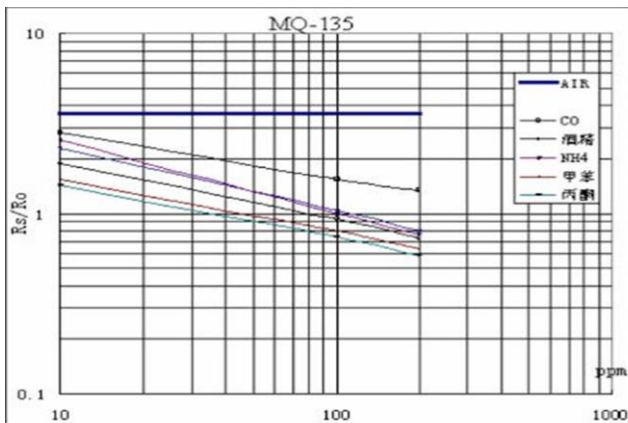


Chart -2: Sensitivity characteristics of MQ135

Features:

- ⊗ Wide sleuthing scope quick response and High sensitivity
- ⊗ Stable and long life straightforward drive circuit

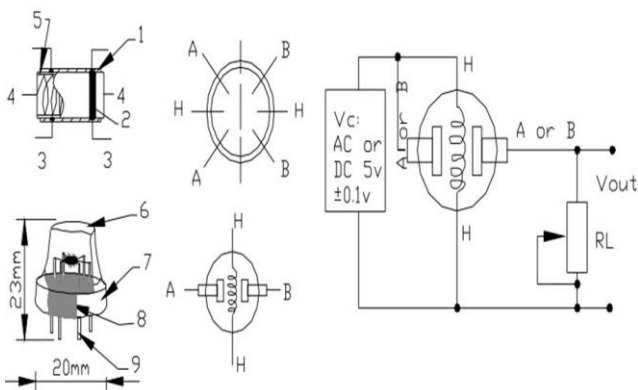


Fig -2: MQ135 Sensor

Application.:

They are utilized in air internal control instrumentality for buildings/offices, are appropriate for sleuthing of NH₃, NO_x, alcohol, Benzene, smoke, CO₂, etc.

MQ4 sensor :[4]

This is a straightforward to use compressed gas device, appropriate for sensing gas (composed of principally methane) concentration within the air.

The MQ4 will observe gas concentrations anyplace from two hundred to 10000ppm. This device incorporate a high sensitivity and quick latent period.

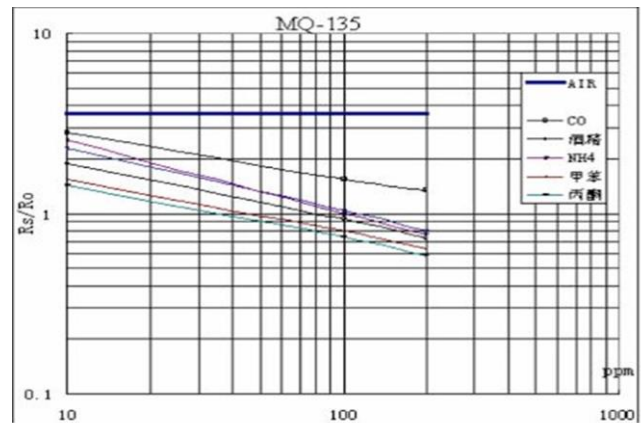


Chart -3: Sensitivity characteristics of MQ4

Features:

- * High sensitivity to CH₄, Natural gas.
- * Little sensitivity to alcohol, smoke.
- * Quick response.
- * Stable and long life
- * Straight forward drive circuit

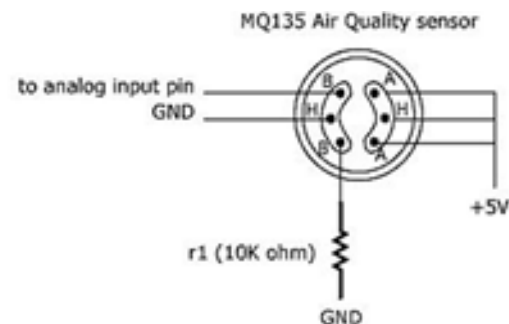


Fig -3: Sectional view

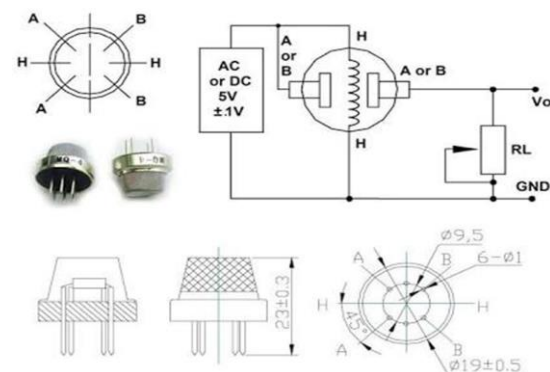


Fig -4: MQ4 Sensor

Application:

They are utilized in gas escape detection equipment's in family and business, square measure appropriate for detection of CH₄, Natural gas. LNG, avoid the noise of alcohol and alter of state fumes and fag smoke.

ATmega328

ATmega328 could be a low power eight bit microcontroller supported AVR increased risk design.

By death penalty powerful instruction in an exceedingly single clock cycle the ATmega328 achieves throughputs near 1MIPS per MHz that empowers system designed to optimize the device for power consumption versus process speed.

It has an upscale instruction set with a 2} general purpose registers that are connected on to ALU (arithmetic logical unit) which allows two freelance register to be processed in an exceedingly single instruction that's dead in an exceedingly one clock cycle.

The ATmega328/P provides the following features:

32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, twenty 3general purpose I/O lines, 32general purpose operative registers, Real Time Counter (RTC), 3 versatile Timer/Counters with compare modes and PWM, one serial programmable USARTs , one byte-oriented 2-wire Serial Interface (I2C), a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal generator, associate SPI port, and 6 code selectable power saving modes. The Idle mode stops the instrumentation whereas permitting the SRAM; Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the generator, Disabling all numerous chip Functions till succeeding interrupt or hardware reset.

In Power-save mode, the asynchronous timer continues to run; permitting the user to stay up a timer base where as a result of the remainder of the device is sleeping. The ADC Noise Reduction mode stops the instrumentation and each one I/O modules except asynchronous timer and ADC to cutback amendment noise throughout ADC conversions. In Standby mode, the crystal/resonator generator is running whereas the remainder of the device is sleeping.

This enables in no time start-up combined with low power consumption. In Extended Standby mode, every the foremost generators and additionally the asynchronous timer still run.

The device is store-bought victimization Atmel's high density non-volatile memory technology. The On-chip ISP Flash permits the program memory to be reprogrammed In-System through Associate in Nursing SPI serial interface, by a standard nonvolatilisable memory computer user, or by Associate in Nursing On-chip Boot program running on the AVR core. The Boot program can use any interface to transfer the applying program inside the applying Flash memory.

Software inside the Boot Flash section will still run whereas the applying Flash section is updated, providing true Read-While-Write operation. By combining Associate in Nursing 8-bit reduced instruction set computing constituent with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega328/P could also be a strong microcontroller that provides a extraordinarily versatile and value effective answer to many embedded management applications.

The ATmega328/P is supported with a full suite of program and system development tools in conjunction with C Compilers, Macro Assemblers, and Program Debugger/Simulators, In-Circuit Emulators, and analysis kits.

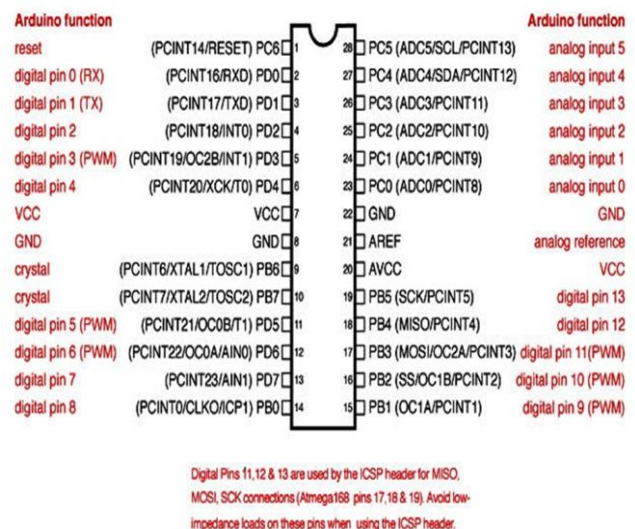


Fig -5: ATmega328

1. VCC:

Digital provides voltage.

2. GND:

Ground.

3. Port B (PB [7:0]) XTAL1/XTAL2/TOSC1/TOSC2:

Port B is Associate in Nursing 8-bit bi-directional I/O port with internal pull-up resistors (selected for every bit). The Port B output buffers have symmetrical drive characteristics with each high sink and supply capability.

As inputs, Port B pins that area unit outwardly force low can supply current if the pull-up resistors area unit activated. The Port B pins area unit tri-stated once a reset condition becomes active, albeit the clock isn't running.

4. Port C (PC [5:0]):

Port C could be a 7-bit bi-directional I/O port with internal pull-up resistors (selected for every bit). The PC [5:0] output buffers have symmetrical drive characteristics with each high sink and supply capability. As inputs, Port C pins that area unit outwardly force low can supply current if the pull-up resistors area unit activated. The Port C pins area unit tri-stated once a reset condition becomes active, albeit the clock isn't running.

5. PC6/RESET:
Note that the electrical characteristics of PC6 differ from If the RSTDISBL Fuse is programmed, PC6 is employed as associate I/O pin. Those of the other pins of Port C. If the RSTDISBL Fuse is un programmed, PC6 is used as a Reset input. . a coffee level on this pin for extended than the minimum pulse length can generate a Reset, even though the clock isn't running. Shorter pulses are not guaranteed to generate a Reset.

The various special features of Port Care elaborated in the Alternate Functions of Port C section.

6. Port D (PD [7:0]):

Port D is associate 8-bit bi-directional I/O port with internal pull-up resistors (selected for every bit). The Port D output buffers have symmetrical drive characteristics with each high sink and provide capability.

As inputs, Port D pins that square measure outwardly force low can supply current if the pull-up resistors square measure activated. The Port D pins square measure tri-stated once a reset condition becomes active, albeit the clock isn't running.

7. AVCC:

AVCC is that the provide voltage pin for the A/D convertor,

PC [3:0], and letter [3:2]. It ought to be outwardly connected to VCC, albeit the ADC isn't used. If the ADC is employed, it ought to be connected to VCC through a low-pass filter. Note that laptop [6:4] use digital provide voltage, VCC.

8. AREF:

AREF is that the analog reference pin for the A/D convertor.

9. ADC [7:6] (TQFP and VFQFN Package Only):

In the TQFP and VFQFN package, ADC [7:6] is analog inputs to the A/D convertor. These pins square measure Powered from the analog provide and function 10-bit ADC channels.

3. CONCLUSIONS

Sensors facilitate to keep safe and healthy atmosphere by continuous watching it. With the advance development several devices are gift currently days however no single sensor is in a position to sight each gas exactly.

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REFERENCES

- [1] A.Kumar*, T.M.G. Kingson, R.P. Verma, A. Kumar, R. Mandal, S. Dutta, S.K. Chaulya and G.M. Prasad CSIR-Central Institute of Mining and Fuel Research, Dhanbad, India, "Application of Gas Monitoring Sensors in Underground Coal Mines and Hazardous Areas"
- [2] M. J. McPherson, "Gas in subsurface opening," In: Subsurface ventilation and environmental engineering, Chapter-11, 1st ed. - London: Chapman and Hall, pp. 11.2-11.4, 1993.
- [3] <http://www.olimex.com>
- [4] <http://www.sparkfun.com>
- [5] <http://www.wiki.seeed.com>