FLAMMABLE GAS PORTABLE DETECTOR USING MICROCONTROLLER

Tamas Levente*, Rodica Meza*, Gyurka Bela Zoltan*

** SC IPA SA Cluj-Napoca Subsidiary*
109 Republicii Str., 400489 Cluj-Napoca, Romania
phone: +40264 596155, fax: +40264 590558, Email: ipacluj@automation.ro

Abstract: This paper offers a design solution for a portable gas detector development. The solution is based on using a catalytic sensors and on the PIC 16C773 controller.

Industrial fires and explosions happen more frequently than most people think. They cause downtime, property damage, injury and sometimes death. These fires and explosions result from a dangerous mixture of flammable vapors with air and a source of ignition. There are two principal categories of dangerous gas types: poisonous gases and explosive gases. Examples of explosive gases are: hydrogen, methane, acetylene, propane, butane, etc. This gases cannot cause an explosion until they reach a certain concentration in the atmosphere. This concentration are unique and characteristic for every gas. Therefore, every explosive gas has its own LEL and UEL (*Lower Explosive Limit, Upper Explosive Limit*). In order to avoid disasters provoked by explosions, the following apparatus (flammable gas detectors) are using, having the goal to generate acoustical and visual warning signals before the concentration reach the LEL.

The " *intrinsically safety*" term means power restriction in dangerous zones, so that no spark appears able to make an explosion or make a heating effect for an explosion.

The apparatus provides the following functions:

- Measuring and displaying the gas concentration from the atmosphere (% LEL or % vol.)
- Auditory and sonorous warnings if the measured concentration level reaches the thresholds
- Configuration possibility : password, parameters, thresholds
- Password protection for parameters
- Visualization, delete and data retention
- Possibility of connecting to a PC for memorized data unloading
- Battery level monitoring

The detecting method used by portable explosion-meter is based on a pellistor sensor, operating according catalyst oxidation. The sensor basically "burns" the flammable gas and measures the heat output to determine the amount of flammable gas in the atmosphere. Within the VQ500 series there are specific sensors that are able to detect most combustible gases/vapors and ammonia at LEL levels. The sensor sensitivity is 30mV / % methane with linear output up to 3%. The measuring range is 0…100 %LEL (4.4% vol.).

The bloc diagram of developed portable explosion-meter is showed in the figure 1. In the same time the figure shows the interconnectivity between the principal modules. Command unit module is realized with PIC16C773 microcontroller. It is 28 pin, 8 bit low power , high speed microcontroller. The device is manufactured using the Microchip high-density technology. The apparatus contains: a 16x2 char backlight LCD module, mini-keyboard with 4 buttons, a buzzer, 8k bytes capacity serial EEPROM (24lc65).

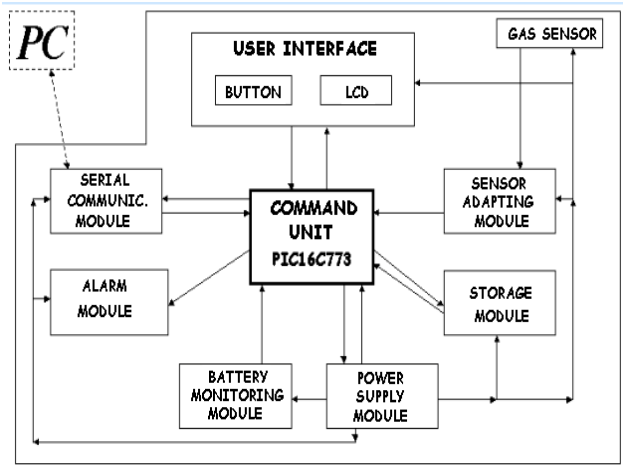

Fig.1 Architecture Block Diagram

The software was developed in MPLAB IDE 6.3 and consist in software modules for each desired function. There are used menus in special for most important tasks like: measuring, configuration, data visualization, data unloading etc.

The developed gas detector is a prototype and has the following features: 0…100%LEL (CH4), 0…4.4%vol measuring range; 0.02 %LEL resolution; response time : < 10s; acoustical and luminous warnings if measured levels reaches the thresholds; power supply from 9V (1.3Ah) rechargeable battery; possibility of RS 232 serial connection; Operating time : >10 hour (in normal operating conditions); Intrinsically safety protection : power dissipation < 1W; dimensions : 100x180x40xmm; weight < 500g;

CONCLUSIONS

The device was developed into the frame of "RISCEX – project" financed in Romanian National Research and Development Program MENER.

The advantage of this solution is getting a lightweight small dimension apparatus that can be employed to protect people which works in potential flammable zone and for prevent these explosions by taking the right protections. Again, this device can be used for all users who wants to know the gas concentration in some risk atmosphere.

The limitation of the equipment is that it cannot be used for more gases in the same time with the same configurations, because of poisoning. For correct functionality maybe is needed to change according the flammable gas type the sensor and the configuration parameters. Other disadvantage it requires oxygen for detection.

Possible applications may be in: consumer based protection, industrial use, personal monitoring, flammable gas leakage detection, confined space entry, etc.

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