Development of Data logger for atmospheric pressure, temperature and relative humidity for gas-filled detector

S. Sahu[1], M. R. Bhuyan[2], S. Biswas[2],* B. Mohanty[2], and P. K. Sahu[1]
[1]*Institute of Physics, Sachivalaya Marg, P.O: Sainik School, Bhubaneswar - 751 005, Odisha, India and*
[2]*School of Physical Sciences, National Institute of Science Education and Research, Bhubaneswar - 751005, Odisha, India*

Introduction

At IoP-NISER an initiative has been taken to build and test micro-pattern gas detector such as Gas Electron Multiplier (GEM) for several upcoming High-Energy Physics (HEP) experiment projects [1]. Temperature (t), atmospheric pressure (p) and relative humidity (RH) monitor and recording is very important for gas filled detector development [2]. The effective gain of the GEM varies with absolute temperature T (=t+273) in Kelvin and pressure p in atmospheric pressure as

$$G(T/p) = Ae^{B\frac{T}{p}} \quad (1)$$

where, A and B are fit parameters, determined by fitting the curve of measured gain and $\frac{T}{p}$ by the exponential function. Here t is expressed in °C.

The Data logger designed here measures temperature, RH and atmospheric pressure. The system consists of two parts one is hardware DAQ (data acquisition) system and other one is a DAQ Software. The hardware DAQ system is designed with a microcontroller based system with a 16×4 line Alphanumeric LCD display unit. The display unit can update with minimum 2-3 sec interval. The interval can be made longer to about a few minutes. The hardware DAQ system has one external power port for 9 V DC and one RS232 communication port to interface to a PC for interfacing with Data logger software. The DAQ system transmits information with following units temperature in °C, RH in % and atmospheric pressure in mbar. The details of the fabrication and operation of the Data logger is presented.

Description of the Data logger

The Data logger hardware unit is shown in Fig. 1 and the display screen is shown in Fig. 2. For the Data logger the power supply specifications are as follows: Input Voltage 230 Volt, 50-60Hz; Output Voltage 9-12 V DC; Output Current: 500-750 mA.

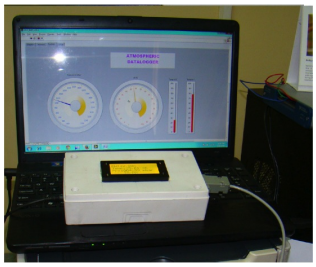

FIG. 1: DAQ hardware.

FIG. 2: The LCD Display unit is consisting of 16×4 line Alphanumeric Display. The Display unit is Back lighted for better visibility.

The parameters for the Data logger are as follows:

1. Temperature: Measurement of temperature can be done with 0.25°C assured accuracy. The rated full range of measurement is

*Electronic address: s.biswas@niser.ac.in,saikat.ino@gmail.com

from 0°C to 150°C. I has very low self heating with resolution $\sim$ 0.01°C.

2. RH: Measurement of RH can be done with 1% resolution and with 4% accuracy. The stability varyies ±1%RH/Year and the hysteresis is 1% RH.

3. Pressure: Measurement of pressure can be done with a range: 300-1100hPa (+9000 m to -500 m above sea level). Low noise: 0.06hPa (0.5m) in ultra low power mode 0.03hPa (0.25m) ultra high resolution mode $<$ 0.1m possible with software averaging algorithm.

Data logger software

The Data logger software is designed and developed with LabView platform of National Instrument, USA. The software developed with a idea to provide maximum user friendly operation. There are multiple tabs in the application named as follows:

Setup: Basically this tab is used for the user to configure the DAQ system as per the requirement.

Gadget: In this tab the parameters are displayed in Gadgets for example, pressure and RH in two separate Dial Gauge. The temperature in °C and °F is displayed in a thermometer.

Numeric: In Numeric Tab all the parameters are displayed in numerical windows for example, pressure in mbar , RH in % , temperature in °C and °F in decimal format.

Graphic: In this Tab all the parameters temperature in °C or in °F, RH in % and pressure at in mbar/100 are displayed on a line graph window with respect to time axis.

The software operations are as follows:

1. The communication port (COM PORT) needs to be selected properly.

2. The sampling interval in msec needs to be entered by the user.

3.The file path needs to be entered for data storing.

Result

The temperature, pressure and RH measured in 24 hours has been plotted as a function of time in Fig. 3. The variation of these three ambient parameters during the day night is observed.

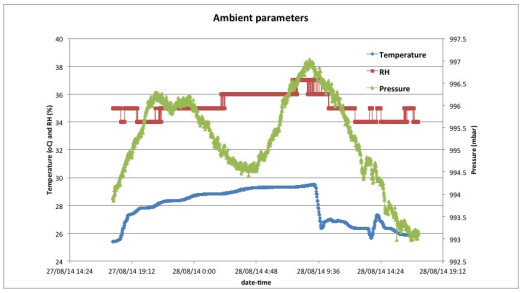

FIG. 3: Temperature, pressure and RH measured in 24 hours as a function of date-time.

Conclusions and outlooks

A Data logger to monitor and record the ambient parameters such as temperature, relative humidity and pressure has been developed. With this Data logger continuous recording of t, p, RH and time stamp can be done with a programmable sampling interval. This data is necessary to correct the gain of a gas filled detector.

Acknowledgements

We are thankful to Prof. T. K. Chandrashekar, Secretary, SERB, Prof. V. Chandrasekhar, Director, NISER and Prof. Sudhakar Panda, Director, IoP for their support in this work. S. Biswas acknowledges the support of DST-SERB Ramanujam Fellowship (D.O. No. SR/S2/RJN-02/2012). XIIth Plan DAE project titled Experimental High Energy Physics Programme at NISER-ALICE is also acknowledged.

References

[1] Technical Design Report for the Upgrade of the ALICE Time Projection Chamber, ALICE-TDR-016, CERN-LHCC-2013-020, March 3 2014.

[2] S. Biswas, et al., 2013 JINST 8 C12002 doi:10.1088/1748-0221/8/12/C12002.