ELECTRONIC CONTROLLING AND PROCESSING SYSTEM FOR NITROAROMATIC SUBSTANCE DETECTION DEVICE

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An express determination of explosive stuff content in the gaseous matter conducted under on field conditions is reported to be an effective solution for general public safety related analysis. The essential growth of interest to such systems nowadays is stipulated by the increase of terrorist attacks in public places all over the world. Our current work is dedicated to designing the electrical circuitry for the device capable to determine the actual explosives stuff concentration in the gaseous volume by the single beam spectroscopy method [1].

The principle of device operation is described in [2]. As the detector is supposed to work in single shot mode, i.e. the actual output absorption spectral distribution will be derived in a single read cycle of light absorption detector, the demands to the circuitry might be described in terms of high sensitivity, high resolution, low power dissipation and capability to operate under temperature range from 290 K up to 320 K.

In the process of developing the circuitry, we accepted the solution of dividing the CCD image sensor signal detection and processing system into two separate functional blocks, namely analog front – end (AFE) and common digital signal processor (DSP) (Fig. 1). This solution enabled us to essentially increase the dynamic range of the signal converting electronic tract, implement efficient offset level reduction and hence improve temperature stability of the scheme. Moreover, as the conditions of measurements imply low demands on the digital circuitry bandwidth, the cost of the device might be substantially lowered by use of cheaper DSP/controller.

Increased temperature stability of the scheme was derived by use of Pelletier element (thermoelectric cooling) for the measurements being conducted under high temperature. The operating conditions of the element are controlled by DSP/controller through temperature gauge coupled with CCD image sensor. Moreover the choice of AFE implied embedded correlated double sample technique, which allows us to substantially reject kT/C noise of CCD cells.

As the light source for sample illumination we chose deuterium lamp. Deuterium lamp output spectra generally matches the spectral range needed for implied absorption measurements; also this spectra is very smooth (compared with analogue light sources) in considered region. This smoothness allowed us to essentially increase the dynamic range of ADC in the AFE. The switching and controlling circuitry has been implemented on the switching voltage converter with regulatory feedback of lamp anode current and cathode temperature. As an optional light source for visible measurements we also consider tungsten lamp.

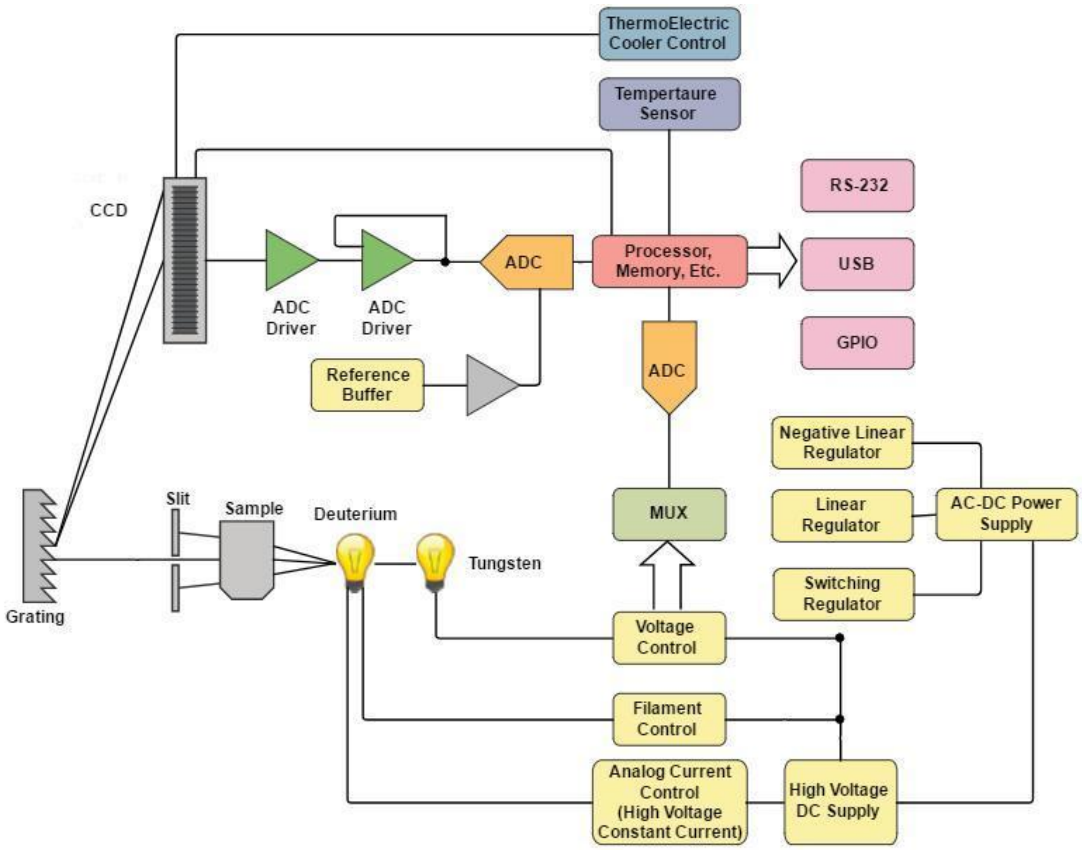

Fig. 1. General scheme of electronic controlling and processing system. ADC Drivers and ADC of electronic signal tract represent AFE. Tungsten light source is optional

On the current stage the project modules discussed have been implemented on the printed circuit boards and undergo test measurements.

1. Лакович Дж., Основы флуоресцентной спектроскопии, Мир (1986).
2. Baranova A.A., Khokhlov K.O., Journal of Physics: Conference Series, № 552., 1-6, (2014)