

A CRYO COMPLEX CONTROL

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Abstract

A Cryogenic complex is being constructed to provide by liquid helium and nitrogen the RF-separator of kaons.

About 500 parameters including temperature (1,8...300)K, liquid helium/nitrogen level, vacuum, 300 digital signals have to be measured, 70 commands generated, 20 closed loops activated.

The paper describes controls electronics which includes home made I8051 compatible controllers connected by the CAN field bus to a bus controller and interface electronic modules for:

- temperature measurements;
- liquid Ni and He level measurements;
- vacuum pumps current measurements;
- analog and digital signals measurements and generations.

The modules are tested together with signal imitators within a vertical slice of the Control System based on EPICS tools.

EQUIPMENT CONTROLLERS

Equipment controllers, totally 50, present a lower level of the Control System (CS), they provide a data acquisition (DA), calculation of regime parameters, communication with CAN field bus. Besides there are closed loop controllers generating digital or 4-20 mA signals. I8051 family is used, because the same family was used for the Extracted Beam Lines CSs including the Separated Kaons Beam Line.

A controller consists of two boards: a microcomputer itself and an interface board.

A software is written on C. There are the following functional groups of controllers:

- surveillance of 16 analog signal;
- surveillance of 16 digital signals;
- calculation of 16 temperatures from resistive temperature sensors;
- calculation of vacuum from 4 couples: medium and high vacuum sensors;
- generation of 16 digit command signals,
- generation of 16 analog command signals.

A closed loop controller is under design study.

A TEMPERATURE MEASUREMENT MODULE

Next classes of temperature sensors intended to be used: Allen-Bredly within 2,8...100 K, germanium TSG-2 within 1,9...27 K with accuracy +/-0,05 K, germanium

TPK within 3,5...20 K with accuracy +/-0,08 K, platinum TP-100 within 13,8...273 K with accuracy +/-0,01 K.

A module houses analog and controller boards. An analog board includes a 16 channel multiplexor, processing time – 100 ms per channel including 35 ms for a current feeding of the sensor.

Using a 4-wire connection of a sensor one can reach a sensor resistance measuring precision about 0,1% on 100 m long communication line.

A measuring procedure consists of 5 steps:

- 15 ms for feeding of the sensor,
- 20 ms for connection of the sensor to an integrator input,
- 0,5 ms pause,
- discharge of the integrator capacitor on a reference resistor,
- 2,5 ms pause with connection of the integrator input to ground.

A limit of the dissipated in the sensor electrical power is been set from an operator console.

A procedure of the automatic set of a reference resistor during the first measurement takes up to 3 steps.

A module power supply is 220 V, a consumption is about 10 W.

A VACUUM METER

An availability of both medium and high vacuum sensors (totally 25) stipulated an idea to design dedicated electronic modules.

A vacuum meter device has been designed as a crate with 4 modules, each with two analog channels (medium and high) vacuum meters, a local LED indication and a controller module.

The controller provides switching between medium and high vacuum ranges, turning power supply off in case of break medium sensor communicationn line and high vacuum sensor overload.

A medium analog channel provides a thermoresistive vacuum sensor with stabilized current and a measuring of its resistance.

A high vacuum measuring module provides 2.5 kV power supply of a cold cathode sensor and measuring of a discharge current. A voltage-current characteristic of the power supply is made identical to characteristic of a commercial device VMB-8, what in turn permits to calculate vacuum using current value.

A LIQUID HELIUM LEVEL METER

A Liquid Helium level sensor is a 400 mm long superconducting wire with warm resistance 111,6 Ω and immersed into Liquid Helium resistance 9,6 Ω . A measurement module provides a 75 mA DC feeding of the sensor, and houses a set of comparators for calculation of 25%, 50%, 75%, 95% filling of a tank.

A LIQUID NITROGEN LEVEL METER

A Liquid Nitrogen discrete level meter is a set of 8 thermoresistors TVO (Allen-Bradly) 510 Ω , 0,125 W. A measurement module provides 15 mA DC feeding of the sensor. Our experiments demonstrated that the best sensitivity of a resistor to sort of ambient (liquid – gas) corresponds to such high current.

CONCLUSION

A set of electronics is ready to a 2004 winter equipment run.

REFERENCES

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