5 - 4 Design of a Front-end Readout Circuit for Terminal Detector

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Aiming at the requirements of beam diagnosis, a controllable integral front-end readout circuit for the terminal ionization chamber was designed by us. A high precision gated integrator is used in the circuit, which can convert the current (charge) into a voltage. The integral duration time is controlled by the DAQ system, and discharge time is about 10 μs.

A unit of the front-end readout circuit with 16-channel integrator circuits is shown in figure 1. It is composed of the high precision gated integrator[1], analog multiplexer, differential driver and control circuit in CPLD. The high precision gated integrator consists of high-speed MOS switches (S_H and S_R), low noise and high precision operational amplifier (OP), the integral capacitor (C). The current (charge) signal from the terminal detector is converted into the voltage on the capacitor C. The multiplexer is a 16-channel analog multiplexer which connects the one of the 16-channel parallel input analog voltage signal from gated integrator to the output under the control inputs. The parallel inputs are converted into serial output to reduce the number of data acquisition card. The differential drive circuit consists of a differential driver, which converts the single-end analog signal into a differential analog signal to improve the anti-interference ability. The control circuit is constructed in a CPLD to control communication with the DAQ system and to realize the control to the integrated circuit and multiplexer.

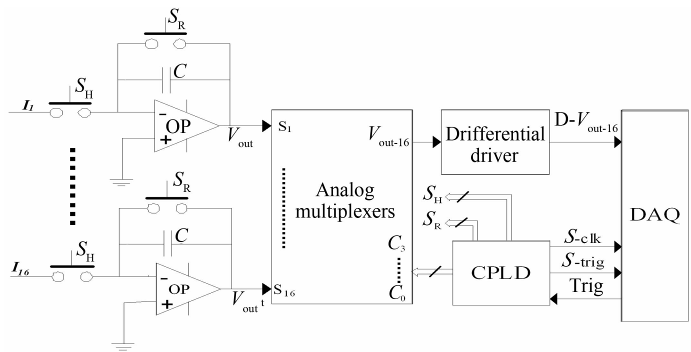

Fig. 1 Schematics of a unit with 16-channel.

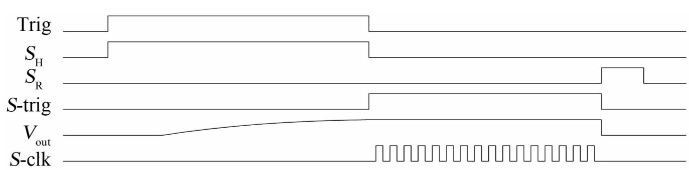

Fig. 2 Time diagram of the circuit.

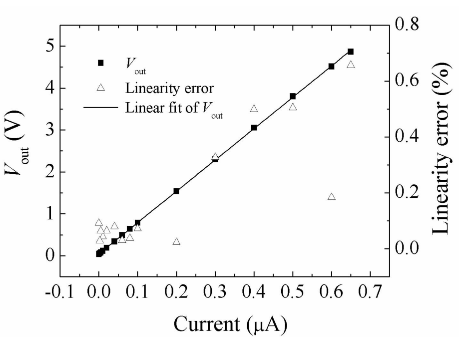

Fig. 3 Transfer curve and linearity errors.

The timing diagram of the circuit is shown in Fig. 2. First, the signal "Trig" from DAQ triggers the control circuit in CPLD and generates signal "S_H" to make the switch S_H of integrated circuit closed, the integrator start to work, meanwhile the discharge switch S_R keeps opened. The status of the switches S_H and S_R is kept unchanged until the end of the integration time. When the signal "S-trig" that is the acquisition enable signal changes from low to high, CPLD begins to send sampling clock signal "S-clk", sixteen pulses in serial, the V_{out} from sixteen integrators, via multiplexer, are acquired serially by DAQ under controlled by each "S-clk" pulse. When DAQ has collected all sixteen analog voltage values, the "S-trig" signal goes low, the discharge switch S_R is closed, the voltage of integral capacitor C is discharged, the time of discharge is about 10 μs, and then a single process cycle ends.

The test to the front-end readout circuit has been implemented. The test result of one channel is described as bellow. The integral duration time is set to 10 μs, a constant weak current is fed into the under-test channel, and a 10 pF integration capacitor is chosen. The range of input equivalent charge is from 0.5 to 48 pC, the range of output voltage is from 0 to + 5 V, the linearity error is less than 0.7%, which is shown in Fig. 3.

Reference

[1] Zhou Chaoyang, Su Hong et al. Nuclear Science and Techniques, 23(2012)237.

5 - 5 Setup of Remote Monitor and Control System for LECR3 and LAPECR1 Ion Sources

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LECR3 and LAPECR1 ion source are the fountainhead of the accelerator system which includes a quite complex and complete structure owing lots of different equipments. In order to improve the operating efficiency of the ion sources, the LECR3 and LAPECR1 ion sources control system has been successfully established as a set of system in August 2012. Two sets of equipment, totally 70 parameters need to be monitored and controlled involve the magnetic field power supplies, high-voltage power supply, HV platform power supplies, beam diagnostic slit movement, vacuum valve, microwave machine, interlock protection and alarm systems, etc. Due to the characteristics of the special nature of the ion source and the dispersed distribution of the equipment, self-designed controller and serial port server have been used to build the hardware platform and the whole control structure is established base on field bus and Ethernet technology. The photo of controllers modules used in this system is shown in Fig. 1. Since this remote control system is used, all equipment has worked smoothly. In aids of this control system, the data real-time monitor, equipment control and interlock protection of the ion sources has been realized and it shows good security and stability since Aug. 2012.

Fig. 1 Picture of controllers modules.

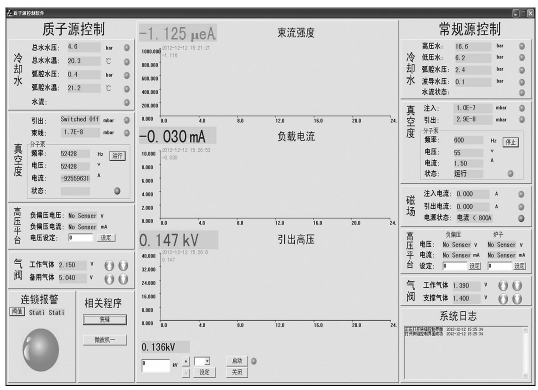

Fig. 2 Software interface of the overall control system.

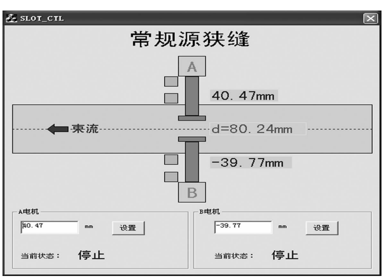

Fig. 3 Beam diagnostic slit movement control.

Integrated control software based on VC has been developed to control all the equipment. Software interface of the overall control system is shown as follows in Fig. 2. The beam diagnostic slit control is com-