IST DISTRIBUTED DAQ SYSTEM FOR INR LINAC

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Abstract

The INR Linac is intended for acceleration of H+ and H- ions. DC power supply of quadrupole doublets of the INR Linac is realized by means of stabilized current sources (SCS) IST type. The Distributed Data Acquisition (DAQ) System, based on ADAM-5000/485 system, was designed and put into operation for the SCS remote control. In this paper the structure, right choice of communication protocol and hardware are specified. In process of DDAQ system designing some peculiarities of SCS operation was taken into account: placement of SCS at a long distance (more then 300m) and work in conditions of high electromagnetic disturbances.

INTRODUCTION

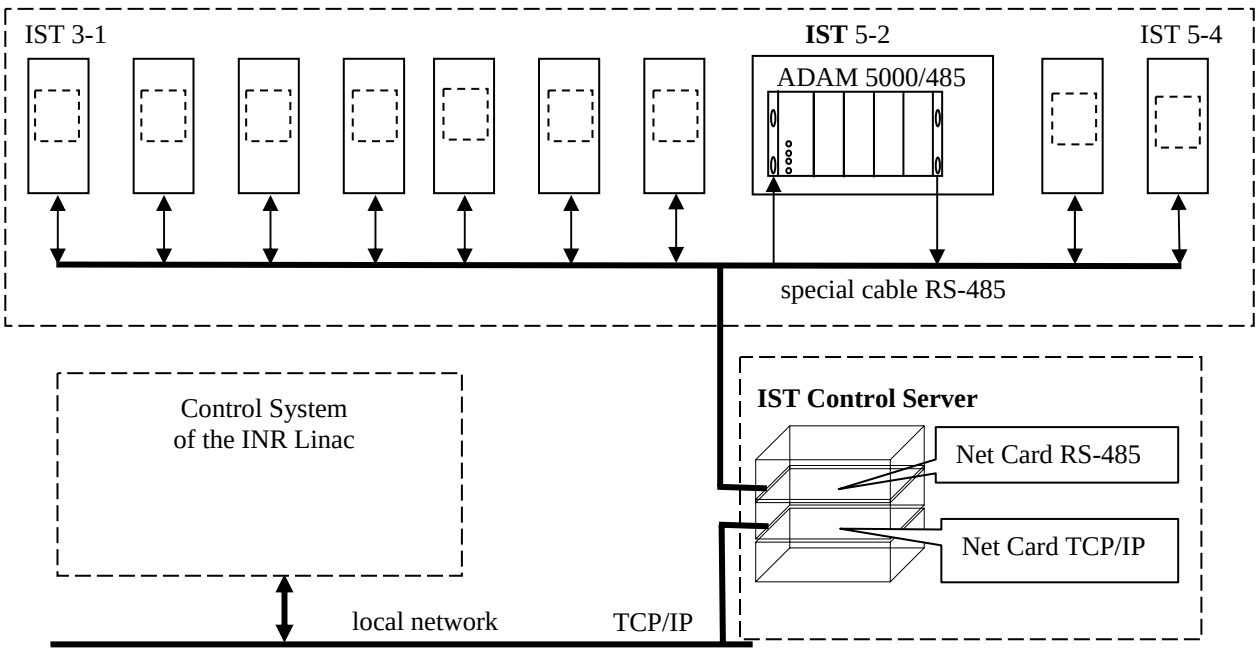
During the latest years the process of equipment's automation, based on modern facilities, takes place in the INR Linac. In 2003 working out computer-aided control system of DC power supplies of quadrupole doublets of the INR Linac came up. Development of the computer-aided control system (CACS) was based on the construction of the Distribution Data Acquisition System (DDAQS).

DC power supplies of quadrupole doublets represent stabilized current sources (SCS) IST type. While working the system out, it is necessary to take into account the peculiarities of SCS's placement. They are situated along the length of more than 300m at a distance about 30m between each other. Power supplies work in conditions of high electromagnetic disturbances.

Linac's control system of based on software product LabVIEW National Instruments Corporation [1]. LabVIEW has a number of advantages, dealing with the simplicity of connection of new equipment and flexibility in making software products. Because of that it was decided to base the DDAQS on the facilities, which support LabVIEW and give an opportunity to integrate in the present Control System of the INR Linac.

SAMPLING OF STRUCTURE

Facilities of various producers were treated, including: Wago, Siemens, National Instruments and Advantech [2]. Having taken into account everything, mentioned above, the choice narrowed to two producers: National Instruments and Advantech. Facilities of National Instruments are considerably more expensive. Facilities of Advantech are cheaper and include complete blocks that



IST – DC power supply IST type,
IST Control Server – Computer IBM/PC.

Figure 1: Structure chart.

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provide registration and transmission of all necessary signals.

While choosing the type of interface, equipment, based on CAN, RS-485 and TCP/IP-protocols was taken into account. CAN-protocol has the highest speed and the greatest rate of disturbance-protection, but CAN-based facilities don't support LabVIEW. TCP/IP protocol has the same speed, but its length is restricted by 100m during the work with standard UTP cables. To augment the length, additional network devices are necessary. The advantage of RS-485 is an opportunity of consecutive connection of facilities within 1,2 km. The disadvantage of this protocol is its low speed as compared to CAN and TCP/IP protocols. In our case it can't be treated as critical parameter, because it is necessary to measure moderate quantity of signals with the period of 1sec.

Finally, the structure, depicted in Figure 1 was chosen [see Fig. 1].

The base block DDAQ system is situated in the control cabinet of SCS.

All blocks are concatenated sequentially by means of special cable of connection RS-485 and card of connection of interface RS-485, installed in computer IST Control Server. Total length of cable is approximately 500m.

Computer Control Server effects control of the blocks through connection card. Computer's connection with the Control System is effected by means of local network through TCP/IP protocol.

SAMPLING OF TECHNICAL FACILITIES

System Specifications Distributed DA&C System Based on RS-485 protocol (ADAM-5000/485 Advantech Company) provides isolation for I/O modules (3000 VDC), communication connection (2500 VDC) and communication power connection (3000 VDC) and communication error checking with checksum [3]. It is a considerable advantage of ADAM-5000 System in sharp conditions of maintenance on the INR Linac.

In order to automate the SCS it is necessary to have the following modules:

- DAC-module for control SCS current;
- ADC-module for the measuring of load current;
- Relay Output Module for the control of SCS;
- Digital I/O Module for the control of power source's conditions.

Figure 2: ADAM-5000/485.

The ADAM 5000/485 system [see Fig. 2] contains four major components, which provide registration and transportation of signals in required quantities:

- ADAM-5024A - 4-channel Analog Output Module (DAC);
- ADAM-5017 - 8-channel Analog Input Module (ADC);
- ADAM-5050A -16-channel Universal Digital I/O Module;
- ADAM-5060 -6-channel Relay Output Module.

The main advantage of the module ADC is opportunity of soft alteration of the range of input (output) signals; for DAC module - it is an opportunity to variate the speed of build up of output signals as well. It is a considerable advantage because the load of power supplies has high inductance.

TEST AND IMPLEMENTATION

Testing of the ADAM-5000 System with different rates of the work of interface RS-485 was carried out. Time of response after dispatch of command of fixing quantity of signal from one channel of module ADAM-5017 was measured.

Table 1: Check delay

Rate of port, kb/s.	Delay,ms.
9,6	25
19,2	14
38,4	9
57,6	7

After the mounting of the system and installation of full software package for the control of SCS, testing of the whole system was carried out. Measurement of the condition of ten power supplies and of dimension of current values is carried out with the period of interrogation less then *100ms* that is on exponent better the necessary period of 1s.

Figure 3: ADAM-500/485 in the control cabinet of SCS.

The system allows switching on, turning off, fix the condition and control the currents of power supplies. The maintenance shower steady work of the system.

CONCLUSION

Use of DDAQS gave an opportunity:

- to raise the reliability of the work of SCS (use of DAC-module ADAM-5000/485);
- to diminish the time of restorations of working condition after short-term deactivating (operative attribution disconnected SCS and its remote initiation);
- remote current control of SCS;
- to raise accuracy of setting of current considerably (before it was specified by manually by means of pointer indicator).

The work completed showed an opportunely to use IST Distributed DAQ System based on ADAM-5000/485 systems for control of power supplies IST type on the INR Linac.

REFERENCES

[1] National Instruments Corporation, http://www.ni.com/labview/.
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[3] Industrial Automation with PCs, Advantech, vol.91, 1999, p.13-8.