

PRECISION GEOMETRIC PARAMETER GAGE FOR SYNCHROTRON RADIATION

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Abstract

This article describes the geometric parameter gage prototype for monitoring synchrotron radiation at the HERA collider (DESY). The system constructed is capable of measuring photo current caused by radiation impinging on a refractory metal. The system component parts are: measuring heads and photo current measuring electronics designed by IHEP, stepper motor by Vacuum Generators with HEDS-550X encoder by Hewlett Packard, and PCI-STEP-4CX 4-Axis Closed Loop Step controller by National Instruments. The device is controlled by means of a Microsoft Visual Basic program using Value Motion Windows Libraries. The device prototype was tested in the beam of the DORIS storage ring.

1 CONSTRUCTION

The collision scheme for HERA upgrade requires a deflection of the electron beam closer to the interaction region by means of superconducting magnets. The deflection is accompanied by the emission of synchrotron radiation which may be used for diagnostic aims. Total radiated power is equal to several KW and the number of radiated photons with energy exceeding 20 Kev under these conditions is $8 \times 10^{17} \text{ sec}^{-1}$. The beam of collider has a flat form and the gage's correspondent finger construction is shown in Figure 1. The Synchrotron Radiation Monitor (SRM) is designed for the operation in high level vacuum conditions. The detector head has five vertical tungsten foils isolated by macor block. Each finger has the dimension 50x5000 mcm. There is a group of electrodes having the same dimensions and made of the same material as the fingers. These are placed on the bar between the fingers and used for feeding bias voltage. In contrast to the water-cooled fingers in the system described in [1], the SRM is cooled by means of heat radiation. The parts denoted in Figure 1 are: 1 – detector head; 2 – vacuum box; 3 – bar; 4 – displacement transducers; 5 –

bellows; 6 – stepper motor with optical encoder; 7 – thermosensor; 8 – tungsten finger; 9 – tungsten electrode of bias.

2 HARDWARE AND SOFTWARE

SRM hardware is shown in Figure 2. The hardware was designed using a two-level scheme: the first level is a "Euromechanics 3U" standard crate placed in the tunnel; the second is the same type crate located in an electronics room. Wide range amplitude (10^4) electronics is used for the fingers signal processing. Each finger has a thermosensor set into its base. Because the expected working temperature is rather high, JUMO sensors with an upper threshold of 800°C are used. A Linear Transfer Mechanism by "Vacuum Generators" is used for SRM movement. Detector heads are placed in a distance of 25 mm across a beam. The optical encoder HEDS-550X by Hewlett Packard is guaranteed to have an accuracy of 25 mcm. The Encoder multiplying factor is dependant on the distance between Forward and Reverse Limit switches. Absolute positioning is realized via a displacement transducer. The controlling PC has a special board made by National Instruments. The board has 4 control circuits. SRM software uses them for motion control, for the encoder counter, and for accumulation of temperature and intensity pulses. The software user interface is shown on Figure 3. The program consists of client and server parts using the TINE protocol.

3 RESULTS

SRM testing was performed on the DORIS storage ring. Five finger signals vs. voltage bias are shown in Figure 4. Apparently full photo electron collection with such a detector head occurs with a bias equal to 500 V and more.

The scanning of the detector head with five fingers across a beam is presented in Figure 5. As appears from the chart, beam size on base ranges from 2 to 3 mm depending on the finger number.

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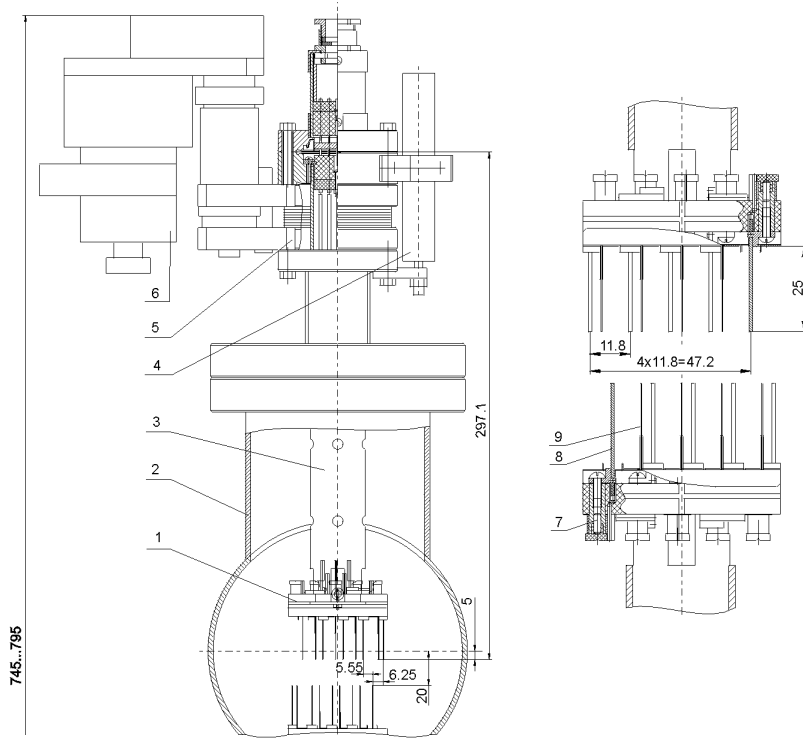


Figure 1: The upper part of SRM construction drawing.

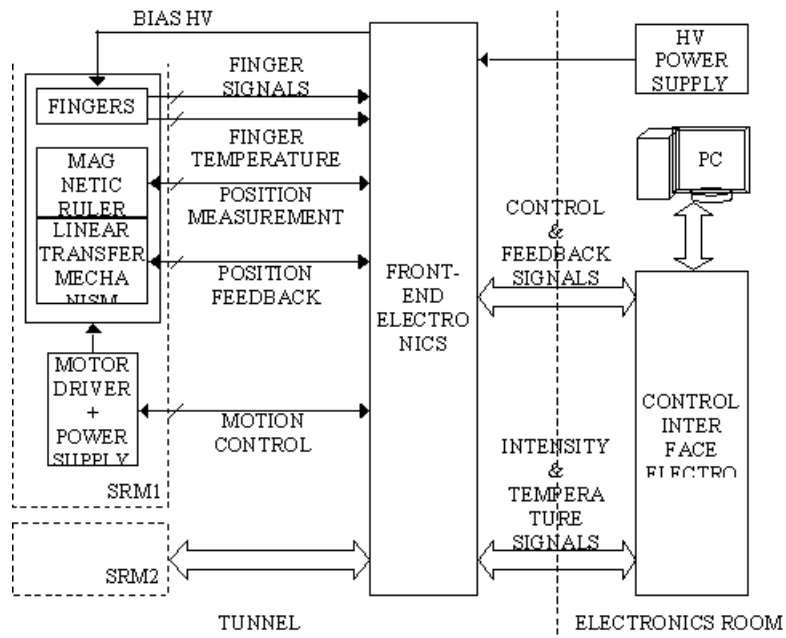


Figure 2: SRM hardware block scheme.

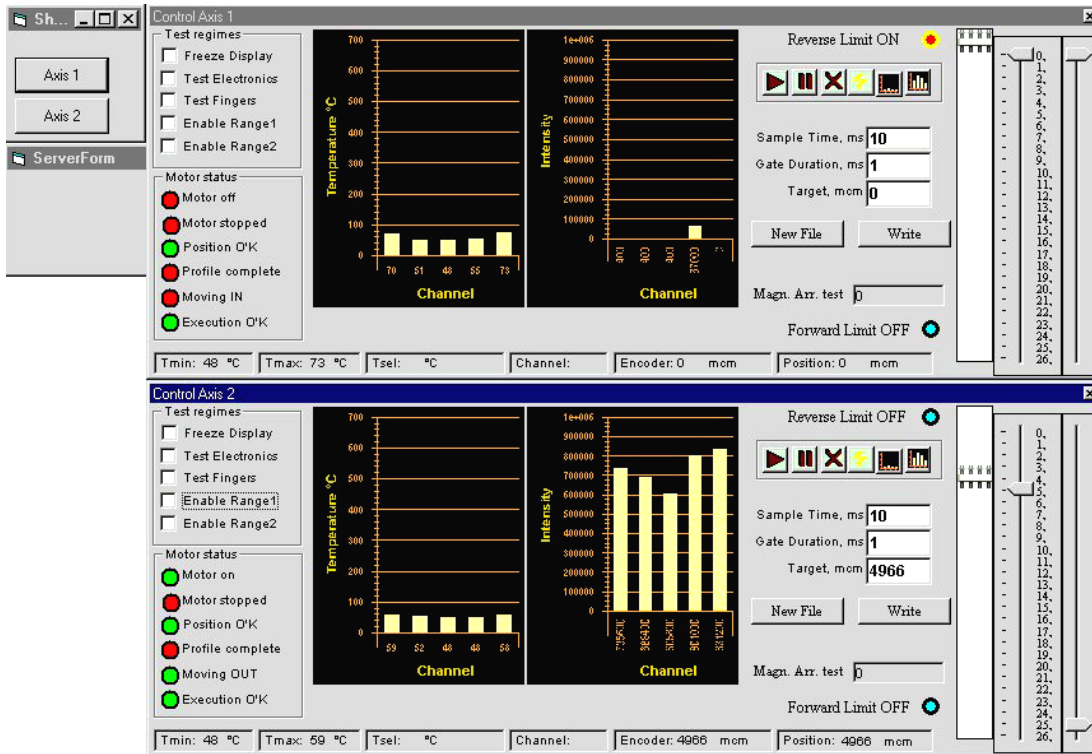


Figure 3: User interface.

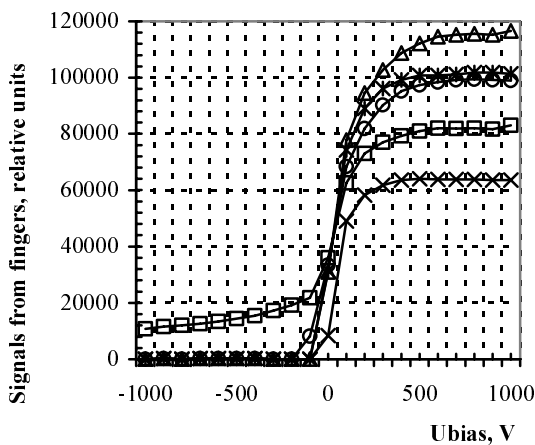


Figure 4: SRM finger's signals vs. U_{bias} position=9500 mcm; $I=70$ mA.

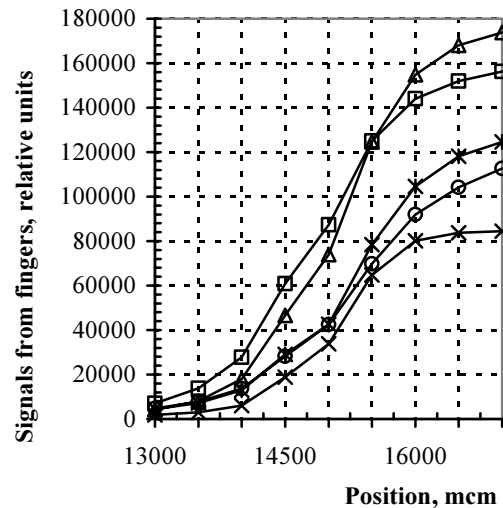


Figure 5: SRM scan-profile: $I=71$ mA; $U_{bias}=800$ V.

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REFERENCES

- [1] G. Mrotzek, R. Cernik, J. Flaherty, P. D. Quinn. "Photon beam position monitors on the SRS at Daresbury.", EPAC'94, London, p. 1563, vol 2, June 1994.