A NEW WIRESCANNER CONTROL UNIT

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Abstract

Wires scanners are standard instruments for beam size measurements in storage rings: A wire is crossing the beam at a given speed and the secondary emission current of the wire and/or the photomultiplier signals produced from Bremsstrahlung or particles scattered at the wire are recorded together with the wire positions. The control unit described here is based on a previous CERN design [1]. It now has additional features:

- Triggered fast scans (1m/s) with a trigger uncertainty below ± 30µs (mechanics + electronics) used at the TTF Linac and at the proton synchrotron DESY III,
- Slow scans (e.g. 50µm/s) for the TTF Linac,
- Positioning of the wire within ± 3µm for tail scans at the storage rings PETRA and HERA,
- A 10.5MHz data acquisition rate for bunch-by-bunch acquisitions in the accelerators at DESY.

Another important design goal was the compatibility with CERN scanners; it is foreseen to operate them at LHC with the new control unit. First measurements with the new control unit at TTF and HERA will be presented.

1 OVERVIEW

The system is based on a special 19" 6HE VME crate controlled by a Motorola CPU running VxWorks. One crate controls 4 Wirescanners, one at a time. The concept is based on an earlier wire scanner control unit designed by J. Koopman, CERN and redesigned for new demands.

2 NEW FEATURES

2.1 Fast Scan with delayed Trigger

A scan can be triggered in synchrotrons (to get a profile for a certain energy) or linacs (to cross the beam exactly while it is present) during a "Fast scan". A trigger delay up to 4 sec can be selected and the real time between trigger and reaching the desired acquisition start position is measured internally. So all time relations between trigger and acquisition data are defined. For storage rings the scan trigger can be disabled. The average trigger uncertainty is below ± 30µs (mechanics + electronics).

2.2 Slow Scan and Tail scans

Slow scans are useful for linacs: a data array (all bunches, all photo multiplier signals) is recorded for each linac pulse while the wire is moving slowly (e.g. 20..100µ/sec) across the beam. For tail scans in circular accelerators the wire can be moved to a given position within ± 3µm. In this mode (useful for the range 3..6σ around the beam) the "statistical" low rate photo multiplier pulses are counted during several seconds per position point.

2.3 Data acquisition

The 8-channel data acquisition for the photo multiplier signals or secondary emission signals from the wire now work up to 10.5 Msample/sec with 14 bits with a maximum of 128k datasets, using a low cost VME ADC card from DESY/Zeuthen.

2.4 Other improvements

The position resolution was improved to 1µm. The positions of all wires are remote accessible at any time. Hardware trimming is no longer necessary. The wire motion is now controlled by a programmable function generator, allowing any movement, only limited by the maximum acceleration. The four-channel system fits into a single crate now.

3 HARDWARE CONFIGURATION

3.1 General

The main system components are:

- The Motorola VME CPU with 4 IP Module sockets, one is occupied by an IP module (TIP570, 8-channel ADC + 8-channel DAC) to control voltage and current of up to 4 high voltage supplies for the photo multipliers
- The photo multiplier signal integration card
- The VME 8-channel 14 bit ADC card (designed by F. Tonisch, DESY/Zeuthen)
- The VME "motion control card" (in-house)
- The "motor driver" module and the ±48V/12A power supply (in-house)

3.2 Motion control card

The motion control card contains:

- A quadrature decoder to read out the 4 optical position encoders including error recognition, connected to a memory for fast position recording
- A delay unit for delayed fast scans
- A time / frequency measurement unit for remote tests of the external clock signals and to check the time between scan trigger and reaching of a given position
- A programmable function generator to generate any motion function

- A Test LED output for remote photo multiplier tests
- A programmable clock processing unit to control synchronised acquisition of photo multiplier signals and positions for the different modes
- An isolated serial link to the motor driver module

3.3 Motor driver module

The 4-channel motor driver module contains:

- Precision readout of the 4 position potentiometers
- Digital position control with position feedback by position potentiometer or optical encoder
- Motor driver amplifier (40V/12A)
- Safety pullout and safety switch off for dangerous conditions
- Interlock interface to inhibit scans for accelerator conditions dangerous to the wire
- Remote readout of power supplies, potentiometer positions, motor voltage and current
- Isolated serial link to the motion control module

The motor driver has its own power supply and communicates with the CPU and the motion control module only over the isolated serial link. So the high power part is totally electrically separated from the VME part to avoid cross talk into the ADC.

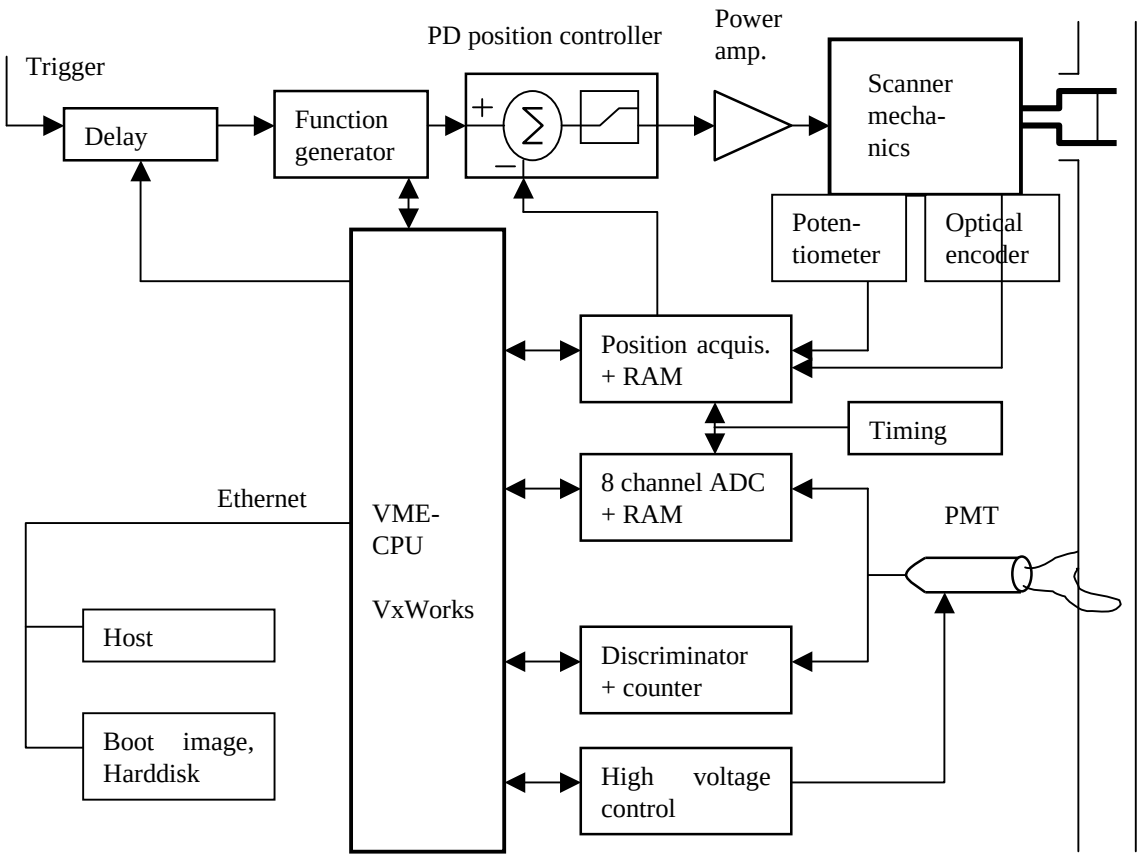

Figure 1: Functional block diagram of the control unit in its environment

4 SCAN EXAMPLES

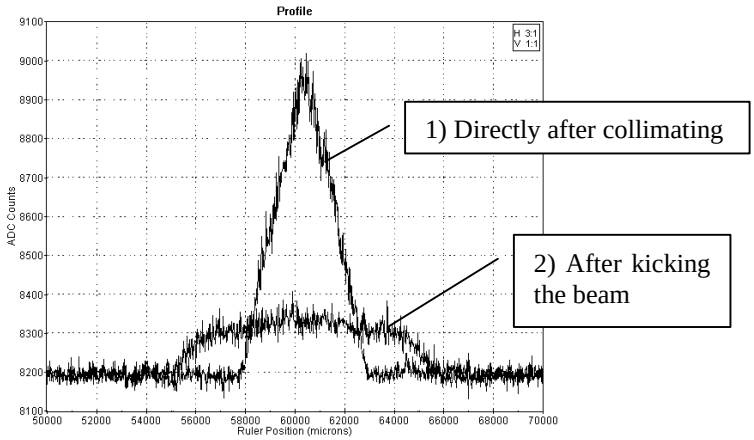

Figure 2: Fast proton scan at HERA (one bunch selected)

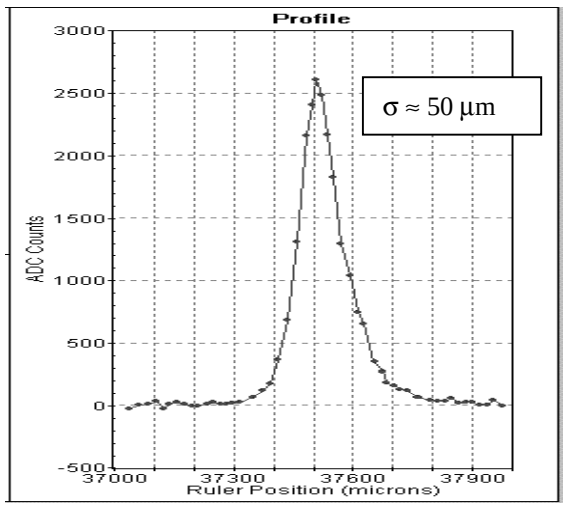

Figure 3: Slow scan at TTF (approx. gaussian beam)

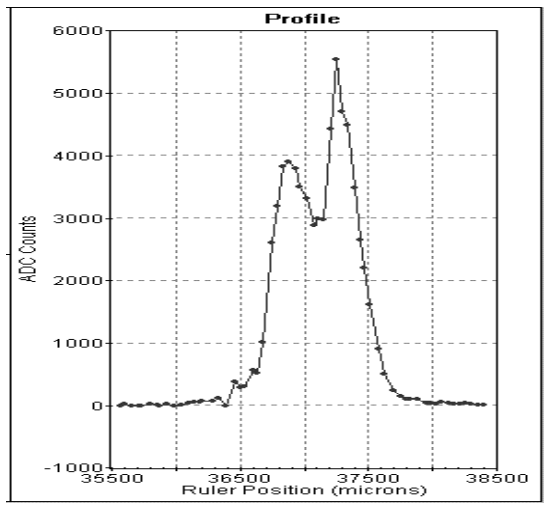

Figure 4: Slow scan at TTF (double peaked beam)

5 CONCLUSION

The unit was commissioned successfully at TTF and HERA-p. The commissioning for HERA-e, PETRA and DESY3 will be done as soon as possible. With a modified mechanical design and an additional new high power motor driver (4 kW power, not yet existing) a maximum speed of 2 m/s could be possible in the future.

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REFERENCES

[1] Wire Scanners at LEP, By B. Bouchet, et al.. CERN-SL-91-20-DI. IEEE PAC San Francisco, CA, 6 - 9 May 1991., p. 1186-1188