Wire Scanner Installation into the MicroTCA Environment for the European XFEL.

T. Lensch, A. Delfs, V. Gharibyan, I. Krouptchenkov, D. Nölle, M. Pelzer, H. Tiessen, M. Werner, K. Wittenburg, DESY, Hamburg, Germany

Abstract

The European XFEL (E-XFEL) is a 4th generation synchrotron radiation source currently under construction in Hamburg. The 17.5 GeV superconducting accelerator will provide photons simultaneously to several user stations. For the transverse beam profile measurement in the high energy sections Wire Scanners are used as an essential part of the accelerator diagnostic system, providing the tool to measure small beam size in an almost nondestructive manner. The scanners will be operated in a fast mode, starting from a trigger the wire will be accelerated to 1 m/s and hitting about 100 bunches out of the long bunch train of E-XFEL within a single macropulse. Slow scans with single bunches are also possible. In the first stage 12 stations are planned to be equipped with Wire Scanners where each station consists of two motion units (horizontal and vertical plane). The new concept uses linear servo motors for the motion of the wires and a new mechanical design has been developed at DESY. This paper describes the electronics developments for the motion part of these Wire Scanners and the integration into the MicroTCA environment.
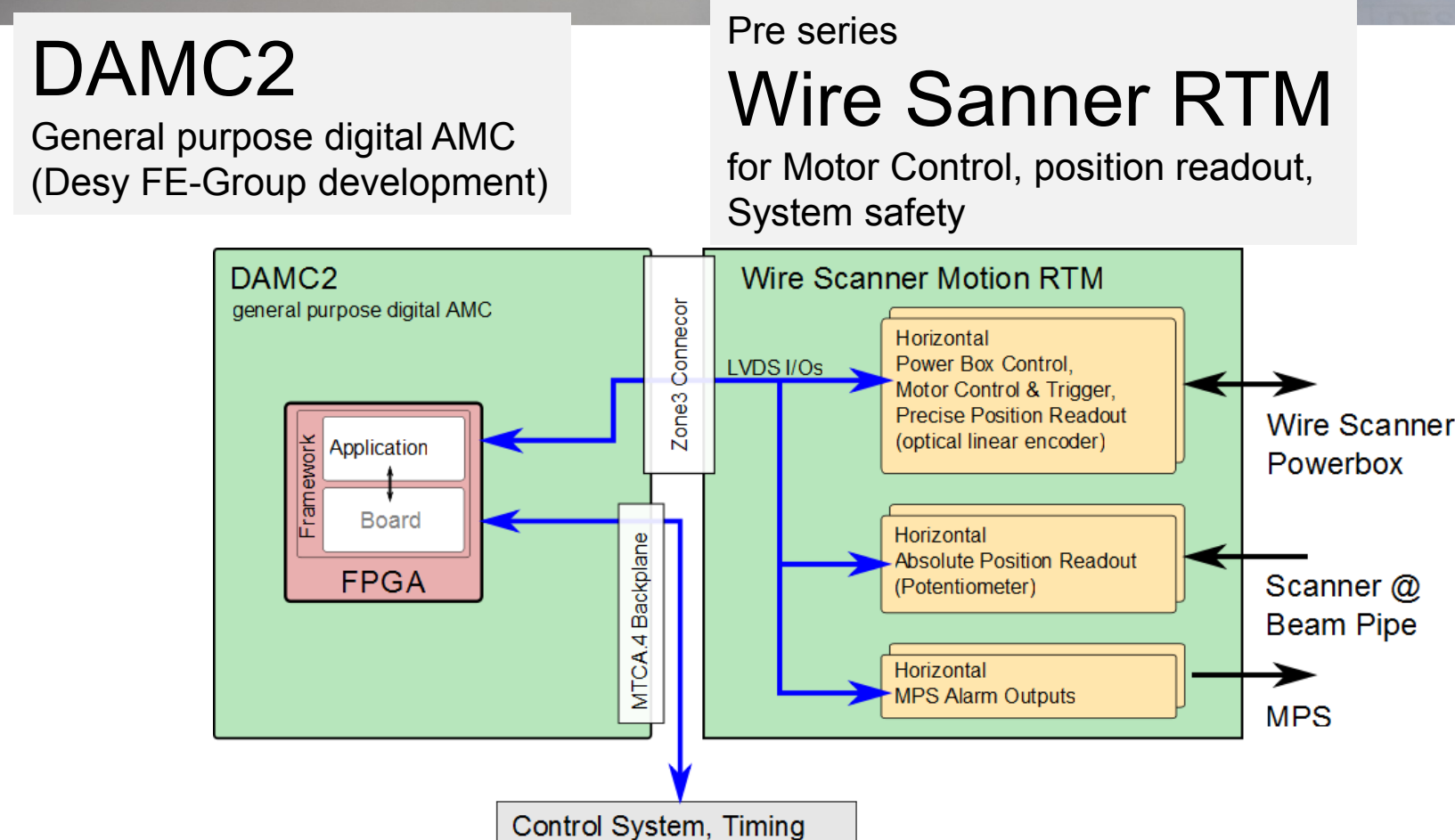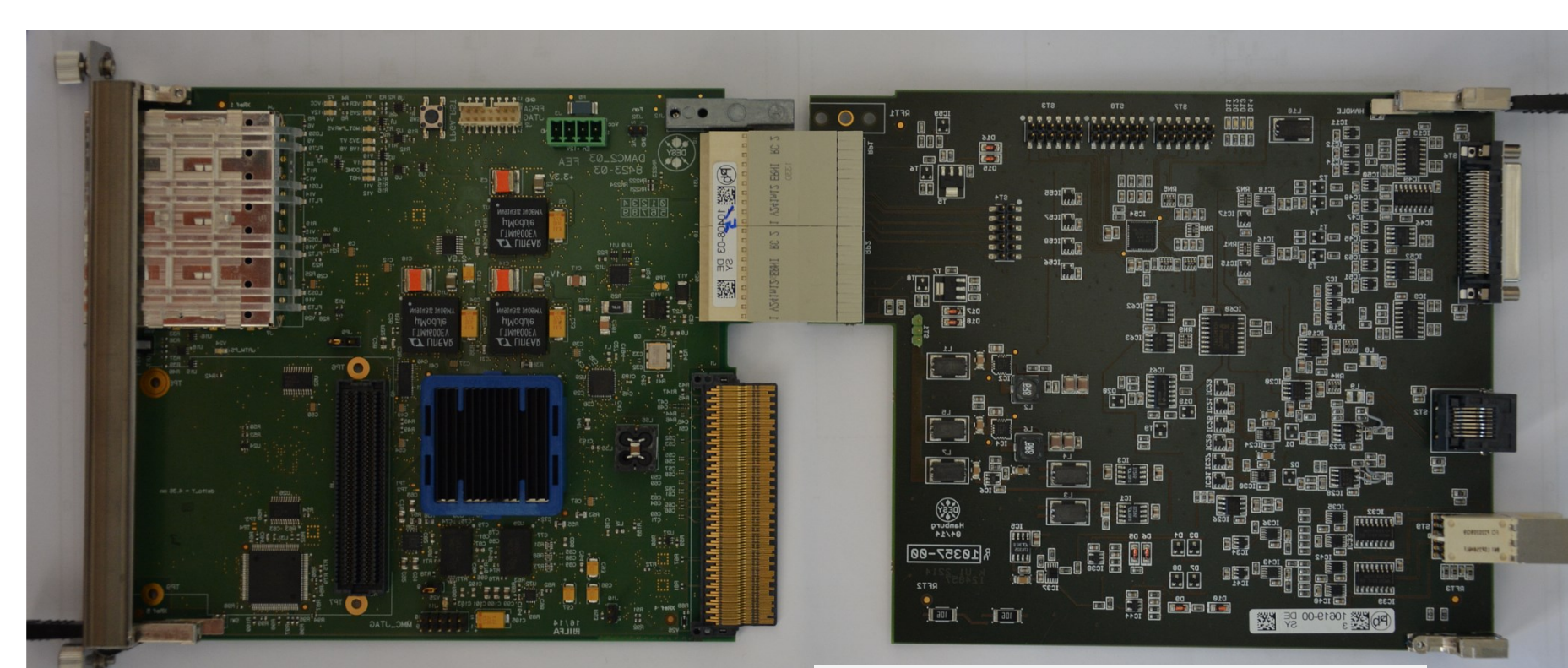
System overview
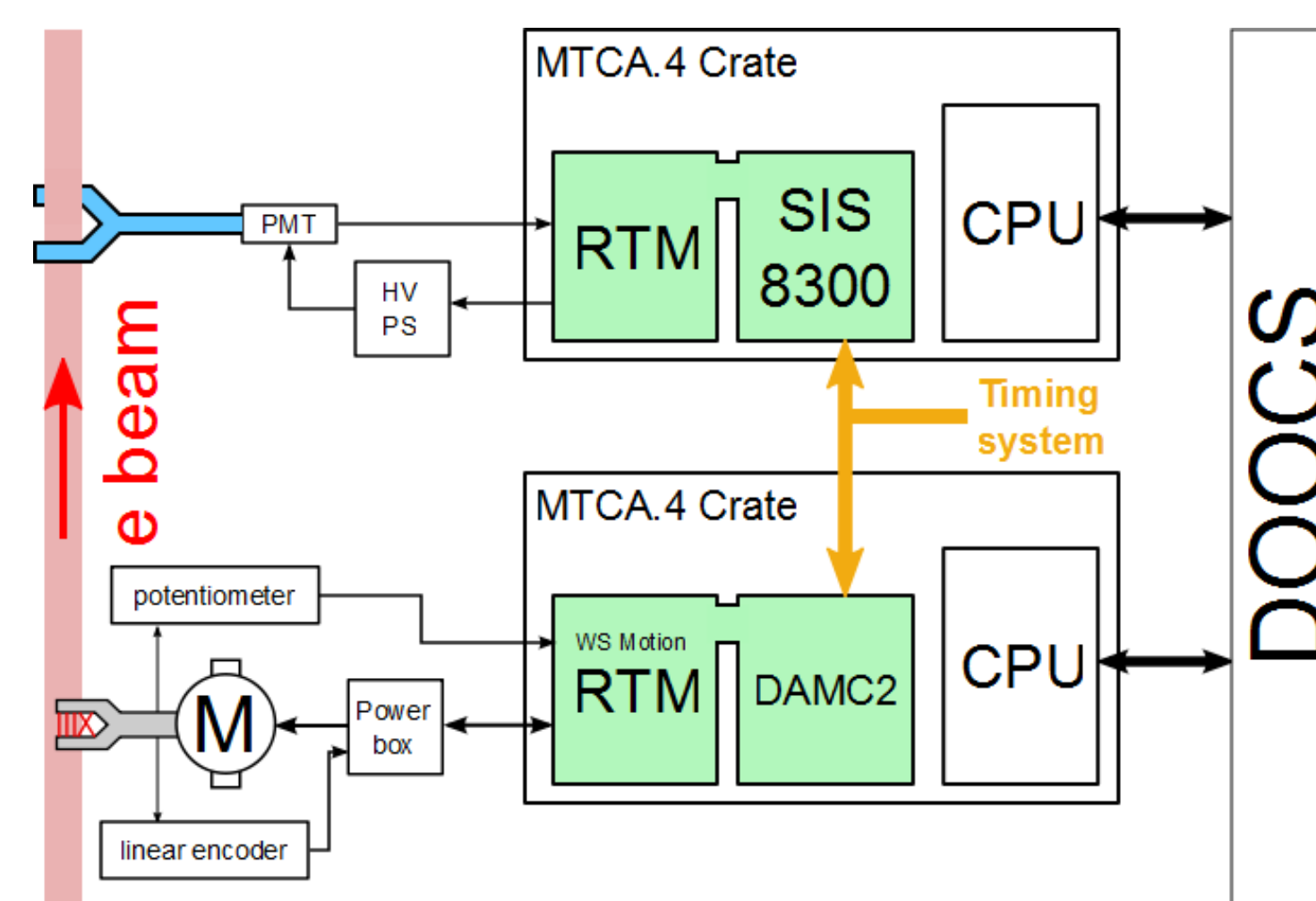
- wire scanner station with corresponding detector readout
- only one motion plane is displayed
- the detector can be meters apart from the motion unit
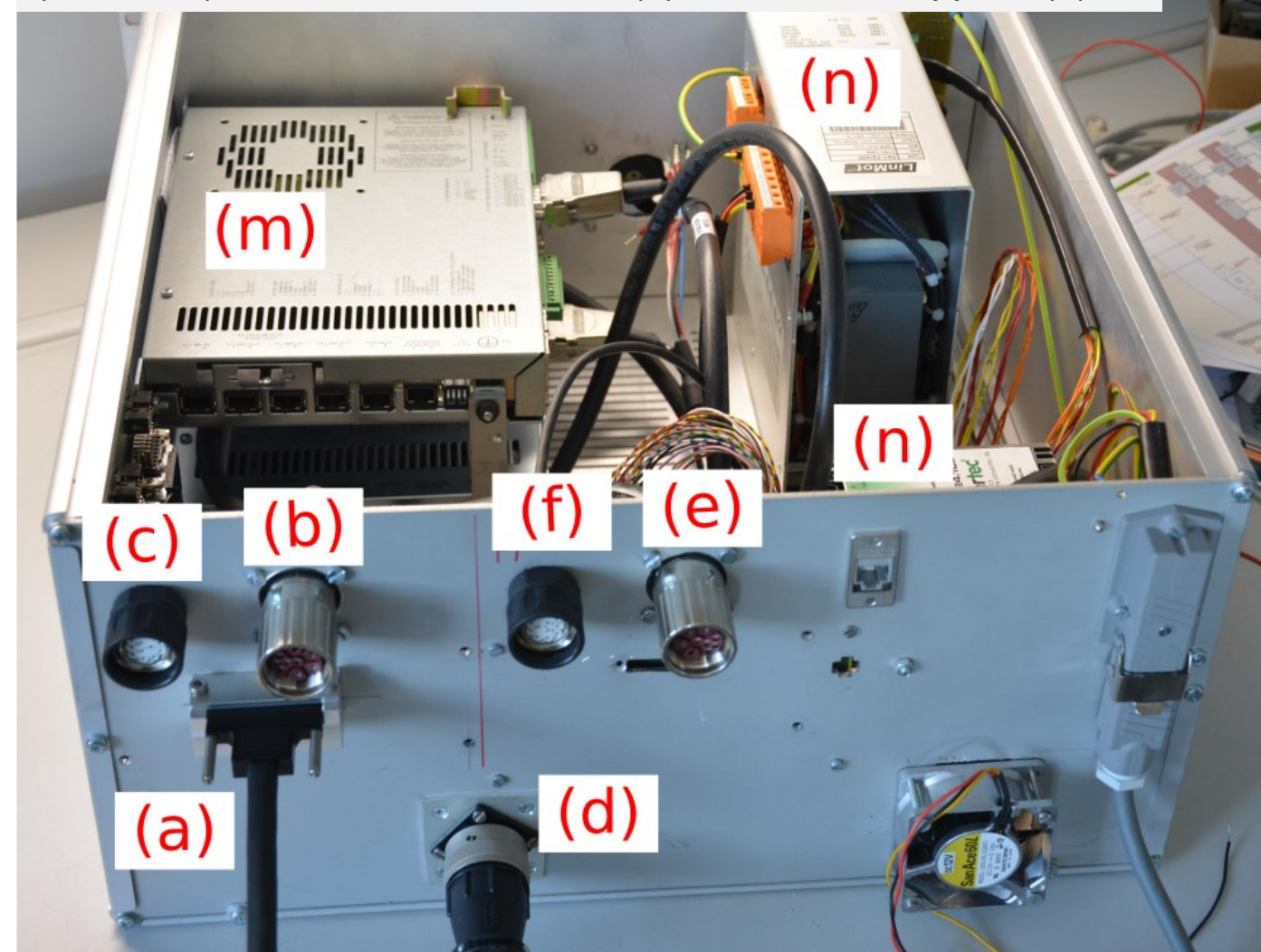
Assembly of Forks
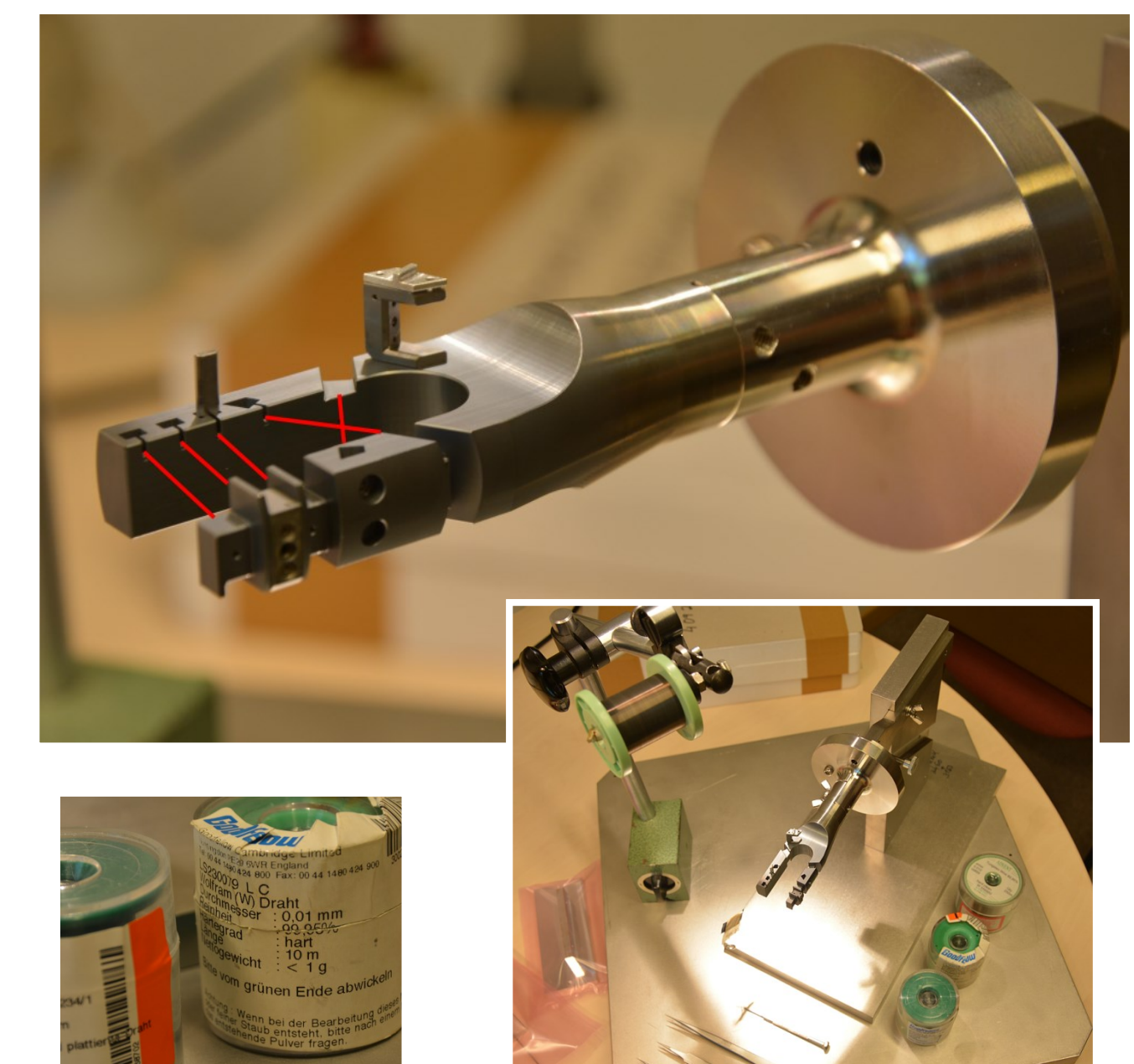
- fork in assembly fixure
- Fork made of Titanium (rigidity, weight)
- 5 Tungsten wires, thicknesses 10 – 30 µm
- detailed improvements to ease wire assembly and adjustment
- Fork gap: 15 mm, wire - wire distances: 5 mm (90°)

From MTCA.4 to Wire Scanner motor units …

DAMC2
General purpose digital AMC
(Desy FE-Group development)

Pre series
Wire Sanner RTM
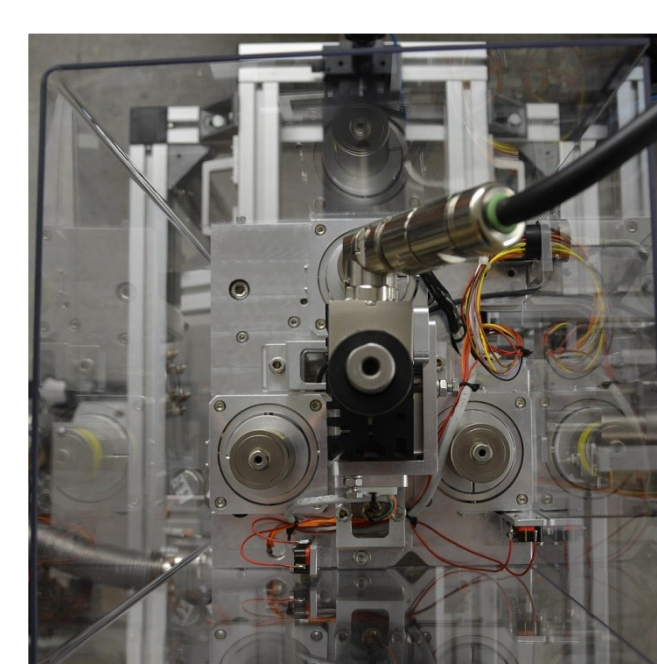for Motor Control, position readout, System safety

Powerbox prototype
(rear view) with LinMot Controllers (a) and Power Supplies (b)

Prototype of Wire Scanner Powerbox (rear view) with LinMot Motor Controllers (m), Power Supplies (n), horizontal and vertical Heidenhain linear encoder readout cables (c, f) and motor cables (b, e), RTM to powerbox cable (a) and cable for end switches and catch units at the scanner (d).

Electronics for Motion Unit

- High precision position readout with optical linear encoder (Heidenhain); **resolution: 0,5µm**
- For saftey purposes: linear radiation resitant potentiometer; **resolution: 50µm**
- Motor control and triggering
- Voluminous and heavy components in power box

Scan Modes

- **Fast Scan**: fine delayed trigger derived from timing systems pre-trigger (60ms before 1st bunch)
- **Slow scan**, only one bunch allowed

Safety Aspects

- Check if bunch number, frequency and charge is in certain range → scan allowed
- Fast Scan: if design speed of 1m/s is not reached in certain position range → stop beam by MPS alarm
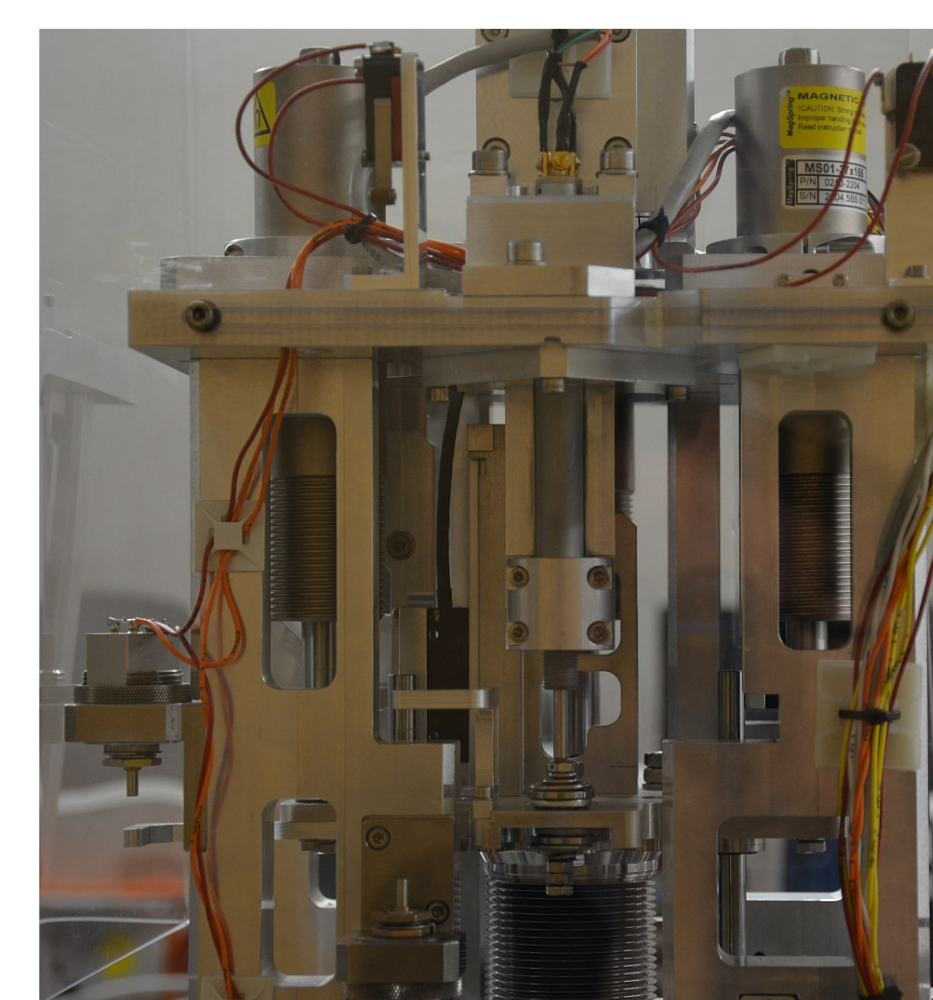

Bird's eye view of vertical motor unit with safety housing with 2 switches, linear motor in center, 3 magnetic springs around, linear potentiometer from top
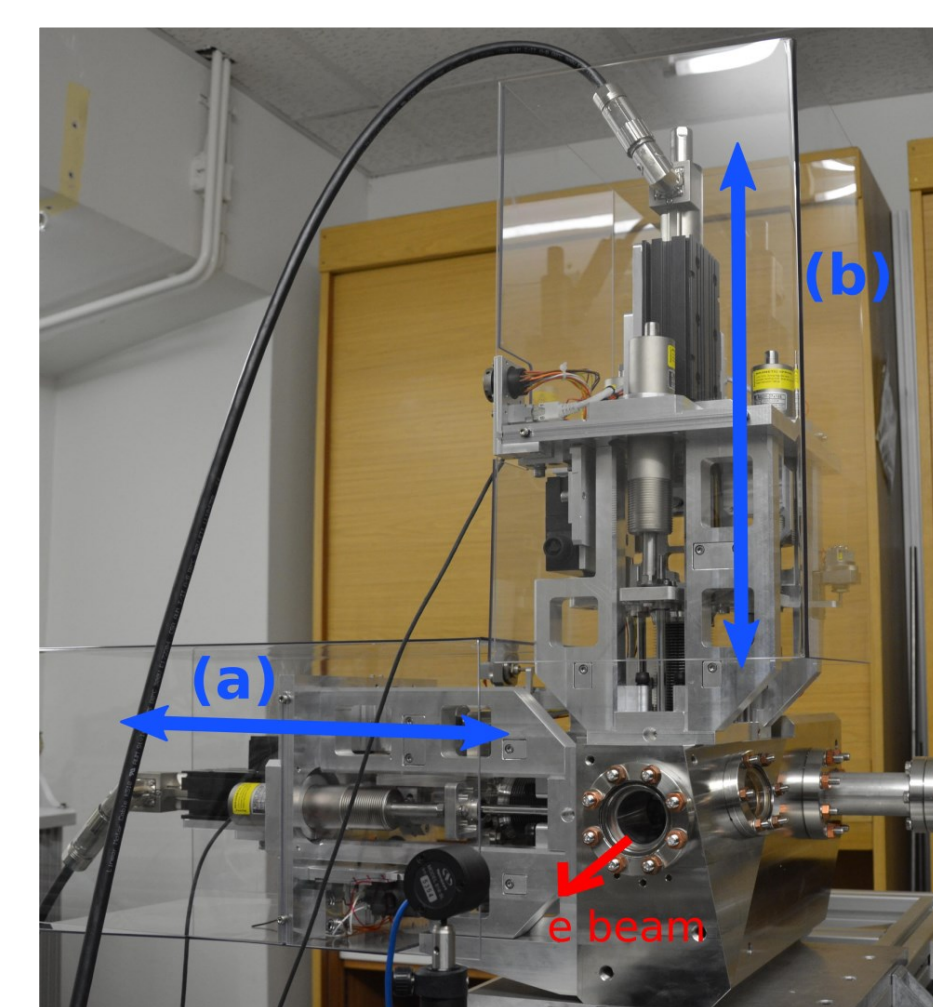
Mechanical Prototype station with horizontal (a) and vertical (b) motion unit.
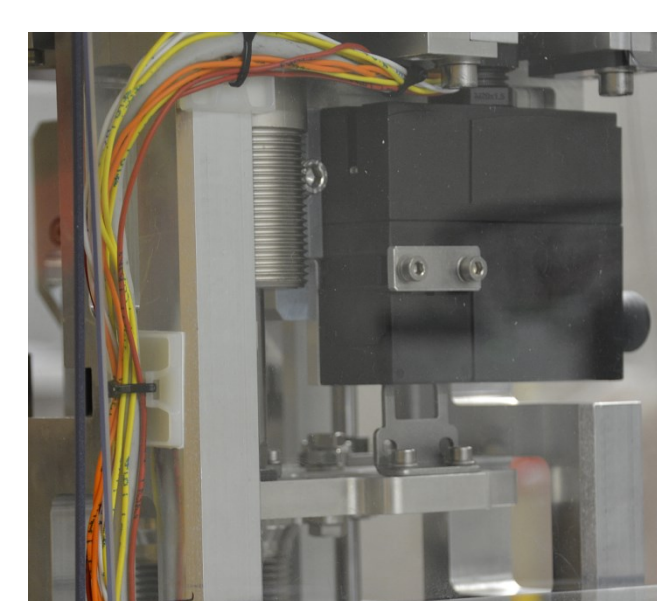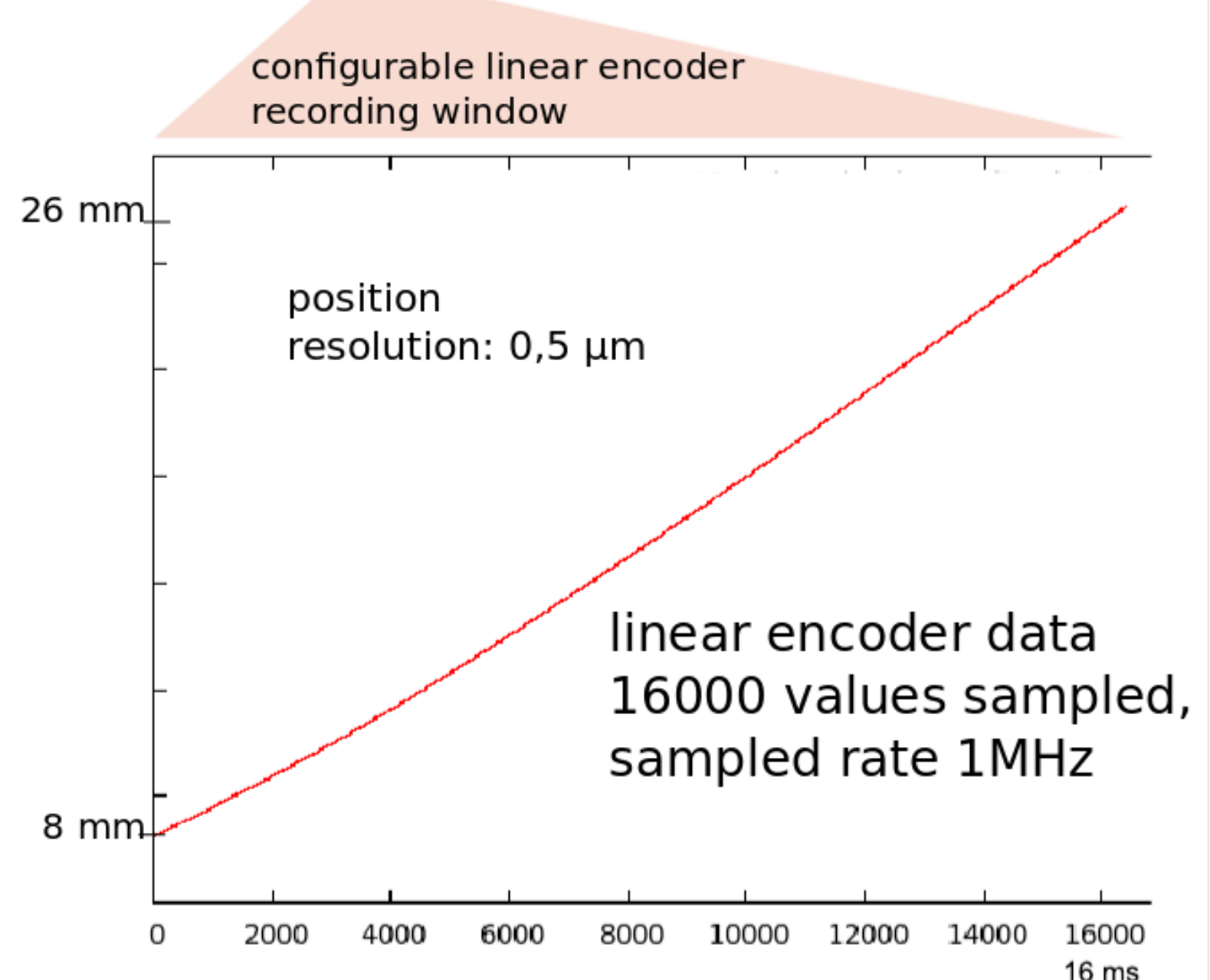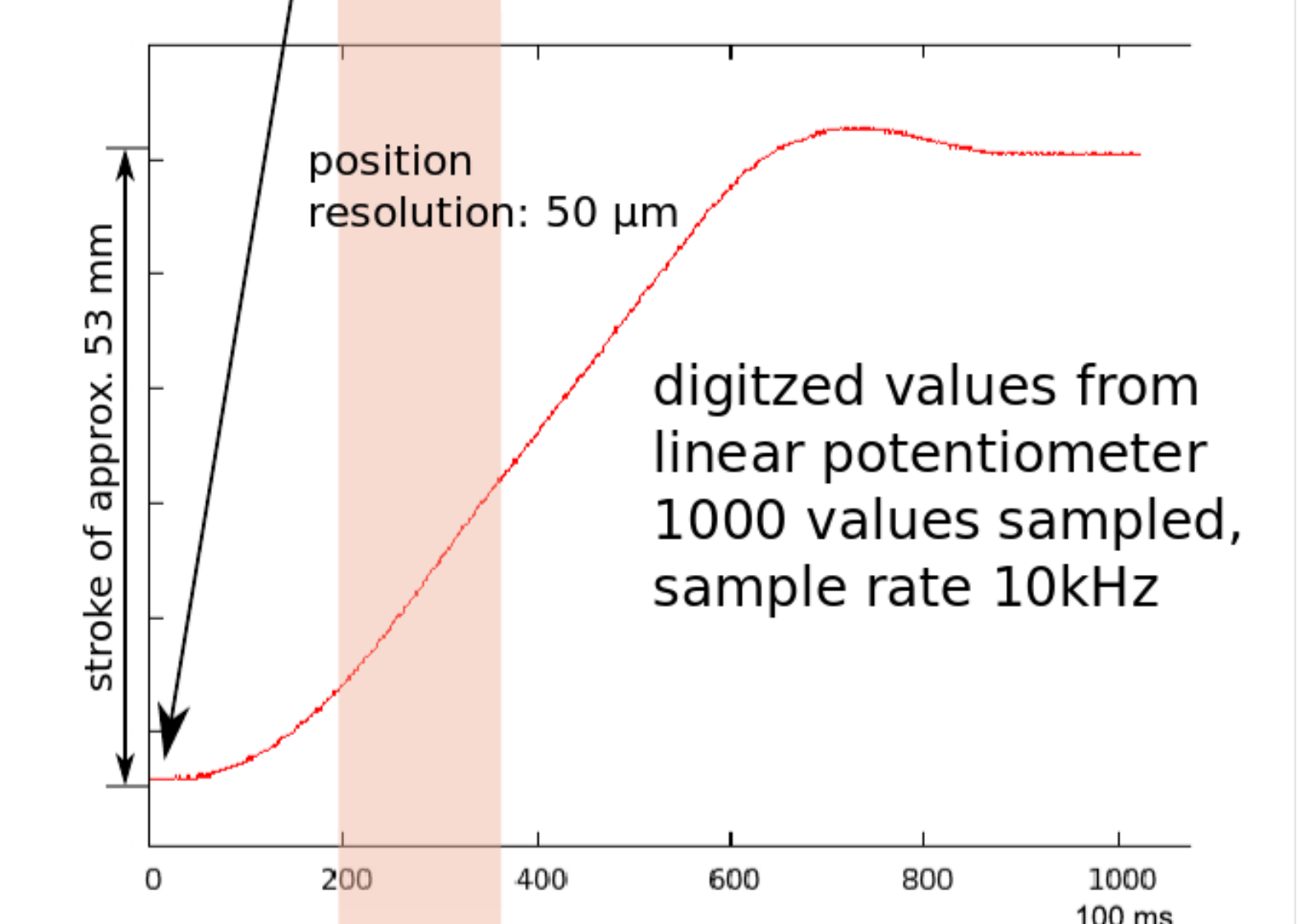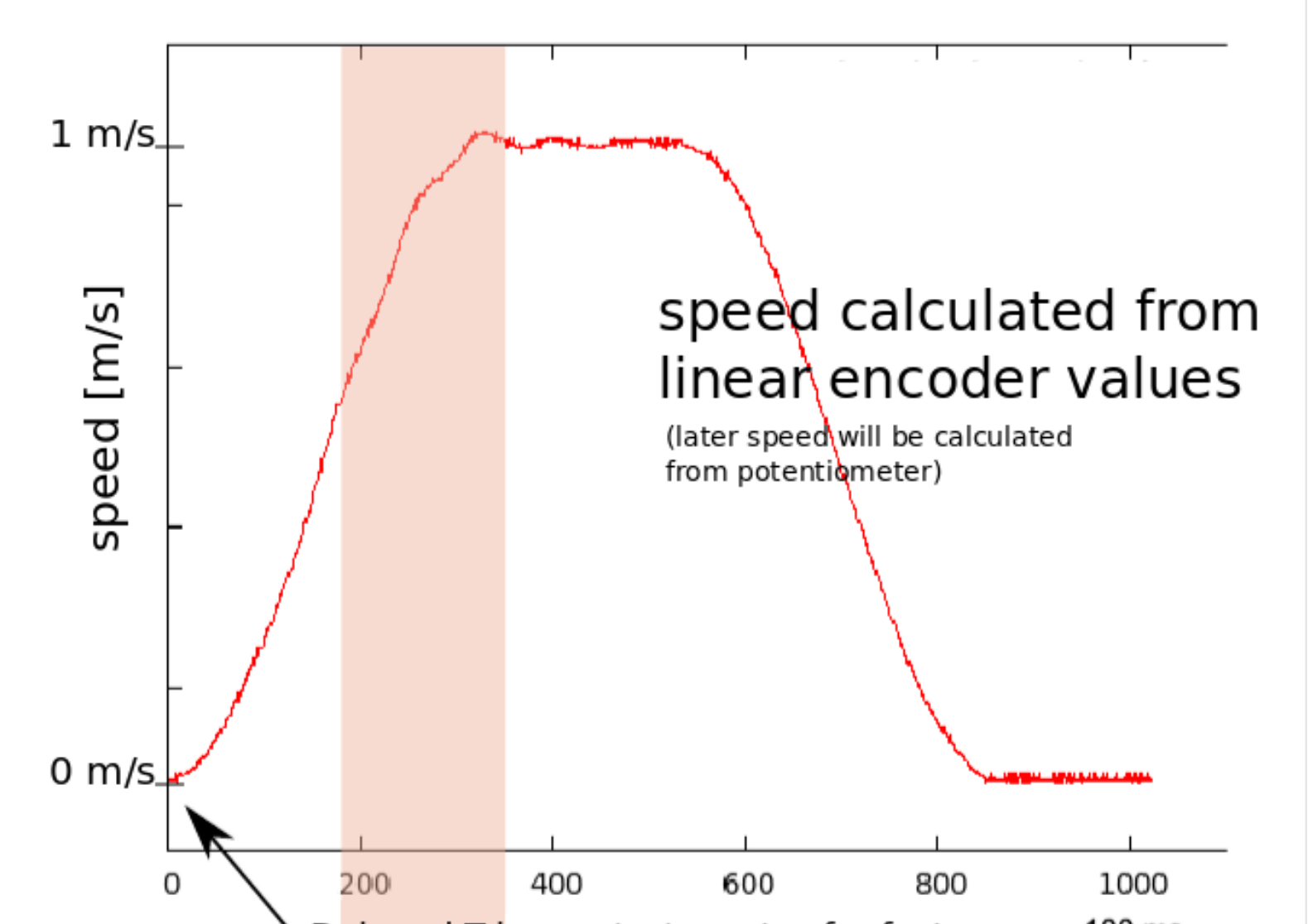

Catch unit for fork in parking position, with integrated end switch

Detailed view with Magnetic springs, safety housing switches, linear potentiometer, Heidenhain ruler&head, end switches, bellow (vacuum system)

Measurement with set of Prototype Hardware

speed calculated from linear encoder values
(later speed will be calculated from potentiometer)

Delayed Trigger starts motor for fast scan

position resolution: 50 µm

digitzed values from linear potentiometer 1000 values sampled, sample rate 10kHz

configurable linear encoder recording window

position resolution: 0,5 µm

linear encoder data 16000 values sampled, sampled rate 1MHz

Complete triggered stroke showing speed, potentiometer data and high precision encoder data