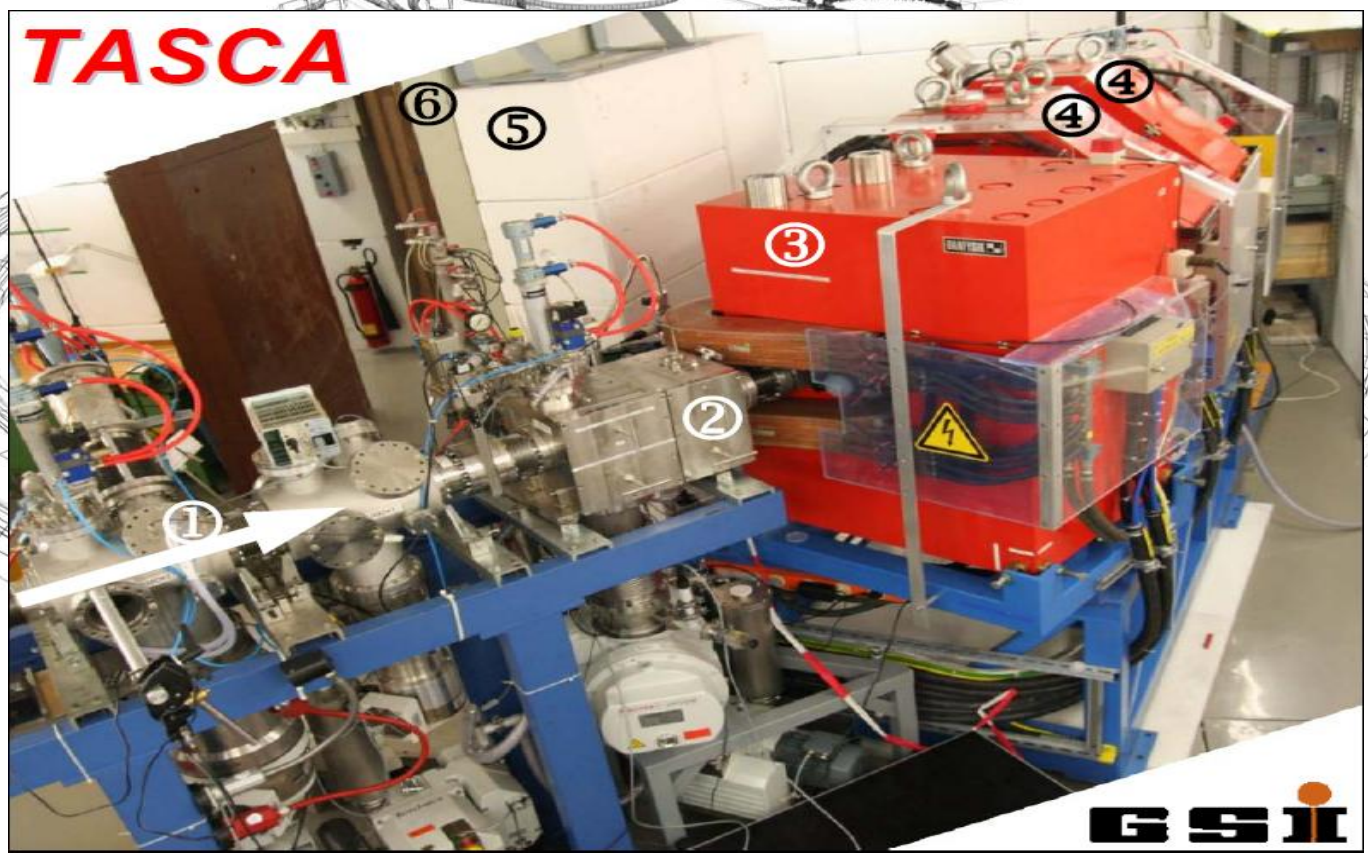
TASCA 4 Target Wheel Control

Motor Control System



Comparison of 4 target and 8 target systems

Analogy:

- Motor control system.
- Target wheel.
- 50 Hz mains synchronic.
- Beam synchronization to targets position.
- Synchronic feedback.
- Position feedback.
- Beckhoff components and software for control system.

Differences:

- 4 targets instead of 8 targets.
- wheel diameter of 120 mm by 4 targets and 350 mm by 8 targets.
- Stepper motor instead of a Servo motor.
- Stepper motor terminal instead of servo drive.
- No encoder use for feedback with stepper.
- Motor velocity 4 target wheel: 37.5 r/s (2250 rpm or 13500°/s or 15000 step/s).
- Motor velocity 8 target wheel: 18.75 r/s (1125 rpm or 6750°/s)

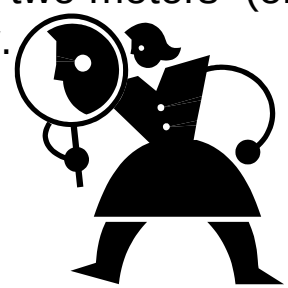
Motivation for the System implementation

- Experience gain with the 8 Target Wheel system and Beckhoff solution.
- Experience gain with stepper motor by the 3 Target Wheel system using at the moment (old one without Beckhoff parts).
- Requirement to update the existing (old) system (3 Target Wheel).
- Advantages of stepper motor include a very good positioning capability and a cost effective alternative.
- Possibility to use the same control loop as use for the 8 Target Wheel system (same software and software function blocks with only some adaptations).
- The effort for changing from a servomotor to a stepper motor - and back - is no greater than changing from one field bus to another one under TwinCAT. (Beckhoff quotation).
- Short implementation time.
- Support giving by Beckhoff

First impressions (EL7041-1000)

- Start work at 23.06.2010 (objective to close the work at end of august).
- Description for Stepper motor terminal configuration on the documentation does not match with the giving options. Maximal and reference velocity equations result on values not applicable on our system (too low values).

- Beckhoff feedback: Description is wrong other equations should be use.
- First test with motor: Motor actual velocity does not agree with Motor set velocity or the motor turns in a very slow motion.
- Some test made for Beckhoff: all the possible micro stepping levels, two motors (one of them a Beckhoff motor) 400 and 200 steps, set ant actual velocity.



First impressions (EL7041-1000)

- Beckhoff feedback: Firmware update required to fix the bug.
- After firmware update still doesn't the terminal work properly. Lag distance to big; trying to solve using the system control factor Kv. Values tested from 0 to 27 and not significant change on lag distance.

- At 29.07.2010 visit Mr. Herschke us and find in a experimental way the convenient values for the terminal configuration.

EL 7041-1000 second part

- At 18.08.2010 (I am back from vacations) restart the work with the motor. Objective: testing motor behaviour by long time under function (more than one hour). Result: after some minutes the motor stop turning.

- Once again, start some test for Beckhoff. Made some changes, motor from serial connection to parallel; trying to solve using the system control factor Kv and other system control loops. Motor oscillations are present; testing with other velocities and accelerations values.
- Beckhoff feedback: Motor should be mount according to the later working conditions, with a load and under flange mounted condition.

EL 7041-1000 second part

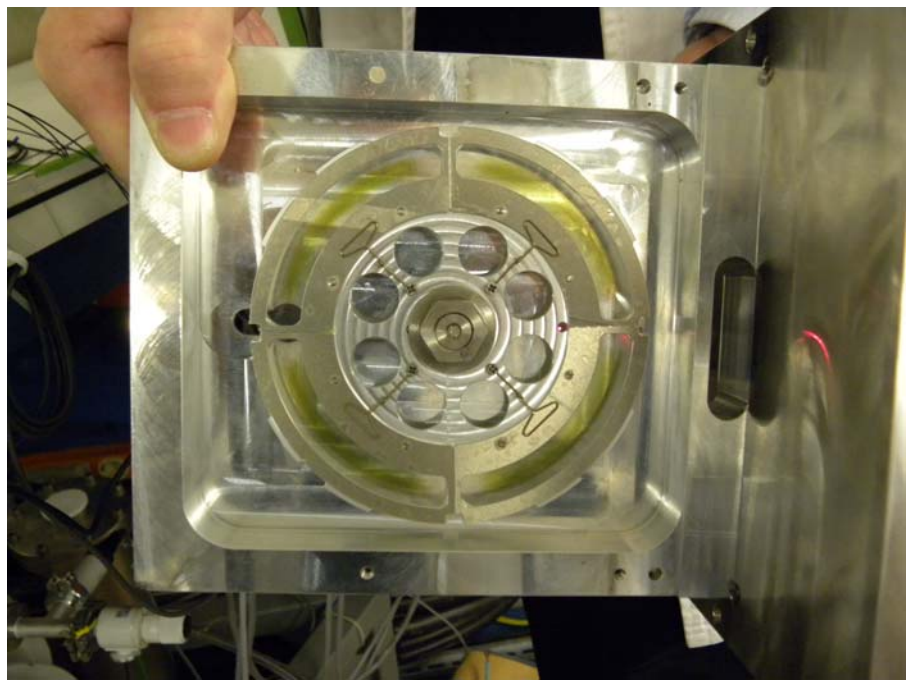
- After this changes the motor turns better but there are still some problems. Solution: do not use system control loop (Kv=0), do not use lag distance monitoring, accept the fact of the stepper motor oscillations.
- By starting with the application software, there are problems again, the velocity synchronisation with the mains frequency does not work.
- Mr. Herschke (Beckhoff) start some test. Results: Stepper terminal has a new hardware version and it works better as the version 01. We get a new stepper terminal. The motor required a attenuator.

EL 7041-1000 trilogy

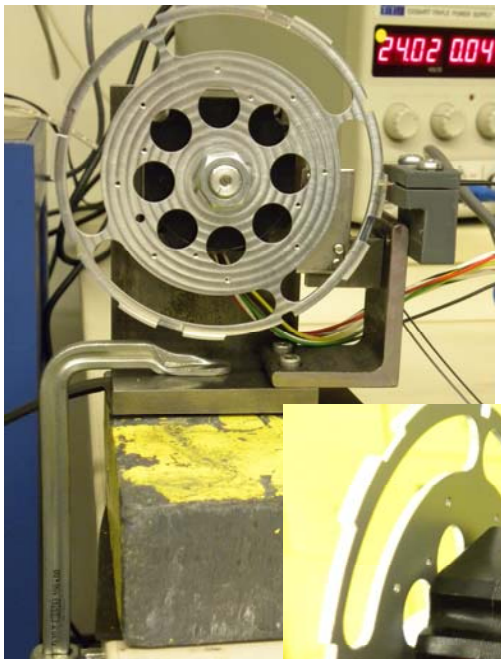
- We made some mechanical improvements on the wheel and improvise an attenuator till the correct one arrives GSI.
- At 08.10.2010 restart with the application program. The motor turns good, some oscillations still present, mains frequency synchronization works. Position synchronization does not work.
- Some adaptations and changes were made on the application program; some suggestions from Mr. Herschke too.
- At 22.10.2010 online support from Mr. Herschke, after long time testing the conclusion was: with the EL7041-1000 stepper terminal is no able to made this synchronization. Solution. Use the KL2541 stepper terminal (old K bus version).
- 25.10.2010 visit Mr. Herschke GSI to implement this change. After 8 hours work we come to the conclusion that the functional block use on the 8 Target wheel application for the control loop is not possible to use on this application. Solution: made an own control loop, we decide to use the same principle use on the main frequency synchronization.
- It is necessary to implement a mechanism to detect if the motor suddenly stops.

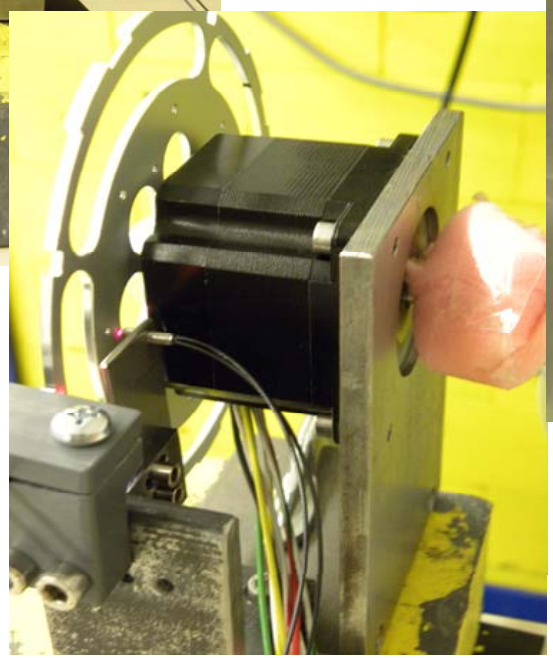
The end of the trilogy.

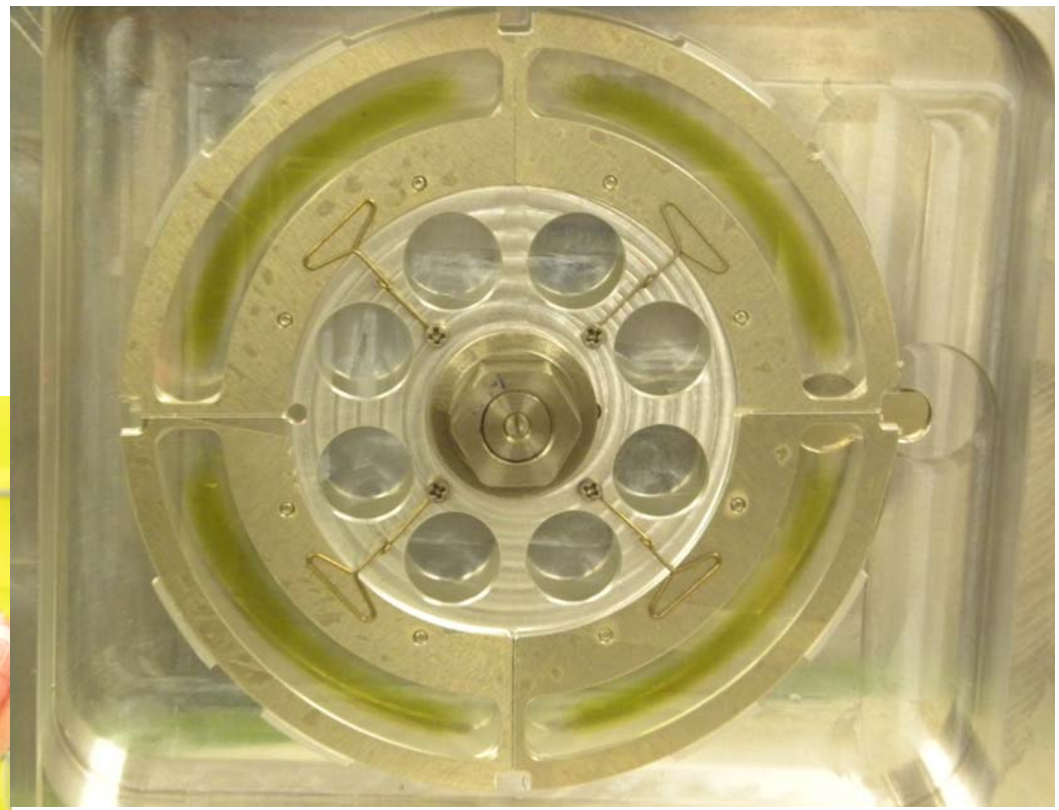
- Stream time started on 28.10.2010 with the old system.
- The program is fix, the 4 target wheel application works on the test place. Some additional test made with long cable connections.
- 03.11.2010. mounting the system on the experiment place. At 17:45 was the first wheel radiated.
- Result: SUCCESS!



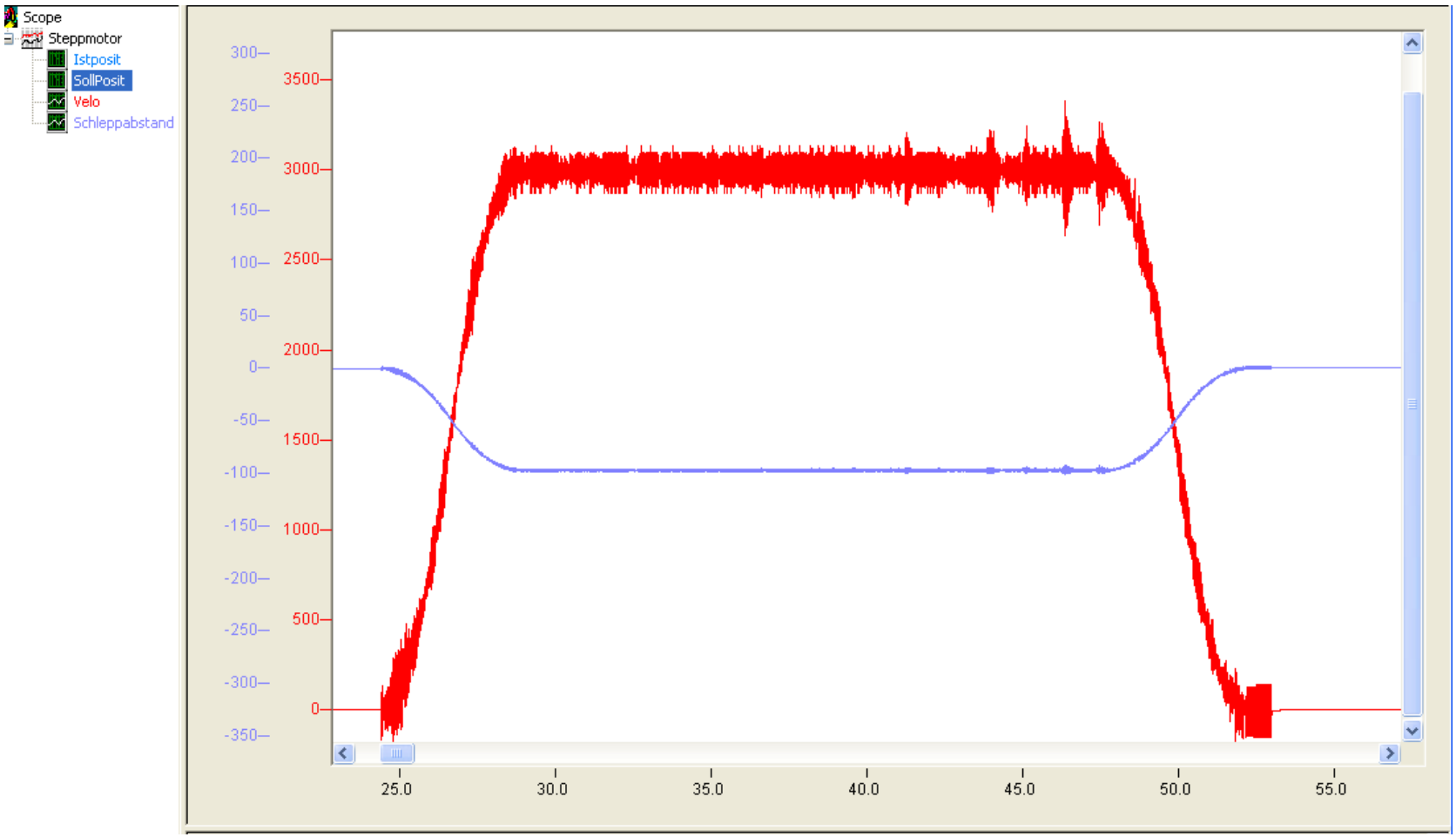
Some pictures



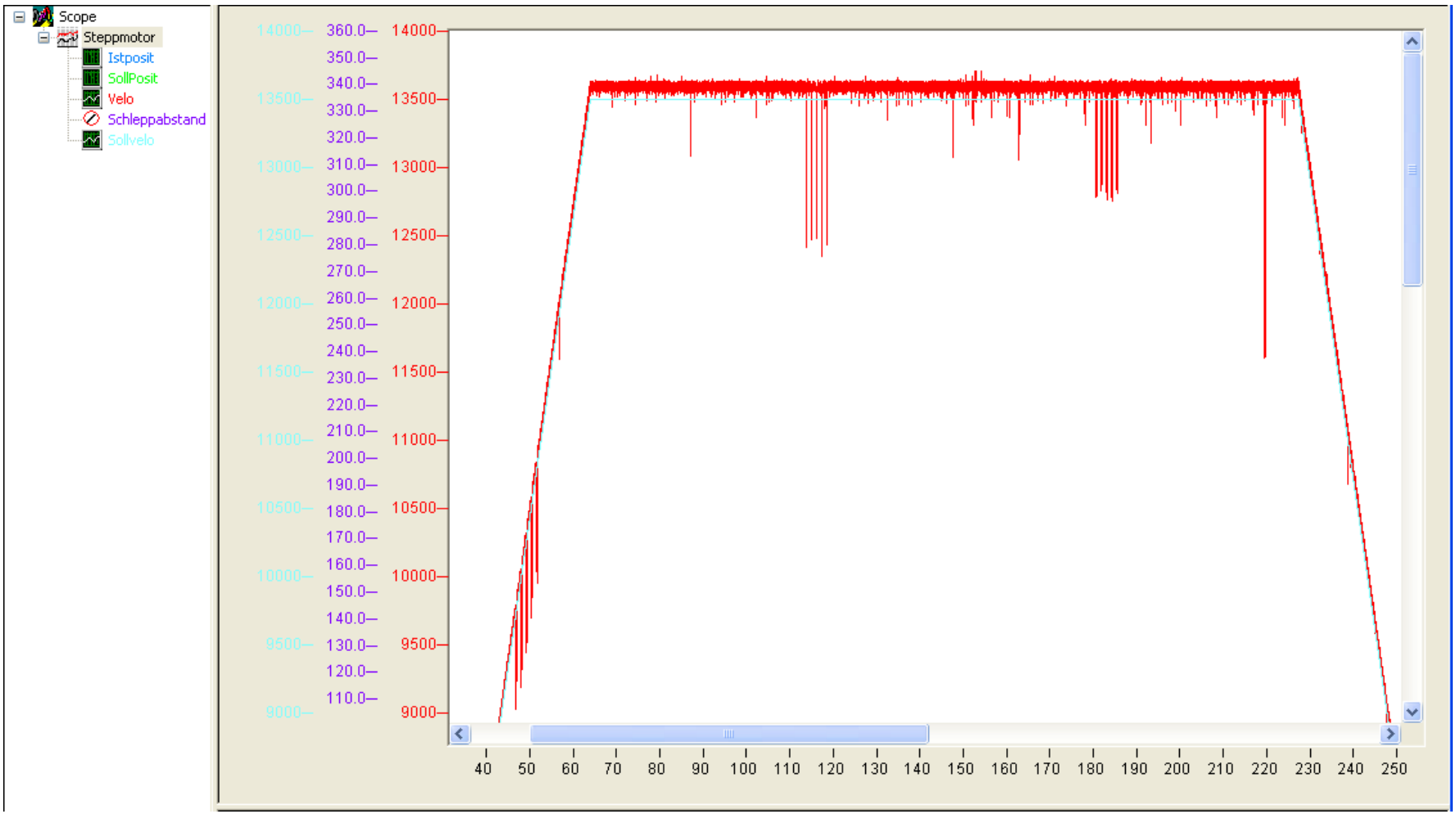




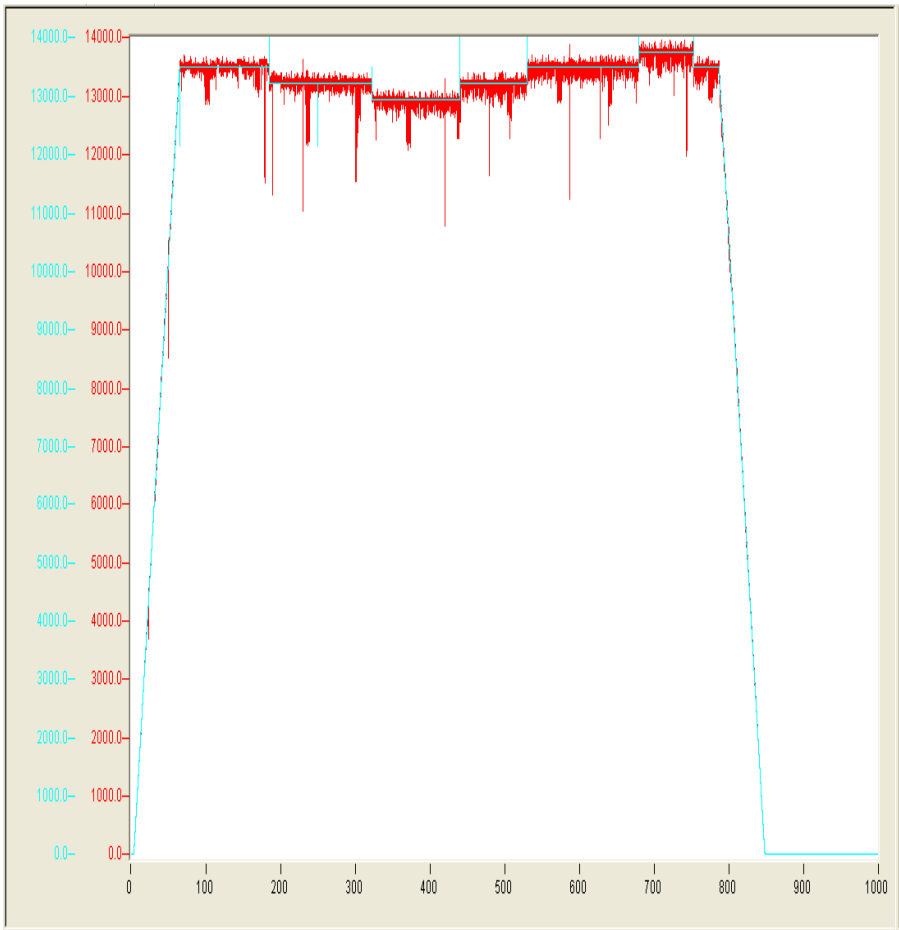
Lag distance and oscillations

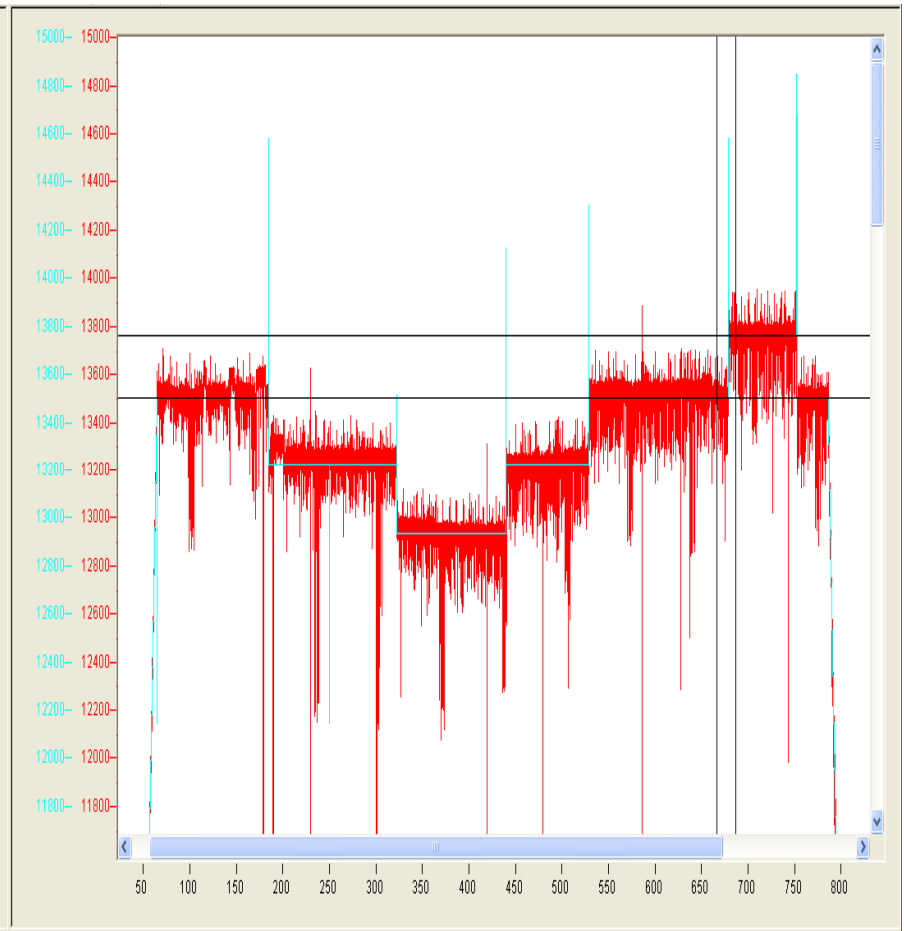


Motor oscillations

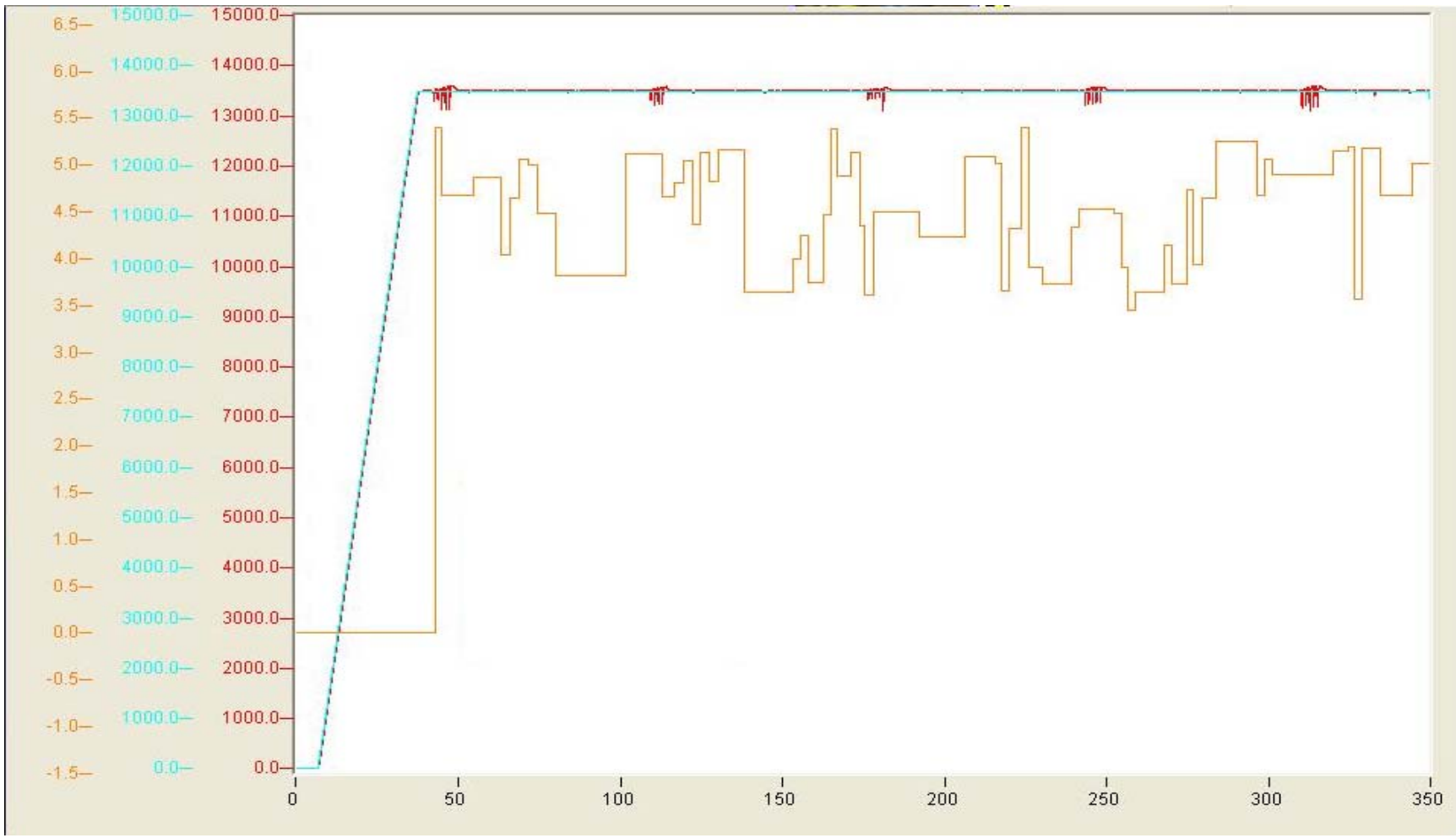


Synchronization with mains frequency





Synchronization problems



Synchronization problems