

Kick-off meeting

Presentation about possible Test Items

November 23, 2017 | Michael Klein & Klaus Bussmann

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- Collection of possible Test Items – Motors
- Collection of possible Test Items – Feedback systems

Test Items – Linear Servomotors

BECKHOFF

- Manufacturer: Beckhoff
- AL2XXX Series, Iron-core Forcer (higher Forces)
- AL20xx: motor with highest power density
- AL24xx: motor for installation in compact mechanics
- AL28xx: motor for applications with highest demands on force and stability



Reference: www.beckhoff.de

- Manufacturer: Beckhoff
- AL38xx Series, ironless Forcer (higher dynamics)
- U-shaped construction of the stator with opposing magnets
- Benefits: the coil part is not attracted by the permanent magnets; reduced weight; reduced inductance of the coil part; => high dynamics, no maintenance



Reference: www.beckhoff.de

Test Items – Linear Servomotors

- Beckhoff only offers the active electrical part of the linear motors (primary section, secondary section, servo amplifier)
=> are not self-contained systems
=> mechanical parts like carrier frame, carriage, type of rail etc. are not included!
- AL2xxx: 3-phases synchronous Linear Servomotors 400 - 480 V AC
AL20xx: Speed max. 2,5 – 7 m/s; Peak Force: 225 – 1600 N;
AL24xx: Speed max. 12 m/s; Peak Force: 105 – 420 N;
AL28xx: Speed max. 2,5 – 6 m/s; Peak Force: 1600 – 6000 N;
- AL38xx: 3-phases synchronous Linear Motors 230V AC
AL38xx: Speed max. 2.7 – 6.6 m/s; Peak Force: 700 – 4200 N;
- Amplifier: Digital Compact Servo Drives AX5000:
 - EtherCAT system communication
 - single- or multi-channel form available
 - wide voltage range 100...480 V AC
 - compact design for cabinet installation



Reference: www.beckhoff.de

Test Items – Linear Servomotors

- Manufacturer: Siemens **SIEMENS**
- SIMOTICS L-1FN3-Motoren, Iron-core Forcer
- Linear drives in a compact design with high power / force density
- Speed max. 836 m/min = ~13,9 m/s; Max. feed force: 20.700 N;
- Siemens only offers the active electrical part of the linear motors (primary section, secondary section, servo amplifier)
- The linear motor complete axes LTS/LTSE (with Siemens 1FN3 motor) supplied by SKF:
A profile rail guide, the primary and secondary motor parts, a linear encoder including limit switches, limit position dampers and cable trailing device connection are fully integrated into the linear complete axis
=> only available with self-cooled motors!
=> the required force decides whether such an axis can be used
- The linear motors are deployed in combination with SINAMICS S120 converters
=> For EtherCAT communication with Beckhoff PLC a PROFIBUS-Master terminal is necessary
=> EL6731 for example



Reference: w3.siemens.com

Test Items – Linear Servomotors



Reference: www.hiwin.de

- Manufacturer: HIWIN Motion Control
- Specialized in the linear motor technology
- Iron-core and ironless motors available => We prefer the ironless motor here (high acceleration)
- LMC – Series: Speed max. 5 m/s; Peak force: 96 – 2736 N;
- LMC series achieve an extremely high level of synchronism and extreme acceleration due to the minimal Forcer mass.
- Between the forcer and stator no cogging moments appear and there is no magnetic attraction introduced into the guiding system. (ironless motor)
- HIWIN offers complete axis (LMX1E) or just the active electrical part (LMC):
=> LMX1E: LMC Motor, Speed max. 5 m/s; Peak
- Amplifier: D1-N series servo drives:
 - Optional Ethercat interface with CoE protocol
 - Digital, analogue, EnDat 2.2 and Resolver encoder interfaces
 - 220 – 400 V AC output voltage



Reference: www.hiwin.de

Test Items – Linear Stepper Motors



- Manufacturer: H2W Technologies / Baldor
- In September 2014 H2W Technologies acquired the Baldor linear motor products
- They offer many different types of Linear motors => We prefer Linear Stepper Motors
- Single Axis Linear Stepper: Speed max. 2 m/s; Peak force: 9 – 222 N; Current: 1,5 – 4 amps
- Forcer is guided by either roller or air-bearings along the platen
- 2 or 4 phases stepper available
- The motion achieved with a full step is .010" [250 microns]
- With a microstep it's .00004" [1 micron].
- Linear stepper motor = complete positioning stage:
=> Motor, the bearings and the positioning system
=> all built into one compact package
- Integrating a linear encoder provides a closed loop system
- Advantages: High Speed, Low cost, no servo tuning
- The ends of the coil are brought out to either a "D" connector or to flying leads.



Reference: www.h2wtech.com



Reference: www.h2wtech.com

Test Items – Linear Stepper Motors



- Manufacturer: H2W Technologies / Baldor
- Dual Axis Linear Stepper: Speed max. 2 m/s; Peak force: 6 – 133 N; Current: 2 or 4 amps
- Forcer is supported by magnetically preloaded air-bearings imbedded in the active surface of the forcer between the forcer and platen (0.025 mm gap between platen and forcer)
- 2 or 4 phases stepper available
- The motion achieved with a full step is .010” [250 microns]
- With a microstep it’s .00004” [1 micron].
- Linear stepper motor = complete positioning stage:
=> Motor, the bearings and the positioning system
=> all built into one compact package
- Platen: Steel plate that is slotted to form 0.5 x 0.5 mm square teeth on the surface. The spaces between the platen teeth are filled with epoxy to provide a flat air-bearing surface for the Forcer.
- Platens can be manufactured in different shapes
- Platen Size [mm]: 457 x 330, 457 x 415, 584 x 457, 838 x 584;



Reference: www.h2wtech.com

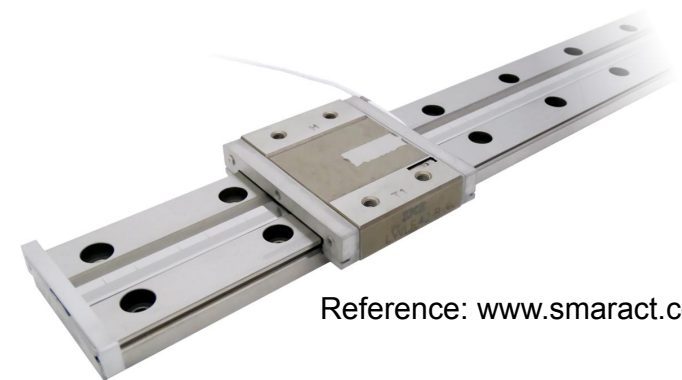
Test Items – Linear Positioners



- Manufacturer: SmarAct GmbH
- SmarAct offer products for micro- and nano-positioning tasks => Based on piezo driving technology
- SLC series:
 - Based on linear slides with crossed-roller bearings;
 - Based on the SCL series, the SHL line for heavy loads is available;
 - Characterized by stability and high accuracy;
 - Available for vacuum environments down to 10^{-11} mbar;
 - Positioners in different broadness and height available;
 - Max. force: 30 N; Max. speed: 20 mm/s (= 0,02 m/s); Travel range: 12 – 123 mm;
- SLL series:
 - Based on recirculating ball slides;
 - Small slide and rails of different length for precise long range positioning;
 - Available for high vacuum;
 - rail length 70 – 1480 mm;
 - Max. force: 30 N; Max. speed: 20 mm/s
 - Sensor resolution: 1nm



Reference: www.smaract.com



Reference: www.smaract.com

Test Items – Feedback systems

- Linear Encoder **HEIDENHAIN**
- Manufacturer: Heidenhain GmbH
- Specialized in Encoder Technologie;
- Sealed linear encoders are protected from dust, chips and splash fluids;
- Exposed linear encoders operate with no mechanical contact between scanning head and scale;
- Linear encoders with slimline scale housing for limited installation space;
- Encoders with full-size scale housing for high resistance to vibration and large measuring lengths;
- Absolute Linear Encoders (EnDat2.2) or Incremental linear measurements (1 V_{SS} sinus or TTL square wave);
- Accuracy class: $\pm 2 \mu\text{m}$ to $\pm 15 \mu\text{m}$;
- Measuring length: up to 72040mm (LB382 series)
- Renishaw or HIWIN (Magic Series) as alternative for Heidenhain

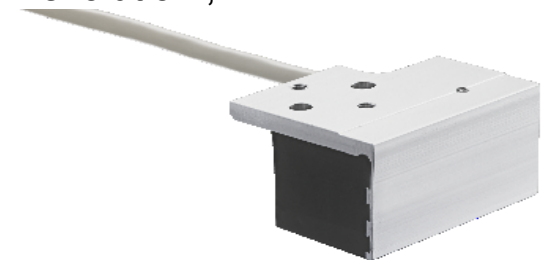


Reference: www.heidenhain.de

Test Items – Feedback systems

BECKHOFF

- Magnetic Encoder System (MES)
- Manufacturer: Beckhoff
- Only suitable for AL2XXX series (Iron-core);
- MES consists of reader head with integrated analog Hall sensors
=> Hall sensors evaluate magnetic field of magnetic plates and convert the signal into an analog output signal (1 V_{SS} , Sinus-Cosinus);
- The additional investment for the complete system increases with the length of the travel path;
- For this reason, Beckhoff has developed a measuring system that monitors the magnetic field of the permanent magnets of the magnetic plate;
- The measuring system provides one sinus oscillation per logical motor revolution.;
- Accuracy class: < 100 µm;



Reference: www.heidenhain.de

Test Items – Feedback systems



- Interferometer
- Manufacturer: attocube (Subsidiary companies of Wittenstein)
- **FPS3010** - Fully automated interferometric displacement;
- **FPS3010-19“** - for operation in electrical cabinets => Ideal for use in our test bench;
- Compatible with up to three fiber-based sensor heads;
- The FPS3010-19“ is compatible with fiber lengths of up to 500 m;
- for applications where Ethernet accessibility of the device is key => TCP/IP and Epics optional;
- Real-time serial-word and incremental interfaces allow the connection of FPS3010 devices with other electronics and host controllers;
- Interfaces: HSSL (digital) & AquadB (digital)
- Renishaw as alternative for attocube;
- **IDS3010** - with BiSS-C Interfaces!



Reference: www.attocube.com

END