

Industry: Mechanical Engineering

Products: Modular controllers , servo drives and motors, frequency inverters , control terminals

Core Competence: High-precision Transformers

Large-scale transformers have a sealed core consisting of several thousand laminations of sheet iron with a special insulating coating. The automatic stacking of these sheets, which are just 0.23 to 0.35mm thick, calls for both high precision and short cycle times, placing high demands on the machines and automation systems involved. The mechanical engineering firm Kohls Maschinenbau GmbH in Freigericht, Germany, opted for an integrated configuration of servo and controller systems from Mitsubishi Electric for a new core stacking machine with 55 drive units.



Modern transformer cores generally have three "legs" that are held together by upper and lower yokes. The cross-section of the core can be made approximately circular by using packets of laminations in graded sizes and thicknesses. The yoke and leg plate joints are interleaved and are frequently also arranged in a "step-lap" configuration, which is more complex but provides a better flux characteristic. In step-lap cores the sheets in the joint areas are also staggered slightly in every layer by a measure of 5 to 7 steps.

Increasingly stringent demands for core quality, shorter production and delivery times, cost pressures and the risks involved in manual stacking all increase the need for automated manufacturing systems. One of the latest developments in this field is the new, almost 20m long transformer core stacking machine from Kohls. It can handle sheets up to 4.7m long and 0.7m wide and can produce transformer legs and yokes with diameters up to 500mm in a fully automated process as complete assembled stacks. Products with larger core diameters up to around 720mm can be produced as partial packages.

The sheets coming from the stamping press are fed into the machine at high speed via a conveyor and transfer belt. The machine then distributes the sheets onto five or six stacks, depending on the design of the core. Three twin handling stations with two vacuum gripper units each pick up the sheets from the belt, choosing them according to their shapes and destined positions in the core, and place them on the two temporary storage locations of the corresponding working table, which is lowered by one sheet thickness as each layer is added.

The brain and control centre of the machine is the MELSEC System Q automation platform, which controls all machine functions along with the 52 servo drives and three frequency inverter drives. Controller tasks are assigned to two motion control processors and one PLC processor, which communicate with one another virtually in real time via the controller platform's backplane bus. Working in tandem with the equally advanced control technology in the MR-J2 Super series servo drives, this system ensures fast access to all controlled axes and thus maximum system speed. Functions like automatic motor identification, real-time auto-tuning and vibration suppression help to speed up installation and setup and enable the configuration of high-precision systems with minimum rise times.

With the help of these systems the machine can stack the up to 4.7m long sheets with a tolerance of just 0.15mm, working in step-lap configuration with offsets of between 7 and 10mm. The cycle period for a complete layer of five sheets is just 10 seconds with sheets in an optimum stamping sequence – and that is significantly faster than is possible with manual stacking by skilled workers.



The key reasons why we chose the controller and servo systems from Mitsubishi Electric included the simple sequential step programming of the axes, the ability to process the movement commands in millimetres and the wide selection of available motors with low to high inertia ratings.

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