

Drive & Control profile

Rexroth brings SYNAX shaftless drive precision to new machinery for solar cell production process



With the Rexroth SYNAX 200 system, all the machines' axes are electronically synchronized so when the line speed increases or decreases, the axes ramp up or down together to maintain precise web position.

A high-accuracy servomotor and motion control system is reducing cost and increasing efficiency in a critical shaftless drive application.

One of the brightest ideas in renewable energy is using solar cell panels to generate electricity without burning hydrocarbon fuels. But compared to generating electricity from coal, the cost of

producing electricity with solar cells is high. In recent years, one solar cell panel manufacturer has been able to reduce the cost of solar cell panels dramatically—thanks to innovative machinery developed

Challenge:

Increase precision and speed while reducing development time in solar cell production

Solution:

- Bosch Rexroth SYNAX 200 shaftless motion control system
- IndraDrive C Converters
- MSK Synchronous Servo Motors

Benefits:

- Precise web control for tight registration in thousandths of millimeters
- Precise position monitoring
- Eliminates mechanical component limitations by using servo drives and electronic cams
- Digital control platform enables Electronic Line Shafting as a virtual drive
- Simple programming environment uses parameter library to eliminate coding, reducing development time by 20 percent
- Modular system simplifies shipping, allows more line flexibility

by Northfield Automation Systems (Northfield, MN — www.northfieldautomation.com), using a Bosch Rexroth shaftless motion control system.

“Manufacturing typical silicon-wafer solar cells is expensive,” explains Darin Stotz, sales manager for Northfield Automation Systems. “That’s because a photovoltaic solar cell is built in layers, and the silicon semiconductor layer that turns light into electric current must be applied in a complex process known as vacuum deposition.”

This particular solar cell panel manufacturer developed a new deposition method using technology from Northfield Automation Systems, which specializes in roll-to-roll thin material handling in the flexible circuit industry. They brought the expertise the solar cell manufacturer critically needed to optimize their processes.

“We implemented a Rexroth motion control solution on machinery that applies semiconductor material in an open-air environment, instead of inside vacuum chambers,” says Stotz.

“Basically, this manufacturer applies copper indium gallium (di)selenide—known as CIGS—onto a web of thin foil in a process that resembles offset printing. Consequently, they can produce CIGS solar cells that are much less expensive than silicon wafer cells, because it eliminates the complexity of vacuum deposition.”



The Rexroth servomotors adjust speed to vary web tension – and use speed to vary print location. Speed and tension can be adjusted by one-percent increments as needed.

The process is similar to printing the Sunday newspaper’s comics, in which layers of ink are aligned on a web of paper so the colors do not blur. But this process requires far tighter registration, as tight as one-thousandths of a millimeter. This level of precision in web handling presented Northfield with several challenges.

“This customer feeds rolls of foil through rolls in large presses similar to those used in rotogravure printing,” says Stotz. “Their challenge was to find a drive and motion control system that could synchronize multiple axes of the rolls in one long production line. As the web moves >100 feet down the line through different processes, the axes have to align the foil material in proper position for the next step.

From step to step, we need tight tolerance control so what happens in one operation lines up with the next. If the layers do not match up, then the solar cell must be scrapped, resulting in wasted materials. Consequently, the machinery has to start with tight tolerances, then maintain it at the next step so we don’t have to make a lot of adjustments to the web’s tension, speed and position.”

In conventional printing, rotary presses often use mechanical shafts and gears, but they do not come close to providing the accuracy required in this application. Neither can stepper motors, a solution that Northfield Automation Systems has traditionally employed in their web-handling machinery.

Motion Tech Automation (Oakdale, MN—www.motiontech.com), a local distributor of Bosch Rexroth motion control products, assisted Northfield in finding a superior alternative—the Rexroth SYNAX 200 shaftless drive system. With the SYNAX 200 system, all the machines’ axes are electronically synchronized so when the line speed increases or decreases, the axes ramp up or down together to maintain precise web position.

To maintain accuracy in thousandths of millimeters along a 100-foot line, Northfield specified Bosch Rexroth’s [SYNAX 200](#) control platform along with IndraDrive intelligent servo drives using SERCOS III industrial Ethernet communication.

Designed for the web-handling industry, Rexroth's SYNAX 200 is a control and drive solution that provides tight control of web positions by making minute changes in speed to maintain registration of the layers. Instead of mechanical cam shafts and gears, tightly synchronized digital servo drives and dynamic servo motors run off a standardized control platform to create virtual drives, an approach known as Electronic Line Shafting. The primary shaft is a virtual master axis. A programmable electronic gearbox ratio simulates the mechanical gearbox between the master axis and the drive. The master axis maintains a fixed relationship between its position and other virtual slave axes to achieve positioning accuracy that can not be obtained with mechanical gearboxes—or even stepper motors.

Web handling can be done with stepper motors, however the positioning accuracy of stepper motors is between 500 and 50,000 steps per revolution. That may seem high, but a servomotor using sine/cosine encoders for position monitoring provides over one million counts per revolution. That improves resolution and accuracy by several orders of magnitude.

The customer was not previously familiar with Electronic Line Shafting. According to Stotz, "They knew what servomotors were capable of, but we showed them how one single controller could run all those axes and how



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the architecture could achieve the precision they wanted.”

For this application, the SYNAX platform included a Machine Vision camera that focuses on registration marks on the web. Position inputs are translated by a PLC that sends instructions to a rack-mounted PPC multiaxis controller. The controller communicates with the Rexroth [IndraDrive C converters](#) powering Rexroth [MSK Synchronous servo motors](#), which make the appropriate position and speed adjustments as required. Each drive functions as a stand-alone device with its own power supply. Data is transmitted between the motion controller and

drives in real time over SERCOS III industrial Ethernet that provides noise immunity.

The servomotors adjust speed to vary web tension—and use speed to vary print location. Speed and tension can be adjusted by one-percent increments as needed.

With the SYNAX 200, achieving precise servomotor control is easy. “SYNAX is an excellent solution with numerous motion-logic functions that saved us the trouble of writing low-level code for tension and registration,” says Stotz. “We could parameterize drives and set up control zones for tension or

registration using drop down menus with fill-in-the-blank dialogs. It's like a function block you take out of a library and populate with values. Answers to basic questions are translated into drive parameters. The software allowed us to work more efficiently, which helped cut development time by 20 percent."

The SYNAX controller automatically recognized the servomotors, thanks to electronic nameplates that identified the motor, its maximum current and RPM. Then the controller automatically sets up the drive based on those parameters without having to individually input values.

Northfield Automation Systems has installed and built several machines with the SYNAX 200 platform for this manufacturer. The modularity

inherent in the SYNAX 200 system made it possible to develop modular machine designs, which simplifies shipping and provides flexibility in configuring the line to meet various requirements of the solar cell production process.

"Thanks to the SYNAX 200 shaftless motion control environment, we've been able to cut machine development time by 20 percent," says Stotz. "Getting those fabs up and running accurately and reliability at maximum speed gives our customer a real competitive advantage. They're producing solar panels 100 times thinner than typical panels and depositing semiconductors 100 times faster. That's turning time into money to help make solar cell panels more economically viable."

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