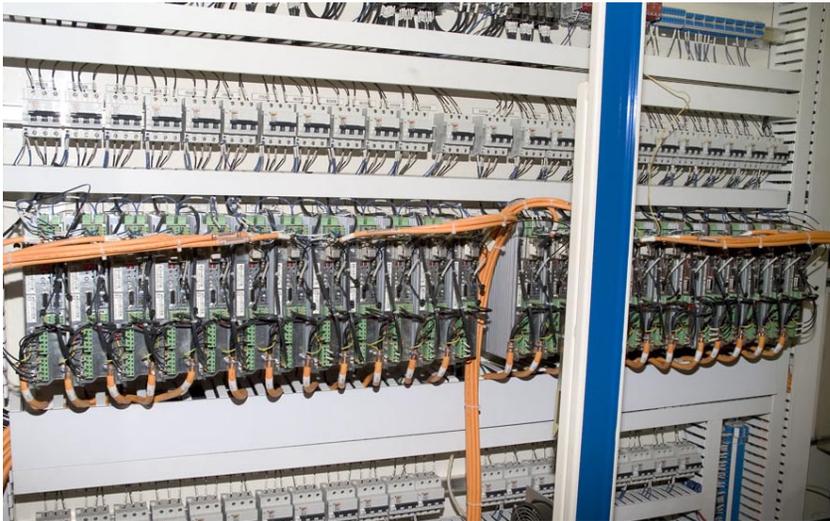


# Drive & Control profile

## Bosch Rexroth Provides EtherNet/ IP-Based Pneumatics for Advanced Diagnostics in Automotive Industry



A bank of Bosch Rexroth DKC EcoDrives using high-speed SERCOS interconnections - which allows for a clean uncluttered cabinet - control the crowding function that precisely positions metal blanks.

DaimlerChrysler destacker is first to use EtherNet/IP with pneumatics in North America. Industrial Ethernet, after some slow starts, is finding traction in automation. Ethernet becomes more attractive as you push the technology further and further down to the factory floor. Ethernet interfaces don't stop at the PLC, but are found today in local and

remote I/O, pneumatic valves, actuators and sensors.

Ethernet itself is the IEEE 802.3-defined lower-layer protocol for the physical and media-access layers of the protocol stack. But industrial flavors of Ethernet include the upper layers as well to achieve a complete communications and control solution. One popular

### Challenge

Introducing EtherNet/IP as an upgrade to DaimlerChrysler's automotive stamping operations

### Bosch Rexroth Solution

- Bosch Rexroth linear and rotary motors
- Bosch Rexroth 261 series manifolds
- EtherNet/IP
- Rexroth Drive & Diagnostic Link (DDL)

### Benefits

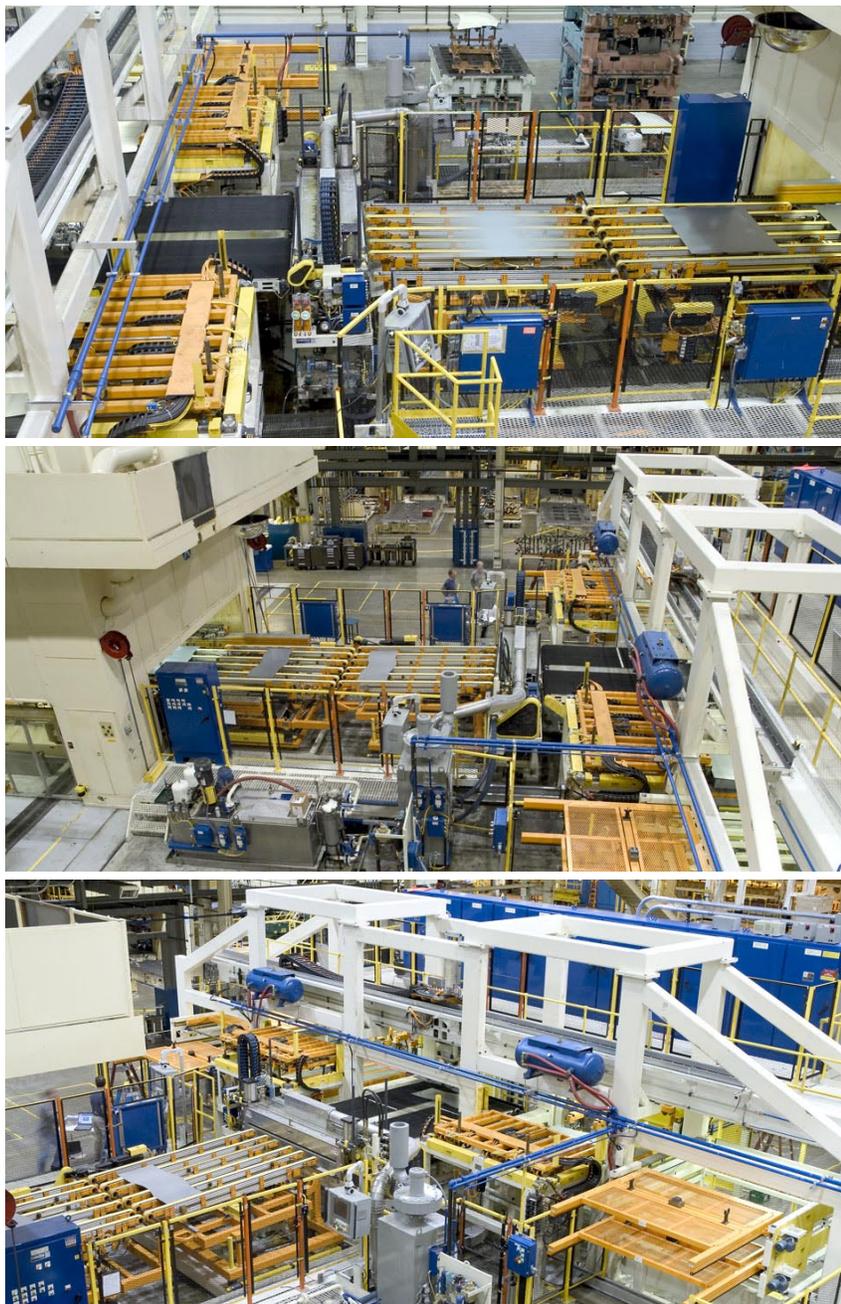
- Improved efficiency and productivity
- Network types minimized
- Achieved over 50 axes of control
- Simplified design and construction
- Increased equipment reliability and higher capabilities
- Real-time monitoring of voltage levels
- Built-in preventive maintenance
- Reduced labor costs

version is EtherNet/IP, which uses the existing top-level control and information protocols of DeviceNet/ControlNet and TCP/IP for network and transport layers. EtherNet/IP offers the means to carry DeviceNet information over high-speed Ethernet. (The *IP* in EtherNet/IP, incidentally, stands for *industrial protocol* and not the more common *internet protocol* as commonly supposed.)

The allure of Ethernet stems from three factors: performance, compatibility, and costs.

**Performance:** Ethernet offers higher speeds than traditional fieldbus interfaces: 10 or 100 Mb/s on the factory floor and up to 10 Gb/s in bandwidth-hungry enterprise applications. Thus, while fieldbuses have moved from kilobit speeds to megabit speeds, Ethernet offers speeds in order of a magnitude higher. Equally important, Ethernet has matured from its earlier incarnation to offer the deterministic operation required for many factory operations. Switched Ethernet does away with the collisions that made the technology nondeterministic.

**Compatibility:** Using the same protocol throughout a corporation—from the sensor to the enterprise—offers great advantages in handling and processing real-time information to improve efficiency and productivity. Since Ethernet is the hands-down winner in networking, its migration to the factory floor means one network across the enterprise. And with the Internet, geographical boundaries to the factory for monitoring and control



Description: Destackers from High Precision Technology feed blanks into a stamping unit where they are stamped into body panels and interior structural parts.

equipment for the stamping industry. The company's destackers shuttle metal blanks into the stamping units, where the blanks

performance. "With all the communication technology in today's networks, you need to be an expert in too many systems.

EtherNet/IP integrates with our high-level Ethernet networks and minimizes the number of network types we have to deal with.”

As stamping equipment becomes more sophisticated, destackers must be able to handle a range of blank sizes, materials, weights, and shapes. The operating speed must be somewhat faster than the stamping machine to maintain overall cycle times of the line. The highly automated destacking system consists of a gantry, shuttle, drop-off conveyor, washer, ramp conveyor, and centering station.

The HPT destackers currently run 22 different parts, most of which are odd-shaped developed blanks. In the stamping process, metal blanks can measure up to 96 inches by 66 inches. The destacker can run two unattached blanks simultaneously and achieve rates up to 16 stampings per minute for single blanks and 32 stampings per minute for double blanks.

Blanks are supplied to the destackers by a remotely guided vehicle, which provides an automated method to ensure a steady supply of blanks. The stack of blanks are pulled from the RGV and prepped for destacking in the load area. The gantry pulls the blanks from either of two load stations using suction cups to lift each one. The gantry shuttles the blank to a drop-off conveyor. The conveyor moves the blank through a washer, where it is cleaned top and bottom by rollers in a squeegee-like fashion. The blank then moves onto the ramp conveyor, which carries it to the centering

station. Here the blank is precisely positioned for alignment with the stamping dies. Once centered, the blank is fed to the first station of the stamping machine. All operations must be closely synchronized to ensure efficient production.

The HPT destacker is servo controlled and uses Bosch Rexroth linear and rotary motors to achieve over 50 axes of control. Pneumatics is used for various functions, including separating blanks at the beginning of the process and for centering the blanks before they are fed to the stamping station.

For separating aluminum blanks, the system uses air knives controlled pneumatically. The system operates in both an on/off mode and a high-pressure/low-pressure mode to control the separation of the first blank in the feed stack.

In the centering station, blanks are aligned both electrically and pneumatically. Pneumatics are used both in the setup of the station and for up/down movements of the blanks.

The operation of the pneumatics is controlled by 261 series manifolds from Bosch Rexroth. The 261 series conforms to the ISO 5599-2 standard which provides a standardized plug-in footprint for pneumatic valves. The body-to-base interface allows valves to plug directly into the manifold electrically and mechanically. What’s noteworthy is that the Bosch Rexroth manifolds offer an EtherNet/IP interface.

When DaimlerChrysler’s specification required EtherNet/IP,



Pneumatic directional control valves plug into the EtherNet/IP-equipped Series 261 manifold. The valves use the Bosch Rexroth Drive & Diagnostic Link (DDL) to provide sophisticated diagnostic monitoring down to the solenoid level.

Jay Finn, applications engineer at HPT went looking for pneumatic systems so equipped.

“We’d seen and heard a lot of vendors hyping fieldbus,” says Finn. “Of the vendors we worked with, only Bosch Rexroth came to the table with an EtherNet/IP solution. That product has been operating in our destackers for over a year. Bosch Rexroth still has the only EtherNet/IP option we have used.”

EtherNet/IP interfaces have become common on electronic PLCs, remote I/O, servo controls, and the like. But they have been slower to appear in pneumatic devices. One reason for this is that PLCs are inherently intelligent electronic devices. Electronic

intelligence has come more slowly to pneumatic devices and hence there was little need for a high-performance electronic interface like EtherNet/IP. Engineers became comfortable with traditional pneumatics where the control intelligence is centralized and little, if any, intelligence is distributed outward to individual components.

### **Intelligence adds reliability**

But intelligent pneumatics offer great benefits in simplified design, higher capabilities, and increased equipment reliability. One example of the benefits from intelligent pneumatics is the deep diagnostics built into the Bosch Rexroth 261 series manifolds. The Rexroth Drive & Diagnostic Link (DDL) can monitor the electrical control system down to the solenoid level. The DDL continuously checks each valve for the following:

- Supply voltage tolerances on electronics power
- Supply voltage tolerances on valve/communication power
- Solenoid coil opens or shorts
- Short circuits

The DDL provides real-time monitoring of voltages levels and report if the voltage falls out of tolerance.

Because the DDL can report this information for each valve or sensor over the fieldbus to the PLC well in advance of failure, the PLC can provide much richer information on fault causes and remedies, including advanced predictive diagnostics.

This low-voltage detection can indicate a power supply issue that could be—or soon become—a major problem in a system's 24-volt DC power loop.

The ability for the DDL system to detect a rise in current draw on each output provides warning of a breakdown of a valve coil or an external device hardwired to a DDL system's output module, well in advance of an actual failure. This significant advance in diagnostics allows for built-in preventive maintenance on any system controlled by the DDL.

Beyond diagnostics, DDL's daisy-chained bus structure simplifies electrical wiring—in some cases by 90%. It becomes easy to create more sophisticated capabilities without adding complexity—or even while reducing complexity. The savings in labor to build a system can thus be quite significant in both production and custom systems. Simplified wiring means

fewer mistakes and quicker installation. Testing and commissioning can be achieved faster, with fewer glitches. And, if problems occur, they can be more easily traced and remedied.

DaimlerChrysler's Stamping Project Manager Joe Mitory likes the simplicity and power offered by DDL, noting that it simplifies design and construction. Every engineer appreciates getting vastly improved capabilities in a simpler design. According to Joe Mitory, "Diagnostic capabilities are always part important, and as systems become more complex, we need them to have higher levels of self-diagnostics." Simplicity begets reliability, and improved diagnostics eliminates surprises.

Finn also notes that DaimlerChrysler had recommended Bosch Rexroth, based on years of favorable experience with Rexroth products and support. HPT's experience bears out DaimlerChrysler's confidence in Rexroth pneumatic components.

# Servo control and linear motion by Bosch Rexroth, too



Bosch Rexroth DIAX04 servo drives control the horizontal movement of blanks.

The HPT destacker motion is precisely coordinated with the Bosch Rexroth Visual Motion (PPC) control system, using high-performance IndraDyn L linear motors and rotary servo motors achieving over 50 axes of control. The PPC offers several standard bus systems, including Ethernet/IP and ControlNet for uniform communication to other machine control units.

The majority of axes are for the crowding function, in which Bosch Rexroth compact MKD rotary motors with absolute feedback and

DKC EcoDrive drives precisely position the blanks before each is fed into the first stamping station. Servo rotary motors are also used for vertical Z-axis movements, but in some cases a linear motor is also used. Conveyors use high-performance Rexroth MHD servo motors with absolute feedback.

For the critical horizontal motion, the destackers use water-cooled IndraDyn L (MLP and MLS) linear permanent magnet motors driven by the company's digital intelligent DIAX 04 servo drives. Automatic motor commutation permits the

## Challenge

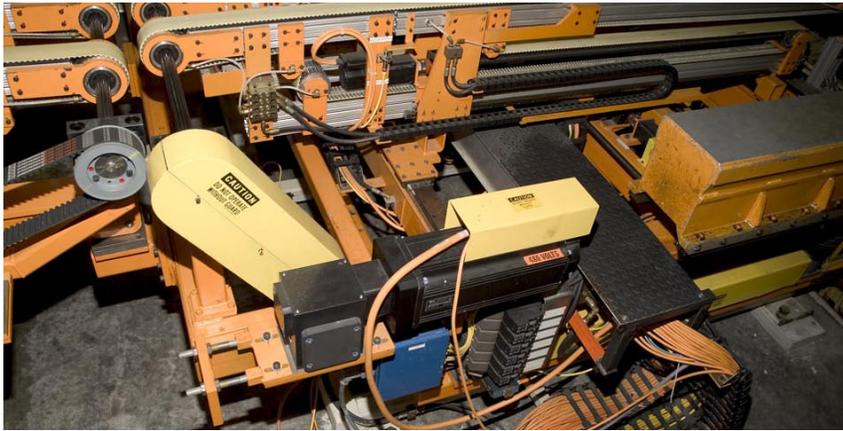
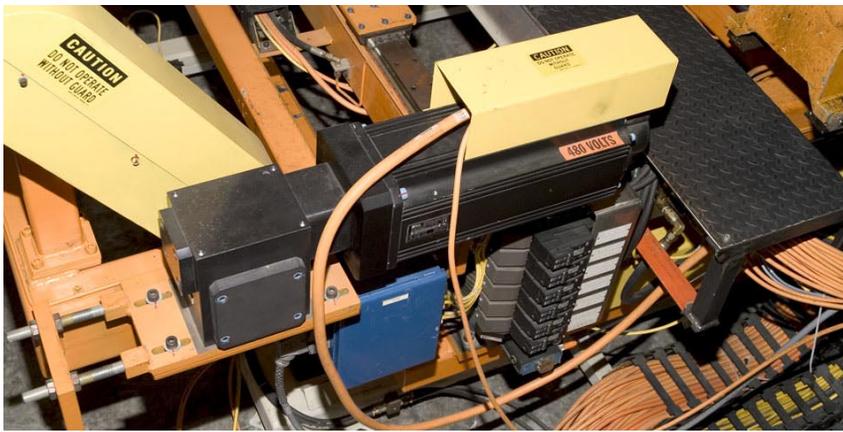
Replace old methods of mechanical systems with servo control

## Bosch Rexroth Solution

- Bosch Rexroth Visual Motion
- Bosch Rexroth compact MKD rotary motors with absolute feedback
- DKC EcoDrive
- Rexroth MHD servo motors
- IndraDyn L (MLP and MLS) linear permanent magnet motors
- Rexroth DIAX 04 servo drive
- SERCOS
- Rexroth PPC controller
- Rexroth MKR belt-driven linear modules
- Bosch Rexroth Ball Rail®

## Benefits

- Increased productivity
- Reduced maintenance and setup time
- Faster operating speeds
- Improved diagnostics
- Increased flexibility



Conveyors use high-performance Bosch Rexroth MHD servo motors with absolute feedback.

use of standard non-absolute scales for the very long horizontal slide. Horizontal speeds of up to 300m/min and  $20\text{m/s}^2$  are achieved during the destacking cycles.

The communication architecture uses the SERCOS standard fiber optic network to reliably interconnect the axes, with the Rexroth PPC controller.

The advantages of servo control over older methods of belts, gears, and other mechanical linkages are widely documented in several industries. The drawbacks of mechanical systems are well known. Setup times for new jobs can involve hours of labor in physically changing gears, cams, or other parts, checking the new setup, and making any fine adjustments necessary. Mechanical machines are also prone to wear and tear, requiring significant maintenance to maintain and replace parts. What's more, if the mechanical linkages fall out of synchronization, it can be a major task to readjust the machine. Not only are mechanical machines costly to maintain, the time required for setup and changeovers reduces productivity.

Daimler Chrysler's Stamping Project Manager Joe Mitory says, "Improved setup, faster operating speeds, improved diagnostics all favor servo-driven systems in achieving the key goal we're after, which is productive uptime."

With servo control, wrenches and screwdrivers are replaced by a touchscreen or computer keyboard. The operator simply sets new parameters; the servo control system programs the servo accordingly and monitors their operation. What once required hours now needs only minutes to accomplish.

In essence, servo-based control hides the mechanical complexity behind sophisticated programming and an easy-to-use HMI. The servo system can handle a wide range of mechanical functions, electronically changing camming and even synchronization timing. But because the line shaft is electronic rather than mechanical, the machine never loses synchronization.

Servo-controlled linear actuators are used to horizontally gauge and position blanks accurately. Rexroth MKR belt-driven linear modules move 16 gauging blocks into and out of position. MKR modules use a rugged anodized aluminum frame and Bosch Rexroth Ball Rail® to provide the rigidity and accuracy when moving heavy loads. While the task could have been achieved with short-stroke pneumatics, the linear modules offer a longer 24-inch stroke and more flexibility in running both aluminum and steel blanks. Plus, servo control means faster, easier setup and changeovers for new runs.

**Rexroth**  
Bosch Group