



Turnkey robotic systems for automotive assembly

One Panel PC coordinates manufacturing cell with 21 KUKA robots

With 32 manufacturing facilities around the world, Sodecia, Portuguese supplier to the automotive industry, maintains its position as a leading solutions provider and vehicle manufacturer. Based in London, Ontario, Sodecia's Global Tech & Automation Center (GTAC) delivers highly automated machine lines, on which the components are manufactured and assembled. Sodecia GTAC uses PC-based control technology in its assembly lines in order to offer high quality while keeping cost under control.



Robots play the main role in the highly automated assembly of BIW components: they weld the individual stampings and sub-assemblies to form the body.



Calvin Wallace, Regional Sales Manager, Beckhoff Automation, and from Sodecia GTAC, Jon Bysma, Controls Specialist, Rob Remillard, Lead Controls Engineer and Brent Lekx-Toniolo, Control System Concept Developer (from left to right).

“Our current ‘bread and butter’ product is our successful, turnkey robotic weld cell solution,” says Brent Lekx-Toniolo, Control System Concept Developer, Sodecia GTAC. “Our largest project to-date was completed in spring 2015 and includes 21 KUKA robots of various sizes (series KR 210, KR 30 and KR 6), which are used in the assembly of body frame and chassis segments (so-called body in white, BIW), for welding, material handling and sealant applications,” reflects Jon Bysma, Controls Specialist, Sodecia GTAC. “To begin, an assortment of small stampings are welded robotically into sub-assemblies. They are automatically unloaded and transferred to subsequent stages, where the different components are assembled to form the BIW. From here the process splits into two identical product pipelines – this split creates redundancy and improves throughput. Various sensors carry out comprehensive analysis, for example, to ensure that all fasteners are placed correctly on the assemblies, and send the data to the controller. After further assembly steps, the two pipelines merge back into one, and the assemblies move on to a final fixture.”

PC-based control throughout

Sodecia GTAC has been using the PC-based controllers from Beckhoff for its BIW assembly lines since 2008. “To-date, Sodecia GTAC has built 49 manufacturing lines based on Beckhoff PC-based control, ranging anywhere from machines with a single robot to lines with over 20 articulated robots,” says Jon Bysma. The currently realized welding cell with 21 robots uses a CP6202 Panel PC with 15-inch screen and Intel® Celeron® ULV processor. The Panel PC also handles robot-to-robot interference detection and OEE (Overall Equipment Effectiveness) tracking, while managing overall fault detection and annunciation by acting as the HMI for the machine, and integrating all safety aspects of the machinery. The robots are controlled by KR C4 controllers from KUKA.



Application at a glance:

Solutions for the automotive industry

Robot-assisted assembly of automotive sub-assemblies (BIW components)

Applied PC Control

- Integrated control of an assembly cell with 21 KUKA robots
- Integration of 228 TwinSAFE I/Os for hundreds of safety devices

Customer benefit

- High system throughput
- Reduced commissioning time
- Small footprint of control cabinets thanks to IP 67 EtherCAT Box modules
- Comprehensive diagnostic functions through EtherCAT and TwinSAFE

“The TwinCAT development environment and various software libraries reduced the programming time for the robotic cells by a wide margin,” recounts Rob Remillard, Lead Controls Engineer, Sodectia GTAC. “In TwinCAT, we can quickly develop sections of code in any of the IEC 61131-3 languages and then deploy them in several instances. With other platforms this isn’t so easy.”

Integrated safety solution

EtherCAT also factors heavily in the application. The fast communication system handles all robotic communications, the I/Os, and the safety functions via the TwinSAFE I/O terminals. “A total of 228 safety devices are integrated in this line via TwinSAFE,” explains Calvin Wallace, Regional Sales Manager, Beckhoff Canada. “The modularity and scalability of this safety concept is of great benefit for Sodectia GTAC,” adds Brent Lekx-Toniolo. “This way our safety configuration doesn’t change much, whether we design a machine with one robot or a system with 21 robots as in this case. We simply remove sections we don’t need from the pre-built framework, but the underlying functionality remains the same.”

Sodectia even uses the TwinSAFE technology for robot programming. “During teaching and program verification procedures, TwinSAFE handles robot-to-robot lockout,” explains control specialist, Jon Bysma. “If a robot tech is teaching a robot, all other robots that could move into that operating space are locked out by means of an e-stop signal loss to the other robots. The enabling switches are all monitored in TwinSAFE.”

Each major automated component in the Sodectia GTAC robotic assembly line is connected to an EL6900 TwinSAFE logic terminal and a series of EL1904 and EL2904 digital inputs and outputs to handle the processing of the safety I/O, as well as communication with other safety equipment. The EL6900 serves as master for the safe communication and evaluates the data of the safe I/Os. The integrated safety functions include e-stops, machine monitoring, “AND” and “OR” functions and decouplers. The TwinSAFE option card integrated in the AX5103 EtherCAT Servo Drives features motion safety functions such as STO (Safe Torque Off) and SS2 (Safe Stop 2) to ensure safe operation of the welding equipment. Additional safety is offered by the two-hand function for machine initiation.

Zero space required in control cabinets: EtherCAT Box modules

In addition to the IP 20-rated EtherCAT Terminals, machine-mountable EtherCAT Box I/O modules in IP 67 protection are also used throughout the assembly line. The EP1908 TwinSAFE Box, for example, provides additional safety connectivity to switch plates at each safety gate entrance. Various EtherCAT Box modules are also used in non-safety technology settings, connecting to sensors, cylinders, air pressure switches, solenoid valves, as well as measuring devices. “Benefits from the IP 67 Box modules include reduced cabinet requirements, easier mounting and wiring efforts, as well as exceptional physical durability,” Toniolo adds. Also, the communication status on EtherCAT Box modules is easy to diagnose in the field, as all signal status indicators are highly visible.

Optimum diagnostic functionality

“EtherCAT also enabled us to implement all relevant diagnostic functions,” explains Toniolo. “For just one example, we’ve used this information to localize cable breakage right down to the exact cable in the line, resulting in indicators that blink on the HMI. Similarly, TwinSAFE offers an abundance of diagnostic information, which we’ve utilized in the project. Thanks to the openness and



The assembly cell is controlled from a Beckhoff CP6202 Panel PC with 15-inch screen.

compatibility of EtherCAT, we can easily integrate and monitor EtherCAT slaves from other manufacturers with identical diagnostic functions. We’ve only just scratched the surface with the potential diagnostics so the possibilities for building on this into the future are vast.”

High system throughput – reduced commissioning time

While never welcome in any manufacturing environment, unscheduled downtime in the automotive industry is especially cost-intensive. “The new PC-controlled manufacturing line has achieved an average cycle time of just under 50 seconds and can produce 72 complex parts per hour and up to 355,000 parts per year,” Toniolo explains. As a result of the functionality inherent in PC-based control and EtherCAT, Sodectia GTAC has also been able to reduce time to market significantly. “Based on a conventional controller, PLC configuration and programming of a system with one or two robots would normally take up to two months. Through the use of TwinCAT, this timeframe has been slashed down to two weeks, and the commissioning time for the control has also been cut by at least 50 percent: “In the current project with 21 robots, it took around two months from setting up the production lines, teach-in of the robots and the PLC programming, right up to commissioning and production of the first trial parts for the end customer,” says Brent Lekx-Toniolo.

“As a strong sign of continuity and reliability, Sodectia has been using the same CP6202 Panel PC type since 2008,” Toniolo explains. “It is robust and offers excellent value for money.” Sodectia GTAC will standardize on a new multi-touch Panel PC from Beckhoff in the near future to incorporate enhanced HMI technologies and functionality in its assembly lines. “Also, we will evolve our control programming to utilize TwinCAT 3 so we can better harness the convergence of automation technology and information technology.”

Further information:

www.sodectia.com

www.beckhoff.ca