From painted body to fully assembled car – thanks to innovative control technology, the flexible store at the Dingolfing BMW plant can handle all doors from the assembly line for mid-range and luxury automobiles and requires minimal floor space

■ BMW, Dingolfing

Just-In-Time Doors

Profinet with Profisafe and distributed control technology minimize space requirements and increase the flexibility of an assembly line.

At its Dingolfing plant in Germany, BMW produces cars for its 5, 6 and 7 Series. As is standard procedure in assembly, the doors are removed from the vehicle so that workers can fit the necessary components inside more easily. The doors then need to be re-fitted to the vehicle in parallel to the assembly process. Providing the right doors for each vehicle on the assembly line at the correct time poses a logistical challenge.

Minimizing space requirements

First of all, the doors need to be marked, stored, fitted with all supplementary components, stored again and then returned to the assembly line. The previous logistical solution with sequential storage before and after door assembly required an excessive amount of floor space.

As a result, BMW decided to work with control specialists from Staudinger GmbH in Loiching and mechatronics experts from Rofa Rosenheimer Förderanlagen GmbH to develop a totally new concept. A comprehensive range of components from the Siemens control system provide the necessary flexibility and safety in the new processes.

Electric overhead conveyor for flexible store

After removal, doors are carried up to the storage level of the flexible store via elevators. From here, they are conveyed to door assembly on special assembly racks and back to the vehicle assembly line on a vertical elevator. In the flexible store, a pair of doors is loaded onto suspension racks on an overhead conveyor, which stores the doors in an extensive network of classification areas and transport routes on the upper floor of the assembly shop. A key feature is that unassembled and fully assembled doors can both be held randomly in the same store. As a result, the flexible store only requires a minimal amount of floor space.

Random temporary storage – reliable control

The crucial factor behind the success of this innovative storage concept is the sophisticated control technology, which features a number of components from Siemens. Each load carrier on the electric overhead conveyor has an RFID chip. Moby type read/write stations assign each of these storage locations ▸▸

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a comprehensive individual data record to uniquely identify the doors. The advantage of Moby type RFID technology is that the data can be read and updated at any point when the doors pass a read/write station. In addition, once the storage locations have been fitted on the suspension racks they can be reset and rewritten any number of times. This provides the required flexibility to load the racks on the conveyor with doors in any order. Mechanically, the racks can be adjusted quickly and easily for different door models. In conjunction with a total of 122 read/write stations, the racks are directed through the flexible store in different directions and on changing routes using points in the electric conveyor rails. The read/write units and the points are controlled and monitored decentrally by distributors. All 76 of the stations have terminals, some of them Simatic PC 677, for reading and editing system parameters and statuses. Simatic ET 200pro interface modules integrate the read/write units for the RFID store and the motor controllers for the point drives into the data network.

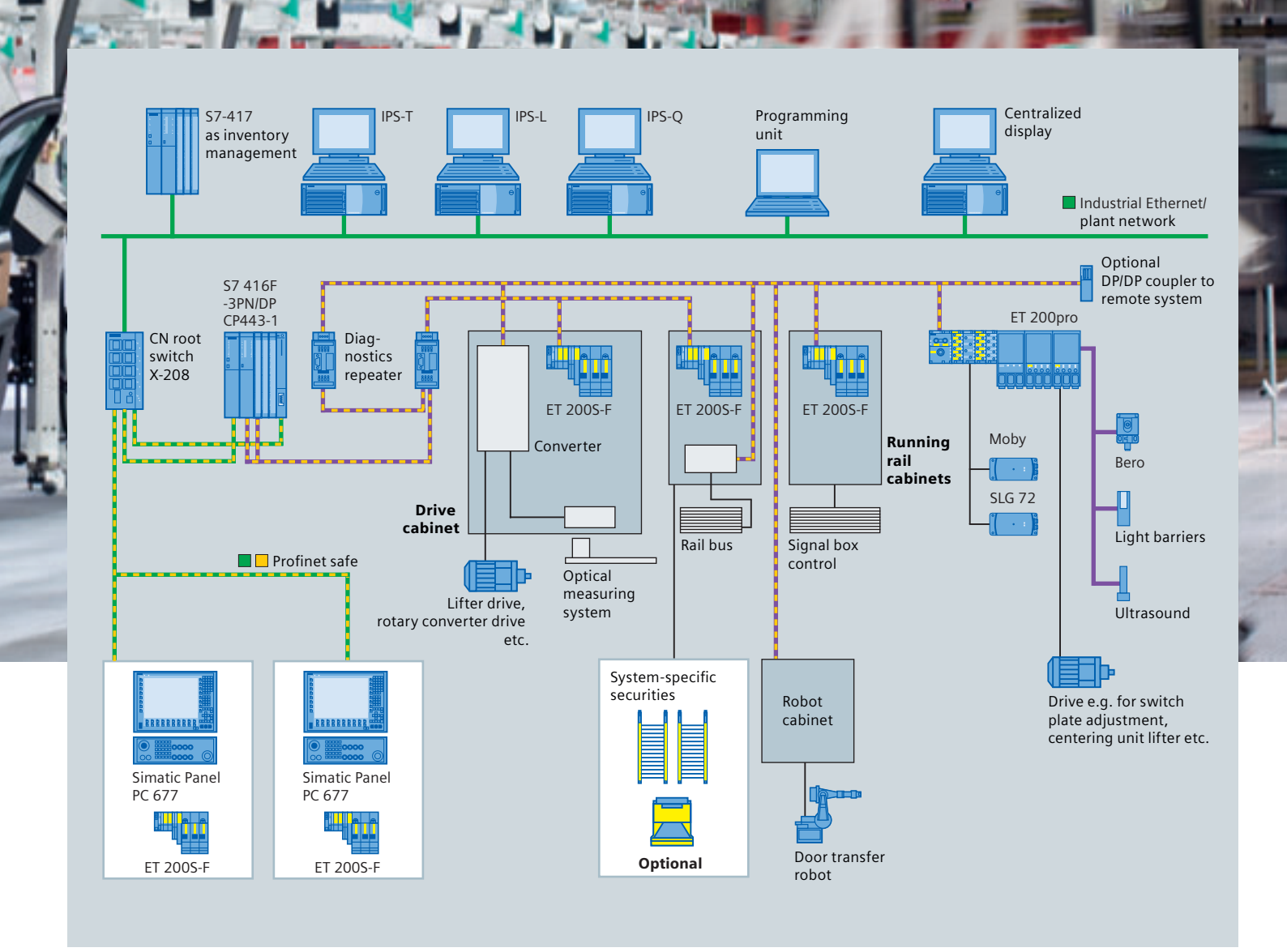
The Safety Integrated concept is particularly important for communication via Profinet. In conjunction with Simatic S7 programmable logic controllers, it ensures maximum operating safety in the system. Sensors, drives and controllers are diagnosed and evaluated for any malfunction. The data is transmitted from the distributors to the subordinate Simatic S7 PLCs via Profinet. Siemens has implemented an open system, which allows Safety Integrated to be combined with any other standard components as required. The two loading and unloading stations and the conveyors at the vertical elevators are integrated into this concept for controlling and monitoring the flexible store.

The robot station for transferring the doors from the flexible store racks to the assembly racks is also fully integrated. Special Simatic ET 200R interface modules protected against strong electromagnetic fields are used here. A flexible sorting store is also part of the automation system networked using Profinet and Profibus. The doors pass through this after assembly to allow a response to any changes in the vehicle assembly sequence.

Flexible design without switch cabinets

Because of their IP65 protection class, the Siemens automation components for distributed control of the system have a key advantage: They provide the required degree of flexibility for cost-effective expansion of the automation network. The components

Simatic ET 200pro with power modules allows decentralized and flexible automation solutions to be set up



The automation network for the flexible store uses Profinet and Profisafe in conjunction with a Simatic S7 programmable logic controller as the warehouse management computer, along with ET 200pro interface modules and motor actuators with IP65 protection

can be positioned on standard mounting rails without a switch cabinet. Unique connectors and couplings connect the modules to the power and data network. This minimizes the assembly work, reduces costs and allows rapid, flexible installation. The same applies to the modular construction, particularly of the input/output modules from the ET 200 family. The Simatic ET 200pro has proved to be particularly flexible. It enables bus, electronic, connection and load modules and motor starters to be combined into flexible, compact units for each of the individual functions required.

Controllers networked using Profinet with Safety Integrated

The routes taken by the racks through the flexible store are controlled and monitored by distributed stations with a total of seven Simatic S7-416 PLCs, networked via Industrial Ethernet. For the first time in a system of this size, a Simatic S7-417 is being used as the warehouse management controller. The subordinate Simatic S7-416 PLCs act as data collectors. They are also used for data storage and to regenerate data if there is a temporary failure of the warehouse management controller.

With this pioneering system concept for a compact flexible store, Siemens and its regional system partners, Staudinger GmbH in this case, is once again demonstrating its leading position when it comes to complex automation solutions. Sophisticated components from the Totally Integrated Automation system also contribute to its flexible operation and outstanding safety. ■

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