Amphenol
COMMUNICATIONS SOLUTIONS

**Control Cabinets and Components**

Machines in chemical, petrochemical, food, beverage, oil, gas, pharmaceutical, and energy industries perform synchronized tasks. These can be done using industrial PCs or Control Cabinets.

Control cabinets are vertical enclosures with servo drives and other electromechanical components that control or monitor machinery and factory systems associated with it. The control cabinet is a stainless steel box, which can either be wall-mounted or a standalone module on the floor. Inside the control cabinet, there are many components from servo drives to PLCs and terminal blocks.

Control Cabinets are often preferred over PCs as they are more reliable, durable, and flexible. Based on programmed logic, they accept sensor inputs and convert them into output commands that run the machines. While each cabinet has an assigned function, they can cover for others in case of component failure.

Structure-wise, the cabinet is a stainless steel enclosure that can be wall-mount, flush-mount, or free-standing. It features standardized application-specific architecture that houses DIN-rails and terminal blocks so that components can snap on and connect. The wire duct within the cabinet helps to tidy up hundreds of wired interconnections. The Ethernet and Field Bus protocols replace point-to-point wiring by using a single line to connect field devices to the controller inside the cabinet providing a lean and cost-effective approach.

A control cabinet consists of a main controller, which is a PLC or processor with I/O modules stacked beside and device modules that are usually starters and contactors for motors and controller gateways for sensors. The cabinet can also communicate wirelessly to the operations and management center using a modem or switch. It also features an enhanced HMI with LCD touch panel on the cabinet door. In addition, it includes relays and breakaways, transformer and an UPS.

Power is typically supplied to the cabinet from the top portion. There is an AC power distribution system (PDS), associated with the main power breaker. The PDS, transfer power to all components that require AC power. Power Supplies convert AC to DC voltage, which is required for the performance of the majority of other components within the cabinet. The power supply will typically convert 480V or 120V AC to 24V DC as DC is generally regarded as a safer voltage to deal with inside the panel.

The converted DC voltage is passed on a DC power distribution system which further takes to other components. Another important component of the cabinet is the Ethernet switches. This helps in establishing a communication between the devices within the cabinet using a Cat5 or Cat6 cable. The radios process the data that comes from the control panel and transmits to other locations or machines which is far away from the control cabinet with the help of an industrial antenna. The radio is paired with a polyphaser that protects the internal panel hardware from lightning.

**Programmable Logic Controllers**

PLCs or programmable logic controllers are the brain of the control cabinet. The bottom rack of the cabinet contains terminal blocks that act as the connection point for the field instruments to interface with the control cabinet. Depending on the function, different signals, either analog or digital, are processed by the terminal blocks.

Programmable Logic Controllers or PLCs are designed to control machinery like robots or servo motors inside a factory. They are programmable computers packed inside rectangular cabinet boxes that can

withstand extreme temperatures and moisture. Being modular, multiple units of these devices can be stacked to carry out additional controlling if desired. PLCs replace hardwired relays which were cumbersome and financially demanding to operate. They can easily run codes that accept inputs from a sensor device and output the decision to an alarm, display, or printer. The codes are looped and triggered either by inputs or by clock.

With rapid developments in industrial automation, PLC or Programmable Logic Controllers are being an essential part of any manufacturing environment. A PLC generally has a PLC Rack, Interface Module, Communication Module, CPU Module and a Power Supply Module.

**PLC vs Relays**

Then we have relays that control the digital outputs, which use a lower voltage signal to control the higher voltage circuits. These also protect the PLC from overcurrent. These components are attached to the control cabinet using DIN rails and also wire ducts that tidily arrange the numerous wiring, and together these are mounted onto a backplate that is separate from the enclosure.

A PLC must be real-time capable like the relays, but also reliable. What relays lacked additionally was the flexibility with which PLCs can be reprogrammed to adapt to a change in factory conditions.

Whereas earlier, one PLC used to handle a group of machines, with Industry 4.0, multiple PLCs are interspersed among the factory fabric with every robot or servo motor having their own controllers. The controllers must now talk with each other and to the cloud, do authentication over the factory wifi to remain secure, and respond to customer orders. Flexibility is not an option here anymore, nor is speed, reliability or size.

**Modules of PLC**

The CPU module is considered as the brain of the PLC that runs ladder-logic programs that help to automate factory processes. A CPU module has both internal and external connectors. Amphenol's Millipacs® vertical and RA receptacles are simple backplane connectors helping to connect the CPU module to the PLC rack as well as the other modules like the input module lying beside. In addition Minitek® Board-to-Board 2.00mm connectors also goes inside the CPU module. The external CPU module connectors include input output connectors like D-Sub board mount connectors and RJ45.

Amphenol's wire-to-board power connectors can be designed for the 3-pin external power connector in the power supply module which helps in sourcing power for the PLC.

The PLC rack serves as the backbone synchronizing power and signal communication. In addition Minitek® MicroSpeed, USB Connectors, Modular Jacks, Minitek® Pwr and Minitek® 1.25 mm are also used in the PLC application. The interface and communication modules have D-Sub cable connectors that plug into standard board mount connectors. This helps in interfacing the modules and establishing communication channels with other components of the control cabinet in which the PLC is housed, like servo drive controllers and relays.

So how can a Connected Controller be flexible, fast, reliable, and compact?

They can have MPUs (processors) with multiple cores which can execute the same program to compare and catch any errors that compromise on safety. It is also worth noting that MPUs with Signal Processing technology can offload mathematically intensive tasks leaving only the generic program execution to the main registers.

They can be made smaller by substituting blower fans for convective heat sinks.

Outside, they can have connectors with ruggedness, IP67 sealing, and gigabit speeds for Factory 4.0. Amphenol's rugged USB 3.0 is designed for the harsh environment with the same ruggedness and sealing and reaches external I/O speeds of 10Gb/s. Amphenol's internal connectors like Minitek® 2.00mm wire-to-board and the smaller BergStak® 0.50mm board-to-board bridge PCBs and wires inside the controller with reliable, durable, and retentive capabilities.

Besides programmable logic, the ever growing need to stay connected while in control, has led to intelligent and efficient controllers stepping in and joining the Industrial Internet Network of machines in which they are housed.

With advances in technology like Industrial Internet of Things (IIoT), wireless smart field devices will bypass controllers and drives to work directly with command centers, bringing converged architecture to future control cabinets, thus making them smaller and smarter. Amphenol continues to develop solutions to meet the future trends.