

A single drives concept throughout the production line

The idea of providing a single concept for drives to cover a broad spectrum of requirements within production leads to the Danfoss VLT[®] AutomationDrive.

In traditional manufacturing machines were driven by a single big motor. First by steam machines, later replaced by DC and AC electric motors. The power output was transmitted to various stages in the machine via power transmission equipment such as shafts, spur gears, bevel gears, various types of gearboxes, belts, chains and corresponding pulleys. A critical trend in machine design during the last few decades has been to replace this old, very inflexible mechanical technology with a much more flexible multi-motor drive concept. Now, manufacturing machines are typically driven by many motors – one motor per machine shaft.

Controlling a host of motors

It's not uncommon for a manufacturing line to include several hundreds of motors. In addition to diminishing the need for a lot of mechanical power transmission equipment and reducing maintenance, this also offers opportunities to control the speed, or position, of each shaft independently during operation.

Consequently, a single process can now be fine-tuned without stopping the whole line. This allows the plant to handle adjustments, improve quality, reduce scrap and increase output volume. Another important advantage is the easy change of set-up if shifting from one product variant to another that necessitates adjustment of speed ratios, ramps, torque or other parameters.

The precondition for achieving this high flexibility is that all motors are controlled by electronic drives and are not connected direct on the mains. In most production lines performance requirements for various shafts differ greatly, in functions such as speed accuracy, speed control range, dynamics, synchronizing, positioning, CAM control, etc.

Only one concept

In order to fulfil these requirements cost-effectively and with technical efficiency, machine manufacturers equip their machines with several drive series, such as low performance variable speed drives, voltage vector drives, flux vector- or servo drives, and often these are of different makes. In some cases DC drives are used with AC drives.

There are many reasons for the use of these various drives. For one thing, the standard, general purpose variable speed drive is inexpensive and fulfils requirements if simple variable speed control is needed, but it is insufficient if high dynamics or positioning is required.

Servo drives may fulfil requirements regarding high dynamics, positioning, high accuracy and others, but from a cost point of view it can be overkill to apply it for a simple variable speed application.

As opposed to servo drives most variable speed drives are still designed for single motor applications and do not fit very well into a multi-motor drive concept. Some limitations are that: they have no load sharing ability, no serial bus from master to slaves, they are not designed for side by side panel mounting, and common AC supply for several inverters is not possible.

This means it is common for up to three different drive series to be used in one machine, which has a lot of disadvantages. It poses challenges not only for the machine builder during engineering, mounting and commissioning, but also for the end-user during operation and servicing.

Based on these findings and many years of experience with drives, Danfoss developed the idea to provide one drive concept for the whole production line. The goal was to design a drive that covers the extremely broad spectrum of requirements mentioned above.

The AutomationDrive

The critical challenge was to cover this wide shaft performance spectrum, ranging from simple reference speed control to high dynamic servo performance, with built-in motion control functions, and all in a cost-effective way.

The outcome is a highly flexible, configurable and user-friendly drives concept from Danfoss called VLT® AutomationDrive. In order to improve its usability, especially in multi-motor applications, high priority has been given to the mechanical design, dimensions, convection and cold-plate cooling. There are other features, such as load sharing, kinetic backup, external 24V supply, master-slave control via local bus and easy mounting side by side in panels. In addition, much attention has been given to improving user-friendliness in areas such as automatic motor adaptation (AMA), a plug-in option concept, plug-in terminals, and up and down-load of parameters with Local Control Panels (LCP).

Using the VLT® AutomationDrive means there is, finally, a single drives concept for the whole production line. For the customer this means low lifecycle costs and less downtime!

The AutomationDrive consists of the following variants and options:

- Two basic versions cover the power range from 0.25 to 7.5 kW with and without EMC filter, the FC301 and the FC302 to which different options can be added according to requirements. (Power sizes above 7.5 kW to be added in a later phase).
- The FC301 is intended for low to medium performance speed control applications.
- The FC302 is for high demand speed control and dynamic servo applications (with or without motion control functions).
- The optional Programmable Logic Controller MCO 300 provides basic PLC functions and complies with the standard IEC 61131-3.
- The optional Motion Control PLC MCO310 performs advanced motion control functions such as synchronizing, positioning, CAM control and others (complies with the standard IEC 61131-3).
- Several input/output extension options with digital, analogue, encoder/sin-cos and resolver input/output terminals.
- Fieldbus options: Profibus, DeviceNet, CAN open, Ethernet and ProfiSafe.
- Optional Local Control Panels, the LCP 101 (numeric) and the LCP 102 (graphical)
- PC based commissioning tool MCT 10 Setup Software

Machine manufacturer benefits:

- Less costs during the engineering phase (one drive = only one set of functions).

- Less space required, lower mounting costs due to common mechanical and wiring concept.
- Purchase only the performance and functions needed (high flexibility, high modularity).
- Customer doesn't need to learn different series, which makes commissioning easy (less staff training).
- Fewer suppliers to deal with in certain cases and easy to target help if support is required.
- In small to medium sized machines separate PLC and motion controllers can be avoided (optional Programmable Logic Controller and Motion Control PLC).

End-user benefits

- Easy operation and easy service, no need to learn different series.
- Fewer spares in stock needed (only one series, high modularity).
- Easy to pinpoint responsibility if after-sales service is needed.