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The new Multidrive concept for engineered drive application

**Abstract:**

This paper summarizes the most important features of ABB's multidrive concept for engineered drive applications. The new concept adds operational flexibility through standardised hardware and software modules, a streamlined communication network and reduced equipment requirements. Due to the modern digital technology and ABB's concept higher availability is obtained.

**Key words:** Multidrive system, (CDC) Common Drive Control, (APC) Application Controller, (DDC) Digital Drive Controller, MasterBus 90, AC/DC 700 systems.

1. Multidrive concept

The Multidrive concept gives users of drive systems with a number of different possibilities to solve their engineering problems.

A new concept for engineered drive applications includes: built-in distributed application control, open communication and advanced PC based tools for application programming, commissioning, troubleshooting and drive monitoring (fig 1.)

The Application Controller (APC), common for both DC and AC drives, is basically a single board controller with all the software and hardware facilities needed to handle the application specific functions.

The Digital Drive Controller (DDC) software is fixed but various functions and operating modes can be selected via parameters. The DDC is controlled by either a torque or a speed reference provided by the APC.

In distributed multicontroller systems, several application controllers are interconnected by fast communication link where each drive can be used as a node. Common control functions are distributed to separate nodes by the use of digital communication. As well, APC's can communicate with external systems with communication boards.
2. Common Drive Control structure

The Common Drive Control (CDC) architecture is presented in figure 2.

Control System

The basic parts of a CDC systems are the application controller (APC) and the Drive controller (DDC). Interface to the outside world is achieved through a Panel Bus, local/remote I/O and a connection to the PC Drive Tools for commissioning/maintenance. Communication to the Supervisory System is achieved by Bus Administrator (BA) with ABB Master Bus 90 (MB90).

The application controller takes care of the specific control functions of the basically, it is a single board controller with all software and hardware facilities needed for a single or multi-drive system. The application controller is programmable. Optional boards exist for I/O and communication extensions.

The functions of the drive controller are independent whether an AC or DC drive application is used. The Digital Drive Controller (DDC) principally is not programmable and operation modes and other functions are selected by a fixed set of parameters. These parameters are visible, and can be set from the application controller.

The basic structure is that one application controller controls one drive controller. Up to four drive controllers can however be connected to the application controller.

Communication between application controllers is established via "MasterBus 90" protocol. The transmission speed is 1.5 MBit/s and it is possible to use for communication to the overriding ABB MasterPiece automation system.

Communication to alien systems is possible through the use of optional communication boards.

The Panel Bus makes it possible to connect up to four control panels and remote I/O's to the application controller. The Panel Bus could be used for low speed data interchange for up to 4 application controllers. MasterAid and DriveTools (Windows 3.1 based) could be connected to the application controller through the local PC interface or Master Bus 90.

The APC is a micro controller based board in "flat-pack" mounting. A basic I/O is standard and included for the simple application needs, e.g. web tension measurement and process interlock. I/O capability, can be increased by adding additional I/O boards for local and remote use.

The APC is equipped with a fast micro controller (32 bits internal, 16 MHz clock) which allows application programs to be run with cycle times as short as 2 ms. The application program (possibility for on line programming) is stored in the capacitor-backed RAM's during power shut-downs of up to several hours of duration, and permanently stored in Flash type PROM.

The available application memory is sufficient for four average sectional drive sections. One APC can control up to four DDC's communicating with them via fibre optic link.

The DDC's can be AC or DC microprocessor based drive controllers for high performance torque and speed control loops.
The drive controller is normally equipped with speed measurement facilities, and could be defined either as torque or speed controlled section. Torque reference is used when speed control is located in the application controller or when the drive controller is used in the torque control mode.
3. Communication capabilities

The CDC concept provides an open system, with a growing selection of communication modules (fig 3.).

### Communication

<table>
<thead>
<tr>
<th>Master Bus 90</th>
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<tbody>
<tr>
<td>- Max bus length 300 m, bit rate 1.5 Mbit/s</td>
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<tr>
<td>- 32 nodes (Application controller)</td>
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</table>

#### Drive Communication Board

- Siemens (53964, 53964R)
- Allen Bradley
- Master Field Bus

#### RS 485 Bus

- Bit rate 19200 b/s
- 8 nodes
- Max length 300 m

**fig 3.**

Different communication capabilities between APC system to other APC's, overriding ABB Master Piece or alien systems are included in the multidrive system.

Possibility of communication with user's panel, remote I/O or communication between the nodes is also possible through the use of a limited functionality bus. This bus could be used instead of Master Bus 90 for communication between nodes when demands on performance and functionality are limited. The communication speed is 1.5 Mbit/s. Only cyclic messages can be transmitted between application controllers.

ABB Master Bus 90 is used for communication between application controllers, Tools and the Master Piece system.

ABB drive DCB communication is used to communicate with alien systems. In this case, a communication board designed according to the IDR standard (based on iSBX) is used.

ABB Master Bus 90 is a high speed serial communication link. Communication is handled by an optional daughter board directly mounted to the APC board. The communication protocol is controlled by a separate bus administrator.

The drive controller interface is a high speed communication link based on the SDLC standard protocol. The APC has onboard hardware support for one drive controller. Optionally, an additional extension (optical distributor) board is used to connect up to four DDC's. Basic DDC link communication features could be summarized as follows:

- Multiplexed point to point
- 1.5 MBits/s transmission
- Cyclic and event transmission
- 32 bytes maximum length of data messages
- Hardware CRC generation and check
- Hardware address recognition

The PC Tools can communicate with any APC connected to the bus. The PC is connected to the RS232 interface (9.6 KBit/s) of one APC and communication to the other APC's on the same bus is easily accomplished. The messages are relayed back and forth through that one APC.
4. Drive systems

The ABB DCV 700 DC converters are intended for the most demanding multi drive systems with high performance and reliability specifications. It is a fully digital and enclosed complete with all the necessary equipment, meeting the most stringent safety standards. Accomplishing standard solutions is simple, but the flexibility of the system also allows for customization according to the most demanding applications.

In the DC drive the DDC contains the thyristor bridge for power conversion and the microprocessor based control.

Converters are available as 6-pulse 2- or 4-quadrant converters with current ranges from 22 up to 5150 A, and supply voltages from 380V to 1000V. Selection of options is available to provide the user with a system meeting the technical requirements and performance expectations. The control electronics are common through-out the complete range.

Digitally controlled functions includes autotuning for the armature current and field current. A high performance speed controller will reduce the effects from gear back-lash and torsional effects arising from the mechanical systems.

The ABB ACV 700 is an optimised solution for AC drive systems over a wide power range. The drive consists of the DDC's comprising the control and the inverter. The main rectifier, the line reactor, the capacitor bank and switching and protection devices constitute the supply section. The drive section is based on a new inverter design, which uses IGBT power semiconductors for powers up to 400 kVA/500 V, and GTO thyristors for higher powers and voltages. The pulse width modulation together with scalar or vector control is utilized.

The main features of the AC drive DDC's can be summarized as follows:
- Modular construction
- Possibility of four-quadrant operation
- Fast torque and speed control
- Common DC bus system.
- Motor to motor braking through the DC bus,
  - etc.

Both closed loop vector control and open loop control are available. Vector control will provide the user with a fast and accurate control for a demanding application with control range from zero to maximum speed, fast accelerations and minimal impact drop effect.

Digital control provides the possibility of comprehensive diagnostics for man machine communication and protections such as:
- Overcurrent
- Overvoltage
- Earth faults
- etc.

The above conditions are easily detected and troubleshooting is facilitated through the use of the Control Panel and the PC equipped with Commissioning and Maintenance Tools (CMT's). The DDC software includes a real time fault logger. Information on internal stored signals can be displayed by the CMT for easy fault finding.
5. Conclusion

The ABB configuration consists of the converter and software, application controller, engineering tools and different communication links to other automation systems. The above mentioned concept includes an application control and a drive control with well defined functions and interface for both DC and AC drive systems.

References

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