MPS Press Control 760
Shaftless Printing Presses with Individual Drives
Shaftless printing presses have many distinct advantages

As an add-on to an existing press or a complete new press, for gravure or offset, for newspaper or commercial printing:

MPS Press Control 760—tomorrow’s technology for today’s presses!

As a leading supplier of control, automation and drive systems for printing presses, ABB in close cooperation with a printing press manufacturer has constructed the world’s first fully shaftless printing press. Fitted with ABB’s control and drive system MPS Press Control 760, this press is an evolutionary milestone in the history of newspaper printing.

The new shaftless printing press dispenses with the disadvantages of horizontal and vertical drive shafts and their associated gears and replaces them with modern electronics. In the case of the solution presented here, every printing couple, folder and draw element is equipped with its own individual high-precision digital drive.

Shaftless printing presses both improve print quality, shorten production time and offer previously unattained commercial advantages. All in all, this advanced technology should strengthen the position of newspapers in the communication market by enhancing the opportunities for personalization and increased color flexibility.

MPS Press Control 760 is applicable to all kinds of printing presses. Similar equipment has been in operation since 1991 on shaftless gravure, flexo and textile presses. The number and arrangement of the drives varies from one press type to another. ABB’s distributed system fits to any conceivable configuration; it provides unbeatable functionality using well-tried established technologies.
**Independent drives replace rigid mechanics**

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<th>Advantage</th>
<th>achieved by</th>
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<td><strong>Maximum production flexibility</strong></td>
<td>■ a freely configurable printing press with numerous alternative production possibilities; amongst others: different products on a single printing unit,</td>
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<td>■ the ability to start and stop printing couples during production, i.e. no downtime when changing editions,</td>
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<td>■ minimum downtime when changing the number of pages.</td>
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<td><strong>Reduced operating and maintenance costs</strong></td>
<td>■ fewer paper breaks because of less vibration and torsional stress and elimination of gear backlash; instead the paper is transported by position and torque controlled drives,</td>
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<td>■ elimination of many mechanical parts subject to wear,</td>
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<td>■ use of maintenance-free AC drives (no commutators and brushes),</td>
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<td></td>
<td>■ running only those printing couples that really need to run,</td>
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<td>■ a more compact press design, giving better access for operation and maintenance.</td>
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<td><strong>Consistently high printing quality</strong></td>
<td>■ elimination of numerous sources of mechanical vibration,</td>
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<td>■ „torsion-free electrical shafts“ replace mechanical shafts — the drives ensure consistent torque direction,</td>
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<td>■ a reduced temperature gradient along the printing cylinders,</td>
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<td>■ improved web control through constant web stretch and better register stability during startup, shutdown and reel changes.</td>
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<td><strong>Higher availability and reliability</strong></td>
<td>■ ability to service, set up, strip, clean etc. one printing couple independently of the others,</td>
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<td>■ torque limitation within the drives prevents overloads and undesired downtime due to safety devices,</td>
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<td>■ redundant transmission of drive data between printing units and folder via optical fiber cables immune to electromagnetic interference,</td>
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<td>■ the use of industrially proven drive and control components.</td>
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<td><strong>Less power consumption</strong></td>
<td>■ running only those printing couples actually required for the production,</td>
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<td>■ AC motors with a higher power factor,</td>
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<td>■ reduced frictional losses.</td>
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<td><strong>Reduced capital investment for infrastructure</strong></td>
<td>■ compact printing press design with less weight,</td>
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<td>■ optimum utilization of available space through possibilities for unconventional press arrangement,</td>
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<td>■ less heat dissipated to the environment,</td>
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<td>■ extension of existing presses with shaftless units; no mechanical coupling required.</td>
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Tasks performed by MPS Press Control 760...

MPS Press Control 760 is a general term for the solution for all the control and drive tasks associated with a shaftless printing press. It is not only applicable to complex newspaper printing presses, but to any kind of printing press that fulfills certain mechanical prerequisites. The structure of the system is based on distributed intelligence which has proven itself in many installations.

A shaftless printing press will generally have one drive per printing couple or printing couple pair (bridge). Additional drives will be used on the roller top of former, the infeed unit, the draw rollers and the folder. The relative speeds and positions of all the drives are controlled and synchronized electronically. The various print functions of a shaftless press can be controlled more precisely than on a conventional press, resulting in saleable copies during even the most adverse dynamic press conditions.

MPS Press Control 760 takes over full automatic control of printing press operation and generates the setpoints for all the drives according to the web leads selected. For the control functions ABB is using a system from the widely used Advant® OCS series. This system is used throughout ABB and has proved its reliability under severe industrial conditions in all parts of the world. The abbreviation OCS stands for “Open Control System” and is intended to underline the system's extreme user-friendliness and the open interfaces. By integrating the intelligence needed to generate the setpoints for the drives in the control system, it is possible to use standard drives supplied by different manufacturers.

MPS Press Control 760 provides a variety of unique features for performing the following tasks:

Tasks and features of MPS Press Control 760

- control of all elements in the printing press process,
- automatic operating procedures for starting up, shutting down, production changes and new functions such as page or volume changes during production,
- generation and synchronous distribution of the setpoints for every drive,
- accurate maintenance of color and cutoff registers through precise position control of the printing cylinders,
- consistent web stretch through precise control of web tension elements,
- exchange of data between press, control system, drives, control console and preset system,
- minimization of the effects of disturbances such as cylinder gaps, folder blade, etc.,
- highly dynamic control of the large rotating masses over the entire speed range,
- guaranteed high availability as a consequence of the distributed system structure,
- high immunity to electromagnetic influences.

Example of a printing press with one drive per blanket cylinder.

Control systems
Drive systems
Since shaftless printing presses first appeared, printing press manufacturers have presented a number of alternative drive configurations. The illustration below shows some of these. The principal benefits of a shaftless printing press lie with the previously unknown freedom of press arrangement, resulting in the best possible use of space, and the enormous production flexibility. The selection of web leads can even be made in such a way that, for example, one printing unit works with two separate folders. This can go so far that every bridge becomes an independent printing press. Not all the alternative drive configurations in the illustration below meet the requirements with regard to flexibility and printing press utilization. It is a matter for the owner of the press to decide which alternative suits his production requirements best.

A special feature only available on shaftless printing presses is what is referred to as a “flying plate change”. This involves exchanging the printing plates for the different editions on a stationary plate cylinder which can be manipulated independently while the rest of the press is in full production. The plates are changed with the press running. As soon as the number of copies for the current production has been reached, the printing couple with the plates for the next edition is run up to press speed and synchronized and printing starts absolutely in register. At the same time the printing couples which are no longer needed are disengaged and shut down. It is not only possible to change the contents of individual pages on shaftless presses, with certain restrictions it is also possible to change the number of pages without stopping the press.

It follows from the above that, to take full advantage of all these possibilities, the control system, control console and preset system are required to perform more complex tasks. The many installations in commercial production conclusively demonstrated the correct operation of MPS Press Control 760.

for a wide range of printing press configurations

Some of the possible drive configurations.
MPS Press Control 760 is an integral part of Master Printing System 700, ABB’s automation system for newspaper printing presses. The functions of the overall system are divided among different subsystems on several hierarchical levels, and the structure maximizes the clarity and availability of the entire automation system.

The subsystems at the three levels of ABB’s Master Printing System 700 perform the following functions:

- **Management level with:**
  MPS Production 700 — computer system for job and product planning, production preparation and press preset. Possibility of integration in a computer network together with other publishing, pressroom and mailroom systems.

- **Group control level with:**
  MPS Control Console 750 — control console for newspaper printing presses, «Press Master» — data processing and link between MPS Press Control 760, MPS Control Console 750 and MPS Production 700, Fault logging system — for the acquisition of events and their distribution to the fault printer, MPS Control Console 750 and MPS Production 700.

- **Individual control level with:**
  MPS Press Control 760 — the control and drive systems for the printing press.

Overview of Master Printing System 700. To simplify the illustration, only one control and one drive system are shown for MPS Press Control 760.
Attention was paid when designing MPS Press Control 760 that a single fault in a subsystem could not have more serious consequences than an equivalent fault in the mechanical part. Redundant components are therefore used where relevant.

For the most part, control and drive tasks are performed at the individual control level of MPS Press Control 760. The press elements to be controlled are allocated to control stations, thus extending the principle of distributed control. Typically there is one control station for every H-type printing unit and one for the folder. Depending on the number and space available, the auxiliaries (central ink supply, damping water supply, hydraulics, etc.) will have their own control station, otherwise they are included in the folder control station. Every control station is an independent unit, receiving its commands, setpoints, etc., from the subsystems at the group control level via a real-time data bus and sending its status signals back the same way.

For the acquisition of statuses of the press elements and the output of commands, ABB uses modular input/output units especially designed for installation close to the associated actuators and limit switches. Data is transferred to and from the input/output units via a serial fieldbus passing through the printing units and folder.

The considerations governing the assignment of drives are similar to those for the control system. All the drives in a printing unit or a folder form an independent group with its own power supply and data link.
MPS Press Control 760 uses the following components in order to perform its many control and drive system tasks:

- **Advant Controller 110**: programmable process controller
- **Advant Fieldbus 100**: real-time bus for communication between Advant stations
- **Advant Station 100**: PC station for programming and system maintenance
- **Fieldbus**: serial exchange of data to and from the I/O units located in the printing press
- **I/O units**: for the input and output of signals from and to the press
- **Drive interface and modem**: for the cyclic and synchronous transfer of drive data; plug-in module in the Advant Controller 110 and modem for coupling to drive buses
- **Drive system**: MPS Drive 760 or standard drives of various manufacture

ABB uses the programmable controller Advant Controller 110 from its Advant® OCS series to perform the MPS Press Control 760 control functions. It comprises a rack with a varying complement of plug-in modules according to application. A wide range of I/O and processing units is available for accomplishing such functions as analogue and digital control, counting, measuring, arithmetic etc. The Advant Fieldbus 100 interface provides for real-time communication between the control stations and the control consoles.

The drive interfaces in conjunction with the associated modems establish the communication between the control system and the drives. Typically, one interface and one modem is used for all drives of a printing unit or a folder. The interface transfers the drive data to the drive bus and also provides for communication between the buses. The modem converts electrical signals to optical signals and vice versa.
Advant Controller 110 is programmed using a function block language with which the user becomes proficient after only a brief familiarization. In this programming method, the functions for logic, analogue and sequential control are represented graphically. Efficient testing and fault-finding routines support the user during commissioning and in the event of a fault. The computer-based archiving and documentation system for the application programs ensures that the documentation is always up-to-date and corresponds to the version of the program actually in use.

Advant Controller 110 features

- use as a stand-alone station or as a component of a distributed modular system,
- high functionality for performing analogue and digital control, counting and arithmetic tasks,
- high-performance central unit for short cycle times and fast processing,
- application programs stored in non-volatile memories (flash EPROM’s) therefore no need for standby batteries and time-consuming deletion procedures,
- remote station diagnosis and programming by linking an Advant Controller 110 to the telephone or ISDN network via a modem,
- Advant Fieldbus100 — fast real-time bus for the redundant interconnection of up to 80 stations,
- Drive interface and modem for communication and synchronous real-time operation of all drive controllers via optical fiber,
- Fieldbus for serial communication with the I/O units distributed throughout the printing press,
- graphic programming under Windows® using a standard PC with many useful tools for system configuration and diagnosis; central access to all control units via the buses,
- provision for different auxiliary supply voltages (24 V DC, 110...220 V AC) and I/O devices to suit all the usual industrial voltages; insulated or non-electrically insulated,
- robust DIN rack assemblies for wall mounting or cubicle installation; fast replacement of modules without disconnection of power,
- low-cost wiring to screw-type terminals at the front.

[Image: Graphic programming with function blocks under Windows®. The system includes a wide range of standard function blocks for analogue and digital control, counting and arithmetic functions etc. To this range can be added complex user specific blocks.]
Replacing the mechanical shafts and gears on a printing press by electronics amplifies the demands on the control and drive systems. An accuracy of 10 µm at the circumference is required in newspaper printing when positioning the cylinders. However, the position has to be set while the cylinder is in motion and this means that at a typical web speed of 10 m/s, the correct position has to be reached within 1 µs. In other words, the synchronization of the cylinder positions must be achieved in less than <1 µs. Modern drives, e.g. such as MPS Drive 760, are able to meet these requirements.

Because of the high number of drives and the differing machine configurations from one production to another, additional measures have to be taken in the case of newspaper printing presses to position the drives to the required degree of accuracy.

The application of the IEC 1491 standard for the communication of the drive data is basically undisputed. In theory the standard permits in excess of 100 drives to be connected to one system. However, as this number has an adverse influence on the availability, it is out of the question for shaftless printing presses. A MPS Press Control 760 configuration therefore allocates a drive bus to every printing unit and folder and includes typically up to 32 drives per ring. Dividing the drives into several groups in this way makes an additional measure necessary to synchronize the groups. ABB therefore uses a drive interface and modem to provide communication between the various printing units and folders within the permissible synchronization time. The redundant optical fiber cables ensure the high degree of availability required for these connections.

Features of distributed drive control

- standard AC drives as part of MPS Drive 760 or servo drives of different manufacture,
- clearly defined response in the event of a fault; only a limited number of printing couples affected should a drive or ring fail,
- division into several independent drive buses to limit the number of drives per group,
- operation within the positioning accuracy and synchronizing time essential for shaftless printing presses,
- redundant communication between the printing units and the folder.

The drive bus is designed in accordance to IEC 1491 (SERCOS) serving for open, real-time serial communication, devised by leading manufacturers for motion control.
for high accuracy and availability

Compared with other buses, there is one important feature of the IEC 1491 communication standard: all the commands to the drives are transferred synchronously. The data are refreshed cyclically according to a fixed time slot pattern. The drive controllers then ensure that the actual values for all the drives meet the positional setpoints within the appointed time slot. Intelligent drives have additional internal models which enable them to interpolate setpoints between two synchronisation cycles. The position and speed setpoints and actual values are transferred with a resolution of 32 Bit and those for torques with a resolution of 16 Bit.

The cycle time of a drive bus can be set to one millisecond or any integer multiple thereof depending on the number of drives in the ring. The use that can be made of this setting is, however, restricted in the case of shaftless printing presses for the reasons given above.

The drives are configured and set with the aid of a programming and test device provided by the drive manufacturer. During normal operation, the control system and the drives communicate with each other via the drive interface and exchange commands, return signals, setpoints, actual values and service data.

The drives used are IEC 1491 compatible products supplied by approved manufacturers.

Drive interface features

- open real-time bus for synchronous movements designed according to the IEC 1491 standard,
- extremely precise synchronisation between several drive buses,
- adjustable cycle time (typically 2 ms for 8 drives); drive bus expandable up to 32 drive nodes,
- data transfer rate 2 Mbit/s,
- optical fiber cables for immunity to electromagnetic interference and reliable transmission of drive data,
- optical fiber buses replace costly wiring; maximum distance between two drives: 60 m using plastic fibers and 250 m using glass fibers,
- prefabricated optical fiber cables with connectors for simple installation and connection.
Overview of MPS Systems

MPS Cockpit
Central planning, disposition and controlling system for the entire newspaper production process which interacts with all connected systems — from prepress to truck loading.

MPS Inform 710
Information system for the global acquisition and evaluation of data in general in newspaper printing. In conjunction with “MPS Production”, it provides information relating to printing press operation and maintenance and material management.

MPS Edition
System for planning all products to be printed in coordination with the prepress. The system is used by the prepress and the pressroom and can cover one or more printing locations.

MPS Roll Handling
Logistics and control system for handling paper rolls which interacts with the reelstand loading system. It takes care of disposition, transport and tracking of paper rolls, the returning of rest rolls and the disposal of waste paper.

MPS Production
Production management system for newspaper printing presses. It contains comprehensive functions for job and product planning, production preparation and press presetting. Core system for integration with systems in the prepress, film and plate handling, roll supply and the mailroom.

MPS Control Console 750
Control console for the central control and supervision of newspaper printing presses. It includes a logging system to record all events, operating statuses and faults.

MPS Drive 760
Drive system for shaftless printing presses using standard AC drives from ABB instead of specific servo drives.

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