Rexroth HNC100® 2X Series – Digital Controller Assemblies with NC Functionality

For electrohydraulic and electromechanical drives
Everything is controlled – by a modular, scalable automation concept

The digital HNC100® 2X Series axis controller is a freely programmable, bus-capable NC control assembly for both electromechanical as well as electrohydraulic drives.

It handles communication to the higher-level SPS or PC controller, to additional HNCs as well as the sequence control and the closed-loop control from up to two drives per unit that are independent of one another.

For years, the three letters HNC have stood for “Hydraulics-capable NC Control” from Rexroth.

In numerous applications, HNC has proven its flexibility and reliability in the field of open and closed loop drive control.

Thanks to open and closed-loop algorithms designed especially for hydraulic systems, electrohydraulic drives have achieved optimal performance capability.
Parameterizing and (sequence) programming (NC programs) are done by the customer using a PC and the WIN-PED® software (“Windows program for parameterizing, editing, diagnosis”) – a clear advantage for the user thanks to a maximum of flexibility with additional protection for the individual process know-how.

Profibus-DP, Interbus-S, CANopen as field bus and the SERCOS interface as drive bus are available for communicating to the higher-level controllers.

This is how a modular, scalable automation concept is developed.
Interfaces for the measuring systems:
- 2x incremental TTL
- 2x digital absolute (SSI)
- 1x 1Vss
- 1x EnDat
- 4x analog (Voltage ± 10 Volt or current 4–20 mA)
- 2x inductive measuring systems optional

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Interfaces for pressure/force control:
- 4x analog (Voltage ± 10 Volt or current)
- 2x analog (Voltage ± 10 Volt) for auxiliary functions

Interfaces for open-loop drive control:
- 2x analog (voltage ± 10 Volt or current)
- 2x analog (voltage ± 10 Volt) for auxiliary functions

Communication between numerous HNCs:
- local CAN-Bus

Field bus systems:
- Profibus DP
- Interbus-S
- CAN (CANopen)
- SERCOS interface (output bus)

Process connection to higher-level control:
- 8, 16, and 24 digital inputs
- 8, 16, and 24 digital outputs
- analog COM inputs and outputs

Flexible communication for flexible solutions: The interfaces

Thanks to their compact design and the field buses available, the HNC100® is becoming more and more important as a decentralized unit in direct drive proximity.

Both the stable interior construction and the HNC100’s housing, which is made of tough continuous cast aluminum, make it resistant to vibration, shock, and climate. It is therefore the perfect control unit for use in harsh industrial environments.
Open and closed-loop algorithms for ideal system performance

The features of closed-loop drives are critically dependent on the closed-loop algorithms used. That’s why high-performance closed-loop control structures for both electromechanical as well as electrohydraulic axes are integrated in the HNC100® because both drive principles are fundamentally different. In addition to standard functions, the HNC100® offers special closed-loop algorithms that reflect Rexroth’s experience and know-how in this field, thus achieving ideal system performance.

For a quick and easy system start-up, users can set and adjust the individual closed-loop control functions using the transparent WIN-PED® parameterizing software.

### Controller Functions Tailored to the Specific Requirements Electrohydraulic Drives

**Closed-loop position control:**
- PDT1 controller
- Linear gain characteristic curve
- Direction-dependent gain*
- Inflected gain characteristic curve (linearization of valve curves)
- Gain can be changed via the NC program
- Fine positioning (switching integrator)*
- Residual voltage principle/overlap jump*
- Compensation of valve offset
- State feedback (Acceleration/pressure)*
- Command value feedforward
- Limitation of control value via the NC program

**Position-dependent braking:**
- Open-loop controlled start-up, closed loop controlled braking (linear, root-shaped, or sinusoidal characteristics)*
- The same parameters used for the position controller are also used for closed-loop controlled braking*

**Closed loop velocity control:**
- PI controller

**Closed-loop pressure/force control:**
- PIDT1 controller*
- Differential pressure evaluation for closed-loop force control*
- Pressure limitation*
- Position monitoring
- Alternating closed-loop control: Closed-loop position control → closed-loop pressure control*

**Synchronization control:**
- 2-axis synchronization per HNC100®:
  - Master-slave principle
  - Average value principle

*controller functions tailored to the specific requirements electrohydraulic drives
Flexibility for hydraulic drives: Expanded NC programming for motion sequences

Users can define the motion sequences of the axes using freely programmable NC programs. This offers two decisive advantages:

- Maximum flexibility with regard to defining the motion sequences
- User’s know-how is protected in terms of the process engineering of its machines and systems

The set of commands was modeled on the syntax (DIN 66025) commonly used in the machine tool industry.

Besides standard commands, special NC commands tailored to the particular features of hydraulic axes and their applications have been implemented. These include the fields of closed-loop force/pressure control and limitation, transitions from closed-loop position to pressure control, control variable limitation and influencing controller functions.

The WINPED® PC software is used to generate NC programs. The NC programs are then loaded into the HNC100® via serial interfaces and lastly stored there in Flash.

A few additional functions:

- Flexible cam controller for position and pressure
- Internal variables
- Arithmetic in NC programs
- Variable (R parameters) for exchanging values with the higher-level controller and visual display systems
- Additional NC program for coordinating and monitoring functions

The "Curves" function allows users to generate a command value in the form of a polygonal sequence with up to 600 interpolation points as a function of time or of an actual value (e.g. "force in relation to travel" or "travel in relation to travel").

Excerpt from the list of NC commands

* NC commands tailored to the special features of hydraulic drives
Example of NC programming

;Definition of switching position

/Trig A A1.7=1 XR200 B=R206 B+R206 <>
/Trig A A1.8=1 XR201 B=R208 B+R208 <>
;
;Program sequence
;
;Wait until input is set.
;With input 4, the movement to
;position R201 is started
;and with input 5, the movement to
;position R200
;
L00
if E1.4=1 jmp L10 ;jump: input 4 is set
if E1.5=1 jmp L20 ;jump: input 5 is set
jmp L00
;
L10
if E1.4=1 jmp L11 ;Traversing to rapid speed position
if E1.5=1 jmp L21 ;Traversing to end position
L11
if E1.4=1 jmp L11 ;Waiting until input is
;is reset
 ;
L20
g01 xR205 i1000 j850 fR210 R211
;Returning to the initial position
L21
if E1.5=1 jmp L21 ;Waiting until input is
;reset
jmp L00
m02 ;end of program
Parameterizing, programming, editing, diagnosis: nothing is simpler than WIN-PED® by Rexroth

The HNC100® can be configured and the sequence programmed with the help of a PC and the Rexroth software program WIN-PED (WIN-DOWS), which runs on any PC with Windows version 95 or higher. The NC programs are loaded into the HNC100® and saved in Flash by connecting with the serial interface.

Consistently observing Windows conventions makes it considerably easier to get used to WIN-PED®. The integrated “online” documentation allows users to access context-related information on the program as well as to complete documentation on the HNC100®, such as a description of NC commands or machine data.

- Managing data from one or more HNCs in one project
- Data security and initialization functionality for all HNC data
- Parameterizing the HNC100®
- Generating NC programs (editor with syntax test and compiler)
- Bus manager for comfortable configuration of the data exchange with the higher-level controller
- Diagnosis function for all system variables as well as integrated “software oscilloscope” (4 channels)
- Integrated “Online Manual” for direct access to the complete HNC documentation
In addition to axis functionalities and the internal data exchange between the HNCs, the option of connecting the HNC100® to the higher-level controller (e.g. SPS or PC) is very important. These are the options available for performing the respective task at hand:

**Connection via the digital input/output level**
The HNC100® has 8, 16, 24 inputs/outputs.

**Connection using standard field buses (global bus)**
Currently, the following field bus systems are all supported: the DP Profibus, the Interbus-S, CAN (CAN open), SERCOS interface.

There are more under development.

These standard field buses make it possible to develop cost-effective, modular, decentralized automation concepts with the necessary data transparency.

**Bus manager**
Two options are available for connecting the control level and the HNC:

- The use of a bus manager (compare WIN-PED®) for easily configuring data to be exchanged (standard) on a cyclical basis.
- The use of so-called function components that Rexroth developed for numerous standard SPS systems (for the Simatic S5 and S7 and the Allen Bradley System, among others).
HNC100® with SERCOS interface: The solution for interpolating axes

Rexroth offers a communication model via the SERCOS interface specifically designed for applications in the field of interpolating axes. The functional scope in this case varies as shown below:

- The position command values are cyclically forwarded to the HNC100® (in the range of 2-8 ms) using the SERCOS interface.
- The HNC100® works exclusively as a controller for an electrohydraulic axis. The NC functionality is dropped.
- A special closed-loop algorithm provides maximum contour accuracy.
- To simplify application programming in the beginning, the “internal drive interpolation” operating mode is available.
- Operating modes to handle closed-loop force or pressure control are currently under development.

Contour accuracy 2 µm

Electrical drive: Closed-loop drive control device and electro-mechanical axis

Higher-level controller

SERCOS interface (Command value specification and actual values)
General controller solutions for interpolating electrical and hydraulic drives

In general, all systems that meet the B conformity class according to the SERCOS interface specification are suitable as the higher-level CNC controller assembly.

Perfect compatibility with the open-loop control systems from Bosch Rexroth is a must in order to meet "drive and control" requirements.

**HNC100® with SERCOS interface:**
- SERCOS interface in accordance to IEC 61491 with 2, 4, 8 or 16 MBaud
- Fiber optic cable ring
- Special closed-loop control algorithm for interpolation tasks
- Operating modes:
  - Position control
  - Internal drive interpolation
  - Closed-loop force or pressure control under development

Additional axes possible

Hydraulic drive: Axis controller and hydraulic axis
HNC100® – where drives are controlled

Thanks to its flexibility and diverse range of uses, the HNC100® is found in the following machines and systems:

**Plastics processing machines**
- Injection molding machines
- Blow-forming machines
- Rubber molding presses
- Calenders
- Die-casting machines
- Rotary table injection molding machines
- Rotary table soling machines
- Core molding machines

**Special machines**
- Packaging machines
- Bending machines
- Sheet metal flanging machines
- Calenders
- Shears
- Lifting devices
- Assembly machines

**The foundry and rolling mill industry**
- Stretching units
- Oscillating molds
- Rolling mill machines
- Rotary furnace control
- Slab turn-over devices
- Roll stands
- Transfer systems

**Presses**
- Drawing presses
- Extrusion presses
- Forging presses
- Manipulators
- Cutter presses
- Punching presses
- Hydraulic forming systems
- Tube testing presses
- Pipe-bending machines
- Press brake
- Roof tile presses
- Assembly presses
- Tile presses
- Chipboard presses

**Machine tooling**
- Grinding machines
- Drilling machines
- Bending machines
- Broaching machines
- Material handling and storage systems
- Milling machines

**Woodworking machines**
And many more
HNC100® – the function defines the form

Depending on the requirement and the operation purpose, the HNC100® is equipped with various functionalities. The “type key” will help you make the right selection:

**Axes**
- Design with 1 axis: 1
- Design with 2 axes: 2

**Type of installation**
- Wall assembly: W
- Subrack assembly: M

**Digital inputs/outputs**
- 8 I/O: 08
- 24 I/O: 24
- 16 I/O (2-axis version): 16

**Bus connection**
- without bus: 0
- DP Profibus: P
- CANopen: C
- InterBus S: I
- InterBus S with LWL: L
- SERCOS interface: S

**Inductive position sensor**
- Without: 0
- Calibrated for two DM15/4: B
- Calibrated for two IW9: C
- Calibrated for HR1000 and HR2000: D

**Special functions**
- 2. Counter interface: INK2
- EnDat-Interface; 1 Vss: ENDA

**Device dimensions:**
- Device depth (above all): 192.0 mm
- Device width (1 axis): 71.0 mm
- Device width (2 axis): 106.5 mm
- Housing depth (w/o boards): 184.0 mm
- Housing height (w/o boards): 111.5 mm
- Height of front plates: 128.4 mm
- Height of back plates: 155.0 mm

**Mounting using the back plate:**
- Drill hole distance (1 axis) (4x ø 4.5 mm) horizontal: 44.0 mm
- Drill hole distance (2 axis) (4x ø 4.5 mm) horizontal: 79.0 mm
- Drill hole distance vertical: 135.0 mm
The HNC100® Online-Support:
www.boschrexroth.com/hnc100

Thanks to Bosch Rexroth’s online services, you can quickly update your digital controller assembly at any time.

Whether you want to update your WIN-PED® software, acquire information on Rexroth firmware, or want to get familiar with the newest tools and configurations or even if you want to deepen your HNC100® knowledge and skills – take advantage of the comprehensive download area on the Bosch Rexroth website.

In addition to comprehensive documentation, you will find detailed answers to all your questions concerning digital controller assemblies.

And should you require direct support above and beyond our online support, please contact:

OUR SPECIALISTS who you can reach at the below e-mail address:
support.nc-systems@boschrexroth.de
When it comes to training, programming, start-up: Rexroth is always there for you

Bosch Rexroth offers a complete service package for the HNC100®. It is divided into three areas:

- Customized individual training
- The creation of NC programs for customer applications
- Start-up on site

As a rule, the training sessions last two to three days and are tailored to your individual needs.

The goal of these courses is to communicate the necessary know-how for the respective application so that you can generate NC programs yourself and, if necessary, perform the start-up procedure on your own.

However, if Rexroth generates the NC program, it will be done in close cooperation with you using a jointly prepared customer specification. On request, Rexroth will provide start-up service support on site.

Intelligent hydraulics in new dimensions
At Rexroth you can select from the worlds’ largest standard product range in the field of hydraulics, application-specific and customized special system solutions of high quality. With advanced micro-electronics Rexroth has made hydraulics even more powerful. Benefit from our application specialists’ expertise – from engineering to the hand-over of turnkey systems. Thanks to the use of hydraulic drive and control technology from Rexroth you will be more competitive than ever.

Rely on service across technologies.
Rexroth integrates all services for the entire product spectrum in the field of factory and industrial automation into a single organization: from immediate support, spare parts service, field and repair service, retrofit/modernization through to training.