Rexroth IndraDrive C
Drive Controllers
HCS02.1, HCS03.1

Operating Instructions
This documentation describes the mounting, installation, commissioning, parameterization and troubleshooting of Rexroth IndraDrive controllers on the basis of the power sections HCS02 or HCS03 and the control sections BASIC OPENLOOP or BASIC PROFIBUS with comfort control panel.

<table>
<thead>
<tr>
<th>Description</th>
<th>Release Date</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOK-INDRV*-FU*******-IB01-EN-P</td>
<td>06-2006</td>
<td>First Release</td>
</tr>
</tbody>
</table>

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Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2 • D-97816 Lohr a. Main
Telephone +49 (0)93 52/40-0 • Tx 68 94 21 • Fax +49 (0)93 52/40-48 85
http://www.boschrexroth.de/
Dept. EDY1 (RR/US/BB)

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1 Introducing the Products

1.1 Introduction

Terms, Basic Principles

Parameters
Communication between master and drive takes place, with a few exceptions, by means of parameters.

Parameters are used for:
- determining the configuration
- parameterizing the control loop
- triggering and controlling drive functions and commands
- transmitting command values and actual values (according to requirements, cyclically or acyclically)

All operating data are mapped to parameters!

The operating data stored in parameters can be identified by means of the IDN. They can be read and transferred, if required. The user write access to parameters depends on the properties of the respective parameter and the current communication phase. Specific parameter values (operating data) are checked for validity by the drive firmware.

Data Storage and Parameter Handling

Data Memory
Several non-volatile data memories are available in an IndraDrive device:
- in the controller
- in the motor encoder (depending on motor type)

In addition, a volatile data memory (working memory) is available in the controller.

Condition As Supplied
Condition as supplied of the Rexroth drive components:
- The controller memory contains the drive firmware and the controller-specific parameter values.
- The motor encoder memory contains the encoder-specific and, depending on the motor type, the motor-specific parameter values.

Storing the Application-Specific Parameter Values

The application-specific parameter values are stored in the controller. Due to the limited number of writing cycles of non-volatile storage media, application-specific parameter values can be stored in the working memory (volatile memory), too.

Saving Parameter Values

Saving application-specific parameter values is required in the following cases:
- after initial commissioning of the machine axis or the motor
- before replacing the controller for servicing (if possible)

Application-specific parameter values can be saved via:
- "IndraWorks D" commissioning tool → saving the parameter values on external data carrier
- control master → saving the parameter values on master-side data carrier
- comfort control panel
Parameter IDN Lists

The drive supports master-side saving of parameter values by listing parameter identification numbers (IDNs). Using these lists guarantees complete storage of the application-specific parameter values. It is also possible to determine IDN lists defined by the customer.

Loading Parameter Values

Loading parameter values is required in the following cases:

• initial commissioning of the motor (loading basic parameter values and motor-specific parameter values)
• serial commissioning of machine axes at series machines (loading the values saved after initial commissioning)
• reestablishing a defined original status (repeated loading of the values saved after initial commissioning)
• replacing the controller for servicing (loading the current parameter values saved before servicing)
• Possibilities of loading parameter values to the controller:
  • motor encoder data memory → loading the parameter values by command or via the control panel during initial motor commissioning
  • "IndraWorks D" commissioning tool → loading the parameter values from external data carrier
  • control master → loading the parameter values from master-side data carrier

Checksum of Parameter Values

By means of checksum comparison, the control master can determine whether the values of the application-specific parameter values currently active in the drive correspond to the values saved on the master side.

Password

IndraDrive controllers provide the possibility to protect parameter values against accidental or unauthorized change by means of a password. With regard to write protection, there are 3 groups of parameters that can be written:

• Parameters that are write-protected as a standard, such as motor parameters, hardware code parameters, encoder parameters, error memory etc. ("administration parameters"). The values of these parameters guarantee correct function and performance of the drive.
• Parameters the customer can combine in groups and protect them with a so-called customer password. This allows protecting parameter values, that are used for adjusting the drive to the axis, after having determined them.
• All other parameters that can be written and are not contained in the above-mentioned groups. They are not write-protected.

Kinds of Passwords

The drive firmware allows activating and deactivating the write protection for parameter values by means of three hierarchically different passwords:

• Customer password
  The parameter values of a parameter group combined by the customer can be protected.

• Control password
  Parameters protected by a customer password can be written; "administration parameters" remain write-protected.

• Master password
  All parameters that can be written, including "administration parameters" and parameters protected by a customer password, can be changed.
Commands

Commands are used to activate and control complex functions or monitoring features in the drive. The higher-level master can start, interrupt or clear commands.

Each command is assigned to a parameter by means of which the execution of the command can be controlled. During the execution of the command the display of the control panel reads "Cx", "C" representing the diagnostic command message and "x" representing the number of the command.

Note: Each command that was started must be actively cleared again.

All commands available in the drive are stored in the S-0-0025, IDN-list of all procedure commands parameter.

Kinds of Commands

There are 3 different kinds of commands:

- **Drive control commands**
  - can cause automatic drive motion,
  - can be started only when drive enable has been set,
  - deactivate the active operating mode during its execution.

- **Monitoring commands**
  - activate or deactivate monitors or functions in the drive.

- **Administration commands**
  - carry out administration tasks,
  - cannot be interrupted.

See also "Command Processing" in chapter "Master Communication"

Operating Modes

The selection of operating modes defines which command values will be processed in which way, in order to lead to the desired drive motion. The operating mode does not determine how these command values are transmitted from the master to the slave.

One of the four or eight (for SERCOS) operating modes defined in parameters is always active when the following conditions have been fulfilled:

- control section and power section are ready for operation
- drive enable signal sees a positive edge
- drive follows command value
- "Drive Halt" function has not been activated
- no drive control command is active
- no error reaction is carried out

The display of the control panel reads "AF" when an operating mode was activated.

Note: All implemented operating modes are stored in the S-0-0292, List of all operating modes parameter.

See also chapter "Operating Modes"
Warnings

Depending on the active operating mode and the parameter settings, many monitoring functions are carried out. If a status is detected that still allows correct operation but in case this status persists will cause an error to occur and therefore cause the drive to be automatically switched off, the drive firmware generates a warning message.

**Note:** Warnings do not cause automatic shutdown (exception: fatal warning).

**Warning Classes**

Warnings are classified in different warning classes which determine whether the drive, when the warning is generated, carries out an automatic reaction or not.

**Note:** The warning class can be recognized by the diagnostic message.

The following classes of warnings are distinguished:

- **without drive reaction** \(\rightarrow\) diagn. message no. **E2xxx, E3xxx, E4xxx**
- **with drive reaction** \(\rightarrow\) diagn. message no. **E8xxx**

**Note:** Warnings cannot be cleared. They persist until the condition that activated the warning is no longer fulfilled.

Errors

Depending on the active operating mode and the parameter settings, many monitoring functions are carried out. If a status is detected that affects or prevents correct operation the drive firmware generates an error message.

**Error Classes**

Errors are classified in different error classes. There are 6 error classes with different drive error reactions.

**Note:** The error class can be recognized by the diagnostic message number.

<table>
<thead>
<tr>
<th>Diagnostic message number</th>
<th>Error class</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2xxx</td>
<td>non-fatal error</td>
</tr>
<tr>
<td>F3xxx</td>
<td>non-fatal safety technology error</td>
</tr>
<tr>
<td>F4xxx</td>
<td>interface error</td>
</tr>
<tr>
<td>F6xxx</td>
<td>travel range error</td>
</tr>
<tr>
<td>F7xxx</td>
<td>safety technology error</td>
</tr>
<tr>
<td>F8xxx</td>
<td>fatal error</td>
</tr>
<tr>
<td>F9xxx</td>
<td>fatal system error</td>
</tr>
<tr>
<td>E-xxxx</td>
<td>fatal system error &quot;processor exception&quot;</td>
</tr>
</tbody>
</table>

**Fig. 1-1:** Overview of error classes

**Note:** Apart from the mentioned error classes that can occur during operation, errors can occur when the devices are booted and
during firmware download. These errors are not displayed at the control panel with a diagnostic message number of the "Fxxxx" pattern, but with a short text. Boot errors and firmware download errors are separately described in the documentation "Troubleshooting Guide" (diagnostic message description).

### Error Reactions of the Drive

If the drive controller is in control and an error status is detected, the execution of a drive error reaction is automatically started. The diagnostic message number "Fxxxx" flashes on the display of the control panel.

The drive reaction in the case of interface errors and non-fatal errors is determined in parameter **P-0-0119, Best possible deceleration** At the end of each error reaction, the drive is torque-free.

See also "Error Reactions" in chapter "Drive Functions"

### Clearing Error Messages

Error messages are not cleared automatically but by the following action:

- activating the **S-0-0099, C0500 Reset class 1 diagnostics** command
- or -
- actuating the "Esc" button on the control panel

If the error status persists the error message is immediately generated again.

### Clearing Error Messages when Drive Enable Was Set

If a drive error occurs while operating with drive enable having been set, the drive carries out an error reaction. The drive automatically deactivates itself at the end of each error reaction; in other words, the output stage is switched off and the drive switches from an energized to a de-energized state.

To reactivate the drive:

- clear the error message and
- input a positive edge for drive enable again.

### Error Memory

The diagnostic message numbers of occurring errors are written to an error memory. This memory contains the diagnostic message numbers of the last 50 errors that occurred and the time when they occurred. Errors caused by a shutdown of the control voltage (e.g. **F8070 +24Volt DC error**) are not stored in the error memory.

The diagnostic message numbers in the error memory are mapped to the **P-0-0192, Diagnostic numbers of error memory** parameter and can be displayed by means of the control panel. By means of the "IndraWorks D" commissioning tool it is possible to display the diagnostic message numbers and the respective times at which the errors occurred.
1.2 Rexroth IndraDrive Hardware Platform

Drive Controllers

**Overview**
The drive controller consists of two essential parts:
- power section
- control section

**Power section**
The power section incorporates the control section and has the following connections:
- mains voltage connection (at supply modules and HCS devices)
- motor connection (with optional motor holding brake and motor temperature monitor)
- 24 V control voltage
- DC bus connection
- module bus connection
- connection for external braking resistor (at HCS devices)

**Control section**
The control section is a separate component that is plugged into the power section. The drive controller is supplied complete with factory-installed (possibly configured) control section.

**Power Sections**

**IndraDrive C**

- 300 mm Design
  - HCS02.1E-W0012
  - HCS02.1E-W0028
  - HCS02.1E-W0054
  - HCS02.1E-W0070

- 400 mm Design
  - HCS03.1E-W0070
  - HCS03.1E-W0100
  - HCS03.1E-W0150
  - HCS03.1E-W0210

**Control Sections**
- BASIC OPENLOOP (single axis; type CSB01.1N-FC-…)
- BASIC PROFIBUS (single axis CSB01.1N-PB-…)

**Supported Control Section Configurations**
The configurable control sections differ with regard to the scope of their configurability. It basically depends on the control section type and the corresponding firmware variant. The following abbreviations are used:

**Options for master communication:**
- **PB** → PROFIBUS-DP
- **FC** → FC Interface
Motors and Measuring Systems

Supported Motors

The table below contains an overview of the Rexroth motors which can be operated at IndraDrive controllers.

<table>
<thead>
<tr>
<th>Housing motors</th>
<th>Kit motors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>synchronous</td>
<td>asynchronous</td>
<td>synchronous asynchr.</td>
</tr>
<tr>
<td>MHD</td>
<td>2AD</td>
<td>MLF (IndraDyn L)</td>
</tr>
<tr>
<td>MKD</td>
<td>ADF</td>
<td>MBS (Standard)</td>
</tr>
<tr>
<td>MKE</td>
<td>MAD (IndraDyn A)</td>
<td>MBSxx2 (IndraDyn H)</td>
</tr>
<tr>
<td>MSK (IndraDyn S)</td>
<td>MAF (IndraDyn A)</td>
<td>MBT (IndraDyn T)</td>
</tr>
<tr>
<td>MAL</td>
<td></td>
<td>LSF</td>
</tr>
<tr>
<td>SF (Bosch)</td>
<td></td>
<td>1MB</td>
</tr>
</tbody>
</table>

Fig. 1-2: Appropriate Rexroth motors for IndraDrive

Third party motors

Third party motors must meet the specified requirements.

Supported Measuring Systems

In addition to the encoders integrated in the Rexroth motors, the IndraDrive firmware can evaluate the following measuring systems as motor encoders or as external optional control encoders:

- Bosch Rexroth GDS or GDM encoders (single-turn or multi-turn type)
- resolvers according to Rexroth signal specification (single-turn or multi-turn type)
- encoders with sine signals and EnDat2.1 interface (1 V<sub>pp</sub>)
- encoders with sine signals (1 V<sub>pp</sub>)
- encoders with square-wave signals (TTL)
- Hall sensor box and encoder with sine signals (1 V<sub>pp</sub>)
- Hall sensor box and encoder with square-wave signals (TTL)
- encoders with sine signals and HIPERFACE interface (1 V<sub>pp</sub>)

For measuring purposes the firmware can evaluate the following measuring systems (measuring encoders, no control encoders):

- Bosch Rexroth GDS or GDM encoders (single-turn or multi-turn type)
- encoders with sine signals and EnDat2.1 interface (1 V<sub>pp</sub>)
- encoders with sine signals (1 V<sub>pp</sub>)
- encoders with square-wave signals (TTL)
- encoders with sine signals and HIPERFACE interface (1 V<sub>pp</sub>)
- motor encoders of MSK, MHD, 2AD, ADF, MAD, MAF motors
- SSI encoders

Note: Resolvers cannot be evaluated as measuring encoders!
Master Communication

PROFIBUS Interface

General Features
- cyclic data exchange of command and actual value (max. 32 byte each direction; min. cycle time of 500 µs)
- parameter channel for parameterization and diagnosing via field bus
- safe process data channel (PROFIsafe), optional
- free configuration of telegram contents possible (many cyclic configurable parameter IDN)

1.3 Rexroth IndraDrive Firmware Platform

Type Code

Structure of the Firmware Type Designation
The individual functional packages can be combined to form the following firmware types that can be ordered:

<table>
<thead>
<tr>
<th>Control section</th>
<th>Firmware range</th>
<th>Base package of variant (depending on control section)</th>
<th>Version</th>
<th>Release</th>
<th>Language</th>
<th>Open/closed-loop</th>
<th>Alternative expansion packages</th>
<th>Additive expansion packages</th>
<th>IndraMotion MLD-S</th>
<th>Scope of functional packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic single-axis</td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>-</td>
<td>-</td>
<td>xxx-</td>
<td>xx</td>
<td>base package (open-loop)</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>0- SNC</td>
<td>-NN</td>
<td>-</td>
<td></td>
<td>base package (open-loop) + synchronization</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>0- MSP</td>
<td>-NN</td>
<td>-</td>
<td></td>
<td>base package (open-loop) + main spindle</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>0- ALL</td>
<td>-NN</td>
<td>-</td>
<td></td>
<td>base package (open-loop) + all altern. functions</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>0- NNN</td>
<td>-ML</td>
<td>-</td>
<td></td>
<td>base package (open-loop) + IndraMotion MLD-S</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>1- ***</td>
<td>-ML</td>
<td>-</td>
<td></td>
<td>base package (open-loop) + *** + IndraMotion MLD-S</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>1- SRV</td>
<td>-NN</td>
<td>-</td>
<td></td>
<td>base package (closed-loop) + servo function</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>1- SNC</td>
<td>-NN</td>
<td>-</td>
<td></td>
<td>base package (closed-loop) + synchronization</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>1- MSP</td>
<td>-NN</td>
<td>-</td>
<td></td>
<td>base package (closed-loop) + main spindle</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>1- ALL</td>
<td>-NN</td>
<td>-</td>
<td></td>
<td>base package (closed-loop) + all altern. functions</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>1- NNN</td>
<td>-ML</td>
<td>-</td>
<td></td>
<td>base package (closed-loop) + IndraMotion MLD-S</td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*</td>
<td>-MPB-</td>
<td>04</td>
<td>VRS-</td>
<td>D5-</td>
<td>1- ***</td>
<td>-ML</td>
<td>-</td>
<td></td>
<td>base package (closed-loop) + *** + IndraMotion MLD-S</td>
</tr>
</tbody>
</table>

*** selected option “alternative functional packages” according to availability

Fig. 1-3: Basic structure of the firmware type designation

Fig. 1-4: Overview of firmware types and functional packages they are containing
Functions Overview

Supported Operating Modes
The drive firmware supports the following operating modes:

- torque/force control
- velocity control
- position control with cyclic command value input
- drive-internal interpolation
- drive-controlled positioning
- positioning block mode
- synchronization modes:
  - velocity synchronization with real/virtual master axis
  - phase synchronization with real/virtual master axis
  - electronic cam shaft with real/virtual master axis
  - electronic motion profile with real/virtual master axis

Note: The operating modes supported by the firmware depend on the hardware and firmware and are contained in parameter S-0-0292, List of all operating modes.

Drive Functions
These are the most important drive functions of the MPX-04 firmware:

- Drive Halt
- establishing the position data reference
  - drive-controlled homing
  - setting absolute measuring
  - shifting the position data reference
- drive error reactions
  - best possible deceleration
  - package reaction on error
  - NC reaction on error
- E-Stop function
- compensation functions/corrections
  - friction torque compensation
  - encoder correction
  - axis error correction
  - quadrant error correction
- spindle positioning
- drive-integrated command value generator
- parameter set switching
- probe function
- encoder emulation
- programmable position switch
- drive-integrated PLC (IndraMotion MLD-S)
- integrated safety technology
Introducing the Products Rexroth IndraDrive

- monitoring functions
- limitations that can be parameterized
- output of control signals
- numerous diagnostic possibilities
  - drive-internal generation of diagnostic messages
  - analog output
  - status displays, status classes
  - oscilloscope function
  - monitoring function
  - patch function
  - code of optional card
  - parameter value check
  - operating hours counter, logbook function, error memory

Performance Data

Overview
For the control performance of the IndraDrive range we basically distinguish three levels with regard to the clock rates (cycle times):

- **Basic** performance
  → standard control performance by medium internal clock rates for the control loops and the signal processing of inputs/outputs or drive-integrated PLC (IndraMotion MLD-S)

In this documentation the clock rate data refer to the following characteristic values:

- current loop clock \( T_{A_{\text{current}}} \)
- velocity loop clock \( T_{A_{\text{velocity}}} \)
- position loop clock \( T_{A_{\text{position}}} \)
- cycle time of PLC (IndraMotion MLD-S) \( T_{\text{MLD-S}} \)
- cycle time of master communication \( T_{\text{MastCom}} \)

The table below contains an overview of the clock rates depending on the respective control performance. The detailed assignment of the clock rate to control section design, performance level and parameter setting is contained in the table in section "Control Section Design and Performance" (see below).

<table>
<thead>
<tr>
<th>Performance</th>
<th>( T_{A_{\text{strom}}} )</th>
<th>( T_{A_{\text{Geschw}}} )</th>
<th>( T_{A_{\text{Lage}}} )</th>
<th>( T_{\text{MLD-S}} )</th>
<th>( T_{\text{FKM}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>62.5/83.3/125 ( \mu s )</td>
<td>250 ( \mu s )</td>
<td>500 ( \mu s )</td>
<td>2000 ( \mu s )</td>
<td>500/1000 ( \mu s )</td>
</tr>
</tbody>
</table>

Fig. 1-5: Clock rates (depending on the available performance)

<table>
<thead>
<tr>
<th>Control section type/ firmware</th>
<th>Functional packages</th>
<th>Perform. level</th>
<th>( T_{A_{\text{current}}} )</th>
<th>( T_{A_{\text{velocity}}} )</th>
<th>( T_{A_{\text{position}}} )</th>
<th>( T_{\text{MLD-S}} )</th>
<th>( T_{\text{MastCom}} )</th>
<th>Switching frequency</th>
<th>P-0-0556</th>
<th>Switching frequency</th>
<th>P-0-0556</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSB01.1/MPB</td>
<td>all, except for &quot;synchronization&quot; and &quot;IndraMotion&quot;</td>
<td>Basic</td>
<td>125 ( \mu s )</td>
<td>250 ( \mu s )</td>
<td>500 ( \mu s )</td>
<td>--</td>
<td>1000 ( \mu s )</td>
<td>4000 Hz</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Basic</td>
<td>Basic</td>
<td>125 ( \mu s )</td>
<td>250 ( \mu s )</td>
<td>500 ( \mu s )</td>
<td>--</td>
<td>1000 ( \mu s )</td>
<td>8000 Hz</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^1\): can be set via P-0-0001
P-0-0556: config word of axis controller

Fig. 1-6: Performance depending on the control section design
For certain applications it is necessary to use the same clock rates in all axes so that the slowest drive sets the clock. It is therefore possible to specifically reduce the performance via bit 2 and bit 5 of parameter P-0-0556, Config word of axis controller.

- For **BASIC control sections** it is possible to select the performance levels "Basic" or "Economy" via bit 5 of P-0-0556.

See also Parameter Description "P-0-0556, Config word of axis controller"

**Note:** The effective clock rates of the active performance level are contained in the table “Performance depending on the control section design” in section "Control Section Design and Performance" (see above).

If you use extensive and complex functions, the internal clock rates for **BASIC control sections** (CSB with firmware MPB and CDB with firmware MPD) are automatically reduced. This applies to the use of the following functional packages:

- drive-integrated PLC "IndraMotion MLD-S" (functional package "ML")
- expansion package "synchronization" (functional package "SNC")

If you use one of these functional packages for BASIC control sections, the clock rates (position loop, velocity loop) are reduced to the lowest performance level "Economy!"
1.4 Rexroth IndraDyn Motors

Housing Motors

**Type Code S**

Example: MSK030B-0900-NN-S1-UG0-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Motor size</th>
<th>Motor length</th>
<th>Windings code</th>
<th>Housing design</th>
<th>Encoder</th>
<th>Electrical Connection</th>
<th>Shaft</th>
<th>Holding brake</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSK</td>
<td>030</td>
<td>B</td>
<td>0900</td>
<td>NN</td>
<td>S1</td>
<td>U</td>
<td>G</td>
<td>0</td>
<td>NNNN</td>
</tr>
</tbody>
</table>

Fig. 1-7: Basic structure of type code

**Type Code IndraDyn A**

Example: MAF130B-0150-FQ-M0-LH0-05-N1

<table>
<thead>
<tr>
<th>Product</th>
<th>Motor size</th>
<th>Motor length</th>
<th>Windings code</th>
<th>Cooling mode</th>
<th>Encoder</th>
<th>Electrical Connection</th>
<th>Shaft</th>
<th>Holding brake</th>
<th>Mounting style</th>
<th>Bearings</th>
<th>Vibration severity grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAF</td>
<td>130</td>
<td>B</td>
<td>0150</td>
<td>FQ</td>
<td>M0</td>
<td>L</td>
<td>H</td>
<td>0</td>
<td>05</td>
<td>N</td>
<td>1</td>
</tr>
</tbody>
</table>

Fig. 1-8: Basic structure of type code

**Kit Motors**

**Type Code IndraDyn L**

Example: MLP100A-0120-FS-N0CN-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Motor size</th>
<th>Motor length</th>
<th>Windings code</th>
<th>Cooling mode</th>
<th>Encapsulation</th>
<th>Encoder</th>
<th>Electrical Connection</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLP</td>
<td>100</td>
<td>A</td>
<td>0120</td>
<td>F</td>
<td>S</td>
<td>N0</td>
<td>CN</td>
<td>NNNN</td>
</tr>
</tbody>
</table>

Fig. 1-9: Basic structure of type code
Type Code IndraDyn H

Example 1  MRS102B-1N-0046-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Motor size</th>
<th>Motor length</th>
<th>Mounting style</th>
<th>Internal diameter of the rotor</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRS</td>
<td>102</td>
<td>B</td>
<td>1N</td>
<td>0046</td>
<td>NNNN</td>
</tr>
</tbody>
</table>

Fig. 1-10: Basic structure of type code

Example 2  MSS102B-0800-FA-N0CN-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Motor size</th>
<th>Motor length</th>
<th>Windings code</th>
<th>Cooling mode</th>
<th>Cooling connector</th>
<th>Encoder</th>
<th>Electrical connection</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSS</td>
<td>102</td>
<td>B</td>
<td>0800</td>
<td>F</td>
<td>A</td>
<td>N0</td>
<td>CN</td>
<td>NNNN</td>
</tr>
</tbody>
</table>

Fig. 1-11: Basic structure of type code

1.5  Third-Party Motors at IndraDrive Controllers

General Information on Third-Party Motors

Why Use Third-Party Motors at IndraDrive?

Today machine axes are mainly moved with electric drives. Motors of standard design are used in most cases as this is the most cost-efficient solution.

Special Requirements

Due to special requirements at machine axes, constructional or safety-related aspects, it may be necessary for the machine manufacturer to use a motor construction diverging from the standard.

Undeliverable Motor Design

For these cases there is the demand on the drive supplier to realize, apart from the deliverable standard drive consisting of (standard) motor, controller, cable and, if required, machine control unit, drives with motors that are not included in his own product range due to the special design.

Check Before Using Third-Party Motors

At Rexroth controllers of the IndraDrive range it is also possible to use third-party motors. For this purpose, check whether the third-party motor complies with the requirements of use.

Which are the Important Directives?

According to the legal requirements
- of the EU directives EMC89/336/EEC and
- the German EMC laws

installations and machines have to be designed and built according to the present state of standardization. In order to comply with the machine directives regarding "electromagnetic compatibility (EMC)", a conformity test of the drive system (motor with controller and connection design) has
to be carried out. The test of the drive system and compliance with the directives have to be guaranteed by the machine manufacturer.

**Third-Party Motors to be Controlled**

The following motor types can be controlled:

- asynchronous motors, rotary
- asynchronous motors, linear
- synchronous motors, rotary
- synchronous motors, linear

These motors can be operated within the scope of the technical data of the selected IndraDrive controller. If motors have been provided with a holding brake, it should be controlled via the controller. Make sure that the relevant technical data of the motor holding brake are complying with those of the holding brake output.

**Note:** For third-party motors Bosch Rexroth, as a matter of principle, does not assume the guarantee for the power data at the motor shaft!

**Synchronous Motors**

In the case of synchronous motors, the commutation offset has to be set during commissioning. The drive firmware provides several methods for determining this offset so that it is possible to determine the value for different motor characteristics.

**Note:** Observe the restrictions in conjunction with the commutation offset determination when using synchronous motors! See Functional Description of firmware “Motor Control: Commutation Setting” in chapter “Drive Control”

Possibly available reluctance property cannot be used for synchronous third-party motors! For third-party motors it is impossible to determine fail-safe motor parameter values for using the reluctance property; the respective bit of P-0-4014, Type of construction of motor therefore mustn't be set!

**Requirements on Third-Party Motors**

For successful and fail-safe use of a third-party motor check

- whether the third-party motor to be controlled satisfies the voltage loads,
- which controller, including supply, is suitable due to the motor power to be delivered,
- whether the third-party motor has the required minimum inductance,
- whether the motor can be protected against inadmissible temperature rise in the case of overload (temperature evaluation),
- whether the mounted position measuring system can be evaluated by the controller or which position measuring system can be selected for kit motors.

**Voltage Load of the Third-Party Motor**

The voltage load of the insulation system of a motor occurring in practical application is mainly influenced by the following characteristics:

- The output variables of the drive controller which is used (feed the transmission distance).
• The cable parameters depending on cable design and length (determine the properties of the transmission distance, such as the attenuation).

• The motor design regarding capacitive and inductive properties (form the end of the transmission distance).

As a result of the variables, the insulation system of the third-party motor, as regards voltage, is loaded by the values

• peak voltage $U_{pp}$ and

• voltage change $\frac{dv}{dt}$.

The occurring peak voltages at the motor are caused by reflections in the motor cable. The insulation of the motor is thereby loaded with other peak voltages and voltage changes than the ones occurring at the output of the power section.

**Note:** Determine the occurring voltage load at the terminals of the third-party motor in the application with all involved components.

**Use of Voltage-Reducing Components, Motor Filter HMF**

Use voltage-reducing components (e.g. motor filter HMF), if one of the following criteria applies:

• allowed voltage change ($\frac{dv}{dt}$) of third-party motor **smaller than 5 kV/µs**

• allowed peak voltage (crest value) of third-party motor between phase-phase and phase-housing **smaller than 1500 V**

• motor cable length **smaller than 25 m**

• mains voltage **greater than AC440V**

**Note:** Apart from the nominal current $I_N$, especially take the maximum allowed switching frequency of the power output stage ($f_s$) into account with which the motor filter HMF may be operated.

Verify the success of the voltage-reducing measure.

**Minimum Inductance of Third-Party Motor**

Depending on the controller used, the motor has to have a minimum value for inductance. The actually available inductance of a motor can be measured directly between two motor terminals by means of an inductance measuring bridge. The measurement has to be made for a complete motor wired for normal operation but not yet connected. During the measurement one motor terminal remains open!

For asynchronous motors the measured value can only be used if the rotor doesn’t have closed slots!

<table>
<thead>
<tr>
<th>Controller type</th>
<th>Minimum required motor inductance</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS with 3*AC230V</td>
<td>$L_{U-V} = 60 \ast 4/(\sqrt{2} \ast I_{Typ} \ast f_s)$ (in mH)</td>
</tr>
<tr>
<td>HMS, HMD at HMV (3*AC400V)</td>
<td>$L_{U-V} = 80 \ast 4/(\sqrt{2} \ast I_{Typ} \ast f_s)$ (in mH)</td>
</tr>
<tr>
<td>HMS, HMD at HCS (3*AC400V)</td>
<td>$L_{U-V} = 116 \ast 4/(\sqrt{2} \ast I_{Typ} \ast f_s)$ (in mH)</td>
</tr>
</tbody>
</table>

$I_{Typ}$: maximum controller current acc. to type code (rms value)

$f_s$: desired switching frequency in kHz

Fig. 1-12: Minimum inductances depending on controller data, supply units and supply voltage
Use a three-phase choke in the motor feed wire, if the inductance of the third-party motor is smaller than indicated in the table above. This choke has to increase the inductance that can be measured between two motor terminals to the minimum value.

**Note:** When the inductance is measured, different inductance values can be determined at different rotor positions within one pole pair distance of the motor. The average value is relevant for the check of the minimum value.

Correct values can only be determined when the motor is in **standstill**.

<table>
<thead>
<tr>
<th>Available third-party motor</th>
<th>Planned third-party motor</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Motor" /></td>
<td><img src="image" alt="Motor" /></td>
</tr>
<tr>
<td>$L_{U-V_{\text{min}}}$</td>
<td>$L_{U-V}$</td>
</tr>
<tr>
<td>$3 \times L_{Dr}$</td>
<td></td>
</tr>
</tbody>
</table>

$L_{Dr} = 0.5 \times (L_{U-V_{\text{min}}} - L_{U-V})$

(Inductance measurement with 1 kHz)

Mounting of $3 \times L_{Dr}$ (three-phase choke)

Calculating the leakage inductance (asynchronous motor) or inductance (synchronous motor) of the third-party motor by means of the single-phase equivalent circuit diagram (manufacturer’s specification!).

Determine choke by means of calculation, if necessary.

It is recommended to contact Rexroth!

**Requirements on the choke:**
- $I_{n\_Dr} \geq I_{n\_Mot}$
  The rated current of the choke has to be greater than or equal to the rated motor current.
- Depending on the maximum speed, the choke is loaded with the respective output frequency and the PWM frequency of the controller.
- The insulation class has to correspond at least to that of the motor or has to be dimensioned for higher temperatures.
- The voltage load of the choke depends on the controller used.

Fig. 1-13: Data for possibly required choke

**Temperature Evaluation of Third-Party Motor**

Only operate such motors with incorporated temperature sensor at IndraDrive controllers so that the motor can be thermally monitored by the controller and protected against destruction by too high temperature rise (see P-0-0512, Temperature sensor).

When, in exceptional cases, you want to operate third-party motors without temperature sensor at IndraDrive controllers, you must determine the thermal time constants of motor housing (P-0-4035) and motor winding (P-0-4034, P-0-4037). The firmware-internal motor temperature model can thereby reflect the cooling situation of the motor correctly.

**Note:** In case the motor housing or blower is dirty, this worsens the cooling situation of the motor and protection against thermal overload is therefore insufficient!
Requirements on the Encoder of the Third-Party Motor

**Motor Encoder of Asynchronous Third-Party Motor**

Asynchronous motors can also be controlled by IndraDrive controllers in "open-loop" operation (without motor encoder). In "closed-loop" operation (with motor encoder) a relative measuring system is sufficient for asynchronous motors.

**Motor Encoder of Synchronous Third-Party Motor**

For fail-safe drives with synchronous third-party motors at IndraDrive controllers the following possible combinations or restrictions have to be taken into account when selecting the measuring system:

<table>
<thead>
<tr>
<th>Drive range</th>
<th>Motor measuring system</th>
<th>Synchronous third-party motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>IndraDrive</td>
<td>absolute</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>relative</td>
<td>o</td>
</tr>
</tbody>
</table>

+ ... advantageous combination

o ... Combination is possible (restrictions specific to application), commissioning may be more complicated!

Fig. 1-14: Possible combinations of synchronous third-party motor and motor measuring system

**Note:**

The control section integrated in the controller can evaluate measuring systems as a motor encoder if they are contained in P-0-0074, Encoder type 1 (motor encoder) (see also Project Planning Manual of the IndraDrive control sections).

For information on absolute and relative measuring systems see section "Measuring Systems" of Functional Description of firmware!

---

**Notes on Selection and Commissioning**

**Selecting the Controller as Regards Continuous Current**

The controller required for the respective motor and the supply unit are determined by comparing the motor data to the data of these devices (see documentation for HMS/HMD and HMV or HCS).

**Note:**

The continuous current of the controller should be greater than that of the motor, the continuous power of the supply must be greater than the sum of all average powers of the axes of the drive system!

**Selecting the Connection Technique**

The available power and encoder cables are described in the documentation "Connection Cables; Selection Data" (DOK-CONNECT-CABLE*STAND-AU...).

**Notes on Commissioning**

**Note:**

For further information, notes on commissioning and supporting documents (e.g. forms for entering the required data) see Functional Description of firmware.
1.6 Approval, Listing

Conformities

Declaration of Conformity
For Rexroth IndraDrive components there are declarations of conformity available. These declarations confirm that the components are designed according to valid EC directives. If required, you can ask your sales representative for these declarations.

Low-Voltage Directive
The Rexroth products of a drive system mentioned in this documentation comply with the requirements of the EC Directive 73/23/EEC (Low-Voltage Directive), annex III B.

EMC Directive
The Rexroth products of a drive system mentioned in this documentation comply with the requirements of the EC Directive 89/336/EEC (EMC Directive) with the amendments 91/263/EEC and 93/68/EEC.

C-UL-US-Listing
Devices approved by the UL agency carry the following label:
Motors approved by the UL agency carry the following label:

![UL label](image)

Fig. 1-17: C-UR-US label

### C-UL-US Listed Components

<table>
<thead>
<tr>
<th>Product</th>
<th>Component</th>
<th>File Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMS01.1N-</td>
<td>W0020, W0036, W0054, W0070, W0150, W0210</td>
<td>E 134201</td>
</tr>
<tr>
<td>HMS02.1N-</td>
<td>W0028, W0054</td>
<td>E 134201</td>
</tr>
<tr>
<td>HMD01.1N-</td>
<td>W0012, W0020, W0036</td>
<td>E 134201</td>
</tr>
<tr>
<td>HCS02.1E-</td>
<td>W0012, W0028, W0054, W0070</td>
<td>E 134201</td>
</tr>
<tr>
<td>HCS03.1E-</td>
<td>W0070, W0100, W0150, W0210</td>
<td>Manufacturer REFU E254781</td>
</tr>
<tr>
<td>HCSV03.1E-</td>
<td>W0070, W0100, W0150, W0210</td>
<td>E 134201</td>
</tr>
<tr>
<td>HLV01.1C-</td>
<td>01K0-N06R0-A-007-NNN</td>
<td>E 134201</td>
</tr>
<tr>
<td>HLB01.1D-</td>
<td>02K0-N03R4-A-007-NNN</td>
<td>E 134201</td>
</tr>
<tr>
<td>HLC01.1C-</td>
<td>01M0-A-007, 02M4-A-007</td>
<td>E 134201</td>
</tr>
<tr>
<td>HLC01.1D-</td>
<td>05M0-A-007</td>
<td>E 134201</td>
</tr>
<tr>
<td>NFD03.1-</td>
<td>-007, -016, -030, -055, -075, -130, -180</td>
<td>E 172117 and CSA Cert. 1038841Master Contr. 171321</td>
</tr>
<tr>
<td>HNL01.1-</td>
<td>.....</td>
<td>CSA Cert. 1492099Master Contr. 222887</td>
</tr>
<tr>
<td>HNF01.1</td>
<td>In preparation</td>
<td>E 134201</td>
</tr>
<tr>
<td>HNK01.1</td>
<td>In preparation</td>
<td>E 134201</td>
</tr>
<tr>
<td>HLR01.1</td>
<td>In preparation</td>
<td>E 134201</td>
</tr>
</tbody>
</table>

Fig 1-18: C-UL-US listed Rexroth IndraDrive components

**Note:** The components are listed by the file number of „Underwriters Laboratories Inc.®“ (UL). The documented evidence of listing can be seen in the internet: [http://www.ul.com, "Certifications", enter file number or "Company name: Rexroth.](http://www.ul.com) The control sections are included in the listing of the power sections. The control sections are not listed separately.
2 Important Directions for Use

2.1 Appropriate Use

Introduction

Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Rexroth as manufacturer is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, make sure that all the pre-requisites for an appropriate use of the products are satisfied:

• Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.

• If the products take the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.

• Do not mount damaged or faulty products or use them in operation.

• Make sure that the products have been installed in the manner described in the relevant documentation.
Areas of Use and Application

Drive controllers made by Bosch Rexroth are designed to control electrical motors and monitor their operation.
Control and monitoring of the motors may require additional sensors and actors.

Note: The drive controllers may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines. Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant Functional Descriptions.

Every drive controller has to be programmed before commissioning, making it possible for the motor to execute the specific functions of an application.
The drive controllers have been developed for use in single- and multi-axis drive and control tasks.
To ensure an application-specific use, the drive controllers are available with different drive power and different interfaces.
Typical applications of the drive controllers include:
- handling and mounting systems,
- packaging and food machines,
- printing and paper processing machines and
- machine tools.
The drive controllers may only be operated under the assembly and installation conditions described in this documentation, in the specified position of normal use and under the ambient conditions as described (temperature, degree of protection, humidity, EMC, etc.).

2.2 Inappropriate Use

Using the drive controllers outside of the operating conditions described in this documentation and outside of the indicated technical data and specifications is defined as "inappropriate use".
Drive controllers must not be used, if
- ... they are subject to operating conditions that do not meet the specified ambient conditions. This includes, for example, operation under water, under extreme temperature fluctuations or extremely high maximum temperatures.
- Furthermore, the drive controllers must not be used in applications which have not been expressly authorized by Rexroth.
- Please carefully follow the specifications outlined in the general Safety Instructions!
3 Safety Instructions for Electric Drives and Controls

3.1 General Information

Using the Safety Instructions and Passing them on to Others

Do not attempt to install or commission this device without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Bosch Rexroth sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.

If the device is resold, rented and/or passed on to others in any other form, then these safety instructions must be delivered with the device.

WARNING

Improper use of these devices, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

Instructions for Use

Read these instructions before the initial startup of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times.

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.

- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.

- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this device.

- Only assign trained and qualified persons to work with electrical installations:

  Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.

  Furthermore, they must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.

- Only use spare parts and accessories approved by the manufacturer.

- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
• The devices have been designed for installation in industrial machinery.
• The ambient conditions given in the product documentation must be observed.
• Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and material damage.
• The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions. The machine and installation manufacturer must make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components, make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
• Startup of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
• Operation is only permitted if the national EMC regulations for the application are met.
• The instructions for installation in accordance with EMC requirements can be found in the documentation "EMC in Drive and Control Systems".
• The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
• Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.
Explanation of Warning Symbols and Degrees of Hazard Seriousness

The safety instructions describe the following degrees of hazard seriousness. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions:

<table>
<thead>
<tr>
<th>Warning symbol with signal word</th>
<th>Degree of hazard seriousness according to ANSI Z 535</th>
</tr>
</thead>
<tbody>
<tr>
<td>[DANGER]</td>
<td>Death or severe bodily harm will occur.</td>
</tr>
<tr>
<td>[WARNING]</td>
<td>Death or severe bodily harm may occur.</td>
</tr>
<tr>
<td>[CAUTION]</td>
<td>Bodily harm or material damage may occur.</td>
</tr>
</tbody>
</table>

Fig. 3-1: Hazard classification (according to ANSI Z 535)
Hazards by Improper Use

- **DANGER**
  - High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!

- **DANGER**
  - Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

- **WARNING**
  - High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!

- **WARNING**
  - Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

- **CAUTION**
  - Hot surfaces on device housing! Danger of injury! Danger of burns!

- **CAUTION**
  - Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting, or improper handling of pressurized lines!

- **CAUTION**
  - Risk of injury by improper handling of batteries!
3.2 Instructions with Regard to Specific Dangers

Protection Against Contact with Electrical Parts

**Note:** This section only concerns devices and drive components with voltages of more than 50 Volt.

Contact with parts conducting voltages above 50 Volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the devices conduct dangerous voltage.

---

**High electrical voltage! Danger to life, electric shock and severe bodily injury!**

⇒ Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.

⇒ Follow general construction and safety regulations when working on electrical power installations.

⇒ Before switching on the device, the equipment grounding conductor must have been non-detachably connected to all electrical equipment in accordance with the connection diagram.

⇒ Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.

⇒ Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.

⇒ With electrical drive and filter components, observe the following: Wait 30 minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.

⇒ Never touch the electrical connection points of a component while power is turned on.

⇒ Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.

⇒ A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.

⇒ Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.

European countries: according to EN 50178/ 1998,
section 5.3.2.3.
USA: See National Electrical Code (NEC), National Electrical Manufacturers' Association (NEMA), as well as local engineering regulations. The operator must observe all the above regulations at any time.

With electrical drive and filter components, observe the following:

High housing voltage and large leakage current!
Risk of death or bodily injury by electric shock!
⇒ Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
⇒ The equipment grounding conductor of the electrical equipment and the units must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
⇒ Over the total length, use copper wire of a cross section of a minimum of 10 mm$^2$ for this equipment grounding connection!
⇒ Before start-up, also in trial runs, always attach the equipment grounding conductor or connect with the ground wire. Otherwise, high voltages may occur at the housing causing electric shock.

Protection Against Electric Shock by Protective Low Voltage (PELV)
All connections and terminals with voltages between 5 and 50 Volt at Rexroth products are protective extra-low voltage systems which are provided with touch guard according to the product standards.

High electric voltage by incorrect connection!
Risk of death or bodily injury by electric shock!
⇒ To all connections and terminals with voltages between 0 and 50 Volt, only devices, electrical components, and conductors may be connected which are equipped with a PELV (Protective Extra-Low Voltage) system.
⇒ Connect only voltages and circuits which are safely isolated from dangerous voltages. Safe isolation is achieved for example by isolating transformers, safe optocouplers or battery operation without mains connection.
Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation. The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.
Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

⇒ For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, bodily harm and/or material damage:

⇒ Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:
  - use safety fences
  - use safety guards
  - use protective coverings
  - install light curtains or light barriers

⇒ Fences and coverings must be strong enough to resist maximum possible momentum.

⇒ Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don’t operate the device if the emergency stop is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.

⇒ Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.

⇒ Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example:
  - mechanically securing the vertical axes,
  - adding an external braking/ arrester/ clamping mechanism or
  - ensuring sufficient equilibration of the vertical axes.

The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!
Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those with heart pacemakers, metal implants and hearing aids.

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

Persons with heart pacemakers and metal implants are not permitted to enter following areas:
- Areas in which electrical equipment and parts are mounted, being operated or commissioned.
- Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.

If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The interference immunity of present or future implanted heart pacemakers differs greatly, so that no general rules can be given.

Those with metal implants or metal pieces, as well as with hearing aids must consult a doctor before they enter the areas described above. Otherwise health hazards may occur.
Protection Against Contact with Hot Parts

<table>
<thead>
<tr>
<th>CAUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!</td>
</tr>
<tr>
<td>⇒ Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!</td>
</tr>
<tr>
<td>⇒ Do not touch housing surfaces of motors! Danger of burns!</td>
</tr>
<tr>
<td>⇒ According to operating conditions, temperatures can be higher than 60 °C, 140 °F during or after operation.</td>
</tr>
<tr>
<td>⇒ Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require up to 140 minutes! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.</td>
</tr>
<tr>
<td>⇒ After switching drive controllers or chokes off, wait 15 minutes to allow them to cool down before touching them.</td>
</tr>
<tr>
<td>⇒ Wear safety gloves or do not work at hot surfaces.</td>
</tr>
<tr>
<td>⇒ For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.</td>
</tr>
</tbody>
</table>
Protection During Handling and Mounting

In unfavorable conditions, handling and assembling certain parts and components in an improper way can cause injuries.

**Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!**

⇒ Observe the general construction and safety regulations on handling and assembly.
⇒ Use suitable devices for assembly and transport.
⇒ Avoid jamming and bruising by appropriate measures.
⇒ Always use suitable tools. Use special tools if specified.
⇒ Use lifting equipment and tools in the correct manner.
⇒ If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
⇒ Do not stand under hanging loads.
⇒ Immediately clean up any spilled liquids because of the danger of skidding.

Battery Safety

Batteries consist of active chemicals enclosed in a solid housing. Therefore, improper handling can cause injury or damages.

**Risk of injury by improper handling!**

⇒ Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
⇒ Do not recharge the batteries as this may cause leakage or explosion.
⇒ Do not throw batteries into open flames.
⇒ Do not dismantle batteries.
⇒ Do not damage electrical parts installed in the devices.

**Note:** Environmental protection and disposal! The batteries installed in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separate from other waste. Observe the local regulations in the country of assembly.
Protection Against Pressurized Systems

According to the information given in the Project Planning Manuals, motors cooled with liquid and compressed air, as well as drive controllers, can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids, and cooling lubricating agents. In these cases, improper handling of external supply systems, supply lines, or connections can cause injuries or damages.

CAUTION

Risk of injury by improper handling of pressurized lines!

⇒ Do not attempt to disconnect, open, or cut pressurized lines (risk of explosion).
⇒ Observe the respective manufacturer's operating instructions.
⇒ Before dismounting lines, relieve pressure and empty medium.
⇒ Use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
⇒ Immediately clean up any spilled liquids from the floor.

Note: Environmental protection and disposal! The agents used to operate the product might not be economically friendly. Dispose of ecologically harmful agents separate from other waste. Observe the local regulations in the country of assembly.
4 Identification, Transport, Storage, Installation Conditions

4.1 Identification

Type Code

### Firmware MPB-04

<table>
<thead>
<tr>
<th>Control section</th>
<th>Firmware range</th>
<th>Base package version</th>
<th>Release</th>
<th>Language</th>
<th>Open-loop functional packages</th>
<th>Alternative functional packages</th>
<th>IndraMotion MLD-S</th>
<th>Scope of functional packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic single-axis</td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-0</td>
<td>NNN</td>
<td>-NN</td>
<td>base package (open-loop)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-0</td>
<td>SNC</td>
<td>-NN</td>
<td>base package (open-loop) + synchronization</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-0</td>
<td>MSP</td>
<td>-NN</td>
<td>base package (open-loop) + main spindle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-0</td>
<td>ALL</td>
<td>-NN</td>
<td>base package (open-loop) + all altern. functions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-0</td>
<td>NNN</td>
<td>-ML</td>
<td>base package (open-loop) + IndraMotion MLD-S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-0</td>
<td>***</td>
<td>-ML</td>
<td>base package (open-loop) + *** + IndraMotion MLD-S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-1</td>
<td>NNN</td>
<td>-NN</td>
<td>base package (closed-loop)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-1</td>
<td>SRV</td>
<td>-NN</td>
<td>base package (closed-loop) + servo function</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-1</td>
<td>SNC</td>
<td>-NN</td>
<td>base package (closed-loop) + synchronization</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-1</td>
<td>MSP</td>
<td>-NN</td>
<td>base package (closed-loop) + main spindle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-1</td>
<td>ALL</td>
<td>-NN</td>
<td>base package (closed-loop) + all altern. functions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-1</td>
<td>NNN</td>
<td>-ML</td>
<td>base package (closed-loop) + IndraMotion MLD-S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWA-INDRV*-MPB-04 VRS-0 D5-1</td>
<td>***</td>
<td>-ML</td>
<td>base package (closed-loop) + *** + IndraMotion MLD-S</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Power Sections HCS

**Examples**

HCS02.1E-W0012-A-03-NNNV (with integrated 24V supply);
HCS03.1E-W0100-A-05-NNBV (with integrated brake transistor)

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>Power supply</th>
<th>Cooling mode</th>
<th>Maximum current</th>
<th>Protection mode</th>
<th>Mains connecting voltage</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS</td>
<td>02</td>
<td>1</td>
<td>E</td>
<td>W</td>
<td>0012</td>
<td>A</td>
<td>03</td>
<td>NNNV</td>
</tr>
</tbody>
</table>

*Fig. 4-1: Basic structure of type code*
Control Sections BASIC CSB01.1N

Example  CSB01.1.N-FC-NNN-NNN-NN-C-NN-FW

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>Configuration option</th>
<th>Master communication</th>
<th>Option 1</th>
<th>Option 2</th>
<th>Safety option</th>
<th>Display</th>
<th>Other design</th>
<th>Firmware (to be ordered extra)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSB</td>
<td>01</td>
<td>1</td>
<td>N</td>
<td>FC</td>
<td>NNN</td>
<td>NNN</td>
<td>NN</td>
<td>C</td>
<td>NN</td>
<td>FW</td>
</tr>
</tbody>
</table>

Fig. 4-2: Basic structure of type code

Additional Components

Mains Choke HNL

Example  HNL01.1E-0980-N0026-A-480-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>Supply system</th>
<th>Nominal inductance</th>
<th>Additional option</th>
<th>Nominal current</th>
<th>Degree of protection</th>
<th>Mains connecting voltage</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNL</td>
<td>01</td>
<td>1</td>
<td>E</td>
<td>0980</td>
<td>N</td>
<td>0026</td>
<td>A</td>
<td>480</td>
<td>NNN</td>
</tr>
</tbody>
</table>

Fig. 4-3: Basic structure of type code

Mains Filter HNF, HNK

Example  HNF01.1A-F240-R0094-A-480-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>EMC-area per DIN 61800-3</th>
<th>Applications</th>
<th>Supply system</th>
<th>Nominal current</th>
<th>Degree of protection</th>
<th>Mains connecting voltage</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNF</td>
<td>01</td>
<td>1</td>
<td>A</td>
<td>F240</td>
<td>R</td>
<td>0094</td>
<td>A</td>
<td>480</td>
<td>NNN</td>
</tr>
<tr>
<td>HNK</td>
<td>01</td>
<td>1</td>
<td>A</td>
<td>A075</td>
<td>E</td>
<td>0050</td>
<td>A</td>
<td>500</td>
<td>NNN</td>
</tr>
</tbody>
</table>

Fig. 4-4: Basic structure of type code
### Motor Filter HMF

**Example**  
HMF01.1A-N1K5-E0070-A-500-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>Mounting style</th>
<th>Filter class</th>
<th>Motor frequency</th>
<th>Switching frequency</th>
<th>Nominal current</th>
<th>Degree of protection</th>
<th>Voltage rating</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMF</td>
<td>01</td>
<td>1</td>
<td>A</td>
<td>N</td>
<td>1K5</td>
<td>E</td>
<td>0070</td>
<td>A</td>
<td>500</td>
<td>NNNN</td>
</tr>
</tbody>
</table>

Fig. 4-5: Basic structure of type code

### Braking Resistor HLR

**Example**  
HLR01.1N-1K08-N05R0-A-007-NNNN

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>Mounting style</th>
<th>Continuous output</th>
<th>Additional option</th>
<th>Resistance</th>
<th>Degree of protection</th>
<th>DC bus nominal voltage</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HLR</td>
<td>01</td>
<td>1</td>
<td>N</td>
<td>1K08</td>
<td>N</td>
<td>05R0</td>
<td>A</td>
<td>007</td>
<td>NNNN</td>
</tr>
</tbody>
</table>

Fig. 4-6: Basic structure of type code

### Accessories

**HAS01.1**

**Example**  
HAS01.1-050-048-NN

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>Device width</th>
<th>Bus-bar</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAS</td>
<td>01</td>
<td>1</td>
<td>050</td>
<td>048</td>
<td>NN</td>
</tr>
</tbody>
</table>

Fig. 4-7: Basic structure of type code
HAS02.1

Example HAS02.1-001-NNN-NN

<table>
<thead>
<tr>
<th>Product</th>
<th>Line</th>
<th>Design</th>
<th>Device assignment</th>
<th>Other feature</th>
<th>Other design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAS</td>
<td>02</td>
<td>1</td>
<td>001</td>
<td>NNN</td>
<td>NN</td>
</tr>
</tbody>
</table>

Fig. 4-8: Basic structure of type code

Type Plates

Each drive component is marked by a type designation. There is a type plate attached to all devices.

Type Plates at the Drive Controller

1: Power section type plate
2: Control section type plate
3: Firmware type plate

Fig. 4-9: Type plates at the drive controller
Type Plates at the Control Section
Control Section Type Plate

![Control Section Type Plate Diagram]

Example: 05W24 means year 2005, week 24

Fig. 4-10: Control section type plate

Firmware Type Plate

![Firmware Type Plate Diagram]

Example: 05W24 means year 2005, week 24

Fig. 4-11: Firmware type plate (example)
4.2 Transport and Storage

Transport of the Devices

**Conditions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>temperature</td>
<td>-25…70 °C</td>
</tr>
<tr>
<td>relative humidity</td>
<td>5…95%; climatic category 2K3</td>
</tr>
<tr>
<td>absolute humidity</td>
<td>1…60 g/m³; climatic category 2K3</td>
</tr>
<tr>
<td>moisture condensation</td>
<td>not allowed</td>
</tr>
<tr>
<td>icing</td>
<td>not allowed</td>
</tr>
<tr>
<td>shock test out of operation</td>
<td>half sine in 3 axes: 10g / 11ms</td>
</tr>
<tr>
<td>according to EN 60068-2-27</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 4-12: Conditions for transport

Storage of the Devices

**Conditions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>temperature</td>
<td>-25…55 °C</td>
</tr>
<tr>
<td>relative humidity</td>
<td>5…95%; climatic category 1K3</td>
</tr>
<tr>
<td>absolute humidity</td>
<td>1…29 g/m³; climatic category 1K3</td>
</tr>
<tr>
<td>moisture condensation</td>
<td>not allowed</td>
</tr>
<tr>
<td>icing</td>
<td>not allowed</td>
</tr>
</tbody>
</table>

Fig. 4-13: Conditions for storage

**Extended Storage**

Some devices contain electrolytic capacitors which may deteriorate during storage.

**Note:** When storing these devices for a longer period of time, operate them once a year for at least 1 hour with power ON:

- devices HCS with mains voltage $U_{LN}$
4.3 Installation Conditions

Ambient and Operating Conditions

The drive controllers and their additional components are designed for control cabinet mounting!

**Note:** The user must check that the ambient conditions, in particular the control cabinet temperature, are complied with by calculating the heat levels in the control cabinet and making the corresponding measurements.

In the Technical Data the power dissipation is indicated as an input value for calculating the heat levels.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>degree of protection</td>
<td>IP20 according to IEC529</td>
</tr>
<tr>
<td>ambient temperature</td>
<td>0…+40 °C</td>
</tr>
<tr>
<td>ambient temperature with power reduction</td>
<td>0…+55 °C; see characteristic in Fig. 4-15</td>
</tr>
<tr>
<td>temperature during storage</td>
<td>see section 4.2 Transport and Storage</td>
</tr>
<tr>
<td>temperature during transport</td>
<td>see section 4.2 Transport and Storage</td>
</tr>
<tr>
<td>installation altitude with nominal data</td>
<td>&lt;1000 m above sea level</td>
</tr>
<tr>
<td>installation altitude with power reduction *</td>
<td>see characteristic in Fig. 4-16</td>
</tr>
<tr>
<td>maximum installation altitude *</td>
<td>4000 m</td>
</tr>
<tr>
<td>relative humidity (operation)</td>
<td>5%…95%</td>
</tr>
<tr>
<td>absolute humidity</td>
<td>1…29 g/m³</td>
</tr>
<tr>
<td>climatic category</td>
<td>Cl. 3K3 according to IEC721</td>
</tr>
<tr>
<td>degree of dirt contamination</td>
<td>degree of dirt contamination 2 in accordance with EN50178</td>
</tr>
<tr>
<td>dust, steam</td>
<td>allowed according to EN 50178, table A.2</td>
</tr>
<tr>
<td>sine vibration during operation according to EN 60068-2-6</td>
<td>amplitude and frequency: 0.15 mm (peak-peak) at 10…57 Hz</td>
</tr>
<tr>
<td></td>
<td>acceleration and frequency: 1 g at 57…150 Hz</td>
</tr>
<tr>
<td></td>
<td>tolerance: ±15 %</td>
</tr>
<tr>
<td>noise vibration (random) during operation according to IEC 68-2-36</td>
<td>frequency: 20…150 Hz</td>
</tr>
<tr>
<td></td>
<td>spectral acceleration density amplitude: 0.005 g²/Hz</td>
</tr>
<tr>
<td></td>
<td>tolerance: ±3 dB</td>
</tr>
<tr>
<td></td>
<td>rms value of the total acceleration: 1.0 g</td>
</tr>
</tbody>
</table>

* For installation altitudes of more than 2000 m, an overvoltage limiter for transient overvoltage 1.2/50 μs must be installed in the installation or building in order to limit the voltage to 1.0 kV between the outer conductors and to 2.5 kV between conductor-ground.

Fig. 4-14: Ambient and operating conditions
Capacity Utilization
Where installation conditions differ, the following performance data are reduced in accordance with the diagrams (see "Fig. 4-15:" and "Fig. 4-16:"):

**drive controller:**
- allowed continuous DC bus power
- continuous power of braking resistor
- continuous current

**motor:**
- power
- continuous torque at standstill
- S1 continuous torques
- short-time service torque MKB

If differing ambient temperatures and higher installation altitudes occur simultaneously, both capacity utilization factors must be multiplied. The installation altitude must only be taken into account once, deviating ambient temperatures must be taken into account separately for motor and drive controller.

![Capacity utilization diagram](Fig. 4-15: Capacity utilization at higher ambient temperature)
Compatibility with Foreign Matters

All Rexroth controls and drives are developed and tested according to the state-of-the-art technology.

As it is impossible to follow the continuing development of all materials (e.g. lubricants in machine tools) which may interact with our controls and drives, it cannot be completely ruled out that any reactions with the materials used by Bosch Rexroth might occur.

For this reason, before using the respective material a compatibility test has to be carried out for new lubricants, cleaning agents etc. and our housings/our housing materials.
5 Electrical Data

5.1 Power Sections

Unless otherwise specified, the following data apply to

- $T_a = T_{\text{amax}}$
- $U_{LN} = 3\text{AC}400\text{V}$
- use of HNL and HNK mains chokes

Type Current and Connected Load

<table>
<thead>
<tr>
<th>Compact converter</th>
<th>Type current</th>
<th>Attached mains choke HNL, HNK</th>
<th>Nominal motor power (2)</th>
<th>Connec-ted load</th>
<th>Mains input contin. current</th>
<th>Nominal fuse current / fuse type characteristic gL</th>
<th>Contin. current (1)</th>
<th>Peak current (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>[kW] [kVA] [A] [A] [A] [A]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCS02</td>
<td>W0012</td>
<td>HNL01.1E-1000-N0012</td>
<td>1.5</td>
<td>3.5</td>
<td>6</td>
<td>10</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>W0028</td>
<td>HNL01.1E-1000-N0012</td>
<td>4.0</td>
<td>7.3</td>
<td>13</td>
<td>20</td>
<td>11</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>W0054</td>
<td>HNL01.1E-1000-N0020</td>
<td>7.5</td>
<td>13.3</td>
<td>19</td>
<td>25</td>
<td>22</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>W0070</td>
<td>HNL01.1E-0600-N0032</td>
<td>11</td>
<td>18.5</td>
<td>30</td>
<td>35</td>
<td>28</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>W0070</td>
<td>HNL01.1E-0571-N0050 HNK01.1A-A075-E0080</td>
<td>18.5</td>
<td>35</td>
<td>50</td>
<td>3NA6820-4</td>
<td>45</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>W0100</td>
<td>HNL01.1E-0362-N0080; HNK01.1A-A075-E0080</td>
<td>30</td>
<td>55.2</td>
<td>80</td>
<td>3NA6824-4</td>
<td>73</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>W0150</td>
<td>HNL01.1E-0240-N0106 HNK01.1A-A075-E0106</td>
<td>45</td>
<td>72.9</td>
<td>106</td>
<td>3NA6832-4</td>
<td>95</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>W0210</td>
<td>HNL01.1E-0170-N0146 HNK01.1A-A075-E0146</td>
<td>75</td>
<td>99.3</td>
<td>146</td>
<td>3NA6836-4</td>
<td>145</td>
<td>210</td>
</tr>
</tbody>
</table>

(1) at $f_s = 4 \text{ kHz}$; without overload
(2) for standard motor, when using mains choke HNL01; at 3 AC 400 V
variable torque, low overload

Fig. 5-1: Type current and connected load
Control Voltage Supply

**Note:** The control sections are supplied via the terminal connectors 24V and 0V at the power section (24V supply).

**Note:** The isolated inputs/outputs at X31 and X32 are not supplied via the connections of the 24V supply of the power section. A separate voltage supply is required for these inputs/outputs.

**Note:** Overvoltage of more than 33 V has to be discharged by means of the appropriate electrical equipment of the machine or installation.

This equipment includes:
- 24V power supply units that reduce incoming overvoltages to the allowed value.
- Overvoltage limiters at the control cabinet input that limit existing overvoltage to the allowed value. This, too, applies to long 24V lines that have been run in parallel to power cables and mains cables and can absorb overvoltages by inductive or capacitive coupling.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>24V control voltage supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCS02.1E; HCS03.1E</td>
<td>UN3</td>
<td>V</td>
</tr>
<tr>
<td>max. ripple content</td>
<td>w</td>
<td>-</td>
</tr>
<tr>
<td>max. allowed overvoltage</td>
<td>UN3max</td>
<td>V</td>
</tr>
</tbody>
</table>

**Power consumption of power sections 1)**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS02.1E-W0012</td>
<td>PN3</td>
<td>W 12</td>
</tr>
<tr>
<td>HCS02.1E-W0028</td>
<td>PN3</td>
<td>W 14</td>
</tr>
<tr>
<td>HCS02.1E-W0054</td>
<td>PN3</td>
<td>W 23</td>
</tr>
<tr>
<td>HCS02.1E-W0070</td>
<td>PN3</td>
<td>W 23</td>
</tr>
<tr>
<td>HCS03.1E-W0070</td>
<td>PN3</td>
<td>W 23</td>
</tr>
<tr>
<td>HCS03.1E-W0100</td>
<td>PN3</td>
<td>W 25</td>
</tr>
<tr>
<td>HCS03.1E-W0150</td>
<td>PN3</td>
<td>W 25</td>
</tr>
<tr>
<td>HCS03.1E-W0210</td>
<td>PN3</td>
<td>W 30</td>
</tr>
</tbody>
</table>

**Power consumption of control sections 2)**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSB01.1N-FC…</td>
<td>PN3</td>
<td>W 7.5</td>
</tr>
<tr>
<td>CSB01.1N-PB…</td>
<td>PN3</td>
<td>W 7.5</td>
</tr>
</tbody>
</table>

Typ. inrush current of control sections
### Power Voltage Supply- Mains Connection

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
<th>HCS02.1E</th>
<th>HCS03.1E</th>
</tr>
</thead>
<tbody>
<tr>
<td>allowed range of mains input voltage, three-phase; TN-S, TN-C, TT mains</td>
<td>$U_{LN}$</td>
<td>V</td>
<td>$3 \times AC \ (200...500) +10%$</td>
<td>$3 \times AC \ (400...500) +10% \ -15%$</td>
</tr>
<tr>
<td>allowed range of mains input voltage, three-phase; IT mains</td>
<td>$U_{LN}$</td>
<td>V</td>
<td>$3 \times AC \ (200...230) +10%$</td>
<td>not allowed</td>
</tr>
<tr>
<td>allowed range of mains input voltage, single-phase</td>
<td>$U_{LN}$</td>
<td>V</td>
<td>$1 \times AC \ (200...250) +10%$</td>
<td>not allowed</td>
</tr>
<tr>
<td>rotary field</td>
<td></td>
<td></td>
<td>no rotary field condition</td>
<td></td>
</tr>
<tr>
<td>allowed range of mains frequency</td>
<td>$f_{LN}$</td>
<td>Hz</td>
<td>$(50...60) + \cdot 2$</td>
<td></td>
</tr>
<tr>
<td>max. allowed mains frequency change</td>
<td>$d f_{LN}/t$</td>
<td>Hz/s</td>
<td></td>
<td>$2% \times f_{LN}$</td>
</tr>
</tbody>
</table>

**Note:** When using HCS02 and HCS03 devices in the mains voltage range up to $3 \times AC \ 500 \ V$, make sure the additional components you use may be operated in this mains voltage range. NFD mains filters, for example, can only be used up to $3 \times AC \ 480 \ V$. 
Limited Length of Motor Power Cables

Keep in mind, that the allowed maximum motor cable length is depending on the switching frequency of the power output stage. On principle, the higher the switching frequency, the shorter the allowed cable length (in order to protect the drive controllers against overload).

**Note:** Always use switching frequencies supported by the components of your drive system. Observe the technical data of the drive controllers and motors.

See also Parameter Description "P-0-0001, Switching frequency of the power output stage".

The lengths indicated in the table below are recommended as guide values (at an ambient temperature of ≤ 40 °C in accordance with EN 60 204).

Allowed line lengths for motor connection **without** filter measures at motor output:

<table>
<thead>
<tr>
<th>PWM frequency [kHz]</th>
<th>Max. allowed line length [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shielded line</td>
</tr>
<tr>
<td>2 2)</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>8</td>
<td>38</td>
</tr>
<tr>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

1) only allowed at HCS drive controllers
2) depending on the drive controller

Fig. 5-4: Line lengths

Operation with unshielded motor cables of up to 150 m
- aims at applications with "operation without encoder" (Open Loop)
- does not include the control voltage lines to the motor
- requires additional measures with regard to EMC on the part of the operating company

Allowed line lengths for motor connection **with** additional components HMF or HML:

<table>
<thead>
<tr>
<th>PWM frequency [kHz]</th>
<th>Max. allowed line length [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shielded line</td>
</tr>
<tr>
<td>4 2)</td>
<td>75</td>
</tr>
</tbody>
</table>

1) only allowed at HCS03 drive controllers
2) higher PWM frequencies are not allowed

Fig. 5-5: Line lengths

**Documentation Motor Power Cables**

The documentation "Rexroth Connection Cables; Selection Data" is available for selecting the motor power cables and other connections, such as encoder cables.

Rexroth IndraDrive drive systems have to be equipped with shielded motor power cables of the RKL line.
Requirements on third-party motor power cables:
Maximum allowed cable length at A1, A2, A3:
- see description above

Maximum allowed capacitance per unit length at A1, A2, A3:
- against ground, each: 0.5 nF/m
- against each other: 0.5 nF/m

Maximum allowed inductance per unit length at A1, A2, A3:
- 100 nH/m each

Note: If you use third-party motor power cables not corresponding to the requirements, Rexroth's guarantee for the drive system will expire.
Use ready-made Rexroth cables.
5.2 Control Sections

Relay Contact Type 1

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>current load capacity</td>
<td>A</td>
<td></td>
<td></td>
<td>DC 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AC 2</td>
</tr>
<tr>
<td>voltage load capacity</td>
<td>V</td>
<td></td>
<td></td>
<td>DC 30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AC 250</td>
</tr>
<tr>
<td>minimum contact load</td>
<td>mA</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>contact resistance at minimum current</td>
<td>mOhm</td>
<td></td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>switching actions at max. time constant</td>
<td>ms</td>
<td></td>
<td></td>
<td>100000</td>
</tr>
<tr>
<td>number of mechanical switching cycles</td>
<td>ms</td>
<td></td>
<td></td>
<td>1 * 10^6</td>
</tr>
<tr>
<td>time constant of load</td>
<td>ms</td>
<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>pick up delay</td>
<td>ms</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>drop out delay</td>
<td>ms</td>
<td></td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Fig. 5-6: Relay contacts type 1

Relay Contact Type 2

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>current load capacity</td>
<td>A</td>
<td></td>
<td></td>
<td>DC 1</td>
</tr>
<tr>
<td>voltage load capacity</td>
<td>V</td>
<td></td>
<td></td>
<td>DC 30</td>
</tr>
<tr>
<td>minimum contact load</td>
<td>mA</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>contact resistance at minimum current</td>
<td>mOhm</td>
<td></td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>switching actions at max. time constant</td>
<td>ms</td>
<td></td>
<td></td>
<td>1 * 10^6</td>
</tr>
<tr>
<td>number of mechanical switching cycles</td>
<td>ms</td>
<td></td>
<td></td>
<td>1 * 10^8</td>
</tr>
<tr>
<td>time constant of load</td>
<td>ms</td>
<td></td>
<td></td>
<td>ohmic</td>
</tr>
<tr>
<td>pick up delay</td>
<td>ms</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>drop out delay</td>
<td>ms</td>
<td></td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Fig. 5-7: Relay contacts type 2
Relay Contact Type 3

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>current load capacity</td>
<td>A</td>
<td></td>
<td></td>
<td>DC 1</td>
</tr>
<tr>
<td>voltage load capacity</td>
<td>V</td>
<td></td>
<td></td>
<td>DC 30</td>
</tr>
<tr>
<td>minimum contact load</td>
<td>mA</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>contact resistance at minimum current</td>
<td>mOhm</td>
<td></td>
<td></td>
<td>1000</td>
</tr>
<tr>
<td>switching actions at max. time constant of load</td>
<td></td>
<td></td>
<td></td>
<td>$1 \times 10^6$</td>
</tr>
<tr>
<td>number of mechanical switching cycles</td>
<td></td>
<td></td>
<td></td>
<td>$1 \times 10^7$</td>
</tr>
<tr>
<td>time constant of load</td>
<td>ms</td>
<td></td>
<td></td>
<td>ohmic</td>
</tr>
<tr>
<td>pick up delay</td>
<td>ms</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>drop out delay</td>
<td>ms</td>
<td></td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Fig. 5-8: Relay contacts type 3

Digital Inputs/Outputs

**Digital Inputs**
The digital inputs correspond to IEC 61131, type 1.

![Symbol of digital input](image)

**Data**

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>allowed input voltage</td>
<td>V</td>
<td>-3</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>On</td>
<td>V</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off</td>
<td>V</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>input current</td>
<td>mA</td>
<td>2</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>input resistance</td>
<td>kOhm</td>
<td>non-linear, varies depending on input voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sampling frequency</td>
<td>kHz</td>
<td>depending on firmware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>probe input delay</td>
<td>us</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 5-10: Digital inputs

**Note:** Probe inputs are fast inputs. For triggering use bounce-free switches.
Digital Outputs
The digital outputs correspond to IEC 61131.

Note: Do not operate digital outputs at low-resistance sources. Observe Functional Description of the firmware section "Notes on Commissioning" particularly parameter P-0-0302, Digital I/O, Direction.

![Symbol of digital output](image)

### Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>output voltage &quot;ON&quot;</td>
<td>V</td>
<td>Uext - 0,5</td>
<td>24</td>
<td>Uext</td>
</tr>
<tr>
<td>output voltage &quot;OFF&quot;</td>
<td>V</td>
<td></td>
<td>2,1</td>
<td></td>
</tr>
<tr>
<td>output current &quot;OFF&quot;</td>
<td>mA</td>
<td></td>
<td>0,05</td>
<td></td>
</tr>
<tr>
<td>allowed output current per output</td>
<td>mA</td>
<td></td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>allowed output current total or per group</td>
<td>mA</td>
<td></td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>update interval</td>
<td>ns</td>
<td></td>
<td>depending on firmware</td>
<td></td>
</tr>
<tr>
<td>short circuit protection</td>
<td></td>
<td></td>
<td>present</td>
<td></td>
</tr>
<tr>
<td>overload protection</td>
<td></td>
<td></td>
<td>present</td>
<td></td>
</tr>
<tr>
<td>allowed energy content of connected inductive loads, e.g. relay coils; only allowed as single pulse</td>
<td>mJ</td>
<td></td>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>

![Digital outputs](image)

Note: The digital outputs have been realized with so-called high-side switches. This means that these outputs can actively supply current but not drain it.

Note: The energy absorption capacity of the outputs is used to limit voltage peaks caused when inductive loads are switched off. Limit voltage peaks by using free-wheeling diodes directly at the relay coil.
Analog Inputs/Outputs

The analog inputs correspond to IEC 61 131.

**Analog Input Type 1**

![Diagram of analog input type 1](image)

**AD**: analog/digital converter

Fig. 5-13: Analog voltage inputs

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>allowed input voltage inputs</td>
<td>V</td>
<td>-10</td>
<td></td>
<td>+10</td>
</tr>
<tr>
<td>input resistance voltage input</td>
<td>kOhm</td>
<td>180</td>
<td></td>
<td></td>
</tr>
<tr>
<td>input bandwidth</td>
<td>kHz</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>common-mode range</td>
<td>V</td>
<td>-20</td>
<td>+20</td>
<td></td>
</tr>
<tr>
<td>common-mode rejection</td>
<td>dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relative measuring error at 90% U_{max}</td>
<td>%</td>
<td>-1</td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>converter width A/D converter incl. polarity sign</td>
<td>Bit</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oversampling</td>
<td></td>
<td>8-fold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dynamic converter width with oversampling</td>
<td>Bit</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resulting resolution</td>
<td>mV/Ink</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cyclic conversion</td>
<td>us</td>
<td>500 (depending on firmware)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conversion time</td>
<td>us</td>
<td>n.s.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 5-14: Analog voltage inputs
Analog Input Type 2

**Fig. 5-15:** Analog voltage inputs

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>allowed input voltage</td>
<td>V</td>
<td>-10</td>
<td></td>
<td>+10</td>
</tr>
<tr>
<td>voltage inputs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>input resistance</td>
<td>kOhm</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>voltage input</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>input bandwidth</td>
<td>kHz</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>common-mode range</td>
<td>V</td>
<td>-50</td>
<td></td>
<td>+50</td>
</tr>
<tr>
<td>common-mode rejection</td>
<td>dB</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>relative measuring error</td>
<td>%</td>
<td>-0.3</td>
<td></td>
<td>+0.3</td>
</tr>
<tr>
<td>at 90% U_{max}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>converter width A/D converter</td>
<td>Bit</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>incl. polarity sign</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>oversampling</td>
<td></td>
<td>8-fold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dynamic converter width with oversampling</td>
<td>Bit</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oversampling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>resulting resolution</td>
<td>mV/Ink</td>
<td>1.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cyclic conversion</td>
<td>us</td>
<td>500 (depending on firmware)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conversion time</td>
<td>us</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 5-16:** Analog voltage inputs
Analog Input Type 3

AD: analog/digital converter

Fig. 5-17: Analog current inputs

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>allowed input current</td>
<td>mA</td>
<td>0</td>
<td>+20</td>
<td></td>
</tr>
<tr>
<td>input resistance</td>
<td>Ohm</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>input bandwidth</td>
<td>kHz</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>common-mode range</td>
<td>V</td>
<td>-20</td>
<td>+20</td>
<td></td>
</tr>
<tr>
<td>common-mode rejection</td>
<td>dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relative measuring error at 90% $U_{\text{max}}$</td>
<td>%</td>
<td>-1</td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>converter width A/D converter incl. polarity sign</td>
<td>Bit</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oversampling</td>
<td></td>
<td>8-fold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dynamic converter width with oversampling</td>
<td>Bit</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resulting resolution</td>
<td>µA/Ink</td>
<td>5,45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cyclic conversion</td>
<td>us</td>
<td>500 (depending on firmware)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conversion time</td>
<td>us</td>
<td>n.s.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analog Input Type 4

![Diagram of Analog Input Type 4](DA000025v01_nn.FH9)

AD: analog/digital converter

Fig. 5-19: Analog voltage inputs

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>allowed input voltage voltage inputs</td>
<td>V</td>
<td>-10</td>
<td></td>
<td>+10</td>
</tr>
<tr>
<td>input resistance voltage input</td>
<td>kOhm</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>input resistance voltage input CSH01.2C</td>
<td>kOhm</td>
<td>160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>input bandwidth</td>
<td>kHz</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>common-mode range</td>
<td>V</td>
<td>-20</td>
<td>+20</td>
<td></td>
</tr>
<tr>
<td>common-mode rejection</td>
<td>dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relative measuring error at 90% $U_{\text{max}}$</td>
<td>%</td>
<td>-1</td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>converter width A/D converter incl. polarity sign</td>
<td>Bit</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>oversampling</td>
<td></td>
<td>8-fold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dynamic converter width with oversampling</td>
<td>Bit</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resulting resolution</td>
<td>mV/Ink</td>
<td>1.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cyclic conversion</td>
<td>us</td>
<td>500 (depending on firmware)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conversion time</td>
<td>us</td>
<td>n.s.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 5-20: Analog voltage inputs
### Analog Output Type 1

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>output voltage</td>
<td>V</td>
<td>0</td>
<td></td>
<td>+10</td>
</tr>
<tr>
<td>output load</td>
<td>kOhm</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>output current</td>
<td>mA</td>
<td>0</td>
<td></td>
<td>+5</td>
</tr>
<tr>
<td>converter width digital/analog converter incl. polarity sign</td>
<td>Bit</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resolution</td>
<td>mV/Ink</td>
<td>9,8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>conversion time (incl. response time)</td>
<td>us</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cyclic conversion</td>
<td>us</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>short circuit protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overload protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 5-21: Analog outputs type 1

### Analog Output Type 2

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>output voltage</td>
<td>V</td>
<td>0</td>
<td></td>
<td>+5</td>
</tr>
<tr>
<td>output load</td>
<td>kOhm</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>output current</td>
<td>mA</td>
<td>0</td>
<td></td>
<td>+1</td>
</tr>
<tr>
<td>converter width digital/analog converter incl. polarity sign</td>
<td>Bit</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resolution</td>
<td>mV/Ink</td>
<td>19,5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>accuracy at R=5 kOhm</td>
<td>%</td>
<td></td>
<td>5</td>
<td>FMR</td>
</tr>
<tr>
<td>accuracy at R=10 kOhm</td>
<td>%</td>
<td></td>
<td>2,5</td>
<td>FMR</td>
</tr>
<tr>
<td>conversion time (incl. response time)</td>
<td>us</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cyclic conversion</td>
<td>us</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>short circuit protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>overload protection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FMR: final value of measuring range

Fig. 5-22: Analog outputs type 2
## Analog Output Type 3

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>output voltage</td>
<td>V</td>
<td>-10</td>
<td></td>
<td>+10</td>
</tr>
<tr>
<td>output load</td>
<td>kOhm</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>output current</td>
<td>mA</td>
<td>0</td>
<td></td>
<td>+1</td>
</tr>
<tr>
<td>converter width digital/analog converter incl. polarity sign</td>
<td>Bit</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>resolution</td>
<td>mV/Ink</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>accuracy at R = 1 kOhm</td>
<td>%</td>
<td></td>
<td>1 of FMR</td>
<td></td>
</tr>
<tr>
<td>accuracy at R = 10 kOhm</td>
<td>%</td>
<td></td>
<td>0.2 of FMR</td>
<td></td>
</tr>
<tr>
<td>conversion time (incl. response time)</td>
<td>us</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>cyclic conversion</td>
<td>us</td>
<td></td>
<td></td>
<td>depending on firmware</td>
</tr>
<tr>
<td>short circuit protection</td>
<td></td>
<td></td>
<td></td>
<td>present</td>
</tr>
<tr>
<td>overload protection</td>
<td></td>
<td></td>
<td></td>
<td>present</td>
</tr>
</tbody>
</table>

FMR: final value of measuring range

Fig. 5-23: Analog outputs type 3
## 5.3 Additional Components

### Mains Filter HNF

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power dissipation</strong></td>
<td>W</td>
<td>&lt; 89 &lt; 91</td>
<td>&lt; 127 &lt; 174</td>
<td>&lt; 238 &lt; 373</td>
<td>&lt; 73 &lt; 77</td>
<td>&lt; 163 &lt; 157</td>
<td>&lt; 135 &lt; 146</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phase current (continuous current)</strong></td>
<td>A</td>
<td>51</td>
<td>125</td>
<td>125</td>
<td>202</td>
<td>202</td>
<td>26</td>
<td>26</td>
<td>65</td>
<td>94</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td><strong>Phase current (peak current</strong></td>
<td>A</td>
<td>77</td>
<td>188</td>
<td>188</td>
<td>303</td>
<td>303</td>
<td>65</td>
<td>65</td>
<td>163</td>
<td>163</td>
<td>235</td>
<td>235</td>
</tr>
<tr>
<td><strong>Leakage current at filters input (line side)</strong></td>
<td>A</td>
<td>&lt; 2</td>
<td>&lt; 2</td>
<td>&lt; 2,2</td>
<td>&lt; 2,5</td>
<td>&lt; 2</td>
<td>&lt; 2</td>
<td>&lt; 2</td>
<td>&lt; 2,2</td>
<td>&lt; 2,2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leakage current at filters output (load side)</strong></td>
<td>A</td>
<td>&lt; 2</td>
<td>&lt; 2</td>
<td>&lt; 2,2</td>
<td>&lt; 2,5</td>
<td>&lt; 2</td>
<td>&lt; 2</td>
<td>&lt; 2</td>
<td>&lt; 2,2</td>
<td>&lt; 2,2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>allowed THD (Total Harmonic Distortion)</strong></td>
<td>%</td>
<td>see Project Planning Manual &quot;Rexroth IndraDrive Drive System&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reduction of allowed operating data due to harmonic content</strong></td>
<td>-</td>
<td>see Project Planning Manual &quot;Rexroth IndraDrive Drive System&quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Input supply voltage</strong></td>
<td>V</td>
<td>3 x AC 380...480V ±10%, 50/60Hz ±2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sum of leakage currents at filters input with power supply unit switched off:</strong></td>
<td>A</td>
<td>&lt; 0,83</td>
<td>&lt; 1,4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 phase failed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 phases failed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leakage resistance (Phase – Ground)</strong></td>
<td>MΩ</td>
<td>&gt; 15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Protection category</strong></td>
<td>-</td>
<td>IP20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Materials</strong></td>
<td>-</td>
<td>free of asbestos and silicone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Terminal L1, L2, L3 resp. L1.1, L2.1, L3.1:**

| Cross section flexible min. | mm² | 0,5 | 0,5 | 16 | 16 | 50 | 50 | 0,5 | 0,5 | 10 | 10 | 16 | 16 |
| Cross section flexible max. | mm² | 16 | 16 | 50 | 50 | 150 | 150 | 10 | 10 | 25 | 25 | 50 | 50 |
| Cross section rigid min. | mm² | 0,5 | 0,5 | 16 | 16 | 35 | 35 | 0,5 | 0,5 | 6 | 6 | 16 | 16 |
| Cross section rigid max. | mm² | 25 | 25 | 50 | 50 | 150 | 150 | 16 | 16 | 35 | 35 | 50 | 50 |
| Cross section AWG min. | -- | 20 | 20 | 6 | 6 | 2 | 2 | 20 | 20 | 6 | 6 | 6 | 6 |
| Cross section AWG max. | -- | 4 | 4 | 0 | 0 | 00/3 | 00/3 | 6 | 6 | 2 | 2 | 0 | 0 |

| **Tightening torque** | Nm | 4,8 ±0,5 | 4,8 ±0,5 | < 25 | < 25 | < 25 | < 25 | 4,8 ±0,5 | 4,8 ±0,5 | 4,8 ±0,5 | 4,8 ±0,5 | < 25 | < 25 |

1) duration: 300 ms ;
cycle duration: for feeding units: 0,67 s ;
for regenerating units: 1,42 s ;
base load: 60% (continuous current)

Fig. 5-24: Data HNF
Mains Filter (-Combination) HNK

<table>
<thead>
<tr>
<th>Mains filter HNK01.1A-A075</th>
<th>Unit</th>
<th>E0050</th>
<th>E0080</th>
<th>E0106</th>
<th>E0146</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage</td>
<td>V</td>
<td>3*AC400…500</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominal current</td>
<td>A</td>
<td>50</td>
<td>80</td>
<td>106</td>
<td>146</td>
</tr>
<tr>
<td>Inductance</td>
<td>µH</td>
<td>571</td>
<td>362</td>
<td>240</td>
<td>170</td>
</tr>
<tr>
<td>Connection cross section</td>
<td>mm²</td>
<td>16 (AWG 6)</td>
<td>25 (AWG 3)</td>
<td>25 (AWG 3)</td>
<td>50 (AWG 1/0)</td>
</tr>
<tr>
<td>Protection category</td>
<td></td>
<td>-</td>
<td></td>
<td>IP20</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>kg</td>
<td>15</td>
<td>20</td>
<td>20</td>
<td>28</td>
</tr>
</tbody>
</table>

Fig. 5-25: Data HNK

Mains Choke HNL01.1E (feeding)

<table>
<thead>
<tr>
<th>Mains choke</th>
<th>Uₕ</th>
<th>Iₕ</th>
<th>Lₙ</th>
<th>Pₕ</th>
<th>Iₘₚ</th>
<th>Lₘₚ at Iₘₚ</th>
<th>Connection cross section</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNL01.1E-1000-N0012-A-500-NNNN</td>
<td>500</td>
<td>12</td>
<td>3 x 1000</td>
<td>40</td>
<td>25</td>
<td>50% of Lₙ</td>
<td>4 (a, b: 4)</td>
</tr>
<tr>
<td>HNL01.1E-1000-N0020-A-500-NNNN</td>
<td>500</td>
<td>20</td>
<td>3 x 1000</td>
<td>60</td>
<td>50</td>
<td>50% of Lₙ</td>
<td>6 (a, b: 4)</td>
</tr>
<tr>
<td>HNL01.1E-0600-N0032-A-500-NNNN</td>
<td>500</td>
<td>32</td>
<td>3 x 600</td>
<td>75</td>
<td>80</td>
<td>50% of Lₙ</td>
<td>10 (a, b: 4)</td>
</tr>
<tr>
<td>HNL01.1E-0571-N0050-A-500-NNNN</td>
<td>500</td>
<td>50</td>
<td>3 x 571</td>
<td>50</td>
<td>100</td>
<td>50% of Lₙ</td>
<td>16 (a, b: -)</td>
</tr>
<tr>
<td>HNL01.1E-0400-N0051-A-480-NNNN</td>
<td>480</td>
<td>51</td>
<td>3 x 400</td>
<td>165</td>
<td>77</td>
<td>50% of Lₙ</td>
<td>16 (a, b: 2.5)</td>
</tr>
<tr>
<td>HNL01.1E-0362-N0080-A-500-NNNN</td>
<td>500</td>
<td>80</td>
<td>3 x 362</td>
<td>80</td>
<td>160</td>
<td>50% of Lₙ</td>
<td>35 (a, b: -)</td>
</tr>
<tr>
<td>HNL01.1E-0240-N0106-A-500-NNNN</td>
<td>500</td>
<td>106</td>
<td>3 x 240</td>
<td>100</td>
<td>212</td>
<td>50% of Lₙ</td>
<td>50 (a, b: -)</td>
</tr>
<tr>
<td>HNL01.1E-0200-N0125-A-480-NNNN</td>
<td>480</td>
<td>125</td>
<td>3 x 200</td>
<td>170</td>
<td>188</td>
<td>50% of Lₙ</td>
<td>70 (a, b: 2.5)</td>
</tr>
<tr>
<td>HNL01.1E-0170-N0146-A-500-NNNN</td>
<td>500</td>
<td>146</td>
<td>3 x 170</td>
<td>130</td>
<td>292</td>
<td>50% of Lₙ</td>
<td>95 (a, b: -)</td>
</tr>
<tr>
<td>HNL01.1E-0100-N0202-A-480-NNNN</td>
<td>480</td>
<td>202</td>
<td>3 x 100</td>
<td>200</td>
<td>303</td>
<td>50% of Lₙ</td>
<td>150 (a, b: 2.5)</td>
</tr>
</tbody>
</table>

Fig. 5-26: Data HNL

Temperature Contact a, b

Switching Capacity 1 A / AC 250 V; DC 24 V

Switching Temperature 125 °C

Note: HNL01.1E mains chokes of type 1 are equipped with a temperature contact (a, b), types 2, 3 and 4 are not.
## Mains Choke HNL01.1E-****-S (Current-Compensated)

<table>
<thead>
<tr>
<th></th>
<th>HNL01.1 … -A-480-NNNN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight kg</td>
<td>11 26 30 12 14 24</td>
</tr>
<tr>
<td>Inductance LN mH</td>
<td>3 x 5,7 3 x 2,8 3 x 3,4 3 x 4,2 3 x 6,3 3 x 3,0</td>
</tr>
<tr>
<td>Nominal current A</td>
<td>51 125 202 26 65 94</td>
</tr>
<tr>
<td>Peak current A</td>
<td>77 188 303 65 163 235</td>
</tr>
<tr>
<td>Total leakage current at power terminal A</td>
<td>&lt; 2 &lt; 2,2 &lt; 2,2 &lt; 2 &lt; 2 &lt; 2</td>
</tr>
<tr>
<td>Allowed power dissipation at nominal current and maximum leakage current W</td>
<td>83 179 320 80 138 142</td>
</tr>
<tr>
<td>Input supply voltage 3 x AC 380…480V ±10%, 50/60Hz ±2%</td>
<td></td>
</tr>
<tr>
<td>Minimum inductance L_min 0,8*L_N at I_max</td>
<td></td>
</tr>
<tr>
<td>Protection category</td>
<td>IP20</td>
</tr>
</tbody>
</table>

1) duration: 300 ms;  
cycle duration:  
for feeding units: 0,67 s;  
for regenerating units: 1,42 s;  
base load: 60%

Fig. 5-27: Data HNL…S

## Braking Resistor HLR

<table>
<thead>
<tr>
<th>Designation</th>
<th>Symbol</th>
<th>Unit</th>
<th>0300-N17R5</th>
<th>0470-N11R7</th>
<th>0780-N07R0</th>
<th>1K08-N05R0</th>
</tr>
</thead>
<tbody>
<tr>
<td>nominal braking resistance</td>
<td>R_{DC_Bleeder}</td>
<td>Ohm</td>
<td>17,5</td>
<td>11,7</td>
<td>7,0</td>
<td>5,0</td>
</tr>
<tr>
<td>braking resistor continuous power, at Ta ≤ 40 °C</td>
<td>P_{BD}</td>
<td>kW</td>
<td>0,30</td>
<td>0,47</td>
<td>0,78</td>
<td>1,08</td>
</tr>
<tr>
<td>resistance value at P_{BD}</td>
<td>Ω</td>
<td></td>
<td>20,5</td>
<td>13,7</td>
<td>8,2</td>
<td>5,8</td>
</tr>
<tr>
<td>braking resistor peak power at U_{DC} = 850 V</td>
<td>P_{BS}</td>
<td>kW</td>
<td>35</td>
<td>52</td>
<td>88</td>
<td>124</td>
</tr>
<tr>
<td>max. regenerative power that can be absorbed</td>
<td>W_{R_max}</td>
<td>kW s</td>
<td>37</td>
<td>56</td>
<td>93</td>
<td>130</td>
</tr>
<tr>
<td>max. allowed duty cycle</td>
<td>t s</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>min. allowed cycle time</td>
<td>t s</td>
<td></td>
<td>120</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>time constant</td>
<td>s</td>
<td></td>
<td>780</td>
<td>780</td>
<td>780</td>
<td>780</td>
</tr>
<tr>
<td>weight</td>
<td>m kg</td>
<td></td>
<td>3</td>
<td>4,5</td>
<td>5,5</td>
<td>8</td>
</tr>
<tr>
<td>connection cross section</td>
<td>mm²</td>
<td></td>
<td>10</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>AWG</td>
<td></td>
<td>8</td>
<td>3</td>
<td>3</td>
<td>1/0</td>
</tr>
</tbody>
</table>

Fig. 5-28: Data HLR01.1N-xxxx-Nxxxx-A-007-NNNN
## Braking Resistors for HCS03.1E-W0070

<table>
<thead>
<tr>
<th>HLR01.1N-xxxx-xxxx-A-007-NNNN</th>
<th>-01K6-N18R0</th>
<th>-03K5-N19R0</th>
<th>-04K5-N18R0</th>
<th>-06K5-N18R0</th>
<th>-10K0-N18R0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>continuous power</strong> kW</td>
<td>1.6</td>
<td>3.5</td>
<td>4.5</td>
<td>6.5</td>
<td>10</td>
</tr>
<tr>
<td><strong>resistance value in operating status</strong> Ω</td>
<td>20.0</td>
<td>21.3</td>
<td>20.2</td>
<td>20.2</td>
<td>20.2</td>
</tr>
<tr>
<td><strong>type</strong></td>
<td>A5</td>
<td>B1</td>
<td>B2</td>
<td>B2</td>
<td>B3</td>
</tr>
</tbody>
</table>

### Energy absorption at peak power, duty cycle t = x sec and load cycle T = 120 sec

<table>
<thead>
<tr>
<th>energy absorption at peak power kWs</th>
<th>109</th>
<th>252</th>
<th>432</th>
<th>686</th>
<th>1080</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>peak power</strong> kW</td>
<td>34</td>
<td>31</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td><strong>t sec</strong></td>
<td>3.3</td>
<td>8</td>
<td>13</td>
<td>21</td>
<td>32</td>
</tr>
<tr>
<td><strong>duty cycle ED %</strong></td>
<td>2.7</td>
<td>6.7</td>
<td>11</td>
<td>17</td>
<td>27</td>
</tr>
</tbody>
</table>

### Braking power at x % ED and a load cycle T = 120 sec

<table>
<thead>
<tr>
<th>braking power kW</th>
<th>15</th>
<th>14</th>
<th>14</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>t sec</strong></td>
<td>7.2</td>
<td>18</td>
<td>30</td>
<td>48</td>
<td>72</td>
</tr>
<tr>
<td><strong>ED %</strong></td>
<td>6</td>
<td>15</td>
<td>25</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

### Connection cross section

<table>
<thead>
<tr>
<th>mm²</th>
<th>2.5</th>
<th>4</th>
<th>6</th>
<th>10</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWG</td>
<td>14</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

Fig. 5-29: Technical data for braking resistors at HCS03.1E-W0070
Braking resistors for HCS03 ... 0070
Peak power $P_s$ and Energy absorption $W$

Fig. 5-30: Selection aid for braking resistors for HCS03.1E-W0070
Braking Resistors for HCS03.1E-W0100

<table>
<thead>
<tr>
<th>HLR01.1N-xxxx-xxxx-A-007-NNNN</th>
<th>-02K0-N15R0</th>
<th>-05K0-N15R0</th>
<th>-07K0-N14R0</th>
<th>-09K5-N13R0</th>
<th>-14K5-N13R0</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuous power kW</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>9,5</td>
<td>14,5</td>
</tr>
<tr>
<td>resistance value in Ω</td>
<td>16,7</td>
<td>16,9</td>
<td>15,7</td>
<td>14,6</td>
<td>14,6</td>
</tr>
<tr>
<td>type</td>
<td>A6</td>
<td>B2</td>
<td>B3</td>
<td>B3</td>
<td>B4</td>
</tr>
</tbody>
</table>

Energy absorption at peak power, duty cycle $t = x$ sec and load cycle $T = 120$ sec

| energy absorption at peak power kWs | 137 | 360 | 672 | 1003 | 1566 |
| peak power kW                      | 40  | 40  | 43  | 46   | 46   |
| t sec                              | 3,4 | 9   | 16  | 22   | 34   |
| duty cycle ED %                    | 2,8 | 7,5 | 13  | 18   | 28   |

Braking power at $x$ % ED and a load cycle $T = 120$ sec

| braking power kW                  | 19  | 20  | 22  | 21   | 22   |
| t sec                             | 7,2 | 18  | 30  | 48   | 72   |
| ED %                              | 6   | 15  | 25  | 40   | 60   |

connection cross section

<table>
<thead>
<tr>
<th>mm²</th>
<th>4</th>
<th>6</th>
<th>10</th>
<th>10</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWG</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

Fig. 5-31: Technical data for braking resistors at HCS03.1E-W0100
Braking resistors for HCS03 ... 0100
Peak power $P_s$ and Energy absorption $W$

Fig. 5-32: Selection aid for braking resistors for HCS03.1E-W0100
### Braking Resistors for HCS03.1E-W0150

<table>
<thead>
<tr>
<th>HLR01.1N-xxxx-xxxxx-A-007-NNNN</th>
<th>-04K5-N07R4</th>
<th>-08K5-N08R0</th>
<th>-11K0-N07R3</th>
<th>-15K0-N08R1</th>
<th>-24K0-N07R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuous power kW</td>
<td>4.5</td>
<td>8.5</td>
<td>11</td>
<td>15</td>
<td>24</td>
</tr>
<tr>
<td>resistance value in Ω</td>
<td>8.3</td>
<td>9.0</td>
<td>8.2</td>
<td>9.1</td>
<td>8.1</td>
</tr>
<tr>
<td>type</td>
<td>B1</td>
<td>B3</td>
<td>B3</td>
<td>B4</td>
<td>C3</td>
</tr>
</tbody>
</table>

Energy absorption at peak power, duty cycle t = x sec and load cycle T = 120 sec

<table>
<thead>
<tr>
<th>energy absorption at peak power kWs</th>
<th>246</th>
<th>612</th>
<th>1056</th>
<th>1584</th>
<th>2592</th>
</tr>
</thead>
<tbody>
<tr>
<td>peak power kW</td>
<td>81</td>
<td>75</td>
<td>82</td>
<td>74</td>
<td>83</td>
</tr>
<tr>
<td>t sec</td>
<td>3</td>
<td>8.2</td>
<td>13</td>
<td>21</td>
<td>31</td>
</tr>
<tr>
<td>duty cycle ED %</td>
<td>2.5</td>
<td>6.8</td>
<td>11</td>
<td>18</td>
<td>26</td>
</tr>
</tbody>
</table>

Braking power at x % ED and a load cycle T = 120 sec

<table>
<thead>
<tr>
<th>braking power kW</th>
<th>34</th>
<th>34</th>
<th>35</th>
<th>33</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>t sec</td>
<td>7.2</td>
<td>18</td>
<td>30</td>
<td>48</td>
<td>72</td>
</tr>
<tr>
<td>ED %</td>
<td>6</td>
<td>15</td>
<td>25</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

connection cross section

<table>
<thead>
<tr>
<th>mm²</th>
<th>10</th>
<th>16</th>
<th>25</th>
<th>25</th>
<th>35</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWG</td>
<td>8</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Fig. 5-33 Technical data for braking resistors at HCS03.1E-W0150
### Braking Resistors for HCS03...0150

**Peak power $P_s$ and Energy absorption $W$**

<table>
<thead>
<tr>
<th>Duty cycle [s]</th>
<th>$W$ [kWs]</th>
<th>$P_s$ [kW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>10000</td>
<td>10000</td>
<td>10000</td>
</tr>
</tbody>
</table>

**Energy**
- HLR01.1N-24K0-N07R2
- HLR01.1N-15K0-N08R0
- HLR01.1N-11K0-N07R3
- HLR01.1N-08K5-N08R0
- HLR01.1N-04K5-N07R4

**Power**
- HLR01.1N-24K0-N07R2
- HLR01.1N-15K0-N08R0
- HLR01.1N-11K0-N07R3
- HLR01.1N-08K5-N08R0
- HLR01.1N-04K5-N07R4

*Fig. 5-34: Selection aid for braking resistors for HCS03.1-W0150*
**Braking Resistors for HCS03.1E-W0210**

<table>
<thead>
<tr>
<th>HLR01.1N-xxxx-xxxxx-A-007-NNNN</th>
<th>-06K5-N06R1</th>
<th>-12K5-N05R5</th>
<th>-17K0-N05R1</th>
<th>-23K0-N05R5</th>
<th>-36K0-N05R4</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuous power kW</td>
<td>6,5</td>
<td>12,5</td>
<td>17</td>
<td>23</td>
<td>36</td>
</tr>
<tr>
<td>resistance value in Ω</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>type</td>
<td>B2</td>
<td>B4</td>
<td>B5</td>
<td>C2</td>
<td>C4</td>
</tr>
</tbody>
</table>

Energy absorption at peak power, duty cycle t = x sec and load cycle T = 120 sec

<table>
<thead>
<tr>
<th>energy absorption at peak power kWs</th>
<th>356</th>
<th>900</th>
<th>1632</th>
<th>2429</th>
<th>3888</th>
</tr>
</thead>
<tbody>
<tr>
<td>peak power kW</td>
<td>98</td>
<td>109</td>
<td>117</td>
<td>109</td>
<td>111</td>
</tr>
<tr>
<td>t sec</td>
<td>3,6</td>
<td>8,3</td>
<td>14</td>
<td>22</td>
<td>35</td>
</tr>
<tr>
<td>duty cycle ED %</td>
<td>3</td>
<td>6,9</td>
<td>12</td>
<td>18</td>
<td>29</td>
</tr>
</tbody>
</table>

Braking power at x % ED and a load cycle T = 120 sec

| braking power kW                    | 49  | 50  | 54   | 51   | 54   |
| t sec                               | 7,2 | 18  | 30   | 48   | 72   |
| ED %                                | 6   | 15  | 25   | 40   | 60   |

connection cross section

<table>
<thead>
<tr>
<th>mm²</th>
<th>16</th>
<th>35</th>
<th>35</th>
<th>50</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>AWG</td>
<td>6</td>
<td>2</td>
<td>2</td>
<td>1/0</td>
<td>1/0</td>
</tr>
</tbody>
</table>

Fig. 5-35: Technical data for braking resistors at HCS03.1E-W0210
Line Cross Sections for Reinforced Braking Resistors HLR01.1

According to the standards "Electronic equipment for use in power installations" (EN 50178, chapter 5.3.2.1) and "Adjustable speed electrical power drive systems" (EN 61800-5-1, chapter 4.2.5.4.2), a stationary connection of the equipment grounding conductor is required. The following requirement has to be complied with: cross section of equipment grounding conductor at least 10 mm² (mechanical stability).

Note: For the equipment grounding conductor run lines with a cross section corresponding to that of the lines for mains connection at the drive controller HCS and having at least 10 mm².

Requirements for line routing:
- The cross sections are valid for one phase each in the case of stranded wires and are specified according to the regulations of VDE0298.
- Up to 50 mm², solid wires in the cable duct.
## Motor Filter HMF

<table>
<thead>
<tr>
<th>Motor filter</th>
<th>$I_N$ [A]</th>
<th>$P_V$ [W]</th>
<th>$L_M$ [µH]</th>
<th>$f_{out , max}$ [Hz]</th>
<th>$f_{p , max}$ [kHz]</th>
<th>du/dt at output [kV / us]</th>
<th>$U_{out , max}$ [kV]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMF01.1A-N0K2-D0045-A-500-NNNN</td>
<td>45</td>
<td>120</td>
<td>3 x 160</td>
<td>200</td>
<td>4</td>
<td>&lt; 1</td>
<td>1,2</td>
</tr>
<tr>
<td>HMF01.1A-N0K2-D0073-A-500-NNNN</td>
<td>73</td>
<td>160</td>
<td>3 x 100</td>
<td>200</td>
<td>4</td>
<td>&lt; 1</td>
<td>1,2</td>
</tr>
<tr>
<td>HMF01.1A-N0K2-D0095-A-500-NNNN</td>
<td>95</td>
<td>190</td>
<td>3 x 78</td>
<td>200</td>
<td>4</td>
<td>&lt; 1</td>
<td>1,2</td>
</tr>
<tr>
<td>HMF01.1A-N0K2-D0145-A-500-NNNN</td>
<td>145</td>
<td>220</td>
<td>3 x 50</td>
<td>200</td>
<td>4</td>
<td>&lt; 1</td>
<td>1,2</td>
</tr>
</tbody>
</table>

**Fig. 5-37:** Electrical data

<table>
<thead>
<tr>
<th>Motor filter</th>
<th>Cross section [mm²]</th>
<th>Cross section flexible [mm²]</th>
<th>Cross section [AWG]</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMF01.1A-N0K2-D0045-A-500-NNNN</td>
<td>16</td>
<td>-</td>
<td>6</td>
<td>1,5</td>
</tr>
<tr>
<td>HMF01.1A-N0K2-D0073-A-500-NNNN</td>
<td>35</td>
<td>-</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>HMF01.1A-N0K2-D0095-A-500-NNNN</td>
<td>50</td>
<td>2*25</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>HMF01.1A-N0K2-D0145-A-500-NNNN</td>
<td>95</td>
<td>2*50</td>
<td>4/0</td>
<td>25</td>
</tr>
</tbody>
</table>

**Fig. 5-38:** Terminal connector data
6 Mounting and Installation

6.1 Mounting

Dimensions – Power Sections

<table>
<thead>
<tr>
<th>Device</th>
<th>Device width [mm]</th>
<th>Min. mounting width [mm] 1)</th>
<th>Device height [mm] 2)</th>
<th>Device depth [mm] 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS02.1E-W0012</td>
<td>65</td>
<td>70</td>
<td>290</td>
<td>265</td>
</tr>
<tr>
<td>HCS02.1E-W0028</td>
<td>65</td>
<td>70</td>
<td>352</td>
<td></td>
</tr>
<tr>
<td>HCS02.1E-W0054</td>
<td>105</td>
<td>110</td>
<td>352</td>
<td></td>
</tr>
<tr>
<td>HCS02.1E-W0070</td>
<td>105</td>
<td>110</td>
<td>352</td>
<td></td>
</tr>
<tr>
<td>HCS03.1E-W0070</td>
<td>125</td>
<td>125</td>
<td>440</td>
<td>322</td>
</tr>
<tr>
<td>HCS03.1E-W0100</td>
<td>225</td>
<td>225</td>
<td>440</td>
<td></td>
</tr>
<tr>
<td>HCS03.1E-W0150</td>
<td>225</td>
<td>225</td>
<td>440</td>
<td></td>
</tr>
<tr>
<td>HCS03.1E-W0210</td>
<td>350</td>
<td>350</td>
<td>440</td>
<td></td>
</tr>
</tbody>
</table>

1) incl. minimum distance between the components
2) device body without mounting flange on top and bottom, as well as minimum distances for ventilation and installation
3) incl. touch guard, connector housing, bending radius of fiber optic cable, control panel "C"

Fig. 6-1: Mounting dimensions
Drilling Pattern for the Mounting Plate

Fig. 6-2: Drilling pattern

Note: The figure shows the back of the devices.

<table>
<thead>
<tr>
<th>Device</th>
<th>K [mm]</th>
<th>L [mm]</th>
<th>M [mm]</th>
<th>P [mm]</th>
<th>R [mm]</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS02.1E-W0012</td>
<td>0</td>
<td>316</td>
<td>32,5</td>
<td>13</td>
<td>7</td>
<td>observe additional distance to lateral neighboring devices</td>
</tr>
<tr>
<td>HCS02.1E-W0028</td>
<td>0</td>
<td>378</td>
<td>32,5</td>
<td>13</td>
<td>7</td>
<td>observe additional distance to lateral neighboring devices</td>
</tr>
<tr>
<td>HCS02.1E-W0054</td>
<td>55</td>
<td>378</td>
<td>25</td>
<td>13</td>
<td>7</td>
<td>observe additional distance to lateral neighboring devices</td>
</tr>
<tr>
<td>HCS02.1E-W0070</td>
<td>55</td>
<td>378</td>
<td>25</td>
<td>13</td>
<td>7</td>
<td>observe additional distance to lateral neighboring devices</td>
</tr>
<tr>
<td>HCS03.1E-W0070</td>
<td>75</td>
<td>466</td>
<td>25</td>
<td>13</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>HCS03.1E-W0100</td>
<td>175</td>
<td>466</td>
<td>25</td>
<td>13</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>HCS03.1E-W0150</td>
<td>175</td>
<td>466</td>
<td>25</td>
<td>13</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>HCS03.1E-W0210</td>
<td>250</td>
<td>466</td>
<td>50</td>
<td>13</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>HNL02.1</td>
<td>100</td>
<td>378</td>
<td>20</td>
<td>13</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 6-3: Drilling pattern
Distances for Drive Controllers

In addition to the mounting dimensions, the components of the Rexroth IndraDrive range require additional mounting clearance:

- to ventilate the components
- to mount accessories and connections
- to take temperature limits of neighboring mounting parts, such as cable ducts etc., into account

To determine the required mounting clearances in the control cabinet, take additional distances between the components and on their tops and bottoms into account.

Distance between Drive Controllers

Owing to power dissipation in the components, especially due to installed braking resistors in compact devices, the temperatures of neighboring components are rising. In the case of lateral mounting, trouble-free operation therefore requires the following minimum distances in [mm] between the components.

<table>
<thead>
<tr>
<th>from</th>
<th>to</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS02.1E</td>
<td>HCS03 (HNK01, HLR01)</td>
</tr>
<tr>
<td>HCS02.1E</td>
<td>5</td>
</tr>
<tr>
<td>HCS03.1E with HNK01 and HLR01</td>
<td>0</td>
</tr>
<tr>
<td>--</td>
<td>not allowed</td>
</tr>
</tbody>
</table>

Fig. 6-4: Minimum distance in [mm]

Note: For arrangement of the components in the control cabinet, take their dimension sheets and the required minimum distances into account.
Distances on Top and Bottom of Components

Owing to power dissipation in the components, the temperature of the cooling air current at the device outlet is rising to values higher than ambient temperature at device inlet.

---

**CAUTION**

Property damage due to temperatures higher than 105 °C!

⇒ Comply with indicated minimum distances!

---

In order that drive controllers can discharge the power dissipation generated inside of them, they need space on their top (A) and bottom (B).

---

A: air intake
B: air outlet
C: mounting surface in control cabinet
d: distance to top of device

Fig. 6-5: Air intake and air outlet at drive controller
Minimum distance for ventilation

For sufficient ventilation of the components you have to comply with the minimum distances below. At components without integrated braking resistor, there will be temperatures of up to 105 °C at the air outlet (B) (with an air intake temperature of 45 °C).

<table>
<thead>
<tr>
<th>Component</th>
<th>Minimum distance for ventilation</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>at the bottom (A) [mm] 1</td>
<td></td>
</tr>
<tr>
<td>HCS02</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>HCS03</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td></td>
<td>at the top (B) [mm] 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>80</td>
<td></td>
</tr>
</tbody>
</table>

1) for additional mounting parts, such as HAS, see dimensional drawings
2) integrated braking resistors require additional distance

Fig. 6-6: Minimum distance for ventilation

Note: If there are different minimum distances for the individual components in a drive system, the greatest value determines the minimum distance to be observed.

Minimum Distance to Braking Resistor

For components with integrated braking resistor (supply units, DC bus resistor units, HCS02 drive controllers) their higher outlet temperatures have to be taken into account.

To determine the required distances the resulting outlet temperatures are indicated in diagrams in the technical data of the components.

Input value in the diagrams is the generated power of the braking resistors or the individual output current. See exemplary diagram below:
Input value in the diagrams is the generated power of the braking resistors or the individual output current. See exemplary diagram below:

![Exemplary diagram](image)

- $P_{BD}$: average continuous braking resistor power
- $d$: distance to top of device
- $\Delta T$: temperature rise

Fig. 6-7: Exemplary diagram

The minimum distance for these mounting parts results from the intersection of the input value with the allowed temperature rise.
Dimensions – Mains Filter HNF

Drilling Pattern

<table>
<thead>
<tr>
<th>Mains filter</th>
<th>K [mm]</th>
<th>L [mm]</th>
<th>M [mm]</th>
<th>N [mm]</th>
<th>P [mm]</th>
<th>R [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNF01.1A-F240-E0051-A-480-NNNN</td>
<td>50</td>
<td>466</td>
<td>25</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
<tr>
<td>HNF01.1A-M900-E0051-A-480-NNNN</td>
<td>125</td>
<td>466</td>
<td>12,5</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
<tr>
<td>HNF01.1A-F240-E0202-A-480-NNNN</td>
<td>125</td>
<td>466</td>
<td>12,5</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
<tr>
<td>HNF01.1A-M900-E0202-A-480-NNNN</td>
<td>150</td>
<td>466</td>
<td>50</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
<tr>
<td>HNF01.1A-F240-R0026-A-480-NNNN</td>
<td>50</td>
<td>466</td>
<td>25</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
<tr>
<td>HNF01.1A-M900-R0026-A-480-NNNN</td>
<td>100</td>
<td>466</td>
<td>25</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
<tr>
<td>HNF01.1A-F240-R0065-A-480-NNNN</td>
<td>100</td>
<td>466</td>
<td>25</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
<tr>
<td>HNF01.1A-M900-R0065-A-480-NNNN</td>
<td>125</td>
<td>466</td>
<td>12,5</td>
<td>7</td>
<td>13</td>
<td>6,5</td>
</tr>
</tbody>
</table>

Note: The figure shows the back of the devices.

Fig. 6-8: Drilling pattern
## Dimensions

### Mains filter

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>HNF01.1A-F240-R0026-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>100</td>
<td>440</td>
<td>-</td>
<td>-</td>
<td>26</td>
<td>M6x20</td>
<td>8.6</td>
</tr>
<tr>
<td>HNF01.1A-F240-E0051-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>100</td>
<td>440</td>
<td>-</td>
<td>-</td>
<td>33</td>
<td>M6x16</td>
<td>2.3</td>
</tr>
<tr>
<td>HNF01.1A-M900-R0026-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>150</td>
<td>440</td>
<td>-</td>
<td>-</td>
<td>26</td>
<td>M6x20</td>
<td>8.6</td>
</tr>
<tr>
<td>HNF01.1A-F240-R0065-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>150</td>
<td>440</td>
<td>40</td>
<td>110</td>
<td>40</td>
<td>M6x16</td>
<td>4.8</td>
</tr>
<tr>
<td>HNF01.1A-F240-R0094-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>150</td>
<td>440</td>
<td>40</td>
<td>110</td>
<td>45</td>
<td>M10x30</td>
<td>25</td>
</tr>
<tr>
<td>HNF01.1A-F240-E0125-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>150</td>
<td>440</td>
<td>40</td>
<td>110</td>
<td>45</td>
<td>M10x30</td>
<td>25</td>
</tr>
<tr>
<td>HNF01.1A-F240-E0202-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>150</td>
<td>440</td>
<td>40</td>
<td>110</td>
<td>63.5</td>
<td>M10x30</td>
<td>25</td>
</tr>
<tr>
<td>HNF01.1A-M900-E0202-A-480-NNNN</td>
<td>480</td>
<td>262</td>
<td>250</td>
<td>440</td>
<td>40</td>
<td>110</td>
<td>63.5</td>
<td>M10x30</td>
<td>25</td>
</tr>
</tbody>
</table>

Fig. 6-9: Dimensions
Dimensions – Mains Choke HNL01.1E (infeeding)

Dimensions Type 1:

Dimensions Type 2:

Dimensions Type 3:
Dimensions Type 4:

<table>
<thead>
<tr>
<th>Mains choke</th>
<th>Type</th>
<th>Dim. [mm]</th>
<th>Weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNL01.1E-1000-N0012-A-500-NNNN</td>
<td>1</td>
<td>120 61 164 81 - 44 6,4 x 11</td>
<td>2,7</td>
</tr>
<tr>
<td>HNL01.1E-1000-N0020-A-500-NNNN</td>
<td>1</td>
<td>150 66,5 184 113 - 49,5 6,4 x 11</td>
<td>3,8</td>
</tr>
<tr>
<td>HNL01.1E-0600-N0032-A-500-NNNN</td>
<td>1</td>
<td>150 66,5 185 113 - 49,5 6,4 x 11</td>
<td>4,5</td>
</tr>
<tr>
<td>HNL01.1E-0571-N0050-A-500-NNNN</td>
<td>4</td>
<td>153 100 238 127 - 80 8,5 x 12</td>
<td>400 30 13</td>
</tr>
<tr>
<td>HNL01.1E-0400-N0051-A-480-NNNN</td>
<td>1</td>
<td>180 112 225 125 80 87 7 x 15</td>
<td>13,5</td>
</tr>
<tr>
<td>HNL01.1E-0362-N0080-A-500-NNNN</td>
<td>3</td>
<td>175 205 180 145 - 185 8,5 x 12</td>
<td>350 ca. 12 13</td>
</tr>
<tr>
<td>HNL01.1E-0240-N0106-A-500-NNNN</td>
<td>3</td>
<td>193 205 210 145 - 185 8,5 x 12</td>
<td>380 ca. 12 15</td>
</tr>
<tr>
<td>HNL01.1E-0200-N0125-A-480-NNNN</td>
<td>1</td>
<td>230 148 295 180 - 122 8 x 12</td>
<td>24</td>
</tr>
<tr>
<td>HNL01.1E-0170-N0146-A-500-NNNN</td>
<td>3</td>
<td>205 250 230 152 - 230 8,5 x 12</td>
<td>400 ca. 12 22</td>
</tr>
<tr>
<td>HNL01.1E-0100-N0202-A-480-NNNN</td>
<td>1</td>
<td>265 152 350 215 - 126 15 x 11</td>
<td>33</td>
</tr>
</tbody>
</table>

1) long hole in "B" direction

Fig. 6-10: Mechanical data HNL
### Mains Choke

<table>
<thead>
<tr>
<th>Mains Choke</th>
<th>$U_N$ [V]</th>
<th>$I_N$ [A]</th>
<th>$L_N$ [µH]</th>
<th>$P_V$ [W]</th>
<th>$I_{max}$ [A]</th>
<th>$L_{min}$ at $I_{max}$ Connection</th>
<th>Cross Section [mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNL01.1E-1000-N0012-A-500-NNNN</td>
<td>500</td>
<td>12</td>
<td>3 x 1000</td>
<td>40</td>
<td>25</td>
<td>50% of $L_N$</td>
<td>4 (a, b: 4)</td>
</tr>
<tr>
<td>HNL01.1E-1000-N0020-A-500-NNNN</td>
<td>500</td>
<td>20</td>
<td>3 x 1000</td>
<td>60</td>
<td>50</td>
<td>50% of $L_N$</td>
<td>6 (a, b: 4)</td>
</tr>
<tr>
<td>HNL01.1E-0600-N0032-A-500-NNNN</td>
<td>500</td>
<td>32</td>
<td>3 x 600</td>
<td>75</td>
<td>80</td>
<td>50% of $L_N$</td>
<td>10 (a, b: 4)</td>
</tr>
<tr>
<td>HNL01.1E-0571-N0050-A-500-NNNN</td>
<td>500</td>
<td>50</td>
<td>3 x 571</td>
<td>50</td>
<td>100</td>
<td>50% of $L_N$</td>
<td>16 (a, b: -) AWG 8</td>
</tr>
<tr>
<td>HNL01.1E-0400-N0051-A-480-NNNN</td>
<td>480</td>
<td>51</td>
<td>3 x 400</td>
<td>165</td>
<td>77</td>
<td>50% of $L_N$</td>
<td>16 (a, b: 2,5)</td>
</tr>
<tr>
<td>HNL01.1E-0362-N0080-A-500-NNNN</td>
<td>500</td>
<td>80</td>
<td>3 x 362</td>
<td>80</td>
<td>160</td>
<td>50% of $L_N$</td>
<td>35 (a, b: -) AWG 6</td>
</tr>
<tr>
<td>HNL01.1E-0240-N0106-A-500-NNNN</td>
<td>500</td>
<td>106</td>
<td>3 x 240</td>
<td>100</td>
<td>212</td>
<td>50% of $L_N$</td>
<td>35 (a, b: -) AWG 1/0</td>
</tr>
<tr>
<td>HNL01.1E-0200-N0125-A-480-NNNN</td>
<td>480</td>
<td>125</td>
<td>3 x 200</td>
<td>170</td>
<td>188</td>
<td>50% of $L_N$</td>
<td>70 (a, b: 2,5)</td>
</tr>
<tr>
<td>HNL01.1E-0170-N0146-A-500-NNNN</td>
<td>500</td>
<td>146</td>
<td>3 x 170</td>
<td>130</td>
<td>292</td>
<td>50% of $L_N$</td>
<td>50 (a, b: -) AWG 1/0</td>
</tr>
<tr>
<td>HNL01.1E-0100-N0202-A-480-NNNN</td>
<td>480</td>
<td>202</td>
<td>3 x 100</td>
<td>200</td>
<td>303</td>
<td>50% of $L_N$</td>
<td>150 (a, b: 2,5)</td>
</tr>
</tbody>
</table>

Fig. 6-11: Electrical data HNL

**Temperature Contact a, b**

- **Switching Capacity**: 1 A / AC 250 V; DC 24 V
- **Switching Temperature**: 125 °C

**Note**: HNL01.1E mains chokes of type 1 are equipped with a temperature contact (a, b), types 2, 3 and 4 are not.
Dimensions – Standard Braking Resistors HLR01.1

**Note:** The standard braking resistors are intended to be mounted above the drive controllers HCS03; otherwise, forced convection (blower) with a volume stream of 200 m³/hour is to be provided.

Fig. 6-12: Dimensional drawing braking resistor HLR01.1N-0300-N17R5-A-007-NNNN
Fig. 6-13: Dimensional drawing braking resistor HLR01.1N-0470-N11R7-A-007-NNNN and HLR01.1N-0780-N07R0-A-007-NNNN

Note: The joint bar (ground strap) is contained in the scope of supply of the standard braking resistors HLR01.

Fig. 6-14: Dimensional drawing braking resistor HLR01.1N-1K08-N05R0-A-007-NNNN
Dimensions – Reinforced Braking Resistors HLR01.1

Fixed Resistors IP 20 Type A

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
<td>B</td>
</tr>
<tr>
<td>A5</td>
<td>586</td>
<td>185</td>
</tr>
<tr>
<td>A6</td>
<td>686</td>
<td>185</td>
</tr>
</tbody>
</table>

Fig. 6-15: Type A5 – A6

Fig. 6-16: Dimensions table braking resistor type A
Steel Grid Fixed Resistors IP 20 Type B

<table>
<thead>
<tr>
<th>Type</th>
<th>B</th>
<th>T</th>
<th>H</th>
<th>B1</th>
<th>T1</th>
<th>D</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>490</td>
<td>300</td>
<td>270</td>
<td>380</td>
<td>270</td>
<td>M10</td>
<td>9.5</td>
</tr>
<tr>
<td>B2</td>
<td>490</td>
<td>400</td>
<td>270</td>
<td>380</td>
<td>370</td>
<td>M10</td>
<td>13</td>
</tr>
<tr>
<td>B3</td>
<td>490</td>
<td>600</td>
<td>270</td>
<td>380</td>
<td>570</td>
<td>M10</td>
<td>22</td>
</tr>
<tr>
<td>B4</td>
<td>490</td>
<td>800</td>
<td>270</td>
<td>380</td>
<td>770</td>
<td>M10</td>
<td>33</td>
</tr>
<tr>
<td>B5</td>
<td>490</td>
<td>1000</td>
<td>270</td>
<td>380</td>
<td>970</td>
<td>M10</td>
<td>44</td>
</tr>
</tbody>
</table>

Fig.: 6-17  Type B1 – B4

Tab.: 6-1  Dimensions table braking resistor type B
Steel Grid Fixed Resistors IP 20 Type C

Fig.: 6-18 Type C1 – C7

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions in mm</th>
<th>Weight in kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>T</td>
</tr>
<tr>
<td>C2</td>
<td>595</td>
<td>490</td>
</tr>
<tr>
<td>C3</td>
<td>795</td>
<td>490</td>
</tr>
<tr>
<td>C4</td>
<td>995</td>
<td>490</td>
</tr>
</tbody>
</table>

Tab.: 6-2 Dimensions table braking resistor type C

**Note:** Under consideration of the technical data for the minimum braking resistance and the brake chopper, other braking resistors can be used alternatively.
Dimensions – Motor Filter HMF

Fig. 6-19: Dimensions motor filter HMF01.1A-N0K2-D0045-A-500-NNNN

Fig. 6-20: Dimensions motor filter HMF01.1A-N0K2-D0073-A-500-NNNN, HMF01.1A-N0K2-D0095-A-500-NNNN and HMF01.1A-N0K2-D0145-A-500-NNNN

<table>
<thead>
<tr>
<th>Type</th>
<th>Dimensions in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
</tr>
<tr>
<td>0073</td>
<td>225</td>
</tr>
<tr>
<td>0095</td>
<td>225</td>
</tr>
<tr>
<td>0145</td>
<td>350</td>
</tr>
</tbody>
</table>

Fig. 6-21: Dimensions motor filter
Arrangement of the Components HCS03.1 / Motor Filter HMF

Fig. 6-22: Sample mounting HCS03.1E-W0070 / HMF01.1A-N0K2-D0045
Fig. 6-23: Sample mounting HCS03.1E-W0100 0150 0210 / motor filter

<table>
<thead>
<tr>
<th>HCS03.1E-</th>
<th>H</th>
<th>B</th>
<th>B1</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0100</td>
<td>720</td>
<td>225</td>
<td>175</td>
</tr>
<tr>
<td>W0150</td>
<td>720</td>
<td>225</td>
<td>175</td>
</tr>
<tr>
<td>W0210</td>
<td>780</td>
<td>350</td>
<td>250</td>
</tr>
</tbody>
</table>

Fig. 6-24: Dimensions table for sample mounting HCS03.1E-... / motor filter HMF
Arrangement of the Components HCS03.1 / Motor Filter and Mains Filter

Fig. 6-25: Arrangement HCS03.1-E-W0070 / motor filter and mains filter + HAS05.1-001 + HAS05.1-002
Fig. 6-26: Arrangement of device 0100, 0150, 0210 / motor filter and mains filter

<table>
<thead>
<tr>
<th>HCS03.1E-</th>
<th>H</th>
<th>B1</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0100</td>
<td>980</td>
<td>175</td>
<td>225</td>
</tr>
<tr>
<td>W0150</td>
<td>980</td>
<td>175</td>
<td>225</td>
</tr>
<tr>
<td>W0210</td>
<td>1090</td>
<td>250</td>
<td>350</td>
</tr>
</tbody>
</table>

Fig. 6-27: Dimensions table for sample mounting HCS03.1E-.. / mains filter / motor filter
Combination of Drive Controllers of the Rexroth IndraDrive C Product Range

![Diagram of Rexroth IndraDrive C components](image)

**Fig. 6-28: Rexroth IndraDrive C components**

**Note:** Observe that using **HAS04** accessory at the HCS arranged at the utmost left position requires additional space of 30 mm.

Rexroth IndraDrive components are arranged in line to the right starting from the supplying device. Arrange the drive controllers with high capacity as close to the supplying unit as possible.

The **HAS02** accessories in the figure require additional mounting clearance.
Dimension Z is significantly determined by the involved components. The table below contains the dimensions Z between the component arranged to the left and the component arranged to the right.

<table>
<thead>
<tr>
<th>Component left</th>
<th>Component right</th>
<th>Dimension Z [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS02.1E-W0012</td>
<td>HCS02.1E-W0012</td>
<td>70</td>
</tr>
<tr>
<td>HCS02.1E-W0028</td>
<td>HCS02.1E-W0028</td>
<td></td>
</tr>
<tr>
<td>HCS02.1E-W0054</td>
<td>HCS02.1E-W0054</td>
<td>55</td>
</tr>
<tr>
<td>HCS02.1E-W0070</td>
<td>HCS02.1E-W0070</td>
<td></td>
</tr>
<tr>
<td>HCS02.1E-W0054</td>
<td>HCS02.1E-W0070</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(without distance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>between the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>components)</td>
</tr>
<tr>
<td>HCS02.1E-W0012</td>
<td>HCS02.1E-W0028</td>
<td>57.5</td>
</tr>
<tr>
<td>HCS02.1E-W0028</td>
<td></td>
<td>(without distance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>between the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>components)</td>
</tr>
<tr>
<td>HCS02.1E-W0054</td>
<td>HCS02.1E-W0070</td>
<td>62.5</td>
</tr>
<tr>
<td>HCS02.1E-W0070</td>
<td>HCS02.1E-W0100</td>
<td>50</td>
</tr>
<tr>
<td>HCS03.1E-W0150</td>
<td></td>
<td>(without distance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>between the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>components)</td>
</tr>
<tr>
<td>HCS03.1E-W0210</td>
<td>HCS03.1E-W0210</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(without distance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>between the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>components)</td>
</tr>
<tr>
<td>HCS03.1E-W0070</td>
<td>HCS03.1E-W0100</td>
<td>75</td>
</tr>
<tr>
<td>HCS03.1E-W0150</td>
<td></td>
<td>(without distance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>between the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>components)</td>
</tr>
<tr>
<td>HCS03.1E-W0210</td>
<td>HCS03.1E-W0070</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>HCS03.1E-W0100</td>
<td>(without distance</td>
</tr>
<tr>
<td></td>
<td>HCS03.1E-W0150</td>
<td>between the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>components)</td>
</tr>
</tbody>
</table>

Fig. 6-29: Table for dimension Z
Multiple-Line Arrangement of Drive Controllers

Control Cabinet with Multiple-Line Structure

Note: Particular attention should be paid to the maximum allowed air intake temperature of components when they are arranged in multiple lines in the control cabinet. Where necessary, cooling air guides are to be provided with blowers specially used for this purpose.

Fig. 6-30: Example of arrangement for multiple-line structure with components
### 6.2 Electrical Installation

**Note:** For successful project planning of the electrical installation with regard to EMC, also observe the Project Planning Manual on the drive system Rexroth IndraDrive. The explanations below will help you detect and remove malfunction.

---

## Rules for Design of Installations with Drive Controllers in Compliance with EMC

<table>
<thead>
<tr>
<th>Section</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mains Filter</strong></td>
<td>Correctly use a mains filter recommended by Rexroth for radio interference suppression in the supply feeder of the AC drive system.</td>
</tr>
<tr>
<td><strong>Control Cabinet Grounding</strong></td>
<td>All metal parts of the cabinet have to be connected with one another over the largest possible surface area to establish a good electrical connection. This, too, applies to the mounting of the EMC filter. If required, use serrated washers which cut through the paint surface. The cabinet door should be connected to the cabinet using the shortest possible grounding straps.</td>
</tr>
<tr>
<td><strong>Line Routing</strong></td>
<td>Avoid coupling routes between lines with high potential of noise and noise-free lines, therefore signal, mains and motor lines and power cables have to be routed separately from another (this eliminates mutual interference!). Minimum clearance: 10 cm. Provide separating sheets between power and signal lines. Separating sheets have to be grounded at several points. Lines with high potential of noise at the drive controller are lines for the mains supply (incl. mains synchronization), lines at the motor connection and DC bus connections. Generally, interference injection are reduced by routing cables close to grounded sheet steel panels. For this reason, cables and wires should not be routed freely in the cabinet, but close to the cabinet housing or mounting panels. The incoming and outgoing cables of the radio interference suppression filter have to be separated.</td>
</tr>
<tr>
<td><strong>Interference Suppression Elements</strong></td>
<td>Contactors, relays, solenoid valves, electromechanical operating hour counters etc. in the control cabinet must be provided with interference suppression combinations. These combinations must be connected directly at each coil.</td>
</tr>
<tr>
<td><strong>Twisted Wires</strong></td>
<td>Non-shielded cables belonging to the same circuit (feeder and return cable) have to be twisted or the surface between feeder and return cable has to be kept as small as possible. Ground cables that are not used at both ends.</td>
</tr>
<tr>
<td><strong>Lines of Measuring Systems</strong></td>
<td>Lines of measuring systems have to be shielded. The shield has to be connected to ground at both ends and over the largest possible surface area. The shield may not be interrupted, e.g. using intermediate terminals.</td>
</tr>
<tr>
<td><strong>Digital Signal Lines</strong></td>
<td>The shields of digital signal lines have to be grounded at both ends (transmitter and receiver) over the largest possible surface area and with low impedance. Bad ground connection between transmitter and receiver requires additional routing of a bonding conductor (min. 10 mm²). Braided shields are to be preferred to foil shields.</td>
</tr>
<tr>
<td><strong>Analog Signal Lines</strong></td>
<td>The shields of analog signal lines generally have to be grounded at one end (transmitter or receiver) over the largest possible surface area and...</td>
</tr>
</tbody>
</table>
with low impedance, in order to avoid low-frequency interference current (in the mains frequency range) on the shield. Keep connection lines of mains chokes as short as possible and twist them.

- Preferably use the motor power cables with shield provided by Rexroth. If you use other motor power cables, they have to be run in shielded form.
- Keep length of motor power cable as short as possible.
- Ground shield of motor cable at both ends over the largest possible surface area to establish a good electrical connection.
- Run motor lines in shielded form inside the control cabinet.
- Do not use any steel-shielded lines.
- The shield of the motor cable mustn’t be interrupted by mounted components, such as output chokes, sine filters, motor filters.

**EMC-Optimal Installation in Facility and Control Cabinet**

With regard to EMC-optimal installation, a spatial separation of the interference-free area (mains connection) and the interference-susceptible area (drive components) is recommended, as shown in the figures below.

**Note:** For EMC-optimal installation in the control cabinet use a separate control cabinet panel for the drive components.

**Division into Areas (Zones)**

The arrangement in the control cabinet can be seen from Fig. 6-31.

There are three areas to be distinguished:

1. **Interference-free area of control section (area A):**

   This includes:
   - supply feeder, input terminals, fuse, main switch, mains side of mains filter for drives and corresponding connecting lines
   - control voltage or auxiliary voltage connection with power supply unit, fuse and other parts unless connection is run via the mains filter of the AC drives
   - all components that aren’t electrically connected with the drive system

2. **Interference-susceptible area (area B):**

   - mains connections between drive system and mains filter for drives, mains contactor
   - interface lines of drive controller

3. **Strongly interference-susceptible area (area C):**

   - motor cable including single strands

Never run lines of one of these areas in parallel with lines of another area so that there isn’t any unwanted interference injection from one area to the other and that the filter is jumpered with regard to high frequency. Keep connection lines as short as possible.

For complex systems it is recommended to put the drive components into a cabinet and the controls into a separate second cabinet.
Badly grounded control cabinet doors act as antennas. It is recommended to connect the doors to the control section on top, in the middle and on the bottom via short equipment grounding conductors with a cross section of at least 6 mm² or, even better, via grounding straps with the same cross section. Make sure connection points have good contact.

Fig. 6-31: Separation of interference-free area and interference-susceptible area in control cabinet
Design and Installation in Interference-Free Area of Control Cabinet (Area A)

When arranging the components in the control cabinet, it is recommended that you place the components and electrical elements (switches, pushbuttons, fuses, terminal connectors) in the interference-free zone A with a distance of at least \( d_1 = 200 \) mm to the components in both other zones B and C.

In particular, a distance of at least \( d_2 = 500 \) mm has to be kept in zone A between magnetic components, such as transformers, line reactors and DC-link reactors, that are directly connected to the power terminals of the drive system and the interference-free components and lines between supply system and filter including the mains filter. If this distance is not kept, the magnetic leakage fields are injected to the interference-free components and lines connected to the mains so that the limit values at the supply connection are exceeded in spite of the installed filter.

The distance between the power input line and the lines between filter and exit point from the control cabinet in area A and the lines in areas B and C must be at least 200 mm (distances \( d_1 \) and \( d_3 \) in the figure) at all points.

If this is impossible, there are two alternatives:

- Install these lines with a shield and connect the shield, at several points, but at least at the beginning and at the end of the line, to the mounting plate or the control cabinet housing over a large surface area, or:
- Separate these lines from the other interference-susceptible lines in zones B and C by means of a grounded distance plate vertically attached to the mounting plate.

In addition, these lines have to be kept as short as possible within the control cabinet and installed directly on the grounded metal surface of the mounting plate or of the control cabinet housing.

Mains supply lines from zones B and C must not be connected to the mains without a filter.

**Note:** In case the information on cable routing given in this section is not observed, the effect of the mains filter is totally or partly neutralized. You must therefore expect the noise level of the interference emission to be higher within the range of 150 kHz to 40 MHz and the limit values at the connection points of the machine or installation to be exceeded.

Routing and Connecting a Neutral Conductor (N)

If a neutral conductor is used together with a three-phase connection, it must not be installed unfiltered in zones B and C, in order to keep interference off the mains.

Connecting Motor Blowers

Single-phase or three-phase supply lines of motor ventilators, that are usually routed in parallel with motor cables or interference-susceptible lines, also have to be provided with a filter. They either have to be filtered via a separate single-phase filter (NFE type) or three-phase filter (HNF, NFD type) near the supply connection of the control cabinet, or to be connected at the load side of the existing three-phase filter for the power connector of the drive system. When switching power off, make sure the ventilator is not switched off.
Shielding Mains Supply Lines in Control Cabinet

If there is a high degree of interference injection to the power input line within the control cabinet, in spite of you having observed the above instructions (to be found out by standard EMC measurement), the lines in area A have to be routed in shielded form. In this case the shields have to be connected to the mounting plate at the beginning and the end of the line by means of clips. The same procedure may be required for long cables of more than 2 m between the point of power supply connection of the control cabinet and the filter within the control cabinet.

Mains Filters for AC Drives

The mains filter ideally should be mounted on the parting line between area A and B. Make sure the ground connection between filter housing and housing of the drive controllers has good electrically conductive properties. If single-phase loads are connected on the load side of the filter, their current may only be a maximum of 10% of the three-phase operating current. A highly imbalanced load of the filter would deteriorate its interference suppression capacity.

If the mains voltage is more than 480 V, the filter has to be connected on the output side of the transformer and not on its supply side.

Grounding

In the case of bad ground connections in the installation, the distance between the lines to the grounding points E1, E2 in area A and the other grounding points of the drive system should be at least \(d_4 = 400 \text{ mm}\), in order to minimize interference injection from ground and ground cables to the power input lines.

Point of Connection for Equipment Grounding Conductor of Machine, Installation, Control Cabinet

The equipment grounding conductor of the power cable of the machine, installation or control cabinet of the has to be **firmly connected** at point PE and have a **cross section of at least 10 mm\(^2\)** or to be complemented by a second equipment grounding conductor via separate terminal connectors (according to EN50178/1997, section 5.3.2.1). If the cross section of the outer conductor is bigger, the cross section of the equipment grounding conductor has to be adjusted accordingly.

Design and Installation in Interference-Susceptible Area of Control Cabinet (Area B)

Modules, components and lines in area B should be placed at a distance of at least \(d_1 = 200 \text{ mm}\) from modules and lines in area A or shielded by distance plates mounted vertically on the mounting plate. As an alternative, the lines can be shielded.

Power supply units for auxiliary or control voltage connections in the drive system mustn't be directly connected to the mains, but have to be connected to the mains via a mains filter, as indicated in Fig. 6-31.

Keep line length between drive controller and filter as short as possible. Avoid unnecessary lengths.

Control Voltage or Auxiliary Voltage Connection

Only in exceptional cases should a connection of power supply unit and fusing for the control voltage connection be made at phase and neutral conductor. In this case these components have to be mounted and installed in area A, far away from the areas B and C of the drive system. For details see chapter "Design and Installation in Interference-Free Area of Control Cabinet (Area A)."

The connection between control voltage connection of the drive system and power supply unit used has to be run through area B over the shortest distance.

Line Routing

Run the lines along grounded metal surfaces, in order to minimize radiation of interference fields to area A (transmitting antenna effect).
Design and Installation in Strongly Interference-Susceptible Area of Control Cabinet (Area C)

Area C mainly concerns the motor cables, especially at the connection point at the device.

Influence of the Motor Power Cable

The discharge capacitance is limited to ensure compliance with the limit values. The calculation of the discharge capacitance can be found in the "Calculations" chapter.

If the applications allows this, the cable length should always be kept short. Avoid unnecessary line lengths.

Routing the Motor Cables

The motor cables have to be run in shielded form. Besides they are always to be routed with a distance of \( d_5 = 100 \text{ mm} \) to the other interference-free lines and to signal cables and lines, or to be separated from them by a grounded distance plate. The latter is not required for the feedback cables of Rexroth motors.

At the drive controller connection the motor cables and the (unfiltered) power connection lines may only be routed in parallel for a distance of 300 mm. After that distance, motor cables and power supply cables have to be routed in opposite directions in separate cables ducts, as illustrated in the following figures (Fig. 6-32; Fig. 6-33) by the example of a drive system with separate mains connection per drive axis IndraDrive HCS.

![Diagram of motor cable routing and connection]

Fig. 6-32: Option 1: separate routing of motor cable and mains connection lines via 2 cable ducts
Additional Recommendations on Cable Routing

The motor cables should be routed along grounded metal surfaces, both inside the control cabinet and outside of it, in order to minimize radiation of interference fields. If possible the motor cables should be routed in metal-grounded cable ducts.

The outlet of the motor cables at the control cabinet should ideally be provided in a distance of at least $d_3 = 200$ mm from the (filtered) power supply cable.
Ground Connections

Housing and Mounting Plate
By means of appropriate ground connections it is possible to avoid the emission of interference, because interference is discharged to earth on the shortest possible way. Ground connection of the metal housings of EMC-critical components such as filters, devices of the drive system, connection points of the cable shields, devices with microprocessor and switching power supply units have to be over a large surface area and well contacted. This also applies to all screw connections of between mounting plate and control cabinet wall and to the mounting of a ground bus to the mounting plate.

For this purpose it is recommended to use a zinc-coated or chromatized mounting plate. Compared to a lacquered plate, the connections in this case have a good long-time stability.

Connection Elements
For lacquered mounting plates always use screw connections with tooth lock washers and zinc-coated, tinned screws as connection elements. At the connection points selectively scratch off the lacquer so that there is safe electrical contact over a large surface area. Contact over a large surface area is established by means of bare connection surfaces or several connection screws. For screw connections the contact to lacquered surfaces is ensured by using tooth lock washers.

Metal Surfaces
In any case use connection elements with good electroconductive surface.

Bare zinc-coated, tinned and chromatized metal surfaces have good electroconductive properties. Anodized, yellow chromatized, black gunmetal finish or lacquered metal surfaces have bad electroconductive properties and therefore shouldn’t be used for connection elements (screws, nuts, plain washers).

Ground Wires and Shield Connections
For connecting ground wires and shield connections it is not the cross section but the size of contact surface that is important, as the high-frequency interference currents mainly flow on the surface of the conductor.

Any connection of cable shields, especially of shields of the motor power cables with ground potential (see section "Connection of Motor Cable to Drive Controller") always has to be provided over a large surface area.
Installing Signal Lines and Cables

**Line Routing**

For measures to prevent interference see the Project Planning Manuals of the respective device. In addition, observe the following recommendations:

Signal and control lines have to be routed separately from the power cables with a minimum distance of \( d_5 = 100 \) mm (see Fig. 6-31:) or with a grounded separating sheet. The optimum way is to route them in separate cable ducts. If possible, lead signal lines into control cabinet at one point only.

Exception: If there is no other way to do it, motor feedback cables can be routed together with the motor power cables.

If signal lines are crossing power cables, they should be routed in an angle of 90° in order to avoid interference injection.

Spare cables that are not used and have been connected should be grounded at least at both ends so that they don't have any antenna effect.

Avoid unnecessary line lengths.

Run cables as close as possible to grounded metal surfaces (reference potential). The ideal solution are closed, grounded cable ducts or metal pipes which, however, is only obligatory for high requirements (sensitive instrument leads).

Avoid suspended lines or lines routed along synthetic carriers, because they are functioning both like good reception antennas (noise immunity) and like good transmitting antennas (emission of interference). Exceptional cases are trailing cable installations over short distance of a max. of 5 m.

**Shielding**

The cable shield has to be connected immediately at the devices in the shortest and most direct possible way and over the largest possible surface area.

The shield of analog signal lines is connected at one end over a large surface area, normally in the control cabinet at the analog device. Make sure the connection to ground/housing is over a large surface area and short.

The shield of digital signal lines is connected at both ends over a large surface area and in short form. In the case of potential differences between beginning and end of the line, run an additional bonding conductor in parallel. The guide value for the cross section is 10 mm².

You absolutely have to equip separable connections with connectors with grounded metal housing.

In the case of non-shielded lines belonging to the same circuit, twist feeder and return cable.
General Measures of Radio Interference Suppression for Relays, Contactors, Switches, Chokes, Inductive Loads

If, in conjunction with electronic devices and components, inductive loads, such as chokes, contactors, relays are switched by contacts or semiconductors, appropriate interference suppression has to be provided for them. In the case of d.c. operation, this is achieved by arranging free-wheeling diodes and in the case of a.c. operation, by arranging usual RC interference suppression elements depending on the contactor type, immediately at the inductance. Only the interference suppression element arranged immediately at the inductance serves this purpose. Otherwise the emitted noise level is too high which can affect the function of the electronic system and of the drive.

If possible, mechanical switches and contacts should only be realized as snap contacts. Contact pressure and contact material must be suited for the corresponding switching currents.

Slow-action contacts should be replaced by snap switches or by solid-state switches, because slow-action contacts strongly bounce and are in an undefined switching status for a long time which emits electromagnetic waves in the case of inductive loads. These waves are an especially critical aspect in the case of manometric or temperature switches.
Installing the 24V Supply

As a matter of principle, the 24V supply of the components of the drive system Rexroth IndraDrive has to be installed in star-shaped form, i.e. for each group of drive controllers or third-party components it is necessary to run separate supply lines. This, too, applies to multiple-line arrangement in the case of supply from a supply unit, for example.

Note:

If you use several power supply units for 24 V supply, make sure that

- the reference conductors 0V of the individual power supply units are interconnected with low impedance
- the output voltages of the power supply units are within the allowed voltage range
- the power supply units are synchronously switched on and off.
Connection Diagram

HCS02

- XS1: shield connection
- X1:Out: bus connection OUT
- X1:In: bus connection IN
- X13:1 0V: control voltage
- X13:2 0V
- X13:3 +24V
- X13:4 +24V
- L+: DC bus
- L-:
  - L1: mains connection
  - L2
  - L3
- A1
- A2
- A3
- G:
  - MotTemp+: motor temperature monitoring
  - MotTemp-:
  - +24VBr
  - 0VBr
- X6:
  - 1: external braking resistor
  - 2
- X8:
  - 1
  - 2

X1, L+/L not available for HCS02.1E-W0012
X9 not available for HCS02.1E-W0012 and --W0028

Fig. 6-35: Complete connection diagram

Note: Apart from the connections listed below, it is necessary to wire the Bb contact at the control section for signaling the readiness for operation of the drive controller.
Fig. 6-36: Connection diagram
Connections and Connectors

Power Sections HCS02.1E-W0012

X3: Mains connection
X5: Motor connection
X6: Motor temperature monitoring and motor holding brake
X13: Control voltage connection
XS1: Shield connection of signal cables
XS2: Shield connection of motor cable

Fig. 6-37: HCS02.1E-W0012 power section connections (left: front, right: bottom)
Power Sections HCS02.1E-W0028, -W0054, -W0070

Fig. 6-38: HCS02.1E-W0028, -W0054, -W0070 power section connections (left above: front, right above: bottom –W0028, below: bottom –W0054 and –W0070)

X1: Module bus
X3: Mains connection
X5: Motor connection
X6: Motor temperature monitoring and motor holding brake
X9: Braking resistor connection
X13: Control voltage connection
XS1: Shield connection of signal cables
XS2: Shield connection of motor cable
Power Sections HCS03.1

1, 1.1: Module bus X1
2: Control voltage; +24 V and 0 V
3: DC bus; L+ and L-
4: Connection of equipment grounding conductor
5: Motor
6: Shield connection of motor cable
7: Motor temperature monitoring and motor holding brake (X6)
8: Mains connection

Fig. 6-39: Connections at power section HCS03.1
**X3, Mains connection**
**X5, Motor connection**
**X6, Connection of motor temperature, motor holding brake**

Fig. 6-40: Connections at power section (bottom) HCS03.1E-W0070

**X1, Module Bus**
The module bus permits data exchange between the drive controllers.

**Graphic Representation**

Fig. 6-41: X1

<table>
<thead>
<tr>
<th>Design</th>
<th>Type</th>
<th>No. of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ribbon cable connector</td>
<td>8</td>
<td>Connector at device</td>
</tr>
<tr>
<td></td>
<td>Ribbon cable socket</td>
<td>8</td>
<td>Socket at ribbon cable</td>
</tr>
</tbody>
</table>

Fig. 6-42: Design
**X3, Mains Connection**

**DANGER**

High electrical voltage! Danger to life, severe bodily harm by electric shock!

⇒ Always operate the drive controller with plugged on connector!

### Design

<table>
<thead>
<tr>
<th>HCS02.1E-</th>
<th>Type</th>
<th>Number of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0012</td>
<td>Screw terminal block</td>
<td>4</td>
<td>Pins on device</td>
</tr>
<tr>
<td>W0028</td>
<td>Screw terminal block</td>
<td>4</td>
<td>Pins on device</td>
</tr>
<tr>
<td>W0054</td>
<td>Screw terminal block</td>
<td>4</td>
<td>Pins on device</td>
</tr>
<tr>
<td>W0070</td>
<td>Screw terminal block</td>
<td>4</td>
<td>Pins on device</td>
</tr>
</tbody>
</table>

Fig. 6-43: Design

<table>
<thead>
<tr>
<th>HCS03.1E-</th>
<th>Type</th>
<th>No. of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0070</td>
<td>Connector</td>
<td>4</td>
<td>Screw connection</td>
</tr>
<tr>
<td>W0100</td>
<td>Terminal block</td>
<td>3</td>
<td>Screw connection for M6 ring cable lugs</td>
</tr>
<tr>
<td>W0150</td>
<td>Terminal block</td>
<td>3</td>
<td>Screw connection for M6 ring cable lugs</td>
</tr>
<tr>
<td>W0210</td>
<td>Terminal block</td>
<td>3</td>
<td>Screw connection for M10 ring cable lug</td>
</tr>
</tbody>
</table>

Fig. 6-44: Design

**Identification of the individual connections:**

<table>
<thead>
<tr>
<th>Identification</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>phase 1</td>
</tr>
<tr>
<td>L2</td>
<td>phase 2</td>
</tr>
<tr>
<td>L3</td>
<td>phase 3</td>
</tr>
<tr>
<td>(PE)</td>
<td>equipment grounding conductor</td>
</tr>
</tbody>
</table>

Fig. 6-45: Identification of the individual connections mains connection

**Note:** Only with single-phase operation: connect the connecting lines of the mains voltage supply L1 and N with the connections L1 and L2.

### Connection Cross Section

<table>
<thead>
<tr>
<th>HCS02.1E-</th>
<th>Cross section single-wire [mm²]</th>
<th>Cross section multi-wire [mm²]</th>
<th>Cross section in AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0012, W0028</td>
<td>0,2-4</td>
<td>0,2-4</td>
<td>24-10</td>
</tr>
<tr>
<td>W0054, W0070</td>
<td>0,5-10</td>
<td>0,5-10</td>
<td>20-8</td>
</tr>
</tbody>
</table>

Fig. 6-46: Connection cross section
HCS03.1E- Cross section

<table>
<thead>
<tr>
<th>Cross section single-wire [mm²]</th>
<th>Cross section multi-wire [mm²]</th>
<th>Cross section in AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0070 16</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>W0100 35</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>W0150 50</td>
<td>2*25</td>
<td>0</td>
</tr>
<tr>
<td>W0210 95</td>
<td>2*50</td>
<td>4/0</td>
</tr>
</tbody>
</table>

Fig. 6-47: Connection cross section

HCS02.1E- Tightening torque [Nm]

<table>
<thead>
<tr>
<th>Type No. of poles</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0012, W0028</td>
<td>0,5 – 0,6</td>
</tr>
<tr>
<td>W0054, W0070</td>
<td>1,2 – 1,5</td>
</tr>
</tbody>
</table>

Fig. 6-48: Tightening torques

HCS03.1E- Tightening torque [Nm]

<table>
<thead>
<tr>
<th>Type No. of poles</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0070</td>
<td>1,5</td>
</tr>
<tr>
<td>W0100, W0150</td>
<td>6</td>
</tr>
<tr>
<td>W0210</td>
<td>25</td>
</tr>
</tbody>
</table>

Fig. 6-49: Tightening torques

Damage to the drive controller

⇒ Strain relief for the motor power cable must be provided within the control cabinet, or you can use the optionally available connection accessory HAS02.1.

Note: Observe the following for use within the scope of C-UL:

- Use 60/75 °C copper wire only
- Use Class 1 wire only or equivalent
- Suitable for use on a circuit capable of delivering not more than 8 kA (10 kA) rms symmetrical amperes for a maximum voltage of 500 V (400 V)

X5, Motor Connection

High electrical voltage! Danger to life, severe bodily harm by electric shock!

⇒ Always operate the drive controller with plugged on connector!

HCS02.1E- Type No. of poles

<table>
<thead>
<tr>
<th>Type</th>
<th>No. of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screw terminal block</td>
<td>4</td>
<td>Pins on device</td>
</tr>
</tbody>
</table>

Fig. 6-50: Design
<table>
<thead>
<tr>
<th>HCS03.1E-</th>
<th>Type</th>
<th>No. of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0070</td>
<td>Connector</td>
<td>4</td>
<td>Screw connection</td>
</tr>
<tr>
<td>W0100, W00150</td>
<td>Terminal block</td>
<td>3</td>
<td>Screw connection for M6 ring cable lugs</td>
</tr>
<tr>
<td>W0210</td>
<td>Terminal block</td>
<td>3</td>
<td>Screw connection for M10 ring cable lugs</td>
</tr>
</tbody>
</table>

Identification of the individual connections:

<table>
<thead>
<tr>
<th>Identification</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
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<tr>
<td>A2</td>
<td>phase 2</td>
</tr>
<tr>
<td>A3</td>
<td>phase 3</td>
</tr>
<tr>
<td>(PE)</td>
<td>equipment grounding conductor</td>
</tr>
</tbody>
</table>

Short Circuit Protection

The outputs A1, A2, A3 are short-circuit proof at the device output against each other and against ground.

Connection Cross Section

<table>
<thead>
<tr>
<th>HCS02.1E-</th>
<th>Cross section single-wire [mm²]</th>
<th>Cross section multi-wire [mm²]</th>
<th>Cross section in AWG</th>
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</thead>
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<td>24-10</td>
</tr>
<tr>
<td>W0054, W0070</td>
<td>0,5-10</td>
<td>0,5-10</td>
<td>20-8</td>
</tr>
</tbody>
</table>

Tightening Torque

<table>
<thead>
<tr>
<th>HCS02.1E-</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0012, W0028</td>
<td>0,5 – 0,6</td>
</tr>
<tr>
<td>W0054, W0070</td>
<td>1,2 – 1,5</td>
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<table>
<thead>
<tr>
<th>HCS03.1E-</th>
<th>Tightening torque [Nm]</th>
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</thead>
<tbody>
<tr>
<td>W0070</td>
<td>1,5</td>
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<tr>
<td>W0100, W0150</td>
<td>6</td>
</tr>
<tr>
<td>W0210</td>
<td>25</td>
</tr>
</tbody>
</table>

Fig. 6-51: Design

Fig. 6-52: Identification of the individual connections motor connection

Fig. 6-53: Connection cross section

Fig. 6-54: Connection cross section

Fig. 6-55: Tightening Torque

Fig. 6-56: Tightening Torque
Connection of the Motor Power Cable
For the connection between drive controller and motor, use Rexroth motor power cables (see documentation "Rexroth Connection Cables; Selection Data", DOK-CONNEC-CABLE*STAND-AUxx-EN-P).

---

Damage to the drive controller!
⇒ Strain relief for the motor power cables cannot be provided at the drive controller. Therefore, make sure strain relief of the motor power cables is provided in the control cabinet or cable use our special accessories HAS02.1.

---

Connection of Motor Cable to Drive Controller
There are the following minimum requirements for connecting the motor cables to the drive controller:

- Connect the shield of the motor cable over the largest possible surface area (with low impedance) to the drive controller. The connection of cable shields by means of round wires (so-called "pig tails") at the cable ends to ground and housing is normally insufficient.
- Make sure there is sufficient strain relief for the motor cable itself.

Optional accessory HAS02 to be used with connection over a large surface area directly to the device. This is the best solution. The figure below illustrates this by the example of HCS02 drive controllers:

---

Shield Connection with Accessory HAS02

Fig. 6-57: Connecting HAS02 to HCS02

---

Shield Connection without Accessory HAS02
For shield connection without HAS02 accessory connect the cable shield with the lowest possible impedance to the drive controller.

The following paragraphs describe two basic alternatives of this kind of connection.
**Alternative 1**

Connect cable shield to a ground bus. The maximum distance between ground bus and device connection is 100 mm. For this purpose take the given length of the single strands at the cable end into account for ready-made Rexroth motor power cables.

1: drive controller  
2: clip for shield contact  
3: overall shield of the motor power cable folded back  
4: ground bus in control cabinet  
5: single strands of motor power cable  
6: connection of ground bus to supplying device  
7: strain relief (as near as possible to control cabinet outlet)

Fig. 6-58: Shield contact, alternative 1

- With a clip (2) connect overall shield of motor power cable (3) to ground bus (4). (If you use your own cable make sure the shields of the two inner pairs of wires are in contact with the overall shield.)
- With a cable (6) (line cross section at least 10 mm²) connect ground bus (4) to ground connection at supplying device (Rexroth IndraDrive supply unit or Rexroth IndraDrive drive controller HCS).
Alternative 2  Connect cable shield to a ground bus. The cable length between device and ground bus mustn't be more than a max. of 1 m. For this purpose prepare the motor cable in accordance with the description below:

- With a cable tie (2) press the drive-side cable end in such a way that the shields of the two inner pairs of wires (motor temperature, holding brake) have good contact with the overall shield of the motor power cable (3). (If you use your own cable make sure the shields of the two inner pairs of wires are in contact with the overall shield.)
- On the level of the ground bus in the control cabinet remove a piece of the cable sheath from the motor power cable in order to lay bare the overall shield (5).
- Connect overall shield (5) to ground bus in the control cabinet with an appropriate connection (clip). The connection must have a cross section of at least 10 mm².
- With a cable (6) (line cross section at least 10 mm²) connect ground bus (4) to ground connection at supplying device (Rexroth IndraDrive supply unit or Rexroth IndraDrive drive controller HCS).
- Make sure there is sufficient strain relief for the motor power cable as near as possible to the drive-side cable end (7).

Fig. 6-59: Shield contact, alternative 2
- In addition, make sure there is sufficient strain relief for the motor power cable as near as possible to the control cabinet outlet of the motor power cable (8).

**Note:** Do not remove the shield of the motor cable between ground bus and device.

If the motor cables are routed to the control cabinet via flange boxes, the shield is directly connected to the wall of the control cabinet over a large surface area via the housing of the flange box. Make sure there is sufficient separate strain relief.

**Bonding Conductor**

Bad ground connection between motor housing and control cabinet housing, as well as long motor cables, can require additional routing of a bonding conductor of a cross section of normally 10 mm² between control cabinet housing and motor housing.

**Note:** For cable lengths of more than 50 m the cross section should be at least 35 mm².

**Shield Connection of Kit Motors**

For kit motors make sure that the connection lines are run in shielded form or under metal between winding and terminal box, if the terminal box is not directly mounted on the spindle case.

**Shield Connection for Linear Motors**

For linear motors connect the shield of the connection cable between primary part and terminal box via clips to machine housing or metal shell.

**Shielding of Temperature Monitor and Brake**

The inner shields of temperature monitor and brake in the motor cable are connected to the drive controller at one end.

**X6, Motor Temperature Monitoring and Motor Holding Brake**

The drive controller is supplied with 24V for the motor holding brake via the control voltage connection.

---

**DANGER**

High electrical voltage! Danger to life, severe bodily harm by electric shock!

⇒ Always operate the drive controller with plugged on connector, because high voltages can occur at the connector at the end of the cable (coming from motor).

### Design

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring tension</td>
<td>4</td>
<td>Pins on device</td>
</tr>
</tbody>
</table>

Fig. 6-60: Design

### Connection

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MotTemp+</td>
<td>Monitoring the motor temperature</td>
</tr>
<tr>
<td>2</td>
<td>MotTemp-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>+24 V</td>
<td>Motor holding brake</td>
</tr>
<tr>
<td>4</td>
<td>0 V</td>
<td></td>
</tr>
</tbody>
</table>
**HCS02.1N-W0012, -W0028, -W0054, -W0070:**

<table>
<thead>
<tr>
<th>Cross section single-wire [mm²]</th>
<th>Cross section multi-wire [mm²]</th>
<th>Cross section in AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.14-1.5</td>
<td>0.14-1.5</td>
<td>28-16</td>
</tr>
</tbody>
</table>

Fig. 6-61: Connection cross section

**HCS03.1E-W0070:**

<table>
<thead>
<tr>
<th>Cross section single-wire [mm²]</th>
<th>Cross section multi-wire [mm²]</th>
<th>Cross section in AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,5</td>
<td>1,5</td>
<td>16</td>
</tr>
</tbody>
</table>

Fig. 6-62: Connection cross section X6 (HCS03.1E-W0070)

**HCS03.1E-W0100, -W0150 and W0210:**

<table>
<thead>
<tr>
<th>Cross section single-wire [mm²]</th>
<th>Cross section multi-wire [mm²]</th>
<th>Cross section in AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,5</td>
<td>2,5</td>
<td>12</td>
</tr>
</tbody>
</table>

Fig. 6-63: Connection cross section X6 (HCS03.1E-W0100...W0210)

**Note:** Make sure the voltage supply for the motor holding brake is sufficient. In this respect observe the lengths and cross sections of the cables used.

Fig. 6-64: Motor cable, temperature monitor and holding brake connection
Maximum allowed braking current:
- HCS02.1N-W0012…-W0070: 2.0 A_{\text{eff}}
- HCS03.1N-W0070…-W0210: 2.0 A_{\text{eff}}

Where braking currents are higher, the motor holding brake must be activated by means of an external contact element.

The contact elements used in the drive controller are subject to wear. **Guaranteed number of switching actions** at max. time constant of load < 50 ms \( (L_{\text{Brake}}/(24V/I_{\text{Brake}})) \): 250,000.

**Maximum switching frequency:** 0.5 Hz

---

**Dangerous movements! Danger to personnel from falling or slipping axes!**

⇒ The standard motor holding brake provided or an external motor holding brake controlled directly by the drive controller are not sufficient on their own to guarantee the safety of personnel!

⇒ Personnel safety must be achieved using higher-ranking, fail-safe procedures:

- Dangerous areas should be blocked off with protective fences or grids.
- Additionally secure vertical axes against falling or sinking after switching off the motor power by, for example:
  - mechanically locking the vertical axis
  - providing external braking/catching/clamping mechanisms
  - adequately counterbalancing the axis.

For the current consumption of the motor holding brake see the project planning documentation for the AC motors.

The motor holding brake of the AC motors has not been designed as a service brake. After approximately 20,000 motor revolutions against the closed brake armature disc it will be worn.

The drive controller can assume the control of the motor holding brake.

**X9, Connection of Braking Resistor**

**Lethal electric shock caused by live parts with more than 50 V!**

⇒ Exclusively operate the drive controller with plugged on connector!

### Design

<table>
<thead>
<tr>
<th>Design</th>
<th>Type</th>
<th>No. of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS02.1E-</td>
<td>W0054, W0070</td>
<td>2</td>
<td>Pins on device</td>
</tr>
</tbody>
</table>

---

Fig. 6-65: Design
### Identification of the individual connections:

<table>
<thead>
<tr>
<th>Identification</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phase 1</td>
</tr>
<tr>
<td>2</td>
<td>Phase 2</td>
</tr>
</tbody>
</table>

### Connection Cross Section

<table>
<thead>
<tr>
<th>HCS02.1E-</th>
<th>Cross section single-wire [mm²]</th>
<th>Cross section multi-wire [mm²]</th>
<th>Cross section in AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0054, W0070</td>
<td>0.5-10</td>
<td>0.5-10</td>
<td>20-8</td>
</tr>
</tbody>
</table>

### Tightening Torque

<table>
<thead>
<tr>
<th>HCS02.1E-</th>
<th>Tightening torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>W0054, W0070</td>
<td>1.2 – 1.5</td>
</tr>
</tbody>
</table>

### Note:

With twisted or shielded cable, the maximum cable length for the braking resistor is 5 m.
X13, Control Voltage (+24 V, 0 V)
The external 24V supply is applied via connection X13 for
• the power section of the drive controller
• brake control via X6 and
• the control section of the drive controller

With regard to control voltage supply, the HCS02.1 drive controllers are available in two different designs.
• Standard design HCS02.1E-W****-***N:
The control voltage is supplied by an external 24V power supply unit.
• Optional design HCS02.1E-W****-***V:
The control voltage is supplied by an integrated 24V power supply unit.
A power supply unit that makes available the control voltage supply for the power section and the control section from the DC bus is integrated in the drive controller.

Note:
• Falling short of the permissible control voltage leads to a corresponding error message (=> refer also to firmware function description).
• Interruption to the control voltage when the motor is running leads to torque-free (brakeless) runout in the motor.

Note on design -***V:
• The brake supply has to be realized via an external power supply unit.
• Applying the external supply voltage for the purpose of buffering at no-power operation is allowed.
• Load at the terminal X13 is not allowed.

DANGER
Dangerous movement caused by brakeless motor coasting to stop in the event of an interruption to the control voltage supply!
⇒ Do not stay within the motional range of the machine. Possible measures to prevent personnel from accidentally accessing the machine:
   – protective fencing
   – protective grid
   – protective cover
   – light barrier.
⇒ Fencing and covers must be adequately secured against the maximum possible force of movement.
Design

<table>
<thead>
<tr>
<th>Type</th>
<th>Number of poles</th>
<th>Type of design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring power</td>
<td>4</td>
<td>Pins on connector</td>
</tr>
</tbody>
</table>

Fig. 6-72: Design

Connection Cross Section

<table>
<thead>
<tr>
<th>Cross section</th>
<th>Cross section</th>
<th>Cross section</th>
</tr>
</thead>
<tbody>
<tr>
<td>single-wire</td>
<td>multi-wire</td>
<td>in AWG</td>
</tr>
<tr>
<td>[mm²]</td>
<td>[mm²]</td>
<td></td>
</tr>
<tr>
<td>0.14-1.5</td>
<td>0.14-1.5</td>
<td>28-16</td>
</tr>
</tbody>
</table>

Fig. 6-73: Connection Cross Section

Connection

<table>
<thead>
<tr>
<th>Connection</th>
<th>Load Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3, 4</td>
<td>+24 V</td>
</tr>
<tr>
<td>1, 2</td>
<td>0 V</td>
</tr>
</tbody>
</table>

Fig. 6-74: Identification of the individual connections

Load Capacity

<table>
<thead>
<tr>
<th>Load Capacity</th>
<th>Line cross section</th>
<th>max. allowed inductance between 24V supply source and X13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Looping through the power supply</td>
<td>up to max. 6 A&lt;sub&gt;off&lt;/sub&gt; allowed</td>
<td>100 µH (corresponds to approx. 2*75 m)</td>
</tr>
<tr>
<td>Polarity reversal protection</td>
<td>over the allowed voltage range by internal protective diode of +24V circuit</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 6-75: Load capacity

Note: The input 0 V connected in conductive form with the housing potential. It is therefore impossible to use an insulation monitor at +24 V and 0 V against housing.

Lines +24 V and 0 V

<table>
<thead>
<tr>
<th>Lines +24 V and 0 V</th>
<th>Line cross section</th>
<th>max. allowed inductance between 24V supply source and X13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line cross section</td>
<td>min. 1 mm&lt;sup&gt;2&lt;/sup&gt;</td>
<td>100 µH (corresponds to approx. 2*75 m)</td>
</tr>
<tr>
<td>Line routing</td>
<td>preferably in parallel</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 6-76: Supply line 24 V
The control voltage supply is routed to the connection X13 from above (see following figure).

![Diagram showing control voltage supply at X13](image)

1: lines to control voltage supply

Fig. 6-77: Control voltage supply at X13

**Optional Control Voltage (HCS03)**

Control voltage is supplied by an external 24V power supply unit.

**Note:** Technical data of control voltage: see section "Electrical Data"

**Design**

The control voltage supply is connected via contact bars and screws (M6) at the front of the drive controller. Depending on the width of the drive controllers, there are contact bars of different lengths.

**Tightening Torque**

6 Nm

**Multiple-Line Arrangement**

The following figures show the correct control voltage connection for stacked drive controllers. The illustrated way of connection ensures that the touch guard can be correctly mounted and the required clearances and creepage distances can be complied with.

The cables have to be twisted. Observe the notes in chapter "Arranging the Components in the Control Cabinet", section "Installing the 24V Supply".
Cable Routing to the Left:

![Diagram of cable routing to the left]

Fig. 6-78: Control voltage connections for cable routing to the left

Cable Routing to the Right:

![Diagram of cable routing to the right]

Fig. 6-79: Control voltage connections for cable routing to the right
DC Bus (L+, L-)

By means of the DC bus connection, the following components are linked:

- several drive controllers to one another, and
- drive controllers to additional components in order to increase the stored power by means of DC bus capacitor unit
  - increase the permissible braking resistor continuous output by means of DC bus resistor unit

**Design**

The DC bus is connected via contact bars and screws (M6) at the front of the drive controller. Depending on the width of the drive controllers, there are contact bars of different lengths.

**Tightening Torque**

6 Nm

**DC Bus Wiring**

If in special cases it is not possible to use the DC bus rails for connection, connection must be established using the shortest possible twisted wires.

| Length of twisted wire | HCS02: max. 2 m  
| HCS03: max. 4 m |
| Wire cross section | min. 10 mm², but not less than supply feeder cross section |
| Wire protection | by means of fuses in the mains supply |
| Dielectric strength of single strand against ground | > 750 V (e.g.: strand type - H07) |

---

**Damage caused by voltage arcing!**

⇒ If drive controllers are stacked in the control cabinet, the connections for the DC buses between the drive controllers have to be correctly made.

The figures below illustrate the correct DC bus connection for stacked drive controllers. The illustrated way of connection keeps bare wire sections from being situated directly vis-à-vis. This avoids voltage arcing. The cables have to be twisted.

---

**Risk of damage!**

⇒ Connect the devices both to the left and to the right screw connection at the terminal block.
Cable Routing to the Left:

**Damage caused by voltage arcing!**

⇒ Insulate ring terminals and connecting lines with a heat-shrinkable sleeve. Afterwards only strip the insulation of the contact surface of the ring terminal. Realize connections according to figure.

---

**Fig. 6-80:** DC bus connections for cable routing to the left
Cable Routing to the Right:

**Damage caused by voltage arcing!**

⇒ Insulate ring terminals and connecting lines with a heat-shrinkable sleeve. Afterwards only strip the insulation of the contact surface of the ring terminal.

---

**Connection Point of Equipment Grounding Conductor and Equipment Grounding Connections**

**Dangerous contact voltage at device housing! Lethal electric shock!**

⇒ Connect the drive controller to the equipment grounding system via connection X3 (mains).

---

**Ground Connection of Housing**

The ground connection of the housing is used to provide functional safety of the drive controllers and protection against contact in conjunction with the equipment grounding conductor.

Ground the housings of the drive controllers:

1. Connect the bare metal back panel of the drive controller in conductive form to the mounting surface in the control cabinet. To do this use the supplied mounting screws.

2. Connect the mounting surface of the control cabinet in conductive form to the equipment grounding system.
XS1, Shield Connection (Control Wires)

Fig. 6-82: Shield connection XS1

Connection for shields of lines connected to the control section (only for lines with connectors, which do not have their own shield connection).

**Note:** Always connect shields of control lines with a large metal-to-metal contact surface.

---

**CAUTION**

Risk of damage caused by high temperature of outlet air!
⇒ Observe outlet temperatures at the top of the drive controllers.
XS2, Shield Connection HCS02 (Motor Cable)

Fig. 6-83: XS2

XS2 is used for mounting the accessory HAS02.1 for shield connection of the motor cable.
Control Sections BASIC OPENLOOP - CSB01.1N-FC

Front View with Connections at Basic Circuit Board:

<table>
<thead>
<tr>
<th>Front view</th>
<th>Connec tion point</th>
<th>Strande d wire [mm²]</th>
<th>AWG</th>
<th>Tightening torque [Nm]</th>
<th>Description</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X31 / X32</td>
<td>0,08-1,5</td>
<td>28-14</td>
<td></td>
<td>digital and analog inputs/outputs; voltage input (24V, 0V)</td>
<td><img src="image" alt="X31/X32" /></td>
</tr>
<tr>
<td></td>
<td>X11 / X12</td>
<td>0,08-1,5</td>
<td>28-14</td>
<td></td>
<td>relay contacts</td>
<td><img src="image" alt="X11/X12" /></td>
</tr>
<tr>
<td></td>
<td>X35 / X36</td>
<td>0,08-1,5</td>
<td>28-14</td>
<td></td>
<td>analog inputs / outputs; voltage output (24V, 0V)</td>
<td><img src="image" alt="X35/X36" /></td>
</tr>
<tr>
<td></td>
<td>X2</td>
<td>0.25-0.5</td>
<td>-</td>
<td></td>
<td>serial interface</td>
<td><img src="image" alt="X2" /></td>
</tr>
<tr>
<td></td>
<td>H1</td>
<td>-</td>
<td>-</td>
<td></td>
<td>interface for control panel</td>
<td><img src="image" alt="H1" /></td>
</tr>
</tbody>
</table>

see also chapter “Connections with Spring Terminals”

Fig. 6-84: Connections BASIC OPENLOOP
## Functions

**Note:** Factory settings depend on the firmware. Following settings are valid for firmware MPx04.

<table>
<thead>
<tr>
<th>Function</th>
<th>Connec tion</th>
<th>Factory setting</th>
<th>Nominal data</th>
<th>Technical data</th>
</tr>
</thead>
<tbody>
<tr>
<td>relay contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rel 3</td>
<td>no Rel 3</td>
<td>X11.3 &quot;speed reached&quot;, S-0-0013</td>
<td>AC250V /2A</td>
<td>relay contact</td>
</tr>
<tr>
<td></td>
<td>com Rel 3</td>
<td>X11.4</td>
<td></td>
<td>type 1</td>
</tr>
<tr>
<td></td>
<td>nc Rel 3</td>
<td>X11.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relay contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rel 2</td>
<td>no Rel 2</td>
<td>X12.3 &quot;Ready&quot;, P-0-0115</td>
<td>AC250V /2A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>com Rel 2</td>
<td>X12.4</td>
<td>DC30V /1A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nc Rel 2</td>
<td>X12.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>relay contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rel 1</td>
<td>no Rel 1</td>
<td>X12.1 ready for operation, P-0-0115</td>
<td>AC250V /2A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>no Rel 1</td>
<td>X12.2</td>
<td>DC30V /1A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>digital inputs</td>
<td>E1</td>
<td>X31.3 &quot;clear error&quot;, S-0-0099</td>
<td>24 V / 3 mA</td>
<td>digital inputs</td>
</tr>
<tr>
<td></td>
<td>E2</td>
<td>X31.4 &quot;drive ON&quot;, P-0-4028</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E3</td>
<td>X31.5 &quot;velocity cmd value from memory of fixed values&quot;, P-0-1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E4</td>
<td>X31.6 &quot;velocity cmd value from memory of fixed values&quot;, P-0-1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E5</td>
<td>X31.7 &quot;velocity cmd value from memory of fixed values&quot;, P-0-1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E8</td>
<td>X32.6 &quot;E-Stop&quot;, P-0-0223</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E9</td>
<td>X32.7 &quot;velocity cmd value from memory of fixed values&quot;, P-0-1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E10</td>
<td>X32.8 &quot;velocity cmd value from memory of fixed values&quot;, P-0-1200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Analog Inputs

<table>
<thead>
<tr>
<th>Function</th>
<th>Connector</th>
<th>Factory Setting</th>
<th>Nominal Data</th>
<th>Technical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage input</td>
<td>EA1+</td>
<td>X32.4</td>
<td>+/- 10 V</td>
<td>Analog inputs type 1</td>
</tr>
<tr>
<td></td>
<td>EA1-</td>
<td>X32.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage input</td>
<td>EA2+</td>
<td>X32.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EA2-</td>
<td>X32.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current input</td>
<td>AI1+</td>
<td>X36.1</td>
<td>0…20 mA</td>
<td>Analog inputs type 3</td>
</tr>
<tr>
<td></td>
<td>AI1-</td>
<td>X36.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current input</td>
<td>AI2+</td>
<td>X36.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AI2-</td>
<td>X36.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Analog Outputs

<table>
<thead>
<tr>
<th>Function</th>
<th>Connector</th>
<th>Factory Setting</th>
<th>Nominal Data</th>
<th>Technical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage output</td>
<td>AN1</td>
<td>X32.9</td>
<td>0…+10 V</td>
<td>Analog outputs type 1</td>
</tr>
<tr>
<td>Reference potential for analog voltage output</td>
<td>A_GND</td>
<td>X32.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Connector</th>
<th>Factory Setting</th>
<th>Nominal Data</th>
<th>Technical Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage output</td>
<td>AN2</td>
<td>X35.3</td>
<td>0…+10 V</td>
<td>Analog outputs type 1</td>
</tr>
<tr>
<td>Reference potential for analog voltage output</td>
<td>A_GND</td>
<td>X35.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Input for Voltage Supply of Digital Inputs

<table>
<thead>
<tr>
<th>Function</th>
<th>Connector</th>
<th>Factory Setting</th>
<th>Nominal Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply of digital inputs</td>
<td>+24V</td>
<td>X31.8</td>
<td>DC 19…30 V; max. 0,1A</td>
</tr>
<tr>
<td></td>
<td>0V</td>
<td>X31.9</td>
<td></td>
</tr>
</tbody>
</table>

### Output (Source) for Voltage Supply of Digital Inputs

<table>
<thead>
<tr>
<th>Function</th>
<th>Connector</th>
<th>Factory Setting</th>
<th>Nominal Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect supply (source) of digital inputs with X31.8 or X31.9</td>
<td>+24V</td>
<td>X35.1</td>
<td>DC 19…30 V max. 0,1A; protected against polarity reversal; short-circuit proof</td>
</tr>
<tr>
<td></td>
<td>0V</td>
<td>X35.2</td>
<td></td>
</tr>
</tbody>
</table>

### Serial Interface

<table>
<thead>
<tr>
<th>Function</th>
<th>Connector</th>
<th>Factory Setting</th>
<th>Nominal Data</th>
<th>Technical Data</th>
</tr>
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<tbody>
<tr>
<td>Serial Interface</td>
<td>X2</td>
<td></td>
<td></td>
<td>Corresponds to RS232</td>
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</table>

Fig. 6-85: Functions BASIC OPENLOOP
### BASIC PROFIBUS - CSB01.1N-PB

**Front View with Connections at Basic Circuit Board**

<table>
<thead>
<tr>
<th>Front view</th>
<th>Connection point</th>
<th>Stranded wire [mm²]</th>
<th>AWG</th>
<th>Tightening torque [Nm]</th>
<th>Description</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X8</td>
<td>0,25-0,5</td>
<td>-</td>
<td>-</td>
<td>encoder evaluation ENS</td>
<td><img src="DA000053_v1_nn.FH9" alt="Encoder Evaluation ENS" /></td>
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<tr>
<td></td>
<td>X31 / X32</td>
<td>0,08-1,5</td>
<td>28-14</td>
<td>-</td>
<td>digital inputs/outputs; voltage input (24V, 0V)</td>
<td><img src="DA000051_v1_nn.FH9" alt="Digital Inputs/Outputs" /></td>
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<tr>
<td></td>
<td>X41</td>
<td>0,25-0,5</td>
<td>-</td>
<td>-</td>
<td>optional: starting lockout</td>
<td><img src="DA000054_v1_nn.FH9" alt="Optional Starting Lockout" /></td>
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<tr>
<td></td>
<td>X30</td>
<td>0,08-0,5</td>
<td>-</td>
<td>-</td>
<td>master communication PROFIBUS</td>
<td><img src="DA000054_v1_nn.FH9" alt="Master Communication PROFIBUS" /></td>
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<tr>
<td></td>
<td>X2</td>
<td>0,25-0,5</td>
<td>n.s.</td>
<td>-</td>
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<td>H1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>interface for control panel</td>
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---

**Fig. 6-86: BASIC PROFIBUS**

---

*see also chapter "Connections with Spring Terminals"*
**Functions**

**Note:** Factory settings depend on the firmware. Following settings are valid for firmware MPx04.

**Note:** Observe that the connections X32.6, X32.7 and X32.8 can be configured as digital input (E8, E9, E10) or digital output (A8, A9, A10).

<table>
<thead>
<tr>
<th>Function</th>
<th>Connection point</th>
<th>Factory setting</th>
<th>Nominal data</th>
<th>Technical data</th>
</tr>
</thead>
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<td>PB X30</td>
<td>12 MBaud</td>
<td></td>
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<tr>
<td>encoder interfaces</td>
<td>ENS</td>
<td>X8</td>
<td>DC11V6; 300 mA</td>
<td>see Technical Data Optional Module ENS</td>
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<td>relay contact</td>
<td>E1  X31.1</td>
<td>&quot;ready for operation&quot; P-0-0115</td>
<td>DC24V / 1A</td>
<td>relay contact type 2</td>
</tr>
<tr>
<td></td>
<td>E2  X31.4</td>
<td></td>
<td>24 V / 3 mA</td>
<td>digital inputs</td>
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<tr>
<td></td>
<td>E3  X31.5</td>
<td>&quot;travel range limit switch&quot; P-0-0222</td>
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<td>digital inputs</td>
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<tr>
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<td>E4  X31.6</td>
<td>&quot;travel range limit switch&quot; P-0-0222</td>
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<td>digital inputs</td>
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<td>E5  X31.7</td>
<td>&quot;home switch&quot; S-0-0400</td>
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<td></td>
<td>E8  X32.6</td>
<td>&quot;E-Stop&quot; P-0-0223</td>
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<td></td>
<td>E9  X32.7</td>
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<td></td>
<td>E10 X32.8</td>
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<td>digital outputs</td>
<td>A8  X32.6</td>
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<td>24 V / 0,5 A</td>
<td>digital outputs</td>
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<td>A9  X32.7</td>
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<td></td>
<td>A10 X32.8</td>
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</tr>
<tr>
<td>voltage supply of digital inputs/outputs</td>
<td>+24V X31.8</td>
<td></td>
<td>DC 19...30 V; max. 1,1A</td>
<td></td>
</tr>
<tr>
<td>serial interface</td>
<td>RS232 X2</td>
<td></td>
<td></td>
<td>serial interface</td>
</tr>
<tr>
<td>optional: starting lockout</td>
<td>X41</td>
<td></td>
<td></td>
<td>see Optional Module Starting Lockout</td>
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</tbody>
</table>

**Fig. 6-87:** Functions BASIC PROFIBUS
Serial Interface (RS232) The serial interface (RS232) is required for programming, parameterization and diagnosis during commissioning and servicing.

<table>
<thead>
<tr>
<th>Connection point</th>
<th>Type</th>
<th>No. of poles</th>
<th>Stranded wire [mm²]</th>
<th>Description</th>
<th>Figure</th>
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<tr>
<td>X2</td>
<td>MiniDin, female (device)</td>
<td>8</td>
<td>0,25-0,5</td>
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Fig. 6-88: Connections

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<th>Signal</th>
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<tr>
<td>1</td>
<td>RTS</td>
<td>Request to send</td>
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<tr>
<td>2</td>
<td>CTS</td>
<td>Clear to send</td>
</tr>
<tr>
<td>3</td>
<td>TxD</td>
<td>Transmit Data</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>reference potential</td>
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<tr>
<td>5</td>
<td>RxD</td>
<td>Receive Data</td>
</tr>
<tr>
<td>6</td>
<td>Vcc</td>
<td>supply voltage</td>
</tr>
<tr>
<td>7</td>
<td>n.c.</td>
<td>n.c.</td>
</tr>
<tr>
<td>8</td>
<td>n.c.</td>
<td>n.c.</td>
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Fig. 6-89: Pin assignment of serial interface

Serial Interface to PC with 9-Pin SUB-D:

Fig. 6-90: Connection of serial interface to PC with 9-pin SUB-D

Note: For direct connection to the serial interface, use our cable IKB 0041.

Fig. 6-91: Connection of serial interface to PC with 25-pin SUB-D
## Accessories HAS

### Overview

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Fig. 6-92: Accessories HAS01

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</table>

Fig. 6-93: Accessories HAS02
Basic Accessories HAS01

Accessories for mounting and installation of drive controllers in combination, i.e. next to each other.

Type Code:

<table>
<thead>
<tr>
<th>Abbrev. Column</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example:</td>
<td>H A S 0 1</td>
<td>1 - 0 5 0 - 0 7 2 - M 2</td>
<td></td>
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</tbody>
</table>

1. **Product**
   1.1 Accessories IndraDrive . . . = HAS

2. **Line**
   2.1 Basic kit . . . . . . . . = 01

3. **Design**
   3.1 1 . . . . . . . . . . = 1

4. **Device width**
   4.1 50 . . . . . . . . . . = 050
   4.2 65 . . . . . . . . . . = 065
   4.3 75 . . . . . . . . . . = 075
   4.4 100 . . . . . . . . . . = 100
   4.5 105 . . . . . . . . . . = 105
   4.6 125 . . . . . . . . . . = 125
   4.7 150 . . . . . . . . . . = 150
   4.8 175 . . . . . . . . . . = 175
   4.9 200 . . . . . . . . . . = 200
   4.10 225 . . . . . . . . . . = 225
   4.11 250 . . . . . . . . . . = 250
   4.12 350 . . . . . . . . . . = 350

5. **Bus-bar**
   5.1 with cross-sectional area 48 mm² . . . . . . . . = 048
   5.2 with cross-sectional area 72 mm² . . . . . . . . = 072
   5.3 without . . . . . . . . . . = NNN

6. **Other design**
   6.1 Compact units . . . . . . . . . . . . . . . . = CN
   6.2 Compact unit, HCS04.1E×500 . . . . . . . . = CA
   6.3 Modular units in line "02" . . . . . . . . . . = M2
   6.4 Modular units . . . . . . . . . . . . . . . . = MN
   6.5 none . . . . . . . . . . . . . . . . . . . . . = NN

Note:
1 only for device width of "065", "105", "125", "150", "175", "225", "250" and "350"

Fig. 6-94: Type code HAS01.1

As adjusted to the device widths, the basic accessories are supplied with or without contact bars.

HAS01 without contact bars and HAS01 with contact bars.

- Example 1: **Without** contact bars (-NNN).
- Example 2: **With** contact bars to interconnect the DC buses (e.g. -048 or -072); the bars are adjusted to the device width.
- Example 3: **With** contact bars to interconnect the DC buses (e.g. -048 or -072); the bars are adjusted to the device width. In addition, the joint bars for connecting the equipment grounding conductors are contained in this case.
Note: Please observe that the contact bars of the basic accessories HAS01 are used for connection to the drive controller to the left side.

Applications
The HAS01 accessories are used to
- fasten the drive controllers on a mounting surface,
- interconnect the DC bus connections of drive controllers,
- connect the 24V supply of drive controllers of the Rexroth IndraDrive M range,
- establish the connection of the equipment grounding conductors from drive controller to drive controller or supply module,
- increase the current carrying capacity of the contact bars in the DC bus.

Scope of Supply
The basic accessories HAS01 without contact bars is contained in the standard scope of supply of the HCS02 drive controllers.

Further Accessories
Note: You find a complete overview of available accessories in the Project Planning Manual "Rexroth IndraDrive Drive System".
Accompanying Note

The accessories will be delivered with an accompanying note. The accompanying note shows the parts of the accessories.

Fig. 6-95: Accompanying note (example)
Mounting the Parts "Bar" and "End Piece" from the HAS01 Accessories

The parts "bar" and "end piece" increase the current carrying capacity of the DC bus connection by reducing the involved contact resistances.

1: bar  
2: end pieces (right end)  
3: end pieces (left end)  

Fig. 6-96: Mounting bar and end piece from HAS01

- Ad 1: Use the bars contained in all HAS01.1-***-072-** at L+ and L- as illustrated above.
- Ad 2 and 3: Use the end pieces contained in all HAS01.1-350-***-** and HAS01.1-200-***-** at the right and left ends of the DC bus connections in the drive system.
Shield Connection HAS02

Accessories for appropriate connection of the motor cable to the drive controller, especially the shield connection of the motor cable.

There are appropriate HAS02 available for the different connection cross sections of the drive controllers.

Type Code

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<tr>
<th>Abbrev. Column</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>0</th>
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<td>Example</td>
<td>H A S 0 2 . 1 - 0 0 1 - N N N - N N</td>
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<td></td>
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</tr>
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</table>

1. **Product**
   1.1 Accessories
   IndraDrive... = HAS

2. **Line**
   2.1 Shield connection... = 02

3. **Design**
   3.1 ........................ = 1

4. **Device assignment**
   4.1 HMS01.1N-W0020 ......... = 001
   4.2 HMS01.1N-W0036 ......... = 001
   4.3 HMS01.1N-W0054 ......... = 002
   4.4 HMS01.1N-W0070 ......... = 002
   4.5 HMD01.1N-W0020 ......... = 002
   4.6 HMD01.1N-W0036 ......... = 002
   4.7 HCS02.1E-W0012 .......... = 002
   4.8 HCS02.1E-W0028 .......... = 002
   4.9 HCS02.1E-W0054 .......... = 002
   4.10 HCS02.1E-W0070 .......... = 002
   4.11 HMS01.1N-W0150 .......... = 003
   4.12 HMS01.1N-W0210 .......... = 003
   4.13 HCS03.1E-W0070 .......... = 004
   4.14 HCS03.1E-W0100 .......... = 005
   4.15 HCS03.1E-W0150 .......... = 005
   4.16 HNK01.1A-A075-E0050 ...... = 006
   4.17 HNK01.1A-A075-E0080 ...... = 007
   4.18 HNK01.1A-A075-E0106 ...... = 007
   4.19 HCS03.1E-W0210 .......... = 008
   4.20 HNK01.1A-A075-E0146 ...... = 009
   4.21 HMS02.1N-W0028 .......... = 010
   4.22 HMS02.1N-W0054 .......... = 011
   4.23 HCS04.1E-X0500 .......... = 012

5. **Other feature**
   5.1 none ........................ = NNN

6. **Other design**
   6.1 none ........................ = NN

Fig. 6-97: Type code HAS02.1
Applications
The HAS02 accessories are used to

- provide the motor connection cables with a strain relief,
- connect the shield of the motor connection cables to the drive controller.

Scope of Supply
The HAS02 accessories are available as an option, they are not part of the standard scope of supply.
Fig. 6-98: Accompanying note
**Fig. 6-99: Accompanying note**
Fig. 6-100: Accompanying note
Fig. 6-101: Accompanying note
Mounting the HAS02 Accessories
The sheet metal of the accessories is screwed to the bottom of the drive controller (see also figure below):

- Unscrew bottom or bottom left fixing screw of drive controller.
- Put sheet metal of accessories to bottom of drive controller and screw down fixing screw of drive controller again.

![Image of screwing process]

---

**Risk of damage to the drive controller caused by too long screws!**

⇒ Exclusively use the supplied screws of a length of 12 mm for the thread of the shield connection XS2.

---

- Screw second screw (M6 x 12) in thread XS2 at bottom of drive controller.
- Screw fixing device to sheet metal of accessories according to desired cable routing of motor cable (45° or horizontal). (The figure below illustrates cable routing with 45°.)
- According to diameter of motor cable, fix motor cable to corresponding support of fixing device (12-18 mm or 19-30 mm) with a clip. Make sure that shield of motor cable has good contact with fixing device.

**Diagram: Shield connection of motor cable**

1: screw in thread XS2
2: sheet metal of accessories
3: fixing device
4: shield of motor cable
5: clip

Fig. 6-102: Shield connection of motor cable
1. By means of supplied screws, fasten shield angle steel to bottom of drive controller.
2. Fix support to shield angle steel as required.

3. Fix shield of motor cable to shielding plate with a clip.

**Note:** Adapt the size of the clip to the motor cable cross section.

1. Hang up support at guide section at bottom of drive controller and fasten it by means of supplied screws.
2. Screw shielding plate to shield angle steel.

According to required motor cable routing, it is possible to mount angle plate for shield connection in different positions:
- motor cable routed in parallel or
- 45° to bottom of drive controller.
Mounting Shield Connection HAS02.1-008-NNN-NN to Drive Controller HCS03.1E-W0210:

1. By means of supplied screws (from the accessories kit SCHR-LIN-M6.0 x 12.0), fasten support to bottom of drive controller.
2. By means of supplied screws (from the accessories kit SCREW...M6 x 12), fasten shielding plate between the supports.

Note: Adapt the size of the clip to the motor cable cross section.

Fig. 6-104: Shielding plate HAS02.1-005-NNN-NN at the bottom of the drive controller HCS03.1E-W0100 / 0150

3. Fix shield of motor cable to shielding plate with a clip.
According to required power supply cable and motor cable routing, it is possible to mount shielding plate for shield connection in different positions.

3. Fix shield of power supply cable and motor cable to shielding plate with a clip.

**Note:** Adapt the size of the clip to the power supply cable and motor cable cross sections.

**Shield Connection of Motor Cable via Mains Filter**

For shield connection of the motor cable at the drive controller via the mains filter, a special shielding plate is available:

**Note:** Using the shielding plate guarantees optimum shield contact of the motor cable. You should therefore **always** use the shielding plate, **where possible**.

The shielding plate is only available as an option.

**Shield Connection of Motor Cable HAS02.1-006-NNN-NN with Mains Filter Mounted:**

1. Hang up shielding plate at bottom of mains filter at threaded bolts and fasten with supplied nuts.
2. Screw support to shielding plate.
   Clips can be mounted depending on motor cable cross section.
Fig. 6-106: Shielding plate HAS02.1-006-NNN-NN at the bottom of the mains filter (nominal current 50 A)

3. Fix shield of motor cable to shielding plate with a clip.

**Note:** The shield terminals must not be used to provide strain relief.

1. Hang up support at bottom of mains filter and fasten it by means of supplied screws.
2. Screw shielding plate of power supply cable to support.

According to required power supply cable routing, it is possible to mount shielding plate in different positions:

- power supply cable routed in parallel or,
- 45° to bottom of mains filter or,
- 90° to bottom of mains filter.
3. Fix shield of power supply cable to front side of mains filter with a clip.
For shield connection of the power supply cable at the mains filter, clips of various sizes are available according to cross sections and number of cables, which are hung up to the punched holes.

**Note:** The shield terminals must not be used to provide strain relief.
Accessories HAS05.1

Type code HAS05.1:

| Abbrev. Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 |
| Example: H A S 0 5 | 1 | 0 | 0 | 1 | N | N | N | N |

1. **Product**
   1.1 HAS. = HAS

2. **Line**
   2.1 Cable, connectors and adapter = 05

3. **Design**
   3.1 1 = 1

4. **Assignment**
   4.1 Adapter
      - HCS03.1E-W0070 = 001
      - HMF01.1..0070 = 002
      - Level emulation Encoder emulation = 003
      - DC bus, 2 x 50 mm² = 004
      - RS232/RS485 converter = 005

5. **Other features**
   5.1 none = NNN
   5.2 Fitting direction: on both sides = NNB
   5.3 Fitting direction: lefthand = NNL
   5.4 Fitting direction: righthand = NNR

6. **Other design**
   6.1 none = NN

To field 4. Assignment:
- Adapter: "001"
- Adapter: "002"
- Adapter: "003"
- Adapter: "004"
- Adapter: "005"

Fig. 6-108: Type code HAS05.1
Applications:

<table>
<thead>
<tr>
<th>HAS05-Typ</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAS05.1-001-NNN-NN</td>
<td>is used for electrical connection between motor filter HMF01.1A-D0K2-D0045 and HCS03.1E-W0070, as well as between mains filter HNK01.1A-A075-E0050 and HCS03.1E-W0070</td>
</tr>
<tr>
<td>HAS05.1-002-NNN-NN</td>
<td>is used for electrical connection between mains filter HNK01.1A-A075-E0050 and HCS03.1E-W0070, if a motor filter has been mounted between HCS03.1 and mains filter</td>
</tr>
</tbody>
</table>

Fig. 6-109: HAS05 type

Scope of Supply:
The HAS05.1 accessories have to be ordered separately.

Accessories **HAS05.1-001-NNN-NN**

Fig. 6-110: Accessories HAS05.1-001
When mounting the motor filter HMF01.1 to HCS03.1, connection from filter to drive controller is established via connector X5 of HAS05.1-001.

When mounting the mains filter HNK01.1 to HCS03.1, connection from filter to drive controller is established via connector X3 of HAS05.1-001.

Accessories HAS05.1-002-NNN-NN

Fig. 6-112: Sample mounting HCS03.1 / HMF01.1 / HNK01.1 with accessories HAS05.1
7 Commissioning and Parameterization

7.1 Basics

Control Panels

IndraDrive controllers are equipped with a control panel; its front consists of a display and keys located underneath it. The display shows operating states, command and error diagnoses, as well as present warnings. By means of the keys you can make settings, call information and trigger some commands.

The control panel for IndraDrive controllers can be supplied in two variants of different possibilities of display and performance:

- standard control panel
- comfort control panel

Via the serial interface of the controller it is additionally possible to connect an independent operator terminal VCP that can, for example, be integrated in the front of the control cabinet.

Parameters

Communication between master and drive takes place, with a few exceptions, by means of parameters.

Parameters are used for:

- determining the configuration
- parameterizing the control loop
- triggering and controlling drive functions and commands
- transmitting command values and actual values (according to requirements, cyclically or acyclically)

All operating data are mapped to parameters!

The operating data stored in parameters can be identified by means of the IDN. They can be read and transferred, if required. The user write access to parameters depends on the properties of the respective parameter and the current communication phase. Specific parameter values (operating data) are checked for validity by the drive firmware.

Data Storage and Parameter Handling

Several non-volatile data memories are available in an IndraDrive device:

- in the controller
- in the motor encoder (depending on motor type)

In addition, a volatile data memory (working memory) is available in the controller.

Condition as supplied of the Rexroth drive components:

- The controller memory contains the drive firmware and the controller-specific parameter values.
- The motor encoder memory contains the encoder-specific and, depending on the motor type, the motor-specific parameter values.

Storing the application-specific parameter values

The application-specific parameter values are stored in the controller. Due to the limited number of writing cycles of non-volatile storage media,
application-specific parameter values can be stored in the working memory (volatile memory), too.

**Saving Parameter Values**

Saving application-specific parameter values is required in the following cases:

- after initial commissioning of the machine axis or the motor
- before replacing the controller for servicing (if possible)

Application-specific parameter values can be saved via:

- "IndraWorks D" commissioning tool → saving the parameter values on external data carrier
- control master → saving the parameter values on master-side data carrier
- comfort control panel

**Parameter IDN Lists**

The drive supports master-side saving of parameter values by listing parameter identification numbers (IDNs). Using these lists guarantees complete storage of the application-specific parameter values. It is also possible to determine IDN lists defined by the customer.

**Loading Parameter Values**

Loading parameter values is required in the following cases:

- initial commissioning of the motor (loading basic parameter values and motor-specific parameter values)
- serial commissioning of machine axes at series machines (loading the values saved after initial commissioning)
- reestablishing a defined original status (repeated loading of the values saved after initial commissioning)
- replacing the controller for servicing (loading the current parameter values saved before servicing)
- Possibilities of loading parameter values to the controller:
  - motor encoder data memory → loading the parameter values by command or via the control panel during initial motor commissioning
  - "IndraWorks D" commissioning tool → loading the parameter values from external data carrier
  - control master → loading the parameter values from master-side data carrier
  - comfort control panel

**Checksum of Parameter Values**

By means of checksum comparison, the control master can determine whether the values of the application-specific parameter values currently active in the drive correspond to the values saved on the master side.
Master Communication Interfaces

The basic functions of master communication apply to each type of master communication, in the case of IndraDrive devices to SERCOS interface, field bus interface, parallel and analog interface.

Features

All variants of master communication supported by IndraDrive have the following functional features in common:

- **address assignment**
  → communication address to be freely parameterized (via master communication, serial and control panel) via parameter P-0-4025, **Drive address of master communication**

- **command processing**
  → drive commands to be externally activated (via master communication, serial and control panel)

- **device control** (status machine)
  → individual status machines for master communication and device

  - According to the variant of master communication, the master communication status machine has different functionality and complexity. The communication-specific states are distinguished and mapped to the status words of the corresponding master communication (e.g. for SERCOS: S-0-0014, S-0-0135).

  - The device status machine is independent of the variant of master communication and maps the device-specific states to parameter S-0-0424, **Status parameterization level**. We always distinguish operating mode (OM) and parameter mode (PM).

- **extended possibilities of control**
  - signal control word/signal status word (S-0-0144, S-0-0145)
  - multiplex channel

  See section "Possibilities of Control/Additional Functions" in the same chapter

Note: The status machine of the master communications is briefly outlined in this section; it will be described in detail, i.e. including the individual status transitions, in the main chapter of the respective master communication.
Parameterization Mode / Operating Mode

Communication Phases According to SERCOS Specification

Note: For drives of the IndraDrive range the communication phases according to SERCOS specification are valid for all kinds of master communication. The only restriction is that for field bus and parallel/analog interface only the communication phases 2, 3 and 4 are supported.

![Diagram of communication phases of the drive according to SERCOS specification](image)

Note: The currently valid communication phase is contained in parameter **S-0-0014, Interface status** (bit 0..2). For field bus drives there also is the parameter **P-0-4078, Field bus: status word** (bit 0, 1) for this purpose.

The individual phases (states) have the following functions:

- **P-1**: After it is switched on, the drive goes to phase –1 and carries out a baud rate scan. As soon as the drive receives valid SERCOS telegrams from the master, it changes to phase 0.
- **P0**: The master checks the SERCOS ring by sending synchronization telegrams. During phase 0 communication between master and drive isn’t possible yet.
- **P1**: When the ring is closed, the master changes to phase 1 and scans the slaves. In addition, it checks the configuration of the ring.
- **P2**: In phase 2 the complete drive parameterization can be carried out.

The following kinds of parameters **can only be changed in phase 2**:

- communication parameters (according to SERCOS)
- configuration of axis control (sampling times)
• all factory-specific settings (can only be changed via master password)

• **P3**: When changing from P2 → P3 only the parameters that can be changed in phase 2 (see above) are checked.
  In phase 3 the following parameters can be changed:
  • parameters for operating mode configuration
  • error reaction settings
  • motor configuration parameters, holding brake parameters
  • encoder configuration parameters
  • mechanical transmission elements (gear, feed constant)
  • scaling and polarity parameters, position data format, modulo value
  • configuration of analog and digital inputs/outputs
  • configuration of switch on / switch off sequence of drive enable (waiting times, ...)

**Note:** According to SERCOS specification, the parameterization mode is divided into phases 2 and 3. In phase 3 the limit values for all scaling-dependent parameters are not yet known. When these parameters are written in phase 3, the extreme value check is only carried out during phase switch to phase 4.

• **P4**: In phase 4, the so-called operating mode, only the cyclic data can be changed, the configuration parameters cannot. The switch to the operating mode always causes a new initialization of all functions available in the drive.

The supported communication phases, as well as the handling of the switching between the communication phases (e.g. parameterization and operating mode) are depending on the master communication that is used. The control information preset for master communication is displayed in parameter **P-0-4086, Master communication status**.

• **SERCOS interface**
  For SERCOS devices all 5 communication phases (as well as phase –1 → baud rate scan) are supported. According to SERCOS specification, switching takes place by setting the communication phase by the master.

• **Field bus interface**
  For field bus devices only the communication phases 2 to 4 are supported!

  Switching takes place in the freely configurable operating mode (P-0-4084 = 0xFFFF) by presetting the desired mode via bit 1 in **P-0-4077, Field bus: control word**.

  Switching can also take place by executing the transition check commands (see below).

• **Parallel/analog interface**
  For devices with analog or parallel interface only the communication phases 2 to 4 are supported!

  Switching always takes place when the transition check commands (see below) are executed.

After the controller is switched on it does not automatically go to the operating mode, but has to be switched to this mode by the master.

This switching of the drive controller to the operating mode is closely connected to establishing the readiness for operation.
The procedure comprises several steps and is controlled by the master by presetting communication phases –1 to 4 and starting/completing the following commands:

- S-0-0127, C0100 Communication phase 3 transition check
- S-0-0128, C0200 Communication phase 4 transition check

When the drive has reached communication phase 4 without error, the display reads "bb". The corresponding diagnostic message is:

- A0013 Ready for power on

### Transition Check Commands

To switch from communication phase 2 to 3 and from 3 to 4 it is necessary to activate transition check commands in the drive:

- S-0-0127, C0100 Communication phase 3 transition check
- S-0-0128, C0200 Communication phase 4 transition check

### Note:

In order to get back from the operating mode to the parameterization mode, there is the command P-0-4023, C0400 Communication phase 2 transition.

By executing the command S-0-0127, C0100 Communication phase 3 transition check a number of checks and parameter conversions are carried out that can possibly cause the listed command errors:

- Checking whether functional package selection was changed
  - C0199 Functional package selection changed. Restart
  → drive has to be rebooted before it is possible to switch to phase 3

- Checking validity of parameters required for switching to phase 3
  If one of these parameters has never been written or the backup was carried out incorrectly, the error message "C0101" is generated. The IDNs of the faulty parameters are listed in parameter S-0-0021, IDN list of invalid operating data for communication phase 2. These parameters have to be set valid by writing correct values to them.
  - C0101 Invalid parameters (-> S-0-0021)

- Checking device configuration
  - C0132 Invalid settings for controller cycle times
  - C0138 Invalid amplifier data (->S-0-0021)

- Checking telegram configuration, especially in the case of configured telegrams
  In this case a check is run to find out whether the parameters selected for the configurable data block in the cyclic command value channel (MDT) or actual value channel (AT) may be configured and whether the allowed length of the configurable data blocks is complied with.
  - C0104 Config. IDN for MDT not configurable
  - C0105 Maximum length for MDT exceeded
  - C0106 Config. IDNs for AT not configurable
  - C0107 Maximum length for AT exceeded

- If necessary, checking timing parameters for SERCOS communication in phases 3 and 4 for validity and compliance with requirements
  - C0108 Time slot parameter > Serco cycle time
  - C0109 Position of data record in MDT (S-0-0009) even
C0110 Length of MDT (S-0-0010) odd
C0111 ID9 + Record length - 1 > length MDT (S-0-0010)
C0112 TNcyc (S-0-0001) or TScyc (S-0-0002) error
C0113 Relation TNcyc (S-0-0001) to TScyc (S-0-0002) error
C0114 T4 > TScyc (S-0-0002) - T4min (S-0-0005)
C0115 T2 too small
C0116 T3 (S-0-0008) within MDT (S-0-0089 + S-0-0010)
C0139 T2 (S-0-0089) + length MDT (S-0-0010) > TScyc (S-0-0002)

If necessary, checking parameters for field bus communication for validity and compliance with requirements

C0154 Field bus: IDN for cycl. command val. not configurable
C0155 Field bus: max. length for cycl. command val. exceeded
C0156 Field bus: IDN for cycl. actual val. not configurable
C0157 Field bus: length for cycl. actual values exceeded
C0158 Field bus: Tcyc (P-0-4076) incorrect
C0159 Field bus: P-0-4077 missing for cycl. command values

Checking configuration of multiplex channel

C0118 Order of MDT configuration incorrect
C0151 IDN for command value data container not allowed
C0152 IDN for actual value data container not allowed

Limit value check of communication parameters and system

C0102 Limit error in parameter (-> S-0-0021)
C0103 Parameter conversion error (->S-0-0021)
C0131 Switching to phase 3 impossible

With the S-0-0128, C0200 Communication phase 4 transition check command the following checks and initializations are carried out that can possibly cause the listed command errors:

C0201 Invalid parameters (->S-0-0022)
C0212 Invalid control section data (->S-0-0022)

Checking motor and encoder configuration

C0219 Max. travel range too large
C0270 Error when reading encoder data => motor encoder
C0271 Incorrect parameterization of motor encoder (hardware)
C0272 Incorr. parameteriz. of motor enc. (mechanical system)
C0273 Modulo value for motor encoder cannot be displayed
C0274 Motor encoder unknown
C0275 Error when reading encoder data => optional encoder
C0276 Incorrect parameterization of optional enc. (hardware)
C0277 Incorr. parameteriz. of opt. enc. (mechanical system)
C0278 Modulo value for optional encoder cannot be displayed
C0279 Optional encoder unknown
C0280 Maximum travel range cannot be displayed internally
C0284 Invalid motor data in encoder memory (->S-0-0022)
C0285 Type of construction of motor P-0-4014 incorrect
C0286 Several motor encoders connected
C0287 Error during initialization of motor data (->S-0-0022)
C0288 Rotary scaling not allowed
C0289 Error at init. of synchr. motor with reluctance torque
C0290 Error when reading encoder data => measuring encoder
C0291 Incorr. prarmeterization of measuring enc. (hardware)
C0292 Measuring encoder unknown
C0293 Modulo value for measuring encoder cannot be displayed
C0294 Incorrect measuring encoder configuration

Checking modulo range
C0244 Act. modulo value cycle greater than max. travel range

Checks during encoder initialization
C0220 Error when initializing position of encoder 1
C0221 Initialization velocity encoder 1 too high
C0224 Error when initializing position of encoder 2
C0225 Initialization velocity encoder 2 too high
C0227 Error when initializing position of measuring encoder
C0228 Initialization velocity measuring encoder too high

Initializing optional additional functions (digital I/Os)
C0243 Brake check function not possible
C0250 Probe inputs incorrectly configured
C0260 Incremental enc. emulator resol. cannot be displayed

Initializing integrated safety technology
C0254 Configuration error PROFIsafe
C0255 Safety command for system init. incorrect
C0257 No encoder assigned to slot 1

Limit value check
C0202 Parameter limit error (->S-0-0022)
C0203 Parameter calculation error (->S-0-0022)

General system checks
C0245 Operating mode configuration (->S-0-0022) not allowed

Initializing fine interpolator
C0258 Error in relation TNyc (S-0-0001) to fine interpol.

Initializing digital inputs/outputs
C0246 Trav. range lim. switch not ass. to dig. input
C0247 Dig. output already assigned to other axis
C0248 Dig. input assigned differently to axes
C0249 Dig. I/Os: bit number too large

Checking interface configuration
C0242 Multiple configuration of a parameter (->S-0-0022)

Checking master communication
C0251 Error during synchronization to master communication
Default Settings in the Motor Encoder Data Memory ("Load Defaults Procedure")

**Loading Basis Parameter**

The following Rexroth housing motors are equipped with an encoder data memory:

- MHD, MKE, MKD
- MSK, MSH, MAD, MAF, MAL

**Note:** The Bosch motor with the type designation "SF..." that can be operated with IndraDrive controllers is equipped with an encoder data memory, too. As regards commissioning and parameters, SF motors have the same behavior as Rexroth housing motors with encoder data memory!

**Notes on Commissioning**

In the case of Rexroth housing motors with encoder data memory, the values for the motor parameters stored in the encoder, the measuring system parameters and, where required, the motor holding brake parameters are automatically loaded to the controller when the drive is switched on.

At the initial commissioning of a drive the **F2008 RL The motor type has changed.** error message will appear. This message only means that this motor has not yet been connected to the controller.

By clearing this error message (reset via control panel or S-0-0099, C0500 Reset class 1 diagnostics) **S-0-0262, C07_x Load defaults procedure command** is automatically started. Default control loop parameter values for this motor are thereby loaded.

**Note:** Depending on the setting in **P-0-4090, Index for C07 Load defaults procedure**, the following parameter values are loaded with the "load defaults procedure" command (S-0-0262):

- default control loop parameter values (default setting)
- basic parameter values (default parameter set) of the firmware.

In the case of motors with integrated holding brake, the type of motor holding brake and the activation of the brake control is automatically set in **P-0-0525, Holding brake control word.**

In the case of motors with several cooling type variants (MHD, MKD), the load data can be referred to the cooling type realized by entering the corresponding value in **P-0-0640, Cooling type.**

**Recommissioning**

When the machine is repaired the motor can be replaced by a motor of the same type without any problem. The adjustment to the controller does not need to be repeated. In the case of an absolute motor encoder, it is only necessary to make an adjustment to the machine axis by establishing the position data reference.

If the motor type connected to the controller has changed, the controller signals this with **F2008 RL The motor type has changed.** and requests the default control loop parameter values and the motor type parameter to be loaded. In the case of a desired motor change, initial commissioning of the new axis motor is necessary. Otherwise there is an assembly error that has to be corrected!
7-10 Commissioning and Parameterization

**Diagnostic Messages**

- While the default control loop parameter values and the motor type parameter is loaded the controller signals:
  
  **C07_0 Load defaults procedure com. (load controller param.)**

- If the parameter values in the encoder data memory cannot be read:
  
  **C0706 Error when reading the controller parameters**

- If the motor type connected to the controller has changed:
  
  **F2008 RL The motor type has changed.**

- If an invalid value for the commutation offset is contained in the encoder memory, the controller signals:
  
  **F2104 Commutation offset invalid**

**Load Defaults Procedure**

For all Rexroth motors of the series with motor encoder data memory (e.g. MHD, MKD, MKE, MSK and possibly MAD and MAF), the basic settings for the controllers are stored and can be loaded to the drive by executing the "load defaults procedure" command (S-0-0262).

There are two ways to activate the **S-0-0262, C07_x Load defaults procedure command** parameter:

- Automatically when running up the drive by recognizing that the motor type (cf. parameter S-0-0141) has changed. The display then reads "RL" and the "load defaults procedure" command is internally started by pressing the "Esc" button on the control panel, unless this was deactivated in **P-0-0556, Control word of axis controller**.

- Starting the command by writing "11b" to parameter S-0-0262.

See also "Loading, Storing and Saving Parameters" in chapter "Handling, Diagnostic and Service Functions"

**Note:** In order to start the "load defaults procedure" command the value "0" (default setting) must have been set in parameter **P-0-4090, Index for C07 Load defaults procedure**.

During the load defaults procedure, the following control loop parameters are set to their default values optimized for the respective motor:

- **S-0-0100, Velocity loop proportional gain**
- **S-0-0101, Velocity loop integral action time**
- **S-0-0104, Position loop Kv-factor**
- **S-0-0106, Current loop proportional gain 1**
- **S-0-0107, Current loop integral action time 1**
- **P-0-0004, Velocity loop smoothing time constant**

**Note:** The default settings for the current loop (cf. S-0-0106 and S-0-0107) are automatically adjusted to the currently parameterized PWM frequency (cf. P-0-0001) and performance setting (cf. P-0-0556)!

In addition, the following control loop parameters are set to their firmware-side default values although there haven’t been any default values stored for them in the motor data memory:

- **S-0-0348, Acceleration feedforward gain**
- **P-0-1125, Velocity control loop: average value filter clock**
Note: In the majority of cases, the controller settings stored in the motor encoder data memory provide a useful and reliable control loop setting. In exceptional cases, however, it may be necessary to make the settings with regard to the specific application.
7.2 Parameterization

Control Panels

Standard Control Panel
Can be used with control sections CSB01, CSH01, CDB01.

Fig. 7-2: Standard control panel

Possibilities of Display of Standard Control Panel
The standard control panel allows the following displays:
- status of the master communication
- operating status
- activated commands and command diagnoses
- warnings and error diagnoses
- extended displays such as contents of error memories, diagnostic message memory, operating hours counter of control section, operating hours counter of power section, type designation of firmware active in the device, safety technology code (if safety technology option available)

Possible Settings with Standard Control Panel
The following settings can be made with the standard control panel:
- set the drive address (drive number in the bus system of the master communication)
- set the length of the fiber optic cable
- activate the master communication mode “Easy Startup”

Command Activation with Standard Control Panel
The following commands can be activated with the standard control panel:
- activate S-0-0262, C07_x Load defaults procedure command (load controller parameters or basic parameters)
- activate other commands, such as:
  - C2200 Backup working memory procedure command
  - C2300 Load working memory procedure command
  - C2500 Copy IDN from optional memory to internal memory
  - C2600 Copy IDN from internal memory to optional memory
Comfort Control Panel

Note: The comfort control panel
- can be used with control sections CSB01.1N-FC
- requires firmware FWA-INDRV*-MPB-04V12 at least
- only supports voltage controlled operation (V/f control)
- must have been plugged in when the drive controller is switched on so that it can be recognized
- is suited for hot plug, i.e. you may disconnect it when the drive controller has been switched on

Compared to the standard control panel, the comfort control panel, due to the fact that it can be programmed, provides additional settings, as well as additional display and command functions.

Possibilities of Display of Comfort Control Panel
Additional possibilities of display of the comfort control panel (compared to the standard control panel), for example:
- cyclic parameter display
- measured value of motor temperature sensor
- message threshold or shutdown threshold for motor temperature
- active switching frequency (PWM)

Note: To use this function you need a comfort control panel of version VCP01.2BWA-TS-NN-FW (see type plate of comfort control panel).

Possible Settings with Comfort Control Panel
Additional possibilities of setting of the comfort control panel (compared to the standard control panel), for example:
- language selection
- set/change single parameters
- input of motor data acc. to type plate data for asynchronous third-party motors

Command Activation with Comfort Control Panel
Activation of further commands with the comfort control panel (compared to the standard control panel), for example:
- C3200 Command Calculate motor data
The comfort control panel in particular supports the commissioning of asynchronous third-party motors – another commissioning tool is not required for this purpose. The required steps are given by the display, the corresponding input is made by means of the keys of the control panel.

**Editing Mode**
The editing mode is the status in which you can enter or change values by pressing the key *Prog* or *Mon* at the control panel. The corresponding field of the value then is highlighted in black on the display. To have the value applied by the drive press the *Enter* key. If you do not want to apply changed values, press the *Esc* key. By doing this you exit the editing mode. The corresponding field then no longer is highlighted in black.

<table>
<thead>
<tr>
<th>Keys</th>
<th>Key</th>
<th>Function</th>
</tr>
</thead>
</table>
| *Esc* | return to previous menu item (without applying possibly changed values)  
| | exit editing mode (without applying possibly changed values)  
| | reset error |
| *Mon* | Editing mode: reduce value  
| | Motor potentiometer: reduce speed  
| | go to monitor mode |
| *Prog* | Editing mode: increase value  
| | Motor potentiometer: increase speed |
| *Enter* | Editing mode: apply displayed value |
| ✈️ | arrow key (e.g. navigation up) |
| 🎨 | arrow key (e.g. navigation down) |
| 🔷 | arrow key (e.g. navigation to previous display mask, cursor to the left) |
| ⚡️ | arrow key (e.g. navigation to subsequent display mask, cursor to the right) |

Fig. 7-4: Keys
Display Mask

The figure below illustrates a typical display mask of the comfort control panel.

Fig. 7-5: Display mask
The diagram below shows the complete menu structure of the control panel. The individual modes (monitor, operating and parameter modes) are described in the next sections.

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main screen</strong>&lt;br&gt;Clear error&lt;br&gt;DE / EN / … (Language setting)&lt;br&gt;Mode selection</td>
<td><strong>Monitor</strong>&lt;br&gt;Single parameter display&lt;br&gt;Cycl. parameter list display&lt;br&gt;History, error memory&lt;br&gt;Current configuration (see description of monitor)</td>
<td><strong>Single parameter display</strong>&lt;br&gt;(any parameter)</td>
</tr>
<tr>
<td><strong>Mode selection</strong>&lt;br&gt;Monitor&lt;br&gt;Motor potentiometer&lt;br&gt;Torque/Force limit value&lt;br&gt;Parameterization&lt;br&gt;Parameter management</td>
<td><strong>Cycl. parameter list display</strong>&lt;br&gt;P-0-4024 (Element 0…7)</td>
<td><strong>History; error memory</strong>&lt;br&gt;Error memory&lt;br&gt;Diagnostic message memory&lt;br&gt;Operating hours: Control section and power section</td>
</tr>
<tr>
<td><strong>Monitor</strong>&lt;br&gt;Single parameter display&lt;br&gt;Cycl. parameter list display&lt;br&gt;History, error memory&lt;br&gt;Current configuration (see description of monitor)</td>
<td><strong>Current configuration</strong>&lt;br&gt;Firmware&lt;br&gt;Motor type&lt;br&gt;Control section&lt;br&gt;Power section</td>
<td></td>
</tr>
<tr>
<td><strong>Motor potentiometer</strong>&lt;br&gt;(see description of motor potentiometer)</td>
<td></td>
<td><strong>Bipolar torque/force limit value</strong>&lt;br&gt;S-0-0092&lt;br&gt;(see description of Bipolar torque/force limit value)</td>
</tr>
<tr>
<td>Level 1</td>
<td>Level 2</td>
<td>Level 3</td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td><strong>Parameterization</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Guided parameterization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Change single parameter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see description of &quot;Parameterization&quot;)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Parameter management</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Load basic parameters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Save/Load parameters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(see description of &quot;Parameter management&quot;)</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7-6: Menu structure
When you switch the drive controller on, the following start screen appears after a boot sequence with various displays:

![Start Screen](image)

**Main Screen**

After the start screen, the control panel automatically displays the main screen:

![Main Screen](image)

**On the main screen you can:**

- With **Clear error**, clear errors which are present:
  First remove cause of error. Then press **Esc** key.

- Set the language in which text is displayed. Main screen only shows languages which are available (e.g. DE: German; EN: English; FR: French; IT: Italian; SP: Spanish).

**DE/EN/... (Language setting):**

- Press key ◄:
  Screen for setting the language is displayed.

- Press **Prog** or **Mon** key to set desired language:
  0: German
  1: English
  2: French
  3: Italian
  4: Spanish

- Press **Enter** key.
- Go to **Mode selection**:  
  Press key ►. 
  Selection list is displayed:

![Mode selection](image)

- Go directly to **Monitor**:  
  Press `Mon` key.

**Monitor**

- **Go to Monitor**  
  Starting point: main screen;  
  By pressing key ◄ several times you get to main screen. By means of **Esc** key, you might possibly have to exit editing mode before.  
  - By means of "Mon" key, go to monitor.  
    Selection list appears.

![Monitor mode](image)

- With key ▲ or ▼ select desired menu item. Symbol ">" in left-most position marks selected menu item.  
  Then press key ►.
Single Parameter Display

With **Single parameter display** it is possible to display the value of any parameter.

**How to select the parameter:**

- Select **Single parameter display**.
- Press key ▶.
  Last selected parameter is displayed.
- With keys **Prog***,  "Mon*, **Enter*, ◄, ►*, enter desired parameter (see also example below):
  **Prog***,  "Mon: change setting
  **Enter*, ◄, ►: move cursor to the left or to the right

![Diagram of Single Parameter Display](image)

**Fig. 7-11:** Enter parameter

- Press **Enter** key.
- Press **Esc** key.
- Press key ▶.
  Value of parameter is displayed.
- Press **Esc** key.
- Press key ◄.
  Name and unit of parameter are displayed.
- Press key ◄ to go to previous display.

**Example:**

Last parameter displayed was S-0-0383.

Parameter P-0-1222 is to be displayed.

- S → key **Prog** → P → key **Enter**
- 0 → key **Enter**
- 0 → key **Prog** → 1 → key ▶
- 3 → key "Mon → 2 → key ▶
- 8 → key "Mon → 7 ... → key "Mon → 2 → key ▶
- 3 → key "Mon → 2 → key ▶
- Press **Enter** key.
- Press **Esc** key.
- Press ▶ key.
  Value of parameter P-0-1222 is displayed.
- Press **Esc** key.
- Press ◄ key.
  Name and unit of parameter are displayed.
**Cyclic Parameter List Display**

Up to 8 arbitrary parameters can be displayed. The parameters can be displayed successively. Parameter P-0-4024 contains the IDNs of the parameters which can be selected for cyclic parameter display.

Presetting of list in P-0-4024:

<table>
<thead>
<tr>
<th>List element</th>
<th>Listed IDN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>S-0-0040</td>
<td>Velocity feedback value</td>
</tr>
<tr>
<td>1</td>
<td>S-0-0084</td>
<td>Torque/force feedback value</td>
</tr>
<tr>
<td>2</td>
<td>P-0-0043</td>
<td>Torque-generating current, actual value</td>
</tr>
<tr>
<td>3</td>
<td>S-0-0382</td>
<td>DC bus power</td>
</tr>
<tr>
<td>4</td>
<td>S-0-0000</td>
<td>dummy ID</td>
</tr>
<tr>
<td>5</td>
<td>S-0-0000</td>
<td>dummy ID</td>
</tr>
<tr>
<td>6</td>
<td>S-0-0000</td>
<td>dummy ID</td>
</tr>
<tr>
<td>7</td>
<td>S-0-0000</td>
<td>dummy ID</td>
</tr>
</tbody>
</table>

Fig. 7-12: Presetting of list in P-0-4024

The "dummy" S-0-0000 will be ignored during configuration, i.e. only entries with valid IDNs are displayed (in this case: entries in list elements 0...3).

- From each display you can go to setting of list parameter P-0-4024 by pressing ▲ key.
- Select IDN in table by pressing ▲ or ▼ key.
- Modify IDN.
- Press **Enter** key.
- Press **Esc** key.
- Press ► key to restart cyclic parameter display.

At first, list entries are checked. Then first parameter of list is displayed. Top right you see number of list element displayed.

Fig. 7-13: Example of the first list element displayed

- Press ► key to go to next list element.
- Press ◄ key to go to previous list element.
- Press **Esc** key to leave the Cyclic Parameter List Display.
**History, Error Memory**
- **Error memory** (P-0-0192) with indication of time during which error is present (P-0-0193)
- Press ► key.
- **Diagnostic message memory** (S-0-0375) with indication of time during which diagnostic message is present (P-0-0105)
- Press ► key.
- **Operating hours**:
  - Control section (P-0-0190)
  - Power section (P-0-0191)
  - The operating hours are displayed as seconds.

**Current Configuration**
Current configuration of the drive controller:
- **Firmware**
  - display of firmware version (S-0-0030)
- **Motor type**
  - type designation of motor (S-0-0141)
  - Press ► key.
- **Control section**
  - type designation of control section (P-0-1520)
- **Power section**
  - type designation of power section (S-0-0140)

**Motor Potentiometer**

**Requirements**
To use the motor potentiometer you must have selected and parameterized "Motor potentiometer" as velocity command value (see description of "Guided Parameterization").

**Motor Potentiometer Operation**
- Starting point: main screen
  - By pressing key ◄ several times you get to main screen. By means of Esc key, you might possibly have to exit editing mode before.
  - Press key ►.
  - Mode selection is displayed.
- **Select Motor potentiometer**.
- Press key ►.
  - Motor potentiometer display appears:

  ![Fig. 7-14: Motor potentiometer](image)

- **Reduce** velocity of motor:
  - Press ‘Mon key and keep it pressed.
- **Increase** velocity of motor:
  - Press Prog+ key and keep it pressed.
- Exit motor potentiometer:
  - Press Esc key.
**Bipolar Torque/Force Limit Value**

- **Starting point:** main screen
  
  By pressing key ▼ several times you get to main screen. By means of Esc key, you might possibly have to exit editing mode before.

- **Press ► key.**
  
  Mode selection is displayed.

- **Select Bipol. torque/force limit val.**

- **Press ► key.**
  
  Following display appears. Enter desired value for "bipolar torque/force limit value" (parameter S-0-0092).

![Fig. 7-15: Bipolar torque/force limit value (S-0-0092)](image)

- Data field in which you can make inputs is highlighted in black.

- **Enter desired value:**
  
  ▼, ►: move cursor to the left or to the right
  
  Prog*, “Mon: change setting

- **Press Enter key to confirm your setting.**

- **Press Esc to leave editing mode.**

**S-0-0092**

By this parameter it is possible to limit the torque/force command value to allowed maximum values in order to protect the mechanical components.

The parameter acts in a bipolar way, i.e. positive and negative command values are limited to the entered value. The limitation acts on the sum of all torque command values, i.e. on the sum of the command value components of the velocity controller output and the command value components from acceleration-dependent feedforwards ("S-0-0348, Acceleration feedforward gain"; "P-0-1126, Velocity control loop: acceleration feedforward"). The unit of S-0-0092 depends on the scaling that has been set.

**Note:** The effective limit value is displayed in P-0-0049, Effective torque/force command value. This value can be limited with regard to S-0-0092, due to a lower value in "P-0-0109, Torque/force peak limit" or due to a current limit by the respective work load of amplifier or motor.

If in stationary operation (constant speed) a lower torque than in the case of acceleration processes is to be made available to the drive, this can be achieved by appropriate values of "S-0-0082, Torque/force limit value positive" and "S-0-0083, Torque/force limit value negative" in conjunction with acceleration feedforward (S-0-0348 or P-0-1126).

The bipolar torque/force limit value also acts on "C1300 Positive stop drive procedure command", the value of S-0-0092 is a criterion for the acknowledgment of C1300.
Parameterization

- Go to main screen.
  By pressing key ◄ several times you get to main screen. By means of Esc key, you might possibly have to exit editing mode before.
- Press key ►.
  Mode selection is displayed.
- Select Parameterization
- Press key ►.
  Parameter mode is automatically displayed. Following display appears:

```
1  PM
> Guided Parameterization
Change single parameter
< up down >
```

Fig. 7-16: Display "Parameterization"

When drive controller was in status AF (drive enable), following display appears:

```
Status switching OM > PM
Command error  C0401
Drive active
Switch off drive enable
```

Fig. 7-17: Error message when switching operating mode/parameter mode

Switch off drive enable and repeat procedure.
Guided Parameterization

- Select **Guided Parameterization**.
- Press ► key.

"Motor data" display appears:

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
</table>
| Enter motor data (P-0-4032):
  - Rated current
  - Rated voltage
  - Rated frequency
  - Rated speed
  - Power factor cos φ
  - Rated power (see description below) | | |
| Automatic calculation of motor data (P-0-4033, C3200 Command Calculate motor data) | | |
| Motor peak current (Display) (S-0-0109) $A_{eff}$ | | |
| Select temperature sensor (P-0-0512):
  - 0: without
  - 1: PTC150
  - 3: KTY84
  - 4: PTC130 | | |
| If you have selected a temperature sensor:
  Enter motor warning temperature (S-0-0201) | | |
| If you have selected a temperature sensor:
  Enter motor shutdown temperature (S-0-0204) | | |
| Select switching frequency of power output stage (P-0-0001):
  - 4000 Hz
  - 8000 Hz | | |
| Velocity command value
  Analog input
  Motor potentiometer
  Fixed cmd value | Analog input | Select analog mode I/O (P-0-0218):
  - U signals
  - I signals
  - 4…20 mA |
<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter scaling (P-0-0214)</td>
<td>Enter offset (P-0-0215)</td>
<td>Enter dead zone (P-0-0216)</td>
</tr>
<tr>
<td>Enter time constant input filter (P-0-0217)</td>
<td>continue with Positive velocity limit value (S-0-0038)</td>
<td></td>
</tr>
<tr>
<td>Motor potentiometer</td>
<td>Enter step size (P-0-1217)</td>
<td>Enter acceleration (P-0-1215)</td>
</tr>
<tr>
<td>Enter deceleration (P-0-1216)</td>
<td>Fixed cmd value (P-0-1206) (see description below)</td>
<td></td>
</tr>
<tr>
<td>Enter positive velocity limit value (S-0-0038)</td>
<td>Enter negative velocity limit value (S-0-0039)</td>
<td></td>
</tr>
<tr>
<td>Enter ramp 2 pitch (P-0-1203)</td>
<td>Enter deceleration ramp 2 (P-0-1213)</td>
<td></td>
</tr>
<tr>
<td>Enter velocity command filter (P-0-1222)</td>
<td>Automatic switching from parameter mode to operating mode P2 -&gt; P3 -&gt; P4</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7-18: Settings (parameterizing the drive controller)
Enter Motor Data:

At the beginning of parameterization you must enter the motor data (see type plate of motor).

<table>
<thead>
<tr>
<th>List element</th>
<th>Characteristic value of motor</th>
<th>Unit</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>rated current</td>
<td>A_{eff}</td>
<td>rms value of the electric current in the motor feed wire (motor phase) at rated load</td>
</tr>
<tr>
<td>1</td>
<td>rated voltage</td>
<td>V_{eff}</td>
<td>rms value of the phase-to-phase voltage between the motor terminal pins at rated load</td>
</tr>
<tr>
<td>2</td>
<td>rated frequency</td>
<td>Hz</td>
<td>frequency of the feeding, sinusoidal electric voltage</td>
</tr>
<tr>
<td>3</td>
<td>rated speed</td>
<td>1/min</td>
<td>speed of motor output shaft at rated load</td>
</tr>
<tr>
<td>4</td>
<td>power factor ( \cos \phi )</td>
<td>1</td>
<td>power factor at rated load</td>
</tr>
<tr>
<td>5</td>
<td>rated power</td>
<td>kW</td>
<td>mechanical power that can be continuously delivered at rated load</td>
</tr>
</tbody>
</table>

Data field in which you can make inputs is highlighted in black.

- With key ▲ or ▼ you can select a specific data field.
- With keys ◀, ▶, Prog*, ~Mon enter desired value:
  ◀, ▶: move cursor to the left or to the right
  Prog*, ~Mon: change setting
- With Enter key confirm entered value.
  Next data field is automatically activated.
- When you have made all inputs:
  Press Esc key.
Fixed Command Value (P-0-1206):

After selecting **Fixed cmd value** the following display appears (example):

![Display Example](image)

Data field in which you can make inputs is highlighted in black (editing mode).

**Fig. 7-21:** Fixed command value (example)

- To display all fixed command values:
  - In editing mode: Press ▲ or ▼ key
  - Else: Press Prog+ or Mon key

- To modify fixed command values (in editing mode only):
  - Press Prog+ or Mon key.
  - Press Enter key to confirm your setting.
  - Press Esc key to leave editing mode.

P-0-1206, Memory of velocity command values:

Function of the parameter:

Five velocity command values are stored in this list parameter. In contrast to S-0-0036 this parameter cannot be cyclically written. It is used as a fixed command value memory the individual values of which can be selected via the control word P-0-1200 (switch function). The range of values and unit of the parameter elements in P-0-1206 correspond to those of the velocity command value S-0-0036.

See also Functional Description "Operating Modes - Velocity Control"

Parameter structure:

For selecting the command values there is the following assignment:

<table>
<thead>
<tr>
<th>P-0-1206</th>
<th>Selection by P-0-1200</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>element 1</td>
<td>bit 0 = 1</td>
<td>1</td>
</tr>
<tr>
<td>element 2</td>
<td>bit 1 = 1</td>
<td>2</td>
</tr>
<tr>
<td>element 3</td>
<td>bit 2 = 1</td>
<td>3</td>
</tr>
<tr>
<td>element 4</td>
<td>bit 3 = 1</td>
<td>4</td>
</tr>
<tr>
<td>element 5</td>
<td>bit 4 = 1</td>
<td>5</td>
</tr>
</tbody>
</table>

If more than one bit has been set, the priority indicated in the right column applies (1 = highest priority).
Change Single Parameter

- Go to main screen. By pressing key ◀ several times you get to main screen. By means of Esc key, you might possibly have to exit editing mode before.

- Press key ►.
  Mode selection is displayed.

- Select Parameterization.

- Press key ►.
  Parameter mode is automatically displayed. Following display appears:

```
1 PM
> Guided Parameterization
Change single parameter
< up down >
```

Fig. 7-22: Parameterization

When drive controller was in status AF (drive enable), following display appears:

```
Status switching OM > PM
Command error C0401
Drive active
Switch off drive enable
```

Fig. 7-23: Error message when switching operating mode/parameter mode

Switch off drive enable and repeat procedure.
- Select Change single parameter
- Press ► key.
  The following display appears:

![Select parameter display](image)

Fig. 7-24: Select parameter

- With keys Prog*, Mon, Enter, ◄, ►, enter desired parameter (see also example below):
  Prog*, Mon: change setting
  Enter, ◄, ►: move cursor to the left or to the right

![Enter parameter display](image)

Fig. 7-25: Enter parameter

- After desired parameter has been entered:
  Press Enter key.
- Press Esc key.
- Press key ►.
  Value of parameter is displayed.
- Press Esc key.

To display name and unit of parameter:
- Press key ▼.
  Name and unit of parameter are displayed.
- Press key ◄ to go to previous display.

Example:
Last parameter displayed was S-0-0383. Parameter P-0-1222 is to be displayed.
- S → key Prog+ → P → key Enter
- 0 → key Enter
- 0 → key Prog+ → 1 → key ►
- 3 → key *Mon → 2 → key ►
- 8 → key *Mon → 7 ... → key *Mon → 2 → key ►
- 3 → key *Mon → 2 → key ►
- Press Enter key.
- Press Esc key.
- Press ► key.
  Value of parameter P-0-1222 is displayed.
- Press Esc key.
• Press ▼ key.  
  Name and unit of parameter are displayed.

**Parameter Management**

• Go to main screen.  
  By pressing key ◄ several times you get to main screen. By means of  
  Esc key, you might possibly have to exit editing mode before.

• Press key ►.  
  Mode selection is displayed.

• Select **Parameter management**

• Press key ►.  
  Parameter mode is automatically displayed. Following display appears:

```
1  PM
Load basic parameters
Save/Load parameters
< up down >
```

PM: parameter mode  
Fig. 7-26: Display “Load basic parameters”

When drive controller was in status AF (drive enable), following display appears:

```
Status switching OM > PM
Command error C0401
Drive active
Switch off drive enable
```

Fig. 7-27: Error message when switching operating mode/parameter mode

Switch off drive enable and repeat procedure.

**Load Basic Parameters**

• Select **Load basic parameters**.

• Press ► key.  
  Following display appears:

```
1  PM
Load basic parameters
< Prog+ >
```

Fig. 7-28: Load basic parameters
Save/Load Parameters (Copying Parameter Sets)

You can save the parameter set of a drive controller on the comfort control panel and then load the parameter set which was saved to another drive controller. The parameter set which was saved contains the parameters from the list of backup parameters.

Requirements

**Note:** To use this function you need a comfort control panel of version VCP01.2BWA-TS-NN-FW (see type plate of comfort control panel).

![Type plate on the back of the comfort control panel](image)

1: Type plate on the back of the comfort control panel

Fig. 7-29: Type plate of the comfort control panel

To use this function
- the functional package "Open-Loop" must be active in the firmware which is used and
- the drive controller with comfort control panel plugged must have booted

Save Parameters

- Go to main screen.
  By pressing key ◄ several times you get to main screen. By means of Esc key, you might possibly have to exit editing mode before.
- Press key ►.
  Mode selection is displayed.
- Select **Parameter management**
- Press key ►.
  Parameter mode is automatically displayed. Following display appears:
When drive controller was in status AF (drive enable), following display appears:

- Select **Save/load parameters**.
- Press key ►.

Following display appears:

Fig. 7-30: Parameter management

Fig. 7-31: Error message when switching operating mode/parameter mode

Switch off drive enable and repeat procedure.

Fig. 7-32: Parameter management
Press “Mon” key.
At start of process, **Start Save** is displayed (see following figure) and parameter set is copied to comfort control panel. At the same time, number of **bytes** already copied is displayed. By means of numbers, **Progress** shows you current status of process (on the right there is the end number; to the left of the end number there is the current number).

**Data Saved** indicates successful end of process.
If an error occurred, the corresponding message is displayed in lowest line. In this case you have to remove error first and then restart process.

![Save parameters active](image)

ErrCode: Displayed only in the case of an error (e.g. "Err at Init")

Fig. 7-33: Save parameters

### Load Parameters
- Plug comfort control panel with copied parameter set on drive controller to which parameter set is to be loaded.
- **Reboot drive controller** with comfort control panel plugged.
- Go to main screen.
  - By pressing key ◄ several times you get to main screen. By means of **Esc** key, you might possibly have to exit editing mode before.
- Press key ►.
  - Mode selection is displayed.
- Select **Parameter management**
- Press key ►.
  - Parameter mode is automatically displayed. Following display appears:

![Parameter management](image)

Fig. 7-34: Parameter management

When drive controller was in status AF (drive enable), following display appears:
Switch off drive enable and repeat procedure.

- Select **Save/Load parameters**
- Press key ▶.

Following display appears:

![Parameter management](image)

- Press **Prog+** key.
  
  At start of process, **Start Restore** is displayed (see following figure) and parameter set is loaded to drive controller. At the same time, number of **bytes** already loaded is displayed. By means of numbers, **Progress** shows you current status of process (on the right there is the end number; to the left of the end number there is the current number).
  
  **Data Restored** indicates successful end of process.
  
  If an error occurred, the corresponding message is displayed in lowest line. In this case you have to remove error first and then restart process.

![Load parameters](image)

ErrCode: Displayed only in the case of an error (e.g. "Err at Init")
### 7.3 Overview of Parameters – Base Package

This chapter contains the parameters of firmware MPx-04 which are relevant for open-loop or closed-loop applications.

#### S-0-0000 – S-0-0100

**S-0-0030, Manufacturer version**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: This parameter contains the drive firmware version in the form of a text (ASCII format).

See also Functional Description "System Overview"

**S-0-0032, Primary mode of operation**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>2</td>
</tr>
</tbody>
</table>

Function: The operating mode determined in this parameter is activated in the drive, if:
- the primary mode of operation was selected in the master control word (bits 8 and 9 = "00") and
- control and power sections are ready for operation and
- drive enable "RF" was set.

See also Functional Description "Selecting the Operating Mode"

**S-0-0033, Secondary operation mode 1**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>2</td>
</tr>
</tbody>
</table>

Function: The operating mode determined in this parameter is activated in the drive, if:
- the secondary operating mode 1 was selected in the master control word (bits 8 and 9 = "01"),
- control and power sections are ready for operation and
- drive enable "RF" was set.

See also Functional Description "Selecting the Operating Mode"

**S-0-0034, Secondary operation mode 2**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>2</td>
</tr>
</tbody>
</table>

Function: The operating mode determined in this parameter is activated in the drive, if:
• the secondary operating mode 2 was selected in the master control word (bits 8 and 9 = "10"),
• control and power sections are ready for operation and
• drive enable "RF" was set.
See also Functional Description “Selecting the Operating Mode”

S-0-0035, Secondary operation mode 3

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>2</td>
</tr>
</tbody>
</table>

Function
The operating mode determined in this parameter is activated in the drive, if:
• the secondary operating mode 3 was selected in the master control word (bits 8 and 9 = "11"),
• control and power sections are ready for operation and
• drive enable "RF" was set.

See also Functional Description “Selecting the Operating Mode”

S-0-0036, Velocity command value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

Function
In the "velocity control" mode the control unit cyclically enters the command value in this parameter.

Note: The velocity command value actually effective (addition of all components that generate the velocity command value) at the input of the velocity loop is displayed in parameter P-0-0048.

See also Functional Description "Operating Modes - Velocity Control”

S-0-0037, Additive velocity command value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

Function
In velocity-controlled and position-controlled operating modes, the control unit can cyclically enter an additive command value in this parameter in case the control unit provides the respective value.

Note: The velocity command value actually effective (addition of all components that generate the velocity command value) at the input of the velocity loop is displayed in parameter P-0-0048.

See also Functional Description "Operating Modes - Velocity Control”

S-0-0038, Positive velocity limit value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
</table>
Function Depending on the application, this parameter indicates the value for the maximum allowed positive velocity command value of the motor.

See also Functional Description "Velocity Limitation"

S-0-0039, Negative velocity limit value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>---</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

Function Depending on the application, this parameter indicates the value for the maximum allowed negative velocity command value of the motor.

See also Functional Description "Velocity Limitation"

S-0-0040, Velocity feedback value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

Function The actual velocity value of the motor encoder can be transmitted by the drive controller to the control unit either cyclically or via the service channel.

Note: In open-loop operation, parameter S-0-0040 contains the actual velocity value estimated by means of a motor model.

See also Functional Description "Operating Modes - Velocity Control"

S-0-0044, Velocity data scaling type

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>2</td>
</tr>
</tbody>
</table>

Function The scaling type of the velocity data determines in which format and which reference the velocity data are exchanged between the drive and the control unit or user interface.

See also Functional Description "Scaling of Physical Data"

S-0-0082, Torque/force limit value positive

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>400.0</td>
<td>S-0-0086</td>
</tr>
</tbody>
</table>

Function This parameter allows determining a torque or force limit value for positive torque/force command values. This limit value only takes effect with regard to the torque command value of the velocity controller (P-0-0049) and not with regard to command values from the acceleration feedforwards (S-0-0348, P-0-1126). Positive torque takes effect in the case of:

- motive operation at positive velocity
• regenerative operation at negative velocity

See also Functional Description "Torque/Force Limitation"

**S-0-0083, Torque/force limit value negative**

| Function | This parameter allows determining a torque or force limit value for negative torque/force command values. This limit value only takes effect with regard to the torque command value of the velocity controller (P-0-0049) and not with regard to command values from the acceleration feedforwards (S-0-0348, P-0-1126). Negative torque takes effect in the case of:
• motive operation at negative velocity
• regenerative operation at negative velocity

See also Functional Description "Torque/Force Limitation"

**S-0-0084, Torque/force feedback value**

| Function | Display parameter for the actual torque/force value currently effective.

### Calculating the actual torque/force value

\[
\text{actual torque/force value} = \text{torque-generating current, actual value} \times \text{torque factor}
\]

Fig. 7-38: Relation for calculating the actual torque/force value

**Note:** The value displayed in S-0-0084 is only an approximation of the torque or the force of the motor actually generated!

See also Functional Description "Torque/Force Limitation"

**S-0-0085, Torque/force polarity parameter**

| Function | In this parameter it is possible to invert the polarities of the indicated torque/force data with regard to the application. The polarities are changed outside of the controlled system, i.e. at the input and output of the controlled system.

The following applies to rotary motors:
A clockwise turn of the motor output shaft in the case of positive torque and positive polarity.

The following applies to linear motors:
A move of the primary part in the direction of the cable connection side in the case of positive force and positive polarity.
See also Functional Description "Scaling of Physical Data"

**S-0-0086, Torque/force data scaling type**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**
The unit and reference of the torque/force data of a drive are set by this parameter:
- percentage-based scaling (% of reference value, see below)
- rotary scaling (Nm, inlb)
- linear scaling (N, lb)

See also Functional Description "Scaling of Physical Data"

**S-0-0091, Bipolar velocity limit value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>10000000</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

**Function**
Depending on the application, this parameter indicates the value for the maximum allowed velocity command value of the motor, independent of the sense of rotation.

The maximum value for S-0-0091 is the value of "S-0-0113, Maximum motor speed". This value also is the maximum value for all other velocity parameters.

Depending on the sense of rotation, the maximum velocity limit can be influenced by the parameters "S-0-0038, Positive velocity limit value" and "S-0-0039, Negative velocity limit value". These two parameters have the default value "0" and thereby are switched off, only S-0-0091 takes effect.

See also Functional Description "Velocity Limitation"

**S-0-0092, Bipolar torque/force limit value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>400.0</td>
<td>S-0-0086</td>
</tr>
</tbody>
</table>

**Function**
By this parameter it is possible to limit the torque/force command value to allowed maximum values in order to protect the mechanical components.

See also Functional Description "Torque/Force Control"

**S-0-0093, Torque/force data scaling factor**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This parameter is always adapting itself to the selected preferred scaling. The parameter cannot be changed!

**Note:** Freely parameterizable scaling (parameter scaling) is impossible for the torque/force data!
See also Functional Description "Torque/Force Control"

**S-0-0094, Torque/force data scaling exponent**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter is always adapting itself to the selected preferred scaling. The parameter cannot be changed!

**Note:** Freely parameterizable scaling (parameter scaling) is impossible for the torque/force data!

**S-0-0095, Diagnostic message**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter contains the operating status of the drive at present relevant in the form of a text.

Preceding the text is the respective content of parameter **S-0-0390, Diagnostic message number**.

**Example:** "A0010 Drive HALT"

See also Functional Description "Coded Diagnostic Drive Messages"

**S-0-0100, Velocity loop proportional gain**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,000 / 2147483,647</td>
<td>0,050 P-0-4014</td>
</tr>
</tbody>
</table>

**Function**

The speed loop generates a torque/force command value (P-0-0049) from the difference of velocity command value and actual velocity value (S-0-0347, Velocity error).

See also Functional Description "Control Loop Structure"
See also Functional Description "Operating Modes - Velocity Control"

**S-0-0101 – S-0-0200**

**S-0-0101, Velocity loop integral action time**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,0 / 6553,5</td>
<td>100,0 ms</td>
</tr>
</tbody>
</table>

**Function**

The speed controller generates a torque/force command value (P-0-0049) from the difference of velocity command value and actual velocity value (S-0-0347, Speed deviation).

See also Functional Description "Operating Modes - Velocity Control"
S-0-0106, Current loop proportional gain 1

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,00 / 500,00</td>
<td>8,00</td>
<td>V/A</td>
</tr>
</tbody>
</table>

**Function**
This parameter is used to define the P-gain for the current loop (for the I_d and I_q control loop). Parameterization of the current loop proportional gain depends on the control performance (current loop clock T_A) and the selected switching frequency (cf. P-0-0001).

S-0-0107, Current loop integral action time 1

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0 / 429496729,5</td>
<td>2,0</td>
<td>ms</td>
</tr>
</tbody>
</table>

**Function**
The value for the current loop integral action time 1 is motor-specific and is determined individually for each motor type.

S-0-0109, Motor peak current

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,000 / 1000,000</td>
<td>5,000</td>
<td>A eff</td>
</tr>
</tbody>
</table>

**Function**
Maximum allowed current that may temporarily flow in the motor.

See also Functional Description "Limitations"

S-0-0110, Amplifier peak current

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>A eff</td>
</tr>
</tbody>
</table>

**Function**
Peak current of the controller. The value is set automatically by the device. This current is only available temporarily.

See also Functional Description "Current Limitation"

S-0-0111, Motor current at standstill

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,000 / 500,000</td>
<td>1,000</td>
<td>A eff</td>
</tr>
</tbody>
</table>

**Function**
The value of this parameter is the torque-/force-generating component of the continuous motor current when the motor is loaded with the least allowed cooling type, with the continuous torque ensured at standstill or with the ensured continuous force (see motor data sheet).

See also Functional Description "Rexroth Motors"

S-0-0112, Amplifier nominal current

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>A eff</td>
</tr>
</tbody>
</table>
This parameter displays the maximum possible continuous current of the drive.

Note: In the case of rotary field frequencies smaller than 3 Hz, the possible amplifier continuous current is reduced by means of a temperature model (see Technical Data in hardware Project Planning Manual).

See also Functional Description "Current Limitation"

### S-0-0113, Maximum motor speed

**Function** Value for the maximum allowed velocity command value of the motor. The actual velocity value may be a maximum of 12.5% higher than the value of S-0-0113, with higher actual values the drive reacts with torque disable and generates the error message F8079 Velocity limit S-0-0091 exceeded.

See also Functional Description "Limitations"

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>3000.0000</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

### S-0-0127, C0100 Communication phase 3 transition check

**Function** When executing the S-0-0127, C0100 Communication phase 3 transition check command, all interface parameters are checked for validity.

See also Functional Description "Device Control (Status Machine)"

### S-0-0128, C5200 Communication phase 4 transition check

**Function** When executing the command S-0-0128, C0200 Communication phase 4 transition check is executed, all parameters are checked for validity and possible limit value violations.

See also Functional Description "Device Control (Status Machine)"

### S-0-0134, Master control word

**Function** For drives with SERCOS interface the master control word is cyclically transmitted from master to drive.
There is important control information defined in the master control word, like for example:

- drive enable
- Drive Halt
- selection of command operating mode

See also Functional Description "Device Control (Status Machine)"
See also Functional Description "System Overview - Master Communication - SERCOS interface"
See also Functional Description "Drive Functions – Drive Halt"

**S-0-0135, Drive status word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

For drives with SERCOS interface the master status word is cyclically transmitted from drive to master. There is important status information contained in the master status word, like for example:

- readiness for operation of control and power sections
- drive error
- change bits class 2 and 3 diagnostics
- current operating mode

See also Functional Description "Device Control (Status Machine)"
See also Functional Description "System Overview - Master Communication - SERCOS interface"
See also Functional Description "Drive Functions – Drive Halt"

**S-0-0140, Controller type**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

The power section type is contained in the operating data of this parameter in the form of a text (e.g. HCS02.1).

See also Functional Description "Controller Design"

**S-0-0141, Motor type**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

The type designation of the motor is entered in this parameter.

See also Functional Description "Motor, Mechanical Axis System, Measuring Systems"

**S-0-0142, Application type**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>
A descriptive name (text) for the drive or the axis (e.g. swiveling axis) can be stored in this parameter.

Note: It does not have any influence on the function.

**S-0-0144, Signal status word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: By means of the signal status word it is possible to transmit signals in real time from the drive to the control unit.

See also Functional Description "Configurable Signal Status Word"

**S-0-0145, Signal control word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: By means of the signal control word it is possible to transmit signals in real time from the control unit to the drive.

See also Functional Description "Configurable Signal Control Word"

**S-0-0160, Acceleration data scaling type**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>2</td>
</tr>
</tbody>
</table>

Function: As described below, it is possible to set different scaling types for the acceleration data in the drive.

The scaling type of the acceleration data determines in which format and which reference the acceleration data are exchanged between the drive and the control unit or user interface. The values of the acceleration data parameters (e.g. **S-0-0138, Bipolar acceleration limit value**) are displayed by the drive with the scaling that has been set. The scaling setting is normally preset by the control unit.

See also Functional Description "Scaling of Physical Data"

**S-0-0201 – S-0-0300**

**S-0-0201, Motor warning temperature**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>145,0</td>
<td>S-0-0208</td>
</tr>
</tbody>
</table>

Function: If the motor temperature exceeds the motor warning temperature, the drive sets bit 2 (motor overtemperature warning) in **S-0-0012, Class 2 diagnostics** and the warning **E2051 Motor overtemp. prewarning** is output. In the case of MHD and MKD motors, the drive sets this parameter to 145 °C, in the case of MKE motors to 125 °C.
See also Functional Description "Motor Temperature Monitoring"

**S-0-0204, Motor shutdown temperature**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>155.0</td>
<td>S-0-0208</td>
</tr>
</tbody>
</table>

**Function**
If the motor temperature exceeds the motor shutdown temperature, the drive sets bit 2 (motor overtemperature shutdown) in S-0-0011, Class 1 diagnostics and the error F2019 Motor overtemperature shutdown is generated. In the case of MHD and MKD motors, the drive sets this parameter to 155 °C, in the case of MKE motors to 135 °C.

See also Functional Description "Motor Temperature Monitoring"

**S-0-0208, Temperature data scaling type**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**
By means of this parameter the unit of the temperature data of the drive is determined. The values are displayed with the first decimal place.

**S-0-0265, Language selection**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / var.</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**
All parameter names, units and diagnostic/error messages are stored in the drive controller in several languages. This parameter determines the language of the texts to be output.

- 0: German
- 1: English
- 2: French
- 3: Italian
- 4: Spanish

See also Functional Description "Language Selection"

**S-0-0292, List of all operating modes**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
All operating modes that are supported by the drive firmware used are listed in this parameter.

The codes (hexadecimal) of those operating modes are displayed that can be entered in the parameters S-0-0032 ... S-0-0035 and S-0-0284 ... S-0-0287 (primary mode of operation and secondary operation modes) in the form of binary values.

See also Functional Description "Operating Modes"
S-0-0301 – S-0-0400

S-0-0328, Assign list signal status word

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 31</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
In this list parameter the assignment is made which bit of the respective parameter entered in S-0-0026, Configuration list signal status word is to be mapped to S-0-0144, Signal status word.

See also Functional Description “Configurable Signal Status Word”

S-0-0329, Assign list signal control word

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 31</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
In this list parameter the assignment is made which bit of the respective parameter entered in S-0-0027, Configuration list signal control word is written via the signal control word (S-0-0145).

See also Functional Description “Configurable Signal Control Word”

S-0-0330, Message 'n_actual = n_command'

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
This parameter displays whether the actual velocity value has reached the command value within a tolerance window (message "n_actual = n_command").

|S-0-0040 – S-0-0036 – S-0-0037| <= S-0-0157

S-0-0331, Status 'n_feedback = 0'

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
This parameter displays whether the actual velocity value has fallen below a threshold value that can be set, below which the controller recognizes motor or axis standstill ("n_feedback = 0" message).

See also Functional Description “Status Classes”

S-0-0332, Message 'nactual < nx'

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
This parameter displays whether the actual velocity value has fallen below a threshold value that can be set ("n_actual = nx" message).

See also Functional Description “Status Classes”
S-0-0333, Message 'T >= Tx'

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This parameter indicates whether the actual torque or force value has exceeded a threshold value ("T >= Tx" message) that can be set.

See also Functional Description "Status Classes"

S-0-0334, Message 'T >= Tlimit'

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This parameter indicates whether the actual torque or force value has reached the limit value ("T >= Tlimit" message). The limit value is generated by the smallest value of
- P-0-0109, Torque/force peak limit
- S-0-0092, Bipolar torque/force limit value
- S-0-0082, Torque/force limit value positive
- S-0-0083, Torque/force limit value negative
- work load-dependent limits by motor and controller.

See also Functional Description "Velocity Limitation"

S-0-0335, Message 'n command > n limit'

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This parameter displays when the absolute velocity command value is greater than the velocity limit value that can be set ("n command > n limit" message).

See also Functional Description "Velocity Limitation"

S-0-0337, Message 'P >= Px'

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This parameter indicates whether the absolute value of the actual power value has exceeded a threshold value that can be set ("P >= Px" message). Bit 0 of this parameter becomes "1" when the absolute value of S-0-0382, DC bus power is greater than or equal to the value of S-0-0158, Power threshold Px.

This message also appears in S-0-0013, Class 3 diagnostics.
S-0-0349, Jerk limit bipolar

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0160</td>
</tr>
</tbody>
</table>

Function: The bipolar jerk limit value, in the operating modes listed below, describes the maximum allowed acceleration change per time (= jerk), symmetrically in both directions (acceleration and deceleration).

The limit value takes effect in the following operating modes:
- Position control
- drive-internal interpolation
- drive-controlled positioning

Note: The bipolar jerk limit value limits the change in acceleration per time for "Drive Halt", the error reaction quick stop (velocity command value reset with filter and ramp) and the commands that are generating their own position command values. The value "0" switches the jerk filter off!

See also Functional Description "Establishing the Position Data Reference (Drive Controlled Homing)"
See also Functional Description "Spindle Positioning"
See also Functional Description "Drive Functions - Drive Halt"

S-0-0375, List of diagnostic numbers

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- / ---</td>
</tr>
</tbody>
</table>

Function: The drive enters every change of parameter S-0-0390, Diagnostic message number in this list. The list is organized as a ring buffer; it can contain up to 50 diagnostic message numbers. When the list is read, the last diagnostic message number displayed is displayed in the 1st element of the parameter.

See also Functional Description "Diagnostic System"

S-0-0380, DC bus voltage

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

Function: This parameter is used to display the DC bus voltage currently measured.

S-0-0382, DC bus power

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>Watt</td>
</tr>
</tbody>
</table>

Function: This parameter displays the DC bus power currently demanded by the motor.
S-0-0383, Motor temperature

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- S-0-0208</td>
</tr>
</tbody>
</table>

**Function**: This parameter indicates the measured value of the winding temperature of the motor, if the temperature sensor incorporated in the motor allows analog temperature evaluation!

**Note**: In the case of MHD, MKD, MKE and LSF motors, the values indicated by S-0-0383 do not allow, due to the temperature sensor characteristic (switching performance), drawing a conclusion regarding the actual motor temperature!

See also Functional Description "Motor Temperature Monitoring"

S-0-0384, Amplifier temperature

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- S-0-0208</td>
</tr>
</tbody>
</table>

**Function**: Display parameter for the measured temperature of the controller power output stage (heat sink temperature).

S-0-0401 – S-0-1000

S-0-0520, Control word of axis controller

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>4 --</td>
</tr>
</tbody>
</table>

**Function**: The control word of axis controller takes effect in all position-controlled operating modes and allows influencing the axis control.

See also Functional Description "Operating Modes"

S-0-0521, Status word of position loop

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- --</td>
</tr>
</tbody>
</table>

**Function**: The status word of position loop displays current information relevant to position control of the active operating mode.

See also Functional Description "Operating Modes"

S-0-0822, Torque/force ramp

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,0</td>
<td>S-0-0086</td>
</tr>
</tbody>
</table>

**Function**: With the torque/force ramp time (S-0-0823) the torque/force ramp defines an increase for the torque/force command value (S-0-0080) in the operating mode "torque/force control".
Note: Parameter S-0-0822 replaces the previously available filtering by means of the PT1 filter (cf. P-0-0176).

See also Parameter Description “S-0-0822, Torque/force ramp”

See also Parameter Description “S-0-0824, Message torque/force command value reached”

See also Functional Description “Operating Modes - Torque/Force Control”

S-0-0823, Torque/force ramp time

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,0 / 6553,5</td>
<td>0,0</td>
</tr>
</tbody>
</table>

Function: The torque/force ramp time (S-0-0823) is the reference time for the torque/force ramp. In the operating mode torque/force control, the parameter S-0-0823, together with the torque/force ramp (S-0-0822), defines an increase for the torque/force command value (S-0-0080).

See also Parameter Description “S-0-0822, Torque/force ramp”

See also Parameter Description “S-0-0824, Message torque/force command value reached”

See also Functional Description “Operating Modes - Torque/Force Control”

S-0-0824, Message torque/force command value reached

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: In the operating mode “torque/force control”, the message “S-0-0824, Message torque/force command value reached” indicates that the internal “S-0-0080, Torque/force command value” has reached the preset value.

See also Functional Description “Operating Modes”

P-0-0001 – P-0-0689 (General Functions)

P-0-0001, Switching frequency of the power output stage

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>4000 / 8000</td>
<td>4000</td>
</tr>
</tbody>
</table>

Function: The switching frequency of the power output stage can be set. The max. switching frequency is determined by P-0-0408, Amplifier type data, list element 16. Depending on the device type, the following values can be set, for example:

<table>
<thead>
<tr>
<th>Device type / switching freq. fs [kHz]</th>
<th>2</th>
<th>4</th>
<th>8</th>
<th>12</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS02</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HCS03</td>
<td>O</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
HCS04 (as of MPx04) | X | X | X | X | O
| HMS01          | O | X | X | X | X
| HMS02 (as of MPx04) | O | X | X | O | O
| HMD01          | O | X | X | O | O

O  not allowed  
X  allowed  

Fig. 7-39: Switching frequency

**Note:** Only set such switching frequencies which are supported by the involved components! Observe the Technical Data for drive controllers and motors.

See also Functional Description "Current Controller"

**P-0-0004, Velocity loop smoothing time constant**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 65500</td>
<td>800 us</td>
</tr>
</tbody>
</table>

**Function**
The time constant that can be activated in this parameter takes effect in the velocity controller and is suited for suppressing quantization effects and limiting the bandwidth of the velocity control loop.

See also Functional Description "Velocity Control Mode"

The limit frequency results from the smoothing time constant by means of the following relationship:

\[
 f_s = \frac{1}{2 \cdot \pi \cdot T}
\]

Fig. 7-40: Bandwidth

By inputting the minimum input value the filter is switched off.

**P-0-0007, Display text of diagnostic message**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This parameter contains the display text currently displayed on the control panel of the drive.

**Example:** "AF" or "PL"

See also Functional Description "Coded Diagnostic Drive Messages"

**P-0-0008, Activation E-Stop function**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 7</td>
<td>0</td>
</tr>
</tbody>
</table>

DOK-INDRV*-FU*********-IB01-EN-P
**Function**

This parameter is used for activating the E-Stop input and selecting a reaction for the shutdown of the drive.

See also Functional Description "E-Stop Function"

See also Functional Description "Activation and Polarity of the E-Stop Input"

---

**P-0-0009, Error number**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

When the drive diagnoses a class 1 diagnostics error, a bit is set in parameter **S-0-0011, Class 1 diagnostics**. Bit 13 for "Error in class 1 diagnostics" is then set in the drive status word.

See also Functional Description "Error Memory (Power Section and Control Section)"

---

**P-0-0018, Number of pole pairs/pole pair distance**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>1 / var.</td>
<td>3</td>
</tr>
</tbody>
</table>

**Function**

The following settings can be made depending on bit 9 of parameter **P-0-4014, Type of construction of motor**:

- number of pole pairs in the case of rotary motors
- pole pair distance/pole pair length in the case of linear motors

**Note:**

Writing the correct value to this parameter:

- In the case of MHD, MKD, MKE, automatically at initial commissioning.
- In the case of 2AD, ADF, linear and rotary kit motors, by loading the motor parameters with the IndraWorks D commissioning tool.
- In the case of other motors, manual input according to manufacturer's specification.

See also Functional Description "Motor, Mechanical Axis System, Measuring Systems"

---

**P-0-0043, Torque-generating current, actual value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

Display parameter for the torque-generating component of the measured actual current value. The value is updated with the current loop cycle time.
Note: The phase currents of the three-phase AC motor are measured. The resulting torque-generating content of the total current is calculated internally and displayed by means of this parameter.

### P-0-0044, Flux-generating current, actual value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- A eff</td>
</tr>
</tbody>
</table>

**Function**
Display parameter for the content of the measured actual current value that generates the magnetic flux in the motor. The value is updated with current loop cycle time.

Note: The phase currents of the three-phase AC motor are measured. The resulting flux-generating content of the total current is calculated internally and displayed by means of this parameter.

### P-0-0045, Control word of current controller

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0 --</td>
</tr>
</tbody>
</table>

**Function**
This parameter is used to configure the current controller. This means that with this parameter you can activate and deactivate extended functions.

See also Functional Description "Motor Control"

### P-0-0046, Status word of current controller

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- --</td>
</tr>
</tbody>
</table>

**Function**
This parameter displays states that affect the correct behavior of the current loop.

### P-0-0048, Effective velocity command value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- S-0-0044</td>
</tr>
</tbody>
</table>

**Function**
By means of this parameter it is possible to display the velocity command value at the summing point of the velocity controller.

**Note:** At the summing point the actual velocity value is subtracted from the effective velocity command value. The result of this calculation (control difference) is the input of the speed controller.
See also the functional description: "Velocity Loop"
See also the functional description: "Synchronization Modes"

**P-0-0051, Torque/force constant**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,01 / 21474836,47</td>
<td>1,00</td>
<td>P-0-4014</td>
</tr>
</tbody>
</table>

**Function**
The torque/force constant indicates the relation of the motor torque/force and the associated torque-generating current of the motor, if the motor is not in the field weakening range.

If the motor is in the field weakening range, the actually effective torque/force constant is reduced depending on the speed/velocity. The value in this parameter, however, remains unchanged (relation to operation without field weakening).

**Note:**
Writing the correct value to this parameter:

- In the case of MHD, MKD, MKE, automatically at initial commissioning.
- In the case of 2AD, ADF, linear and rotary kit motors, by loading the motor parameters with the IndraWorks D commissioning tool.
- In the case of other motors, manual input according to manufacturer's specification.

See also Functional Description "Torque/Force Control"
See also Functional Description "Motor, Mechanical Axis System, Measuring Systems"

**P-0-0059, Additive position command value, controller**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0</td>
<td>S-0-0076</td>
<td></td>
</tr>
</tbody>
</table>

**Function**
By means of this parameter an additional position command value can be added, directly at the input of the position loop, to the position command value generated by command value adjustment. The value is neither limited nor changed. This is why the user has to make sure that absolute value, characteristic and the derived values are within their allowed ranges of values!

**Note:**
The actually effective position command value (addition of position command value from command value adjustment of current operating mode and "additive position command value, controller") is displayed in parameter **P-0-0434, Position command value of controller**.

This parameter is used, for example, by the drive firmware in order to set command values from the firmware-internal command value generator without limitation and deformation (noise generator for control loop analysis). It can also be used by the control master for adding feedforward values, for example!
See also Functional Description "Position Control with Cyclic Command Value Input"

**P-0-0063, Torque-generating voltage, actual value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V eff</td>
</tr>
</tbody>
</table>

**Function**
Display parameter for the torque-generating component of the voltage output by the current loop. The value is updated with the current loop cycle time.

**P-0-0064, Flux-generating voltage, actual value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V eff</td>
</tr>
</tbody>
</table>

**Function**
Display parameter for the flux-generating component of the voltage output by the current loop. The value is updated with the current loop cycle time.

**P-0-0065, Absolute voltage value, actual value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V eff</td>
</tr>
</tbody>
</table>

**Function**
This parameter displays the absolute value of the voltage output by the current loop which consists of the voltage components Ud and Uq.

**Note:** The displayed voltage value corresponds to the measured value available at the motor terminals (conductor reference) and is updated with the current loop cycle time!

See also Functional Description "Motor Control"

**P-0-0067, Phase current U, actual value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>A</td>
</tr>
</tbody>
</table>

**Function**
This parameter is used to display the actual current value in the motor phase U measured in the current loop clock (T_{A, current}).

See also Functional Description "Performance Data"

**P-0-0068, Phase current V, actual value**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>A</td>
</tr>
</tbody>
</table>

**Function**
This parameter is used to display the actual current value in the motor phase V measured in the current loop clock (T_{A, current}).

See also Functional Description "Performance Data"
P-0-0081, Parallel output 1

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>... / ...</td>
<td>...</td>
</tr>
</tbody>
</table>

**Function**
The content of **P-0-0081, Parallel output 1** is output at the digital outputs of the optional cards "MD1" (7 outputs) or "MD2" (16 outputs).

**Note:** By writing P-0-0081 (e.g. by means of MLD) the digital outputs can be directly addressed.

See also Functional Description "Digital Inputs/Outputs"

P-0-0082, Parallel input 1

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>... / ...</td>
<td>...</td>
</tr>
</tbody>
</table>

**Function**
The content of **P-0-0082, Parallel input 1** maps the digital inputs of the option MD1 (11 inputs) or MD2 (16 inputs).

**Note:** By reading P-0-0082 (e.g. by means of MLD) the digital inputs can be directly detected.

See also Functional Description "Digital Inputs/Outputs"

P-0-0090, Travel range limit parameter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 7</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**
This parameter defines the signal behavior of the travel range limit switch inputs and the behavior of the drive with regard to exceeded travel ranges.

See also Functional Description "Position Limitation/Travel Range Limit Switch"

P-0-0101, Configuration for starting lockout selector

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>... / ...</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**
In parameter **P-0-0101, Configuration for starting lockout selector** it is possible to configure the selection of the activation circuit of the starting lockout.

**Parameter structure:**

<table>
<thead>
<tr>
<th>Bit</th>
<th>Designation/function</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0: N/C-N/O combination</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0: N/C-N/C combination</td>
<td></td>
</tr>
</tbody>
</table>
Fig. 7-41: P-0-0101, Configuration for starting lockout selector

**P-0-0102, Oper. hours power section at last activat. of start. lockout**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0,0</td>
</tr>
<tr>
<td>--- / s</td>
<td>s</td>
<td></td>
</tr>
</tbody>
</table>

**Function**
Parameter P-0-0102, Oper. hours power section at last activat. of start. lockout displays the operating hours of the power section since the last time the starting lockout function was deselected.

**P-0-0105, Time stamp for list of diagnostic message numbers**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
<tr>
<td>--- / s</td>
<td>s</td>
<td></td>
</tr>
</tbody>
</table>

**Function**
This parameter contains a list of the points of time at which the diagnostic drive message was changed. At each change of S-0-0390, Diagnostic message number the respective point of time (value from P-0-0190, Operating hours control section) is recorded. The last point of time at which the diagnostic message was changed is entered in the first line of the list, all entries already existing are moved down by one line. The list is full after 50 entries, each other entry causes the oldest value to get lost.

The list from P-0-0105 corresponds with S-0-0375, List of diagnostic numbers. These parameters in the same line contain the diagnostic message number corresponding to the respective point of time.

**Note:**
The numbers of the diagnostic error messages and the respective points of time of the error events are only accepted in S-0-0375 and P-0-0105 by clearing the error message!

**P-0-0109, Torque/force peak limit**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>400.0</td>
<td>S-0-0086</td>
</tr>
</tbody>
</table>

**Function**
Torque/force limit value that acts on the sum of all torque/force command values:
- command values from the acceleration feedforwards (S-0-0348, P-0-1126)
- command values from the velocity controller (P-0-0049)

See also Functional Description "Torque/Force Limitation"

**P-0-0114, Undervoltage threshold**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 500</td>
<td>0</td>
</tr>
</tbody>
</table>
Function: With this parameter it is possible to determine and activate an individual undervoltage threshold, differing from the standard value, for the DC bus voltage.

**P-0-0115, Device control: status word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: By means of this parameter it is possible to read the drive status (device control) independent of the master communication that is used.

See also Functional Description "Master Communication"

See also Functional Description "Drive Functions - Drive Halt"

**P-0-0116, Device control: control word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: This parameter indicates whether the master communication has activated the drive.

**P-0-0117, Activation of NC reaction on error**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

Function: This parameter allows activating an error reaction controlled by the control unit. When error reaction controlled by the control unit is active, the control unit (external control/NC or local MLD) still can input command values for the drive for 30 s. This allows realizing an error reaction coordinated by the control unit in the case of error.

Note: When the 30 seconds are over, the error reaction set in 
**P-0-0119, Best possible deceleration** is carried out.

See also Functional Description "NC Reaction on Error"

**P-0-0118, Power supply, configuration**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>3</td>
</tr>
</tbody>
</table>

Function: In parameter P-0-0118 settings with regard to error messages and error reactions are made for drives that are interconnected via the DC bus and the module bus ("drive system"). In addition, the handling of DC bus undervoltage is determined.

Note: The DC bus voltage (power bus) for the "drive system" in operation is not switched off in the case of non-fatal drive errors!

See also Functional Description "Power Supply"
### P-0-0119, Best possible deceleration

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0 / 3</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**

This parameter determines the way the drive is shut down in case:
- non-fatal errors occur
- interface errors occur
- communication phase is reset
- drive enable is disabled

See also Functional Description "Best Possible Deceleration"

### P-0-0139, Analog output 1

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,000 / 10,000</td>
<td>0,000</td>
<td>V</td>
</tr>
</tbody>
</table>

**Function**

This parameter indicates the voltage value that is output via the analog output 1 of the drive controller.

See also Functional Description "Analog Outputs"

### P-0-0140, Analog output 2

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,000 / 10,000</td>
<td>0,000</td>
<td>V</td>
</tr>
</tbody>
</table>

**Function**

This parameter indicates the voltage value that is output via the analog output 2 of the drive controller.

See also Functional Description "Analog Outputs"

### P-0-0141, Thermal drive load

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0 / 100,0</td>
<td>---</td>
<td>%</td>
</tr>
</tbody>
</table>

**Function**

The P-0-0141, Thermal drive load parameter is used to check the thermal load of the amplifier, 0% of the chip overtemperature corresponding to 0 Kelvin, 100% corresponding to the maximum chip overtemperature. Given the correct dimensioning of the drive, the thermal load should not exceed the value of 80% for the intended processing cycles.

### P-0-0180, Acceleration feedforward smoothing time constant

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0 / 10000</td>
<td>0</td>
<td>us</td>
</tr>
</tbody>
</table>

**Function**

This parameter allows filtering the
• double differentiated position command value (cyclic position control)
• differentiated velocity command value (velocity control)

with a 1st order low pass in order to realize an acceleration feedforward which avoids an unduly high excitation of the system even in the case of poor position or velocity resolution. For the double differentiation can cause a highly noisy feedforward value which in turn is added as an additive torque command value.

Fig. 7-42: Parameterizable filter cascade

See also Functional Description "Drive Control - Axis Control (Closed-Loop Operation)"

**P-0-0190, Operating hours control section**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- s</td>
</tr>
</tbody>
</table>

**Function**
This parameter displays the operating time of the drive's control section. By means of this parameter it is possible to display the total duty cycle of the control electronics since the delivery of the device. If a class 1 diagnostics error occurs, the content of this parameter at this point of time is stored at the first place in the **P-0-0193, Error memory operating hours of control section** parameter.

**Note:** The value is displayed in seconds and is stored on the control section!

See also Functional Description "Operating Hours Counter"

**P-0-0191, Operating hours power section**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- s</td>
</tr>
</tbody>
</table>

**Function**
This parameter displays the operating hours of the power section since the delivery of the device. These operating hours are the time during which the drive has been operated with drive enable switched on.

**Note:** The value is displayed in seconds and is stored on the power section!

See also Functional Description "Operating Hours Counter"
P-0-0192, Error memory of diagnostic numbers

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-- / --</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**

When the drive diagnoses a class 1 diagnostics error, a bit is set in parameter **S-0-0011, Class 1 diagnostics**. Bit 13 for "Error in class 1 diagnostics" is then set in the drive status word.

See also Functional Description "Error Memory (Power Section and Control Section)"

---

P-0-0193, Error memory operating hours of control section

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-- / --</td>
<td>s</td>
</tr>
</tbody>
</table>

**Function**

When the drive diagnoses a class 1 diagnostics error, a bit is set in parameter **S-0-0011, Class 1 diagnostics**. Bit 13 for "Error in class 1 diagnostics" is then set in the drive status word.

See also Functional Description "Error Memory (Power Section and Control Section)"

---

P-0-0194, Error memory power section

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 4294967295</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**

When the drive diagnoses a class 1 diagnostics error, a bit is set in parameter **S-0-0011, Class 1 diagnostics**. Bit 13 for "Error in class 1 diagnostics" is then set in the drive status word.

See also Functional Description "Error Memory (Power Section and Control Section)"

---

P-0-0196, Build date and time

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-- / --</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**

The build date and build time of the drive firmware can be read from this parameter as a text.

See also Functional Description "System Overview"

---

P-0-0197, System time

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-- / --</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**

Parameter P-0-0197 contains a system time of the drive with a resolution of 100 ns. It can be used in conjunction with the parameters P-0-0198 and
P-0-0199 to establish an axis-comprehensive time reference in the case of error.

**Note:** In the case of drive errors, the drive stores the system time in parameter P-0-0198, System time error memory.

See also Functional Description "Diagnostic and Service Functions"
See also Parameter Description "P-0-0198, System time error memory"
See also Parameter Description "P-0-0199, System time error code"

### P-0-0198, System time error memory

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
The count of parameter P-0-0197, System time at the time the error is detected is stored in parameter P-0-0198, System time error memory. It can be used in conjunction with the parameters P-0-0197 and P-0-0199 to establish an axis-comprehensive time reference in the case of error.

**Note:** P-0-0198 is stored together with P-0-0199 as customer data; in this way the system time error memory and the system time error code remain in the system when parameter download takes place via the master communication or the serial interface or the MMC.

See also Functional Description "Diagnostic and Service Functions"
See also Parameter Description "P-0-0197, System time"
See also Parameter Description "P-0-0199, System time error code"

### P-0-0199, System time error code

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
Parameter P-0-0199 contains the error code consistent with P-0-0197, System time. It can be used in conjunction with the parameters P-0-0197 and P-0-0198 to establish an axis-comprehensive time reference in the case of error.

### P-0-0208, Analog input 5

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

**Function**
The input voltage currently provided at the analog input 5 can be read and displayed in Volt by means of this parameter.

**Note:** Analog input 5 is only available in conjunction with a double-axis device with configuration of 2 optional cards MA1!

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"
P-0-0209, Analog input 6

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

Function
The input voltage currently provided at the analog input 6 can be read and displayed in Volt by means of this parameter.

Note:
Analog input 6 is only available in conjunction with a double-axis device with configuration of 2 optional cards MA1!

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

P-0-0210, Analog input 1

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

Function
The input voltage currently provided at the analog input 1 can be read and displayed in Volt by means of this parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

P-0-0211, Analog input 2

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

Function
The input voltage currently provided at the analog input 2 can be read and displayed in Volt by means of this parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

P-0-0212, Analog input, list of assignable parameters

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--</td>
</tr>
</tbody>
</table>

Function
This list parameter contains the IDNs of the parameters that can be entered in P-0-0213, Analog input, assignment A, target parameter and P-0-0236, Analog input, assignment B, target parameter. These parameters are available for assigning an analog input value.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

P-0-0213, Analog input, assignment A, target parameter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
</table>

Function
P-0-0214, Analog input, assignment B, target parameter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
</table>

Function

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"
In this parameter the IDN of that parameter is entered to which a value corresponding to the voltage at the respective analog input is to be written. The scaling is made via P-0-0214, Analog input, assignment A, scaling per 10V full scale!

Note: Only such IDNs can be entered in P-0-0213 that are contained in P-0-0212, Analog input, list of assignable parameters.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0214, Analog input, assignment A, scaling per 10V full scale**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

Function

By means of this parameter the analog input for assignment A (range of values per 10 V) is scaled. Unit, decimal places and data type are determined by the parameter assigned in P-0-0213, Analog input, assignment A, target parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0215, Analog input, assignment A, signal value at 0V**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

Function

In this parameter the reference of the analog input for assignment A (value with a voltage of 0 V at the analog input) is defined. This allows compensating a possible offset of the voltage at the analog input for assignment A.

Unit, decimal places and data type are determined by the parameter assigned in P-0-0213, Analog input, assignment A, target parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0216, Analog input, assignment A, dead zone**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,000 / 10,000</td>
<td>0,000</td>
</tr>
</tbody>
</table>

Function

By means of this parameter it is possible to define, for the analog input voltage (assignment A), a range of values that is interpreted as voltage value 0 V ("dead zone") by the drive controller.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0217, Analog input 1, time constant input filter**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,250 / 60,000</td>
<td>0,250</td>
<td>ms</td>
</tr>
</tbody>
</table>

**Function**
The analog input 1 can be read by the drive firmware via a digital low-pass filter. The limit frequency of this filter is set by this parameter, if necessary the filter can also be deactivated.

\[ f_{\text{limit}} = \frac{1000}{(2 \pi T_{\text{input}})} \]

- \( f_{\text{limit}} \): limit frequency in Hz
- \( T_{\text{input}} \): time constant of input filter in ms

Fig. 7-43: Calculating the limit frequency of the analog input filter

**Performance (P-0-0556)**

<table>
<thead>
<tr>
<th>Input filter</th>
<th>( T_{\text{input}} ) in µs</th>
</tr>
</thead>
<tbody>
<tr>
<td>inactive</td>
<td>500 µs</td>
</tr>
<tr>
<td>active</td>
<td>&gt;500 µs</td>
</tr>
<tr>
<td>high (bit 2 = 1)</td>
<td>inactive</td>
</tr>
<tr>
<td></td>
<td>active</td>
</tr>
</tbody>
</table>

Fig. 7-44: Settings of the analog input filter

See also Functional Description "Analog Interface"

See also Functional Description "Analog Inputs"

**P-0-0218, Analog input, control parameter**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**
This parameter is used:
- for controlling the command "analog input adjust"
- for assigning the analog channels for "assignment analog channel A" or "assignment analog channel B"
- for selecting current input or voltage input
- for selecting the measuring range
- for selecting the kind of reaction in the case of wire break

**Note:** It is possible to adjust both analog voltage and current inputs!

See also Functional Description "Analog Interface"

See also Functional Description "Analog Inputs"

**P-0-0219, Analog input, maximum value for adjust**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

---

DOK-INDRV*-FU*********.IB01-EN-P
### Function
This parameter makes available a defined command value for determining the values of

- P-0-0214, Analog input, assignment A, scaling per 10V full scale or
- P-0-0237, Analog input, assignment B, scaling per 10V full scale

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

### P-0-0220, C2800 Analog input adjust command

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
By means of this command, together with

- P-0-0218, Analog input, control parameter
- P-0-0219, Analog input, maximum value for adjust

it is possible to carry out a zero point and gain adjust for the respective selected analog input (cf. P-0-0218).

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

### P-0-0222, Travel range limit switch inputs

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**
In this parameter the signals of the travel range limit switch inputs are displayed. It is used to diagnose the travel range limit switch inputs.

See also Functional Description "Position Limitation/Travel Range Limit Switch"

### P-0-0223, E-Stop input

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
The status of the E-Stop input is mapped to this parameter. The parameter can be used to check the E-Stop input or for visualization by a commissioning program.

See also Functional Description "E-Stop Function"

### P-0-0228, Analog input 3

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

**Function**
The input voltage currently provided at the analog input 3 can be read and displayed in Volt by means of this parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0229, Analog input 4**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

**Function**
The input voltage currently provided at the analog input 4 can be read and displayed in Volt by means of this parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0231, Analog input 2, time constant input filter**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,250 / 60,000</td>
<td>ms</td>
</tr>
</tbody>
</table>

**Function**
The analog input 2 can be read by the drive firmware via a digital low-pass filter. The limit frequency of this filter is set by this parameter, if necessary the filter can also be deactivated.

\[
f_{\text{grenz}} = \frac{1000}{(2 \cdot \pi \cdot T_{\text{Eng.}})}
\]

\(f_{\text{grenz}}\): limit frequency in Hz
\(T_{\text{Eng.}}\): time constant of input filter in ms

Fig. 7-45: Calculating the limit frequency of the analog input filter

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0232, Analog input 3, time constant input filter**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,250 / 60,000</td>
<td>ms</td>
</tr>
</tbody>
</table>

**Function**
The analog input 3 can be read by the drive firmware via a digital low-pass filter. The limit frequency of this filter is set by this parameter, if necessary the filter can also be deactivated.

\[
f_{\text{limit}} = \frac{1000}{(2 \cdot \pi \cdot T_{\text{input}})}
\]

\(f_{\text{limit}}\): limit frequency in Hz
\(T_{\text{input}}\): time constant of input filter in ms

Fig. 7-46: Calculating the limit frequency of the analog input filter

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

**P-0-0233, Analog input 4, time constant input filter**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,250 / 60,000</td>
<td>ms</td>
</tr>
</tbody>
</table>

See also Functional Description "Analog Inputs"
The analog input can be uploaded/downloaded by the drive firmware via a digital low-pass filter. The limit frequency of this filter is set by this parameter, if necessary the filter can also be deactivated.

\[ f_{\text{grau}} = \frac{1000}{2 \cdot \pi \cdot T_{\text{Eing.}}} \]

\( f_{\text{limit}} \): limit frequency in Hz
\( T_{\text{input}} \): time constant of input filter in ms

Fig. 7-47: Calculating the limit frequency of the analog input filter

See also Functional Description “Analog Interface”
See also Functional Description “Analog Inputs”

### P-0-0234, Analog input 5, time constant input filter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0.250 / 60,000</td>
<td>0.250</td>
<td>ms</td>
</tr>
</tbody>
</table>

**Function**
The analog input 5 can be read by the drive firmware via a digital low-pass filter.

**Note:** Analog input 5 is only available in conjunction with a double-axis device with configuration of 2 optional cards MA1!

See also Functional Description “Performance Data”
See also Functional Description “Analog Interface”
See also Functional Description “Analog Inputs”

### P-0-0235, Analog input 6, time constant input filter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0.250 / 60,000</td>
<td>0.250</td>
<td>ms</td>
</tr>
</tbody>
</table>

**Function**
The analog input 6 can be read by the drive firmware via a digital low-pass filter.

**Note:** Analog input 6 is only available in conjunction with a double-axis device with configuration of 2 optional cards MA1!

See also Functional Description “Performance Data”
See also Functional Description “Analog Interface”
See also Functional Description “Analog Inputs”

### P-0-0236, Analog input, assignment B, target parameter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**
In this parameter the IDN of that parameter is entered to which a value corresponding to the voltage at the respective analog input is to be written. The scaling is made via P-0-0237, Analog input, assignment A, scaling per 10V full scale!
Note: Only such IDNs can be entered in P-0-0213 that are contained in P-0-0212, Analog input, list of assignable parameters.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

P-0-0237, Analog input, assignment B, scaling per 10V full scale

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-- / --</td>
<td>0</td>
</tr>
</tbody>
</table>

Function
By means of this parameter the analog input for assignment B (range of values per 10 V) is scaled.
Unit, decimal places and data type are determined by the parameter assigned in P-0-0236, Analog input, assignment B, target parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

P-0-0238, Analog input, assignment B, signal value at 0V

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-- / --</td>
<td>0</td>
</tr>
</tbody>
</table>

Function
In this parameter the reference of the analog input for assignment B (value with a voltage of 0 V at the analog input) is defined. This allows compensating a possible offset of the voltage at the analog input.
Unit, decimal places and data type are determined by the parameter assigned in P-0-0236, Analog input, assignment B, target parameter.

See also Functional Description "Analog Interface"
See also Functional Description "Analog Inputs"

P-0-0239, Analog input, assignment B, dead zone

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0.000 / 10.000</td>
<td>0.000 V</td>
</tr>
</tbody>
</table>

Function
By means of this parameter it is possible to define a range of values for the analog input voltage (assignment B). The controller interprets this range of values as voltage value 0 V ("dead zone").

P-0-0300, Digital I/Os, assignment list

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-- / --</td>
<td>--</td>
</tr>
</tbody>
</table>

Function
Via parameter P-0-0300 drive signals are assigned to the digital inputs/outputs of the control section by configuring the corresponding IDN in the list parameter.
Note: Apart from the IDN, the bit number desired for the input or output (cf. P-0-0301, Digital I/Os, bit numbers) and the output direction (cf. P-0-0302, Digital I/Os, direction) have to be defined!

See also Functional Description "Digital Inputs/Outputs"

**P-0-0301, Digital I/Os, bit numbers**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter is used to configure the digital inputs/outputs of the control section.

In **P-0-0301, Digital I/Os, bit numbers** the desired bit number which is to be assigned to the digital input or output is indicated for each assigned parameter (cf. P-0-0300, Digital I/Os, assignment list).

Note: Apart from determining the bit number, the IDN desired for the output or input has to be defined via **P-0-0300, Digital I/Os, assignment list**.

See also Parameter Description "P-0-0300, Digital I/Os, assignment list"

See also Functional Description "Digital Inputs/Outputs"

**P-0-0302, Digital I/Os, direction**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter is used to configure the digital inputs/outputs of the control section.

In parameter **P-0-0302, Digital I/Os, direction** the desired function (direction) is indicated for each assigned parameter (cf. P-0-0300, Digital I/Os, assignment list). This means that parameter P-0-0302 sets the digital input or output.

- "0" for "input" function
- "1" for "output" function

Note: Apart from determining the "digital I/Os, direction", the desired IDN and bit number for the output or input has to be defined via **P-0-0300, Digital I/Os, assignment list** or **P-0-0301, Digital I/Os, bit numbers**.

See also Functional Description "Digital Inputs/Outputs"

**P-0-0303, Digital I/Os, status display**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>
This parameter displays the current states of the digital inputs. This means that the current signal level or switch status (only for MP*02VRS!) is displayed.

The table below illustrates the different significance of the individual bits depending on control section and firmware:

### P-0-0304, Digital I/Os, outputs

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>--</td>
</tr>
</tbody>
</table>

This parameter displays the states of the digital outputs and relay outputs. This means that the current signal level or switch status is displayed; the following cases have to be distinguished for inputs/outputs that can be switched:

- With configuration as output, the output signal status is displayed in P-0-0304.
- With configuration as input, the input signal status is displayed in P-0-0303, Digital I/Os, inputs.

**Note:** Configuration takes place via P-0-0302, Digital I/Os, direction.

See also Functional Description "Digital Inputs/Outputs"

### P-0-0414, Analog Output 3

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: -10,000 / 10,000</td>
<td>0,000</td>
<td>V</td>
</tr>
</tbody>
</table>

This parameter indicates the voltage value that is output via the analog output 3 of the drive controller.

See also Functional Description "Analog Outputs"

### P-0-0415, Analog Output 4

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: -10,000 / 10,000</td>
<td>0,000</td>
<td>V</td>
</tr>
</tbody>
</table>

This parameter indicates the voltage value that is output via the analog output 4 of the drive controller.

See also Functional Description "Analog Outputs"

### P-0-0416, Analog Output 5

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: -10,000 / 10,000</td>
<td>0,000</td>
<td>V</td>
</tr>
</tbody>
</table>

This parameter displays the voltage value that is output via the analog output 5 of the drive controller.
Note: Analog output 5 is only available in conjunction with a double-axis device with configuration of 2 optional cards MA1!

See also Functional Description "Analog Outputs"

P-0-0417, Analog Output 6

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-10,000 / 10,000</td>
<td>0,000 V</td>
</tr>
</tbody>
</table>

Function: This parameter displays the voltage value that is output via the analog output 6 of the drive controller.

Note: Analog output 6 is only available in conjunction with a double-axis device with configuration of 2 optional cards MA1!

See also Functional Description "Analog Outputs"

P-0-0418, Analog output, assignment A, signal value at 0V

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

Function: In this parameter the reference of the analog output of assignment A (value with an output of 0 V) is defined. The unit is determined by the parameter assigned in **P-0-0420, Analog output, assignment A, signal selection**.

When assigning parameters with the "binary" display attribute, the parameter is not active.

See also Functional Description "Analog Outputs"

P-0-0419, Analog output, assignment B, signal value at 0V

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

Function: In this parameter the reference of the analog output of assignment B (value with an output of 0 V) is defined. The unit is determined by the parameter assigned in **P-0-0423, Analog output, assignment B, signal selection**.

When assigning parameters with the "binary" display attribute, the parameter is not active.

See also Functional Description "Analog Outputs"

P-0-0420, Analog output, assignment A, signal selection

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

See also Functional Description "Analog Outputs"
By means of this parameter it is possible to assign a parameter IDN to the analog outputs 1 and 3 of the drive controller. The current parameter value is output as voltage at the analog output, if the mode of the analog output in P-0-0427, Control parameter of analog output has been set to output of assignment A. The output voltage can be made visible with an oscilloscope, for example.

It is only possible to assign those IDNs that have been entered in the P-0-0426, Analog output IDN list of assignable parameters list.

See also Functional Description "Analog Outputs"

**P-0-0422, Analog output, assignment A, scaling [1/V]**

| Function | This parameter is used to scale the voltage output by analog output 1 and 3. The unit is determined by the parameter assigned in P-0-0420, Analog output, assignment A, signal selection.
| --- | --- |
| | When assigning parameters with the "binary" display attribute, the number of the bit to be output at the analog output is defined in this parameter.
| | When the respective bit has not been set, the output voltage is 0 V. When the bit has been set, 1 V is output.
| See also | Functional Description "Analog Outputs"

**P-0-0423, Analog output, assignment B, signal selection**

| Function | By means of this parameter it is possible to assign a parameter IDN to the analog outputs 2 and 4 of the drive controller. The current parameter value is output as voltage at the analog output, if the mode of the analog output in P-0-0427, Control parameter of analog output has been set to output of assignment B. The output voltage can be made visible with an oscilloscope, for example.
| --- | --- |
| | It is only possible to assign those IDNs that have been entered in the P-0-0426, Analog output IDN list of assignable parameters list.
| See also | Functional Description "Analog Outputs"

**P-0-0425, Analog output, assignment B, scaling [1/V]**

| Function | This parameter is used to scale the voltage output by analog output 2 and 4. The unit is determined by the parameter assigned in P-0-0423, Analog output, assignment B, signal selection.
| --- | --- |
| | When assigning parameters with the "binary" display attribute, the number of the bit to be output at the analog output is defined in this parameter.
| | When the respective bit has not been set, the output voltage is 0 V. When the bit has been set, 1 V is output.
See also Functional Description "Analog Outputs"

**P-0-0426, Analog output IDN list of assignable parameters**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This parameter contains a list of all parameter IDNs that can be assigned via

- P-0-0420, Analog output, assignment A, signal selection
- P-0-0423, Analog output, assignment B, signal selection

See also Functional Description "Analog Outputs"

**P-0-0427, Control parameter of analog output**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
This configuration parameter determines the signal source and conditions for the analog outputs.

See also Functional Description "Analog Outputs"

**P-0-0440, Actual output current value (absolute value)**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>A eff</td>
</tr>
</tbody>
</table>

**Function**
Display parameter for the measured actual current value which is the rms value of the motor phase current.

The phase currents are scanned in the current controller cycle, converted as a current vector and the rms value is calculated from these data. This parameter displays the value averaged during 2 ms and is used as the input value for the overload models of amplifier and motor.

**P-0-0441, Overload warning**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 100</td>
<td>80 %</td>
</tr>
</tbody>
</table>

**Function**
Parameter for determining a threshold value for thermal controller work load.

If the value displayed in P-0-0141, Thermal drive load exceeds the determined threshold, the warning **E2061 Amplifier overload prewarning** is generated.

The unit of the threshold value corresponds to the one of P-0-0141 (%).

**Note:** When 100% is entered, **E2061 Amplifier overload prewarning** is not displayed. Instead, the warning **E8057 Amplifier overload, current limit active** is already generated with approx. 97% of the thermal work load.
P-0-0442, Actual value torque limit positive (stationary)

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
Display parameter for the effective positive torque limit value. The value displayed is the lowest value of
- S-0-0092, Bipolar torque/force limit value
- P-0-0109, Torque/force peak limit
- S-0-0082, Torque/force limit value positive
- work load-dependent limits by motor and controller
- motor depending limits.

P-0-0443, Actual value torque limit negative (stationary)

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
Display parameter for the effective negative torque limit value. The value displayed is the lowest value of
- S-0-0092, Bipolar torque/force limit value
- P-0-0109, Torque/force peak limit
- S-0-0083, Torque/force limit value negative
- work load-dependent limits by motor and controller
- motor depending limits.

See also Functional Description "Torque/Force Limitation"

P-0-0444, Actual value peak torque limit

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
Display parameter for the maximum drive torque or the maximum drive force. The value is the limit value for positive and negative torque/force command values.
The value displayed is the lower value of
- P-0-0109, Torque/force peak limit
- S-0-0092, Bipolar torque/force limit value
- work load-dependent limits by motor and controller
- motor-dependent limits.
The unit for the values of this parameter depends on the scaling that has been set (S-0-0086, Torque/force data scaling type).

See also Functional Description "Torque/Force Limitation"
**P-0-0445, Status word torque/current limit**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- / ---</td>
</tr>
</tbody>
</table>

**Function**

This parameter contains the status messages (bits) for the torque/current limitation.

See also Functional Description "Torque/Force and Current Limitation"

**P-0-0512, Temperature sensor**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / var.</td>
<td>1</td>
</tr>
</tbody>
</table>

**Function**

The controller monitors the motor temperature by means of temperature sensors installed in the motor. The controller can directly evaluate standard temperature sensors because the characteristics of the sensors are stored in the firmware.

See also Functional Description "Motor Temperature Monitoring"

**P-0-0513, Temperature sensor characteristic**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 4294967295</td>
<td>--- / Ohm</td>
</tr>
</tbody>
</table>

**Function**

If a temperature sensor is to be evaluated the characteristic of which has not been stored in the firmware, the characteristic has to be entered in this parameter in the form of a value table.

See also Functional Description "Motor Temperature Monitoring"

**P-0-0525, Holding brake control word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**

By this parameter the controller is informed of the type of motor holding brake and the way it is controlled:

- self-releasing or self-holding brake
- main drive brake or servo brake
- automatic brake check when switching drive enable on and off
- enabling the "release holding brake" command

**Note:**

- For Rexroth motors with encoder data memory, MHD, MKD, MKE and MSK, bit 0 and bit 2 are automatically set!
- For motors without encoder data memory, bit 0 and bit 2, depending on whether a holding brake is available, have to be manually set to the appropriate value!
- For motors without integrated holding brake, an external holding brake can be controlled by the controller (set bit 2 to "1"). Set bit 0 according to type of holding brake!
See also Functional Description "Motor Holding Brake"

**P-0-0528, Flux control loop proportional gain**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,00 / 100,00</td>
<td>1,00</td>
<td>--</td>
</tr>
</tbody>
</table>

*Function*  
For asynchronous motors, the gain of the flux loop is entered in this parameter.

See also Functional Description "Field-Oriented Closed-Loop Current Control"

**P-0-0529, Scaling of stall current limit**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 10 / 150</td>
<td>100</td>
<td>%</td>
</tr>
</tbody>
</table>

*Function*  
The stall current limit is the limit for the torque-generating current of asynchronous motors.

See also Functional Description "Field-Oriented Closed-Loop Current Control"

**P-0-0530, Slip increase**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 1,00 / 2,00</td>
<td>1,50</td>
<td>1/100K</td>
</tr>
</tbody>
</table>

*Function*  
This parameter is only used for asynchronous motors. In the asynchronous motor the rotor resistance and therefore the rotor time constant change as the temperature changes.

See also Functional Description "Field-Oriented Closed-Loop Current Control"

**P-0-0532, Premagnetization factor**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: var. / var.</td>
<td>100</td>
<td>%</td>
</tr>
</tbody>
</table>

*Function*  
With this parameter it is possible to reduce the magnetizing current of an asynchronous motor and therefore the rotor flux. The factor is referring to P-0-4004, Magnetizing current.

See also Functional Description "Motor, Mechanical Axis System, Measuring Systems"

**P-0-0533, Voltage loop proportional gain**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,000 / 4294967,295</td>
<td>0,500</td>
<td>A/V</td>
</tr>
</tbody>
</table>
Function

By means of this parameter the proportional gain of the voltage loop is entered. The voltage loop is used to control the motor voltage in the field-weakening range.

---

**Note:**

Writing the correct value to this parameter:

- In the case of MAD and MAF with encoder data memory automatically during initial commissioning.
- In the case of 2AD, ADF, linear and rotary kit motors, by loading the motor parameters with the commissioning software (e.g. IndraWorks).
- In the case of other motors: default value or manual input.

See also Functional Description “Third-Party Motors at IndraDrive Controllers”

---

### P-0-0534, Voltage loop integral action time

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0 / 429496729,5</td>
<td>600,0</td>
<td>ms</td>
</tr>
</tbody>
</table>

Function

By means of this parameter the integral action time of the voltage loop is entered. The voltage loop is used to control the motor voltage in the field-weakening range.

---

**Note:**

Writing the correct value to this parameter:

- In the case of MAD and MAF with encoder data memory automatically during initial commissioning.
- In the case of 2AD, ADF, linear and rotary kit motors, by loading the motor parameters with the commissioning software (e.g. IndraWorks).
- In the case of other motors: default value or manual input.

See also Functional Description “Determining the Motor Parameter Values”

---

### P-0-0535, Motor voltage at no load

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0 / 100,0</td>
<td>80,0</td>
<td>%</td>
</tr>
</tbody>
</table>

Function

As a matter of principle, this parameter only takes effect in field weakening operation. It defines a voltage that is indicated in percent of the maximum converter output voltage.

See also Functional Description “Determining the Motor Parameter Values”

---

### P-0-0536, Maximum motor voltage
**MPB:** 50.0 / 100.0 90.0 %

**Function** This parameter defines the command voltage of the voltage loop. It is indicated in percent of the maximum converter output voltage.

**Note:**
Writing the correct value to this parameter:
- In the case of MAD and MAF with encoder data memory automatically during initial commissioning.
- In the case of 2AD, ADF, linear and rotary kit motors, by loading the motor parameters with the commissioning software (e.g. IndraWorks).
- In the case of other motors: Default value or manual input, set a maximum of 90% because of the required control margin!

See also Functional Description “Third-Party Motors at IndraDrive Controllers”

**P-0-0539, Holding brake status word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function** This parameter displays the current status of the holding brake.

See also Functional Description "Motor Holding Brake"

**P-0-0542, C2000 Command Release motor holding brake**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function** By means of this parameter it is possible to release the motor holding brake when the drive enable has been switched off. At the start of the command the motor holding brake is released, when the command is terminated the brake is applied again.

If drive enable is set with the command being active, the holding brake remains released, when drive enable is switched off, the brake is automatically applied.

**Note:** The command has to be activated via bit 5 in **P-0-0525, Holding brake control word.**

See also Functional Description "Motor Holding Brake"

**P-0-0551, Current load torque**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>S-0-0086</td>
</tr>
</tbody>
</table>

**Function** In this parameter, the maximum occurring load torque of the axis in standstill is displayed and cyclically compared to **P-0-0547, Nominal load**
of holding system. When P-0-0547, Nominal load of holding system is exceeded, the error message F3116 Nominal load torque of holding system exceeded is output.

**P-0-0555, Status word of axis controller**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter contains the following status information (messages) regarding axis control in the form of individual status bits:
- velocity messages
- limits that have been reached, i.e. information regarding an active limitation

See also Functional Description "Limitations"
See also Functional Description "Axis Control"

**P-0-0556, Config word of axis controller**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>32769</td>
</tr>
</tbody>
</table>

**Function**

This parameter is used for configuring functions specific to axis control and setting the control performance.

See also Functional Description "Drive Control - Axis Control (Closed-Loop Operation)"
See also Functional Description "Performance Data"

**P-0-0568, Voltage boost**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,00 / 50,00</td>
<td>0,00 V eff</td>
</tr>
</tbody>
</table>

**Function**

By means of this parameter it is possible to increase the voltage at the base point of the U/f characteristic (in the case of standstill or very low speed of an asynchronous motor). The voltage required at the base point is determined on the basis of the motor data and provided by the controller.

**P-0-0569, Maximum stator frequency change**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,01 / 3000,00</td>
<td>200,00 Hz/s</td>
</tr>
</tbody>
</table>

**Function**

The maximum change of velocity with which the drive can follow the command values is determined by the motor and the sampling time of the stall protection loop. The limit value can be set with this parameter.

**P-0-0570, Stall protection loop proportional gain**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,00 / 500,00</td>
<td>100,00 %</td>
</tr>
</tbody>
</table>
This parameter presets the P-gain of the stall protection loop.
The enable signal of the stall protection loop is controlled via bit 12 in P-0-0045, Control word of current controller.

### P-0-0571, Stall protection loop integral action time

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0 / 6500,0</td>
<td>1,0</td>
<td>ms</td>
</tr>
</tbody>
</table>

The enable signal of the stall protection loop is controlled via bit 12 in P-0-0045, Control word of current controller.

By means of this parameter it is possible to set the integral action time of the stall protection loop.

### P-0-0572, Slip compensation factor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,00 / 320,00</td>
<td>0,00</td>
<td>%</td>
</tr>
</tbody>
</table>

By means of this parameter it is possible to trim the slip compensation feedforward. With the setting 0.00% the feedforward is switched off completely.

### P-0-0573, IxR boost factor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,00 / 320,00</td>
<td>0,00</td>
<td>%</td>
</tr>
</tbody>
</table>

By means of this parameter it is possible to trim the feedforward of the IxR boost. With the setting 0.00% the feedforward is switched off completely.

### P-0-0574, Oscillation damping factor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: -320,00 / 320,00</td>
<td>0,00</td>
<td>%</td>
</tr>
</tbody>
</table>

By means of this parameter it is possible to trim the oscillation damping feedforward. With the setting 0.00% the feedforward is switched off completely.

### P-0-0575, Search mode: search current factor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 1,00 / 320,00</td>
<td>60,00</td>
<td>%</td>
</tr>
</tbody>
</table>

Via P-0-0045, Control word of current controller the search mode function can be selected. During the search process a search current is generated in the still turning machine that is to be searched.

Search current = magnetizing current * P-0-0575 / 100%
P-0-0576, Search mode: finding point slip factor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: -320,00 / 320,00</td>
<td>100,00</td>
<td>%</td>
</tr>
</tbody>
</table>

**Function**
The search mode function is selected via P-0-0045, **Control word of current controller**. As soon as the machine has been found the rated slip is added to the speed at the "finding point". 100% are corresponding to the rated slip of the machine.

With clockwise rotating field: \( V = V_{\text{finding point}} + (V_{\text{slip}} \times \frac{P-0-0576}{100\%}) \)

With anti-clockwise rotat. field: \( V = V_{\text{finding point}} - (V_{\text{slip}} \times \frac{P-0-0576}{100\%}) \)

P-0-0577, Square characteristic: lowering factor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,00 / 100,00</td>
<td>50,00</td>
<td>%</td>
</tr>
</tbody>
</table>

**Function**
The square characteristic is selected via P-0-0045, **Control word of current controller**. The degree of lowering in the basic range of setting is trimmed with this parameter.

The value of 100% corresponds to the original square curve. When the percentage value becomes lower, this lowering factor is reduced until the setting 0% has been reached which corresponds to the linear characteristic.

P-0-0590, Motor model frequency loop proportional gain

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,00 / 655,35</td>
<td>10,00</td>
<td>%</td>
</tr>
</tbody>
</table>

**Function**
This parameter only takes effect in conjunction with field-oriented current control without encoder. Together with P-0-0591, **Motor model frequency loop integral action time**, parameter P-0-0590 is used to parameterize the "frequency loop".

By means of the differences between motor model and measured currents, the frequency loop determines the current rotational frequency of the motor shaft. The output of the frequency loop supplies parameter S-0-0040, **Velocity feedback value** and is transmitted according to the velocity loop.

**Note:** Field-oriented current control without encoder is activated via P-0-0045, **Control word of current controller**. If the functional package "closed-loop" is active, "operation without encoder" has to be set in P-0-0074, **Encoder type 1 (motor encoder)".

See also Functional Description "Field-Oriented Current Control"
See also Functional Description "Automatic Setting of Motor Control Parameters"

P-0-0591, Motor model frequency loop integral action time

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0 / 100,0</td>
<td>5,0</td>
<td>ms</td>
</tr>
</tbody>
</table>
This parameter only takes effect in conjunction with field-oriented current control without encoder. Together with P-0-0590, Motor model frequency loop proportional gain, parameter P-0-0591 is used to parameterize the “frequency loop”.

By means of the differences between motor model and measured currents, the frequency loop determines the current rotational frequency of the motor shaft. The output of the frequency loop supplies parameter S-0-0040, Velocity feedback value and is transmitted according to the velocity loop.

Note: Field-oriented current control without encoder is activated via P-0-0045, Control word of current controller. If the functional package “closed-loop” is active, “operation without encoder” has to be set in P-0-0074, Encoder type 1 (motor encoder).

See also Functional Description “Field-Oriented Current Control”
See also Functional Description “Automatic Setting of Motor Control Parameters”

P-0-0592, Motor model adjust factor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0.000 / 1.000</td>
<td>0.100</td>
<td>--</td>
</tr>
</tbody>
</table>

Note: Field-oriented current control without encoder is activated via P-0-0045, Control word of current controller. If the functional package “closed-loop” is active, “operation without encoder” has to be set in P-0-0074, Encoder type 1 (motor encoder).

See also Functional Description “Field-Oriented Current Control”
See also Functional Description “Automatic Setting of Motor Control Parameters”

P-0-0640, Cooling type

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0 / 4</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

Note: Field-oriented current control without encoder is activated via P-0-0045, Control word of current controller. If the functional package “closed-loop” is active, “operation without encoder” has to be set in P-0-0074, Encoder type 1 (motor encoder).

The motors of the MSK, MHD and MKD series can be operated in different cooling types. Depending on the motor type, cooling can be realized as:
- standard cooling (natural convection, non-ventilated)
- surface ventilation
- liquid cooling
• improved nat. cooling
• reduced nat. cooling

See also Functional Description "Motor, Mechanical Axis System, Measuring Systems" and "Current and Torque Limitation (Closed-Loop)"

P-0-0690 – P-0-0899 (Synchronization Mode)

P-0-0690, Additive velocity command value, process loop

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

Function
In addition to S-0-0037, parameter P-0-0690 is used to set an additive velocity command value.

Note: P-0-0690 can preferably be used for drive-based process loops (by means of MLD)!

P-0-0806, Current mains voltage crest value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>V</td>
</tr>
</tbody>
</table>

Function
This parameter for HCS03 devices (converters) displays the current crest value of the mains voltage.

P-0-0810, Minimum mains crest value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 780</td>
<td>V</td>
</tr>
</tbody>
</table>

Function
For HCS converters, in this parameter it is possible to set an individual minimum value for the crest value of the mains voltage. The value is only effective, if it is greater than the minimum value of the mains connection voltage range!

For HCS02
If the mains crest value, when the converter is switched on, is lower than the value in P-0-0810, the diagnostic message **E2814 Undervoltage in mains** is generated.

For HCS03
If the mains crest value, when the converter is switched on or is in operation, is lower than the value in P-0-0810, the diagnostic message **E2814 Undervoltage in mains** is generated.

Note: The mains voltage crest value detected when switching on, for HCS devices is displayed in P-0-0815, Nominal mains voltage crest value!
P-0-0815, Nominal mains voltage crest value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>V</td>
</tr>
</tbody>
</table>

**Function**
This parameter for HCS converters displays the mains voltage crest value that was measured when the mains voltage was switched in the first time. From this value the standard value for the undervoltage threshold (P-0-0114), the standard minimum value of the mains voltage crest value (P-0-0810) and the standard switch-on threshold of a braking resistor (P-0-0858) are derived.

P-0-0819, Energy counter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: -20000000,00 / 20000000,00</td>
<td>0,00</td>
<td>kWh</td>
</tr>
</tbody>
</table>

**Function**
This parameter displays the energy which was supplied to the drive. The energy is determined by means of the operating time as the sum of the effective power.

P-0-0833, Braking resistor threshold

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>V</td>
</tr>
</tbody>
</table>

**Function**
The braking resistor is only switched on via the firmware if this is required for braking. This means that it is switched on whenever the DC bus voltage is higher than the voltage threshold P-0-0833, Braking resistor threshold.

P-0-0844, Braking resistor load

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>%</td>
</tr>
</tbody>
</table>

**Function**
This parameter indicates the thermal energy in percent, in relation to its maximum allowed energy content, currently stored in the braking resistor.

P-0-0858, Data of external braking resistor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**
For HCS02/HCS03 converters the type data of an externally connected braking resistor are entered in this list parameter.

**Note:**
For HCS03 devices there is only an optional external braking resistor available!

See also Functional Description "Power Supply"
P-0-0859, Data of internal braking resistor

**Function**
For converters the type data of the device-internal braking resistor are displayed in this list parameter. The parameter is stored in non-volatile form in the power section.

P-0-0860, Converter configuration

**Function**
In this parameter basic settings are made especially for converters. Parameter P-0-0860 is specifically used for configuring the power section of converters (HCS02.1, HCS03.1,...).

See also Functional Description “Power Supply”

P-0-0861, Power supply status word

**Function**
This parameter is used for status display of the power supply.

See also Functional Description “Power Supply”

P-0-1100 – P-0-1299 (Velocity Control)

P-0-1120, Velocity control loop filter: filter type

**Function**
This parameter allows activating and selecting up to 4 different filters (2nd order).

See also Functional Description “Velocity Loop”

P-0-1121, Velocity control loop filter: limit frequency of low pass

**Function**
This parameter is used to parameterize the corner frequency of the 4 filters that can be selectively activated via P-0-1120. The input value is in Hz, i.e. the actual frequency (f=1/T) is input at which it is intended to obtain an attenuation of –3dB (attenuation of the amplitude to 0.707 of the input amplitude!).

See also Functional Description “Velocity Loop”
### P-0-1122, Velocity control loop filter: bandwidth of band-stop filter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 10,0 / 1000,0</td>
<td>---</td>
<td>Hz</td>
</tr>
</tbody>
</table>

**Function**

This parameter is used to parameterize the bandwidth of the 4 band-stop filters that can be selectively activated via P-0-1120 \([n]=2\). The input value is in Hz, i.e. the actual frequency \((f=1/T)\) is input. Notes on how to parameterize the band-stop filter are contained in the Functional Description.

See also Functional Description "Velocity Loop"

### P-0-1123, Vel. cont. loop filter: center frequency of band-stop filter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 4,0 / 4000,0</td>
<td>---</td>
<td>Hz</td>
</tr>
</tbody>
</table>

**Function**

This parameter is used to parameterize the center frequency of the 4 band-stop filters that can be selectively activated via P-0-1120 \([n]=2\). The input value is in Hz, i.e. the actual frequency \((f=1/T)\) is input. Notes on how to parameterize the band-stop filter are contained in the Functional Description.

See also Functional Description "Velocity Loop"

### P-0-1125, Velocity control loop: average value filter clock

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 1 / 16</td>
<td>1</td>
<td>--</td>
</tr>
</tbody>
</table>

**Function**

This parameter allows filtering the velocity control loop deviation with a moving average filter. In the case of this filter type and with constant input value, the output is always:

\[
\Delta Y = \frac{X}{M}
\]

This means that the filter output, with constant input value, increases in a linear way and has reached its final value at the filter output after the time \(t = M \cdot T_A\).

**Note:** This filter type therefore does not show the typical "creep behavior" (filter output increases and decreases according to an e-function!) of the usual VZ1 and VZ2 filters.

See also Functional Description "Velocity Loop"

### P-0-1126, Velocity control loop: acceleration feedforward

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0000 / 214748,3647</td>
<td>0,0000</td>
<td>P-0-4014</td>
</tr>
</tbody>
</table>
**Function**

This parameter is used for activating and setting a variable acceleration feedforward in the "velocity control" mode.

See also Functional Description "Velocity Loop"

See also Functional Description "Position Loop (with Respective Feedforward Functions)"

**P-0-1150, Command value generator output**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter displays the output value of the command value generator. The output value is displayed in the format of the assigned parameter.

**P-0-1151, Command value generator, list of possible target parameters**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This list parameter contains the IDNs of the parameters that can be entered in P-0-1152, Command value generator, target parameter assignment. These parameters are available for assigning the command value generator command value.

**P-0-1152, Command value generator, target parameter assignment**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**

In this parameter the IDN of that parameter is entered to which the result of the command value generator is to be written.

**P-0-1153, Command value generator, control word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**

This parameter is used for configuring the integrated command value generator and provides the following possible settings.

See also Functional Description "Drive-Integrated Command Value Generator"

**P-0-1154, Command value generator, offset**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>-214748.3647 / 214748.3647</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

--- / --- --- --
This parameter is used for setting the direct component (offset) for the selected signal (sine, square-wave, noise). The display, i.e. unit and scaling of the parameter, are set according to the assigned parameter.

**P-0-1155, Command value generator, amplitude**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0.0001 / 214748.3647</td>
<td>10.0000 --</td>
</tr>
</tbody>
</table>

This parameter is used for setting the amplitude (double crest value, peak-to-peak value). The range of values of the selected signal shape (sine, square-wave, noise) is between half the plus/minus amplitude. The display, i.e. unit and scaling of the parameter, are set according to the assigned parameter.

**P-0-1156, Command value generator, duration 1**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0.0000 / 4294967.295</td>
<td>0.000 s</td>
</tr>
</tbody>
</table>

This parameter is used for setting the square-wave signal. For the duration **P-0-1156, Command value generator, duration 1** the command value generator output **P-0-1150, Command value generator, command value** is set to half the positive amplitude **P-0-1155, Command value generator, amplitude** plus offset **P-0-1154, Command value generator, offset**.

When the duration 1 is over, the output of the command value generator is set to half the negative amplitude **P-0-1155, Command value generator, amplitude** plus offset **P-0-1154, Command value generator, offset**. Duration 2 starts as of this point of time.

**P-0-1157, Command value generator, duration 2**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0.0000 / 4294967.295</td>
<td>0.000 s</td>
</tr>
</tbody>
</table>

This parameter is used for setting the square-wave signal for command value generator.

When duration 1 is over, duration 2 starts. For this duration **P-0-1157, Command value generator, duration 2** the command value generator output **P-0-1150, Command value generator, command value** is set to half the negative amplitude **P-0-1155, Command value generator, amplitude** plus offset **P-0-1154, Command value generator, offset**.

When duration 2 is over, the output signal is set to the offset **P-0-1154, Command value generator, offset** until the periodic time has been reached.

**P-0-1200, Control word 1 velocity control**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 0x3FF</td>
<td>0 --</td>
</tr>
</tbody>
</table>

In the "velocity control" mode this parameter is used to control or configure the following functions:
- channel for velocity command value input (memory of fixed values or S-0-0036)
- behavior of ramp generator (run-up stop)
- command value generator (motor potentiometer)

**Note:** The control word can be cyclically written, the assignment of individual bits from signal control word or digital inputs is possible, too. In contrast to P-0-1214, parameter P-0-1200 is stored in the drive in volatile form!

See also Functional Description "Operating Mode: Velocity Control/Motor Potentiometer"

**P-0-1201, Ramp 1 pitch**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0160</td>
</tr>
</tbody>
</table>

**Function**
The acceleration entered in **P-0-1201, Ramp 1 pitch** takes effect in the "velocity control" mode during acceleration.

See also Functional Description "Operating Modes - Velocity Control"

**P-0-1202, Final speed ramp 1**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

**Function**
The parameter **P-0-1202, Final speed ramp 1** takes effect in the "velocity control" mode during acceleration and deceleration.

When exceeding (acceleration) or falling below (deceleration) the velocity indicated in **P-0-1202, Final speed ramp 1**, the pitch of the drive-internal speed command value ramp changes as follows:

- from the value indicated in **P-0-1201, Ramp 1 pitch** to the value indicated in **P-0-1203, Ramp 2 pitch** (acceleration)
- or from the value indicated in **P-0-1211, Deceleration ramp 1** to the value indicated in **P-0-1213, Deceleration ramp 2** (deceleration).

See also Functional Description "Velocity Command Value Reset with Filter and Ramp (Quick Stop)"

**P-0-1203, Ramp 2 pitch**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0160</td>
</tr>
</tbody>
</table>

**Function**
The acceleration entered in **P-0-1203, Ramp 2 pitch** takes effect in the "velocity control" mode during acceleration.

With the acceleration entered in this parameter, the acceleration takes place from the last effective command value to the new preset command value as soon as the velocity at the ramp output is greater than the value entered in **P-0-1202, Final speed ramp 1**.

Influence of P-0-1209
If the function "speed masking in command value channel" is used (P-0-1207, P-0-1208, P-0-1209), the content of P-0-1201 is multiplied with the content of P-0-1209 and this influences the effective acceleration.

**Note:** If the value in parameter P-0-1203, Ramp 2 pitch = 0, the ramp 2 is not active.

See also Functional Description "Velocity Control Mode"

### P-0-1206, Memory of velocity command values

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>---</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

**Function**

This list parameter is used as a memory of fixed command values for velocity command values. The individual values can be selected via the control word P-0-1200.

**Note:** As of MP*04VRS, selection via P-0-1200 takes place in binarily coded form!

See also Functional Description "Operating Modes - Velocity Control"

See also Parameter Description "P-0-1200, Control word 1 velocity control"

### P-0-1207, Lower limit of velocity masking window

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>---</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

**Function**

The list parameter "P-0-1207", in conjunction with the parameter "P-0-1208" (upper limit of velocity masking window), defines four velocity ranges (velocity windows).

The ranges apply to positive and negative velocities, the definitions of the ranges are mirrored with regard to speed zero.

**Note:**

- The function "velocity masking window" is only effective in the "velocity control" mode.
- The parameter "P-0-1210, Status word of velocity control mode" contains information on the status of the current command value with regard to a velocity masking window.

See also Functional Description "Velocity Loop"

### P-0-1208, Upper limit of velocity masking window

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>---</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>


Function

The list parameter "P-0-1208", in conjunction with the parameter "P-0-1207" (lower limit of velocity masking window), defines four velocity ranges (velocity windows).

The ranges apply to positive and negative velocities, the definitions of the ranges are mirrored with regard to speed zero.

Note:

- The function "velocity masking window" is only effective in the "velocity control" mode.
- The parameter "P-0-1210, Status word of velocity control mode" contains information on the status of the current command value with regard to a velocity masking window.

See also Functional Description "Velocity Loop"

P-0-1209, Acceleration factors for velocity masking window

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>1.00 / 100,00</td>
<td>---</td>
</tr>
</tbody>
</table>

Function

The list parameter P-0-1209 contains the acceleration factors that take effect in the velocity ranges defined with P-0-1207 and P-0-1208.

The ramp generator passes the range of the velocity window (P-0-1207 and P-0-1208). But the acceleration factors indicated in P-0-1209 have a multiplying effect on the acceleration and deceleration values or, in the case of alternative scaling of the acceleration, on the ramp times of the ramp generator (P-0-1201, P-0-1203, P-0-1211 and P-0-1213).

See also Functional Description "Velocity Loop"

P-0-1210, Status word of velocity control mode

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function

For the velocity control mode the parameter P-0-1210 contains information on the current status of the ramp generator and the current command value.

Note:

The parameter P-0-1210 can be configured in the cyclic actual value channel (e.g. AT with SERCOS) in S-0-0144, Signal status word and assigned to the digital outputs.

See also Functional Description "Velocity Loop"

P-0-1211, Deceleration ramp 1

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0160</td>
</tr>
</tbody>
</table>

Function

The deceleration entered in P-0-1211, Deceleration ramp 1 only takes effect in the "velocity control" mode.
With the deceleration entered in this parameter, the deceleration takes place from the last effective velocity command value to the new velocity command value as soon as the velocity at the ramp output is smaller than the value in P-0-1202, Final speed ramp 1.

See also Functional Description "Velocity Command Value Reset with Filter and Ramp (Quick Stop)"

P-0-1213, Deceleration ramp 2

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0</td>
<td>S-0-0160</td>
</tr>
</tbody>
</table>

**Function**

The deceleration entered in P-0-1213, Deceleration ramp 2 takes effect in the "velocity control" mode during the deceleration process.

With the deceleration entered in this parameter, the deceleration takes place from the last effective velocity command value to the new velocity command value as long as the velocity at the ramp output is greater than the value in P-0-1202, Final speed ramp 1.

See also Functional Description "Velocity Control Mode"

P-0-1214, Control word 2 velocity control

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

**Function**

Via this parameter it is possible to influence, i.e. to control, the execution of a velocity control mode in the operating mode.

**Note:** P-0-0088 can be configured in the cyclic command value telegram!

See also Functional Description "Operating Modes - Velocity Control"

P-0-1215, Motor potentiometer, acceleration

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>100000</td>
<td>S-0-0160</td>
</tr>
</tbody>
</table>

**Function**

In conjunction with the motor potentiometer available in the "velocity control" mode, this parameter is used for the following purposes:

- **For linear velocity change:**
  Definition of the velocity change by which the ramp velocity changes when setting P-0-1214, bit8 ("ramp+")
  \[ \Delta P-0-1218 = \text{activation time} \times [P-0-1215] \]

- **For square velocity change:**
  Definition of the acceleration change by which the ramp velocity changes within 2 s when setting P-0-1214, bit8 ("ramp+")
  \[ \Delta \text{acceleration} = \text{activation time} \times \left( \frac{[P-0-1215]}{2 \text{ s}} \right) \]

**Note:** With the input activated the velocity is increased in linear or square form (see P-0-1214, Motor potentiometer, control
parameter) until the effective positive velocity limit value, i.e. minimum value (S-0-0091, S-0-0038), has been reached.

See also Functional Description “Operating Modes - Velocity Control”

### P-0-1216, Motor potentiometer, deceleration

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>100000</td>
<td>S-0-0160</td>
</tr>
</tbody>
</table>

**Function**

In conjunction with the motor potentiometer available in the “velocity control” mode, this parameter is used for the following purposes:

- **For linear velocity change:**
  - definition of the velocity change by which the ramp velocity changes when setting P-0-1214, bit9 (“ramp-“)
  - \( \Delta P-0-1218 = \text{activation time} \times [P-0-1216] \)

- **For square velocity change:**
  - definition of the acceleration change by which the ramp velocity changes within 2s when setting P-0-1214, bit9 (“ramp-“)
  - \( \Delta \text{deceleration} = \text{activation time} \times ([P-0-1216] / 2s) \)

**Note:** With the input activated the velocity is reduced in linear or square form (see P-0-1214, Motor potentiometer, control parameter) until the effective negative velocity limit value, i.e. minimum value (S-0-0091, S-0-0039), has been reached.

See also Functional Description “Operating Modes - Velocity Control”

### P-0-1217, Motor potentiometer, step size

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>500000</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

**Function**

This parameter takes effect when bit 4 “change by constant velocity step” is one in P-0-1214, Motor potentiometer, control parameter.

P-0-1218, Motor potentiometer, command value, i.e. the velocity command value, is increased by the velocity value with every positive edge at the ramp input ramp+ until the positive velocity limit value S-0-0038 has been reached. With every negative edge at the ramp input ramp- it is reduced by the velocity value until the negative velocity limit value S-0-0039 has been reached.

See also Functional Description “Command Value Adjustment in Velocity Control”

### P-0-1218, Motor potentiometer, command value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>S-0-0044</td>
</tr>
</tbody>
</table>

**Function**

Parameter P-0-1218, Motor potentiometer, command value is used to display the velocity command value generated by the motor.
potentiometer. This value is then processed in the ramp generator and transmitted to P-0-0048, Effective velocity command value.

**Note:** The value of parameter P-0-1218 is stored in case the control voltage fails so that it is possible to reuse the value.

See also Functional Description "Operating Modes - Velocity Control"

### P-0-1222, Velocity command filter

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0 / 16</td>
<td>0</td>
<td>ms</td>
</tr>
</tbody>
</table>

**Function:** This parameter is used to round acceleration jumps in the velocity command value characteristics in order to have a smooth initialization or deceleration of the drive in velocity control.

See also Functional Description "Velocity Command Value Reset with Filter and Ramp (Quick Stop)"

### P-0-1500 – P-0-1599 (General Device Parameters)

#### P-0-1520, Control section type

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function:** This parameter displays the type designation of the control section. By means of circuit board code parameters the controller firmware identifies all circuit boards incorporated in the control section and thus generates the type designation.

The type designation of the control section also implies firmware dependencies.

### P-0-2000 – P-0-2999 (General Device Parameters)

#### P-0-2004, Active functional packages

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function:** This parameter contains the active functional packages. When booting the functional packages selected in P-0-2003 are activated and then the respective bits are set or cleared in P-0-2004. This allows recognizing at any time which functional packages are actually active.

**Note:** This parameter can neither be written nor stored. It is for display only.

See also Functional Description "Enabling of Functional Packages"
See also Functional Description "Functional Packages"
P-0-3600 – P-0-4095 (General Device Parameters)

P-0-4004, Magnetizing current

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,000 / var.</td>
<td>1,000</td>
</tr>
</tbody>
</table>

**Function**

In the case of asynchronous motors, the nominal magnetizing current defined by Bosch Rexroth is entered in this parameter. The actually flowing magnetizing current in the base speed range results by multiplication of the value of P-0-4004 with **P-0-0532, Premagnetization factor**. In the field weakening range the magnetizing current, with increasing speed, is reduced by the flux loop based on the value of this product.

**Note:**

Writing the correct value to this parameter:

- In the case of Rexroth motors of the 2AD, ADF lines and in the case of linear and rotary kit motors, by loading the motor parameters with the commissioning software (e.g. IndraWorks).
- In the case of other asynchronous motors: manual input according to manufacturer's specification.
- In the case of synchronous motors, the parameter is not used and automatically set to $A_{\text{eff}} = 0$.

See also Functional Description "Motor, Mechanical Axis System, Measuring Systems"

P-0-4005, Flux-generating current, limit value

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>var. / 0,000</td>
<td>0,000</td>
</tr>
</tbody>
</table>

**Function**

In this parameter a negative limit value for the flux-generating current can be entered.

This limit value is available for field weakening operation of synchronous motors and therefore exclusively takes effect for synchronous motors for which field weakening operation was allowed (see parameter **P-0-0045, Control word of current controller**).

**Note:**

Writing the correct value to this parameter:

- In the case of Rexroth motors of the MHD, MKD, MKE and MSK lines, automatically at initial commissioning.
- In the case of linear and rotary synchronous kit motors by loading the motor parameters with the commissioning software (e.g. IndraWorks).
- In the case of other synchronous motors: manual input according to manufacturer's specification.
- In the case of asynchronous motors, this parameter is automatically set to $A_{\text{eff}} = 0$.

See also Functional Description "Limitations"
P-0-4014, Type of construction of motor

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

By this parameter the controller is informed of control-relevant features of the connected motor, such as:

- functional principle
- type of construction
- encoder data memory

See also Functional Description "General Information on the Operation of Motors with IndraDrive"

P-0-4022, Drive address of serial interface

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>1 / 99</td>
<td>256</td>
</tr>
</tbody>
</table>

**Function**

By means of this parameter it is possible to set the address for the serial interface. This can be done via the control panel, the serial interface or the master communication interface.

**Note:**

The effective address can be directly taken from P-0-4022 or from the list P-0-4031, Overview of device addresses!

See also Functional Description "Serial Communication"

See also Parameter Description "P-0-4031, Overview of device addresses"

P-0-4025, Drive address of master communication

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>1 / 99</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

By means of this parameter it is possible to set the address for the master communication (e.g. SERCOS, Profibus...). This can be done via the control panel, the serial interface or the master communication interface itself.

**Note:**

The currently effective address can be directly taken from parameter S-0-0096, Slave arrangement (SLKN) or P-0-4031, Overview of device addresses!

See also Functional Description "Serial Communication"

P-0-4028, Device control word

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>
This parameter is used to control the drive in the following cases:

- for devices with analog or parallel master communication
- When the drive is switched to the "easy startup mode" via the control panel.

**Note:** In the case of master communication via field bus or SERCOS, **P-0-4077, Field bus: control word** and **S-0-0134, Master control word** are used accordingly for controlling the drive!

See also Functional Description "Master Communication"
See also Functional Description "Operating Modes"

### P-0-4031, Overview of device addresses

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

This parameter is used to display the following addresses in clearly structured and holistic form which is particularly important for multi-axis devices:

- effective drive address of master communication that was set via parameter P-0-4025
- effective drive address of serial interface that was set via parameter P-0-4022

**Note:** Especially for multi-axis devices (e.g. HMD01.1) the parameter P-0-4031 provides a clear overview as regards the axis addresses effective in the device.

### P-0-4032, Motor type plate data

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0,000 / 250000,000</td>
<td>---</td>
</tr>
</tbody>
</table>

For asynchronous third-party motors it is possible via **C3200 Command Calculate motor data** to calculate the values for motor parameters from the type plate data and then the values of the motor control parameters. The activation of C3200 first requires manual input of the motor data from the type plate of the asynchronous motor in the list parameter **P-0-4032, Motor type plate data**.

**Note:** When a Rexroth motor is used, the content of P-0-4032 and the command C3200 are irrelevant as for these motors all parameters required for operation are stored in the data base for motor data (DriveBase).

See also Functional Description "Automatic Setting of Motor Control Parameters"

### P-0-4033, C3200 Command Calculate motor data
For asynchronous third-party motors it is possible via C3200 Command Calculate motor data to calculate the values for motor parameters from the type plate data and then the values of the motor control parameters. The activation of C3200 first requires manual input of the motor data from the type plate of the asynchronous motor in the list parameter P-0-4032, Motor type plate data.

**Note:** When a Rexroth motor is used, the content of P-0-4032 and the command C3200 are irrelevant as for these motors all parameters required for operation are stored in the data base for motor data (DriveBase).

See also Functional Description "Automatic Setting of Motor Control Parameters"

### P-0-4036, Rated motor speed

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,0000 / 429496,7295</td>
<td>1000,000</td>
<td>Rpm</td>
</tr>
</tbody>
</table>

**Function:** This parameter defines the speed that begins above the field weakening range. Voltage reference value is DC bus voltage DC540V (uncontrolled supply at 3xAC400V –5%).

**Note:** Writing the correct value to this parameter:

- for Rexroth motors of the MAD and MAF lines, if an encoder data memory is available, automatically at initial commissioning
- for linear and rotary asynchronous kit motors by loading the motor parameters with the "IndraWorks D" commissioning tool
- for other asynchronous motors manual input according to manufacturer's specification (see completed form for the output data of asynchronous motors!)
- The parameter is not used for synchronous motors.

See also Functional Description "Motor Control"

### P-0-4039, Stator leakage inductance

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0,001 / 4294967,295</td>
<td>5,000</td>
<td>mH</td>
</tr>
</tbody>
</table>

**Function:** This parameter is only used for operating asynchronous motors and takes effect for current control of the motor.

For Rexroth motors this value is stored in the DriveBase.

For third-party motors this parameter is calculated via the command C3200 Command Calculate data for asynchronous motor that is started with P-0-4033.
P-0-4040, Rotor leakage inductance

**Input min/max:** 0.001 / 4294967.295  
**Default value:** 5.000  
**Unit:** mH

**Function**
This parameter is only used for operating asynchronous motors and takes effect for current control of the motor.
For Rexroth motors this value is stored in the DriveBase. For third-party motors this parameter is calculated via the command **C3200 Command Calculate data for asynchronous motor** that is started with P-0-4033.

P-0-4041, Motor magnetizing inductance

**Input min/max:** 0.010 / 4294967.295  
**Default value:** 50.000  
**Unit:** mH

**Function**
This parameter is only used for operating asynchronous motors and takes effect for current control of the motor.
For Rexroth motors this value is stored in the DriveBase. For third-party motors this parameter is calculated via the command **C3200 Command Calculate data for asynchronous motor** that is started with P-0-4033.

See also Functional Description "Determining the Motor Parameter Values"

P-0-4042, Characteristic of motor magnetizing inductance

**Input min/max:** 0.500 / 2.000  
**Default value:** --  
**Unit:** --

**Function**
This list parameter is only used for operating asynchronous motors and takes effect for current control of the motor.
- For Rexroth motors the characteristic values are made available by the manufacturer, either by means of a data sheet or the commissioning software (e.g. IndraWorks).
- For third-party motors the characteristic in the majority of cases is unknown. Via the command **C3200 Command Calculate data for asynchronous motor** that is started with P-0-4033 the list is neutrally assigned.
- Via the command **C3600 Command Motor data identification** that is started with P-0-0565 the characteristic of the asynchronous motor is determined and entered in this list.

See also Functional Description "Motor Control"

P-0-4043, Rotor time constant

**Input min/max:** 0.100 / 10000.000  
**Default value:** 100.000  
**Unit:** ms

**Function**
This parameter is only active for asynchronous motors. It has a considerable influence on the torque generation of the motor, as it decisively determines the so-called "slip" in the case of load.
Note: "Slip" is the difference of the rotational frequency of the electric rotary field in the stator divided by the number of pole pairs of the motor and the mechanical rotational frequency of the rotor.

The value for P-0-4043 is motor-specific and for asynchronous Rexroth motors is made available via the commissioning software (e.g. IndraWorks) or via the Intranet output of the manufacturer-side data base DriveBase!

P-0-4045, Maximum possible continuous current

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- A eff</td>
</tr>
</tbody>
</table>

Function: This parameter indicates how much current the controller can continuously provide in the present load situation. At the same time, this current is the current to which the continuous current limitation would reduce, if the load situation would continue.

See also Functional Description "Current Limitation"

P-0-4046, Effective peak current

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>--- A eff</td>
</tr>
</tbody>
</table>

Function: This parameter displays the maximum current that the controller can temporarily supply to the motor in the active load condition. This is the rms value of the total current, i.e. torque-generating and magnetic-field-generating components are contained!

See also Functional Description "Current Limitation"

P-0-4065, Non-volatile memory active

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>2 --</td>
</tr>
</tbody>
</table>

Function: This parameter contains information on the active, non-volatile memory. The parameter values and, in the case of control voltage failure, the retain data are stored in the active memory.

Meaning of the value:
- 1: MultiMediaCard (MMC) is the active, non-volatile memory
- 2: internal, non-volatile memory is active

See also Functional Description "Parameters, Basics"

P-0-4068, Field bus: control word IO

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0 --</td>
</tr>
</tbody>
</table>
The parameter P-0-4068, Field bus: control word IO is used as field bus control word (16 bits) in the I/O mode. We distinguish the two following profile types with freely expandable real-time data and configurable field bus status word:

- "I/O mode positioning" (P-0-4084, Field bus: Profile type = 0xFF82)
- "I/O mode preset velocity" (P-0-4084, Field bus: Profile type = 0xFF82)

See also Functional Description "Profile Types - I/O Mode"

P-0-4069, Field bus: module diagnosis

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: Parameter for reading master communication settings and states (with field buses).

Note: This parameter is only relevant for the development staff! It is irrelevant for the application side!

See also Functional Description "PROFIBUS-DP"

P-0-4071, Field bus: length of cyclic command value data channel

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 32</td>
<td>2 Byte</td>
</tr>
</tbody>
</table>

Function: This parameter indicates the number of bytes of the process data channel parameterized in P-0-4081, Field bus: config. list of cyclic command value data ch.

This length does not contain the length parameterized in P-0-4083, Field bus: length of parameter channel of a possibly available parameter channel. The graduation takes place in word boundaries, i.e. possible values are 2, 4, 6, ... 32.

Note: For communication via Interbus it is obligatory, due to the bus structure (shift register), that P-0-4071 = P-0-4082.

See also Functional Description "PROFIBUS-DP"

P-0-4072, C2900 Command Firmware update from MMC

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: With this command, the firmware is copied from the MultiMediaCard plugged in the controller to the controller and to possibly available firmware-carrying additional components.

The command can be started via the control panel or via a commissioning tool ("IndraWorks D" or "SynTop"). After successful firmware update the message "End C29" is displayed. The user now has to switch the drive off and on again so that the new firmware becomes active.
Note: If you make an attempt of phase progression without the drive having been rebooted, either a switching command error will occur or a system error (F8xxx) entered before the firmware update will be displayed.

See also Functional Description "MultiMediaCard (MMC)"

**P-0-4073, Field bus: diagnostic message**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: This parameter contains the status of the field bus status machine in plain text. The diagnostic messages depends on the field bus used and is according to the designations used in the standard.

See also Functional Description "PROFIBUS-DP"

**P-0-4074, Field bus: data format**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 0 / 1</td>
<td>0</td>
<td>--</td>
</tr>
</tbody>
</table>

Function: Parameter **P-0-4074, Field bus: data format** describes the arrangement of 32-bit-values in the telegram (process data channel).

![Diagram showing data format]

See also Functional Description "PROFIBUS-DP"

**P-0-4075, Field bus: watchdog**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: --- / ---</td>
<td>0</td>
<td>ms</td>
</tr>
</tbody>
</table>

Function: In this parameter the watchdog time transmitted by the master in the parameterization telegram is stored in ms. If the master communication is interrupted for more than this time, a communication error is generated.

See also Functional Description "PROFIBUS-DP"

**P-0-4076, Field bus: cycle time (Tcyc)**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB: 500 / 65000</td>
<td>2000</td>
<td>us</td>
</tr>
</tbody>
</table>
The content of P-0-4076, Field bus: cycle time (Tcyc) defines the time intervals in which the cyclic real-time data (command values and actual values) are processed in the field bus drive.

See also Functional Description "PROFIBUS-DP"

**P-0-4077, Field bus: control word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

Function

This parameter is used as field bus control word for all BRC profiles such as "freely configurable mode" (0xFFFF).

**Note:** The significance and function of the control bits cannot be configured and is defined by the profile selection!

See also Functional Description "Profile Types - Rexroth Profile Types"

**P-0-4078, Field bus: status word**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0</td>
</tr>
</tbody>
</table>

Function

In the case of field bus drives that are operated in the freely configurable profile type (P-0-4084 = 0xFFFF), the parameter P-0-4078, Field bus: status word is used as status word for feedback of the drive status to the field bus master.

**Note:** The configuration of P-0-4078, Field bus: status word cannot be changed, i.e. the bit assignment is fixed and cannot be parameterized.

See also Functional Description "Supported Profile Types"

**P-0-4079, Field bus: baud rate**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0.00 kBaud</td>
</tr>
</tbody>
</table>

Function

Parameter P-0-4079 contains the active baud rate of the field bus interface. You have to distinguish the following cases:

- **PROFIBUS-DP and PROFINet:**
  The baud rate used by the field bus is automatically determined and only displayed in this parameter.

- **DeviceNet and CanOpen:**
  The baud rate used by the field bus is set in parameter P-0-4079.

**Note:** By inputting “0” as baud rate it is possible to activate automatic baud rate detection. In some cases this however might not work correctly so that it is recommended to make a manual input.
P-0-4080, Field bus: config. list of cyclic actual value data ch.

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
With this parameter the process input data channel (slave-master, i.e. "AT") is configured independent of the field bus used.

See also Functional Description "PROFIBUS-DP"

P-0-4081, Field bus: config. list of cyclic command value data ch.

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function
With this parameter the process output data channel (master-slave, i.e. "MDT") is configured independent of the field bus used.

See also Functional Description "PROFIBUS-DP"

P-0-4082, Field bus: length of cyclic actual value data channel

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 32</td>
<td>Byte</td>
</tr>
</tbody>
</table>

Function
This parameter indicates the number of bytes of the process data channel parameterized in P-0-4080, Field bus: config. list of cyclic actual value data ch.. This length does not contain the length parameterized in P-0-4083, Field bus: length of parameter channel of a possibly available parameter channel. The graduation takes place in word boundaries, i.e. possible values are 2, 4, 6, ... 32.

Note: For communication via Interbus it is obligatory, due to the bus structure (shift register), that P-0-4071 = P-0-4082.

See also Functional Description "PROFIBUS-DP"

P-0-4083, Field bus: length of parameter channel

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 16</td>
<td>Byte</td>
</tr>
</tbody>
</table>

Function
Apart from the transmission of real-time data (also called process data), communication via a field bus also requires the transmission of...
parameters that are not linked to a real-time cycle. In the case of PROFINET, for which not all control units are supporting acyclic access, these data can be exchanged via a parameter channel.

See also Functional Description "PROFINET"

**P-0-4084, Field bus: profile type**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>0xFF82</td>
</tr>
</tbody>
</table>

**Function**

The setting of **P-0-4084, Field bus: profile type** influences

- the profile-dependent interpretation of the control and status words
- the preselection of the primary mode of operation set in the drive
- the configuration of the real-time data channel (unless freely configurable).

See also Functional Description "PROFINET"

**P-0-4085, C4700 Command Activate easy startup mode**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter is used for activating the easy startup mode via the serial interface. With the start of this command the drive switches master communication (SERCOS or Profinet) off. The drive automatically switches to the parameter mode, makes the parameter setting for the "easy startup mode" and switches to the operating mode. The parameter setting is stored in volatile form. The easy startup mode can only be deactivated by switching control voltage off and on.

**P-0-4086, Master communication status**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

**Function**

This parameter contains important status information regarding the current status of master communication or device control. Independent thereof some control information for handling the communication phase switch, as well as for enabling the hardware inputs for drive enable and Drive Halt, is controlled.

**Note:** Users cannot write this parameter, it is only used for diagnostic purposes.

See also Functional Description "Initial Start in "Easy Startup" Mode"
See also Functional Description "Device Control (Status Machine)"
See also Functional Description "Master Communication"

**P-0-4090, Configuration for loading default values**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>
The effects of the command **S-0-0262, C07_x Load defaults procedure command** depend on the configuration available in P-0-4090 at the command start.

See also Functional Description "Loading Default Values"
See also Parameter Description "S-0-0262, C07_x Load defaults procedure command"

**P-0-4091, C2500 Copy IDN from optional memory to internal memory**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: By means of this command the parameter values are copied from the MultiMediaCard (MMC) to the internal, non-volatile memory (flash).

**P-0-4092, C2600 Copy IDN from internal memory to optional memory**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>--- / ---</td>
<td>---</td>
</tr>
</tbody>
</table>

Function: By means of this command the parameter values are copied from the internal, non-volatile memory (flash) to the MultiMediaCard (MMC).

**P-0-4095, RS-232/485 Parity**

<table>
<thead>
<tr>
<th>Input min/max:</th>
<th>Default value:</th>
<th>Unit:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPB:</td>
<td>0 / 2</td>
<td>0</td>
</tr>
</tbody>
</table>

Function: By means of this parameter it is possible to set several parities for the communication via the serial interface.

<table>
<thead>
<tr>
<th>Parity</th>
<th>Setting in P-0-4095</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>0</td>
</tr>
<tr>
<td>odd</td>
<td>1</td>
</tr>
<tr>
<td>even</td>
<td>2</td>
</tr>
</tbody>
</table>

Fig. 7-48: Coding of the parity in P-0-4095

The initial setting is no parity (default value).

See also Functional Description "Serial Communication"

### 7.4 Basic Functions

**Serial Communication**

The serial interface of the drive controller is used as a universal medium of communication for different services. It can be used for master communication (in addition to SERCOS), for reading and writing
parameters, for replacing the firmware, for locating errors and for other services. The physical standard used is RS232 (with accessory HAS05.1-005 "RS232/RS485 converter", RS485 is possible, too).

Two protocols are supported for serial communication:
- ASCII-based protocol
- SIS protocol (Rexroth-standard serial binary protocol)

**Note:** The protocol is automatically recognized by the drive!

The following functions are made possible via the serial interface:
- reading and writing parameters via terminal or commissioning tool in parallel with the existing master communication
- connecting a control terminal (BTV04)
- downloading firmware via the "IndraWorks D" program

The maximum baud rate is 115 kB.

**General Information on the Parameter Structure**

All parameters of the drive controller are stored in a uniform parameter structure. Each parameter consists of 7 elements. The table below describes the individual elements and the possibilities of access. The following sections will also refer to the parameter structure below.

<table>
<thead>
<tr>
<th>Element No.</th>
<th>Data block element</th>
<th>Possibility of access</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IDN</td>
<td>read</td>
</tr>
<tr>
<td>2</td>
<td>name</td>
<td>read</td>
</tr>
<tr>
<td>3</td>
<td>attribute</td>
<td>read</td>
</tr>
<tr>
<td>4</td>
<td>unit</td>
<td>read</td>
</tr>
<tr>
<td>5</td>
<td>min. input value</td>
<td>read</td>
</tr>
<tr>
<td>6</td>
<td>max. input value</td>
<td>read</td>
</tr>
<tr>
<td>7</td>
<td>operating data</td>
<td>read / write</td>
</tr>
</tbody>
</table>

**Fig. 7-49:** Parameter structure

**Interface Mode**

The serial interface can optionally be operated in the
- RS232 mode or
- RS485 mode.

**Note:** Communication via RS485 is only possible in conjunction with an external RS232/RS485 converter (e.g. with accessory module HAS05.1-005 by Bosch Rexroth). Depending on the mode, it is necessary to use different cables (see Project Planning Manual).

**Transmission Protocols**

Two different protocols are supported on the drive side:
- ASCII protocol
- SIS protocol
When switching on the 24 V supply voltage an automatic protocol detection is activated when receiving signals via the serial interface. A soon as either

- a valid ASCII start sequence
- or -
- a valid SIS telegram
was received the drive internally switches to the respective kind of protocol.

**Properties of ASCII Protocol**

- transmission rates of 9600 and 19200 baud
- 8-bit ASCII protocol
- no parity bit
- one stop bit

**Note:** There isn't any telegram frame used but the transmitted ASCII signs are converted and interpreted. It is only necessary to comply with a certain order.

**Properties of SIS Protocol**

- binary protocol
- checksum test (higher Hamming distance D)
- all telegrams are identified by an unequivocal start character ("0x02")
- defined structure of the telegram frame
- it is possible to activate motions (e.g. jogging)

---

**Master Communication**

**General**

- **address assignment**
  - communication address to be freely parameterized (via master communication, serial and control panel) via parameter **P-0-4025**, Drive address of master communication
- **Baud rate PROFIBUS-DP**
  - **P-0-4079**, Field bus: Baud rate

The baud rate used by the field bus is automatically determined and only displayed in this parameter.

**Note:** By inputting "0" as baud rate it is possible to activate automatic baud rate detection. In some cases this however might not work correctly so that it is recommended to make a manual input.

---

**Open Loop**

In operation without encoder (open-loop operation) the velocity control loop is not closed in the drive, but the drive is operated in a velocity-controlled way (without feedback) via open-loop U/f control.

**Note:** The method of open-loop/closed-loop motor control can be selected via bit 14 of parameter **P-0-0045**, Control word of current controller.
Features

The velocity control has the following features:

- fine interpolation of the velocity command value (can be switched off)
- monitoring of the velocity control loop (can be switched off via P-0-0556, bit 1)
- filtering of actual velocity value to be parameterized
- additive velocity command value (S-0-0037)
- display of resulting command value (in P-0-0048)
- monitoring and limitation of the maximum stator frequency change that results from the command velocity change
- stall protection loop (PI loop that can be optionally activated to prevent breakdown of the machine when the torque limits are attained)
- slip compensation (feedforward of estimated slip of the machine by means of rotor time constant and slip compensation factor)
- calculation of output voltage by means of a U/f characteristic based on motor model data
- subsequent trimming of magnetization via premagnetization factor (linear or square characteristic to be selected)
- IxR boost (adjustable load-dependent feedforward of the output voltage due to the voltage drop on the motor winding resistance)
- oscillation damping (adjustable load-dependent feedforward to prevent velocity oscillations in the partial load and idling ranges)
- current limitation loop to protect the output stage
- velocity search mode of a coasting machine after switching drive enable on (can be set for one or both rotational directions)

Profibus Interface

Overview

Drive controllers of the IndraDrive range have a master communication module with PROFIBUS interface. Via this module it is possible to exchange real-time data with a PROFIBUS-DP master. Using the master communication "PROFIBUS-DP" requires the following control section design:

- single-axis BASIC PROFIBUS (not configurable) (CSB01.1N-PB)

In addition it is possible to use the following configurable control sections if they have been designed with the optional module PB:

- single-axis BASIC UNIVERSAL (CSB01.1C)
- single-axis ADVANCED (CSH01.1C)
- double-axis BASIC UNIVERSAL (CDB01.1C)

The following communication channels are distinguished:

- **cyclic data channel** (PROFIBUS-DP)
  The field bus provides data containers in which useful data can be cyclically transmitted. This section is called cyclic data channel. The cyclic data channel is divided into
  - a device-specific **parameter channel** (optional) for reading and writing all parameters via PROFIBUS-DP,

  **Note:** This parameter channel does not fulfill "real-time properties!"

  - an (optional) **safety related**, axis-specific process data channel (PROFIsafe) that allows transmitting safety-relevant signals depending on firmware and hardware (see also "Drive-Integrated Safety Technology" in chapter "Drive Functions"),
  - an axis-specific **process data channel** (real-time channel) containing firmly specified information that can be directly interpreted by the receiver.

- **acyclic data channel** (DPV1 parameter communication)
  The following are supported:
  - one class-1 connection
  - two class-2 connections

```
<table>
<thead>
<tr>
<th>master → slave</th>
<th>safety related</th>
<th>not safety related</th>
</tr>
</thead>
<tbody>
<tr>
<td>param. channel</td>
<td>PROFIsafe</td>
<td>ctrl word, cmd values</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>slave → master</th>
<th>safety related</th>
<th>not safety related</th>
</tr>
</thead>
<tbody>
<tr>
<td>param. channel</td>
<td>PROFIsafe</td>
<td>status word, act. val.</td>
</tr>
</tbody>
</table>
```

Note: To simplify field bus communication Bosch Rexroth makes available function blocks for different programmable logic controllers (PLCs). The principles applied can be easily used for other field bus masters.

The slave PROFIBUS-DP circuit with master communication module PL has the following functional features:

- support of **RS485 interfaces according to IEC61158-2**
- support of all **data rates according to IEC61158-2**, with exclusive use of PROFIBUS-DP (9.6 kBaud, 19.2 kBaud, 45.45 kBaud, 93.75 kBaud, 187.5 kBaud, 500 kBaud, 1.5 Mbaud, 3 Mbaud, 6 Mbaud, 12 Mbaud)
- automatic baud rate detection
- configurable **cyclic data** up to 10 parameters (incl. field bus control word and field bus status word) in both data directions (max. 40 bytes or 20 words)
- additional optional **parameter channel** in the cyclic channel with up to 16 bytes (8 words)
- monitoring of the cyclical data exchange (watchdog function)
- LED for diagnosing the PROFIBUS interface

Features
• supported DPV0 services:
  • Slave_Diag (read diagnostic data)
  • Get_Cfg (read configuration data)
  • Set_Prm (send parameterization data)
  • Chk_Cfg (check configuration data)
  • Data Exchange (transfer I/O data)
  • Global Control (synchronization)
  • RD_Outp (read output data)
  • RD_Inp (read input data)
• parameter access with DPV1-class-1 services
  • DDLM_Initiate (establishment of connection)
  • DDLM_Read (acyclic read access)
  • DDLM_Write (acyclic write access)
  • DDLM_Abort (abortion of connection)
  • DDLM_Idle (connection monitoring)
• support of up to two DPV1-class-2 connections
• supported field bus profiles:
  • 0xFF82: I/O mode "positioning" with configurable real-time data
  • 0xFF92: I/O mode "preset velocity" with configurable real-time data
  • 0xFFFE: freely configurable mode
• access to all device parameters according to PROFIdrive specification

Pertinent Parameters

Communication Parameters
Specific parameters for communication via PROFIBUS-DP:
• P-0-3290, PROFIsafe: F_Destination_Address
• P-0-4069, Field bus: module diagnosis
Parameters for general communication via field bus interfaces:
• P-0-4073, Field bus: diagnostic message
• P-0-4074, Field bus: data format
• P-0-4075, Field bus: watchdog
• P-0-4076, Field bus: cycle time (Tcyc)
• P-0-4079, Field bus: baud rate

Profile Type Parameters
Apart from mere communication parameters, we use parameters in conjunction with the profile types.
See also section "Profile Types (with Field Bus Interfaces)" in the same chapter

Parameters for Extended Communication
We use additional parameters for extended communication.
See the following sections under "Possibilities of Control/Additional Functions" in the same chapter:
• "Configurable Signal Control Word"
• "Configurable Signal Status Word"
• "Multiplex Channel"
Profile Types

**IO Mode - Supported Profile Types**

When a field bus interface is used for master communication, IndraDrive controllers support the following profile types (modes):

- I/O mode positioning
- I/O mode preset velocity
- freely configurable mode (Rexroth profile type)

The table below contains an overview of the most important properties and features of the 3 profile types:

<table>
<thead>
<tr>
<th>Content of P-0-4084, Profile type</th>
<th>Master communication</th>
<th>Field bus or drive operating mode</th>
<th>Features</th>
</tr>
</thead>
</table>
| Profile type: I/O mode positioning | FF82h PROFIBUS, CANopen, DeviceNet | I/O mode positioning (positioning block mode, encoder 1, lagless) | - up to 64 positioning blocks can be controlled via field bus  
- apart from control and status word, other real-time data can be configured (in P-0-4080 and P-0-4081)  
- bits can be freely defined in signal status word via function "configurable signal status word" |
| Profile type: I/O mode preset velocity | FF92h PROFIBUS, CANopen, DeviceNet | I/O mode preset velocity | - fixed velocity command values can be controlled and ramp generator can be operated via field bus  
- apart from control and status word, other real-time data can be configured (in P-0-4080 and P-0-4081)  
- bits can be freely defined in signal status word via function "configurable signal status word" |
| Profile type: freely configurable mode | FFFEh PROFIBUS, CANopen, DeviceNet | freely configurable mode (default assignment is "drive-controlled positioning" with corresponding required cyclic data) | - possible use of complete drive functionality by free configuration of real-time data and operating mode selection  
- control and status word have a Rexroth-specific structure  
- selection suited for operation with analog command values in commissioning phase |
| FFFDh like profile FFFEh, but reduced field bus control word (relevant for MLD applications, for example) | |

Fig. 7-52: Supported profile types for IndraDrive firmware

**Basic Principles and Terms**

**Drive Profile**

The drive profile defines

- the structure of the field bus control word (P-0-4077) and of the field bus status word (P-0-4078),
- the structure and content of real-time channel (P-0-4080, P-0-4081),
- the active operating mode (S-0-0032, S-0-0033, S-0-0034, S-0-0035)
- the drive states and their transitions (status machine of I/O mode or Rexroth profile type).
By selecting a profile type, the commissioning of field bus drives becomes very easy for the user. The advantage of the profile selection is that all important basic settings for the desired drive function are thereby made automatically in the drive. As the profile types are defined independently of the bus, the transfer of applications from one field bus to the other is also facilitated.

**Status Machine**

A status (e.g. Drive Halt, drive error, ...) represents a specific internal and external behavior. The status can be exited by defined events (e.g. drive commands, switching of operating modes, ...). Corresponding status transitions are assigned to the events. The interaction of control and status bits or the status transitions are called status machine.

**Abbreviations**

- **i16**: 16-bit variable with sign (1 word) in Intel format
- **i32**: 32-bit variable with sign (2 words) in Intel format
- **u16**: 16-bit variable without sign (1 word) in Intel format
- **u32**: 32-bit variable without sign (2 words) in Intel format
- **ZKL1**: class 1 diagnostics
- **ZKL2**: class 2 diagnostics

**I/O Mode (Positioning and Preset Velocity)**

We distinguish the following variants of the profile type “I/O mode”:

- I/O mode positioning (functionality similar to parallel interface)
- I/O mode preset velocity (e.g. for open-loop applications)

The I/O mode has the following features:

- optional parameter channel can be activated, if required, via P-0-4083, **Field bus: length of parameter channel** (max. 8 words) (default: P-0-4083 = 0 → without parameter channel)
- real-time channel consists of at least one word (16 bits), the field bus control word (P-0-4068) and the signal status word (S-0-0144)

<table>
<thead>
<tr>
<th>Data direction</th>
<th>Word1</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>master --&gt; slave</td>
<td>P-0-4068, Field bus: control word IO</td>
<td>u16 (1 word)</td>
</tr>
<tr>
<td>slave --&gt; master</td>
<td>S-0-0144, Signal status word</td>
<td>u16 (1 word)</td>
</tr>
</tbody>
</table>

- freely expandable real-time channel by configuration of real-time data:
  - **Master → slave** (drive) configuration of P-0-4081, **Field bus: config. list of cyclic command value data ch.**
  - **Slave (drive) → master** configuration of P-0-4080, **Field bus: config. list of cyclic actual value data ch.**
- freely configurable field bus status word (cf. S-0-0144)
- Relationship between profile type selection and operating mode which takes effect:
  - In the I/O modes there is a determined relationship between profile type and predefined primary mode of operation (S-0-0032).
  - The **freely configurable mode** allows free selection of the operating modes (S-0-0032, S-0-0033, ...).
Note: The respective default settings are activated by selecting the profile type and subsequent action "load default communication parameters" (see also P-0-4090 and S-0-0262).

Features of "I/O Mode Positioning" Specific features of "I/O mode positioning":
- The drive is operated in "positioning block mode, lagless, encoder 1" (see also "Positioning Block Mode" in chapter "Operating Modes").
- In this operating mode, 64 programmable positioning blocks can be selected and started via 6 bits (in the 16 bit wide control word).
- The jog function can be activated in P-0-4068, Field bus: control word IO. "Drive-controlled positioning" was set as the 1st secondary operating mode (see also "Drive-Controlled Positioning" in chapter "Operating Modes").

Features of "I/O Mode Preset Velocity" Specific features of "I/O mode preset velocity":
- The drive is operated in the "velocity control" mode (see also "Velocity Control" in chapter "Operating Modes").
- In this operating mode you can, for example, select and start 5 programmable fixed velocity command values (in the 16 bit wide control word) and operate the ramp generator function.

Freely Configurable Mode (Rexroth Profile Type)
To use the extensive and numerous functions of a Rexroth drive with field bus interface it is necessary, in addition to the I/O modes, to define another profile, the freely configurable mode. This implies the use of a specific control and status word (P-0-4077, Field bus: control word and P-0-4078, Field bus: status word).

Features
- The structure (content) of the real-time data channel must be defined via the configuration parameters P-0-4080 and P-0-4081. No profile-dependent settings and checks are carried out!
- In this profile type it is the Rexroth-specific definitions for the field bus control and status words which apply. Some bits in the parameters P-0-4077, Field bus: control word and P-0-4078, Field bus: status word can only be used in conjunction with certain operating modes.
- This profile type allows using the entire drive functionalities (e.g. velocity synchronization, drive-controlled positioning, ...).
- The primary mode of operation and the secondary operating modes can be freely determined in the parameters S-0-0032, S-0-0033 etc.
- The operating mode "drive-controlled positioning" is set as default setting with the command values S-0-0282, S-0-0259 and 2x S-0-0000 and the actual values S-0-0386, S-0-0040, S-0-0390 (see also below "Exemplary Configurations: Drive-Controlled Positioning").

Note: The parameter P-0-4077, Field bus control word or P-0-4078, Field bus status word must always be contained in the 1st place in the configuration parameters P-0-4080 and P-0-4081.

Real-Time Channel
In the real-time channel of the field bus the data configured in P-0-4081, Field bus: config. list of cyclic command value data ch. and
P-0-4080, Field bus: config. list of cyclic actual value data ch. are transmitted between master and drive.

<table>
<thead>
<tr>
<th>Data direction</th>
<th>Word1</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>master --&gt; slave</td>
<td>P-0-4077, Field bus: control word</td>
<td>u16 (1 word)</td>
</tr>
<tr>
<td></td>
<td>optional command values</td>
<td></td>
</tr>
<tr>
<td>slave --&gt; master</td>
<td>P-0-4078, Field bus: status word</td>
<td>u16 (1 word)</td>
</tr>
<tr>
<td></td>
<td>optional actual values</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The IDNs of the parameters of the cyclically configurable command values or actual values are listed in S-0-0188, List of configurable data in the MDT and S-0-0187, List of configurable data in the AT.

Content and order of data in real-time channel:

<table>
<thead>
<tr>
<th>Data direction</th>
<th>Word1</th>
<th>Word2</th>
<th>...</th>
<th>Word n</th>
</tr>
</thead>
<tbody>
<tr>
<td>master --&gt; slave</td>
<td>P-0-4077</td>
<td>cmd value 1</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>slave --&gt; master</td>
<td>P-0-4078</td>
<td>actual value 1</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>

**Motor Control**

**Open-Loop/Closed-Loop Operation**

The IndraDrive firmware supports the following two basic principles of motor control:

- **motor control** (U/f control) in open-loop operation
  → open-loop-controlled operation without encoder information

- **motor control** in closed-loop operation
  - with encoder feedback
    → closed-loop-controlled operation (position, velocity and current)
  - without encoder feedback
    → closed-loop-controlled operation with motor model (velocity and current)

Via bit 14 and bit 15 of parameter P-0-0045, Control word of current controller the method of motor control is selected.

**Cycle Times and PWM Frequencies**

Depending on the firmware variant (MPH, MPD or MPB) and the respective control section (CSH01.1, CDB01.1, CSB01.1), there are the following possible cycle times and PWM frequencies:

<table>
<thead>
<tr>
<th>TA current</th>
<th>P-0-0001</th>
<th>FWA variant</th>
<th>P-0-0556, bit 2</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>62.5 µs</td>
<td>16000</td>
<td>MPH</td>
<td>0</td>
<td>Basic</td>
</tr>
<tr>
<td>83.3 µs</td>
<td>12000</td>
<td>MPH</td>
<td>0</td>
<td>Basic</td>
</tr>
<tr>
<td>125 µs</td>
<td>8000</td>
<td>MPH MPB MPD</td>
<td>0</td>
<td>Basic</td>
</tr>
<tr>
<td>125 µs</td>
<td>4000</td>
<td>MPH MPB MPD</td>
<td>0</td>
<td>Basic</td>
</tr>
</tbody>
</table>
Scaling of Physical Data

The controller via data maps the drive to an internal mathematical model. The status variables of the drive are determined on the basis of:

- position measurement,
- current measurement and
- temperature measurement.

The measured values collected in this way are converted into physical data:

- position, velocity, acceleration and jerk data
- current data, torque and force data
- temperature data and load data

The master transmits command values to the drive that are used by the controller for transforming them at the motor output shaft or mechanical axis system. The drive in return registers and transmits actual values, signals operating and command states and, if necessary, generates error messages and warnings.

Communication between drive and master also takes place by exchanging data.

**Scaling**

An operating data (numeric value) can only be evaluated as a physical value, when the numeric value is connected to a physical unit and the position of the decimal point (decimal places). The data thereby is "scaled" in a qualitative and quantitative way.

**Parameters**

All data are stored in parameters and transmitted as parameter values (for explanations on parameters see chapter "Parameters, Basics" in chapter "Handling, Diagnostic and Service Functions"). The scaling of the parameters containing data of the following physical values can be defined by the customer:

- position
- velocity
- acceleration
- torque/force
• temperature

Preferred Scaling/Parameter Scaling
To simplify the scaling definition so-called "preferred scalings" were predefined. But physical data can also be exchanged in the control-internal format, i.e. without concrete reference to physical units. To do this, the scaling for certain data can be freely set ("parameter scaling").

Linear and Rotary Data
Depending on the kind of motion of motor or load, the data can be displayed
• in linear form (linear axis or motor motion)
- or -
• in rotary form (rotary axis or motor motion)

Motor Reference/Load Reference
In the drive firmware there are mechanical transfer elements between motor and load mapped by means of mathematical models. The physical data can thereby be referred to
• the point where the load takes effect (load-side data reference)
- or -
• the point where the force is input (motor-side data reference).

Absolute/Modulo Evaluation
For technical reasons, the value range of the position data the controller can display is limited.

In the case of axes with limited travel range (e.g. linear axes), the current axis position within the controller-side value range can be unequivocally displayed (see "Measuring Systems: "Basics on Measuring Systems, Resolution" in chapter "Motor, Mechanical Axis System, Measuring Systems").

In the case of axes with unlimited travel range (e.g. rotary axes) it is useful to limit the infinite value range of the position data to a finite value. With continuous motion the value range is recurrently run from minimum to maximum value ("modulo" evaluation of the actual position value).

Basic Scaling Settings
First make the basic scaling settings for position, velocity, acceleration and torque/force data. This is only possible in the parameter mode (communication phase 2).

You have to determine:
• scaling type (rotary/linear/without scaling/percentage-based, if necessary)
• unit of measurement and unit of time, if necessary
• data reference (motor/load)
• absolute/modulo format for position data
• preferred scaling (predefined) or parameter scaling (can be individually defined)

To do this, set the respective bits in the following parameters:
• S-0-0076, Position data scaling type
• S-0-0044, Velocity data scaling type
• S-0-0160, Acceleration data scaling type
• S-0-0086, Torque/force data scaling type

Settings and Tips for Modulo Scaling
When selecting "modulo format" the value range limit has to be set in parameter S-0-0103, Modulo value.

Note: For "modulo format" enter a value greater than or equal to the value of parameter S-0-0103 in parameter S-0-0278, Maximum travel range!
**WARNING**

Danger of incorrect actual position value of encoders evaluated in absolute form after switching the drive on, when the mechanical drive system, with the drive switched off, was moved in the case of modulo scaling!

⇒ Make sure that the mechanical drive system, with the drive switched off, is as a maximum moved by a distance or angle corresponding to half the absolute encoder range (S-0-0378, Absolute encoder range of motor encoder or S-0-0379, Absolute encoder range of optional encoder)!

---

**Temperature Scaling**

In addition, make the scaling setting for temperature data in parameter S-0-0208, Temperature data scaling type.

**Individual Settings for Parameter Scaling**

**position data:**
- S-0-0077, Linear position data scaling factor position data
- S-0-0078, Linear position data scaling exponent
  - or -
- S-0-0079, Rotational position resolution

**velocity data:**
- S-0-0045, Velocity data scaling factor
- S-0-0046, Velocity data scaling exponent

**acceleration data:**
- S-0-0161, Acceleration data scaling factor
- S-0-0162, Acceleration data scaling exponent

**Diagnostic Messages of Scaling Setting**

If inadmissible scaling settings were made, they are detected when switching from parameter mode (communication phase 2) to operating mode (communication phase 4). The drive in this case does not reach the operating mode and, according to setting, displays the following command errors:
- C0122 Incorr. parameteriz. of motor enc. (mechanical system)
- C0123 Modulo value for motor encoder cannot be displayed
- C0127 Incorr. parameteriz. of opt. enc. (mechanical system)
- C0128 Modulo value for optional encoder cannot be displayed
- C0140 Rotary scaling not allowed
- C0101 Invalid parameters (see S-0-0021)
- C0102 Limit error in parameter (-> S-0-0021)
- C0103 Parameter conversion error (->S-0-0021)

**Example of Scaling Settings**

There are many possibilities to make settings for the scaling type. The table below shows useful settings for which there aren't any command errors to be expected:

---

**Further Settings for Parameter Scaling**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-0-0077</td>
<td>Linear position data scaling factor position data</td>
</tr>
<tr>
<td>S-0-0078</td>
<td>Linear position data scaling exponent</td>
</tr>
<tr>
<td>S-0-0079</td>
<td>Rotational position resolution</td>
</tr>
<tr>
<td>S-0-0045</td>
<td>Velocity data scaling factor</td>
</tr>
<tr>
<td>S-0-0046</td>
<td>Velocity data scaling exponent</td>
</tr>
<tr>
<td>S-0-0161</td>
<td>Acceleration data scaling factor</td>
</tr>
<tr>
<td>S-0-0162</td>
<td>Acceleration data scaling exponent</td>
</tr>
</tbody>
</table>
### Mechanical system | Encoder | Useful scaling type settings
---|---|---
Motor | Load gear | Feed spindle | Motor encoder | External encoder | Motor reference | Load reference | Modulo
---|---|---|---|---|---|---|---
rotary | available | not available | rotary | no | rotary | rotary | possible
rotary | available / not available | available | rotary | no | rotary | --- | possible
rotary | available / not available | available | rotary | no | --- | linear | possible
rotary | available | not available | rotary | rotary | rotary | --- | possible
rotary | available / not available | available | rotary | rotary | --- | linear | possible
rotary | available / not available | available | rotary | linear | rotary | --- | possible
rotary | available / not available | available | rotary | linear | --- | linear | possible
linear | not available | not available | linear | --- | --- | linear | not possible

Fig. 7-54: Useful scaling type settings depending on mechanical drive system and measuring systems

### 7.5 Voltage-Controlled Operation (Open-Loop U/f Control)

#### Overview

The drive function "voltage-controlled operation of asynchronous motors without encoder in open-loop U/f control" is made available in the base package "open-loop" in the "velocity control" mode. When the expansion package "synchronization" has been enabled, the operating mode "velocity synchronization with real/virtual master axis" is additionally available.

---

**Features**

- Monitoring and **limitation** of the maximum **stator frequency change** that results from the command velocity change

---

Fig. 7-55: Principle of open-loop U/f control
- **stall protection loop** (PI loop that can be optionally activated to prevent breakdown of the machine when the torque limits are attained)
- **slip compensation** (feedforward of estimated slip of the machine by means of slip compensation factor)
- calculation of output voltage by means of a **U/f characteristic** based on motor model data
- subsequent trimming of magnetization via premagnetization factor, as well as linear or square characteristic to be selected
- **IxR boost** (adjustable load-dependent feedforward of the output voltage due to the voltage drop on the motor winding resistance)
- **oscillation damping** (adjustable load-dependent feedforward to prevent velocity oscillations in the partial load and idling ranges)
- **current limitation loop** to protect the output stage of the drive controller, as well as limitation to the effective peak current
- **velocity search mode** of a coasting machine after switching drive enable on (can be set for the preset rotational direction or both rotational directions)
- **user-side torque/force limitation** via enabled stall protection loop

### Automatic Setting of Motor Control Parameters

For operating motors it is necessary to collect the values for motor parameters (resistance values, inductances, ...) in order to determine the motor control parameters (flux loop, voltage loop, current loop) with these values.

Depending on the manufacturer and type of the motor to be controlled, the values for motor parameters and motor control parameters are made available to the controller in different ways:

#### Motors by Bosch Rexroth

For Rexroth motors the values for the motor and motor control parameters are optimized and made available by the manufacturer. The automatic setting of the motor control parameters by the drive firmware is not required and not allowed for Rexroth motors!

- for motors **with motor encoder data memory**:
  → automatic loading of the parameters when drive is switched on (see "Overview: Default Settings in the Motor Encoder Data Memory ("load defaults procedure") in section "Closed-Loop Axis Control (Closed-Loop Operation")")

- for motors **without motor encoder data memory**:
  - loading the parameters via the commissioning tool "IndraWorks D" from the motor data base (DriveBase)
    - or -
  - manually writing the individual parameters via the serial interface or the master communication interface by means of a motor parameter list

#### Third-Party Motors

For third-party motors the drive firmware possesses commands by means of which the values for the motor and motor control parameters are generated depending on the available output data and the functional principle of the motor.

The following commands are available for calculating values for the motor and motor control parameters:

- **C3200 Command Calculate motor data**
  1. calculating the motor parameter values for asynchronous motors from the data on the type plate
2. calculating the values to be set for the motor control parameters

- **C3600 Command Motor data identification**
  1. identifying (or optimizing) the motor parameter values for asynchronous motors
     
     **Note:** Appropriate start values already have to be available!
  2. calculating the values of the motor control parameters

- **C4600 Command Calculate motor control parameters**
  calculating the values of the motor control parameters from the motor parameters for synchronous motors and, if necessary, for asynchronous motors (after manual input of motor data in motor parameters)

**Note:** The prerequisite basically is the "Form for Output Data of Asynchronous Motors/Synchronous Motors" to be completed by the motor manufacturer (see "Third-Party Motors at IndraDrive Controllers" in chapter "Motor, Mechanical Axis System, Measuring Systems")!

**Overview**

The figure below illustrates an overview of the possibilities of determining the motor and motor control parameters for motors without motor encoder data memory:
third-party motors

1. manual input of data from type plate in parameter P-0-4032
2. automatic calculation of motor parameters via command

motor parameters
(S-0-0109, P-0-4016, P-0-4039, P-0-4048, ...)

automatic calculation of motor control parameters via command

motor control parameters
(S-0-0106, S-0-0107, P-0-0532, ...)

Rexroth motors

DriveBase
(motor data base)

loading of motor parameters and motor control parameters via commissioning tool

command execution includes:

- C3200 Command Calculate motor data
  → steps A and C
- C3600 Command Motor data identification
  → steps B and C
- C4600 Command Calculate motor control parameters
  → step C

Fig. 7-56: Determining the motor and motor control parameters for motors without motor encoder data memory

Note: Apart from collecting or determining the motor and motor control parameters, further data on measuring system, temperature sensor, motor temperature model, motor holding brake and, if necessary, position and velocity loop are required.

See also "Closed-Loop Axis Control (Closed-Loop Operation)" in the same chapter

See "Third-Party Motors at IndraDrive Controllers: Notes on Commissioning" in chapter "Motor, Mechanical Axis System, Measuring Systems"

Overview of Motor and Motor Control Parameters

The table below contains an overview of the motor parameters for synchronous and asynchronous motors:

Motor Parameters

P-0-4032: motor type plate data
Motor parameters

<table>
<thead>
<tr>
<th>Synchronous motor</th>
<th>Asynchronous motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-0-4014, Type of construction of motor</td>
<td></td>
</tr>
<tr>
<td>S-0-0109, Motor peak current</td>
<td></td>
</tr>
<tr>
<td>S-0-0111, Motor current at standstill</td>
<td></td>
</tr>
<tr>
<td>S-0-0113, Maximum motor speed</td>
<td></td>
</tr>
<tr>
<td>P-0-0018, Number of pole pairs/pole pair distance</td>
<td></td>
</tr>
<tr>
<td>P-0-0051, Torque/force constant</td>
<td></td>
</tr>
<tr>
<td>P-0-0510, Rotor inertia</td>
<td></td>
</tr>
<tr>
<td>P-0-4048, Stator resistance</td>
<td></td>
</tr>
<tr>
<td>P-0-4013, Current limit value of demagnetization</td>
<td></td>
</tr>
<tr>
<td>P-0-0530, Slip increase</td>
<td></td>
</tr>
<tr>
<td>P-0-4016, Direct-axis inductance of motor</td>
<td></td>
</tr>
<tr>
<td>P-0-4004, Magnetizing current</td>
<td></td>
</tr>
<tr>
<td>P-0-4017, Quadrature-axis inductance of motor</td>
<td></td>
</tr>
<tr>
<td>P-0-4036, Rated motor speed</td>
<td></td>
</tr>
<tr>
<td>P-0-4002, Charact. of quadrature-axis induct. of motor, inductances</td>
<td></td>
</tr>
<tr>
<td>P-0-4039, Stator leakage inductance</td>
<td></td>
</tr>
<tr>
<td>P-0-4003, Charact. of quadrature-axis inductance of motor, currents</td>
<td></td>
</tr>
<tr>
<td>P-0-4040, Rotor leakage inductance</td>
<td></td>
</tr>
<tr>
<td>P-0-4005, Flux-generating current, limit value</td>
<td></td>
</tr>
<tr>
<td>P-0-4041, Motor magnetizing inductance</td>
<td></td>
</tr>
<tr>
<td>P-0-4042, Characteristic of motor magnetizing inductance</td>
<td></td>
</tr>
<tr>
<td>P-0-4043, Rotor time constant</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 7-57: Overview of motor parameters for synchronous and asynchronous motors

Motor Control Parameters

The following table contains an overview of the motor control parameters for synchronous and asynchronous motors that are used for field-oriented current control (with and without encoder) and the voltage-controlled operation:

<table>
<thead>
<tr>
<th>Synchronous motor</th>
<th>Asynchronous motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field-oriented current control (FOC)</td>
<td></td>
</tr>
<tr>
<td>S-0-0106, Current loop proportional gain 1</td>
<td></td>
</tr>
<tr>
<td>S-0-0107, Current loop integral action time 1</td>
<td></td>
</tr>
<tr>
<td>P-0-0533, Voltage loop proportional gain</td>
<td></td>
</tr>
<tr>
<td>P-0-0534, Voltage loop integral action time</td>
<td></td>
</tr>
<tr>
<td>P-0-0535, Motor voltage at no load</td>
<td></td>
</tr>
<tr>
<td>P-0-0536, Maximum motor voltage</td>
<td></td>
</tr>
<tr>
<td>P-0-0528, Flux control loop proportional gain</td>
<td></td>
</tr>
<tr>
<td>P-0-0529, Scaling of stall current limit</td>
<td></td>
</tr>
<tr>
<td>P-0-0532, Premagnetization factor</td>
<td></td>
</tr>
<tr>
<td>P-0-0590, Frequency loop proportional gain</td>
<td></td>
</tr>
<tr>
<td>P-0-0591, Frequency loop integral action time</td>
<td></td>
</tr>
<tr>
<td>P-0-0592, Motor model adjust factor</td>
<td></td>
</tr>
</tbody>
</table>
### Voltage-controlled operation (U/f)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-0-0106</td>
<td>Current loop proportional gain 1</td>
</tr>
<tr>
<td>S-0-0107</td>
<td>Current loop integral action time 1</td>
</tr>
<tr>
<td>P-0-0532</td>
<td>Premagnetization factor</td>
</tr>
<tr>
<td>P-0-0568</td>
<td>Voltage boost</td>
</tr>
<tr>
<td>P-0-0569</td>
<td>Maximum stator frequency change</td>
</tr>
<tr>
<td>P-0-0570</td>
<td>Stall protection loop proportional gain</td>
</tr>
<tr>
<td>P-0-0571</td>
<td>Stall protection loop integral action time</td>
</tr>
<tr>
<td>P-0-0572</td>
<td>Slip compensation factor</td>
</tr>
<tr>
<td>P-0-0573</td>
<td>tR boost factor</td>
</tr>
<tr>
<td>P-0-0574</td>
<td>Oscillation damping factor</td>
</tr>
<tr>
<td>P-0-0575</td>
<td>Search mode: search current factor</td>
</tr>
<tr>
<td>P-0-0576</td>
<td>Search mode: finding point slip factor</td>
</tr>
<tr>
<td>P-0-0577</td>
<td>Square characteristic: lowering factor</td>
</tr>
</tbody>
</table>

**Fig. 7-58:** Overview of motor control parameters for synchronous and asynchronous motors

### Determining Parameters by Means of Type Plate Data

For asynchronous motors it is possible via **C3200 Command Calculate motor data** to calculate the values for motor parameters from the type plate data and then the values of the motor control parameters. The activation of C3200 first requires manual input of the motor data from the type plate of the asynchronous motor in parameter **P-0-4032, Motor type plate data**.

See Parameter Description "P-0-4032, Motor type plate data"

**Note:** The command C3200 can only be used for asynchronous motors and can only be activated in communication phases "P2" or "P3"!

The figure below illustrates the scope of functions of the command C3200:
third-party motors (asynchronous)

motor data on type plate

1. manual input of data from type plate in parameter P-0-4032
2. automatic calculation of motor parameters via command C3200

motor parameters
(S-0-0109, P-0-4016, P-0-4039, P-0-4048, ...)

automatic calculation of motor control parameters via already activated command C3200

motor control parameters
(S-0-0106, S-0-0107, P-0-0532, ...)

Fig. 7-59: Functions of C3200 Command Calculate motor data

Note: The type plate does not contain the complete information required for safe operation of the third-party motor!
All required data are part of the form of manufacturer-side motor data which has to be available in completed form. The additional data, however, are not required for executing the command C3200.

Internally Calculated Parameter Values

By activating the command C3200 (P-0-4033) the following parameter values are calculated from the data of the asynchronous motor entered in list parameter P-0-4032:

- motor parameters
  - motor parameters, general (for synchronous and asynchronous motors)
  - specific motor parameters for asynchronous motors
- motor control parameters
  - motor control parameters for field-oriented current control (FOC) of synchronous and asynchronous motors
  - motor control parameters for field-oriented current control (FOC) of asynchronous motors
  - motor control parameters for voltage-controlled operation (U/f) of asynchronous motors without encoder

Annotations

As regards the operating principle of the command C3200, observe the following points:
- Input in parameter P-0-4032 is irrelevant unless the command C3200 has been started.
- When the command was processed without error, the calculated values of motor and motor control parameters are operational.

**Identifying and Optimizing the Motor Parameter Values**

For asynchronous motors it is possible via **C3600 Command Motor data identification** to automatically identify and optimize the optimum motor and motor control parameters on the basis of appropriate start values.

**Note:** The command C3600 can only be used for asynchronous motors and can only be activated in the operating mode (communication phase "P4")!

The figure below illustrates the scope of functions of the command C3600:

![Diagram](DF000163v01_en.th7)

**Fig. 7-60: Function of C3600 Command Motor data identification**

**Requirements**

To execute the command C3600 the following requirements have to be fulfilled:

- manual input of motor data from type plate in parameter P-0-4032, **Motor type plate data** and then execution of **C3200 Command Calculate motor data**
- or -
- manual input of all motor data in the motor parameters according to manufacturer's specification in completed motor data form

**Sequence of Actions**

In status "ready for power output" ("Ab"), current and voltage test signals are transmitted to the motor with the execution of command C3600. In this way the motor parameters for asynchronous motors (see above) are checked and, if necessary, optimized.

A possibly available holding brake continues remaining in the status of control as existing in the operating status "Ab".

After having successfully completed the command execution, the motor and motor control parameters have been optimized and stored.

The following parameters are recalculated:

- motor control parameters for field-oriented current control (FOC) of synchronous and asynchronous motors
• motor control parameters for field-oriented current control (FOC) of asynchronous motors
• motor control parameters for voltage-controlled operation (U/f) of asynchronous motors without encoder

Annotations
As regards the operating principle of the command C3600, observe the following points:
• Motor motion is not required; the motor holding brake possibly applied at "Ab" remains applied. The motor does not generate torque. With little friction and inertial mass, little motion can however occur!
• When the command was processed without error, the calculated values of motor and motor control parameters are operational. If the command execution is aborted during the measurement, all motor and motor control parameters remain unchanged.

Calculating the Motor Control Parameters from the Motor Parameters
For synchronous motors and in special cases (see "Requirements" below) for asynchronous motors it is possible via **C4600 Command Calculate motor control parameters** to calculate the motor control parameters from the motor parameters.

Note: The command C4600 can only be activated in the parameter mode (communication phase "P2" or "P3")!

The figure below illustrates the scope of functions of the command C4600:

![Function of C4600 Command Calculate motor control parameters](DF000164v01_en.png)

Fig. 7-61: Function of **C4600 Command Calculate motor control parameters**

Requirements
To execute the command C4600 the following requirements have to be fulfilled:

• **Synchronous third-party motors** require manual input of the motor data in the motor parameters (see "Third-Party Motors at IndraDrive Controllers" in chapter "Motor, Mechanical Axis System, Measuring Systems").

• For **asynchronous third-party motors** the command C4600 is only useful if the motor control parameters are to be generated from specific, manually input motor parameters (e.g. from equivalent circuit diagram data, see "Third-Party Motors at IndraDrive Controllers" in chapter "Motor, Mechanical Axis System, Measuring Systems").
calculated values for the motor control parameters thereby might possibly be more exact! It is easier, however, to use the commands C3200 and C3600 (see above) for asynchronous motors.

Annotations  As regards the operating principle of the command C4600, observe the following points:
- When the command was processed without error, the calculated values of motor and motor control parameters are operational.

Notes on Commissioning

<table>
<thead>
<tr>
<th>Motor connected to controller</th>
<th>Parameter values made available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor manufacturer</td>
<td>Motor design</td>
</tr>
<tr>
<td>Bosch Rexroth</td>
<td>housing</td>
</tr>
<tr>
<td></td>
<td>2AD, ADF, MSD</td>
</tr>
<tr>
<td></td>
<td>kit</td>
</tr>
<tr>
<td>third-party motor</td>
<td>housing or kit</td>
</tr>
<tr>
<td></td>
<td>housing or kit</td>
</tr>
</tbody>
</table>

A: automatically after drive switched on  
D: download via commissioning tool  
M: manual input via control master  
C: automatic determination via drive command

Fig. 7-62: Making available values for motor parameters and motor control parameters

Rexroth Motors  For Rexroth motors both the motor and motor control parameters are optimized by the manufacturer via the encoder data memory of the motor encoder or, for motors without encoder memory, via the commissioning tool.

Note: For Rexroth motors it is not required to determine the motor or motor control parameters! The commands C3200, C3600 and C4600 mustn’t be started for drives with Rexroth motors because otherwise the values of motor and motor control parameters optimized by the manufacturer are overwritten with the values calculated by means of command. This can modify the drive characteristics in a disadvantageous way!

Third-Party Motors  The commissioning of a third-party motor is similar to the commissioning of a Rexroth motor without motor encoder data memory. The major difference is that the motor and motor control parameters cannot be loaded from the motor parameter data base of the commissioning tool, but are determined by the controller via command after manual input of the type plate data and the motor parameter values (see "Third-Party Motors at IndraDrive Controllers" in chapter "Motor, Mechanical Axis System, Measuring Systems").
Diagnostic and Status Messages
If the command execution cannot be carried out successfully, diagnostic messages will be signaling the respective errors. The description of the respective command error contains information on the causes and suggests measures for remedy. If necessary, the manufacturer-side motor data have to be questioned and the motor and motor control parameters determined again!

See descriptions of diagnostic messages in the separate documentation "Troubleshooting Guide"

7.6 Closed-Loop Axis Control (Closed-Loop Operation)

Control Loop Structure
The drive controller has a cascade structure, i.e. the individual loops (position, velocity and current) are connected into one another. Depending on the operating mode there are different control loop structures with different points of input and paths of the command values. Depending on the active operating mode it is only possible to close the torque control loop, the torque and velocity control loop or additionally the position control loop in the drive. The overall structure of the control loops is illustrated below.
Features of the Control Loops

For simplifying parameterization of the control loops and increasing the capacity, some standardizations and structural modifications were made.

The internal controller cycle times (current, velocity and position) depend on the following requirements and parameters:

- **control section design** (CSH, CSB or CDB)
- **activation of functional packages**
- **P-0-0001, Switching frequency of the power output stage**

**Performance (Controller Cycle Times)**

[sample text from the diagram]

---

Fig. 7-63: Overall structure of control loop
• **P-0-0556, Config word of axis controller** (bits 2 and 5)

With IndraDrive and ADVANCED control sections (and firmware) the following cycle and switching times can be obtained:

- PWM switching frequency \( \text{max. } 16 \text{ kHz} \)
- current loop clock \( T_{A,\text{current}} = 62.5 \mu s \)
- velocity loop clock \( T_{A,\text{velocity}} = 125 \mu s \)
- position loop clock \( T_{A,\text{position}} = 250 \mu s \)

With IndraDrive and BASIC control sections (and firmware) the following cycle and switching times can be obtained:

- PWM switching frequency \( \text{max. } 8 \text{ kHz} \)
- current loop clock \( T_{A,\text{current}} = 125 \mu s \)
- velocity loop clock \( T_{A,\text{velocity}} = 250 \mu s \)
- position loop clock \( T_{A,\text{position}} = 500 \mu s \)

**Note:** All data on performance are contained in section "Overview of Functions: Performance Data" in chapter "System Overview".

---

**Position Loop**

- Jerk limitation in the "cyclic position control" mode by introducing the **S-0-0349, Jerk limit bipolar** parameter. The filter degree of the smoothing filter (moving average) can be set in parameter **P-0-0042, Current position command average value filter order**.
- velocity feedforward to be set, i.e. the feedforward degree can be set via parameter **P-0-0040, Velocity feedforward evaluation** (0 % … 100 %)
- input value for parameter **S-0-0348, Acceleration feedforward gain** can be the respective inertia in kg*m^2 (for rotary motor) or the mass in kg (for linear motor)

**Velocity Loop**

- Standardization of the output value at the velocity loop to Newton (N) or Newton meter (Nm). According to the motor type, there are the following units for parameter S-0-0100 for IndraDrive:
  - rotary motor \( \rightarrow \) Nm * s/rad
  - linear motor \( \rightarrow \) N * min/mm
- Extending the possibilities for filtering resonance frequencies. There are 4 filters of 2nd degree available that can be set via the parameters P-0-1120, P-0-1121, P-0-1122 and P-0-1123.
- limiting the acceleration in velocity control by setting in parameter **S-0-0138, Bipolar acceleration limit value**

**Possibilities of Accessing Outer Control Loops**

It is possible to access the outer control loops when operating in a higher-level mode. Depending on the basic operating mode, the following parameters are available to do this.

In position control:

- **P-0-0059, Additive position command value, controller**
- **S-0-0037, Additive velocity command value**
- **S-0-0081, Additive torque/force command value**

In velocity control:

- **S-0-0037, Additive velocity command value**
- **S-0-0081, Additive torque/force command value**
  In current control:
  - **S-0-0081, Additive torque/force command value**

**Command Value Processing Depending on Operating Mode**

**Position Control**
In the case of the following operating modes, the position control loop, apart from the velocity and current control loop, is closed internally (in the drive), too:
- position control with cyclic command value input
- drive-internal interpolation
- drive-controlled positioning

See also description of the respective operating mode in chapter "Operating Modes"

**Velocity Control**
In the "velocity control" mode the velocity control loop, apart from the current control loop, is closed in the drive, too.
See also "Velocity Control" in chapter "Operating Modes"

**Torque/Force Control**
The "torque/force control" mode actually isn't torque or force control but current control. Therefore, only the current control loop is closed in the drive.
See also "Torque/Force Control" in chapter "Operating Modes"
Notes on Commissioning for Control Loop Setting

The control loop settings in a digital drive controller are very important for the features of the servo axis.

To optimize the control loop setting, application-specific controller parameters are available for all digital Rexroth drives.

Due to the cascade structure of the control loops it is necessary to parameterize them “from the inside to the outside”. The resulting order for setting the control loops is as follows:

1. **Current control loop**
   - For **Rexroth motors with motor encoder data memory** (MHD, MKD and MKE series), optimizing the current loop is not required because the corresponding parameter values (S-0-0106 and S-0-0107) are read from the motor encoder data memory.
   - For all **Rexroth motors without motor encoder data memory** (e.g. linear motors), the parameter settings can be taken from a central motor data base via the "IndraWorks D" commissioning tool.
   - The commissioning of **third-party motors** (incl. control loop setting) is described in the respective sections on third-party motors in this documentation (see "Third-Party Motors at IndraDrive Controllers" in chapter "Motor, Mechanical Axis System, Measuring Systems").

2. **Velocity control loop**
   - The settings of the velocity loop (S-0-0100 and S-0-0101) with the respective filters (P-0-0004 and P-0-1120, P-0-1121, P-0-1122, P-0-1123) on the one hand depend on the motor parameters (inertia and torque/force constant), on the other hand they strongly depend on the mechanical properties (load inertia/mass, friction, stiffness of the connection, ...). Therefore, manual or automatic optimization is often required.

3. **Position control loop**
   - In general, the position control loop only has to be adjusted to the dynamics of the outer velocity loop, as well as to the kind of preset command values (jerk, acceleration and interpolation procedure).

**Default Settings in the Motor Encoder Data Memory**

("Load Defaults Procedure")

For all Rexroth motors of the series with motor encoder data memory (e.g. MHD, MKD, MKE, MSK and possibly MAD and MAF), the basic settings for the controllers are stored and can be loaded to the drive by executing the "load defaults procedure" command (S-0-0262).

There are two ways to activate the **S-0-0262, C07_x Load defaults procedure command** parameter:

- Automatically when running up the drive by recognizing that the motor type (cf. parameter S-0-0141) has changed. The display then reads "RL" and the "load defaults procedure" command is internally started by pressing the "Esc" button on the control panel, unless this was deactivated in **P-0-0556, Config word of axis controller**.

- Starting the command by writing "11b" to parameter S-0-0262.

See also "Loading, Storing and Saving Parameters" in chapter "Handling, Diagnostic and Service Functions".

**Note:** In order to start the "load defaults procedure" command the value "0" (default setting) must have been set in parameter **P-0-4090, Configuration for loading default values**.
During the load defaults procedure, the following control loop parameters are set to their default values optimized for the respective motor:

- **S-0-0100**, Velocity loop proportional gain
- **S-0-0101**, Velocity loop integral action time
- **S-0-0104**, Position loop Kv-factor
- **S-0-0106**, Current loop proportional gain 1
- **S-0-0107**, Current loop integral action time 1
- **P-0-0004**, Velocity loop smoothing time constant

**Note:** The default settings for the current loop (cf. S-0-0106 and S-0-0107) are automatically adjusted to the currently parameterized PWM frequency (cf. P-0-0001) and performance setting (cf. P-0-0556)!

In addition, the following control loop parameters are set to their firmware-side default values although there haven't been any default values stored for them in the motor data memory:

- **S-0-0348**, Acceleration feedforward gain
- **P-0-1125**, Velocity control loop: average value filter clock

**Note:** In the majority of cases, the controller settings stored in the motor encoder data memory provide a useful and reliable control loop setting. In exceptional cases, however, it may be necessary to make the settings with regard to the specific application.

### Automatic Setting of Axis Control

To facilitate drive parameterization, the IndraDrive firmware provides automatic control loop setting in closed-loop operation. Parameters **P-0-0163**, Damping factor for autom. controller adjust and **P-0-0164**, Application for autom. controller adjust can be used to influence the result of the control loop setting (obtained control loop dynamics).

**Note:** To carry out the automatic control loop setting it is necessary to move the drive. The velocity and position control loops are optimized.

### Features

- definition of a travel range for movement control for the automatic control loop setting by
  - absolute travel limits
  - or -
    - entering a travel distance based on the current actual position
- use of drive-internal interpolation and its parameters
- possible settings in **P-0-0165**, Selection for autom. controller adjust for:
  - velocity loop
  - position loop
  - acceleration feedforward
  - determination of load inertia
  - determination of maximum acceleration
• oscillation movement/unipolar movement
• absolute travel limits/relative movement around the starting position

7.7 Positioning Block Mode

In the "positioning block mode" it is possible to run up to 64 programmed positioning blocks. The drive moves to the target position in position control, while maintaining velocity, acceleration, deceleration and jerk limits as defined in the respective positioning block.

Fig. 7-65: "Positioning block mode" block diagram

Features
• parameterization of up to 64 positioning blocks; each with target position/travel distance, velocity, acceleration, deceleration and jerk
• defined block acceptance by toggling bit 0 in S-0-0346 with reaction time $t_{R\_Strobe} = t_{\_position}$
  Note: With field bus drives, the I/O mode and control via the parallel interface are exceptions. In these cases acceptance takes place by a 0-1 edge of bit 0 in P-0-4060.
• block selection and acknowledgment via separate parameters (→ handshake principle)
• positioning modes to be freely parameterized
  • relative positioning
  • absolute Positioning
  • infinite travel (positive or negative)
• single-block or sequential block mode with different conditions for advance:
  • block advance with switch cams
  • block advance at defined position value
  • block transition with "old" or "new" positioning velocity
• positioning block transition with freely definable delay time (P-0-4018)
• positioning while taking command value mode into account (shortest distance, positive direction, ...)
• residual path processing can be activated (→ no loss of incremental dimension)
• "slow travel" mode can be activated
• velocity override to be set

Fields of Application

Sequential block processing allows executing several positioning blocks processed in direct sequence without having to give a new start signal each time. Typical fields of application are:
• There is none or only a very simple higher-level control unit available and control is realized via digital I/Os only or a field bus control word (I/O mode with field bus interface).
• There are quick reaction times or block advances required. The required motion profiles can be represented in the drive by the maximum possible 64 positioning blocks.

• There are positioning processes required which cover long distances at high speeds (rapid traverse) and then position at the end position at low speed without any intermediate stops; for example:
  • taking up or putting down transport goods in handling robots
  • execution of joining processes in assembly facilities
8 Diagnostic and Service Functions

8.1 Diagnostic System

Diagnostic Status Messages

The diagnostic status messages display the phases of communication build-up and initialization (boot phase), operating states or the currently active operating mode.

**Note:** In the case of some diagnostic status messages the diagnostic message number contained in parameter S-0-0390, Diagnostic message number differs from the display at the drive controller.

Diagnostic Command Messages

Commands are used to control complex functions in the drive. The command execution is displayed in a diagnostic message.

By means of the respective parameter that is assigned to the command, a higher-level control unit can start, interrupt and clear commands. In addition, some selected commands can be directly started via the control panel of the drive controller.

There are 3 command types:

- **Drive Control Commands**
  Drive control commands can only be started when drive enable was set. They might possibly cause automatic drive motion and deactivate the active operating mode during its execution.

- **Monitoring Commands**
  Executing monitoring commands activates or deactivates monitors and functions.

- **Administration Commands**
  Administration commands execute administration tasks. They cannot be interrupted.

**Note:** Command errors are displayed with a diagnostic message, too. By means of the first three digits (Cxx) of the diagnostic message number it is possible to recognize which command caused the command error.

Each command started by a control unit must be actively cleared (see also "Basic Functions of Master Communication", "Command Processing").

A command error cannot be removed by "clearing errors", but only by completing the corresponding command.

Warnings

While in operation the drive controller carries out monitoring functions. Some monitoring functions depend on the operating mode that is used and/or parameter settings. If a status is detected that still allows correct operation but persists, which would then cause an error to be generated, a warning is generated.

**Note:** Some warnings won't result in an error if they are ignored.
Warning Classes

Warnings can be divided into two classes:

- without drive reaction (diagnostic message numbers E1xxx .. E7xxx)
- with drive reaction (diagnostic message number E8xxx)

Warnings cannot be cleared externally.

Warnings (E2xxx)

In the case of warnings of category E2xx, the drive normally does not carry out any drive reaction, unless the warning was generated due to a mains or undervoltage error. In this case the behavior of the drive can be determined via the parameter P-0-0118, Power off on error.

A second group of warnings within this category signals that a limit value determined (parameterized) by the user has been exceeded.

Fatal Warnings (E8xxx)

In the case of warnings of category E8xxx, the drive carries out a drive reaction. In the case of warnings that were generated due to a mains or undervoltage error, the behavior of the drive can be determined via the parameter P-0-0118, Power off on error.

General Description of Error Messages and Error Reactions

Depending on the operating mode that is used and some parameter settings, the drive controller carries out monitoring functions. An error message is generated by the drive controller, if a status is detected that no longer allows correct operation.

Errors can be divided into several error classes. The error class is represented by the first two digits of the diagnostic message number.

<table>
<thead>
<tr>
<th>Diagnostic message number</th>
<th>Error class</th>
<th>Drive reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2xxx</td>
<td>non-fatal error</td>
<td>as set in P-0-0119, Best possible deceleration</td>
</tr>
<tr>
<td>F3xxx</td>
<td>non-fatal safety technology errors</td>
<td>as set in P-0-0119, Best possible deceleration</td>
</tr>
<tr>
<td>F4xxx</td>
<td>interface error</td>
<td>as set in P-0-0119, Best possible deceleration</td>
</tr>
<tr>
<td>F6xxx</td>
<td>travel range error</td>
<td>closed Loop: velocity command value reset open Loop: shutdown in compliance with P-0-0569, Maximum stator frequency change</td>
</tr>
<tr>
<td>F7xxx</td>
<td>safety technology error</td>
<td>velocity command value reset</td>
</tr>
<tr>
<td>F8xxx</td>
<td>fatal error</td>
<td>torque disable</td>
</tr>
<tr>
<td>F9xxx and E-xxxx</td>
<td>fatal system error</td>
<td>torque disable</td>
</tr>
</tbody>
</table>

Fig. 8-1: Error classes and drive reaction

Note: These Operating Instructions do not list all the errors which can occur during the operation of one of our IndraDrive controllers / supply units; the documentation "Troubleshooting Guide" contains descriptions of all possible kinds of malfunction.
**Non-Fatal Errors (F2xxx)**

Non-fatal errors are errors that are still allowing a freely definable, variable error reaction.

The user can define the drive behavior for the case of non-fatal errors occurring via the setting of the parameters **P-0-0117, Activation of NC reaction on error** and **P-0-0119, Best possible deceleration**.

The drive can only be put into operation again when:

1. the error reaction has been completed, i.e. the drive has stopped \( (v=0!) \).
2. the error message was cleared by the error clearing command (cf. **S-0-0099, C0500 Reset class 1 diagnostics**).
3. the cause of the error was removed.
4. drive enable was switched on again \( (0-1 \text{ edge}) \).

**Interface Errors (F4xxx)**

The user can influence the drive behavior in the case of interface errors by means of the parameterization of **P-0-0119, Best possible deceleration** (see also Functional Description "Error Reaction").

**Note:** In the case of an interface error, activating the NC reaction via **P-0-0117, Activation of NC reaction on error** is no longer possible!

At the end of each error reaction, the drive goes torque-free.

The drive can only be put into operation again when:

1. the error reaction has been completed, i.e. the drive has stopped \( (v=0!) \).
2. the error message was cleared by the error clearing command (cf. **S-0-0099, C0500 Reset class 1 diagnostics**).
3. the cause of the error was removed.
4. the drive is in the operating mode again and power was switched on \( ("Ab") \).
5. drive enable was switched on again \( (0-1 \text{ edge}) \).

**Travel Range Errors (F6xxx)**

Travel range errors are errors associated with exceeding a travel range previously defined via hardware or software switches; independent of the settings in **P-0-0118, Power supply, configuration** still are taken into account.

The kind of deceleration depends on the control mode:

- **closed-loop**: velocity command value reset
- **open-loop**: under compliance with **P-0-0569, Maximum stator frequency change**

See also Functional Description "Error Reaction"

**Note:** In the case of travel range errors, the settings in **P-0-0118, Power supply, configuration** still are taken into account.

At the end of each error reaction, the drive goes torque-free.
The drive can only be put into operation again when:

1. the error reaction has been completed, i.e. the drive has stopped ($v=0$).
2. the error message was cleared by the error clearing command (cf. S-0-0099, C0500 Reset class 1 diagnostics).
3. the cause of the error was removed.
4. the drive is in the operating mode again and power was switched on ("Ab").
5. drive enable was switched on again (0-1 edge).

Fatal Errors (F8xxx)

Basically there are 2 kinds of fatal errors (F8 errors):

- fatal errors during initialization (initialization errors) (e.g. F8201 and F8203, F8118, F8120, ...)
- fatal errors during operation (e.g. F8060, F8022, ...)

Note: Fatal initialization errors cannot be cleared, they require the drive to be switched off completely.

In addition to completely switching off the drive, fatal errors associated with the safety technology (e.g. F8201 and F8203) require safety technology to be completely recommissioned.

In the case of fatal errors, closed-loop control (or open-loop U/f control) of the drive is no longer ensured; with these errors the drive, independent of the setting in P-0-0119, Best possible deceleration and P-0-0117, Activation of NC reaction on error, therefore is immediately switched off, i.e. it goes torque-free (see also Functional Description "Error Reaction").

Note: In the case of fatal errors, the settings in P-0-0118, Power supply, configuration still are taken into account.

After a fatal error has occurred, the drive can only be commissioned again when:

1. the error message was cleared by the error clearing command (cf. S-0-0099, C0500 Reset class 1 diagnostics) [to do this it might possibly be necessary to switch to the parameter mode or switch the drive off completely].
2. the actual cause of the error was recognized and removed. This might possibly imply the replacement of an entire component (e.g. motor or drive controller).
3. the drive is in the operating mode again and power was switched on again ("Ab").
4. drive enable was switched on again (0-1 edge).

Note: In case fatal errors are occurring repeatedly, contact our service department as operating the drive then is no longer possible.
Fatal System Errors (F9xxx and E-xxxx)

In the case of fatal system errors there is a grave problem in the drive system (e.g. watchdog error, processor crash, ...) which does no longer allow regular operation of the drive. Due to a hardware or firmware error, the drive firmware is no longer operable; clearing an error is no longer possible.

In this case the drive reacts automatically as follows:

- All digital outputs are set to "0".
- Safety technology: safety related feedback is deactivated!
- The "ready for operation" relay opens, this also switches power off in case the wiring is correct.
- The output stage is locked, this disables the drive torque.
- The brake output is deactivated; if a self-holding brake is used, it is applied!
- One of the following diagnostic messages is output at the display:
  - F9xxx (fatal system errors),
  - E8xxx (exceptions),
  - or E-xxxx (processor error), e.g. E-0800 (detailed information in the English language is output via the serial interface).

After a fatal system error has occurred, the drive can only be put into operation again when:
1. the 24 V supply is completely switched off and on so that a restart of the drive is carried out (incl. booting process and initialization).
2. the drive is run up to the operating mode again.
3. power is switched on again.

Note: In case fatal system errors are occurring repeatedly, contact our service department as operating the drive then is no longer possible.

8.2 Recommended Actions for Operating States, Activities and Reactions of the Drive Controller

The following table lists operating states, activities and reactions of the drive controller. If an error, for example, occurs during operation, take the actions in the given order until the error has been limited / cleared.
<table>
<thead>
<tr>
<th>Display at comfort control panel</th>
<th>S-0-0095, Diagnostic message text</th>
<th>See documentation “Troubleshooting Guide”</th>
<th>Contact our sales and service facility</th>
<th>Contact machine manufacturer / installation programmer</th>
<th>Switch supply unit off and on again</th>
<th>Switch drive controller off and on again</th>
<th>Check encoder function and mounting (motor encoder and external encoder))</th>
<th>Check encoder cabling</th>
<th>Check motor cabling</th>
<th>Check wiring of inputs and outputs and their 24V power supply</th>
<th>Check connection of master communication</th>
<th>Check connection of control circuit for mains connection</th>
<th>Check mechanical system (stiffness, loose connection,...)</th>
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<tbody>
<tr>
<td>P0</td>
<td>A0000 Communication phase 0</td>
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<td>A0009 Automatic baud rate detection for SERCOS interface</td>
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<td>Contact machine manufacturer / Installation programmer</td>
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<td>Switch drive controller off and on again</td>
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<p>| C0114 | C0114 T4 &gt; TScyc (S-0-0002) - T4min (S-0-0005) | 1 | 3 | 2 |
| C0115 | C0115 T2 too small | 1 | 3 | 2 |
| C0116 | C0116 T3 (S-0-0008) within MDT (S-0-0089 + S-0-0010) | 1 | 3 | 2 |
| C0119 | C0119 Max. travel range too large | 1 | 3 | 2 |
| C0120 | C0120 Error when reading encoder data =&gt; motor encoder | 4 | 2 | 3 | 1 |
| C0121 | C0121 Incorrect parameterization of motor encoder (hardware) | 1 | 3 | 2 |
| C0122 | C0122 Incorrect parameterization of motor encoder (hardware) | 1 | 3 | 2 |
| C0123 | C0123 Modulo value for motor encoder cannot be displayed | 1 | 3 | 2 |
| C0124 | C0124 Motor encoder unknown | 4 | 2 | 3 | 1 |
| C0125 | C0125 Error when reading encoder data =&gt; optional encoder | 4 | 3 | 2 | 1 |
| C0126 | C0126 Incorrect parameterization of optional encoder (hardware) | 1 | 3 | 2 |
| C0127 | C0127 Incorrect parameterization of optional encoder (hardware) | 1 | 3 | 2 |
| C0128 | C0128 Modulo value for optional encoder cannot be displayed | 1 | 3 | 2 |
| C0129 | C0129 Optional encoder unknown | 4 | 3 | 2 | 1 |
| C0130 | C0130 Maximum travel range cannot be displayed internally | 1 | 3 | 2 |
| C0131 | C0131 Switching to phase 3 impossible | 1 | 3 | 2 |
| C0132 | C0132 Invalid settings for controller cycle times | 1 | 3 | 2 |
| C0134 | C0134 Invalid motor data in encoder memory (-&gt;S-0-0021) | 4 | 5 | 2 | 3 | 1 |
| C0135 | C0135 Type of construction of motor P-0-4014 incorrect | 4 | 5 | 2 | 3 | 1 |
| C0136 | C0136 Several motor encoders connected | 1 | 2 |
| C0137 | C0137 Error during initialization of motor data (-&gt;S-0-0021) | 4 | 5 | 2 | 3 | 1 |
| C0138 | C0138 Invalid control section data (-&gt;S-0-0021) | 2 | 1 |
| C0139 | C0139 T2 (S-0-0089)+length MDT (S-0-0010)-&gt;TScyc (S-0-0002) | 1 | 3 | 2 |
| C0140 | C0140 Rotary scaling not allowed | 1 | 3 | 2 |</p>
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<th>Contact machine manufacturer / installation programmer</th>
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<th>Switch supply unit off and on again</th>
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<td>Display at comfort control panel</td>
<td>S-D-0095, Diagnostic message text</td>
<td>See documentation &quot;Troubleshooting Guide&quot;</td>
<td>Contact our sales and service facility</td>
<td>Contact machine manufacturer / installation programmer</td>
<td>Check motor incl. holding brake, battery, encoder and cooling system</td>
<td>Switch supply unit off and on again</td>
<td>Switch drive controller off and on again</td>
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8-14 Diagnostic and Service Functions

Display at comfort control panel
S-0-0095, Diagnostic message text
See documentation "Troubleshooting Guide"
Contact our sales and service facility
Contact machine manufacturer / installation programmer
Check motor incl. holding brake, battery, encoder and cooling system
Switch supply unit off and on again
Switch drive controller off and on again
Check encoder function and mounting (motor encoder and external encoder))
Check encoder cabling
Check motor cabling
Check wiring of inputs and outputs and their 24V power supply
Check connection of master communication
Check control circuit for mains connection
Check mechanical system (stiffness, loose connection,...)

C2202  C2202 Error when writing data to non-volatile memory  1  2
C23   C2300 Load working memory command  1
C2301  C2301 Error when reading non-volatile memory  1  2
C2302  C2302 Error when converting parameters  1  2
C24   C2400 Selectively backup working memory procedure command  1  2
C2402  C2402 Error when saving parameters  1  2
C25   C2500 Copy IDN from optional memory to internal memory  1
C2502  C2502 Error when accessing the MMC  1  2
C2504  C2504 Error when writing data to internal memory  1  2
C26   C2600 Copy IDN from internal memory to optional memory  1  2
C2602  C2602 Error when accessing the MMC  1  2
C2604  C2604 Error when reading the internal memory  1  2
C28   C2800 Analog input adjust command  1
C2801  C2801 Analog input not configured
C2802  C2802 Oscillations of input signal outside tolerance range  1  2
C2803  C2803 Measured values at zero point and max. value identical  1  2
C2804  C2804 Automatic adjust failed  1  2
C29   C2900 Command Firmware update from MMC  1
C2903  C2903 Error when accessing the MMC  1  2
C2904  C2904 Error when accessing the flash  2  3  1
C2905  C2905 Programmed firmware defective  1  2
C31   C3100 Recalculate actual value cycle  1
C3101  C3101 Act. modulo value cycle greater than max. travel range  1  3  2
C3102  C3102 Drive is still in drive enable  1  2
C32   C3200 Command Calculate motor data  1
C3201  C3201 Incorrect input for current  1  3  2
C3202  C3202 Incorrect input for voltage  1  3  2
C3203  C3203 Incorrect input for frequency  1  3  2
C3204  C3204 Incorrect input for speed  1  3  2
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<th>Contact machine manufacturer / Installation programmer</th>
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<th>Switch supply unit off and on again</th>
<th>Switch drive controller off and on again</th>
<th>Check encoder function and mounting (motor encoder and external encoder)</th>
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<th>Check connection of master communication</th>
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<td>Display at comfort control panel</td>
<td>S-0-0095. Diagnostic message text</td>
<td>See documentation “Troubleshooting Guide”</td>
<td>Contact our sales and service facility</td>
<td>Contact machine manufacturer / Installation programmer</td>
<td>Check motor incl. holding brake, battery, encoder and cooling system</td>
<td>Switch supply unit off and on again</td>
<td>Switch drive controller off and on again</td>
<td>Check encoder function and mounting (motor encoder and external encoder))</td>
<td>Check encoder cabling</td>
<td>Check motor cabling</td>
<td>Check wiring of inputs and outputs and their 24V power supply</td>
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<td>Check control circuit for mains connection</td>
<td>Check mechanical system (stiffness, loose connection,...)</td>
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8.3 Troubleshooting

Check Drive Components

Motor
- brake
- battery of encoder
- cooling system
- cable

Supply Unit
- wiring
- 24V supply voltage
- mains voltage 3 * 400V

Drive Controller
- note down error number
- wiring
- 24V supply voltage
- mains voltage 3 * 400V

Encoder
- You can check the encoder signals by means of the oscilloscope function of the firmware

Cables
- encoder cable
- motor cable
- input and output cables incl. 24V supply voltage
- cables of the master communication

Peripheral Equipment
- mains connection / switch-on logic
- mechanics (rough running, loose connections, …)
- transition resistances within the emergency circuit

Replacing Devices

Note: For replacing devices you absolutely have to observe the safety instructions contained in chapter 3!

Replacing the Motor
- Eventually note down the last absolute value.
- open main switch
- make sure main switch cannot be switched on again
- disconnect plug-in connectors
Note: When replacing the motor, cover the open mating sites of power lines with protective caps if sprinkling with cooling liquid/lubricant or soiling may occur (allowed degree of soiling according to EN50178: 2).

- replace motor

Note: To mechanically replace the AC servo motor, observe the instructions of the machine manufacturer.

- connect plug-in connectors

Risk of accident due to accidental axis movement!

⇒ Servo axes with indirect distance measuring system via the motor encoder will loose the position data reference when the motor is replaced! This position data reference to the machine coordinate system must therefore be reestablished after replacement.

- for servo axes with absolute motor encoder, reestablish the position data reference

Replacing the Supply Unit

Note: Replacing the unit requires, depending upon unit weight, a lifting device and an identical replacement unit.

Electrical shock due to voltage-containing parts of more than 50 V!

⇒ The unit may only be replaced by qualified personnel, which have been trained to perform the work on or with electrical devices.

Note: Prior to the replacement of the unit please check according to the type plates, whether these units are of the same types. Replace only units of the same types.

Proceed as follows:
1. Switch voltage to installation off and secure it against being switched back on.
2. Using an appropriate measuring device, check whether the installation is power free. Wait the discharge time.
3. Motors must be standing still.
4. Secure vertical axes against motion.
5. Release all connections from the defective unit.
6. Release the fixing bolts and remove the unit from the control cabinet. Use the lifting device, if necessary.
7. Hang replacement unit into mounting rails. Use the lifting device, if necessary.
8. Reconnect the unit as per the terminal diagram of the machine manufacturer.
9. If vertical axes have been mechanically secured prior to replacement, then remove these devices at this point.
10. While reading out the fault memories of the connected drive controllers make sure that the device fault has not been triggered by the drive controllers.

The unit replacement is completed. The system can be put back into operation.

**Replacing the Drive Controller**

- save parameter set
- open main switch
- make sure main switch cannot be switched on again
- make sure drive controller is completely de-energized

---

**DANGER**

Lethal electric shock caused by contact to live parts!

⇒ Before touching live parts allow the capacitors to discharge! Only then start working on the connection cables!

- remove touch guard and separate connecting lines from drive controller
- unscrew screws on top and bottom of housing
- take drive controller out of drive system
- mount new drive controller
- connect new drive controller as specified in machine circuit diagram
- mount touch guard
- copy firmware and parameter set to new drive controller (see firmware documentation)

---

**Cables**

**Replacing Cables**

---

**WARNING**

Lethal electric shock caused by live parts with more than 50 V!

⇒ Power connectors of the cables may only be separated or connected if the installation has been de-energized!

**Note:** When replacing cables, observe the instructions of the machine manufacturer.

If you do not use ready-made Rexroth cables, check to ensure that the cables match the terminal diagram of the machine manufacturer!

- open main switch
- make sure main switch cannot be switched on again
- disconnect plug-in connectors
Note: When replacing cables, cover the open mating sites of power lines with protective caps if sprinkling with cooling liquid/lubricant or soiling may occur (allowed degree of soiling according to EN50178: 2).

- replace cable

Property damage caused by bad power connectors!

⇒ Only separate or connect clean and dry power connectors.

- connect plug-in connectors

Replacing the Firmware

Basic Principles

For firmware replacement we distinguish the following cases:

- **Release update**
  An old firmware release (e.g. MPH04V06) contained in the device is replaced by a new firmware release (e.g. MPH04V08).

- **Version upgrade**
  The old firmware version (e.g. MPH03V20) contained in the device is replaced by a new firmware version (e.g. MPH04V08).

Note: The paragraphs below describe the recommended options of firmware replacement by higher releases ("update") or versions ("upgrade"). The same conditions and sequences of actions apply to firmware replacement by older releases or older firmware versions.

Firmware for IndraDrive is replaced using the following hardware and software:

- MultiMediaCard (MMC)
- PC with software "IndraWorks D"

Note: The commissioning software "IndraWorks D" can be ordered from one of our sales and service facilities under the designation SWA-IWORKS-D**-03VRS-D0-CD650-COPY (part no. R911312495). The scope of supply of "IndraWorks D" contains a documentation which describes the operation of the program.

Preparing the Firmware Replacement

You have to make the following preparations for firmware replacement:

1. Drive controller must be on (24 V supply).
2. Be absolutely sure to save parameter values before any firmware version upgrade (for release update this is recommended).
   See section "Loading, Storing and Saving Parameters"
3. Drive controller mustn't be in operating mode (communication phase 4) [cf. P-0-0115].
You have to observe the following points when carrying out the firmware replacement:

- Do not switch off the 24 V control voltage while replacing the firmware.
- Firmware replacement always must be carried out completely, i.e. firmware on optional safety technology module must be replaced, too.
- For firmware replacement we distinguish between release update and version upgrade.

**Note:** When firmware is replaced in conjunction with the option starting lockout ("L1"), this does not require any specific measure, i.e. the additional measures described below only apply to the use of option "S1"!

### Firmware Release Update

When firmware in a drive controller is replaced by firmware of a new release, this is called firmware release update (e.g. FWA-INDRV*-MPH-04V06-D5 replaced by FWA-INDRV*-MPH-04V08-D5).

The described sequences of the firmware release update depend on the configuration of the control section and the hardware (MMC or PC) used for update. The basically recommended sequence of the firmware release update is illustrated in the scheme below:
Loading New Firmware to MMC

**Requirements**

The following requirements must have been fulfilled for loading firmware to the MMC of the drive:

- new firmware available (ibf file)
- PC with MMC reader
- MMC with old firmware in drive

**Loading Firmware to MMC**

The following steps are required for loading the firmware to the MMC:

1. Switch drive off and remove MMC.
2. Plug MMC into MMC reader and open folder "Firmware" on MMC.
3. Delete old firmware (e.g. FWA-INDRV_-MPH-04V06-D5.ibf).
4. Copy new firmware (e.g. FWA-INDRV_-MPH-04V08-D5.ibf) to folder "Firmware".
Note: Only one firmware file may be stored in the folder "Firmware" on the MMC. With several firmware files, the message "MMC not correct" appears on the display of the drive after booting.

5. Remove MMC from MMC reader after writing process has been completed.

Variant 1: Release Update with MMC

Carrying out the firmware release update with MMC makes sense when the controller has not been equipped with a BASIC single-axis control section.

The optional MultiMediaCard (MMC) allows transmitting drive firmware to the drive controller in a quick and uncomplicated way.

Note: As the MMC is a storage medium that can be written in a simple way (e.g. via PC), it is recommended that you check the MMC content before downloading the firmware. You have to make sure that the MMC really contains the appropriate firmware type.

An MMC with the current release of the required firmware can be ordered from one of our sales and service facilities.

Carrying out the firmware release update with MMC requires the following steps:

1. **Load firmware**
   - Switch drive off.
   - Plug MMC with new firmware into corresponding slot at controller.
   - Restart drive with MMC plugged.
     - After drive has been booted, the following message appears:
       - "Firmware update?"
     - Acknowledge this message by pressing "Enter" key of control panel. By doing this, firmware is loaded from plugged MMC to controller.
     - If drive before firmware replacement was operated without MMC plugged, the following message appears:
       - "Load new param.?")
         - Switch drive off, remove MMC and restart drive.

2. **Put machine into ready-for-operation status**
   - Put machine into ready-for-operation status again according to machine manufacturer’s instructions.
   - Check functions of drive.
3. **Check safety technology parameters** (only when safety technology has been activated in drive)

In the case of a release update, safety technology parameters are retained. With safety technology activated, the following steps are additionally required:

⇒ Check whether correct safety technology parameters for drive are still available.

To do this, check the following points:

- data in P-0-3205, **Safety technology device identifier**
- status of safety technology via P-0-3207, **Safety technology password level** (in the case of active and locked safety technology, level is 2)
- change counter of safety technology memory (P-0-3201, **Change counter of safety technology memory**)
- operating hours at last change of memory (P-0-3202, **Operating hours at last change of memory**)

---

**Variant 2: Release Update with IndraWorks D**

The following requirements should have been fulfilled in order that carrying out the firmware release update with IndraWorks D makes sense:

- Controller is operated without MMC.
- or -
- Controller has been equipped with BASIC single-axis control section.

Carrying out the firmware release update with IndraWorks D requires the following steps:

1. **Load firmware**

⇒ Call IndraWorks D.

⇒ Load project for corresponding axis or create new project; to do this, address axis via a serial connection.

⇒ Switch project "online".

⇒ Select/highlight controller and call "Firmware management" in context menu.

⇒ A new window opens and firmware currently available in drive is displayed on its right side. On left side of window, firmware available in current firmware directory is displayed.

⇒ Highlight new firmware (*.ibf file) on left side and start firmware download via "Download" button.

⇒ Firmware download runs automatically and all required firmware components are loaded to drive.

⇒ After firmware download has been completed, close "Firmware management" window.

2. **Put machine into ready-for-operation status**

⇒ Put machine into ready-for-operation status again according to machine manufacturer’s instructions.

⇒ Check functions of drive.
3. **Check safety technology parameters** (only when safety technology has been activated in drive)

In the case of a firmware release update, safety technology parameters are retained. With safety technology activated, the following steps are additionally required:

- Check whether correct safety technology parameters for drive are still available.

  To do this, check the following points:

  - data in P-0-3205, **Safety technology device identifier**
  - status of safety technology via P-0-3207, **Safety technology password level** (in the case of active and locked safety technology, level is 2)
  - change counter of safety technology memory (P-0-3201, **Change counter of safety technology memory**)
  - operating hours at last change of memory (P-0-3202, **Operating hours at last change of memory**)

---

**Firmware Version Upgrade**

When firmware in a drive controller is replaced by firmware of a **new version**, this is called **firmware version upgrade** (e.g. FWA-INDRV*-MPH-03V20-D5 replaced by FWA-INDRV*-MPH-04V08-D5).

---

**Note:** Before carrying out the firmware version upgrade, you must save all parameters (e.g. with IndraWorks D). After firmware replacement the parameters must be restored because the command "C07_1 Load defaults procedure command" is carried out automatically. After the desired parameter file was loaded, the drive controller is ready for operation again.

The described sequences of the firmware version upgrade depend on the configuration of the control section and the firmware used. The basically recommended sequence of the firmware version upgrade is illustrated in the scheme below:
**Fig. 8-3: Schematic sequence of firmware version upgrade**

**CSH0x.x:** ADVANCED single-axis control section  
**CDB0x.x:** BASIC double-axis control section  
**CSB0x.x:** BASIC single-axis control section  
**active memory:** "programming module" operation of MMC (see P-0-4065)

**Note:** The action instructions marked with dark background in the illustration are described in the paragraphs below.
Saving Parameters
Before firmware upgrade all application-specific parameters must be saved on a data carrier. Parameter backup can be carried out by means of:

- commissioning software "IndraWorks D"
  → saving parameter values on external data carrier
- or -
- control master
  → saving parameter values on master-side data carrier

Note: Saving the parameters on the MMC available in the drive is without effect, as this backup will be deleted during the firmware upgrade.

Loading New Firmware to MMC
Requirements
The following requirements must have been fulfilled for loading firmware to the MMC of the drive:

- new firmware available (ibf file)
- PC with MMC reader
- MMC with old firmware in drive

Loading Firmware to MMC
The following steps are required for loading the firmware to the MMC:
1. Switch drive off and remove MMC.
2. Plug MMC into MMC reader and open folder “Firmware” on MMC.
3. Delete old firmware (e.g. FWA-INDRV*-MPH-03V20-D5.ibf).
4. Copy new firmware (e.g. FWA-INDRV*-MPH-04V08-D5.ibf) to folder "Firmware".

Note: Only one firmware file may be stored in the folder "Firmware" on the MMC. With several firmware files, the message “MMC not correct” appears on the display of the drive after booting.

Variant 1: Version Upgrade with MMC (without Safety Technology)
Selection Criterion
The following requirements should have been fulfilled in order that carrying out the firmware version upgrade with MMC makes sense (without safety technology):

- Controller has not been equipped with BASIC single-axis control section.
- Optional slot for safety technology has not been equipped with option "safety technology I/O" (S1).
- Current parameter setting of axis was saved.
Carrying out the firmware version upgrade with MMC requires the following steps (without safety technology):

1. **Load firmware**
   - Switch drive off.
   - Plug MMC with new firmware into corresponding slot at controller.
   - Restart drive with MMC plugged.
     After drive has been booted, the following message appears:
     - “Firmware update?”
   - Acknowledge this message by pressing “Enter” key of control panel.
     By doing this, firmware is loaded from plugged MMC to controller.

If drive before firmware replacement was operated without MMC plugged, the following message appears:
- “Load new param.?”
  → Switch drive off, remove MMC and restart drive.

2. **Put drive into ready-for-operation status**
   - As number of parameters to be buffered has changed, “PL” appears on display (in case errors are present, remove them first). If you now press “Esc” key, all buffered parameters are set to their default values. During this time, message “C07 Load default parameters” appears on display.

3. **Load parameter values**
   - Load parameter file which was saved.
   - Switch drive off and restart it (only if drive was operated with MMC plugged).

4. **Put machine into ready-for-operation status**
   - Put machine into ready-for-operation status again according to machine manufacturer’s instructions.
   - Check functions of drive.

**Variant 2: Version Upgrade with MMC (with Safety Technology)**

The following requirements should have been fulfilled in order that carrying out the firmware version upgrade with MMC makes sense (with safety technology):
- Controller has not been equipped with BASIC single-axis control section.
- Optional slot for safety technology has been equipped with option “safety technology I/O” (S1).
- Current parameter setting of axis was saved.

Carrying out the firmware version upgrade with MMC requires the following steps (with safety technology):

1. **Load firmware**
   - Switch drive off.
   - Plug MMC with new firmware into corresponding slot at controller.
   - Restart drive with MMC plugged.
     After drive has been booted, the following message appears:
     - “Firmware update?”
⇒ Acknowledge this message by pressing "Enter" key of control panel. By doing this, firmware is loaded from plugged MMC to controller.

If drive before firmware replacement was operated without MMC plugged, the following message appears:

• "Load new param.?"
  → Switch drive off, remove MMC and restart drive.

2. Put drive into ready-for-operation status

⇒ As number of parameters to be buffered has changed, "PL" appears on display (in case errors are present, remove them first). If you now press "Esc" key, all buffered parameters are set to their default values. During this time, message "C07 Load default parameters" appears on display.

3. Load parameter values

⇒ Load parameter file which was saved.

If drive before firmware replacement was operated with MMC plugged:

→ Switch drive off, remove MMC and restart drive.

4. Complete commissioning of integrated safety technology

⇒ Switch drive to operating mode (communication phase 4).

If drive before firmware replacement was operated without MMC plugged, error message "F3152 Incorrect backup of safety technology data" appears as safety technology parameter set between firmware versions 02, 03 and 04 has changed.

→ Clear error message.

⇒ Activate command "synchronize and store safety technology IDN" (C3000).

⇒ Activate safety technology by inputting safety technology password (P-0-3206).

⇒ Carry out new acceptance test.

See sections "Activating the safety technology" and "Acceptance Test" in the separate documentation "Rexroth IndraDrive: Integrated Safety Technology" (DOK-INDRV*-SI*-**VRS**-FK**-EN-P; part no. R911297838)

Note: After a firmware version upgrade for drive controllers with optional safety technology module ("S1"), you have to carry out a complete acceptance test.

⇒ Make safety technology parameter backup, compile acceptance test protocol and add it to safety-relevant documentation of machine.

5. Put machine into ready-for-operation status

⇒ Put machine into ready-for-operation status again according to machine manufacturer’s instructions.

⇒ Check functions of drive.
Variant 3: Version Upgrade with IndraWorks D

The following requirements should have been fulfilled in order that carrying out the firmware version upgrade with IndraWorks D makes sense:

- Controller has been equipped with BASIC single-axis control section.
- Current parameter setting of axis was saved.

Carrying out the firmware version upgrade with IndraWorks D requires the following steps:

1. **Load firmware**
   - Call IndraWorks D.
   - Load project for corresponding axis or create new project. To do this, address axis via a serial connection.
   - Switch project "online".
   - Select/highlight controller and call "Firmware management" in context menu.
     → A new window opens and firmware currently available in drive is displayed on its right side. On left side of window, firmware available in current firmware directory is displayed.
   - Highlight new firmware (*.ibf file) on left side and start firmware download via "Download" button.
     → Firmware download runs automatically and all required firmware components are loaded to drive.
   - After firmware download has been completed, close "Firmware management" window.

2. **Put drive into ready-for-operation status**
   - Switch project "offline" and then "online" again.
     → After project has been switched online, a message signals that IndraWorks D could not establish communication to drive via serial interface, as drive-internal settings for serial communication were reset.
     Reconfigure communication via button "Search for devices".
   - As firmware in drive no longer complies with version stored in project, a corresponding message is displayed. To adjust firmware version in project, first select option "Repair" and then options "Delete existing drive from project" and "Add new drive to project".
   - As number of parameters to be buffered has changed, "PL" appears on display (in case errors are present, clear them first). If you now press "Esc" key, all buffered parameters are set to their default values. During this time, message "C07 Load default parameters" appears on display.

3. **Load parameter values**
   - Load parameter file which was saved.

4. **Put machine into ready-for-operation status**
   - Put machine into ready-for-operation status again according to machine manufacturer's instructions.
   - Check functions of drive.
Possible Problems during Firmware Replacement

Firmware replacement is carried out incompletely if one of the following situations occurs during the sequence of firmware replacement:

- 24V supply of control section is switched off
- connection to drive is interrupted (e.g. defective interface cable)
- software crashes

The drive controller then possibly is no longer operable because the firmware contained in the components is no longer compatible.

If there isn't any valid firmware available in the control section in this case, the loader is started. The drive display signals "LOADER". The loader only allows updating the firmware of the control section. Optional cards, such as "safety technology I/O" (S1) or "cross communication" (CCD) cannot be programmed in this status. This must be done, after successful firmware replacement in the control section, in a second run according to the descriptions of the firmware replacement variants.

In this situation, replacement of the control section firmware is only supported by IndraWorks D.

Note: Upon successful firmware replacement in the control section, a restart has to be carried out. Then all available components have to be updated, too.

Requirements for Loading the Firmware

The following requirements must have been fulfilled for loading firmware to the drive:

- serial connection to drive available
- drive display signals "LOADER"

Firmware Replacement in Control Section in the Case of Error

The following steps are required for loading the firmware to the control section in the case of error:

1. Call IndraWorks D.
2. In menu call firmware management under "Extras → Extras → Drive → Firmware management".
3. Select device and COM interface.
   → A new window opens and firmware available in current firmware directory is displayed on its left side.
4. Highlight new firmware (*.ibf file) on left side and start firmware download via "Download" button.
   → Firmware download runs automatically and all required firmware components are loaded to drive.
5. After firmware download has been completed, close "Firmware management" window.
6. Restart drive.

If drive has not been equipped with optional cards, such as "safety technology I/O" (S1) or "cross communication" (CCD), continue following instructions for release update or version upgrade! Otherwise, carry out release update or version upgrade again to program optional cards.
8.4 Service and Maintenance

Deactivation

In the case of malfunctions, maintenance measures or to deactivate the motors, proceed as follows:

1. Observe the instructions of the machine documentation.
2. Use the machine-side control commands to bring the drive to a controlled standstill.
3. Switch off the power and control voltage of the drive controller.
4. **Only at motors with fan unit:** Switch off the motor protection switch for the motor fan.
5. Switch off the main switch of the machine.
6. Secure the machine against accidental movements and against unauthorized operation.
7. Wait for the discharge time of the electrical systems to expire and then disconnect all electrical connections.
8. Before dismantling, secure the motor and blower unit against falling or movements before disconnecting the mechanical connections.

Dismantling

---

**DANGER**

Fatal injury due to errors in trigger motors and moving elements!

- Do not work on unsecured and operating machines.
- Secure the machine against accidental movements and against unauthorized operation.
- Before dismantling, secure the motor and power supply against falling or movements before disconnecting the mechanical connections.

---

**WARNING**

Combustion via hot surface with temperatures over 100°C

- Let the motor cool down, before maintenance. The stated thermal time constant in the technical data is a measure for the cooling time. A cooling time up to 140 minutes can be necessary!
- Do not work on hot surfaces.
- Use safety gloves.

---

1. Observe the instructions of the machine documentation.
2. Please heed the safety notes and carry out all steps as described in the anterior instructions in the chapter “Deactivation”.
3. Before dismantling, secure the motor and power supply against falling or movements before disconnecting the mechanical connections.
4. Dismantle the motor from the machine. Store the motor properly!
Disposal

Products
Our products can be returned to us free of charge for disposal. It is a precondition, however, that the products are free of oil, grease or other dirt.

In addition, when returned the products mustn’t contain any undue foreign matter or foreign component.

Please send the products free domicile to the following address:
Bosch Rexroth AG
Electric Drives and Controls
Bürgermeister-Dr.-Nebel-Straße 2
D-97816 Lohr am Main

Packaging Materials
The packaging materials consist of cardboard, wood and polystyrene. They can be easily recycled. For ecological reasons you should not return the empty packages to us.

Environmental Protection

No Release of Hazardous Substances
Our products do not contain any hazardous substances that they can release in the case of appropriate use. Normally there aren’t any negative effects on the environment to be expected.

Materials Contained in the Products
Electronic devices mainly contain:
- steel
- aluminum
- copper
- synthetic materials
- electronic components and modules

Motors mainly contain:
- steel
- aluminum
- copper
- brass
- magnetic materials
- electronic components and modules

Recycling
Due to their high content of metal most of the product components can be recycled. In order to recycle the metal in the best possible way it is necessary to disassemble the products into individual modules.

The metals contained in the electric and electronic modules can also be recycled by means of specific separation processes.

The synthetic materials remaining after these processes can be thermally recycled.
9 Service & Support

9.1 Helpdesk
Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns telefonisch - by phone: +49 (0) 9352 40 50 60
über Service Call Entry Center Mo-Fr 07:00-18:00 Central European Time
- via Service Call Entry Center Mo-Fr 7:00 am - 6:00 pm CET
- per Fax - by fax: +49 (0) 9352 40 49 41
- per e-Mail - by e-mail: service.svc@boschrexroth.de

9.2 Service-Hotline
Außerhalb der Helpdesk-Zeiten ist der Service Deutschland direkt ansprechbar unter +49 (0) 171 333 88 26
oder - or +49 (0) 172 660 04 06
Hotline-Rufnummern anderer Länder entnehmen Sie bitte den Adressen in den jeweiligen Regionen.

9.3 Internet

*) Die Angaben in der vorliegenden Dokumentation können seit Drucklegung überholt sein.

9.4 Vor der Kontaktaufnahme... - Before contacting us...
Wir können Ihnen schnell und effizient helfen wenn Sie folgende Informationen bereithalten:
1. detaillierte Beschreibung der Störung und der Umstände.
2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Tele-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

At www.boschrexroth.com you can find additional notes about service, repairs and training. The current addresses *) for our sales and service facilities locations around the world are on the following pages.

*) Data in the present documentation may have become obsolete since printing.
9.5 Kundenbetreuungsstellen - Sales & Service Facilities

Deutschland – Germany

<table>
<thead>
<tr>
<th>Vertriebsgebiet Mitte</th>
<th>Service automation</th>
<th>Call entry center</th>
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<tr>
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<td>Helpdesk</td>
<td>MO – FR</td>
<td>HOTLINE 24 / 7 / 365</td>
<td>Ersatzteile / Spares</td>
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<tr>
<td>Bgm.-Dr.-Nebel-Str. 2 / Postf. 1357 97816 Lohrmann / 97803 Lohrmann Kompetenzzentrum Europa</td>
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<td>außerhalb der Helpdesk-Zeit</td>
<td>verlängerte Ansprechzeit</td>
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<td>Tel.: +49 (0) 9352 40-0</td>
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<tr>
<td><strong>Austria - Österreich</strong></td>
<td>Bosch Rexroth GmbH, Electric Drives &amp; Controls, Stachsgasse 13, 1120 Wien</td>
<td>+43 (0) 1 985 25 40</td>
<td>+43 (0) 1 985 25 40-1459</td>
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<td><strong>Belgium - Belgien</strong></td>
<td>Bosch Rexroth NV/SA, Henri Genesestraat 1, 1070 Brussels</td>
<td>+32 (0) 2 451 26 08</td>
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<td><strong>Denmark - Dänemark</strong></td>
<td>BEC A/S, Zirkelvej 6, 8900 Randers</td>
<td>+45 87 11 90 60</td>
<td>+45 87 11 90 61</td>
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<td><strong>France - Frankreich</strong></td>
<td>Bosch Rexroth SAS, Electric Drives &amp; Controls, ZI de Tihaut, 20 bd. Tihaut (BP. 1751), 31384 Toulouse</td>
<td>+33 (0) 5 61 43 94 12</td>
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<td><strong>Italy - Italien</strong></td>
<td>Bosch Rexroth S.p.A., Electric Drives &amp; Controls, Via Isonzo, 61 40033 Casalecchio di Reno (Bo)</td>
<td>+39 02 94 8 70 13 70</td>
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<td><strong>Spain - Spanien</strong></td>
<td>Bosch Rexroth S.A., Electric Drives &amp; Controls, C/ Francisco Grandmontagne no.2, 20025 Legnano</td>
<td>+39 0 331 4671</td>
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<td>Bosch Rexroth AB, Electric Drives &amp; Controls, Eskvårdan 7, 254 67 Helsingborg</td>
<td>+46 (0) 4 238 88 -50</td>
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<td>Bosch Rexroth Suisse SA, Av. Général Guisan 26, 1800 Vevey</td>
<td>+41 (0) 21 632 84 20</td>
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**Europe (West) - Europe (West)**

**Französisch**:
- (0) nach Landeskennziffer weglassen
- vom Ausland: don't dial (0) after country code
- Italy: dial 0 after country code

**Englisch**:
- don't dial (0) after country code, Italy
- from abroad: vom Ausland:
- (0) nach Landeskennziffer weglassen, Italien
## Europa (Ost) - Europe (East)

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<td>Czech Republic</td>
<td>Bosch - Rexroth, spol.s.r.o. Hviezdoslavova 5 627 00 Brno</td>
<td>Tel.: +420 (0)548126358 Fax: +420 (0)548126112</td>
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<td>Tightening &amp; Press-fit: Bosch - Rexroth, spol.s.r.o. Sterkova 18 140 68 Praha 4</td>
<td>Tel.: +420 (0)241 406 675</td>
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<td>Hungary</td>
<td>Bosch Rexroth Kft. Angel utca 34 1149 Budapest</td>
<td>Tel.: +36 (1) 422 3200 Fax: +36 (1) 422 3201</td>
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<td>Poland</td>
<td>Bosch Rexroth Sp.z.o.o. ul. Staszica 1 05-800 Pruszków</td>
<td>Tel.: +48 (0) 22 738 18 00 Fax: +48 (0) 22 738 18 46</td>
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<td>Tightening &amp; Press-fit: Bosch Rexroth Sp.z.o.o. str. Drobety nr. 4-10, app. 14 70258 Bucuresti, Sector 2</td>
<td>Tel.: +40 (0)1 210 48 25 Fax: +40 (0)1 210 29 50</td>
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<td>Czech Republic</td>
<td>TMS, spol.s.r.o. 02755 Kriva 53</td>
<td>Tel.: +43 581 161</td>
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<td>Slovakia</td>
<td>DOMEL Otoki 21 64 228 Zelezniki</td>
<td>Tel.: +386 5 5117 152 Fax: +386 5 5117 225</td>
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<td>Turkey</td>
<td>Servo Kontrol Ltd. St. Perpa Ticaret Merkezi B Blok Kat.11 No: 1609 80270 Omeydani-Istanbul</td>
<td>Tel.: +90 212 320 30 80 Fax: +90 212 320 30 81</td>
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<td>Australia</td>
<td>AIMS - Australian Industrial Machinery Services Pty. Ltd. 28 Westside Drive Laverton North Vic 3026 Melbourne</td>
<td>Tel.: +61 3 93 14 3321 Fax: +61 3 93 14 3329 Hotlines: +61 3 93 14 3321 +61 4 19 369 195 <a href="mailto:enquiries@aimservices.com.au">enquiries@aimservices.com.au</a></td>
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<td>South Africa</td>
<td>TECTRA Automation (Pty) Ltd. 100 Newton Road, Meadowdale Edenivale 1609</td>
<td>Tel.: +27 11 971 94 00 Fax: +27 11 971 94 40 Hotline: +27 82 903 29 23 <a href="mailto:geor@gmail.com">geor@gmail.com</a></td>
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<td>AIMS - Australian Industrial Machinery Services Pty. Ltd. 28 Westside Drive Laverton North Vic 3026 Melbourne</td>
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**From abroad:** don't dial (0) after country code.
Asien - Asia (incl. Pacific Rim)

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<td>Bosch Rexroth (China) Ltd., Satellite Service Office Wuhan No. 22, Pingleju, Mianyan, Golden Harbor No. 236 Longyang Avenue Economic &amp; Technology Development Zone Wuhan 430056 - P.R.China Tel.: +86 21 87 07 23 92 Mobile: +86 139 71 58 89 67 <a href="mailto:ym.zhu@boschrexroth.com.cn">ym.zhu@boschrexroth.com.cn</a></td>
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<tr>
<td>China</td>
<td>Bosch Rexroth (China) Ltd., Satellite Service Office Changshun No. 22, Xian, Dadingdong, Saha-gu, 21514 Daedae-Dong, Daejeon 305-713, P.R.China Tel.: +86 21 87 05 00 30 Mobile: +86 139 81 96 65 22 <a href="mailto:shuhong.wang@boschrexroth.com.cn">shuhong.wang@boschrexroth.com.cn</a></td>
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<td>Korea</td>
<td>Bosch Rexroth (Korea) Ltd., Tension &amp; Press-fit: K. Melchers GmbH &amp; Co. 13 Floor East Ocean Central No.588 Yaran Rd. East 65 Yaran Rd. West Shanghai 200001 Tel.: +86 21 63 52 88 48 Fax: +86 21 63 51 31 38 <a href="mailto:ahernarxia@zh.melchers.com">ahernarxia@zh.melchers.com</a></td>
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<td>India - Indien</td>
<td>Bosch Rexroth (India) Ltd., Electric Drives &amp; Controls Advance House, II Floor Ark Industrial Compound Narol Naka, Makwana Road Andheri (East), Mumbai - 400 059 Tel.: +91 22 28 56 32 90 Fax: +91 22 28 56 32 83 <a href="mailto:singh.op@boschrexroth.co.in">singh.op@boschrexroth.co.in</a></td>
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<td>Thailand</td>
<td>Bosch Rexroth (Korea) Ltd., Tension &amp; Press-fit: K. Melchers GmbH &amp; Co. 13 Floor East Ocean Central No.588 Yaran Rd. East 65 Yaran Rd. West Shanghai 200001 Tel.: +86 21 63 52 88 48 Fax: +86 21 63 51 31 38 <a href="mailto:ahernarxia@zh.melchers.com">ahernarxia@zh.melchers.com</a></td>
<td></td>
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Service & Support 9-5

Rexroth IndraDrive

DOK-INDRV*-FU*********-IB01-EN-P
## USA

<table>
<thead>
<tr>
<th>Region</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headquarters - Hauptniederlassung</td>
<td>Bosch Rexroth Corporation Electric Drives &amp; Controls 5150 Prairie Stone Parkway Hoffman Estates, IL 60192-3707 Tel.: +1 847 645-3600 Fax: +1 847 645-6201 <a href="mailto:servicebrc@boschrexroth-us.com">servicebrc@boschrexroth-us.com</a> <a href="mailto:repairbrc@boschrexroth-us.com">repairbrc@boschrexroth-us.com</a></td>
</tr>
<tr>
<td>USA Northeast Region – Nordost</td>
<td>Bosch Rexroth Corporation Electric Drives &amp; Controls 99 Rainbow Road East Granby, CT 06026 Tel.: +1 860 844-8377 Fax: +1 860 844-8595</td>
</tr>
<tr>
<td>USA Central Region - Mitte</td>
<td>Bosch Rexroth Corporation Electric Drives &amp; Controls 1701 Harmon Road Auburn Hills, MI 48326 Tel.: +1 248 393-3330 Fax: +1 248 393-2906</td>
</tr>
<tr>
<td>USA Southeast Region - Südost</td>
<td>Bosch Rexroth Corporation Electric Drives &amp; Controls 2810 Premiere Parkway, Suite 500 Duluth, GA 30097 Tel.: +1 678 957-4050 Fax: +1 678 417-6637</td>
</tr>
<tr>
<td>USA West Region – West</td>
<td>Bosch Rexroth Corporation Electric Drives &amp; Controls 7901 Stoneridge Drive, Suite 220 Pleasanton, CA 94588 Tel.: +1 925 227-1084 Fax: +1 925 227-1081</td>
</tr>
<tr>
<td>USA Northeast Region – Nordost</td>
<td>Bosch Rexroth Canada Corporation 5345 Outer Drive unit 5 Windsor, Ontario Canada N9A 6J3 Tel.: +1 519 737 7393 Fax.: +1 519 737 9999</td>
</tr>
<tr>
<td>USA Central Region - Mitte</td>
<td>Bosch Rexroth Canada Corporation Automation Division 3426 Mainway Drive Burlington, Ontario Canada L7M 1A8 Tel.: +1 905 335 5511 Fax: +1 905 335 4184 (Main) +1 905 335 9803 (Serv.) <a href="mailto:automation.service@boschrexroth.ca">automation.service@boschrexroth.ca</a> <a href="mailto:automation.repair@boschrexroth.ca">automation.repair@boschrexroth.ca</a></td>
</tr>
<tr>
<td>Canada East - Kanada Ost</td>
<td>Bosch Rexroth Canada Corporation 3426 Mainway Drive Burlington, Ontario Canada L7M 1A8 Tel.: +1 905 335 5511 Fax: +1 905 335 4184 (Main) +1 905 335 9803 (Serv.) <a href="mailto:automation.service@boschrexroth.ca">automation.service@boschrexroth.ca</a> <a href="mailto:automation.repair@boschrexroth.ca">automation.repair@boschrexroth.ca</a></td>
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## Canada West - Kanada West

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Bosch Rexroth Canada Corporation 5345 Goring St. Burnaby, British Columbia Canada V7J 1R1 Tel.: +1 604 205 5777 Fax: +1 604 205 6944</td>
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## Canada East - Kanada Ost

<table>
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<tr>
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<tbody>
<tr>
<td>Bosch Rexroth Mexico S.A. de C.V. Calle Neptuno 72 Unidad Ind. Valles 07700 Mexico, D.F. Tel.: +52 55 57 54 17 11 Fax: +52 55 57 54 50 73 <a href="mailto:mariol.francioli@boschrexroth.com.mx">mariol.francioli@boschrexroth.com.mx</a></td>
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## Canada Service Hotline

<table>
<thead>
<tr>
<th>- 7 days week/ 24 hrs day -</th>
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<tbody>
<tr>
<td>+1 905 335 5511</td>
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## Mexico

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<tr>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bosch Rexroth S.A. de C.V. Calle Argentina No 3913 Fracc. las Torres 64830 Monterrey, N.L. Tel.: +52 81 83 49 80 91 Fax: +52 81 83 49 80 92 +52 81 83 49 80 93</td>
</tr>
</tbody>
</table>

## South America

### Argentine - Argentinien

<table>
<thead>
<tr>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bosch Rexroth S.A.I.C. “The Drive &amp; Control Company” Rosario 2302 B1606DDL Carapachay Provincia de Buenos Aires Tel.: +54 11 4756 01 40 +54 11 4756 02 40 +54 11 4756 03 40 +54 11 4756 04 40 +54 11 4756 01 36 +54 11 4721 91 53 <a href="mailto:victor.jabif@boschrexroth.com.ar">victor.jabif@boschrexroth.com.ar</a></td>
</tr>
</tbody>
</table>

### Argentina - Argentinien

<table>
<thead>
<tr>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAKASE SRL Servicio Tecnico CNC Calle 49. No. 5764/66 B1653AOX Villa Ballester Provincia de Buenos Aires Tel.: +54 11 4768 42 42 Fax: +54 11 4768 42 42 111 Hotline: +54 11 155 307 6781 <a href="mailto:nakase@nakase.com">nakase@nakase.com</a></td>
</tr>
</tbody>
</table>

### Brazil - Brasilien

<table>
<thead>
<tr>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bosch Rexroth Ltda. Av. Tégula, 888 Ponte Alta, Albaia SP CEP 12942-440 Tel.: +55 11 4414-56 92 +55 11 4414-56 84 Fax sales: +55 11 4414-57 07 Fax serv.: +55 11 4414-56 86 <a href="mailto:alexandre.wittwer@rexroth.com.br">alexandre.wittwer@rexroth.com.br</a></td>
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### Brazil - Brasilien

<table>
<thead>
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</tr>
</thead>
<tbody>
<tr>
<td>Bosch Rexroth Ltda. R. Dr.Humberto Pinheiro Vieira, 100 Distrito Industrial [Caixa Postal 1273] 89220-390 Joinville - SC Tel./Fax: +55 47 473 58 33 Mobil: +55 47 9974 6645 <a href="mailto:sergio.prochnow@boschrexroth.com">sergio.prochnow@boschrexroth.com</a></td>
</tr>
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