Commissioning the CKL Drive Controller
The data specified only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. Catalog specifications do not constitute assured characteristics. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

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Original instruction manual.
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1 General

1.1 Scope and purpose of the documentation
• This document is intended to be a guideline for initial axis commissioning of the CKL Linear Motor Module.
• The parameters found within are based solely on the use of Bosch Rexroth IndraDrive Cs servo drives.
• For 3rd Party Servo Drives, while items on the initial parameter set may be the same, expect minor adjustment requirements depending on the Drives' Manufacturer recommendations.

2 Commissioning
• Verify actual CKL system in-hand and all Preconditions (see page 5).
• Print or display the “Commissioning Flowchart” Part 1 and Part 2 relevant to Hall sensor type as you commission the CKL system.
• Step through the flowchart by reading the relevant instruction pages.
• Please be advised, the instruction pages are NOT meant to be completely read straight-through in page order. For example, if using analog Hall sensor, not all instruction pages are necessary (see flowchart). Furthermore, depending on success/failure of a step, looping through previous steps might be required (see flowchart).
3 Commissioning Flowcharts

3.1 Commissioning Flowchart – Part 1

Start Initial Commissioning

Preconditions

Network Connection

Firmware

Language Selection

Master Communication

Power Supply

Scaling / Mechanical System

Limit Values

Motor

Motor Encoder

Data Reference Motor Encoder

Axis Control Parameters

Hall Sensor?

Digital or none

Analog

Analog Hall

Digital Hall or without Hall

Proceed to Part 2 for relevant Hall Sensor type.
3.2 Commissioning Flowchart – Part 2 – Analog Hall

- Analog Hall
- Easy Startup Mode
  - PM to OM?
    - Yes: Enable Drive Power
    - No: Drive Error Diagnostics
  - Home Axis
  - Save Basic Parameters
- Move Axis
  - Motion OK?
    - Yes, with Basic Parameters: Save Optimized Parameters
    - Yes, with Optimized Parameters: Optimize Control Loops
    - No: Finished Initial Commissioning
3.3 Commissioning Flowchart – Part 2 – Digital Hall or without Hall

1. Digital Hall or without Hall
   - Comutation Settings
   - Easy Startup Mode
     - PM to OM?
       - Yes: Determine Commutation Offset
       - No: Drive Error Diagnostics
     - No: Verify Commutation Offset
       - OK: Home Axis
       - Not OK: Move Axis
         - Motion OK?
           - Yes, with Basic Parameters: Save Basic Parameters
           - Yes, with Optimized Parameters: Optimize Control Loops
         - No: Optimize Control Loops
     - P519 Bit1=0, commutation offset not optimized
   - P519 Bit1=1, commutation offset optimized to ref (homed) point
   - Save Optimized Parameters
   - Finished Initial Commissioning

2. Yes: Commutation Settings
   - Easy Startup Mode
     - PM to OM?
       - Yes: Determine Commutation Offset
       - No: Drive Error Diagnostics
     - No: Verify Commutation Offset
       - OK: Home Axis
       - Not OK: Move Axis
         - Motion OK?
           - Yes, with Basic Parameters: Save Basic Parameters
           - Yes, with Optimized Parameters: Optimize Control Loops
         - No: Optimize Control Loops
     - P519 Bit1=0, commutation offset not optimized
   - P519 Bit1=1, commutation offset optimized to ref (homed) point
   - Save Optimized Parameters
   - Finished Initial Commissioning
4 Preconditions

4.1 Commissioning the CKL drive controller

4.1.1 Hardware

Compact Module CKL

<table>
<thead>
<tr>
<th>System size</th>
<th>Carriage length</th>
<th>Primary part</th>
<th>Secondary part</th>
</tr>
</thead>
<tbody>
<tr>
<td>CKL 110</td>
<td>180 mm</td>
<td>MCP030B-V180-Ni-xxCN-NNNN</td>
<td>MCS030-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>240 mm</td>
<td>MCP030C-V180-Ni-xxCN-NNNN</td>
<td>MCS030-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>MCP030D-V180-Ni-xxCN-NNNN</td>
<td>MCS030-3S-xxxx-NNNN</td>
</tr>
<tr>
<td>CKL 145</td>
<td>244 mm</td>
<td>MCP040C-V300-Ni-xxCN-NNNN</td>
<td>MCS040-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>364 mm</td>
<td>MCP040E-V300-Ni-xxCN-NNNN</td>
<td>MCS040-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>484 mm</td>
<td>MCP040G-V300-Ni-xxCN-NNNN</td>
<td>MCS040-3S-xxxx-NNNN</td>
</tr>
<tr>
<td>CKL 200</td>
<td>237 mm</td>
<td>MCP070C-V300-Ni-xxCN-NNNN</td>
<td>MCS070-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>297 mm</td>
<td>MCP070D-V300-Ni-xxCN-NNNN</td>
<td>MCS070-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>417 mm</td>
<td>MCP070F-V300-Ni-xxCN-NNNN</td>
<td>MCS070-3S-xxxx-NNNN</td>
</tr>
</tbody>
</table>

xx: L0 = digital Hall, L1 = analog Hall, N0 = without Hall

xxxx: 0120, 0180, 0300 = secondary part length mm, select any value

HCS01 IndraDrive Cs with Firmware MPx-17V08 or greater

Supported feedback combinations:

<table>
<thead>
<tr>
<th>Firmware</th>
<th>Encoder</th>
<th>HCS01 connector</th>
<th>Hall unit</th>
<th>HCS01 connector</th>
<th>Additional hardware requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPE/B/C</td>
<td>analog</td>
<td>X4</td>
<td>without</td>
<td>without</td>
<td>none</td>
</tr>
<tr>
<td>MPE/B/C</td>
<td>digital</td>
<td>X4</td>
<td>without</td>
<td>without</td>
<td>none</td>
</tr>
<tr>
<td>MPE/B/C</td>
<td>analog</td>
<td>X4</td>
<td>digital</td>
<td>X4</td>
<td>with SHL03 Hall sensor box</td>
</tr>
<tr>
<td>MPB/C</td>
<td>digital</td>
<td>X4</td>
<td>analog</td>
<td>X8</td>
<td>with HCS01 dual encoder interface (EC-EC)</td>
</tr>
<tr>
<td>MPB/C</td>
<td>analog</td>
<td>X4</td>
<td>analog</td>
<td>X8</td>
<td>with HCS01 dual encoder interface (EC-EC)</td>
</tr>
</tbody>
</table>

Firmware: MPE=Economy, MPB=Basic, MPC=Advanced

Encoder: digital encoder is supported but analog encoder is recommended with IndraDrive!

For detailed descriptions of firmware and encoders, please see the IndraDrive MPx-17 (or later) Functions Applications Manual.

4.1.2 Software

• IndraWorks Ds 13VRS (recommended)
• IndraWorks Ds 12VRS (possible with caution*)

4.1.3 Operating System

• Windows 7 (recommended)
• Windows XP (possible with caution*)

NOTE: Caution* = software bugs, unexpected behavior, limited tests
5 Network Connection

5.1 Connect PC to IndraDrive via the Non-Real Time (NRT) channel for drive commissioning

5.1.1 Steps for configuring the network connection:
1. Right mouse button click on Local Area Connection and select Properties in the pop-up menu.
2. Select Internet Protocol (Windows XP) or Internet Protocol Version 4 (Windows 7).
3. Press the Properties button.
5.1.1 Steps for configuring the network connection (continued)

4. Enter a unique IP address for the PC (must be different than the IndraDrive, see below note), then click inside the Subnet mask field, the Subnet mask will default to 255.255.255.0.

5. Open IndraWorks Ds.

6. Enter the IP address of the IndraDrive, the default factory setting is 192.168.0.1.

7. Press the Browse button.

8. The connected IndraDrive appears with device information.

9. Press the OK button.

**NOTE:** If the IP address of the IndraDrive is 192.168.0.1, then the PC’s first three dot-decimal numbers must be the same (for example, 192.168.0.x). The fourth number (x) must be different from that of the IndraDrive’s IP address, and be a number between 0 to 255.
6 Firmware

6.1 Check compatibility and update IndraDrive firmware

6.1.1 Steps for checking firmware compatibility:
1. Select the Help pull-down menu, then select Info.
2. Verify that firmware version MPx-17VRS or later is supported. If not, install a later release of IndraWorks Ds.
6 Firmware (continued)

6.1.1 Steps for checking firmware compatibility (continued)
3. In the Explorer tree, right mouse button click on the Axis and select Properties in the pop-up menu.
4. Verify that firmware version MPx-17V08 or later is on the IndraDrive. If not, download new firmware to the drive.
6 Firmware (continued)

6.1.2 Steps for updating firmware to the drive:

1. Select the Diagnosis / Service pull-down menu, then select Firmware Management.
2. Press the […] browse button, select the new firmware .ibf file obtained from Rexroth support based on the following compatibility table:

<table>
<thead>
<tr>
<th>Drive Controller Type</th>
<th>Functionality/Communication</th>
<th>Firmware</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCS01.1E-…-E-S3-…</td>
<td>ECONOMY / SERCOS III</td>
<td>FWA-INDRV*-MPE-…</td>
</tr>
<tr>
<td>HCS01.1E-…-B-ET-…</td>
<td>BASIC / Multi-Ethernet</td>
<td>FWA-INDRV*-MPB-…</td>
</tr>
<tr>
<td>HCS01.1E-…-A-CC-…</td>
<td>ADVANCED / SERCOS III-Master Cross Comm</td>
<td>FWA-INDRV*-MPC-…</td>
</tr>
</tbody>
</table>

3. Press the Download button, the Progress bars will indicated download progression.
4. When download is complete, press the Close button.
7 Language Selection

7.1 Select the language for drive parameter names, units and diagnostic/error messages

7.1.1 Steps for configuring the drive language:
1. Select the Parameter Editor or Parameter Search window.
2. If opened the Parameter Search window, type “language” in the Text search box, and select parameter S-0-0265 from the list.
3. Enter the desired language by typing one of the following values:
   - 0 = German [factory default]
   - 1 = English
   - 2 = French
   - 3 = Spanish
   - 4 = Italian

If necessary, the IndraWorks user interface language setting can be changed by selecting Tools → Options → Environment → Language.
8  Master Communication

8.1  Configure master communication if the IndraDrive is Multi-Ethernet type (i.e. Basic Universal or Advanced)

8.1.1  Steps for configuring master communication:
1. In the Explorer tree, select Master Communication.
2. Select the desired master communication in the Basic setting pull-down menu, Sercos III is the factory default setting.
   • Please be advised, selecting EtherCAT disables the Ethernet engineering communication. Therefore, for initial drive commissioning select No master comm. activated or Sercos III to commission the drive axis, then select EtherCAT master communication for application programming/operation.
3. Reboot the drive to activate the changes.
9 Power Supply

9.1 Configure power supply

9.1.1 Steps for configuring the power supply:
1. In the Explorer tree, select Power Supply.
2. If drive is connected to:
   - 3-phase mains supply: check box Phase monitoring of mains voltage.
   - 1-phase mains supply: uncheck box Phase monitoring of mains voltage.

NOTE: For all CKL linear motor sizes, allowed mains supply 1- or 3-phase AC 110-230V connected to drive. If a drive for higher voltage is used (e.g. 3 ~ 400V with HCS01.1E-W00xx-A-03-...), please use a transformer and limit bleeder to 390V.
10 Scaling/Mechanical System

10.1 Configure scaling and mechanical system

10.1.1 Steps for configuring scaling and mechanical system:
1. In the Explorer tree, select Scaling / Units
2. Select linear (this updates units in other windows, e.g. Scaling/Units Extended, Motor Encoder, etc)
3. Select negation: no = factory default = motor effective force and encoder positive counting directions
4. (a) Press the Extended button or (b) select Scaling/Units Extended in the Explorer tree
5. Select extended options, e.g. change velocity scaling unit from factory default mm/min to mm/s
10 Scaling/Mechanical System (continued)

10.1.1 Configure scaling and mechanical system (continued)

6. In the Explorer tree, select Mechanical Gear.

7. Enter Maximum travel range and Feed constant:
   - Maximum travel range = see S-0-0278 parameter help for detailed description
   - Feed constant = 1 for direct drive (factory default is 10)

8. Enter Load inertia. This is actually Load mass for a linear motor axis. The value does not have to be exact, since it is used as an initial value for automatic control loop optimization (see IndraDrive Firmware help for command C1800). The following are approximate values with a cable chain and empty carriage:
   - 4kg: for CKL 110 with motor primary MCP030
   - 5kg: for CKL 145 with motor primary MCP040
   - 6kg: for CKL 200 with motor primary MCP070

Add external payload if known.
11 Limit Values

11.1 Configure motion limit values

11.1.1 Steps for configuring motion limit values:
1. In the Explorer tree, select Motion Limit Values
2. If application requires software limit switches, to activate functionality on the drive check box Position limit value monitoring (factory default is unchecked), then enter the positive and negative position limit values or bipolar limit value for symmetric +/- limit
3. If application has hardware limit switches, to activate functionality on the drive check box Travel range limit switch monitoring (factory default is unchecked), then select switch type (normally closed or normally open) and drive reaction when travel range exceeded:
   • Warning = axis stopped, command is allowed to move axis to permissible travel range
   • Error = axis fault, drive power disabled
4. Enter Velocity limit values (limit is not active if value = 0)
5. Enter acceleration and jerk limit values (limit is not active if value = 0)
11 Limit Values (continued)

11.2 Configure torque/force limit values

11.2.1 Steps for configuring torque/force limit values:
1. In the Explorer tree, select Torque / Force Limits
2. Based on application requirements, enter torque/force limit values (factory default is 400% of the nominal continuous torque/force, see motor datasheet)

NOTE: Per parameter S-0-0086, for linear kit motors, the reference value (100% value) also corresponds to the continuous torque at standstill or the continuous force at standstill. In this case, the cooling factor is “1.0” because the cooling type is invariable (P-0-0640 is inactive).
12 Motor

12.1 Update the motor database if outdated

12.1.1 Steps for updating the motor database:
1. If the Date of motor database is outdated, proceed to step 2.
2. Select the Diagnosis / Service pull-down menu, then select Drive Database.
3. Press the Update button (must have direct internet connection, if not, reconfigure your Network Connection properties).
12 Motor (continued)

12.2 Configure linear motor from database

12.2.1 Steps for configuring the linear motor from database:
1. In the Explorer tree, select Motor.
2. Select Rexroth kit motor in the Motor category box drop-down list.
12 Motor (continued)

12.2.1 Steps for configuring the linear motor from database: (continued)

3. Enter the primary and secondary type codes based on the below table, then select the Linear and Synchronous options.

<table>
<thead>
<tr>
<th>System size</th>
<th>Carriage length</th>
<th>Primary part</th>
<th>Secondary part</th>
</tr>
</thead>
<tbody>
<tr>
<td>CKL 110</td>
<td>180 mm</td>
<td>MCP030B-V180-NI-xxCN-NNNN</td>
<td>MCS030-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>240 mm</td>
<td>MCP030C-V180-NI-xxCN-NNNN</td>
<td>MCS030-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>MCP030D-V180-NI-xxCN-NNNN</td>
<td>MCS030-3S-xxxx-NNNN</td>
</tr>
<tr>
<td>CKL 145</td>
<td>244 mm</td>
<td>MCP040C-V300-NI-xxCN-NNNN</td>
<td>MCS040-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>364 mm</td>
<td>MCP040E-V300-NI-xxCN-NNNN</td>
<td>MCS040-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>484 mm</td>
<td>MCP040G-V300-NI-xxCN-NNNN</td>
<td>MCS040-3S-xxxx-NNNN</td>
</tr>
<tr>
<td>CKL 200</td>
<td>237 mm</td>
<td>MCP070C-V300-NI-xxCN-NNNN</td>
<td>MCS070-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>297 mm</td>
<td>MCP070D-V300-NI-xxCN-NNNN</td>
<td>MCS070-3S-xxxx-NNNN</td>
</tr>
<tr>
<td></td>
<td>417 mm</td>
<td>MCP070F-V300-NI-xxCN-NNNN</td>
<td>MCS070-3S-xxxx-NNNN</td>
</tr>
</tbody>
</table>

xx: L0 = digital Hall, L1 = analog Hall, N0 = without Hall
xxxx: 0120, 0180, 0300 = secondary part length mm, select any value

4. Press the DB → Drive button to download the motor parameters to the drive.
12 Motor (continued)

12.2.1 Steps for configuring the linear motor from database: (continued)

5. Select Mounting method B.
6. Press the OK button.
7. You can now see that the motor parameters in the drive are the same as in the database.
12 Motor (continued)

12.3 Configure linear motor continuous current for CKL system

12.3.1 Steps for configuring the linear motor continuous current for CKL system:

1. Double-click parameter S-0-0111 in the parameter list.
2. Input the CKL value (see below table) and then press the Enter key.

<table>
<thead>
<tr>
<th>System size</th>
<th>Carriage length</th>
<th>Primary part</th>
<th>DB value</th>
<th>Factor %</th>
<th>CKL value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CKL 110</td>
<td>180 mm</td>
<td>MCP030B-V180</td>
<td>1.3</td>
<td>75</td>
<td>0.98</td>
</tr>
<tr>
<td></td>
<td>240 mm</td>
<td>MCP030C-V180</td>
<td>1.8</td>
<td>75</td>
<td>1.35</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>MCP030D-V180</td>
<td>2.5</td>
<td>75</td>
<td>1.88</td>
</tr>
<tr>
<td>CKL 145</td>
<td>244 mm</td>
<td>MCP040C-V300</td>
<td>2.9</td>
<td>85</td>
<td>2.47</td>
</tr>
<tr>
<td></td>
<td>364 mm</td>
<td>MCP040E-V300</td>
<td>4.7</td>
<td>85</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>484 mm</td>
<td>MCP040G-V300</td>
<td>6.6</td>
<td>85</td>
<td>5.61</td>
</tr>
<tr>
<td>CKL 200</td>
<td>237 mm</td>
<td>MCP070C-V300</td>
<td>5.1</td>
<td>82</td>
<td>4.18</td>
</tr>
<tr>
<td></td>
<td>297 mm</td>
<td>MCP070D-V300</td>
<td>6.4</td>
<td>82</td>
<td>5.25</td>
</tr>
<tr>
<td></td>
<td>417 mm</td>
<td>MCP070F-V300</td>
<td>9.0</td>
<td>82</td>
<td>7.38</td>
</tr>
</tbody>
</table>

3. Parameter S-0-0111 value is now updated in the drive for the specific CKL system size.
4. Close the Parameter editor.
13 Motor Encoder

13.1 Configure motor encoder

13.1.1 Steps for configuring motor encoder:
1. In the Explorer tree, select Motor Encoder.
2. Select Encoder combination:

<table>
<thead>
<tr>
<th>Encoder</th>
<th>Hall</th>
<th>Motor encoder</th>
</tr>
</thead>
<tbody>
<tr>
<td>analog</td>
<td>none</td>
<td>Encoder with sine signals (1Vpp, 5V supply)</td>
</tr>
<tr>
<td>digital</td>
<td>none</td>
<td>Encoder with square-wave signals (TTL, 5V supply)</td>
</tr>
<tr>
<td>analog</td>
<td>digital</td>
<td>Encoder combination: Encoder with sine signals (1Vpp, 5V supply) and digital Hall sensor box (12V supply), with SHL03</td>
</tr>
<tr>
<td>digital</td>
<td>analog</td>
<td>Encoder combination: Encoder with square-wave signals (TTL, 5V supply) and Hall sensor box SHL02 (12V supply)</td>
</tr>
<tr>
<td>analog</td>
<td>analog</td>
<td>Encoder combination: Encoder with sine signals (1Vpp, 5V supply) and Hall sensor box SHL02 (12V supply)</td>
</tr>
</tbody>
</table>

3. Select Linear encoder, then enter Resolution:

<table>
<thead>
<tr>
<th>Encoder type</th>
<th>Encoder interpolation</th>
<th>Encoder resolution (µm)</th>
<th>Resolution* (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>analog</td>
<td>n/a</td>
<td>&lt;0.1</td>
<td>0.02</td>
</tr>
<tr>
<td>digital</td>
<td>x8</td>
<td>2.5</td>
<td>0.01</td>
</tr>
<tr>
<td>digital</td>
<td>x40</td>
<td>0.5</td>
<td>0.002</td>
</tr>
</tbody>
</table>

**NOTE:** Resolution drive parameter is defined as follows:
- analog encoder: 1-sine period, drive then interpolates up to maximum 13-bits (8192)
- digital encoder: 1-square wave, drive then evaluates the 4-quadrants (=Encoder resolution)
14 Data Reference Motor Encoder

14.1 Configure data reference motor encoder

14.1.1 Steps for configuring data reference motor encoder:
1. In the Explorer tree, select Data Reference Motor Encoder
2. Select Reference travel direction and Evaluation method, enter Reference distance and Homing motion profile. If none of the Evaluation methods are selected, please see warning at bottom of this page. For possible motion type homing Evaluation method combinations, please see following:
   Recommended:
   • Reference mark with limit switch: move to limit switch then reverse move to reference mark.
   • Home switch with limit switch: move to limit switch then reverse move to home switch.
   Possible with caution*:
   • Reference mark with positive stop: move to hard-stop then reverse move to reference mark.
   • Home switch with positive stop: move to hard-stop then reverse move to home switch.
   • Limit switch with positive stop: move to hard-stop then reverse move to limit switch.
   • Positive stop only: move to hard-stop then reverse move to reference point offset value.

NOTE: Caution* = when homing with positive stop, it may require reducing application torque/force limits (see Limit Values page 17) to prevent max exceeded torque/force (over-current) fault at the positive (hard) stop. For execution of the homing command, advise using ≤100% torque/force limit value. After successful completion of homing, the torque/force limits can be increased to the application requirements.

WARNING! If none of the Evaluation methods are selected, the axis references with motionless homing. After execution of the homing command, the actual physical position of the axis is set to the user specified Reference distance in step 2. Therefore, on subsequent homing, the axis reference may differ depending on where the axis is actually “resting”.
15 Axis Control Parameters

15.1 Load basic CKL system control loop parameters

15.1.1 Steps for loading basic CKL system control loop parameters (choose either method):
1a. Open the Parameter editor box.
1b. In the Explorer tree select Axis Control Settings.
2a. Type parameter IDN (e.g. S100 for S-0-0100, input values and then press Enter after each entry.
2b. Input values in the screen fields.
3b. Select “V-loop Filter” to input parameter P4.

See below table for parameter values.

<table>
<thead>
<tr>
<th>System</th>
<th>Carriage length</th>
<th>Primary part</th>
<th>S-0-0100</th>
<th>S-0-0101</th>
<th>P-0-0004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Velocity loop – proportional gain</td>
<td>Velocity loop – integral time</td>
<td>Velocity loop – smoothing time</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>N/(mm/min)</td>
<td>ms</td>
<td>µs</td>
</tr>
<tr>
<td>CKL 110</td>
<td>180 mm</td>
<td>MCP030B-V180</td>
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<td>8.9</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>240 mm</td>
<td>MCP030C-V180</td>
<td>0.033</td>
<td>8.9</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>300 mm</td>
<td>MCP030D-V180</td>
<td>(tbd.)</td>
<td>(tbd.)</td>
<td>(tbd.)</td>
</tr>
<tr>
<td>CKL 145</td>
<td>244 mm</td>
<td>MCP040C-V300</td>
<td>0.063</td>
<td>8.9</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>364 mm</td>
<td>MCP040E-V300</td>
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<td>8.9</td>
<td>300</td>
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<tr>
<td></td>
<td>484 mm</td>
<td>MCP040G-V300</td>
<td>0.136</td>
<td>8.1</td>
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</tr>
<tr>
<td>CKL 200</td>
<td>237 mm</td>
<td>MCP070C-V300</td>
<td>0.057</td>
<td>20.7</td>
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<td></td>
<td>297 mm</td>
<td>MCP070D-V300</td>
<td>0.058</td>
<td>20.7</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>417 mm</td>
<td>MCP070F-V300</td>
<td>0.059</td>
<td>28.5</td>
<td>600</td>
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</tbody>
</table>
16 Commutation Settings

16.1 Configure commutation settings with digital Hall or without Hall sensor

16.1.1 Steps for configuring commutation settings with digital Hall or without Hall sensor:
1. In the Explorer tree, select Commutation Settings.
2. Select Sine-wave method and check box Initial commissioning mode.
3. Check box Switch off automatic backward movement.
4. Enter Amplitude, which is based on a percentage of the maximum continuous force at standstill. The value does not have to be exact, since it is used as an initial minimum value for determining commutation. However, too low of an initial value may result in poor commutation. Suggest using the following values:
   • Amplitude ≥ 40%, for CKL 110 with motor primary MCP020/30
   • Amplitude ≥ 60%, for CKL 145/200 with motor primary MCP040/70
5. If using a digital Hall sensor:
   • If value of 0 in the box field, right mouse button click in the box field, then in the pop-up menu select Parameter Info (P-0-0509.0.0) and enter the following in the Parameter editor:
     – Value = 62, for CKL 110/145/200 with motor primary MCP030/40/70
If not using a Hall sensor:
   • Not applicable, ignore this step.

For detailed information, see the Rexroth IndraDrive MPx-17 (or later) Functions Applications Manual sections "Commutation Setting" and "Sine-Wave Method".
17 Easy Startup Mode

17.1 Configure and start easy startup mode

17.1.1 Steps for configuring easy startup mode:
1. In the Explorer tree, select Easy Startup Mode.
2. Select Engineering Port (TCP/IP).
3. Press the Start Easy Startup Mode button to put drive in “Drive Ready” state (Ab).
4. If successful, Easy startup mode status is active and the Enable button is selectable.
18 Drive Error Diagnostics

18.1 Fix drive error/fault (example)

18.1.1 Steps for drive error diagnostics:
1. Start Easy Startup Mode (PM → OM) failed.
2. Axis status indicates a drive error, in this example F8022 encoder error message.
3. Select the Help icon for a description of the error, possible cause, and remedy (e.g. check encoder cable is securely connected to drive).
4. After checking possible remedy, set drive to Parameter mode.
5. Clear error.
6. Re-try Start Easy Startup Mode (PM → OM).
7. If Axis status indicates another error, repeat steps 3 to 6.
18 Drive Error Diagnostics (continued)

18.2 Further drive error diagnostics (example)

18.2.1 Steps for further drive error diagnostics:
1. Select the Diagnosis/Service pull-down menu, then select Error/Diagnostic Memory.
2. In the Error memory tab, the most recent drive errors are shown at the top of the list.
3. Select the Help icon and search for the error code (e.g. F2019) for further help.
19 Determine Commutation Offset

19.1 Determine commutation offset with digital Hall or without Hall sensor

19.1.1 Steps for determining commutation offset with digital Hall or without Hall sensor:

**ATTENTION:**
Prior to this command, the axis position must allow UNRESTRICTED MOVEMENT!

1. In the Explorer tree, select Commutation Settings.
2. Press the Determine Commutation Offset button (drive must be in Ab for this step).
   
   **WARNING:** Stay clear, axis will MOVE!

3. After commutation, values for test signal Amplitude and Frequency, Effective offset and Offset are determined.
4. Repeat step 2 multiple times to verify that the commutation offset has a stable value, e.g. within approximately ±10% of measured value.

For detailed information, see the Rexroth IndraDrive MPx-17 (or later) Functions Applications Manual sections “Commutation Setting” and “Sine-Wave Method”.
20 Enable Drive Power

20.1 Enable drive power

20.1.1 Steps for enabling drive power:
1. In the Explorer tree, select Easy Startup Mode.
2. Press the Enable button to put drive in “Drive Enable” state (AF).
3. After thoroughly reading the warning message and safety instructions, press the OK button.
4. Drive enabled (AF), with (a) Drive OFF button is selectable; (b) floating Drive OFF button appears.
21 Verify Commutation Offset

21.1 Verify commutation offset with digital Hall or without Hall sensor

21.1.1 Steps for verifying commutation offset with digital Hall or without Hall sensor:
1. If not already, start Easy Startup Mode and enable power.
2. Select Cmd value input.
3. Select Torque input.
4. Enter a safe torque/force command value, suggest start from low to high, for following cases:
   • Value = 10-30%, for zero to light payload on carriage
   • Value = 20-50%, for medium to heavy payload on carriage
5. Press the ± arrow keys to command negative/positive current control movement of the axis.

**ATTENTION:**
Prior to this command, the axis position must allow UNRESTRICTED MOVEMENT!

**WARNING:** Stay clear, axis will MOVE!

6. If axis moves smoothly in the expected direction, then the commutation offset has been verified*. If not, then repeat Determine Commutation Offset procedure (see flowchart).

**NOTE:** Verified* = this is a practical field method using current loop control only, i.e. without influence of the velocity and position loop controllers. Depending on the application, further commutation offset optimization may be required. For further details, please see the Rexroth IndraDrive MPx-17 (or later) Functions Applications Manual sections “Commutation Setting” and “Sine-Wave Method".
22 Home Axis

22.1 Drive controlled homing

22.1.1 Steps for homing access:
1. In the Explorer tree, select Data Reference Motor Encoder.
2. Press the Drive Controlled Homing button (drive must be in AF for this step).
3. If homing successful, Motor encoder and System in reference LEDs are green.

**WARNING!** If none of the Evaluation methods (reference mark, switch, stop) are selected, the axis references without homing motion. After execution of the homing command, the current physical position of the axis is set to the user specified Reference distance in step 2. Therefore, on subsequent homing commands, the axis reference may differ depending on where the axis is physically “resting” at the time.
23 Stop Initial Commissioning Mode

23.1 Stop initial commissioning mode with digital Hall or without Hall sensor

23.1.1 Steps for stopping initial commissioning mode with digital Hall or without Hall sensor:

1. In the Explorer tree, select Commutation Settings.
2. Uncheck box Initial commissioning mode
   - If using a digital Hall sensor:
     • After the initial commutation/homing procedure, the commutation offset (P-0-0508) is stored in the IndraDrive Cs. Therefore, on subsequent drive power cycles and/or PM→OM state changes, the CKL is operational with full force after homing to the same reference point used in the initial commissioning homing. If no homing command is performed the CKL is operational with a reduced force (see Firmware help for parameter P-0-0509 Commutation offset coarse). Re-determining the commutation offset is only necessary after mechanically servicing the linear motor, encoder, or Hall sensor.
   - If not using a Hall sensor:
     • The commutation offset is not stored in the IndraDrive Cs. Therefore, on subsequent drive power cycles and/or PM→OM state changes, after drive power is enabled, the drive immediately determines the commutation offset using the stored Amplitude and Frequency test signal parameters, i.e. drive performs axis moving Sine-Wave Method.
3. Verify Commutation status word (parameter P-0-0519) by the Parameter editor, enter “p519” in the IDN field. In the value field, Bit1 (the 2nd digit from right-side LSB) value should be 1 = Active, correction value was determined, full 100% capacity according to initial commissioning!
4. If parameter P-0-0519 Bit1=0, re-determine the commutation offset (see flowchart).

For detailed information, see the Rexroth IndraDrive MPx-17 (or later) Functions Applications Manual sections “Commutation Setting” and “Sine-Wave Method”. 
24 Save/Backup Parameters

24.1 Save/backup parameters to PC

24.1.1 Steps for saving parameters:
1. If not done already, press the Drive OFF button to disable drive power for safety
2. Select the Parameterization pull-down menu, then select Save
3. Follow Save instructions
25 Move Axis

25.1 Move axis test with jogging or motion profile

25.1.1 Steps for moving axis:

**Jogging (top)**
1. Select Easy Startup Mode.
2. Enter Jogging mode and ± velocity.
3. Press the Jog ± button.

**Motion Profile (bottom)**
1. Select Command Value Box.
2. Select Reversing, position-controlled.
3. Enter command value inputs.
4. Press the Start button.
26 Optimize Control Loops

26.1 Optimize control loops for a specific application

Basic motor and CKL system control loop parameters are described in this document for initial startup.

When the application specifications (load, motion profile, etc) are known, further control loop tuning might be required. Two methods are possible with IndraWorks, manual and automatic methods. A suggestion would be to perform automatic for initial tuning and manual for fine-tuning. Be advised, due to the cascading structure of the control loops, for manual tuning start with the inner most loop and work your way outward, i.e. current loop → velocity loop → position loop. The current loop is already optimized for the linear motor; therefore, current loop tuning is typically not required. However, adjusting the PWM Switching Frequency (parameter P-0-0001 in Motor Control → Current Control screen) may be desirable for some applications, e.g. lower noise generation. If making this or any other motor current control adjustments, please consult IndraDrive Firmware help.

24.1.1 Steps for optimizing CKL system velocity/position control loops (repeat as necessary):

<table>
<thead>
<tr>
<th>No.</th>
<th>Function</th>
<th>Purpose</th>
<th>Automatic Method</th>
<th>Manual Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Easy Startup Mode</td>
<td>Enable power</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2</td>
<td>Automatic Setting of Axis Control</td>
<td>Automatic tuning</td>
<td>YES</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>Command Value Box</td>
<td>Start velocity/position move</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>4</td>
<td>Axis Control functions</td>
<td>Adjust control loop parameters</td>
<td>N/A</td>
<td>YES</td>
</tr>
<tr>
<td>5</td>
<td>IndraWorks Oscilloscope</td>
<td>Analyze transient performance</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>6</td>
<td>Frequency Response Analysis</td>
<td>Analyze control loop stability</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>7</td>
<td>Save Parameters</td>
<td>Save optimized parameters</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

For detailed functional descriptions and instructions, please see IndraDrive Firmware help.
Notes
The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.