CANopen
User manual v1.1
Preface

Dear User,

We are delighted that you have chosen a product from LINAK®. LINAK systems are high-tech products based on many years of experience in the manufacture and development of actuators, electric control boxes, controls, and chargers.

This user manual does not address the end-user, but is intended as a source of information for the manufacturer of the equipment or system only, and it will tell you how to install, use and maintain your LINAK electronics. It is the responsibility of the manufacturer of the end-use product to provide a User Manual where relevant safety information from this manual is passed on to the end-user.

We are confident that your LINAK product/system will give you many years of hassle-free operation. Before our products leave the factory they undergo full function and quality testing. If you should experience any problem with your LINAK product/system please contact your local supplier. LINAK subsidiaries and some distributors have authorised service centres, which are always ready to help you.

LINAK provides warranty on all LINAK products. The warranty, however, is subject to correct use in accordance with the specifications, maintenance being done correctly and any repairs being carried out at a service centre, which is authorised to repair LINAK products.
Changes in installation and use of LINAK products/systems can affect their operation and durability. The products are not to be opened by unauthorised personnel.

This User Manual has been written based on our present technical knowledge. We are constantly striving to update both our products and the associated information we therefore reserve the right to carry out technical modifications without prior notice.

This user manual refers to the CANopen software version: SW01050007V3-1

LINAK A/S
LINAK® application policy

The purpose of the application policy is to define areas of responsibilities in relation to applying a LINAK product defined as hardware, software, technical advice, etc. related to an existing or a new customer application.

LINAK products as defined above are applicable for a wide range of applications within Medical, Furniture, Desk, and Industry areas. Yet, LINAK cannot know all the conditions under which LINAK products will be installed, used, and operated, as each individual application is unique.

The suitability and functionality of the LINAK product and its performance under varying conditions (application, vibration, load, humidity, temperature, frequency, etc.) can only be verified by testing, and shall ultimately be the responsibility of the LINAK customer using any LINAK product.

LINAK shall be responsible solely that LINAK products comply with the specifications set out by LINAK and it shall be the responsibility of the LINAK customer to ensure that the specific LINAK product can be used for the application in question.
About LINAK® CAN bus actuators

Summary

This document describes the capabilities of LINAK TECHLINE® CANopen components and the requirements for controlling these. It specifies the technologies involved, the environmental data specification and the functional description.

LINAK TECHLINE CANopen actuators are primarily designed with focus on industrial automation.

The communication protocol relies on the CiA 301 standard. The contents of this document assume that the reader is familiar with the CiA 301 standard.

In addition to full position control, the CANopen actuator can provide feedback information about the piston position, service data and full diagnostics. It also provides system identification data and actual current at runtime.
Functional overview

The LINAK® TECHLINE® CANopen offers a communication profile defined in CiA DS 301 V 4.0.2. This includes a command set for controlling the actuator in addition to feedback status.

- Process Data Objects PDO
- Service Data Objects SDO
- Objects with special functions for synchronization, error alert and response.
  - Synchronization object (SYNC)
  - Emergency object (EMCY)
- Network Management Objects (NMT) for initialization, error monitoring and status monitoring of the device.
  - NMT commands
  - Boot-up messages
  - Heartbeat messages
Command details

Run in/out
In and out movement is performed by sending the proper identifier while the actuator is in CANopen mode. In Service mode, movement is achieved by using the LINAK® BusLink PC software or by applying the proper signals to the Manual run wires. Using manual run, a start-up delay of up to 150 ms must be expected due to safety measures.

Position
Max/min. position: Stroke length
Level setting steps: 0.1 mm

Load, ramping up and down and specific actuator type (spindle/gear box) should be taken into account in regard to accuracy.
The Position SetPoint can be set dynamically.
If the new SetPoint involves a change in running direction, the ramps will follow the pre-set ramp time.

Maximum current in/out
Applying a current limit will induce a degree of mechanical overload protection to the installation.

Max. current limit: Fixed limit*
Level setting steps: 0.25 A

*The custom current limit setting cannot overrule the fixed factory setting which insures partially protection of the electronics and mechanics. See “Internal monitoring” on page 16 for details.
Speed control
The speed is controlled using Pulse Width Modulation (PWM).

Min. duty cycle: 0 %
Max. duty cycle: 100 %
Level setting steps: 0.5 %

Closed loop speed control will ensure a more accurate speed. In order to obtain this, the maximum speed is reduced to approximately 80%. The actual speed will be influenced by the gear and spindle size in the actuator. The speed setting can be changed dynamically at run time.

Figure 1. Speed control Graphics
Running conditions

In order to run the actuator please take the following into account.

- If the Heartbeat is not present the actuator will not accept any PDO commands.
- Commands must be resend if communication is interrupted or the Heartbeat signal is missing.
- RUN IN and RUN OUT commands cannot be issued if errors are present (error code != 0).
- Heartbeat status can be read with status bit 5.
- Upon entering OPERATIONAL actuator requires a STOP or CLEAR ERROR command.

Figure 2. Running conditions
Starting procedures

Follow the example below to complete the startup procedures necessary for successful communication.

<table>
<thead>
<tr>
<th>CAN ID (hex)</th>
<th>Data (hex)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>701</td>
<td>05</td>
<td>Master Heartbeat. Sent every 100ms</td>
</tr>
<tr>
<td>720</td>
<td>00</td>
<td>Actuator boot-up</td>
</tr>
<tr>
<td>620</td>
<td>23 16 10 01 C8 00 01 00</td>
<td>Configure actuator as heartbeat consumer with 200ms heartbeat time</td>
</tr>
<tr>
<td>5A0</td>
<td>60 16 10 01 00 00 00 00</td>
<td>Actuator response</td>
</tr>
<tr>
<td>000</td>
<td>01 20</td>
<td></td>
</tr>
<tr>
<td>1A0</td>
<td>00 00 00 C1 01 00 00 C0</td>
<td>TPDO1</td>
</tr>
<tr>
<td>220</td>
<td>03 FB FB FB FB FB 00 00</td>
<td>Stop command</td>
</tr>
<tr>
<td>1A0</td>
<td>00 00 00 C1 00 00 00 C0</td>
<td>TPDO1. Need STOP Command cleared</td>
</tr>
<tr>
<td>220</td>
<td>01 FB FB FB FB FB 00 00</td>
<td>Run out command</td>
</tr>
<tr>
<td>1A0</td>
<td>A1 00 06 C8 00 31 00 C0</td>
<td>TPDO1. Actuator is running out</td>
</tr>
<tr>
<td>1A0</td>
<td>F7 01 00 C2 00 00 00 C0</td>
<td>TPDO1. Actuator reached EOS out</td>
</tr>
<tr>
<td>220</td>
<td>02 FB FB FB FB FB 00 00</td>
<td>Run in command</td>
</tr>
<tr>
<td>1A0</td>
<td>60 00 06 D0 00 32 00 C0</td>
<td>TPDO1. Actuator is running in</td>
</tr>
<tr>
<td>1A0</td>
<td>00 00 00 C1 00 00 00 C0</td>
<td>TPDO1. Actuator reached EOS in</td>
</tr>
</tbody>
</table>

Master
Actuator

Figure 3. Starting procedures
# Process Data Objects (PDO)

RPDO1 is mapped to 0x2000  
TPDO1 is mapped to 0x2001  

## Command details

<table>
<thead>
<tr>
<th>Index</th>
<th>Subindex</th>
<th>Command</th>
<th>Data type</th>
<th>Details</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxml2000</td>
<td>1</td>
<td>Position</td>
<td>UINT16</td>
<td>0-64255</td>
<td>Run to position</td>
<td>0.1 mm/bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64256</td>
<td>Clear ErrorCode register (see 0x1001)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64257</td>
<td>Command run actuator out</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64258</td>
<td>Command run actuator in</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64259</td>
<td>Command stop actuator*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64260</td>
<td>Command run to actuator out, Recovery mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64261</td>
<td>Command run to actuator in, Recovery mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64262-65535</td>
<td>Invalid value, actuator will not run</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Current</td>
<td>UINT8</td>
<td>0-250</td>
<td>Maximum current limit</td>
<td>0.25 A/bit</td>
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<td></td>
<td></td>
<td></td>
<td>251</td>
<td>Use default current value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>252-255</td>
<td>Invalid value, actuator will not run</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Speed</td>
<td>UINT8</td>
<td>0-200</td>
<td>Speed to use</td>
<td>0.5%/bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>201-250</td>
<td>Use 100% speed</td>
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<td></td>
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<td></td>
<td></td>
<td>251</td>
<td>Actuator default speed value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>252-255</td>
<td>Invalid value, actuator will not run</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Soft start</td>
<td>UINT8</td>
<td>0-250</td>
<td>Start ramping time (ms)</td>
<td>0.05 s/bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>251</td>
<td>Use default soft start value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>252-255</td>
<td>Invalid value, actuator will not run</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Soft stop</td>
<td>UINT8</td>
<td>0-250</td>
<td>Stop ramping time (ms)</td>
<td>0.05s/bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>251</td>
<td>Use default soft stop value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>252-255</td>
<td>Invalid value, actuator will not run</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Command details.
## Feedback status details

<table>
<thead>
<tr>
<th>Index</th>
<th>Subindex</th>
<th>Command</th>
<th>Data type</th>
<th>Details</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Position</td>
<td>UINT16</td>
<td>0-64255</td>
<td>Position of actuator piston</td>
<td>0.1 mm/bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>64256-65023</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65024</td>
<td>Position lost</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>65025-65535</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Current</td>
<td>UINT8</td>
<td>0</td>
<td>Not running</td>
<td>0.25 A/bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1-250</td>
<td>Measured motor current</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>251-253</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>254</td>
<td>Fault in current measurement circuit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>255</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Status flags</td>
<td>UINT8</td>
<td>b0</td>
<td>EOS in</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b1</td>
<td>EOS out</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>b2</td>
<td>Over current</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b3</td>
<td>Running out</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b4</td>
<td>Running in</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b5</td>
<td>CANopen heartbeat needed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b6-b7</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Error codes</td>
<td>UINT8</td>
<td>0</td>
<td>No error</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>Need stop command</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Hall error</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Over voltage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>Under voltage</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>Failed to maintain heartbeat</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>EOS error</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>Temperature error</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
<td>Heart beat error (internal)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Speed</td>
<td>UINT8</td>
<td>0-4015</td>
<td>Speed of actuator piston</td>
<td>0.1 mm/s/bit</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>4016-65535</td>
<td>Reserved</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Input state</td>
<td>UINT8</td>
<td>b0-b1</td>
<td>Input 1 level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b2-b3</td>
<td>Input 2 level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b4-b5</td>
<td>Input 3 level</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>b6-b7</td>
<td>Reserved (always 1)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Feedback status details.
## Service Data Objects (SDO)

<table>
<thead>
<tr>
<th>Index</th>
<th>Subindex</th>
<th>Data type</th>
<th>Access</th>
<th>Name</th>
<th>Details</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x1000</td>
<td></td>
<td></td>
<td></td>
<td>Device type</td>
<td>see CiA 301 7.5.2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x1001</td>
<td></td>
<td></td>
<td></td>
<td>Error register</td>
<td>see CiA 301 7.5.2.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0x1005</td>
<td></td>
<td></td>
<td></td>
<td>CO B- IDSYNC</td>
<td>see CiA 301 7.5.2.5</td>
<td></td>
<td>Default value is used (0x80)</td>
</tr>
<tr>
<td>0x1009</td>
<td></td>
<td></td>
<td></td>
<td>Manufacturer hardware version</td>
<td>see CiA 301 7.5.2.9</td>
<td></td>
<td>PCBA name</td>
</tr>
<tr>
<td>0x1014</td>
<td></td>
<td></td>
<td></td>
<td>CO B- IDEMCY</td>
<td>see CiA3017.5.2.17</td>
<td></td>
<td>Default value is used (0x80 + Node-ID)</td>
</tr>
<tr>
<td>0x1015</td>
<td></td>
<td></td>
<td></td>
<td>Inhibit time EMCY</td>
<td>see CiA 301 7.5.2.18</td>
<td></td>
<td>Default value is used (0)</td>
</tr>
<tr>
<td>0x1016</td>
<td></td>
<td></td>
<td></td>
<td>Consumer heartbeat time</td>
<td>see CiA 301 7.5.2.19</td>
<td></td>
<td>Only one consumer heartbeat at time is supported</td>
</tr>
<tr>
<td>0x1017</td>
<td></td>
<td></td>
<td></td>
<td>Producer heartbeat time</td>
<td>see CiA 301 7.5.2.20</td>
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<td>0x1018</td>
<td></td>
<td></td>
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<td>Identity object</td>
<td>see CiA 301 7.5.2.21</td>
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<td>0x1200</td>
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<td></td>
<td></td>
<td>SDO server parameter</td>
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</tr>
<tr>
<td>1</td>
<td></td>
<td>UINT32</td>
<td>R</td>
<td>Vendor ID</td>
<td>0x000004AA</td>
<td>LINAK</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>UINT32</td>
<td>R</td>
<td>Producer code</td>
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<td>UINT32</td>
<td>R</td>
<td>Revision number</td>
<td></td>
<td>CANopen interface revision</td>
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<td></td>
<td>UINT32</td>
<td>R</td>
<td>Serial number</td>
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<td>Same as UIN</td>
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<tr>
<td>0x1400</td>
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<td></td>
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<td>RPDO communication parameter</td>
<td>see CiA 301 7.5.2 35</td>
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</tr>
<tr>
<td>1</td>
<td></td>
<td>UINT32</td>
<td>R</td>
<td>RPDO communication parameter</td>
<td></td>
<td>Default value is used (0x200 + Node-ID)</td>
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</tr>
<tr>
<td>2</td>
<td></td>
<td>UINT8</td>
<td></td>
<td>Transmission Character</td>
<td></td>
<td>event-driven (manufacturer-specific)</td>
<td></td>
</tr>
<tr>
<td>0x1600</td>
<td></td>
<td></td>
<td></td>
<td>RPDO mapping parameter</td>
<td>see CiA 301 7.5.2 36</td>
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<td>1 to 1 mapping of 0x2000 (Actuator Command)</td>
</tr>
<tr>
<td>0x1800</td>
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<td></td>
<td></td>
<td>TPDO communication parameter</td>
<td>see CiA 301 7.5.2 37</td>
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<td>Default value is used (0x180+ Node-ID)</td>
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<tr>
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<td>UINT32</td>
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<td>TPDO mapping parameter</td>
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<td>1 to 1 mapping of 0x2001 (Actuator Status)</td>
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<td></td>
<td>UINT8</td>
<td></td>
<td>Transmission Character</td>
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<td>event-driven (manufacturer-specific)</td>
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<td>5</td>
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<td>UINT16</td>
<td></td>
<td>Event timer</td>
<td>250</td>
<td>1ms/bit</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Service Data Objects.
<table>
<thead>
<tr>
<th>Index</th>
<th>Subindex</th>
<th>Data type</th>
<th>Access</th>
<th>Name</th>
<th>Details</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Highest sub-index supported</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>UINT8</td>
<td>RW</td>
<td></td>
<td>Current limit out</td>
<td>0.25A/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>UINT8</td>
<td>RW</td>
<td></td>
<td>Current limit in</td>
<td>0.25A/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>UINT16</td>
<td>RW</td>
<td></td>
<td>Soft start time out</td>
<td>1ms/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>UINT16</td>
<td>RW</td>
<td></td>
<td>Soft start time in</td>
<td>1ms/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>UINT16</td>
<td>RW</td>
<td></td>
<td>Soft stop time out</td>
<td>1ms/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>UINT16</td>
<td>RW</td>
<td></td>
<td>Soft stop in</td>
<td>1ms/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>UINT8</td>
<td>RW</td>
<td></td>
<td>Maximum speed</td>
<td>0-200 201-255</td>
<td>0.5%/bit</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>UINT16</td>
<td>RW</td>
<td></td>
<td>Virtual EOS out position</td>
<td>0.1mm/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>UINT16</td>
<td>RW</td>
<td></td>
<td>Virtual EOS in position</td>
<td>0.1mm/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>UIN</td>
<td>8 number format</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>SW variant [x]</td>
<td></td>
<td></td>
<td>Software number (e.g. 105000)</td>
</tr>
<tr>
<td>12</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>SW version Major [y]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>SW version Minor [z]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>Config production order number</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>Production date</td>
<td>yyyyymmdd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Maximum current seen</td>
<td>0.25A/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Maximum FET temperature seen</td>
<td>1 °C/bit-40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>Maximum ambient temperature seen</td>
<td>1 °C/bit-40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Minimum ambient temperature seen</td>
<td>1 °C/bit-40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>Current usage</td>
<td>1As/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>UINT32</td>
<td>R</td>
<td></td>
<td>Runtime</td>
<td>1s/bit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Number of stops due to overvoltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Number of stops due to FET over temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Number of stops due to ambient over temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Number of stops due to low voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>UINT</td>
<td>R</td>
<td></td>
<td>Number of stops due to hall errors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Number of stops due to EOS switch errors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>LINAK current overload out stops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>LINAK current overload in stops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Resettable Custom current overload out stops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>UINT8</td>
<td>R</td>
<td></td>
<td>Resettable Custom current overload in stops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>UINT16</td>
<td>R</td>
<td>Communication errors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>UINT16</td>
<td>R</td>
<td>Number of EOS out</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>UINT16</td>
<td>R</td>
<td>Number of EOS in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>UINT32</td>
<td>R</td>
<td>Number of starts out</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>UINT32</td>
<td>R</td>
<td>Number of starts in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>UINT32</td>
<td>R</td>
<td>Total piston distance</td>
<td>1m/bit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>UINT16</td>
<td>R</td>
<td>Last stop reason id 0</td>
<td>Stop reason id</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>UINT8</td>
<td>R</td>
<td>Last stop count id 0</td>
<td>Number of consecutive stop reasons of the same type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>UINT32</td>
<td>R</td>
<td>Last stop powered time id 0</td>
<td>Powered time when the last stop occured</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>UINT16</td>
<td>R</td>
<td>Last stop reason id 1</td>
<td>Stop reason id</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>UINT8</td>
<td>R</td>
<td>Last stop count id 1</td>
<td>Number of consecutive stop reasons of the same type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>UINT32</td>
<td>R</td>
<td>Last stop powered time id 1</td>
<td>Powered time when the last stop occurred</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>UINT16</td>
<td>R</td>
<td>Last stop reason id 2</td>
<td>Stop reason id</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>UINT8</td>
<td>R</td>
<td>Last stop count id 2</td>
<td>Number of consecutive stop reasons of the same type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>UINT32</td>
<td>R</td>
<td>Last stop powered time id 2</td>
<td>Powered time when the last stop occurred</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>UINT16</td>
<td>R</td>
<td>Last stop reason id 3</td>
<td>Stop reason id</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>UINT8</td>
<td>R</td>
<td>Last stop count id 3</td>
<td>Number of consecutive stop reasons of the same type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>UINT32</td>
<td>R</td>
<td>Last stop powered time id 3</td>
<td>Powered time when the last stop occurred</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>UINT16</td>
<td>R</td>
<td>Last stop reason id 4</td>
<td>Stop reason id</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>UINT8</td>
<td>R</td>
<td>Last stop count id 4</td>
<td>Number of consecutive stop reasons of the same type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>UINT32</td>
<td>R</td>
<td>Last stop powered time id 4</td>
<td>Powered time when the last stop occurred</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>UINT32</td>
<td>R</td>
<td>Total corrected distance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Service Data Objects.
Internal monitoring

A number of parameters are monitored during operation to prevent overloading the electronics and to minimise the risk of mechanical damage.

Current limits and measurements
The principle behind the current measurement is an ‘above limit’ and ‘below limit’ accumulating counter. When the Timeout counter reaches a specific value the current cut-off goes into effect. The timeout value is pre-set at 200 to 500ms depending on actuator type.

![Diagram showing current limit principle](image)

Figure 3. Dynamic current limit principle.

In case of current limit activation (Timeout counter max is reached), the actuator will stop and an over current error is triggered. The error is cleared when the actuator is activated in the opposite direction or by issuing a Clear error command.

Custom over current limit can only be lower than or equal to the fixed factory setting.
Voltage
The supply voltage level is monitored in order to maintain a safe operation and to protect the circuitry.

Temperature
Two temperature monitoring circuits are in place to measure the absolute temperature of the board and the centre temperature of the H-bridge.

H-bridge
The H-bridge conditions are monitored at all times. Several conditions are required in order to run. Among these are:

- Correct voltage supplies
- Heartbeat safety signal
- Correct temperatures
- No errors

Parameters
In addition to the immediate monitoring, a number of parameters are saved for long-term evaluation. These include:

- Number of starts in either direction
- Reason for last stop
- Total running time
- Under and over voltage
- Maximum current
- Number of current overloads in either direction

These parameters will help the engineer sort out existing issues. Considering a combination of parameter values, the lifetime load can indicate a potential failure before it happens and thereby prevent downtime.
Environmental data and tests

The CAN bus actuators fulfil the environmental requirements as defined:

Operational environment
Ambient temperature: -30°C to 65°C (full performance only from +5°C to 40°C)
Relative humidity: 30% to 80% @ 30°C
Pressure: 700hPa to 1060hPa

Storage environment
Ambient temperature: -55°C to 105°C
Relative humidity: 30% to 80% @ 30°C
Pressure: 700hPa to 1060hPa

Supply voltage
The actuator will be available in two supply voltage ranges, 12 VDC, 24 VDC, and 48 VDC. The accepted supply voltage range is specified according to ISO16750-2012.

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>V_MIN</th>
<th>V_TYP</th>
<th>V_MAX</th>
<th>Reference</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 V</td>
<td>10.5 V</td>
<td>12 V</td>
<td>16 V</td>
<td>ISO 16750-2:2012 - Code D</td>
<td>Motor running</td>
</tr>
<tr>
<td></td>
<td>6 V</td>
<td>12 V</td>
<td>39 V</td>
<td>ISO 16750-2:2012 - Code A</td>
<td>Motor not running CAN communication possible</td>
</tr>
</tbody>
</table>

Table 4. Voltage supply levels.

Power loss
In case of power loss, the actuator position and other important data is saved by the on-board microcontroller.

Over voltage
If the voltage rises above the set limit, the system will enter overvoltage protection mode and shut down.
The Electromagnetic Compatibility tests performed on the LINAK® CANopen actuator comply with the TECHLINE® Electrical Test Specification. The scope of tests is verified and accredited by DELTA A/S test laboratory.

<table>
<thead>
<tr>
<th>Norm/Standard</th>
<th>Test description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 16750-2:2012</td>
<td>Supply voltage range</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Overvoltage</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Superimposed alternating voltage</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Slow lowering and raising the voltage supply</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Momentary drop in supply voltage</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Reset behaviour for voltage drop</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Reversed voltage</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Ground reference and supply offset</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Open circuit test</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Short circuit protection</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Load dump – Test pulse 5a</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Load dump test pulse 5b</td>
</tr>
<tr>
<td>ISO 7637-2:2011</td>
<td>Test pulse 1</td>
</tr>
<tr>
<td>ISO 7637-2:2011</td>
<td>Test pulse 2a</td>
</tr>
<tr>
<td>ISO 7637-2:2011</td>
<td>Test pulse 2b</td>
</tr>
<tr>
<td>ISO 7637-2:2011</td>
<td>Test pulse 3a</td>
</tr>
<tr>
<td>ISO 7637-2:2011</td>
<td>Test pulse 3b</td>
</tr>
<tr>
<td>ISO 16750-2:2012</td>
<td>Test pulse 4</td>
</tr>
<tr>
<td>ISO 7637-2:2011</td>
<td>Voltage transient emission test on power supply lines</td>
</tr>
<tr>
<td>ISO 7637-3:2007</td>
<td>Electric transient transmission by cap. and inductive coupling</td>
</tr>
<tr>
<td>CISPR 25 IEC:2008</td>
<td>Conducted disturbance voltage measurement</td>
</tr>
<tr>
<td>CISPR 16-1-2:2010</td>
<td>Conducted emission</td>
</tr>
<tr>
<td>CISPR 16-2-3:2010</td>
<td>Radiated emission</td>
</tr>
<tr>
<td>ISO 10605 2nd Ed.</td>
<td>ESD immunity</td>
</tr>
<tr>
<td>IEC 61000-4-2 2nd Ed.</td>
<td>ESD immunity</td>
</tr>
<tr>
<td>IEC 61000-4-3:2006</td>
<td>Interference fields immunity test</td>
</tr>
<tr>
<td>IEC 61000-4-8:2010</td>
<td>Power frequency magnetic field</td>
</tr>
<tr>
<td>IEC 61000-4-4:2004</td>
<td>Burst transients</td>
</tr>
<tr>
<td>IEC 61000-4-5:2006</td>
<td>Surge transients</td>
</tr>
</tbody>
</table>

Table 5. LINAK TECHLINE EMC test overview.
BusLink service interface

The BusLink service interface offers a wide range of settings and status feedback options. Use the LINAK® USB2LIN cable and the LINAK BusLink PC software will gain access to:

**BusLink settings**

- Initialisation
- Current limit settings
- Soft start/stop timing

**BusLink feedback**

- Run time parameters
- Number of starts and stops
- Maximum current and temperature
- Error messages

The actuator can also be run manually using BusLink control interface. During normal CAN operation, BusLink manual run is disabled. The service interface is only intended to run with the BusLink PC software tool.

See the **BusLink Quick Guide** for details on how to connect to the specific actuator model.

The USB2LIN service cable and adapter cable suitable for CAN actuators can be ordered as:

USB2LIN adapter               USB2LIN06
LA14CAN/ LA25CAN Adapter     0965205-A
LA33CAN/ LA36CAN/ LA37Can Adapter  0968011-A
Installing LINAK® CANopen actuators

Introduction

This section will assist you in the installation of the LINAK CANopen actuator. Going through parameters and procedures necessary for a successful implementation.

- Connections
- Electrical installation
- Communication

Connections

The tables below define the wire connections to the LINAK TECLINE CANopen actuators. The colours are consistent with all LINAK TECLINE CANopen actuators. The pinning definition provided by CiA 303-1 for mini-fit connector do not comply with the definition below.

**Single connector actuators**

Power connector, 8-pin mini-fit connector

<table>
<thead>
<tr>
<th>LINAK cable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>+ Power supply (12/24/48VDC)</td>
</tr>
<tr>
<td>Blue</td>
<td>- Power supply (GND)</td>
</tr>
<tr>
<td>Black</td>
<td>Manual run in</td>
</tr>
<tr>
<td>Red</td>
<td>Manual run out</td>
</tr>
<tr>
<td>White</td>
<td>Service interface GND</td>
</tr>
<tr>
<td>Purple</td>
<td>Service interface DATA</td>
</tr>
<tr>
<td>Yellow</td>
<td>CAN H</td>
</tr>
<tr>
<td>Green</td>
<td>CAN L</td>
</tr>
</tbody>
</table>

Table 6. Power and communication wire colour.

By default, cables are supplied with flying leads.

**Dual connector actuators**

Power connector, 6-pin mini-fit connector

<table>
<thead>
<tr>
<th>LINAK cable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>+ Power supply (12/24/48VDC)</td>
</tr>
<tr>
<td>Blue</td>
<td>- Power supply (GND)</td>
</tr>
</tbody>
</table>

Table 7. Power wire colours.

Communication connector, 6-pin micro-fit connector

<table>
<thead>
<tr>
<th>LINAK cable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Manual run in</td>
</tr>
<tr>
<td>Red</td>
<td>Manual run out</td>
</tr>
<tr>
<td>White</td>
<td>Service interface GND</td>
</tr>
<tr>
<td>Purple</td>
<td>Service interface</td>
</tr>
<tr>
<td>Yellow</td>
<td>CAN H</td>
</tr>
<tr>
<td>Green</td>
<td>CAN L</td>
</tr>
</tbody>
</table>

Table 8. Communication wire colours.
**Electrical installation**

**Physical specifications**

LINAK CANopen actuators provide a physical layer according to ISO 11898-2.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>250 kbps</td>
</tr>
<tr>
<td>Max bus length</td>
<td>250 meters</td>
</tr>
<tr>
<td>Max stub length</td>
<td>11 meters</td>
</tr>
<tr>
<td>Accumulated stub length</td>
<td>55 meters</td>
</tr>
<tr>
<td>Max node count</td>
<td>127</td>
</tr>
<tr>
<td>Cable impedance</td>
<td>120 Ω (±10%)</td>
</tr>
</tbody>
</table>

**Power supply**

The power supply for the LINAK CANopen actuator should be kept separate from the CANopen power supply, if such one exists.

![Power supply connection setup.](image)

The power supply for the LINAK® CAN bus actuator should be kept separate from the CAN bus power supply, if such one exists.

**Electronic Datasheet**

An *eds* file can be obtained by contacting Linak. The *eds* file complies with the CiA 306 standard. An XML based *xdd* file format, defined according to CiA311 is also available.
Connection diagram

During the optional manual run mode, the actuator will continue to send status feedback on the CAN bus. However, if other CAN devices are active on the network, manual run mode will be disengaged. The Service interface is also accessible during manual run mode.

Termination

Termination resistors of 120 Ω should be connected according to figure 7. The actuator does not have internal termination.
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