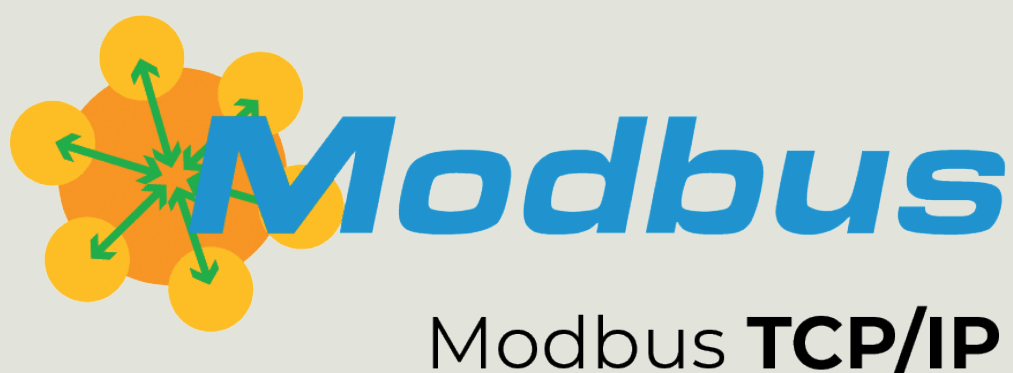


# Modbus TCP/IP User Manual



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## Preface

Dear User,

We are delighted that you have chosen a LINAK® product.

LINAK systems are high-tech products based on many years of experience in the manufacture and development of actuators, lifting columns, desk frames, electric control boxes, controls, batteries, accessories and chargers.

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

We are convinced that your LINAK product/system will give you many years of problem-free operation.

Before our products leave the factory, they undergo both function and quality testing. Should you, nevertheless, experience problems with your product/system, you are always welcome to contact your supplier.

LINAK subsidiaries and some distributors situated all over the world have authorised service centres, which are always ready to help you. Locate your local contact information on the back page.

LINAK provides a warranty on all products. (See warranty section).

This 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 systems can affect their operation and durability. The products may only be opened by authorised personnel.

This User Manual has been written based on the present technical knowledge. LINAK reserves the right to carry out technical modifications and keeps the associated information updated.

**LINAK A/S**

## Terms of use

LINAK® takes great care in providing accurate and up-to-date information on its products. However, the user is responsible for determining the suitability of LINAK products for a specific application.

Due to continual development, LINAK products are subject to frequent modifications and changes. LINAK reserves the rights to conduct modifications, updates, and changes without any prior notice. For the same reason, LINAK cannot guarantee the correctness and actual status of imprinted information on its products.

LINAK uses its best efforts to fulfil orders. However, for the reasons mentioned above, LINAK cannot guarantee availability of any particular product at any given time. LINAK reserves the right to discontinue the sale of any product displayed on its website or listed in its catalogues or in other written material created and produced by LINAK, LINAK subsidiaries, or LINAK affiliates.

All sales are subject to the 'Standard Terms of Sale and Delivery for LINAK A/S' available on LINAK websites.

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## Revision overview

### Edition 3

LA14 and LA25 removed	Page 6
LA33 added	Page 6
Information about separate supplies added	Page 11
Timeframe changed from 500 ms to 2,000 ms	Page 13
'Command examples' section updated	Page 13-15
'Registers' section added	Page 16-20
'Register overview' section removed	

### Edition 2

Item number for cable kit added	Page 6-7
'Manual run' changed to 'Extends actuator' and 'Retracts actuator'	Page 6-8
'Service interface' changed to 'Parallel data'	Page 6-8
'Service interface GND' changed to 'Parallel GND'	Page 6-8
'V DC' added	Page 6-8
Information about separate supplies added	Page 8
'Parallel' section updated	Page 10-11
Power supply table updated	Page 12
'Configuration' updated	Page 12
IP address updated	Page 13
'Run out command' changed to 'Command examples'	Page 14
'Communication sequence...' changed to 'Run the actuator outwards'	Page 14

### Edition 1

New document

## Connection diagram

Applicable for: LA33, LA36, LA37, LA76 and LA77

### Power

**BROWN**

24/48 V DC

**BLUE**

GND



### Control

**1**

Extends the actuator

**2**

Retracts the actuator

**4\***

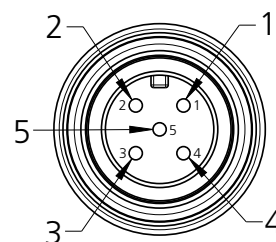
Split power supply V DC

**3**

Parallel data

**5**

Parallel GND



**M12**

### Communication

**1**

ETH\_TX+

**2**

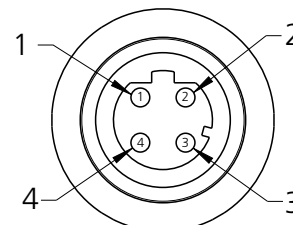
ETH\_RX+

**3**

ETH\_TX-

**4**

ETH\_RX-



**M12**



The physical layer conforms to the IEEE 802.3-2018 standard with communication speeds of 10 Mbps and 100 Mbps, respectively. Cable length is reduced to = 100 m without repeater, as determined by IEEE 802.3-2018.

\* Split power supply and motor supply (Brown), which refer to a common GND (Blue).

This approach is used to maintain power on the intelligent part of the actuator. In case the main supply is disconnected, split power supply allows e.g. that the position is maintained. The main supply may be disconnected for reasons related to safety, maintenance or installation.



**Actuator Connect™ is available for Modbus TCP/IP actuators and can be used for:**

Diagnostics, manual run and configuration. The newest version is available online [here](#).



Connect the actuator to Actuator Connect via a USB adapter cable (must be purchased separately) to enable and configure various features.

Item number for cable kit: 0367996

## Connection diagram

Applicable for: LC3 IC

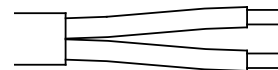
### Power

**BROWN**

24/48 V DC

**BLUE**

GND



### Control

**RED**

Extends the actuator

**BLACK**

Retracts the actuator

**ORANGE\***

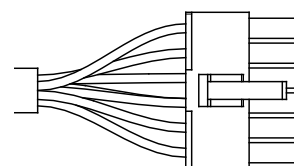
Split power supply V DC

**VIOLET**

Parallel data

**WHITE**

Parallel GND



**Molex mini-fit  
12-pin**

### Communication

**1**

ETH\_TX+

**3**

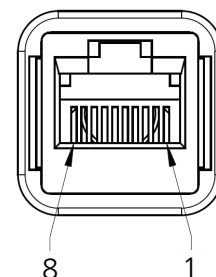
ETH\_RX+

**2**

ETH\_TX-

**6**

ETH\_RX-



**RJ45**



The physical layer conforms to the IEEE 802.3-2018 standard with communication speeds of 10 Mbps and 100 Mbps, respectively. Cable length is reduced to = 100 m without repeater, as determined by IEEE 802.3-2018. The wiring conforms to the T-568A standard.

\* Split power supply and motor supply (Brown), which refer to a common GND (Blue).

This approach is used to maintain power on the intelligent part of the actuator. In case the main supply is disconnected, split power supply allows e.g. that the position is maintained. The main supply may be disconnected for reasons related to safety, maintenance or installation.



**Actuator Connect™ is available for Modbus TCP/IP actuators and can be used for:**


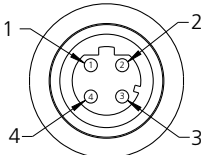
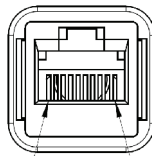
Diagnostics, manual run and configuration. The newest version is available online [here](#).



Connect the actuator to Actuator Connect via a USB adapter cable (must be purchased separately) to enable and configure various features.

Item number for cable kit: 0367996

## I/O specifications

Input/Output	Specification	Comments
Description	The communication protocol conforms to the IEEE 802.3-2018 Ethernet standard with communication speeds of 10 Mbps and 100 Mbps.	<div></div> <div>Modbus <b>TCP/IP</b></div>
Brown	Connect Brown to positive 24/48 V DC	<p>Note:</p> <p>Do not change the power supply polarity on the Brown and Blue wires!</p> <p>Only for powering the motor driver module. Power supply GND is electrically connected to the housing through a capacitor and resistor in parallel.</p>
Blue	Connect Blue to negative GND	
<b>PIN out</b>	<b>Data cable M12 - 5-pin male</b>	
Pin 1	Extends the actuator	<p>The signal becomes active at: <math>V_{IN} &gt; 67\%</math> of V DC</p> <p>The signal becomes inactive at: <math>V_{IN} &lt; 33\%</math> of V DC</p> <p>Input current: 10 mA</p>
Pin 2	Retracts the actuator	
Pin 4	Split power supply V DC	<p>Split power supply:</p> <p>24 V DC with <math>\approx 28</math> mA current consumption.</p> <p>48 V DC with <math>\approx 16</math> mA current consumption.</p> <p>The split power supply uses the common GND from the power supply (Blue).</p> <p>Split power supply is only for powering the communication of the integrated controller.</p>
Pin 3	Parallel data	<p>The Parallel drive function will support up to 8 actuators running simultaneously.</p> <p>It is possible to run Parallel with a main power supply or separate power supplies.</p> <p>It is possible to run Parallel with a main power supply or separate power supplies. If separate supplies are used, they must have the same potential, and the power supply GND (Blue wires) must be connected in the common ground.</p>
Pin 5	Parallel GND	
<b>PIN in</b>	<b>Data cable M12 - 4-pin female</b>	
Pin 1	ETH_TX+	
Pin 2	ETH_RX+	
Pin 3	ETH_TX-	
Pin 4	ETH_RX-	
<b>PIN in</b>	<b>RJ45 (Only for LC3 IC)</b>	
Pin 1	ETH_TX+	
Pin 3	ETH_RX+	
Pin 2	ETH_TX-	
Pin 6	ETH_RX-	



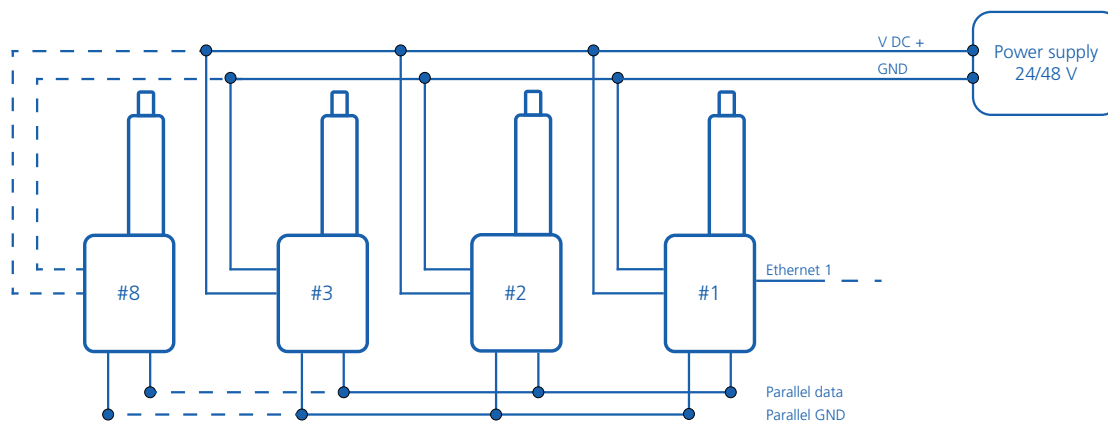
## Parallel

The industrial LINAK® actuators can be ordered with parallel functionality. If this feature is enabled, it is possible to run up to 8 actuators in a parallel system with just one actuator occupying an Ethernet port connection. The system works as a critical parallel, meaning that all actuators must be present in the system and have the exact same configuration (both mechanical and software functionality).

Below is a checklist to ensure that the system operates as intended:

Action	Description
Set up parallel in Actuator Connect™	Each actuator must be configured to operate in parallel (2-8 actuators). This can be set up using the Actuator Connect tool. <i>Please note: In some cases this is pre-configured from factory.</i>
Wire up the system	The actuators feature internal communication for parallel synchronisation and error codes.
Check cable lengths	Keep the total length of the communication line below 40 meters to avoid communication dropouts. In a parallel system with 8 actuators this would result in signal cable lengths of <5 metres.
Check power supply	The system can be designed with either one main power supply or it can be supplied by individual supplies corresponding to the number of actuators in the system. Please respect actuator specifications regarding voltage level and current consumption! Make sure that the power supplies have a common GND and the same potential.

### Option 1 - A simple parallel setup

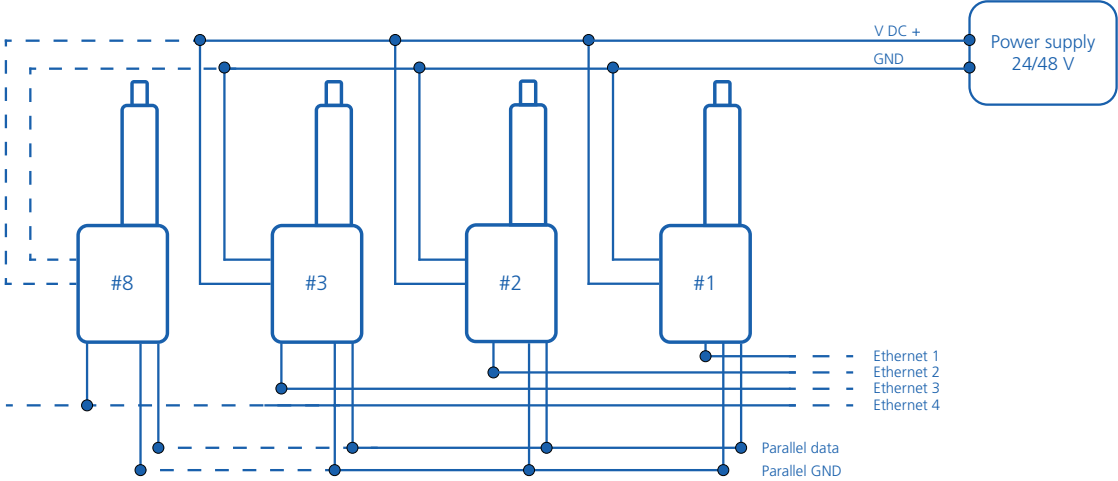


In a simple parallel setup there is only one actuator connected to the network communication. This actuator receives run commands and shares data with the controller. The remaining actuators in the system are only connected to internal parallel communication. This way, the internal communication ensures that the system operates in parallel and stops in case of an obstacle, or when other errors occur on one of the actuators.

The actuators share simple error messages with the master, which can be distributed via the network.

# Parallel

## Option 2 - Bus communication on all actuators



If there is a need for e.g. monitoring the real-time data of each actuator, it is possible to connect all actuators as nodes to the network. This will provide comprehensive usage data, which can be used to enhance performance in the application. Similar to option 1, this requires that all actuators are connected to internal parallel communication.

It is also possible to use two separate power supplies in parallel under the condition that they have the same voltage and wattage output. It is essential that both power supplies share a common ground connection (Blue wire).

## Getting started

This section further describes how to communicate with LINAK® Modbus TCP/IP actuators and contains examples of typical user scenarios and application solutions. All examples include references to registers which are further described in detail below.

### Power supply

Modbus TCP/IP actuators are available with the following supply voltage range: 24 and 48 V DC. The accepted supply voltage range is specified for the version as shown below:

Supply voltage	Function	Voltage range		
		V <sub>IN</sub>	V <sub>TYP</sub>	V <sub>MAX</sub>
24 V	Motor	18 V	24 V	32 V
	Modbus TCP/IP communication	10 V	24 V	39 V
48 V	Motor	36 V	48 V	58 V
	Modbus TCP/IP communication	10 V	48 V	60 V

For more information about wiring/connector, please see the connection diagram.

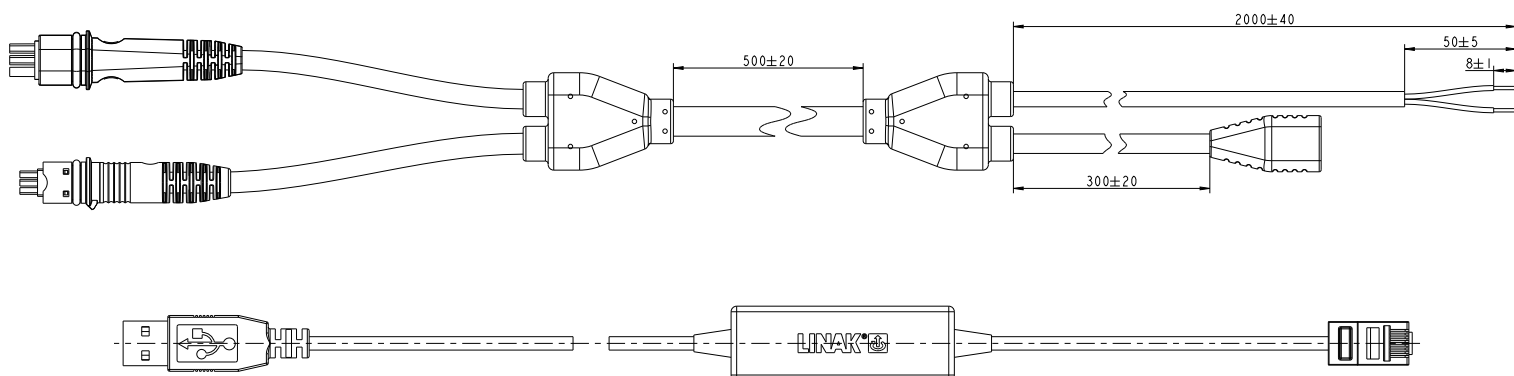
### Configuration

Before being integrated into a Modbus system, a few of the actuator parameters must be checked and eventually changed. This preparation is done via the use of the configuration tool Actuator Connect™ and guarantees that the actuator is able to execute basic functionality.

Further fine-tuning may be required to fulfil system or application requirements. Via this tool it is also possible to access historical usage data and real-time monitoring.

#### Valid for LA33, LA36, LA37, LA76 and LA77:

A separate configuration cable (item no. 0367996) is required to use Actuator Connect on a PC. This cable must be connected to the 6-pin and 9-pin connector on the actuator side. On the opposite side, power must be applied to the flying leads, and the USB connector must be inserted into your PC.



For more information about wiring/connector, please see the connection diagram.

**Parameters to be verified by Actuator Connect™**

Parameters	Description
DHCP	DHCP is a client/server protocol that automatically provides an IP address. <b>If enabled: below parameters are not configurable</b>
IP Address	Set the device IP address to a unique address in the network. 192.168.1.10 (default)
Subnet mask	Set the subnet mask. 255.255.255.0 (default)
Gateway	Set the gateway. 192.168.1.1 (default)

The full Application Data Unit (ADU) used by the Modbus TCP/IP protocol is encapsulated within the data segment of a conventional TCP packet. This packet is then transmitted over the network to the designated system port number 502, a port which is exclusively allocated for Modbus application communications.



Users are strongly advised against configuring their assets directly to the public internet. By taking this precautionary measure, the risk of unauthorized and malicious cyber activities from external threats is significantly reduced.

## Command examples

Before the actuator can engage movement, some general prerequisites must be fulfilled. Timing (e.g. when the actuator is still moving), environmental conditions and errors may indicate that the actuator is in a state where further operation is not possible.

### General run prerequisites

Step	Read/ Write	Register*	Action
1	Write	HR [0x2001] Index 0	<p>“Communication heartbeat counter” must be incremented periodically with the value ranging from 0-255 [0x00-FF]</p> <p>Must be updated in periods no longer than 2,000 ms</p> <p>If not updated within 2,000 ms, the actuator will stop and the “Error code” register will read a value of 5 (Communication sync.)</p>
2	Write	HR [0x2002] Index 1	<p>“Position” must be set to = 64259 [0x FB03] for ‘Stop’</p> <p>To prevent unintended movement, it is required to send a ‘Stop’ command before running the actuator</p>
3	Read	IR [0x2104] Index 3	“Error code” must be = 0 [0x00]
4	Read	IR [0x2103] Index 2	“Status Flags” bit 2 (Overcurrent) must be = 0
5	Read	IR [0x2103] Index 2	“Status Flags” bit 5 (Heartbeat needed) must be = 0
6	Read	IR [0x2103] Index 2	“Status Flags” bit 6 (Actuator is running outside nominal conditions) must be = 0

\* IR = Input Register / HR = Holding Register

## Run the actuator outwards

Step	Read/Write	Register*	Action
1		-	Check that general run prerequisites are fulfilled.
2	Write	HR [0x2003] Index 2	"Current" must be set to a value 0-250 [0x00-FA] = Current limit 0.25 A /bit 251 [0xFB] = Default current limit set via Actuator Connect™ 252-255 [0xFC-FF] = Reserved
3	Write	HR [0x2004] Index 3	"Speed" must be set to a value 0-200 [0x00-FA] = Speed 0.5% /bit 201-250 [0xC9-FA] = 100% speed 251 [0xFB] = Default speed set via Actuator Connect 252-255 [0xFC-FF] = Reserved
4	Write	HR [0x2005] Index 4	"Soft Start" must be set to a value 0-200 [0x00-FA] = Start ramp time 0.05 s /bit 251 [0xFB] = Default speed set via Actuator Connect 252-255 [0xFC-FF] = Reserved
5	Write	HR [0x2006] Index 5	"Soft Stop" must be set to a value 0-200 [0x00-FA] = Stop ramp time 0.05 s /bit 251 [0xFB] = Default speed set via Actuator Connect 252-255 [0xFC-FF] = Reserved
6	Write	HR [0x2002] Index 1	"Position" must be set to = 64257 [0xFB01] for 'Run out'
7**	Read	IR [0x2103] Index 2	"Status Flags" bit 3 and bit 1 change to 1 to indicate that: Bit 3 = Actuator is running out Bit 1 = Endstop reached signal out

\* IR = Input Register / HR = Holding Register

\*\* Optional

## Run the actuator to target position (150 mm)

Step	Read/Write	Register*	Action
1		-	Check that general run prerequisites are fulfilled.
2	Write	HR [0x2003] Index 2	"Current" must be set to a value 0-250 [0x00-FA] = Current limit 0.25 A/bit 251 [0xFB] = Default current limit set via Actuator Connect™ 252-255 [0xFC-FF] = Reserved
3	Write	HR [0x2004] Index 3	"Speed" must be set to a value 0-200 [0x00-FA] = Speed 0.5%/bit 201-250 [0xC9-FA] = 100% speed 251 [0xFB] = Default speed set via Actuator Connect 252-255 [0xFC-FF] = Reserved
4	Write	HR [0x2005] Index 4	"Soft Start" must be set to a value 0-200 [0x00-FA] = Start ramp time 0.05 s/bit 251 [0xFB] = Default speed set via Actuator Connect 252-255 [0xFC-FF] = Reserved
5	Write	HR [0x2006] Index 5	"Soft Stop" must be set to a value 0-200 [0x00-FA] = Stop ramp time 0.05 s/bit 251 [0xFB] = Default speed set via Actuator Connect 252-255 [0xFC-FF] = Reserved
6	Write	HR [0x2002] Index 1	"Position" must be set to = 1500 [0x05DC] for 'Run to Target Position 150 mm'
7**	Read	IR [0x2103] Index 2	"Status Flags" bit 3 or bit 4 change to 1 to indicate that either: Bit 3 = Actuator is running out Bit 4 = Actuator is running in

## Clear error in overcurrent situation

If an overcurrent occurs, the actuator will be stopped and blocked in that direction until an activation in the opposite direction has been made or the system has been re-powered.

Step	Read/Write	Register*	Action
1	Read	IR [0x2103] Index 2	Confirm that "Status Flags" bit 2 is = 1 for 'Overcurrent'
2	Write	HR [0x2003] Index 2	"Position" must be set to run in the opposite direction of the blockage Set to = 64257 [0xFB01] for 'Run out' or Set to = 64258 [0xFB02] for 'Run in'
3**	Read	HR [0x2103] Index 2	"Status Flags" bits change to 1 to indicate that either: Bit 3 = Actuator is running out Bit 4 = Actuator is running in Bit 1 = Endstop reached out Bit 0 = Endstop reached in

\* IR = Input Register / HR = Holding Register

\*\* Optional

## Registers

When controlling the actuator from the Modbus controller, it is important to understand the input and output data. The specific data is described in the tables below.

### Holding Registers

Holding Registers Process data					
0x2006	0x2005	0x2004	0x2003	0x2002	0x2001
Soft Stop	Soft Start	Speed	Current	Position	Heartbeat

Holding Registers 0x2001-2006			Command	Data type	Access	Details	Description	Scaling
Index	[hex]	[dec]						
0	0x2001	8193	Communication Heartbeat counter	UINT8	Read/Write	0-255 [0x00-FF]	Without regular updates, actuator will stop	
1	0x2002	8194	Position	UINT16	Read/Write	0-64255 [0x0000-FAFF]	Run to position	0.1 mm/bit
						64256 [0xFB00]	Clear error codes (see IR 0x2104)	
						64257 [0xFB01]	Run out	
						64258 [0xFB02]	Run in	
						64259 [0xFB03]	Stop	
						64260 [0xFB04]	Recovery run out	
						64261 [0xFB05]	Recovery run in	
						64262- 65535 [0xFB06-FFFF]	Invalid value, actuator will not run	
2	0x2003	8195	Current	UINT8	Read/Write	0-250 [0x00-FA]	Maximum current limit	0.25 A/bit
						251 [0xFB]	Use default current value	
						252-255 [0xFC-FF]	Invalid value, actuator will not run	
3	0x2004	8196	Speed	UINT8	Read/Write	0-200 [0x00-C8]	Speed	0.5%/bit
						201-250 [0xC9-FA]	Use 100% speed	
						251 [0xFB]	Use default speed value	
						252-255 [0xFC-FF]	Invalid value, actuator will not run	



## Holding Registers

Holding Registers 0x2001-2006			Command	Data type	Access	Details	Description	Scaling
Index	[hex]	[dec]						
4	0x2005	8197	Soft Start	UINT8	Read/ Write	0–250 [0x00-FA]	Start ramping time	0.05 s /bit
						251 [0xFB]	Use default soft start value	
						252–255 [0xFC-FF]	Invalid value, actuator will not run	
5	0x2006	8198	Soft Stop	UINT8	Read/ Write	0–250 [0x00-FA]	Stop ramping time	0.05 s /bit
						251 [0xFB]	Use default soft stop value	
						252–255 [0xFC-FF]	Invalid value, actuator will not run	

## Input Registers

Input Registers Process data					
0x2106	0x2105	0x2104	0x2103	0x2102	0x2101
AUX Input	Speed	Error Code	Status Flags	Current	Position

Input Registers 0x2101-2106			Status	Data type	Access	Details	Description	Scaling
Index	[hex]	[dec]						
0	0x2101	8449	Position	UINT16	Read	0–64255 [0x0000-FAFF]	Position of the actuator piston	0.1 mm /bit
						64256– 65023 [0xFB00-FDFF]	Reserved	
						65024 [0xFE00]	Position lost	
						65025– 65535 [0xFE01-FFFF]	Reserved	
1	0x2102	8450	Current	UINT8	Read	0 [0x00]	Not running	0.25 A /bit
						1–250 [0x00-FA]	Measured motor current	
						251–253 [0xFB-FD]	Reserved	
						254 [0xFE]	Fault in current measurement circuit	
						255 [0xFF]	Reserved	

## Input Registers

Input Registers 0x2101-2106			Status	Data type	Access	Details	Description	Scaling
Index	[hex]	[dec]						
2	0x2103	8451	Status Flags	UINT8	Read	b0	Endstop reached in	8-bit independent status indicators
						b1	Endstop reached out	
						b2	Overcurrent	
						b3	Running out	
						b4	Running in	
						b5	Communication heartbeat needed	
						b6	Actuator is running outside nominal conditions	
						b7	Reserved. Always high	
3	0x2104	8452	Error Code	UINT8	Read	0 [0x00]	No error detected	8-bit error code showing the currently active error with the highest priority only
						1 [0x01]	'Run' command overruled	
						2 [0x02]	Position sensor	
						3 [0x03]	Overvoltage	
						4 [0x04]	Undervoltage	
						5 [0x 05]	Communication sync.	
						6 [0x06]	Endstop switch	
						7 [0x07]	Temperature	
						8 [0x08]	Motor controller	

## Input Registers

Input Registers 0x2101-2106			Status	Data type	Access	Details	Description	Scaling
Index	[hex]	[dec]						
3	0x2104	8452	Error Code	UINT8	Read	9 [0x09]	Internal power supply	8-bit error code showing the currently active error with the highest priority only
						10 [0x0A]	Internal current measurement	
						11 [0x0B]	Parallel arbitration	
						12 [0x0C]	Position not changing	
						13 [0x0D]	Position initialisation not possible	
						14 [0x0E]	Alone in parallel system	
						15 [0x0F]	Incorrect number in parallel system	
						254 [0xFE]	Other internal error (Not specified)	
						255 [0xFF]	Other external error (Not specified)	
4	0x2105	8453	Speed	UINT16	Read	0–4015 [0x0000-0FAF]	Speed of actuator piston	0.1 mm/s /bit
						4016–65535 [0x0FB0-FFFF]	Reserved	
5	0x2106	8454	AUX Input	UINT8	Read	b0–b1	Input 1 level	25% VCC /bit
						b2–b3	Input 2 level	
						b4–b5	Reserved	
						b6–b7	Reserved	Always high

## Input Registers (Parallel feedback)

Input Registers Process data Only for Parallel feedback		
0x210A	0x2109	0x2107
Status Flags	Error Group	Error Source

Input Registers 0x2107-210A			Status	Data type	Access	Details	Description	Scaling
Index	[hex]	[dec]						
6	0x2107	8455	Error Source	UINT32	Read	0 [0x00000000]	No error is active on any actuator in parallel system, or error source ID is irrelevant  ("Parallel start-up" error is reported by an actuator still connected to the system)	32-bit IP address
						1-4294967295 [0x00000001-FFFFFFFF]	IP address of actuator with highest priority error	
8	0x2109	8456	Error Group	UINT8	Read	0 [0x00]	No error detected	8-bit error code showing the currently active error with the highest priority on any actuator in the parallel system
						1 [0x01]	Current overload	
						2 [0x02]	Hardware	
						3 [0x03]	Temperature	
						4 [0x04]	Overvoltage	
						5 [0x05]	Undervoltage	
						6 [0x06]	Analogue input out of range error (N/A for bus interfaces)	
						7 [0x07]	Position not changing	
						8 [0x08]	'Run' signal overruled	
						9 [0x09]	Position initialisation not possible	

## Input Registers (Parallel feedback)

Input Registers 0x2107-210A			Status	Data type	Access	Details	Description	Scaling
Index	[hex]	[dec]						
8	0x2109	8456	Error Group	UINT8	Read	10 [0x0A]	Parallel start-up	8-bit error code showing the currently active error with the highest priority on any actuator in the parallel system
						11 [0x0B]	Parallel running	
						12 [0x0C]	BLDC motor	
						13 [0x0D]	Endstop switch	
						14 [0x0E]	Parallel communication	
						15 [0x0F]	Parallel setup stopped	
						8824 [0x18]	Other error	
						25 [0x19]	Position lost	
9	0x210A	8457	Status Flags	UINT8	Read	b0	Parallel endstop reached out	8-bit independent status indicators
						b1	Parallel endstop reached in	
						b2	Parallel running outside nominal conditions	
						b3-b7	Reserved	

## Error codes

Error	Description
0	<b>No error detected</b> No LINAK defined error detected
1	<b>'Run' command overruled</b> As a safety precaution to prevent unintentional movement at power-up, the actuator will not run until a 'Stop' command or 'Clear error' command has been sent.
2	<b>Position sensor</b> Position sensors are outside of expected operating range. VCC motor OK. 10 pulses were reported on one Hall sensor and no Hall pulses on the other. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
3	<b>Overvoltage</b> Input supply voltage is above operating voltage level. Consult the documentation for correct voltage levels. The error will automatically be cleared when voltage is within operating limits.
4	<b>Undervoltage</b> Input supply voltage is below operating voltage level. Consult the documentation for correct voltage levels. The error will automatically be cleared when voltage is within operating limits.
5	<b>Communication sync</b> Heartbeat from the master is not within the expected heartbeat interval. Consult the documentation for minimum requirements for heartbeat interval.
6	<b>Endstop switch (N/A for bus interfaces)</b> Endstop switches are behaving unexpectedly. Both endstop switches have been activated simultaneously for more than 100 ms. Perform the initialization process by running the actuator fully extended and retracted.
7	<b>Temperature</b> Internal actuator temperature is above operating limit. Consult the documentation for correct temperature levels. The error will automatically be cleared when the temperature is within operating limits.
8	<b>Motor controller</b> Internal motor controller hardware error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
9	<b>Internal power supply</b> The internal power supply is behaving unexpectedly. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
10	<b>Internal current measurement</b> Internal current reference is outside the expected limits. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
11	<b>Parallel arbitration</b> Start-up parallel configuration procedure in progress.

## Error codes

Error	Description
12	<b>Position not changing</b> Internal position sensor is behaving unexpectedly and motor might stall. Please check your application for blockage or other irregularities. If the error persists, contact LINAK or replace the product.
13	<b>Position initialisation not possible</b> Internal initialisation parameters missing. Contact LINAK.
14	<b>Alone in parallel system</b> Incorrect number of actuators in parallel system.
15	<b>Incorrect number in parallel system</b> Incorrect number of actuators in parallel system or wrongly configured
254	<b>Other internal error (Not specified)</b> Unspecified internal hardware/software error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
255	<b>Other external error (Not specified)</b> Unspecified external hardware/software error. Please inspect your application for possible issues. Send 'Clear error' command to clear error.

## Parallel error codes

Error	Description
0	<b>No error detected</b> No LINAK defined error detected
1	<b>Current overload</b> Current draw is above allowed operating limit. Reduce load, send a 'Clear error' command, and run the actuator in the opposite direction.
2	<b>Hardware</b> Internal hardware error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
3	<b>Temperature</b> Internal actuator temperature is above operating limit. Consult the documentation for correct temperature levels. The error will automatically be cleared when the temperature is within operating limits.
4	<b>Overvoltage</b> Input supply voltage is above operating voltage level. Consult the documentation for correct voltage levels. The error will automatically be cleared when voltage is within operating limits.
5	<b>Undervoltage</b> Input supply voltage is below operating voltage level. Consult the documentation for correct voltage levels. The error will automatically be cleared when voltage is within operating limits.

## Parallel error codes

Error	Description
6	<b>Analogue input out of range (N/A for bus interfaces)</b> Analogue input signal is outside operating limits. Servo or Proportional. Consult the documentation for correct input signal.
7	<b>Position not changing</b> Internal position sensor is behaving unexpectedly and motor might stall. Please check your application for blockage or other irregularities. If the error persists, contact LINAK or replace the product.
8	<b>Run signal overruled</b> Communication has been overruled by a higher priority input. Communication is split into the following priorities: 1. Bus communication (CAN bus, Ethernet, etc.) 2. LINAK service tool (Actuator Connect™) 3. Manual run using Red and Black wires Send a 'Clear error' command to continue.
9	<b>Position initialisation not possible</b> Internal initialisation parameters missing. Contact LINAK.
10	<b>Parallel start-up</b> Error in parallel setup. The number of connected actuators does not match your configuration. Check the configuration by using the LINAK tool Actuator Connect.
11	<b>Parallel running</b> The actuators are performing the internal setup and are not ready for operation.
12	<b>BLDC motor</b> Internal hardware error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
13	<b>Endstop switch (N/A for bus interfaces)</b> Endstop switches are behaving unexpectedly. Both endstop switches have been activated simultaneously for more than 100ms. Perform the initialization process by running the actuator fully extended and retracted.
14	<b>Parallel communication</b> Error in internal parallel communication. More than 5 communication errors in 500 ms. Please check the wire connections and re-power the complete setup.



## Parallel error codes

Error	Description
15	<b>Parallel setup stopped</b> One or more actuators cannot comply with commands and stop. Master commands 'Stop' to other actuators in the network. Send 'Clear error' command to clear error. If the error persists, check your application and wire connections and re-power your complete setup.
24	<b>Other error</b> Actuator receives an undefined error code. This can be due to outdated firmware. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
25	<b>Position lost</b> Follow the relevant initialisation procedures by running the actuators from fully retracted to fully extended. If the error persists, contact LINAK or replace the product.

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