

RS485 Modbus RTU

# User Manual



Modbus **RTU**

## Contents

Preface .....	3
Terms of use .....	4
Revision overview.....	5
About LINAK® Modbus RTU RS485 actuators .....	6
Modbus RTU specifications .....	6
Connection diagram .....	7
Applicable for: LA14, LA25, LA36, LA37, LA76 and LA77 .....	7
I/O specifications.....	8
Parallel.....	9
Getting started .....	11
Power supply.....	11
Configuration.....	11
Parameters to be verified by Actuator Connect™ .....	12
Command examples .....	12
General run prerequisites.....	12
Run the actuator outwards .....	13
Register overview.....	14
Command details .....	14
Feedback status details .....	15
Parallel feedback status details.....	17
Diagnostics data .....	18
FAQ .....	22
Error codes .....	22
Parallel error codes.....	24

## 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.

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## Revision overview

### Edition 2

'About Modbus RTU actuators' section added	Page 6
'Manual run' changed to 'Extends actuator' and 'Retracts actuator'	Page 7-8
'Service interface' changed to 'Parallel data'	Page 7-8
'Service interface GND' changed to 'Parallel GND'	Page 7-8
Orange and Grey added to connection diagram	Page 7
Information about separate supplies added	Page 8
'Parallel' section updated	Page 9-10
'Class A' added	Page 9+11
Power supply table updated	Page 11
'Configuration' updated	Page 11
Actuator Connect™ parameters table updated	Page 12
'Run out command' changed to 'Command examples'	Page 12
'Communication sequence...' changed to 'Run the actuator outwards'	Page 13

### Edition 1

New document

## About LINAK® Modbus RTU RS485 actuators

LINAK TECHLINE® Modbus RTU actuators are primarily designed with focus on industrial automation. The communication protocol relies on the EIA/TIA-485 standard. The contents of this document assume that the reader is familiar with the EIA/TIA-485 standard.

In addition to full position control, the Modbus RTU actuator is able to provide feedback information about the piston position, service data, and full diagnostics. It also provides system identification data and actual current at runtime.

### Modbus RTU specifications

This section describes the requirements of the Modbus RTU hardware and software interface:

Baud rate	300 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps. Changeable in Actuator Connect™
Max. bus length	1,000 metres
Max. stub length	3 metres
Cable impedance	120 Ω (±10%)

## Connection diagram

Applicable for: LA14, LA25, LA36, LA37, LA76 and LA77

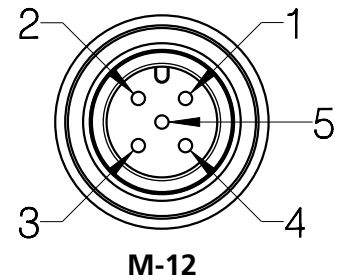
### Power

<b>BROWN</b>	24/48 V DC
<b>BLUE</b>	GND



### Control

<b>RED</b>	Extends the actuator	2
<b>BLACK</b>	Retracts the actuator	3
<b>GREEN</b>	RS485 A	5
<b>YELLOW</b>	RS485 B	4
<b>LIGHT BLUE</b>	Common GND	1



### Communication

<b>VIOLET*</b>	Parallel data
<b>WHITE*</b>	Parallel GND
<b>ORANGE</b>	Not to be connected
<b>GREY</b>	Not to be connected

\* Only available with flying leads




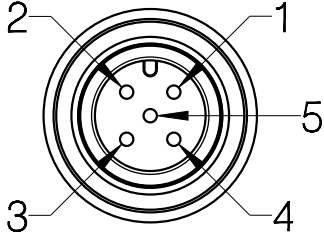
### Grounding arrangements

The RS485 Signal Common must be connected directly to protective ground at one point only for the entire bus. Generally this point is to be chosen on the master device or on its TAP, preferably using the power supply GND (negative supply). It is highly recommended that the RS485 interface on the master is chosen to be an isolated type.



It is not allowed to connect the RS485 Signal Common to the power supply GND at the actuator nodes. Doing so will cause high ground currents to flow in the « Common » circuit.

## I/O specifications

Input/Output	Specification	Comments
Description	<p>RS495 Modbus RTU is a serial communication interface between the actuators and a control system.</p> <p>The Modbus interface can communicate directly with a PLC with a Modbus module or a PC through an external USB to RS485 interface box.</p>	 <p>Modbus <b>RTU</b></p>
Brown	Connect Brown to positive 24/48 V DC $\pm$ 10%	<p>Note: Do not change the power supply polarity on the Brown and Blue wires!</p> <p>Power supply GND is electrically connected to the housing through a capacitor and resistor in parallel.</p>
Blue	Connect Blue to negative GND	
PIN out	Data cable M12 - 5-pin male	
Pin 2 Red	Extends the actuator	<p>The signal becomes active at: <math>V_{IN} &gt; 67\%</math> of V DC = ON</p> <p>The signal becomes inactive at: <math>V_{IN} &lt; 33\%</math> of V DC = OFF</p> <p>Input current: 10 mA</p> <p>Reference to - GND</p>
Pin 3 Black	Retracts the actuator	
Pin 5 Green	RS485 A RS485 inverting signal (TxD- / RxD-)	
Pin 4 Yellow	RS485 B RS485 non-inverting signal (TxD+ / RxD+)	
Pin 1 Light Blue	Common GND Common RS485 signal reference + shield of the cable	
Violet*	Parallel data	
White*	Parallel GND	
		<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>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>

\* Only available with flying leads



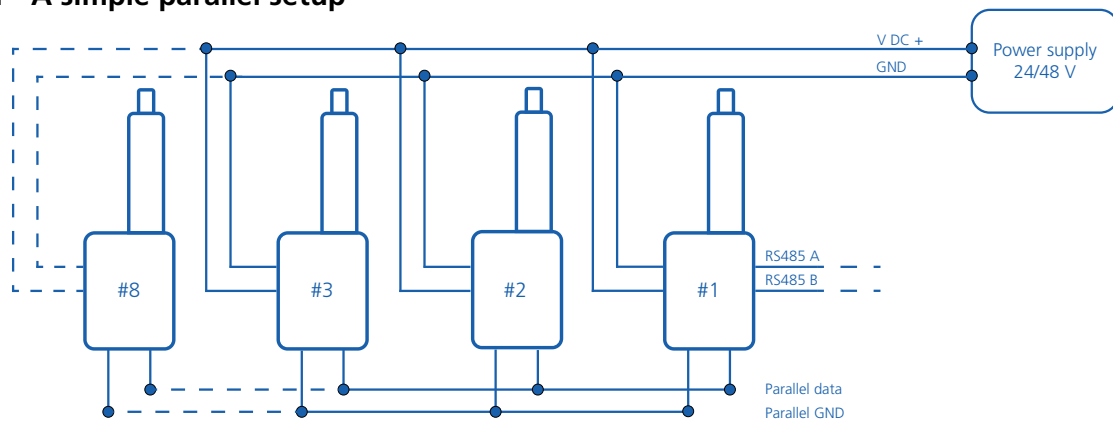
## Parallel

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 one node. 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. Parallel communication utilises two wires, which must be separately connected in a junction box (see connection diagram).
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

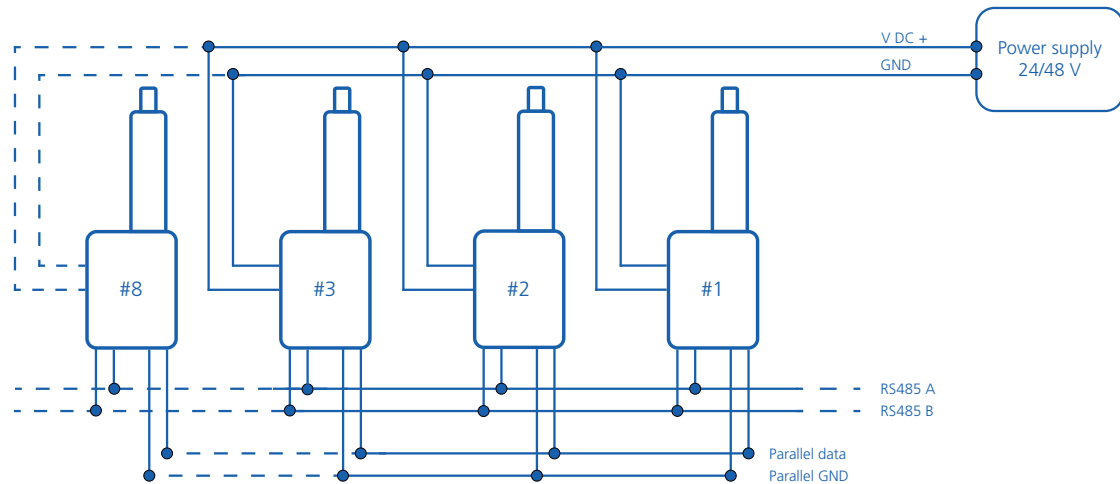


In a simple parallel setup there is only one actuator connected to the bus communication. This actuator receives run commands and shares data with the bus controller. The remaining actuators in the system are only connected to internal parallel communication. This way, the internal communication ensures 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 bus communication.

## 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 bus communication. 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.

## Getting started

This section further describes how to communicate with LINAK® Modbus RTU 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 RTU 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 RTU communication	10 V	24 V	39 V
48 V	Motor	36 V	48 V	58 V
	Modbus RTU communication	10 V	48 V	60 V

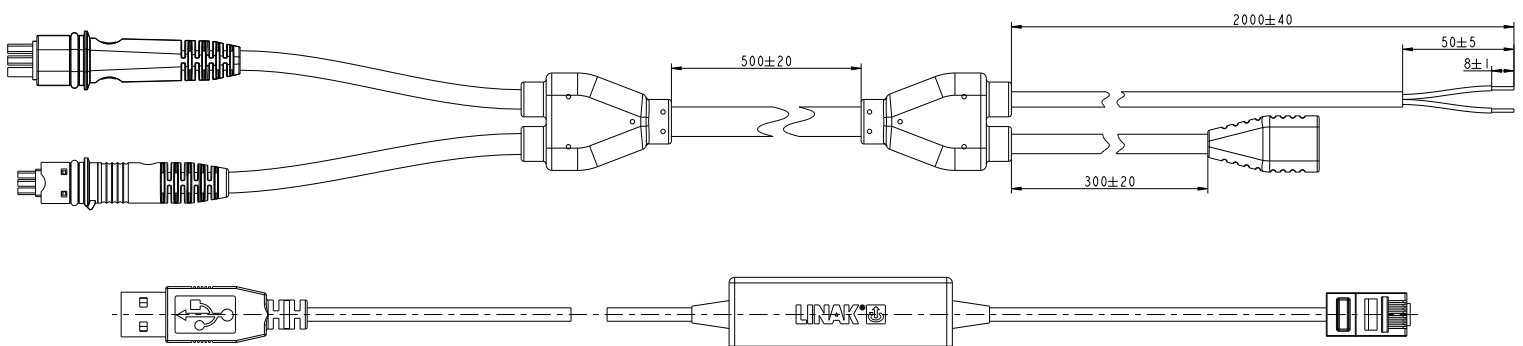
## Configuration

Before being integrated into a Modbus system, a few of the actuator parameters must be checked and possibly 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 kit (item no. 0367996 = straight Y-cable + USB2LIN) is required to use Actuator Connect™ on a PC. This cable must be connected to the 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
Baud rate	The baud rate parameter is set to the communication speed required by the PLC / system. Default value: 19200
Slave address	Set the Modbus device address to a unique value between 1 and 246. Default value: 247
Parity	The parity parameter is set to the value required by the PLC / system. Default parameter: Even
Stop bits	The stop bits parameter is set to the value required by the PLC / system. Default value: One
Response delay	Delay in ms from reception of last character in request frame before response is sent. Default value: 3 ms

## 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	Register	Action
1	HR* 8193 (0x2001)	'Communication heartbeat counter' must be incremented periodically with the value ranging from 0-255. Must be updated in periods no longer than 500 ms. If not updated within 500 ms, the actuator will stop, and the "Error Code" register will read a value of 5.
2	HR 8194 (0x2002)	'Position' must be set to = 64259 for Stop. To prevent unintended movement, it is required to send a 'Stop' command before running the actuator.
3	HR 8452 (0x2104)	"Error Code" must be = 0
4	HR 8451 (0x2103)	"Status Flags" bit 2 (overcurrent) must be = 0
5	HR 8451 (0x2103)	"Status Flags" bit 0 (heartbeat needed) must be = 0
6	HR 8451 (0x2103)	"Status Flags" bit 6 (actuator is running outside normal conditions) must be = 0

\* HR = Holding register

## Run the actuator outwards

Step	Register	Action
1	-	Check that general run prerequisites are fulfilled.
2	HR 8195 (0x2003)	<p>“Current” must be set to a value</p> <p>0-250 = Current limit 0.25 A/bit</p> <p>251 = Default current limit set via Actuator Connect</p> <p>252-255 = Reserved</p>
3	HR 8196 (0x2004)	<p>“Speed” must be set to a value</p> <p>0-200 = Speed 0.5% /bit</p> <p>201-250 = 100% speed</p> <p>251 = Default speed set via Actuator Connect</p> <p>252-255 = Reserved</p>
4	HR 8197 (0x2005)	<p>“Soft Start” must be set to a value</p> <p>0-250 = Start ramp time 0.05 s/bit</p> <p>251 = Default speed set via Actuator Connect</p> <p>252-255 = Reserved</p>
5	HR 8198 (0x2006)	<p>“Soft Stop” must be set to a value</p> <p>0-250 = Stop ramp time 0.05 s/bit</p> <p>251 = Default speed set via Actuator Connect</p> <p>252-255 = Reserved</p>
6	HR 8194 (0x2002)	“Position” must be set to = 64257 for run out
7**	HR 8451 (0x2103)	“Status Flags” bit 3 will change to 1 to indicate the actuator is running out.

\*\* Optional

## Register overview

### Command details

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x2001	8193	UINT8	RW	Communication Heartbeat Counter	0-255	Without regular updates the actuator will stop*	
0x2002	8194	UINT16	RW	Position	0-64255	Run to position	0.1 mm/bit
					64256	Clear error register (see 0x1001)	Command
					64257	Run out	Command
					64258	Run in	Command
					64259	Stop	Command
					64260	Recovery run out	Command
					64261	Recovery run in	Command
					64262-65535	Invalid value, actuator will not run	Reserved
0x2003	8195	UINT8	RW	Current	0-250	Maximum current limit	0.25 A/bit
					251	Use default current value	Command
					252-255	Invalid value, the actuator will not run	Reserved
0x2004	8196	UINT8	RW	Speed	0-200	Speed to use	0.5% /bit
					201-250	Use 100% speed	
					251	Use default speed value	Command
					252-255	Invalid value, the actuator will not run	Reserved
0x2005	8197	UINT8	RW	Soft Start	0-250	Start ramping time	0.05 s/bit
					251	Use default start value	Command
					252-255	Invalid value, the actuator will not run	Reserved
0x2006	8198	UINT8	RW	Soft Stop	0-250	Stop ramping time	0.05 s/bit
					251	Use default soft stop value	Command
					252-255	Invalid value, the actuator will not run	Reserved

\* Should increment at least every 500 ms

## Feedback status details

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x2101	8449	UINT16	R	Position	0-64255	Position of the actuator piston	0.1 mm/bit
					64256-65023	Reserved	
					65024	Position lost	
					65025-65535	Reserved	
0x2102	8450	UINT8	R	Current	0	Not running	
					1-250	Measured motor current	0.25 A/bit
					251-253	Reserved	
					254	Fault in current measurement circuit	
					255	Reserved	
0x2103	8451	UINT8	R	Status Flags		8-bit independent status bit-indicators	
					b0	Endstop reached inwards	
					b1	Endstop reached outwards	
					b2	Overcurrent	
					b3	Running out	
					b4	Running in	
					b5	Heartbeat needed	
					b6-b7	Reserved	

## Feedback status details

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x2104	8452	UINT8	R	Error Code		8-bit error code indicating the currently active error of highest priority	
					0	No error detected	
					1	'Run' command overruled	
					2	Position sensor	
					3	Overvoltage	
					4	Undervoltage	
					5	Communication sync	
					6	Endstop switch	
					7	Temperature	
					8	Motor controller error	
					9	Internal power supply	
					10	Internal current measurement	
					11	Parallel arbitration	
					12	Position not changing	
					13	Position initialisation not possible	
					14	Alone in parallel system	
254	Other internal error (Not specified)						
255	Other external fault (Not specified)						
0x2105	8453	UINT16	R	Speed	0-4015	Speed of actuator piston	0.1 mm/s
					4016-65535	Reserved	
0x2106	8454	UINT8	R	Input State	b0-b1	Input 1 level	0.25% /bit
					b2-b3	Input 2 level	0.25% /bit
					b4-b5	Input 3 level	0.25% /bit
					b6-b7	Always set	Reserved



## Parallel feedback status details

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x2201	8705	UINT32	R	Error Source	0	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)	
					1-4294967295	IP address of actuator with highest priority error	32-bit IP address
0x2203	8706	UINT8	R	Error Group	0	No error detected	8-bit error code indicating the currently active error of highest priority on any actuator in the parallel system
					1	Current overload	
					2	Hardware	
					3	Temperature	
					4	Overvoltage	
					5	Undervoltage	
					6	Analogue input out of range error (N/A for bus interfaces)	
					7	Position not changing	
					8	Run signal overruled	
					9	Position initialisation not possible	
					10	Parallel start-up	
					11	Parallel running	
					12	BLDC motor error	
					13	Endstop switch (N/A for bus interfaces)	
					14	Parallel communication	
					15	Parallel setup stopped	
24	Other error						
25	Position lost						
0x2204	8707	UINT8	R	Status Flags	b0	Parallel endstop reached inwards	8-bit independent status bit-indicators
					b1	Parallel endstop reached outwards	
					b2	Parallel running outside nominal conditions	
					b3-b7	Reserved	

## Diagnosics data

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x4001	16385	UINT8	RW	Current Limit Out			0.25 A/bit
0x4002	16386	UINT8	RW	Current Limit In			0.25 A/bit
0x4003	16387	UINT16	RW	Soft Start Time Out			1 ms/bit
0x4004	16388	UINT16	RW	Soft Start Time In			1 ms/bit
0x4005	16389	UINT16	RW	Soft Stop Time Out			1 ms/bit
0x4006	16390	UINT16	RW	Soft Stop Time In			1 ms/bit
0x4007	16391	UINT8	RW	Maximum Speed	0-200		0.5% /bit
					201-255		100%
0x4008	16392	UINT16	RW	Virtual Endstop Reached Outwards Position			0.1 mm/bit
0x4009	16393	UINT16	RW	Virtual Endstop Reached Inwards Position			0.1 mm/bit
0x400A	16394	UINT32	R	UIN			8 number format
0x400C	16396	UINT32	R	SW Variant		Software number (e.g. 1050000)	SWxxxxxxxxVx-x
0x400E	16398	UINT32	R	SW Version Major			SWxxxxxxxxVx-x
0x4010	16400	UINT32	R	SW Version Minor			SWxxxxxxxxVx-x
0x4012	16402	UINT32	R	Config. Production Order Number			
0x4014	16404	UINT32	R	Production Date			yyymmdd
0x4016	16406	UINT8	R	Maximum Current Seen			0.25 A/bit
0x4017	16407	UINT8	R	Maximum FET Temperature Seen			1°C/bit - 40
0x4018	16408	UINT8	R	Maximum Ambient Temperature Seen			1°C/bit - 40
0x4019	16409	UINT8	R	Minimum Ambient Temperature			1°C/bit - 40
0x401A	16410	UINT32	R	Current Usage			1 As/bit
0x401C	16412	UINT32	R	Runtime			1 s/bit
0x401E	16414	UINT8	R	Number of Stops Due to Overvoltage			
0x401F	16415	UINT8	R	Number of Stops Due to FET Overtemperature			
0x4020	16416	UINT8	R	Number of Stops Due to Ambient Overtemperature			

## Diagnosics data

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x4021	16417	UINT8	R	Number of Stops Due to Low Voltage			
0x4022	16418	UINT8	R	Number of Stops Due to Hall Errors			
0x4023	16419	UINT8	R	Number of Stops Due to Endstop Reached Switch Errors			
0x4024	16420	UINT8	R	LINAK Current Overload Out Stops			
0x4025	16421	UINT8	R	LINAK Current Overload In Stops			
0x4026	16422	UINT8	R	Resettable Custom Current Overload Out Stops			
0x4027	16423	UINT8	R	Resettable Custom Current Overload In Stops			
0x4028	16424	UINT16	R	Communication Errors			
0x4029	16425	UINT32	R	Number of Endstop Reached Outwards			
0x402B	16427	UINT32	R	Number of Endstop Reached Inwards			
0x402D	16429	UINT32	R	Number of Starts Out			
0x402F	16431	UINT32	R	Number of Starts In			
0x4031	16433	UINT32	R	Total Piston Distance			5 m/bit
0x4033	16435	UINT16	R	Last Stop Reason ID 0		Stop Reason ID	
0x4034	16436	UINT8	R	Last Stop Count ID 0		Number of Consecutive Stop Reasons of the Same Type	
0x4035	16437	UINT32	R	Last Stop Powered Time ID 0		Powered Time When the Last Stop Occurred	1 s/bit
0x4037	16439	UINT16	R	Last Stop Reason ID 1		Stop Reason ID	
0x4038	16440	UINT8	R	Last Stop Count ID 1		Number of Consecutive Stop Reasons of the Same Type	

## Diagnostics data

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x4039	16441	UINT32	R	Last Stop Powered Time ID 1		Powered Time When the Last Stop Occurred	1 s/bit
0x403B	16443	UINT16	R	Last Stop Reason ID 2		Stop Reason ID	
0x403C	16444	UINT8	R	Last Count ID 2		Number of Consecutive Stop Reasons of the Same Type	
0x403D	16445	UINT32	R	Last Stop Powered Time ID 2		Powered Time When the Last Stop Occurred	1 s/bit
0x403F	16447	UINT16	R	Last Stop Reason ID 3		Stop Reason ID	
0x4040	16448	UINT8	R	Last Stop Count ID 3		Number of Consecutive Stop Reasons of the Same Type	
0x4041	16449	UINT32	R	Last Stop Powered Time ID 3		Powered Time When the Last Stop Occurred	1 s/bit
0x4043	16451	UINT16	R	Last Stop Reason ID 4		Stop Reason ID	
0x4044	16452	UINT8	R	Last Stop Count ID 4		Number of Consecutive Stop Reasons of the Same Type	
0x4045	16453	UINT32	R	Last Stop Powered Time ID 4		Powered Time When the Last Stop Occurred	1 s/bit
0x4047	16455	UINT32	R	Total Corrected Distance			1 mm/bit
0x4049	16457	UINT8	R	FET Temperature			1°C/bit - 40
0x404A	16458	UINT8	R	Ambient Temperature			1°C/bit - 40
0x404B	16459	UINT32	R	Stroke Length			0.1 mm/bit
0x404D	16461	UINT32	R	Zero Point Offset			0.1 mm/bit
0x404F	16463	UINT32	R	Actuator PO Number			
0x4051	16465	UINT8		LINAK Special Function	0	Reserved	
					1	Restart actuator	
					2-255	Reserved	
0x4052	16466	UINT8		IP Address 1 in Parallel System			

## Diagnostics data

Index		Data type	Access	Name	Details	Description	Unit
[hex]	[dec]						
0x4053	16467	UINT8		IP Address 2 in Parallel System			
0x4054	16468	UINT8		IP Address 3 in Parallel System			
0x4055	16469	UINT8		IP Address 4 in Parallel System			
0x4056	16470	UINT8		IP Address 5 in Parallel System			
0x4057	16471	UINT8		IP Address 6 in Parallel System			
0x4058	16472	UINT8		IP Address 7 in Parallel System			
0x4059	16473	UINT8		IP Address 8 in Parallel System			

## FAQ

Problem	Cause / Solution
The master does not receive any response from the actuator.	<p><b>Cause:</b> The power or communication cabling is not implemented as specified.  <b>Solution:</b> Inspect cabling and repair.</p> <p><b>Cause:</b> Communication baud rate, parity, stop bits are not set correctly.  <b>Solution:</b> Set up communication parameters as required by use of Actuator Connect™.</p> <p><b>Cause:</b> The device does not have the expected slave address.  <b>Solution:</b> Set up the slave address between 1 and 246 using Actuator Connect.</p>
The actuator does not move after a 'Run' command.	<p><b>Cause:</b>  <b>Solution:</b> Make sure your heartbeat counter is properly transmitted by the master and received by the slave.</p>

## Error codes

Error	Description
0	<p><b>No error detected</b>            No LINAK defined error detected</p>
1	<p><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.</p>
2	<p><b>Position sensor</b>            Position sensors are outside of expected operating range. VCC motor OK.            Example: 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.</p>
3	<p><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.</p>
4	<p><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.</p>
5	<p><b>Communication sync</b>            Heartbeat from the master is not within the expected heartbeat interval. Consult the documentation for minimum requirements for heartbeat interval.</p>
6	<p><b>Endstop switch (N/A for bus interfaces)</b>            Endstop switches are behaving unexpectedly.            Example: Both endstop switches have been activated simultaneously for more than 100 ms. Perform the initialization process by running the actuator fully extended and retracted.</p>

## Error codes

Error	Description
7	<p><b>Temperature</b></p> <p>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.</p>
8	<p><b>Motor controller</b></p> <p>Internal motor controller hardware error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.</p>
9	<p><b>Internal power supply</b></p> <p>The internal power supply is behaving unexpectedly. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.</p>
10	<p><b>Internal current measurement</b></p> <p>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.</p>
11	<p><b>Parallel arbitration</b></p> <p>Start-up parallel configuration procedure in progress.</p>
12	<p><b>Position not changing</b></p> <p>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.</p>
13	<p><b>Position initialisation not possible</b></p> <p>Internal initialisation parameters missing. Contact LINAK.</p>
14	<p><b>Alone in parallel system</b></p> <p>Incorrect number of actuators in parallel system.</p>
15	<p><b>Incorrect number in parallel system</b></p> <p>Incorrect number of actuators in parallel system or wrongly configured</p>
254	<p><b>Other internal error (Not specified)</b></p> <p>Unspecified internal hardware/software error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.</p>
255	<p><b>Other external error (Not specified)</b></p> <p>Unspecified external hardware/software error. Please inspect your application for possible issues. Send 'Clear error' command to clear error.</p>

## Parallel error codes

Error	Description
0	<p><b>No error detected</b></p> <p>No LINAK defined error detected</p>
1	<p><b>Current overload</b></p> <p>Current draw is above allowed operating limit. Reduce load, send a 'Clear error' command, and run the actuator in the opposite direction.</p>
2	<p><b>Hardware</b></p> <p>Internal hardware error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.</p>
3	<p><b>Temperature</b></p> <p>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.</p>
4	<p><b>Overvoltage</b></p> <p>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.</p>
5	<p><b>Undervoltage</b></p> <p>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.</p>
6	<p><b>Analogue input out of range (N/A for bus interfaces)</b></p> <p>Analogue input signal is outside operating limits. Servo or Proportional. Consult the documentation for correct input signal.</p>
7	<p><b>Position not changing</b></p> <p>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.</p>
8	<p><b>Run signal overruled</b></p> <p>Communication has been overruled by a higher priority input. Communication is split into the following priorities:</p> <ol style="list-style-type: none"> <li>1. Bus communication (CAN bus, Ethernet, etc.)</li> <li>2. LINAK service tool (Actuator Connect™)</li> <li>3. Manual run using Red and Black wires</li> </ol> <p>Send a 'Clear error' command to continue.</p>



## Parallel error codes

Error	Description
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.
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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