TECHLINE®
IMPROVING FLEXIBILITY

I/O™ Interface
User Manual

TM

LINAK®
WE IMPROVE YOUR LIFE

LINAK.COM/TECHLINE

Contents

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.

LINAK and the LINAK logotype are registered trademarks of LINAK A/S. All rights reserved.

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.

Warranty

For a period of 18 months from production of TECHLINE® products, LINAK warrants the Products to conform to written specifications and to be free from defects in material and workmanship under use and service. The production date is specified on the product label, which is present on all LINAK products.

Review the full terms of the LINAK warranty for TECHLINE products here: www.LINAK.com/warranty

Revision overview

Edition 5

Min. stroke length for LA14 corrected to 75 mm	Page 9

Edition 4

Min. stroke length for LA14 and LA25 changed to 100 mm	Page 9
Motor voltage added to 'Compatible actuators'	Page 9-11
LA76, LA77 and LC3 IC added to 'Compatible actuators'	Page 10-11
Connection diagrams and I/O specifications sorted by compatibility	Page 14-31
'Parallel communication' figure updated	Page 33
'Parallel connection' table removed	Page 33
'Parallel Manual Service Mode' section added	Page 34
'Supply voltage' table updated	Page 35
'Dual input' figure updated	Page 40
PWM removed from text and 'Servo' table	Page 42
PWM removed from 'Single input' table	Page 43
Digital output options added	Page 48
'At endstop zone - Active high signal' figure updated	Page 49
'At current limit - Active high' and 'At current limit - Active low' figures updated	Page 50
'Endstop reached (Both directions) and 'Parallel endstop reached' sections added	Page 51
'Current limit' section updated	Page 55
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Structure of document slightly rearranged	
'Version' changed to 'Edition'	

Edition 3

LA14 compatibility added	All over the document
Illustration colours updated	All over the document
Inputs and Outputs illustration removed	Page 11
I/O Basic connection diagram added	Page 12
I/O Basic I/O specifications added	Page 13
I/O Customised or Full connection diagram added	Page 14
I/O Customised or Full I/O specifications added	Page 15-17
Parallel communication illustration added	Page 18
12 V supply voltage added	Page 19
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Edition 2

'External' changed to 'passive'	Page 20
Illustration regarding Analogue Feedback added	Page 21
Supplementary text regarding wiring information added	Page 37
Sleep mode section deleted	Page 31 and 32

Compatible actuators

The I/O™ interface is offered for the following LINAK® actuators:

LA14

The actuator LA14 is a very tough actuator with a high IP degree and aluminium housing, making it ideal for use in harsh and demanding environments.

The LA14 offers top quality in every detail and ensures reliable performance in temperatures ranging from -40°C to +85°C. With its small size the LA14 is well suited to applications that require short linear movements.

- Max. load: 750 N
- Max. speed: 45 mm/s
- Stroke length: 75-130 mm
- Motor voltage: 12 or 24 V DC

LA25

With its robust design, high IP degree and aluminium housing, the actuator LA25 is ideal for harsh environments where operation under extreme conditions is required.

Furthermore, the compact dimensions of this actuator makes it applicable for confined spaces.

- Max. load: 2,500 N
- Max. speed: 25 mm/s
- Stroke length: 100-600 mm
- Motor voltage: 12 or 24 V DC

LA33

The actuator LA33 combines compact design and high power in a solution fit for use in industrial settings and for demanding applications that require customised interfaces, faster, or silent operation and to work in harsh and extreme environments.

A thorough and demanding testing programme is behind the maintenance-free and long-lasting performance of this solid and high-quality actuator.

- Max. load: 5,000 N
- Max. speed: 70 mm/s
- Stroke length: 100-600 mm
- Motor voltage: 12, 24 or 48 V DC

LA36

The actuator LA36 is one of the most solid and powerful LINAK® actuators, designed to operate under extreme conditions.

The LA36 is a maintenance-free product with a long service life and a high IP degree. It is also available with an extra-long service life.

This high-quality actuator offers a very strong alternative to hydraulic solutions.

- Max. load: 6,800 N
- Max. speed: 168 mm/s
- Stroke length: 100-1,200 mm
- Motor voltage: 12, 24 or 48 V DC

LA37

The actuator LA37 is specifically developed for heavy-duty applications in harsh environments, where there is a need for high lifting capacity and holding force.

The LA37 offers the well-known LINAK quality, guaranteeing you a maintenance-free product with a long lifetime.

- Max. load: 15,000 N
- Max. speed: 10 mm/s
- Stroke length: 100-600 mm
- Motor voltage: 12, 24 or 48 V DC

LA76

The actuator LA76 is robust and highly versatile. Equipped with a brushless DC motor (BLDC) this actuator offers an extended service life. It has been testen to run a minimum of 200,000 cycles at maximum load and maximum duty cycle, showcasing its long-term performance.

This maintenance-free actuator is designed to excel in harsh environments and undergoes rigorous testing to ensure durability against dust, vibrations, salt vapours, water ingress, heat, and shock.

- Max. load: 6,800 N
- Max. speed: 142 mm/s
- Stroke length: 100-1,200 mm
- Motor voltage: 24 or 48 V DC

LA77

The actuator LA77 is designed to operate effectively under tough conditions and is subjected to an extensive testing programme including shock and vibration, mechanical durability, temperature, humidity, salt, and chemical IP testing.

The LA77 is built for applications that require toughness and high load capacity, and it is a strong choice for machinery and equipment in areas such as marine, material handling, construction, and outdoor power equipment.

- Max. load: 15,000 N
- Max. speed: 7 mm/s
- Stroke length: 100-600 mm
- Motor voltage: 24 or 48 V DC

LC3 IC

The LC3 IC is a smart electric lifting column designed to easily incorporate heavy lifts in automation projects. It is field-tested for robust, lasting industrial performance, because we know reliability is good for business. In short, the LC3 IC is ideal for applications where automation technology is used to improve machine processes or the working environment.

- Max. load: 6,000 N
- Max. speed: 100 mm/s
- Stroke length: 1,100 mm
- Motor voltage: 24 or 48 V DC

Introduction - what is I/O™?

I/O is a universal industrial interface which has been developed by LINAK®. It is a part of the IC - Integrated Controller™ range, which is offered across all industrial actuators. I/O is a common term used in the industry to describe inputs and outputs. Traditionally, an electric linear actuator has been perceived as a simple device - combining electronics and mechanics to form linear movement. The main driver for this movement is either a brushed or brushless DC motor. These were typically controlled by external power electronics to change the direction of the current and adjust the speed.

With IC, the basic control of the actuator has been taken care of. Decades of experience has matured this solution, and with I/O it all comes together - to form a smart actuator interface which can be deployed across all industries.

Three different I/O options

The I/O actuator comes in three variants: Basic, Full, and Customised. I/O Basic has basic functionality with all the benefits of the Integrated Controller. I/O Full is pre-configured like the I/O Basic but has access to all features in the supporting PC tool Actuator Connect™ - something that could be especially relevant in the prototype stage, where all features can be explored. I/O Customised is pre-configured from the factory for plug-and-play installation.

	I/O Basic	**I/O Full**	**I/O Customised**
	Basic functionality with all the benefits of IC	Explore all the features with a full version	Pre-configured to your needs
Actuator Connect™ - supporting PC tool	√	√	√
Adjust movement	Standard run only	√	🔒 ADD-ON
Diagnostics	Current status only	√	🔒 ADD-ON
Monitor	Real-time charts only	√	🔒 ADD-ON
Parallel	Not applicable	√	🔒 ADD-ON
Position feedback	Endstop reached only	√	🔒 ADD-ON
Protection	Default values*	√	🔒 ADD-ON
* Default values - not possible to configure			
Upgrade to Full version (post-purchase)	ONE-TIME FEE	-	ONE-TIME FEE

Table 1 I/O options

Inputs and outputs - wiring flexibility

Flexibility is key when describing the possibilities of an I/O™ actuator. A total of six wires are customisable and this opens a world of intelligent actuator control.

To create movement, it is a prerequisite that the actuator receives an input signal. This can be as simple as a constant high digital signal on the Red wire - commanding the actuator to run outwards. If there is a need for other control options, the I/O actuator is able to receive e.g. an analogue servo or a proportional signal.

Modern applications also rely on a constant stream of data from the components for increased efficiency and reliable operation - here referred to as outputs from the actuator. These outputs can be either digital or analogue, depending on the requirement from the control unit.

Fixed wires

The signal cable has a total of nine pins in the connector or nine wires for flying leads. As mentioned above, six of these are customisable and the remaining three are used for parallel run, service interface (USB connection to Actuator Connect™) and Bluetooth® antenna. See wiring diagram on the next page.

The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG Inc. and any use of such marks and logos by LINAK is under license.

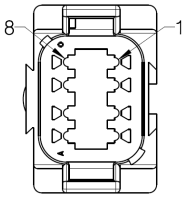
I/O Basic

Valid for: LA14 and LA25

Connection diagram

		Power
BROWN	12/24 V DC	**11**
BLUE	GND	**12**
		Signal
RED	Digital input	**8**
BLACK	Digital input	**7**
YELLOW	Digital output	**5**
GREEN	Digital output	**6**
ORANGE	Not used*	
LIGHT BLUE	Not used*	
VIOLET	Not used*	
WHITE	Not used*	
GREY	Not to be connected	

Deutsch



Not used*: The I/O Basic actuator can be upgraded to I/O Full if more functionality is needed - even after purchase. Connect the actuator to Actuator Connect™ via Bluetooth® or a USB adapter cable (must be purchased separately), and request an unlock key from your local LINAK® office.

I/O Basic

Valid for: LA14 and LA25

I/O specifications

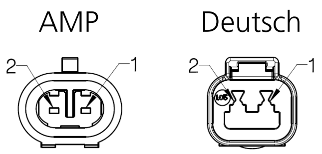
Input/Output	Specification	Comments
Description	I/O is a universal industrial interface developed by LINAK®. I/O is a common term used to describe inputs and outputs. As part of the IC (Integrated Controller) range, the I/O interface offers a range of digital and analogue in- and outputs. It can be deployed through all industries.	
Brown	Connect Brown to positive 12/24 V DC + (VCC)	Note: Do not swap the power supply polarity on the Brown and Blue wires! The PCB is coupled to the housing through a capacitor. Current limit levels can be adjusted through Actuator Connect™. Standby current consumption (also when actuator is not running): 12 V ≈ 100 mA 24 V ≈ 60 mA
Blue	Connect Blue to negative (GND)	
Red	Extends the actuator - Standard run	The signal becomes active at: > 67% of V_{IN} The signal becomes inactive at: < 33% of V_{IN} Input current: 10 mA
Black	Retracts the actuator - Standard run	
Yellow	Digital position output - Endstop reached (inwards)	Digital outputs: The digital output is active high - Output voltage min. V_{IN} - 2 V - Source current max. 100 mA
Green	Digital position output - Endstop reached (outwards)	
Orange	Not to be used	Actuator can be upgraded to Full version - wire is then used as either an analogue output or digital input.
Light Blue	Not to be used	Actuator can be upgraded to Full version - wire is then used as either an analogue output or digital input.
Purple	Not to be used	Actuator can be upgraded to Full version - wire is then used as parallel communication
White	Not to be used	Actuator can be upgraded to Full version - wire is then used as parallel common GND
Grey	Antenna for Bluetooth®	The Grey wire is used to strengthen the Bluetooth signal, allowing a stable wireless connection and has no functionality during operation.

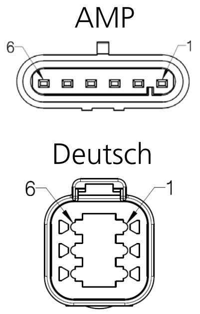
I/O Basic

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

Connection diagram

		Power
BROWN	12/24/48 V DC	2
BLUE	GND	1
		Signal
RED	Digital input	5
BLACK	Digital input	4
YELLOW	Digital output	2
GREEN	Digital output	3
ORANGE	Not used*	
LIGHT BLUE	Not used*	
VIOLET	Not used*	
WHITE	Not used*	
GREY	Not to be connected	





Not used*: The I/O Basic actuator can be upgraded to I/O Full if more functionality is needed - even after purchase. Connect the actuator to Actuator Connect™ via Bluetooth® or a USB adapter cable (must be purchased separately), and request an unlock key from your local LINAK® office.

I/O Basic

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

I/O specifications

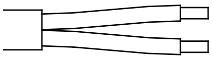
Input/Output	Specification	Comments
Description	I/O is a universal industrial interface developed by LINAK®. I/O is a common term used to describe inputs and outputs. As part of the IC (Integrated Controller) range, the I/O interface offers a range of digital and analogue in- and outputs. It can be deployed through all industries.	
Brown	Connect Brown to positive 12/24/48 V DC + (VCC)	Note: Do not swap the power supply polarity on the Brown and Blue wires! The PCB is coupled to the housing through a capacitor. Current limit levels can be adjusted through Actuator Connect™. Standby current consumption (also when actuator is not running): 12 V ≈ 100 mA 24 V ≈ 60 mA 48 V ≈ 40 mA
Blue	Connect Blue to negative (GND)	
Red	Extends the actuator - Standard run	The signal becomes active at: > 67% of V_{IN} The signal becomes inactive at: < 33% of V_{IN} Input current: 10 mA
Black	Retracts the actuator - Standard run	
Yellow	Digital position output - Endstop reached (inwards)	Digital outputs: The digital output is active high - Output voltage min. V_{IN} - 2 V - Source current max. 100 mA
Green	Digital position output - Endstop reached (outwards)	
Orange	Not to be used	Actuator can be upgraded to Full version - wire is then used as either an analogue output or digital input.
Light Blue	Not to be used	Actuator can be upgraded to Full version - wire is then used as either an analogue output or digital input.
Purple	Not to be used	Actuator can be upgraded to Full version - wire is then used as parallel communication
White	Not to be used	Actuator can be upgraded to Full version - wire is then used as parallel common GND
Grey	Antenna for Bluetooth®	The Grey wire is used to strengthen the Bluetooth signal, allowing a stable wireless connection and has no functionality during operation.

I/O Basic

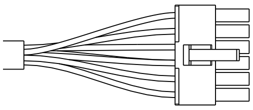
Valid for: LC3 IC

Connection diagram

		Power
BROWN	24/48 V DC	**2**
BLUE	GND	**1**
		Signal
RED	Digital input	**5**
BLACK	Digital input	**4**
YELLOW	Digital output	**2**
GREEN	Digital output	**3**
ORANGE	Not used*	
LIGHT BLUE	Not used*	
VIOLET	Not used*	
WHITE	Not used*	
GREY	Not to be connected	



Flying leads
Molex mini-fit 12-pin



Not used*: The I/O Basic actuator can be upgraded to I/O Full if more functionality is needed - even after purchase. Connect the actuator to Actuator Connect™ via a USB adapter cable (must be purchased separately), and request an unlock key from your local LINAK® office.

I/O Basic

Valid for: LC3 IC

I/O specifications

Input/Output	Specification	Comments
Description	I/O is a universal industrial interface developed by LINAK®. I/O is a common term used to describe inputs and outputs. As part of the IC (Integrated Controller) range, the I/O interface offers a range of digital and analogue in- and outputs. It can be deployed through all industries.	
Brown	Connect Brown to positive 24/48 V DC + (VCC)	Note: Do not swap the power supply polarity on the Brown and Blue wires! The PCB is coupled to the housing through a capacitor. Current limit levels can be adjusted through Actuator Connect™. Standby current consumption (also when actuator is not running): 24 V ≈ 60 mA 48 V ≈ 40 mA
Blue	Connect Blue to negative (GND)	
Red	Extends the actuator - Standard run	The signal becomes active at: > 67% of V_{IN} The signal becomes inactive at: < 33% of V_{IN} Input current: 10 mA
Black	Retracts the actuator - Standard run	
Yellow	Digital position output - Endstop reached (inwards)	Digital outputs: The digital output is active high - Output voltage min. V_{IN} - 2 V - Source current max. 100 mA
Green	Digital position output - Endstop reached (outwards)	
Orange	Not to be used	Actuator can be upgraded to Full version - wire is then used as either an analogue output or digital input.
Light Blue	Not to be used	Actuator can be upgraded to Full version - wire is then used as either an analogue output or digital input.
Purple	Not to be used	Actuator can be upgraded to Full version - wire is then used as parallel communication
White	Not to be used	Actuator can be upgraded to Full version - wire is then used as parallel common GND
Grey	Not to be used	

I/O Customised or Full

Valid for: LA14 and LA25

Connection diagram

		Power
BROWN	12/24 V DC	**11**
BLUE	GND	**12**
		Signal
RED	Digital input	**8**
BLACK	Digital input	**7**
YELLOW	Digital output	**5**
GREEN	Digital output	**6**
ORANGE	Analogue output (+) OR digital input*	**2**
LIGHT BLUE	Analogue output (-) OR digital input*	**9**
VIOLET	Parallel*	**4**
WHITE	Parallel GND*	**3**
GREY	Not to be connected	

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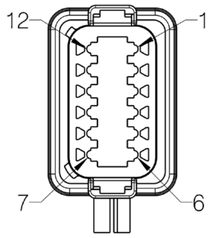


*Customisable: The I/O Customised actuator is configured based on customer needs - for detailed information about wire functionality, please see the auto-generated data sheet (type in J-number from product label)

The I/O Full actuator is configured like an I/O Basic from factory but with full access to all features. Connect the actuator to Actuator Connect^{TM} via Bluetooth® or a USB adapter cable (must be purchased separately) to enable and configure various features.

I/O Customised or Full

Valid for: LA14 and LA25

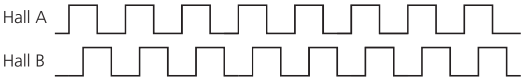
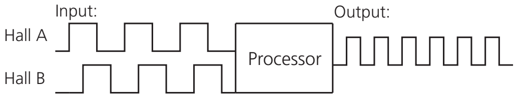
I/O specifications

Input/Output	Specification	Comments
Description	I/O is a universal industrial interface developed by LINAK®. I/O is a common term used to describe inputs and outputs. As part of the IC (Integrated Controller) range, the I/O interface offers a range of flexible digital and analogue in- and outputs. It can be deployed through all industries.	
Brown	Connect Brown to positive 12/24 V DC + (VCC)	Note: Do not swap the power supply polarity on the Brown and Blue wires! The PCB is coupled to the housing through a capacitor. Current limit levels can be adjusted through Actuator Connect™. Standby current consumption (also when actuator is not running): 12 V ≈ 100 mA 24 V ≈ 60 mA
Blue	Connect Blue to negative (GND)	
Red	Extends the actuator features*: - Standard run (outwards) - Predefined positions - Servo (+) - Proportional (+) - Impulse run	For digital inputs, standard run and impulse run: The signal becomes active at: > 67% of V_{IN} The signal becomes inactive at: < 33% of V_{IN} Input current: 10 mA
Black	Retracts the actuator features*: - Standard run (inwards) - Predefined positions) - Servo (-) - Proportional (-) - Impulse run	

I/O Customised or Full

Valid for: LA14 and LA25

I/O specifications

Input/Output	Specification	Comments
Yellow	Digital position output features*: • Endstop reached (inwards) • Endstop zone reached (inwards) - At current cut-off - At endstop zone • Endstop reached (both directions) • Parallel endstop reached (inwards) • Target position reached (1 to 4) • Single Hall XOR • Dual Hall (A) • Actuator running • Constantly high • Constantly low • Not in use	Digital outputs: The digital outputs are either active high or active low, depending on the preferred signal type. - Output voltage min.: V_{IN} - 2 V - Current draw max.: 100 mA Dual Hall:  Single Hall XOR output: 
Green	Digital position output features*: • Endstop reached (outwards) • Endstop zone reached (outwards) - At current cut-off - At endstop zone • Endstop reached (both directions) • Parallel endstop reached (outwards) • Target position reached (1 to 4) • Single Hall XOR • Dual Hall (B) • Actuator running • Constantly high • Constantly low • Not in use	

I/O Customised or Full

Valid for: LA14 and LA25

I/O specifications

Input/Output	Specification	Comments
Orange	Differential analogue output or Digital input feature*: • Analogue output feedback (+) - Position - Temperature - Current draw • Digital input - Predefined position 1	Customisable (Default for Full version)
Light Blue	Differential analogue output or Digital input feature*: • Analogue output feedback (-) - Position - Temperature - Current draw • Digital input - Predefined position 2	Customisable (Default for Full version)
Violet	Parallel communication*	Customisable (Default for Full version) The Parallel drive function will support up to 8 actuators running simultaneously.
White	Parallel signal GND	Only to be connected to other Parallel GND and only in Parallel systems.
Grey	Antenna for Bluetooth®	The Grey wire is used to strengthen the Bluetooth signal, allowing a stable wireless connection, and has no functionality during operation.

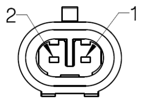
I/O Customised or Full

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

Connection diagram

		Power
BROWN	12/24/48 V DC	**2**
BLUE	GND	**1**
		Signal
RED	Digital input	**5**
BLACK	Digital input	**4**
YELLOW	Digital output	**2**
GREEN	Digital output	**3**
ORANGE	Analogue output (+) OR digital input*	**1**
LIGHT BLUE	Analogue output (-) OR digital input*	**6**
VIOLET	Parallel*	**7** Alt. 1**
WHITE	Parallel GND*	**8** Alt. 6**
GREY	Not to be connected	

AMP



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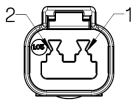
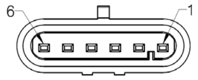


AMP



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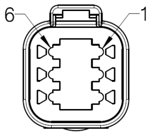

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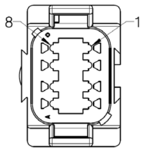


*Customisable: The I/O Customised actuator is configured based on customer needs - for detailed information about wire functionality, please see the auto-generated data sheet (type in J-number from product label)
The I/O Full actuator is configured like an I/O Basic from factory, but with full access to all features. Connect the actuator to Actuator Connect™ via Bluetooth® or a USB adapter cable (must be purchased separately), to enable and configure various features.

**If 'Endstop reached' is not used, a 6-pin connector can be chosen, where the alternative pins are used.

I/O Customised or Full

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

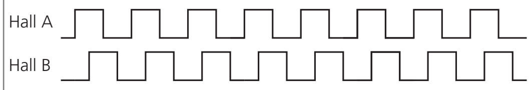
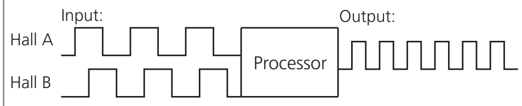
I/O specifications

Input/Output	Specification	Comments
Description	I/O is a universal industrial interface developed by LINAK®. I/O is a common term used to describe inputs and outputs. As part of the IC (Integrated Controller) range, the I/O interface offers a range of flexible digital and analogue in- and outputs. It can be deployed through all industries.	
Brown	Connect Brown to positive 12/24/48 V DC + (VCC)	Note: Do not swap the power supply polarity on the Brown and Blue wires! The PCB is coupled to the housing through a capacitor. Current limit levels can be adjusted through Actuator Connect™. Standby current consumption (also when actuator is not running): 12 V ≈ 100 mA 24 V ≈ 60 mA 48 V ≈ 40 mA
Blue	Connect Blue to negative (GND)	
Red	Extends the actuator features*: - Standard run (outwards) - Predefined positions - Servo (+) - Proportional (+) - Impulse run	For digital inputs, standard run and impulse run: The signal becomes active at: > 67% of V_{IN} The signal becomes inactive at: < 33% of V_{IN} Input current: 10 mA
Black	Retracts the actuator features*: - Standard run (inwards) - Predefined positions) - Servo (-) - Proportional (-) - Impulse run	

I/O Customised or Full

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

I/O specifications

Input/Output	Specification	Comments
Yellow	Digital position output features*: • Endstop reached (inwards) • Endstop zone reached (inwards) - At current cut-off - At endstop zone • Endstop reached (both directions) • Parallel endstop reached (inwards) • Target position reached (1 to 4) • Single Hall XOR • Dual Hall (A) • Actuator running • Constantly high • Constantly low • Not in use	Digital outputs: The digital outputs are either active high or active low, depending on the preferred signal type. - Output voltage min.: V_{IN} - 2 V - Current draw max.: 100 mA Dual Hall:  Single Hall XOR output: 
Green	Digital position output features*: • Endstop reached (outwards) • Endstop zone reached (outwards) - At current cut-off - At endstop zone • Endstop reached (both directions) • Parallel endstop reached (outwards) • Target position reached (1 to 4) • Single Hall XOR • Dual Hall (B) • Actuator running • Constantly high • Constantly low • Not in use	

I/O Customised or Full

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

I/O specifications

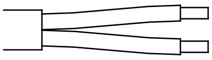
Input/Output	Specification	Comments
Orange	Differential analogue output or Digital input feature*: • Analogue output feedback (+) - Position - Temperature - Current draw • Digital input - Predefined position 1	Customisable (Default for Full version)
Light Blue	Differential analogue output or Digital input feature*: • Analogue output feedback (-) - Position - Temperature - Current draw • Digital input - Predefined position 2	Customisable (Default for Full version)
Violet	Parallel communication*	Customisable (Default for Full version) The Parallel drive function will support up to 8 actuators running simultaneously.
White	Parallel signal GND	Only to be connected to other Parallel GND and only in Parallel systems.
Grey	Antenna for Bluetooth®	The Grey wire is used to strengthen the Bluetooth signal, allowing a stable wireless connection, and has no functionality during operation.

I/O Full

Valid for: LC3 IC

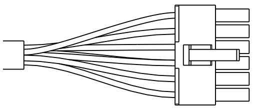
Connection diagram

		Power
BROWN	24/48 V DC	2
BLUE	GND	1



		Signal
RED	Digital input	5
BLACK	Digital input	4
YELLOW	Digital output	2
GREEN	Digital output	3
ORANGE	Analogue output (+) OR digital input*	1
LIGHT BLUE	Analogue output (-) OR digital input*	6
VIOLET	Parallel*	7
WHITE	Parallel GND*	8
GREY	Not to be connected	

Flying leads
Molex mini-fit 12-pin



The I/O Full actuator is configured like an I/O Basic from factory, but with full access to all features. Connect the actuator to Actuator Connect™ via a USB adapter cable (must be purchased separately), to enable and configure various features.

I/O Customised is not available for LC3 IC.

I/O Full

Valid for: LC3 IC

I/O specifications

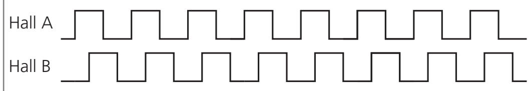
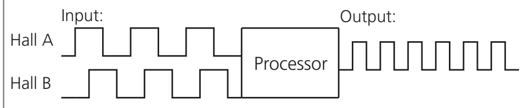
Input/Output	Specification	Comments
Description	I/O is a universal industrial interface developed by LINAK®. I/O is a common term used to describe inputs and outputs. As part of the IC (Integrated Controller) range, the I/O interface offers a range of flexible digital and analogue in- and outputs. It can be deployed through all industries.	
Brown	Connect Brown to positive 24/48 V DC + (VCC)	Note: Do not swap the power supply polarity on the Brown and Blue wires! The PCB is coupled to the housing through a capacitor. Current limit levels can be adjusted through Actuator Connect™. Standby current consumption (also when actuator is not running): 24 V ≈ 60 mA 48 V ≈ 40 mA
Blue	Connect Blue to negative (GND)	
Red	Extends the actuator features*: - Standard run (outwards) - Predefined positions - Servo (+) - Proportional (+) - Impulse run	For digital inputs, standard run and impulse run: The signal becomes active at: > 67% of V_{IN} The signal becomes inactive at: < 33% of V_{IN} Input current: 10 mA
Black	Retracts the actuator features*: - Standard run (inwards) - Predefined positions) - Servo (-) - Proportional (-) - Impulse run	

I/O Customised is not available for LC3 IC.

I/O Full

Valid for: LC3 IC

I/O specifications

Input/Output	Specification	Comments
Yellow	Digital position output features*: • Endstop reached (inwards) • Endstop zone reached (inwards) - At current cut-off - At endstop zone • Endstop reached (both directions) • Parallel endstop reached (inwards) • Target position reached (1 to 4) • Single Hall XOR • Dual Hall (A) • Actuator running • Constantly high • Constantly low • Not in use	Digital outputs: The digital outputs are either active high or active low, depending on the preferred signal type. - Output voltage min.: V_{IN} - 2 V - Current draw max.: 100 mA Dual Hall:  Single Hall XOR output: 
Green	Digital position output features*: • Endstop reached (outwards) • Endstop zone reached (outwards) - At current cut-off - At endstop zone • Endstop reached (both directions) • Parallel endstop reached (outwards) • Target position reached (1 to 4) • Single Hall XOR • Dual Hall (B) • Actuator running • Constantly high • Constantly low • Not in use	

I/O Customised is not available for LC3 IC.

I/O Full

Valid for: LC3 IC

I/O specifications

Input/Output	Specification	Comments
Orange	Differential analogue output or Digital input feature*: • Analogue output feedback (+) - Position - Temperature - Current draw • Digital input - Predefined position 1	Customisable (Default for Full version)
Light Blue	Differential analogue output or Digital input feature*: • Analogue output feedback (-) - Position - Temperature - Current draw • Digital input - Predefined position 2	Customisable (Default for Full version)
Violet	Parallel communication*	Customisable (Default for Full version) The Parallel drive function will support up to 8 actuators running simultaneously.
White	Parallel signal GND	Only to be connected to other Parallel GND and only in Parallel systems.
Grey	Not to be used	

☞ I/O Customised is not available for LC3 IC.

Parallel run

The I/O™ actuator offers parallel run, where up to eight actuators can work jointly. In the parallel system, there is one primary and up to seven followers. The primary will always be the actuator with the highest serial number (also referred to as #W/O number on the printed product label).

The parallel system

When installing several actuators in a parallel setup, please consider the following:

- Parallel works as a 'critical' system, meaning that all actuators must be present in the system before it allows movement - it will also stop if a malfunction is detected on one of the actuators
- The system can be designed with either one main power supply only 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!
- If an overload occurs, the actuators 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

Recovery mode

To ensure maximum reliability, the parallel system will reduce the speed (to 50%) in the event of a position lost. This way, there is a visual indication that the system is not fully operational and a reinitialisation is necessary. To reinitialise the parallel system, please drive the actuators fully inwards followed by a smooth movement past the Zero Point initialisation zone (at least 70 mm in outwards direction).

Actuator Connect™ connection

If minor adjustments or reconfiguration of the actuators are required in the system, each actuator must be connected to Actuator Connect™ - one at a time. This process can be sped up by connecting via Bluetooth® instead of using a USB cable. It is also possible to add or remove an actuator from the system, or even turn a single actuator into a parallel actuator.

It is important that all actuators in the system have the same configuration - otherwise the actuators will not be operational.

Wiring up the parallel system

Below is an example of a parallel system with four actuators, operated from one main power supply. All Violet and White wires are connected to each other, ensuring that they can communicate, e.g. status messages and position feedback to the master. Run signals can be applied on the Red or Black wire and does not necessarily have to be connected to the master.

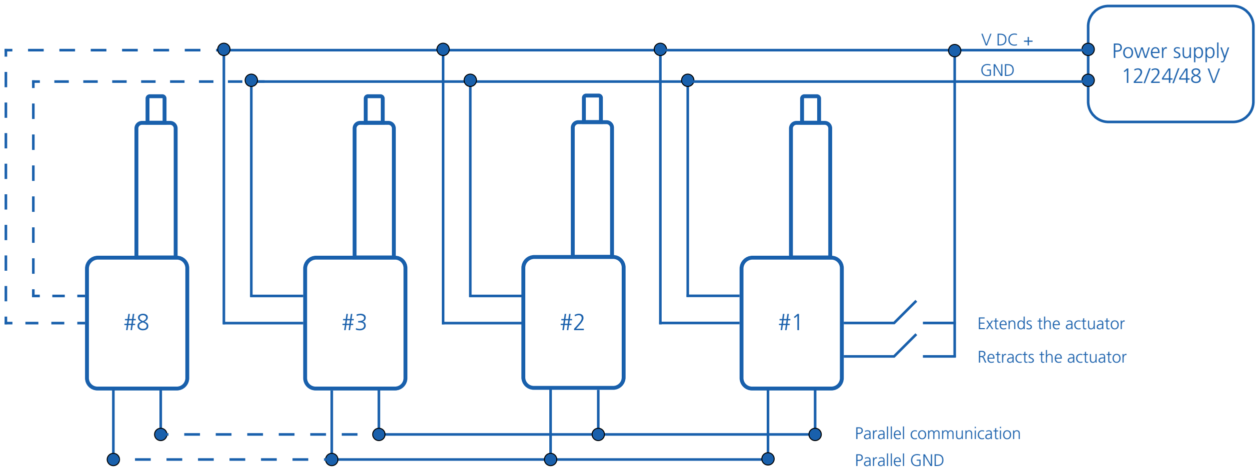


Figure 1 Parallel communication

Parallel limitations

When parallel run is enabled, please note that the following Adjust movement features are unavailable:

- Virtual limits - Learning mode

Keep the total length of the communication line (Violet wires) below 40 meters to avoid communication dropouts. In a parallel system with 8 actuators, this would result in signal cable lengths of < 5 meters.

For more information about wiring possibilities, please see connection diagrams.

Parallel Manual Service Mode

With the Parallel Manual Service Mode it is possible to drive one or more Parallel actuators separately by using the Red and Black wire from each actuator.

An example: if there are 4 actuators in the system and one is removed, the remaining 3 actuators will still be operational simultaneously - so long as they are connected via the Violet and White wires, and given that 'Parallel manual service mode' is activated on at least one of them.

For activation of 'Parallel manual service mode', please follow the instructions below:

	Procedure	Min.	Max.
First step	Power up all remaining actuators in the system	-	-
Hold	Put power on the Red and Black wires for 10-30 seconds	10 seconds	30 seconds
Difference	The Red and Black wires must all be connected to the power supply within 0.5 seconds	0 seconds	0.5 seconds
Release	Disconnect all wires and wait 0.5-2 seconds before the next step	0.5 seconds	2 seconds
Extend/Retract	Now choose either to extend or retract the actuator To extend the actuator: Connect only the Red wire(s) to the power supply To retract the actuator: Connect only the Black wire(s) to the power supply	-	-
Interval	Switch between running in/out as much as needed, without exceeding the 2.0 seconds interval between disconnecting/connecting the Red and Black wires	-	2 seconds
End	To exit the Parallel manual mode, disconnect the Red and Black wires for more than 2.0 seconds	2 seconds	-

Table 2 Parallel Manual Service Mode

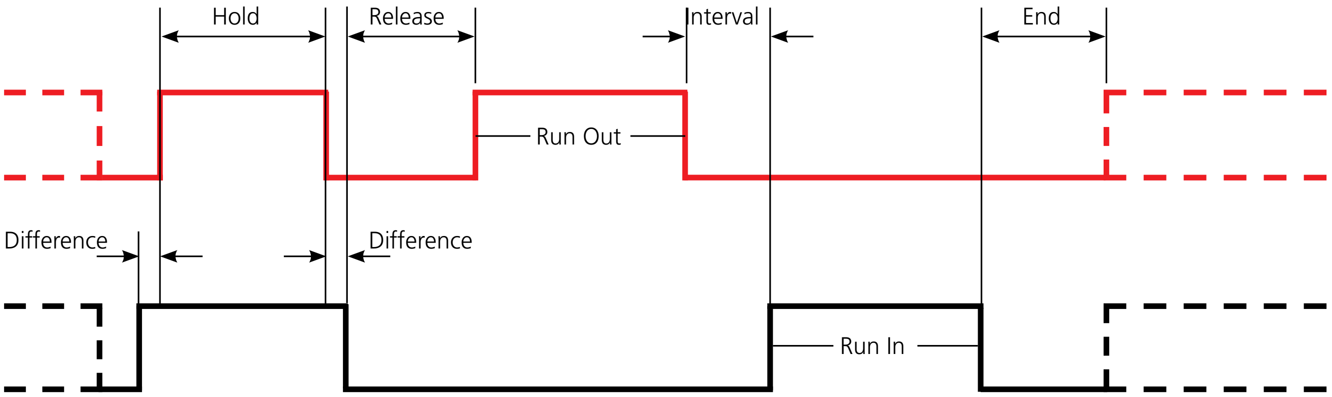


Figure 2 Parallel Manual Service Mode

Power supply

The power source should be un-powered while connecting the power leads to the actuator. Make sure the power supply has sufficient power available for both start-up current and continuous use. Please keep in mind that low temperatures can increase the current usage considerably. Power supply GND is electrically connected to the actuator housing by a capacitor.

Supply voltage

The actuator will be available in three supply voltage ranges: 12 V DC, 24 V DC and 48 V DC. The table below shows the accepted voltage ranges and the consequent actuator behaviour:

Supply voltage	Function	Voltage range	Valid for
12 V	No function	> 60 V	LA14, LA25, LA33, LA36 and LA37
	Motor not running (I/O™ PCB operating)	36-60 V	
	Fully operational	8-21 V	
	Motor not running (I/O PCB operating)	6-8 V	
	No function	< 6 V	
24 V	No function	> 60 V	LA14, LA25, LA33, LA36, LA37, LA76, LA77 and LC3 IC
	Motor not running (I/O™ PCB operating)	36-60 V	
	Fully operational	16-36 V	
	Motor not running (I/O PCB operating)	12-16 V	
	No function	< 12 V	
48 V	No function	> 60 V	LA33, LA36, LA37, LA76, LA77 and LC3 IC
	Motor not running (I/O™ PCB operating)	58-60 V	
	Fully operational	24-58 V	
	Motor not running (I/O PCB operating)	12-24 V	
	No function	< 12 V	

Table 3 Supply voltage

Various power sources

The choice of power supply source can have significant influence on the performance and behaviour of the actuator. Make sure to use the best suitable source for the application.

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

When utilising an alternator for charging batteries, the voltage can increase considerably.
Make sure the supply voltage is kept within the allowed range.

Battery

The actuator is often used in applications that are powered by a battery supply. The most common being Lead-Acid and Lithium-based batteries.

- Connecting an actuator to a Lead-Acid battery is usually trouble-free. The battery is robust in terms of absorbing Back Electromotive Force (Back EMF) and capable of delivering high start-up currents
- Li-Ion batteries can be sensitive to power generated by the load. Make sure the battery controller can suppress Back EMF. The battery package (battery + controller) must be able to deliver the start-up current required by the application.

LPS

A Linear Power Supply (LPS), based on a core transformer, will usually be capable of handling the actuator power pattern due to its robustness. The internal capacitance and the transformer itself can absorb the excess energy from Back EMF.

SMPS

Switch Mode Power Supplies (SMPS) can be susceptible to Back EMF. The possibility to configure ramp times (soft start/stop) in the actuator can be very helpful in dealing with this issue.

Turning power on and off

From the time power is applied to the actuator until the actuator gains full feedback and control capabilities, a delay of approximately 2 seconds must be expected.

In case of power loss

When powering off the actuator or in the event of unintended power loss, the internal non-volatile memory will save the current stroke position along with a number of essential parameters. These will automatically be restored when re-powered.

To ensure maximum self-locking ability, it is important that the motor is shorted when the actuator is stopped. The Integrated Controller of the I/O™ actuator will do this automatically, as long as the actuator is powered.

Adjust movement

A traditional actuator’s task is to run fully inwards and outwards at a default speed. Actuators with I/O™ interface offer flexible control options and the possibility to set virtual limits and adjust the speed.

Speed settings

For all Adjust movement features, it is possible to adjust the speed between 0-100%. A general recommendation is to keep the speed at 40% or more to ensure that the actuator is capable of pushing or pulling the rated maximum load. If the speed is configured to less than 40% there is also an increasing risk of stalling the motor.

Regulated speed

By default, the I/O actuator runs at a regulated speed. This way, the actuator keeps the speed at a constant level regardless of the load applied.

By choosing hard stop for ‘Protection’ the actuator will run with variable speed.

Start and stop – digital inputs

When applying a digital signal to the actuator, there is a delay (also referred to as transaction time) before the actuator either starts or stops moving. Please see the approximate transaction delays in the table below:

Red or Black input signals	Event	Transaction delay
OFF → ON	Actuator starts running	≈ 50 ms
ON → OFF	Actuator stops	≈ 120 ms

Table 4 Start and stop - digital inputs

Please note that ramp up or ramp down times are not considered in the latter mentioned transaction times.

Standard run

Digital standard run is a well-known way of controlling an actuator with integrated H-bridge. A high or low digital signal must be applied as described below, and this will cause the actuator to either run or stop. By default, the Red wire is used to drive the actuator in the outwards direction, and the Black wire is used for the inwards direction. The input current of this signal must be at least 10 mA.

When the signal is more than 2/3 of VCC (VCC = 24 V DC or 48 V DC), it will be considered high, and the actuator will start running. If the signal is less than 1/3 of VCC, it will be considered low, and the actuator will stop. When a high signal is applied to either the Red or Black wire, the voltage level can vary down to 1/3 of VCC before it stops. After a stop, the voltage level must be more than 2/3 of VCC before the actuator starts running again. This is visualised in the graphics below:

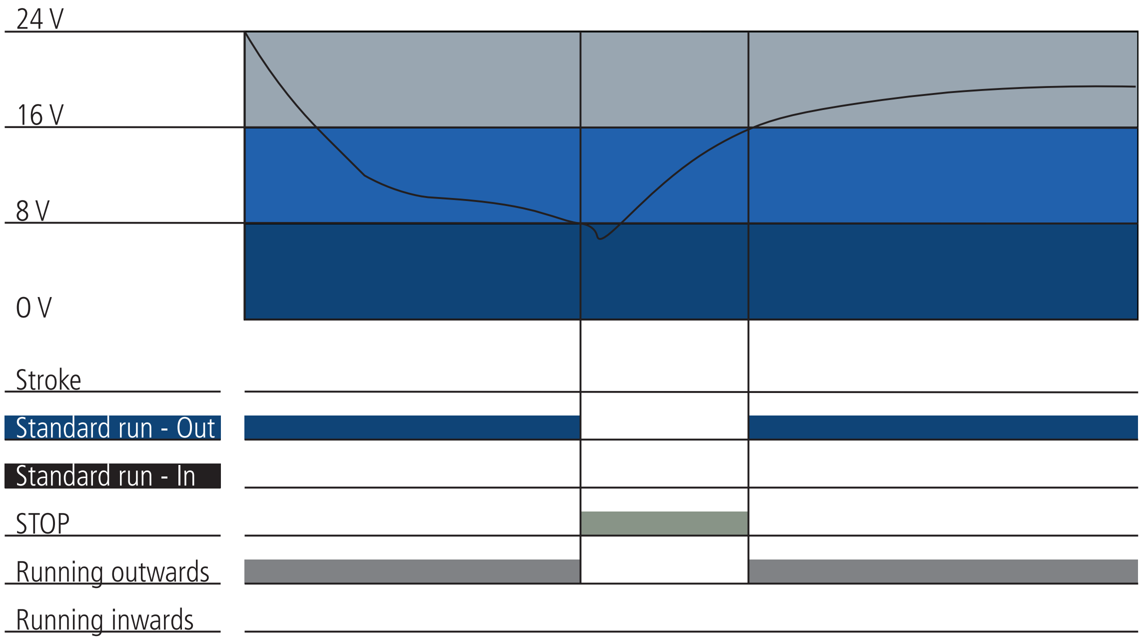


Figure 3 Standard run

Impulse run

Impulse run is the same as standard run in terms of high/low levels. If a signal is 2/3 of VCC (VCC = 12 V DC, 24 V DC or 48 V DC) it will be considered high, and if a signal is less than 1/3 of VCC, it will be considered low.

There are two different ways to control an impulse run:

- **Single input:** one control input for both directions (Red wire)
- **Dual input:** one control input per direction (Red and Black wire)

There are also two parameters to consider when choosing impulse run:

- **Hold time RUN:** Active time [0-65635 ms]. Actuator requires digital input to stay high and start running on impulse activation.
- **Hold time STOP:** Active time [0-65535 ms]. Actuator requires digital input to stay high and abort running on impulse activation.

Single input

For single input impulse run, a signal needs to be applied only on the Red wire for a certain length of time before it will be seen as a true signal and the actuator will react accordingly.

While stopped, an impulse activation (Hold time RUN) will make an actuator run outwards. While running, an impulse activation (Hold time STOP) will make an actuator stop. At the next impulse activation (Hold time RUN), the actuator will run in the opposite direction.

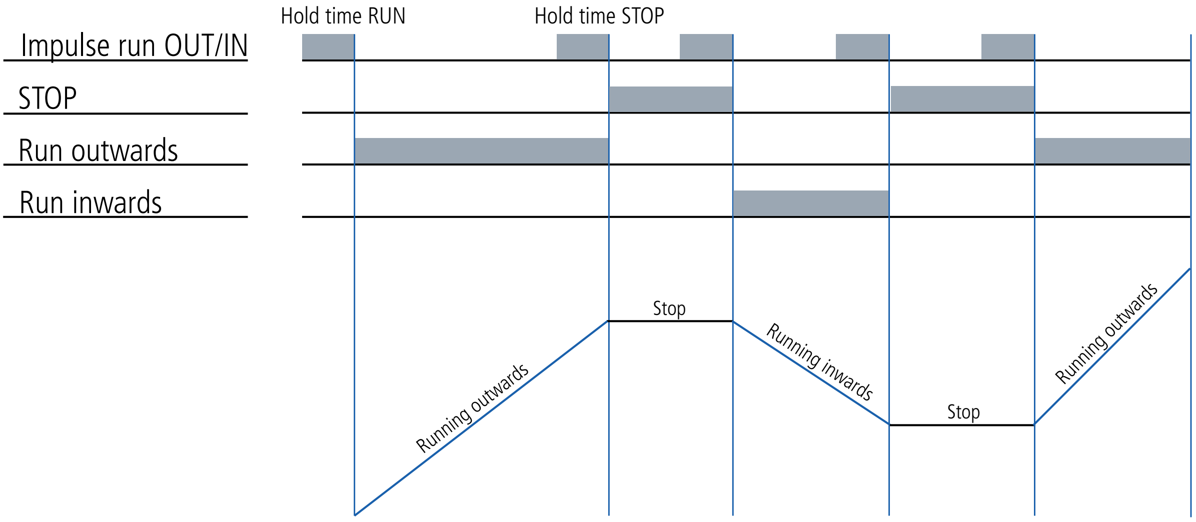


Figure 4 Single input

Dual input

For dual input impulse run, a signal needs to be applied on either the Red or Black wire (depending on the direction) for a certain length of time before it will be seen as a true signal and the actuator will react accordingly.

While stopped, an impulse activation on the Red wire (Hold time RUN) will make an actuator run outwards. While running, an impulse activation on the Black wire (Hold time STOP) will make an actuator stop.

At the next impulse activation on the Red wire (Hold time RUN), the actuator will run outwards. While running, an impulse activation on the Black wire (Hold time STOP) will make the actuator stop. At the next impulse activation on the Black wire (Hold time RUN), the actuator will run inwards.

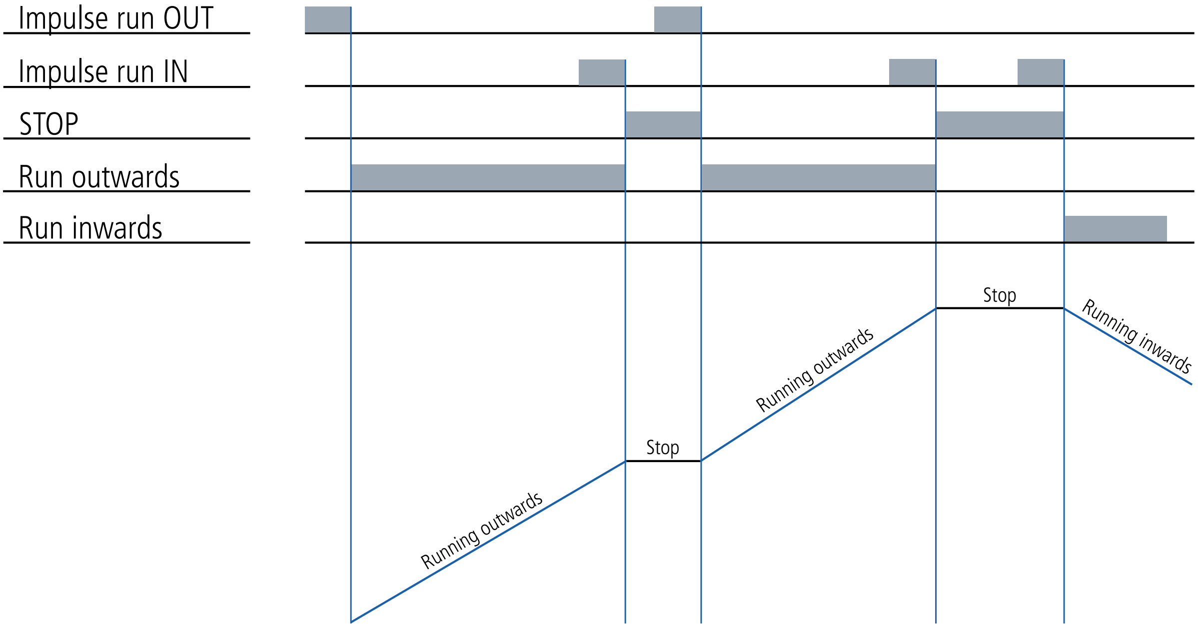


Figure 5 Dual input

Predefined positions

By using the Orange and Light Blue wires as digital inputs, it is possible to get four control options for the actuator. Red and Black will feature standard run as mentioned in “Standard run”, and Orange and Light Blue can be used for target positions.

Two wires are reserved for standard run to ensure that the actuator can run in both directions - which is important if the actuator encounters a position lost error. This way, the actuator can be initialised by running from its fully retracted position past the initialisation zone (35-70 mm).

One target position can be defined for each digital input (Orange and Light Blue), and the actuator will run to this position at a desired speed (independent of the speed chosen for standard run).

Find an example of the digital input options in the table below:

Digital 1 Red	**Digital 2** Black	**Digital 3** Orange	**Digital 4** Light Blue	**Functionality**
0	0	0	0	STOP
1	0	0	0	Run outwards
0	1	0	0	Run inwards
0	0	1	0	Run to target position 1
0	0	0	1	Run to target position 2

Table 5 Predefined positions

The input signal level on the Orange and Light Blue wires (high/low) are the same as “Standard run”. The signal must remain high until the target position is reached, and the actuator will stop by itself. If two or more digital inputs are activated at the same time, the actuator will not run. Also, if the actuator is moving (based on one digital input) and a second input is applied, the actuator will perform a hard stop. To allow movement again, both of the applied digital inputs must be removed.

Servo

Servo control is used to run to a specific position controlled by an analogue input value. The physical stroke length of the actuator is scaled according to the input signal, and LINAK® offers two different servo inputs: Current (4-20 mA) and Voltage (0-10 V).

The functionality of the servo control is illustrated in the figure below:

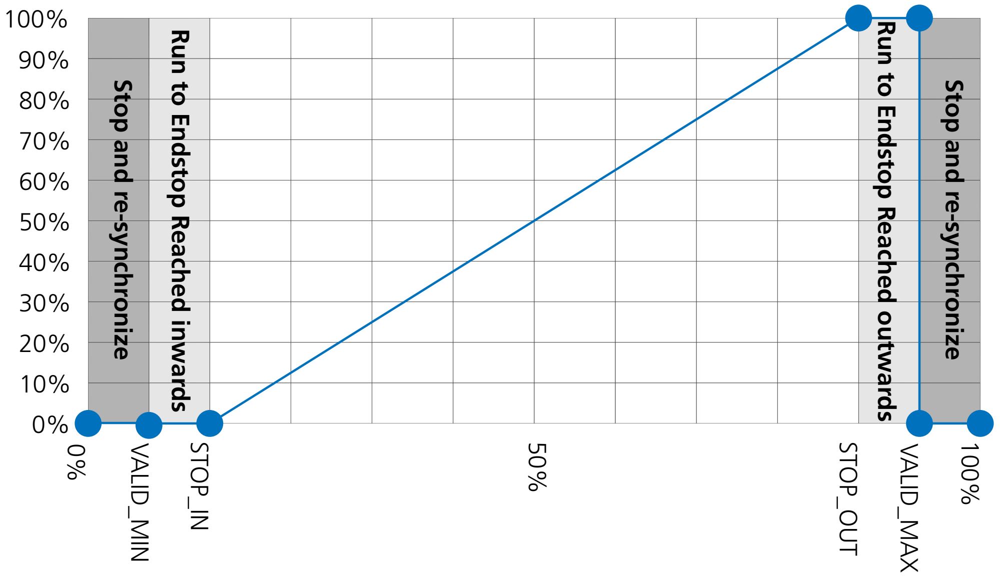


Figure 6 Servo control

Control input levels	Voltage (0-10 V)	Current (4-20 mA)
100%	10.0 V	20.0 mA
VALID_MAX	9.5 V	19.5 mA
STOP_OUT	9.0 V	19.0 mA
STOP_IN	1.0 V	5.0 mA
VALID_MIN	0.5 V	4.5 mA
0%	0.0 V	4.0 mA

Table 6 Servo

Servo control input

LINAK offers current (4-20 mA) or voltage (0-10 V) as differential analogue inputs. Here, the Red wire is used for analogue input (+) and the Black wire is used for differential (-). In some cases, (+) and (–) are also referred to as signal High and signal Low. Both of the signal inputs (+) and (–) are electrically “floating” with respect to analogue GND input, the Blue wire (power supply). This kind of input principle allows measurement between two inputs, providing a very stable and level independent signal.

If the actuator receives input values above VALID_MAX or below VALID_MIN, it will automatically stop and require a resynchronisation before running again.
To resynchronise, the input signal must be between the VALID_MIN and VALID_MAX area (e.g. 0.5-9.5 V for voltage) for at least 100 ms.

Proportional

Control the actuator with a speed proportional to the analogue input value. The proportional control can either be a single control input or a dual control input. Red and Black wires are used for proportional control and standard run is not available when this feature is enabled.

Single input

With a single control input, the actuator speed and direction can be controlled by a single analogue input. Here, the Red wire is used for analogue input (+) and the Black wire is used for differential (-). In some cases, (+) and (-) are also referred to as signal High and signal Low. Both the signal inputs (+) and (-) are electrically "floating" with respect to analogue GND input, the Blue wire (power supply). This kind of input principle allows measurement between two inputs, providing a very stable and level independent signal.

The functionality of the single control input is illustrated in the figure below:

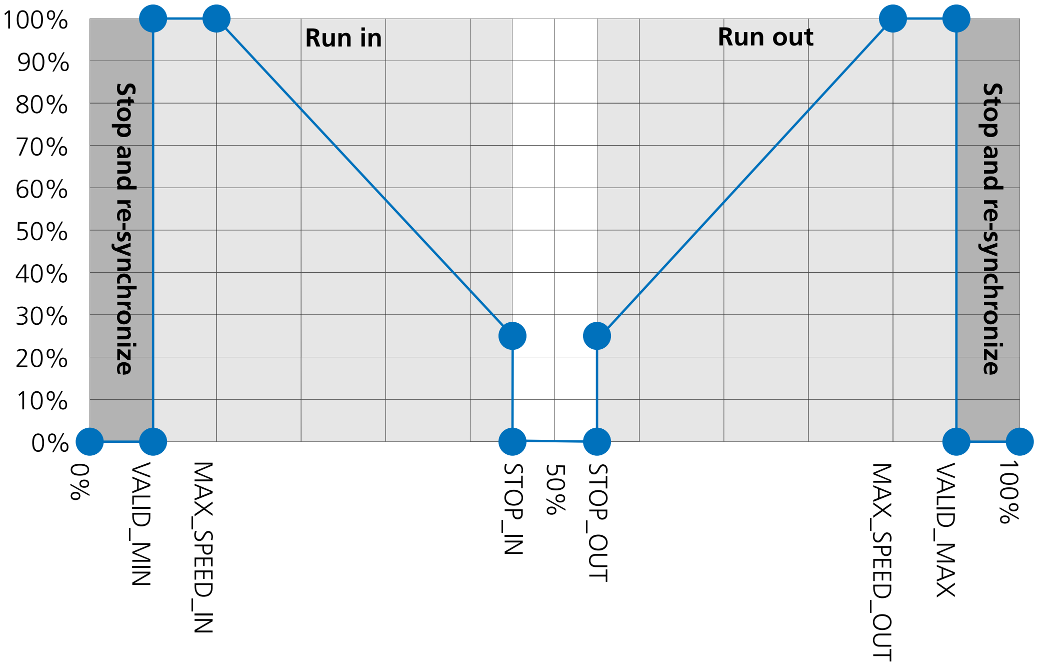


Figure 7 Single input

Control input levels	Voltage (0-10 V)	Current (4-20 mA)
100%	10.0 V	20 mA
VALID_MAX	9.5 V	19.5 mA
MAX_SPEED_OUT	9.0 V	19.0 mA
STOP_OUT	5.5 V	13.0 mA
50%	5.0 V	12.0 mA
STOP_IN	4.5 V	11.0 mA
MAX_SPEED_IN	1.0 V	5.0 mA
VALID_MIN	0.5 V	4.5 mA
0%	0.0 V	4.0%

Table 7 Single input

If the actuator receives input values above VALID_MAX or below VALID_MIN, it will automatically stop and require a resynchronisation before running again.
To resynchronise, the input signal must be between the STOP_IN and STOP_OUT area (e.g. 4.5-5.5 V for Voltage) for at least 100 ms.

Virtual limits

The actuator can stop at a virtual limit, which can be pre-set from the factory or configured in Actuator Connect™. This way, the actuator will no longer run to the physical end of the stroke, but stop at the desired position instead.

The virtual limits can be configured in both directions with the following limitations:

- 70 mm - max. stroke in outwards direction
- 0-35 mm in inwards direction

The virtual limits can be set manually if the stroke limitation is known in advance, or automatically by using Learning mode. Learning mode is a feature where the actuator automatically stores new virtual limits in a blocking situation. The Learning mode functionality is based on the following criteria:

- Zone(s) where the actuator is allowed to store a new virtual limit
- Current limits used to detect the blocking situation
- Step back (mm) if the actuator should reverse from the obstacle, before storing the virtual limit
- Speed in Learning mode (%)

Option 1: Learning mode in Actuator Connect

The criteria mentioned above can be configured in Actuator Connect. It is also possible to complete the learning process and see the stored virtual limits. The actuator saves configuration of zone sizes, current limits etc. to support future Learning mode procedures with option 2 below. If the actuator encounters an error, Learning mode will be interrupted and it will be necessary to restart the process once the error is handled.

Option 2: Learning mode in the application (wires)

The actuator must be powered before engaging manual Learning mode. The Red and Black wires are used to manually set the actuator in Learning mode. Find a description of the procedure below:

	Learning mode - manually
Prerequisite	Power must be applied to the actuator via Brown and Blue throughout the entire Learning mode process
Initiate Learning mode	Apply VCC on the Red and Black wires for 5-10 seconds Both wires must be connected within 0.5 seconds of each other
	Disconnect all wires and wait max. 2 seconds before the next step
In Learning mode	The actuator is now in Learning mode. Choose to either extend or retract the actuator, depending on which direction you want to save a new virtual limit. To extend the actuator: Connect Red wire to VCC To retract the actuator: Connect Black wire to VCC It is possible to switch between wires/direction, but a time limit of 2 seconds must be considered
Learning mode completed	Once the actuator has stopped on a current cut-off (obstacle), the actuator will save the virtual limit. Normal operation can be resumed. After stopping on a current cut-off, the actuator can only run in the opposite direction
Abort Learning mode	Abort Learning mode by disconnecting the Red and Black wires for more than 2.0 seconds (no virtual limits will be set)
Reset virtual limit or set in the other direction	Repeat the process from 'Initiate Learning mode'

Table 8 Learning mode

Visually, the procedure looks like this:

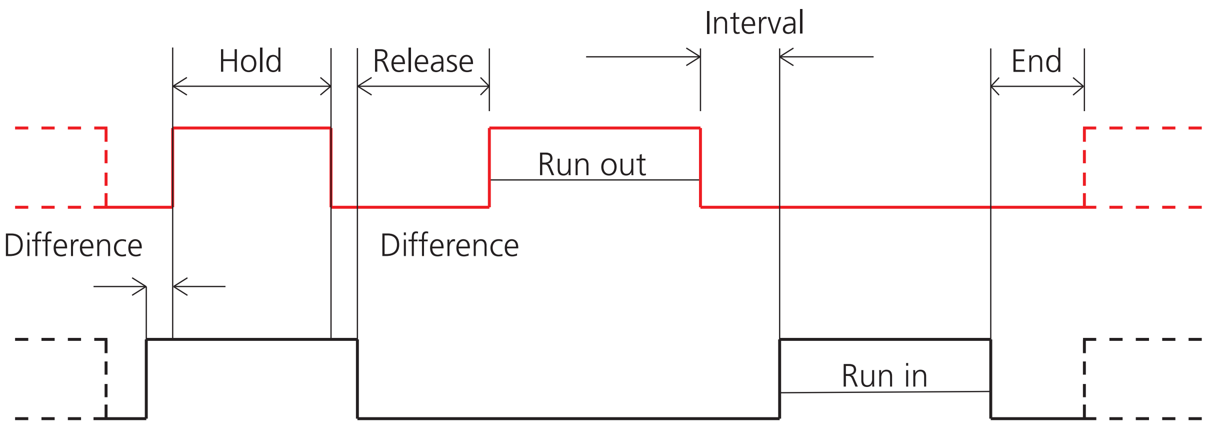


Figure 8 Learning mode - Manually

It is important that the actuator is initialised on a regular basis to avoid lost position. In the event of a lost position, the actuator will not be able to stop at the virtual limit(s) and will instead run to the physical end of stroke.

Position feedback

Achieve optimal performance in your application. Receiving feedback from your actuator makes it easy and fast to read out the position of the actuator. The actuator position can be read out as either a differential analogue output or as a digital output.

Analogue output

The actuator offers a differential analogue output on the Orange and Light Blue wires. This circuit has a separate power supply to ensure stability and high quality of the signal - even for long distance cabling to the PLC or controller. Choose between current [mA] or voltage [V] for the output signal and configure the range to fit the requirements of your controller.

If not otherwise specified, the default ranges are 4-20 mA and 0-10 V for the analogue output. Please note that a constant signal of the max. value (in both cases) is used to flag a Position lost error.

The actuator can scale the feedback signal according to virtual limits (new stroke) if these have been configured. An example hereof could be an actuator with a physical stroke length of 300 mm, where a virtual limit is set to 200 mm in outwards direction. At 200 mm, the analogue output signal would show either 20 mA or 10 V when scaling is enabled.

The table below provides specifications about the two analogue feedback types:

Feedback type	Specifications	
Current (4-20 mA)	Tolerances:	+/- 0.25 mA
	Signal bandwidth:	20 Hz
	Transaction delay (0-100 %):	100 ms
	Linear feedback:	1%
	Output:	2-wire, sink
	Serial resistance:	150 ohm
Voltage (0-10 V)	Tolerance:	+/- 100 mV
	Maximum 20 kHz ripple:	10 mVrms
	Signal bandwidth:	500 Hz
	Transaction delay (0-100 %):	1.8 ms
	Linear feedback:	1%
	Output:	2-wire, source
	Generator impedance:	50 ohm
	Maximum output current:	2 mA

Table 9 Analogue output

Wiring diagram for analogue output

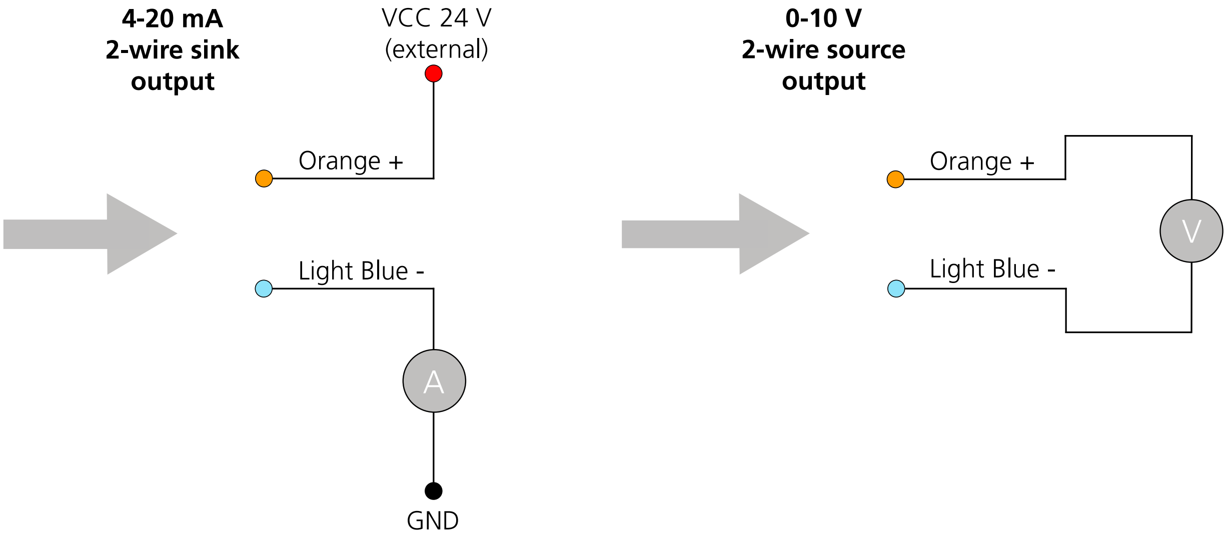


Figure 9 Wiring diagram for analogue output

Analogue output or digital input

The Orange and Light Blue wires can be used for either analogue output or digital input. Learn more about the flexible options with I/O™ in sections "Inputs and outputs - wiring flexibility" and "Predefined positions".

Digital outputs

The actuator offers several digital position output options. Configure the two digital outputs exactly to your needs. To offer full flexibility, the Yellow and Green wires can be used for the following outputs:

Wires	Outputs available
1. Digital position output - Yellow wire	Endstop reached (inwards) Endstop zone reached (inwards) - At current cut-off - At endstop zone Endstop reached (both directions) Parallel endstop reached (inwards) Target position reached Single Hall XOR Dual Hall (A) Actuator running Constantly high Constantly low Not in use
2. Digital position output - Green wire	Endstop reached (outwards) Endstop zone reached (outwards) - At current cut-off - At endstop zone Endstop reached (both directions) Parallel endstop reached (outwards) Target position reached Single Hall XOR Dual Hall (B) Actuator running Constantly high Constantly low Not in use

Table 10 Digital outputs

The maximum output voltage of the digital signal is VCC (Brown and Blue) -1 V.
The digital output voltage is proportional with the input voltage of the actuator.

Endstop reached

Endstop reached can be used to determine when the piston rod reaches the physical end of the stroke in inwards or outwards direction. If a virtual limit is set, the actuator will also send an endstop reached signal. This digital signal comes in two types:

- Active high (default)
- Active low

When the signal is configured as active high, the signal output will become high (VCC-1 V) when the piston rod reaches the end of the stroke. The signal output will remain high as long as the piston rod is not running in the opposite direction, or the actuator is powered off. If the actuator is re-powered, the endstop signal will be high if the actuator is kept in the same position as previously. The digital signal between the two endstops will be considered as low (0 V), as illustrated here:

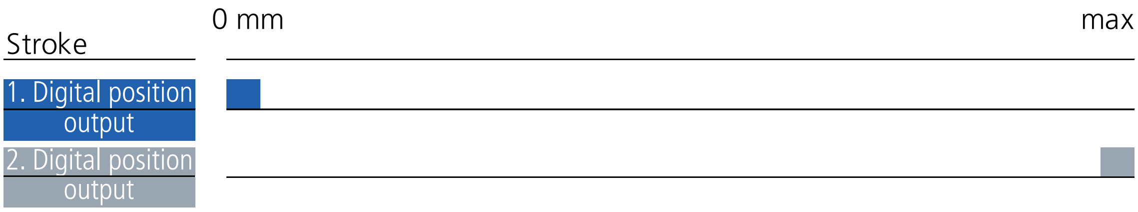


Figure 10 Endstop reached - Active high

Endstop reached

By choosing an active low signal, the digital output will have a high signal (VCC-1 V) when the actuator is operated between the two endstops. When the actuator reaches an endstop, the signal will become low (0 V), as long as the actuator is not running in the opposite direction. This is illustrated here:

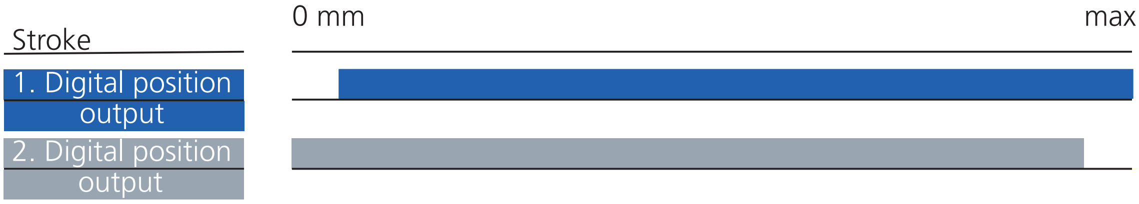


Figure 11 Endstop reached - Active low

Hysteresis for endstop signal

The actuator has a high self-locking ability, which ensures that the actuator maintains its position when stopped and load is applied. Depending on the mechanics (gearbox and spindle) and the applied load, there is a risk of back driving away from the endstop position. Hysteresis allows you to keep the signal high on the endstop output, even when the actuator has moved slightly away from the physical or virtual endstop. The default value is set to two pulses from the Hall magnet, which is between 0.2-1.4 mm (depending on actuator model).

Endstop zone reached

Endstop zone reached is specifically designed for use in applications where tolerances can change over time. In some scenarios, it might not be possible to reach the physical or virtual endstop due to limitations and tolerances in the application. By configuring an endstop zone, the controller will receive a signal via the digital output, based on one of these options:

- At endstop zone (when entering the zone)
- At current cut-off (within the endstop zone)

Like endstop reached, these two options can be configured as either active high or active low.

At endstop zone

When the actuator reaches an endstop zone, it will send a signal to the digital output. It will keep this signal as long as the actuator position is inside the defined zone. When the actuator exits the endstop zone in either inwards or outwards direction, the signal will change status again. If the actuator encounters an obstacle inside the zone and stops on a current cut-off, the signal on the digital output will not change status. If the actuator is powered down and powered up again and the actuator position is still inside the zone – the signal output stores the last saved status. The size of the zone can be defined in mm, and minimum zone size depends on the spindle pitch and the type of actuator.

For an active high signal, the signal will look like this:

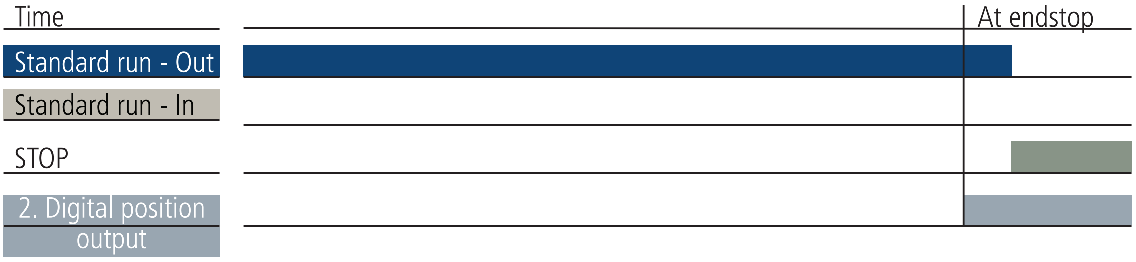


Figure 12 At endstop zone - Active high signal

At endstop zone

For an active low signal, the signal will look like this:

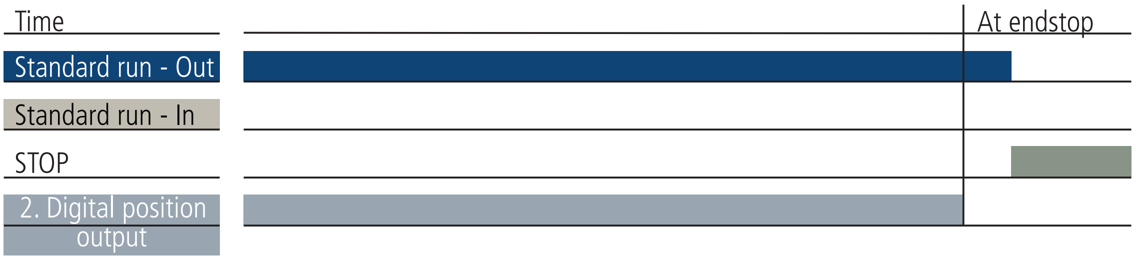


Figure 13 At endstop zone - Active low signal

By using both digital output 1 and 2, it is possible to set endstop zones in both directions. In this case, it is important that the zone in inwards directions is kept between 0-34.9 mm outside the Zero Point Initialisation area.

At current limit

Similar to ‘at endstop zone’, it is possible to define a zone where a current limit will change the status of the digital output. In this case, the actuator can send a digital signal if it meets an obstacle inside the endstop zone OR it reaches the physical endstop or the virtual limit. One of these two conditions must be fulfilled before the digital output changes status. If the actuator stops because of an overcurrent, the status will change and remain like this as long as the power is on, and it will also save this status even if it is powered off.

For an active high signal, the signal at overcurrent inside the zone looks like this:

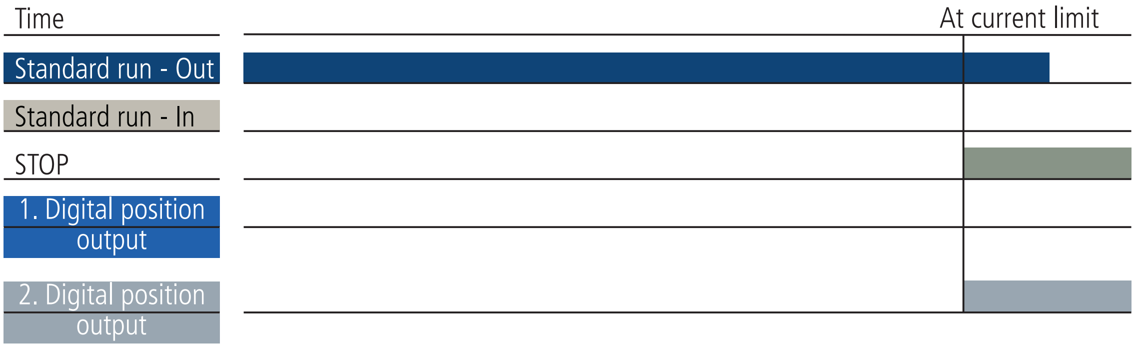


Figure 14 At current limit - Active high

For an active low signal, the signal will look like this:

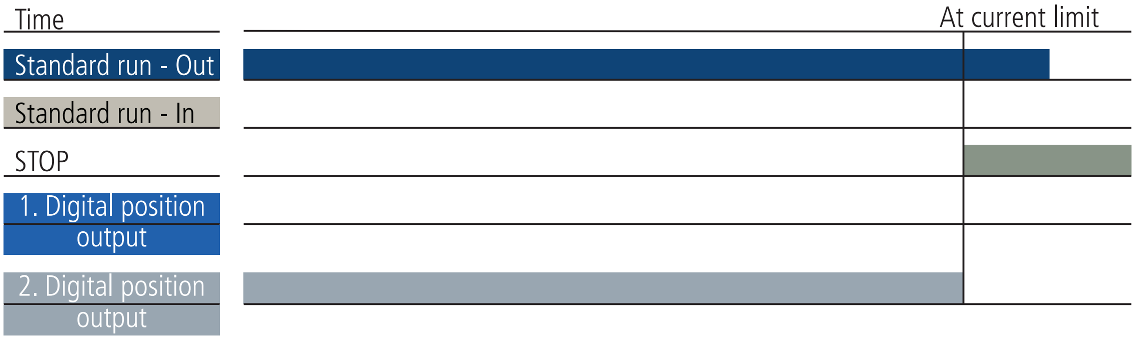


Figure 15 At current limit - Active low

Endstop reached (Both directions)

Due to the complexity of various applications and the need for additional information from the actuator, both endstop reached signals can be combined onto a single wire.

This means that both signals will be represented as either active high or active low signals on one digital output.

The digital signal outputs are illustrated below:

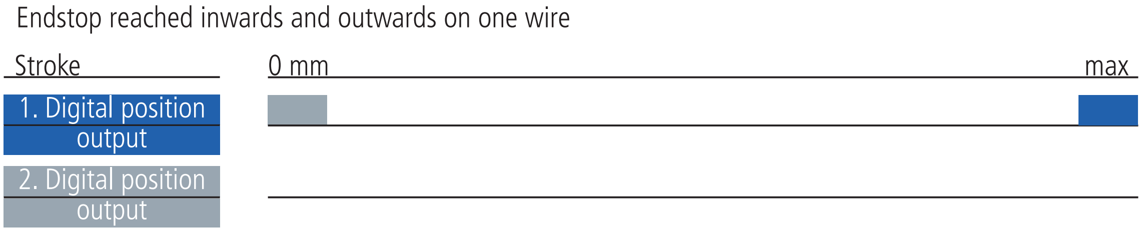


Figure 16 Endstop reached (Both directions)

Parallel endstop reached

When operating actuators in parallel, selecting the appropriate endstop reached output is essential. A dedicated parallel endstop reached output is designed specifically for this scenario, taking into account the tolerance in movement within the application.

It is important to note that not all actuators will consistently reach their physical end of stroke simultaneously; minor discrepancies can occur.

For example, consider a system with a 100 mm stroke. If one actuator reaches the physical or virtual end of stroke first, the others may stop at varying positions, such as one reaching 100 mm while others only reach 99.5 mm. Once the first actuator reaches its endstop, all actuators will send a designated signal (active high or low) on their respective outputs.

This means that it is sufficient to utilise the endstop signals from just one of the parallel actuators to obtain feedback on the endstop positions.

Target position reached

Target position reached is useful if there is a need for an active high signal on the digital output, when the actuator reaches a specific position. It is possible to choose up to four different target positions on one digital output. To compensate for tolerances and minor back driving, it is also possible to set a hysteresis (in mm). This ensures that the controller receives a digital signal, even if the actuator position is slightly off the target.

The state of the output does not affect the running behaviour of the actuator in any way. When the actuator passes a target position and triggers a high signal on the digital output, it will not automatically stop. It will continue to run as long as the run signal is active on either the Red or Black wire. There are two options, if the actuator should stop on these target positions: configure the actuator for 'predefined positions' where Orange and Light Blue wires are used for running the actuator to a specific position(s) or programme this logic directly in your own controller.

Here is an example of the behaviour on the digital outputs for two target positions reached:

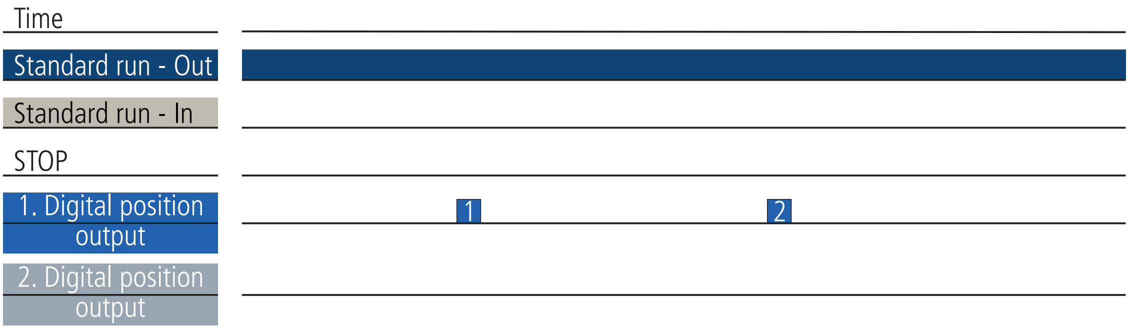


Figure 17 Target position reached

Hysteresis for target positions

Hysteresis is important to consider when target position reached is chosen. If there is no hysteresis (0 mm), then the digital output will be based on a single Hall pulse inside the actuator. The length of the Hall pulse depends on spindle pitch and gearing. The shortest pulse will be equal to 0.110 mm on the stroke and the longest is 0.721 mm. By setting the hysteresis to 0 mm, the actuator will have a very narrow window of sending the high signal on the digital output, which can result in not getting any signal/or a short signal duration. There is only one value for hysteresis, which is applicable in both directions and for all target positions.

Below is an illustration of the digital output signal in a scenario with/without hysteresis:

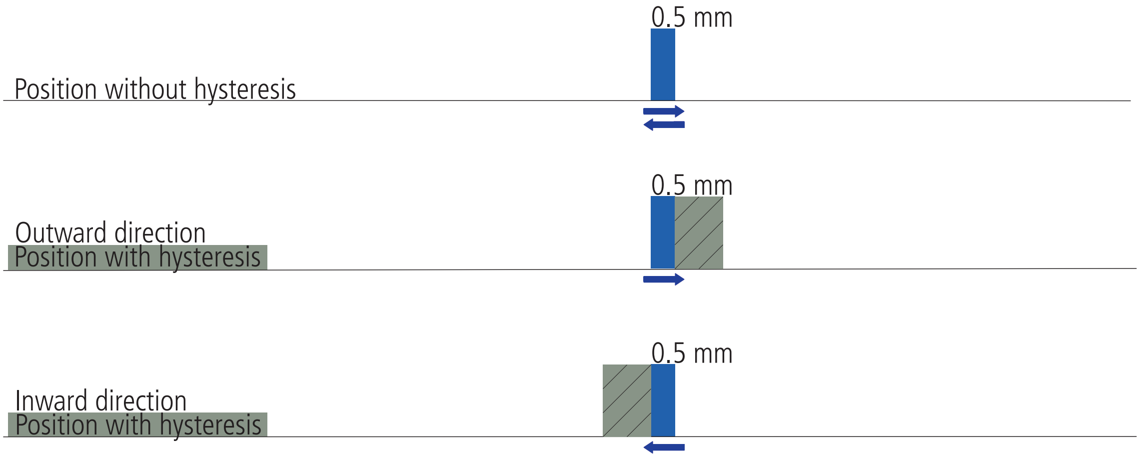


Figure 18 Digital output signal with/without hysteresis

Target position reached can be used in combination with 'predefined positions' - make sure the same positions are set (in mm) on both the digital output and the predefined positions on Orange and Light Blue wires.

Single Hall XOR

Single Hall XOR is a feedback option where a single Hall signal is formed by a quadrature of two Hall signals. The microcontroller counts the pulse flanks (up and down), thereby creating a single but more accurate feedback output. The accuracy of the feedback (number of pulses) depends on three variables: number of poles on the magnet, spindle pitch and gearing. A rule of thumb is that a low spindle pitch will provide the best accuracy on the output side.

An example could be an LA36 with 8 mm spindle pitch and C-gearing (6,800 N option), where the feedback resolution is 0.110 mm per pulse count.

For a faster actuator with 20 mm pitch and F-gearing (500 N option), the resolution is 0.721 mm. A pulse count means every time there is an upward moving or downward moving flank of the pulse, as illustrated here:

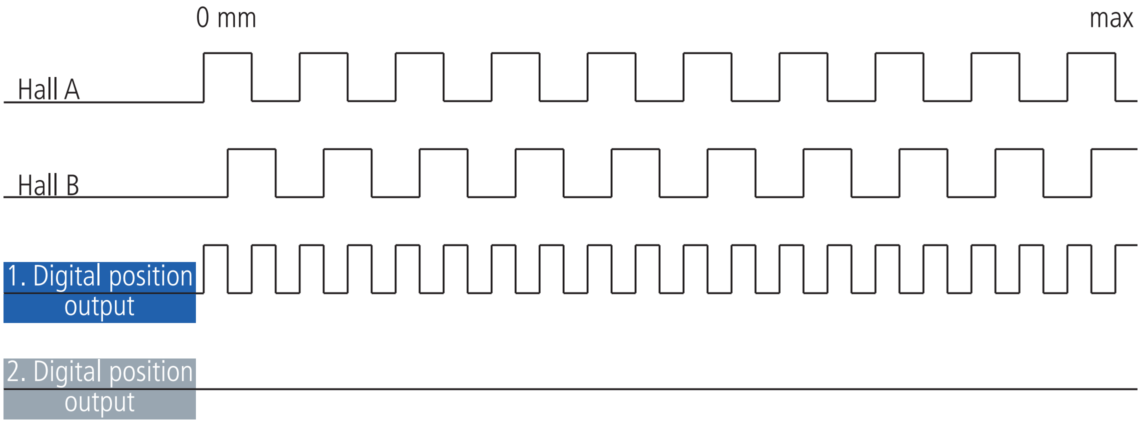


Figure 19 Single Hall XOR

Dual Hall

Dual Hall is a position feedback type where both digital outputs are used for Hall A and B signals. In this case, there is no quadrature of the signal internally in the microcontroller, and the output will get the ‘raw’ data from the Hall element. A benefit of using dual Hall is to know the direction of the movement, which has to be handled externally for single Hall XOR. Pulses from channel A will always come before B in the phase shift of approximately 90 degrees when running outwards, and pulses from channel B will always come before A when running inwards. The PLC will need two inputs for handling dual Hall signal. By having the two signals and knowing the direction of travel, it is also possible to distinguish between normal operation and a slight back drive of the actuator (e.g. high load and lack of self-locking ability).

The dual Hall signal is as illustrated here:

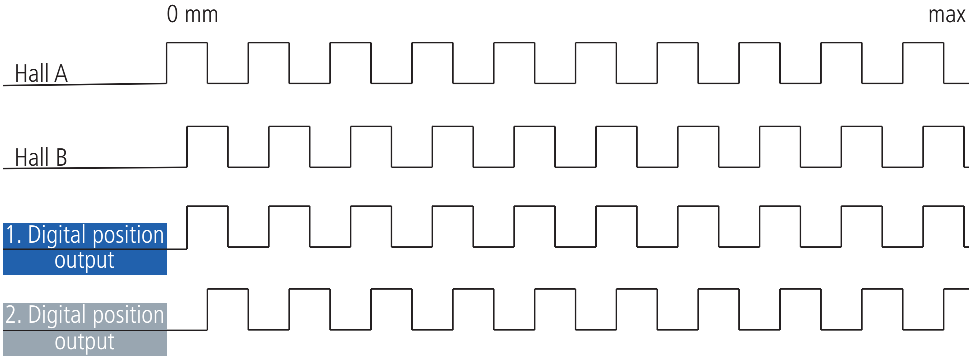


Figure 20 Dual Hall signal

Actuator running

By using a digital output for actuator running, it is possible to get a signal if the actuator is moving or not. This signal can be either active high or active low.

When choosing the active high signal, the digital output will remain high if the piston rod is moving in any direction. When the actuator stops, the signal on the output side will be low - as illustrated here:

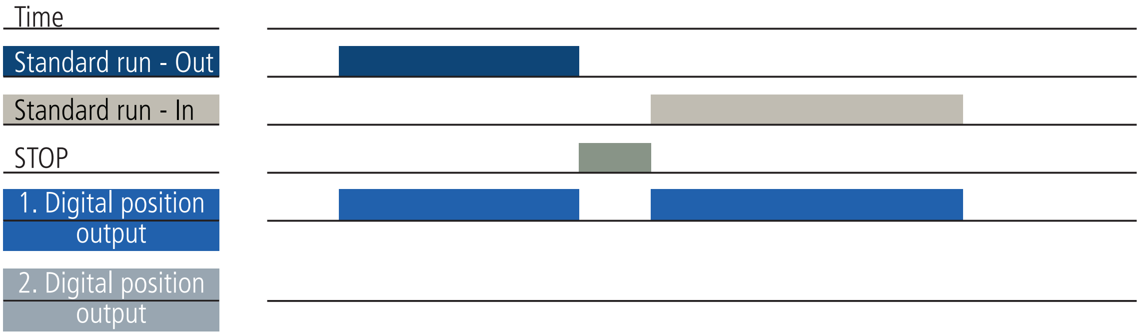


Figure 21 Actuator running - Active high

In the opposite scenario where active low signal is chosen, the digital output will remain low if the piston rod is moving in any direction. When the actuator stops, the signal will be high (if power is still on):

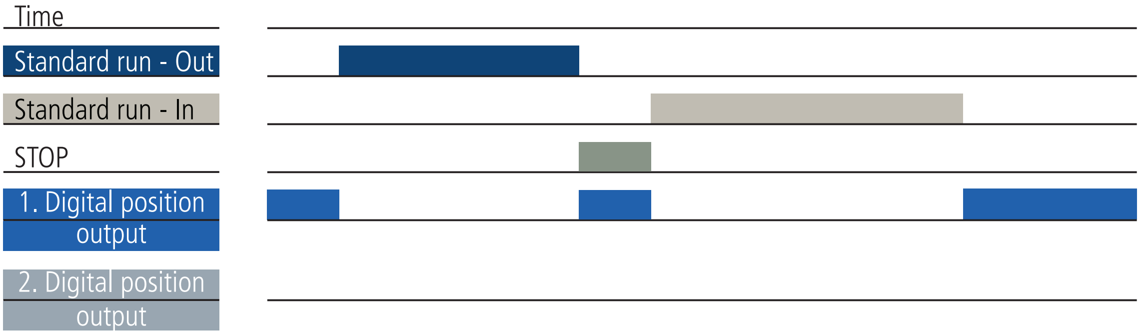


Figure 22 Actuator running - Active low

Constantly high

When choosing constantly high, the signal on the output side will remain high regardless of whether the actuator is moving or not. This feature can be used for supplying/controlling the Red and Black wire (used for standard run). The voltage level on the output side will be approximately VCC-1 V and 100 mA. Constantly high can be chosen on both wires at the same time, if needed.

Figure 23 Constantly high

Choose a 'constantly high' digital output to supply up to 100 mA to one or more push buttons, on a control panel - allowing them to run the actuator in both directions by short circuiting the Red or Black wire to the digital output.

Constantly low

When constantly low is chosen for a digital output, there is a current limited GND. Please note that current draw cannot exceed more than 10 mA before it will shut down.

A digital output can also be 'not in use' and in this case there is no functionality on the wire (not even GND).

Protection

Prevent damage and breakdowns by protecting your application from improper use. Several features can help you achieve the perfect performance of your application.

Current limit

Current limits can be configured to avoid crushing when meeting an obstacle. These values can be adjusted according to your preferences.

It is important to note that current limits should not be relied upon as a general stop function, as this will potentially stress the mechanics and could lead to long-term damage to the actuator.

Furthermore, current limits do not correlate directly with the actuator's load curves, meaning they should not be used as indicators of load. Various tolerances in components such as the spindle, nut, and gears can also affect the current consumption of the actuator. Operation in environments with temperatures below 0°C will also increase the current consumption. When temperature drops below 0°C, the default current limit will change to a higher value.

Actuator specific current limit values (above and below reference temp.) can be found in the respective actuator user manual or in the Actuator Connect service tool under 'Protection'.

The below values are an example of LA36 current limits. For more information about current limit values for LA14, LA25, LA33 and LA37, please see actuator user manual. Please note that the default current limits, above and below the reference temperature, also apply to 'Advanced' current limits.

Standard

Adjusted current limits in both directions with fixed values and with the possibility to set specific values above and below the reference temperature:

Movement	**24 V**	**48 V**	**Temperature**
Outwards	0.0 - 13.0 A Default: 13.0 A	0.0 - 7.0 A Default: 7.0 A	Above
Inwards	0.0 - 13.0 A Default: 13.0 A	0.0 - 7.0 A Default: 7.0 A	
Reference temperature 0 °C			
Outwards	0.0 - 20.0 A Default: 20.0 A	0.0 - 14.0 A Default: 14.0 A	Below
Inwards	0.0 - 20.0 A Default: 20.0 A	0.0 - 14.0 A Default: 14.0 A	

Table 11 Current values - Standard

Advanced

Full control of the actuator with 10 variable current limits in both directions and with the possibility to set specific values above and below the reference temperature. The actuator's stroke length is divided into steps of 10% as seen in the table below:

Movement	**Stroke divided in %**										**Temperature**
	0-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	91-100 %	
Outwards	7 A	7 A	10 A	10 A	10 A	10 A	10 A	13 A	13 A	13 A	Above
Inwards	13 A	13 A	13 A	10 A	10 A	10 A	10 A	10 A	10 A	10 A	
Reference temperature 0 °C											
Outwards	20.0 A	20.0 A	20.0 A	20.0 A	20.0 A	20.0 A	20.0 A	26.0 A	26.0 A	26.0 A	Below
Inwards	20.0 A	20.0 A	20.0 A	15.0 A	15.0 A	15.0 A	15.0 A	15.0 A	15.0 A	10.0 A	

Table 12 Current values - Advanced

Current limit values below temperature limit can only be less than or equal to above current limit values.

The current limiting algorithm

The I/O™ actuator features the latest current limiting algorithm, which has been significantly improved compared to previous versions.

If the actuator's current consumption rises above the set limit, the actuator regulates and tries to keep it below the set current limit by reducing the PWM and therefore also the speed accordingly. The actuator does this continuously, until the actuator stops moving (mechanically blocked) - something that is determined by monitoring the Hall feedback signal. If there are no changes to the Hall feedback signal during the set time frame, the integrated controller will cut power to the h-bridge motor circuit.

If the actuator is stopped due to the above-mentioned criteria, it automatically drives slightly in the opposite direction to reduce the torque in a blocking situation.

This is visualised in the figure below:

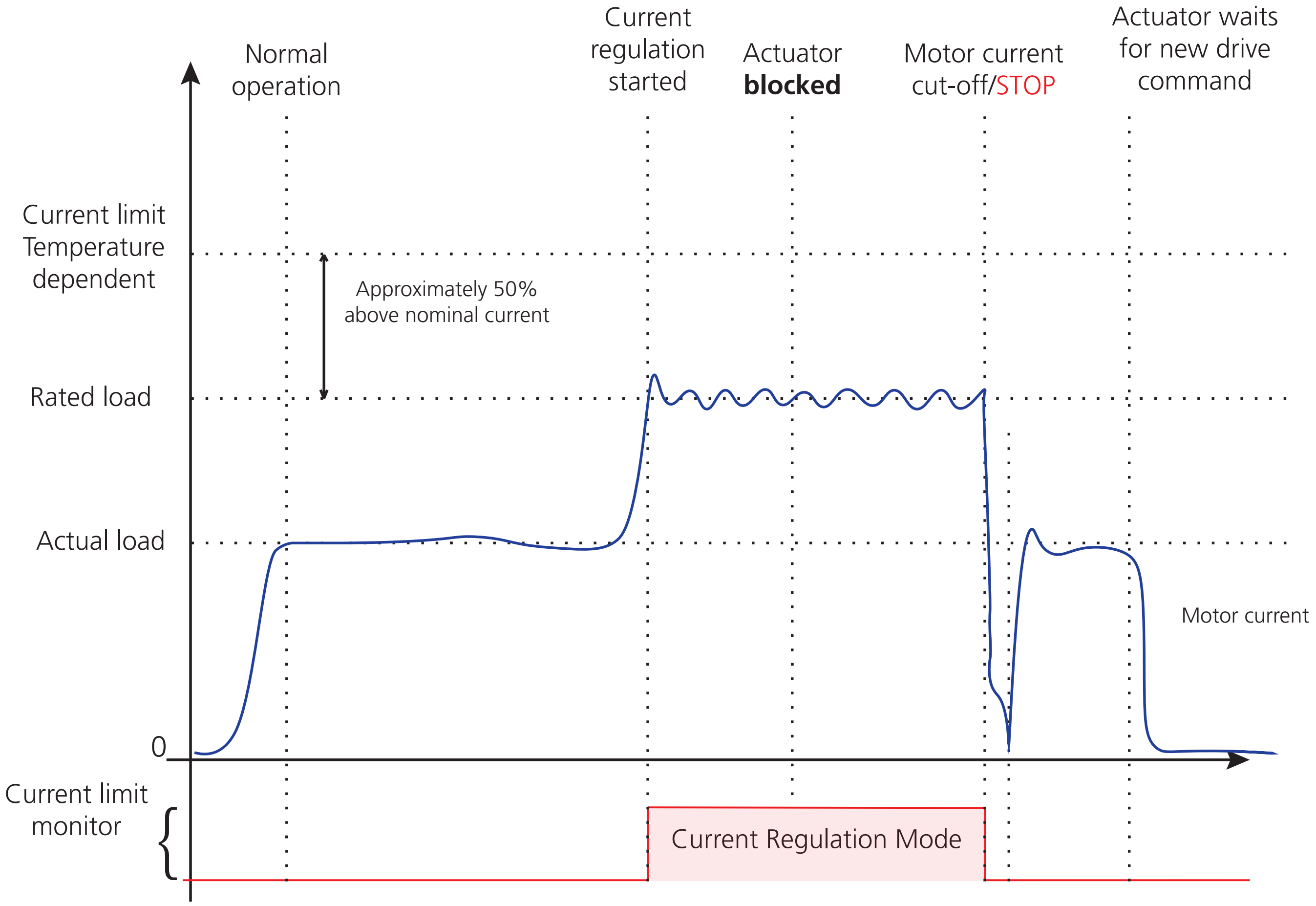


Figure 24 Current limiting algorithm

This control feature makes it possible to avoid loading the internal mechanical system of the actuator above its specification, which ultimately means a longer life for the actuator, especially in an abuse scenario.

The I/O™ actuator comes with factory default current limits. These values can be customised with the 'Protection' option in Actuator Connect™ or when ordering the actuator.

Start/stop settings

To prevent damages and breakdowns and thereby protecting your application, several features can be used to obtain a smoother movement of your application when looking at the following:

- Ramp-up time (in both directions)
- Ramp-down time towards endstop
- Ramp-down time at manual release

Ramp-up time defines an acceleration rate which can create a smoother movement in every application. Ramp-up time can be adjusted in the outwards and inwards direction with two individual time settings (ms). The standard value is set to 300 ms ramp-up time to avoid inrush current when starting to run the actuator. The ramp-up time can be adjusted from 300 ms up to 30,000 ms if needed. To avoid any stress on the actuator, it is not recommended to use 0 ms for ramp-up due to higher inrush current.

Ramp down time towards physical or virtual endstop defines the deceleration rate and can also be adjusted in both directions, inwards and outwards. The actuator will start ramping down at a given time before reaching physical or virtual endstop.

The same time range is available for ramp-down (300-30,000 ms) and 0 ms is also possible as a hard stop.

Manual release is the function when an actuator needs to stop in-between physical or virtual endstop. It is possible to choose a ramp down time and instant stop at manual release.

Run condition

The Orange wire can be used as a conditional digital input alongside the Red and Black wire. The functionality can be set to either stop or run. When choosing a stop external precondition, a high signal on the Orange wire will force the actuator to stop, regardless of the status on the Red and Black wire. When the external signal on the Orange wire changes to low, the run signal on the Red or Black wire must be removed and applied again before the actuator movement is allowed.

For more information about the functionality, please see the table below:

Digital 1 Red	**Digital 2** Black	**Digital 3** Orange	**Event**
1	0	0	Run outwards
1	0	**1**	Stop Run condition active
1	0	0	Stop Red input is still active
0	0	0	Stop Red input removed
0	**1**	0	Run inwards
1	0	0	Run outwards

Table 13 Run condition 1

When choosing a run external precondition, a signal on two inputs must be active before the actuator is allowed to run. The logic states of this functionality are shown in the table below:

Digital 1 Red	**Digital 2** Black	**Digital 3** Orange	**Event**
0	0	0	Stop
1	0	**1**	Run outwards Run condition active
1	0	0	Stop Red input still active
0	0	0	Stop
0	**1**	**1**	Run inwards Run condition active

Table 14 Run condition 2

Monitor

The actuator can provide real-time and historic usage data for useful insights. Use this data to learn more about how the actuator performs in your application.

Real-time monitoring output

Go beyond position feedback and use the analogue or digital output to monitor the real-time data. Choose between current consumption (A) or temperature (°C) and specify the range you want to monitor and the output signal needed.

An example could be to monitor a current consumption range between 0-12 A and using the analogue output in voltage (V) between 0-10 V. In this case, 12 A would be presented as a 10 V signal and the feedback level is scaled according to the monitored value between 0-12 A.

The various output options are presented in the table below:

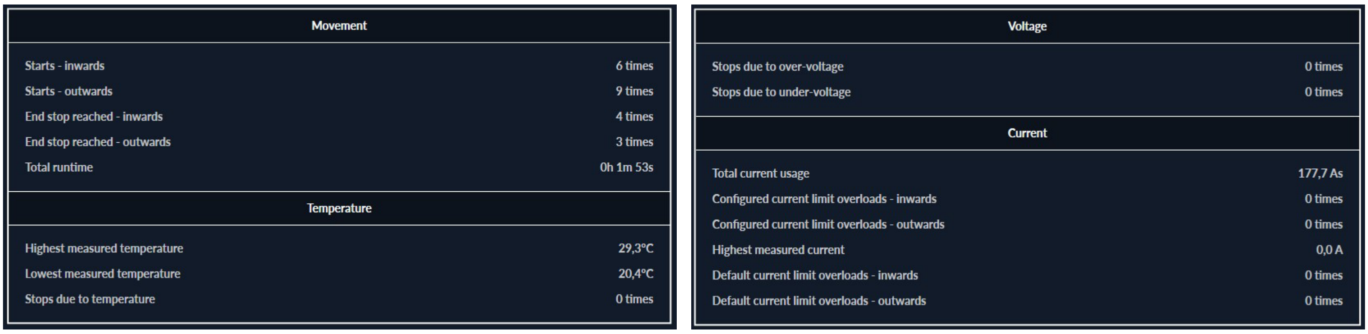
Real-time monitoring	Range	Analogue output	Digital output
Current consumption (A)	0 - max.	Voltage: 0 - 10 V Current: 4 - 20 mA	Digital signal inside current consumption / temperature range
Temperature (°C)	-30°C to +85°C		
Signal type		Differential	Active high or Active low

Table 15 Real-time monitoring output

* can be customised

Historic usage data

From the first time the actuator is powered up, it will start to collect usage data. This information is stored inside the actuator throughout its service life. To extract this information, simply connect the actuator to a PC and use Actuator Connect™ for a quick overview like this:



Movement	
Starts - inwards	6 times
Starts - outwards	9 times
End stop reached - inwards	4 times
End stop reached - outwards	3 times
Total runtime	0h 1m 53s

Temperature	
Highest measured temperature	29,3°C
Lowest measured temperature	20,4°C
Stops due to temperature	0 times

Voltage	
Stops due to over-voltage	0 times
Stops due to under-voltage	0 times

Current	
Total current usage	177,7 As
Configured current limit overloads - inwards	0 times
Configured current limit overloads - outwards	0 times
Highest measured current	0,0 A
Default current limit overloads - inwards	0 times
Default current limit overloads - outwards	0 times

Figure 25 Historic usage data

Use this data to analyse actuator performance in the application and compare it to other actuators that are used for similar tasks.

Diagnostics

Occasionally things stop working and this leaves you with the task of identifying the root cause. Diagnostics can help you to avoid unnecessary downtime in your application and guide you through the troubleshooting. The I/O™ actuator can be equipped with a transparent connector and an LED - enabling fast diagnostics by a simple visual inspection. It is also possible to use Actuator Connect to see the current status and potential error messages. The actuator also logs the last five errors it has encountered, which can give an indication of how frequently the error occurs. Finally, there is the possibility of using a digital output for error codes directly to the controller/PLC.

LED status indicator

The LED can show different colours, depending on the state of the actuator:

LED	Status
🟢	OK
🟡	Inoperative (external errors)
🔴	Inoperative (internal errors)
🔵	Bluetooth® connection

Table 16 LED status indicator

The light from the LED can be used to quickly determine whether the actuator is running as it should or has a fault that needs to be examined more closely.

In addition to creating a visual indicator of the current status, it can also be used to identify which actuator you connected to via Bluetooth® in Actuator Connect™.

If the LED does not light up, try checking the power cable and power supply for improper connections or damage.

The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG Inc. and any use of such marks and logos by LINAK® is under license.

Error log

The actuator logs the last 5 errors it has encountered - data that can be used to identify a pattern. This information can be extracted by using Actuator Connect™, and it shows the following:

- Timestamp
  The actuator will start to collect historic usage data from the first time it is powered up. Each time an error is registered, it will set a timestamp which can be compared to the total powered time of the actuator. This will indicate if the error has occurred recently, or the actuator has been operated a while without errors.
- Times in a row
  If there is a recurring error, the actuator will count the number of the specific error recurrence. A new error type will trigger a new log entry, which will reset the counter. Therefore, it is also a possibility that the same error type is featured multiple times on the error log.
- Error and description
  A total of 13 different error types can be logged inside the actuator. For a complete list and possible remedies, please see the troubleshooting section.

Error codes

For applications where downtime is not an option, the I/O™ interface provides error codes as a digital output for easy troubleshooting. Several error codes can be read out on the digital output.

- Time frame: 10 seconds
- On time of the pulse: 200 ms
- Off time of the pulse: 200 ms

During a time frame of 10 seconds, the actuator will send pulses to the controller (PLC) - depending on the error type - following the pattern in the table below:

Number of pulses (per 10 seconds)	Error type
1	Overcurrent
2	Hardware
3	Temperature
4	Overvoltage
5	Undervoltage
6	Analogue input out of range
7	Position not changing
8	Run signal overruled
9	Initialisation
10	Parallel start-up
11	Parallel running
12	BLDC motor
13	Endstop switch
14	Parallel communication
15	Parallel stopped by slave
25	Position lost

Table 17 Error codes

Error codes

Error	Description
1	**Overcurrent** 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.
2	**Hardware** The actuator has detected an internal hardware error. Try repowering the system or initialise the actuator. If the hardware failure cannot be colved, please contact your local LINAK® office for further assistance.
3	**Temperature** 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	**Overvoltage** 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	**Undervoltage** 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.
6	**Analogue input out of range** The analogue input used to run the actuator (servo or proportional) is out of range. Please make sure that the chosen signal type is within range.
7	**Position not changing** 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	**'Run' command overruled** 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.
9	**Position initialisation not possible** Internal initialisation parameters missing. Contact LINAK.
10	**Parallel arbitration** Start-up parallel configuration procedure in progress.
11	**Parallel running** If one of the parallel actuators is disconnected without the power being turned off, the system will indicate "wrong number of actuators". Please make sure that the number of parallel actuators matches the parallel configuration.
12	**Motor controller** Internal motor controller hardware error. Send 'Clear error' command to clear error. If the error persists, contact LINAK or replace the product.
13	**Endstop switch (N/A for bus interfaces)** Endstop switches are behaving unexpectedly. Example: Both endstop switches have been activated simultaneously for more than 100 ms. Perform the initialisation process by running the actuator fully extended and retracted.
14	**Parallel communication** Incorrect number of actuators in parallel system or wrongly configured. Please make sure that the number of parallel actuators matches the parallel configuration.
15	**Parallel stopped by slave**
25	**Position lost** The actuator has lost track of its position. Please run the actuator completely inwards and run outwards past the area from 35-70 mm to initialise the actuator.

Table 18 Error codes

Error codes

Example 1 - Temperature error

The actuator is equipped with two sensors which monitor two separate internal temperature measurements: FET temperature and ambient temperature. If either of those exceeds the max. temperature, the actuator will stop and start pulsing in the following pattern:

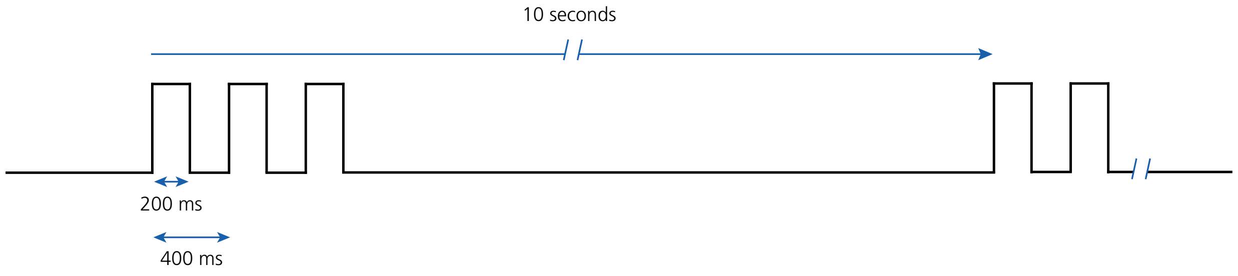


Figure 26 Temperature error 1

The on/off time is 200 ms, and the full length of the error code period is 10 seconds.

The pulses will continue repeating themselves so long as there is a failure on the actuator. The motor will not move even when signal is applied on the Red or Black wire. When the temperature drops down below the reference value, the error code will disappear, and the actuator will be ready to run again.

If the temperature drops below the reference value during the “pulse train” (marked with red), the following pulses will continue coming until the end of the 10 second period. After that, the output will be low again.

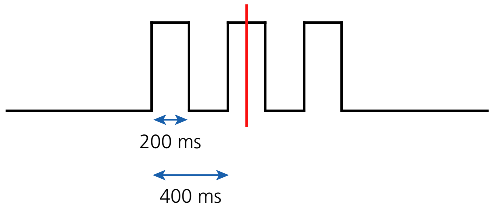


Figure 27 Temperature error 2

Example 2 - Position lost

If an actuator goes into “Position lost state” and needs an initialisation, the actuator will stop and start pulsing in the following pattern:

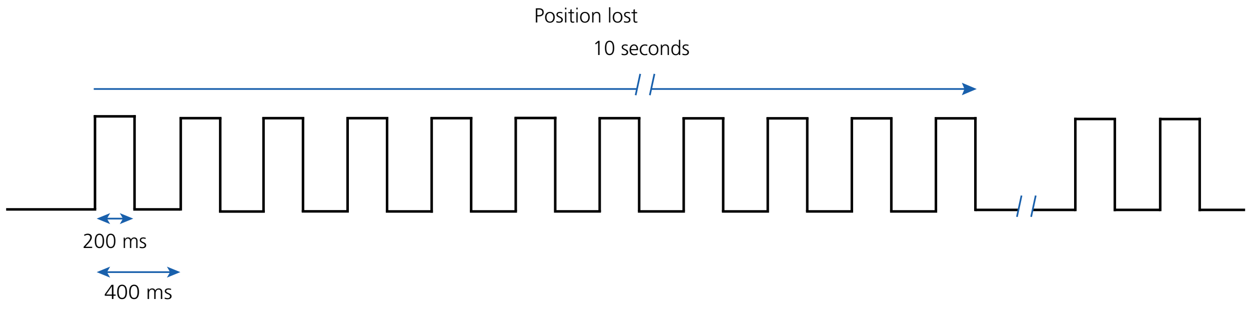


Figure 28 Position lost

The pulses will repeat without pause over a period of 10 seconds, and they will continue repeating over and over so long as an actuator is in Position lost state.

Example 3 - Error priorities

If the actuator experiences Current overload followed by Overvoltage, the actuator will stop and start pulsing in the following pattern:

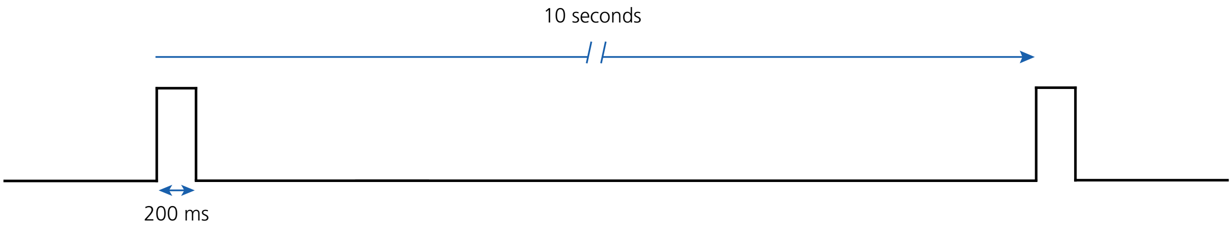


Figure 29 Error priorities

The reason the Overvoltage error cannot be seen in the next pulse train is because of the priority list: Overcurrent has the highest priority and will ignore all the other failures before Overcurrent is cleared.

The priority list is as follows:
1. Overcurrent
2. EOS
3. Hall
4. Temperature
5. Hardware
6. Undervoltage
...

When the Overcurrent error is cleared, the next failure on the priority list (if any) will be shown after the 10 second period is expired.

Bluetooth® Low Energy - wireless connection to PC tool

The I/O™ actuator is equipped with integrated Bluetooth® Low Energy (BLE). This enables fast connection to a PC for easy configuration or troubleshooting in Actuator Connect™ - without having to unplug existing cables when the actuator is mounted in the application.

A Grey wire in the standard cable is used to boost the BLE signal, and this Grey wire should not be connected to the customer controls. This is to compensate for the encapsulation of the antenna inside the aluminium housing of the actuator.

Compatibility

To establish BLE connection, a PC with Windows 10 (version 16299 or newer) is required. The PC must also have integrated Bluetooth® (version 4.2 or newer).

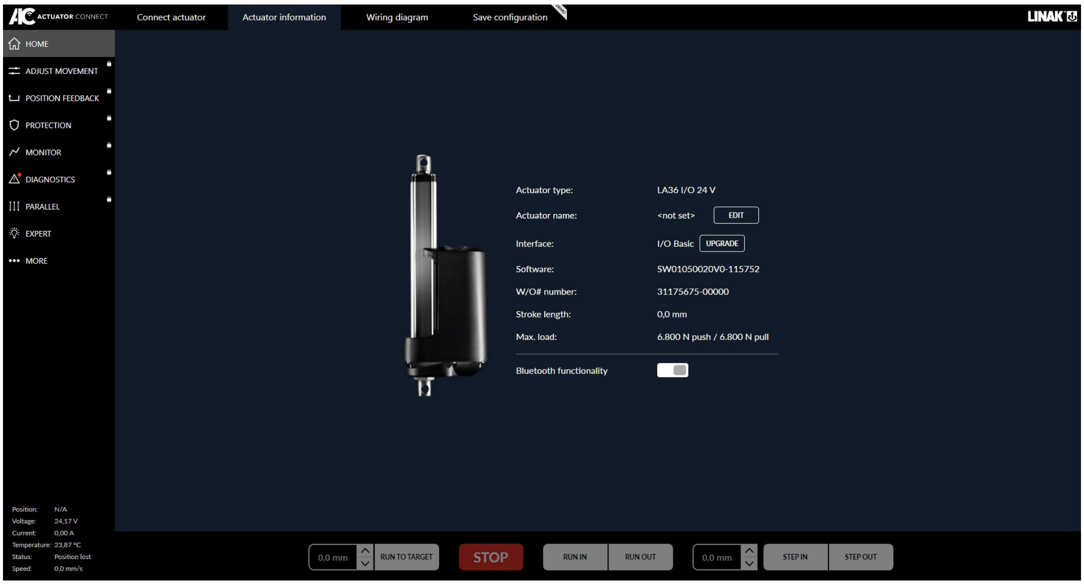
Signal strength

Actuators are used in a wide range of applications in the industry and the Bluetooth® signal strength is affected by other components and machinery.

Actuator Connect - PC tool

Enhance your actuator experience with the intuitive PC tool Actuator Connect:

- Easy connection with Bluetooth® or a USB cable*
- Flexibility in the development phase
- Utilise data to learn about actuator performance
- Diagnostics and troubleshooting



Actuator type: LA36 I/O 24 V
Actuator name: <not set>
Interface: I/O Basic
Software: SW01050020V0-115752
W/O# number: 31175675-00000
Stroke length: 0,0 mm
Max. load: 6.800 N push / 6.800 N pull
Bluetooth functionality

Position: N/A
Voltage: 24,17 V
Current: 0,00 A
Temperature: 23,87 °C
Status: Position lost
Speed: 0,0 mm/s

0,0 mm
0,0 mm

Figure 30 Actuator Connect

The latest version of Actuator Connect can be downloaded here.

* Cable must be purchased separately (item no. 0367996)

The actuator enters ‘Service and configuration mode’ when connected to a PC. Here, the actuator will ignore any run commands on the input wires.

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Zero Point initialisation

Traditionally, electrical switches were mounted at each end of the spindle calibrating the positioning system every time a physical endstop is reached. To get a reliable position feedback from the actuator, it is required to have at least one of these endstop switches activated on a regular basis. If the endstops fail to be activated, the position tolerance will increase over time as Hall pulses on the encoder may be missed, predominantly while powered down.

In an application where full stroke is not required, this can result in imprecise position feedback. This can be the case when a virtual limit is configured or simply due to mechanical tolerances in the application.

A new calibration principle developed by LINAK has changed the way a linear motion can be initialised. The Zero Point technique works independently of electromechanical switches or other mechanical contact. Eliminating the direct electrical contact between two metallic surfaces being operated thousands of times reduces the risk of tear and wear over time. Especially in a challenging operating environment with changing temperatures, humidity, and other factors.

The idea behind the new technology for calibrating the position system is to take advantage of a small magnet located on the moving nut inside the outer tube. This nut moves with the inner tube as it is placed on the spindle and can therefore be used to detect the current position of the actuator. The illustration below shows the cylindrical recess in the spindle nut where the magnet is placed.

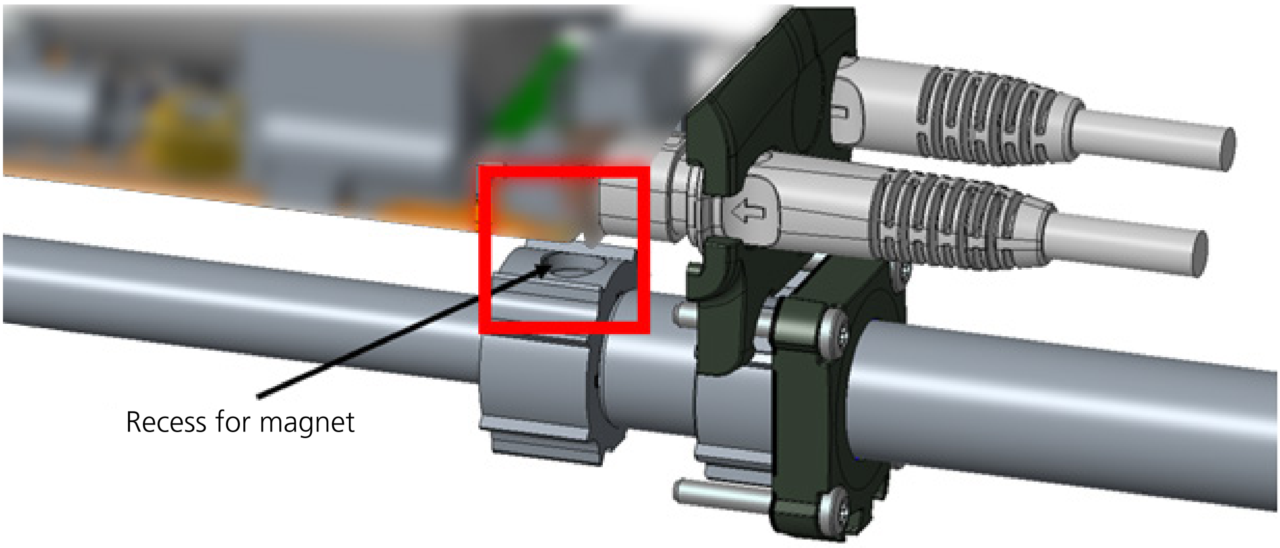

Figure 31 Zero Point initialisation

The Zero Point method makes use of a magnet mounted in a spindle nut, moving past two analogue Hall sensors inside the actuator. These Hall sensors are located on the PCB, and they react when the magnet in the spindle nut passes by - thereby creating a Hall A and Hall B signal. The microprocessor utilises these signals to initialise the position feedback.

To take full advantage of the Zero Point initialisation and its benefits, make sure the Zero Point is crossed as often as possible, preferably at every extension movement.

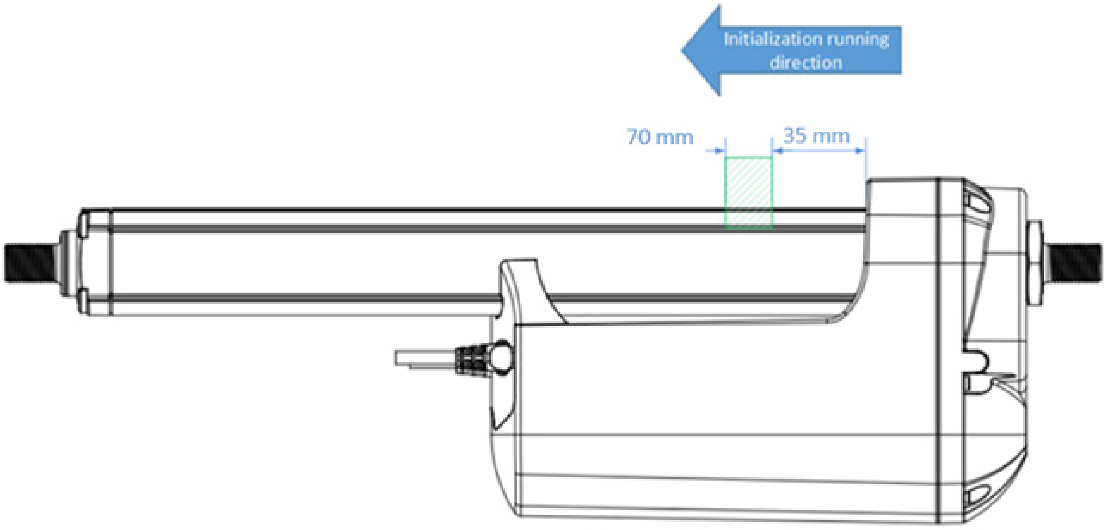

Figure 32 Zero Point crossing

The Zero Point crossing is located between 35 - 70 mm from the fully retracted position and will perform an initialisation at every crossing in the outgoing running direction. Make sure to run fully past the 35-70 mm initialisation area.

Troubleshooting

The table below provides a complete overview of the various error types and possible remedies. The LED distinguishes between internal (Red) and external (Yellow) errors.

LED	Error type	Remedies
🟢	No error	When the actuator is fully operational, the LED will turn Green and the signal will be constantly low. If the colour of the LED or the number of pulses changes, it might indicate a system malfunction.
🟡	Overcurrent (external error)	The actuator has stopped due to overcurrent. Please remove possible obstacle(s) and run in the opposite direction of the blocking.
🔴	Hardware (internal error)	The actuator has detected an internal hardware error. Try repowering the system or initialise the actuator. If the hardware failure cannot be solved, please contact your local LINAK® office for further assistance.
🟡	Temperature (external error)	The actuator has detected high temperature and has been switched off. Please lower the ambient temperature or adjust the duty cycle within range. Also, make sure that the applied load matches the rated maximum of the actuator.
🟡	Overvoltage (external error)	The supply voltage is too high and has caused the actuator to stop. Please check the power supply to make sure that it matches the rated voltage.
🟡	Undervoltage (external error)	The supply voltage is too low and has caused the actuator to stop. Please check the power supply to make sure that it matches the rated voltage and typical amp. consumption of the actuator. Also, ensure that cables are thick enough to avoid voltage drops.
🟡	Analogue input out of range (external error)	The analogue input used to run the actuator (servo or proportional) is out of range. Please make sure that the chosen signal type is within range.
🔴	Position not changing (internal error)	The internal Hall sensor has not seen a pulse for more than 1.5 seconds. This could indicate that the motor is stalling. Try repowering the system or initialise the actuator. If the error cannot be solved, please contact your local LINAK office for further assistance.
🟡	Run signal overruled (external error)	To avoid unintended movement the actuator has ignored the run signal after repowering. Please remove the run signal and try again.
🔴	Initialisation (internal error)	The actuator has detected an internal initialisation error. Try repowering the system or initialise the actuator once more. If the initialisation failure cannot be solved, please contact your local LINAK office for further assistance.
🟡	Parallel start-up (external error)	Upon start-up, the parallel system has detected that the number of actuators is incorrect. Check the configuration in Actuator Connect™ (each actuator must have the same configuration) or check the wiring of the Violet and White wires used for parallel operation.
🔴	Parallel running (internal error)	If one of the parallel actuators is disconnected without the power being turned off, the system will indicate "wrong number of actuators". Please make sure that the number of parallel actuators matches the parallel configuration.
🔴	BLDC motor (internal error)	The actuator has detected an error on the BLDC motor controller. Try repowering the system or initialise the actuator. If the failure cannot be solved, please contact your local LINAK office for further assistance.
🔴	Position lost (internal error)	The actuator has lost track of its position. Please run the actuator completely inwards and run outwards past the area from 35-70 mm to initialise the actuator.

Table 19 Troubleshooting

Initialising the actuator

In general, it is recommended that the actuator is initialised on a regular basis to ensure accurate positioning. This process can also be used to solve simple problems, which may result in an error message.

ⓘ **How to initialise**	To initialise the I/O™ actuator, please start by driving the actuator to its fully retracted position. Then run the actuator past the Zero Point initialisation area (at least past 70 mm) in the outwards direction - preferably in a smooth movement with fixed speed.

Parallel troubleshooting

The parallel system is designed to constantly monitor the status of all actuators present in the system. If the actuator has lost track of its position, the parallel system will enter Recovery mode and initialise itself – here the system runs with reduced speed (50% speed setting) while a run signal is applied (throughout a full stroke length in both directions).

If the system is unable to run in Recovery mode, please continue this troubleshooting process:

1. Check cabling, power supply and communication signals between actuators.
    - See colour on LED for visual inspection of the actuator(s) to locate the one that has caused the system to stop.
2. Connect each of the actuators to the Actuator Connect™ software and look at the current status to learn why the system has stopped.
    - Try to initialise the actuator manually by using the Actuator Connect software (it is a prerequisite that the actuator is either dismounted or allowed to run without the other actuators in the parallel system).
    - If the initialisation process has fixed the internal or external error, the actuator is ready to operate in parallel again.

FCC and IC Statements

For RF-emitting products (e.g. BLUETOOTH®, Wi-Fi) intended to be used on the North American continent, the following applies:

FCC statement:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

IC statement:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L' appareil ne doit pas produire de brouillage;

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