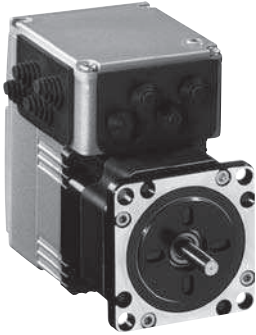


Lexium integrated drives

ILS1 with I/O interface for motion sequence



ILS1 with 3-phase stepper motor

Presentation

The ILS1 with I/O interface for motion sequence consist of a 3-phase stepper motor and integrated electronics. The drive system has integrated interfaces, control electronics, holding brake (optional) and power amplifier.

Application areas

Lexium integrated drives with 3-phase stepper motors offer high torque at low speed of rotation. These Lexium integrated drives are ideally suited as drives in velocity mode with excellent constant velocity characteristics and also for high-resolution positioning. Commissioning the stepper motor drives is simple because it is not necessary to adjust the controller.

Special features

- High continuous stall torque
- Good constant velocity characteristics
- High positioning resolution (0.018°)
- Optionally with holding brake

Control

Up to 16 movement commands can be selected and started directly or sequentially via digital signal inputs. The movement commands can include reference movements or positioning commands. This way, motion sequences can be saved in the drive system and controlled via a master PLC.

The PC commissioning software is used to enter data sets and parameterise the drive system.

Electronics

The electronic system comprises control and power electronics. They have a common power supply and are not galvanically isolated. Four 24 V signals are also available. The assignment of the signal inputs and outputs can be set via parameters.

The electronics are thermally decoupled from the motor by a plastic element.

Supply voltage

These Lexium integrated drives can be operated with a supply voltage of 24 V $\overline{=}$ or 36 V $\overline{=}$.

Connection technologies

ILS1 with I/O interface for motion sequence have the following connections:

- Supply voltage $\overline{0}$ -V
- Multifunction interface
- RS 485 commissioning interface
- 24 V signal interface
- Signal interface for “Safe Torque Off” safety function (“Power Removal”)

Printed circuit board connectors are used for cabling.

Multifunction interface

Up to 16 data sets with movement commands can be selected and started via digital signals of the multifunctional interface.

In addition, two additional signal outputs can be parameterised with special functions.

RS 485 commissioning interface

The RS 485 commissioning interface is used to connect the RS 485 bus for commissioning purposes. A PC can be connected to the commissioning interface via an RS 485-RS 232 converter. The “Lexium CT” commissioning software can be used for tasks such as reading the error memory or monitoring the temperature.

24 V signal interface

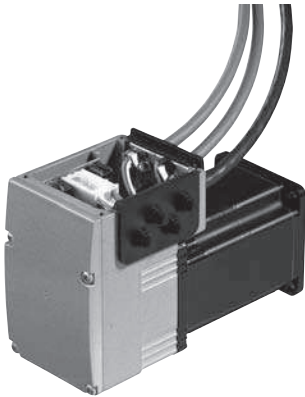
Four digital 24 V signals are available. They can be used as signal input or output. The 24 V signals are available to the master controller. However, they can also be parameterised for special functions, e.g. for connection of limit switches.

The 24 V power supply is internal via the supply voltage of the Integrated Drive System.

Signal interface for “Safe Torque Off” safety function (“Power Removal”)

The integrated “Safe Torque Off” safety function (“Power Removal”) enables a stop of category 0 or 1 as per IEC/EN 60204-1 without external power contactors. The supply voltage does not have to be interrupted. This reduces the system costs and response times.

The “Safe Torque Off” safety function (“Power Removal”) is activated via two redundant 24 V input signals (low active).



Integrated drive system with printed circuit board connectors

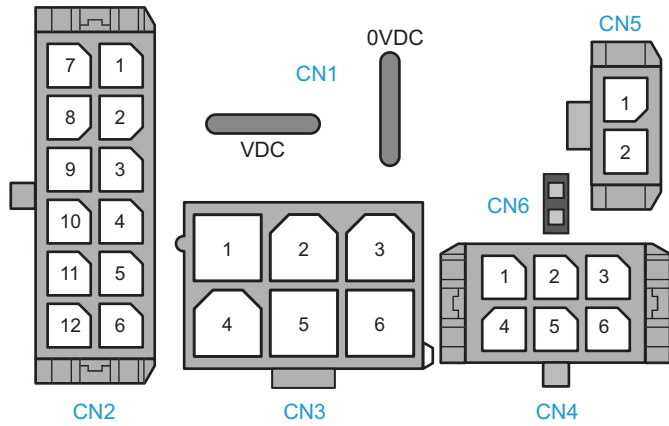
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Connection technologies (continued)

Printed circuit board connector

Printed circuit board connectors are preferably used for cabling series machines with cable harnesses.

- Fieldbus and I/O signal connection with connector “Molex Micro Fit”
 - Power supply connection with “AMP Positive Lock” crimp contacts
- Two cable entries are required for cabling the Lexium integrated drives (see accessories, page 4/107).



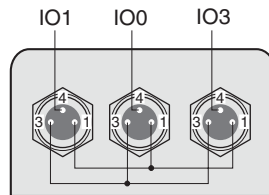
Printed circuit board connector, overview of connections

Connection	Assignment
CN1	Supply voltage $\text{---} V$
CN2	Multifunction interface
CN3	RS 485 commissioning interface
CN4	24 V signal interface
CN5	Interface for “Safe Torque Off” safety function (“Power Removal”)
CN6	Jumper for disabling “Safe Torque Off” safety function (“Power Removal”)

I/O signal inserts

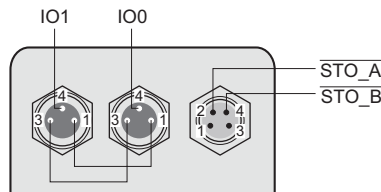
The signals for the “Safe Torque Off” safety function (“Power Removal”) and the freely usable signal input and outputs use industrial connectors. The 24 V power supply to the signal outputs is internal. Different I/O signal inserts are available for this purpose.

I/O signal insert without “Safe Torque Off” safety function (“Power Removal”)



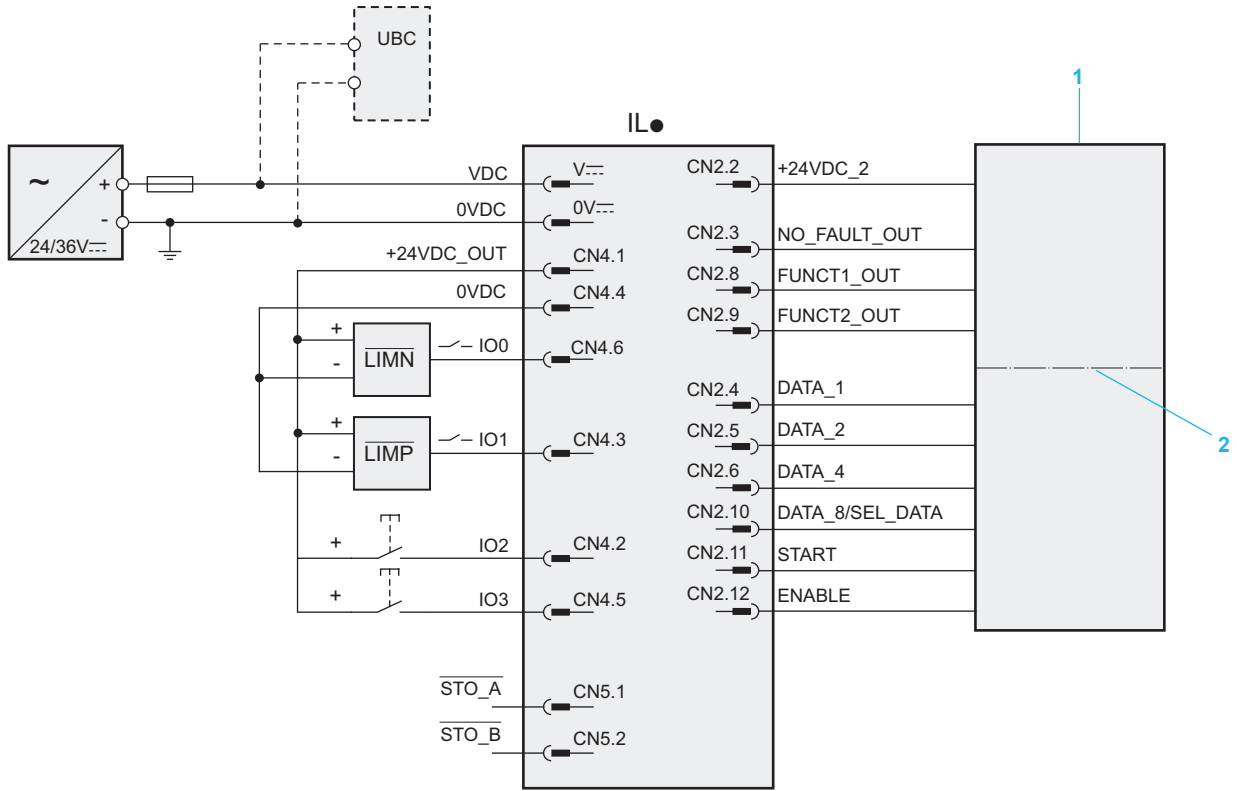
Inserts for three I/O signals

I/O signal insert with “Safe Torque Off” safety function (“Power Removal”)



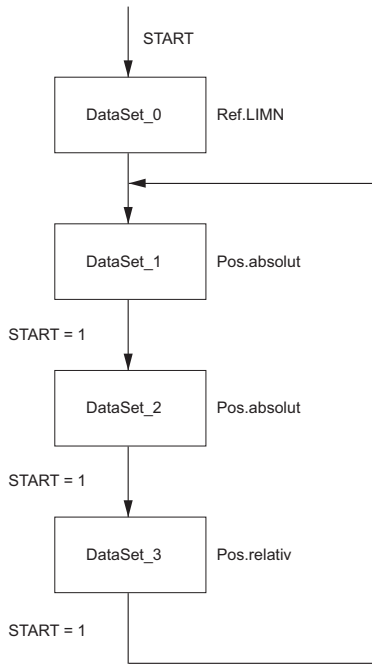
Insert for two I/O signals and STO signals for safety function

Connection example I/O signal connection



Connection example with four I/O signals

- 1 PLC
- 2 Galvanic isolation



Example of sequential selection of movement commands

"Motion Sequence" operating mode

General

In the "Motion Sequence" operating mode, up to 16 data sets with movement commands can be activated directly or sequentially with a PC, fieldbus or digital inputs. The movement commands can include reference movements or positioning commands. This way, a motion sequence can be saved in the drive system and controlled via a master PLC.

The "Lexium CT" PC commissioning software or the fieldbus is used to enter data sets and parameterise the drive system.

Direct selection of movement commands

The direct selection of movement commands is used if a master controller (e.g. PLC) controls the time coordination of the various data sets. The data set to be processed is selected via signal inputs and then activated by a start signal.

Sequential selection of movement commands

The sequential selection of movement commands is used to process simple motion sequences. The time coordination is programmed in the individual data sets via specification of a wait time, a transition condition and the subsequent data set. A transition condition can be, for instance, a rising edge at the START signal input. A motion sequence can also be executed cyclically with or without return to the initial position.

Processing status of a movement command

The processing status of a movement command can be output via the handshake output. In addition, an internal processing status such as "drive system in motion" can be output via an additional signal output.

Selection of the motion profile

Speeds and accelerations are saved in motion profiles. One of the motion profiles can be assigned to every movement command data set.

Operating modes

Overview

The following operating modes can be set via the fieldbus:

- Jog
- Profile position
- Homing

Jog mode

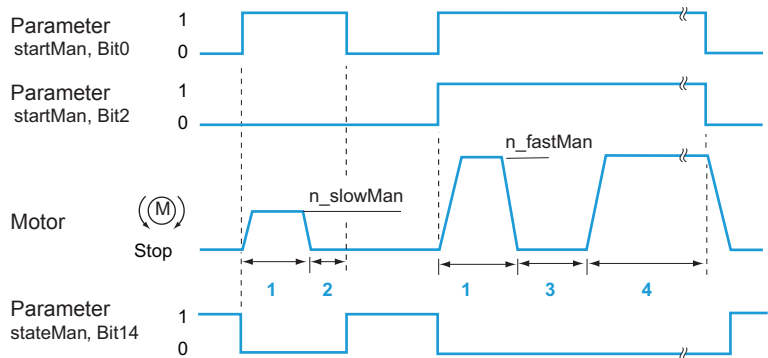
The motor moves by one distance unit or at constant speed in continuous operation. The value of the distance unit, the speed levels and the change-over time in continuous operation can be adjusted manually.

Reference value setting

The reference value is set via PC.

Application example

Setting up a machine during commissioning



Jog, slow and fast

- 1 step_Man
- 2 $t < \text{time_Man}$
- 3 time_Man
- 4 Continuous operation

Profile position

In the operating mode "Profile Position", the motor is positioned from a point A to a point B with a positioning command.

Settings

The positioning path can be specified in two ways:

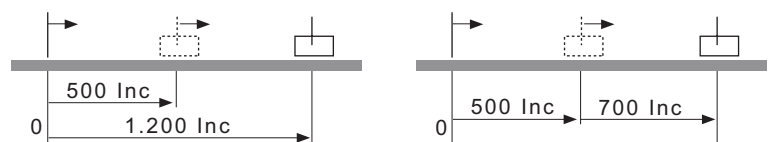
- Absolute positioning, reference point is the zero point of the axis
- Relative positioning, reference point is the current position of the motor

Reference value setting

The reference value is set via PC.

Application example

Pick-and-place with a linear robot



Operating mode "Profile Position", absolute and relative

Homing

There are two types of homing:

- Reference movement
 - Specifying the dimension reference by approach to a limit or reference switch
- Position setting
 - Specifying the position reference relative to the current motor position

Reference movement

During reference movement, the motor moves to a defined position on the axis. The position is defined by a mechanical switch:

- LIMN, LIMP limit switches
- REF reference switch

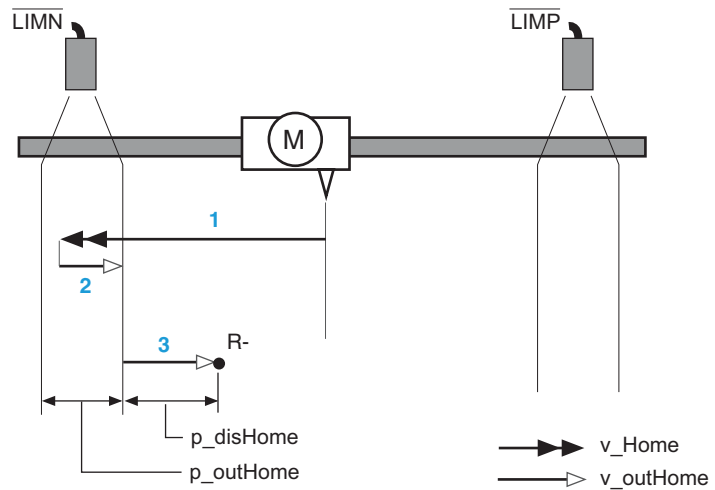
Types of reference movements

There are five standard reference movements:

- Movement to negative limit switch LIMN
- Movement to positive limit switch LIMP
- Movement to REF reference switch with first movement counterclockwise
- Movement to REF reference switch with first movement clockwise
- Reference movement to index pulse with clockwise or counterclockwise rotation

These standard reference movements can be executed without and with index pulse.

Example 1: reference movement to limit switch

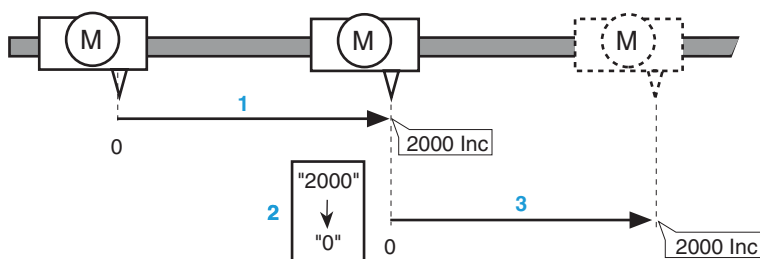


Operating mode "Homing", reference movement to limit switch

- 1 Movement to limit switch at search speed
- 2 Movement to switching edge at clearance speed
- 3 Movement to distance from switching edge at clearance speed

Example 2: position setting

Position setting can be used to execute a continuous motor movement without overtravelling the positioning limits.



Positioning by 4000 increments with position setting

- 1 The motor is positioned by 2000 increments.
- 2 The current motor position is set to position value 0 by position setting to 0 and the new zero point is defined at the same time.
- 3 The new target position is 2000 increments after a new movement command by 2000 increments is triggered.

This procedure prevents overtravel of the absolute position limits during positioning, because the zero point is continuously made to follow.

Reference value setting

The reference value is set via PC.

Application example

Prior to absolute positioning in "Profile Position" mode.

Additional operating modes

Additional operating modes can be activated via PC.

- Reversing direction of rotation of motor
- Setting motion profile via profile generator
- Triggering Quick Stop function
- Function of holding brake
- Programming inputs/outputs.

"Safe Torque Off" ("Power Removal") safety function

The Lexium integrated drive integrates the "Safe Torque Off" ("Power Removal") safety function which prevents unintended restarting of the motor. The motor no longer produces any torque if the safety function is active.

This safety function:

- Complies with the machine safety standard ISO 13849-1, performance level "d" (PL d)
- Complies with the standard for functional safety IEC/EN 61508, SIL2 capability (safety control-signalling applied to processes and systems). The SIL (Safety Integrity Level) capability depends on the connection diagram for the servo drive and for the safety function. Failure to observe the setup recommendations could inhibit the SIL capability of the "Safe Torque Off" ("Power Removal") safety function.
- Complies with product standard IEC/EN 61800-5-2 "Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional" for both stop functions:
 - Safe Torque Off ("STO") corresponds to Category 0 stop according to IEC/EN 60204-1. Standstill by immediate power shutdown to the machine drive elements (i.e. an uncontrolled stop).
 - Safe Stop 1 ("SS1") corresponds to Category 1 stop according to IEC/EN 60204-1. A controlled stop in which the machine drive elements are retained to effect the standstill. The final shutdown is ensured by an external Emergency stop module with safe time delay, e.g. Preventa XPS-AV (1).

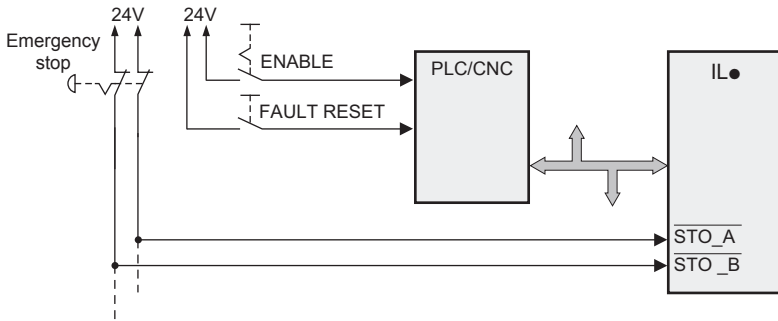
The "Safe Torque Off" ("Power Removal") safety function has a redundant electronic architecture (2) which is monitored continuously by a diagnostics function.

This PL d and SIL2 safety function is certified as conforming to these standards by the TÜV certification body in the context of a voluntary certification.

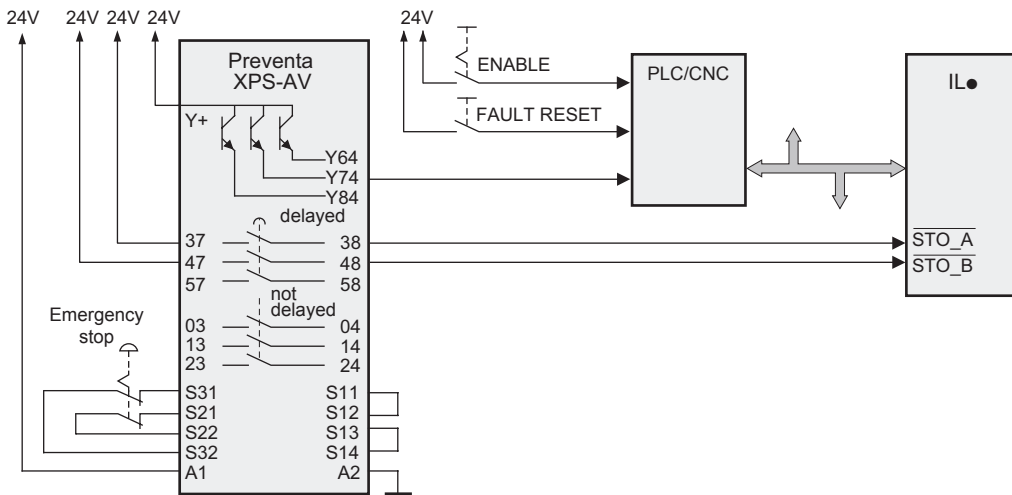
(1) Please refer to the "Safety functions and solutions using Preventa" catalogue.

(2) Redundant: Consists of mitigating the effects of the failure of one component by means of the correct operation of another, assuming that faults do not occur simultaneously on both.

Examples of applications of the safety function



Example of Category 0 Stop



Example of Category 1 Stop

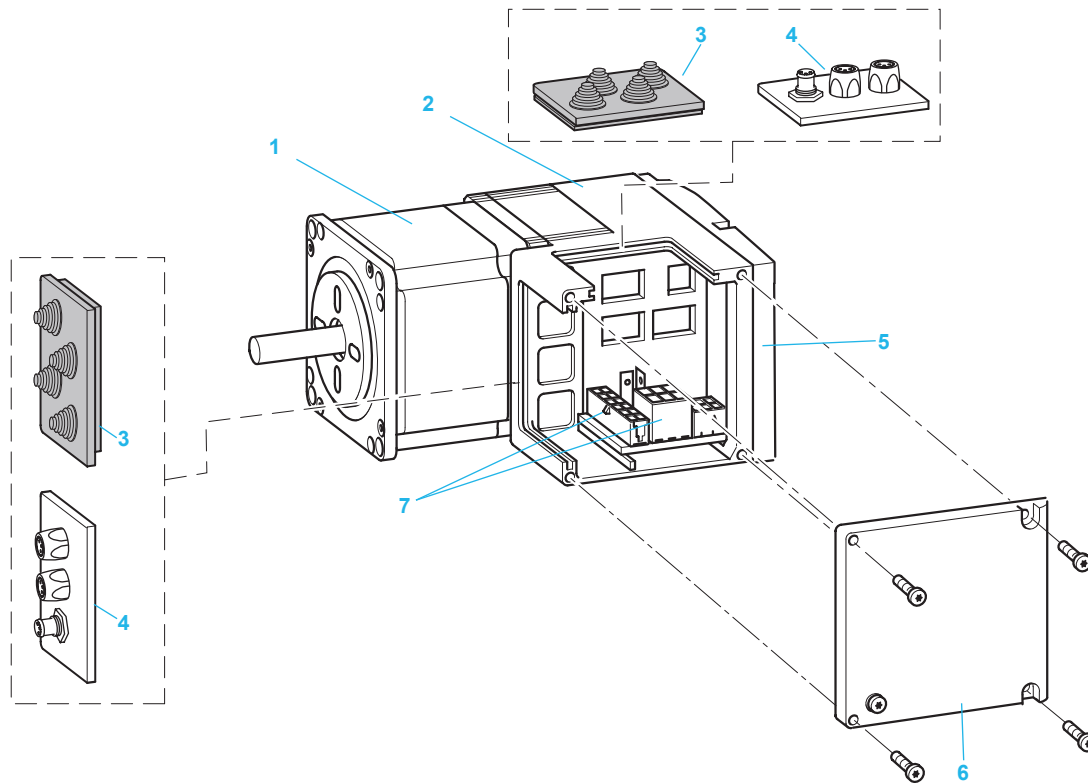
Lexium integrated drives

ILS1 with I/O interface for motion sequence

ILS1 with 3-phase stepper motor

Description

ILS1 with I/O interface for motion sequence consist of control electronics and a 3-phase stepper motor. ILS1 for motion sequence is available with printed circuit board connectors. A holding brake is optionally available for ILS1●85.



- 1 3-phase stepper motor
- 2 Electronics housing
- 3 Insert cable entry (accessory)
- 4 I/O insert with industrial connectors (accessory)
- 5 Cover for electronics housing
- 6 Cover for connector housing
- 7 Electrical interfaces

Certifications		
Conformity to standards		Lexium integrated drives have been developed to comply with the stringent international standards and with the recommendations for electronic control systems in the industry (IEC, EN), specifically: low-voltage switchgear, IEC/EN 61800-5-1, IEC/EN 50178, IEC/EN 61800-3 (noise immunity to conducted and radiated high-frequency signals)
EMC immunity		EN 61800-3:2001, second environment
Conducted and radiated EMC emissions		EN 61800-3:2001-02; IEC 61800-3, Ed.2 ■ Power supplies without external mains filter: <input type="checkbox"/> C3 up to 10 m supply cable length ■ Power supplies with external mains filter: <input type="checkbox"/> C2 up to 20 m supply cable length <input type="checkbox"/> C3 up to 50 m supply cable length
CE marking		The Lexium integrated drives are CE marked in accordance with the European Machinery Directive (98/37/EEC) and the European EMC Directive (89/336/EEC).
Product certifications		UL (USA), cUL (Canada) TÜV certification: Lexium integrated drives are TÜV-certified for device safety and medical devices. The certification includes: ■ Functional safety of electrical/electronic/programmable safety-related electronic systems (IEC 61508:2000; SIL 2) ■ Safety of machinery – functional safety of safety-related electrical and electronic and programmable electronic control systems (IEC 62061:2005; SILcl2) ■ Safety of machinery – safety-related parts of control systems – Part 1: General principles for design (ISO 13849-1:2006; PL d (Category 3))

Ambient conditions		
Ambient temperature (1)	°C	0 ... 65; power reduction by 2%/°C at 50 ... 65
Max. permissible motor temperature (2)	°C	110
Installation height without power reduction	m	< 1000 m above mean sea level
Transport and storage temperature	°C	-25 ... +70
Relative humidity	%	15 ... 85 (not condensing)
Vibration load during operation as per DIN EN 60028-2-6	Number of cycles	10
	Acceleration amplitude:	m/s ² 20
	Frequency range	Hz 10 ... 500
Continuous shocks as per DIN EN 60028-2-29	Number of shocks	1000
	Peak acceleration	m/s ² 150
Thermal class as per DIN EN 60034-1		155 (F)
Shaft wobble and perpendicularity		According to EN 50347 (IEC 60072-1)
Degree of protection as per DIN EN 60034-5		Total except shaft bushing IP54, shaft bushing IP41

Electrical data		
Power supply connection (CN1)		Corresponds to PELV according to DIN 19240, not protected against reverse polarity
Supply voltage range	--- V	18 ... 40
Nominal supply voltage	--- V	24 / 36
Ripple at nominal voltage	V _{pp}	≤ 3.6
Max. current consumption	ILS1M57	A 3.5
	ILS1M851, ILS1M852	A 5
	ILS1M853	A 5
	■ Winding type P ■ Winding type T	A 6
Inrush current		Charging current for capacitor C=1500 µF
External fuse	A	10
Multifunction interface (CN2)		Galvanically isolated from supply voltage VDC; suitable for inductive load (1000 mH)
Voltage supply range	--- V	10 ... 30
Max. switching current per output	mA	50
RS 485 commissioning interface (CN3)		No galvanic isolation; corresponds to RS 485 standard
Transmission rate	kBaud	9.6 / 19.2 / 38.4
24 V signal interface (CN4)		4 signals, each usable as input or output, galvanically connected to 0VDC, not protected against reverse polarity
24 V signal inputs		
Logic 0 (U _{low})	V	-3 ... +5
Logic 1 (U _{high})	V	+15 ... +30
Input current (typical at 24 V)	mA	10
Debounce time IO0..IO3	ms	1 ... 1.5

(1) Limit values with flanged motor mounted on a steel plate 300 x 300 x 10 mm.
 (2) Measured at the surface.

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Electrical data (continued)			
24 V signal outputs		Switching to plus, short-circuit protected, suitable for inductive load (1000 mH / 100 mA)	
Supply voltage range	--- V	10 ... 30	
Max. switching current (total)	mA	200	
Max. switching current per output	mA	100	
Interface for safety function "Safe Torque Off" (CN5)		No galvanic isolation; corresponds to RS 485 standard	
Logic 0 (U _{low})	V	-3 ... +4.5	
Logic 1 (U _{high})	V	+15 ... +30	
Input current (typical at 24 V)	STO_A	mA	≤ 10
	STO_B	mA	≤ 3
Debounce time	ms	1	
Response time (until shutdown of power amplifier)	ms	< 50	
Max. Time offset until detection of signal differences between STO_A and STO_B	S	< 1	

Safety function "Safe Torque Off" ("Power Removal")		
Protection	Of machine	"Safe Torque Off" safety function which forces stopping and/or prevents unintended restarting of the motor, conforming to standard ISO 13849-1, performance level "d" (PL d), and standard IEC/EN 61800-5-2
	Of the system process	"Safe Torque Off" safety function which forces stopping and/or prevents unintended restarting of the motor, conforming to standard IEC/EN 61508 level SIL2 and standard IEC/EN 61800-5-2

Mechanical data ILS1●57				
Type of integrated drive		ILS1●571	ILS1●572	ILS1●573
Winding type		P	P	P
Max. torque	M _{max}	Nm	0.45	0.90
Holding torque		Nm	0.51	1.02
Rotor inertia		kg·cm ²	0.1	0.22
Positioning resolution per revolution			20000	
Systematic angle tolerance per step (1)		arcmin	±6	±6
Mass		kg	1.3	1.6
Shaft load (2)	Max. radial force (3)	N	24	24
	Max. axial tensile force	N	100	
	Max. axial force pressure	N	8.4	
	Nominal bearing service life (4)	h	20000	

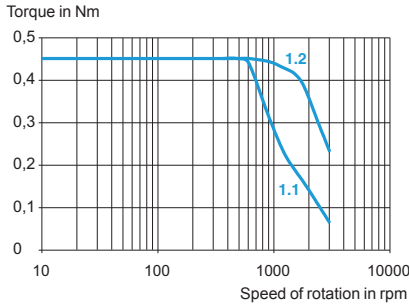
Mechanical data ILS1●85				
Type of integrated drive		ILS1●851	ILS1●852	ILS1●853
Winding type		P	P	P
Max. torque	M _{max}	Nm	2.0	4.0
Holding torque		Nm	2.0	4.0
Rotor inertia		kg·cm ²	1.1	2.2
Positioning resolution per revolution			20000	
Systematic angle tolerance per step (1)		arcmin	±6	
Mass		kg	2.6	3.6
Shaft load (2)	Max. radial force (3)	N	100	100
	Max. axial tensile force	N	170	
	Max. axial force pressure	N	30	
	Nominal bearing service life (4)	h	20000	

Holding brake		
Holding torque	Nm	6
Electrical pull-in power	W	22
Brake release time	ms	40
Brake application time	ms	20
Moment of inertia	kg·cm ²	0.2
Mass	kg	1.8

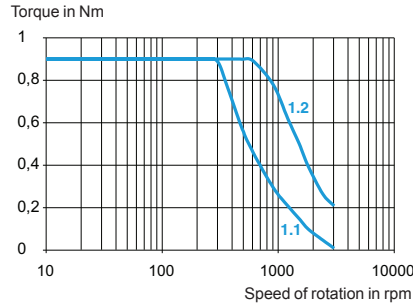
(1) Measured at 1000 steps/revolution, unit: minutes of arc
 (2) Conditions for shaft load: speed of rotation 60 rpm, duty cycle at torque, ambient temperature 40 °C
 (3) Point of application of radial force: 10.5 mm distance to flange
 (4) Operating hours at a probability of failure of 10 %

Torque characteristics ILS1●57

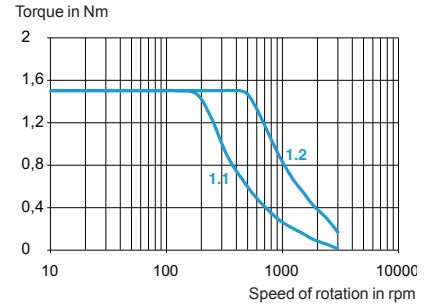
ILS1●571P (winding type P)



ILS1●572P (winding type P)

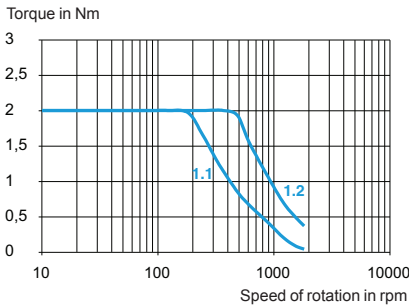


ILS1●573P (winding type P)

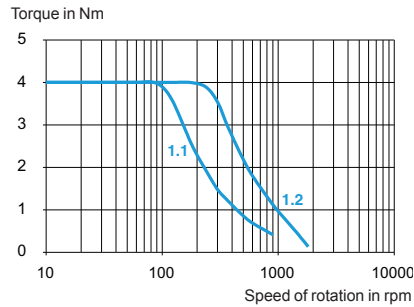


Torque characteristics ILS1●85

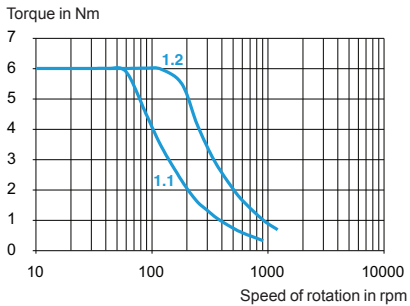
ILS1●851P (winding type P)



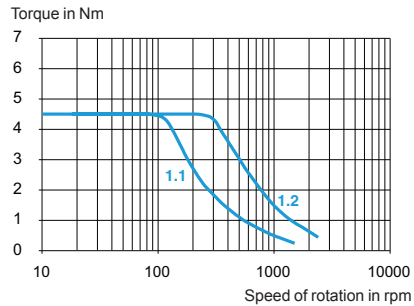
ILS1●852P (winding type P)



ILS1●853P (winding type P)



ILS1●853T (winding type T)



1.1 Max. torque at 24 V
 1.2 Max. torque at 36 V

Lexium integrated drives

ILS1 with I/O interface for motion sequence

ILS1 with 3-phase stepper motor

References												
Example:	I	L	S	1	M	5	7	1	P	B	1	A
Motor type S = 3-phase stepper motor	I	L	S	1	M	5	7	1	P	B	1	A
Supply voltage 1 = 24 ... 36 V	I	L	S	1	M	5	7	1	P	B	1	A
Communication interface M = I/O interface for motion sequence	I	L	S	1	M	5	7	1	P	B	1	A
Flange size 57 = 57 mm 85 = 85 mm	I	L	S	1	M	5	7	1	P	B	1	A
Motor length ("L") (1) 1 = motor length "L" 2 = motor length "L" 3 = motor length "L"	I	L	S	1	M	5	7	1	P	B	1	A
Winding type P = medium speed of rotation, medium torque T = high speed of rotation, medium torque (2)	I	L	S	1	M	5	7	1	P	B	1	A
Connection technology B = printed circuit board connector C = industrial connector	I	L	S	1	M	5	7	1	P	B	1	A
Measurement system 1 = index pulse	I	L	S	1	M	5	7	1	P	B	1	A
Holding brake A = no holding brake F = with holding brake (3)	I	L	S	1	M	5	7	1	P	B	1	A

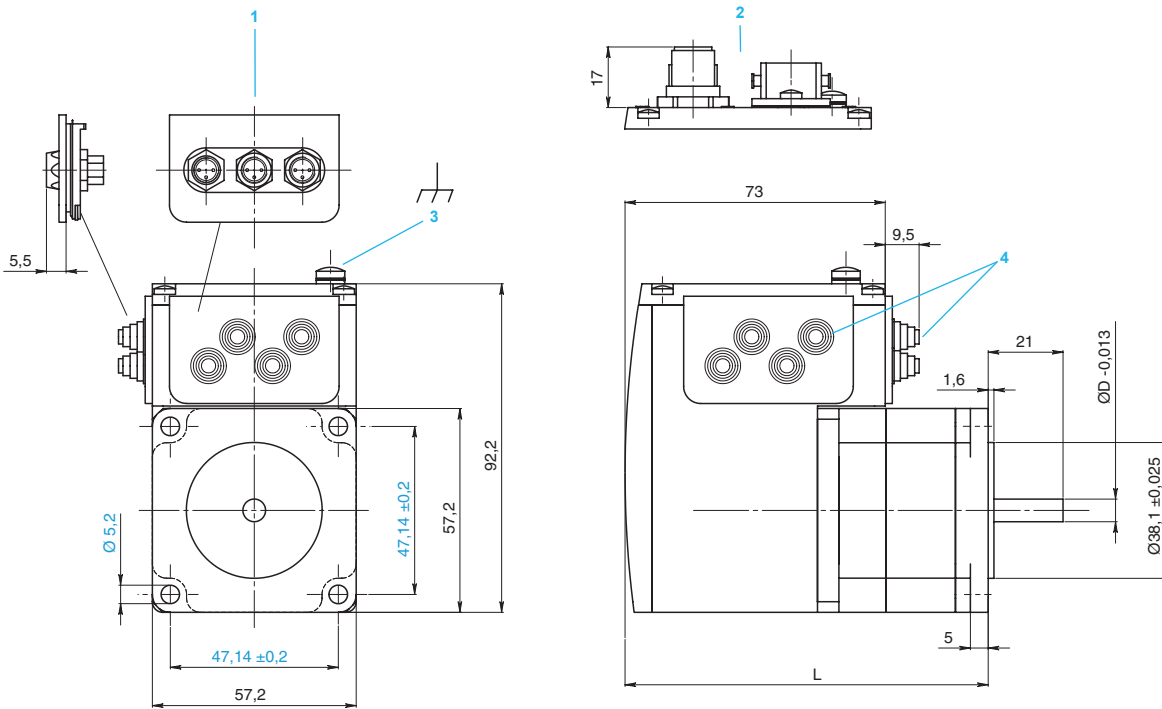
(1) The motor length "L" depends on the mechanical characteristics, see pages 4/82, 4/85 and 4/87.

(2) Winding type T only with ILS1M853.

(3) Holding brake only with ILS1M85.

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ILS1●57 integrated drives

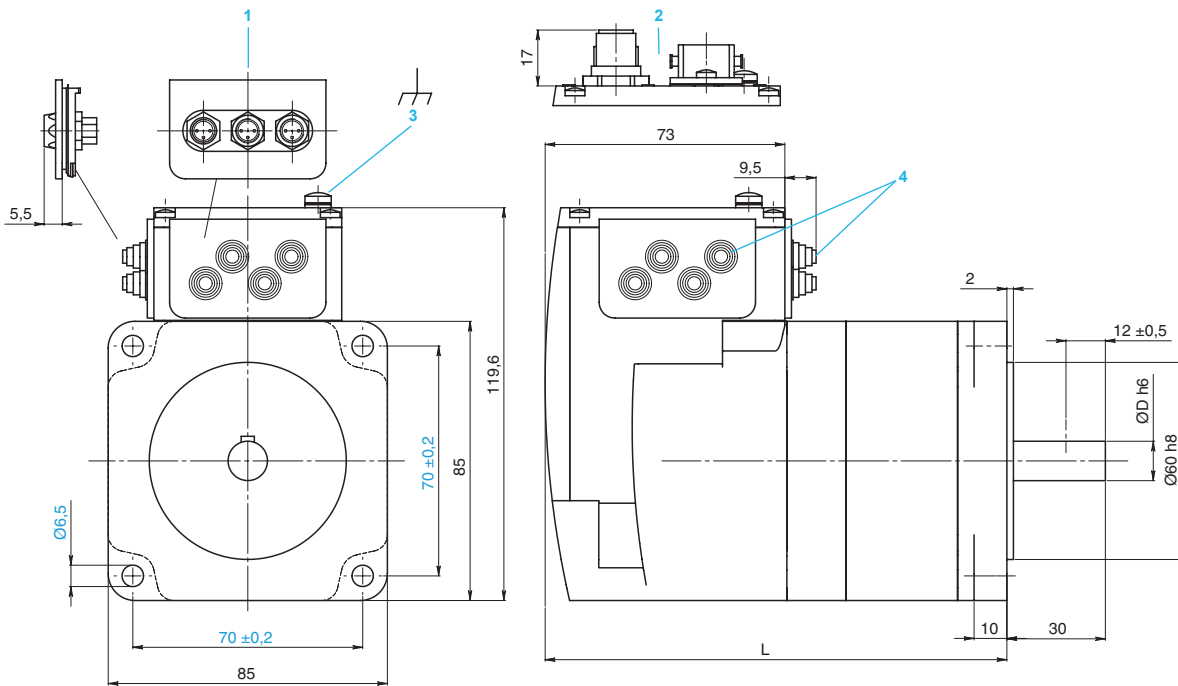


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	L	D
ILS1●571	101.9	6.35
ILS1●572	115.9	6.35
ILS1●573	138.9	8.00

- 1 Accessories: I/O signal insert with industrial connectors
- 2 Option: industrial connectors
- 3 Earth (ground) terminal
- 4 Accessories: cable entries Ø = 3 ... 9 mm

ILS1•85 integrated drives without holding brake

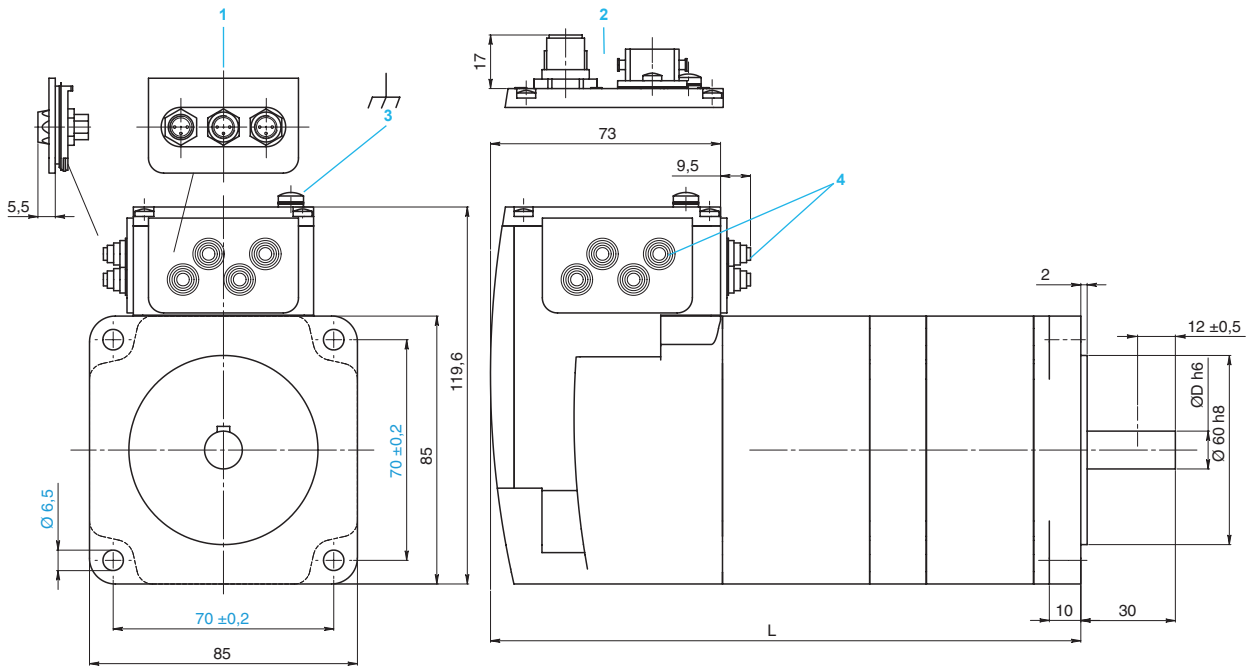


	L	D
ILS1•851	140.6	12
ILS1•852	170.6	12
ILS1•853	200.6	14

- 1 Accessories: I/O signal insert with industrial connectors
- 2 Option: industrial connectors
- 3 Earth (ground) terminal
- 4 Accessories: cable entries $\varnothing = 3 \dots 9$ mm

4

ILS1●85 integrated drives with holding brake



	L	D
ILS1●851	187.3	12
ILS1●852	217.3	12
ILS1●853	247.3	14

- 1 Accessories: I/O signal insert with industrial connectors
- 2 Option: industrial connectors
- 3 Earth (ground) terminal
- 4 Accessories: cable entries $\varnothing = 3 \dots 9$ mm