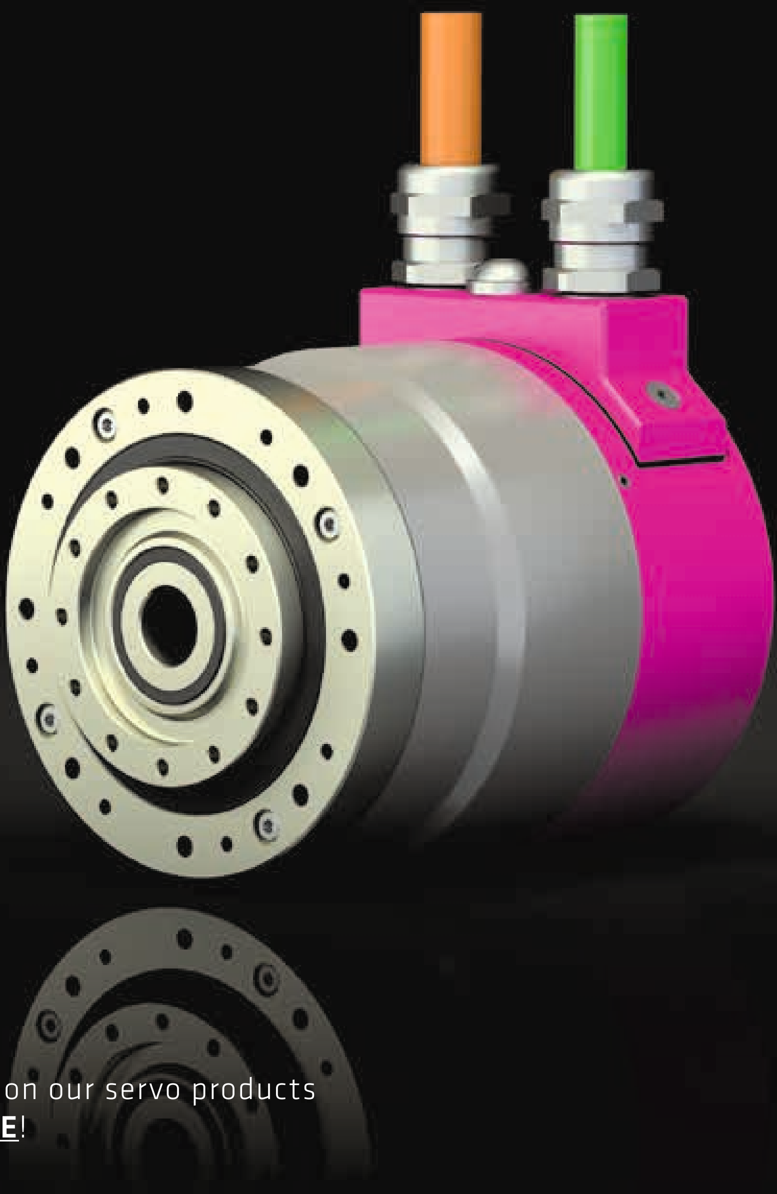
Engineering Data
Servo Actuators CanisDrive®

Harmonic Drive AG



More information on our servo products
can be found **HERE**!

Content

1. General

About this documentation
This document contains safety instructions, technical data and operation rules for products of Harmonic Drive AG. The documentation is aimed at planners, project engineers, commissioning engineers and machine manufacturers, offering support during selection and calculation of gears, servo actuators, servo motors and accessories.

Rules for storage
Please keep this document for the entire life of the product, up to its disposal. Please hand over the documentation when re-selling the product.

Additional documentation
For the configuration of drive systems using the products of Harmonic Drive AG, you may require additional documents. Documentation is provided for all products offered by Harmonic Drive AG and can be found in pdf format on the website.

www.harmonicdrive.de

Third-party systems
Documentation for parts supplied by third party suppliers, associated with Harmonic Drive® Components, is not included in our standard documentation and should be requested directly from the manufacturers.

Before commissioning servo actuators and servo motors from Harmonic Drive AG with servo drives, we advise you to obtain the relevant documents for each device.

Your feedback
Your experiences are important to us. Please send suggestions and comments about the products and documentation to:

Harmonic Drive AG
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Hoenbergstraße 14
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E-Mail: info@harmonicdrive.de

1.1 Description of Safety Alert Symbols

Symbol	**Meaning**
DANGER	Indicates an imminent hazardous situation. If this is not avoided, death or serious injury could occur.
WARNING	Indicates a possible hazard. Care should be taken or death or serious injury may result.
ATTENTION	Indicates a possible hazard. Care should be taken or slight or minor injury may result.
ADVICE	Describes a possibly harmful situation. Care should be taken to avoid damage to the system and surroundings.
INFORMATION	This is not a safety symbol. This symbol indicates important information.
	Warning of a general hazard. The type of hazard is determined by the specific warning text.
	Warning of dangerous electrical voltage and its effects.
	Beware of hot surfaces.
	Beware of suspended loads.
	Precautions when handling electrostatic sensitive components.
	Beware of electromagnetic environmental compatibility.

1.2 Disclaimer and Copyright

We have checked the contents of this document. Since errors cannot be ruled out entirely, we do not accept liability for mistakes which may have occurred. Notification of any mistake or suggestions for improvements will be gratefully received and any necessary correction will be included in subsequent editions.

2. Safety and Installation Instructions

Please take note of the information and instructions in this document. Specially designed models may differ in technical detail. If in doubt, we recommend to contact the manufacturer, giving the type designation and serial number for clarification.

2.1 Hazards

⚠ DANGER

Electric servo actuators and motors have dangerous live and rotating parts. All work during connection, operation, repair and disposal must be carried out by qualified personnel as described in the standards EN 50110-1 and IEC 60364! Before starting any work, and especially before opening covers, the actuator must be properly isolated. In addition to the main circuits, the user also has to pay attention to any auxilliary circuits.

Observing the five safety rules:
• Disconnect mains
• Prevent reconnection
• Test for absence of harmful voltages
• Ground and short circuit
• Cover or close off nearby live parts

The measures taken above must only be withdrawn when the work has been completed and the device is fully assembled. Improper handling can cause damage to persons and property. The respective national, local and factory specific regulations must be adhered to.

⚠ ATTENTION

The surface temperature of products exceed 55 degrees Celsius. The hot surfaces should not be touched.

ADVICE

Cables must not come into direct contact with hot surfaces.

⚠ DANGER

Electric, magnetic and electromagnetic fields are dangerous, in particular for persons with heart pacemaker, implants or similiar. Vulnerable individuals must not be in the close proximity of the product.

⚠ DANGER

Built-in holding brakes are not functional safe by themselves. Particularly with unsupported vertical axes, functional safety can only be achieved with additional, external mechanical brakes.

DANGER

Danger of injury due to improper handling of batteries.

Observing of the battery safety rules:
- do not insert batteries in reverse. Observe the + and - marks on the battery and on the electrical device
- do not short circuit
- do not recharge
- do not open or deform
- do not expose to fire, water or high temperature
- do not leave discharged batteries in the electrical device
- keep batteries out of reach of children. In case of ingestion of a battery, seek medical assistance promptly.

WARNING

The successful and safe operation of products requires proper transport, storage and assembly as well as correct operation and maintenance.

Injury caused by moving or ejected parts:
Contact with moving parts or output elements and the ejection of loose parts (e.g. feather keys) out of the motor enclosure can result in severe injury or death.
- Remove any loose parts or secure them so that they cannot be flung out
- Do not touch any moving parts
- Safeguard all moving parts using the appropriate safety guards

Unexpected movement of machines caused by inactive safety functions:
Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.
- Observe the information in the appropriate product documentation before commissioning
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components

ATTENTION

Use suitable lifting equipment to move and lift products with a weight > 20 kg.

INFORMATION

Special versions of products may differ in the specification from the standard. Further applicable data from data sheets, catalogues and offers of the special version have to be considered.

2.2 Intended Purpose

Harmonic Drive® Products are intended for industrial or commercial applications.

Typical areas of application are robotics and handling, machine tools, packaging and food machines and similar machines.

The products may only be operated within the operating ranges and environmental conditions shown in the documentation (altitude, degree of predection, temperature range, etc).

Before commissioning of plants and machinery including Harmonic Drive® Products, the compliance with the Machinery Directive must be established.

2.3 Non Intended Purpose

The use of products outside the areas of application mentioned above or beyond the operating areas or environmental conditions described in the documentation is considered as non-intended purpose.

2.4 Use in Special Application Areas

The use of the products in one of the following application areas requires a risk assessment and approval by Harmonic Drive AG.

- Aerospace
- Areas at risk of explosion
- Machines specially constructed or used for a nuclear purpose whose breakdown might lead to the emission of radio-activity
- Vacuum
- Household devices
- Medical equipment
- Devices which interact directly with the human body
- Machines or equipment for transporting or lifting people
- Special devices for use in annual markets or leisure parks

2.5 Declaration of Conformity

2.5.1 Gears

Harmonic Drive® Gears are components for installation in machines as defined by the Machinery Directive. Commissioning is prohibited until the end product conforms to the provisions of this directive.

Essential health and safety requirements were considered in the design and manufacture of these gear component sets. This simplifies the implementation of the Machinery Directive by the end user for the machinery or the partly completed machinery. Commissioning of the machine or partly completed machine is prohibited until the end product conforms to the Machinery Directive.

2.5.2 Servo Actuators and Motors

The Harmonic Drive® Servo Actuators and Motors described in the engineering data comply with the Low Voltage Directive. In accordance with the Machinery Directive, Harmonic Drive® Servo Actuators and Motors are electrical equipment for the use within certain voltage limits as covered by the Low Voltage Directive and thus excluded from the scope of the Machinery Directive. Commissioning is prohibited until the final product conforms to the Machinery Directive.

According to the EMC directive Harmonic Drive® Servo Actuators and Motors are inherently benign equipment, unable to generate electromagnetic disturbance or to be affected by such disturbance.

The conformity to the EU directives of equipment, plant and machinery in which Harmonic Drive® Servo Actuators and Motors are installed must be provided by the user before taking the device into operation.

Equipment, plant and machinery with inverter driven motors must satisfy the protection requirements of the EMC directive. It is the responsibility of the user to ensure that the installation is carried out correctly.

Maximum power density and lifetime precision

A large hollow shaft, low weight, small volume and a combination of outstanding torque density, service life and reliability were the key requirements for the development of the new CanisDrive® Series.

Central hollow shaft and output bearing with high tilting capacity

In addition to all these features, the large central hollow shaft is the highlight of this design. This basic feature simplifies the design of numerous applications considerably, offering a time-saving and cost-effective solution. The servo actuators comprise a synchronous servo motor and a zero backlash gear unit. They are available in eight sizes and five gear ratios between 50:1 and 160:1 at a maximum torque of between 23 and 1840 Nm. The output bearing with high tilting capacity enables the direct attachment of heavy payloads without the need for further support, ensuring a simple and space-saving design. With its high protection ratings and excellent corrosion resistance, the series is ideal for use in harsh environmental conditions.

Numerous possible combinations

For adaptation to your concrete application, the CanisDrive® Series offers numerous possible combinations when it comes to selecting the motor winding, motor feedback system, brake and various sensor, cable and connector options. The flexible configuration ensures compatibility with almost all servo controllers on the market. YukonDrive® Servo Controllers, which are specially tailored to the needs of Harmonic Drive® Servo Actuators, provide a preconfigured drive system from a single source – which is, of course, in a specific customised version for your application.

4. Ordering Code

4.1 Ordering Code

Table 11.1

Series	Size Version	Ratio					Motor winding	Connector configuration	Motor feedback system	Brake	Option 1	Option 2	Optional approvals	Special design
CanisDrive	14A	50	80	100			AM FB	H N E L	ROO DCO MGSi MGSe SIE SZE MZE SIH MIH SHH MHH	B	Sensor	Cable / Connector	-UL[1]	According to customer requirements
	17A	50	80	100	120		AO FD							
	20A	50	–	100	120	160	AM							
	25A	50	–	100	–	–	AR							
	32A	50	80	100	120	160	AR							
	40A	50	80	100	120	160	AU							
	50A	50	80	100	120	160	AX							
	58A	50	80	100	120	160	AX							

Ordering code

CanisDrive	**-**	**20A**	**-**	**100**	**-**	**AM**	**-**	**H**	**-**	**MGSi**	**-**	**B**	**-**	**EC**	**-**	**K**	**-**	**UL**	**-**	**SP**

[1] Additional option for CanisDrive-20A ... 40A.
Without indication is the actuator in compliance with the EU directive. If an additional „UL" approval is desired please indicate it in the ordering code.

Table 11.2

Motor winding		
Size Version	**Ordering code**	**Maximum DC bus voltage**
14A	FB[1]	100 VDC
17A	FD[1]	
14A	AM	680 VDC
17A	AO	
20A	AM	
25A	AR	
32A	AR	
40A	AU	
50A	AX	
58A	AX	

[1] Only available with connector configuration „E".

Table 11.3

Connector configuration					
Ordering code	**Motor feedback system**	**Motor**	**Motor feedback**	**Cable outlet**	**Connec-tor**
H	ROO	6 pin (M23)	12 pin (M23)	x	
H	MGS SIE MZE SZE	6 pin (M23)	17 pin (M23)	x	
L	SIH MIH SHH MHH	8 pin (M23)	12 pin (M23)	x	
N	ROO MGS DCO	8 pin (M17)	17 pin (M17)	x	
E	ROO MGS DCO	8 pin (M17)	17 pin (M17)		x

Table 11.4

Motor feedback		
Ordering code	**Type**	**Protocol**
ROO	Resolver	–
DCO	Incremental	–
MGSi	Multi-turn absolute (internal battery)	SSI
MGSe	Multi-turn absolute (external battery)	SSI
SIE	Single turn absolute	EnDat® 2.1 / 01
SZE	Single turn absolute	EnDat® 2.2 / 22
MZE	Multi-turn absolute (external battery)	EnDat® 2.2 / 22
SIH / SHH	Single turn Absolut	HIPERFACE®
MIH / MHH	Multi-turn Absolut	HIPERFACE®

Table 11.5

Option 1	
Ordering code	**Description**
EC	Single turn absolute EnDat® encoder system at the gear output

Table 11.6

Option 2	
Ordering code	**Description**
K	Cable outlet axial
–	Standard (cable outlet radial)

Table 11.7

Optional approvals	
Ordering code	**Description**
UL[1]	CE and UL
–	CE

[1] Limited continuous duty cycle

4.2 Combinations

Table 12.1

Size Version		CanisDrive®							
		14A	17A	20A	25A	32A	40A	50A	58A
Ratio	50	●	●	●	●	●	●	●	●
	80	○	○	-	-	○	○	○	○
	100	●	●	●	●	●	●	●	●
	120	-	○	○	-	○	○	○	○
	160	-	-	○	-	○	○	○	○
Motor winding	FB	●	-	-	-	-	-	-	-
	FD	-	●	-	-	-	-	-	-
	AM	●	-	●	-	-	-	-	-
	AO	-	●	-	-	-	-	-	-
	AR	-	-	-	●	●	-	-	-
	AU	-	-	-	-	-	●	-	-
	AX	-	-	-	-	-	-	●	●
Connector configuration	H	-	-	●	●	●	●	●	●
	L	-	●	●	●	●	●	-	-
	N	●	●	-	-	-	-	-	-
	E	●	●	-	-	-	-	-	-
Motor feedback system	ROO	●	●	-	-	-	-	-	-
	MGSi	●	●	●	-	-	-	-	-
	MGSe	○	○	○	●	●	●	●	●
	SIE	-	-	●	●	●	●	-	-
	DCO	●	●	-	-	-	-	-	-
	SZE	-	-	●	●	●	●	●	●
	MZE	-	-	●	●	●	●	●	●
	SIH	-	●	●	-	-	-	-	-
	MIH	-	●	●	-	-	-	-	-
	SHH	-	-	-	●	●	●	-	-
	MHH	-	-	-	●	●	●	-	-
Brake	B	●	●	●	●	●	●	●	●
Option 1 (Sensor)	EC	-	-	○	○	○	○	-	-
Option 1 (Sensor)	K	-	-	○	○	○	○	-	-
Additional option approval	UL	-	-	●	●	●	●	○	○
Air pressure connection		●	●	○	○	○	○	○	○

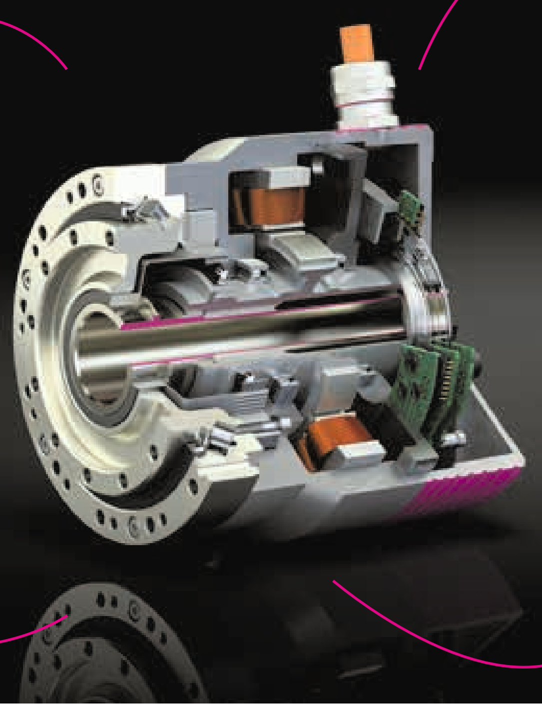
● available ○ on request - not available

Gear Component Set CobaltLine®-Technology

- Zero backlash
- Hollow shaft
- Increased power density
- Increased life time
- Excellent lifetime precision

Motor feedback

- Incremental encoder
- Single- or multi-turn absolute encoder
- Resolver



Output bearing

- High load capacity
- Tilt resistant
- Excellent running characteristics
- Corrosion protected

AC Hollow shaft motor

- Sine commutated synchronous motor
- Multiple motor winding options
- Winding temperature monitoring with temperature sensor
- Maintenance free

5. Technical Data

5.1 General Technical Data

Table 13.1

Motor winding	Symbol [Unit]	Fx	Ax
Insulation class (EN 60034-1)		F	F
Insulation resistance (500 VDC)	MΩ	100	100
Insulation voltage (10 s)	V_{eff}	1400	2500
Lubrication		Flexolub®-A1	Flexolub®-A1
Degree of protection (EN 60034-5)		IP65	IP65
Ambient operating temperature	°C	0 ... 40	0 ... 40
Ambient storage temperature	°C	-20 ... 60	-20 ... 60
Altitude (a. s. l.)	m	< 1000	< 1000
Relative humidity (without condensation)	%	20 ... 80	20 ... 80
Vibration resistance (DIN IEC 60068 Part 2-6, 10 ... 500 Hz)	g	5	5
Shock resistance (DIN IEC 60068 Part 2-27, 18 ms)	g	30	30
Corrosion protection (DIN IEC 60068 Part 2-11 salt spray test)	h	16	16
Temperature sensors CanisDrive-14 ... 40		1 x KTY 84-130[1)] / 1 x PTC	1 x KTY 84-130[1)] / 1 x PTC
Temperature sensors CanisDrive-50 ... 58		–	PT1000

[1)] Safe separation according to EN 61800-5-1.

The continuous operating characteristics given in the following apply to an ambient temperature of 40 °C and an aluminium cooling surface with the following dimensions:

Table 13.2

Series	Size Version	Unit	Dimensions
CanisDrive®	14A	[mm]	200 x 200 x 6
	17A	[mm]	300 x 300 x15
	20A	[mm]	300 x 300 x15
	25A	[mm]	350 x 350 x 18
	32A	[mm]	350 x 350 x 18
	40A	[mm]	400 x 400 x 20
	50A	[mm]	500 x 500 x 25
	58A	[mm]	600 x 600 x 30

5.2 Actuator Data CanisDrive-14A-AM

5.2.1 Technical Data

Table 14.1

	Symbol [Unit]	CanisDrive-14A		
Motor winding		AM		
Motor feedback system		ROO / MGS / DCO		
Ratio	i [ ]	**50**	**80**	**100**
Maximum output torque	T_{max} [Nm]	23	30	36
Maximum output speed	n_{max} [rpm]	170	106	85
Maximum current	I_{max} [A_{rms}]	1.9	1.6	1.5
Continuous stall torque	T_0 [Nm]	9.0	14	14
Continuous stall current	I_0 [A_{rms}]	0.8	0.7	0.6
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680		
Electrical time constant (20 °C)	τ_e [ms]	1.9		
No load current (20 °C)	I_{NLS} [A_{rms}]	0.17	0.16	0.17
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	3.2	5.2	6.1
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.26		
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	20		
Maximum motor speed	n_{max} [rpm]	8500		
Rated motor speed	n_N [rpm]	3500		
Resistance (L-L, 20 °C)	R_{L-L} [W]	7.7		
Synchronous inductance	L_d [mH]	7.5		
Number of pole pairs	p [ ]	5		
Weight without brake	m [kg]	1.4 (DCO) 2.0 (ROO / MGS)		
Weight with brake	m [kg]	1.7 (DCO) 2.3 (ROO / MGS)		
Hollow shaft diameter	d_H [mm]	12		

5.2.2 Moment of Inertia

Table 15.1

	Symbol [Unit]	CanisDrive-14A		
Motor feedback system		ROO		
Ratio	i [ ]	**50**	**80**	**100**
Moment of Inertia output side				
Moment of inertia without brake	J_{out} [kgm²]	0.095	0.243	0.38
Moment of inertia with brake	J_{out} [kgm²]	0.113	0.288	0.45
Moment of Inertia at motor				
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.38		
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.45		
Motor feedback system		MGS		
Ratio	i [ ]	**50**	**80**	**100**
Moment of Inertia output side				
Moment of inertia without brake	J_{out} [kgm²]	0.155	0.397	0.62
Moment of inertia with brake	J_{out} [kgm²]	0.175	0.448	0.7
Moment of Inertia at motor				
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.62		
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.7		
Motor feedback system		DCO		
Ratio	i [ ]	**50**	**80**	**100**
Moment of Inertia output side				
Moment of inertia without brake	J_{out} [kgm²]	0.068	0.173	0.27
Moment of inertia with brake	J_{out} [kgm²]	0.088	0.224	0.35
Moment of Inertia at motor				
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.27		
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.35		

5.2.3 Technical Data Motor Brake

Table 15.2

	Symbol [Unit]	CanisDrive-14A		
Ratio	i [ ]	**50**	**80**	**100**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %		
Brake holding torque (at output)	T_{Br} [Nm]	23	30	36
Brake current to open	I_{OBr} [A_{DC}]	0.6		
Brake current to hold	I_{HBr} [A_{DC}]	0.3		
Number of brake cyles at n = 0 rpm		5000000		
Emergency brake cyles		300		
Opening time	t_O [ms]	-		
Closing time	t_C [ms]	-		

5.2.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 16.1 CanisDrive-14A-AM-50

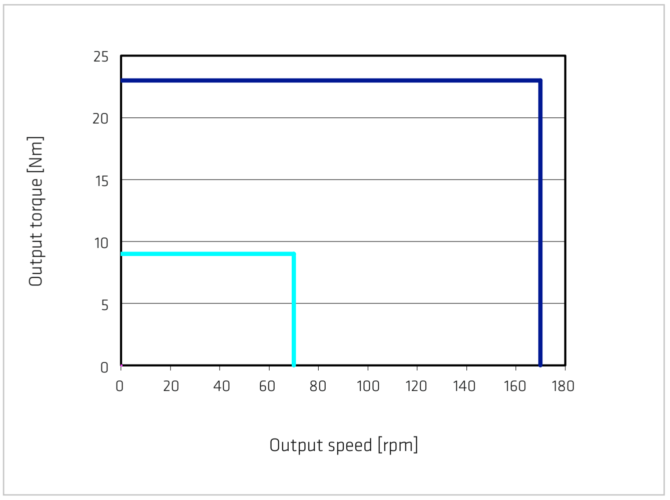


Illustration 16.2 CanisDrive-14A-AM-80

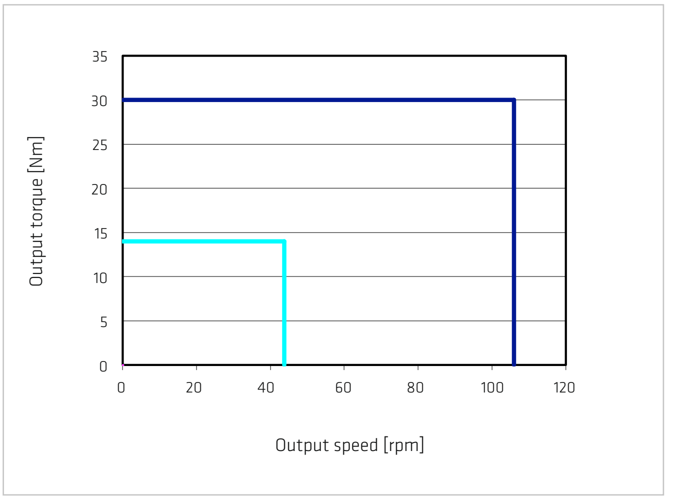
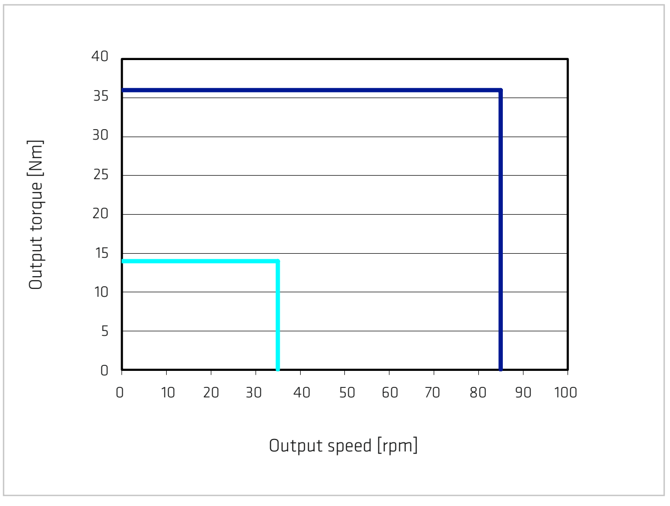


Illustration 16.3 CanisDrive-14A-AM-100



Legend

Intermittent duty
Continuous duty

U_M = 220 ... 400 VAC

5.3 Actuator Data CanisDrive-14A-FB

5.3.1 Technical Data

Table 17.1

	Symbol [Unit]	CanisDrive-14A		
Motor winding		FB		
Motor feedback system		ROO / MGS / DCO		
Ratio	i [ ]	**50**	**80**	**100**
Maximum output torque	T_{max} [Nm]	23	30	36
Maximum output speed	n_{max} [rpm]	170	106	85
Maximum current	I_{max} [A_{rms}]	12.2	9.9	9.6
Continuous stall torque	T_0 [Nm]	9	14	14
Continuous stall current	I_0 [A_{rms}]	4.8	4.6	3.8
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	100		
Electrical time constant (20 °C)	τ_e [ms]	1.3		
No load current (20 °C)	I_{NLS} [A_{rms}]	1.08	1.03	1.04
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	20.9	33.2	38.8
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.04		
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	3.3		
Maximum motor speed	n_{max} [rpm]	8500		
Rated motor speed	n_N [rpm]	3500		
Resistance (L-L, 20 °C)	R_{L-L} [W]	0.42		
Synchronous inductance	L_d [mH]	0.27		
Number of pole pairs	p [ ]	5		
Weight without brake	m [kg]	1.4 (DCO) 2.0 (ROO / MGS)		
Weight with brake	m [kg]	1.7 (DCO) 2.3 (ROO / MGS)		
Hollow shaft diameter	d_H [mm]	12		

5.3.2 Moment of Inertia

Table 18.1

	Symbol [Unit]	CanisDrive-14A		
Motor feedback system		ROO		
Ratio	i [ ]	**50**	**80**	**100**
Moment of Inertia output side				
Moment of inertia without brake	J_{out} [kgm²]	0.095	0.243	0.38
Moment of inertia with brake	J_{out} [kgm²]	0.113	0.288	0.45
Moment of Inertia at motor				
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.38		
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.45		
Motor feedback system		MGS		
Ratio	i [ ]	**50**	**80**	**100**
Moment of Inertia output side				
Moment of inertia without brake	J_{out} [kgm²]	0.155	0.397	0.62
Moment of inertia with brake	J_{out} [kgm²]	0.175	0.448	0.7
Moment of Inertia at motor				
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.62		
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.7		
Motor feedback system		DCO		
Ratio	i [ ]	**50**	**80**	**100**
Moment of Inertia output side				
Moment of inertia without brake	J_{out} [kgm²]	0.068	0.173	0.27
Moment of inertia with brake	J_{out} [kgm²]	0.088	0.224	0.35
Moment of Inertia at motor				
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.27		
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.35		

5.3.3 Technical Data Motor Brake

Table 18.2

	Symbol [Unit]	CanisDrive-14A		
Ratio	i [ ]	**50**	**80**	**100**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %		
Brake holding torque (at output)	T_{Br} [Nm]	23	30	36
Brake current to open	I_{OBr} [A_{DC}]	0.6		
Brake current to hold	I_{HBr} [A_{DC}]	0.3		
Number of brake cyles at n = 0 rpm		5000000		
Emergency brake cyles		300		
Opening time	t_O [ms]	–		
Closing time	t_C [ms]	–		

5.3.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 19.1 CanisDrive-14A-FB-50

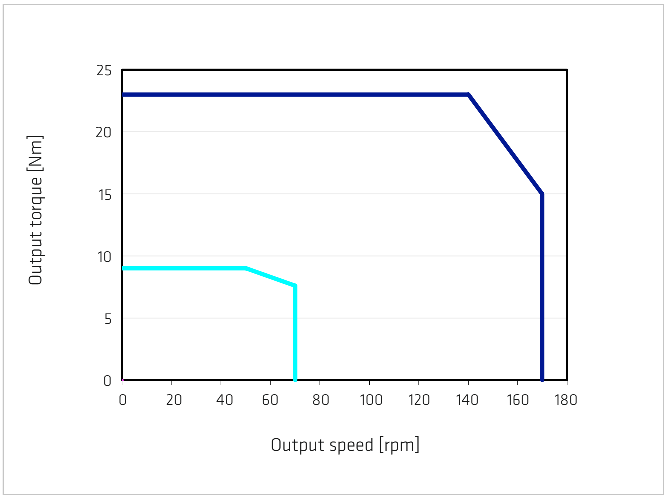


Illustration 19.2 CanisDrive-14A-FB-80

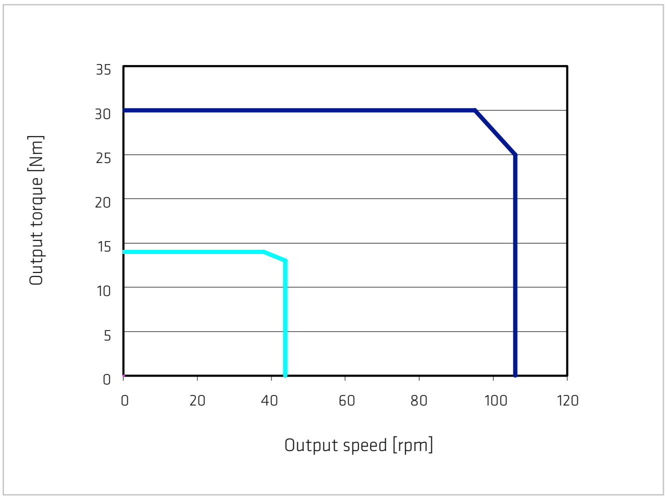
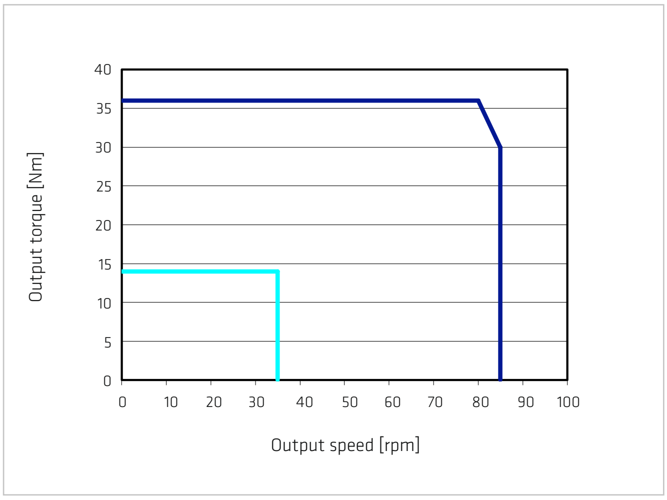


Illustration 19.3 CanisDrive-14A-FB-100



Legend

Intermittent duty

Continuous duty

U_M = 34 VAC

5.4 Actuator Data CanisDrive-17A-AO

5.4.1 Technical Data

Table 20.1

	Symbol [Unit]	CanisDrive-17A			
Motor winding		AO			
Motor feedback system		ROO / MGS / DCO / SIH / MIH			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Maximum output torque	T_{max} [Nm]	44	56	70	70
Maximum output speed	n_{max} [rpm]	146	91	73	61
Maximum current	I_{max} [A_{rms}]	3.1	2.3	2.3	1.9
Continuous stall torque	T_0 [Nm]	33	35	51	51
Continuous stall current	I_0 [A_{rms}]	2.1	1.3	1.5	1.3
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680			
Electrical time constant (20 °C)	τ_e [ms]	3.4			
No load current (20 °C)	I_{NLS} [A_{rms}]	0.11	0.09	0.09	0.09
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	4.3	7.2	8.5	9.7
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.37			
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff}/1000 rpm]	25			
Maximum motor speed	n_{max} [rpm]	7300			
Rated motor speed	n_N [rpm]	3500			
Resistance (L-L, 20 °C)	R_{L-L} [W]	4.9			
Synchronous inductance	L_d [mH]	8.3			
Number of pole pairs	p [ ]	5			
Weight without brake	m [kg]	1.9 (DCO) 2.6 (ROO / MGS / SIH / MIH)			
Weight with brake	m [kg]	2.3 (DCO) 3.0 (ROO / MGS / SIH / MIH)			
Hollow shaft diameter	d_H [mm]	16			

5.4.2 Moment of Inertia

Table 21.1

	Symbol [Unit]	CanisDrive-17A			
Motor feedback system		ROO			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.26	0.666	1.04	1.498
Moment of inertia with brake	J_{out} [kgm²]	0.28	0.717	1.12	1.613
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [· 10^{-4} kgm²]	1.04			
Moment of inertia at motor with brake	J [· 10^{-4} kgm²]	1.12			
Motor feedback system		MGS			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.215	0.55	0.86	1.238
Moment of inertia with brake	J_{out} [kgm²]	0.235	0.602	0.94	1.354
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [· 10^{-4} kgm²]	0.86			
Moment of inertia at motor with brake	J [· 10^{-4} kgm²]	0.94			
Motor feedback system		DCO			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.13	0.333	0.52	0.749
Moment of inertia with brake	J_{out} [kgm²]	0.15	0.384	0.6	0.864
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [· 10^{-4} kgm²]	0.52			
Moment of inertia at motor with brake	J [· 10^{-4} kgm²]	0.6			
Motor feedback system		SIH / MHH			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.137	0.349	0.546	0.786
Moment of inertia with brake	J_{out} [kgm²]	0.158	0.404	0.631	0.909
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [· 10^{-4} kgm²]	0.564			
Moment of inertia at motor with brake	J [· 10^{-4} kgm²]	0.631			

5.4.3 Technical Data Motor Brake

Table 21.2

	Symbol [Unit]	CanisDrive-17A			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %			
Brake holding torque (at output)	T_{Br} [Nm]	23	36	45	54
Brake current to open	I_{OBr} [A_{DC}]	0.6			
Brake current to hold	I_{HBr} [A_{DC}]	0.3			
Number of brake cyles at n = 0 rpm		5000000			
Emergency brake cyles		300			
Opening time	t_O [ms]	-			
Closing time	t_C [ms]	-			

5.4.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 22.1 CanisDrive-17A-AO-50

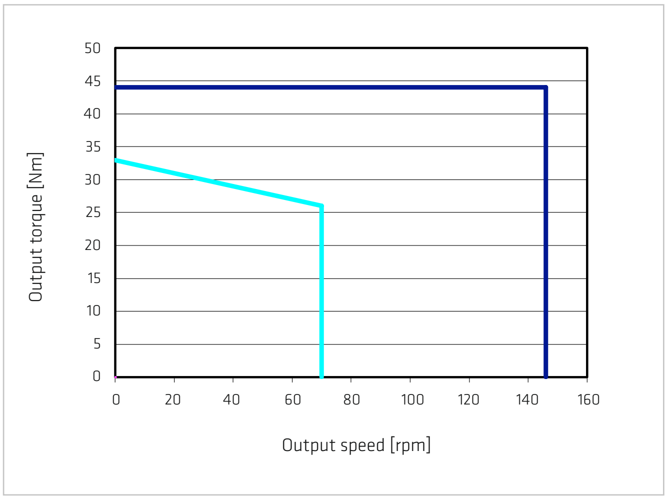


Illustration 22.2 CanisDrive-17A-AO-80

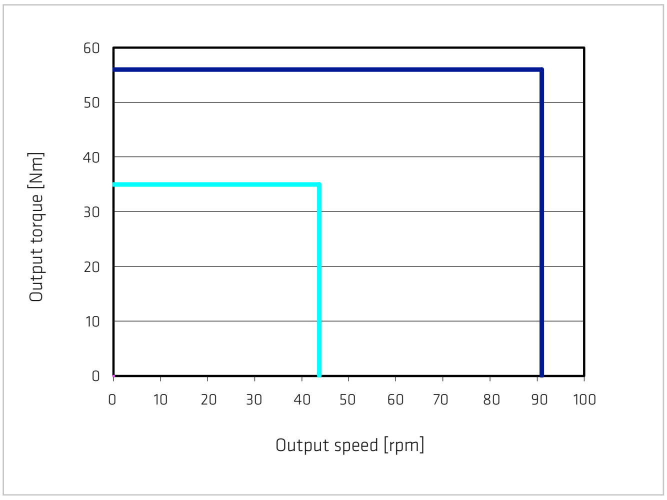


Illustration 22.3 CanisDrive-17A-AO-100

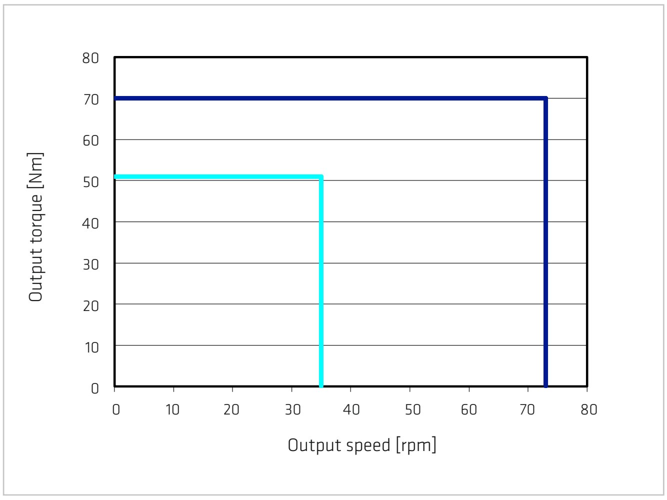
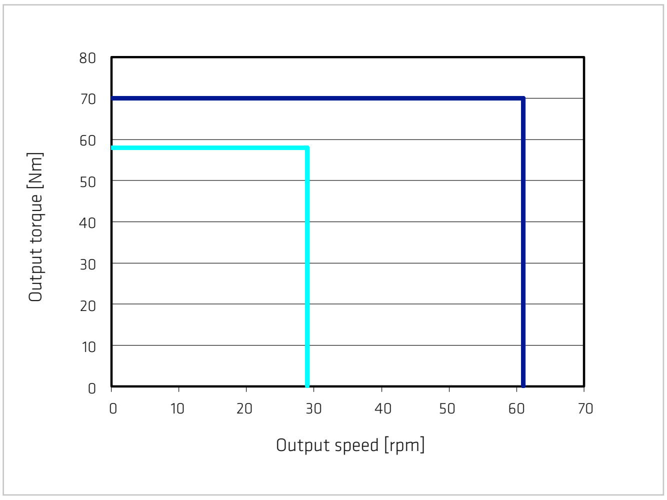


Illustration 22.4 CanisDrive-17A-AO-120



Legend

Intermittent duty —— U_M = 220 ... 400 VAC ——
Continuous duty ——

5.5 Actuator Data CanisDrive-17A-FD

5.5.1 Technical Data

Table 23.1

	Symbol [Unit]	CanisDrive-17A			
Motor winding		FD			
Motor feedback system		ROO / MGS / DCO			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Maximum output torque	T_{max} [Nm]	44	56	70	70
Maximum output speed	n_{max} [rpm]	146	91	73	61
Maximum current	I_{max} [A_{rms}]	13.8	10.8	10.8	9.1
Continuous stall torque	T_0 [Nm]	28	35	51	51
Continuous stall current	I_0 [A_{rms}]	8.3	6.4	7.4	6.2
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	100			
Electrical time constant (20 °C)	τ_e [ms]	2.3			
No load current (20 °C)	I_{NLS} [A_{rms}]	0.48	0.43	0.44	0.45
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	18.7	33.8	39.6	46.3
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.07			
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	5			
Maximum motor speed	n_{max} [rpm]	7300			
Rated motor speed	n_N [rpm]	3500			
Resistance (L-L, 20 °C)	R_{L-L} [W]	0.32			
Synchronous inductance	L_d [mH]	0.36			
Number of pole pairs	p [ ]	5			
Weight without brake	m [kg]	1.9 (DCO) 2.6 (ROO / MGS / SIH / MIH)			
Weight with brake	m [kg]	2.3 (DCO) 3.0 (ROO / MGS / SIH / MIH)			
Hollow shaft diameter	d_H [mm]	16			

5.5.2 Moment of Inertia

Table 24.1

	Symbol [Unit]	CanisDrive-17A			
Motor feedback system		ROO			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.26	0.666	1.04	1.498
Moment of inertia with brake	J_{out} [kgm²]	0.28	0.717	1.12	1.613
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	1.04			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	1.12			
Motor feedback system		MGS			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.215	0.55	0.86	1.238
Moment of inertia with brake	J_{out} [kgm²]	0.235	0.602	0.94	1.354
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.86			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.94			
Motor feedback system		DCO			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.13	0.333	0.52	0.749
Moment of inertia with brake	J_{out} [kgm²]	0.15	0.384	0.6	0.864
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	0.52			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	0.6			

5.5.3 Technical Data Motor Brake

Table 24.2

	Symbol [Unit]	CanisDrive-17A			
Ratio	i [ ]	**50**	**80**	**100**	**120**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %			
Brake holding torque (at output)	T_{Br} [Nm]	23	36	45	54
Brake current to open	I_{OBr} [A_{DC}]	0.6			
Brake current to hold	I_{HBr} [A_{DC}]	0.3			
Number of brake cyles at n = 0 rpm		5000000			
Emergency brake cyles		300			
Opening time	t_O [ms]	–			
Closing time	t_C [ms]	–			

5.5.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 25.1 CanisDrive-17A-FD-50

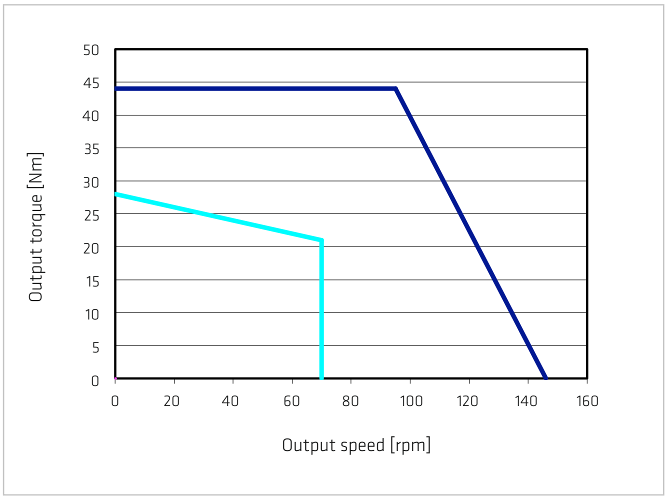


Illustration 25.2 CanisDrive-17A-FD-80

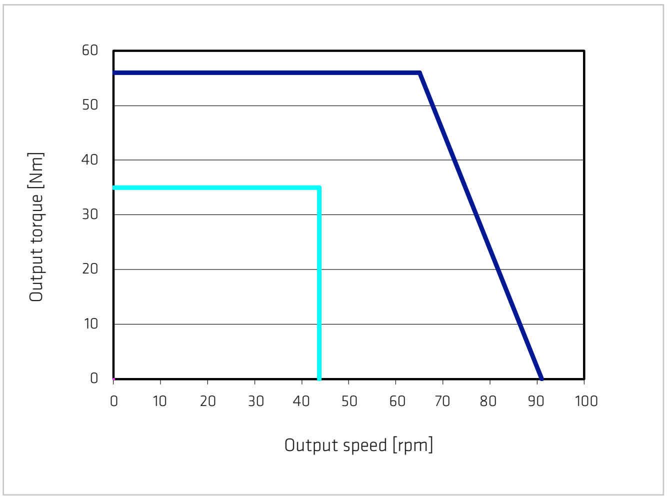


Illustration 25.3 CanisDrive-17A-FD-100

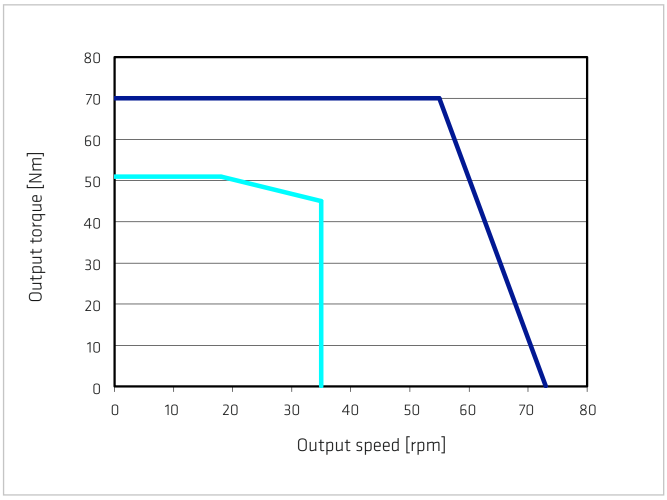
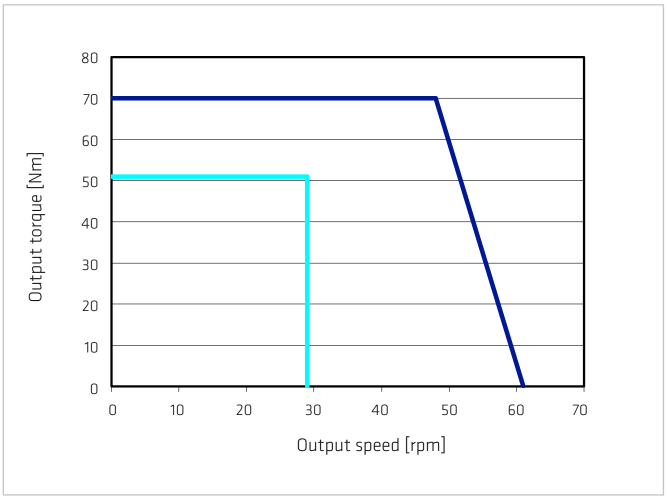


Illustration 25.4 CanisDrive-17A-FD-120



Legend

Intermittent duty
Continuous duty

U_M = 34 VAC

5.6 Actuator Data CanisDrive-20A-AM

5.6.1 Technical Data

Table 26.1

	Symbol [Unit]	CanisDrive-20A			
Motor winding		AM			
Motor feedback system		MGS / SIE / MZE / SZE / SIH / MIH			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	73	107	113	120
Maximum output speed	n_{max} [rpm]	130	65	54	41
Maximum current	I_{max} [A_{rms}]	4.8	3.6	3.2	2.6
Continuous stall torque	T_0 [Nm]	33	64	64	64
Continuous stall current	I_0 [A_{rms}]	2.1	2.1	1.7	1.3
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680			
Electrical time constant (20 °C)	τ_e [ms]	1.4			
No load current (20 °C)	I_{NLS} [A_{rms}]	0.18	0.17	0.18	0.19
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	8.5	16.1	18.9	23.9
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.36			
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	23			
Maximum motor speed	n_{max} [rpm]	6500			
Rated motor speed	n_N [rpm]	3500			
Resistance (L-L, 20 °C)	R_{L-L} [W]	5.9			
Synchronous inductance	L_d [mH]	4			
Number of pole pairs	p [ ]	5			
Weight without brake	m [kg]	3.2			
Weight with brake	m [kg]	3.9			
Hollow shaft diameter	d_H [mm]	18			

5.6.2 Moment of Inertia

Table 27.1

	Symbol [Unit]	CanisDrive-20A			
Motor feedback system		MGS			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.35	1.38	1.99	3.54
Moment of inertia with brake	J_{out} [kgm²]	0.44	1.76	2.54	4.52
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	1.38			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	1.76			
Motor feedback system		SIE / MZE / SZE			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.46	1.85	2.66	4.74
Moment of inertia with brake	J_{out} [kgm²]	0.56	2.23	3.21	5.71
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	1.85			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	2.23			
Motor feedback system		SIH / MIH			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.27	1.08	1.55	2.75
Moment of inertia with brake	J_{out} [kgm²]	0.36	1.46	2.1	3.73
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	1.08			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	1.46			

5.6.3 Technical Data Motor Brake

Table 27.2

	Symbol [Unit]	CanisDrive-20A			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %			
Brake holding torque (at output)	T_{Br} [Nm]	45	90	108	120
Brake current to open	I_{OBr} [A_{DC}]	0.6			
Brake current to hold	I_{HBr} [A_{DC}]	0.3			
Number of brake cyles at n = 0 rpm		10000000			
Emergency brake cyles		200			
Opening time	t_O [ms]	110			
Closing time	t_C [ms]	70			

5.6.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 28.1

CanisDrive-20A-AM-50

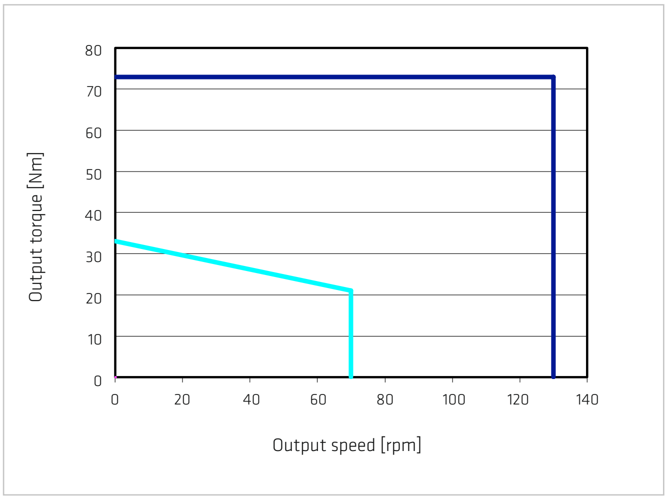


Illustration 28.2

CanisDrive-20A-AM-100

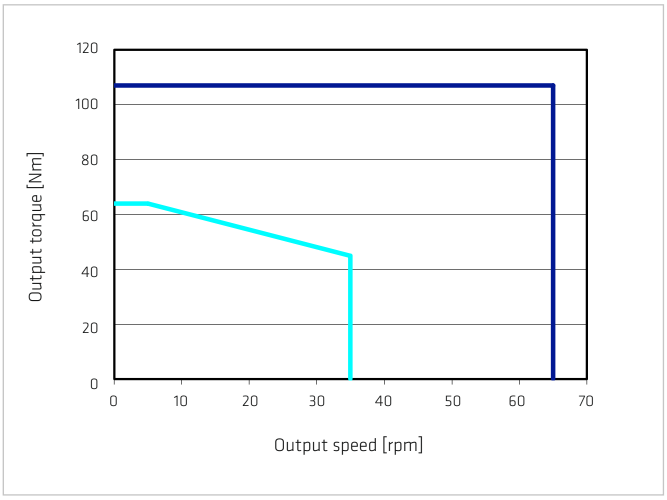


Illustration 28.3

CanisDrive-20A-AM-120

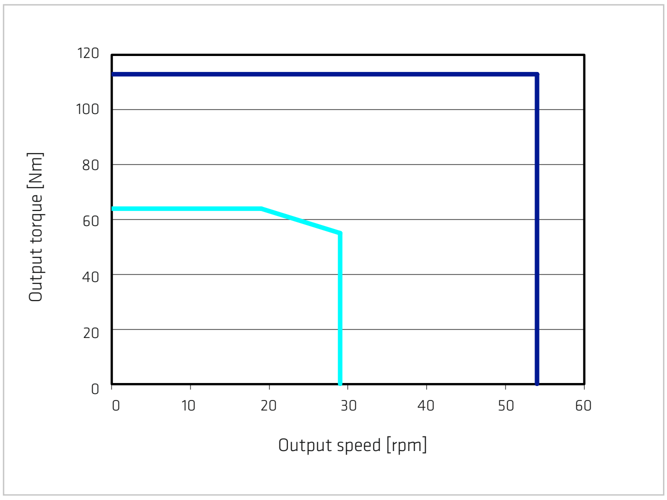
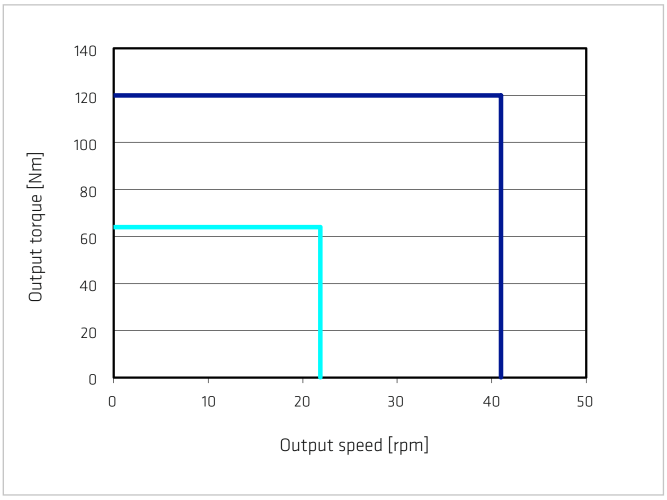


Illustration 28.4

CanisDrive-20A-AM-160



Legend

Intermittent duty

Continuous duty

U_M = 220 ... 400 VAC

5.7 Actuator Data CanisDrive-20A-A-AM-UL

5.7.1 Technical Data

Table 29.1

	Symbol [Unit]	**CanisDrive-20A-UL**			
Motor winding		AM			
Motor feedback system		MGS / SIE / MZE / SZE / SIH / MIH			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	73	107	113	120
Maximum output speed	n_{max} [rpm]	130	65	54	41
Maximum current	I_{max} [A_{rms}]	4.8	3.6	3.2	2.6
Continuous stall torque	T_0 [Nm]	28	58	64	64
Continuous stall current	I_0 [A_{rms}]	1.8	1.8	1.7	1.3
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680			
Electrical time constant (20 °C)	τ_e [ms]	1.4			
No load current (20 °C)	I_{NLS} [A_{rms}]	0.18	0.17	0.18	0.19
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	8.5	16.1	18.9	23.9
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.36			
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	23			
Maximum motor speed	n_{max} [rpm]	6500			
Rated motor speed	n_N [rpm]	3500			
Resistance (L-L, 20 °C)	R_{L-L} [W]	5.9			
Synchronous inductance	L_d [mH]	4			
Number of pole pairs	p [ ]	5			
Weight without brake	m [kg]	3.2			
Weight with brake	m [kg]	3.9			
Hollow shaft diameter	d_H [mm]	18			

5.7.2 Moment of Inertia

Table 30.1

	Symbol [Unit]	CanisDrive-20A-UL			
Motor feedback system		MGS			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.35	1.38	1.99	3.54
Moment of inertia with brake	J_{out} [kgm²]	0.44	1.76	2.54	4.52
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	1.38			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	1.76			
Motor feedback system		SIE / MZE / SZE			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.46	1.85	2.66	4.74
Moment of inertia with brake	J_{out} [kgm²]	0.56	2.23	3.21	5.71
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	1.85			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	2.23			
Motor feedback system		SIH / MIH			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.27	1.08	1.55	2.75
Moment of inertia with brake	J_{out} [kgm²]	0.36	1.46	2.1	3.73
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	1.08			
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	1.46			

5.7.3 Technical Data Motor Brake

Table 30.2

	Symbol [Unit]	CanisDrive-20A-UL			
Ratio	i [ ]	**50**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %			
Brake holding torque (at output)	T_{Br} [Nm]	45	90	108	120
Brake current to open	I_{OBr} [A_{DC}]	0.6			
Brake current to hold	I_{HBr} [A_{DC}]	0.3			
Number of brake cyles at n = 0 rpm		10000000			
Emergency brake cyles		200			
Opening time	t_O [ms]	110			
Closing time	t_C [ms]	70			

5.7.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 31.1 CanisDrive-20A-50-AM-UL

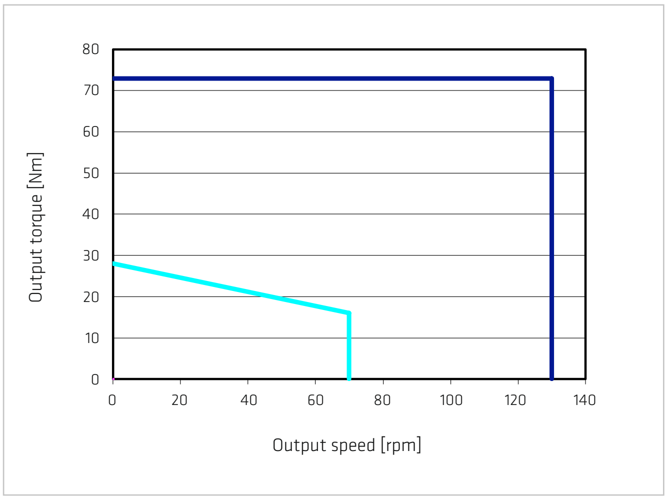


Illustration 31.2 CanisDrive-20A-100-AM-UL

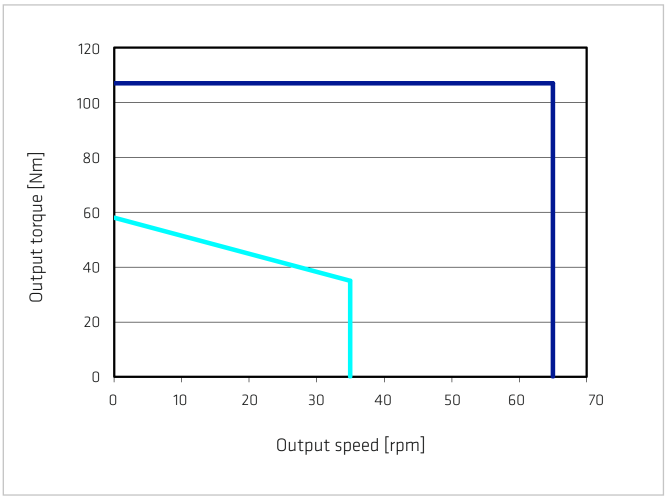


Illustration 31.3 CanisDrive-20A-120-AM-UL

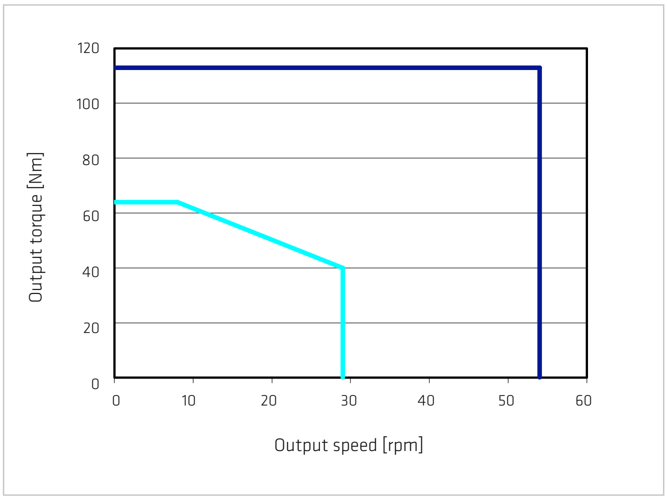
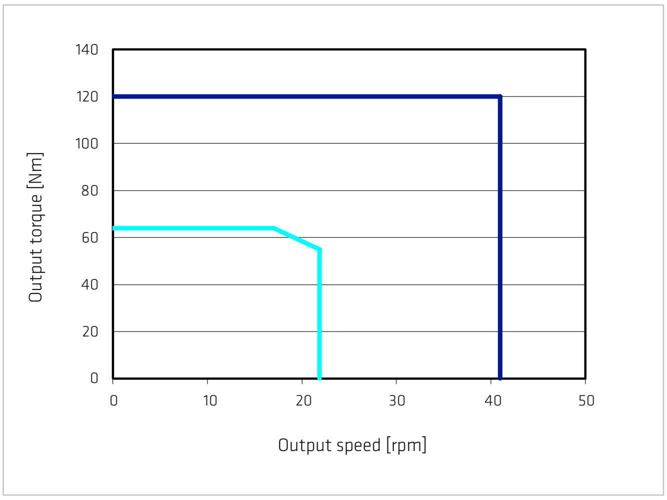


Illustration 31.4 CanisDrive-20A-160-AM-UL



Legend

Intermittent duty
Continuous duty

U_M = 220 ... 400 VAC

5.8 Actuator Data CanisDrive-25A-AR

5.8.1 Technical Data

Table 32.1

	Symbol [Unit]	CanisDrive-25A	
Motor winding		AR	
Motor feedback system		MGS / SIE / MZE / SZE / SHH / MHH	
Ratio	i [ ]	**50**	**100**
Maximum output torque	T_{max} [Nm]	127	204
Maximum output speed	n_{max} [rpm]	112	56
Maximum current	I_{max} [A_{rms}]	5.7	4.5
Continuous stall torque	T_0 [Nm]	72	140
Continuous stall current	I_0 [A_{rms}]	2.9	2.8
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680	
Electrical time constant (20 °C)	τ_e [ms]	2.1	
No load current (20 °C)	I_{NLS} [A_{rms}]	0.26	0.27
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	1.9	10.5
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55	
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff}/1000 rpm]	37	
Maximum motor speed	n_{max} [rpm]	5600	
Rated motor speed	n_N [rpm]	3500	
Resistance (L-L, 20 °C)	R_{L-L} [W]	3.7	
Synchronous inductance	L_d [mH]	3.9	
Number of pole pairs	p [ ]	6	
Weight without brake	m [kg]	4.8	
Weight with brake	m [kg]	6	
Hollow shaft diameter	d_H [mm]	27	

5.8.2 Moment of Inertia

Table 33.1

	Symbol [Unit]	CanisDrive-25A	
Motor feedback system		SIE / MZE / SZE	
Ratio	i [ ]	**50**	**100**
Moment of Inertia output side			
Moment of inertia without brake	J_{out} [kgm^2]	1.06	4.25
Moment of inertia with brake	J_{out} [kgm^2]	1.48	5.92
Moment of Inertia at motor			
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm^2]	4.25	
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm^2]	5.92	
Motor feedback system		MGS	
Ratio	i [ ]	**50**	**100**
Moment of Inertia output side			
Moment of inertia without brake	J_{out} [kgm^2]	1.2	4.8
Moment of inertia with brake	J_{out} [kgm^2]	1.62	6.47
Moment of Inertia at motor			
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm^2]	4.8	
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm^2]	6.47	
Motor feedback system		SHH / MHH	
Ratio	i [ ]	**50**	**100**
Moment of Inertia output side			
Moment of inertia without brake	J_{out} [kgm^2]	0.93	3.73
Moment of inertia with brake	J_{out} [kgm^2]	1.35	5.4
Moment of Inertia at motor			
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm^2]	3.73	
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm^2]	5.4	

5.8.3 Technical Data Motor Brake

Table 33.2

	Symbol [Unit]	CanisDrive-25A	
Ratio	i [ ]	**50**	**100**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %	
Brake holding torque (at output)	T_{Br} [Nm]	90	180
Brake current to open	I_{OBr} [A_{DC}]	0.9	
Brake current to hold	I_{HBr} [A_{DC}]	0.4	
Number of brake cyles at n = 0 rpm		10000000	
Emergency brake cyles		200	
Opening time	t_O [ms]	110	
Closing time	t_C [ms]	70	

5.8.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 34.1 CanisDrive-25A-AR-50

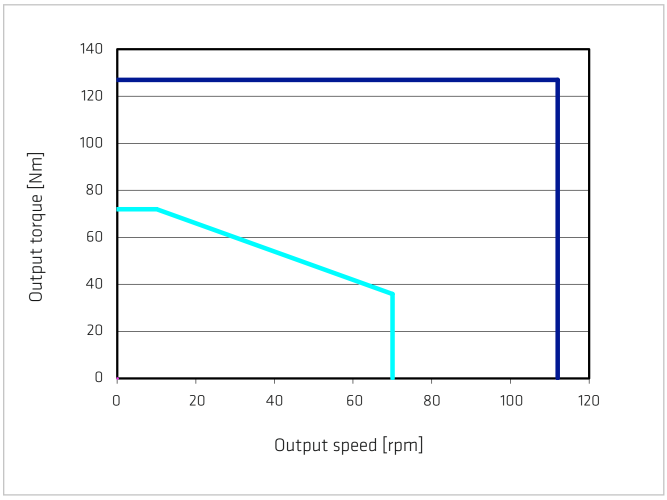
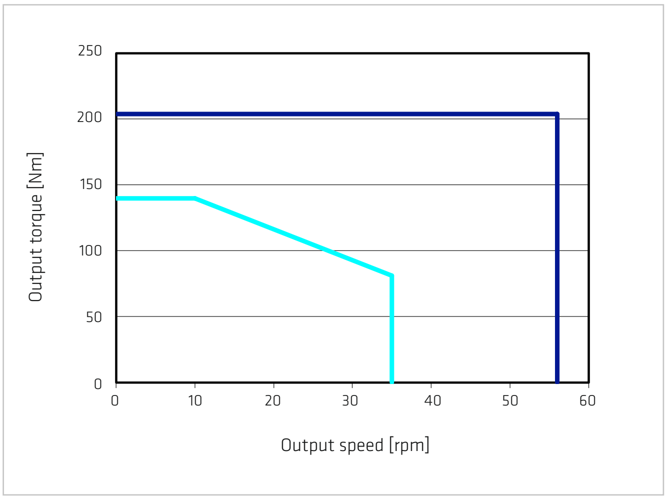


Illustration 34.2 CanisDrive-25A-AR-100



Legend

Intermittent duty
Continuous duty

U_M = 400 VAC

5.9 Actuator Data CanisDrive-25A-AR-UL

5.9.1 Technical Data

Table 35.1

	Symbol [Unit]	CanisDrive-25A-UL	
Motor winding		AR	
Motor feedback system		MGS / SIE / MZE / SZE / SHH / MHH	
Ratio	i [ ]	**50**	**100**
Maximum output torque	T_{max} [Nm]	127	204
Maximum output speed	n_{max} [rpm]	112	56
Maximum current	I_{max} [A_{rms}]	5.7	4.5
Continuous stall torque	T_0 [Nm]	66	136
Continuous stall current	I_0 [A_{rms}]	2.7	2.7
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680	
Electrical time constant (20 °C)	τ_e [ms]	2.1	
No load current (20 °C)	I_{NLS} [A_{rms}]	0.26	0.27
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	1.9	10.5
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55	
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff}/1000 rpm]	37	
Maximum motor speed	n_{max} [rpm]	5600	
Rated motor speed	n_N [rpm]	3500	
Resistance (L-L, 20 °C)	R_{L-L} [W]	3.7	
Synchronous inductance	L_d [mH]	3.9	
Number of pole pairs	p [ ]	6	
Weight without brake	m [kg]	4.8	
Weight with brake	m [kg]	6	
Hollow shaft diameter	d_H [mm]	27	

5.9.2 Moment of Inertia

Table 36.1

	Symbol [Unit]	CanisDrive-25A-UL	
Motor feedback system		SIE / MZE / SZE	
Ratio	i [ ]	**50**	**100**
Moment of Inertia output side			
Moment of inertia without brake	J_{out} [kgm²]	1.06	4.25
Moment of inertia with brake	J_{out} [kgm²]	1.48	5.92
Moment of Inertia at motor			
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	4.25	
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	5.92	
Motor feedback system		MGS	
Ratio	i [ ]	**50**	**100**
Moment of Inertia output side			
Moment of inertia without brake	J_{out} [kgm²]	1.2	4.8
Moment of inertia with brake	J_{out} [kgm²]	1.62	6.47
Moment of Inertia at motor			
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	4.8	
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	6.47	
Motor feedback system		SHH / MHH	
Ratio	i [ ]	**50**	**100**
Moment of Inertia output side			
Moment of inertia without brake	J_{out} [kgm²]	0.93	3.73
Moment of inertia with brake	J_{out} [kgm²]	1.35	5.4
Moment of Inertia at motor			
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	3.73	
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	5.4	

5.9.3 Technical Data Motor Brake

Table 36.2

	Symbol [Unit]	CanisDrive-25A-UL	
Ratio	i [ ]	**50**	**100**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %	
Brake holding torque (at output)	T_{Br} [Nm]	90	180
Brake current to open	I_{OBr} [A_{DC}]	0.9	
Brake current to hold	I_{HBr} [A_{DC}]	0.4	
Number of brake cyles at n = 0 rpm		10000000	
Emergency brake cyles		200	
Opening time	t_O [ms]	110	
Closing time	t_C [ms]	70	

5.9.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 37.1

CanisDrive-25A-50-AR-UL

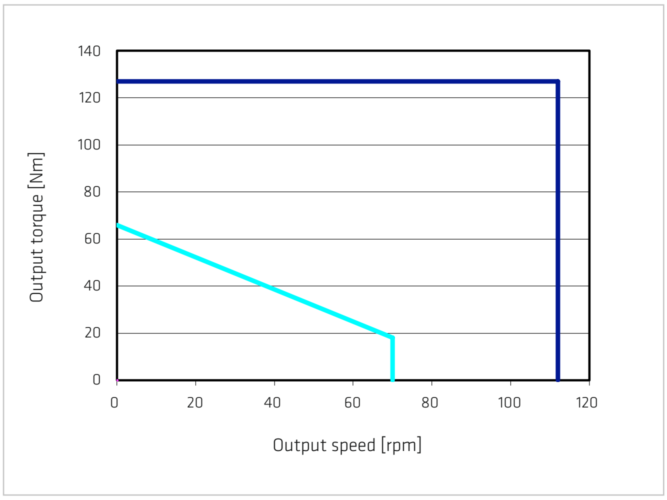
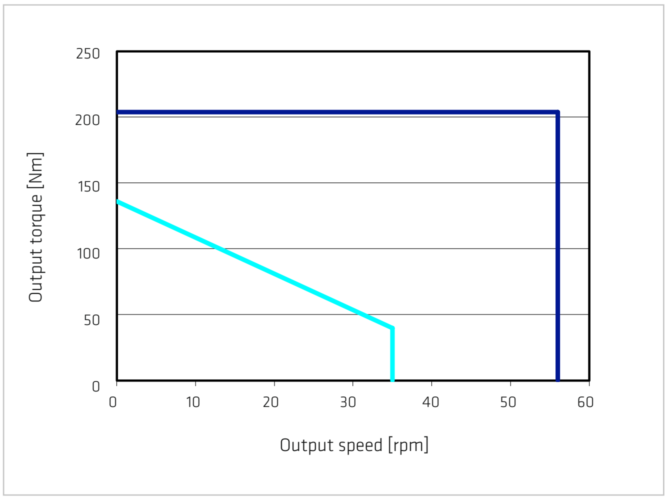


Illustration 37.2

CanisDrive-25A-100-AR-UL



Legend

Intermittent duty

Continuous duty

U_M = 400 VAC

5.10 Actuator Data CanisDrive-32A-AR

5.10.1 Technical Data

Table 38.1

	Symbol [Unit]	CanisDrive-32A				
Motor winding		AR				
Motor feedback system		MGS / SIE / MZE / SZE / SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	281	395	433	459	484
Maximum output speed	n_{max} [rpm]	96	60	48	40	30
Maximum current	I_{max} [A_{rms}]	12.5	10.5	9.1	8	6.4
Continuous stall torque	T_0 [Nm]	79	123	154	185	247
Continuous stall current	I_0 [A_{rms}]	3.3	3.1	3.1	3.1	3.1
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20 °C)	τ_e [ms]	2.1				
No load current (20 °C)	I_{NLS} [A_{rms}]	0.35	0.3	0.3	0.3	0.32
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	16.5	25.7	29.5	34.3	45.8
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55				
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff}/1000 rpm]	37				
Maximum motor speed	n_{max} [rpm]	4800				
Rated motor speed	n_N [rpm]	3500				
Resistance (L-L, 20 °C)	R_{L-L} [W]	3.7				
Synchronous inductance	L_d [mH]	3.9				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	7.3				
Weight with brake	m [kg]	8.4				
Hollow shaft diameter	d_H [mm]	32				

5.10.2 Moment of Inertia

Table 39.1

	Symbol [Unit]	CanisDrive-32A				
Motor feedback system		SIE / MZE / SZE				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	1.57	4.01	6.26	9.01	16
Moment of inertia with brake	J_{out} [kgm²]	1.88	4.81	7.52	10.8	19.3
Moment of Inertia at motor						
Moment of inertia at motor without brake	$J\ [\cdot 10^{-4}\ kgm^2]$	6.26				
Moment of inertia at motor with brake	$J\ [\cdot 10^{-4}\ kgm^2]$	7.52				
Motor feedback system		MGS				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	1.7	4.36	6.81	9.81	17.4
Moment of inertia with brake	J_{out} [kgm²]	2.02	5.16	8.07	11.6	20.7
Moment of Inertia at motor						
Moment of inertia at motor without brake	$J\ [\cdot 10^{-4}\ kgm^2]$	6.81				
Moment of inertia at motor with brake	$J\ [\cdot 10^{-4}\ kgm^2]$	8.07				
Motor feedback system		SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	1.44	3.67	5.74	8.27	14.7
Moment of inertia with brake	J_{out} [kgm²]	1.75	4.48	7	10.1	17.9
Moment of Inertia at motor						
Moment of inertia at motor without brake	$J\ [\cdot 10^{-4}\ kgm^2]$	5.74				
Moment of inertia at motor with brake	$J\ [\cdot 10^{-4}\ kgm^2]$	7				

5.10.3 Technical Data Motor Brake

Table 39.2

	Symbol [Unit]	CanisDrive-32A				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %				
Brake holding torque (at output)	T_{Br} [Nm]	90	144	180	216	288
Brake current to open	I_{OBr} [A_{DC}]	0.9				
Brake current to hold	I_{HBr} [A_{DC}]	0.4				
Number of brake cyles at n = 0 rpm		10000000				
Emergency brake cyles		200				
Opening time	t_O [ms]	110				
Closing time	t_C [ms]	70				

5.10.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 40.1 CanisDrive-32A-AR-50

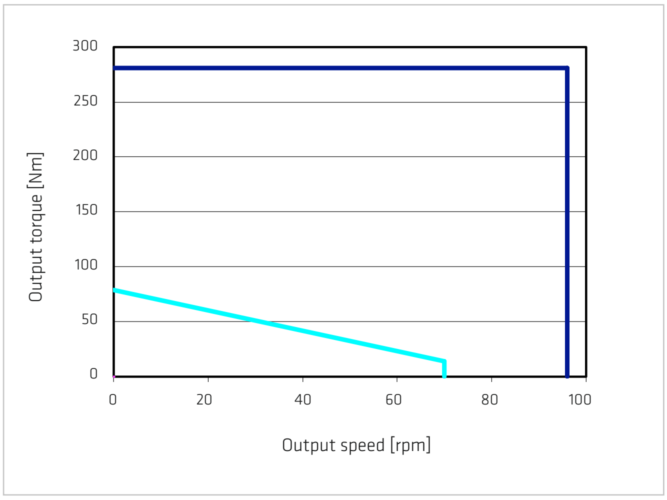


Illustration 40.2 CanisDrive-32A-AR-80

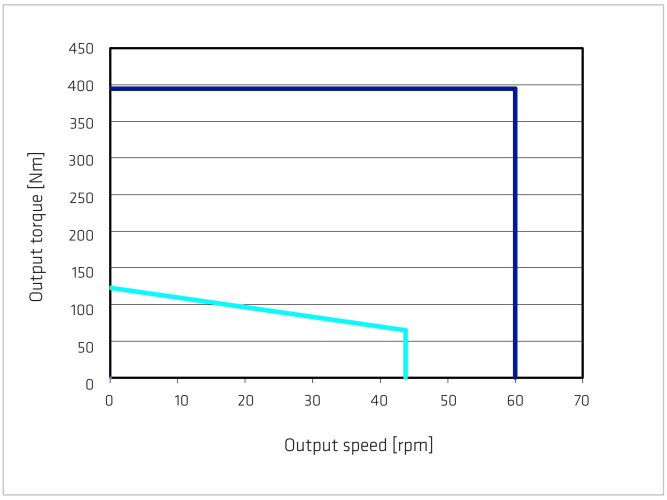


Illustration 40.3 CanisDrive-32A-AR-100

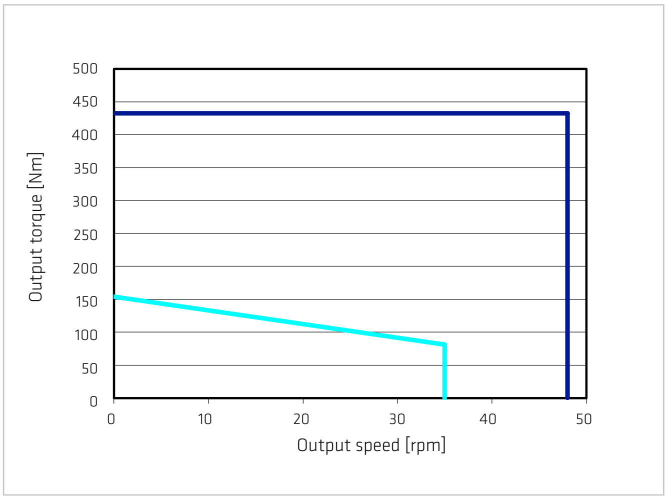


Illustration 40.4 CanisDrive-32A-AR-120

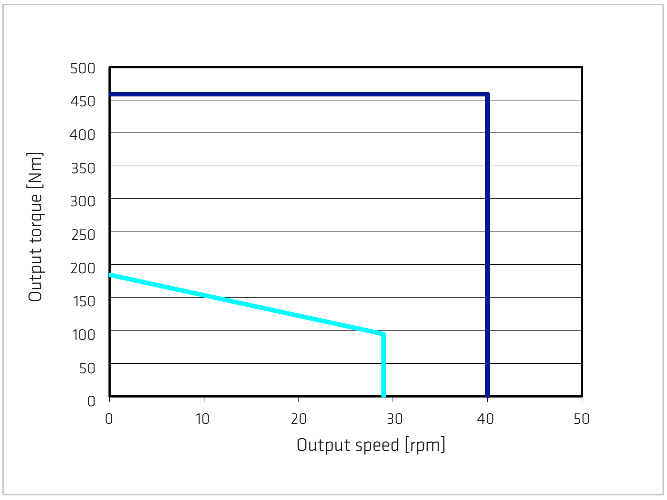
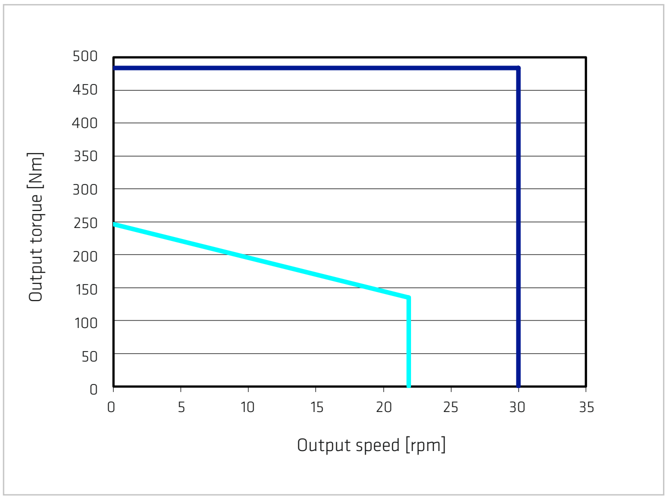


Illustration 40.5 CanisDrive-32A-AR-160



Legend

Intermittent duty ——— U_M = 400 VAC ———
Continuous duty ———

5.11 Actuator Data CanisDrive-32A-AR-UL

5.11.1 Technical Data

Table 41.1

	Symbol [Unit]	CanisDrive-32A-UL				
Motor winding		AR				
Motor feedback system		MGS / SIE / MZE / SZE / SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	281	395	433	459	484
Maximum output speed	n_{max} [rpm]	96	60	48	40	30
Maximum current	I_{max} [A_{rms}]	12.5	10.5	9.1	8	6.4
Continuous stall torque	T_0 [Nm]	68	107	133	160	213
Continuous stall current	I_0 [A_{rms}]	2.9	2.7	2.7	2.7	2.7
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20 °C)	τ_e [ms]	2.1				
No load current (20 °C)	I_{NLS} [A_{rms}]	0.34	0.3	0.3	0.3	0.32
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	16.4	25.7	29.5	34.3	45.8
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55				
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	37				
Maximum motor speed	n_{max} [rpm]	4800				
Rated motor speed	n_N [rpm]	3500				
Resistance (L-L, 20 °C)	R_{L-L} [W]	3.7				
Synchronous inductance	L_d [mH]	3.9				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	7.3				
Weight with brake	m [kg]	8.4				
Hollow shaft diameter	d_H [mm]	32				

5.11.2 Moment of Inertia

Table 42.1

	Symbol [Unit]	CanisDrive-32A-UL				
Motor feedback system		SIE / MZE / SZE				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	1.57	4.01	6.26	9.01	16.03
Moment of inertia with brake	J_{out} [kgm²]	1.88	4.81	7.52	10.83	19.25
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	6.26				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	7.52				
Motor feedback system		MGS				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	1.7	4.36	6.81	9.81	17.4
Moment of inertia with brake	J_{out} [kgm²]	2.02	5.16	8.07	11.6	20.7
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	6.81				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	8.07				
Motor feedback system		SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	1.44	3.67	5.74	8.27	14.7
Moment of inertia with brake	J_{out} [kgm²]	1.75	4.48	7	10.1	17.9
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	5.74				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	7				

5.11.3 Technical Data Motor Brake

Table 42.2

	Symbol [Unit]	CanisDrive-32A-UL				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %				
Brake holding torque (at output)	T_{Br} [Nm]	90	144	180	216	288
Brake current to open	I_{OBr} [A_{DC}]	0.9				
Brake current to hold	I_{HBr} [A_{DC}]	0.4				
Number of brake cyles at n = 0 rpm		10000000				
Emergency brake cyles		200				
Opening time	t_O [ms]	110				
Closing time	t_C [ms]	70				

5.11.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 43.1

CanisDrive-32A-50-AR-UL

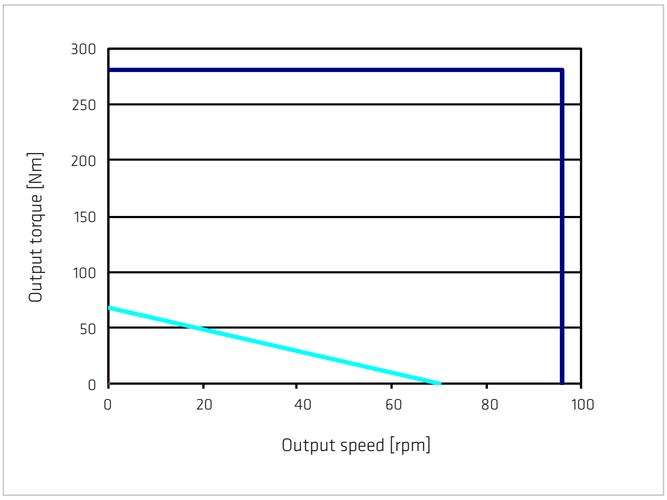


Illustration 43.2

CanisDrive-32A-80-AR-UL

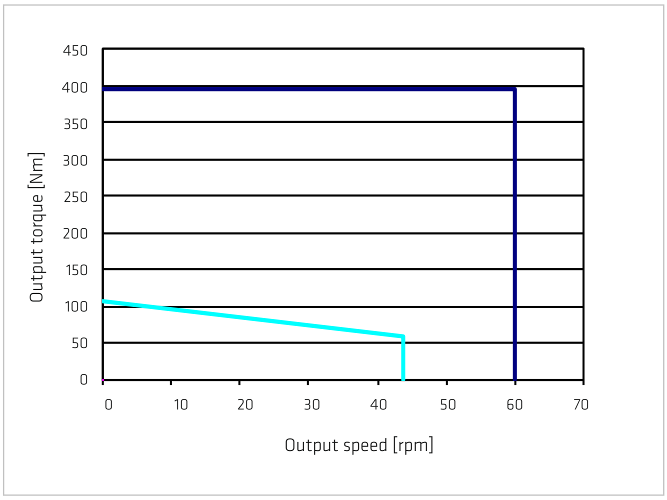


Illustration 43.3

CanisDrive-32A-100-AR-UL

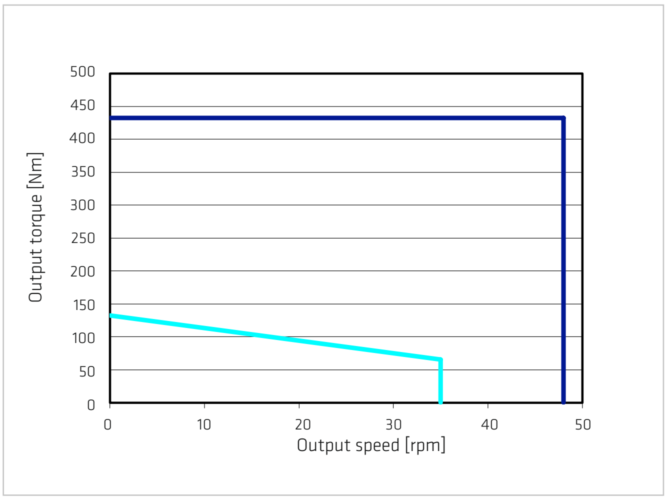


Illustration 43.4

CanisDrive-32A-120-AR-UL

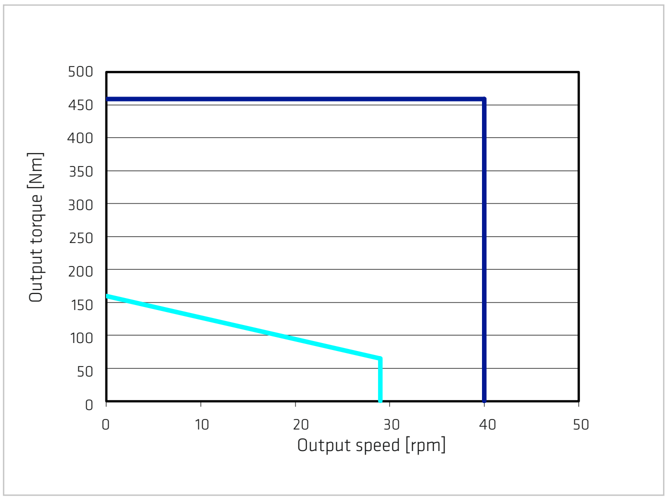
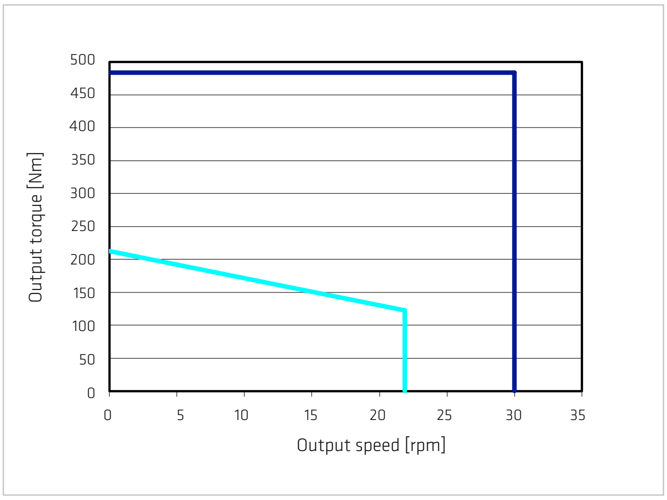


Illustration 43.5

CanisDrive-32A-160-AR-UL



Legend

Intermittent duty

Continuous duty

U_M = 400 VAC

5.12 Actuator Data CanisDrive-40A-AU

5.12.1 Technical Data

Table 44.1

	Symbol [Unit]	CanisDrive-40A				
Motor winding		AU				
Motor feedback system		MGS / SIE / MZE / SZE / SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	523	675	738	802	841
Maximum output speed	n_{max} [rpm]	80	50	40	33	25
Maximum current	I_{max} [A_{rms}]	15.5	11.7	10.1	9.1	7.2
Continuous stall torque	T_0 [Nm]	134	223	279	335	446
Continuous stall current	I_0 [A_{rms}]	3.7	3.7	3.7	3.7	3.7
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20 °C)	τ_e [ms]	2.4				
No load current (20 °C)	I_{NLS} [A_{rms}]	0.37	0.3	0.3	0.31	0.32
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	21.2	31.6	38.1	44.5	56.7
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.83				
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	53				
Maximum motor speed	n_{max} [rpm]	4000				
Rated motor speed	n_N [rpm]	3000				
Resistance (L-L, 20 °C)	R_{L-L} [W]	2.9				
Synchronous inductance	L_d [mH]	3.5				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	11.9				
Weight with brake	m [kg]	13.2				
Hollow shaft diameter	d_H [mm]	39				

5.12.2 Moment of Inertia

Table 45.1

	Symbol [Unit]	CanisDrive-40A				
Motor feedback system		SIE / MZE / SZE / SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.33	8.53	13.3	19.2	34.1
Moment of inertia with brake	J_{out} [kgm²]	3.8	9.73	15.2	21.9	38.9
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	13.3				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	15.2				
Motor feedback system		MGS				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.78	9.66	15.1	21.7	38.7
Moment of inertia with brake	J_{out} [kgm²]	4.25	10.9	17	24.5	43.5
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	15.1				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	17				
Motor feedback system		SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.25	8.32	13	18.7	33.3
Moment of inertia with brake	J_{out} [kgm²]	3.7	9.47	14.8	21.3	37.9
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	13				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	14.8				

5.12.3 Technical Data Motor Brake

Table 45.2

	Symbol [Unit]	CanisDrive-40A				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %				
Brake holding torque (at output)	T_{Br} [Nm]	225	360	450	540	720
Brake current to open	I_{OBr} [A_{DC}]	0.7				
Brake current to hold	I_{HBr} [A_{DC}]	0.3				
Number of brake cyles at n = 0 rpm		10000000				
Emergency brake cyles		200				
Opening time	t_O [ms]	110				
Closing time	t_C [ms]	70				

5.12.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 46.1 CanisDrive-40A-AU-50

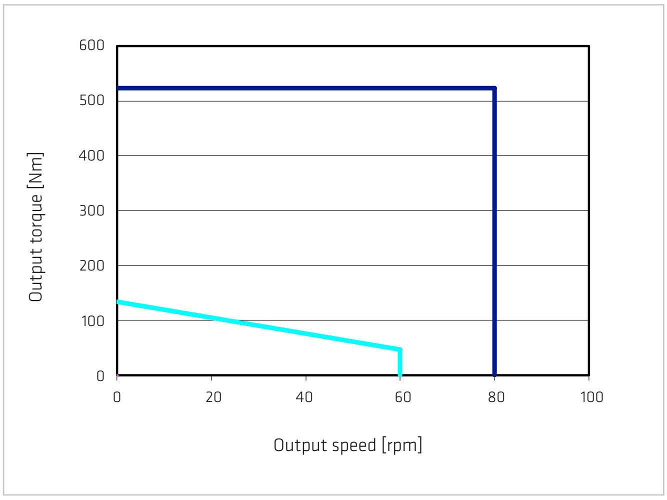


Illustration 46.2 CanisDrive-40A-AU-80

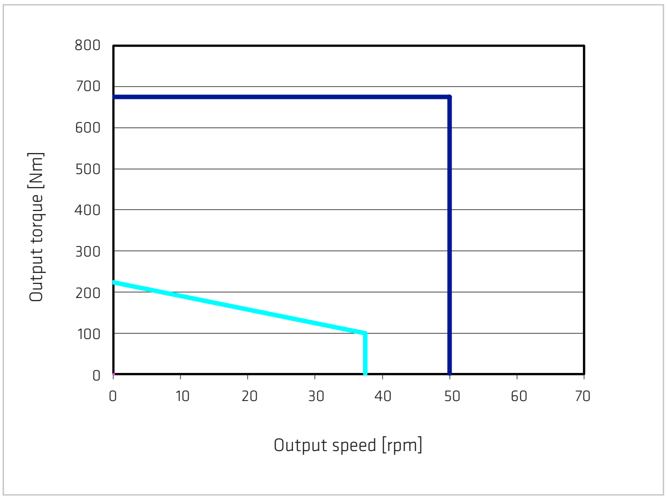


Illustration 46.3 CanisDrive-40A-AU-100

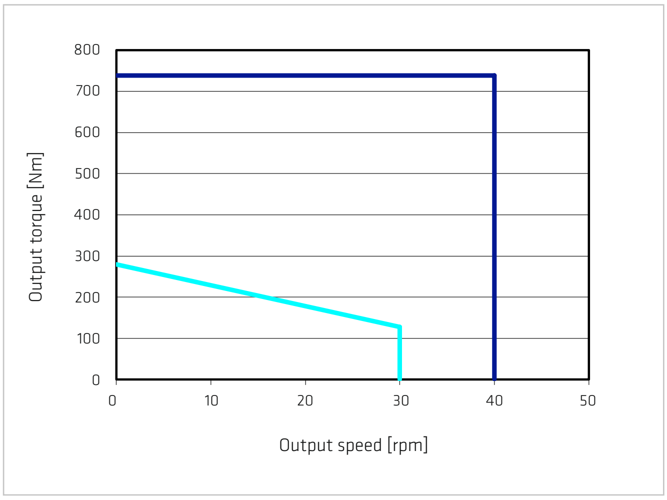


Illustration 46.4 CanisDrive-40A-AU-120

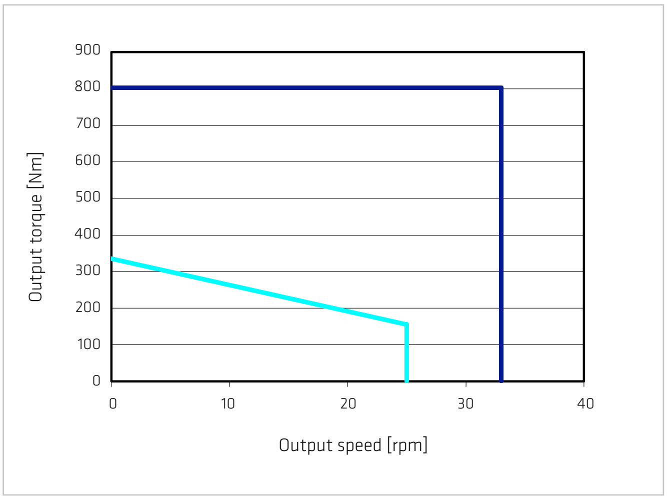
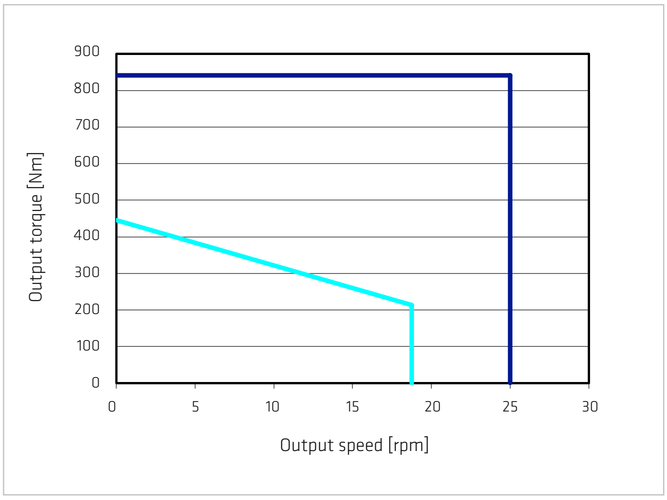


Illustration 46.5 CanisDrive-40A-AU-160



Legend

Intermittent duty ——— U_M = 400 VAC ———
Continuous duty ———

5.13 Actuator Data CanisDrive-40A-AU-UL

5.13.1 Technical Data

Table 47.1

	Symbol [Unit]	CanisDrive-40A-UL				
Motor winding		AU				
Motor feedback system		MGS / SIE / MZE / SZE / SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	523	675	738	802	841
Maximum output speed	n_{max} [rpm]	80	50	40	33	25
Maximum current	I_{max} [A_{rms}]	15.5	11.7	10.1	9.1	7.2
Continuous stall torque	T_0 [Nm]	114	190	238	286	380
Continuous stall current	I_0 [A_{rms}]	3.2	3.2	3.2	3.2	3.2
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20 °C)	τ_e [ms]	2.4				
No load current (20 °C)	I_{NLS} [A_{rms}]	0.37	0.3	0.3	0.31	0.32
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{rms}/rpm]	21.2	31.6	38.1	44.5	56.7
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.83				
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff} /1000 rpm]	53				
Maximum motor speed	n_{max} [rpm]	4000				
Rated motor speed	n_N [rpm]	3000				
Resistance (L-L, 20 °C)	R_{L-L} [W]	2.9				
Synchronous inductance	L_d [mH]	3.5				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	11.9				
Weight with brake	m [kg]	13.2				
Hollow shaft diameter	d_H [mm]	39				

5.13.2 Moment of Inertia

Table 48.1

	Symbol [Unit]	CanisDrive-40A-UL				
Motor feedback system		SIE / MZE / SZE / SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.33	8.53	13.3	19.2	34.1
Moment of inertia with brake	J_{out} [kgm²]	3.8	9.73	15.2	21.9	38.9
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	13.3				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	15.2				
Motor feedback system		MGS				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.78	9.66	15.1	21.7	38.7
Moment of inertia with brake	J_{out} [kgm²]	4.25	10.9	17	24.5	43.5
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	15.1				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	17				
Motor feedback system		SHH / MHH				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.25	8.32	13	18.7	33.3
Moment of inertia with brake	J_{out} [kgm²]	3.7	9.47	14.8	21.3	37.9
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	13				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	14.8				

5.13.3 Technical Data Motor Brake

Table 48.2

	Symbol [Unit]	CanisDrive-40A-UL				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %				
Brake holding torque (at output)	T_{Br} [Nm]	225	360	450	540	720
Brake current to open	I_{OBr} [A_{DC}]	0.7				
Brake current to hold	I_{HBr} [A_{DC}]	0.3				
Number of brake cyles at n = 0 rpm		10000000				
Emergency brake cyles		200				
Opening time	t_O [ms]	110				
Closing time	t_C [ms]	70				

5.13.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 49.1

CanisDrive-40A-50-AU-UL

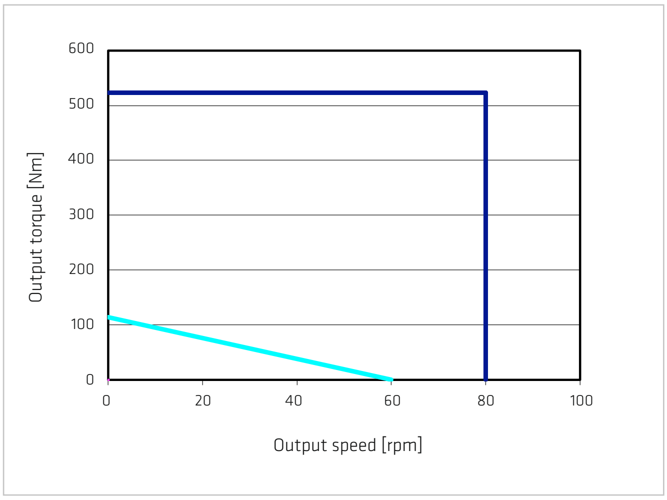


Illustration 49.2

CanisDrive-40A-80-AU-UL

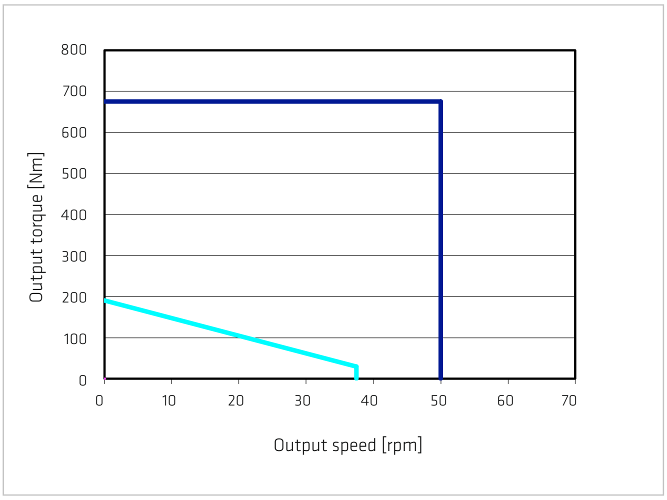


Illustration 49.3

CanisDrive-40A-100-AU-UL

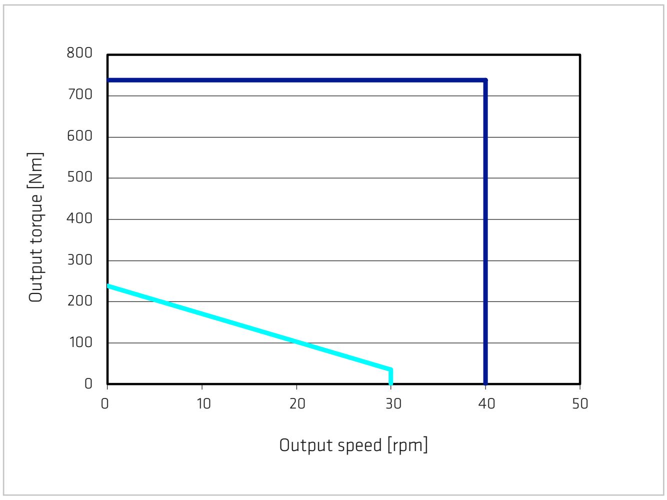


Illustration 49.4

CanisDrive-40A-120-AU-UL

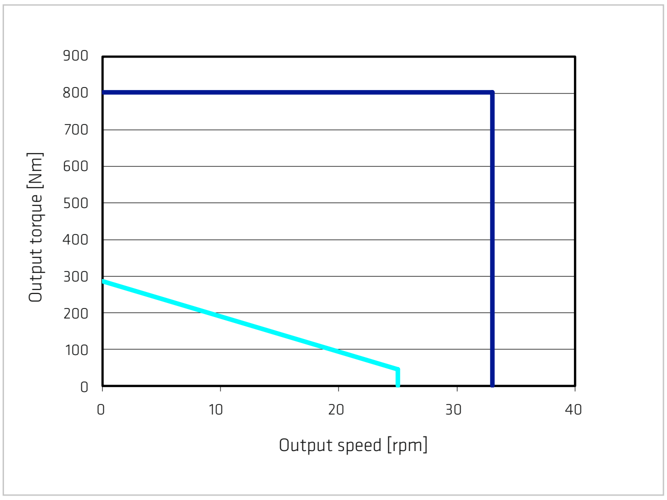
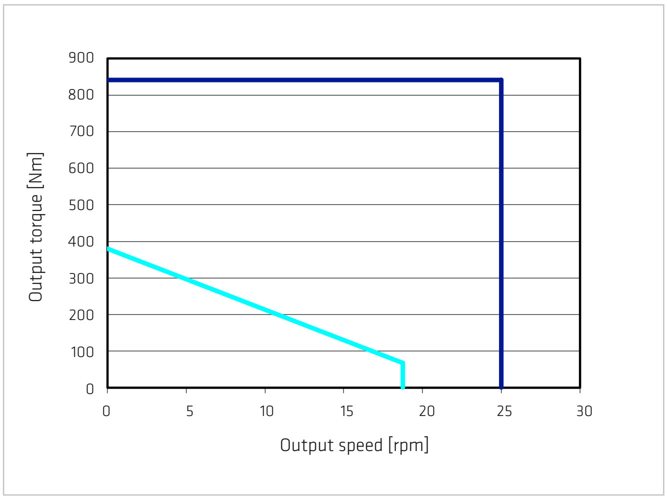


Illustration 49.5

CanisDrive-40A-160-AU-UL



Legend

Intermittent duty

Continuous duty

U_M = 400 VAC

5.14 Actuator Data CanisDrive-50A-AX

5.14.1 Technical Data

Table 50.1

	Symbol [Unit]	CanisDrive-50A				
Motor winding		AX				
Motor feedback system		MGS / SZE / MZE				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	715	941	980	1080	1180
Maximum output speed	n_{max} [rpm]	70	44	35	29	22
Maximum output speed (Dual Use EU1382/2014)	n_{max} [rpm]	64	40	32	26	20
Maximum current	I_{max} [A_{eff}]	10.6	8.5	7.2	6.6	5.5
Continuous stall torque	T_0 [Nm]	122	519	666	813	843
Continuous stall current	I_0 [A_{eff}]	1.9	4.4	4.5	4.6	3.6
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20 °C)	τ_e [ms]	5.7				
No load current (20 °C)	I_{NLS} [A_{eff}]	0.37	0.33	0.33	0.33	0.35
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{eff}/rpm]	20.5	29	33.2	40	51.6
Torque constant (at motor)	k_{TM} [Nm/A_{eff}]	1.62				
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff}/1000 rpm]	108				
Maximum motor speed	n_{max} [rpm]	3500				
Maximum motor speed (Dual Use EU1382/2014)	n_{max} [rpm]	3200				
Rated motor speed	n_N [rpm]	2000				
Resistance (L-L, 20 °C)	R_{L-L} [Ω]	0.94				
Synchronous inductance	L_d [mH]	2.7				
Number of pole pairs	p [ ]	11				
Weight without brake	m [kg]	20.6				
Weight with brake	m [kg]	23.3				
Hollow shaft diameter	d_H [mm]	55.5				

5.14.2 Moment of Inertia

Table 51.1

	Symbol [Unit]	CanisDrive-50A				
Motor feedback system		SIE / MZE / SZE				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	16.2	41.5	64.9	93.4	166.1
Moment of inertia with brake	J_{out} [kgm²]	18.2	46.6	72.8	104.9	186.5
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	64.9				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	72.8				
Motor feedback system		MGS				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	15	38.5	60.1	86.6	153.9
Moment of inertia with brake	J_{out} [kgm²]	17	43.6	68.1	98.1	174.3
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	60.1				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	68.1				

5.14.3 Technical Data Motor Brake

Table 51.2

	Symbol [Unit]	CanisDrive-50A				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %				
Brake holding torque (at output)	T_{Br} [Nm]	585	936	980	1080	1180
Brake current to open	I_{OBr} [A_{DC}]	1.3				
Brake current to hold	I_{HBr} [A_{DC}]	0.7				
Number of brake cyles at n = 0 rpm		10000000				
Emergency brake cyles		500				
Opening time	t_O [ms]	35				
Closing time	t_C [ms]	30				

5.14.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 52.1

CanisDrive-50A-50-AX

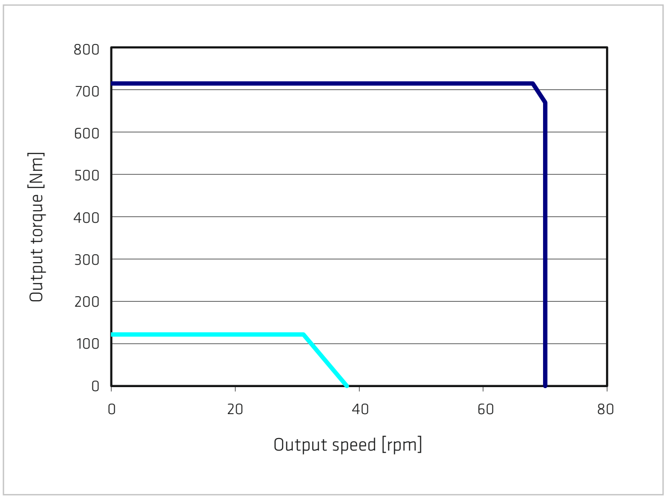


Illustration 52.2

CanisDrive-50A-80-AX

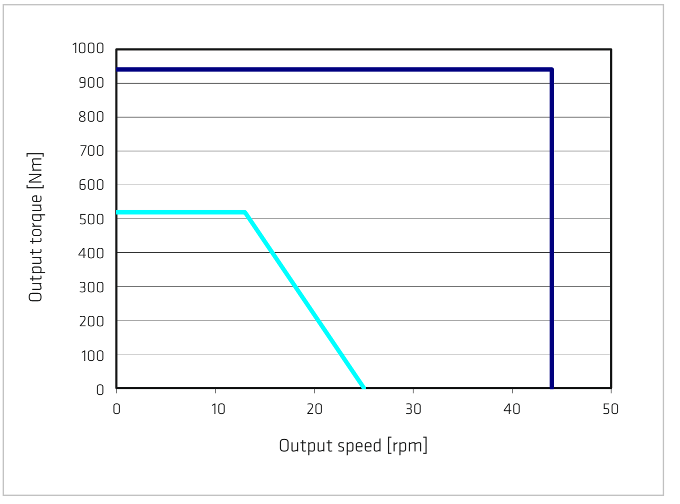


Illustration 52.3

CanisDrive-50A-100-AX

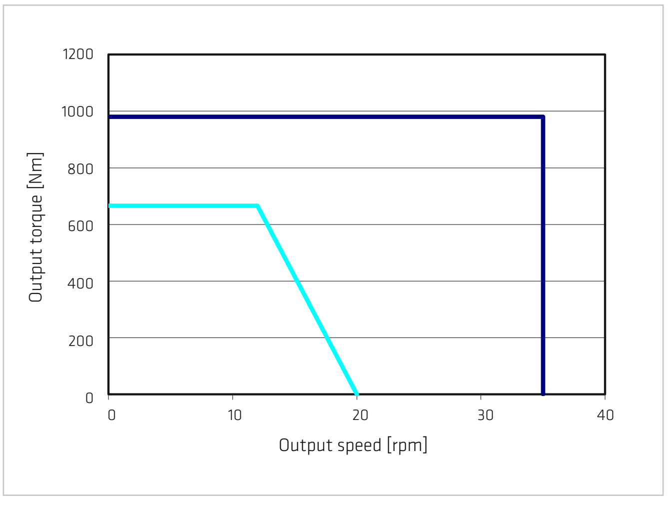


Illustration 52.4

CanisDrive-50A-120-AX

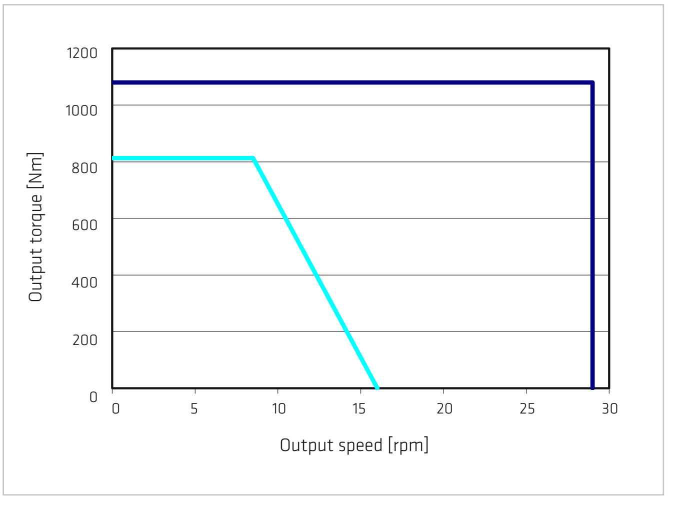
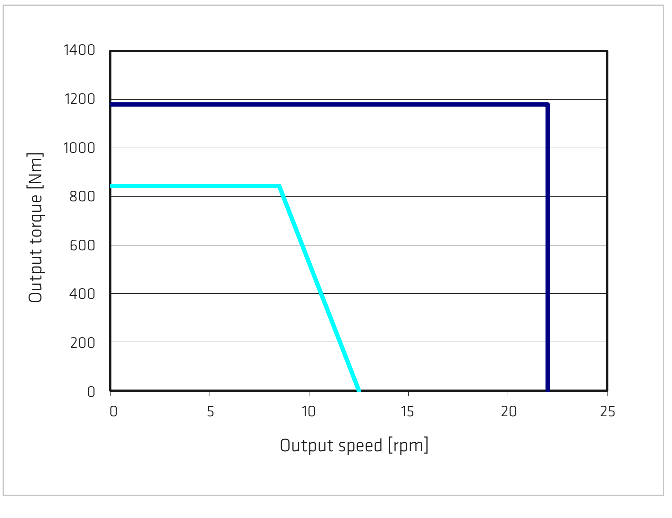


Illustration 52.5

CanisDrive-50A-160-AX



Legend

Intermittent duty

Continuous duty

U_M = 400 VAC

5.15 Actuator Data CanisDrive-58A-AX

5.15.1 Technical Data

Table 53.1

	Symbol [Unit]	CanisDrive-58A				
Motor winding		AX				
Motor feedback system		MGS / SZE / MZE				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	1020	1480	1590	1720	1840
Maximum output speed	n_{max} [rpm]	60	38	30	25	19
Maximum current	I_{max} [A_{eff}]	15	13.7	11.7	10.5	8.5
Continuous stall torque	T_0 [Nm]	177	770	1060	1190	1210
Continuous stall current	I_0 [Aeff]	2.7	6.6	7.2	6.8	5.2
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20 °C)	τ_e [ms]	5.7				
No load current (20 °C)	I_{NLS} [A_{eff}]	0.55	0.47	0.47	0.47	0.49
No load running current constant (20 °C)	K_{INL} [$\cdot 10^{-3}$ A_{eff}/rpm]	29.9	42.9	48.7	58.3	74.6
Torque constant (at motor)	k_{TM} [Nm/A_{eff}]	1.62				
AC voltage constant (L-L, 20 °C, at motor)	k_{EM} [V_{eff}/1000 rpm]	108				
Maximum motor speed	n_{max} [rpm]	3000				
Rated motor speed	n_N [rpm]	2000				
Resistance (L-L, 20 °C)	R_{L-L} [Ω]	0.94				
Synchronous inductance	L_d [mH]	2.7				
Number of pole pairs	p [ ]	11				
Weight without brake	m [kg]	27.5				
Weight with brake	m [kg]	30.1				
Hollow shaft diameter	d_H [mm]	65.5				

5.15.2 Moment of Inertia

Table 54.1

	Symbol [Unit]	CanisDrive-58A				
Motor feedback system		MZE / SZE				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	23.2	59.3	92.7	133.4	237.2
Moment of inertia with brake	J_{out} [kgm²]	25.4	65	101.5	146.1	259.8
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	92.7				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	101.5				
Motor feedback system		MGS				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	22.5	57.6	90	129.6	230.3
Moment of inertia with brake	J_{out} [kgm²]	24.7	63.2	98.8	142.3	252.9
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [$\cdot 10^{-4}$ kgm²]	90				
Moment of inertia at motor with brake	J [$\cdot 10^{-4}$ kgm²]	98.8				

5.15.3 Technical Data Motor Brake

Table 54.2

	Symbol [Unit]	CanisDrive-58A				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10 %				
Brake holding torque (at output)	T_{Br} [Nm]	585	936	1170	1404	1840
Brake current to open	I_{OBr} [A_{DC}]	1.3				
Brake current to hold	I_{HBr} [A_{DC}]	0.7				
Number of brake cyles at n = 0 rpm		10000000				
Emergency brake cyles		500				
Opening time	t_O [ms]	35				
Closing time	t_C [ms]	30				

5.15.4 Performance Characteristics

The performance curves shown below are valid for the specified ambient operating temperature if the motor terminal voltage is higher or equal to the values given in the rating tables.

Illustration 55.1

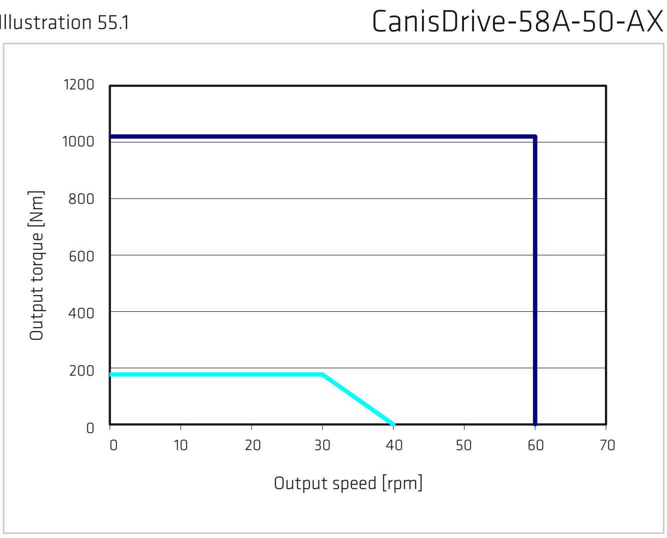


Illustration 55.2

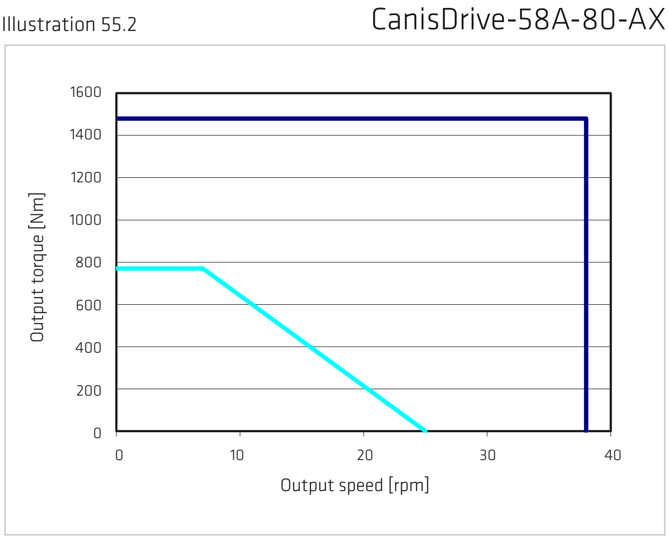


Illustration 55.3

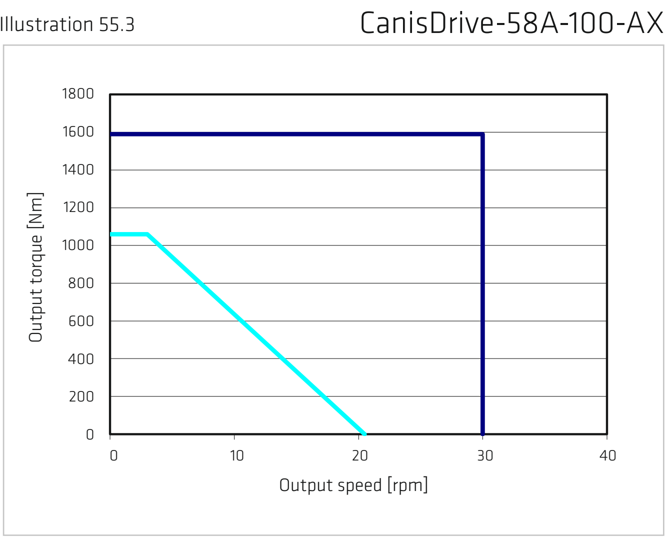


Illustration 55.4

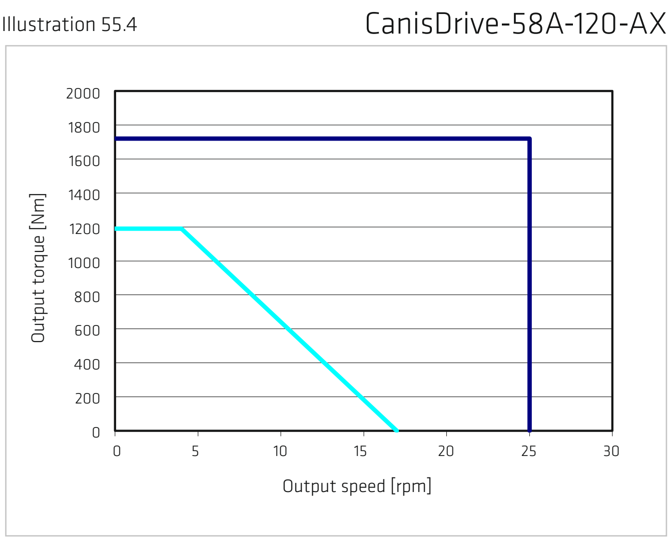
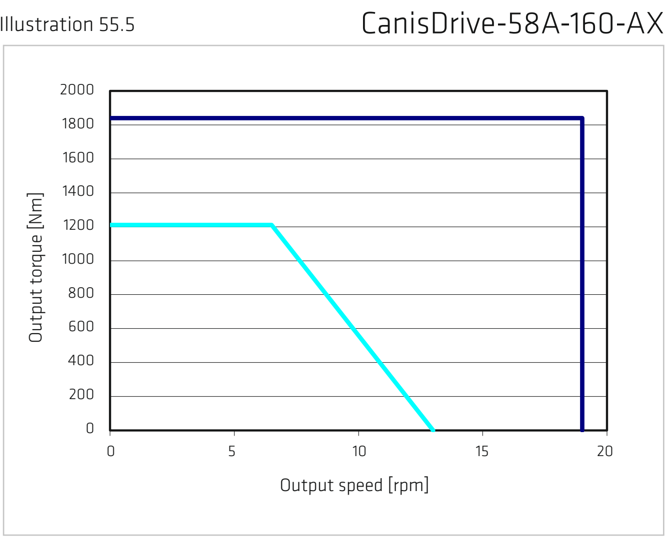


Illustration 55.5



Legend

Intermittent duty
Continuous duty

U_M = 400 VAC

5.16 Dimensions

Illustration 56.1 CanisDrive-14A-FB-E [mm]

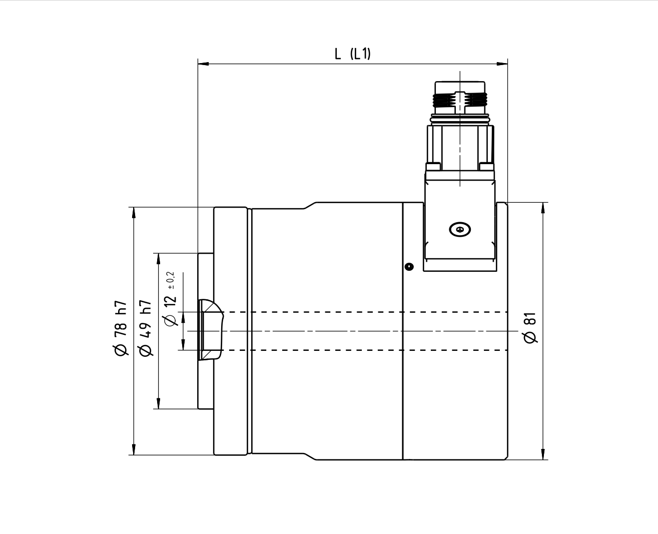


Illustration 56.2 CanisDrive-17A-FD-E [mm]

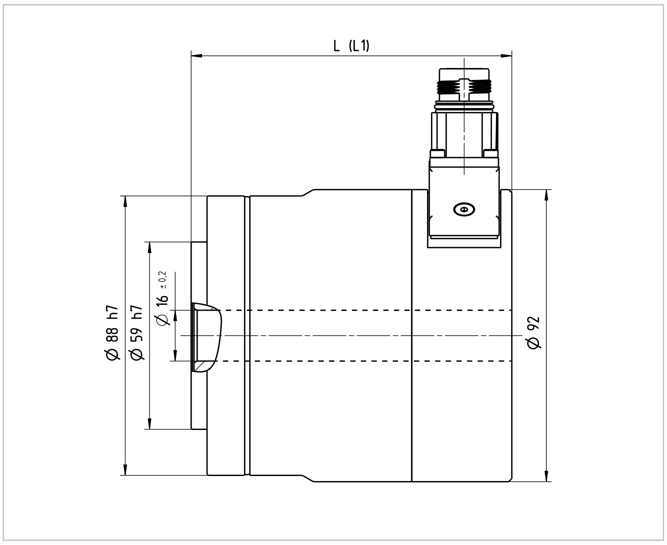


Table 56.3

	Symbol [Unit]	CanisDrive-14A-FB-E	CanisDrive-17A-FD-E
Motor feedback system		ROO / MGS / DCO	ROO / MGS / DCO
Length (without brake)	L [mm]	97.5	101
Length (with brake)	L1 [mm]	120.6	123

Illustration 56.4 CanisDrive-14A-AM [mm]

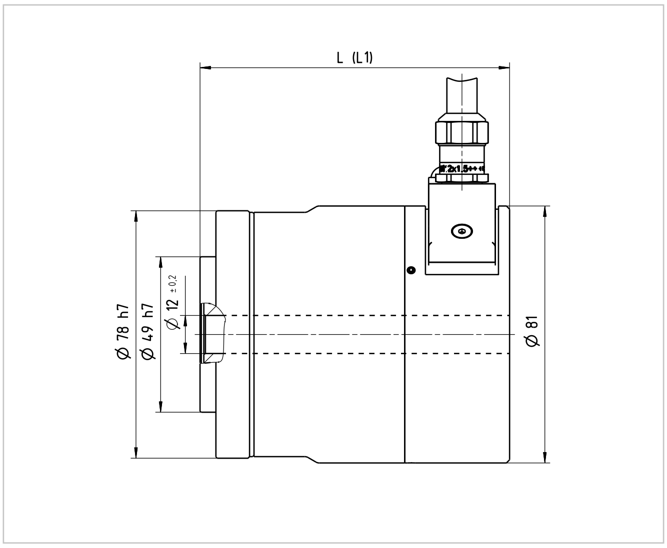


Illustration 56.5 CanisDrive-17A-AO [mm]

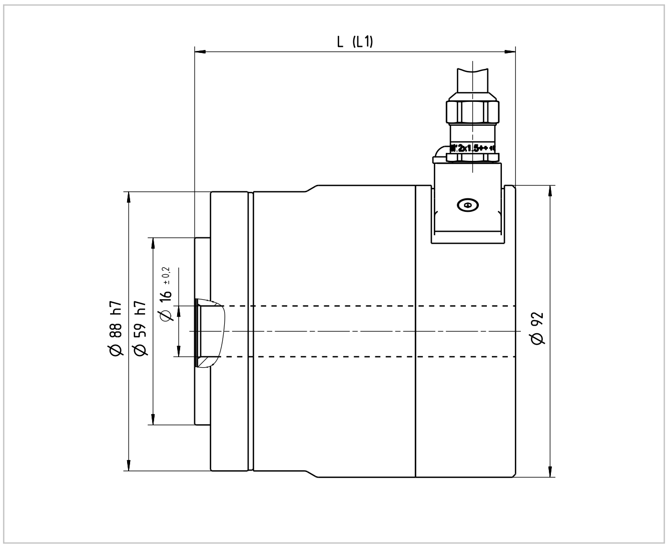


Table 56.6

	Symbol [Unit]	CanisDrive-14A-AM	CanisDrive-17A-AO	
Motor feedback system		ROO / MGS / DCO	ROO / MGS / DCO	SIH / MIH
Length (without brake)	L [mm]	97.5	101	104
Length (with brake)	L1 [mm]	120.6	123	123
Standard cable length	L [m]	1.5	1.5	1.5

Illustration 57.1 CanisDrive-20A [mm]

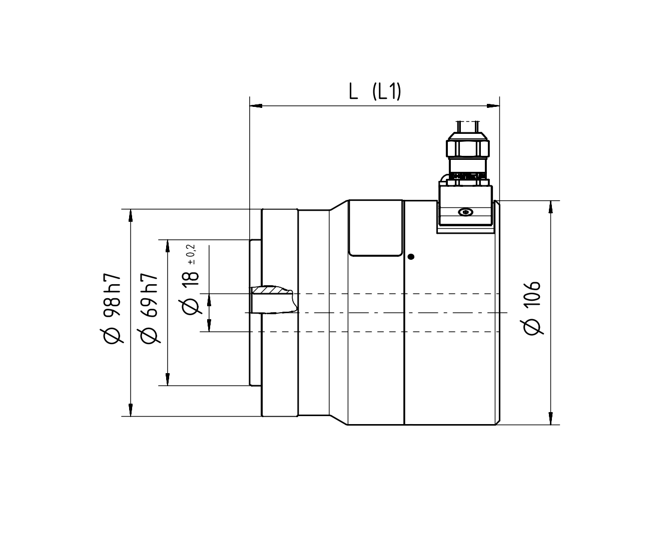


Illustration 57.2 CanisDrive-25A [mm]

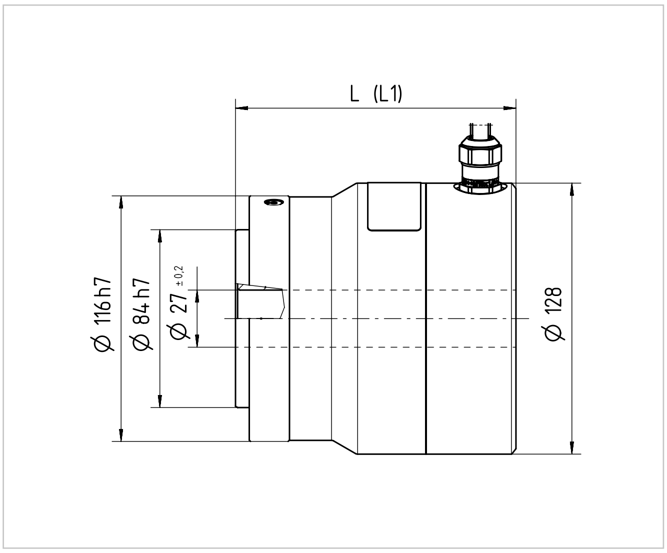


Table 57.3

	Symbol [Unit]	CanisDrive-20A	CanisDrive-25A
Motor feedback system		MGS / SIE / MZE / SZE / SIH / MIH	MGS / SIE / MZE / SZE / SHH / MHH
Length (without brake)	L [mm]	118	132.5
Length (with brake)	L1 [mm]	139	160
Standard cable length	L [m]	1.5	1.5

Illustration 57.4 CanisDrive-32A [mm]

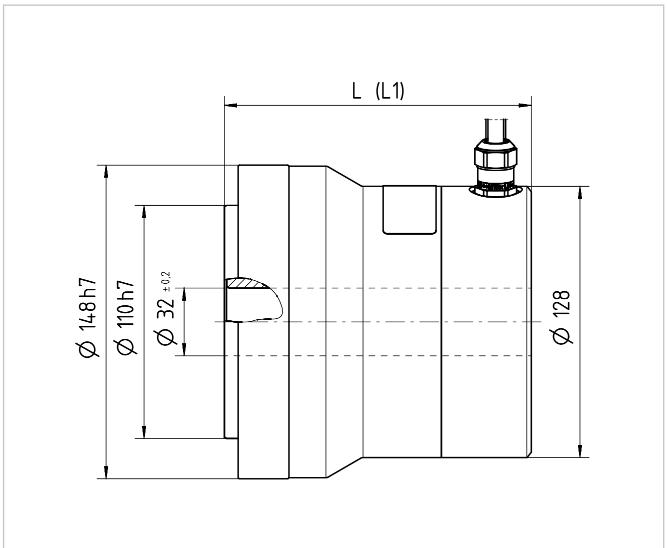


Illustration 57.5 CanisDrive-40A [mm]

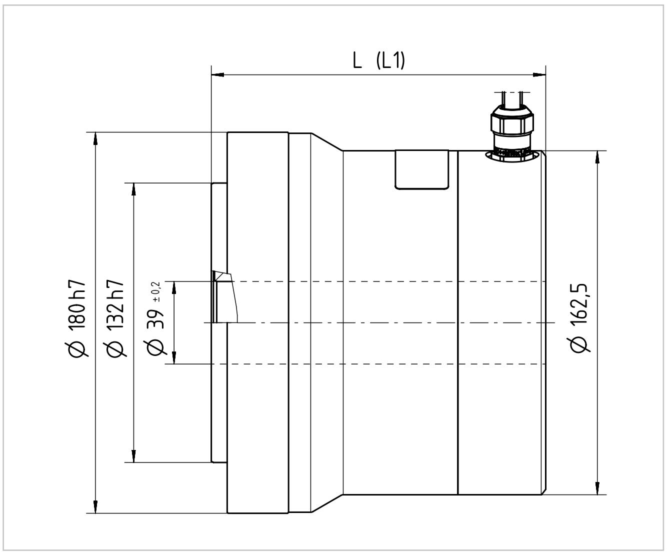


Table 57.6

	Symbol [Unit]	CanisDrive-32A	CanisDrive-40A
Motor feedback system		MGS / SIE / MZE / SZE / SHH / MHH	MGS / SIE / MZE / SZE / SHH / MHH
Length (without brake)	L [mm]	145	158
Length (with brake)	L1 [mm]	172.5	177
Standard cable length	L [m]	1.5	1.5

Illustration 58.1 CanisDrive-50A [mm]

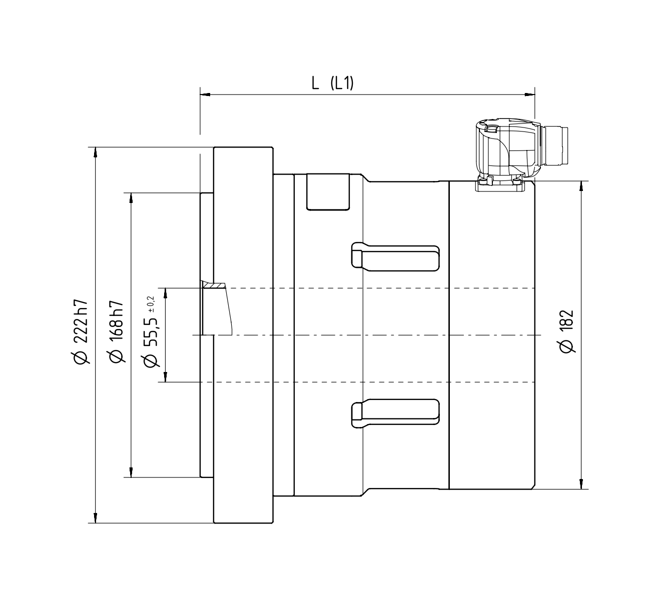


Illustration 58.2 CanisDrive-58A [mm]

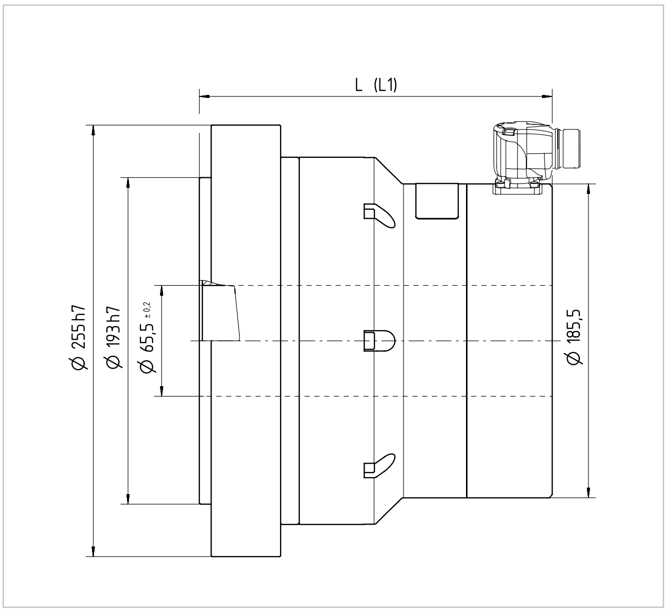


Table 58.3

	Symbol [Unit]	CanisDrive-50A	CanisDrive-58A
Motor feedback system		MGS / MZE / SZE	MGS / MZE / SZE
Length (without brake)	L [mm]	197.5	208
Length (with brake)	L1 [mm]	226.5	235

5.17 Accuracy

Table 59.1

	Symbol [Unit]	CanisDrive-14A		CanisDrive-17A		CanisDrive-20A		CanisDrive-25A	
Ratio	i [ ]	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**
Transmission accuracy	[arcmin]	< 1.5	< 1.5	< 1.5	< 1.5	< 1	< 0.8	< 1	< 0.8
Repeatability	[arcmin]	< ±0.1		< ±0.1		< ±0.1		< ±0.1	
Hysteresis loss	[arcmin]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Lost Motion	[arcmin]	< 1		< 1		< 1		< 1	

Table 59.2

	Symbol [Unit]	CanisDrive-32A		CanisDrive-40A		CanisDrive-50A		CanisDrive-58A	
Ratio	i [ ]	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**
Transmission accuracy	[arcmin]	< 1	< 0.8	< 0.7	< 0.5	< 0.7	< 0.5	< 0.7	< 0.5
Repeatability	[arcmin]	< ±0.1		< ±0.1		< ±0.1		< ±0.1	
Hysteresis loss	[arcmin]	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Lost Motion	[arcmin]	< 1		< 1		< 1		< 1	

5.18 Torsional Stiffness

Table 59.3

	Symbol [Unit]	CanisDrive-14A		CanisDrive-17A		CanisDrive-20A		CanisDrive-25A	
T_1	[Nm]	2		3.9		7		14	
T_2	[Nm]	6.9		12		25		48	
Ratio	i [ ]	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**
K_3	[$\cdot 10^3$ Nm/rad]	5.7	7.1	13	16	23	29	44	57
K_2	[$\cdot 10^3$ Nm/rad]	4.7	6.1	11	14	18	25	34	50
K_1	[$\cdot 10^3$ Nm/rad]	3.4	4.7	8.1	10	13	16	25	31

Table 59.4

	Symbol [Unit]	CanisDrive-32A		CanisDrive-40A		CanisDrive-50A		CanisDrive-58A	
T_1	[Nm]	29		54		108		168	
T_2	[Nm]	108		196		382		598	
Ratio	i [ ]	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**	**50**	**> 50**
K_3	[$\cdot 10^3$ Nm/rad]	98	120	180	230	340	440	540	710
K_2	[$\cdot 10^3$ Nm/rad]	78	110	140	200	280	400	440	610
K_1	[$\cdot 10^3$ Nm/rad]	54	67	100	130	200	250	310	400

5.19 Output Bearing

Our servo actuators incorporate a high stiffness output bearing. This specially developed bearing can withstand high axial forces and radial forces as well as tilting moments. The reduction gear thus protected from external loads, so guaranteeing a long life and consistent performance. The integration of an output bearing also serves to reduce subsequent design and production cost, by removing the need for an additionaly output bearing in many applications.

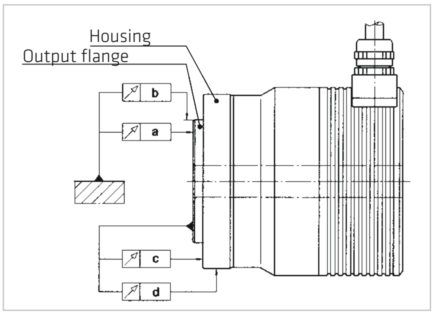
5.19.1 Technical Data

Table 60.1

	Symbol [Unit]	CanisDrive®							
		14A	17A	20A	25A	32A	40A	50A	58A
Bearing type[1]		C	C	C	C	C	C	C	C
Pitch circle diameter	d_p [m]	0.0465	0.059	0.07	0.088	0.114	0.134	0.171	0.192
Offset	R [m]	0.014	0.014	0.016	0.018	0.02	0.026	0.028	0.029
Dynamic load rating	C [N]	8250	10700	21000	21800	34500	43300	81600	87400
Static load rating	C_0 [N]	11400	14800	27000	35800	59000	81600	149000	171000
Dynamic tilting moment[2]	$M_{dyn\,(max)}$ [Nm]	73	114	172	254	578	886	1558	2222
Static tilting moment[3]	$M_{0\,(max)}$ [Nm]	155	276	603	1050	2242	3645	8493	10944
Tilting moment stiffness[5]	K_B [Nm/arcmin]	23	40	70	114	350	522	1020	1550
Dynamic axial load[4]	$F_{A\,dyn\,(max)}$ [N]	2880	4600	15800	19200	22300	42000	56100	57700
Dynamic radial load[4]	$F_{R\,dyn\,(max)}$ [N]	1450	2300	8600	12700	14600	27500	37300	38400

1) C=Cross roller bearing, F = Four point contact bearing
2) These values are valid for moving gears. They are not based on the equation for lifetime of the output bearing but on the maximum allowable deflection of the Harmonic Drive® Component Set. The values indicated in the table must not be exceeded even if the lifetime equation of the bearing permits higher values.
3) These values are valid for gears at a standstill and for a static load safety factor f_s = 1.8 for size 14 ... 20 and f_s = 1.5 for size 25 ... 58.
4) These data are valid for n = 15 rpm and L_{10} = 15000 h
3)4) These data are only valid if the following conditions are fulfilled:
for M_0: F_a = 0 N; F_r = 0 N
F_a: M = 0 Nm; F_r = 0 N
F_r: M = 0 Nm; F_a = 0 N
5) Average value

Illustration 60.2



5.19.2 Tolerances

Table 60.3

	[Unit]	CanisDrive®							
		14A	17A	20A	25A	32A	40A	50A	58A
a	[mm]	0.01	0.01	0.01	0.01	0.012	0.012	0.015	0.015
b	[mm]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
c	[mm]	0.01	0.01	0.01	0.01	0.012	0.012	0.015	0.015
d	[mm]	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

5.20 Motor Feedback Systems

Design and Operation

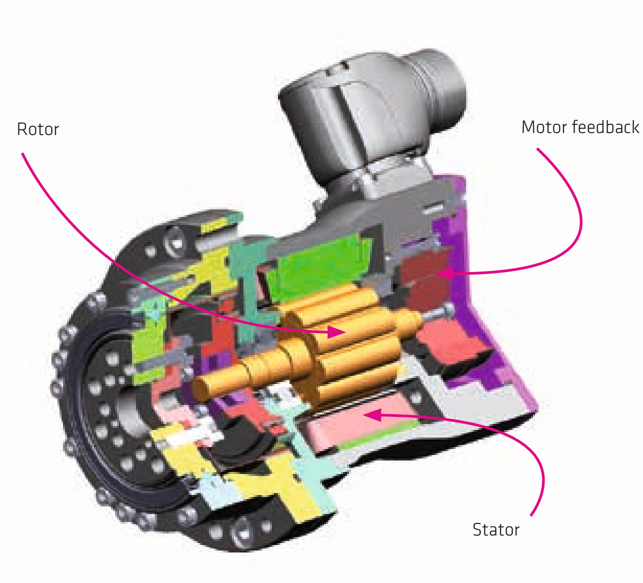
For accurate position setting, the servo motor and its control device are fitted with a measuring device (feedback), which determines the current position (e.g. the angle of redation set for a starting position) of the motor.

This measurement is effected via a redary encoder, e.g. a resolver, an incremental encoder or an absolute encoder. The position controller compares the signal from this encoder with the pre-set position value. If there is any deviation, then the motor is turned in the direction which represents a shorter path to the set value which leads to the deviation being reduced. The procedure repeats itself until the value lies incrementally or approximately within the tolerance limits. Alternatively, the motor position can also be digitally recorded and compared by computer to a set value.

Servo motors and actuators from Harmonic Drive AG use various motor feedback systems which are used as position transducers to fulfil several requirements.

Commutation

Commutation signals or absolute position values provide the necessary information about the rotor position, in order to guarantee correct commutation.



Actual Speed

The actual speed is obtained in the servo controller using the feedback signal, from the cyclical change in position information.

Actual Position

Incremental encoder
The actual signal value needed for setting the position is formed by adding up the incremental position changes. Where incremental encoders have square wave signals, definition of the edge evaluation can be quadrupled (quad counting).
Where incremental encoders have SIN / COS signals, then the definition can be increased by interpolation in the control device.

Absolute encoder
Absolute encoders deliver absolute position information about one (single turn) or several (multi-turn) rotations. This information can on the one hand provide the rotor position for commutation and on the other hand possibly a reference of travel. Where absolute encoders have additional incremental signals, then typically the absolute position information can be read at power up and the incremental signals then evaluated to determine the rotation and actual position value.
Fully digital absolute encoders as motor feedback systems have such a high definition of the absolute value that there is no need for additional incremental signals.

Resolution

In conjunction with the Harmonic Drive AG high precision gears, the output side position can be recorded via the motor feedback system without any additional angle encoders having to be used. The resolution of the motor feedback system can also be multiplied by gear ratio.

Output Side Angle Measurement Devices

Where applications place higher demands on accuracy or need torsion compensation at high torque load, the actual position can also be detected by an additional sensor mounted at the gearbox output side. The adaptation of an output side measurement sytem can be very simply realised for hollow shaft actuators.

5.20.1 MGSi (CanisDrive-14A ... 20A)

Multi-turn absolute motor feedback system with incremental SIN / COS signals and SSI data interface

Table 62.1

Ordering Code	**Symbol [Unit]**	**MGSi (CanisDrive-14A ... 20A)**				
Manufacturer's designation		GEL				
Protocol		SSI (binary)				
Power supply[1]	U_b [VDC]	5 ... 30				
Power consumption (without load)[1]	P [W]	0.1				
Current consumption buffering (at 25 °C)[1]	I [µA]	10				
Power on time[1]	t[s]	< 0.1				
Incremental signals	u_{pp} [V_{ss}]	1				
Signal form		sinusoidal				
Number of pulses	n_1	128				
SSI data word length		29 bit				
Absolute position /revolution (motor side)[3]		131072 (17 bit)				
Number of revolutions		4096 (12 bit) Battery back up (internal battery available)				
Typical battery service life[4]	[a]	10				
Recommended encoder replacement interval	[a]	6				
Accuracy[1]	[arcsec]	±360				
Resolution of the absolute value (output side)		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	0.2	0.2	0.1	0.1	0.1
Number of revolutions (output side)		81	51	40	34	25
Incremental resolution (motor side)[2]	inc [ ]	32768				
Resolution (output side)[2]		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	0.79	0.49	0.4	0.33	0.25

[1] Source: Manufacturer
[2] For interpolation with 8 bit
[3] Increasing position values
- for rotation in clockwise direction, looking at the motor shaft
- for rotation in counter clockwise direction, looking at the output flange

[4] Typical service life with 10 h/day in normal operation, battery temperature 25 °C and a self discharge of 1 %/a.

ADVICE

The internal battery can not be replaced!

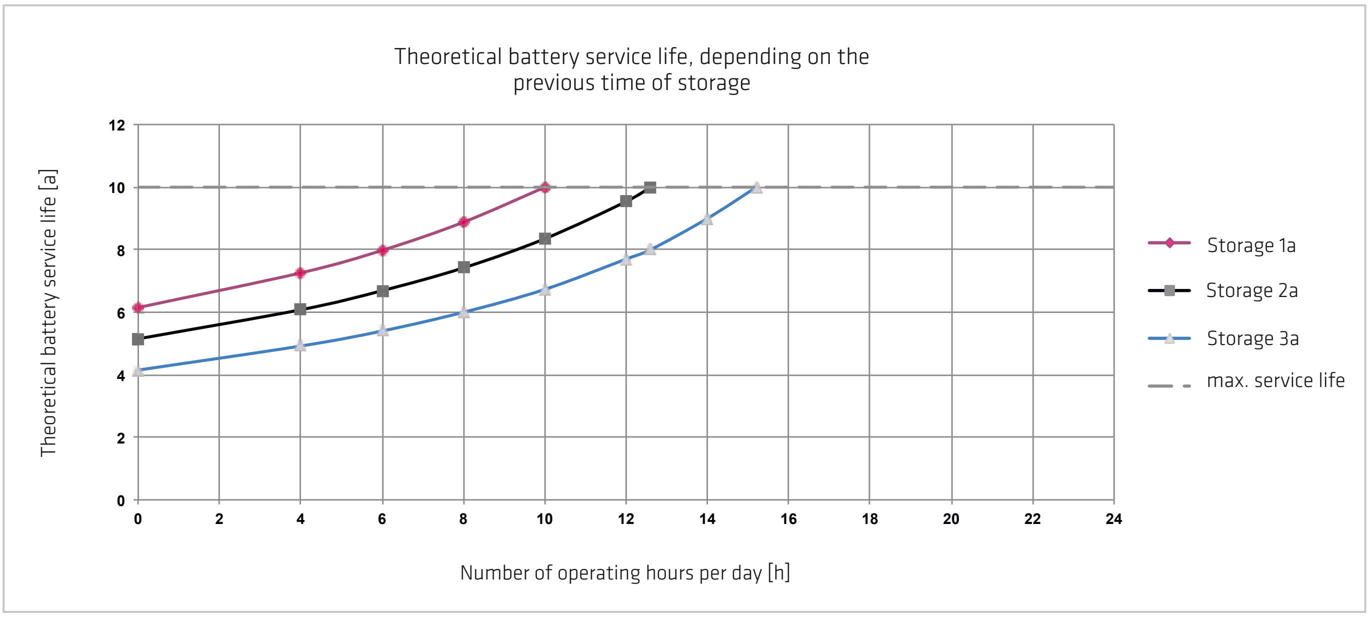
INFO

The use as a single turn absolute motor feedback sytem is not intended.

Battery lifetime

The theoretical battery service life can be determined based on the previous storage time and the daily time of operating.

Illustration 63.1



ADVICE

Regardless of the results from the theoretical battery service life calculation, we specify to change the complete motor feed-back system latest 10 years after delivery.

⚠ ATTENTION

In case of failure or interruption of the battery voltage and simultaneous failure or interruption of the power supply, the reported position after restarting will be wrong!
Undefined positioning can cause injury to persons or damage to the system.

5.20.2 MGSe (CanisDrive-25A ... 58A)

Multi-turn absolute motor feedback system with incremental SIN / COS signals and SSI data interface

Table 64.1

Ordering Code	Symbol [Unit]	MGSe (CanisDrive-25A ... 40A)				
Manufacturer's designation		GEL				
Protocol		SSI (binary)				
Power supply[1]	U_b [VDC]	5 ... 30				
Power consumption (without load)[1]	P [W]	0.1				
Current consumption buffering (at 25 °C)[1]	I [µA]	40				
Power on time[1]	t[s]	< 10				
Incremental signals	u_{pp} [Vss]	1				
Signal form		sinusoidal				
Number of pulses	n_1	128				
SSI data word length		32 bit (30 bit position data; 1 Error-bit; 1 Warning-bit)				
Absolute position / revolution (motor side)[3]		131072 (17 bit)				
Number of revolutions		8192 (13 bit) battery back up (external battery necessary)				
Recommended buffer battery		Lithium thionyl chloride 3.6 V / ≥ 2.0 Ah TADIRAN SL-760 Size: AA				
Typical battery service life[4]	[a]	8				
Recommended encoder replacement interval	[a]	5				
Accuracy[1]	[arcsec]	±180				
Resolution of the absolute value (output side)		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	0.2	0.2	0.1	0.1	0.1
Number of revolutions (output side)		163	102	81	68	51
Incremental resolution (motor side)[2]	inc [ ]	32768				
Resolution (output side)[2]		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	0.79	0.49	0.4	0.33	0.25

[1] Source: Manufacturer.
[2] For interpolation with 8 bit
[3] Increasing position values
- for rotation in clockwise direction, looking at the motor shaft
- for rotation in counter clockwise direction, looking at the output flange

[4] Typical service life with 10 h/day in normal operation, battery temperature 25 °C and a self discharge of 1 %/a.

⚠ ATTENTION

In case of failure or interruption of the battery voltage and simultaneous failure or interruption of the power supply, the reported position after restarting will be wrong!
Undefined positioning can cause injury to persons or damage to the system.

ADVICE

An external battery power supply is necessary to operate the battery buffered multi-turn absolute motor feedback sytem of the CanisDrive-25A ... 40A Series. A battery box MGS is available for this purpose. The handling of the battery box MGS and the electrical connections are described in the chapter "Battery Boxes". The use as a single turn absolute motor feedback sytem is not intended.

5.20.3 R00

Resolver

Table 65.1

Ordering code	Symbol [Unit]	R00				
Manufacturer's designation		RE				
Power supply[1]	U_b [VAC]	7				
Current consumption (max., without load)[1]	I [mA]	50				
Input frequency	f [kHz]	5 ... 10				
Number of pole pairs		1				
Transformation ratio[1]	ü [ ]	0.5 ±10 %				
Accuracy[1]	[arcmin]	±10				
Incremental resolution (motor side)[2]	[inc]	2048				
Resolution (output side)[2]		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	13	8	7	6	4

[1] Source: Manufacturer
[2] For interpolation with 11 bit

5.20.4 SIE

Single turn Absolute motor feedback system with incremental SIN / COS signals and EnDat® data interface

Table 65.2

Ordering code	Symbol [Unit]	SIE				
Manufacturer's designation		ECI 119				
Protocol		EnDat® 2.1 / 01				
Power supply[1]	U_b [VDC]	3.6 ... 14				
Current consumption (typically at 5 VDC, without load)[1]	I [mA]	80				
Incremental signals	u_{pp} [V_{ss}]	0.8 ... 1.2				
Signal form		sinusoidal				
Number of pulses	n_1 [SIN / COS]	32				
Absolute position / revolution (motor side)[3]		524288 (19 bit)				
Number of revolutions		-				
Accuracy[1]	[arcsec]	±90				
Resolution of the absolute value (output side)		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	0.05	0.04	0.03	0.03	0.02
Number of revolutions (at output side)		-	-	-	-	-
Incremental resolution (motor side)[2]	inc [ ]	8192				
Resolution (output side)[2]		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	3.16	1.98	1.58	1.32	0.99

[1] Source: Manufacturer
[2] For interpolation with 8 bit
[3] Increasing position values
- for rotation in clockwise direction, looking at the motor shaft
- for rotation in counter clockwise direction, looking at the output flange

ADVICE

The commutation offset has to be determined during the first setup.

5.20.5 DCO

Incremental motor feedback system with square wave signals, reference signal and commutation signals (RS 422 standard)

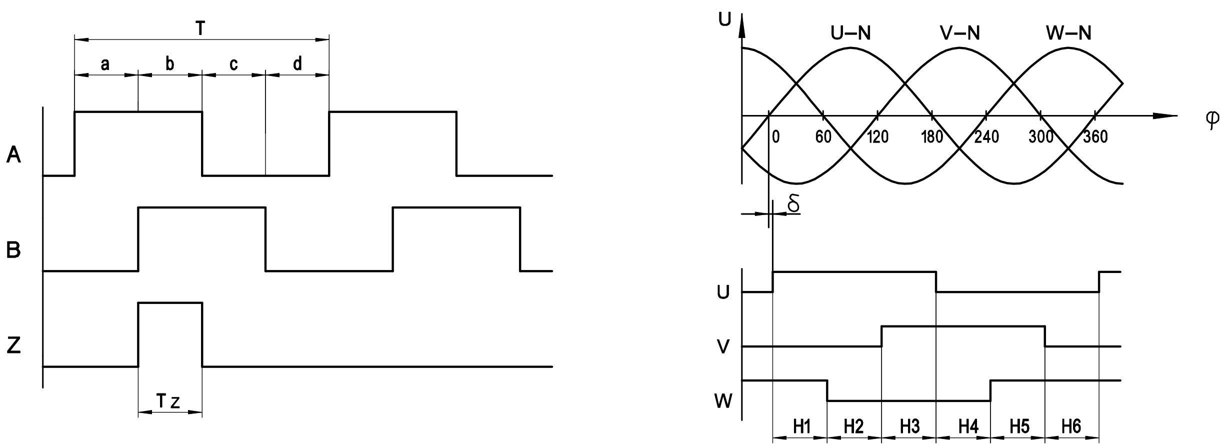
Table 66.1

Ordering code	Symbol [Unit]	DCO				
Manufacturer's designation		EBG				
Power supply[1]	U_b [VDC]	5 ±10 %				
Current consumption (without load)[1]	I [mA]	40				
Incremental signals		RS422				
Wave form		square wave				
Number of pulses	n_1 [A / B]	2048				
Commutation signals		RS422				
Signal form		square wave				
Number of pulses	n_2 [U / V / W]	5				
Reference signal	n_3 [Z]	1				
Accuracy[1]	[arcsec]	±600				
Incremental resolution (motor side)[2]	[qc]	8192				
Resolution (output side)[2]		Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**
	[arcsec]	3.2	2	1.6	1.4	1

[1] Source: Manufacturer
[2] For quadcounting

Signal Wave Form

Illustration 66.2



T = 360°/2048
a, b, c, d = 0.25 T
T_z = 1/4 T
H_N = 360°/5 = 72°
d ≤ ±5° el.

Valid for direction of rotation
- CW motor shaft (with a view from the front of the motor shaft)
- CCW output flange

5.20.6 MZE

Multi-turn absolute motor feedback system with EnDat® 2.2 / 22 data interface

Table 67.1

Ordering code	**Symbol [Unit]**	**MZE (CanisDrive-20 ... 40)**					**MZE (CanisDrive-50 ... 58)**				
Manufacturer's designation		EBI 135					EBI 4010				
Protocol		EnDat® 2.2 / 22					EnDat® 2.2 / 22				
Power supply[1]	U_b [VDC]	3.6 ... 14					3.6 ... 14				
Current consumption (typically at 5 V, without load)[1]	I [mA]	75					95				
Current consumption buffering (at 25 °C)[1) 2)]	I [µA]	12					25				
Incremental signals	u_{pp} [V_{ss}]	-					-				
Signal form		-					-				
Number of pulses	n_1	-					-				
Absolute position / revolution (motor side)[3]		524288 (19 bit)					1048576 (20 bit)				
Number of revolutions		65536 (16 bit) battery back up (external battery necessary)					65536 (16 bit) battery back up (external battery necessary)				
Recommended buffer battery		Lithium thionyl chloride 3.6V / ≥ 2.0Ah Tadiran SL-760S Size: AA					Lithium Thionylchlorid 3.6 V / ≥ 2.0 Ah Tadiran SL-760S Size: AA				
Typical battery service life[4]	[a]	10					10				
Recommended encoder replacement interval	[a]	10					10				
Accuracy[1]	[arcsec]	±90					±25				
Resolution at motor side	[arcsec]	2.47					1.24				
Gear ratio	i [ ]	**50**	**80**	**100**	**120**	**160**	**50**	**80**	**100**	**120**	**160**
Resolution of the absolute value (output side)	[arcsec]	0.049	0.031	0.025	0.021	0.015	0.025	0.015	0.012	0.010	0.008
Number of revolutions (output side)		1310	819	655	546	409	1310	819	655	546	409

1) Source: Manufacturer.
2) Source: Manufacturer. Valid for power off and standstill
3) Increasing position values
- for rotation in clockwise direction, looking at the motor shaft
- for rotation in counter clockwise direction, looking at the output flange
4) Typical service life with 10 h/day in normal operation, battery temperature 25 °C and a self discharge of 1 %/a.

⚠ ATTENTION

In case of failure or interruption of the battery voltage and simultaneous failure or interruption of the power supply, the reported position after restarting will be wrong!
Undefined positioning can cause injury to persons or damage to the system.

ADVICE

Not compatible to Siemens servo controller SINAMICS S120!
The commutation offset has to be determined during the first setup.

ADVICE

An external battery power supply is necessary to operate the battery buffered multi-turn absolute motor feedback system MZE. A battery box MZE is available for this purpose. The handling of the battery box MZE and the electrical connections are described in the chapter "Battery Boxes".
The typical service life of 10 years for the buffer battery applies to 10 h/day in normal operation, battery temperature 25 °C and a self-discharge of 1 %/a. To achieve a long service life of the buffer battery, the main power supply (U_b) must be connected to the encoder while connecting the backup battery, or directly thereafter, in order for the encoder to become fully initialised after having been completely powerless. Otherwise the encoder will consume a significantly higher amount of battery current until main power is supplied the first time.

5.20.7 SZE

Single turn absolute motor feedback system with EnDat® 2.2 / 22 data interface

Table 68.1

Ordering code	**Symbol [Unit]**	**SZE (CanisDrive-20 ... 40)**					**SZE (CanisDrive-50 ... 58)**				
Manufacturer's designation		ECI 119					ECI 4010				
Protocol		EnDat® 2.2 / 22					EnDat® 2.2 / 22				
Power supply[1]	U_b [VDC]	3.6 ... 14					3.6 ... 14				
Current consumption (typically at 5 V, without load)[1]	I [mA]	75					95				
Current consumption buffering (at 25 °C)[1] [2]	I [µA]	-					-				
Incremental signals	u_{pp} [V_{ss}]	-					-				
Signal form		-					-				
Number of pulses	n_1	-					-				
Absolute position / revolution (motor side)[3]		524288 (19 bit)					1048576 (20 bit)				
Number of revolutions		-					-				
Accuracy[1]	[arcsec]	±90					±25				
Resolution at motor side	[arcsec]	2.47					1.24				
Gear ratio	i [ ]	**50**	**80**	**100**	**120**	**160**	**50**	**80**	**100**	**120**	**160**
Resolution of the absolute value (output side)	[arcsec]	0.049	0.031	0.025	0.021	0.015	0.025	0.015	0.012	0.010	0.008
Number of revolutions (output side)		-	-	-	-	-	–	–	–	–	–

[1] Source: Manufacturer.
[2] Source: Manufacturer. Valid for power off and standstill
[3] Increasing position values
- for rotation in clockwise direction, looking at the motor shaft
- for rotation in counter clockwise direction, looking at the output flange

ADVICE

Not compatible to Siemens servo controller SINAMICS S120!
The commutation offset has to be determined during the first setup.

5.20.8 SIH / SHH

Single turn Absolute motor feedback system with incremental SIN / COS signals and HIPERFACE® data interface

Table 69.1

Ordering code	Symbol [Unit]	SIH					SHH				
Manufacturer's designation		SES70					SES90				
Protocol		HIPERFACE®					HIPERFACE®				
Power supply[1]	U_b [VDC]	7 ... 12					7 ... 12				
Current consumption (typically at 7 VDC, without load)[1]	I [mA]	150					150				
Incremental signals	u_{pp} [V_{ss}]	1					1				
Signal form		sinusoidal					sinusoidal				
Number of pulses	n_1	32					64				
Absolute position / revolution (motor side)[3]		1024 (10 bit)					1024 (10 bit)				
Number of revolutions		-					-				
Available memory in EEPROM	[Bytes]	2048					2048				
Accuracy[1]	[arcsec]	±100					±72				
Resolution of the absolute value (output side)		Gear ratio					Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**	**50**	**80**	**100**	**120**	**160**
	[arcsec]	25.3	15.8	12.7	10.5	7.9	25.3	15.8	12.7	10.5	7.9
Number of revolutions (output side)		-	-	-	-	-	-	-	-	-	-
Incremental resolution (motor side)[2]	inc [ ]	8192					16384				
Resolution (output side)[2]		Gear ratio					Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**	**50**	**80**	**100**	**120**	**160**
	[arcsec]	3.16	1.98	1.58	1.32	0.99	1.58	0.99	0.79	0.66	0.49

[1] Sorce: Manufacturer
[2] For interpolation with 8 bit
[3] Increasing position values
- for rotation in clockwise direction, looking at the motor shaft
- for rotation in counter clockwise direction, looking at the output flange

ADVICE

The commutation offset has to be determined during the first setup.

5.20.9 MIH / MHH

Multi-turn absolute motor feedback system with incremental SIN / COS signals and HIPERFACE® data interface

Table 70.1

Ordering code	**Symbol [Unit]**	**MIH**					**MHH**				
Manufacturer's designation		SEM70					SEM90				
Protocol		HIPERFACE®					HIPERFACE®				
Power supply[1]	U_b [VDC]	7 ... 12					7 ... 12				
Current consumption (typically at 7 VDC, without load)[1]	I [mA]	150					150				
Incremental signals	u_{pp} [V_{ss}]	1					1				
Signal form		sinusoidal					sinusoidal				
Number of pulses	n_1	32					64				
Absolute position / revolution (motor side)[3]		1024 (10 bit)					1024 (10 bit)				
Number of revolutions		4096 (12 bit) mechanical multi-turn					4096 (12 bit) mechanical multi-turn				
Available memory in EEPROM	[Bytes]	2048					2048				
Accuracy[1]	[arcsec]	±100					±72				
Resolution of the absolute value (output side)		Gear ratio					Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**	**50**	**80**	**100**	**120**	**160**
	[arcsec]	25.3	15.8	12.7	10.5	7.9	25.3	15.8	12.7	10.5	7.9
Number of revolutions (output side)		81	51	40	34	25	81	51	40	34	25
Incremental resolution (motor side)[2]	inc [ ]	8192					16384				
Resolution (output side)[2]		Gear ratio					Gear ratio				
	i [ ]	**50**	**80**	**100**	**120**	**160**	**50**	**80**	**100**	**120**	**160**
	[arcsec]	3.16	1.98	1.58	1.32	0.99	1.58	0.99	0.79	0.66	0.49

[1] Sorce: Manufacturer
[2] For interpolation with 8 bit
[3] Increasing position values
- for rotation in clockwise direction, looking at the motor shaft
- for rotation in counter clockwise direction, looking at the output flange

ADVICE

The commutation offset has to be determined during the first setup.

5.21 Temperature Sensors

For motor protection at speeds greater than zero, temperature sensors are integrated in the motor windings. For applications with high load where the speed is zero, additional protection (e.g. I^2 t monitoring) is recommended.

Table 71.1

Sensor type	Parameter	T_{Nat} [°C]
PTC	Rated operating temperature	120 (CanisDrive-14A ... 17A) 145 (CanisDrive-20A ... 58A)

PTC thermistors, because of their very high positive temperature coefficient at nominal operating temperature (T_{Nat}), are ideally suited for motor winding predection.

Due to their principle, the PTC sensors should only be used to monitor the winding temperature.

Illustration 71.2 Diagram PTC

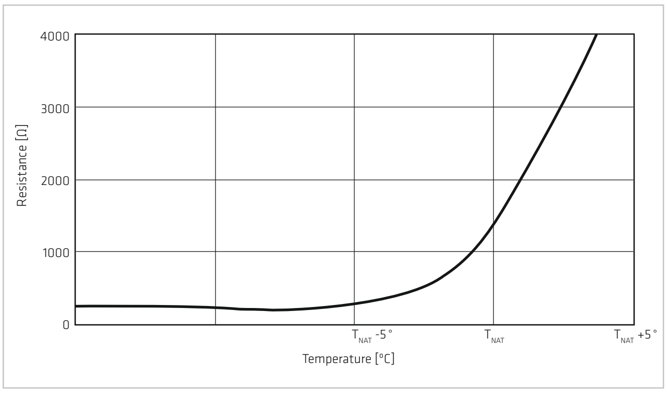


Table 71.3

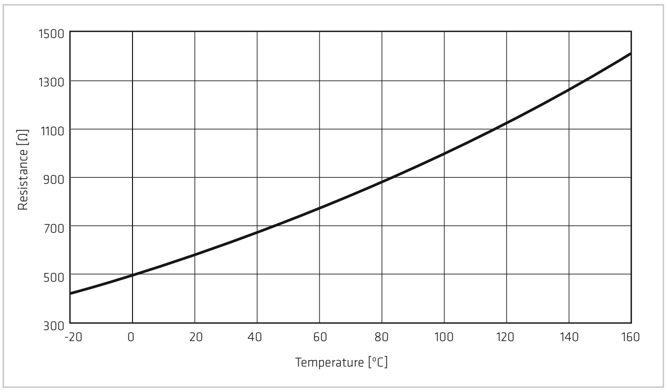
Sensor type	Parameter	Symbol [Unit]	Warning	Shutdown
KTY 84-130	Temperature	T [°C]	110	120
			90 (UL-Version)	100 (UL-Version)

When using the KTY 84-130, the values given in the table must be parameterized in the servo controller or in an external measurement device.
The temperature limits for warning and shutdown must be absolutely observed for UL conform actuators.

The KTY sensor is used for temperature measurement and monitoring the motor winding.

Because the KTY sensor provides an analogue temperature measurement, it is also possible to predect the actuator grease from temperature overload.

Illustration 71.4 Diagram KTY 84-130



5.22 Battery Boxes

5.22.1 Battery box for multi-turn absolute motor feedback system MZE

The battery box MZE is an accessory for the sizes CanisDrive-20A ... 58A to operate the multi-turn absolute motor feedback system MZE. It is used to buffer the position data when the power supply is switched off.
The battery box is intended for installation in the control cabinet. A corresponding protective circuit is integrated for protection against wiring faults.

Illustration 72.1 Battery box Mat.-no. 1024385

ADVICE

The battery is not included!

Recommended battery:	Lithium thionyl chloride 3.6 V / ≥ 2.0 Ah / AA e.g. Tadiran SL-760S

Illustration 72.2 Explosion view

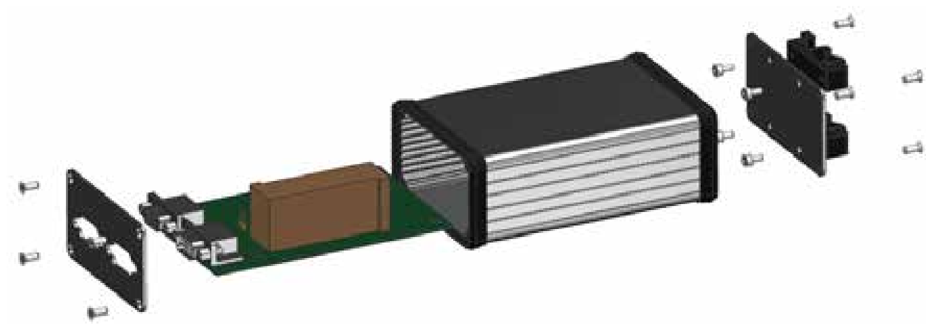
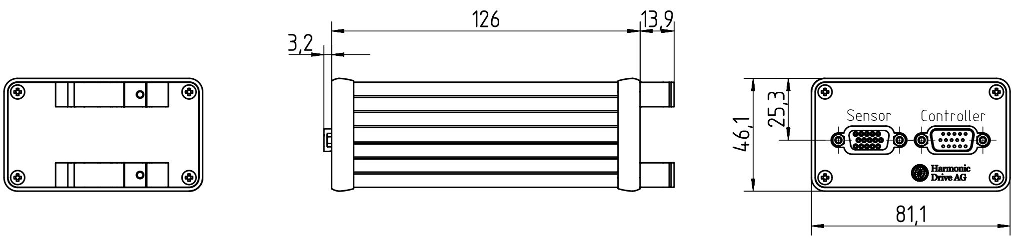


Illustration 72.3 Dimensions



Assembly: DIN mounting rail 35 mm

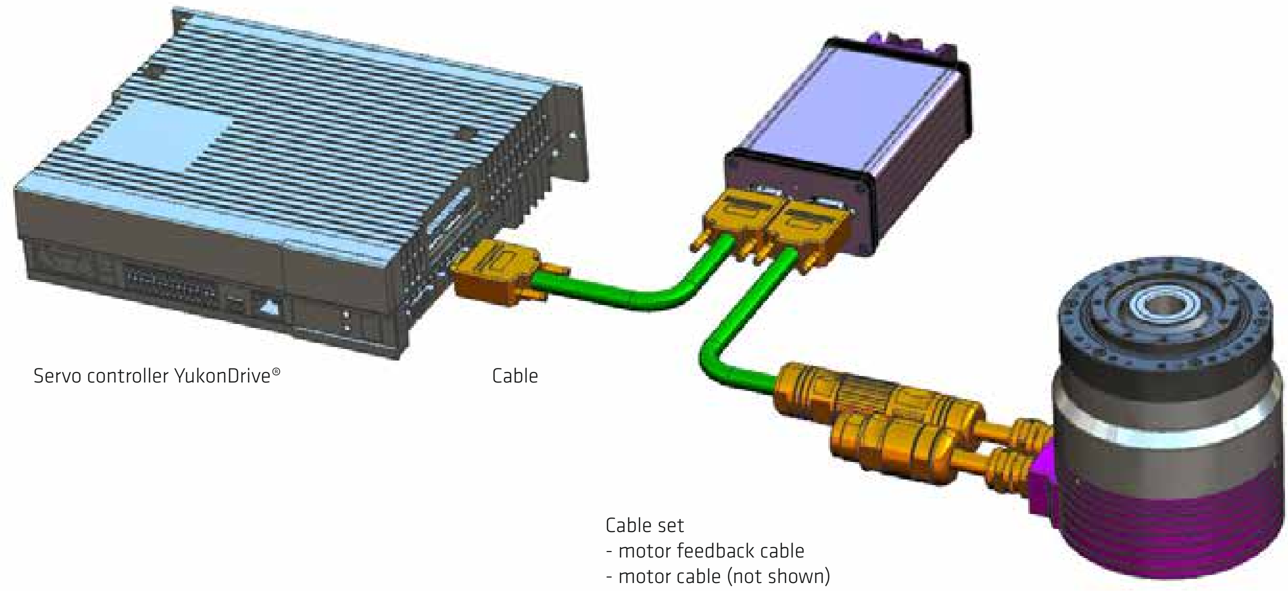
Illustration 73.1

Electrical connection

Sensor 15. pol. Sub D female		Battery	Controller 15. pol. Sub D male	
1	–		1	–
2	–		2	–
3	U_P		3	U_P
4	DATA+		4	DATA+
5	DATA-		5	DATA-
6	–		6	–
7	UBAT+	UBAT+	7	-
8	UBAT- (0V / GND)	UBAT-	8	UBAT- (0V / GND)
9	Temp-		9	Temp-
10	Temp+		10	Temp+
11	–		11	–
12	Sense+		12	Sense+
13	Sense-		13	Sense-
14	CLOCK+		14	CLOCK+
15	CLOCK-		15	CLOCK-

Illustration 73.2

Wiring motor feedback system



Connecting cable for the connection to YukonDrive® or third party controller

Table 74.1

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
CanisDrive-H-MZE	1038711	1033012	5
	1038749	1033013	10
	1038750	1033014	15
	1038752	1039103	25

Connecting cable from battery box to YukonDrive® X7

Table 74.2

Version	Mat.-no.	Length [m]
CanisDrive-H-MZE	1038614	0.5
	1038615	1.0
	1038616	2.0

Connecting cable with open cable end from battery box to third party controller

Table 74.3

Version	Mat.-no.	Length [m]
CanisDrive-H-MZE	1041403	0.5
	1041404	1.0
	1041405	2.0

ADVICE

The connector for the battery box is mounted. The connection for the third party controller has flying leads.

Replacing the battery

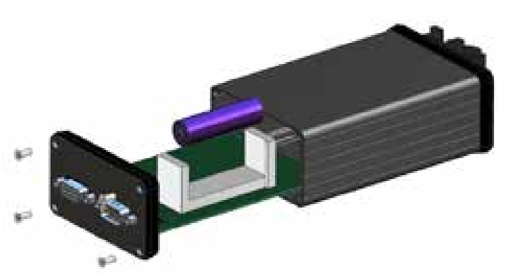
The following preconditions must be ensured in order to maintain the absolute encoder position when replacing the battery.

ADVICE

- The supply voltage of the motor feedback system is provided by the drive controller
- The motor feedback system is connected to the drive controller

⚠ ATTENTION

In case of failure or interruption of the battery voltage and simultaneous failure or interruption of the power supply, the reported position after restarting will be wrong!
Undefined positioning can cause injury to persons or damage to the system.



- Open the cover of the battery box
- Remove the circuit board with the battery
- Remove the old battery and dispose it according to the corresponding directives
- Insert new battery
- Insert the circuit board with the battery
- Close the cover of the battery box
- Reset error and warning bit

Reset error bit and warning bit

The MZE motor feedback system monitors the connected battery and provides, in addition to the position values, also an error bit and a warning bit, which are transmitted via the EnDat® interface.

- Warning „Battery change“
  ≤ 2,8 V ±0,2 V in normal operation mode
- Error message „M power failure“
  ≤ 2,2 V ±0,2 V in battery buffered operation mode (the encoder must be re-referenced)

The warning bit is set when the battery voltage reaches the critical value during operation. After the warning "Battery change" has occurred, the battery must be replaced immediately.

The error message is set with simultaneous failure or interruption of the battery voltage and the voltage supply.

Error bit and warning bit can be reseted via the EnDat® interface.

ADVICE

The EnDat® specification and the EnDat® "Application Notes" from Heidenhain for battery buffered measuring devices must be observed for correct control of the motor feedback system MZE (Heidenhain type EBI135).

5.22.2 Battery box for multi-turn absolute motor feedback system MGSe

The battery box is an accessory for the sizes CanisDrive-25A ... 58A to operate the multi-turn absolute motor feedback system MGSe. It is used to buffer the position data when the power supply is switched off.
The battery box is intended for installation in the control cabinet. A corresponding protective circuit is integrated for protection against wiring faults.

Illustration 76.1 Battery box Mat.-no. 1028280

ADVICE

The battery is not included!

Recommended battery: Lithium thionyl chloride
3.6 V / ≥ 2.0 Ah / AA
e.g. Tadiran SL-760S

Illustration 76.2 Explosion view

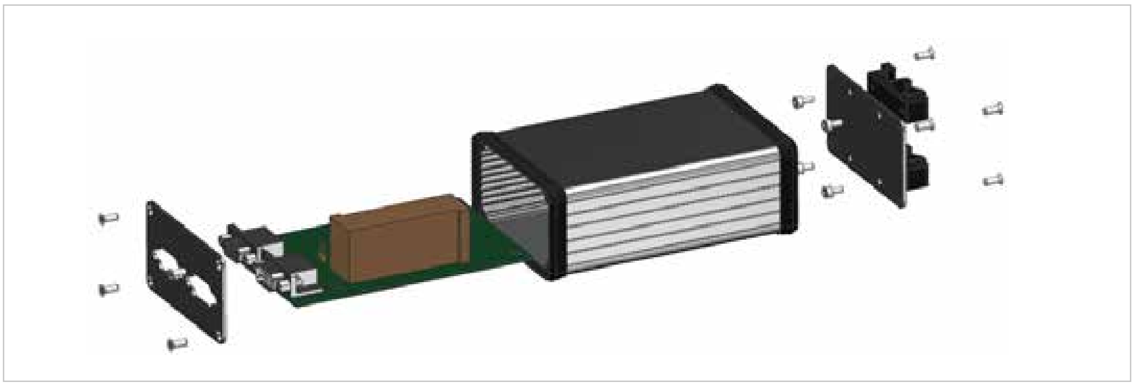
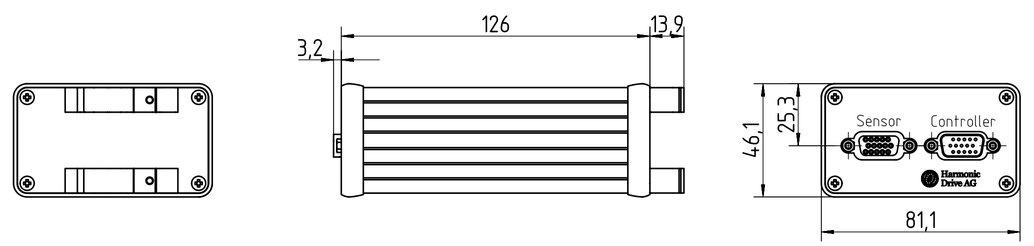


Illustration 76.3 Dimensions



Assembly: DIN mounting rail 35 mm

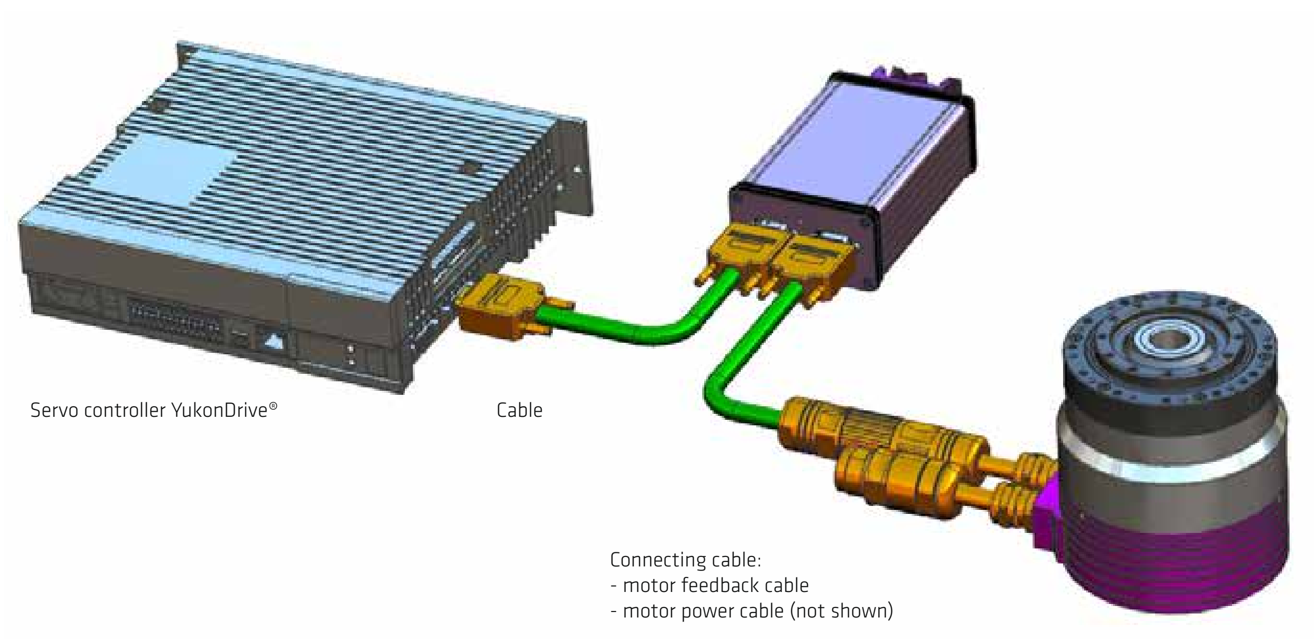
Table 77.1

Electrical connection

Sensor 15. pol. Sub D female		Battery	Controller 15. pol. Sub D male	
1	A- (COS-)		1	A- (COS-)
2	A+ (COS+)		2	A+ (COS+)
3	U_P		3	U_P
4	DATA+		4	DATA+
5	DATA-		5	DATA-
6	B- (SIN-)		6	B- (SIN-)
7	UBAT+	UBAT+	7	-
8	GND (UBAT-)	UBAT-	8	GND (UBAT-)
9	Temp-		9	Temp-
10	Temp+		10	Temp+
11	B+ (SIN+)		11	B+ (SIN+)
12	Reset		12	–
13	-		13	-
14	CLOCK+		14	CLOCK+
15	CLOCK-		15	CLOCK-

Illustration 77.2

Wiring motor feedback system



Connecting cable for the connection to YukonDrive® or third party controller

Table 78.1

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
CanisDrive-H-MGSe	1038711	1039678	5
	1038749	1039679	10
	1038750	1025873	15

Connecting cable from battery box to YukonDrive® X7

Table 78.2

Version	Mat.-no.	Length [m]
CanisDrive-MGSe	1041417	0,5
	1041418	1
	1041419	2

Connecting cable with open cable end from battery box to third party controller

Table 78.3

Version	Mat.-no.	Length [m]
CanisDrive-MGSe	1041420	0,5
	1041421	1
	1041422	2

ADVICE

The connector for the battery box is mounted. The connection for the third party controller has flying leads.

Replacing the battery

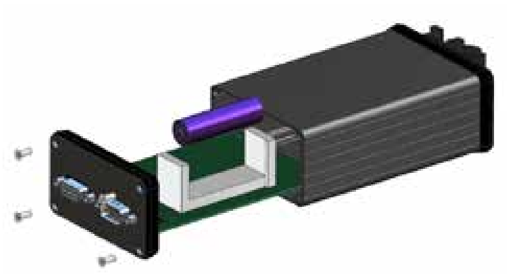
The following preconditions must be ensured in order to maintain the absolute encoder position when replacing the battery:

ADVICE

- The supply voltage of the motor feedback system is provided by the drive controller
- The motor feedback system is connected to the drive controller

⚠ ATTENTION

In case of failure or interruption of the battery voltage and simultaneous failure or interruption of the power supply, the reported position after restarting will be wrong!
Undefined positioning can cause injury to persons or damage to the system.



- Open the cover of the battery box
- Remove the circuit board with the battery
- Remove the old battery and dispose it according to the corresponding directives
- Insert new battery
- Insert the circuit board with the battery
- Close the cover of the battery box
- Reset error and warning bit

Reset error bit and warning bit

The MGSe motor feedback system for CanisDrive-25A ... 58A monitors the connected battery and provides, in addition to the position values, also an error bit and a warning bit, which are transmitted via the SSI interface.

The warning bit is set when the battery voltage reaches the critical value during operation. After the warning "Battery change" has occurred, the battery must be replaced immediately.

The error message is set with simultaneous failure or interruption of the battery voltage and the voltage supply.

Error bit and warning bit can be reseted via the Reset input. The reset is carried out when the Reset button on the battery box is pressed for 3 ... 5 seconds.

INFORMATION

The MGSe motor feedback system for CanisDrive-14A ... 20A didn't provide any warning bit or error bit.

5.23 Electrical Connection

5.23.1 CanisDrive-xxA-N-R00

Motor connection

Table 80.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Mat.-no. 1011445
External diameter	≈ 22 mm
Length	≈ 50 mm

Illustration 80.2

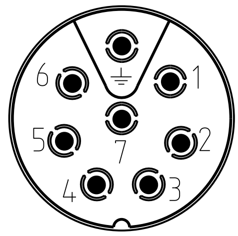


Table 80.3

	CanisDrive-14A ... 17A							
Connector pin	1	6	7	PE	3	4	2	5
Motor phase	U	W	V	PE	BR+	BR-	Temp PTC	Temp PTC

Motor feedback connection

Table 80.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Mat.-no. 1011446
External diameter	≈ 22 mm
Length	≈ 50 mm

Illustration 80.5

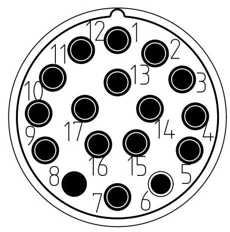


Table 80.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	SIN+	SIN-	–	–	–	–	Vss-	Temp+ KTY	Temp- KTY	Vss+	COS+	COS-	–	–	–	–	–

Connecting cables with open cable end

Table 80.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
N-R00	1021095	1017290	3
	1021097	1017291	5
	1021104	1017294	10

5.23.2 CanisDrive-xxA-N-MGSi

Motor connection

Table 81.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Mat.-no. 1011445
External diameter	≈ 22 mm
Length	≈ 50 mm

Illustration 81.2

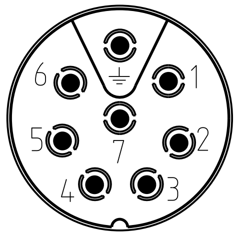


Table 81.3

	CanisDrive-14A ... 17A							
Connector pin	1	6	7	PE	3	4	2	5
Motor phase	U	W	V	PE	BR+	BR-	Temp PTC	Temp PTC

Motor feedback connection

Table 81.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Mat.-no. 1011446
External diameter	≈ 22 mm
Length	≈ 50 mm

Illustration 81.5

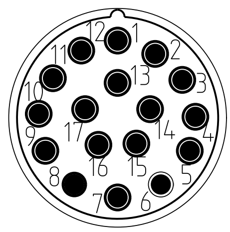


Table 81.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	A+ COS+	A- COS-	DATA+	-	CLOCK+	-	GND	Temp+ KTY	Temp- KTY	Up	B+ SIN+	B- SIN-	DATA-	CLOCK-	GND Sensor	Up Sensor	-

Connecting cables with open cable end

Table 81.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
N-MGSi	1021095	1017382	3
	1021097	1021256	5
	1021104	1021257	10

5.23.3 CanisDrive-xxA-N-DCO

Motor connection

Table 82.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Mat.-no. 1011445
External diameter	≈ 22 mm
Length	≈ 50 mm

Illustration 82.2

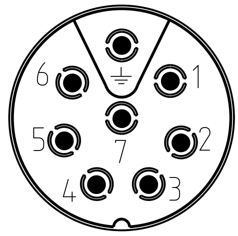


Table 82.3

	CanisDrive-14A ... 17A							
Connector pin	1	6	7	PE	3	4	2	5
Motor phase	U	W	V	PE	BR+	BR-	Temp PTC	Temp PTC

Motor feedback connection

Table 82.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Mat.-no. 1011446
External diameter	≈ 22 mm
Length	≈ 50 mm

Illustration 82.5

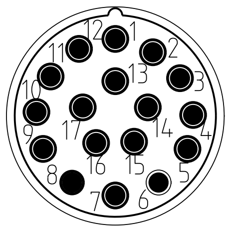


Table 82.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	U+	U-	V+	V-	W+	W-	GND	Up	Z+	Z-	A+	A-	B+	B-	Temp+ KTY	Temp- KTY	-

Connecting cables for the connection to YukonDrive®

Table 82.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
N-DCO	1021095	1021105	3
	1021097	1021147	5
	1021104	1021149	10

Connecting cables with open cable end

Table 82.8

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
N-DCO	1021095	1021181	3
	1021097	1021182	5
	1021104	1021183	10

5.23.4 CanisDrive-xxA-E-R00

Motor connection

Table 83.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Mat.-no. 1011445

Illustration 83.2

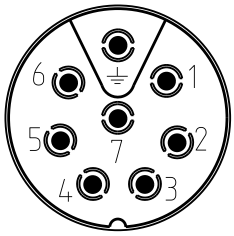


Table 83.3

	CanisDrive-14A ... 17A							
Connector pin	1	6	7	PE	3	4	2	5
Motor phase	U	W	V	PE	BR+	BR-	Temp PTC	Temp PTC

Motor feedback connection

Table 83.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Mat.-no. 1011446

Illustration 83.5

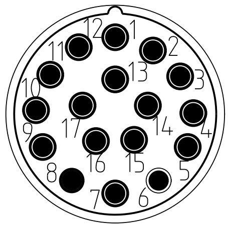


Table 83.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	SIN+	SIN-	-	-	-	-	Vss-	Temp+ KTY	Temp- KTY	Vss+	COS+	COS-	-	-	-	-	-

Connecting cables with open cable end

Table 83.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
E-R00	1021095	1017290	3
	1021097	1017291	5
	1021104	1017294	10

5.23.5 CanisDrive-xxA-E-MGSi

Motor connection

Table 84.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Mat.-no. 1011445

Illustration 84.2

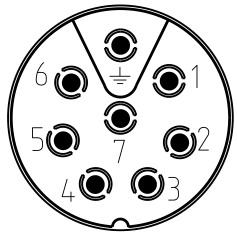


Table 84.3

	CanisDrive-14A ... 17A							
Connector pin	1	6	7	PE	3	4	2	5
Motor phase	U	W	V	PE	BR+	BR-	Temp PTC	Temp PTC

Motor feedback connection

Table 84.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Mat.-no. 1011446

Illustration 84.5

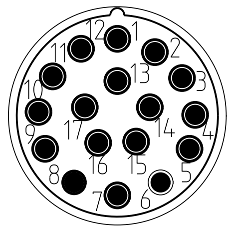


Table 84.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	A+ COS+	A- COS-	DATA+	-	CLOCK+	-	GND	Temp+ KTY	Temp- KTY	Up	B+ SIN+	B- SIN-	DAT-	CLOCK-	GND Sensor	Up Sensor	-

Connecting cables with open cable end

Table 84.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
E-MGSi	1021095	1017382	3
	1021097	1021256	5
	1021104	1021257	10

5.23.6 CanisDrive-xxA-E-DCO

Motor connection

Table 85.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Mat.-no. 1011445

Illustration 85.2

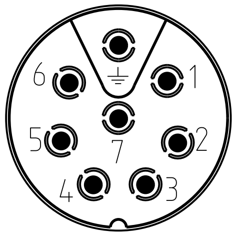


Table 85.3

	CanisDrive-14A ... 17A							
Connector pin	1	6	7	PE	3	4	2	5
Motor phase	U	W	V	PE	BR+	BR-	Temp PTC	Temp PTC

Motor feedback connection

Table 85.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Mat.-no. 1011446

Illustration 85.5

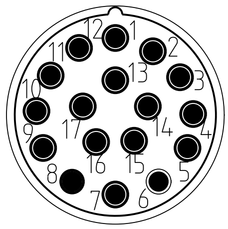


Table 85.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	U+	U-	V+	V-	W+	W-	GND	Up	Z+	Z-	A+	A-	B+	B-	Temp+ KTY	Temp- KTY	-

Connecting cables for the connection to YukonDrive®

Table 85.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
E-DCO	1021095	1021105	3
	1021097	1021147	5
	1021104	1021149	10

Connecting cables with open cable end

Table 85.8

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
E-DCO	1021095	1021181	3
	1021097	1021182	5
	1021104	1021183	10

5.23.7 CanisDrive-xxA-H-SIE

Motor connection

Table 86.1

Motor connector	6 / M23 x 1
Cable plug	6 / M23 x 1 / Mat.-no. 301193
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 86.2

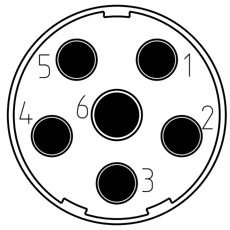


Table 86.3

	CanisDrive-20A ... 58A					
Connector pin	1	2	3	4	5	6
Motor phase	U	V	PE	BR+	BR-	W

Motor feedback connection

Table 86.4

Encoder connector	17 / M23 x 1
Cable plug	17 / M23 x 1 / Mat.-no. 270199
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 86.5

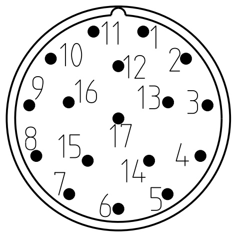


Table 86.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	A+ COS+	A- COS-	DATA+	–	CLOCK+	–	GND	Temp+ (KTY)	Temp- (KTY)	Up	B+ SIN+	B- SIN-	DATA-	CLOCK-	GND Sensor	Up Sensor	Inner shield

Connecting cables SINAMICS S120 with SMC modul

Table 87.1

Power Connection	
without brake	6FX8002-5CG01-1xx0
with brake	6FX8002-5DG01-1xx0
Motor feedback	
H-SIE	6FX8002-2EQ10-1xx0

Connecting cables with open cable end

Table 87.2

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
H-SIE	1038711	1038716	5
	1038749	1038753	10
	1038750	1038754	15
	1038751	1038755	20
	1038752	1038756	25

Connecting cables for the connection to YukonDrive®

Table 87.3

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
H-SIE	1038764	1038774	3
	1038711	1038775	5
	1038749	1038776	10
	1038750	1038777	15

5.23.8 CanisDrive-xxA-H-MGSx

Motor connection

Table 88.1

Motor connector	6 / M23 x 1
Cable plug	6 / M23 x 1 / Mat.-no. 301193
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 88.2

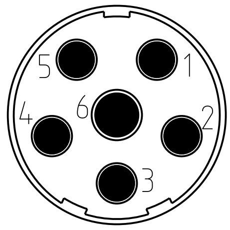


Table 88.3

	CanisDrive-14A ... 58A					
Connector pin	1	2	3	4	5	6
Motor phase	U	V	PE	BR+	BR-	W

Motor feedback connection

Table 88.4

Encoder connector	17 / M23 x 1
Cable plug	17 / M23 x 1 / Mat.-no. 270199
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 88.5

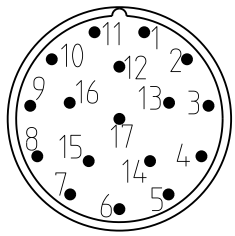


Table 88.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
MGSi signal (CanisDrive-14A ... 20A)	A+ COS+	A- COS-	DATA+	–	CLOCK+	–	GND	Temp+ KTY	Temp- KTY	Up	B+ SIN+	B- SIN-	DATA-	CLOCK-	GND Sensor	Up Sensor	Inner shield
MGSe signal (CanisDrive-25A ... 58A)	A+ COS+	A- COS-	DATA+	UBAT+	CLOCK+	UBAT-	GND	Temp+ KTY	Temp- KTY	Up	B+ SIN+	B- SIN-	DATA-	CLOCK-	–	Reset	Inner shield

Connecting cables SINAMICS S120 with SMC modul

Table 89.1

Power Connection	
without brake	6FX8002-5CG01-1xx0
with brake	6FX8002-5DG01-1xx0
Motor feedback	
H-MGSi (CanisDrive-14A ... 20A)	6FX8002-2EQ10-1xx0
Motor feedback	
H-MGSe (CanisDrive-25A ... 58A)	No standard Siemens cable available!

ADVICE

An external battery power supply is necessary to operate the battery buffered multi-turn absolute motor feedback system MGSe for the sizes CanisDrive-25A ... 40A. A battery box MGS is available for this purpose. The handling of the battery box MGS and the electrical connections are described in the chapter "Battery boxes".

Connecting cables with open cable end

Table 89.2

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
H-MGSi (CanisDrive-14A ... 20A)	1038711	1038716	5
	1038749	1038753	10
	1038750	1038754	15
	1038751	1038755	20
	1038752	1038756	25
H-MGSe (CanisDrive-25A ... 40A)	1038711	1025610	5
	1038749	1025896	10
	1038750	1025897	15

Connecting cables for the connection to YukonDrive®

Table 89.3

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
H-MGSi (CanisDrive-14A ... 20A)	1038764	1038774	3
	1038711	1038775	5
	1038749	1038776	10
	1038750	1038777	15

Connecting cables for the connection to YukonDrive® and to the battery box MGS

Table 89.4

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
H-MGSe (CanisDrive-25A ... 40A)[1]	1038711	1039678	5
	1038749	1039679	10
	1038750	1025873	15

[1] The motor feedback cable can be used for the connection to the battery box! Can also be used for third party drives.

5.23.9 CanisDrive-xxA-H-ROO

Motor connection

Table 90.1

Motor connector	6 / M23 x 1
Cable plug	6 / M23 x 1 / Mat.-no. 1011445
External diameter	≈ 26 mm
Length	≈ 60mm

Illustration 90.2

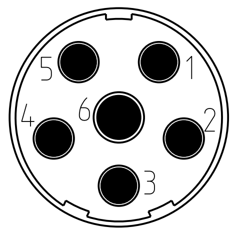


Table 90.3

	CanisDrive-14A ... 17A					
Connector pin	1	2	3	4	5	6
Motor phase	U	V	PE	BR+	BR-	W

Motor feedback connection

Table 90.4

Encoder connector	12 / M23 x 1
Cable plug	12 / M23 x 1 / Mat.-no. 1011446
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 90.5

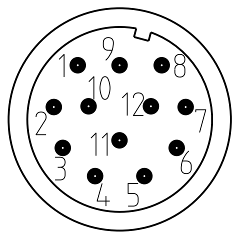


Table 90.6

Connector pin	1	2	3	4	5	6	7	8	9	10	11	12
Signal	SIN+	SIN-	-	-	-	-	Vss-	Temp+ (KTY)	Temp- (KTY)	Vss+	COS+	COS-

Connecting cables SINAMICS S120 with SMC modul

Table 90.7

Power Connection	
without brake	6FX8002-5CG01-1xx0
with brake	6FX8002-5DG01-1xx0
Motor feedback	
ROO	6FX8002-2CF02-1xx0

Connecting cables for the connection to YukonDrive®

Table 90.8

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
H-ROO	1038764	1039680	3
	1038711	1039681	5
	1038749	1039682	10

Connecting cables with open cable end

Table 90.9

Version	Mat.-no. motor power cable	Mat.-no. motor feedback cable	Length [m]
H-ROO	1038764	1024553	3
	1038711	1024558	5
	1038749	1024559	10

5.23.10 CanisDrive-xxA-H-MZE

Motor connection

Table 91.1

Motor connector	6 / M23 x 1
Cable plug	6 / M23 x 1 / Mat.-no. 301193
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 91.2

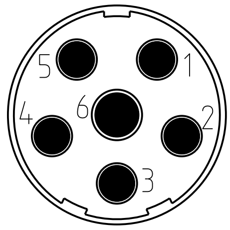


Table 91.3

	CanisDrive-20A ... 58A					
Connector pin	1	2	3	4	5	6
Motor phase	U	V	PE	BR+	BR-	W

Motor feedback connection

Table 91.4

Encoder connector	17 / M23 x 1
Cable plug	17 / M23 x 1 / Mat.-no. 270199
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 91.5

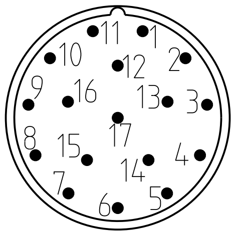


Table 91.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7 (15)**	**8**	**9**	**10 (16)**	**11**	**12**	**13**	**14**	**15 (7)**	**16 (10)**	**17**
Signal	–	–	DATA+	UBAT+	CLOCK+	UBAT-	0V	Temp+ (KTY)	Temp- (KTY)	+Up	–	–	DATA-	CLOCK-	Sense-	Sense+	Inner shield

Connecting cables with open cable end

Table 91.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
H-MZE	1038711	1032999	5
	1038749	1033000	10
	1038750	1033001	15
	1038752	1033002	25

Connecting cables for the connection to YukonDrive® and to the battery box MZE

Table 91.8

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
H-MZE[1)]	1038711	1033012	5
	1038749	1033013	10
	1038750	1033014	15
	1038752	1039103	25

[1)] The motor feedback cable can be used for the connection to the battery box! Can also be used for third party drives.

5.23.11 CanisDrive-xxA-H-SZE

Motor connection

Table 92.1

Motor connector	6 / M23 x 1
Cable plug	6 / M23 x 1 / Mat.-no. 301193
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 92.2

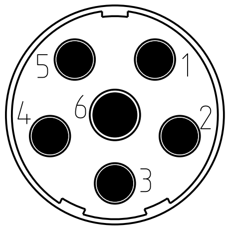


Table 92.3

	CanisDrive-20A ... 58A					
Connector pin	1	2	3	4	5	6
Motor phase	U	V	PE	BR+	BR-	W

Motor feedback connection

Table 92.4

Encoder connector	17 / M23 x 1
Cable plug	17 / M23 x 1 / Mat.-no. 270199
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 92.5

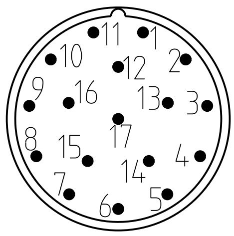


Table 92.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7 (15)**	**8**	**9**	**10 (16)**	**11**	**12**	**13**	**14**	**15 (7)**	**16 (10)**	**17**
Signal	–	–	DATA+	–	CLOCK+	–	0V	Temp+ (KTY)	Temp- (KTY)	+Up	–	–	DATA-	CLOCK-	Sense-	Sense+	Inner shield

Connecting cables with open cable end

Table 92.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
H-SZE	1038711	1032999	5
	1038749	1033000	10
	1038750	1033001	15
	1038752	1033002	25

Connecting cables for the connection to YukonDrive®

Table 92.8

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
H-SZE	1038711	1033012	5
	1038749	1033013	10
	1038750	1033014	15
	1038752	1039103	25

5.23.12 CanisDrive-xxA-L-SxH und MxH

Motor connection

Table 93.1

Motor connector	8 / M23 x 1
Cable plug	8 / M23 x 1 / Mat.-no. 303549
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 93.2

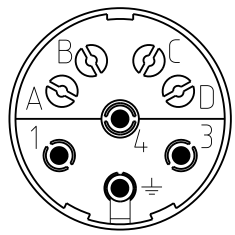


Table 93.3

	CanisDrive-17A ... 40A							
Connector pin	1	2	3	4	A	B	C	D
Motor phase	U	PE	W	V	BR+	BR-	Temp+ (PTC)	Temp- (PTC)

Motor feedback connection

Table 93.4

Encoder connector	12 / M23 x 1
Cable plug	12 / M23 x 1 / Mat.-no. 305068
External diameter	≈ 26 mm
Length	≈ 60 mm

Illustration 93.5

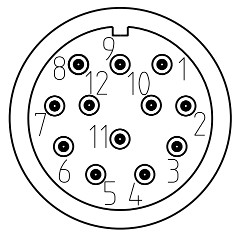


Table 93.6

	CanisDrive-17A ... 40A											
Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Signal	Us	GND	+SIN	REFSIN	Data+	Data-	+COS	REFCOS	Temp+ (KTY)	Temp- (KTY)	–	–

Connecting cables with open cable end

Table 93.7

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
L-SxH L-MxH	1039141	1034532	3
	1039142	1019785	5
	1039143	1039257	10

Connecting cables for the connection to YukonDrive®

Table 93.8

Version	**Mat.-no. motor power cable**	**Mat.-no. motor feedback cable**	**Length [m]**
L-SxH L-MxH	1039159	1039258	3
	1039160	1039259	5
	1039161	1039260	10

5.24 Cable Specification

Table 94.1

	Symbol [Unit]	CanisDrive-xxA			
		Motor power cable		Motor feedback cable	
Size		14 ... 17	20 ... 58	14 ... 17	20 ... 58
Mat.-no.		1014982	270611	-	-
Configuration	[mm²]	(4x0.34+2x(2x0.15)	(4x0.5+2x(2x0.24)	-	-
Diameter	d [mm]	≤ 7.4	≤ 9.5	≤ 7.4	≤ 9.0
Minimum bending radius - fix condition - moving condition	r [mm]	5 · d 10 · d		5 · d 10 · d	
Jacket	[ ]	PUR		PUR	
Oil resistant	[ ]	yes		yes	
Color	[ ]	orange		green	
Approvals	[ ]	CE / UL	CE / UL / CSA	CE / UL	CE / UL

Table 94.2

	Symbol [Unit]	Cable extension		
		Motor power cable		Motor feedback cable
Size		14 ... 17	20 ... 58	14 ... 58
Mat.-no.		1021053	270407	–
Configuration	[mm²]	(4x1.0+2x(2x0.34)	(4x1.5+2x(2x0.75)	–
Diameter	d [mm]	≤ 10	≤ 13	≤ 10
Minimum bending radius - fix condition - moving condition	r [mm]	5 · d 10 · d		5 · d 10 · d
Jacket	[ ]	PUR		PUR
Oil resistant	[ ]	yes		yes
Color	[ ]	orange		green
Approvals	[ ]	CE / UL	CE / UL / CSA	CE / UL

5.25 Options

5.25.1 Position measuring system option EC

The Hollow Shaft Servo Actuators are ideally suited for equipping with a single turn absolute measuring system that can be connected directly to the actuator output.

The ECN 113 single turn absolute encoder is connected to the actuator flange by means of a torsionally stiff hollow shaft.

Table 95.1

Ordering code	**Symbol [Unit]**	**EC**
Manufacturer's designation		ECN 113
Protocol		EnDat® 2.1 / 01
Power supply[1]	U_b [VDC]	5 ±5 %
Current consumption (max. without load)[1]	I [mA]	180
Incremental signals	u_{pp} [V_{ss}]	1
Signal form		sinusförmig
Number of pulses	n_1 [SIN / COS]	2048
Absolute position / revolution (motor side)[3]		8192
Accuracy[1]	[arcsec]	±20

[1] Source: Manufacturer
[2] for interpolation with 8 bit
[3] increasing position values for rotation in CW direction, looking at the output flange

The encoder system is connected using a standard signal connector.
The evaluation of the compatibility of the measurement system must be checked prior to commissioning. The measuring system contains electrostatically sensitive components, please observe the ESD measures.

Illustration 95.3

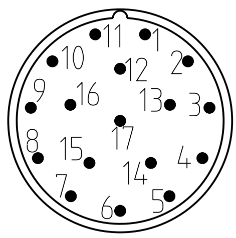


Table 95.2

Encoder connector	17 / M23 x 1
Cable plug	17 / M23 x 1 / Mat.-no. 270199
External diameter	≈ 26 mm
Length	≈ 60 mm

Table 95.4

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Signal	Up Sensor	–	–	GND Sensor	–	–	Up	CLOCK +	CLOCK -	GND	Inner shield	B+	B-	DATA +	A+	A-	DATA -
Connecting Cables																	
SINAMICS S 120 (SMC20)	6FX8002-2CH00-1xx0																
YukonDrive®	Mat.-no. 1010747 (3 m; other length on request)																

6. Actuator Selection Procedure

ADVICE

We will be pleased to make a gear calculation and selection on your behalf.

6.1. Selection Procedure and Calculation Example

Flowchart for actuator selection

Equation 96.1

$$T_1 = T_L + \frac{2\pi}{60} \cdot \frac{(J_{out} + J_L) \cdot n_2}{t_1}$$

Equation 96.2

$$T_2 = T_L$$

$$T_3 = T_L - (T_1 - T_L)$$

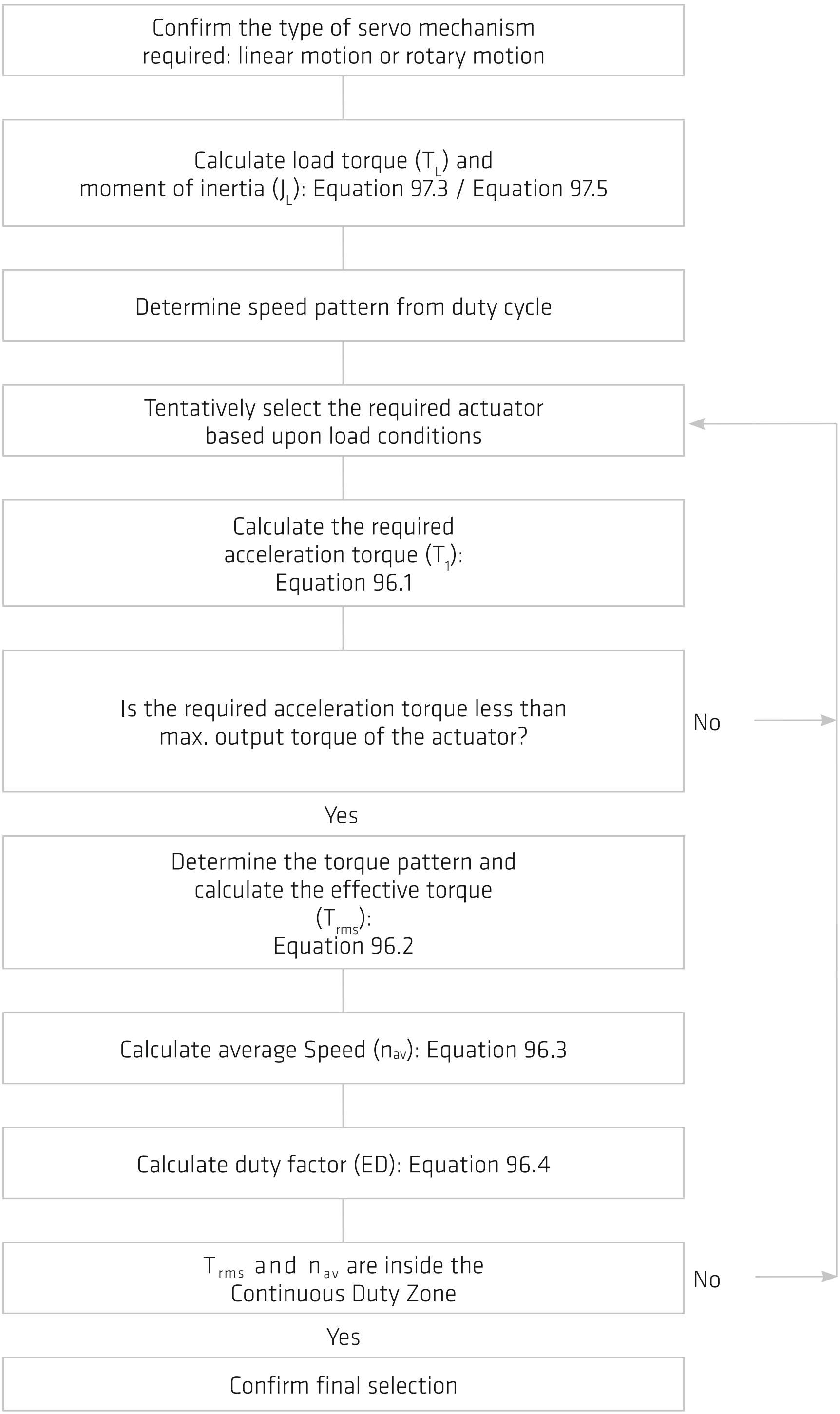
$$T_{rms} = \sqrt{\frac{T_1^2 \cdot t_1 + T_2^2 \cdot t_2 + T_3^2 \cdot t_3}{t_1 + t_2 + t_3 + t_p}}$$

Equation 96.3

$$n_{av} = \frac{\frac{|n^2|}{2} \cdot t_1 + |n^2| \cdot t_2 + \frac{|n^2|}{2} \cdot t_3}{t_1 + t_2 + t_3 + t_p}$$

Equation 96.4

$$ED = \frac{t_1 + t_2 + t_3}{t_1 + t_2 + t_3 + t_p} \cdot 100\ \%$$



Pre selection conditions

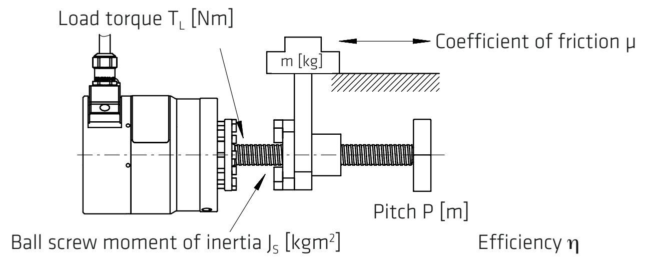
Table 97.1

Load	Confirmation	Catalogue value	Unit
Load max. rotation speed (n_2)	$\leq n_{max}$	Maximum output speed	[rpm]
Load moment of inertia (J_L)	$\leq 3J_{Out}$[1]	Moment of inertia	[kgm²]

[1] $J_L \leq 3 \cdot J_{Out}$ is recommended for highly dynamic applications (high dynamics and accuracy).

Linear horizontal motion

Illustration 97.2



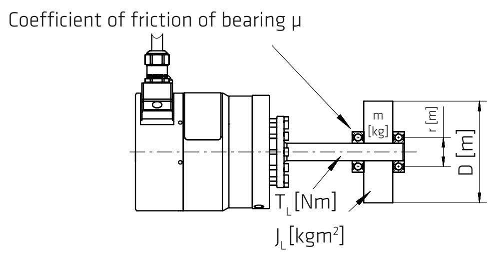
Equation 97.3

$$J_L = J_S + m \cdot \left(\frac{P}{2\pi}\right)^2 \text{ [kgm}^2\text{]}$$

$$T_L = \frac{\mu \cdot m \cdot P \cdot g}{2\pi \cdot \eta} \text{ [Nm]}$$

Rotary motion

Illustration 97.4

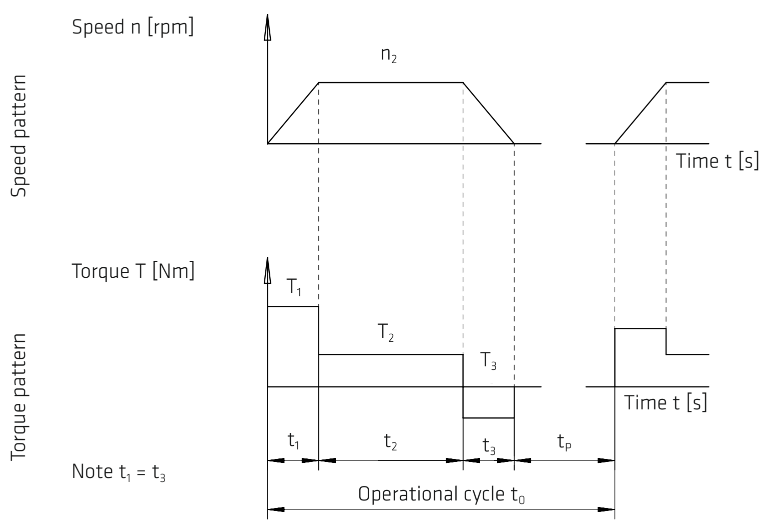


Equation 97.5

$$J_L = \frac{m}{8} \cdot D^2 \text{ [kgm}^2\text{]}$$

$$T_L = \mu \cdot m \cdot g \cdot r \text{ [Nm] } g = 9.81 \text{ [m/s}^2\text{]}$$

Illustration 97.6



Example of actuator selection

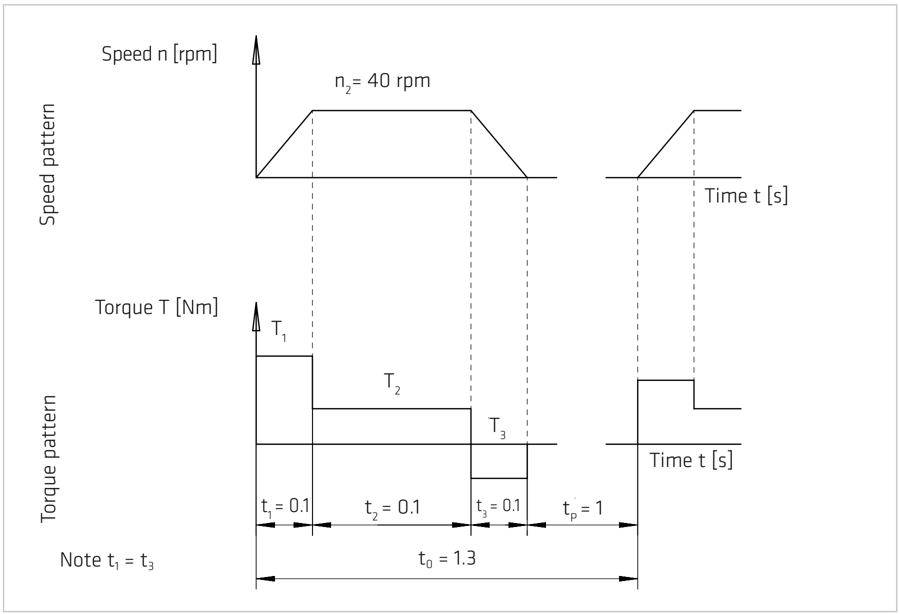
Load Conditions
Assume servo mechanism is used to cyclically position a mass with a horizontal axis of rotation.

Table 98.1

Load rotation speed	n_2 = 40 [rpm]
Load torque (e. g. friction)	T_L = 5 [Nm]
Load inertia	J_L = 1.3 [kgm²]
Speed pattern	
Acceleration; Deceleration	$t_1 = t_3$ = 0.1 [s]
Operate with rated speed	t_2 = 0.1 [s]
Stand still	t_p = 1 [s]
Total cycle time	t_0 = 1.3 [s]

Please note: Each characteristic value should be converted to the value at the output shaft of the actuator.

Illustration 98.2



Actuator data CanisDrive-25A-50

Table 98.3

Maximum Torque	T_{max} = 127 [Nm]
Maximum Speed	n_{max} = 112 [rpm]
Moment of inertia	J_{Out} = 1.063 [kgm²]

Actuator selection

Tentatively select a required actuator based upon load conditions.
CanisDrive-25C-50 meets the tentative selection requirements from catalogue value (see rating table)

n_2 = 40 rpm < n_{max} = 112 rpm
J_L = 1.3 kgm² < $3J_{out}$ = 3.19 kgm²

Calculate required acceleration torque (T_1)

$$T_1 = 5 + \frac{2\pi}{60} \cdot \frac{(1.3 + 0.86) \cdot 40}{0.1} = 103.8 \text{ Nm}$$

Confirm: Is the required acceleration torque less than the maximum output torque of the actuator?

T_1 = 103.8 Nm < T_{max} = 127 Nm

No | Yes

Calculate effective torque (T_{rms})

T_1 = 103.8 Nm
T_2 = T_L = 5 Nm
T_3 = T_L - (T_1 - T_L) = - 93.8 Nm

$$T_{rms} = \sqrt{\frac{103.8^2 \cdot 0.1 + 5^2 \cdot 0.1 + (-93.8)^2 \cdot 0.1}{1.3}} = 38.8 \text{ Nm}$$

Calculation of the average speed

$$n_{av} = \frac{\frac{40}{2} \cdot 0.1 + 40 \cdot 0.1 + \frac{40}{2} \cdot 0.1}{1.3}$$

n_{av} = 6 rpm

Calculation of the duty factor

$$ED = \frac{0.1 + 0.1 + 0.1}{1.3} \cdot 100\ \%$$

ED = 23 %

T_{rms} = 38.8 Nm
n_{av} = 6 rpm

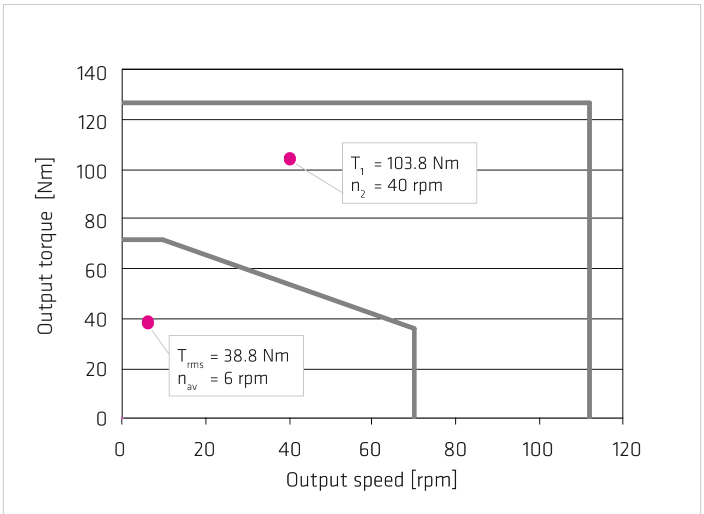
Check according to the performance characteristics

T_{rms} and n_{av} are inside the continuous duty zone

Confirm final selection

Illustration 99.1

CanisDrive-25A-50



6.2 Calculation of the Torsion Angle

Equation 100.1

$$T \leq T_1$$

$$\varphi = \frac{T}{K_1}$$

Equation 100.2

$$T_1 < T \leq T_2$$

$$\varphi = \frac{T_1}{K_1} + \frac{T - T_1}{K_2}$$

Equation 100.3

$$T > T_2$$

$$\varphi = \frac{T_1}{K_1} + \frac{T_2 - T_1}{K_2} + \frac{T - T_2}{K_3}$$

φ = Angle [rad]
T = Torque [Nm]
K = Stiffness [Nm/rad]

Example

$T = 60\ \text{Nm}$	$K_1 = 6.7 \cdot 10^4\ \text{Nm/rad}$
$T_1 = 29\ \text{Nm}$	$K_2 = 1.1 \cdot 10^5\ \text{Nm/rad}$
$T_2 = 108\ \text{Nm}$	$K_3 = 1.2 \cdot 10^5\ \text{Nm/rad}$

$$\varphi = \frac{29\ \text{Nm}}{6.7 \cdot 10^4\ \text{Nm/rad}} + \frac{60\ \text{Nm} - 29\ \text{Nm}}{11 \cdot 10^4\ \text{Nm/rad}}$$

$$\varphi = 7.15 \cdot 10^{-4}\ \text{rad}$$

$$\varphi = 2.5\ \text{arcmin}$$

Equation 100.4

$$\varphi\ [\text{arcmin}] = \varphi\ [\text{rad}] \cdot \frac{180 \cdot 60}{\pi}$$

6.3 Output Bearing

6.3.1 Lifetime Calculation for Continuous Operation

The operating life of the output bearing can be calculated using equation 101.1.

Equation 101.1

$$L_{10} = \frac{10^6}{60 \cdot n_{av}} \cdot \left(\frac{C}{f_w \cdot P_C}\right)^B$$

with:

L_{10} [h]	=	Operating life
n_{av} [rpm]	=	Average output speed
C [N]	=	Dynamic load rating, see table "Output Bearing Ratings"
P_C [N]	=	Dynamic equivalent load
f_W	=	Operating factor (Table 101.2)

Average output speed

$$n_{av} = \frac{|n_1| \cdot t_1 + |n_2| \cdot t_2 + \ldots + |n_n| \cdot t_n}{t_1 + t_2 + \ldots + t_n + t_p}$$

Table 101.2

Load conditions	f_W
No impact loads or vibrations	1 ... 1.2
Normal rotating, normal loads	1.2 ... 1.5
Impact loads and/or vibrations	1.5 ... 3

6.3.2 Lifetime Calculation for Oscillating Motion

The operating life at oscillating motion can be calculated using equation 101.3.

Equation 101.3

$$L_{OC} = \frac{10^6}{60 \cdot n_1} \cdot \frac{180}{\varphi} \cdot \left(\frac{C}{f_w \cdot P_C}\right)^B$$

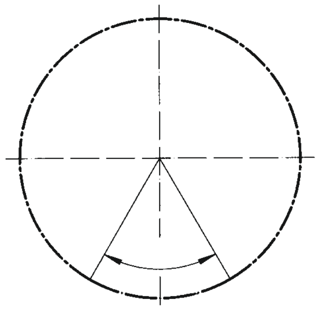
with:

L_{OC} [h]	=	Operating life for oscillating motion
n_1 [cpm]	=	Number of oscillations/minute*
C [N]	=	Dynamic load rating
P_C [N]	=	Dynamic equivalent load
φ [Degree]	=	Oscillating angle
f_W	=	Operating factor (Table 101.2)

* one oscillation means 2φ

Illustration 101.4

Oscillating angle



At oscillating angles < 5° fretting corrosion may occur due to insufficient lubrication. In this case please contact our sales engineer for counter-measures.

Bearing type of selected products see "Output Bearing Ratings".

Table 101.5

Type of bearing	**B**
Cross roller bearing	10/3
Four point bearing	3

Dynamic equivalent load

Equation 102.1

$$P_C = x \cdot \left(F_{rav} + \frac{2M}{dp}\right) + y \cdot F_{aav}$$

Equation 102.2

$$F_{rav} = \left(\frac{|n_1| \cdot t_1 \cdot (|F_{r1}|)^B + |n_2| \cdot t_2 \cdot (|F_{r2}|)^B + \ldots + |n_n| \cdot t_n \cdot (|F_{rn}|)^B}{|n_1| \cdot t_1 + |n_2| \cdot t_2 + \ldots + |n_n| \cdot t_n} \right)^{1/B}$$

Equation 102.3

$$F_{aav} = \left(\frac{|n_1| \cdot t_1 \cdot (|F_{a1}|)^B + |n_2| \cdot t_2 \cdot (|F_{a2}|)^B + \ldots + |n_n| \cdot t_n \cdot (|F_{an}|)^B}{|n_1| \cdot t_1 + |n_2| \cdot t_2 + \ldots + |n_n| \cdot t_n} \right)^{1/B}$$

with:

F_{rav} [N]	=	Radial force
F_{aav} [N]	=	Axial force
d_p [m]	=	Pitch circle
x	=	Radial load factor (Table 102.4)
y	=	Axial load factor (Table 102.4)
M	=	Tilting moment

Table 102.4

Load factors	x	y
$\frac{F_{aav}}{F_{rav} + 2 \cdot M / dp} \leq 1.5$	1	0.45
$\frac{F_{aav}}{F_{rav} + 2 \cdot M / dp} > 1.5$	0.67	0.67

Illustration 102.5

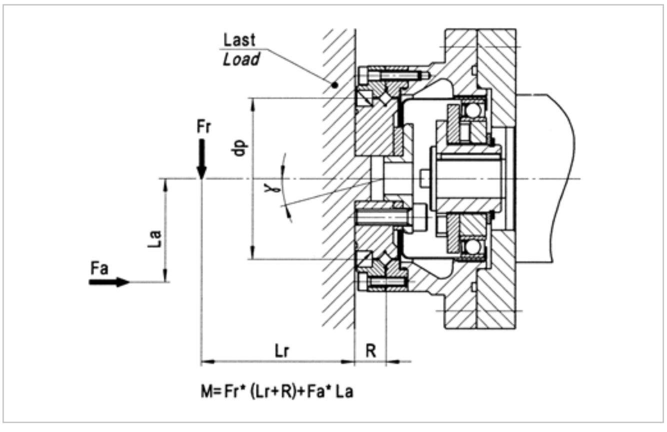
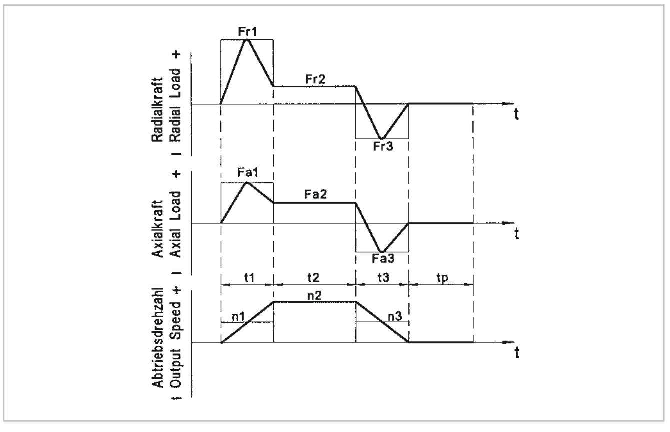


Illustration 102.6



Please note:
F_{rx} represents the maximum radial force.
F_{ax} represents the maximum axial force.
t_p represents the pause time between cycles.

6.3.3 Permissible Static Tilting Moment

In case of static load, the bearing load capacity can be determined as follows:

Equation 103.1

$$f_S = \frac{C_0}{P_0} \quad \text{mit} \quad P_0 = x_0 \left(F_r + \frac{2M}{d_p}\right) + y_0 \cdot F_a$$

Equation 103.2

$$M_0 = \frac{d_p \cdot C_0}{2 \cdot f_S}$$

f_s = Static load safety factor
(f_s = 1,5 ... 3) (Table 103.3)
C_0 = Static load rating
F_r = F_a = 0
x_0 = 1
y_0 = 0.44
P_0 = Static equivalent load
d_p = Pitch circle diameter of the output bearing
M = Moment acting
M_0 = Permissible static tilting moment

Table 103.3

Rotation conditions of bearing	Lower limit value for f_s
Normal	≥ 1.5
Vibrations / Impacts	≥ 2
High transmission accuracy	≥ 3

6.3.4 Angle of Inclination

The angle of inclination of the output flange, as a function of the tilting moment acting on the output bearing, can be calculated by means of equation 103.4:

Equation 103.4

$$\gamma = \frac{M}{K_B}$$

with:
γ [arcmin] = Angle of inclination of the output flange
M [Nm] = Tilting moment acting on the output bearing
K_B [Nm/arcmin] = Moment stiffness of the output bearing

7. Design Notes

7.1 Notes on the Fit Selection

For the mechanical design we recommend the following fit selection.

Table 104.1

	Symbol [Unit]	CanisDrive®							
		14A	17A	20A	25A	32A	40A	50A	58A
Load side									
Fit of bearing inner ring	[mm]	49 h7	59 h7	69 h7	84 h7	110 h7	132 h7	168 h7	193 h7
Recomended tolerance area for transition fit	[mm]	H7	H7	H7	H7	H7	H7	H7	H7
Housing side									
Fit of bearing outer ring	[mm]	78 h7	88 h7	98 h7	116 h7	148 h7	180 h7	222 h7	255 h7
Recomended tolerance area for transition fit	[mm]	H7	H7	H7	H7	H7	H7	H7	H7

8. Installation and Operation

8.1 Transport and Storage

The transportation of the servo actuators and motors should always be in the original packaging.

If the servo actuators and motors are not put into operation immediately after delivery, they should be stored in a dry, dust and vibration free environment. Storage should be for no longer than 2 years at room temperatures (between +5 °C ... +40 °C) so that the grease life is preserved.

INFORMATION

Tensile forces in the connecting cable must be avoided.

ADVICE

Lithium metal batteries are dangerous goods according to UN 3090. Therefore they are generally subject to transport regulations, depending on the transport mode.
The batteries installed in the motor feedback systems do not contain more than 1 g of lithium or lithium alloy and are exempt from dangerous goods regulations.

8.2 Installation

Check the performance and protection and check the suitability of the conditions at the installation site. Take suitable constructive measures to ensure that no liquid (water, drilling emulsion, coolant) can penetrate the output bearing or encoder housing.

ADVICE

The installation must be protected against impact and pressure on the gear.

The mounting must be such that heat loss can be adequately dissipated.

No radial forces and axial forces may act to the protection sleeve of the hollow shaft actuator.

During installation, the actuator must be fitted ensuring the machine housing can be rotated without terminals. Already low terminals may affect the accuracy of the gear and, should this be the case, the installation of the machine housing should be checked.

8.3 Mechanical Installation

The data necessary for mounting the actuator and for connecting to the load are given in the following table.

Table 106.1

	Symbol [Unit]	CanisDrive®							
		14A	17A	20A	25A	32A	40A	50A	58A
Load assembly									
Number of screws		12	12	12	12	12	12	12	12
Screw size		M3	M4	M4	M5	M6	M8	M10	M10
Screw quality		12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Pitch circle diameter	[mm]	43	52	62	76	96	118	152	175
Screw tightening torque	[Nm]	2.3	5.1	5.1	10	17	42	83	83
Transmittable torque	[Nm]	85	188	228	463	847	1964	4086	4688
Housing assembly									
Number of screws		8	12	12	12	12	12	12	12
Screw size		M3	M3	M3	M4	M5	M6	M8	M10
Screw quality		12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9
Pitch circle diameter	[mm]	68	80	89	105	135	168	206	236
Screw tightening torque	[Nm]	2.3	2.3	2.3	5.1	10	17	42.2	83
Transmittable torque	[Nm]	89	158	177	378	805	1482	3419	6317

Data valid for completely degreased connecting interfaces (friction coefficient μ = 0.15).

8.4 Electrical Installation

All work should be carried out with power off.

DANGER

Electric servo actuators and motors have dangerous live and rotating parts. All work during connection, operation, repair and disposal must be carried out only by qualified personnel as described in the standards EN 50110-1 and IEC 60364! Before starting any work, and especially before opening covers, the actuator must be properly isolated. In addition to the main circuits, the user also has to pay attention to any auxilliary circuits.

Observing the five safety rules:
- Disconnect mains
- Prevent reconnection
- Test for absence of harmful voltages
- Ground and short circuit
- Cover or close off nearby live parts

The measures taken above must only be withdrawn when the work has been completed and the device is fully assembled. Improper handling can cause damage to persons and property. The respective national, local and factory specific regulations must be adhered to.

DANGER

Due to the fact that the motor contains permanent magnets, a voltage is generated at the motor terminals when the rotor is turned.

ADVICE

- The connecting leads should be suitable for the type of use, as well as the voltages and amperages concerned.
- The protective earth must be connected to the terminal marked PE.
- All cables used should be provided with a shield and in addition, the encoder cable should feature twisted pair leads.
- The power supply is switched off before connecting and disconnecting the power connection and signal connections.
- Observe EMC-compliant cable routing. Signal lines and power lines must be routed separately.
- Note equipotential bonding.
- When mounting the drives on moving parts, an additional equipotential bonding conductor (≥ 10 mm^2) as close as possible to the servo actuator is recommended.

ADVICE

Encoders and sensors contain electrostatically sensitive components, observe the ESD measures!

8.5 Commissioning

ADVICE

Commissioning must be executed in accordance with the documentation of Harmonic Drive AG.

Before commissioning, please check that:

- The actuator is properly mounted
- All electrical connections and mechanical connections are designed according to requirements
- The protective earth is properly connected
- All attachments (brakes, etc) are operational
- Appropriate measures have been taken to prevent contact with moving and live parts
- The maximum speed n_{max} is specified and cannot be exceeded
- The set up of the drive parameters has been executed
- The commutation is adjusted correctly

⚠ ATTENTION

Check the direction of rotation of the load uncoupled. Any existing loose parts must be removed or secured.

In the event of changes in the normal operating behaviour, such as increased temperature, noise or vibration, switch the actuator off. Determine the cause of the problem and contact the manufacturer if necessary. Even if the actuator is only on test, do not put safety equipment out of operation.

This list may not be complete. Other checks may also be necessary.

ADVICE

Due to heat generation from the actuator itself, tests outside the final mounting position should be limited to 5 minutes of continuous running at a motor speed of less than 1000 rpm.

These values should not be exceeded in order to avoid thermal damage to the actuator.

8.6 Overload Protection

To protect the servo actuators and motors from temperature overload sensors are integrated into the motor windings.

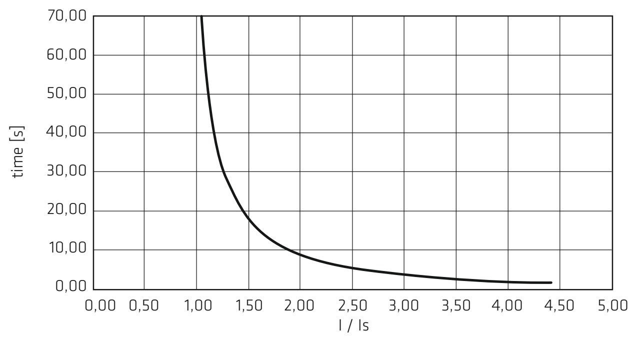
The temperature sensors alone do not guarantee motor protection. Protection against overload of the motor winding is only possible with an input speed > 0. For special applications (eg. load at standstill or very low speed) is an additional overload protection by limiting the overload period.

The built specification of the integrated temperature sensors can be found in the technical data.

In addition, it is recommended to protect the motor winding against overload by the use of I^2t monitoring integrated in the controller. The graph shows an example of the overload characteristic for the I^2t monitoring. The overload factor is the ratio between the actual RMS current and continuous stall current.

Illustration 108.1

Over load characteristic



I_s = Continuous stall current
I = Actual effective current ($I \leq I_{max}$)

8.7 Protection against Corrosion and Penetration of Liquids and Debris

The product is fully protected provided that the connectors are correctly attached. Corrosion from the ambient atmosphere (condensation, liquids and gases) at the running surface of the output shaft seal is prevented.

Contact between sharp edged or abrasive objects (cutting chips, splinters, metallic or minerals dusts, etc.) and the output shaft seal must be prevented. Permanent contact between the output shaft seal and a permanent liquid covering should also be prevented.
A change in the operating temperature of a completely sealed actuator can lead to a pressure differential between the outside and the inside temperature of the actuator. This can cause any liquid covering the output shaft seal to be drawn into the housing which could cause corrosive damage.

As a countermeasure, we recommend the use of an additional shaft seal (to be provided by the user) or the maintenance of a constant pressure inside the actuator. Please contact Harmonic Drive AG for further information.

ADVICE

Specification sealing air: constant pressure in the actuator as described above; the supplied air must be dry and filtered with pressure at not more than 10^4 Pa.

8.8 Shutdown and Maintenance

In case of malfunctions or maintenance measures, or to shutdown the motors, proceed as follows:

1. Follow the instructions in the machine documentation.
2. Bring the actuator on the machine to a controlled standstill.
3. Turn off the power and the control voltage on the controller.
4. For motors with a fan unit; turn off the motor protection switch for the fan unit.
5. Turn off the mains switch of the machine.
6. Secure the machine against accidental movement and against unauthorised operation.
7. Wait for the discharge of electrical systems then disconnect all the electrical connections.
8. Secure the motor, and possibly the fan unit, before disassembly against falling or movement then pay attention to the mechanical connections.

DANGER

Risk of death by electric voltages. Work in the area of live parts is extremely dangerous.

- Work on the electrical system may only be performed by qualified electricians. The use of a power tool is absolutely necessary.
- Observing the five safety rules:
  1. Disconnect mains
  2. Prevent reconnection
  3. Test for absence of harmful voltages
  4. Ground and short circuit
  5. Cover or close off nearby live parts
- Before starting work check with a suitable measuring instrument if there are any parts under residual voltage.(e.g. capacitors, etc.). Wait until the residual voltage is within a save range.

The measures taken above must only be withdrawn when the work has been completed and the device is fully assembled. Improper handling can cause damage to persons and property. The respective national, local and factory specific regulations must be adhered to.

ATTENTION

Burns from hot surfaces with temperatures of over 100 °C

Let the motors cool down before starting work. Cooling times of up to 140 minutes may be necessary.
Wear protective gloves.
Do not work on hot surfaces!

WARNING

Persons and property during maintenance and operation

Never perform maintenance work on running machinery. Secure the system during maintenance against re-starting and unauthorised operation.

Cleaning

Excessive dirt, dust or chips may adversely affect the operation of the device and can, in extreme cases, lead to failure. At regular intervals (latest after one year) you should therefore, clean the device to ensure a sufficient dissipation of the surface heat. Insufficient heat emissions can have undesirable consequences. The lifetime of the device is reduced if temperature overloads occures. Overtemperature can lead to the shutdown of the device.

Insufficient heat radiation can have undesirable consequences.

- The bearing life is reduced by operation at inadmissibly high temperatures (bearing grease decomposes).
- Overtemperature shutdown despite operation after selection data, because the corresponding cooling is missing.

Checking of electric connections

DANGER

Lethal electric shock by touching live parts!

In any case of defects of the cable sheath the system must be shut down immediately and the damaged cable should be replaced. Do not make any temporary repairs on the connection cables.

- Connection cord should be periodically checked for damage and replaced if necessary.
- Check optionally installed power chains for defects.
- Protective conductor connections should be in a good condition and tightness checked at regular intervals. Replace if necessary.

Control of mechanical fasteners

The fastening screws and the load of the housing must be checked regularly.

Maintenance intervals for battery backed motor feedback systems

ADVICE

Please note the information on battery life time in the chapter "Motor Feedback Systems"!

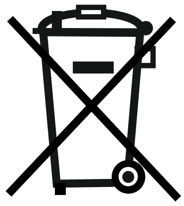
9. Decommissioning and Disposal

The products from Harmonic Drive AG contain lubricants for bearings and gears as well as electronic components and printed circuit boards. Depending on the used motor feedback system the actuator can also include a lithium thionyl chloride battery. It is required to dispose the product correctly in accordance to the national and local regulations.

Lubricants and batteries must be handled in accordance with national health and safety regulations. If required, please request the valid safety data sheet for the lubricant from us.

ADVICE

- Batteries do not contain hazardous materials according to EC directives 91/157/EEC, 93/86/EEC, and 2011/65/EU (RoHS directive)
- EC battery directive 2006/66/EC has been implemented by most EC member states,
- According to the EU Battery Directive, Lithium batteries are marked with the symbol of the crossedout wheeled bin (see figure). The symbol reminds the end user that batteries are not permitted to be disposed of with household waste, but must be collected separately.
- A disposal service is offered upon request by Harmonic Drive AG.



10. Glossary

10.1 Technical Data

AC Voltage constant k_{EM} [V_{rms} / 1000 rpm]
Effective value of the induced motor voltage measured at the motor terminals at a speed of 1000 rpm and an operating temperature of 20 °C.

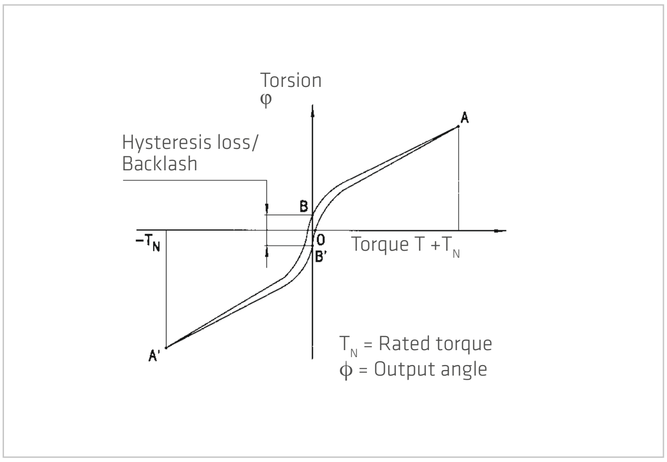
Ambient operating temperature [°C]
The intended operating temperature for the operation of the drive.

Average input speed (grease lubrication) $n_{av\ (max)}$ [rpm]
Maximum permissible average gear input speed for grease lubrication. The applications average input speed must be lower than the permitted average input speed of the gear.

Average input speed (oil lubrication) $n_{av\ (max)}$ [rpm]
Maximum permissible average gear input speed for oil lubrication. The applications average input speed must be lower than the permitted average input speed of the gear.

Average torque T_A [Nm]
When a variable load is applied to the gear, an average torque should be calculated for the complete operating cycle. This value should not exceed the specified T_A limit.

Backlash (Harmonic Planetary Gears) [arcmin]
When subjected to the rated torque, Harmonic Planetary Gears display characteristics shown in the hysteresis curve. When a torque is applied to the output shaft of the gear with the input shaft locked, the torque-torsion relationship can be measured at the output. Starting from point 0 the graph follows successive points A-B-A'-B'-A where the value B-B' is defined as the backlash or hysteresis.



Brake closing time t_C [ms]
Delay time to close the brake.

Brake current to hold I_{HBr} [A_{DC}]
Current for applying the brake.

Brake current to open I_{OBr} [A_{DC}]
Current required to open the brake.

Brake holding torque T_{BR} [Nm]
Torque the actuator can withstand when the brake is applied, with respect to the output.

Brake opening time t_O [ms]
Delay time for opening the brake.

Brake voltage U_{Br} [VDC]
Terminal voltage of the holding brake.

Continuous stall current I_0 [A_{rms}]
Effective value of the motor phase current to produce the stall torque.

Continuous stall torque T_0 [Nm]
Allowable actuator stall torque.

Demagnetisation current I_E [A_{rms}]
Current at which rotor magnets start to demagnetise.

Dynamic axial load $F_{A\ dyn\ (max)}$ [N]
With the bearing rotating, this is the maximum allowable axial load with no additional radial forces or tilting moments applied.

Dynamic load rating C [N]
Maximum dynamic load that can be absorbed by the output bearing before permanent damage may occur.

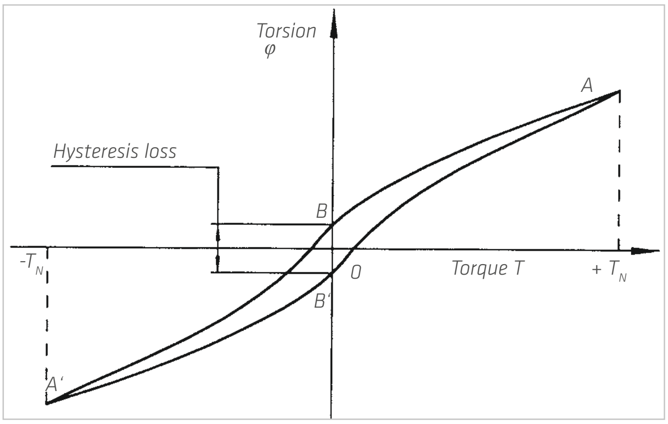
Dynamic radial load $F_{R\ dyn\ (max)}$ [N]
With the bearing rotating, this is the maximum allowable radial load with no additional axial forces or tilting moments applied.

Dynamic tilting moment $M_{dyn\ (max)}$ [Nm]
With the bearing rotating, this is the maximum allowable tilting moment with no additional axial forces or radial forces applied. This value is not based on the equation for lifetime calculation of the output bearing but on the maximum allowable deflection of the Harmonic Drive® Component Set. This value must not be exceeded even if the lifetime calculation of the bearing permits higher values.

Electrical time constant τ_e [s]
The electrical time constant is the time required for the current to reach 63 % of its final value.

Hollow shaft diameter d_H [mm]
Free inner diameter of the axial hollow shaft.

Hysteresis loss (Harmonic Drive® Gears)
When a torque is applied to the output of a Harmonic Drive® Gear with the input locked, the torque-torsion relationship measured at the output typically follows, starting from point 0, the successive points the hysteresis curve A-B-A'-B'-A (see figure). The value of the displacement B-B' is defined as the hysteresis loss.



T_N = Rated output torque
φ = Output rotation angle

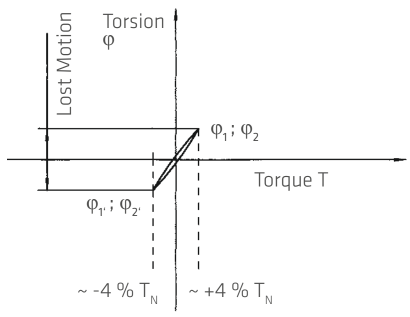
Inductance (L-L) L_{L-L} [mH]

Terminal inductance calculated without taking into account the magnetic saturation of the active motor parts.

Lost Motion (Harmonic Drive® Gears) [arcmin]

Harmonic Drive® Gears exhibit zero backlash in the teeth. Lost motion is the term used to characterise the torsional stiffness in the low torque region.

The illustration shows the angle of rotation φ measured against the applied output torque as a hysteresis curve with the Wave Generator locked. The lost motion measurement of the gear is taken with an output torque of about ±4 % of the rated torque.



Maximum current I_{max} [A]

The maximum current is the maximum current that can be applied for a short period.

Maximum DC bus voltage $U_{DC\,(max)}$ [VDC]

The maximum DC bus power supply for the correct operation of the actuator. This value may only be exceeded for a short period during the braking or deceleration phase.

Maximum hollow shaft diameter $d_{H\,(max)}$ [mm]

For gears with a hollow shaft, this value is the maximum possible diameter of the axial hollow shaft.

Maximum input speed (grease lubrication) $n_{in\,(max)}$ [rpm]

Maximum allowable input speed with grease lubrication for short period. The maximum input speed can be applied as often as desired, as long as the application's average speed is lower than the permitted average input speed of the gear.

Maximum input speed (oil lubrication) $n_{in\,(max)}$ [rpm]

Maximum allowable input speed for gearing with oil lubrication for short period. The maximum input speed can be applied as often as desired, as long as the application's average speed is lower than the permitted average input speed of the gear.

Maximum motor speed n_{max} [rpm]

The maximum allowable motor speed.

Maximum output speed n_{max} [rpm]

The maximum output speed. Due to heating issues, this may only be momentarily applied during the operating cycle. The maximum output speed can occur any number of times as long as the calculated average speed is within the permissible continuous operation duty cycle.

Maximum output torque T_{max} [Nm]

Specifies the maximum allowable acceleration and deceleration torques. For highly dynamic processes, this is the maximum torque available for a short period. The maximum torque can be parameterised by the control unit where the maximum current can be limited. The maximum torque can be applied as often as desired, as long as the calculated average torque is within the permissible continuous operation duty cycle.

Maximum power P_{max} [W]

Maximum power output.

Mechanical time constant τ_m [s]

The mechanical time constant is the time required to reach 63 % of its maximum rated speed in a no-load condition.

Momentary peak torque T_M [Nm]

In the event of an emergency stop or collision, the Harmonic Drive® Gear may be subjected to a brief momentary peak torque. The magnitude and frequency of this peak torque should be kept to a minimum and under no circumstances should the momentary peak torque occur during the normal operating cycle. The allowable number of momentary peak torque events can be calculated with the equations given in chapter "selection procedure".

Moment of inertia J [kgm^2]

Mass moment of inertia at motor side.

Moment of inertia J_{in} [kgm^2]

Mass moment of inertia of the gear with respect to the input.

Moment of inertia J_{out} [kgm^2]

Mass moment of inertia with respect to the output.

Motor terminal voltage (Fundamental wave only) U_M [V_{rms}]

Required fundamental wave voltage to achieve the specified performance. Additional power losses can lead to restriction of the maximum achievable speed.

Nominal Service Life L_n [h]

When loaded with rated torque and running at rated speed the Wave Generator Bearing will reach the nominal service life L_n with 50 % propability of failure. For different load conditions the service life of the Wave Generator Bearing can be calculated using the equations in chapter "selection procedure".

Number of pole pairs p

Number of magnetic pole pairs on the rotor of the motor.

Offset R [m]

Distance between output 's center plane and contact point of the load.

Pitch circle diameter d_p [m] or [mm]

Pitch circle diameter of the output bearing rolling element raceway.

Protection class IP

The degree of protection according to EN 60034-5 provides suitability for various environmental conditions.

Rated current I_N [A]

RMS value of the sinusoidal current when driven at rated torque and rated speed.

Rated motor speed n_N [rpm]

The motor speed which can be continuously maintained when driven at rated torque T_N, when mounted on a suitably dimensioned heat sink.

Rated power P_N [W]

Output power at rated speed and rated torque.

Rated speed n_N [rpm], Servo

The output speed which can be continuously maintained when driven at rated torque T_N, when mounted on a suitably dimensioned heat sink.

Rated speed n_N [rpm], Mechanical

The rated speed is a reference speed for the calculation of the gear life. When loaded with rated torque and running at rated speed the Wave Generator Bearing will reach the nominal service life L_n with 50 % propability of failure. The rated speed n_N is not used for the dimensioning of the gear.

Product series	n_N
CobaltLine®, HFUC, HFUS, CSF, CSG, CSD, SHG, SHD, CPL	2000 rpm
PMG size 5	4500 rpm
PMG size 8 to 14	3500 rpm
HPG, HPGP, HPN	3000 rpm

Rated torque T_N [Nm], Servo

The output torque which can be continuously transmitted when driven at rated input speed, when mounted on a suitably dimensioned heat sink.

Rated torque T_N [Nm], Mechanical

The rated torque is a reference torque for the calculation of the gear life. When loaded with rated torque and running at rated speed the Wave Generator Bearing will reach the nominal service life L_n with 50 % propability of failure. The rated torque T_N is not used for the dimensioning of the gear.

Rated voltage U_N [V_{rms}]

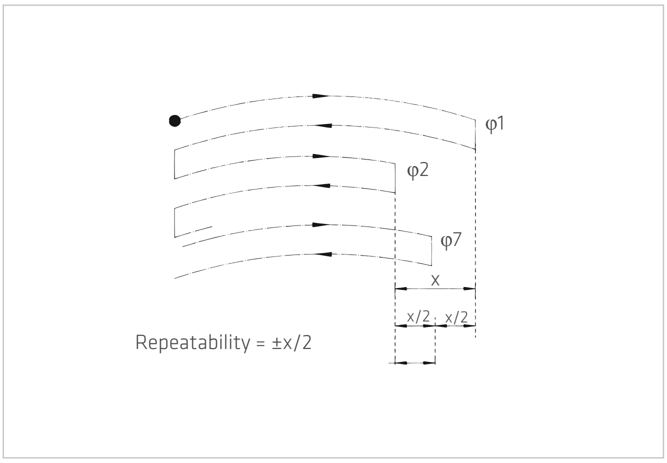
Supply voltage for operation with rated torque and rated speed.

Ratio i [ ]

The ratio is the reduction of input speed to the output speed.
Note for Harmonic Drive® Gears: In the standard drive arrangement, the Wave Generator is the drive element while the Flexspline is the driven element and the Circular Spline is fixed to the housing. Since the direction of rotation of the input (Wave Generator) is opposite to the output (Flexspline), a negative ratio must be considered.

Repeatability [arcmin]

The repeatability of the gear describes the position difference measured during repeated movement to the same desired position from the same direction. The repeatability is defined as half the value of the maximum difference measured, preceded by a ± sign.



Repeated peak torque T_R [Nm]

Specifies the maximum allowable acceleration and deceleration torque. During the normal operating cycle the repeatable peak torque T_R must not be exceeded. The repeated peak torque can be applied as often as desired, as long as the application's average torque is lower than the permitted average torque of the gear.

Resistance (L-L, 20 °C) R_{L-L} [Ω]

Winding resistance measured between two conductors at a winding temperature of 20 °C.

Size

The frame size is derived from the pitch circle diameter of the gear teeth in inches multiplied by 10.

Static load rating C_0 [N]

Maximum static load that can be absorbed by the output bearing before permanent damage may occur.

Static tilting moment M_0 [Nm]

With the bearing stationary, this is the maximum allowable radial load with no additional axial forces or tilting moments applied.

Synchronous inductance L_d [mH]

Sum of air gap inductance and leakage inductance in relation to the single-phase equivalent circuit diagram of the synchronous motor.

Tilting moment stiffness K_B [Nm/arcmin]

The ratio of the tilting angle of the output bearing and the applied moment load.

Torque constant (motor) k_{TM} [Nm/A_{rms}]

Quotient of stall torque and stall current.

Torque constant (output) k_{Tout} [Nm/A_{rms}]

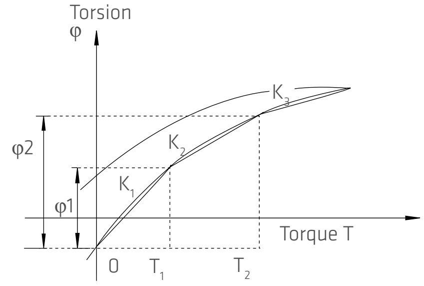
Quotient of stall torque and stall current, taking into account the transmission losses.

Torsional stiffness (Harmonic Drive® Gears) K_1, K_2, K_3 [Nm/rad]

The amount of elastic rotation at the output for a given torque with the Wave Generator blocked. The torsional stiffness may be evaluated by dividing the torque-torsion curve into three regions. The torsional stiffness values K_1, K_2 and K_3 are determined by linearization of the curve.

K_1: low torque region $0 \sim T_1$
K_2: middle torque region $T_1 \sim T_2$
K_3: high torque region $> T_3$

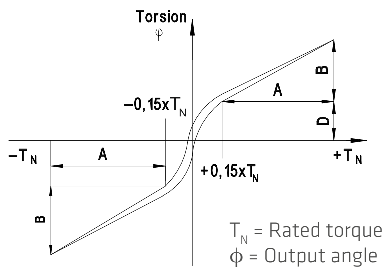
The values given for the torsional stiffness K_1, K_2 and K_3 are average values that have been determined during numerous tests. The limit torques T_1 and T_2 and an calculation example for the torsional angle can be found in chapter "torsional stiffness" and "calculation of the torsion angle" of this documentation.



K_1, K_2, K_3 = Torsional stiffness, w = Output angle
ϕ1 = Torsion angle, with output torque T_1
ϕ2 = Torsion angle, with output torque T_2

Torsional stiffness (Harmonic Planetary Gears) K_3 [Nm/rad]

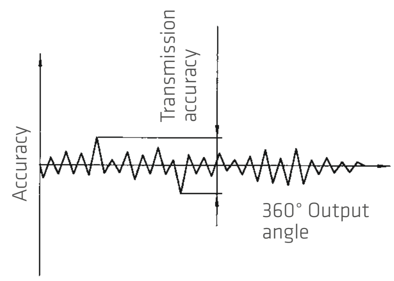
The amount of elastic rotation at the output for a given torque and blocked input shaft. The torsional rigidity of the Harmonic Planetary Gear describes the rotation of the gear above a reference torque of 15 % of the rated torque. In this area the torsional stiffness is almost linear.



T_N = Rated torque
ϕ = Output angle

Transmission accuracy [arcmin]

The transmission accuracy of the gear represents the linearity error between input and output angle. The transmission accuracy is measured for one complete output revolution using a high resolution measurement system. The measurements are carried out without direction reversal. The transmission accuracy is defined as the sum of the maximum positive and negative differences between the theoretical and actual output rotation angles.



Weight m [kg]

The weight specified in the catalog is the net weight without packing and only applies to standard versions.

10.2 Labelling, Guidelines and Regulations

CE-Marking

With the CE marking, the manufacturer or EU importer declares in accordance with EU regulation, that the product meets the applicable requirements of the EU harmonization legislation.

REACH Regulation

REACH is a European Community Regulation on chemicals. REACH stands for Registration, Evaluation, Authorization and Restriction of Chemicals.

RoHS EU Directive

The RoHS EU Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

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