Engineering Data
AC Servo Actuators CHA

Harmonic Drive AG

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...just move it!

Contents

1. General

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

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. Specialy designed models may differ in technical detail. If in doubt, we strong recommend that you 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 redating parts. All work during connection, operation, repair and disposal must be carried out by qualified personnel as described in the standards EN50110-1 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 gears, motors and actuators can 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 pacemakers, implants or similiar. Vulnerable groups must not be in the immediate vicinity of the products themselves.

DANGER

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

WARNING

The successful and safe operation of gears, servo actuators and motors requires proper transport, storage and assembly as well as correct operation and maintenance.

ADVICE

Use suitable lifting equipment to move and lift gears, servo actuators and motors 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

The Harmonic Drive® servo actuators and motors are intended for industrial or commercial applications. They comply with the relevant parts of the harmonised EN 60034 standards series.

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

The servo actuators and motors may only be operated within the operating ranges and environmental conditions shown in the documentation (altitude, degree of predection, temperature range etc).
Before plant and machinery which have Harmonic Drive® servo actuators and motors built into them are commissioned, the compliance must be established with the Machinery Directive, Low Voltage Directive and EMC guidelines.

Plant and machinery with inverter driven motors must satisfy the predection requirements in the EMC guidelines. It is the responsibility of the installer to ensure that installation is undertaken correctly.
Signal and power lines must be shielded. The EMC instructions from the inverter manufacturer must be observed in order that installation meets the EMC regulations.

2.3 Non Intended Purpose

The use of servo actuators and motors outside the areas of application mentioned above or, inter alia, other than in the operating areas or environmental conditions described in the documentation is considered as non-intended purpose.

ADVICE

Direct operating from the mains supply is not allowed.

The following areas of application are, inter alia, those considered as non-intended purpose:

- 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
- Machines for domestic use
- Medical equipment which comes into direct contact with the human body
- Machines or equipment for transporting or lifting people
- Special devices for use in annual markets or leisure parks

2.4 Declaration of Conformity

The Harmonic Drive® servo actuators and motors described in the engineering data comply with the Low Voltage Directive. A copy of the EC conformity declaration is supplied in the appendix.
In accordance with the Machinery Directive , Harmonic Drive® servo actuators and servo 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.

Largest hollow shaft with precision output bearing

CHA Series Hollow Shaft Servo Actuators combine a synchronous servo motor, Unit from the CPU-H Series, feedback sensor and a high capacity precision output bearing. Available in eight sizes with gear ratios between 30 and 160:1, the actuators can provide maximum torques from 8 to 1840 Nm. The output bearing with high tilting capacity often allows direct attachment of heavy payloads without the need for further support, thereby providing simple and space saving design installations.

To adapt to your specific application, the CHA Series offers many possible combinations when selecting the motor winding, Motor feedback system, brake, various sensors and cable as well as connector options.

The integrated hollow shaft can be used to feed through supply lines or services for additional axes, enabling space saving designs with minimal installation dimensions required. With a reinforced output bearing offering maximum tilting rigidity, the actuators can easily absorb and accurately guide heavy payloads. The accurate positioning of the actuator ensures stable machine characteristics, increased operating reliability and consistent quality. With high predection ratings and corrosion resistance, the series is perfectly suited for use in harsh and demanding environmental conditions.

By combining the CHA Actuators with the specially adapted YukonDrive® Servo Controllers, it is possible to provide a single source supply for a pre-configured drive system tailored to suit your application. Alternatively, the flexible configuration of the actuator ensures compatibility with almost any servo controller on the market.

3.2 Ordering Code

Table 9.1

Series	Size Version	Ratio						Motor winding and connector configuration	Motor feed-back system	Brake	Option 1	Option 2	Special design
CHA	14A	30	**50**	80	**100**			E H L N	C1024 S1024[1)] M1024[1)] M512P RES D2048 M128S	B	Sensor	Cable/ connec-tor	According to customer requirements
	17A	30	**50**	80	**100**	120							
	20A	30	**50**	80	**100**	120	160						
	25A	30	**50**	80	**100**	120	160						
	32A	30	**50**	80	**100**	120	160						
	40A		**50**	80	**100**	120	160						
	50A		**50**	80	**100**	120	160						
	58A		**50**	80	**100**	120	160						
Ordering code													
CHA - 20A - 100 - H - C1024 - B - EC - K - SP													

Variations in **bold print** are available at short notice, subject to prior sale.

[1)] The availability of the motor feedback systems S1024 and M1024 is limited until approximately 2016 due to the availability of some electronic components!

Table 9.2

Motor winding and connector configuration

Size Version	Ordering code	Maximum DC bus voltage
14A	E	48 VDC
17A		
14A	H, L, N	680 VDC
17A		
20A		
25A		
32A		
40A		
50A		
58A		

Table 9.3

connector configuration

Ordering code	Motor feedback	Motor	Motor feedback system	Cable outlet	connec-tor
H	C1024	6 pin (M23)	17 pin (M23)	x	
H	M512P				x
H	M128S			x	
H	RES		12 pin (M23)	x	
H	S1024	without	without	x	
H	M1024			x	
L	S1024	8 pin (M23)	17 pin (M23)	x	
L	M1024			x	
N	M128S	8 pin (M17)	17 pin (M17)	x	
N	RES			x	
N	D2048			x	
E	RES	8 pin (M17)	17 pin (M17)		x
E	D2048				x
E	M128S				x

Table 9.4

Motor feedback system

Ordering code	Typ	Protocol
C1024	Incremental	–
S1024	Single turn absolute	HIPERFACE®
M1024	Multi-turn absolute	
M512P		EnDat®
RES	Resolver	
D2048	Incremental	
M128S	Multi-turn absolute	SSI

Table 9.5

Option 1

Ordering code	Description
EC	Single turn absolute EnDat® Encoder system at the gear output

Table 9.6

Option 2

Ordering code	Description
K	Cable outlet axial
R	connector axial (only M512P)
S	connector radial (only M512P)
-	Standard (cable outlet radial)

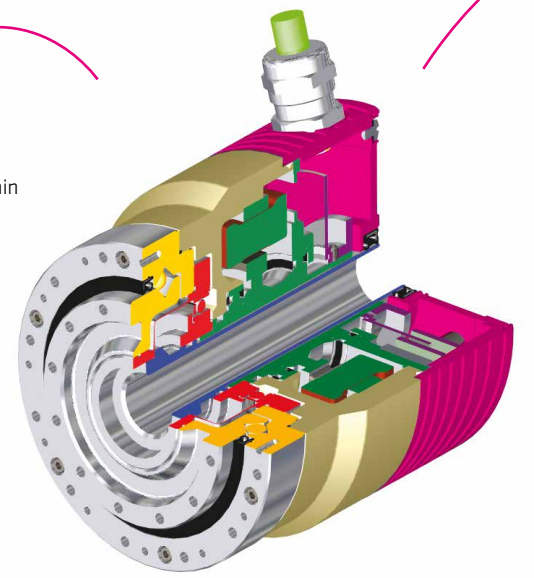
Clarification of the technical data can be found in the Glossary

Combinations

Table 10.1

Size Version		14A	17A	20A	25A	32A	40A	50A	58A
Ratio	30	●	●	●	●	●	-	-	-
	50	●	●	●	●	●	●	●	●
	80	●	●	●	●	●	●	●	●
	100	●	●	●	●	●	●	●	●
	120	-	●	●	●	●	●	●	●
	160	-	-	●	●	●	●	●	●
Motor winding and connector configuration	E	●	●	-	-	-	-	-	-
	H	●	●	●	●	●	●	●	●
	L	-	-	●	●	●	●	●	●
	N	●	●	-	-	-	-	-	-
Motor feedback system	C1024	-	-	●	●	●	●	●	●
	S1024	-	-	●	●	●	●	●	●
	M1024	-	-	●	●	●	●	●	●
	M512P	-	-	●	●	●	●	●	●
	RES	●	●	○	○	○	○	○	○
	D2048	●	●	-	-	-	-	-	-
	M128S	●	●	-	-	-	-	-	-
Brake	B	●	●	●	●	●	●	●	●
Option 1 (Sensor)	EC	-	-	●	●	●	●	●	●
Option 2 (Cable/ connector)	K	○ [1]	○ [1]	○	○	○	○	○	○
	R	-	-	Only in conjunction with M512P					
	S	-	-						

● available ○ on request – not available [1] Only for resolver and with increased length



Gear Component Set

- Zero backlash
- Hollow shaft
- Transmission accuracy better than 1 arcmin
- Repeatability better than ±6 arcsec

Output bearing

- High load capacity
- Tilt resistant
- Excellent running characteristics

Motor feedback system

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

AC Hollow shaft motor

- Sine commutated hollow shaft AC motor
- Multiple motor winding options
- Winding temperature monitoring with temperature sensor
- Maintenance free

3.3 Technical Data

3.3.1 General Technical Data

CHA-xxA-E

Table 11.1

Insulation class (EN 60034-1)		F
Insulation resistance (500VDC)	MΩ	100
Insulation voltage (10s)	V_{rms}	600
Lubrication		Harmonic Drive Flexolub A1
Degree of predection (EN 60034-5)		IP65
Ambient operating temperature	° C	0 ... 40
Ambient storage temperature	° C	-20 ... 60
Relative humidity (without condensation)	%	20 ... 80
Vibration resistance (DIN IEC 68 Teil 2-6, 10 ... 500 Hz)	g	5
Shock resistance (DIN IEC 68 Teil 2-27, 18 ms)	g	30
Temperature sensors		1 x KTY 84-130 // 1 x PTC 116-K135-145° C

CHA-xxA-H/N

Table 11.2

Insulation class (EN 60034-1)		F
Insulation resistance (500VDC)	MΩ	100
Insulation voltage (10s)	V_{rms}	2500
Lubrication		Harmonic Drive Flexolub A1
Degree of predection (EN 60034-5)		IP65
Ambient operating temperature	° C	0 ... 40
Ambient storage temperature	° C	-20 ... 60
Altitude (a. s. l.)	m	< 1000
Relative humidity (without condensation)	%	20 ... 80
Vibration resistance (DIN IEC 68 Teil 2-6, 10 ... 500 Hz)	g	5
Shock resistance (DIN IEC 68 Teil 2-27, 18 ms)	g	30
Temperature sensors		1 x KTY 84-130 // 1 x PTC 116-K135-145° C

The continuous operating characteristics specified in the following refer to a temperature rise of the motor winding of 100 K at an ambient temperature of 40 degrees Celsius. The continuous operating characteristic curve applies to actuators mounted on an aluminium plate with the follwing dimensions.

Table 11.3

Series	Size Version	Unit	Dimensions
CHA	14A	[mm]	200 x 200 x 6
	17A	[mm]	300 x 300 x 15
	20A	[mm]	300 x 300 x 15
	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

3.3.2 Actuator Data

Table 12.1

	Symbol [Unit]	CHA-14A-E			
Motor feedback system		RES / D2048 / M128S			
Ratio	i [ ]	**30**	**50**	**80**	**100**
Maximum output torque	T_{max} [Nm]	9	18	23	28
Maximum output speed	n_{max} [rpm]	283	170	106	85
Maximum current	I_{max} [A_{rms}]	7.4	8.6	6.9	6.7
Continuous stall torque	T_0 [Nm]	6.8	6.9	11	11
Continuous stall current	I_0 [A_{rms}]	5.8	3.8	3.7	3.1
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	48			
Electrical time constant (20° C)	t_e [ms]	0.8			
Mechanical time constant (20° C) Version RES	t_m [ms]	14.0			
Mechanical time constant (20° C) Version D2048	t_m [ms]	9.0			
Mechanical time constant (20° C) Version M128S	t_m [ms]	23.0			
No load current (+20° C)	I_{NLS} [A_{rms}]	1.0	0.9	0.8	0.8
No load current (-40° C)	I_{NLS} [A_{rms}]	3.1	3.7	4.5	5.1
No load running current constant (30° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	4.6	7.6	12.2	15.2
No load running current constant (80° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	1.6	2.7	4.3	5.4
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	1.2	1.8	3.0	3.5
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.04			
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	3			
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	18 ... 34			
Demagnetisation current	I_E [A_{rms}]	-			
Maximum motor speed	n_{max} [rpm]	8500			
Rated motor speed	n_N [rpm]	3500			
Resistance (L-L, 20° C)	R_{L-L} [Ω]	0.42			
Inductance (L-L)	L_{L-L} [mH]	0.35			
Number of pole pairs	p [ ]	5			
Weight without brake	m [kg]	1.6 (D2048) 1.9 (RES / M128S)			
Weight with brake	m [kg]	2.2 (D2048) 2.5 (RES / M128S)			
Hollow shaft diameter	d_h [mm]	12			

Table 13.1

	Symbol [Unit]	CHA-14A-H/N			
Motor feedback system		RES / D2048 / M128S			
Ratio	i [ ]	**30**	**50**	**80**	**100**
Maximum output torque	T_{max} [Nm]	9	18	23	28
Maximum output speed	n_{max} [rpm]	283	170	106	85
Maximum current	I_{max} [A_{rms}]	1.1	1.3	1.0	1.0
Continuous stall torque	T_0 [Nm]	6.8	6.9	11	11
Continuous stall current	I_0 [A_{rms}]	0.9	0.6	0.6	0.5
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680			
Electrical time constant (20° C)	t_e [ms]	1.9			
Mechanical time constant (20° C) Version RES	t_m [ms]	4.4			
Mechanical time constant (20° C) Version D2048	t_m [ms]	3.0			
Mechanical time constant (20° C) Version M128S	t_m [ms]	7.4			
No load current	I_{NLS} [A_{rms}]	0.13	0.12	0.10	0.10
No load running current constant (30° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	0.5	0.8	1	2
No load running current constant (80° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	0.2	0.3	0.5	0.6
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	9.4	14.4	24.4	31.4
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.30			
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	22			
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430			
Demagnetisation current	I_E [A_{rms}]	-			
Maximum motor speed	n_{max} [rpm]	8500			
Rated motor speed	n_N [rpm]	3500			
Resistance (L-L, 20° C)	R_{L-L} [Ω]	7.7			
Inductance (L-L)	L_{L-L} [mH]	15.0			
Number of pole pairs	p [ ]	5			
Weight without brake	m [kg]	1.6 (D2048) 2.2 (RES / M128S)			
Weight with brake	m [kg]	1.9 (D2048) 2.5 (RES / M128S)			
Hollow shaft diameter	d_h [mm]	12			

Moment of Inertia

Table 14.1

	Symbol [Unit]	CHA-14A			
Motor feedback system		**RES**			
Ratio	i [ ]	**30**	**50**	**80**	**100**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.031	0.087	0.222	0.347
Moment of inertia with brake	J_{out} [kgm²]	0.039	0.109	0.280	0.438
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	0.347			
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	0.438			
Motor feedback system		**D2048**			
Ratio	i [ ]	**30**	**50**	**80**	**100**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.020	0.056	0.142	0.223
Moment of inertia with brake	J_{out} [kgm²]	0.028	0.078	0.201	0.314
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	0.223			
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	0.314			
Motor feedback system		**M128S**			
Ratio	i [ ]	**30**	**50**	**80**	**100**
Moment of Inertia output side					
Moment of inertia without brake	J_{out} [kgm²]	0.052	0.145	0.371	0.580
Moment of inertia with brake	J_{out} [kgm²]	0.060	0.168	0.429	0.671
Moment of Inertia at motor					
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	0.580			
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	0.671			

Technical Data Brake

Table 14.2

	Symbol [Unit]	CHA-14A			
Ratio	i [ ]	**30**	**50**	**80**	**100**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%			
Brake holding torque (at output)	T_{Br} [Nm]	9	18	23	28
Brake current to open	I_{OBr} [A_{DC}]	-			
Brake current to hold	I_{HBr} [A_{DC}]	0.54			
Number of brake cyles at n = 0 rpm		-			
Emergency brake cyles		-			
Opening time	t_O [ms]	-			
Closing time	t_C [ms]	-			

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 ratings table.

Illustration 15.1 CHA-14A-30-E

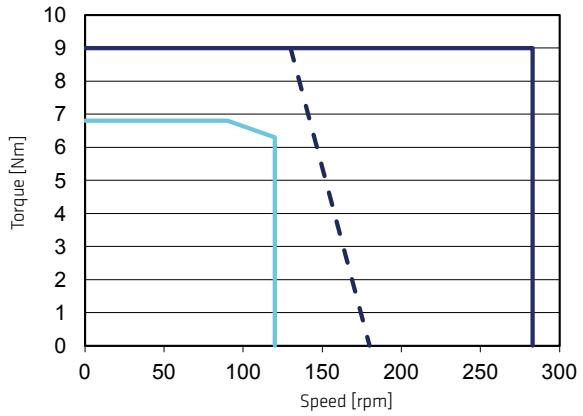


Illustration 15.2 CHA-14A-50-E

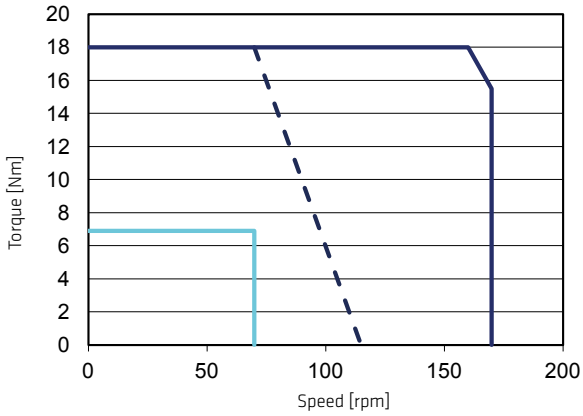


Illustration 15.3 CHA-14A-80-E

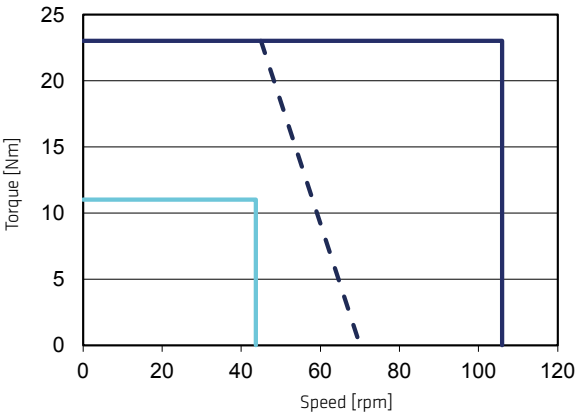
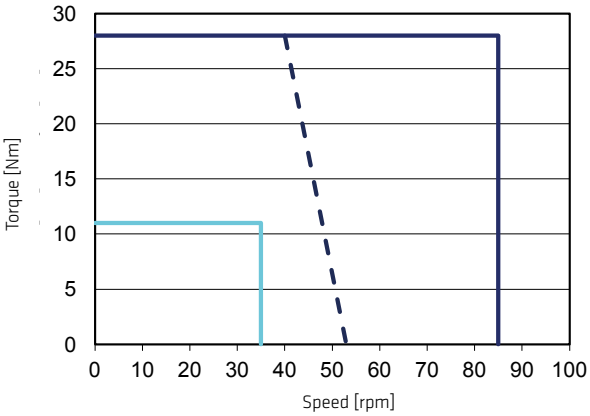


Illustration 15.4 CHA-14A-100-E



Legend

Intermittent duty
Continuous duty

L: U_M = 34 VAC
H: U_M = 18 VAC

S3-ED 50% (1 min)

Illustration 16.1

CHA-14A-30-H/N

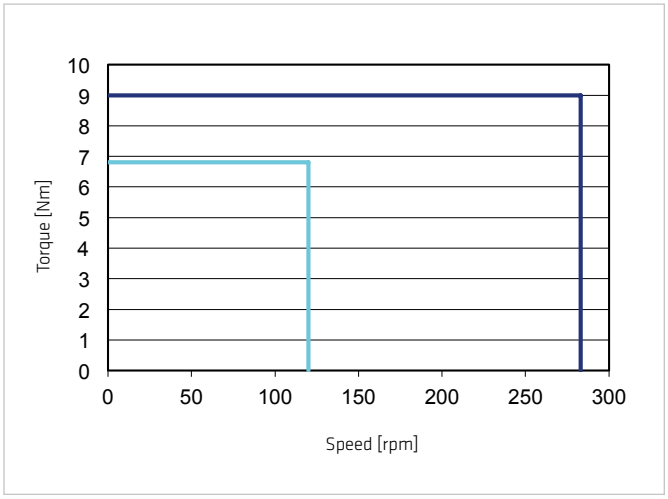


Illustration 16.2

CHA-14A-50-H/N

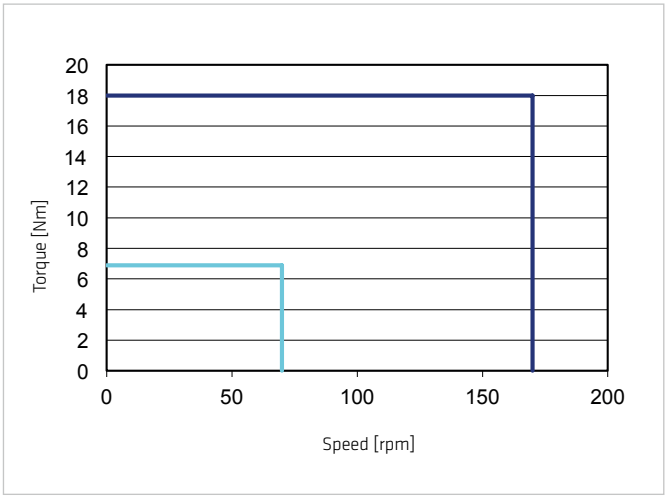


Illustration 16.3

CHA-14A-80-H/N

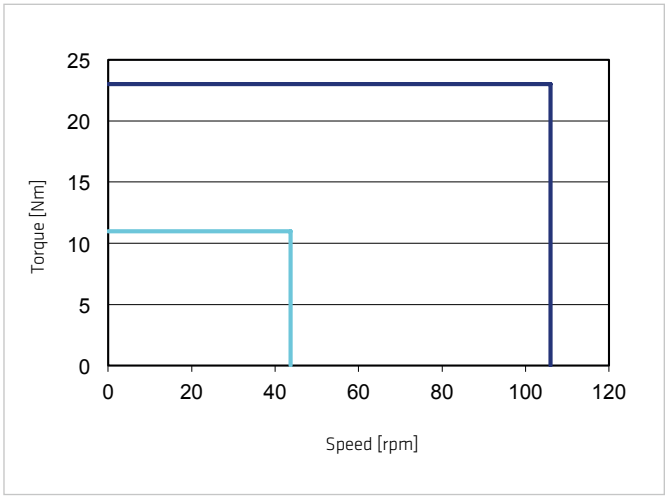
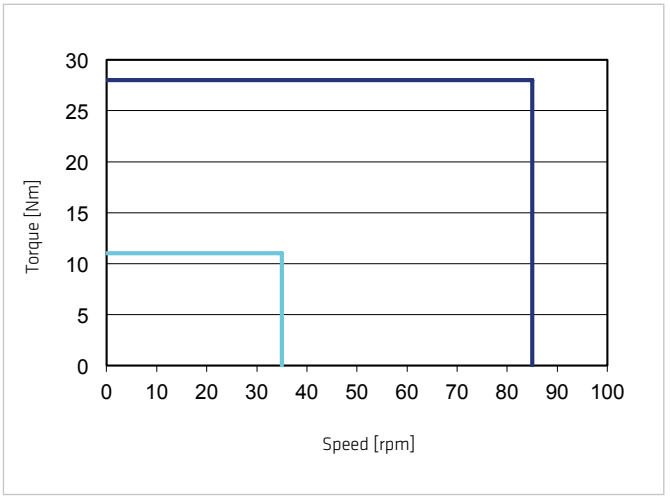


Illustration 16.4

CHA-14A-100-H/N



Legend

Intermittent duty — U_M = 220 ... 430 VAC — S3-ED 50% (1 min)
Continuous duty

Table 17.1

	Symbol [Unit]	CHA-17A-E				
Motor feedback system		RES / D2048 / M128S				
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**
Maximum output torque	T_{max} [Nm]	16	34	43	54	54
Maximum output speed	n_{max} [rpm]	220	132	83	66	55
Maximum current	I_{max} [A_{rms}]	8.3	10.3	8.1	8.1	6.8
Continuous stall torque	T_0 [Nm]	12	26	27	39	39
Continuous stall current	I_0 [A_{rms}]	6.4	8.0	5.3	6.0	5.1
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	48				
Electrical time constant (20° C)	t_e [ms]	1.3				
Mechanical time constant (20° C) Version RES	t_m [ms]	10.0				
Mechanical time constant (20° C) Version D2048	t_m [ms]	5.0				
Mechanical time constant (20° C) Version M128S	t_m [ms]	9.0				
No load current (+20° C)	I_{NLS} [A_{rms}]	0.8	0.7	0.6	0.6	0.6
No load current (-20° C)	I_{NLS} [A_{rms}]	2.6	3.5	3.9	4.4	4.7
No load running current constant (30° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	4.6	7.7	12.3	15.4	18.5
No load running current constant (80° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	1.7	2.8	4.5	5.6	6.8
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	1.9	3.3	5.1	6.5	7.6
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.07				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	5				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	18 ... 34				
Demagnetisation current	I_E [A_{rms}]	-				
Maximum motor speed	n_{max} [rpm]	6600				
Rated motor speed	n_N [rpm]	3500				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	0.32				
Inductance (L-L)	L_{L-L} [mH]	0.42				
Number of pole pairs	p [ ]	5				
Weight without brake	m [kg]	2.1 (D2048) 2.8 (RES / M128S)				
Weight with brake	m [kg]	2.5 (D2048) 3.2 (RES / M128S)				
Hollow shaft diameter	d_h [mm]	16				

Table 18.1

	Symbol [Unit]	CHA-17A-H/N				
Motor feedback system		RES / D2048 / M128S				
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**
Maximum output torque	T_{max} [Nm]	16	34	43	54	54
Maximum output speed	n_{max} [rpm]	243	146	91	73	61
Maximum current	I_{max} [A_{rms}]	1.6	2.0	1.6	1.6	1.3
Continuous stall torque	T_0 [Nm]	12	26	27	39	39
Continuous stall current	I_0 [A_{rms}]	1.3	1.6	1.0	1.2	1.0
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20° C)	t_e [ms]	2.5				
Mechanical time constant (20° C) Version RES	t_m [ms]	5.5				
Mechanical time constant (20° C) Version D2048	t_m [ms]	3.0				
Mechanical time constant (20° C) Version M128S	t_m [ms]	4.5				
No load current	I_{NLS} [A_{rms}]	0.15	0.13	0.11	0.11	0.10
No load running current constant (30° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	1	2	3	4	5
No load running current constant (80° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	0.4	0.6	0.9	1	1
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	10.9	18.3	30.3	37.5	43.3
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.37				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	26				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430				
Demagnetisation current	I_E [A_{rms}]	-				
Maximum motor speed	n_{max} [rpm]	7300				
Rated motor speed	n_N [rpm]	3500				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	4.8				
Inductance (L-L)	L_{L-L} [mH]	12.0				
Number of pole pairs	p [ ]	5				
Weight without brake	m [kg]	2.1 (D2048) 2.8 (RES / M128S)				
Weight with brake	m [kg]	2.5 (D2048) 3.2 (RES / M128S)				
Hollow shaft diameter	d_h [mm]	16				

Moment of Inertia

Table 19.1

	Symbol [Unit]	CHA-17A				
Motor feedback system		**RES**				
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	0.095	0.264	0.676	1.056	1.520
Moment of inertia with brake	J_{out} [kgm²]	0.104	0.289	0.741	1.158	1.667
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10⁻⁴ kgm²]	1.056				
Moment of inertia at motor with brake	J [x10⁻⁴ kgm²]	1.158				
Motor feedback system		**D2048**				
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	0.047	0.131	0.355	0.523	0.753
Moment of inertia with brake	J_{out} [kgm²]	0.060	0.160	0.400	0.630	0.900
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10⁻⁴ kgm²]	0.523				
Moment of inertia at motor with brake	J [x10⁻⁴ kgm²]	0.625				
Motor feedback system		**M128S**				
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	0.078	0.218	0.557	0.871	1.254
Moment of inertia with brake	J_{out} [kgm²]	0.088	0.243	0.623	0.973	1.401
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10⁻⁴ kgm²]	0.871				
Moment of inertia at motor with brake	J [x10⁻⁴ kgm²]	0.973				

Technical Data Brake

Table 19.2

	Symbol [Unit]	CHA-17A				
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%				
Brake holding torque (at output)	T_{Br} [Nm]	15	25	40	50	54
Brake current to open	I_{OBr} [A_{DC}]	-				
Brake current to hold	I_{HBr} [A_{DC}]	0.54				
Number of brake cyles at n = 0 rpm		-				
Emergency brake cyles		-				
Opening time	t_O [ms]	-				
Closing time	t_C [ms]	-				

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 ratings table.

Illustration 20.1 CHA-17A-30-E

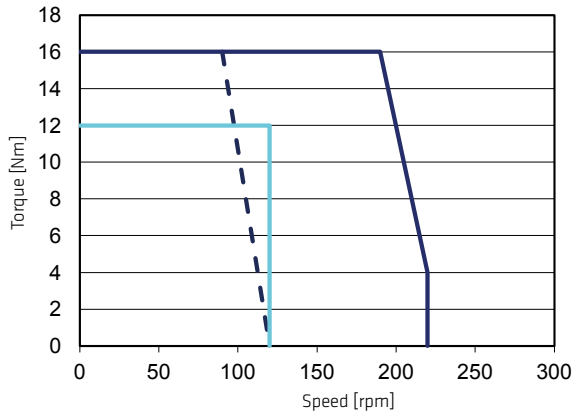


Illustration 20.2 CHA-17A-50-E

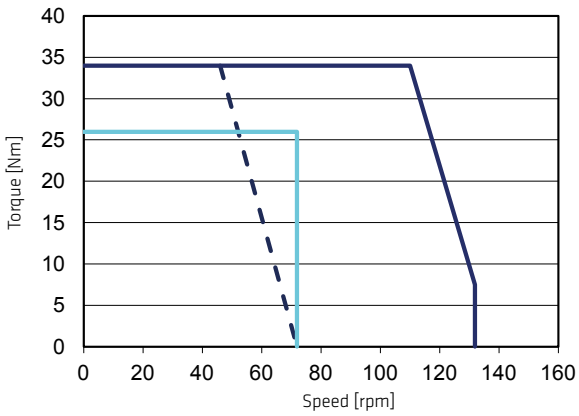


Illustration 20.3 CHA-17A-80-E

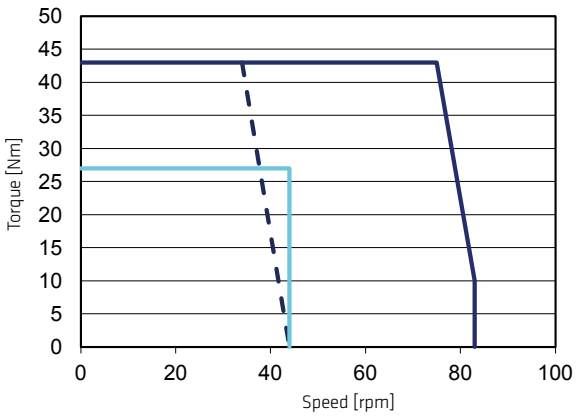


Illustration 20.4 CHA-17A-100-E

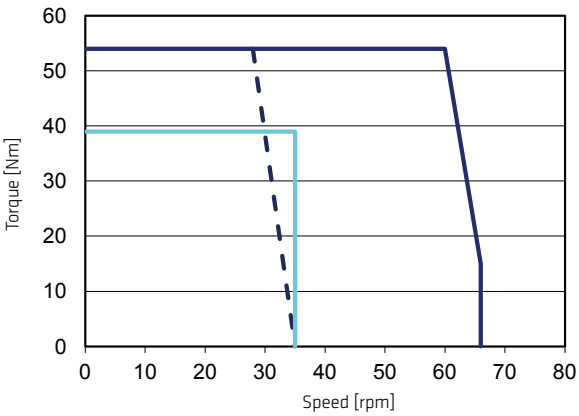
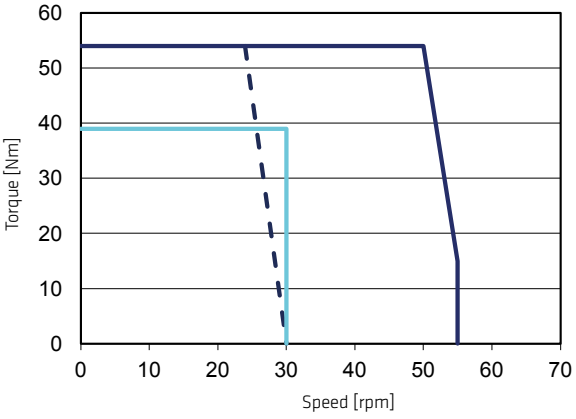


Illustration 20.5 CHA-17A-120-E



Legend

Intermittent duty
Continuous duty
U_M = 34 VAC
U_M = 18 VAC
S3-ED 50% (1 min)

Illustration 21.1

CHA-17A-30-H/N

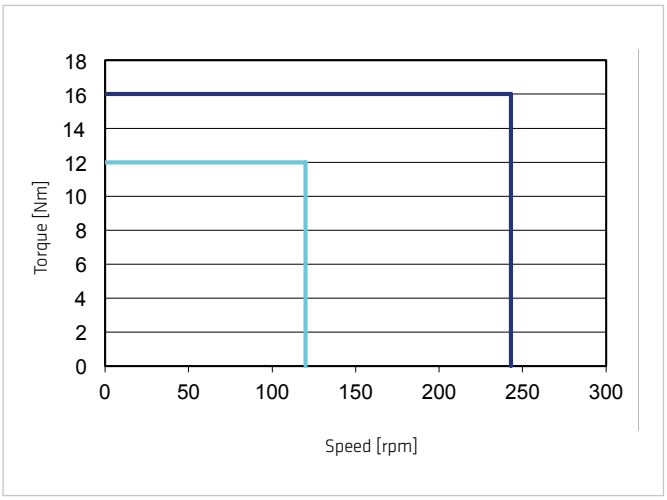


Illustration 21.2

CHA-17A-50-H/N

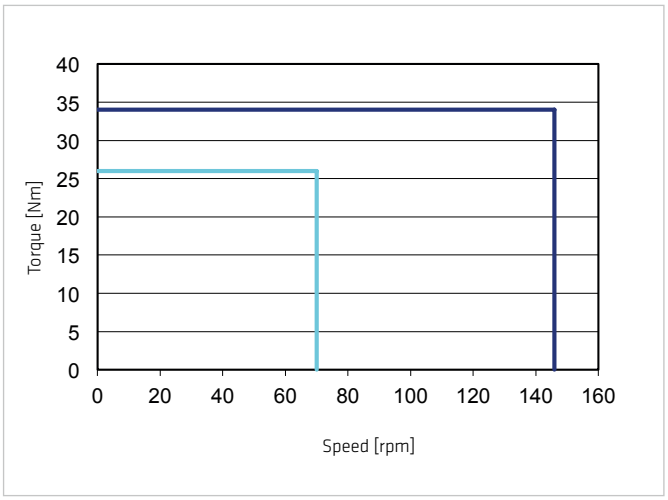


Illustration 21.3

CHA-17A-80-H/N

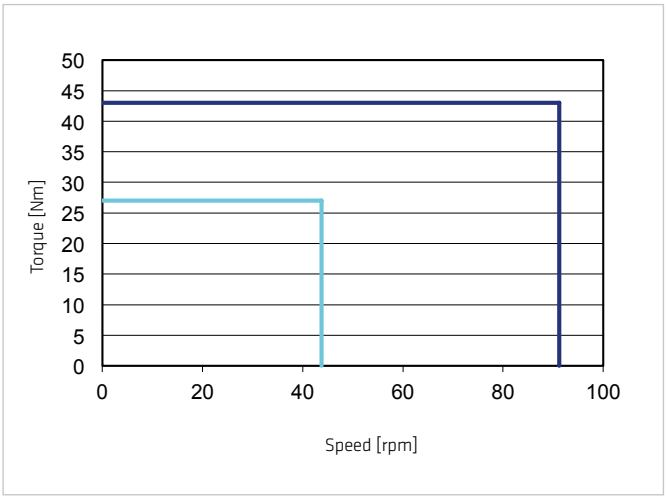


Illustration 21.4

CHA-17A-100-H/N

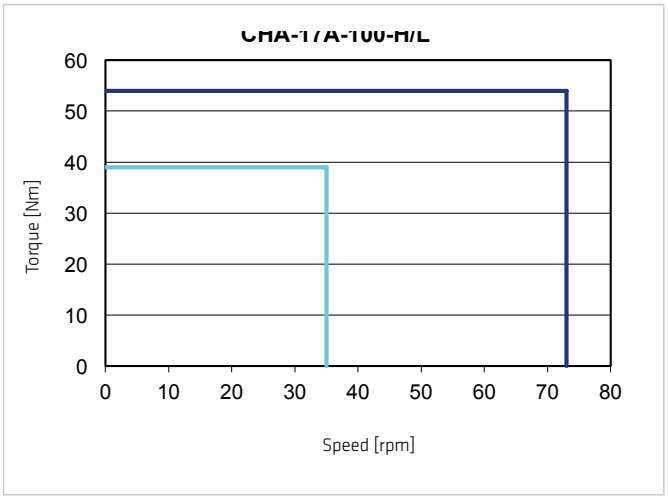
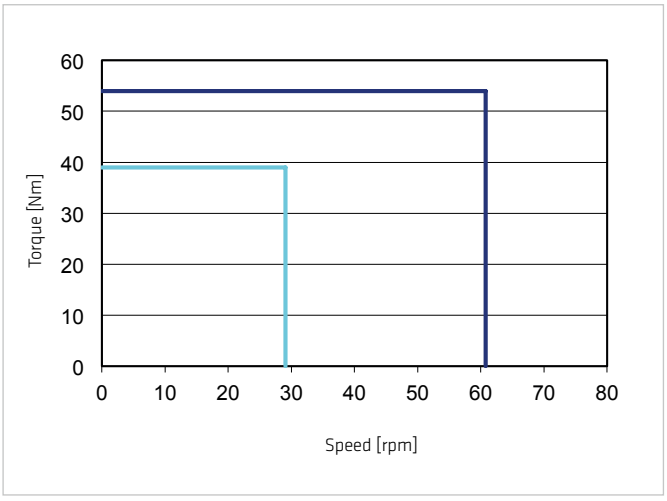


Illustration 21.5

CHA-17A-120-H/N



Legend

Intermittent duty — U_M = 220 ... 430 VAC — S3-ED 50% (1 min)
Continuous duty

Table 22.1

	Symbol [Unit]	CHA-20A					
Motor feedback system		C1024 / S1024 / M1024					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	27	56	74	82	87	92
Maximum output speed	n_{max} [rpm]	200	120	75	60	50	38
Maximum current	I_{max} [A_{rms}]	2.9	3.8	3.1	2.8	2.5	2.1
Continuous stall torque	T_0 [Nm]	19	32	47	49	49	49
Continuous stall current	I_0 [A_{rms}]	2.1	2.1	1.9	1.6	1.4	1.0
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680					
Electrical time constant (20° C)	t_e [ms]	1.4					
Mechanical time constant (20° C)	t_m [ms]	6.7					
No load current	I_{NLS} [A_{rms}]	0.19	0.17	0.14	0.14	0.13	0.13
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	2	4	7	8	9	12
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	0.7	2	2	3	4	5
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	9.9	16.5	26.8	33.4	40.1	53.5
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.36					
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	23					
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430					
Demagnetisation current	I_E [A_{rms}]	7.0					
Maximum motor speed	n_{max} [rpm]	6000					
Rated motor speed	n_N [rpm]	3500					
Resistance (L-L, 20° C)	R_{L-L} [Ω]	5.9					
Inductance (L-L)	L_{L-L} [mH]	8.0					
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					

Moment of Inertia

Table 22.1

	Symbol [Unit]	CHA-20A					
Motor feedback system		C1024 / S1024 / M1024					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side							
Moment of inertia without brake	J_{out} [kgm²]	0.1	0.28	0.72	1.12	1.61	2.86
Moment of inertia with brake	J_{out} [kgm²]	0.13	0.35	0.89	1.39	2.00	3.50
Moment of Inertia at motor							
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	1.12					
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	1.39					

Technical Data Brake

Table 22.2

	Symbol [Unit]	CHA-20A					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%					
Brake holding torque (at output)	T_{Br} [Nm]	27	45	72	82	87	92
Brake current to open	I_{OBr} [A_{DC}]	0.6					
Brake current to hold (10V)	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					

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 ratings table.

Illustration 23.1 CHA-20A-30

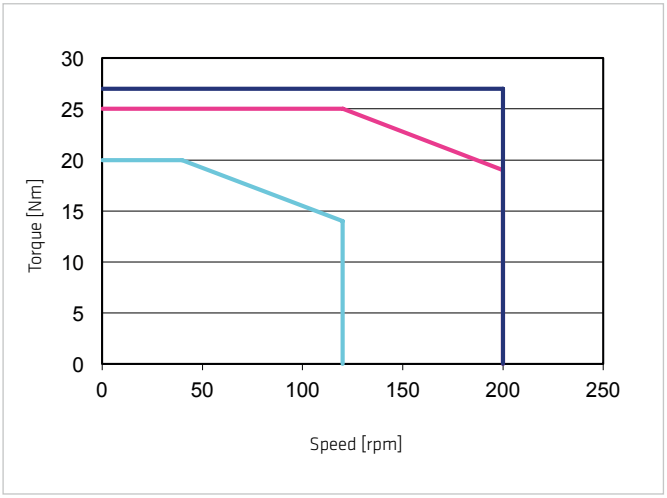


Illustration 23.2 CHA-20A-50

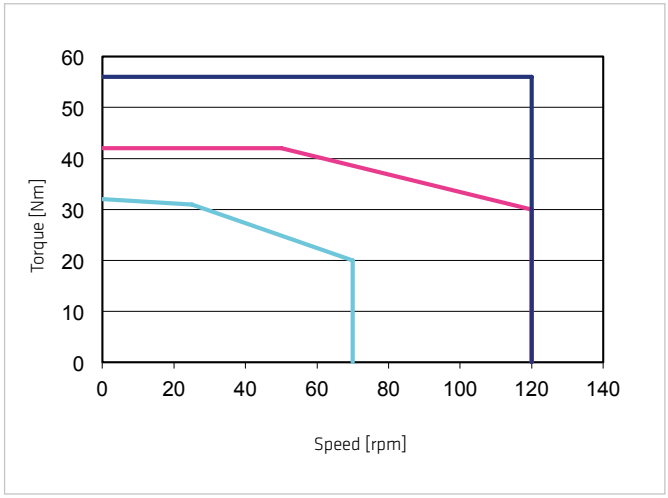


Illustration 23.3 CHA-20A-80

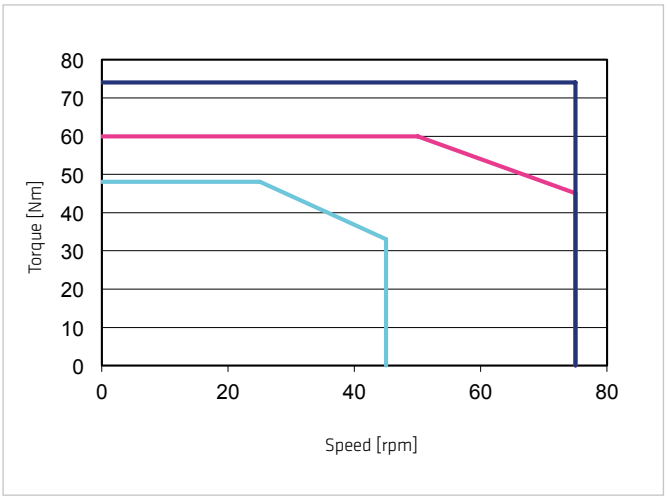


Illustration 23.4 CHA-20A-100

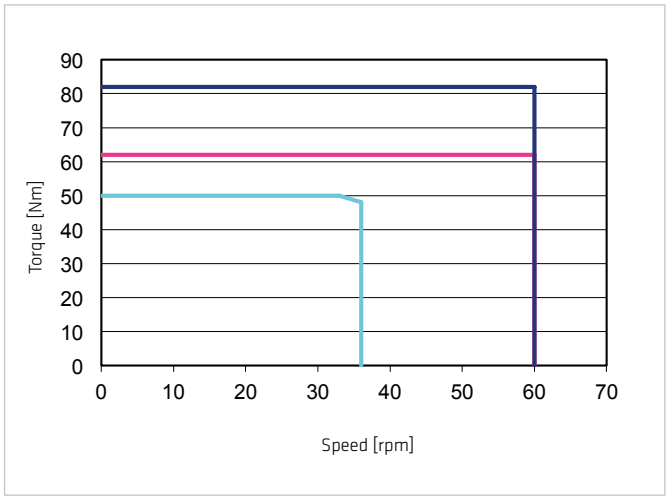


Illustration 23.5 CHA-20A-120

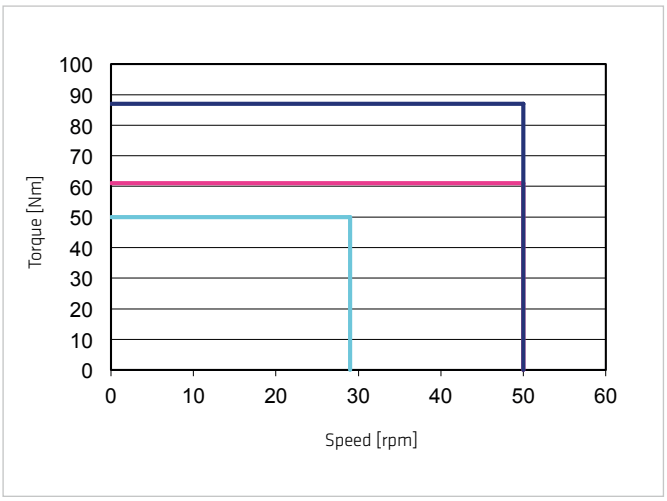
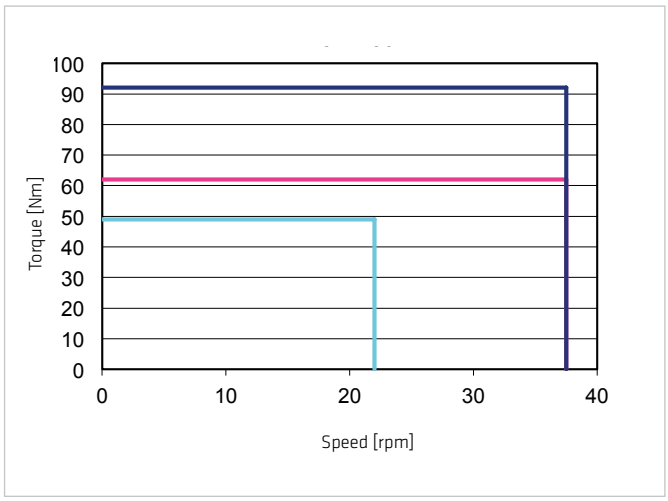


Illustration 23.6 CHA-20A-160



Legend

Intermittent duty
Continuous duty

U_M = 220 ... 430 VAC

S3-ED 50% (1 min)

Table 24.1

	Symbol [Unit]	CHA-25A					
Motor feedback system		C1024 / S1024 / M1024					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	50	98	137	157	167	176
Maximum output speed	n_{max} [rpm]	187	112	70	56	47	35
Maximum current	I_{max} [A_{rms}]	3.5	4.0	3.4	3.2	2.8	2.2
Continuous stall torque	T_0 [Nm]	38	55	87	108	108	108
Continuous stall current	I_0 [A_{rms}]	2.7	2.3	2.2	2.2	1.9	1.4
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680					
Electrical time constant (20° C)	t_e [ms]	1.6					
Mechanical time constant (20° C)	t_m [ms]	5.9					
No load current	I_{NLS} [A_{rms}]	0.21	0.19	0.15	0.15	0.15	0.14
No load running current constant (30° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	4	6	10	12	14	19
No load running current constant (80° C)	K_{INL} [$x10^{-3}$ A_{rms}/rpm]	1	2	3	4	5	7
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	15.5	26.0	42.5	53.1	63.9	85.0
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55					
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	37					
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430					
Demagnetisation current	I_E [A_{rms}]	15					
Maximum motor speed	n_{max} [rpm]	5600					
Rated motor speed	n_N [rpm]	3500					
Resistance (L-L, 20° C)	R_{L-L} [Ω]	3.7					
Inductance (L-L)	L_{L-L} [mH]	6.0					
Number of pole pairs	p [ ]	6					
Weight without brake	m [kg]	4.9					
Weight with brake	m [kg]	6.1					
Hollow shaft diameter	d_h [mm]	27					

Moment of Inertia

Table 24.1

	Symbol [Unit]	CHA-25A					
Motor feedback system		C1024 / S1024 / M1024					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side							
Moment of inertia without brake	J_{out} [kgm^2]	0.29	0.80	2.0	3.2	4.6	8.1
Moment of inertia with brake	J_{out} [kgm^2]	0.35	0.97	2.5	3.9	5.6	9.9
Moment of Inertia at motor							
Moment of inertia at motor without brake	J [$x10^{-4}$ kgm^2]	3.2					
Moment of inertia at motor with brake	J [$x10^{-4}$ kgm^2]	3.9					

Technical Data Brake

Table 24.2

	Symbol [Unit]	CHA-25A					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%					
Brake holding torque (at output)	T_{Br} [Nm]	54	90	137	157	167	176
Brake current to open	I_{OBr} [A_{DC}]	0.9					
Brake current to hold (10V)	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					

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 ratings table.

Illustration 25.1 CHA-25A-30

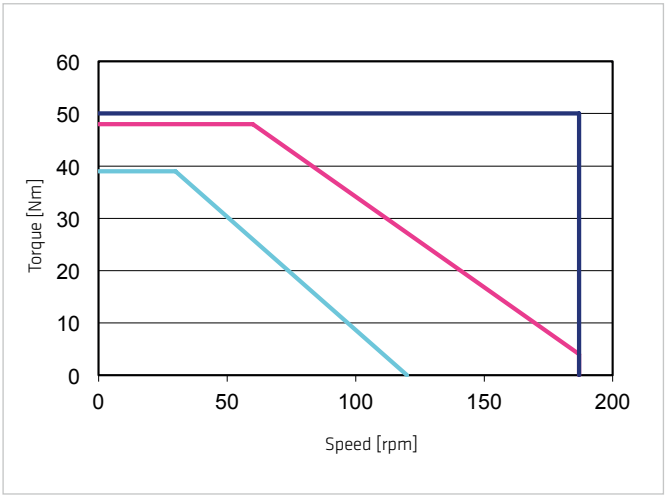


Illustration 25.2 CHA-25A-50

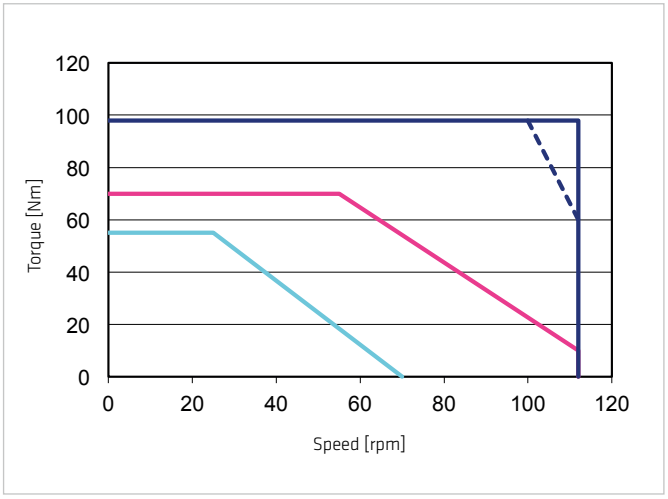


Illustration 25.3 CHA-25A-80

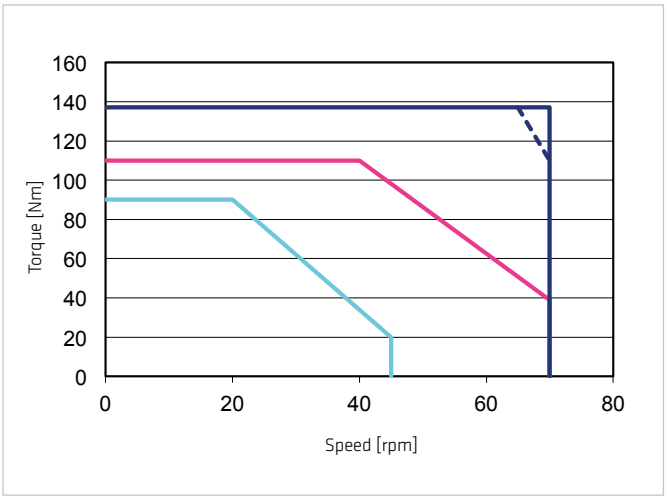


Illustration 25.4 CHA-25A-100

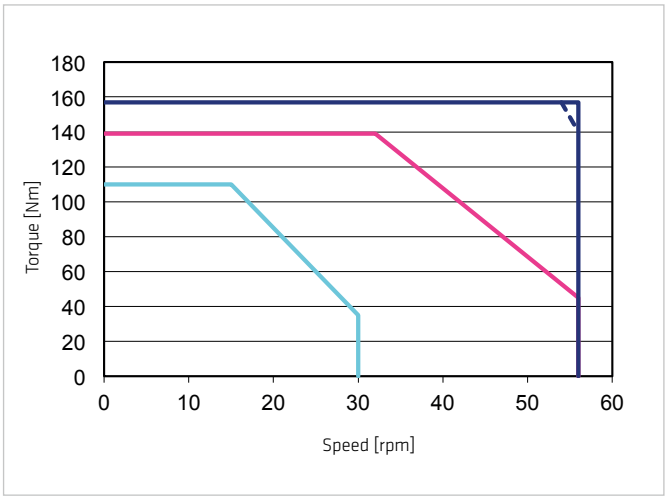


Illustration 25.5 CHA-25A-120

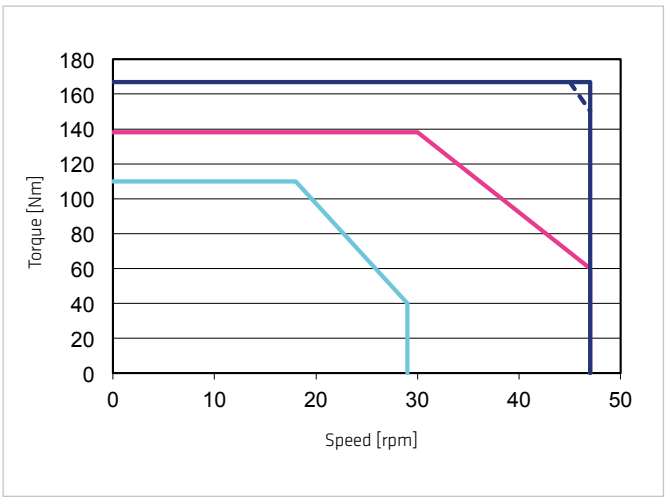
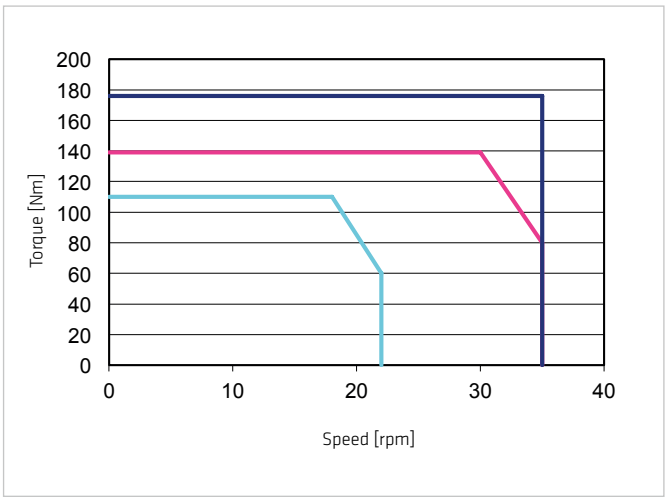


Illustration 25.6 CHA-25A-160



Legend

Intermittent duty
Continuous duty

U_M = 430 VAC
U_M = 220 VAC

S3-ED 50% (1 min)

Table 26.1

	Symbol [Unit]	CHA-32A					
Motor feedback system		C1024 / S1024 / M1024					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	100	216	304	333	353	372
Maximum output speed	n_{max} [rpm]	160	96	60	48	40	30
Maximum current	I_{max} [A_{rms}]	7.1	9.8	8.3	7.2	6.3	5.3
Continuous stall torque	T_0 [Nm]	44	71	119	154	179	216
Continuous stall current	I_0 [A_{rms}]	3.2	3.2	3.2	3.2	3.2	2.9
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680					
Electrical time constant (20° C)	t_e [ms]	1.6					
Mechanical time constant (20° C)	t_m [ms]	7.1					
No load current	I_{NLS} [A_{rms}]	0.30	0.30	0.20	0.20	0.20	0.18
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	6	10	17	21	25	34
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	2	3	6	7	8	11
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	15.5	25.9	42.1	52.5	63.0	84.5
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55					
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	37					
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430					
Demagnetisation current	I_E [A_{rms}]	15					
Maximum motor speed	n_{max} [rpm]	4800					
Rated motor speed	n_N [rpm]	3500					
Resistance (L-L, 20° C)	R_{L-L} [Ω]	3.7					
Inductance (L-L)	L_{L-L} [mH]	6.0					
Number of pole pairs	p [ ]	6					
Weight without brake	m [kg]	6.6					
Weight with brake	m [kg]	7.8					
Hollow shaft diameter	d_h [mm]	32					

Moment of Inertia

Table 26.2

	Symbol [Unit]	CHA-32A					
Motor feedback system		C1024 / S1024 / M1024					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side							
Moment of inertia without brake	J_{out} [kgm²]	0.44	1.22	3.1	4.9	7.1	12.5
Moment of inertia with brake	J_{out} [kgm²]	0.53	1.47	3.8	5.9	8.5	15.0
Moment of Inertia at motor							
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	4.9					
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	5.9					

Technical Data Brake

Table 26.3

	Symbol [Unit]	CHA-32A					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%					
Brake holding torque (at output)	T_{Br} [Nm]	54	90	144	180	216	288
Brake current to open	I_{OBr} [A_{DC}]	0.9					
Brake current to hold (10V)	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					

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 ratings table.

Illustration 27.1 CHA-32A-30

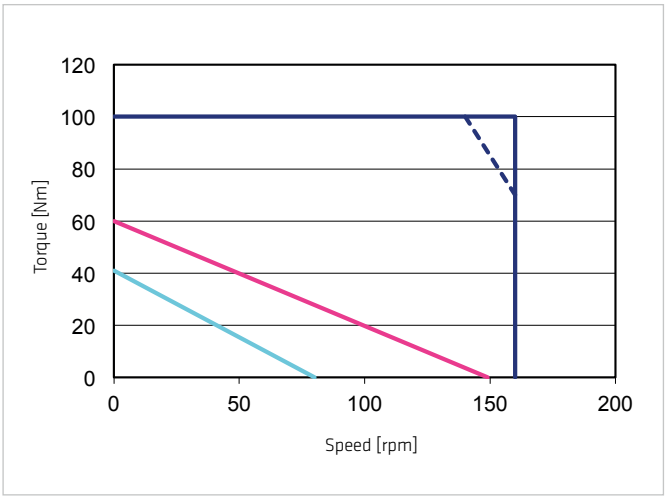


Illustration 27.2 CHA-32A-50

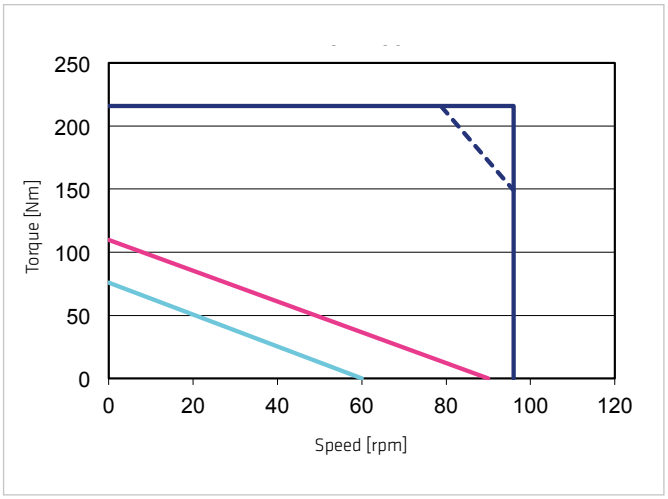


Illustration 27.3 CHA-32A-80

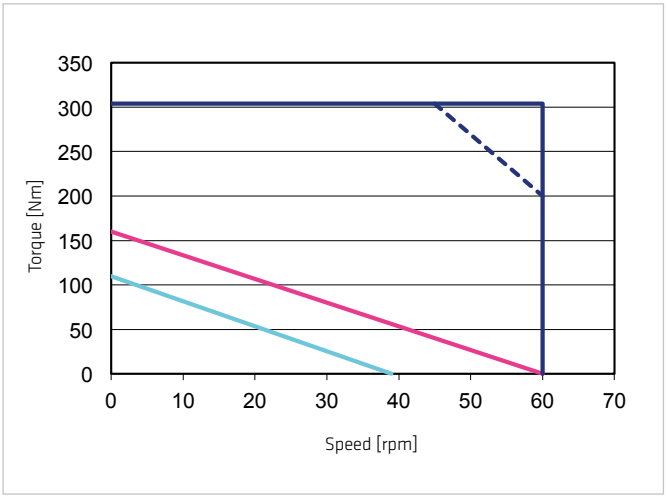


Illustration 27.4 CHA-32A-100

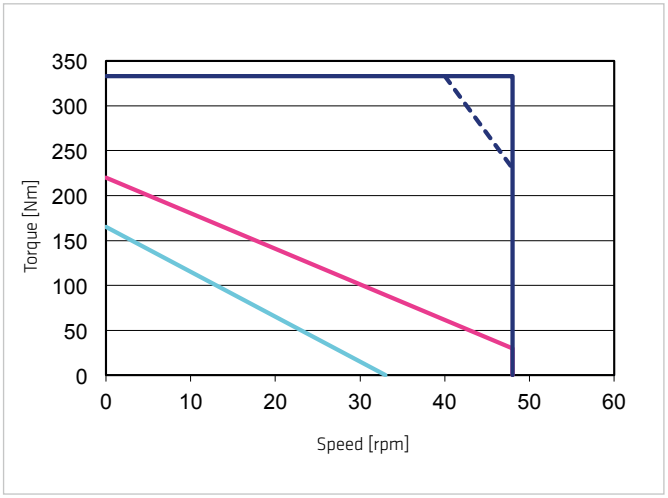


Illustration 27.5 CHA-32A-120

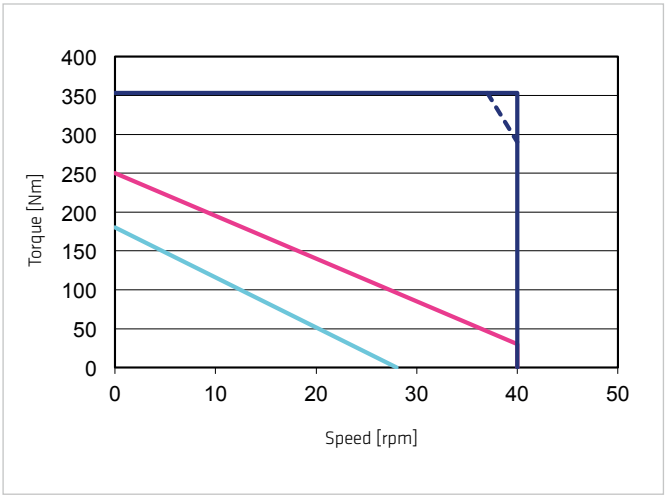
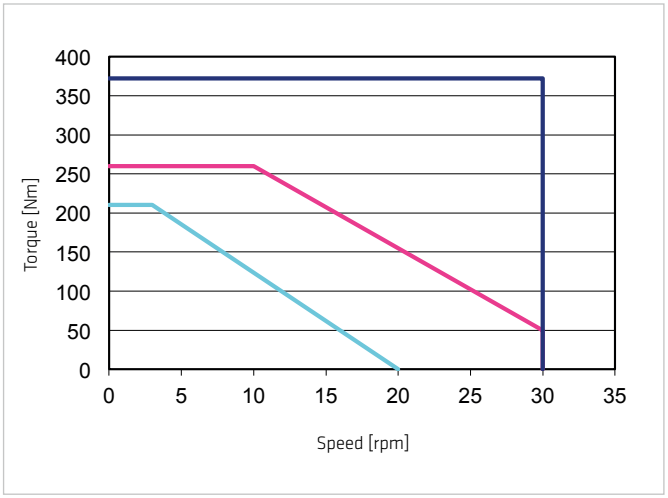


Illustration 27.6 CHA-32A-160



Legend

Intermittent duty
Continuous duty

U_M = 430 VAC
U_M = 220 VAC

S3-ED 50% (1 min)

Table 28.1

	Symbol [Unit]	CHA-40A				
Motor feedback system		C1024 / S1024 / M1024				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	402	519	568	617	647
Maximum output speed	n_{max} [rpm]	80	50	40	33	25
Maximum current	I_{max} [A_{rms}]	11.8	9.2	8.1	7.3	5.9
Continuous stall torque	T_0 [Nm]	125	208	260	314	420
Continuous stall current	I_0 [A_{rms}]	3.6	3.6	3.6	3.6	3.6
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20° C)	t_e [ms]	2.1				
Mechanical time constant (20° C)	t_m [ms]	6.8				
No load current	I_{NLS} [A_{rms}]	0.30	0.20	0.20	0.20	0.20
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	13	20	25	30	40
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	4	6	8	10	13
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	38	62	77	92	123
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.83				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	53				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430				
Demagnetisation current	I_E [A_{rms}]	18				
Maximum motor speed	n_{max} [rpm]	4000				
Rated motor speed	n_N [rpm]	3000				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	2.9				
Inductance (L-L)	L_{L-L} [mH]	6.0				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	11.7				
Weight with brake	m [kg]	13.8				
Hollow shaft diameter	d_h [mm]	39				

Moment of Inertia

Table 28.2

	Symbol [Unit]	CHA-40A				
Motor feedback system		C1024 / S1024 / M1024				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.10	7.90	12.3	17.7	31.4
Moment of inertia with brake	J_{out} [kgm²]	3.60	9.10	14.2	20.4	36.3
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	12.3				
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	14.2				

Technical Data Brake

Table 28.3

	Symbol [Unit]	CHA-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	647
Brake current to open	I_{OBr} [A_{DC}]	0.7				
Brake current to hold (10V)	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				

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 ratings table.

Illustration 29.1 CHA-40A-50

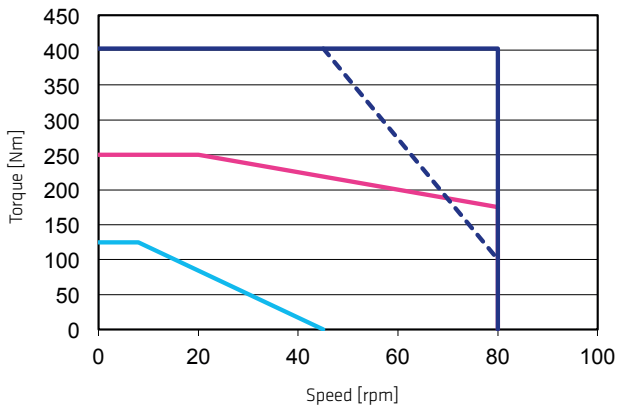


Illustration 29.2 CHA-40A-80

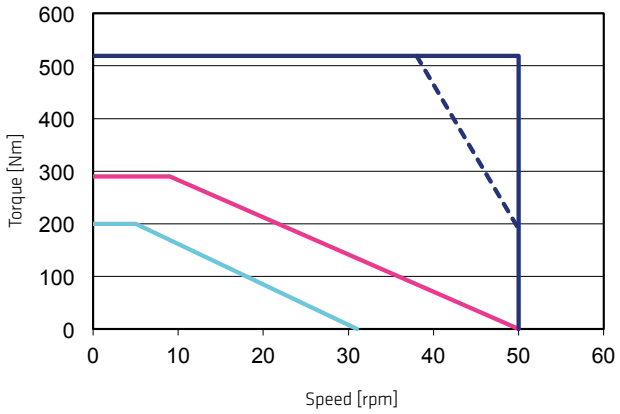


Illustration 29.3 CHA-40A-100

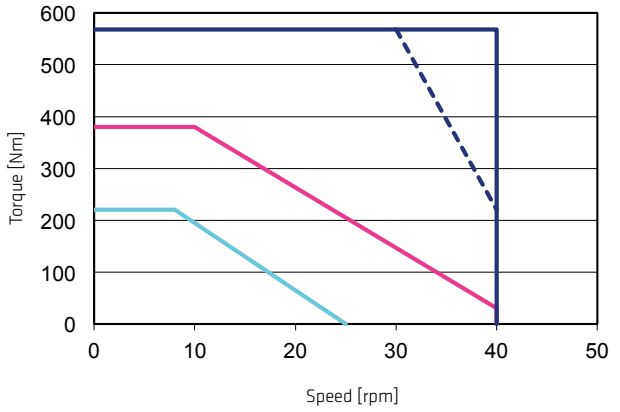


Illustration 29.4 CHA-40A-120

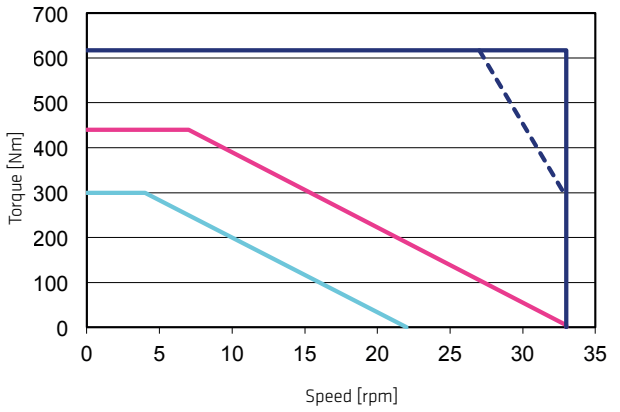
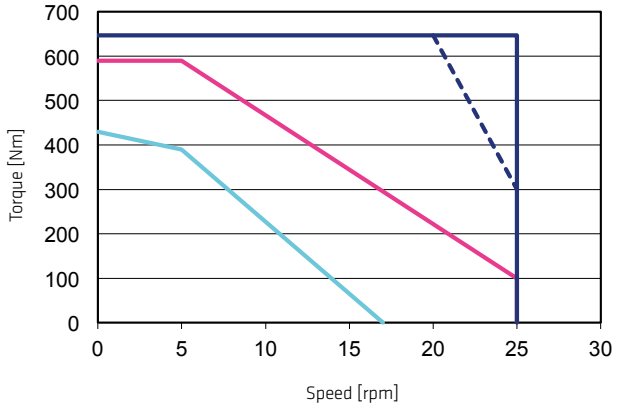


Illustration 29.5 CHA-40A-160



Legend

Intermittent duty
Continuous duty
U_M = 430 VAC
U_M = 220 VAC
S3-ED 50% (1 min)

Table 30.1

	Symbol [Unit]	CHA-50A				
Motor feedback system		C1024 / S1024 / M1024				
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	30	22
Maximum current	I_{max} [A_{rms}]	10.2	8.3	6.9	6.4	5.3
Continuous stall torque	T_0 [Nm]	194	363	456	550	736
Continuous stall current	I_0 [A_{rms}]	2.9	3.2	3.2	3.2	3.1
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20° C)	t_e [ms]	3.4				
Mechanical time constant (20° C)	t_m [ms]	4.7				
No load current	I_{NLS} [A_{rms}]	0.30	0.20	0.20	0.17	0.16
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	12	20	25	29	39
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	4	6	8	9	12
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	74	121	145	181	242
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	1.60				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	104				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430				
Demagnetisation current	I_E [A_{rms}]	18				
Maximum motor speed	n_{max} [rpm]	3500				
Rated motor speed	n_N [rpm]	2500				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	3.5				
Inductance (L-L)	L_{L-L} [mH]	12				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	19.9				
Weight with brake	m [kg]	23.5				
Hollow shaft diameter	d_h [mm]	45				

Moment of Inertia

Table 30.2

	Symbol [Unit]	CHA-50A				
Motor feedback system		C1024 / S1024 / M1024				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm^2]	6.62	16.90	26.5	38.1	67.8
Moment of inertia with brake	J_{out} [kgm^2]	7.30	18.70	29.2	42.0	74.7
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10^{-4} kgm^2]	26.5				
Moment of inertia at motor with brake	J [x10^{-4} kgm^2]	29.2				

Technical Data Brake

Table 30.3

	Symbol [Unit]	CHA-50A				
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 (10V)	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				

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 ratings table.

Illustration 31.1 CHA-50A-50

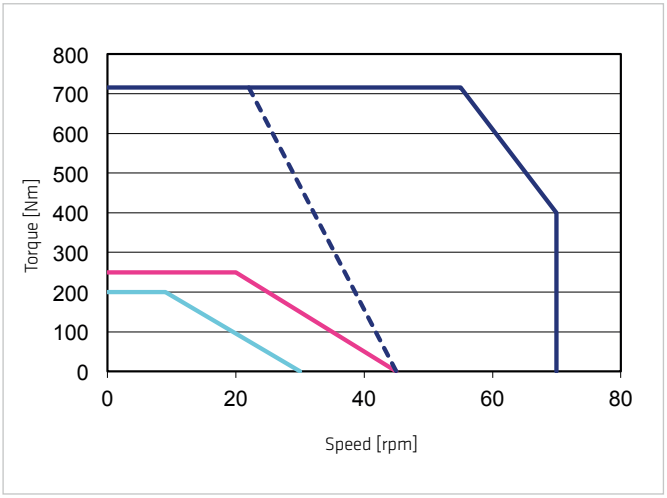


Illustration 31.2 CHA-50A-80

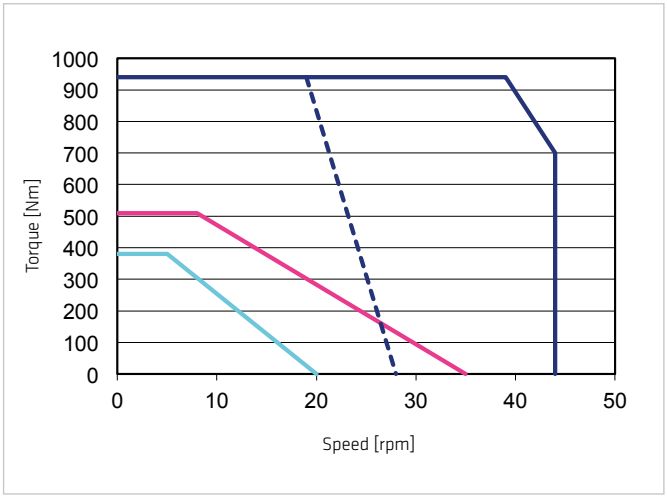


Illustration 31.3 CHA-50A-100

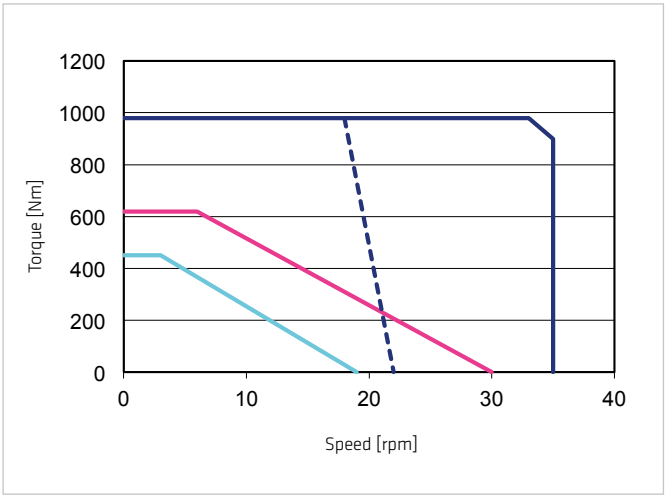


Illustration 31.4 CHA-50A-120

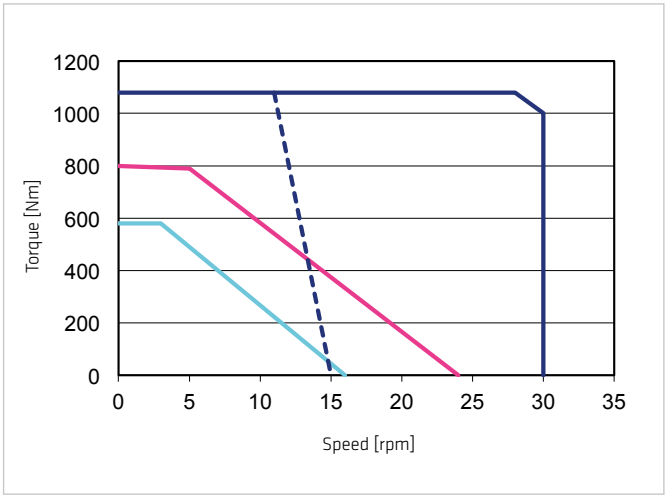
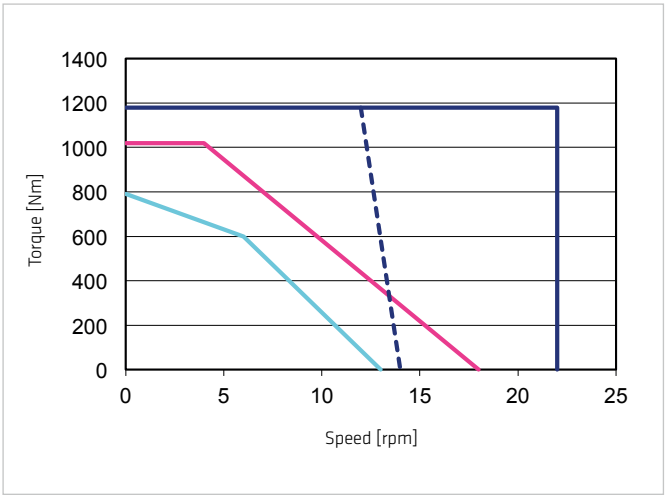


Illustration 31.5 CHA-50A-160



Legend

Intermittent duty
Continuous duty
U_M = 430 VAC
U_M = 220 VAC
S3-ED 50% (1 min)

Table 32.1

	Symbol [Unit]	CHA-58A				
Motor feedback system		C1024 / S1024 / M1024				
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_{rms}]	14.4	12.8	11.1	10.0	8.1
Continuous stall torque	T_0 [Nm]	280	532	670	805	1080
Continuous stall current	I_0 [A_{rms}]	4.2	4.6	4.6	4.6	4.6
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20° C)	t_e [ms]	3.5				
Mechanical time constant (20° C)	t_m [ms]	5.4				
No load current	I_{NLS} [A_{rms}]	0.40	0.28	0.26	0.25	0.23
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	19	30	38	46	61
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	6	10	12	15	19
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	75	122	152	183	244
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	1.70				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	105				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430				
Demagnetisation current	I_E [A_{rms}]	25				
Maximum motor speed	n_{max} [rpm]	3000				
Rated motor speed	n_N [rpm]	2000				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	2.4				
Inductance (L-L)	L_{L-L} [mH]	9				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	27.2				
Weight with brake	m [kg]	31				
Hollow shaft diameter	d_h [mm]	45				

Moment of Inertia

Table 32.2

	Symbol [Unit]	CHA-58A				
Motor feedback system		C1024 / S1024 / M1024				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	11.6	29.8	46.6	67.1	119
Moment of inertia with brake	J_{out} [kgm²]	11.8	30.3	47.3	68.1	121
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	46.6				
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	47.3				

Technical Data Brake

Table 32.3

	Symbol [Unit]	CHA-58A				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%				
Brake holding torque (at output)	T_{Br} [Nm]	450	720	900	1080	1440
Brake current to open	I_{OBr} [A_{DC}]	0.7				
Brake current to hold (10V)	I_{HBr} [A_{DC}]	0.5				
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				

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 ratings table.

Illustration 33.1 CHA-58A-50

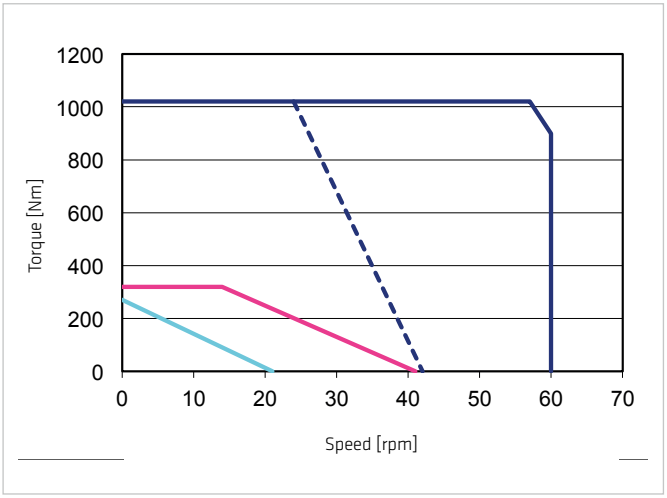


Illustration 33.2 CHA-58A-80

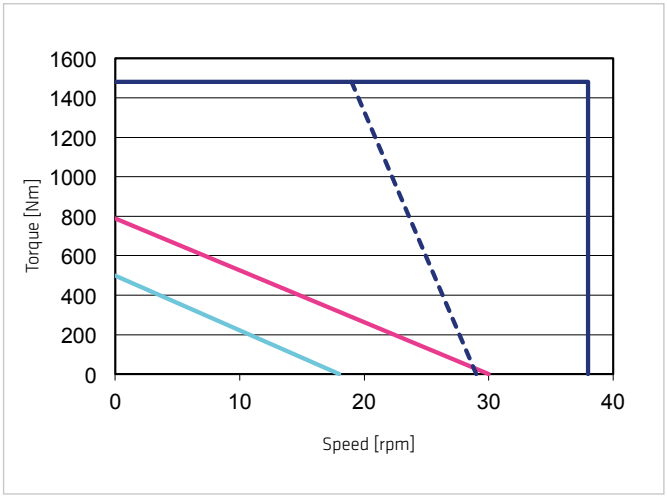


Illustration 33.3 CHA-58A-100

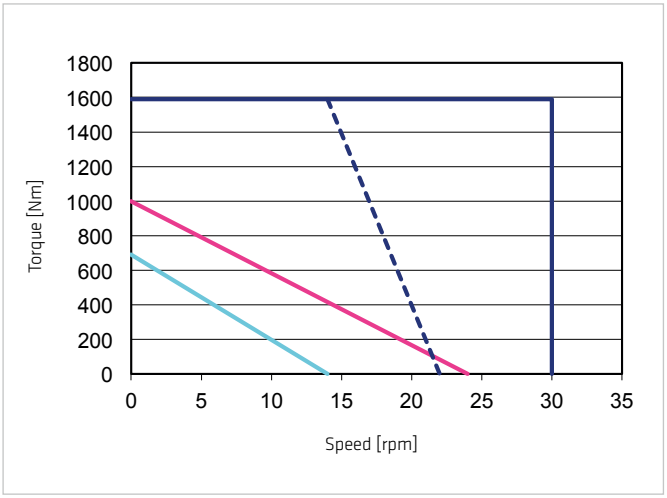


Illustration 33.4 CHA-58A-120

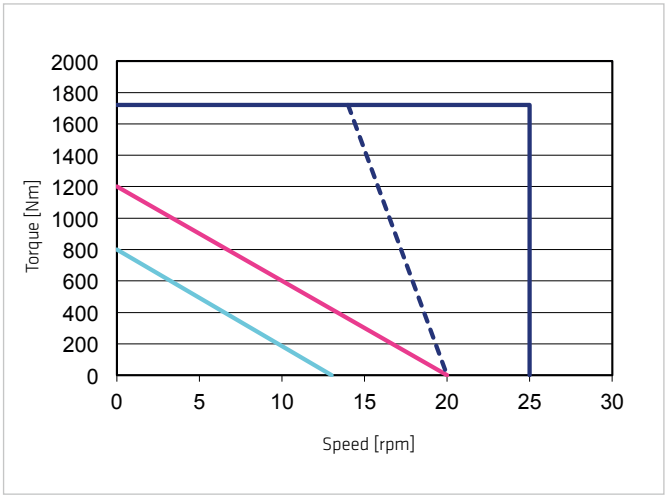
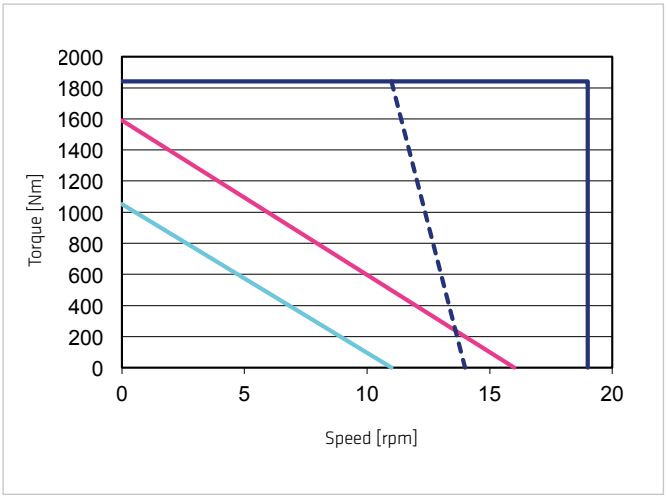


Illustration 33.5 CHA-58A-160



Legend

Intermittent duty
Continuous duty
U_M = 430 VAC
U_M = 220 VAC
S3-ED 50% (1 min)

Table 34.1

	Symbol [Unit]	CHA-20A					
Motor feedback system		M512P					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	27	56	74	82	87	92
Maximum output speed	n_{max} [rpm]	200	120	75	60	50	38
Maximum current	I_{max} [A_{rms}]	2.9	3.8	3.1	2.8	2.5	2.1
Continuous stall torque	T_0 [Nm]	19	32	47	49	49	49
Continuous stall current	I_0 [A_{rms}]	2.1	2.1	1.9	1.6	1.4	1.0
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680					
Electrical time constant (20° C)	t_e [ms]	1.4					
Mechanical time constant (20° C)	t_m [ms]	6.7					
No load current	I_{NLS} [A_{rms}]	0.19	0.17	0.14	0.14	0.13	0.13
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	2	4	7	8	9	12
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	0.7	2	2	3	4	5
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	9.9	16.5	26.8	33.4	40.1	53.5
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.36					
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	23					
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430					
Demagnetisation current	I_E [A_{rms}]	7.0					
Maximum motor speed	n_{max} [rpm]	6000					
Rated motor speed	n_N [rpm]	3500					
Resistance (L-L, 20° C)	R_{L-L} [Ω]	5.9					
Inductance (L-L)	L_{L-L} [mH]	8.0					
Number of pole pairs	p [ ]	5					
Weight without brake	m [kg]	4.2					
Weight with brake	m [kg]	4.9					
Hollow shaft diameter	d_h [mm]	18					

Moment of Inertia

Table 34.2

	Symbol [Unit]	CHA-20A					
Motor feedback system		M512P					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side							
Moment of inertia without brake	J_{out} [kgm²]	0.21	0.58	1.48	2.32	3.30	5.90
Moment of inertia with brake	J_{out} [kgm²]	0.23	0.65	1.65	2.60	3.70	6.60
Moment of Inertia at motor							
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	2.32					
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	2.60					

Technical Data Brake

Table 34.3

	Symbol [Unit]	CHA-20A					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%					
Brake holding torque (at output)	T_{Br} [Nm]	27	45	72	82	87	92
Brake current to open	I_{OBr} [A_{DC}]	0.6					
Brake current to hold (10V)	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					

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 ratings table.

Illustration 35.1 CHA-20A-30

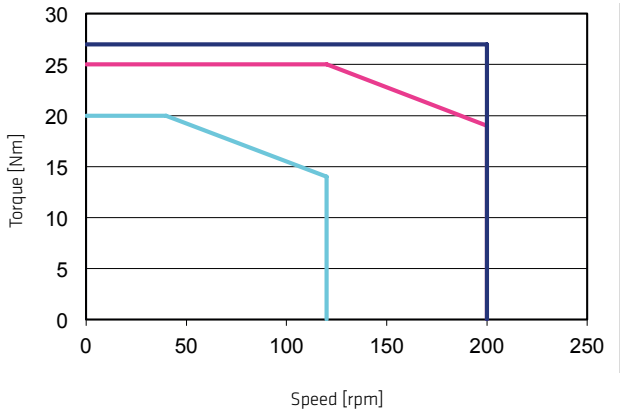


Illustration 35.2 CHA-20A-50

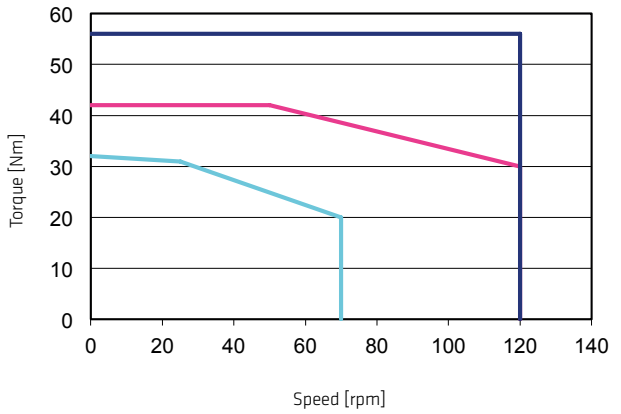


Illustration 35.3 CHA-20A-80

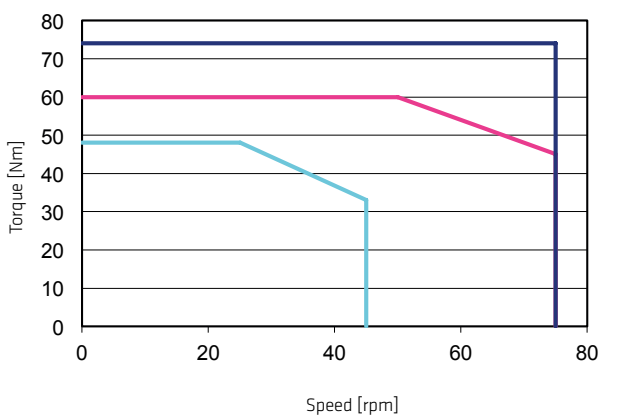


Illustration 35.4 CHA-20A-100

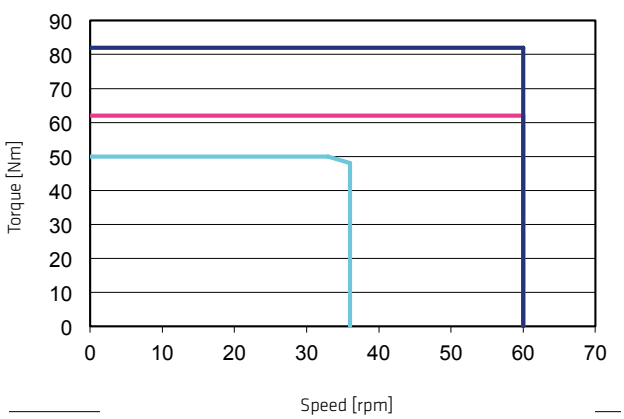


Illustration 35.5 CHA-20A-120

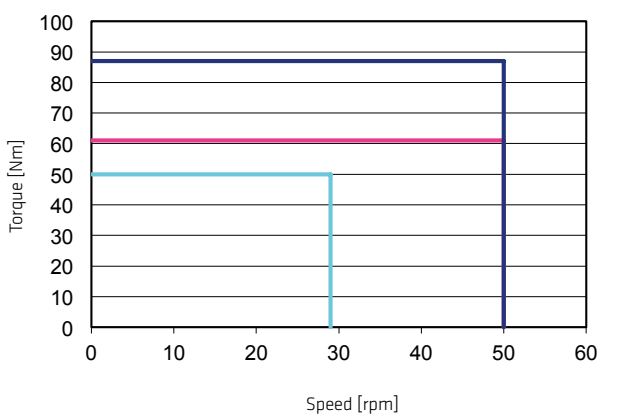
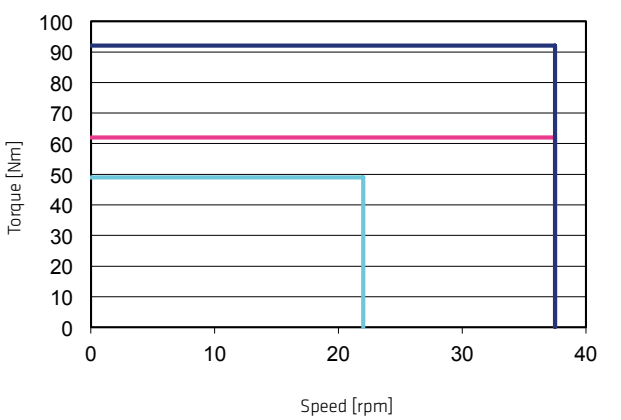


Illustration 35.6 CHA-20A-160



Legend

Intermittent duty — U_M = 220 ... 430 VAC — S3-ED 50% (1 min)
Continuous duty

Table 36.1

	Symbol [Unit]	CHA-25A					
Motor feedback system		M512P					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	50	98	137	157	167	176
Maximum output speed	n_{max} [rpm]	187	112	70	56	47	35
Maximum current	I_{max} [A_{rms}]	3.5	4.0	3.4	3.2	2.8	2.2
Continuous stall torque	T_0 [Nm]	38	55	87	108	108	108
Continuous stall current	I_0 [A_{rms}]	2.7	2.3	2.2	2.2	1.9	1.4
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680					
Electrical time constant (20° C)	t_e [ms]	1.6					
Mechanical time constant (20° C)	t_m [ms]	5.9					
No load current	I_{NLS} [A_{rms}]	0.21	0.19	0.15	0.15	0.15	0.14
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	4	6	10	12	14	19
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	1	2	3	4	5	7
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	15.5	26.0	42.5	53.1	63.9	85.0
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55					
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	37					
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430					
Demagnetisation current	I_E [A_{rms}]	15					
Maximum motor speed	n_{max} [rpm]	5600					
Rated motor speed	n_N [rpm]	3500					
Resistance (L-L, 20° C)	R_{L-L} [Ω]	3.7					
Inductance (L-L)	L_{L-L} [mH]	6.0					
Number of pole pairs	p [ ]	6					
Weight without brake	m [kg]	4.9					
Weight with brake	m [kg]	6.1					
Hollow shaft diameter	d_h [mm]	27					

Moment of Inertia

Table 36.2

	Symbol [Unit]	CHA-25A					
Motor feedback system		M512P					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side							
Moment of inertia without brake	J_{out} [kgm^2]	0.39	0.97	2.8	4.4	6.3	11.2
Moment of inertia with brake	J_{out} [kgm^2]	0.46	1.27	3.2	5.1	7.3	13.0
Moment of Inertia at motor							
Moment of inertia at motor without brake	J [x10^{-4} kgm^2]	4.4					
Moment of inertia at motor with brake	J [x10^{-4} kgm^2]	5.1					

Technical Data Brake

Table 36.3

	Symbol [Unit]	CHA-25A					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%					
Brake holding torque (at output)	T_{Br} [Nm]	54	90	137	157	167	176
Brake current to open	I_{OBr} [A_{DC}]	0.9					
Brake current to hold (10V)	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					

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 ratings table.

Illustration 37.1 CHA-25A-30

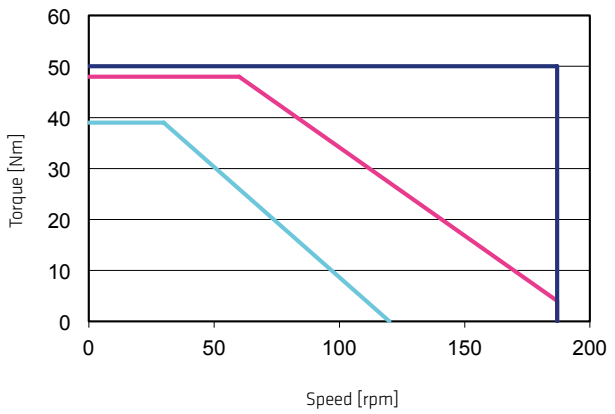


Illustration 37.2 CHA-25A-50

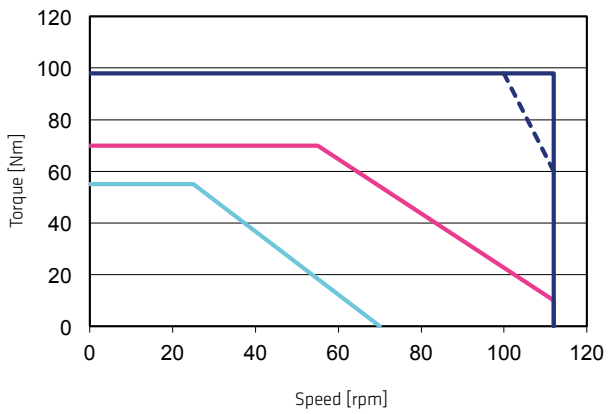


Illustration 37.3 CHA-25A-80

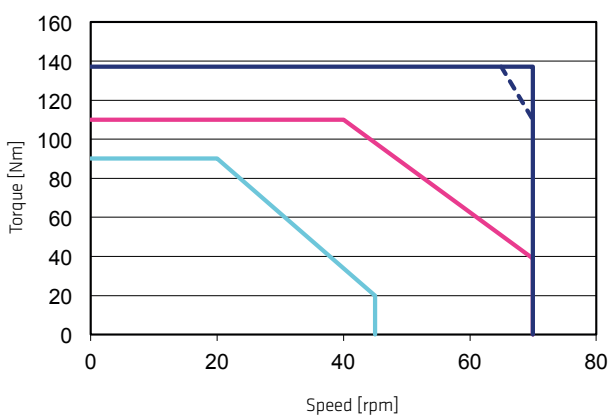


Illustration 37.4 CHA-25A-100

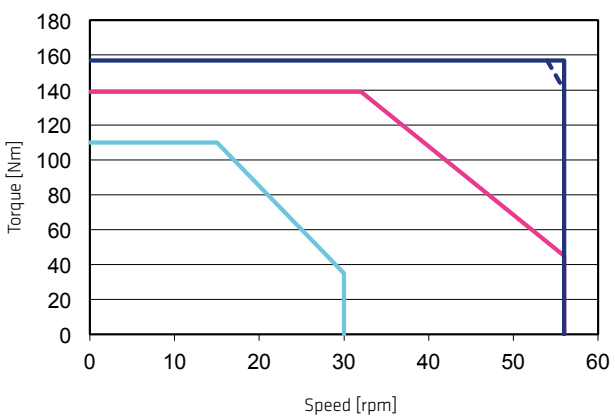


Illustration 37.5 CHA-25A-120

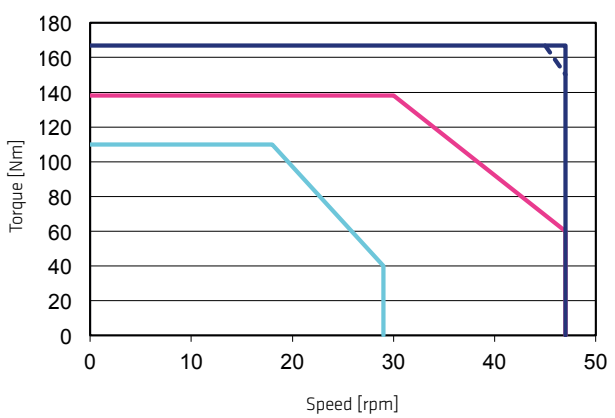
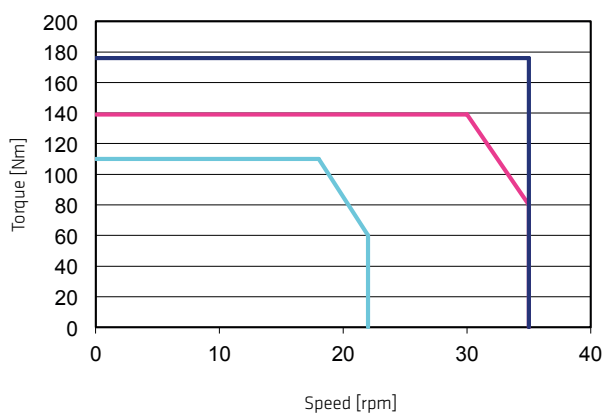


Illustration 37.6 CHA-25A-160



Legend

Intermittent duty
Continuous duty

U_M = 430 VAC
U_M = 220 VAC

S3-ED 50% (1 min)

Table 38.1

	Symbol [Unit]	CHA-32A					
Motor feedback system		M512P					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	100	216	304	333	353	372
Maximum output speed	n_{max} [rpm]	160	96	60	48	40	30
Maximum current	I_{max} [A_{rms}]	7.1	9.8	8.3	7.2	6.3	5.3
Continuous stall torque	T_0 [Nm]	44	71	119	154	179	216
Continuous stall current	I_0 [A_{rms}]	3.2	3.2	3.2	3.2	3.2	2.9
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680					
Electrical time constant (20° C)	t_e [ms]	1.6					
Mechanical time constant (20° C)	t_m [ms]	7.1					
No load current	I_{NLS} [A_{rms}]	0.30	0.30	0.20	0.20	0.20	0.18
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	6	10	17	21	25	34
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	2	3	6	7	8	11
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	15.5	25.9	42.1	52.5	63.0	84.5
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.55					
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	37					
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430					
Demagnetisation current	I_E [A_{rms}]	15					
Maximum motor speed	n_{max} [rpm]	4800					
Rated motor speed	n_N [rpm]	3500					
Resistance (L-L, 20° C)	R_{L-L} [Ω]	3.7					
Inductance (L-L)	L_{L-L} [mH]	6.0					
Number of pole pairs	p [ ]	6					
Weight without brake	m [kg]	7.6					
Weight with brake	m [kg]	8.8					
Hollow shaft diameter	d_h [mm]	32					

Moment of Inertia

Table 38.2

	Symbol [Unit]	CHA-32A					
Motor feedback system		M512P					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side							
Moment of inertia without brake	J_{out} [kgm²]	0.55	1.50	3.9	6.1	8.7	15.6
Moment of inertia with brake	J_{out} [kgm²]	0.64	1.77	4.5	7.1	10.2	18.2
Moment of Inertia at motor							
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	6.1					
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	7.1					

Technical Data Brake

Table 38.3

	Symbol [Unit]	CHA-32A					
Ratio	i [ ]	**30**	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%					
Brake holding torque (at output)	T_{Br} [Nm]	54	90	144	180	216	288
Brake current to open	I_{OBr} [A_{DC}]	0.9					
Brake current to hold (10V)	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					

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 ratings table.

Illustration 39.1 CHA-32A-30

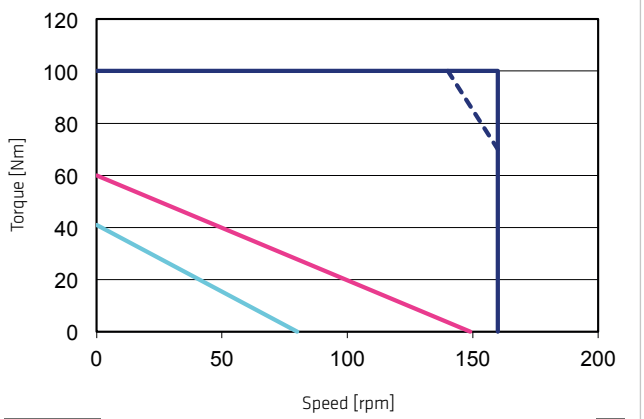


Illustration 39.2 CHA-32A-50

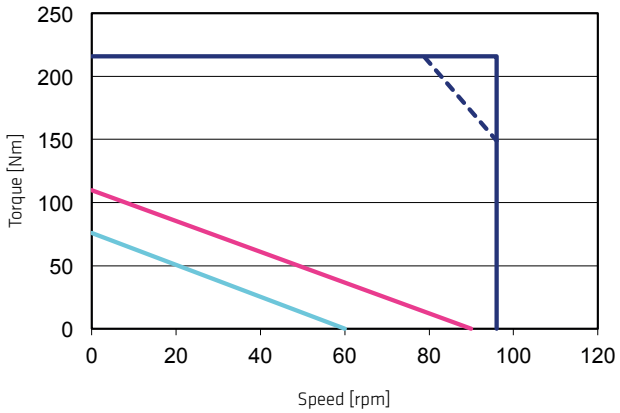


Illustration 39.3 CHA-32A-80

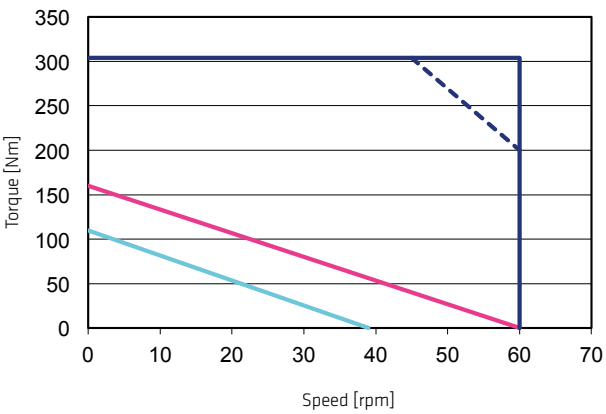


Illustration 39.4 CHA-32A-100

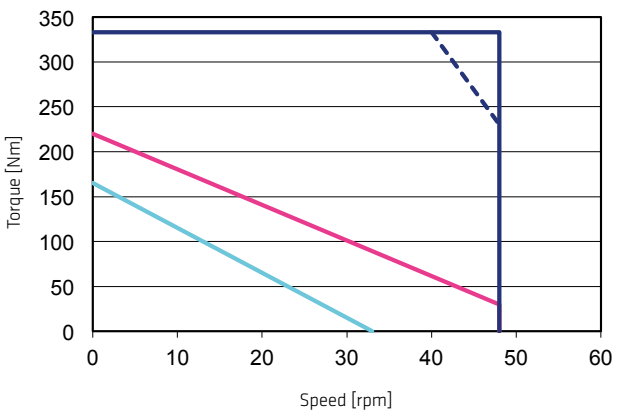


Illustration 39.5 CHA-32A-120

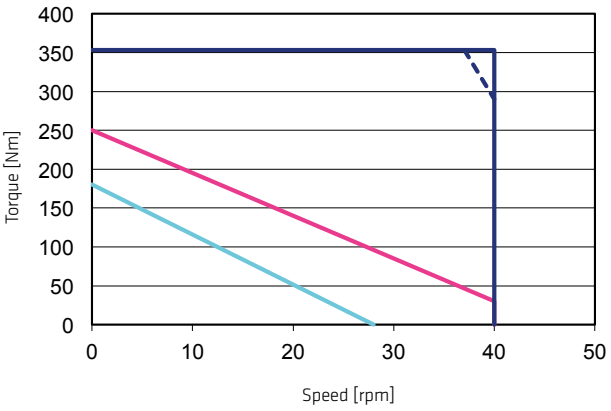
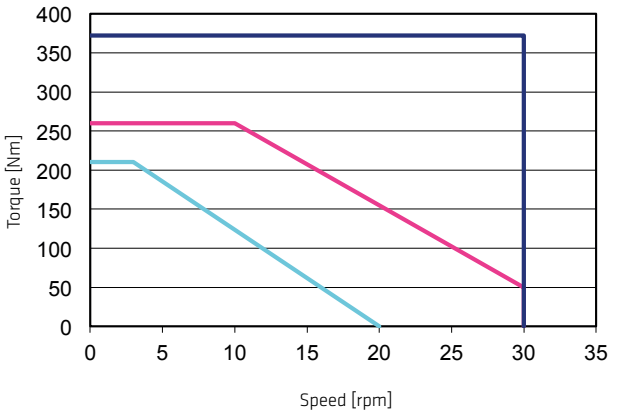


Illustration 39.6 CHA-32A-160



Legend

Intermittent duty
Continuous duty

U_M = 430 VAC
U_M = 220 VAC

S3-ED 50% (1 min)

Table 40.1

	Symbol [Unit]	CHA-40A				
Motor feedback system		M512P				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Maximum output torque	T_{max} [Nm]	402	519	568	617	647
Maximum output speed	n_{max} [rpm]	80	50	40	33	25
Maximum current	I_{max} [A_{rms}]	11.8	9.2	8.1	7.3	5.9
Continuous stall torque	T_0 [Nm]	125	208	260	314	420
Continuous stall current	I_0 [A_{rms}]	3.6	3.6	3.6	3.6	3.6
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20° C)	t_e [ms]	2.1				
Mechanical time constant (20° C)	t_m [ms]	6.8				
No load current	I_{NLS} [A_{rms}]	0.30	0.20	0.20	0.20	0.20
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	13	20	25	30	40
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	4	6	8	10	13
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	38	62	77	92	123
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	0.83				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	53				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430				
Demagnetisation current	I_E [A_{rms}]	18				
Maximum motor speed	n_{max} [rpm]	4000				
Rated motor speed	n_N [rpm]	3000				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	2.9				
Inductance (L-L)	L_{L-L} [mH]	6.0				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	12.7				
Weight with brake	m [kg]	14.8				
Hollow shaft diameter	d_h [mm]	39				

Moment of Inertia

Table 40.2

	Symbol [Unit]	CHA-40A				
Motor feedback system		M512P				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm^2]	3.40	8.60	13.5	19.4	34.6
Moment of inertia with brake	J_{out} [kgm^2]	3.90	9.80	15.4	22.2	39.4
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10^{-4} kgm^2]	13.5				
Moment of inertia at motor with brake	J [x10^{-4} kgm^2]	15.4				

Technical Data Brake

Table 40.3

	Symbol [Unit]	CHA-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	647
Brake current to open	I_{OBr} [A_{DC}]	0.7				
Brake current to hold (10V)	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				

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 ratings table.

Illustration 41.1 CHA-40A-50

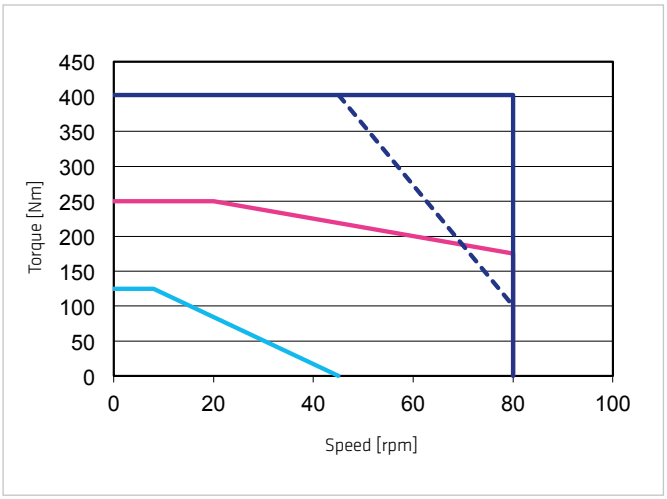


Illustration 41.2 CHA-40A-80

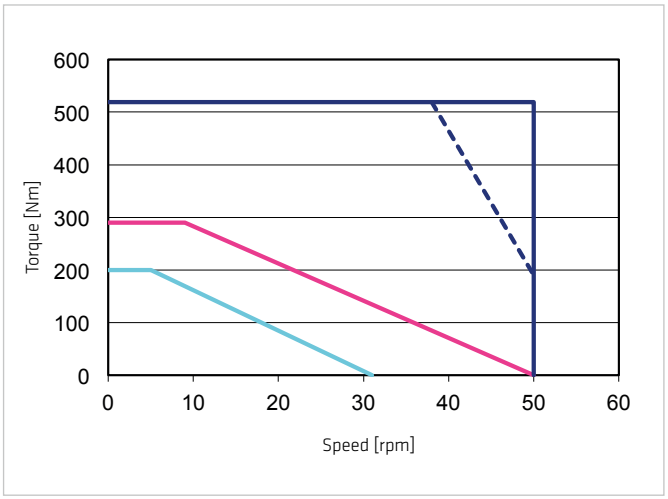


Illustration 41.3 CHA-40A-100

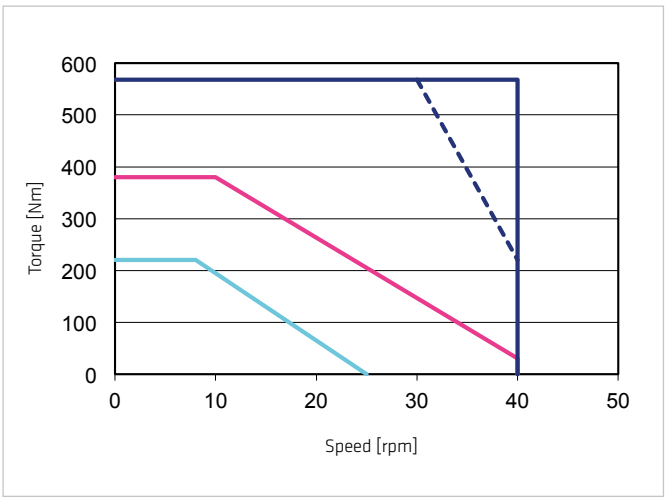


Illustration 41.4 CHA-40A-120

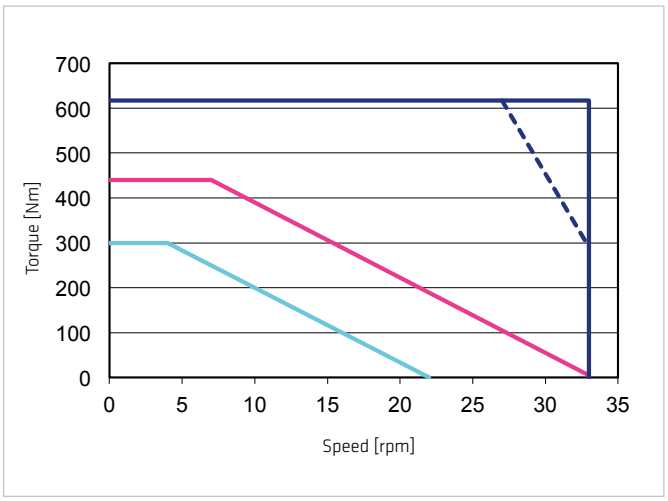
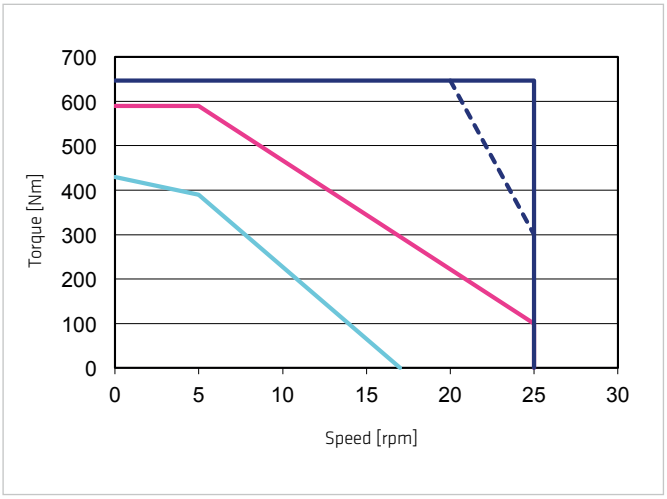


Illustration 41.5 CHA-40A-160



Legend

Intermittent duty
Continuous duty
U_M = 430 VAC
U_M = 220 VAC
S3-ED 50% (1 min)

Table 42.1

	Symbol [Unit]	CHA-50A				
Motor feedback system		M512P				
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	30	22
Maximum current	I_{max} [A_{rms}]	10.2	8.3	6.9	6.4	5.3
Continuous stall torque	T_0 [Nm]	194	363	456	550	736
Continuous stall current	I_0 [A_{rms}]	2.9	3.2	3.2	3.2	3.1
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20° C)	t_e [ms]	3.4				
Mechanical time constant (20° C)	t_m [ms]	4.7				
No load current	I_{NLS} [A_{rms}]	0.30	0.20	0.20	0.17	0.16
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	12	20	25	29	39
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	4	6	8	9	12
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	74	121	145	181	242
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	1.60				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	104				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430				
Demagnetisation current	I_E [A_{rms}]	18				
Maximum motor speed	n_{max} [rpm]	3500				
Rated motor speed	n_N [rpm]	2500				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	3.5				
Inductance (L-L)	L_{L-L} [mH]	12				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	20.9				
Weight with brake	m [kg]	24.5				
Hollow shaft diameter	d_h [mm]	45				

Moment of Inertia

Table 42.2

	Symbol [Unit]	CHA-50A				
Motor feedback system		M512P				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	3.40	8.60	13.5	19.4	34.6
Moment of inertia with brake	J_{out} [kgm²]	3.90	9.80	15.4	22.2	39.4
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	13.5				
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	15.4				

Technical Data Brake

Table 42.3

	Symbol [Unit]	CHA-50A				
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 (10V)	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				

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 ratings table.

Illustration 43.1 CHA-50A-50

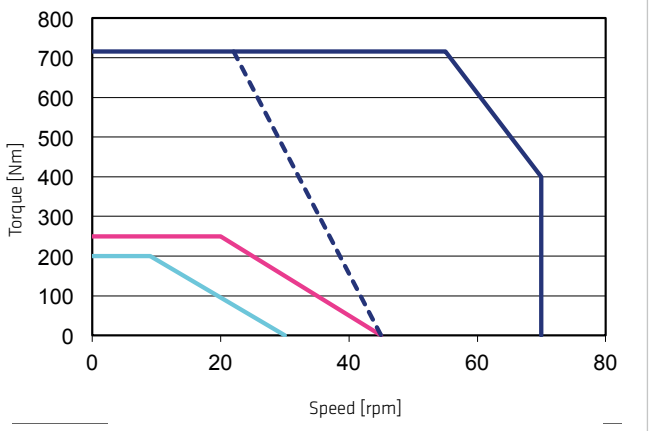


Illustration 43.2 CHA-50A-80

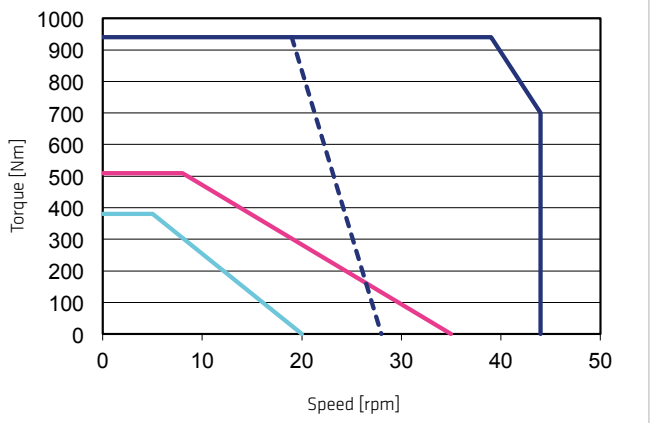


Illustration 43.3 CHA-50A-100

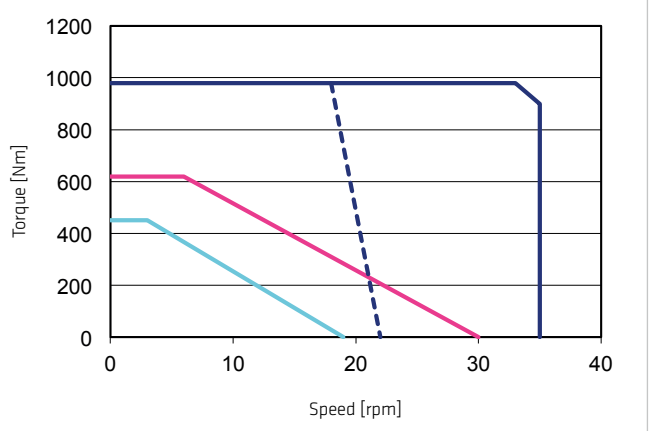


Illustration 43.4 CHA-50A-120

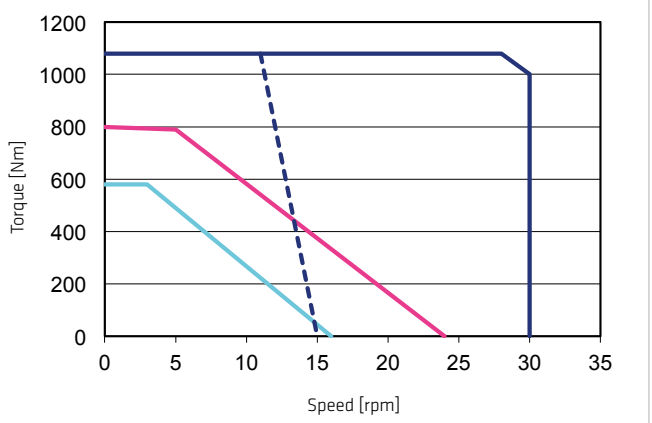
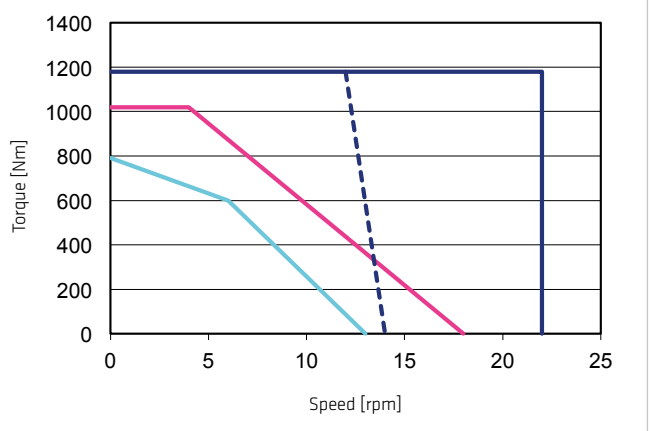


Illustration 43.5 CHA-50A-160



Legend

Intermittent duty
Continuous duty
U_M = 430 VAC
U_M = 220 VAC
S3-ED 50% (1 min)

Table 44.1

	Symbol [Unit]	CHA-58A				
Motor feedback system		M512P				
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_{rms}]	14.4	12.8	11.1	10.0	8.1
Continuous stall torque	T_0 [Nm]	280	532	670	805	1080
Continuous stall current	I_0 [A_{rms}]	4.2	4.6	4.6	4.6	4.6
Maximum DC bus voltage	U_{DCmax} [V_{DC}]	680				
Electrical time constant (20° C)	t_e [ms]	3.5				
Mechanical time constant (20° C)	t_m [ms]	5.4				
No load current	I_{NLS} [A_{rms}]	0.40	0.28	0.26	0.25	0.23
No load running current constant (30° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	19	30	38	46	61
No load running current constant (80° C)	K_{INL} [x10^{-3} A_{rms}/rpm]	6	10	12	15	19
Torque constant (at output)	k_{Tout} [Nm/A_{rms}]	75	122	152	183	244
Torque constant (at motor)	k_{TM} [Nm/A_{rms}]	1.70				
AC voltage constant (L-L, 20° C, at motor)	k_{EM} [V_{rms}/1000 rpm]	105				
Motor terminal voltage (fundamental wave only)	U_M [V_{rms}]	220 ... 430				
Demagnetisation current	I_E [A_{rms}]	25				
Maximum motor speed	n_{max} [rpm]	3000				
Rated motor speed	n_N [rpm]	2000				
Resistance (L-L, 20° C)	R_{L-L} [Ω]	2.4				
Inductance (L-L)	L_{L-L} [mH]	9				
Number of pole pairs	p [ ]	6				
Weight without brake	m [kg]	28.2				
Weight with brake	m [kg]	32.0				
Hollow shaft diameter	d_h [mm]	45				

Moment of Inertia

Table 44.2

	Symbol [Unit]	CHA-58A				
Motor feedback system		M512P				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Moment of Inertia output side						
Moment of inertia without brake	J_{out} [kgm²]	11.9	30.6	47.8	68.8	122
Moment of inertia with brake	J_{out} [kgm²]	12.1	31.1	48.5	69.8	124
Moment of Inertia at motor						
Moment of inertia at motor without brake	J [x10^{-4} kgm²]	47.8				
Moment of inertia at motor with brake	J [x10^{-4} kgm²]	48.5				

Technical Data Brake

Table 44.3

	Symbol [Unit]	CHA-58A				
Ratio	i [ ]	**50**	**80**	**100**	**120**	**160**
Brake voltage	U_{Br} [V_{DC}]	24 ±10%				
Brake holding torque (at output)	T_{Br} [Nm]	450	720	900	1080	1440
Brake current to open	I_{OBr} [A_{DC}]	0.7				
Brake current to hold (10V)	I_{HBr} [A_{DC}]	0.5				
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				

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 ratings table.

Illustration 45.1 CHA-58A-50

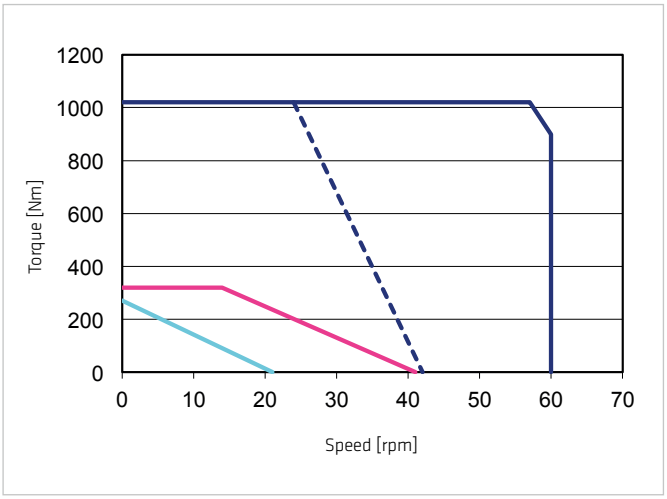


Illustration 45.2 CHA-58A-80

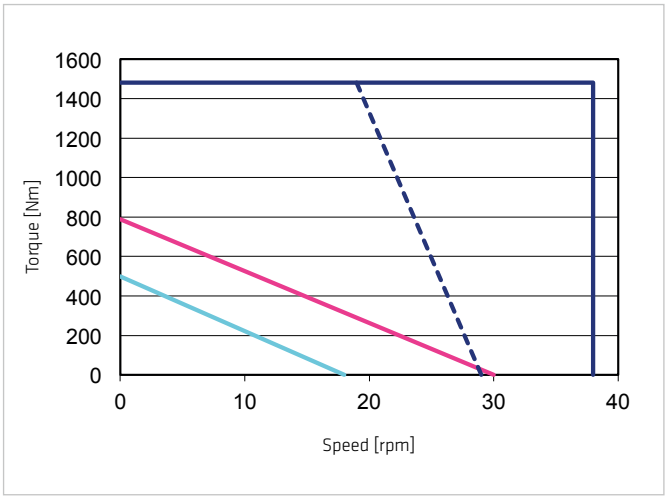


Illustration 45.3 CHA-58A-100

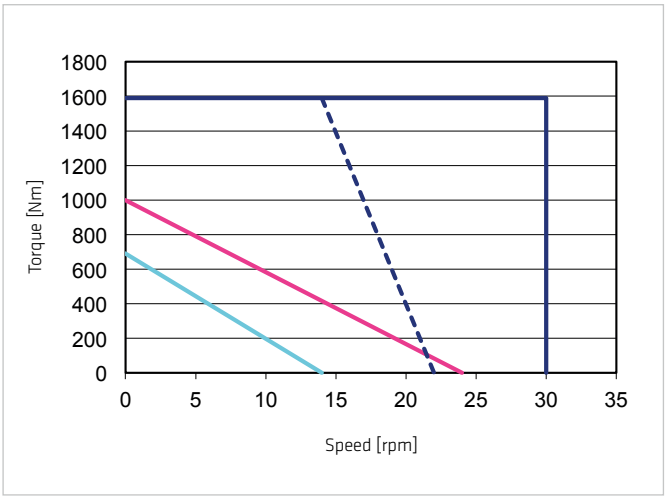


Illustration 45.4 CHA-58A-120

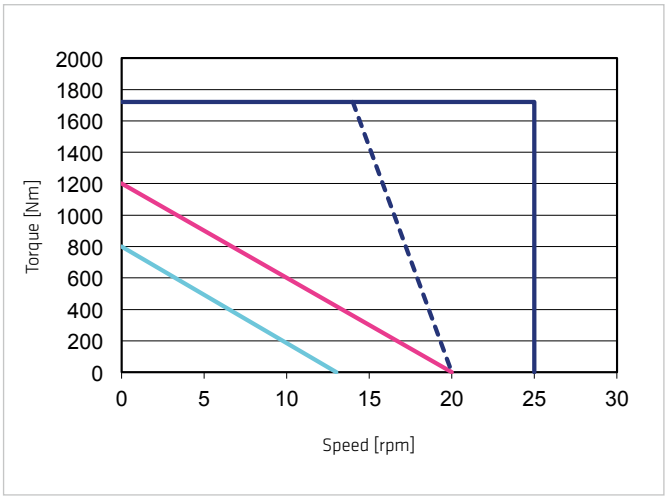
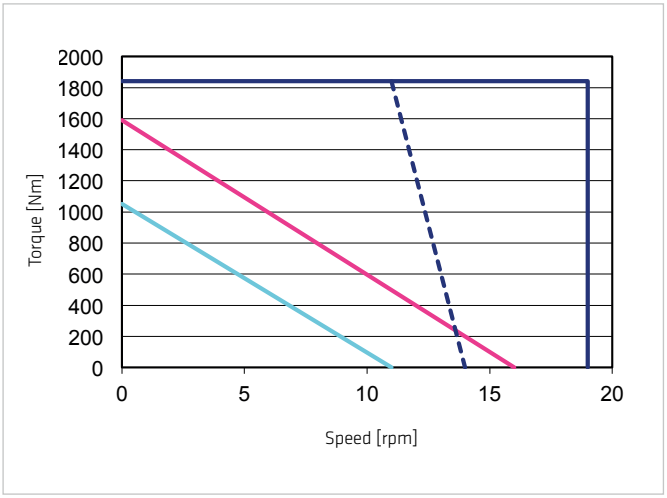


Illustration 45.5 CHA-58A-160



Legend

Intermittent duty
Continuous duty
U_M = 430 VAC
U_M = 220 VAC
S3-ED 50% (1 min)

3.3.3 Dimensions

Detailed 2D drawings and 3D models can be found at the following Quicklink:
QUICKLINK **www.harmonicdrive.de/CAD1010**

Illustration 46.1 CHA-14A-E [mm]

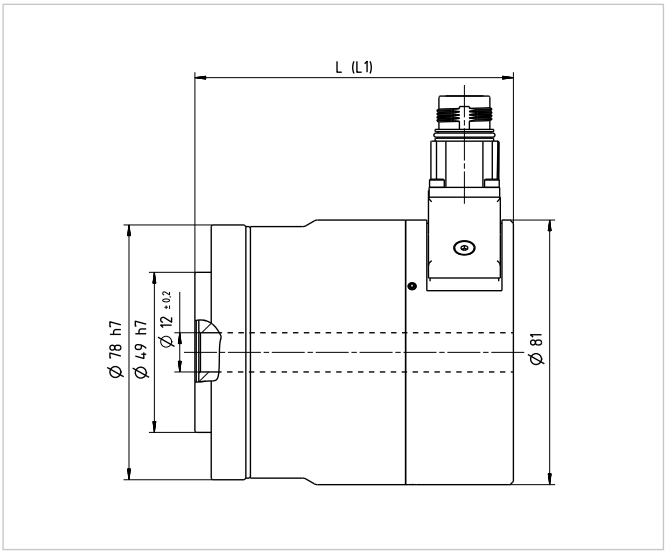


Illustration 46.2 CHA-17A-E [mm]

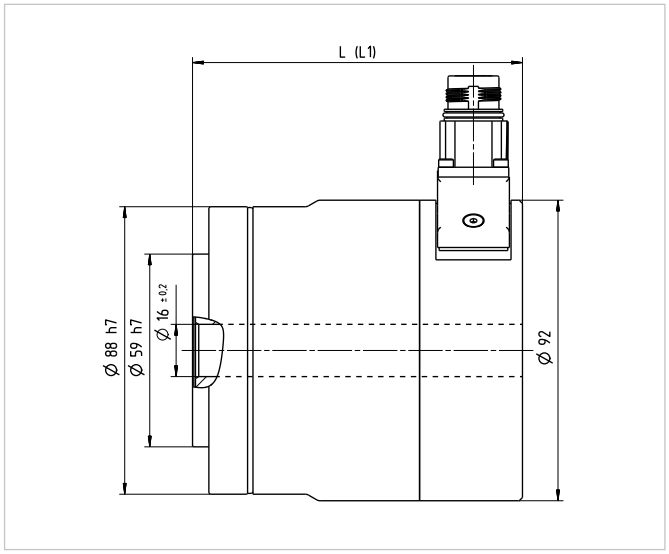


Table 46.3

	Symbol [Unit]	CHA-14A-E	CHA-17A-E
Motor feedback system		RES / D2048/ M128S	RES / D2048/ M128S
Length (without brake)	L [mm]	97.5	101
Length (with brake)	L1 [mm]	120.6	123
Standard cable length	l [m]	approx. 1.5	approx. 1.5

Illustration 46.4 CHA-14A [mm]

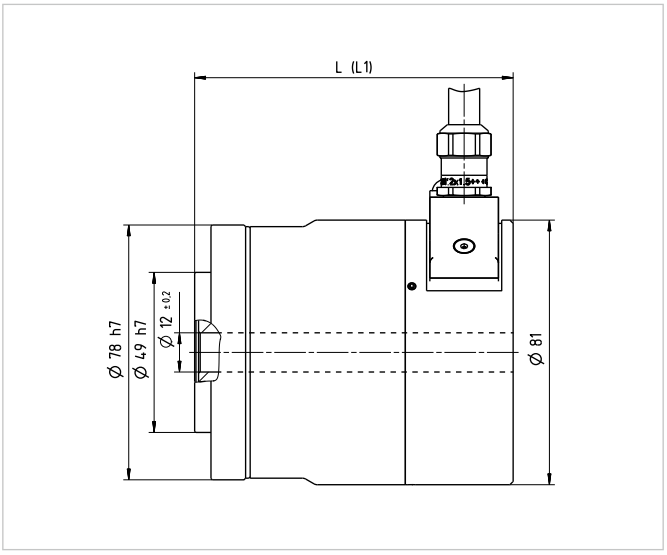


Illustration 46.5 CHA-17A [mm]

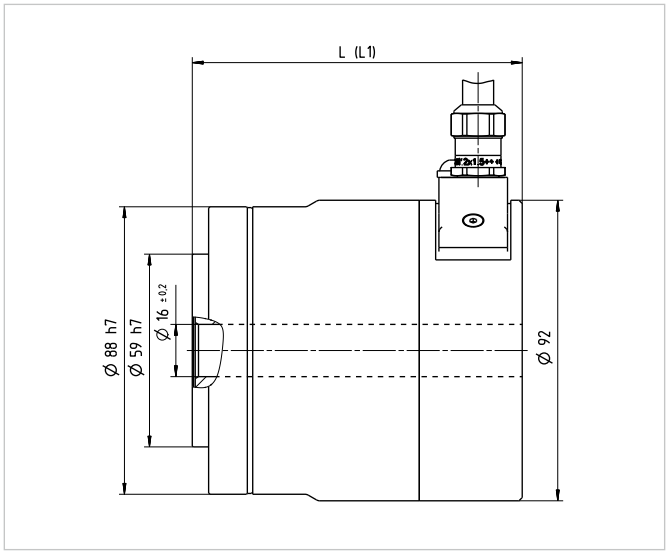


Table 46.6

	Symbol [Unit]	CHA-14A	CHA-17A
Motor feedback system		RES / D2048 / M128S	RES / D2048 / M128S
Length (without brake)	L [mm]	97.5	101
Length (with brake)	L1 [mm]	120.6	123
Standard cable length	l [m]	approx. 1.5	approx. 1.5

Illustration 47.1 CHA-20A [mm]

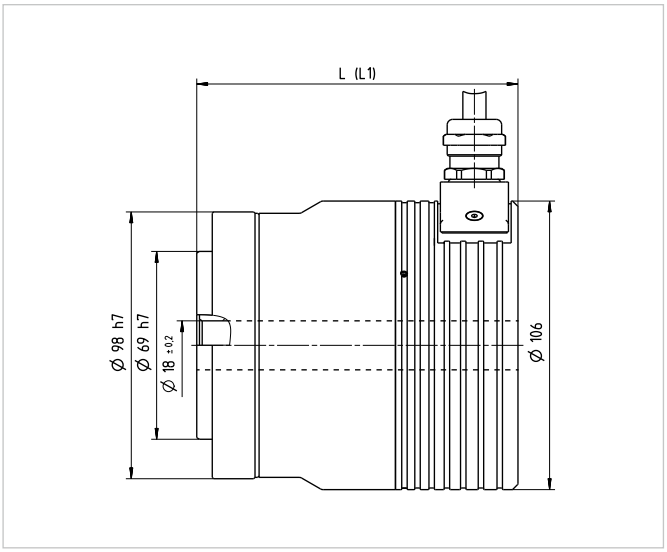


Illustration 47.2 CHA-25A [mm]

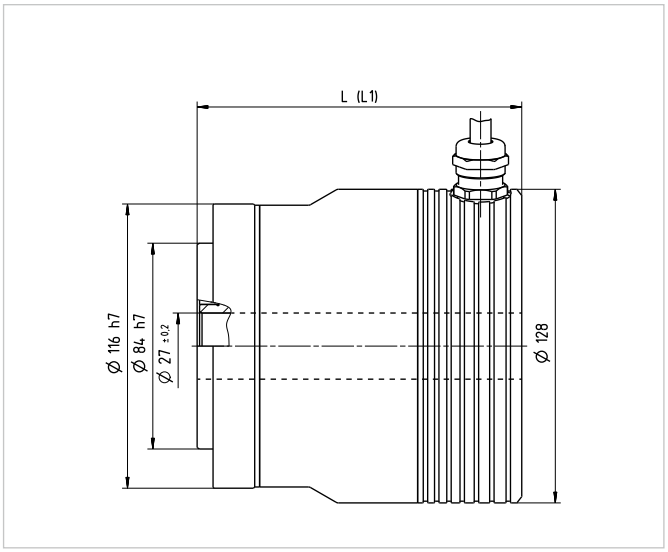


Table 47.3

	Symbol [Unit]	CHA-20A	CHA-25A
Motor feedback system		C1024 / S1024 / M1024	C1024 / S1024 / M1024
Length (without brake)	L [mm]	118	132.5
Length (with brake)	L1 [mm]	138	160
Standard cable length	l [m]	approx. 1.8	approx. 1.8

Illustration 47.4 CHA-32A [mm]

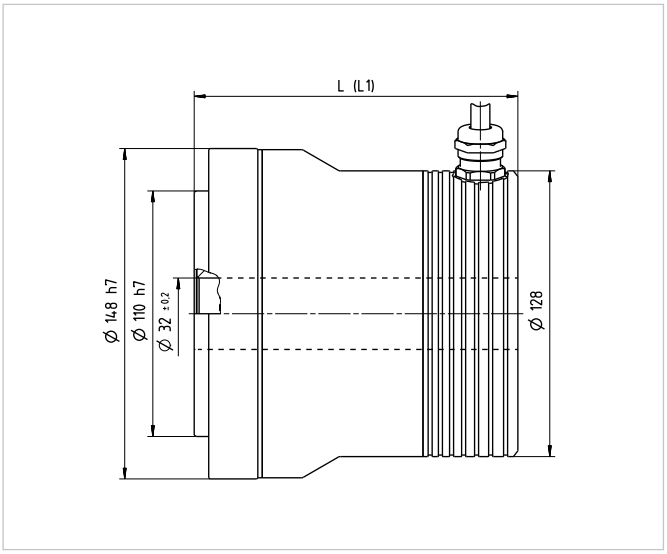


Illustration 47.5 CHA-40A [mm]

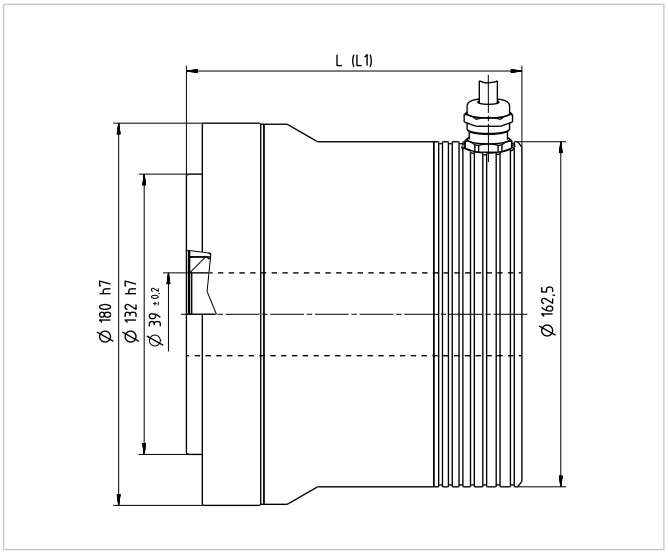


Table 47.6

	Symbol [Unit]	CHA-32A	CHA-40A
Motor feedback system		C1024 / S1024 / M1024	C1024 / S1024 / M1024
Length (without brake)	L [mm]	145	158
Length (with brake)	L1 [mm]	172.5	177
Standard cable length	l [m]	approx. 1.8	approx. 1.8

Illustration 48.1 CHA-50A [mm]

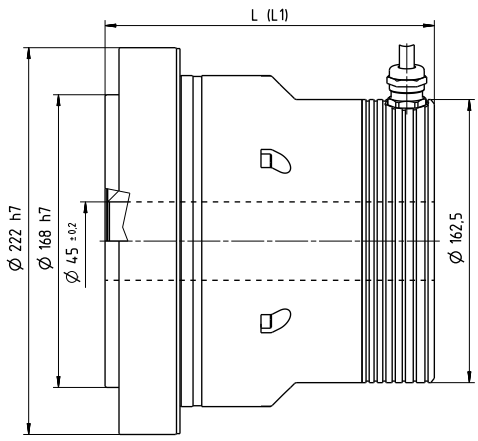


Illustration 48.2 CHA-58A [mm]

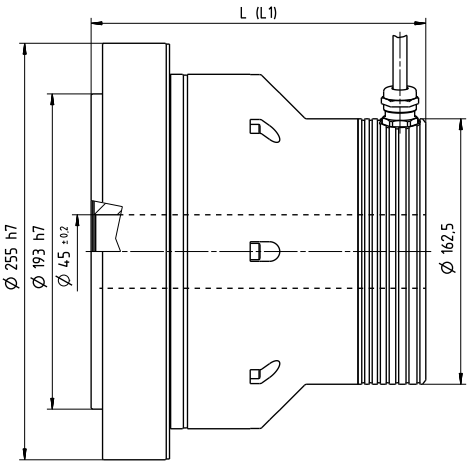


Table 48.3

	Symbol [Unit]	CHA-50A	CHA-58A
Motor feedback system		C1024 / S1024 / M1024	C1024 / S1024 / M1024
Length (without brake)	L [mm]	189	205
Length (with brake)	L1 [mm]	208	226
Standard cable length	l [m]	approx. 1.8	approx. 1.8

Illustration 48.4 CHA-20A-M512P [mm]

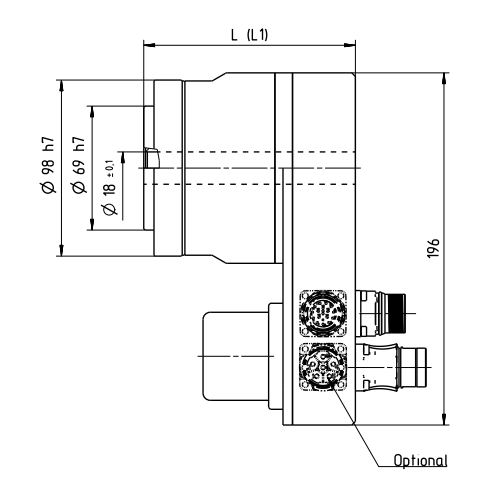


Illustration 48.5 CHA-25A-M512P [mm]

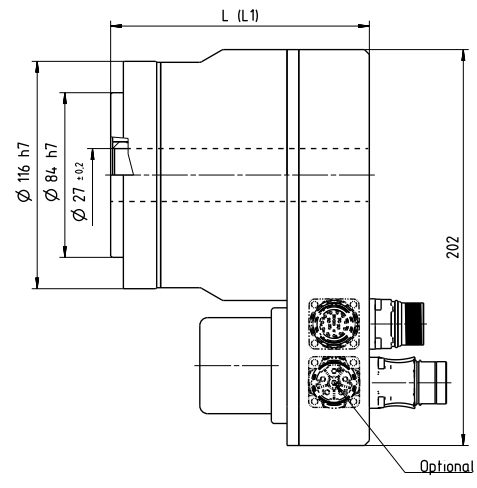


Table 48.6

	Symbol [Unit]	CHA-20A	CHA-25A
Motor feedback system		M512P	M512P
Length (without brake)	L [mm]	118	132
Length (with brake)	L1 [mm]	137	159.5

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Illustration 49.1 CHA-32A-M512P [mm]

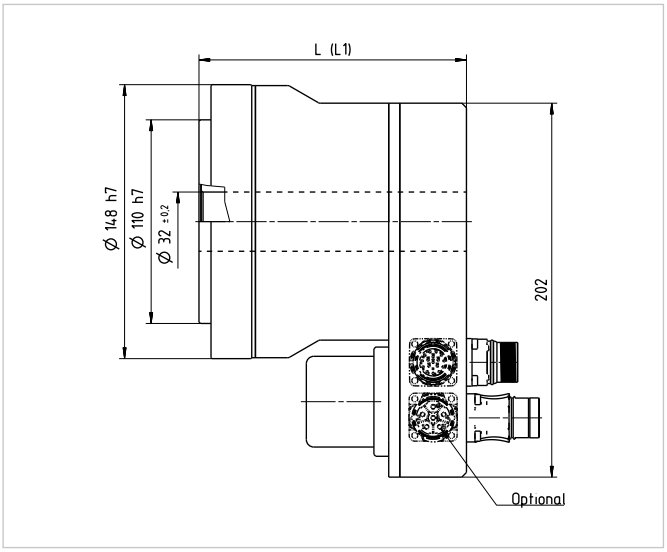


Illustration 49.2 CHA-40A-M512P [mm]

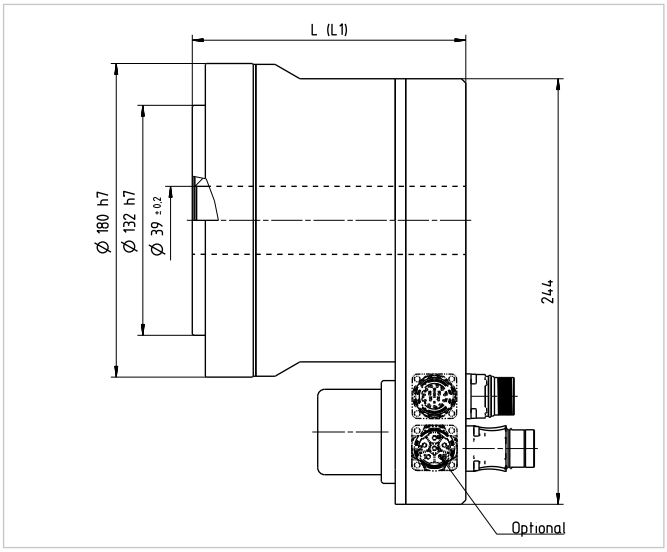


Table 49.3

	Symbol [Unit]	CHA-32A	CHA-40A
Motor feedback system		M512P	M512P
Length (without brake)	L [mm]	144.5	157
Length (with brake)	L1 [mm]	172	176

Illustration 49.4 CHA-50A-M512P [mm]

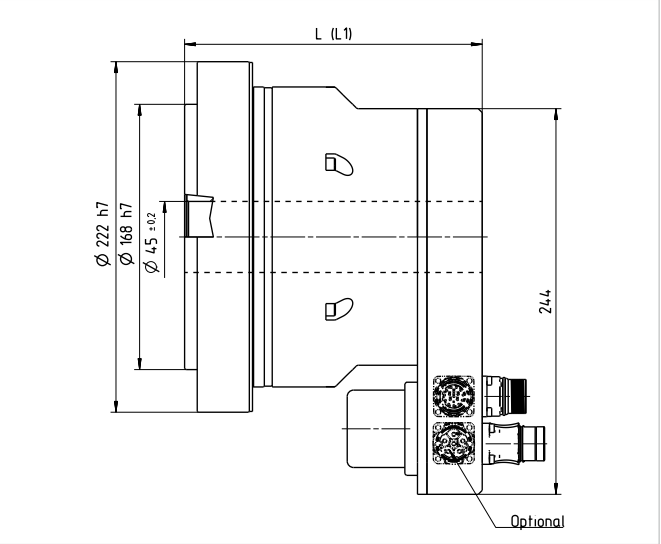


Illustration 49.5 CHA-58A-M512P [mm]

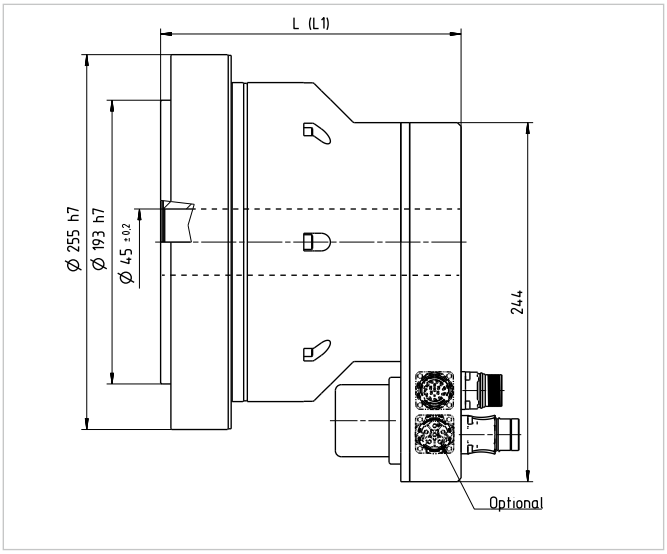


Table 49.6

	Symbol [Unit]	CHA-50A	CHA-58A
Motor feedback system		M512P	M512P
Length (without brake)	L [mm]	188.5	204.4
Length (with brake)	L1 [mm]	207.5	225.4

3.3.4 Accuracy

Table 50.1

	Symbol [Unit]	CHA-14A			CHA-17A			CHA-20A			CHA-25A		
Ratio	i [ ]	30	50	> 50	30	50	> 50	30	50	> 50	30	50	> 50
Transmission accuracy	[arcmin]	< 2	< 1.2	< 1	< 2	< 1.2	< 1	< 1.5	< 1	< 0.8	< 1.5	< 1	< 0.8
Repeatability	[arcmin]	< ± 0.1			< ± 0.1			< ± 0.1			< ± 0.1		
Hysteresis loss	[arcmin]	< 3	< 1	< 1	< 3	< 1	< 1	< 3	< 1	< 1	< 3	< 1	< 1
Lost Motion	[arcmin]	< 1			< 1			< 1			< 1		

Table 50.2

	Symbol [Unit]	CHA-32A			CHA-40A		CHA-50A		CHA-58A	
Ratio	i [ ]	30	50	> 50	50	> 50	50	> 50	50	> 50
Transmission accuracy	[arcmin]	< 1.5	< 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]	< 3	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Lost Motion	[arcmin]	< 1			< 1		< 1		< 1	

3.3.5 Torsional Stiffness

Table 50.3

	Symbol [Unit]	CHA-14A			CHA-17A			CHA-20A			CHA-25A		
T1	[Nm]	2			3.9			7			14		
T2	[Nm]	6.9			12			25			48		
Ratio	i [ ]	30	50	>50	30	50	>50	30	50	>50	30	50	>50
K3	[x10³ Nm/rad]	3.4	5.7	7.1	6.7	13	16	11	23	29	21	44	57
K2	[x10³ Nm/rad]	2.4	4.7	6.1	4.4	11	14	7.1	18	25	13	34	50
K1	[x10³ Nm/rad]	1.9	3.4	4.7	3.4	8.1	10	5.7	13	16	10	25	31

Table 50.4

	Symbol [Unit]	CHA-32A			CHA-40A			CHA-50A		CHA-58A	
T1	[Nm]	29			54			108		168	
T2	[Nm]	108			196			382		598	
Ratio	i [ ]	30	50	>50	30	50	>50	50	>50	50	>50
K3	[x10³ Nm/rad]	49	98	120	-	180	230	340	440	540	710
K2	[x10³ Nm/rad]	30	78	110	-	140	200	280	400	440	610
K1	[x10³ Nm/rad]	24	54	67	-	100	130	200	250	310	400

3.3.6 Output Bearing

CHA series AC hollow shaft Servo Actuators incorporate a high stiffness cross roller bearing to support output loads. This specially developed bearing can withstand high axial and radial forces as well as high tilting moments. The reduction gear is 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 costs, by removing the need for an additional output bearing in many applications. Furthermore, installation and assembly of the CHA servo actuators are greatly simplified.

Technical Data

Table 51.1

	Symbol [Unit]	CHA-14A	CHA-17A	CHA-20A	CHA-25A	CHA-32A	CHA-40A	CHA-50A	CHA-58A
Bearing type [1]		F	F	F	C	C	C	C	C
Pitch circle diameter	d_p [mm]	0.049	0.058	0.070	0.088	0.114	0.134	0.171	0.192
Offset	R [mm]	0.014	0.014	0.016	0.018	0.020	0.026	0.028	0.029
Dynamic load rating	C [N]	8500	11500	24200	30000	34500	43300	81600	87400
Stating load rating	C_0 [N]	11400	17100	31000	45000	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} = 15000h

[3][4] These data are only valid if the following conditions are fulfilled:

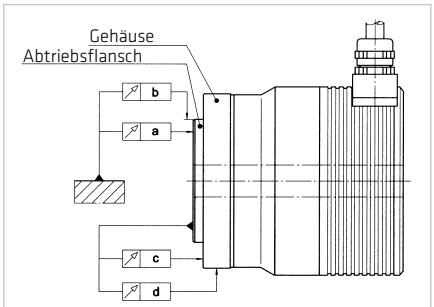
for M_0: F_a=0 N; F_r=0 N

F_a: M=0 Nm; F_r=0 N

F_r: M=0 Nm; F_a=0 N

[5] Average value

Illustration 51.2



Tolerances

Table 51.3

	Symbol [Unit]	CHA-14A	CHA-17A	CHA-20A	CHA-25A	CHA-32A	CHA-40A	CHA-50A	CHA-58A
a	[mm]	0.010	0.010	0.010	0.010	0.012	0.012	0.015	0.015
b	[mm]	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
c	[mm]	0.010	0.010	0.010	0.010	0.012	0.012	0.015	0.015
d	[mm]	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010

3.3.7 Motor Feedback Systems

Design and Operation

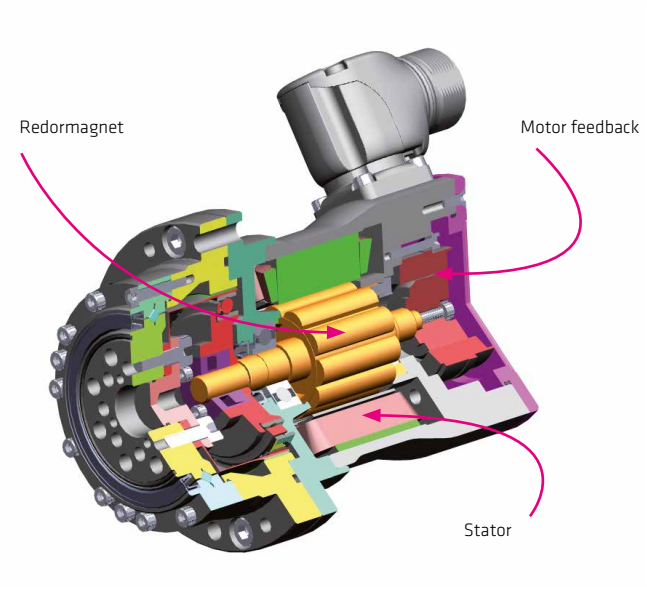
For accurate position setting, the servo motor and its control device are fitted with a measuring device (feedback), which determines the current position (e.g. the angle of redation set for a starting position) of the motor.

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 redor position, in order to guarantee correct commutation.



Actual Speed

The actual speed is obtained in the servo controller suing 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) redations. This information can on the one hand provide the redor 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 redation 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 CHA Series Actuators can be fitted with absolute measurement encoders directly to the actuator output (Option EC).

C1024

Incremental motor feedback with SIN / COS signals reference and commutation signals

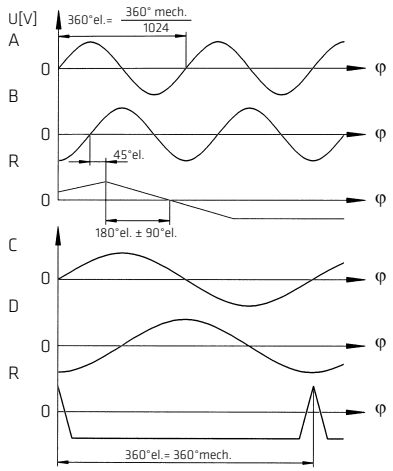
Table 53.1

Ordering code	Symbol [Unit]	C1024					
Manufacturer's designation		CCK					
Power supply [1]	U_b [VDC]	5 ± 10%					
Current consumption [1]	I [mA]	150					
Incremental signals	u_{pp} [V_{ss}]	1 +20% / -25%					
Signal form		sinusoidal					
Number of pulses	n_1 [A / B]	1024					
Commutation signals	u_{pp} [V_{ss}]	1					
Signal form		sinusoidal					
Number of pulses	n_2 [C / D]	1					
Reference signal	n_3 [R]	1					
Accuracy [1]	[arcsec]	±12					
Incremental resolution (motor side) [2]	inc [ ]	262144					
Resolution (output side) [2]		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	0.16	0.10	0.06	0.05	0.04	0.03

[1] Source: Manufacturer
[2] For interpolation with 8 bit

Signal Wave Form

Illustration 53.2



Valid for direction of rotation
- CW at the motor shaft (when viewed from the front face of the motor)
- CCW at the output flange

S1024

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

Table 54.1

Ordering code	Symbol [Unit]	S1024					
Manufacturer's designation		SCK					
Type identifier [1]		22_h					
Protocol		HIPERFACE®					
Power supply [1]	U_b [VDC]	7 ... 12					
Current consumption (max no load) [1]	I [mA]	110					
Incremental signals	u_{pp} [V_{ss}]	0.8 ... 1.1					
Signal form		sinusoidal					
Number of pulses	n_1 [SIN / COS]	1024					
Absolute position / revolution (motor side) [3]		32768					
Available memory in EEPROM	[Bytes]	128					
Accuracy [1]	[arcsec]	±180					
Resolution of the absolute value (output side)		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	1.4	0.8	0.5	0.4	0.4	0.3
Resolution incremental (motor side) [2]	inc [ ]	262144					
Resolution (output side) [2]		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	0.16	0.10	0.06	0.05	0.04	0.03

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

M1024

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

Table 54.1

Ordering code	Symbol [Unit]	M1024					
Manufacturer's designation		SCL					
Type identifier [1]		27_h					
Protocol		HIPERFACE®					
Power supply [1]	U_b [VDC]	7 ... 12					
Current consumption [1]	I [mA]	110					
Incremental signals	u_{pp} [V_{ss}]	0.8 ... 1.1					
Signal form		sinusoidal					
Number of pulses	n_1 [SIN / COS]	1024					
Absolute position / revolution (motor side) [3]		32768					
Number of revolutions		4096					
Available memory in EEPROM	[Bytes]	128					
Accuracy [1]	[arcsec]	±180					
Resolution of the absolute value (output side)		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	1.4	0.8	0.5	0.4	0.4	0.3
Number of revolutions (at output side)		136	81	51	40	34	25
Incremental resolution (motor side) [2]	inc [ ]	262144					
Resolution (output side) [2]		Gear ratio CHA					
	i	30	50	80	100	120	160
	[arcsec]	0.16	0.10	0.06	0.05	0.04	0.03

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

M512P

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

Table 55.1

Ordering code	Symbol [Unit]	M512P					
Manufacturer's designation		EQN 1125					
Protocol		EnDat 2.2					
Power supply [1]	U_b [VDC]	3.6 ... 14					
Current consumption (typically @ 5 VDC, without load) [1]	I [mA]	105					
Incremental signals	u_{pp} [V_{ss}]	0.8 ... 1.2					
Signal form		sinusoidal					
Number of pulses	n_1 [SIN / COS]	512					
Absolute position / revolution (motor side) [3]		8192					
Number of revolutions		4096					
Accuracy [1]	[arcsec]	± 60					
Resolution of the absolute value (output side)		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	5.3	3.2	2.0	1.6	1.4	1.0
Number of revolutions (at output side)		136	81	51	40	34	25
Incremental resolution (motor side) [2]	inc [ ]	131072					
Resolution (output side) [2]		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	0.33	0.20	0.12	0.10	0.08	0.06

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

M128S

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

Table 56.1

Ordering code	Symbol [Unit]	M128S					
Manufacturer's designation		GEL					
Protocol		SSI					
Power supply [1]	U_b [VDC]	5 ... 30					
Current consumption (without load) [1]	P [W]	0.1					
Incremental signals	u_{pp} [V_{ss}]	1					
Signal form		sinusoidal					
Number of pulses	n_1	128					
Absolute position / revolution (motor side) [3]		131072					
Number of revolutions		4096					
Available memory in EEPROM	[Bytes]	-					
Accuracy [1]	[arcsec]	± 360					
Resolution of the absolute value (output side)		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	0.4	0.2	0.2	0.1	0.1	0.1
Number of revolutions (at output side)		136	81	51	40	34	25
Incremental resolution (motor side) [2]	inc [ ]	32768					
Resolution (output side) [2]		Gear ratio CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	1.32	0.79	0.49	0.40	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

RES

Resolver

Table 56.2

Ordering code	Symbol [Unit]	RES					
Manufacturer's designation		RE					
Power supply [1]	U_b [VAC]	7					
Current consumption (max., without Last) [1]	I [mA]	50					
Input frequency	f [kHz]	5 ... 10					
Number of pole pairs, Transmission ratio		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 CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	22	13	8	7	6	4

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

D2048

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

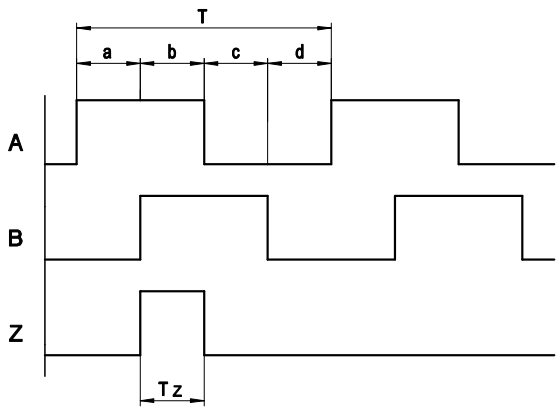
Table 57.1

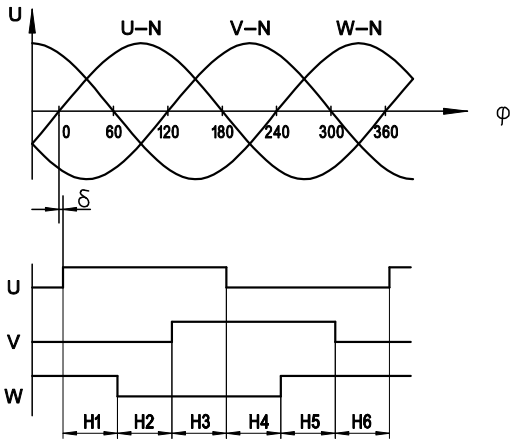
Ordering code	Symbol [Unit]	D2048					
Manufacturer's designation		EBG					
Power supply [1]	U_b [VDC]	5 ± 10%					
Current consumption (without load) [1]	I [mA]	40					
Incremental signals		RS422					
Wave form		square wave					
Number of pulses	n_1 [A / B]	2048					
Commutation signals		RS422					
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 CHA					
	i [ ]	30	50	80	100	120	160
	[arcsec]	5.3	3.2	2.0	1.6	1.4	1.0

[1] Source: Manufacturer
[2] for quadcounting

Signal Wave Form

Illustration 57.2





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 for CHA

3.3.8 Temperature Sensors

For motor predection at speeds greater than zero, temperature sensors are integrated in the motor windings. For applications with high load where the speed is zero, additional predection (eg I^2t monitoring) is recommended. When using the KTY 84-130 the values given in the table can be parametrized in the servo controller or an external evaluation unit.

Table 58.1

Sensor type	Parameter	T_{Nat} [° C]
PTC-116-K135-145°	Rated operating temperature	145

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

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

Illustration 58.2

Diagram PTC

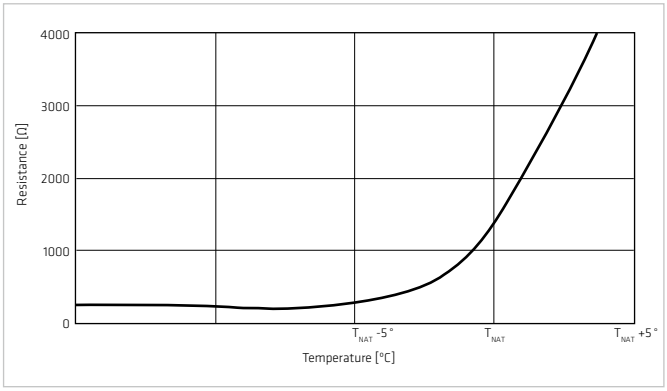


Table 58.3

Sensor type	Parameter	Symbol [Unit]	Warning	Shutdown
KTY 84-130	Temperature	T [° C]	80	90
	Resistance	R [Ω]	882 ± 3%	940 ± 3%

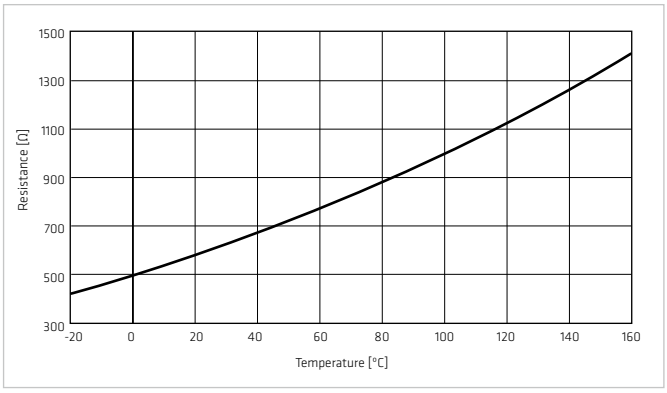
The KTY sensor is used for temperature measurement and monitoring the motor winding.

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

Temperature sensors used in the CHA Actuator Series meet the requirements for safe separation according to EN50178.

Illustration 58.4

Diagram KTY 84-130



3.3.9 Electrical Connections

CHA-xx-H-C1024 / H-M512P / H-M128S

Table 59.1

Motor connector	6 / M23 x 1
Cable plug	6 / M23 x 1 / Part no. 301193
External diameter	ca. 26 mm
Length	ca. 60 mm

Illustration 59.2

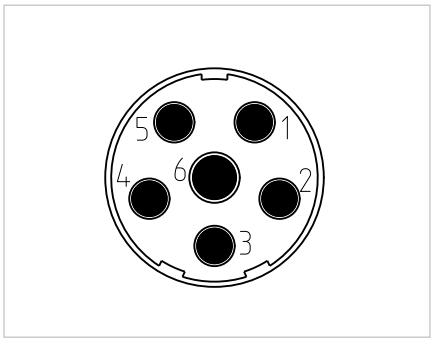


Table 59.3

	CHA-20 / 25 / 32 / 40 / 50 / 58						**CHA-14 / 17**					
Connector pin	1	2	3	4	5	6	1	2	3	4	5	6
Motor phase	U	V	PE	BR+	BR-	W	U	V	PE	BR+	BR-	W
Colour	red	black	green yellow	white	brown	white	red	black	green yellow	black	white	white
Cross section [mm²]	0.5	0.5	0.5	0.25	0.25	0.5	0.34	0.34	0.34	0.15	0.15	0.34

Table 59.4

Encoder connector	17 / M23 x 1
Cable plug	17 / M23 x 1 / Part no. 270199
External diameter	ca. 26 mm
Length	ca. 60 mm

Illustration 59.5

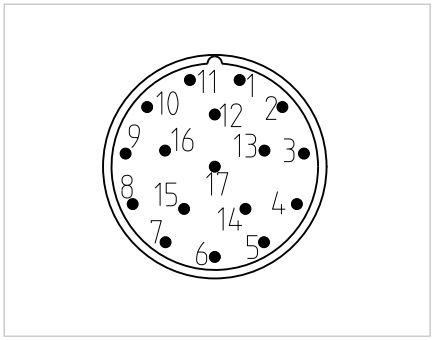


Table 59.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7 (15)**	**8**	**9**	**10 (16)**	**11**	**12**	**13**	**14**	**15 (7)**	**16 (10)**	**17**
C 1024 Signal	A+	A-	R+	D-	C+	C-	GND	Temp+ KTY	Temp- KTY	Up	B+	B-	R-	D+	GND Sensor	Up Sensor	Inner Shield
Colour	yellow	green	red	white yellow	blue	grey	brown blue	green black	green red	brown red	black	brown	orange	white black			
Cross section [mm²]	0.14						0.5	0.25		0.5	0.14						
M512P Signal	A+	A-	Data+	n.c.	Clock+	n.c.	GND	Temp+ KTY	Temp- KTY	Up	B+	B-	Data-	Clock-	GND Sensor	Up Sensor	Inner Shield
Colour	yellow	green	red	white yellow	blue	grey	brown blue	green black	green red	brown red	black	brown	orange	white black			
Cross section [mm²]	0.14						0.5	0.25		0.5	0.14						
M128 Signal	A+ Cos+	A- Cos-	Data+	n.c.	Clock+	n.c.	GND	Temp+ KTY	Temp- KTY	Up	B+ SIN+	B- SIN-	Data-	Clock-	GND Sensor	Up Sensor	Inner shield
Colour	red	white	green	-	blue	-	black	white brown	white blue	red	black	white	white	white			
Cross section [mm²]	0.15						0.5	0.15		0.5	0.15						

Connecting cables SINAMICS S120 with SMC modul

Table 60.1

Power Connection	
CHA without brake	6FX8002-5CA01-1xx0
CHA with brake	6FX8002-5DA01-1xx0
Motor feedback	
H-C1024	6FX8002-2CA31-1xx0
H-M512P H-M128S	6FX8002-2EQ10-1xx0

Connecting cables with flying leads

Table 60.2

Version	**Part no.**	**Length [m]**
H-C1024	308853 308854 308855 308856 308857	5 10 15 20 25
H-M512P H-M128S	308858 308859 308860 308861 308862	5 10 15 20 25

Connecting cables for the connection to YukonDrive®

Table 60.3

Version	**Part no.**	**Length [m]**
H-M128S	314260 314261 314262	3 5 10

CHA-xx-H-RES

Table 61.1

Motor connector	6 / M23 x 1
Cable plug	6 / M23 x 1 / Part no. 301193
External diameter	ca. 26 mm
Length	ca. 60mm

Illustration 61.2

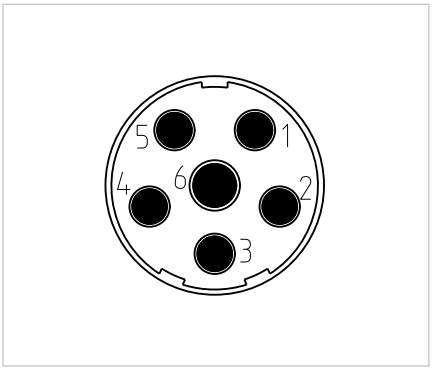


Table 61.3

	CHA-14 / 17					
Connector pin	1	2	3	4	5	6
Motor phase	U	V	PE	BR+	BR-	W
Colour	red	black	green yellow	black	white	white
Cross section [mm²]	0.34	0.34	0.34	0.15	0.15	0.34

Table 61.4

Encoder connector	12 / M23 x 1
Cable plug	12 / M23 x 1 / Part no. 303494
External diameter	ca. 26 mm
Length	ca. 60 mm

Illustration 61.5

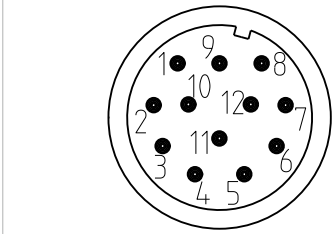


Table 61.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
RES Signal	SIN+	SIN-					Vss-	Temp+ KTY	Temp- KTY	Vss+	COS+	COS-
Colour	green	yellow	-	-	-	-	violett	grey	black white	blue	black	brown
Cross section [mm²]	0.15						0.15	0.15		0.15	0.15	

Connecting cables SINAMICS S120 with SMC modul

Table 61.7

Power Connection	
CHA without brake	6FX8002-5CA01-1xx0
CHA with brake	6FX8002-5DA01-1xx0
Motor feedback	
RES	6FX8002-2CF02-1xx0

Table 62.1

	CHA-20 / 25 / 32 / 40 / 50 / 58							
Motor phase	U	PE	W	V	BR+	BR-	Temp+ PTC	Temp- PTC
Colour	red	green yellow	white	black	white	brown	green	yellow
Cross section [mm²]	0.5				0.25			

Table 62.2

S1024 M1024 Signal	Us	GND	SIN	REFSIN	Data+	Data-	COS	REFCOS	Temp+ KTY	Temp- KTY		
Colour	red	black	yellow	green	violett	blue	black	brown	grey	black white	blue	yellow
Cross section [mm²]	0.5		0.14									

Connecting cables with flying leads and attached wiring connector for motor and motor feedback system

Table 62.3

Version	Part no.	Length [m]
H-S1024 H-M1024	309416 309417 309418 309419 309420 309421	5 10 15 20 25 30

CHA-xx-L-S1024 / L-M1024

Table 63.1

Motor connector	8 / M23 x 1
Cable plug	8 / M23 x 1 / Part no. 303549
External diameter	ca. 26 mm
Length	ca. 60mm

Illustration 63.2

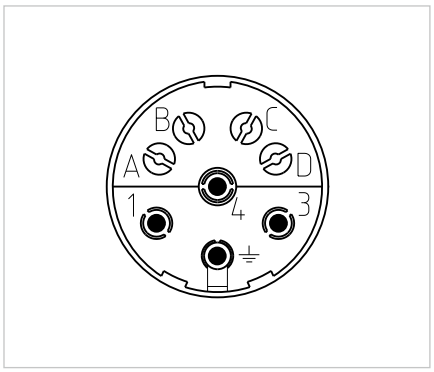


Table 63.3

	CHA-20 / 25 / 32 / 40 / 50 / 58							
Connector pin	1	2	3	4	A	B	C	D
Motor phase	U	PE	W	V	BR+	BR-	Temp+ PTC	Temp- PTC
Colour	red	green yellow	white	black	white	brown	green	yellow
Cross section [mm²]	0.5				0.25			

Table 63.4

Encoder connector	12 / M23 x 1
Cable plug	12 / M23 x 1 / Part no. 305068
External diameter	ca. 26 mm
Length	ca. 60 mm

Illustration 63.5

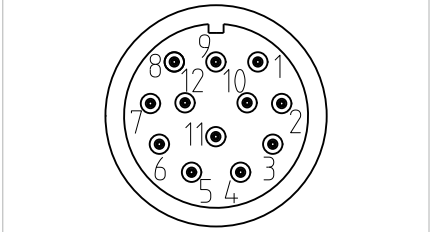


Table 63.6

Connector pin	1	2	3	4	5	6	7	8	9	10	11	12
S1024 M1024 Signal	Us	GND	SIN	REFSIN	Data+	Data-	COS	REFCOS	Temp+ KTY	Temp- KTY		
Colour	red	black	yellow	green	violett	blue	black	brown	grey	black white	blue	yellow
Cross section [mm²]	0.5		0.14									

Connecting cables for the connection to YukonDrive®

Table 63.7

Version	Part no.	Length [m]
L-S1024 L-M1024	1004153 1004154 1004155	3 5 10

Table 64.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Part. no. 1011412
External diameter	ca. 22 mm
Length	ca. 50 mm

Illustration 64.2

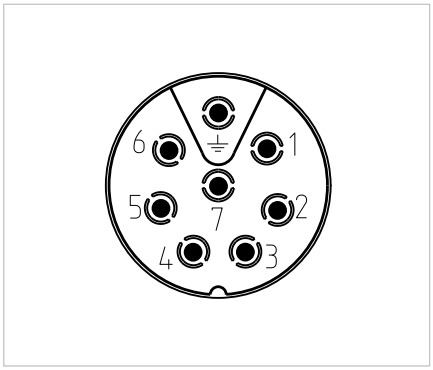


Table 64.3

	CHA-14 / 17							
Connector pin	1	6	7	PE	3	4	2	5
Motor phase	U	W	V	PE	BR+	BR-	Temp PTC	Temp PTC
Colour	red	white	black	green yellow	black	white	blue	white
Cross section [mm²]	0.34				0.15			

Table 64.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Part. no. 1011413
External diameter	ca. 22 mm
Length	ca. 50 mm

Illustration 64.5

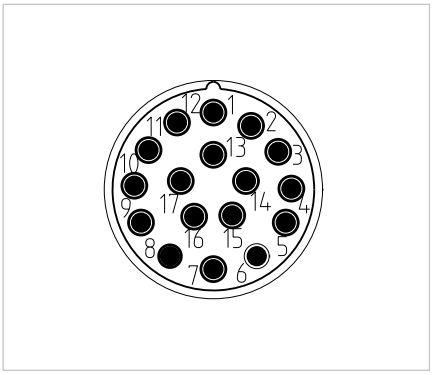


Table 64.6

Connector pin	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
RES Signal	SIN+	SIN-					Vss-	Temp+ KTY	Temp- KTY	Vss+	COS+	COS-					
Colour	green	yellow	-	-	-	-	violet	grey	black white	blue	black	brown	-	-	-	-	-
Cross section [mm²]	0.15						0.15	0.15		0.15	0.15						
D2048 Signal	U+	U-	V+	V-	W+	W-	GND	Up	Z+	Z-	A+	A-	B+	B-			
Colour	green	white	white black	white red	white brown	white blue	black	red	blue	white	black	white	red	white			
Cross section [mm²]																	
M128S Signal	A+ COS+	A- COS-	Data+	n.c	Clock+	n.c	GND	Temp+ KTY	Temp- KTY	Up	B+ SIN+	B- SIN-	Data-	Clock-	GND Sensor	Up Sensor	
Colour	red	white	green	-	blue	-	black	white brown	white blue	red	black	white	white	white			
Cross section [mm²]	0.15						0.5	0.15		0.5	0.15						

Table 65.1

Motor connector	8 / M17 x 1
Cable plug	8 / M17 x 1 / Part. no. 1011412

Illustration 65.2

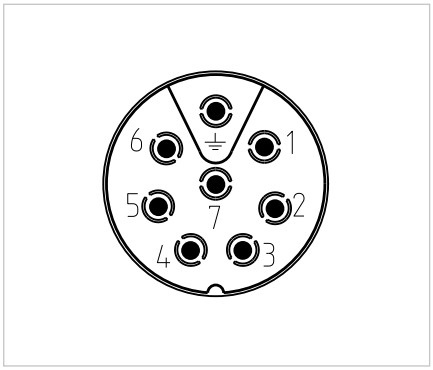


Table 65.3

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

Table 65.4

Encoder connector	17 / M17 x 1
Cable plug	17 / M17 x 1 / Part. no. 1011413

Illustration 65.5

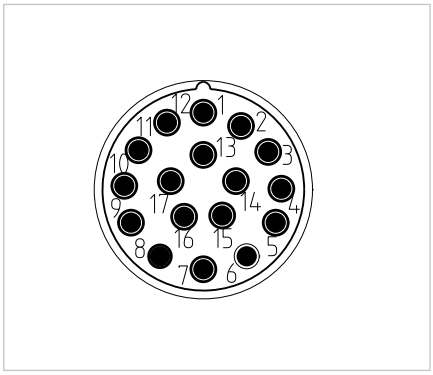


Table 65.6

Connector pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
RES Signal	SIN+	SIN-					Vss-	Temp+ KTY	Temp- KTY	Vss+	COS+	COS-					
D2048 Signal	U+	U-	V+	V-	W+	W-	GND	Up	Z+	Z-	A+	A-	B+	B-	Temp+ KTY	Temp- KTY	
M128S Signal	A+ COS+	A- COS-	Data+	n.c	Clock+	n.c	GND	Temp+ KTY	Temp- KTY	Up	B+ SIN+	B- SIN-	Data-	Clock-	GND Sensor	Up Sensor	

Connecting cables with flying leads

Table 65.7

Variant	Type	Part no.	Length[m]
CHA-E-RES	Motor cable	1017289	3
		1017292	5
		1017293	10
	Resolver cable	1017290	3
		1017291	5
		1017294	10

3.3.10 Options

Position measuring system option EC

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

The ECN113 single turn absolute encoder is connected to the actuator flange by means of a torsionally stiff hollow shaft.

Table 66.1

Ordering code	Symbol	Unit	EC					
Manufacturer's designation			ECN 113					
Protocol			EnDat 2.2					
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			sinusoidal					
Number of pulses	n_1	SIN / COS	2048					
Absolute position / revolution (motor side) [3]			8192					
Accuracy [1]		arcsec	± 20					
Resolution of the absolute value (output side)	phi	arcsec	158					
Resolution (output side) [2]	phi	arcsec	2.5	2.5	2.5	2.5	2.5	2.5

[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

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.

Table 66.2

Encoder connector	17 / M23 x 1
Cable plug	17 / M23 x 1 / Part no. 270199
External diameter	ca. 26 mm
Length	ca. 60 mm

Illustration 66.3

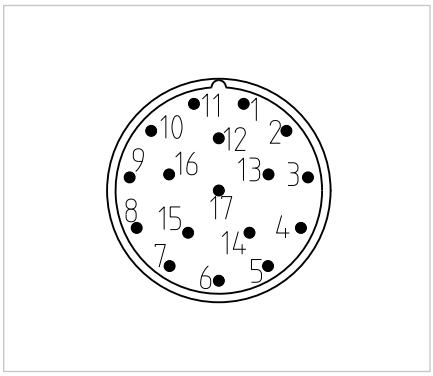


Table 66.4

Connector pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Signal	Up Sensor	n.c	n.c	GND Sensor	n.c	n.c	Up	CLOCK +	CLOCK -	GND	Inner shield	B+	B-	DATA +	A+	A-	DATA -
Connecting Cables																	
SIMODRIVE	6FX8002-2AD00-1xx0																
SINAMICS S 120 (SMC20)	6FX8002-2CH00-1xx0																
YukonDrive®	Part no. 1010747 (3 m; other length on request)																

4. Actuator Selection Procedure

4.1. Selection Procedure and Calculation Example

Flowchart for actuator selection

Equation 67.1

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

Equation 67.2

$$T_2 = T_L$$

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

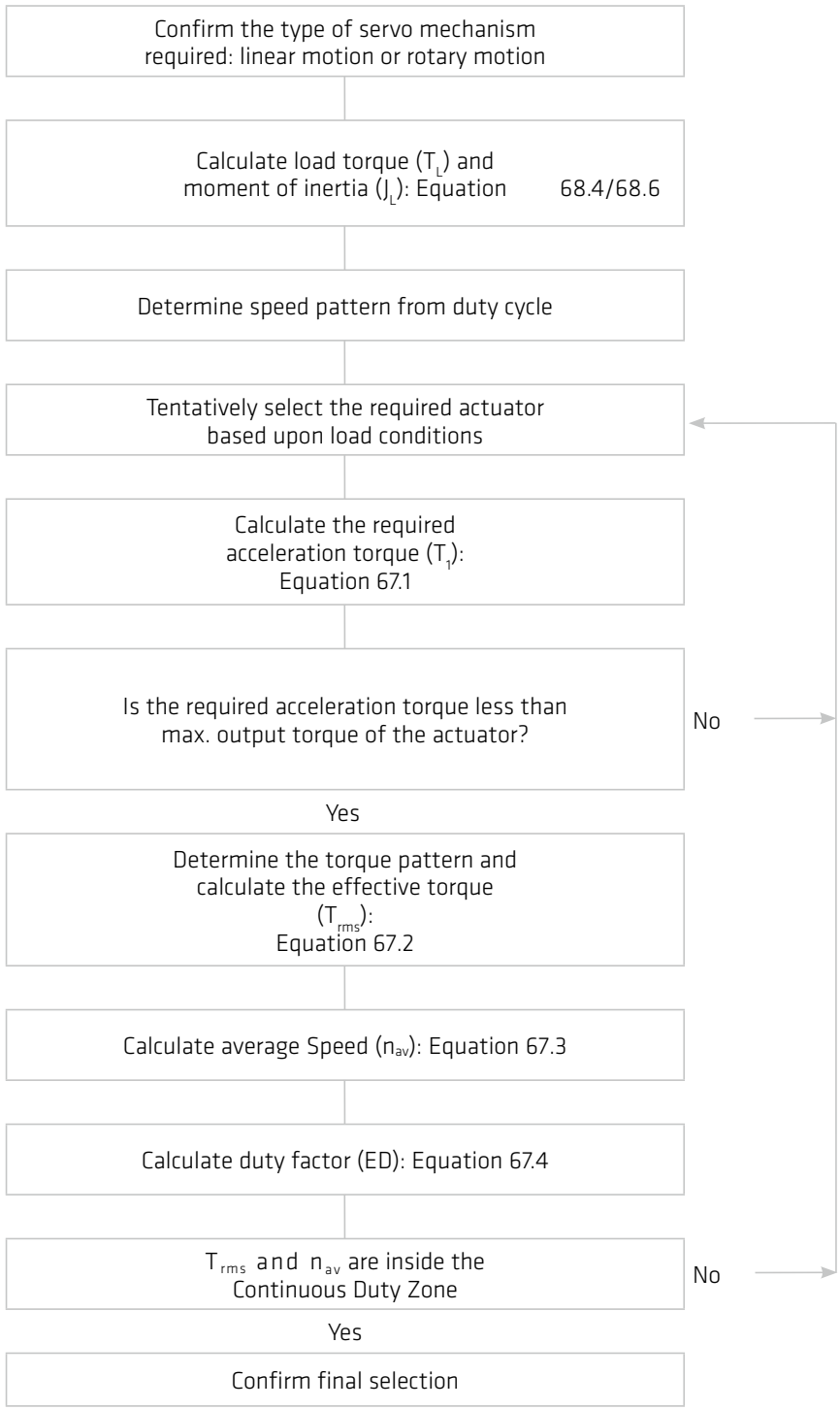
$$T_{rms} = \sqrt{\frac{T_1^2 \cdot t_1 + T_2^2 \cdot t_2 + T_3^2 \cdot t_3}{t_1 + t_2 + t_3 + t_p}}$$

Equation 67.3

$$n_{av} = \frac{\frac{n_2}{2} \cdot t_1 + n_2 \cdot t_2 + \frac{n_2}{2} \cdot t_3}{t_1 + t_2 + t_3 + t_p}$$

Equation 67.4

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



Pre selection conditions

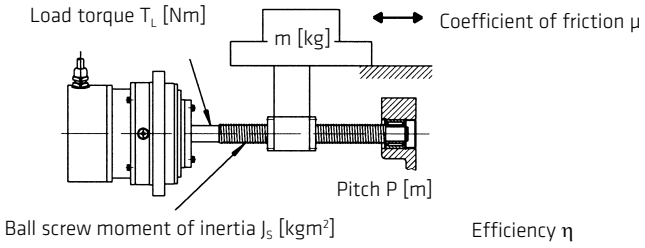
Table 68.1

Load	Confirmation	Catalogue value	Unit
Load max. rotation speed (n_2)	$\leq n_{max}$	Max. 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 responsiveness and accuracy).

Linear horizontal motion

Illustration 68.2



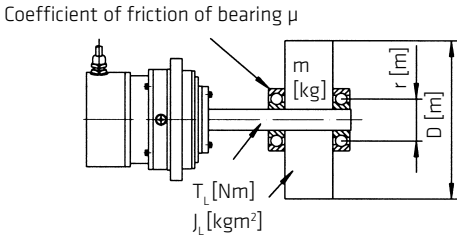
Equation 68.3

$$J_L = J_S + m \left(\frac{P}{2\pi}\right)^2 \text{ [kgm²]}$$

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

Rotary motion

Illustration 68.4

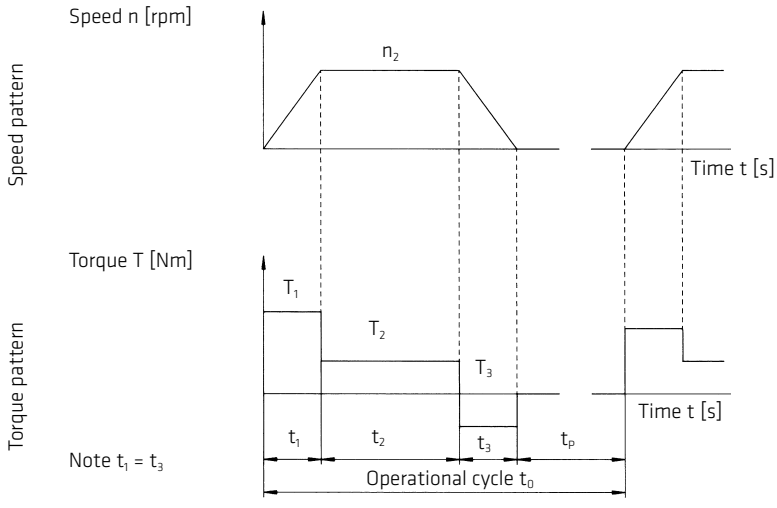


Equation 68.5

$$J_L = \frac{m}{8} \cdot D^2 \text{ [kgm²]}$$

$T_L = \mu \cdot m \cdot g \cdot r$ [Nm] g = 9,81 [m/s²]

Illustration 68.6



Example of actuator selection

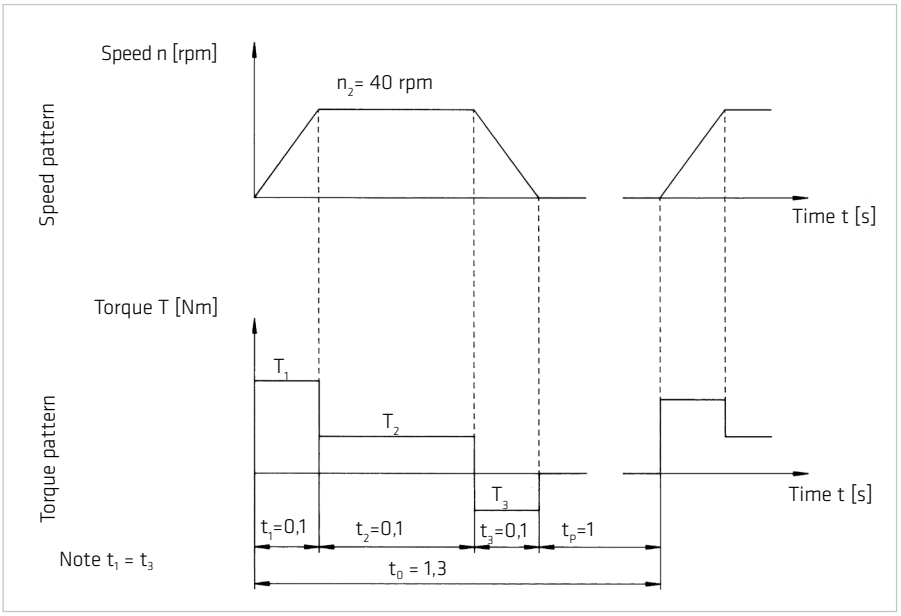
Load Conditions
Assume servo mechanism is used to cyclically position a mass with a horizontal axis of rotation.

Table 69.1

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 69.2



Actuator data FHA-25C-50-L

Table 69.3

Max. Torque	T_{max} = 151 [Nm]
Max. Speed	n_{max} = 90 [rpm]
Moment of inertia	J_{Out} = 0.86 [kgm²]

Actuator selection

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

$n_2 = 40\ rpm < n_{max} = 90\ rpm$
$J_L = 1.3\ kgm^2 < 3J_{out} = 2.58\ kgm^2$

Calculate required acceleration torque (T_1)

$$T_1 = 5 + \frac{2\pi}{60} \cdot \frac{(1.3 + 0.86) \cdot 40}{0.1} = 93\ Nm$$

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

$T_1 = 95\ Nm < T_{max} = 151\ Nm$

No

Yes

Calculate effective torque (T_{rms})

$T_1 = 95\ Nm$
$T_2 = T_L = 5\ Nm$
$T_3 = T_L - (T_1 - T_L) = -85\ Nm$

$$T_{rms} = \sqrt{\frac{95^2 \cdot 0.1 + 5^2 \cdot 0.1 + (-85)^2 \cdot 0.1}{1.3}} = 35\ Nm$$

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

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

$ED = 23\,\%$

$T_{rms} = 35\ Nm$
$n_{av} = 6\ rpm$

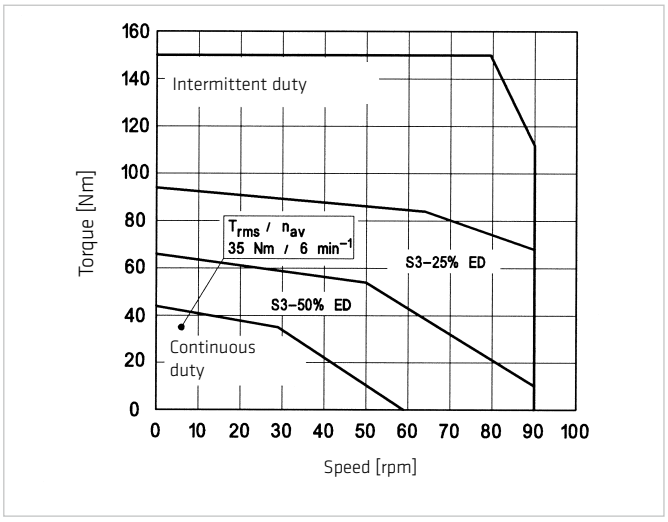
Check according to the performance characteristics

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

Confirm final selection

Illustration 70.1

FHA-25C-50L



$min^{-1} \triangleq rpm$

ED = 1 min.

ADVICE

We will be pleased to make a gear calculation and selection on your behalf. Please contact our application engineers.

4.2 Calculation of the Torsion Angle

Equation 71.1

$$T \leq T_1$$

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

Equation 71.2

$$T_1 < T \leq T_2$$

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

Equation 71.3

$$T > T_2$$

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

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

Example

$T = 60$ Nm $\quad K_1 = 6{,}7 \cdot 10^4$ Nm/rad

$T_1 = 29$ Nm $\quad K_2 = 1{,}1 \cdot 10^5$ Nm/rad

$T_2 = 108$ Nm $\quad K_3 = 1{,}2 \cdot 10^5$ Nm/rad

$$\varphi = \frac{29 \text{ Nm}}{6{,}7 \cdot 10^4 \text{ Nm/rad}} + \frac{60 \text{ Nm} - 29 \text{ Nm}}{11 \cdot 10^4 \text{ Nm/rad}}$$

$$\varphi = 7{,}15 \cdot 10^{-4} \text{ rad}$$

$$\varphi = 2{,}5 \text{ arc min}$$

Equation 71.4

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

4.3 Output Bearing

4.3.1 Lifetime calculation

For oscillating motion

The operating life at oscillating motion can be calculated using equation 72.1.

Equation 72.1

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

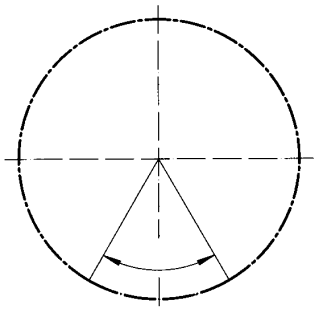
with:

L_{OC} [h]	=	Operating life for oscillating motion
n_1 [cpm]	=	Number of oscillations/minute*
C [N]	=	Dynamic load rating, see table "Output Bearing" in the appropriate product chapter
P_C [N]	=	Dynamic equivalent load
φ [Degree]	=	Oscillating angle
f_W	=	Operating factor

* one oscillation means 2φ

Illustration 72.2

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" in the appropriate product chapter.

Table 72.3

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

For continuous operation

The operating life of the output bearing can be calculated using equation 72.3.

Equation 72.4

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

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

Average output speed

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

Table 72.5

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

Dynamic equivalent load

Equation 73.1

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

Equation 73.2

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

Equation 73.3

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

with:

F_{rav} [N]	=	Radial force
F_{aav} [N]	=	Axial force
d_p [m]	=	Pitch circle
x	=	Radial load factor (Table 73.4)
y	=	Axial load factor (Table 73.4)
M	=	Tilting moment

Table 73.4

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 73.5

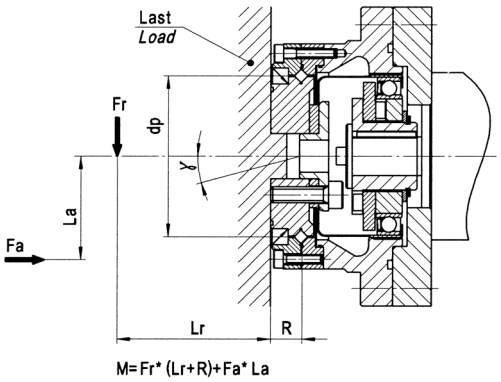
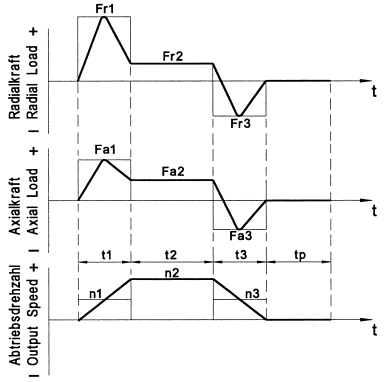


Illustration 73.6



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

4.3.2 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 74.1:

Equation 74.1

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

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

5. Installation and Operation

5.1 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.

5.2 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.

5.3 Mechanical Installation

The data necessary for mounting the actuator and for connecting to the load are given in table 45.1.

Table 75.1

	Symbol [Unit]	CHA-14A	CHA-17A	CHA-20A	CHA-25A	CHA-32A	CHA-40A	CHA-50A	CHA-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). Screws to be secured against loosening. We recommend LOCTITE 243 to secure screws.

5.4 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 EN50110-1 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.

ADVICE

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

5.5 Commissioning

NOTE

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 nmax 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.

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.

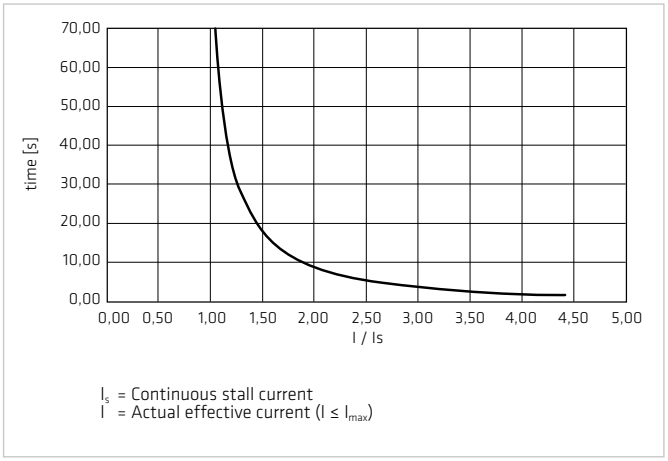
5.6 Overload Protection

Temperature sensors are integrated into the servo actuators and motors to protect them from.

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 only 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.

Illustration 77.1 Over load characteristic



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.

5.7 Protection against Corrosion and Penetration of Liquids and Debris

Table 78.1

	CHA-xxA
Corrosion protection	IEC 68 2-11
Salt spray test	Test time 4 h

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.

5.8 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:
- 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

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 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.

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 (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.

6. Decommissioning and Disposal

The servo actuators and motors from Harmonic Drive AG include lubricants, electronic components and printed circuit boards.

Since lubricants (greases and oils) are considered hazardous substances in accordance with health and safety regulations, it is necessary to dispose of the products correctly. Please ask for safety data sheet where necessary.

7. Glossary

7.1 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.

Average input speed (oil lubrication) $n_{av\ (max)}$ [rpm]

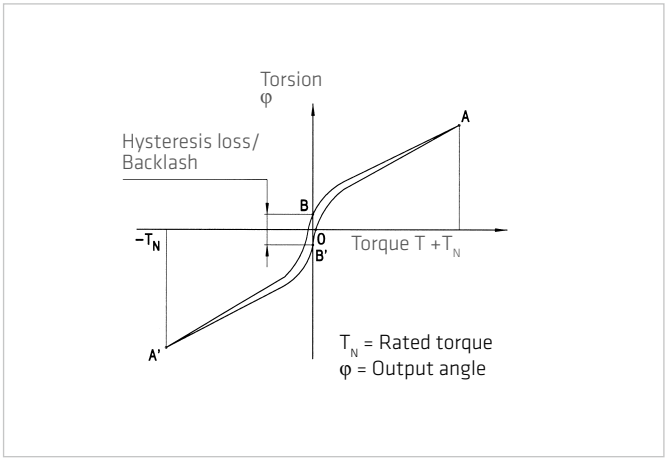
Maximum permissible average gear input speed for oil lubrication.

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 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_H [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.

Collision torque T_M [Nm]

In the event of an emergency stop or collision, the Harmonic Drive® Gearing may be subjected to a brief collision torque. The magnitude and frequency of this collision torque should be kept tom a minimum and under no circumstances should the collision torque occur during the normal operating cycle.

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 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 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.

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 continuous axial hollow shaft.

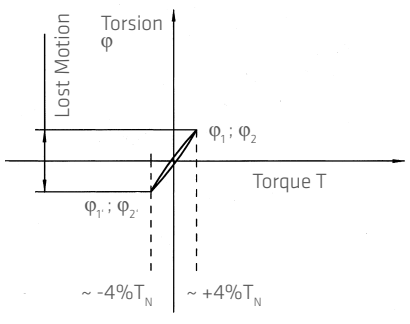
Inductance (L-L) L_{L-L} [mH]

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

Lost Motion (Harmonic Drive® Gearing) [arcmin]

Harmonic Drive® Gearing exhibits 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 diameter of the axial hollow shaft.

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

Maximum allowed input speed for gearing with grease lubrication.

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

Maximum allowed input speed for gearing with oil lubrication.

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 rated speed is greater than the permissible continuous operation calculated in the 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 parameterized 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 average torque is within the permissible continuous operation calculated in the 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.

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 gearing 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.

Number of pole pairs p

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

Offset R [mm]

Distance between output bearing and contact point of load.

Pitch circle diameter d_p [mm]

Pitch circle diameter of the output bearing.

Protetcion 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]

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

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], Mechanic

The rated torque is a reference torque for the calculation of the gear life. When loaded with the rated torque and running at rated speed the gear will reach the average life L_{50}. 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.

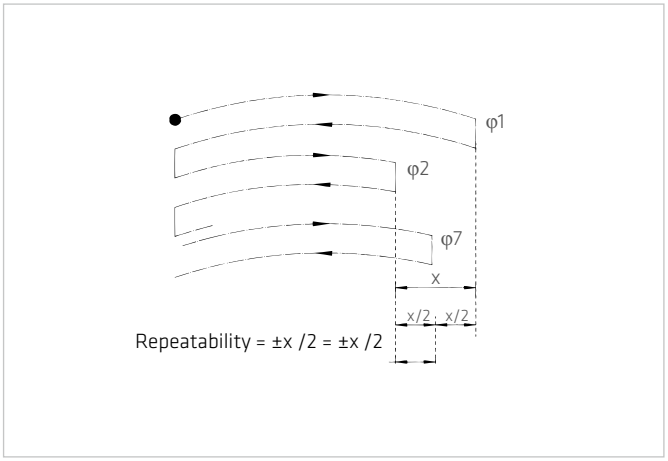
Ratio i [ ]

The ratio is the reduction of input speed to the output speed.

Note for Harmonic Drive® transmission: The standard version of the wave is generating the drive element, the output element of the flexspline and the circular Spline is fixed to the housing. Since the direction of rotation of the drive (Wave Generator) to output reverses (Flexspline), a negative ratio for results Calculations in which the direction of rotation 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.



Repeatable peak torque T_R [Nm]

Specifies the maximum allowable acceleration and braking torques. During the normal operating cycle the repeatable peak torque T_R should be not be exceeded.

Resistance (L-L, 20° C) R_{L-L} [Ω]

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

Size

1) Actuators / Gears with Harmonic Drive® gears or Harmonic Planetary gears
The frame size is derived from the pitch circle diameter of the gear teeth in inches multiplied by 10.

2) CHM Servo motor series
The size of the CHM servo motors is derived from the stall torque in Ncm.

3) Direct drives from the TorkDrive® series
The size of the TorkDrive® series is the outer diameter of theiron core of the stator.

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.

Tilting moment stiffness K_B [Nm/arcmin]

The tilting angle of the output bearing at an applied moment load.

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

Quotient of stall torque and stall current.

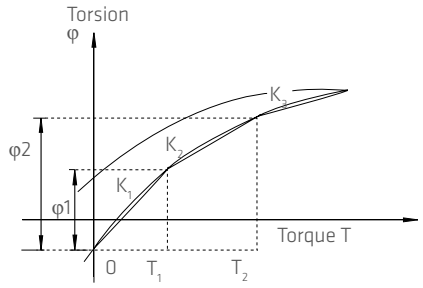
Torque constant (output) k_{Tout} [Nm/A_{rms}]

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

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

The amount of elastic rotation at the output for a given torque and the Wave Generator blocked. The torsional stiffness K_3 describes the stiffness above a defined reference torque where the stiffness is almost linear. Values below this torque can be requested or found on our web site.

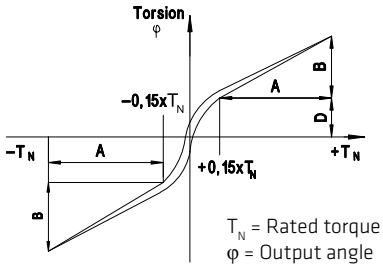
The value given for the torsional stiffness K_3 is an average that has been determined during numerous tests. The limit torques T_1 and T_2 and calculation example for the total torsional angle Gesamtverdrehwinkels can be found in the secondary technical documentation.



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 [Nm/rad]

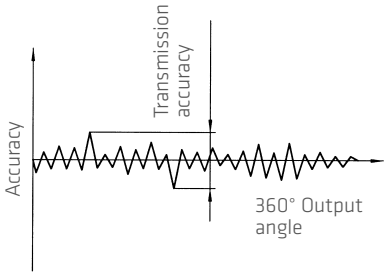
The amount of elastic rotation at the output for a given torque and blocked input shaft. The torsional rigidity of the Harmonic Planetary gear describes the rotation of the gear above a reference torque of 15% of the rated torque. In this area the torsional stiffness is almost linear.



T_N = Rated torque
φ = Output angle

Transmission accuracy [arcmin]

The transmission accuracy of the gear represents a 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 theoretical and actual output rotation angle.



Weight m [kg]

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

7.2 Labelling, Guidelines and Regulations

CE-Marking

With the CE marking, the manufacturer or EU importer declares in accordance with EU regulation, that by affixing the CE mark the product meets the applicable requirements in the harmonization legislation established the Community.

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.

8. Appendix

8.1 Declaration of Conformity CHA-14A ... CHA-17A

EG-Konformitätserklärung
EC Declaration of Conformity

Harmonic Drive AG

Hersteller, *Manufacturer*:	Harmonic Drive AG
Anschrift, *Address*	Hoenbergstraße 14 65555 Limburg
Produktbezeichnung:	**Servoantrieb CHA-14A/17A (in Standardbauform)** **Servomotor CHM-0030A/0070A (in Standardbauform)**
Product description:	***Servo Actuator CHA-14A/17A (standard version)*** ***Servo Motor CHM-0030A/0070A (standard version***

Die oben bezeichneten Produkte stimmen in der von uns in Verkehr gebrachten Ausführung mit den Vorschriften folgender Europäischer Richtlinien überein.
The products described above in the form as delivered are in conformity with the provisions of the following European Directives.

2014/35/EG Elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen.
2014/35/EC Electrical equipment designed for use within certain voltage limits.

Die Konformität wird nachgewiesen durch die Einhaltung nachfolgender Normen.
Conformity is assured through the application of the following Standards.

- EN 60034-1/ 2010
- EN 61800-5-1/ 2008
- EN 60664-1/ 2008

2004/108/EG Elektromagnetische Verträglichkeit.
2004/108/EC Electromagnetic compatibility.

Die Konformität wird nachgewiesen durch die nachfolgender Normen.
Conformity is assured through the application of the following Standards.

- EN 61800-3/ 2012

2011/65/EG Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten.
2011/65/EC Restriction of the use of certain hazardous substances in electrical and electronic equipment.

Die Sicherheitshinweise und die technischen Dokumentation sind zu beachten.
The safety requirements and the technical documentation have to be considered.

CE-Kennzeichnung/ *CE marking:* *July 2013*

Limburg, 01.08.2014

i. V. Ralf Falk
Leiter Konstruktion und Entwicklung Servotechnik
Section Manager Design and Development Servo Drives

i. A. Alois Buss
Produktmanager Servotechnik
Product Manager Servo Drives

Rev.: 06/12

8.2 Declaration of Conformity CHA-20A ... CHA-58A

EG-Konformitätserklärung
EC Declaration of Conformity

Harmonic Drive AG

Hersteller, *Manufacturer*: Harmonic Drive AG
Anschrift, *Address* Hoenbergstraße 14
65555 Limburg

Produktbezeichnung: **Servoantrieb CHA-20A~58A (in Standardbauform)**
Servomotor CHM-0083A~1100A (in Standardbauform)
Product description: ***Servo Actuator CHA-20A~58A (standard version)***
Servo Motor CHM-0083A~1100A (standard version)

Die oben bezeichneten Produkte stimmen in der von uns in Verkehr gebrachten Ausführung mit den Vorschriften folgender Europäischer Richtlinien überein.
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Die Konformität wird nachgewiesen durch die nachfolgender Normen.
Conformity is assured through the application of the following Standards.

- EN 61800-3/ 2012

Die Sicherheitshinweise und die technischen Dokumentation sind zu beachten.
The safety requirements and the technical documentation have to be considered.

CE-Kennzeichnung/ *CE marking:* *January 2006*

Limburg, 01.08.2014

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Rev.: 06/12

...just move it!

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Subject to technical changes

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