19.1 Overview

Compact helical right-angle geared motor

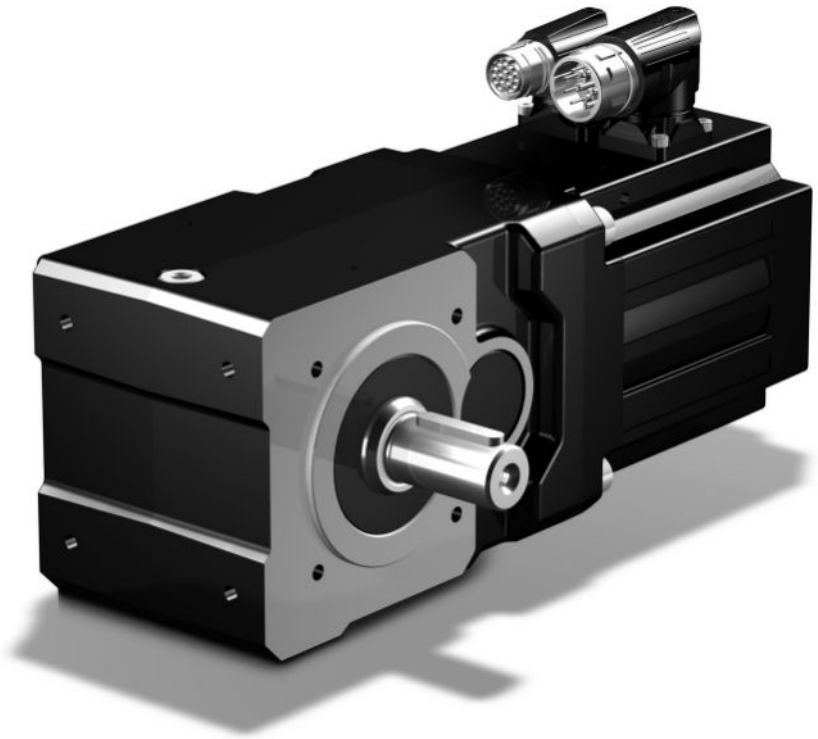
Technical Data

i	4 – 32
M_{2acc}	11 – 65 Nm
$\Delta\varphi_2$	16 – 25 arcmin
η	≤ 97 %

Features

Power density	★★☆☆☆
Backlash	★☆☆☆☆
Price category	€
Shaft load	★★☆☆☆
Smooth running	★★☆☆☆
Torsional stiffness	★★☆☆☆
Mass moment of inertia	★★★★★
Helical gearing	✓
Maintenance-free	✓
Any installation position	✓
Small installation space	✓
FKM sealing ring on the input	✓

Key: ★☆☆☆☆ good | ★★★★★ excellent



19.2 Selection tables

The technical data specified in the selection tables applies for:

- Installation altitudes up to 1000 m above sea level
- Surrounding temperatures from 0° C to 40° C
- Drives with convection cooled motors (e.g. EZ401**U**)

To calculate the technical data for drives with forced ventilated motors (for example EZ401**B**) or water-cooled motors (for example EZ401**W**) visit http://products.stoeber.de.

Formula symbols	Unit	Explanation
a_{th}	–	Parameter for calculating $K_{mot,th}$
C_2	Nm/ arcmin	Torsional stiffness of gear unit (final stiffness) relative to the gear unit output
$\Delta\varphi_2$	arcmin	Backlash on the output shaft with the input blocked
η	%	Efficiency
i	–	Gear ratio
i_{exakt}	–	Mathematically accurate gear transmission ratio
J_1	$10^{-4}kgm^2$	Mass moment of inertia relative to the gear unit input
m	kg	Weight
$M_{2.0}$	Nm	Standstill torque on the gear unit output
M_{2acc}	Nm	Maximum permitted acceleration torque on the gear unit output
$M_{2acc,max}$	Nm	Maximum permitted acceleration torque of a group of geared motor having the same size and nominal speed n_{1N}
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
M_{2NOT}	Nm	Emergency off torque of the gear unit at gear unit output for max. 1000 load changes
n_{1maxDB}	rpm	Maximum permitted input speed of the gear unit in continuous operation
		(for surrounding temperature of 20 °C)
n_{1maxZB}	rpm	Maximum permitted input speed of the gear unit in cyclic operation
		(for surrounding temperature of 20 °C)
n_{1N}	rpm	Nominal speed on the gear unit input
n_{2N}	rpm	Nominal speed on the gear unit output
S	–	Characteristic load value: quotient of nominal gear unit and motor torque without taking the thermal output limit into consideration. Represents a dimension for the reserve of the geared motor.

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n_{2N} [rpm]	M_{2N} [Nm]	$M_{2,0}$ [Nm]	a_{th}	S	Type	M_{2acc} [Nm]	M_{2NOT} [Nm]	i	i_{exakt}	n_{1max} DB [rpm]	n_{1max} ZB [rpm]	J_1 [10^{-4} kgm²]	$\Delta\varphi_2$ [arcmin]	C_2 [Nm/ arcmin]	m [kg]
KL1 (n_{1N} = 3000 rpm, $M_{2acc,max}$ = 30 Nm)															
188	14	15	16	1.7	KL102_0160 EZ301U	30	60	16.00	16/1	4000	6000	0.22	20	1.8	6.6
375	7.2	7.4	17	2.7	KL102_0080 EZ301U	22	58	8.000	8/1	3500	5000	0.28	20	1.8	6.6
375	12	13	29	1.6	KL102_0080 EZ302U	30	58	8.000	8/1	3500	5000	0.38	20	1.8	7.2
375	16	17	38	1.2	KL102_0080 EZ303U	30	58	8.000	8/1	3500	5000	0.49	20	1.8	7.7
750	3.6	3.7	22	3.6	KL102_0040 EZ301U	11	29	4.000	4/1	3500	5000	0.31	25	1.3	6.6
750	6.2	6.5	37	2.1	KL102_0040 EZ302U	19	29	4.000	4/1	3500	5000	0.41	25	1.3	7.2
750	8.0	8.5	49	1.6	KL102_0040 EZ303U	22	29	4.000	4/1	3500	5000	0.52	25	1.3	7.7
KL1 (n_{1N} = 6000 rpm, $M_{2acc,max}$ = 30 Nm)															
375	14	15	20	1.4	KL102_0160 EZ301U	30	60	16.00	16/1	4000	6000	0.22	20	1.8	6.6
750	6.9	7.4	26	1.8	KL102_0080 EZ301U	18	35	8.000	8/1	4000	6000	0.22	25	1.3	6.6
750	12	13	44	1.1	KL102_0080 EZ302U	18	35	8.000	8/1	4000	6000	0.32	25	1.3	7.2
KL2 (n_{1N} = 3000 rpm, $M_{2acc,max}$ = 65 Nm)															
94	29	29	11	1.6	KL202_0320 EZ301U	65	130	32.00	32/1	4000	6000	0.26	16	3.2	9.1
188	14	15	9.0	3.5	KL202_0160 EZ301U	43	120	16.00	16/1	4000	6000	0.28	16	4.0	9.1
188	25	26	15	2.0	KL202_0160 EZ302U	60	120	16.00	16/1	4000	6000	0.38	16	4.0	9.7
188	32	34	20	1.6	KL202_0160 EZ303U	60	120	16.00	16/1	4000	6000	0.49	16	4.0	10
375	7.2	7.4	15	3.5	KL202_0080 EZ301U	22	58	8.000	8/1	4000	6000	0.31	20	2.4	9.1
375	12	13	26	2.0	KL202_0080 EZ302U	35	58	8.000	8/1	4000	6000	0.41	20	2.4	9.7
375	16	17	33	1.6	KL202_0080 EZ303U	35	58	8.000	8/1	4000	6000	0.52	20	2.4	10
375	22	23	29	1.8	KL202_0080 EZ401U	60	120	8.000	8/1	3500	5000	1.2	16	4.0	12
375	36	40	48	1.1	KL202_0080 EZ402U	60	120	8.000	8/1	3500	5000	1.9	16	4.0	13
750	11	12	34	2.6	KL202_0040 EZ401U	33	58	4.000	4/1	3500	5000	1.4	20	2.4	12
750	18	20	57	1.5	KL202_0040 EZ402U	47	58	4.000	4/1	3500	5000	2.1	20	2.4	13
KL2 (n_{1N} = 6000 rpm, $M_{2acc,max}$ = 65 Nm)															
188	28	29	14	1.4	KL202_0320 EZ301U	65	130	32.00	32/1	4000	6000	0.26	16	3.2	9.1
375	14	15	11	2.9	KL202_0160 EZ301U	43	120	16.00	16/1	4000	6000	0.28	16	4.0	9.1
375	23	26	18	1.7	KL202_0160 EZ302U	60	120	16.00	16/1	4000	6000	0.38	16	4.0	9.7
375	30	35	24	1.3	KL202_0160 EZ303U	60	120	16.00	16/1	4000	6000	0.49	16	4.0	10
375	36	43	28	1.1	KL202_0160 EZ401U	60	120	16.00	16/1	4000	6000	1.0	16	4.0	12
750	6.9	7.4	14	3.7	KL202_0080 EZ301U	22	58	8.000	8/1	4000	6000	0.31	20	2.4	9.1
750	12	13	24	2.2	KL202_0080 EZ302U	35	58	8.000	8/1	4000	6000	0.41	20	2.4	9.7
750	15	17	32	1.7	KL202_0080 EZ303U	35	58	8.000	8/1	4000	6000	0.52	20	2.4	10
750	18	22	37	1.4	KL202_0080 EZ401U	35	71	8.000	8/1	4000	6000	1.0	20	2.4	12

19.3 Dimensional drawings

In this chapter you can find the dimensions of the geared motors.

There is a dimensional drawing for every possible shaft/housing design, each with the tables for gear unit dimensions, motor dimensions and geared motor dimensions.

Dimensions may exceed the requirements of ISO 2768-mK due to casting tolerances or the sum of additional tolerances.

We reserve the right to make modifications to the dimensions due to technical advances.

You can download CAD model of our standard drives from http://cad.stoeber.de.

Combined options and the dimensions of forced ventilated or water-cooled geared motors can be found at http://cad.stoeber.de.

Tolerances

Axis height according to DIN 747	Tolerance
Up to 50 mm	-0.4 mm
Up to 250 mm	-0.5 mm
Up to 630 mm	-0.6 mm

Solid shaft	Tolerance
Shaft end fit ∅ ≤ 50 mm	DIN 748-1, ISO k6
Shaft end fit ∅ > 50 mm	DIN 748-1, ISO m6
Feather keys	DIN 6885-1, high shape A

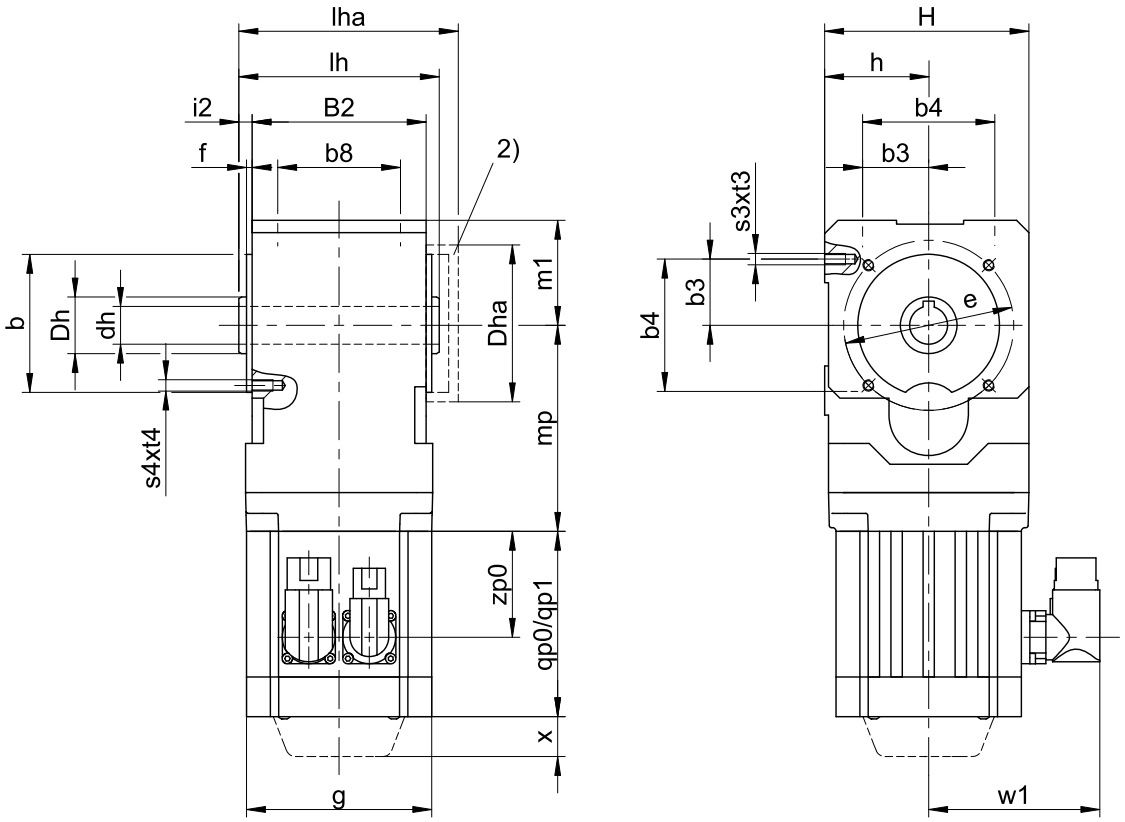
Centering holes in solid shafts according to DIN 332-2, shape DR

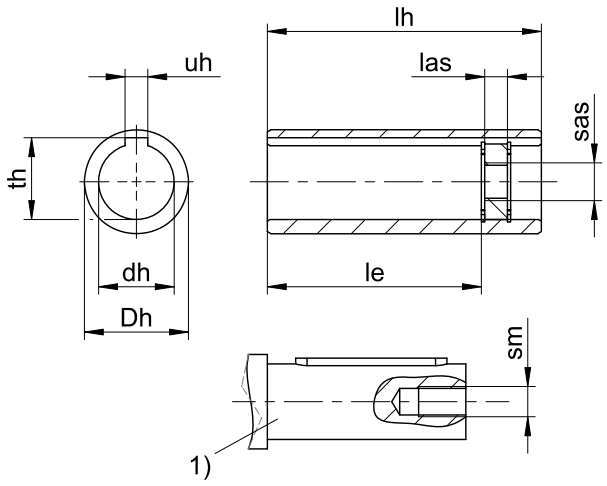
Thread size	M4	M5	M6	M8	M10	M12	M16	M20	M24
Thread depth	10	12.5	16	19	22	28	36	42	50

Hollow shaft	Tolerance
Hollow shaft hole fit	ISO G7

Flange	Pilot tolerance
Up to 300 mm	ISO j6
From 350 mm	ISO h6

19.3.1 Shaft design A (hollow shaft), housing design G (pitch circle diameter)





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.	1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.
2)	Cover (optional)		

Dimensions of gear units

Type	Øb	b3	b4	b8	B2	Ødh	Dh	Dha	Øe	f	h	H	i2	le	lh	las	lha	m1	s3	s4	sm	sas	t3	t4	th	uh
KL1	60_{j6}	27.5	55	50	75	16^{G7}	25	70	75	3	46	90	6	60.5	87	12	114.5	46	M6	M6	M5	M6	11	11	18.3	5^{JS9}
KL2	75_{j6}	35.0	70	65	92	20^{G7}	30	80	90	3	55	108	7	79.5	106	12	139.0	55	M6	M6	M6	M8	11	11	22.8	6^{JS9}

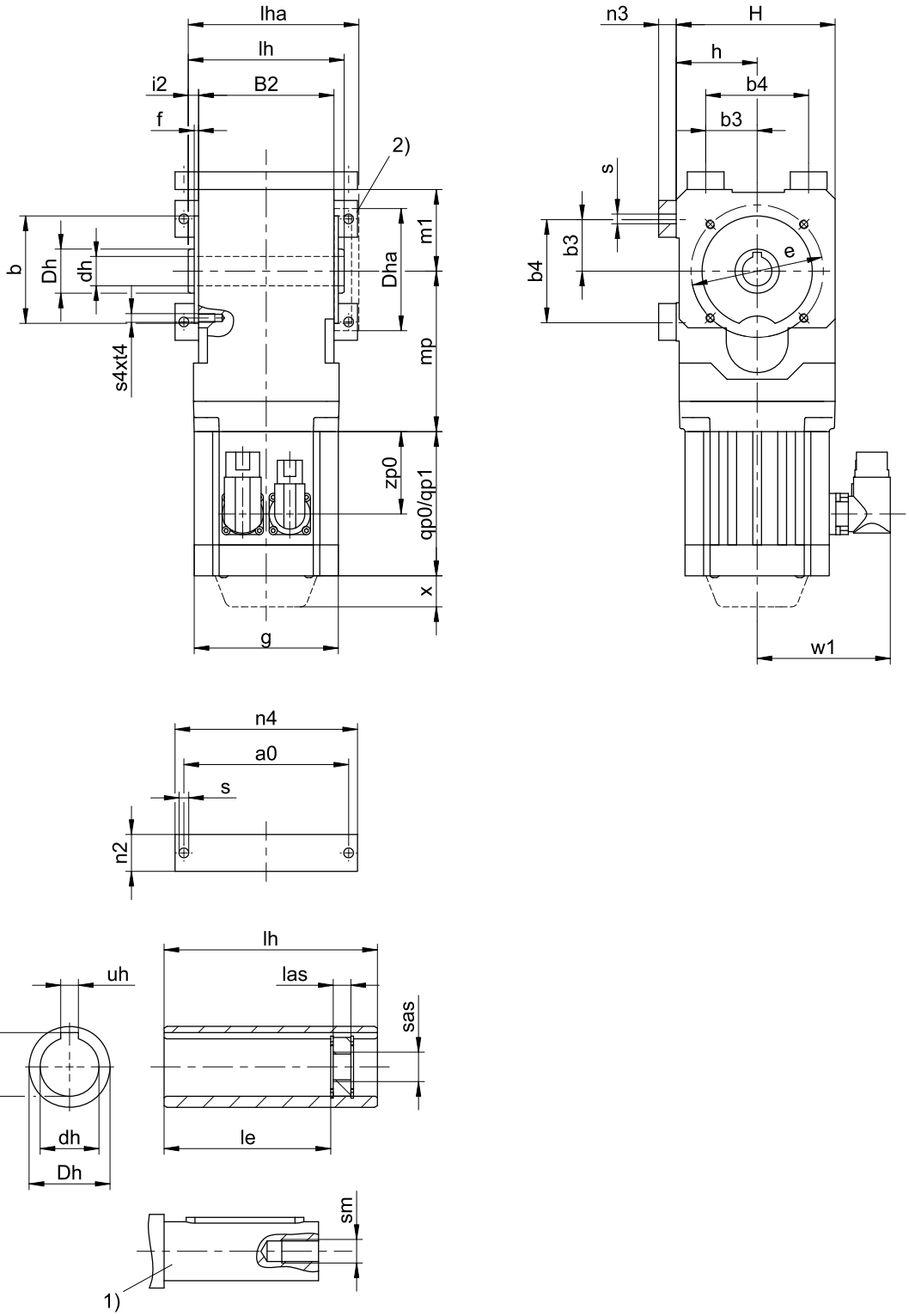
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.2 Shaft design A (hollow shaft), housing design NG (foot + pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.	1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.
2)	Cover (optional)		

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Dimensions of gear units

Type	a0	Øb	b3	b4	B2	Ødh	Dh	Dha	Øe	f	h	H	i2	le	lh	las	lha	m1	n2	n3	n4	Øs	s4	sm	sas	t4	th	uh
KL1	95	60_{j6}	27.5	55	75	16^{G7}	25	70	75	3	46	90	6	60.5	87	12	114.5	46	20	12	107	6.6	M6	M5	M6	11	18.3	5^{JS9}
KL2	112	75_{j6}	35.0	70	92	20^{G7}	30	80	90	3	55	108	7	79.5	106	12	139.0	55	25	12	124	6.6	M6	M6	M8	11	22.8	6^{JS9}

Dimensions of motors

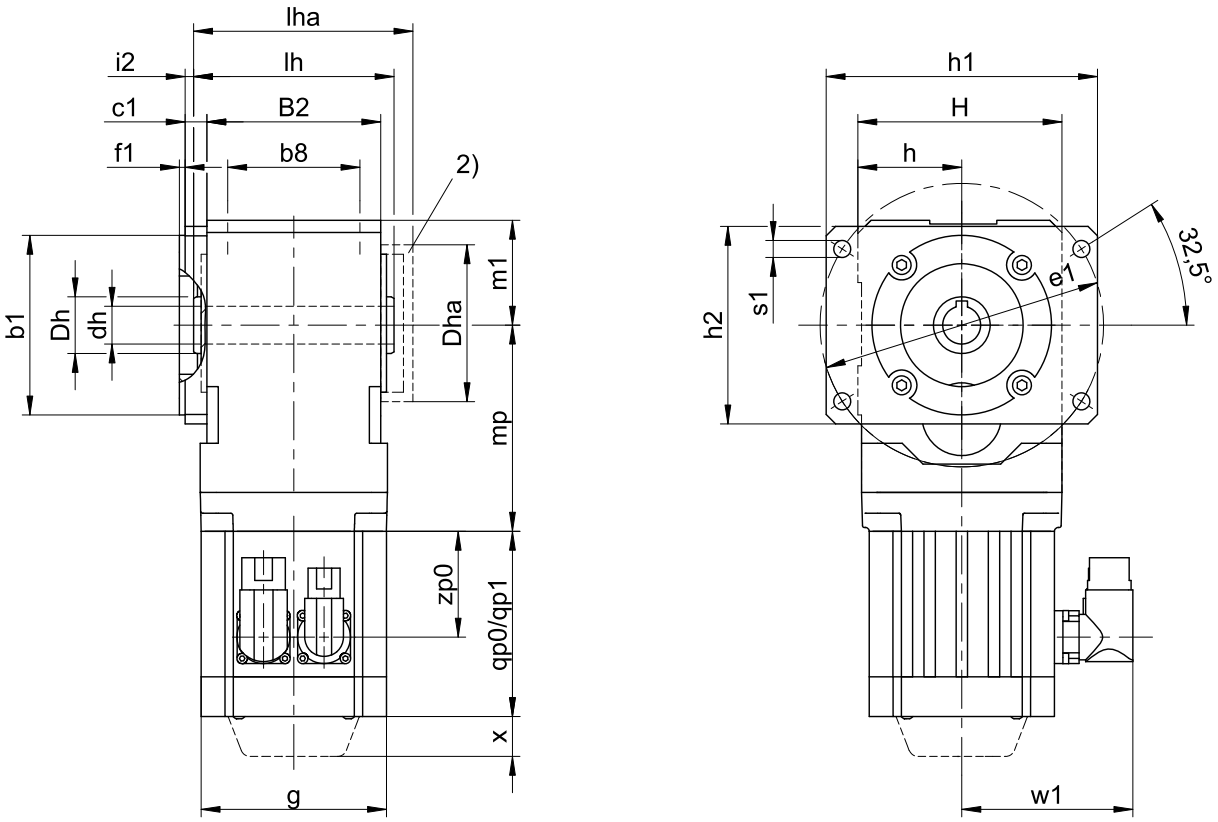
Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

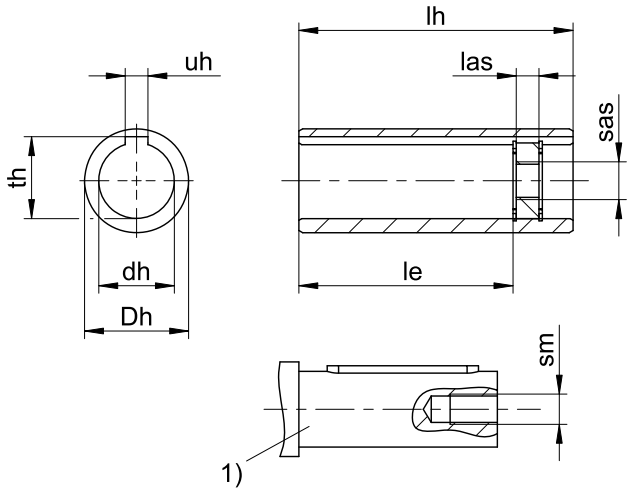
Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

KL

19.3.3 Shaft design A (hollow shaft), housing design F (flange)





qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.	1)	The length of the machine shaft must be at least 2.2 x ∅dh and the length of the feather key must be at least 2 x ∅dh.
2)	Cover (optional)		

Dimensions of gear units

Type	Øb1	b8	B2	c1	Ødh	Dh	Dha	Øe1	f1	h	h1	h2	H	i2	le	lh	las	lha	m1	Øs1	sm	sas	th	uh
KL1	60_{j6}	50	75	11.5	16^{G7}	25	70	130	3	46	128.5	88.5	90	6	60.5	87	12	114.5	46	9	M5	M6	18.3	5^{JS9}
KL2	95_{j6}	65	92	11.5	20^{G7}	30	80	150	3	55	143.5	104.5	108	7	79.5	106	12	139.0	55	9	M6	M8	22.8	6^{JS9}

Dimensions of motors

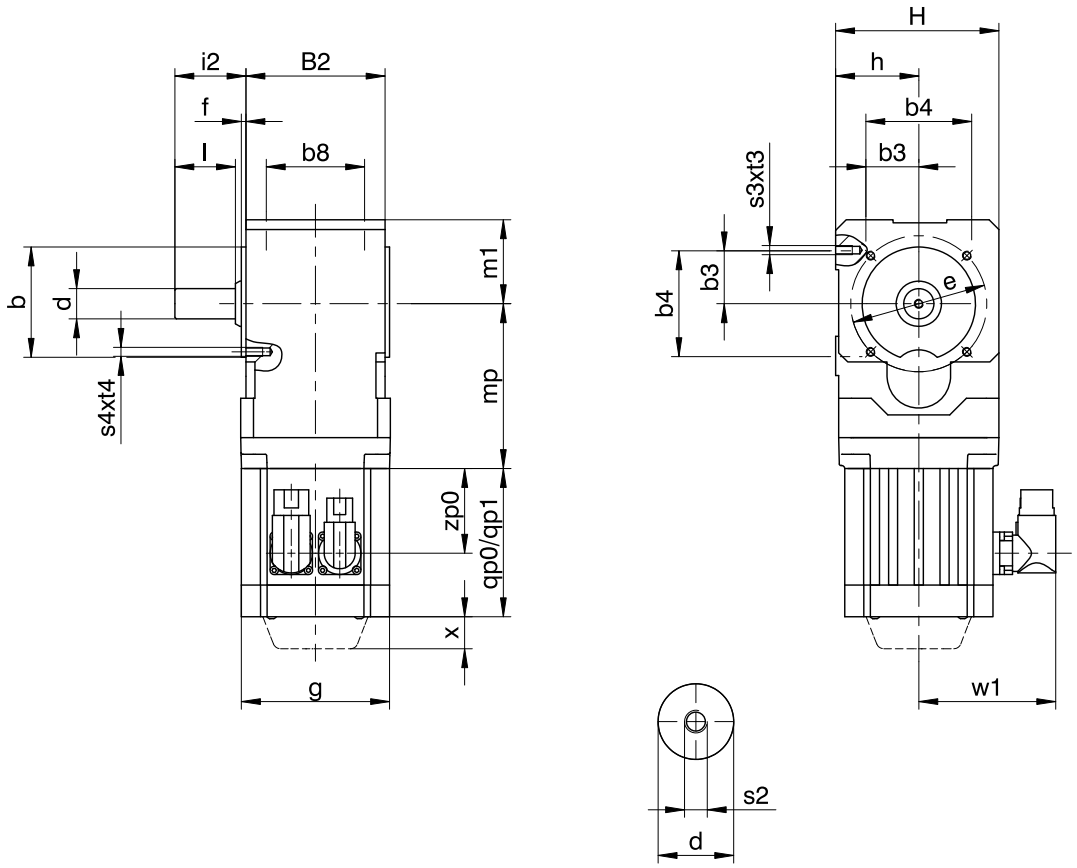
Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

KL

19.3.4 Shaft design G (solid shaft without feather key), housing design G (pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.		

Dimensions of gear units

Type	Øb	b3	b4	b8	B2	Ød	Øe	f	h	H	i2	l	m1	s2	s3	s4	t3	t4
KL1	60_{j6}	27.5	55	50	75	16_{k6}	75	3	46	90	38	32	46	M5	M6	M6	11	11
KL2	75_{j6}	35.0	70	65	92	20_{k6}	90	3	55	108	47	40	55	M6	M6	M6	11	11

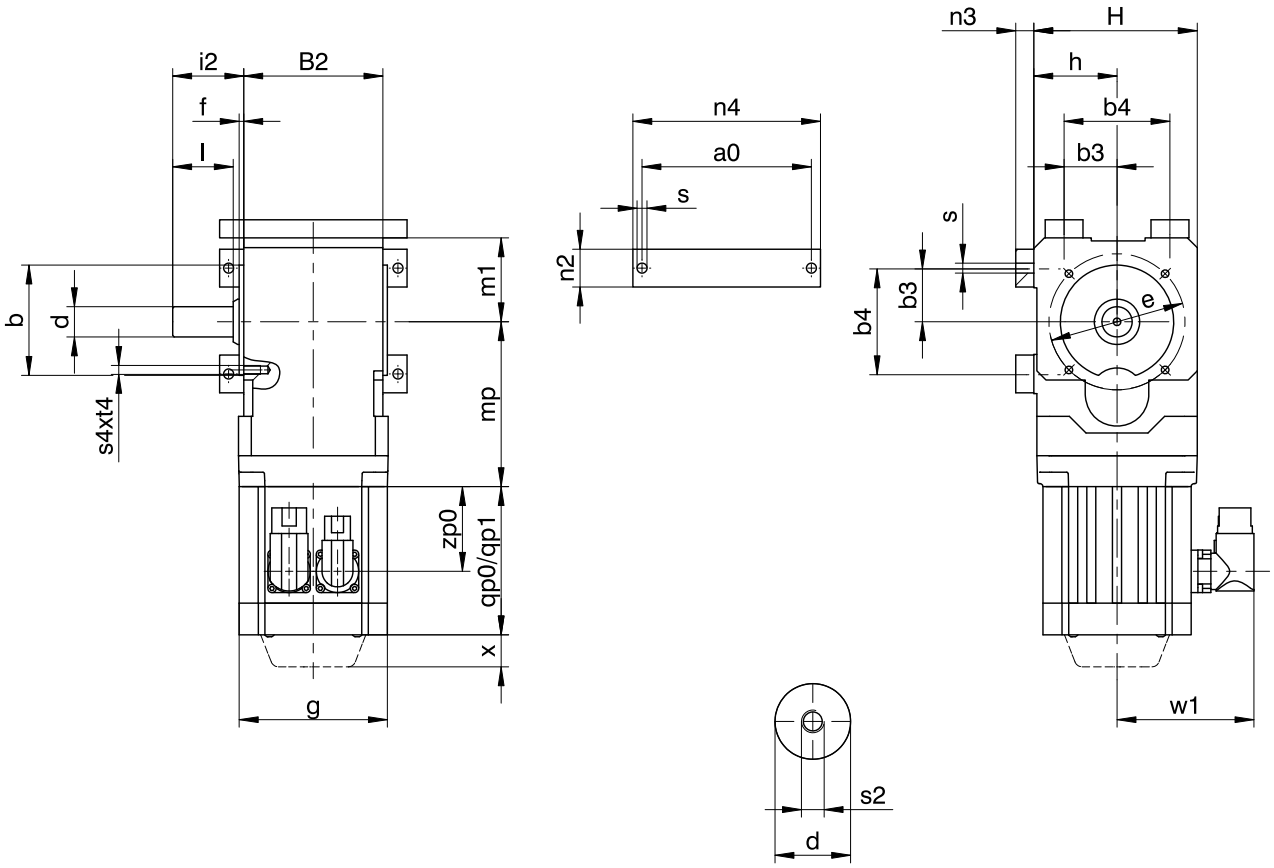
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.5 Shaft design G (solid shaft without feather key), housing design NG (foot + pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.		

KL

Dimensions of gear units

Type	a0	Øb_{j6}	b3	b4	B2	Ød_{k6}	Øe	f	h	H	i2	l	m1	n2	n3	n4	Øs	s2	s4	t4
KL1	95	60_{j6}	27.5	55	75	16_{k6}	75	3	46	90	38	32	46	20	12	107	6.6	M5	M6	11
KL2	112	75_{j6}	35.0	70	92	20_{k6}	90	3	55	108	47	40	55	25	12	124	6.6	M6	M6	11

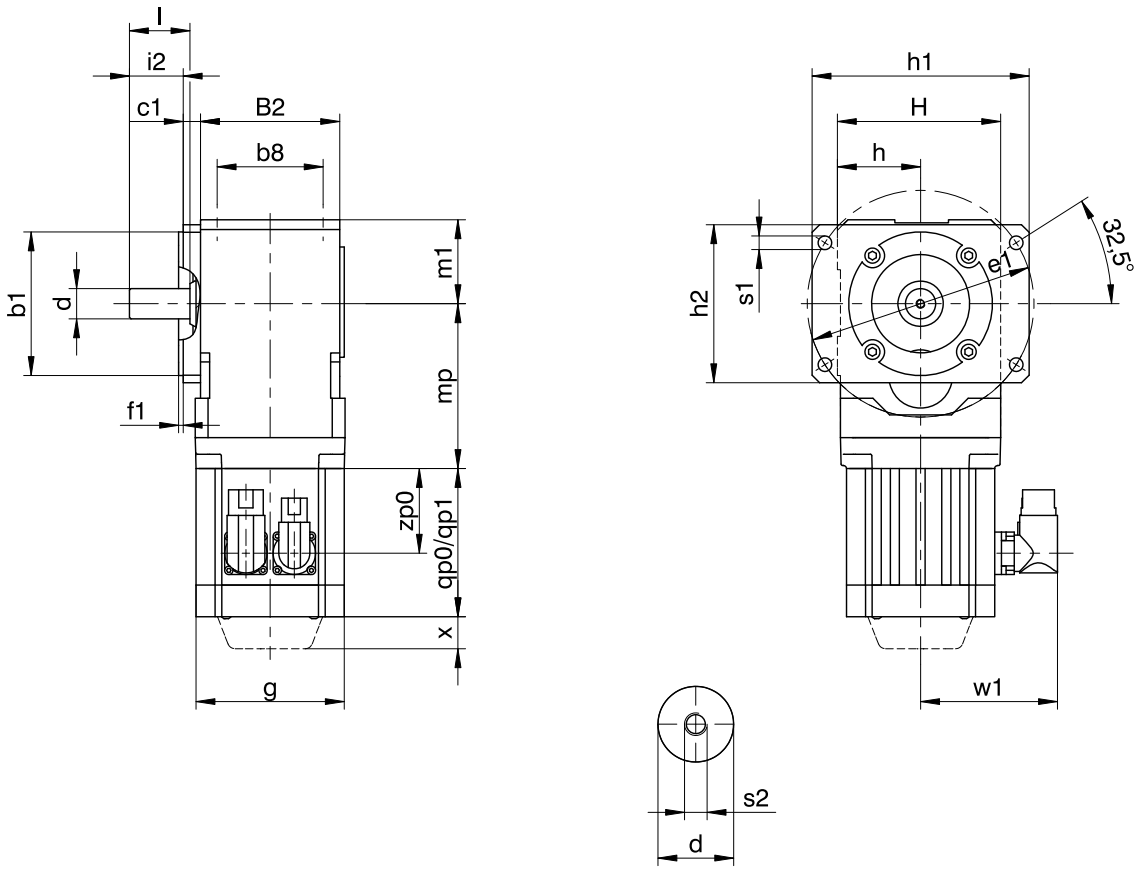
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.6 Shaft design G (solid shaft without feather key), housing design F (flange)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.		

Dimensions of gear units

Type	Øb1	b8	B2	c1	Ød	Øe1	f1	h	h1	h2	H	i2	l	m1	Øs1	s2
KL1	60_{j6}	50	75	11.5	16_{k6}	130	3	46	128.5	88.5	90	26.5	32	46	9	M5
KL2	95_{j6}	65	92	11.5	20_{k6}	150	3	55	143.5	104.5	108	35.5	40	55	9	M6

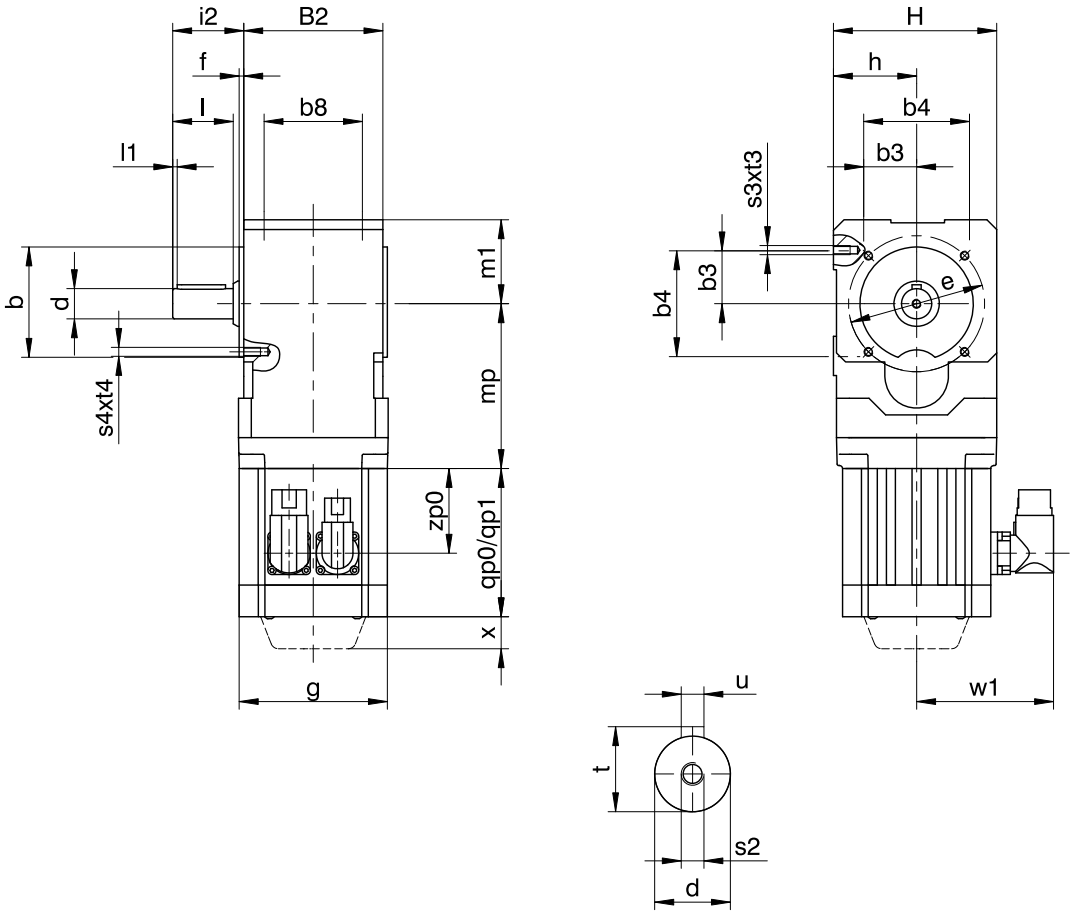
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.7 Shaft design P (solid shaft with feather key), housing design G (pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.		

Dimensions of gear units

Type	Øb	b3	b4	b8	B2	Ød	Øe	f	h	H	i2	l	l1	m1	s2	s3	s4	t	t3	t4	u
KL1	60_{j6}	27.5	55	50	75	16_{k6}	75	3	46	90	38	32	3	46	M5	M6	M6	18	11	11	A5x5x22
KL2	75_{j6}	35.0	70	65	92	20_{k6}	90	3	55	108	47	40	3	55	M6	M6	M6	22.5	11	11	A6x6x32

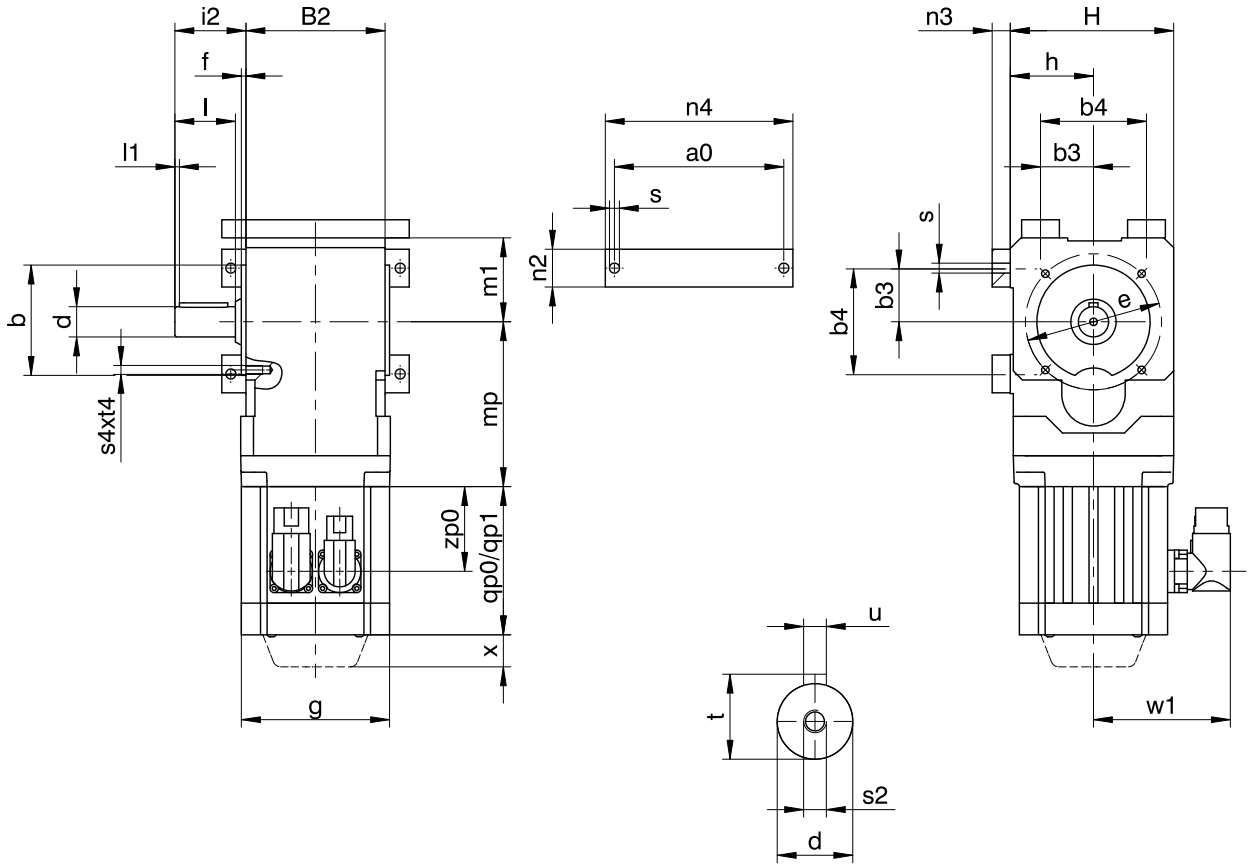
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.8 Shaft design P (solid shaft with feather key), housing design NG (foot + pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.		

Dimensions of gear units

Type	a0	Øb	b3	b4	B2	Ød	Øe	f	h	H	i2	l	l1	m1	n2	n3	n4	Øs	s2	s4	t	t4	u
KL1	95	60_{j6}	27.5	55	75	16_{k6}	75	3	46	90	38	32	3	46	20	12	107	6.6	M5	M6	18.0	11	A5x5x22
KL2	112	75_{j6}	35.0	70	92	20_{k6}	90	3	55	108	47	40	3	55	25	12	124	6.6	M6	M6	22.5	11	A6x6x32

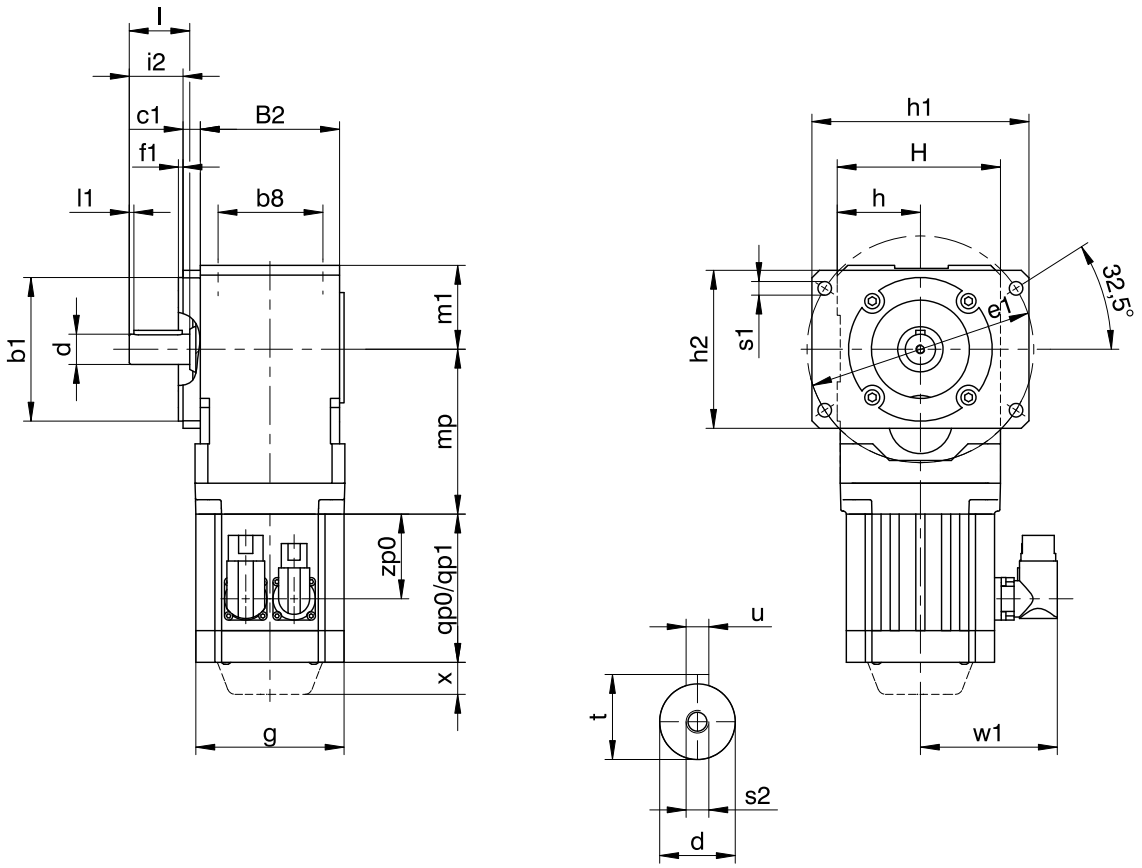
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.9 Shaft design P (solid shaft with feather key), housing design F (flange)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.		

Dimensions of gear units

Type	Ø$b1$	b8	B2	c1	Ød	Ø$e1$	f1	h	h1	h2	H	i2	l	l1	m1	Ø$s1$	s2	t	u
KL1	60_{j6}	50	75	11.5	16_{k6}	130	3	46	128.5	88.5	90	26.5	32	3	46	9	M5	18.0	A5x5x22
KL2	95_{j6}	65	92	11.5	20_{k6}	150	3	55	143.5	104.5	108	35.5	40	3	55	9	M6	22.5	A6x6x32

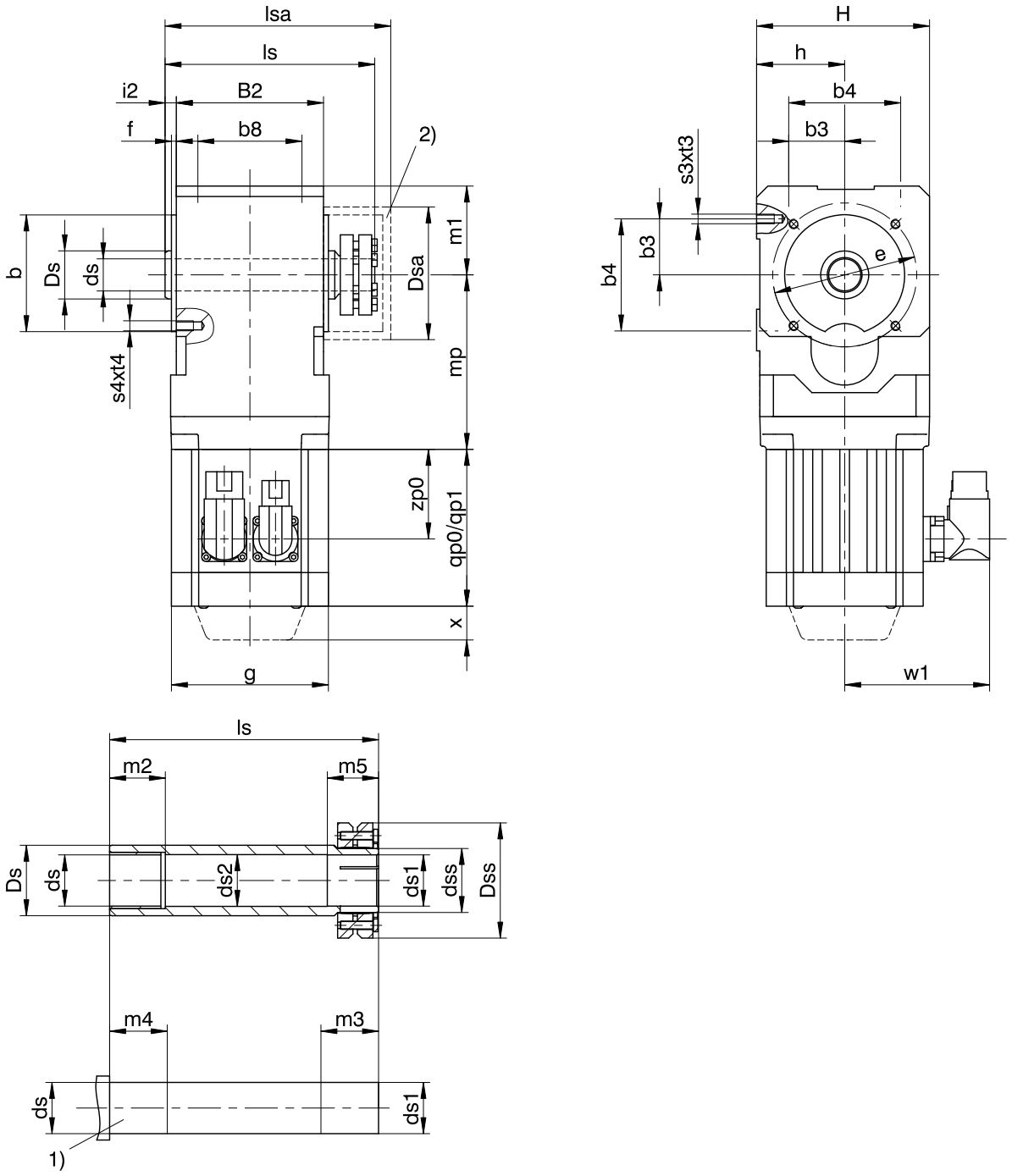
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.10 Shaft design S (hollow shaft with shrink disk), housing design G (pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.	1)	Machine shaft: must not be less than the specified dimension.
2)	Cover (optional)		

Dimensions of gear units

Type	Øb	b3	b4	b8	B2	Øds	Øds1	Øds2	Ødss	ØDs	ØDsa	ØDss	Øe	f	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	s3	s4	t3	t4
KL1	60_{j6}	27.5	55	50	75	16^{H7}	$16_{h6}{}^{H7}$	17.5	20	25	64	46.2	75	3	46	90	6	109	114.5	46	17	22	28	23	M6	M6	11	11
KL2	75_{j6}	35.0	70	65	92	20^{H7}	$20_{h6}{}^{H7}$	21.5	24	30	79	50.0	90	3	55	108	7	131	139.0	55	22	27	31	26	M6	M6	11	11

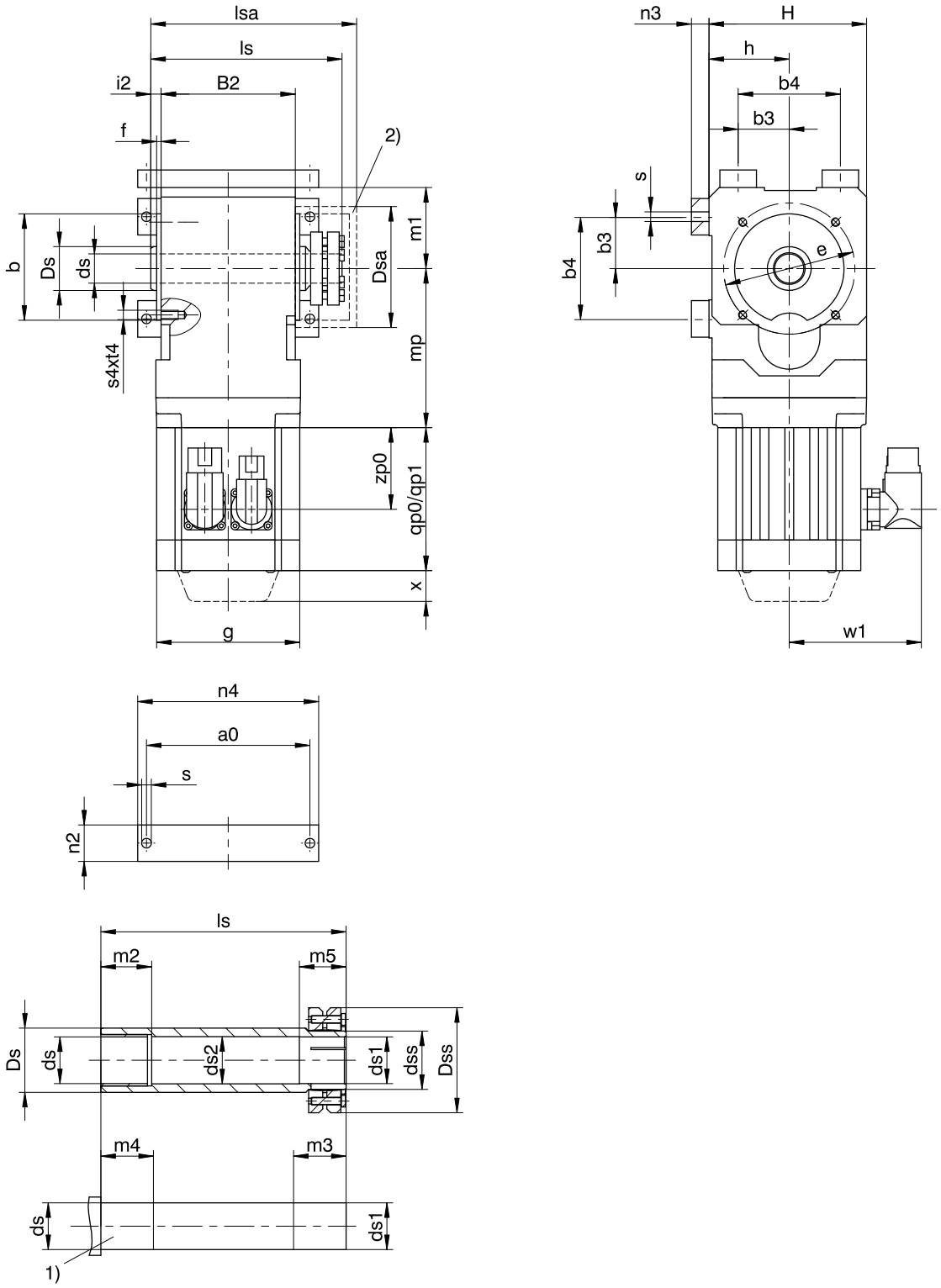
Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.3.11 Shaft design S (hollow shaft with shrink disk), housing design NG (foot + pitch circle diameter)



qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.	1)	Machine shaft: must not be less than the specified dimension.
2)	Cover (optional)		

Dimensions of gear units

Type	a0	Øb	b3	b4	B2	Ød	Ød1	Ød2	Ødss	ØDs	ØDsa	ØDss	Øe	f	h	H	i2	ls	lsa	m1	m2	m3	m4	m5	n2	n3	n4	Øs	s4	t4
KL1	95	60_{j6}	27.5	55	75	16^{H7}	$16_{h6}{}^{H7}$	17.5	20	25	64	46.2	75	3	46	90	6	109	114.5	46	17	22	28	23	20	12	107	6.6	M6	11
KL2	112	75_{j6}	35.0	70	92	20^{H7}	$20_{h6}{}^{H7}$	21.5	24	30	79	50.0	90	3	55	108	7	131	139.0	55	22	27	31	26	25	12	124	6.6	M6	11

Dimensions of motors

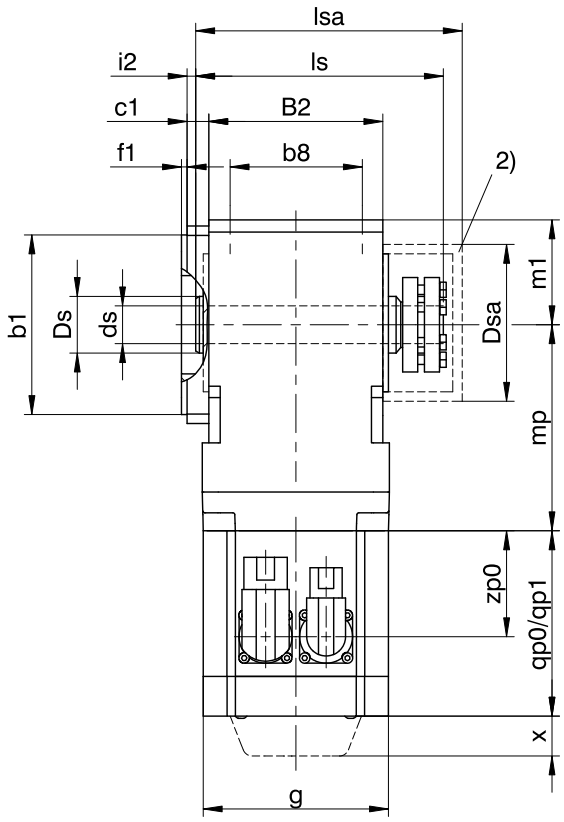
Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

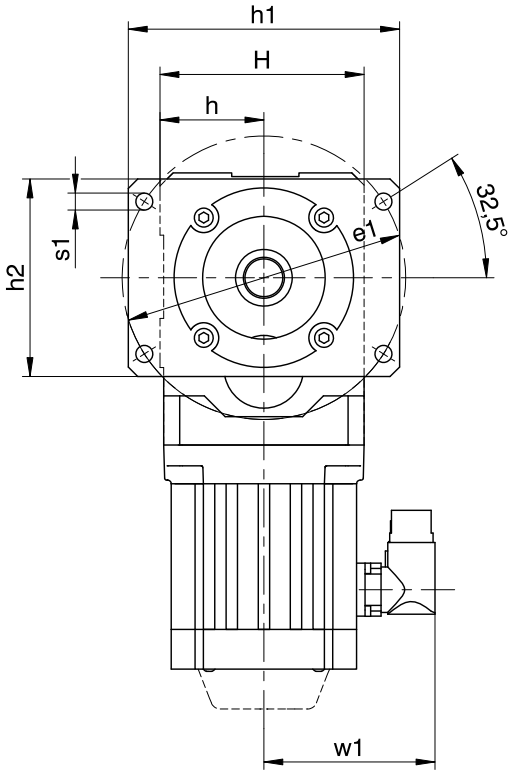
Dimensions of geared motors

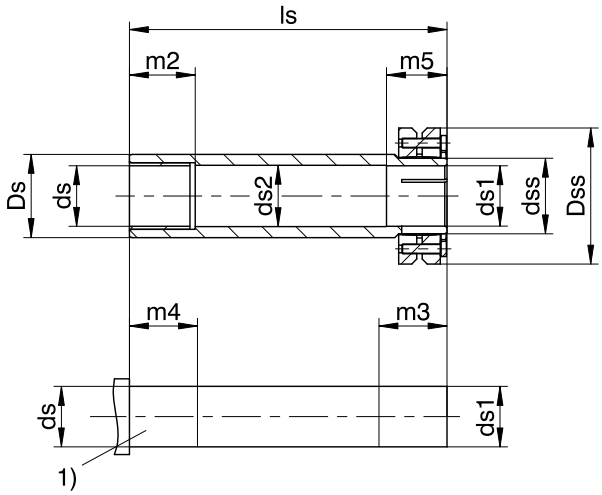
Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

KL

19.3.12 Shaft design S (hollow shaft with shrink disk), housing design F (flange)







qp0	Applies to motors without brake.	qp1	Applies to motors with brake.
x	Applies to encoders based on optical measuring principle.	1)	Machine shaft: must not be less than the specified dimension.
2)	Cover (optional)		

Dimensions of gear units

Type	Øb1	b8	B2	c1	Øds	Øds1	Øds2	Ødss	ØDs	ØDsa	ØDss	Øe1	f1	h	h1	h2	H	i2	ls	lsa	m1	m2	m3	m4	m5	Øs1
KL1	60_{j6}	50	75	11.5	16^{H7}	$16_{h6}{}^{H7}$	17.5	20	25	64	46.2	130	3	46	128.5	88.5	90	6	109	114.5	46	17	22	28	23	9
KL2	95_{j6}	65	92	11.5	20^{H7}	$20_{h6}{}^{H7}$	21.5	24	30	79	50.0	150	3	55	143.5	104.5	108	7	131	139.0	55	22	27	31	26	9

Dimensions of motors

Type	□g	qp0	qp1	w1	x	zp0
EZ301U	72	90	130.0	55.5	21	54.5
EZ302U	72	112	152.0	55.5	21	76.5
EZ303U	72	134	174.0	55.5	21	98.5
EZ401U	98	98	146.5	91.0	22	56.0
EZ402U	98	123	171.5	91.0	22	81.0

Dimensions of geared motors

Type	EZ3	EZ4
	mp	mp
KL102	95.5	–
KL202	112.5	109.0

19.4 Type designation

In this chapter you can find an explanation of the type designation with the associated options.

You can find other order details that do not appear in the type designation at the end of the section.

Sample code

KL	2	0	2	P	G	0080	EZ401U

Explanation

Code	Designation	Design
KL	Type	Helical bevel gear unit
2	Size	2 (example)
0	Generation	Generation 0
2	Stages	2-stage
A S G **P**	Shaft	Hollow shaft with keyway Hollow shaft with shrink disk Solid shaft without feather key Solid shaft with feather key
G F NG	Housing	Pitch circle diameter Flange Foot + pitch circle diameter
0080	Transmission ratio (i x 10)	i = 8 (example)
EZ401U	Motor	Synchronous servo motor EZ

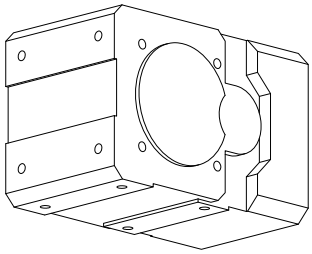
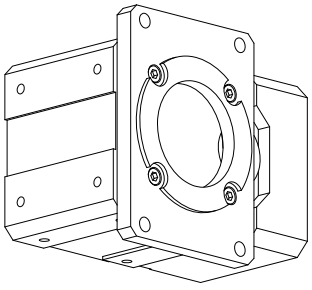
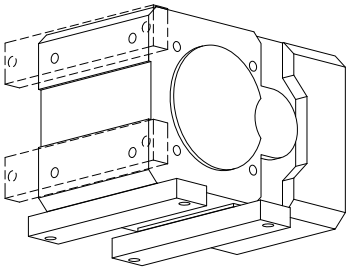
To complete the type designation, please indicate the following in addition:

- For a detailed type designation of the motor, see section [▷ 22]
- Attachment of solid shaft: gear unit side 3 or 4; solid shaft on both sides
- Attachment of hollow shaft with keyway: insertion side 3 or 4
- Attachment of hollow shaft with shrink disk: shrink disk on gear unit side 3 or 4
- Attachment of baseboards: gear unit side 1 or 5
- Attachment of flange: gear unit side 3 or 4
- Pitch circle diameter: gear unit side 3 or 4
- For the position of the plug connectors see section [▷ 19.5.6]

For an explains of the gear unit sides see section [▷ 19.5.4].

19.5 Product description

19.5.1 Housing design

Pitch circle diameter G	Flange F	Foot + pitch circle diameter NG
		

	G	F	NG
KL1	✓	✓	✓
KL2	✓	✓	✓

19.5.2 Combinatorial shaft/housing design

		Housing design		
Shaft design	**Code**	**G**	**F**	**NG**
Hollow shaft with keyway	**A**	AG	AF	ANG
Hollow shaft with shrink disk	**S**	SG	SF	SNG
Solid shaft without feather key	**G**	GG	GF	GNG
Solid shaft with feather key	**P**	PG	PF	PNG

19.5.3 Installation conditions

Hollow shaft

The hollow shaft hole tolerance is ISO G7. The tolerance of the machine shaft must be ISO k6.

When fastening the gear unit in place, make certain the machine shaft is aligned with the gear unit hollow shaft.

Maximum deviation ≤ 0.03 mm.

To make assembly or disassembly of the machine shaft easier, the hollow shafts are fitted with a spiral groove (as a grease reservoir).

A tempered thrust washer with thread is included with delivery. You can also optionally order the hollow shaft without a thrust washer.

Hollow shaft with shrink disk

The tolerance of the hollow shaft hole is ISO H7.

The machine shaft must be ISO h9.

Select a material for the machine shaft with a permitted surface pressure $p \geq 325\ N/mm^2$.

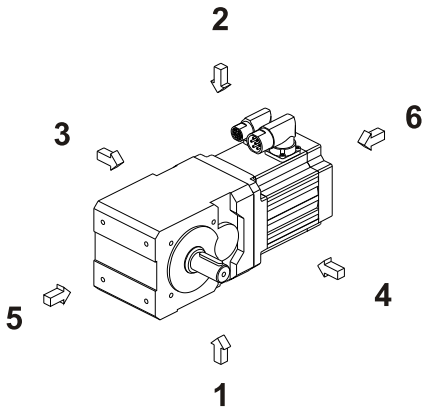
Possible materials:

- C45E +QT
- 42CrMo4

Attaching the gear units using the pitch circle diameter on the machine side

The torques and forces specified only apply for the attachment of gear units on the machine side using screws of quality 10.9. In addition, the gear housing must be adjusted at the pilot (H7).

19.5.4 Gear unit side



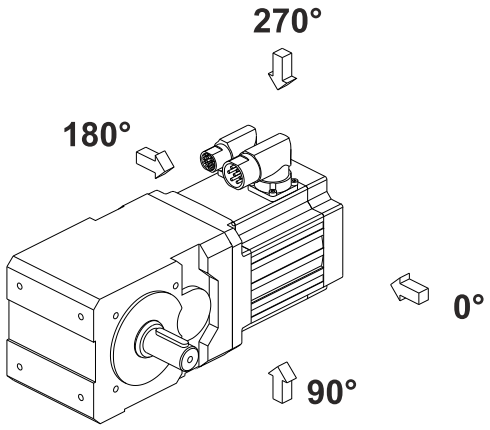
The numbers identify the gear unit sides.

19.5.5 Lubricants

STOBER fills the gear units with the amount and type of lubricant specified on the nameplate.

The Quantity of lubricant for gear units, document ID 441871, can be found online at http://www.stoeber.de

19.5.6 Position of the plug connectors



In the standard version the plug connectors are attached in the 270° position.

Indicate deviations for your geared motor in the purchase order.

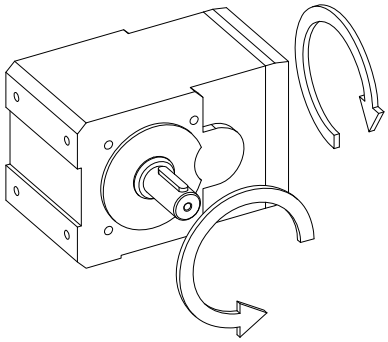
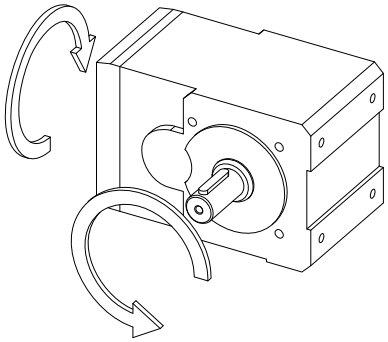
19.5.7 Other product features

Feature	Value
Max. permitted gear unit temperature (on the surface of the gear unit)	≤ 80 °C
Paint	Black RAL 9005
ATEX-Richtlinie 2014/34/EU	Not suitable
Protection class: [1] Gear unit Motor	 IP65 IP56, optionally IP66

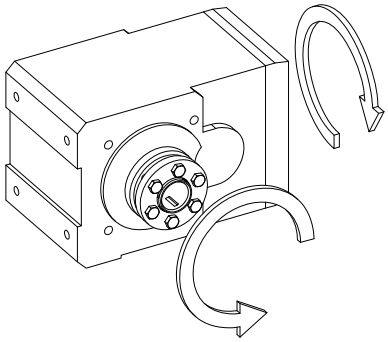
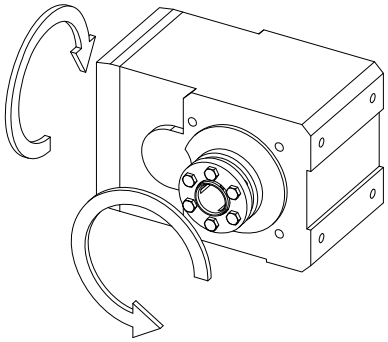
[1] Observe the protection class of all the components.

19.5.8 Direction of rotation

Solid shaft (P, G), solid shaft on both sides (P, G), hollow shaft with keyway (A)

Output side 4	Output side 3
	

Hollow shaft with shrink disk (S)

Output side 4	Output side 3
	

The pictures show installation position EL1.

19.5.9 Possible combinations of KL gear units with water-cooled EZ motor

Type	EZ4_W
KL202	✓

The connections for water cooling can only be mounted in position 90° or 270° (see section [▷ 19.5.6]).

19.6 Projecting

You can project your drives with our SERVOsoft design software. SERVOsoft is available at no cost from your consultant in one of our sales centers. Note the limit conditions in this section for a safe design of your drives.

The formula symbols for values actually present in the application are identified by a *.

Formula symbols	Unit	Explanation
a_{th}	–	Parameter for calculating $K_{mot,th}$
ED	%	Duty cycle relative to 20 minutes
fB_{op}	–	Operational factor – operation mode
fB_t	–	Operational factor – runtime
fB_T	–	Operational factor – temperature
F_{2ax*}	N	Existing axial force on the gear unit output

Formula symbols	Unit	Explanation
F_{2ax100}	N	Permitted axial force on the gear unit output for $n_{2m*} \leq 100$ rpm
F_{2axN}	N	Permitted nominal axial force on the gear unit output
F_{2rad*}	N	Existing radial force on the gear unit output
$F_{2rad100}$	N	Permitted radial force on the gear unit output for $n_{2m*} \leq 100$ rpm
F_{2radN}	N	Permitted nominal axial force on the gear unit output
i	–	Gear ratio
$K_{mot,th}$	–	Factor for determining the thermal limit torque
l	mm	Length of the output shaft
M_{op}	Nm	Torque of motor in the operating point from the motor characteristics for n_{1m*}
$\|M_2\|$	Nm	Amount of the torque on the output
$M_{2.1*} – M_{2.6*}$	Nm	Existing torque in the relevant time segment (1 to 6)
$M_{2,n*}$	Nm	Existing torque in the n-th time segment
M_{2acc}	Nm	Maximum permitted acceleration torque on the gear unit output
M_{2acc*}	Nm	Existing acceleration torque on the gear unit output
M_{2eff*}	Nm	Existing effective torque on the gear unit output
M_{2eq*}	Nm	Existing equivalent torque on the gear unit output
M_{2k100}	Nm	Permitted breakdown torque on the gear unit output for $n_{2m*} \leq 100$ rpm
M_{2kN}	Nm	Permitted nominal breakdown torque on the gear unit output
M_{2k*}	Nm	Existing breakdown torque on the gear unit output
M_{2N}	Nm	Nominal torque on the gear unit output (relative to n_{1N})
M_{2NOT}	Nm	Emergency off torque of the gear unit at gear unit output for max. 1000 load changes
M_{2NOT*}	Nm	Existing emergency off torque for the gear unit on the gear unit output
M_{2th}	Nm	Thermal limit torque on the gear unit output
n_{1m*}	rpm	Existing average input speed
n_{1max*}	rpm	Existing maximum input speed
n_{1maxDB}	rpm	Maximum permitted input speed of the gear unit in continuous operation
n_{1maxZB}	rpm	Maximum permitted input speed of the gear unit in cyclic operation
$\|n_2\|$	rpm	Amount of the output speed
n_{2m*}	rpm	Existing average output speed
$n_{2m,1*} – n_{2m,6*}$	rpm	Existing average output speed in the respective time segment (1 bis 6)
$n_{2m,n*}$	rpm	Existing average output speed in the n-th time segment
t	s	Time
$t_{1*} – t_{6*}$	s	Duration of the relevant time segment (1 to 6)
t_{n*}	s	Duration of the n-th time segment
S	–	Characteristic load value: quotient of nominal gear unit and motor torque without taking the thermal output limit into consideration. Represents a dimension for the reserve of the geared motor.
x_2	mm	Distance from shaft shoulder to the point of application of force

Formula symbols	Unit	Explanation
y_2	mm	Distance from shaft axes to the point of application of axial force
z_2	mm	Distance from shaft shoulder to the center of the output bearing

19.6.1 Calculation of the operating point

Check the following conditions for operating points other than the nominal point specified in the selection tables M_{2N}.

$$n_{1m^*} \leq \frac{n_{1max\,DB}}{fB_T}$$

$$n_{1max^*} \leq \frac{n_{1max\,ZB}}{fB_T}$$

$$M_{2eff^*} \leq M_{2th}$$

$$M_{2acc^*} \leq M_{2acc}$$

$$M_{2NOT^*} \leq M_{2NOT}$$

$$M_{2eq^*} \leq M_{2N} \cdot \frac{S}{fB_{op} \cdot fB_t}$$

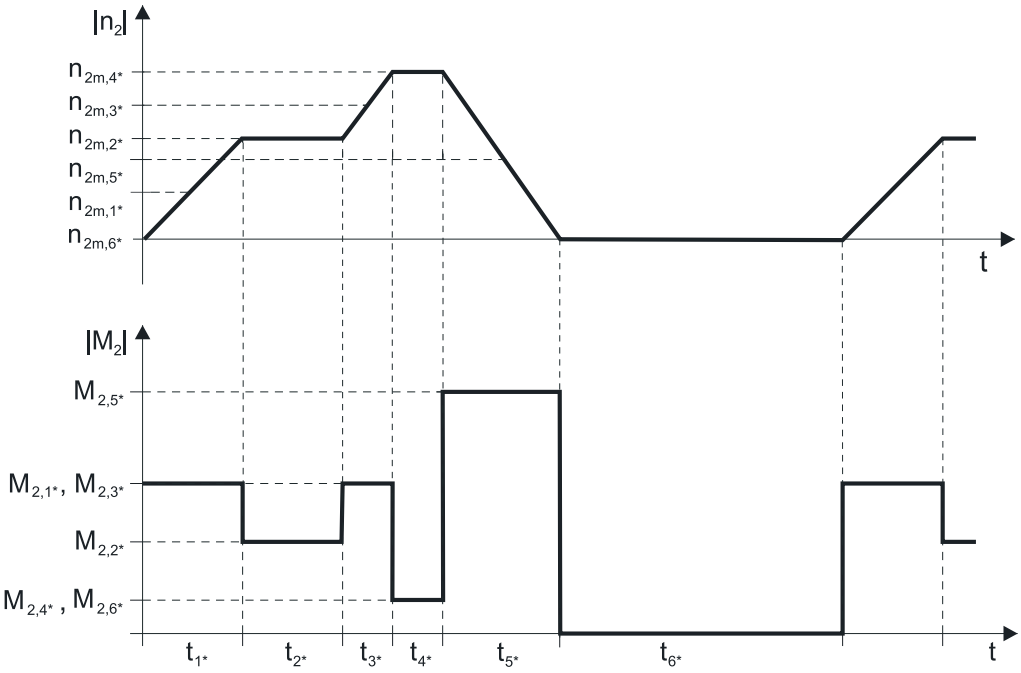
The values for n_{1maxDB}, n_{1maxZB}, M_{2acc}, M_{2NOT}, M_{2N} and S can be found in the selection tables.

The values for fB_T, fB_{op} and fB_t can be found in the relevant tables in this section.

Calculate the thermal limit torque M_{2th} for a duty cycle > 50 %.

Example of cycle sequence

The following calculations refer to a representation of the power consumed on the output based on the following example:



Calculation of the existing average input speed

$$n_{1m^*} = n_{2m^*} \cdot i$$

$$n_{2m^*} = \frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} + ... + \left|n_{2m,n^*}\right| \cdot t_{n^*}}{t_{1^*} + ... + t_{n^*}}$$

If $t_{1^*} + ... + t_{5^*} \geq 20$ min, determine n_{2m^*} without pause t_{6^*}.

For the values for the gear ratio i, see the selection tables.

Calculation of the existing effective torque

$$M_{2eff^*} = \sqrt{\frac{t_{1^*} \cdot M_{2,1^*}{}^2 + ... + t_{n^*} \cdot M_{2,n^*}{}^2}{t_{1^*} + ... + t_{n^*}}}$$

Calculation of the existing equivalent torque

$$M_{2eq^*} = \sqrt[3]{\frac{\left|n_{2m,1^*}\right| \cdot t_{1^*} \cdot \left|M_{2,1^*}{}^3\right| + ... + \left|n_{2m,n^*}\right| \cdot t_{n^*} \cdot \left|M_{2,n^*}{}^3\right|}{\left|n_{2m,1^*}\right| \cdot t_{1^*} + ... + \left|n_{2m,n^*}\right| \cdot t_{n^*}}}$$

Calculation of the thermal limit torque

For a duty cycle ED > 50%, calculate the thermal limit torque M_{2th} for the existing average input speed n_{1m^*}. (With $K_{mot,th} \leq 0$ you must reduce the average input speed n_{1m^*} accordingly or select a different size for the geared motor.)

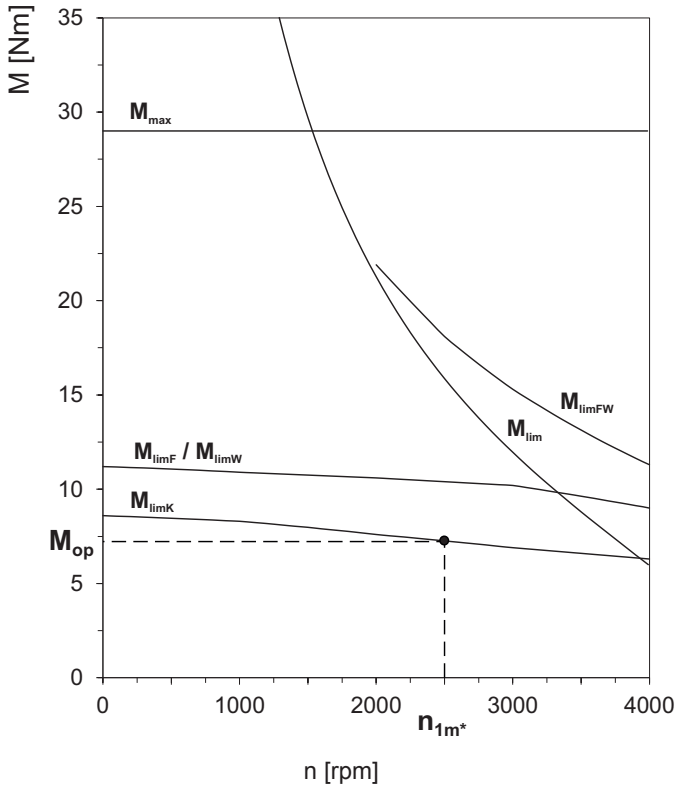
$$M_{2th} = M_{op} \cdot i \cdot K_{mot,th}$$

$$K_{mot,th} = 0{,}9 - \frac{a_{th}}{1000} \cdot fB_T \cdot \left(\frac{n_{1m^*}}{1000}\right)^2$$

For the values for i and a_{th}, see the selection tables.

The values for fB_T can be found in the relevant tables in this section.

The motor characteristics can found in section [▷ 22.3], including the value for the torque of the motor in the operating point M_{op} at the determined average input speed n_{1m^*}. Note the size, nominal speed n_N and cooling type of the motor. The illustration below shows an example of reading the torque M_{op} of a motor with convection cooling in the operating point.



Operation mode	fB_{op}
Consistent continuous operation	1.00
Cyclic operation	1.25
Cyclic operation - reversing load	1.40

Runtime	fB_t
Daily runtime ≤ 8 h	1.00
Daily runtime ≤ 16 h	1.15
Daily runtime ≤ 24 h	1.20

Temperature		fB_T
Motor cooling	**Surrounding temperature**	
Motor with forced ventilation/water cooling	≤ 20 °C ≤ 30 °C ≤ 40 °C	0.9 1.0 1.15
Motor with convection cooling	≤ 20 °C ≤ 30 °C ≤ 40 °C	1.0 1.1 1.25

Instructions

- The maximum permitted gear unit temperature (see Other product feature sections) must not be exceeded. Doing so may result in damage to the geared motor.
- When braking from full speed (for example when the power fails or when setting up the machine), note the permissible gear unit torques (M_{2acc}, M_{2NOT}) in the selection tables.

19.6.2 Permissible shaft loads for output shaft

The values specified in the tables apply to permitted shaft loads:

- For shaft dimensions according to the catalog
- For output speeds $n_{2m*} \leq 100$ rpm ($F_{2axN} = F_{2ax100}$; $F_{2radN} = F_{2rad100}$; $M_{2kN} = M_{2k100}$)
- Only if the lateral forces acting on the gear unit are supported by its pilot (housing, flange shaft)

KL

19.6.2.1 Shaft designs G, P

Permitted shaft loads for shaft designs G, P (solid shaft)

Typ	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	M_{2k100} [Nm]
KL1	20.0	380	1900	68
KL2	22.0	560	2800	118

You can download the diagrams for other output speeds at http://products.stoeber.de.

The following applies for output speeds $n_{2m*} > 100$ rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m*}}{100\ \text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table of permissible shaft loads in this section.

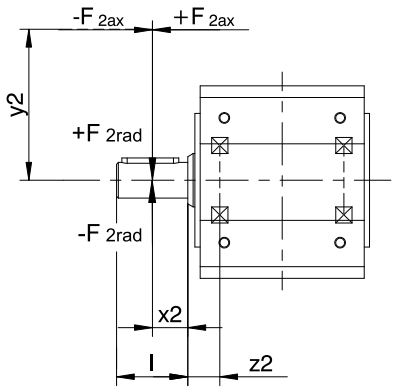


Illustration 1: Application of force points for the solid shaft

The specified values for $F_{2rad100}$ refer to an application of force at the center of the output shaft: $x_2 = l/2$.

You can find the shaft dimensions in the Dimensional drawings section.

The following formula applies to other points of application of force:

$$M_{2k^*} = \frac{2 \cdot F_{2ax^*} \cdot y_2 + F_{2rad^*} \cdot (x_2 + z_2)}{1000} \leq M_{2kN}$$

$$F_{2rad^*} \leq F_{2radN}$$

$$F_{2ax^*} \leq F_{2axN}$$

In applications with multiple axial and/or radial forces, the forces must be added vectorially.

In EMERGENCY OFF mode (max. 1000 load changes) you can multiply the permissible forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of 2.

19.6.2.2 Shaft design A, S

Permitted shaft loads for shaft design A (hollow shaft with keyway)

Typ	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	M_{2k100} [Nm]
KL1	18.5	250	1250	43
KL2	22.0	560	2800	118

Permitted shaft loads for shaft design S (hollow shaft with shrink disk)

Typ	z_2 [mm]	F_{2ax100} [N]	$F_{2rad100}$ [N]	M_{2k100} [Nm]
KL1	18.5	250	1250	43
KL2	22.0	560	2800	118

You can download the diagrams for other output speeds at http://products.stoeber.de.

The following applies for output speeds n_{2m^*} > 100 rpm:

$$F_{2axN} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}} \qquad M_{2kN} = \frac{M_{2k100}}{\sqrt[3]{\frac{n_{2m^*}}{100\ \text{rpm}}}}$$

The values for F_{2ax100}, $F_{2rad100}$ and M_{2k100} can be found in the table of permissible shaft loads in this section.

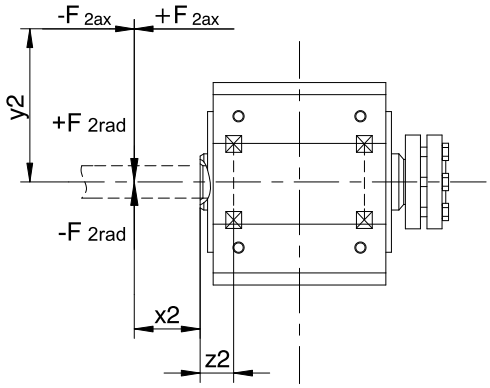


Illustration 2: Application of force points for hollow shaft

The permissible lateral forces can be determined from the permissible breakdown torque M_{2kN}. The existing lateral forces must not exceed the permissible lateral forces. The permitted lateral forces refer to the end of the hollow shaft (x2 = 0).

$$M_{2k*} = \frac{2 \cdot F_{2ax*} \cdot y_2 + F_{2rad*} \cdot (x_2 + z_2)}{1000} \leq M_{2kN}$$

$$F_{2ax*} \leq F_{2axN}$$

In applications with multiple axial and/or radial forces, the forces must be added vectorially.

In EMERGENCY OFF mode (max. 1000 load changes) you can multiply the permissible forces and torques for F_{2ax20}, F_{2rad20} and M_{2k20} by a factor of 2.

19.6.3 Radial shaft seal rings

Leakage protection

Our gear units are equipped with high-quality radial shaft seal rings and are checked for leakage protection. Nevertheless, the possibility of leaks during the service life of the gear units cannot be completely excluded. If you are using gear units with lubricant-compatible goods, you will have to take measures to prevent direct contact with the gear unit lubricant in case of leaks.

KL

19.7 More documentation

More documentation concerning the product can be found at http://www.stoeber.de/en/stoeber_global/service/downloads/downloadcenter.html

Enter the ID of the documentation in the Search... field.

Documentation	ID
Operating manual gear units and geared motors	441972
Quantity of lubricant for gear units	441871