



APEX DYNAMICS, INC.

**HIGH PERFORMANCE
HYPOID GEARBOX K-SERIES
KH / KF**



Hypoid Gearbox Series

► Features:

Innovative Hypoid Helical Bevel Gear

Optimized Inertia Moment

High Positioning Accuracy

High Efficiency

Low Noise

Long Service Life

Flexible Mounting

Multiple Output Types

Same Rotating Direction on Output as the Servo-Motor

The output shaft of APEX K-series rotates in the same direction as the servo-motor that simplifies the machine control and setting.



KH

KF-S1 / S2

KF-S3

KF-S4

ORDERING CODE

KH

—

010⁽¹⁾

/

MOTOR

KF

—

010⁽¹⁾

—

S1⁽²⁾

/

MOTOR

Motor Type :
Manufacturer and Model

Ratio⁽¹⁾:
1-stage: 3, 4, 5, 7,10

Gearbox Size:
KH : KH064, KH090, KH110, KH140, KH200, KH255, KH285
KF : KF060, KF075, KF100, KF140, KF180, KF210, KF240

Ordering Example : KF100 - 010 - S1 / SIEMENS 1FT6 041 - 4AF71

(1) Ratio ($i = N_{in} / N_{out}$) .
(2) S1 = Smooth Output Shaft.
S2 = Output Shaft with Key.
S3 = DIN 5480 Output Shaft.
S4 = Hollow Output Shaft.

KH Gearbox Performance

Model No.		Stages	Ratio ⁽¹⁾	KH 064	KH 090	KH 110	KH 140	KH 200	KH 255	KH 285
Nominal Output Torque T_{2N}	Nm	1	3	25	50	110	210	420	820	1,600
			4	25	60	110	210	420	820	1,600
			5	25	60	110	210	420	820	1,600
			7	23	50	100	200	390	750	1,400
			10	18	40	85	170	360	600	1,100
Emergency Stop Torque T_{2NOT}	Nm	1	3~10	2 times T_{2N}						
Max. Acceleration Torque T_{2B}	Nm	1	3~10	1,5 times T_{2N}						
No Load Running Torque ⁽⁴⁾	Nm	1	3~10	0.9	1.6	3.2	4.2	9.6	16.5	26.4
Backlash ⁽²⁾	arcmin	1	3~10	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3
Torsional Rigidity	Nm/arcmin	1	3~10	1.1	4.5	10	23	54	90	170
Nominal Input Speed n_{1N}	rpm	1	3~10	3,000	2,800	2,700	2,000	2,000	2,000	1,500
Max. Input Speed n_{1B}	rpm	1	3~10	6,000	6,000	4,500	4,500	4,000	3,000	2,500
Max. Radial Load F_{2rB} ⁽³⁾	N	1	3~10	2,400	4,500	5,100	13,000	28,700	36,200	58,300
Max. Axial Load F_{2aB} ⁽³⁾	N	1	3~10	1,200	2,250	2,550	6,500	14,350	18,100	29,150
Service Life ⁽⁵⁾	hr	1	3~10	20,000						
Operating Temp	°C	1	3~10	0° C~ +90° C						
Degree of Gearbox Protection		1	3~10	IP65						
Lubrication		1	3~10	Synthetic lubrication grease						
Mounting Position		1	3~10	All directions						
Running Noise ⁽⁴⁾	dB(A)	1	3~10	≤ 64	≤ 66	≤ 66	≤ 68	≤ 68	≤ 70	≤ 72
Efficiency η	%	1	3~10	$\geq 96\%$						

(1) Ratio ($i = N_{in} / N_{out}$).

(2) Backlash is measured at 2% of Nominal Output Torque T_{2N} .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) without loading at 3,000 rpm, or at the Nominal Input Speed n_{1N} .

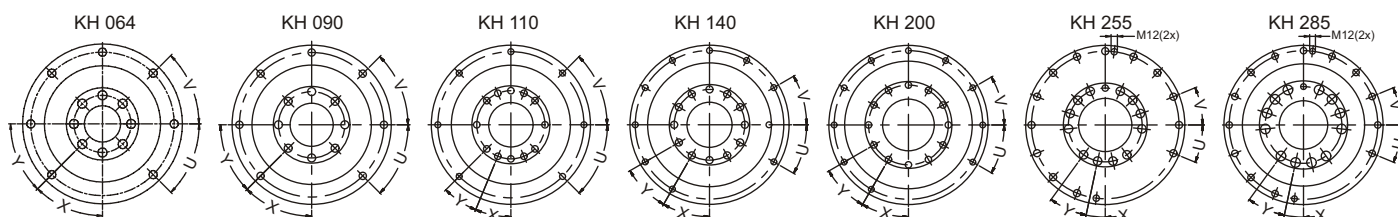
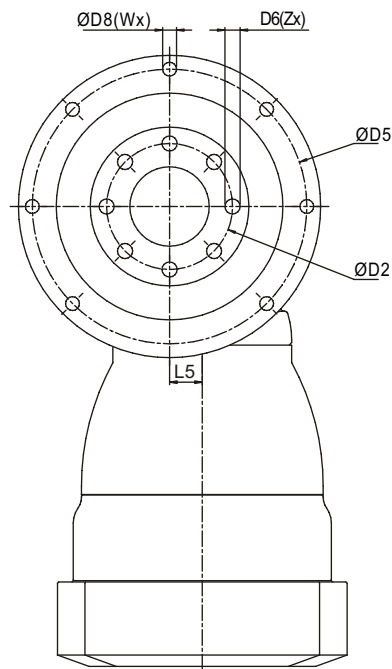
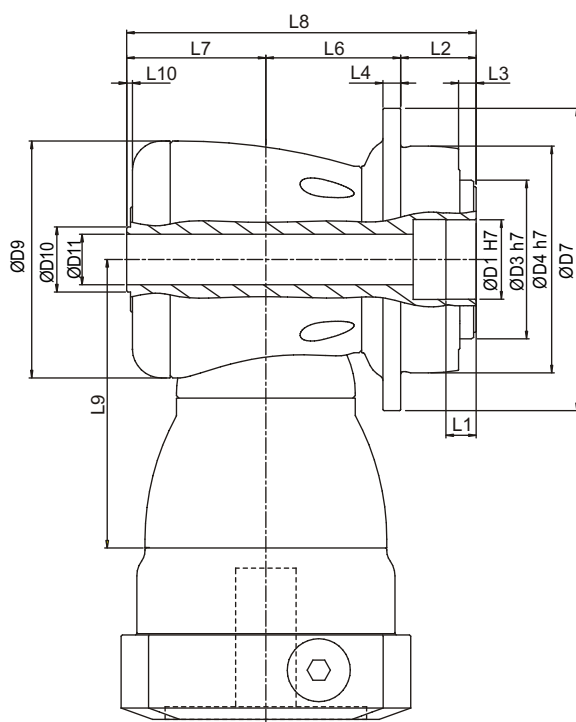
(5) For continuous operation, the service life time is less than 10,000 hrs.

KH Gearbox Inertia

Model No.		KH 064	KH 090	KH 110	KH 140	KH 200	KH 255	KH 285
$\emptyset^{(A)}$ (C3)		1-stage	1-stage	1-stage	1-stage	1-stage	1-stage	1-stage
8	kg.cm ²	0.10	-	-	-	-	-	-
11		0.17	0.18	-	-	-	-	-
14		0.20	0.50	-	-	-	-	-
19		0.59	0.63	1.66	-	-	-	-
24		-	4.42	4.82	4.96	-	-	-
28		-	-	6.05	6.00	-	-	-
32		-	-	8.38	8.70	9.93	-	-
35		-	-	13.86	14.23	15.15	15.62	23.34
38		-	-	18.87	19.88	20.69	21.61	23.34
42		-	-	-	21.75	22.26	23.36	24.97
48		-	-	-	53.91	55.55	58.28	60.43
55		-	-	-	-	-	86.65	88.67
60		-	-	-	-	-	-	111.89

(A) $\emptyset$ = Input shaft diameter.

KH Series Dimension



Dimension		KH 064	KH 090	KH 110	KH 140	KH 200	KH 255	KH 285
		1-stage	1-stage	1-stage	1-stage	1-stage	1-stage	1-stage
D1	H7	20	31.5	40	50	80	100	100
D2		31.5	50	63	80	125	140	160
D3	h7	40	63	80	100	160	180	200
D4	h7	64	90	110	140	200	255	285
D5		79	109	135	168	233	280	310
D6		M5x0.8Px8	M6x1Px10	M6x1Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M20x2.5Px31
D7		88	120	147	180	249.5	302	332
D8		4.5	5.5	5.5	6.6	9	13.5	13.5
D9		73	94	116	163	210	255	300
D10		18.5	25.8	36.8	55.2	69.2	82.2	92.2
D11		10	20	28	40	55	62	70
L1		8	12	12	12	16	20	20
L2		19.5	30	29	38	50	66	75
L3		4	7	7	7.5	8.5	13.5	16.5
L4		5	7	8	10	12	18	20
L5		10	13	17	25	31	36	43
L6		43	53.5	67	81	117	132	160.5
L7		46	55.3	71.3	91.8	118	134	168
L8		108.5	138.8	167.3	210.8	285	332	403.5
L9		94	114.5	129	173.5	228	265.5	294.5
L10		1.5	2.3	3	2.8	3	3	3
X	in Degree	45°	45°	22.5°	30°	30°	12°	12°
Y	in Degree	45°	45°	22.5°	30°	30°	24°	24°
Z		8	8	12	12	12	12	12
U	in Degree	45°	45°	45°	30°	30°	22.5°	22.5°
V	in Degree	45°	45°	45°	30°	30°	22.5°	22.5°
W		7	7	7	10	10	13	13

(1) Dimensions are related to motor interface. Please contact APEX for details.

KF Gearbox Performance

Model No.		Stages	Ratio ⁽¹⁾	KF 060	KF 075	KF 100	KF 140	KF 180	KF 210	KF 240
Nominal Output Torque T_{2N}	Nm	1	3	25	50	110	210	420	820	1,600
			4	25	60	110	210	420	820	1,600
			5	25	60	110	210	420	820	1,600
			7	23	50	100	200	390	750	1,400
			10	18	40	85	170	360	600	1,100
Emergency Stop Torque T_{2NOT}	Nm	1	3~10	2 times T_{2N}						
Max. Acceleration Torque T_{2B}	Nm	1	3~10	1.5 times T_{2N}						
No Load Running Torque ⁽⁴⁾	Nm	1	3~10	0.8	1.3	2.6	3.5	8	11	17.6
Backlash ⁽²⁾	arcmin	1	3~10	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3
Torsional Rigidity	Nm/arcmin	1	3~10	0.8	3.5	9	20.5	44	80	168
Nominal Input Speed n_{1N}	rpm	1	3~10	3,000	2,800	2,700	2,000	2,000	2,000	1,500
Max. Input Speed n_{1B}	rpm	1	3~10	6,000	6,000	4,500	4,500	4,000	3,000	2,500
Max. Radial Load F_{2rB} ⁽³⁾	N	1	3~10	5,700	8,200	12,200	20,100	30,700	40,900	51,900
Max. Axial Load F_{2aB} ⁽³⁾	N	1	3~10	2,850	4,100	6,100	10,050	15,350	20,450	20,950
Service Life ⁽⁵⁾	hr	1	3~10	20,000						
Operating Temp	°C	1	3~10	0° C ~ +90° C						
Degree of Gearbox Protection		1	3~10	IP65						
Lubrication		1	3~10	Synthetic lubrication grease						
Mounting Position		1	3~10	All directions						
Running Noise ⁽⁴⁾	dB(A)	1	3~10	≤ 64	≤ 66	≤ 66	≤ 68	≤ 68	≤ 70	≤ 72
Efficiency η	%	1	3~10	$\geq 96\%$						

(1) Ratio ($i = N_{in} / N_{out}$).

(2) Backlash is measured at 2% of Nominal Output Torque T_{2N} .

(3) Applied to the output shaft center at 100 rpm.

(4) These values are measured by gearbox with ratio = 10 (1-stage) without loading at 3,000 rpm, or at the Nominal Input Speed n_{1N} .

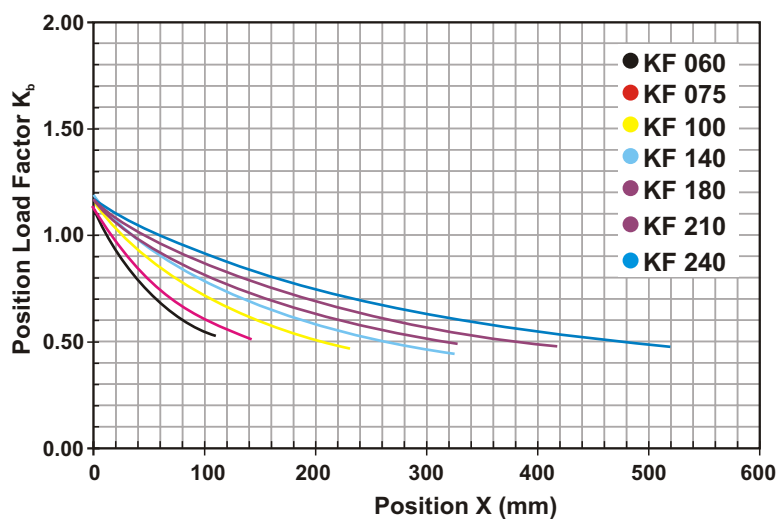
(5) For continuous operation, the service life time is less than 10,000 hrs.

KF Gearbox Inertia

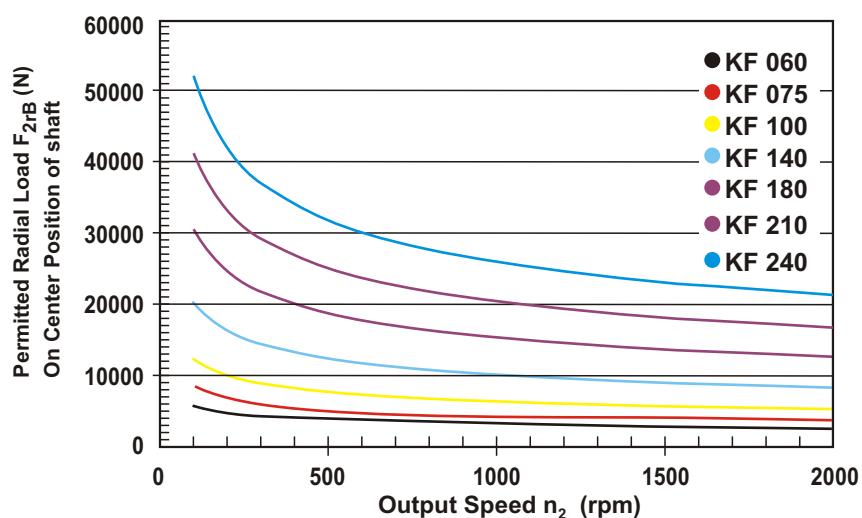
Model No.		KF 060	KF 075	KF 100	KF 140	KF 180	KF 210	KF 240
$\varnothing^{(A)}$ (C3)		1-stage	1-stage	1-stage	1-stage	1-stage	1-stage	1-stage
8	kg. cm ²	0.10	-	-	-	-	-	-
11		0.17	0.18	-	-	-	-	-
14		0.20	0.50	-	-	-	-	-
19		0.59	0.63	1.66	-	-	-	-
24		-	4.42	4.82	4.96	-	-	-
28		-	-	6.05	6.00	-	-	-
32		-	-	8.38	8.70	9.93	-	-
35		-	-	13.86	14.23	15.15	15.62	23.34
38		-	-	18.87	19.88	20.69	21.61	23.34
42		-	-	-	21.75	22.26	23.36	24.97
48		-	-	-	53.91	55.55	58.28	60.43
55		-	-	-	-	-	86.65	88.67
60		-	-	-	-	-	-	111.89

(A) $\varnothing$ = Input shaft diameter.

Permitted Radial And Axial Loads^(B)



If radial force F_{2r} is not exerted on the center of the output shaft $X < 1/2 L$ or $X > 1/2 L$, the permitted radial and axial loads can be calculated by the position load factor K_b on the above diagram.



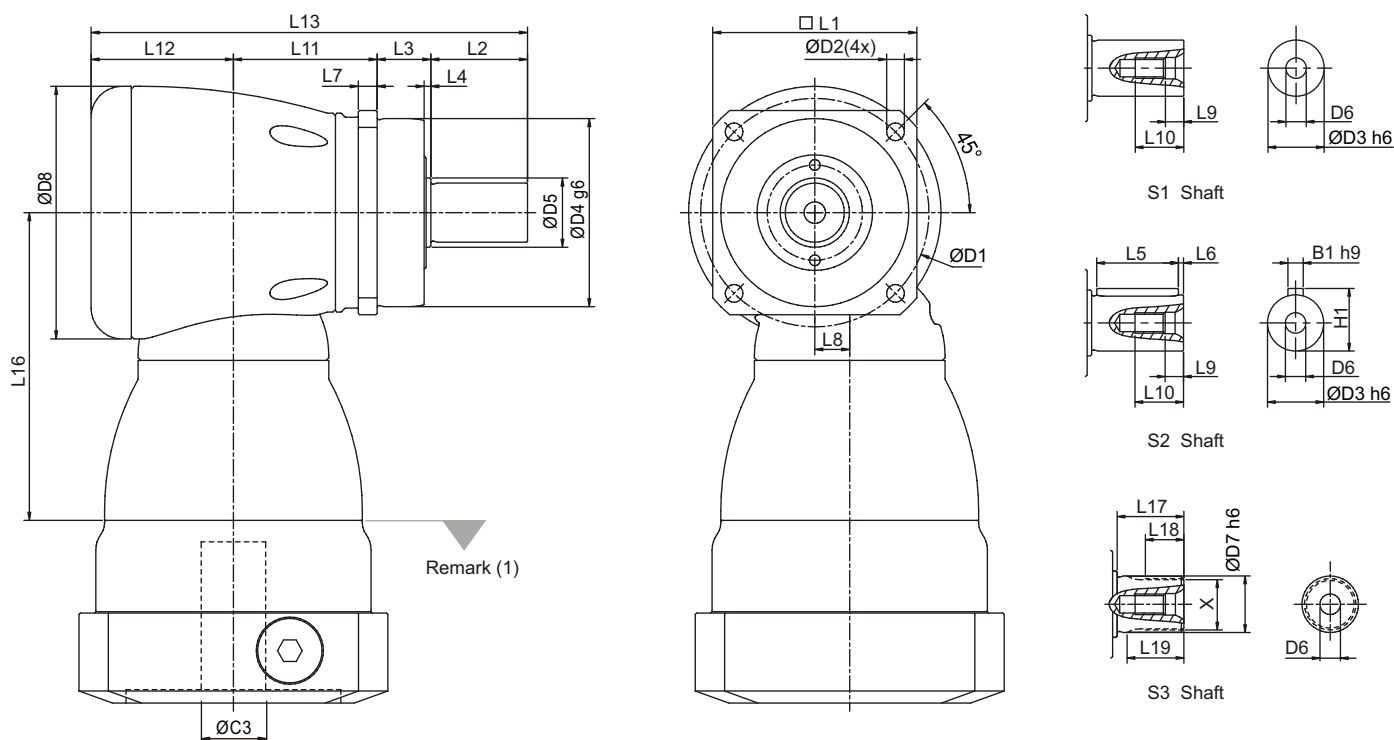
Permitted radial load F_{2r} on center of output shaft $X = 1/2 L$ for various output speeds.
Values provided are for 20,000 hours^(C) life.

(A) $\varnothing$ = Input shaft diameter.

(B) Permitted loading values on the output shaft. Please refer to P. 10 glossary.

(C) For Continuous Operation(S1), the service life reduced to 50%.

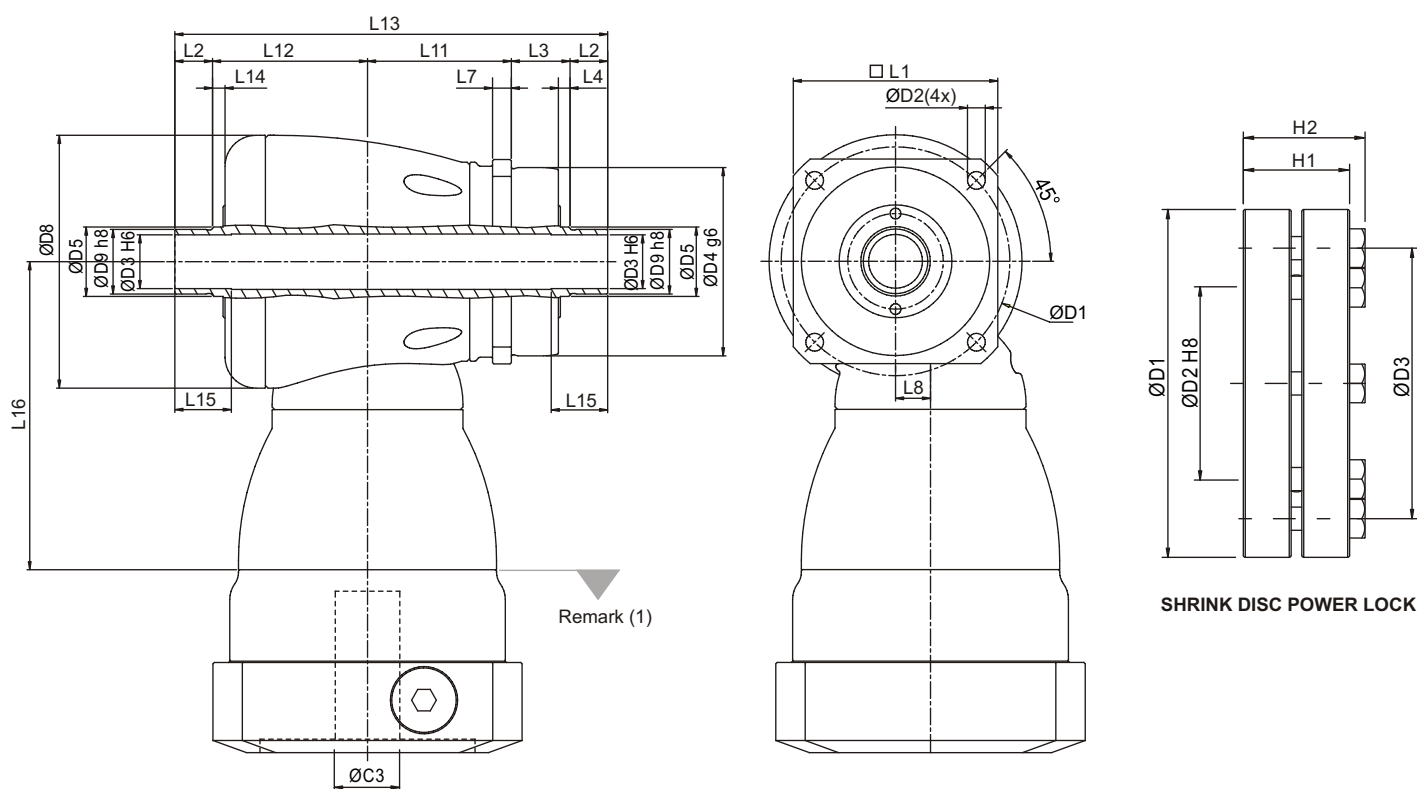
KF-S1 / S2 / S3 Series Dimension



Dimension	KF 060	KF 075	KF 100	KF 140	KF 180	KF 210	KF 240
	1-stage	1-stage	1-stage	1-stage	1-stage	1-stage	1-stage
D1	68	85	120	165	215	250	290
D2	5.5	6.6	9	11	13.5	17	17
D3 h6	16	22	32	40	55	75	85
D4 g6	60	70	90	130	160	180	200
D5	18.5	25.8	36.8	55.2	69.2	82.2	92.2
D6	M5X0.8P	M8X1.25P	M12X1.75P	M16X2P	M20X2.5P	M20X2.5P	M20X2.5P
D7 h6	16	22	32	40	55	75	85
D8	73	94	116	163	210	255	300
L1	62	76	101	141	182	215	245
L2	28	36	58	82	82	105	130
L3	20	20	30	30	30	38	40
L4	2	2.5	3	3	3	3	3
L5	25	32	50	63	70	90	125
L6	2	2	4	5	6	7	3
L7	6	7	10	12	15	17	20
L8	10	13	17	25	31	36	43
L9	4.8	7.2	10	12	15	15	15
L10	12.5	19	28	36	42	42	42
L11	43	53.5	67	90	119	141	176
L12	44.5	53	68.3	89	115	131	165
L13	135.5	162.5	223.3	291	346	415	511
L16	94	114.5	129	173.5	228	265.5	294.5
L17	26	26	26	40	41.5	52	60
L18	15	15	15	20	21.5	28	36
L19	21	22.5	23	33.5	33.5	45	53
B1 h9	5	6	10	12	16	20	22
H1	18	24.5	35	43	59	79.5	90
X DIN 5480	W16x0.8x30x18x6m	W22x1.25x30x16x6m	W32x1.25x30x24x6m	W40x2x30x18x6m	W55x2x30x26x6m	W70x2x30x34x6m	W80x2x30x38x6m

(1) Dimensions are related to motor interface. Please contact APEX for details.

KF-S4 Series Dimension



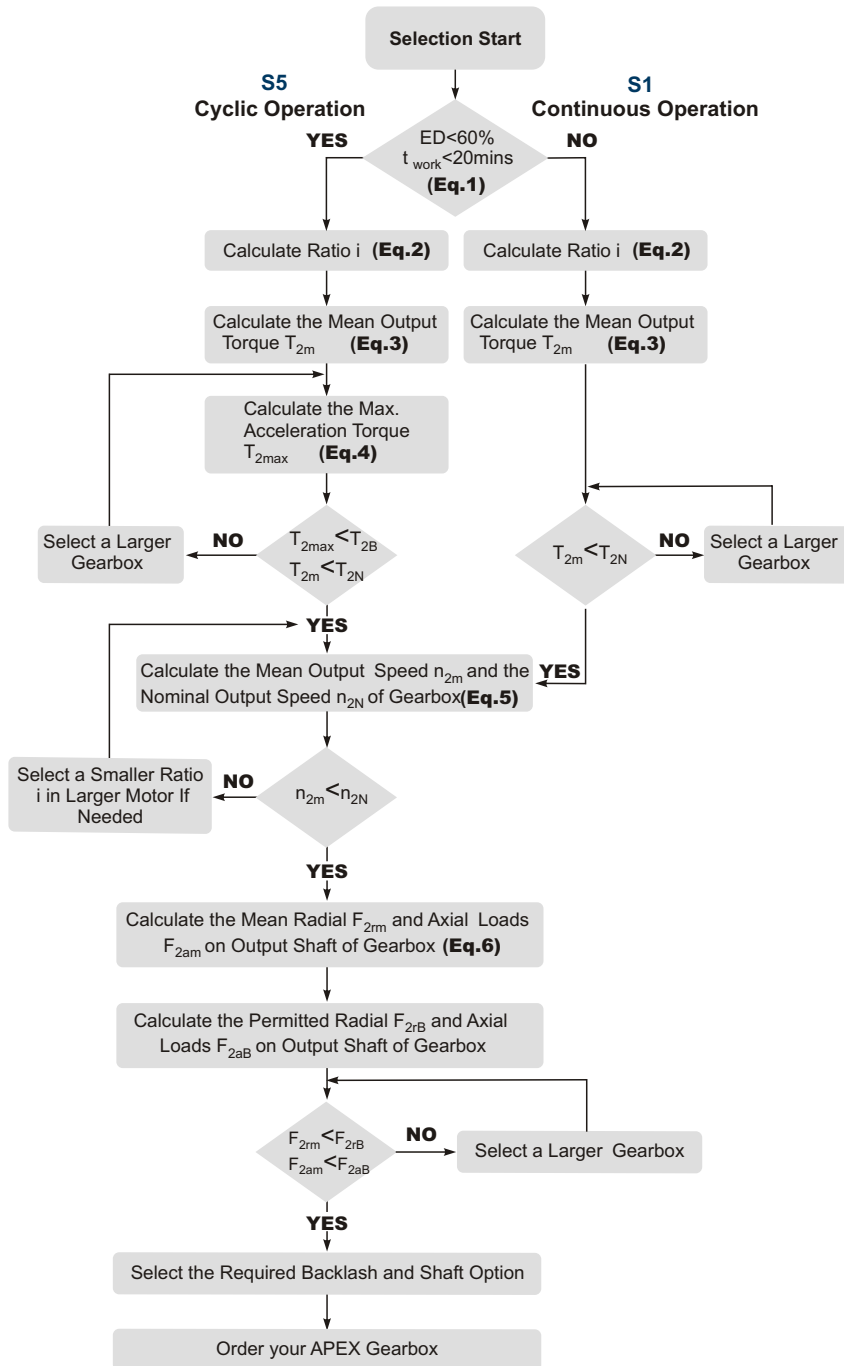
Dimension	KF 060					KF 075					KF 100					KF 140					KF 180				
	1-stage					1-stage					1-stage					1-stage					1-stage				
D1	68					85					120					165					215				
D2	5.5					6.6					9					11					13.5				
D3 H6	15					20					30					40					55				
D4 g6	60					70					90					130					160				
D5	18.5					25.8					36.8					55.2					69.2				
D8	73					94					116					163					210				
D9 h8	18					24					36					50					68				
L1	62					76					101					141					182				
L2	12					14					18					22					23				
L3	22					21.8					32					33					34				
L4	4					4.3					5					6					7				
L7	6					7					10					12					15				
L8	10					13					17					25					31				
L11	43					53.5					67					90					119				
L12	48.5					57.7					73.3					95					122				
L13	137.5					161					208.3					262					321				
L14	4					4.7					5					6					7				
L15	19					21					25					30					30				
L16	94					114.5					129					173.5					228				

(1) Dimensions are related to motor interface. Please contact APEX for details.

SHRINK DISC POWER LOCK

Dimension	D1	D2	D3	H1	H2
SSD-d18xdw15	44	19.5	30	15	18.5
SSD-d24xdw20	50	26	36	18	21.5
SSD-d36xdw30	72	38	52	22	26
SSD-d50xdw40	90	51.6	70	27.5	31.5
SSD-d68xdw55	115	70.5	86	30.5	34.5

Selection of the optimum gearbox



Recommended (for S5 Cycle Operation)

The general design is given for

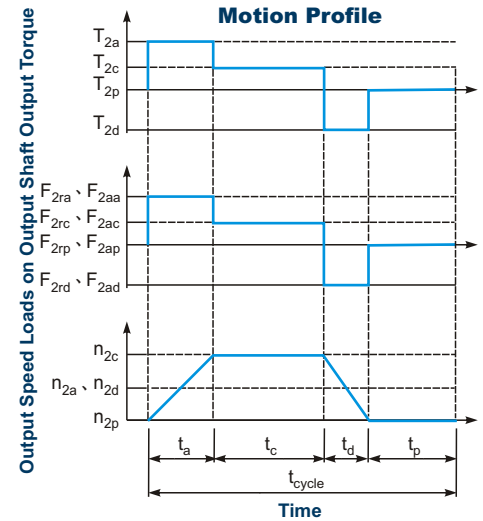
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

The optimal design is given for

$$\frac{J_L}{i^2} \cong J_m$$

J_L Load Inertia

J_m Motor Inertia



$$1. ED = \frac{t_a + t_c + t_d}{t_{cycle}} \times 100\%, t_{work} = t_a + t_c + t_d$$

Index : a. Acceleration, c. Constant,
d. Deceleration, p. Pause (Eq.1)

$$2. i \cong \frac{n_m}{n_{work}}$$

n_m Output Speed of the Motor
 n_{work} Working Speed (Eq.2)

$$3. T_{2m} = 3 \sqrt{\frac{n_{2a} \times t_a \times T_{2a}^3 + n_{2c} \times t_c \times T_{2c}^3 + n_{2d} \times t_d \times T_{2d}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

(Eq.3)

$$4. T_{2max} = T_{mB} \times i \times K_s \times \eta$$

where K_s is

K_s	No. of Cycles / hr
1.0	0 ~ 1,000
1.1	1,000 ~ 1,500
1.3	1,500 ~ 2,000
1.6	2,000 ~ 3,000
1.8	3,000 ~ 5,000

T_{mB} Max. Output Torque of the Motor

η Efficiency of the Gearbox (Eq.4)

$$5. n_{2a} = n_{2d} = \frac{1}{2} \times n_{2c}$$

$$n_{2m} = \frac{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}{t_a + t_c + t_d}$$

$$n_{2N} = \frac{n_{1N}}{i}$$

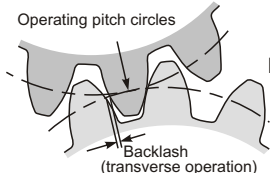
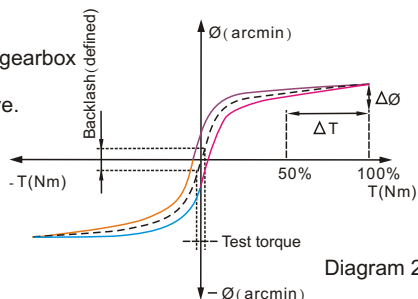
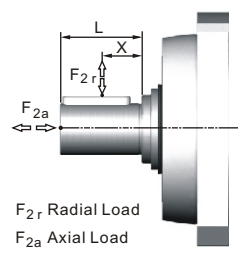
(Eq.5)

$$6. F_{2rm} = 3 \sqrt{\frac{n_{2a} \times t_a \times F_{2ra}^3 + n_{2c} \times t_c \times F_{2rc}^3 + n_{2d} \times t_d \times F_{2rd}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

$$F_{2am} = 3 \sqrt{\frac{n_{2a} \times t_a \times F_{2aa}^3 + n_{2c} \times t_c \times F_{2ac}^3 + n_{2d} \times t_d \times F_{2ad}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

(Eq.6)

Glossary

Emergency Stop Torque T_{2NOT}	Nm	The Emergency Stop Torque is the maximum permitted torque at the output of gearbox. This may happen only occasionally and may not exceed 1,000 times during the whole service life.
Max. Acceleration Torque T_{2B}	Nm	Under the Cyclic Operation (S5), the Max. Acceleration Torque is the maximum torque which can be transmitted only briefly to the output of gearbox up to 1,000 cycles/hr.
No Load Running Torque	Nm	The No Load Running Torque is the min. torque to overcome the internal friction of a gearbox without loading*.
Nominal Input Speed n_{1N}	rpm	The Nominal Input Speed is the permitted input speed of gearbox by the Continuous Operation (S1) while the housing temperature does not exceed 90°C. This value is measured at environment temperature 25°C.
Max. Input Speed n_{1B}	rpm	The Max. Input Speed is the max. permitted input speed of gearbox by the Cyclic operation (S5). This value is measured at environment temperature 25°C and serves as the absolute limit of the gearbox.
Backlash	arcmin	The Backlash is the maximum angular measurement between two teeth of gears when the transverse operation occurs (refer to Diagram 1). The arcmin is the measurement unit for the backlash. One arcmin equals 1/ 60 degree, symbolized as 1'.  Diagram 1
Torsional Rigidity	Nm/arcmin	Torsional Rigidity is the quotient ($\Delta T / \Delta \theta$) between the applied torque and resulting torsion angle. This value indicates how much torque is needed on the gearbox to rotate the output shaft for 1 arcmin. The Torsional Rigidity can be determined by Hysteresis Curve. Hysteresis Curve When the input shaft is locked, increase torque at the output slowly up to T_{2B} in both directions and then release the torque gradually. According to the measured torque and torsion angle, a closed curve will be acquired as in the Diagram 2.  Diagram 2
Radial Load And Axial Load	N	The permitted radial and axial loads on output shaft of the gearbox depend on the design of the gearbox supporting bearings. For more information, please refer to APEX website. 
Efficiency η	%	The transmission efficiency of the gears inside a gearbox (without friction).
Operating Temperature	° C	The Operating Temperature indicates the temperature of gearbox housing.
Degree of Protection		IP code stands for International Protection standard. The IP65 as example: the first IP number stands for protection degree against dust; the second IP number stands for protection against liquid.
Lubrication		APEX uses synthetic lubrication grease. Alternate greases are available, please contact APEX.
Running Noise	dB(A)	The Running Noise is measured depends on gearbox size, the ratio and the speed*. Higher speed usually induces higher noise level, while higher ratio induces lower noise level.
Moment of Inertia J_1	kg.cm ²	The Moment of Inertia J1 is a measurement of the effort applied to an object to maintain its momentary condition at rest or rotating.
Breakaway Torque	Nm	The Breakaway Torque is the minimum torque to start the rotation from the input side of gearbox. A smaller size or a higher ratio gearbox requests less Breakaway Torque.
Back Driving Torque	Nm	The Back Driving Torque is the minimum torque to start the rotation from the output side of gearbox. A larger size or a higher ratio gearbox requires greater Back Driving Torque.

* This value is measured at environment temperature 25°C and the input speed 3,000 rpm. If the Nominal Input Speed n_{1N} of gearbox is lower than 3,000 rpm, this value is measured by that specific Nominal Input Speed.



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APEX-2015-08-K SERIES-1.0E-1.0V

