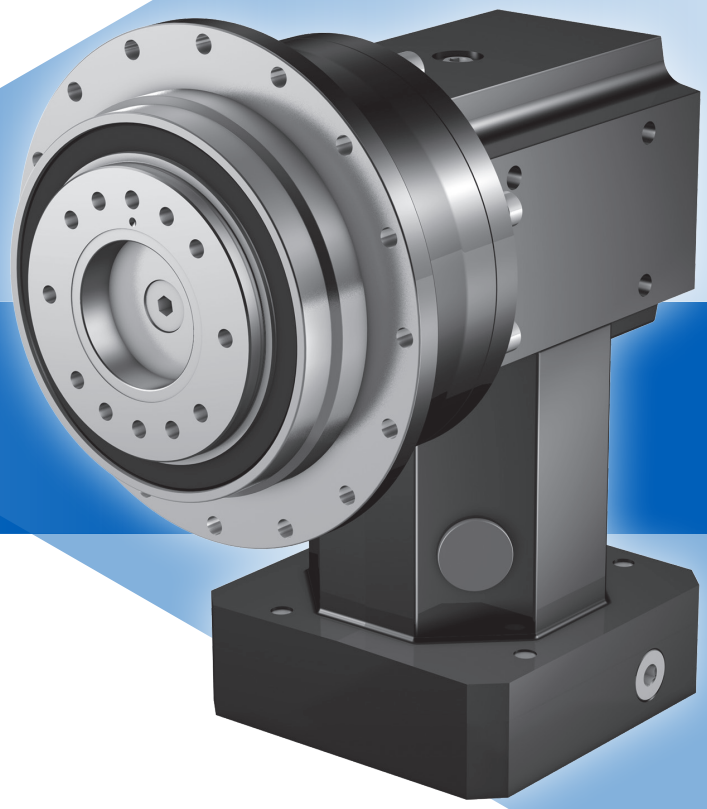
PHKX Series: RIGHT ANGLE – Flange Output

PHKX Features

- 4:1 to 300:1 ratios (higher ratios available. Contact STOBER.)
- Quiet running (<64dB(A))
- High load capacity and tilting rigidity through symmetrical bearing arrangement
- FKM seals for extended gearbox life
- Large motor input option to accept bigger diameter motor shafts so you don't use an oversized gearbox
- Error free motor mounting and quick changeover with toleranced pilot on motor plate
- Low no load running torque, giving you more torque for your application
- Magnetic oil filtration to remove contaminants to prevent breakdowns
- Build and ship in one day
- Assembled in the USA

STOBER PHKX provides a right angle option with planetary gearing. Every gearbox is made to order. STOBER will custom whatever you need to fit your application. Contact us today to learn more.



SHIPS in 1 DAY!
NO EXPEDITE FEE FOR 24 HOUR SERVICE

General Specifications

Ambient Temperature	0°C to +40°C (104°F) [Unit temperature <90°C Max]
Backlash	≤3.5 (see performance overview chart on page 226
Coating	Standard Black (RAL-9005)
Degree of Protection	IP65
Direction of Rotation	See page 227
Efficiency	PHKX: 1 stage 96%, 2 stage 94%
Input RPM	Up to 6,000 RPM
Installation	Requires 12.9 fasteners. See page 306, for more information
Lubrication	Lubricated for life – standard Mobil SHC629; option food grade Mobil SHC CIBUS 150
Mounting Position	Must be specified, see page 227
Warranty	5 Year Limited (2 Years on normal wear items: bearings, seals, etc.)

Overview

Selection Options *At-a-Glance*

Using the **Selection Data** table later in this section, select the PHKX Series Gearhead with the appropriate performance and design options tailored to your motor choice and exact application requirements. Use the part number guide below as a reference to build a part number for the complete gearhead assembly.

Part Number Examples:

	1	2	3	4	5	6	7	8	9	0	!	@	
PHKX	PH	3	3	1	S	F	S	S	0040	KX301VF	0010	MF	EL1 *

	Design Option	Part Number Code	Description
1	**Series**	PH	Rotating flange output planetary
2	**Size**	3 4 5 7 8	5 sizes of gearhead
3	**Generation**	3	Version of gearhead
4	**# of Stages**	1 2	One stage for ratios of ≤ 10:1 Two stage for ratios >30:1
5	**Housing**	S	Standard mounting style
6	**Output Shaft**	F	Flange output
7	**Bearing**	S V	Standard Reinforced Bearing (Sizes 3-5)
8	**Backlash**	S R	Standard Backlash Reduced Backlash
9	**Ratio**	0040	Ratios range from 4:1 to 100:1 (0040=4:1; 0055=5.5:1; 1000=100:1, ect.)
0	**Secondary Unit**	KX301VF	KX Series right angle unit: 5 sizes, 1 stage, without output shaft (V) and with flange (F)
!	**Secondary Unit Ratio**	0010	Ratios from 1:1 to 3:1 (0010=1:1; 0020=2:1; 0030=3:1)
@	**Motor Adapter**	MF	Motor Adapter with FlexiAdapt coupling
*	**Mounting Position**	EL1 EL2 EL3 EL4 EL5 EL6	Required special instruction for all units, see page 227

Options

Coating Options

- Available with multi-layer, industrial 316 stainless steel epoxy coating. Contact factory for this option.

ATEX

- ATmosphere EXplosible – rated for explosive environments. Contact factory for this option and allow additional time for delivery.

PHKX Performance Overview

PH Series performance is dependent on several factors including duty cycle, bearing design, gearhead size and stage configuration, among others. Use the chart below for preliminary evaluation, then use the following performance chart and selection information on the following pages for specific performance sizing and selection.

Size/Generation/# of Stages		PH331	PH332	PH431	PH432	PH531	PH532	PH731	PH732	PH831	PH832
Secondary Unit		KX3	KX3	KX4	KX3	KX5	KX4	KX7	KX5	KX7	KX7
Acceleration Torque M_{2BMAX}	Nm	75	80	160		370	385	840	866	1200	2100
Output Torque Nom. [1] M_{2N}	Nm	53		110		296		600		1557	
Torsional Stiffness C_2	Nm/arcmin	8.4	13	19	30	46	78	122	176	253	489
Torsional Backlash [2]	Δϕ	≤5	≤4	≤4	≤3	≤4	≤3	≤4	≤3	≤4	≤3
	Δϕ Reduced	≤3	≤2	≤2	≤1	≤2	≤1	≤2	≤1	≤2	≤1
	arcmin										
Input Speed Max. n_{1MAX}	Continuous	3500		3000	3500	3000		2100	3000	2100	2100
	Cyclic	6000		5500	6000	5000		4000	5000	4000	4500
Efficiency (@nom torque)	%	95	92	95	92	95	92	95	92	95	92
Weight	kg	3.5	4.0	7.9	6.5	13.5	11.8	25.5	21.8	43.9	49.4
	lbs	7.7	8.8	17.4	14.3	29.7	26	56.1	48	96.6	108.7
Noise [3]	dB(A)	≤64		≤66	≤64	≤68	≤66	≤70	≤68	≤70	
Performance by Bearing Design Option [4]											
Permitted Axial Force F_{2ax100}	N	1650		2150		4150		6150		10,050	
Permitted Tilting Torque M_{2K100}	Nm	101		257		440		1466		3486	
Performance by Reinforced Bearing Design Option											
Permitted Axial Force F_{2ax100}	N	2200		2900		5000		—		—	
Permitted Tilting Torque ≤100RPM M_{2K100}	Nm	150		354		572		—		—	

[1] *Ratings based on input speed (n_1) of 1500 RPM.*

For torque at higher input speeds (M_{2NX}) solve the formula:
where n_1 = Actual Input Speed.

$$M_{2NX} = \frac{M_{2N}}{\sqrt[3]{\frac{n_1}{1500}}}$$

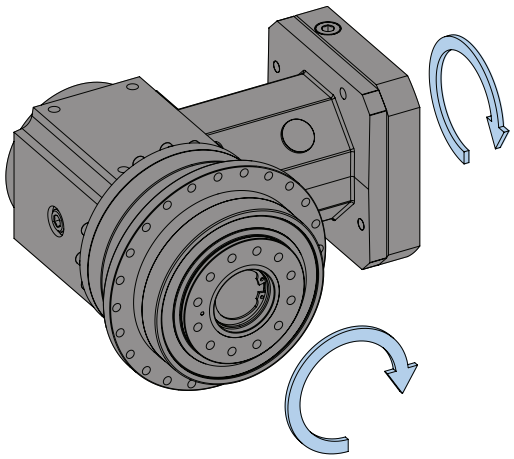
[2] *Tested at 1.5% of nominal torque and recorded on the output side of the gearhead. For lower backlash, contact STOBER technical support.*

[3] *Measurement at one (1) meter distance with input speed (n_1) of 1500 RPM.*

[4] *Rating based on output speed (n_2) of 100 RPM. For values at other speeds see page 229.*

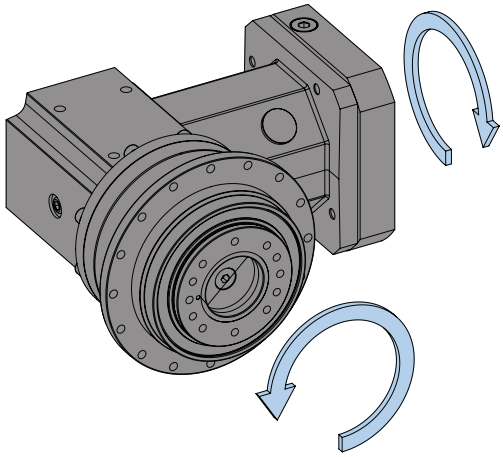
PHKX Series Direction of Rotation

CW



1 Stage Units (PH7 & PH8)
2 Stage Units (PH7 & PH8)

CCW

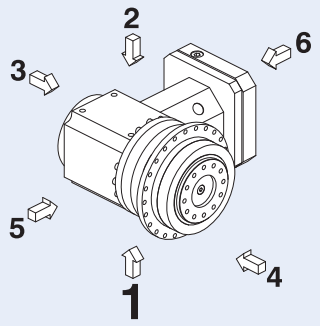


1 Stage Units (PH3 thru PH5)
2 Stage Units (PH3 thru PH5)

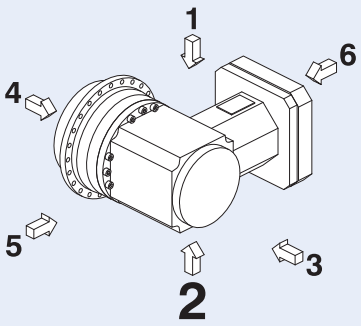
PHKX Mounting Position Options

Horizontal Positions (EL1, EL2, EL5, EL6) are interchangeable;

Vertical Positions (EL3 and EL4) MUST BE SPECIFIED

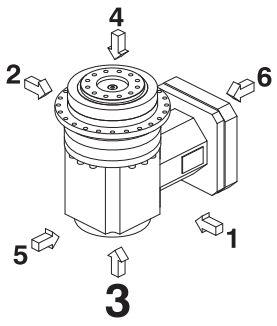


EL1

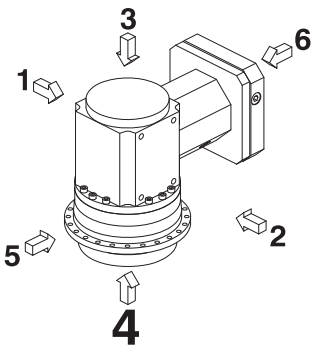


EL2

IMPORTANT: Mounting PHKX in either vertical mounting position (EL3 or EL4) must be specified when ordering.

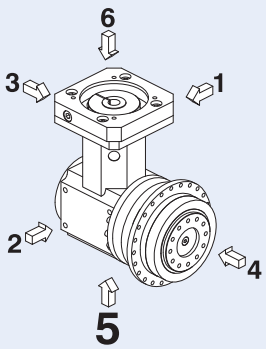


EL3

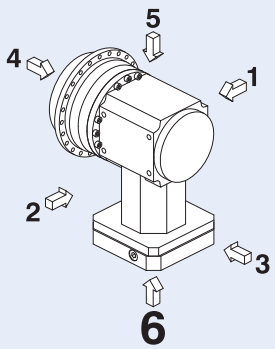


EL4

IMPORTANT: Mounting PHKX in either vertical mounting position (EL3 or EL4) must be specified when ordering.



EL5



EL6

PHKX Series Motor Mounting Plate Option

STOBER Servo Gearheads fit the motor of your choice with the appropriate motor mounting plate assembled between the motor and the gearhead.

NOTE: When ordering a gearhead:

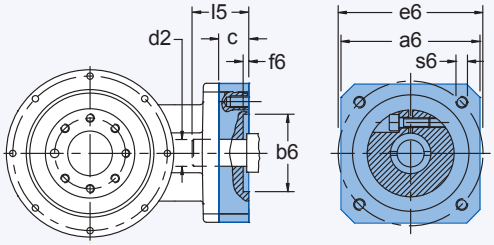
- Specify the motor manufacturer and part number
- Provide the motor drawing with dimensions, or specify the motor mounting dimensions (per the list shown at right)

For a precise dimension on a specific motor, or for general assistance, we recommend you contact STOBER Technical Support.

Customer Required Dimensions for Properly Sized Motor Mounting Plate

Motor information required with Motor Adapter (MF option for PHKX)

d2	Motor Shaft Diameter (If an adapter bushing is required it will be supplied with the motor plate.)
b6	Pilot Diameter
e6	Bolt Circle Diameter
s6	Bolt Diameter
l5	Motor Shaft Length
f6	Pilot Length
a6	Square Flange (Optional – motor plate will typically be made to match this dimension.)

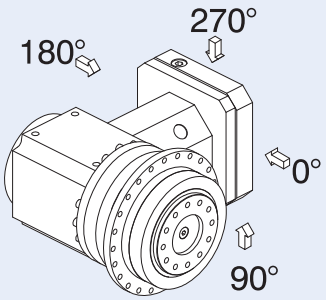


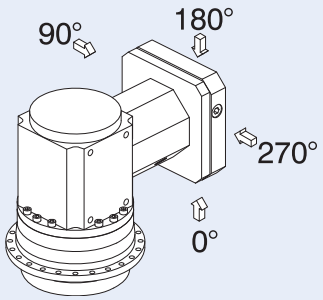
PHKX Motor Mounting Plate Dimensions — mm (Gearhead Part Number Specific)	PH331KX3 PH332KX3 PH432KX3	PH431KX4 PH532KX4	PH531KX5 PH732KX5	PH731KX7 PH831KX7 PH832KX7
Maximum Allowed Motor Shaft Dia. d2	19	24	32	38
Minimum Allowed Motor Plate Thickness c*	18	21	24	25

** Note that the c motor plate thickness is determined by the motor shaft length. The minimum motor plate thickness is the value listed.*

PHKX Series Motor Mounting Plate Access Hole

Access to the clamping screw for the motor coupling is located on the 270° side of the motor mounting plate at the location shown. If necessary, the motor mounting plate can be rotated in the field, if a 0°, 90° or 180° orientation for the access hole is desirable.

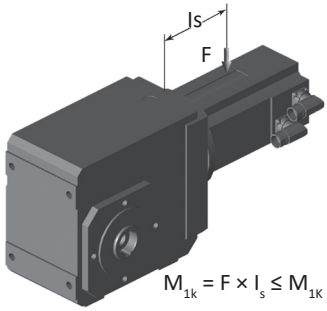




PHKX Series Permissible Motor Tilting Torque

The permissible tilting torque of the motor attached to the gear unit is a result of the static and dynamic load "F" from the motor weight, mass acceleration, and vibration multiplied by the distance from the center of gravity "l_s" of the motor.

M_{1K}	PHKX (MF Motor Adapters)			
	PHKX3	PHKX4	PHKX5	PHKX7
Nm	12	24	50	100



PHKX Series Permissible Output Shaft Load and Tilting Moments – Standard Bearings

Size	Z_2 Distance of Shaft Shoulder to Center of Output Bearing mm	F_{2ax100} Permitted Axial Force N	$F_{2rad100}$ Permitted Radial Force ≤100RPM N	$F_{2rad,acc}$ Radial Acceleration Force N	M_{2K100} Permitted Tilting Torque ≤100RPM Nm	$M_{2K,acc}$ Permitted Acceleration Tilting Torque Nm	C_{2K} Tilting Stiffness Nm/arcmin
3	62.5	1650	1613	1613	101	101	75
4	83.0	2150	3095	3571	257	296	192
5	97.0	4150	4536	4897	475	475	429
7	86.0	6150	17,045	17,045	1466	1466	500
8	125.5	10,050	27,778	27,778	3486	3486	1550
9	155.0	33,000	48,387	70,968	7500	11,000	7500
10	171.0	50,000	51,462	73,099	8800	12,500	9500

PHKX Series Permissible Output Shaft Load and Tilting Moments – Reinforced Bearings

Size	Z_2 Distance of Shaft Shoulder to Center of Output Bearing mm	F_{2ax100} Permitted Axial Force N	$F_{2rad100}$ Permitted Radial Force ≤100RPM N	$F_{2rad,acc}$ Radial Acceleration Force N	M_{2K100} Permitted Tilting Torque ≤100RPM Nm	$M_{2K,acc}$ Permitted Acceleration Tilting Torque Nm	C_{2K} Tilting Stiffness Nm/arcmin
3	66.5	2200	2250	2250	150	150	80
4	88.5	2900	4000	4000	354	354	217
5	104.0	5000	5500	5500	572	572	478

PHKX Series Load/Life/Speed Calculations

The permissible load and tilting moment values are based on an output speed of 100 RPM. For higher speeds the following applies, where n_2 is the desired speed:

$$F_{2radN} = \frac{F_{2rad100}}{\sqrt[3]{\frac{n_{2m*}}{100rpm}}} \qquad F_{2AX} = \frac{F_{2ax100}}{\sqrt[3]{\frac{n_2}{100}}} \qquad M_{2KX} = \frac{M_{2K100}}{\sqrt[3]{\frac{n_2}{100}}}$$

The application output tilting moment should be determined by the following formula:

$$M_{2k,acc*} = \frac{2 \bullet F_{2ax100*} \bullet y_2 + F_{2rad,acc*} \bullet (x_2 + Z_2)}{1000} \leq M_{2k,acc}$$

$$M_{2k,eq*} = \sqrt[3]{\frac{n_{2b1} \bullet t_{b1} \bullet M_{2kb1}{}^3 + \ldots + n_{2bn} \bullet t_{bn} \bullet M_{2kbn}{}^3}{n_{2b1} \bullet t_{b1} + \ldots + n_{2bn} \bullet t_{bn}}} \leq M_{2kN}$$

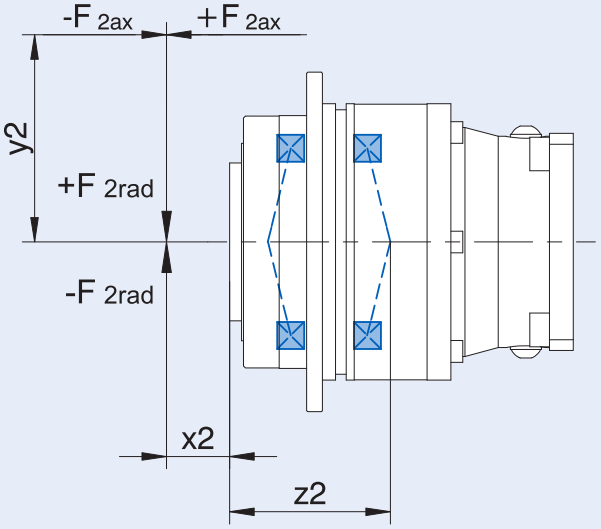
$$F_{2rad,eq*} = \sqrt[3]{\frac{n_{2b1} \bullet t_{b1} \bullet F_{2rb1}{}^3 + \ldots + n_{2bn} \bullet t_{bn} \bullet F_{2rbn}{}^3}{n_{2b1} \bullet t_{b1} + \ldots + n_{2bn} \bullet t_{bn}}} \leq F_{2radN}$$

Where:

Z_2	Distance of Shaft Shoulder to Center of Output Bearing
n_2	Actual Average Output Speed
X_2	Distance of the Shaft Shoulder to the Force Application Point
Y_2	Distance of the Shaft Axis to the Axial Force Application Point
F_{2ax*}	Actual Axial Force at Gear Unit Output
F_{2ax100}	Permitted Axial Force
$F_{2rad100}$	Permitted Radial Force ≤100RPM
$F_{2rad,acc}$	Radial Acceleration Force
$F_{2rad,acc*}$	Radial Acceleration Force at Gear Unit Output
M_{2K100}	Permitted Tilting Torque ≤100RPM
$M_{2K,acc}$	Permitted Acceleration Tilting Torque
$M_{2k,acc*}$	Permitted Acceleration Tilting Torque at Gear Unit Output
C_{2K}	Tilting Stiffness

All formulas shown are based on METRIC values

Upper case letters are permissible values. Lower case letters are for existing values.



The hours of life (L_h) of the unit can be determined by the following formula:

bearing life for duty cycle ≤ 40%

L_h > 10,000 hours if $M_{2K100}/M_{2A*} < 1.25$ and > 1
L_h > 20,000 hours if $M_{2K100}/M_{2A*} > 1.25$ and > 1.5
L_h > 30,000 hours if $M_{2K100}/M_{2A*} < 1.5$

bearing life for duty cycle ≥ 40%

$$L_{hA} = L_h \left(\frac{40\%}{\text{Duty Cycle}}\right)$$