



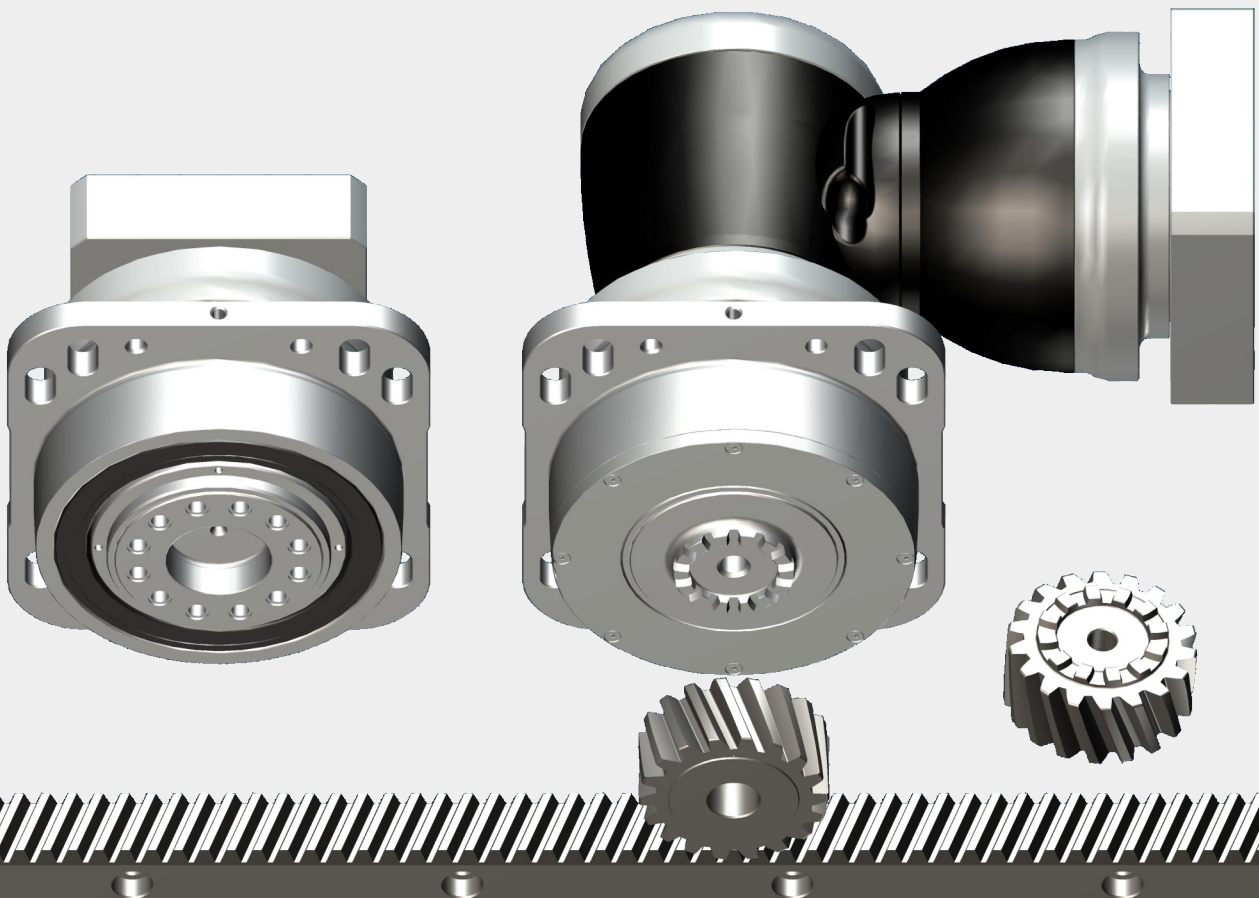
APEX DYNAMICS, INC.

High Performance Gearbox

MG / MGK Series

MGH / MGHK

MGHC / MGHCCK Series



Gearbox Series - MG / MGK

► Features:

- Enhanced Axial and Radial Load
- Easy Installation and Adjustment
- High Torque
- High Torsional Rigidity
- Long-Term Persistence of Low Backlash
- Long Service Life
- High Efficiency / Optimized Inertia Moment
- Identical Input-Output Rotating Direction with Hypoid Right-Angle K-Series
- Standard Flange or Curvic Output



Ordering Code - MG / MGK Series

MG115	—	005	/	MOTOR
MGK115	—	012	—	A / MOTOR
MGKB115				Motor Type
				Application Direction
				Ratio
				Gearbox Size

Gearbox Size

MG	115 / 140 / 170 / 240 / 285 / 320
MGK	115 / 140 / 170 / 240 / 285 / 320

Ratio⁽¹⁾

MG	(1 Stg.) 4 / 5 / 7 / 10
	(2 Stg.) 16 / 20 / 21 / 25 / 28 / 31 / 35 / 40 / 46 / 50 / 61 / 70 / 91 / 100
MGK	(2 Stg.) 12 / 15 / 16 / 20 / 25 / 28 / 35 / 40 / 49 / 50 / 70 / 100
MGKA	(3 Stg.) 100 / 125 / 140 / 175 / 200 / 250 / 280 / 350 / 500 / 700 / 1,000
MGKB	(3 Stg.) 64 / 84 / 100 / 125 / 140 / 175 / 200 / 250 / 280 / 350 / 400 / 500 / 700 / 1,000
MGK	(4 Stg.) 1,225 / 1,400 / 1,750 / 2,000 / 2,800 / 3,500 / 5,000 / 7,000 / 10,000
MGKC	4 / 5 / 7 / 8 / 10 / 21 / 31 / 46 / 61 / 91

Application Direction⁽²⁾: A = 6 o'clock
 (For MGK serie only) **B = 9 o'clock**
 C = 12 o'clock
 D = 3 o'clock

Motor Type
Manufacturer and Model

(1) Ratio (I=N_{in}/N_{out}). Please refer to the specifications for the ratios provided in each series.
 (2) Please refer to page 06.



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Performance - MG Gearbox

Model No.	Stage	Ratio ⁽¹⁾	MG115	MG140	MG170	MG240	MG285	MG320				
Nominal Output Torque T_{2N} By n_{1N}	1	4	205	380	765	1,415	2,190	4,035				
		5	185	325	660	1,225	1,905	3,505				
		7	135	260	515	980	1,530	2,530				
		10	55	160	315	700	1,070	1,810				
	2	16	195	385	805	1,485	2,295	4,215				
		20	190	370	795	1,495	1,990	3,660				
		21	195	345	700	1,295	2,005	3,685				
		25	195	345	700	1,295	2,005	3,685				
		28	180	345	755	1,510	2,335	4,290				
		31	135	280	560	1,050	1,620	2,590				
		35	195	350	705	1,310	2,030	3,725				
		40	96	220	615	1,260	2,360	4,280				
		46	55	160	335	660	1,005	1,700				
		50	120	275	715	1,325	2,050	3,765				
		61	135	285	585	1,095	1,670	2,675				
		70	135	285	585	1,095	1,670	2,675				
		91	55	160	345	660	1,005	1,700				
100	55	160	345	660	1,005	1,700						
Emergency Stop Torque T_{2NOT}	Nm	1,2	4~100	3 times T_{2N}								
Max. Acceleration Torque T_{2B}	Nm	1,2	4~100	1.5 times T_{2N}								
No Load Running Torque ⁽³⁾	Nm	1	4~10	0.7	1.4	3.5	7	11	14			
		2	16~100	0.3	0.6	1.3	2.2	3.5	4.5			
Backlash ⁽²⁾	arcmin	1	4~10	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3			
		2	16~100	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4			
Torsional Rigidity	Nm/arcmin	1,2	4~100	22	60	115	395	650	1,050			
Nominal Input Speed n_{1N}	rpm	1	4~10	3,600	3,600	3,000	2,700	2,400	2,100			
		2	16~100	4,600	4,600	4,000	3,700	3,400	3,100			
Max. Input Speed n_{1B}	rpm	1	4~10	6,000	6,000	5,000	4,500	4,000	3,500			
		2	16~100	7,000	7,000	6,000	5,500	5,000	4,500			
Max. Axial Load F_{2a} ⁽⁴⁾	N	1,2	4~100	10,600	15,700	20,100	43,100	61,000	83,500			
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	1,2	4~100	1,300	2,180	3,600	10,600	18,400	21,900			
Operating Temp	°C	1,2	4~100	-10° C ~ 90° C								
Degree of Gearbox Protection		1,2	4~100	IP67								
Lubrication		1,2	4~100	Synthetic lubrication grease								
Mounting Position		1,2	4~100	All directions								
Running Noise ⁽³⁾	dB(A)	1	4~10	≤ 58	≤ 59	≤ 64	≤ 65	≤ 66	≤ 66	≤ 66	≤ 68	≤ 70
		2	16~100	≤ 58	≤ 59	≤ 60	≤ 63	≤ 66	≤ 66	≤ 66	≤ 66	≤ 68
Efficiency η	%	1	4~10	≥ 97%								
		2	16~100	≥ 94%								

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

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

(3) The values are measured by gearbox with ratio 10 (1-stage) or ratio 100 (2-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.
By lower ratio and/or higher RPM, the values could be higher.

(4) Applied to the output flange center at 100 rpm.

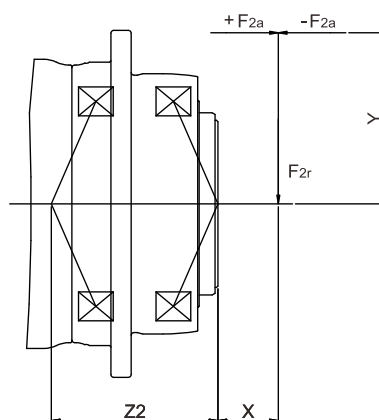
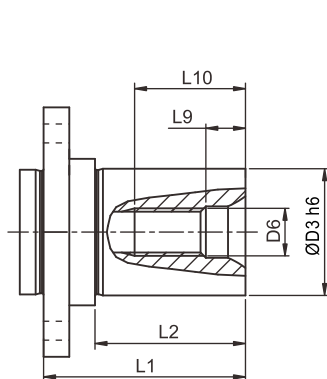
(5) Continuous operation is not recommended.

Inertia - MG Gearbox

Model No.	MG115		MG140		MG170		MG240		MG285		MG320	
	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.
$\emptyset^{(A)}$ (C3)												
8	-	-	-	-	-	-	-	-	-	-	-	-
11	-	0.17	-	-	-	-	-	-	-	-	-	-
14	0.53	0.21	-	0.53	-	-	-	-	-	-	-	-
19	0.68	0.63	1.83	0.68	-	1.83	-	-	-	-	-	-
24	4.52	-	5.04	4.52	5.63	5.04	-	5.63	-	-	-	-
28	-	-	6.33	-	7.18	6.33	-	7.18	-	-	-	-
32	-	-	8.73	-	10.1	8.73	12.63	10.1	-	12.63	-	-
35	-	-	14.04	-	15.54	14.04	17.75	15.54	17.35	17.75	28.18	20.8
38	-	-	19.05	-	21.32	19.05	23.26	21.32	23.61	23.26	28.18	27.05
42	-	-	-	-	23.2	-	25.4	23.2	25.5	25.4	30.52	28.95
48	-	-	-	-	56.07	-	61.02	56.07	61.22	61.02	66.85	64.66
55	-	-	-	-	-	-	88.51	-	88.86	-	94.91	-
60	-	-	-	-	-	-	-	-	-	-	117.73	-

(A) \emptyset = Input shaft diameter.

Flange Shaft - MG



$$M_{2K} = \frac{F_{2a} * Y + F_{2r} * (X + Z_2)}{1000}$$

$$M_{2K} : [\text{Nm}]$$

$$F_{2a}, F_{2r} : [\text{N}]$$

$$X, Y, Z_2 : [\text{mm}]$$

Dimension	L1	L2	D3 h6	D6	L9	L10	Order Code
MG115	41	30	22	M8	7.2	19	FLS-AH090-S22
			32	M12	10	28	FLS-AH090-S32
MG140	51	38	32	M12	10	28	FLS-AH110-S32
			40	M16	12	36	FLS-AH110-S40
MG240	54	38	40	M16	12	36	FLS-AH140-S40
			55	M20	15	42	FLS-AH140-S55
MG285	73	52	55	M20	15	42	FLS-AH200-S55
			75	M20	15	42	FLS-AH200-S75
MG320	150	123	90	M24	18	50	FLS-AH255-S90

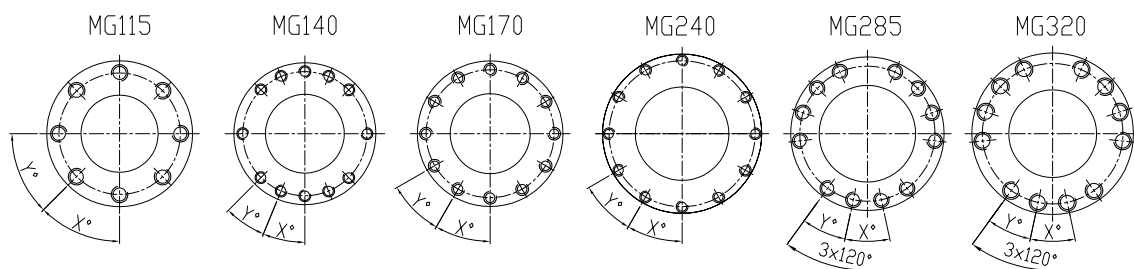
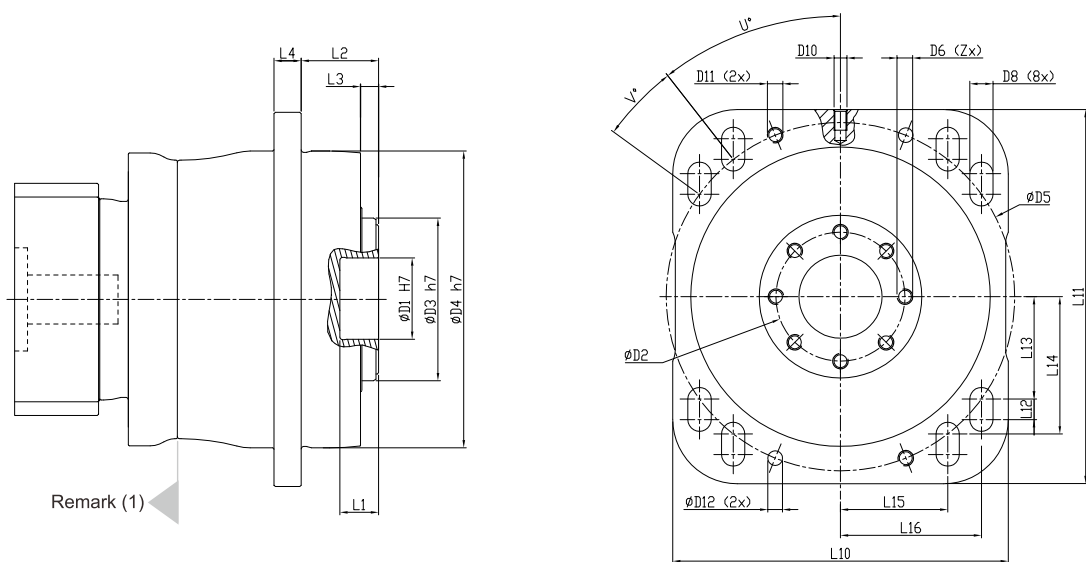
Note: Dimensions are related to gearbox flange interface.

M2K

MG / MGK	115	140	170	240	285	320
Z2 [mm]	81	123.7	104.6	145.7	183.4	196.1

Note : Applied to the output flange center at 100 rpm

Dimension - MG Gearbox

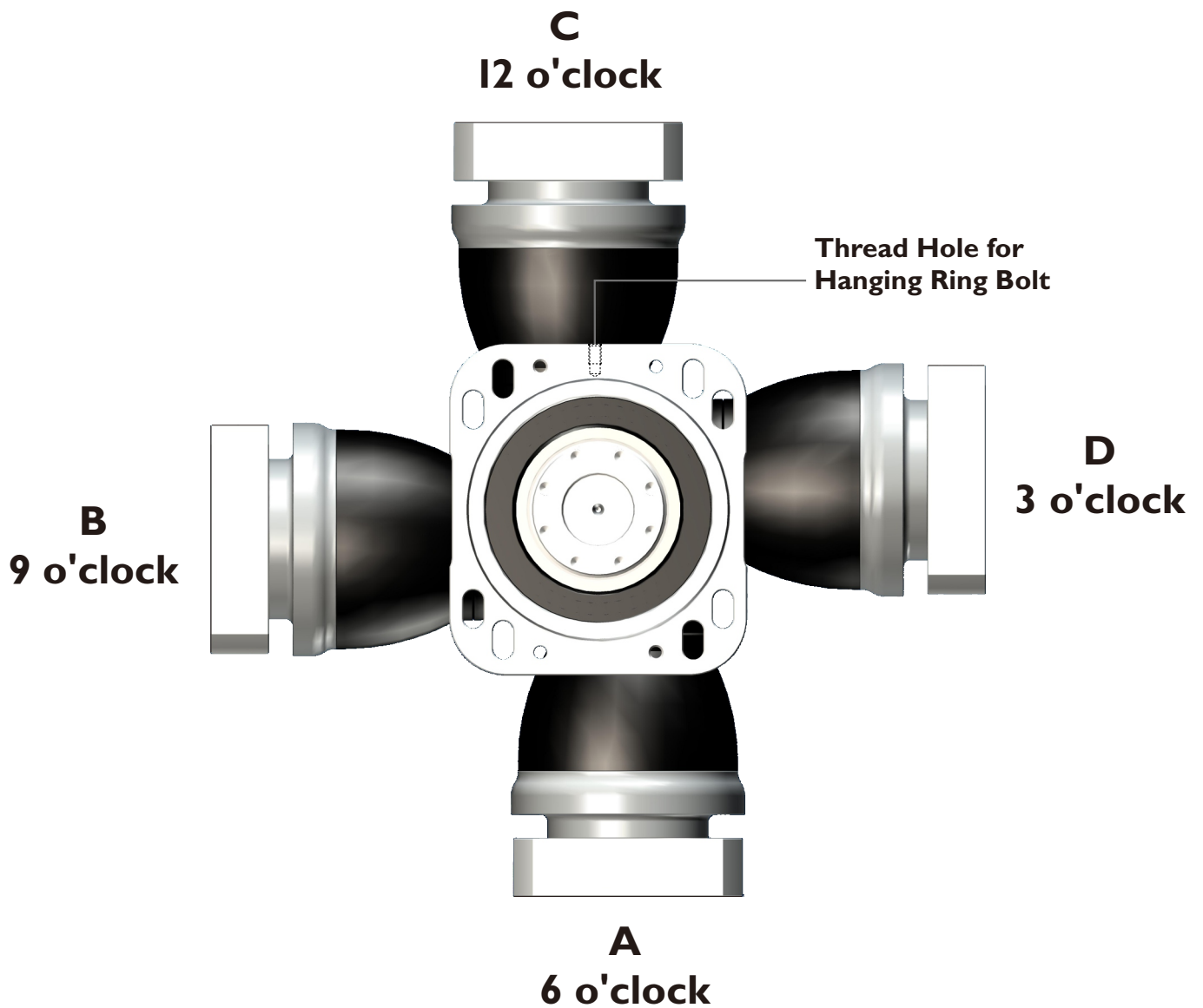


Dimension		MG115	MG140	MG170	MG240	MG285	MG320
D1	H7	31.5	40	50	80	100	100
D2		50	63	80	125	140	160
D3	h7	63	85	100	160	186	208
D4	h7	115	140	170	240	285	320
D5		135	167	200	276	327	368
D6 x Pitch x Deep.		M6x1Px10	M6x1Px11	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M20x2.5Px31
D8		9	11	13.5	17.5	22	26
D10 x Pitch		M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch		M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12		5.7	7.7	9.7	11.7	15.7	15.7
L1		15	15	15	16	16	16
L2		30	41	48	60	70	79.9
L3		7	7	7.5	10	13.5	16.5
L4		10.5	12	15	17	22	25
L10	h8	130	160	190	260	315	350
L11		145	180	215	280	335	390
L12		8	10	12	14	18	22
L13		39.7	49.1	58.8	79.2	91.4	108.2
L14		53.2	65.8	78.8	104.1	123.4	143
L15		41.6	51.4	61.6	90.5	107.3	115.8
L16		54.6	67.6	80.9	113	135.5	148.9
X in Degree		45	22.5	30	30	24	24
Y in Degree		45	22.5	30	30	24	24
Z		8	12	12	12	12	12
U in Degree		38	38	38	41	41	39
V in Degree		16	16	16	14	15	15

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

Application Direction - MGK Gearbox

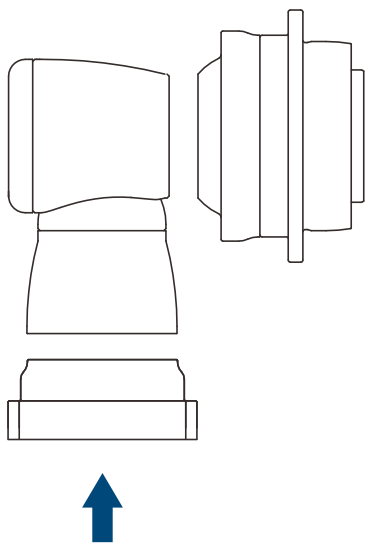
Ordering Code : MGKBI15 - 064 - A / MOTOR



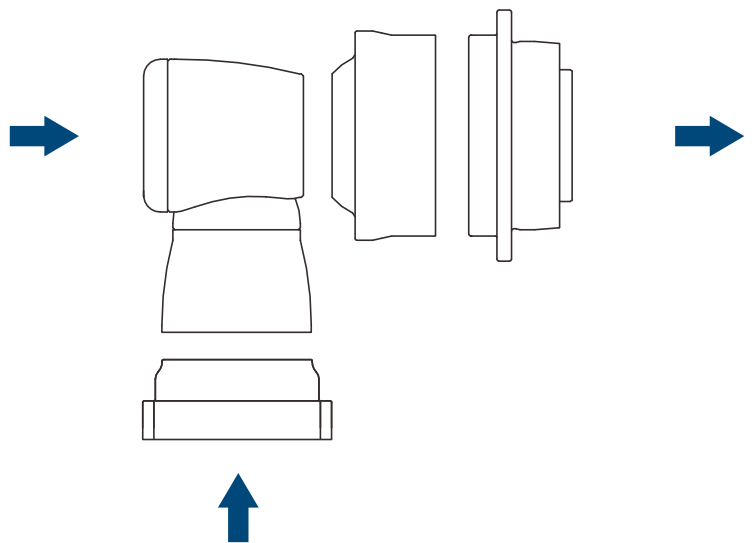
MGK Gearbox Structure

MGK Structure

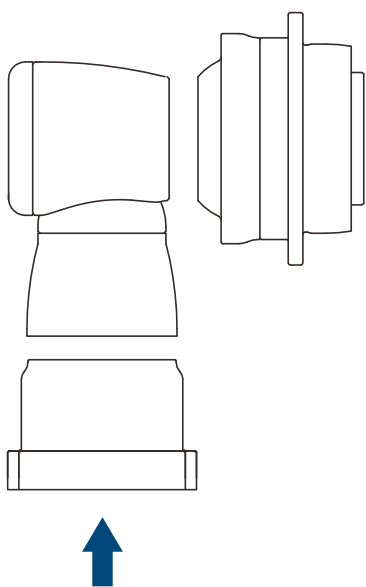
(I) MGK-2 Stage



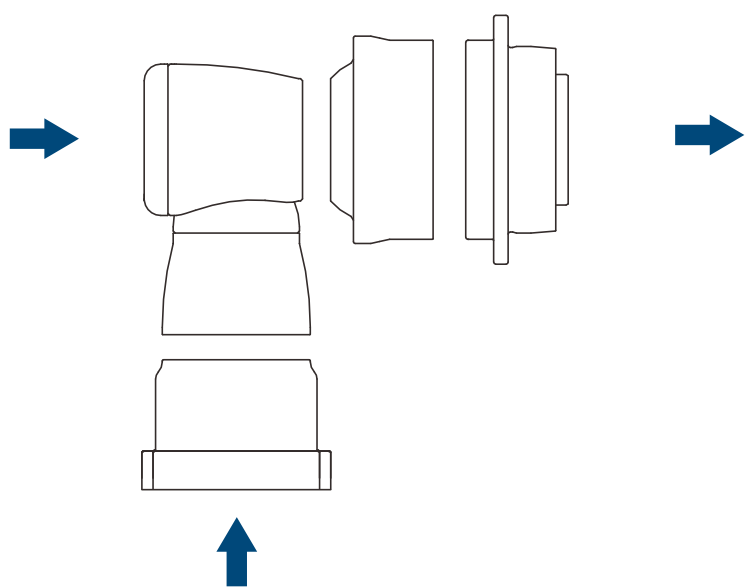
(II) MGKA-3 Stage



(III) MGKB-3 Stage



(IV) MGK-4 Stage



Performance - MGK (2 Stage) Gearbox

Model No.	Stage	Ratio ⁽¹⁾	MGK115	MGK140	MGK170	MGK240	MGK285	MGK320	
Nominal Output Torque T_{2N} By n_{IN}	Nm	2	12	195	365	805	1,495	1,680	3,280
			15	-	-	-	-	2,005	3,675
			16	185	350	775	1,510	1,680	3,280
			20	180	335	750	1,520	1,780	3,710
			25	195	350	710	1,320	1,775	3,735
			28	170	320	720	1,465	1,560	3,000
			35	190	355	715	1,330	1,950	3,750
			40	160	305	680	1,405	1,440	2,400
			49	135	290	585	1,105	1,680	2,685
			50	185	345	725	1,345	1,800	3,000
70	135	295	600	1,130	1,710	2,730			
100	57	160	350	605	915	1,590			
Emergency Stop Torque T_{2NOT}	Nm	2	12~100	2 times T_{2N}					
Max. Acceleration Torque T_{2B}	Nm	2	12~100	1.5 times T_{2N}					
No Load Running Torque ⁽³⁾	Nm	2	12~100	1.3	2	3.1	6	13	16
Backlash ⁽²⁾	arcmin	2	12~100	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	2	12~100	27	56	112	389	642	1,275
Nominal Input Speed n_{IN}	rpm	2	12~100	3,000	2,800	2,700	2,200	2,100	2,000
Max. Input Speed n_{IB}	rpm	2	12~100	6,000	6,000	4,500	4,500	4,000	3,000
Max. Axial Load F_{2a} ⁽⁴⁾	N	2	12~100	10,600	15,700	20,100	43,100	61,000	83,500
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	2	12~100	1,300	2,180	3,600	10,600	18,400	21,900
Operating Temp	°C	2	12~100	-10° C ~ 90° C					
Degree of Gearbox Protection		2	12~100	IP67					
Lubrication		2	12~100	Synthetic lubrication grease					
Mounting Position		2	12~100	All directions					
Running Noise ⁽³⁾	dB(A)	2	12~100	≤ 66	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72
Efficiency η	%	2	12~100	$\geq 94\%$					

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

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

(3) The values are measured by gearbox with ratio 10 (1-stage) or ratio 100 (2-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.

By lower ratio and/or higher RPM, the values could be higher.

(4) Applied to the output flange center at 100 rpm.

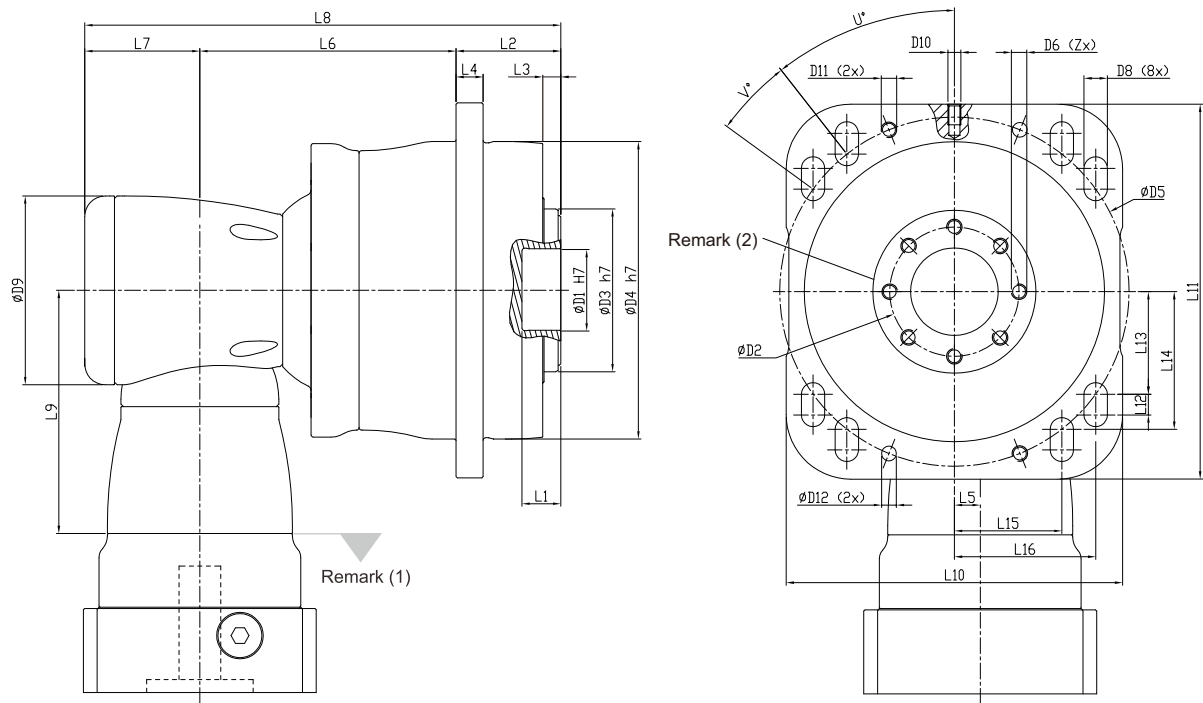
(5) Continuous operation is not recommended.

Inertia - MGK (2 Stage) Gearbox

Model No.	MGK115	MGK140	MGK170	MGK240	MGK285	MGK320
8	-	-	-	-	-	-
11	0.18	-	-	-	-	-
14	0.5	0.52	-	-	-	-
19	0.65	1.69	1.71	-	-	-
24	-	4.89	5.05	6.92	-	-
28	-	-	6.55	6.98	-	-
32	-	-	9.47	10.18	10.18	-
35	-	-	14.91	15.21	15.21	15.68
38	-	-	20.69	20.7	20.7	21.69
42	-	-	-	22.83	22.83	23.59
48	-	-	-	58.45	58.45	59.3

(A) \varnothing = Input shaft diameter.

Dimension - MGK (2 Stage) Gearbox (Ratio $i=12\sim100$)



Dimension	MGK115	MGK140	MGK170	MGK240	MGK285	MGK320
D1 H7	31.5	40	50	80	100	100
D2	50	63	80	125	140	160
D3 h7	63	85	100	160	186	208
D4 h7	115	140	170	240	285	320
D5	135	167	200	276	327	368
D6 x Pitch x Deep.	M6x1Px10	M6x1Px11	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M20x2.5Px31
D8	9	11	13.5	17.5	22	26
D9	94	116	163	210	210	255
D10 x Pitch	M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	5.7	7.7	9.7	11.7	15.7	15.7
L1	15	15	15	16	16	16
L2	30	41	48	60	70	79.9
L3	7	7	7.5	10	13.5	16.5
L4	10.5	12	15	17	22	25
L5	13	17	25	31	31	36
L6	118	120	156.5	189.9	242.8	272.9
L7	53	68.3	89	115	115	131
L8	201	229.3	293.5	364.9	427.8	483.8
L9	114.5	129	173.5	228	228	265.5
L10 h8	130	160	190	260	315	350
L11	145	180	215	280	335	390
L12	8	10	12	14	18	22
L13	39.7	49.1	58.8	79.2	91.4	108.2
L14	53.2	65.8	78.8	104.1	123.4	143
L15	41.6	51.4	61.6	90.5	107.3	115.8
L16	54.6	67.6	80.9	113	135.5	148.9
X in Degree	45	22.5	30	30	24	24
Y in Degree	45	22.5	30	30	24	24
Z	8	12	12	12	12	12
U in Degree	38	38	38	41	41	39
V in Degree	16	16	16	14	15	15

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

(2) Refer to the MG series (Page 05) for flange interface.

Performance - MGKA (3 Stage) Gearbox

Model No.		Stage	Ratio ⁽¹⁾	MGKA320
Nominal Output Torque T_{2N} By n_{1N}	Nm	3	100	3,875
			125	3,900
			140	3,910
			175	3,930
			200	3,945
			250	3,970
			350	4,000
			500	4,035
			700	3,090
			1,000	1,770
Emergency Stop Torque T_{2NOT}	Nm	3	100~1,000	2 times T_{2N}
Max. Acceleration Torque T_{2B}	Nm	3	100~1,000	1.5 times T_{2N}
No Load Running Torque ⁽³⁾	Nm	3	100~1,000	6
Backlash ⁽²⁾	arcmin	3	100~1,000	≤ 4
Torsional Rigidity	Nm/arcmin	3	100~1,000	1,275
Nominal Input Speed n_{1N}	rpm	3	100~1,000	2,100
Max. Input Speed n_{1B}	rpm	3	100~1,000	4,000
Max. Axial Load F_{2a} ⁽⁴⁾	N	3	100~1,000	83,500
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	3	100~1,000	21,900
Operating Temp	°C	3	100~1,000	-10° C ~ 90° C
Degree of Gearbox Protection		3	100~1,000	IP67
Lubrication		3	100~1,000	Synthetic lubrication grease
Mounting Position		3	100~1,000	All directions
Running Noise ⁽³⁾	dB(A)	3	100~1,000	≤ 72
Efficiency η	%	3	100~1,000	$\geq 92\%$

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

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

(3) The values are measured by gearbox with ratio 10 (1-stage) or ratio 100 (2-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.
By lower ratio and/or higher RPM, the values could be higher.

(4) Applied to the output flange center at 100 rpm.

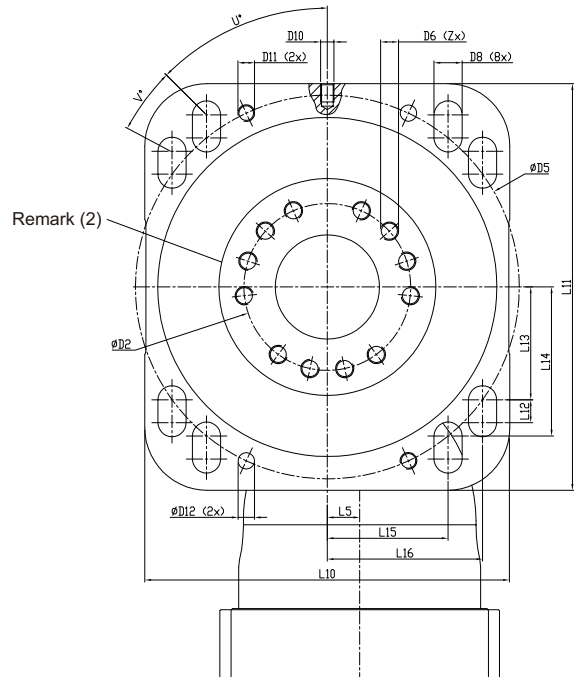
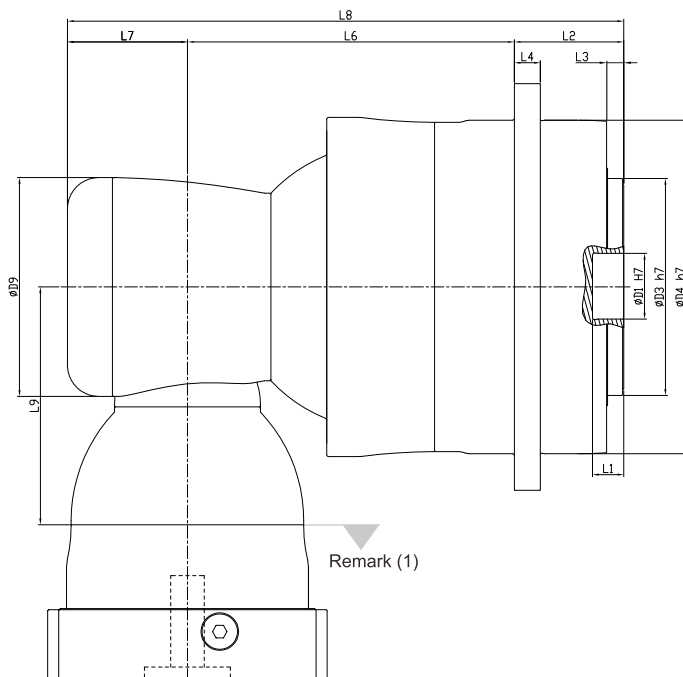
(5) Continuous operation is not recommended.

Inertia - MGKA (3 Stage) Gearbox

Model No.		MGKA320
Input Shaft (C3) $\varnothing^{(A)}$		
32	kg.cm ²	10.18
35		15.21
38		20.7
42		22.83
48		58.45

(A) \varnothing = Input shaft diameter.

Dimension - MGKA (3 Stage) Gearbox (Ratio $i = 100 \sim 1,000$)



Dimension		MGKA320
D1	H7	100
D2		160
D3	h7	208
D4	h7	320
D5		368
D6 x Pitch x Deep.		M20x2.5Px31
D8		26
D9		210
D10 x Pitch		M16x2P
D11 x Pitch		M16x2P
D12		15.7
L1		16
L2		79.9
L3		16.5
L4		25
L5		31
L6		323.4
L7		115
L8		518.3
L9		228
L10	h8	350
L11		390
L12		22
L13		108.2
L14		143
L15		115.8
L16		148.9
X in Degree		24
Y in Degree		24
Z		12
U in Degree		39
V in Degree		15

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

(2) Refer to the MG series (Page 05) for flange interface.

Performance - MGKB (3 Stage) Gearbox

Model No.	Stage	Ratio ⁽¹⁾	MGKB115	MGKB140	MGKB170	MGKB240	MGKB285	MGKB320	
Nominal Output Torque T_{2N} By n_{1N}	Nm	3	64	165	310	690	1,425	1,680	3,280
			84	165	300	670	1,380	1,680	3,280
			100	165	290	655	1,355	2,085	3,830
			125	190	330	730	1,355	2,095	3,850
			140	170	285	630	1,310	2,100	3,860
			175	190	325	705	1,370	2,115	3,885
			200	175	290	605	1,265	2,100	3,900
			250	195	335	680	1,380	2,135	3,920
			280	180	300	610	1,230	1,560	3,000
			350	200	345	705	1,395	1,950	3,750
			400	160	330	670	1,330	1,440	2,400
			500	200	380	760	1,405	1,800	3,000
			700	135	325	670	1,240	1,875	3,005
			1,000	55	160	380	660	1,065	1,725
Emergency Stop Torque T_{2NOT}	Nm	3	64~1,000	2 times T_{2N}					
Max. Acceleration Torque T_{2B}	Nm	3	64~1,000	1.5 times T_{2N}					
No Load Running Torque ⁽³⁾	Nm	3	64~1,000	0.2	0.2	0.3	0.4	1	1.2
Backlash ⁽²⁾	arcmin	3	64~1,000	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	3	64~1,000	27	56	112	389	642	1,275
Nominal Input Speed n_{1N}	rpm	3	64~1,000	5,500	4,600	4,600	4,000	3,700	3,400
Max. Input Speed n_{1B}	rpm	3	64~1,000	7,000	7,000	7,000	6,000	5,500	5,000
Max. Axial Load F_{2a} ⁽⁴⁾	N	3	64~1,000	10,600	15,700	20,100	43,100	61,000	83,500
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	3	64~1,000	1,300	2,180	3,600	10,600	18,400	21,900
Operating Temp	°C	3	64~1,000	-10° C ~ 90° C					
Degree of Gearbox Protection		3	64~1,000	IP67					
Lubrication		3	64~1,000	Synthetic lubrication grease					
Mounting Position		3	64~1,000	All directions					
Running Noise ⁽³⁾	dB(A)	3	64~1,000	≤ 66	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72
Efficiency η	%	3	64~1,000	≥ 92%					

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

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

(3) The values are measured by gearbox with ratio 10 (1-stage) or ratio 100 (2-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.

By lower ratio and/or higher RPM, the values could be higher.

(4) Applied to the output flange center at 100 rpm.

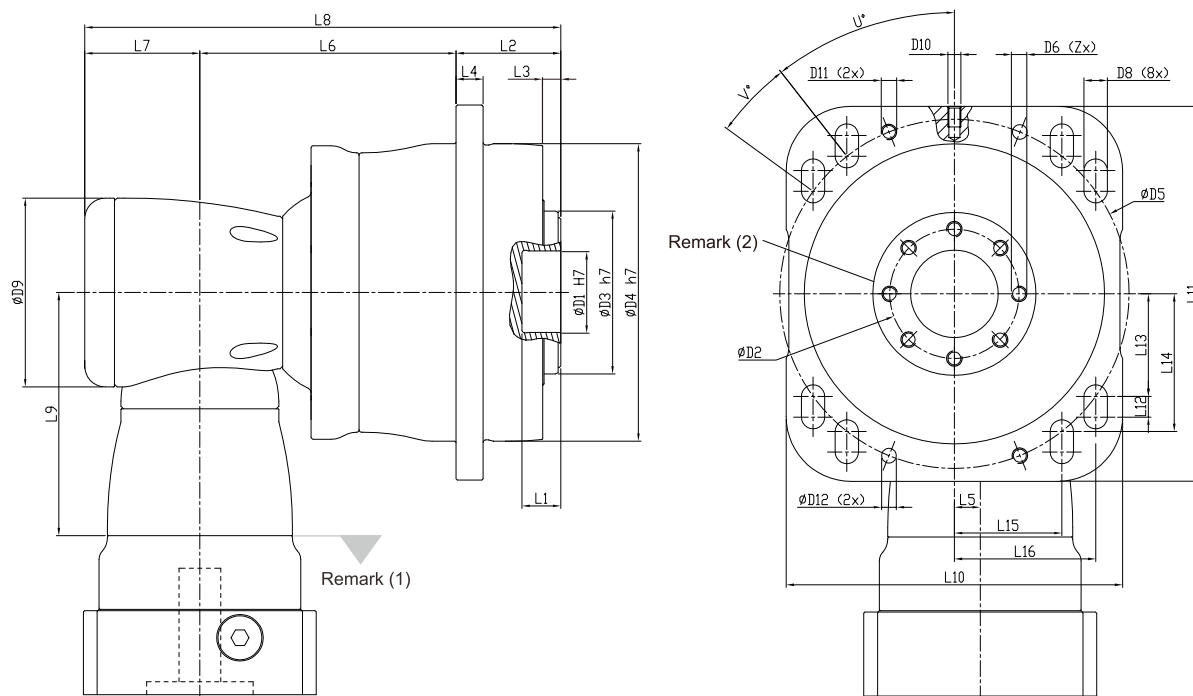
(5) Continuous operation is not recommended.

Inertia - MGKB (3 Stage) Gearbox

Model No.	MGKB115	MGKB140	MGKB170	MGKB240	MGKB285	MGKB320
Input Shaft (C3) $\varnothing^{(A)}$						
8	0.17	-	-	-	-	-
11	0.17	0.52	-	-	-	-
14	0.21	0.53	1.83	-	-	-
19	-	0.68	1.83	5.6	-	-
24	-	-	5.04	5.63	5.63	-
28	-	-	-	7.18	7.18	-
32	-	-	-	10.1	10.1	12.63
35	-	-	-	15.54	15.54	17.75
38	-	-	-	21.32	21.32	23.26
42	-	-	-	-	23.2	25.4
48	-	-	-	-	56.07	61.02

(A) \varnothing = Input shaft diameter.

Dimension - MGKB (3 Stage) Gearbox (Ratio $i = 64 \sim 1,000$)



Dimension		MGKB115	MGKB140	MGKB170	MGKB240	MGKB285	MGKB320
D1	H7	31.5	40	50	80	100	100
D2		50	63	80	125	140	160
D3	h7	63	85	100	160	186	208
D4	h7	115	140	170	240	285	320
D5		135	167	200	276	327	368
D6 x Pitch x Deep.		M6x1Px10	M6x1Px11	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M20x2.5Px31
D8		9	11	13.5	17.5	22	26
D9		94	116	163	210	210	255
D10 x Pitch		M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch		M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12		5.7	7.7	9.7	11.7	15.7	15.7
L1		15	15	15	16	16	16
L2		30	41	48	60	70	79.9
L3		7	7	7.5	10	13.5	16.5
L4		10.5	12	15	17	22	25
L5		13	17	25	31	31	36
L6		118	120	156.5	189.9	242.8	272.9
L7		53	68.3	89	115	115	131
L8		201	229.3	293.5	364.9	427.8	483.8
L9		114.5	129	173.5	228	228	265.5
L10	h8	130	160	190	260	315	350
L11		145	180	215	280	335	390
L12		8	10	12	14	18	22
L13		39.7	49.1	58.8	79.2	91.4	108.2
L14		53.2	65.8	78.8	104.1	123.4	143
L15		41.6	51.4	61.6	90.5	107.3	115.8
L16		54.6	67.6	80.9	113	135.5	148.9
X in Degree		45	22.5	30	30	24	24
Y in Degree		45	22.5	30	30	24	24
Z		8	12	12	12	12	12
U in Degree		38	38	38	41	41	39
V in Degree		16	16	16	14	15	15

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

(2) Refer to the MG series (Page 05) for flange interface.

Performance - MGK (4 Stage) Gearbox

Model No.		Stage	Ratio ⁽¹⁾	MGK320
Nominal Output Torque T_{2N} By n_{1N}	Nm	4	1,225	4,070
			1,400	4,085
			1,750	4,100
			2,000	4,120
			2,800	3,185
			3,500	4,180
			5,000	4,285
			7,000	3,445
			10,000	2,240
Emergency Stop Torque T_{2NOT}	Nm	4	1,225~10,000	2 times T_{2N}
Max. Acceleration Torque T_{2B}	Nm	4	1,225~10,000	1.5 times T_{2N}
No Load Running Torque ⁽³⁾	Nm	4	1,225~10,000	0.4
Backlash ⁽²⁾	arcmin	4	1,225~10,000	≤ 4
Torsional Rigidity	Nm/arcmin	4	1,225~10,000	1,275
Nominal Input Speed n_{1N}	rpm	4	1,225~10,000	3,700
Max. Input Speed n_{1B}	rpm	4	1,225~10,000	5,500
Max. Axial Load F_{2a} ⁽⁴⁾	N	4	1,225~10,000	83,500
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	4	1,225~10,000	21,900
Operating Temp	°C	4	1,225~10,000	-10° C ~ 90° C
Degree of Gearbox Protection		4	1,225~10,000	IP67
Lubrication		4	1,225~10,000	Synthetic lubrication grease
Mounting Position		4	1,225~10,000	All directions
Running Noise ⁽³⁾	dB(A)	4	1,225~10,000	≤ 72
Efficiency η	%	4	1,225~10,000	$\geq 90\%$

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

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

(3) The values are measured by gearbox with ratio 10 (1-stage) or ratio 100 (2-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.
By lower ratio and/or higher RPM, the values could be higher.

(4) Applied to the output flange center at 100 rpm.

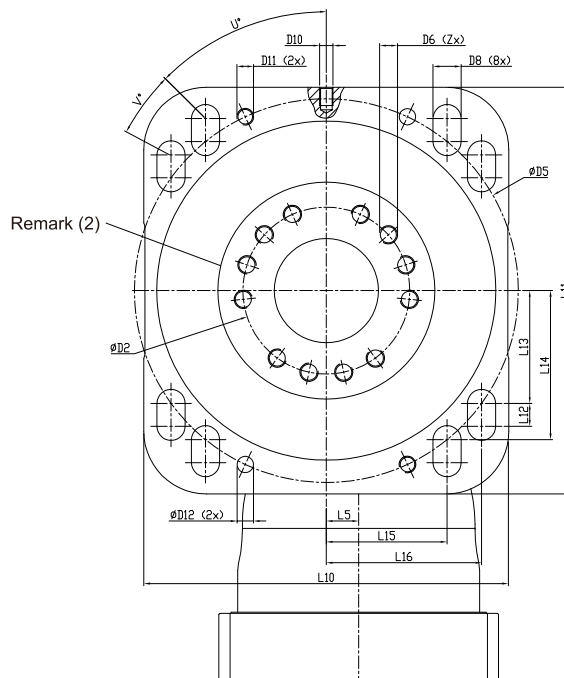
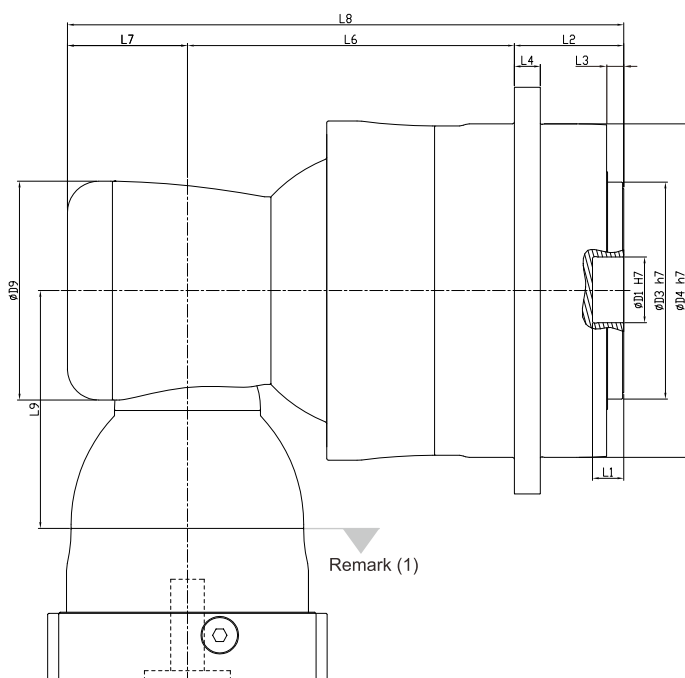
(5) Continuous operation is not recommended.

Inertia - MGK (4 Stage) Gearbox

Model No.		MGK320
Input Shaft (C3) $\varnothing^{(A)}$		
24	kg.cm ²	5.63
28		7.18
32		10.1
35		15.54
38		21.32

(A) \varnothing = Input shaft diameter.

Dimension - MGK (4 Stage) Gearbox (Ratio $i = 1,225\sim 10,000$)



Dimension		MGKA320
D1	H7	100
D2		160
D3	h7	208
D4	h7	320
D5		368
D6 x Pitch x Deep.		M20x2.5Px3 l
D8		26
D9		210
D10 x Pitch		M16x2P
D11 x Pitch		M16x2P
D12		15.7
L1		16
L2		79.9
L3		16.5
L4		25
L5		31
L6		323.4
L7		115
L8		518.3
L9		228
L10	h8	350
L11		390
L12		22
L13		108.2
L14		143
L15		115.8
L16		148.9
X in Degree		24
Y in Degree		24
Z		12
U in Degree		39
V in Degree		15

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

(2) Refer to the MG series (Page 05) for flange interface.

Performance - MGKC Gearbox

Model No.	Stage	Ratio ⁽¹⁾	MGKCI15	MGKCI40	MGKCI70	MGKC240	MGKC285	MGKC320	
Nominal Output Torque T_{2N} By n_{IN}	2	4	205	380	775	1,440	2,240	4,160	
		5	185	330	670	1,250	1,930	3,610	
		7	135	260	525	1,000	1,565	2,535	
		8	205	395	800	1,320	2,300	4,260	
		10	190	340	690	1,290	2,000	3,700	
	3	21	195	345	700	1,310	2,045	3,750	
		31	135	275	565	1,070	1,665	2,660	
		46	57	160	340	660	1,000	1,710	
		61	135	285	590	1,115	1,720	2,750	
91	57	160	350	660	985	1,600			
Emergency Stop Torque T_{2NOT}	Nm	2,3	4~91	2 times T_{2N}					
Max. Acceleration Torque T_{2B}	Nm	2,3	4~91	1.5 times T_{2N}					
No Load Running Torque ⁽³⁾	Nm	2	4~10	2.5	5.8	12	25	48	95
		3	21~91	1.5	2.5	4	9	18.5	35
Backlash ⁽²⁾	arcmin	2	4~10	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
		3	21~91	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	2,3	4~91	27	56	112	389	642	1,275
Nominal Input Speed n_{IN}	rpm	2	4~10	3,600	3,000	2,300	1,800	1,500	1,100
		3	21~91	4,600	4,000	3,000	2,300	1,800	1,500
Max. Input Speed n_{IB}	rpm	2	4~10	6,000	5,500	4,500	3,500	3,000	2,200
		3	21~91	7,000	6,500	5,500	4,500	3,500	3,000
Max. Axial Load F_{2a} ⁽⁴⁾	N	2,3	4~91	10,600	15,700	20,100	43,100	61,000	83,500
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	2,3	4~91	1,300	2,180	3,600	10,600	18,400	21,900
Operating Temp	°C	2,3	4~91	-10° C ~ 90° C					
Degree of Gearbox Protection		2,3	4~91	IP67					
Lubrication		2,3	4~91	Synthetic lubrication grease					
Mounting Position		2,3	4~91	All directions					
Running Noise ⁽³⁾	dB(A)	2	4~10	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74
		3	21~91	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74
Efficiency η	%	2	4~10	≥ 95%					
		3	21~91	≥ 93%					

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

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

(3) The values are measured by gearbox with ratio 10 (1-stage) or ratio 100 (2-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.
By lower ratio and/or higher RPM, the values could be higher.

(4) Applied to the output flange center at 100 rpm.

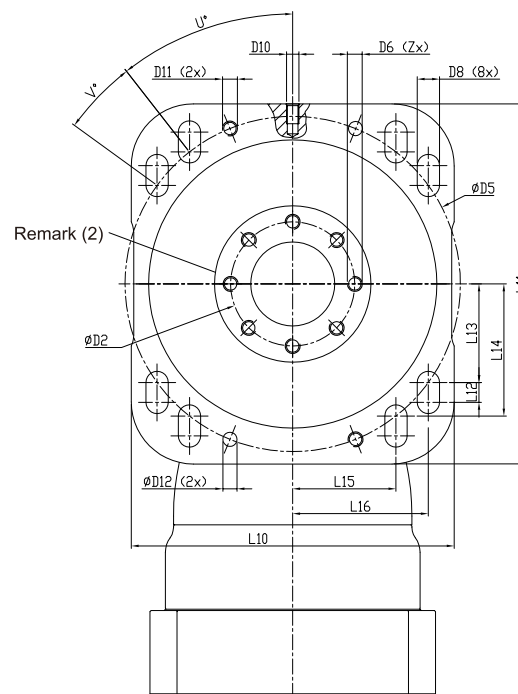
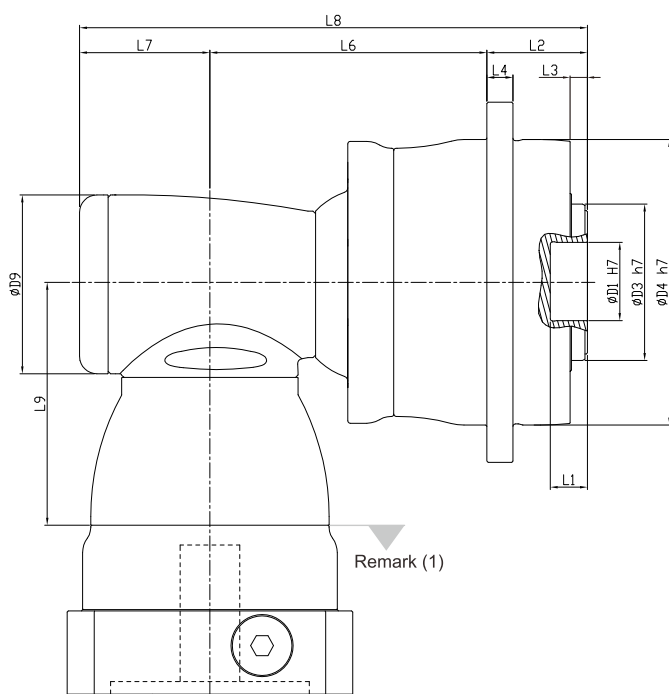
(5) Continuous operation is not recommended.

Inertia MGKC Gearbox (Ratio $i=4\sim10 / 21\sim91$)

Model No.	MGKCI15		MGKCI40		MGKCI70		MGKC240		MGKC285		MGKC320	
	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.
$\emptyset^{(A)}$ (C3)												
8	-	0.1	-	-	-	-	-	-	-	-	-	-
11	0.52	0.17	-	-	-	-	-	-	-	-	-	-
14	0.52	0.21	-	0.52	-	-	-	-	-	-	-	-
19	1.69	0.62	1.71	1.69	-	1.71	-	-	-	-	-	-
24	4.89	-	5.05	4.89	6.92	5.05	-	6.92	-	-	-	-
28	-	-	6.55	-	6.98	6.55	-	6.98	-	-	-	-
32	-	-	9.47	-	10.18	9.47	10.18	10.18	-	10.18	-	-
35	-	-	14.91	-	15.21	14.91	15.21	15.21	15.68	15.21	23.46	15.68
38	-	-	20.69	-	20.7	20.69	20.7	20.7	21.69	20.7	23.46	21.69
42	-	-	-	-	22.83	-	22.83	22.83	23.59	22.83	25.28	23.59
48	-	-	-	-	58.45	-	58.45	58.45	59.3	58.45	61.61	59.3
55	-	-	-	-	-	-	-	-	86.95	-	89.67	-
60	-	-	-	-	-	-	-	-	-	-	112.49	-

(A) \emptyset = Input shaft diameter.

Dimension - MGKC Gearbox (Ratio $i = 4\sim 10 / 21\sim 91$)



Dimension	MGKC115		MGKC140		MGKC170		MGKC240		MGKC285		MGKC320	
	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.
D1 H7	31.5		40		50		80		100		100	
D2	50		63		80		125		140		160	
D3 h7	63		85		100		160		186		208	
D4 h7	115		140		170		240		285		320	
D5	135		167		200		276		327		368	
D6 x Pitch x Deep.	M6x1Px10		M6x1Px11		M8x1.25Px15		M10x1.5Px20		M16x2Px25		M20x2.5Px31	
D8	9		11		13.5		17.5		22		26	
D9	94	64	116	92	156	116	156	156	195	156	240	195
D10 x Pitch	M5x0.8P		M6x1P		M8x1.25P		M10x1.5P		12x1.75P		M16x2P	
D11 x Pitch	M6x1P		M8x1.25P		M10x1.5P		M12x1.75P		M16x2P		M16x2P	
D12	5.7		7.7		9.7		11.7		15.7		15.7	
L1	15		15		15		16		16		16	
L2	30		41		48		60		70		79.9	
L3	7		7		7.5		10		13.5		16.5	
L4	10.5		12		15		17		22		25	
L6	128	149	130.5	148	184.5	183.5	199.9	259.4	250.3	315.8	288.9	330.9
L7	61.5	46.5	76	61.5	97.5	76	97.5	97.5	105.5	97.5	141	105.5
L8	219.5	225.5	247.5	250.5	330	307.5	357.4	416.9	425.8	483.3	509.8	516.3
L9	113.5	81.5	147.5	113.5	196.5	147.5	196.5	196.5	229	196.5	260	229
L10 h8	130		160		190		260		315		350	
L11	145		180		215		280		335		390	
L12	8		10		12		14		18		22	
L13	39.7		49.1		58.8		79.2		91.4		108.2	
L14	53.2		65.8		78.8		104.1		123.4		143	
L15	41.6		51.4		61.6		90.5		107.3		115.8	
L16	54.6		67.6		80.9		113		135.5		148.9	
X in Degree	45		22.5		30		30		24		24	
Y in Degree	45		22.5		30		30		24		24	
Z	8		12		12		12		12		12	
U in Degree	38		38		38		41		41		39	
V in Degree	16		16		16		14		15		15	

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

(2) Refer to the MG series (Page 05) for flange interface.

Ordering Code - MGH / MGHK Series

MGHI 15	—	004	/	MOTOR
MGHKI 15	—	016	—	A / MOTOR
MGHCKI 15				Motor Type
				Application Direction
				Ratio
				Gearbox Size

Gearbox Size

MGH	115 / 140 / 170 / 240 / 285 / 320
MGHC	115 / 140 / 170 / 240 / 285 / 320
MGHK	115 / 140 / 170 / 240 / 285 / 320
MGHCK	115 / 140 / 170 / 240 / 285 / 320

Ratio⁽¹⁾

MGH/MGHC	(1 Stg.) 4 / 5.5
MGH/MGHC	(2 Stg.) 16 / 20 / 22 / 27.5 / 28 / 38.5 / 40 / 55
MGH/MGHC	(3 Stg.) 64 / 88 / 100 / 110 / 140 / 154 / 160 / 200 / 220 / 280 / 400
MGHK/MGHCK	(2 Stg.) 4 / 5.5 / 8 / 11
MGHK/MGHCK	(2 Stg.) 16 / 20 / 22 / 27.5 / 28 / 38.5 / 40 / 55
MGHK/MGHCK	(3 Stg.) 64 / 88 / 100 / 110 / 137.5 / 140 / 154 / 160 / 200 / 220 / 280 / 385
MGHK/MGHCK	(4 Stg.) 400 / 440 / 500 / 550 / 700 / 770 / 1000 / 1078 / 1400 / 1540 / 1600 / 2000 / 2695 / 2800 / 3850 / 4000 / 5500

Application Direction⁽²⁾: A = 6 o'clock
 (For MGHK / MGHCK series only) **B = 9 o'clock**
C = 12 o'clock
D = 3 o'clock

Motor Type

Manufacturer and Model

(1) Ratio ($I = N_{in}/N_{out}$). Please refer to the specifications for the ratios provided in each series.

(2) Please refer to page 06.



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Performance - MGH / MGHC Gearbox

Model No.	Stage	Ratio ⁽¹⁾	MGH 115 MGHC 115	MGH 140 MGHC 140	MGH 170 MGHC 170	MGH 240 MGHC 240	MGH 285 MGHC 285	MGH 320 MGHC 320	
Nominal Output Torque T_{2N} By n_{1N}	1	4	205	505	790	1,885	2,920	5,380	
		5.5	230	435	735	1,635	2,535	4,580	
	2	16	300	530	895	1,980	3,055	5,615	
		20	300	535	900	1,995	3,080	5,660	
		22	240	460	770	1,710	2,640	4,755	
		27.5	240	460	775	1,720	2,660	4,785	
		28	250	540	910	2,015	3,110	5,720	
		38.5	245	465	785	1,740	2,690	4,830	
		40	96	225	650	1,610	3,145	5,780	
		55	130	315	795	1,740	2,715	4,875	
	3	64	310	500	930	2,060	3,180	5,840	
		88	250	470	800	1,780	2,720	4,920	
		100	315	560	945	2,085	3,215	5,910	
		110	250	475	810	1,790	2,760	4,945	
		140	315	565	950	2,105	3,245	5,965	
		154	250	480	815	1,805	2,785	4,980	
		160	210	385	915	2,110	3,255	5,985	
		200	265	480	960	2,125	3,270	6,020	
	220	255	480	825	1,820	2,810	5,020		
	280	250	575	970	2,140	3,300	6,070		
400	100	235	980	2,160	3,330	6,120			
Emergency Stop Torque T_{2NOT}	Nm	1,2,3	4~400						
Max. Acceleration Torque T_{2a}	Nm	1,2,3	4~400						
No Load Running Torque ⁽²⁾	Nm	1	4~5.5	1.5	2.5	7.1	14	22	28
		2	16~55	0.6	1.1	3.7	8	12	18
		3	64~400	0.35	0.7	1.6	4	4.5	6.5
Backlash ⁽³⁾	arcmin	1	4~5.5						
		2,3	16~400						
Torsional Rigidity	Nm/arcmin	1,2,3	4~400	42	95	205	650	1,200	1,800
Nominal Input Speed n_{1N}	rpm	1	4~5.5	3,600	3,600	3,000	2,700	2,400	2,100
		2	16~55	4,600	4,600	4,000	3,700	3,400	3,100
		3	64~400	5,000	5,000	4,600	4,000	3,700	3,400
Max. Input Speed n_{1B}	rpm	1	4~5.5	6,000	6,000	5,000	4,500	4,000	3,500
		2	16~55	7,000	7,000	6,000	5,500	5,000	4,500
		3	64~400	7,000	7,000	7,000	6,000	5,500	5,000
Max. Axial Load F_{2a} ⁽⁴⁾	N	1,2,3	4~400	10,600	15,700	20,100	43,100	61,000	83,500
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	1,2,3	4~400	1,300	2,180	3,600	10,600	18,400	21,900
Operating Temp.	°C	1,2,3	4~400						
Degree of Gearbox Protection		1,2,3	4~400						
Lubrication		1,2,3	4~400						
Mounting Position		1,2,3	4~400						
Running Noise ⁽²⁾	dB(A)	1	4~5.5	≤ 59	≤ 64	≤ 66	≤ 66	≤ 68	≤ 68
		2	16~55	≤ 60	≤ 62	≤ 64	≤ 66	≤ 67	≤ 67
		3	64~400	≤ 60	≤ 62	≤ 64	≤ 66	≤ 66	≤ 67
Efficiency η	%	1	4~5.5						
		2	16~55						
		3	64~400						

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

(2) The values are measured by gearbox with ratio 5.5 (1-stage), 55 (2-stage) or ratio 220 (3-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.
By lower ratio and/or higher RPM, the values could be higher.

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

(4) Applied to the output flange/curvic center at 100 rpm. The calculation formula please refer to Fig. 1.

(5) Continuous operation is not recommended.

$$\text{Max. Tilting Moment } M_{2K} = \frac{F_{2a} * Y + F_{2r} * (X+Z2)}{1000}$$

$M_{2K} : [\text{Nm}]$
 $F_{2a}, F_{2r} : [\text{N}]$
 $X, Y, Z2 : [\text{mm}]$

MGH / MGHK MGHC/MGHC	115	140	170	240	285	320
Z2 [mm]	81	123.7	104.6	145.7	183.4	196.1

Note : Applied to the output flange center at 100 rpm.

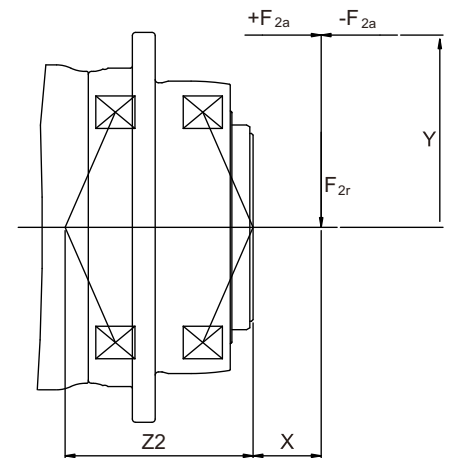


Fig. 1

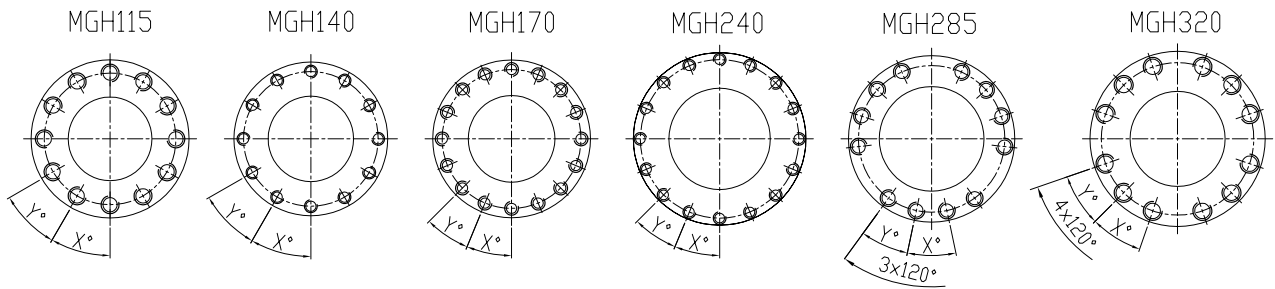
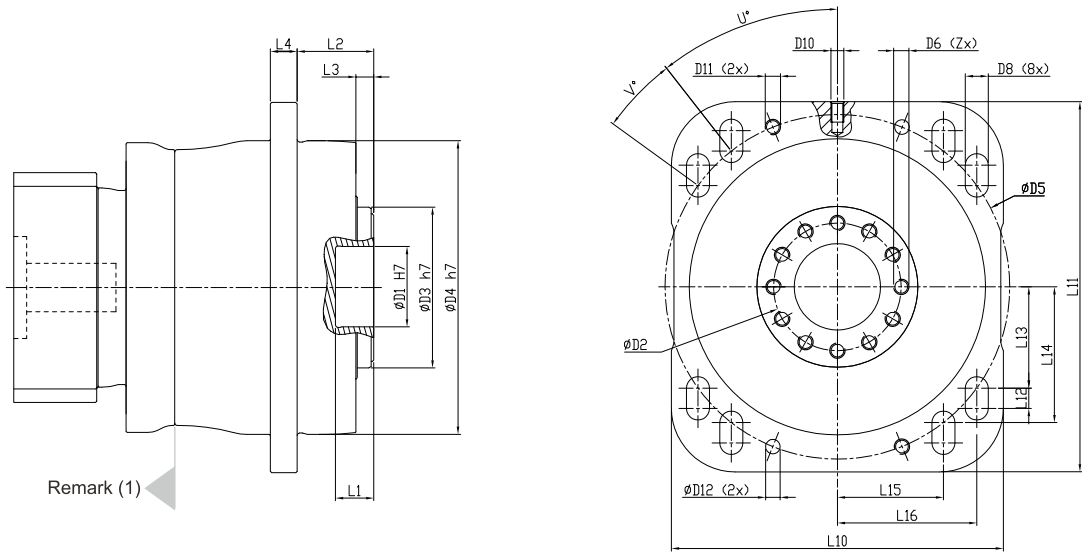
Max. Inertia - MGH / MGHC Gearbox

Model No.		MGH/MGHC 115			MGH/MGHC 140			MGH/MGHC 170			MGH/MGHC 240			MGH/MGHC 285		
Ø ^(A)	Stage	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
11	kg.cm ²	-	-	0.16												
14		0.42	0.21	0.19	-	-	0.21	-	-	-	-	-	-	-	-	-
19		0.66	0.6	-	1.84	0.66	0.6	-	-	0.66	-	-	-	-	-	-
24		3.94	-	-	4.11	3.94	-	4.61	4.11	3.94	-	-	4.11	-	-	-
28		-	-	-	5.48	-	-	6.14	5.48	-	-	-	5.48	-	-	6.14
32		-	-	-	7.36	-	-	8.17	7.36	-	-	8.17	7.36	-	-	8.17
35		-	-	-	14.04	-	-	15.54	14.04	-	17.75	15.54	14.04	-	17.75	15.54
38		-	-	-	16.71	-	-	18.19	16.71	-	20.17	18.19	16.71	-	20.17	18.19
42		-	-	-	-	-	-	23.2	-	-	25.4	23.2	-	28.88	25.4	-
48		-	-	-	-	-	-	52.42	-	-	55.18	52.42	-	58.64	55.18	-
55		-	-	-	-	-	-	-	-	-	88.51	-	-	92.48	-	-
60		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Model No.		MGH/MGHC 320		
Ø ^(A)	Stage	1	2	3
11	kg.cm ²			
14		-	-	-
19		-	-	-
24		-	-	-
28		-	-	-
32		-	-	-
35		-	-	17.75
38		-	23.66	20.17
42		-	28.88	25.4
48		69.78	58.64	55.18
55		104.22	92.48	-
60		127.69	-	-

(A) Ø = Input shaft diameter.

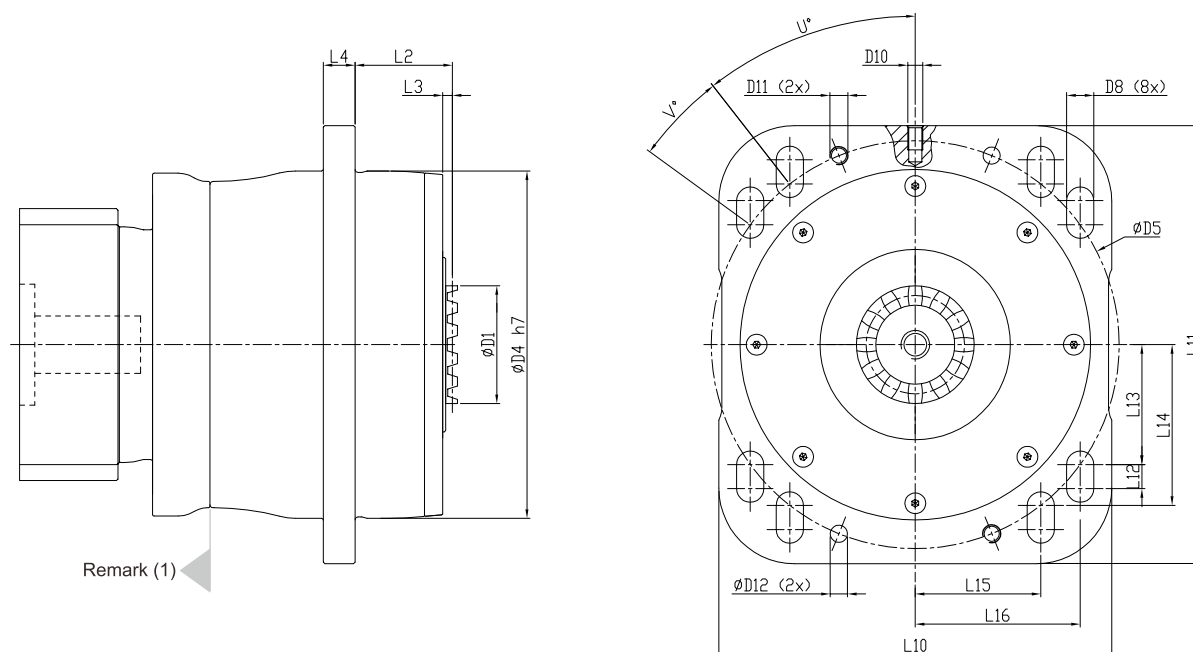
Dimension - MGH Gearbox



Dimension		MGH115	MGH140	MGH170	MGH240	MGH285	MGH320
D1	H7	31.5	40	50	80	100	100
D2		50	63	80	125	140	160
D3	h7	63	85	100	160	186	208
D4	h7	115	140	170	240	285	320
D5		135	167	200	276	327	368
D6 x Pitch x Deep.		M6x1Px11	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37
D8		9	11	13.5	17.5	22	26
D10 x Pitch		M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch		M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12		5.7	7.7	9.7	11.7	15.7	15.7
L1		15	15	15	16	16	16
L2		30	41	48	60	70	79.9
L3		7	7	7.5	10	13.5	16.5
L4		10.5	12	15	17	22	25
L10	h8	130	160	190	260	315	350
L11		145	180	215	280	335	390
L12		8	10	12	14	18	22
L13		39.7	49.1	58.8	79.2	91.4	108.2
L14		53.2	65.8	78.8	104.1	123.4	143
L15		41.6	51.4	61.6	90.5	107.3	115.8
L16		54.6	67.6	80.9	113	135.5	148.9
X in Degree		30	30	22.5	22.5	24	26
Y in Degree		30	30	22.5	22.5	24	26
Z		12	12	16	16	12	12
U in Degree		38	38	38	41	41	39
V in Degree		16	16	16	14	15	15

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

Dimension - MGHC Gearbox



Dimension	MGHC115	MGHC140	MGHC170	MGHC240	MGHC285	MGHC320
D1	36	46	68	108	120	132
D4 h7	115	140	170	240	285	320
D5	135	167	200	276	327	368
D8	9	11	13.5	17.5	22	26
D10 x Pitch	M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	5.7	7.7	9.7	11.7	15.7	15.7
L2	32.5	46.5	54.5	70	80.5	90.4
L3	3.5	6.5	7.5	11	11.5	11.5
L4	10.5	12	15	17	22	25
L10 h8	130	160	190	260	315	350
L11	145	180	215	280	335	390
L12	8	10	12	14	18	22
L13	39.7	49.1	58.8	79.2	91.4	108.2
L14	53.2	65.8	78.8	104.1	123.4	143
L15	41.6	51.4	61.6	90.5	107.3	115.8
L16	54.6	67.6	80.9	113	135.5	148.9
U in Degree	38	38	38	41	41	39
V in Degree	16	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Performance - MGHK / MGHC Gearbox

Model No.	Stage	Ratio ⁽¹⁾	MGHK 115 MGHC 115	MGHK 140 MGHC 140	MGHK 170 MGHC 170	MGHK 240 MGHC 240	MGHK 285 MGHC 285	MGHK 320 MGHC 320	
Nominal Output Torque T_{2N} By n_{1N}	2	16	255	528	848	1,800	2,015	3,935	
		20	255	528	848	1,800	2,015	3,935	
		22	245	465	780	1,740	2,685	4,815	
		27.5	245	465	785	1,750	2,700	4,840	
		28	240	480	848	1,800	1,872	3,600	
		38.5	245	470	795	1,770	2,574	4,885	
		40	192	408	816	1,725	1,728	2,880	
	55	250	475	805	1,785	2,376	3,790		
	3	64	-	565	845	2,080	3,220	5,815	
		88	-	480	815	1,800	2,185	4,970	
		100	-	565	845	2,105	3,260	5,815	
		110	-	480	820	1,810	2,800	4,990	
		137.5	-	480	825	1,820	2,815	5,020	
		140	-	565	840	2,125	3,285	5,815	
		154	-	485	825	1,825	2,820	5,035	
		160	-	565	845	2,130	3,295	5,760	
		200	-	565	845	2,145	3,315	5,815	
		220	-	490	835	1,840	2,850	5,070	
		280	-	540	845	2,160	3,345	5,815	
	385	-	495	850	1,845	2,890	5,130		
	4	400	-	565	845	2,155	3,320	5,815	
		440	-	450	835	1,840	2,840	5,060	
		500	-	565	845	2,165	3,340	5,815	
		550	-	490	845	1,860	2,870	5,110	
		700	-	590	995	2,185	3,370	6,195	
		770	-	495	850	1,870	2,895	5,150	
		1,000	-	565	810	2,205	3,400	5,815	
		1,078	-	500	860	1,890	2,920	5,180	
		1,400	-	540	845	2,220	3,430	5,815	
		1,540	-	500	870	1,910	2,945	5,220	
		1,600	-	565	845	2,225	3,435	5,760	
	2,000	-	565	810	2,240	3,455	5,815		
	2,695	-	510	880	1,935	2,980	5,275		
	2,800	-	540	845	2,225	3,480	5,815		
	3,850	-	510	980	1,610	2,995	5,365		
	4,000	-	225	650	1,840	3,515	5,815		
	5,500	-	315	895	1,980	3,110	5,515		
	Emergency Stop Torque T_{2NOT}	Nm	2,3,4	2 times T_{2N}					
Max. Acceleration Torque T_{2B}	Nm	2,3,4	1.5 times T_{2N}						
No Load Running Torque ⁽²⁾	Nm	2	16~55	1.3	2	3.1	6	13	16
		3	64~385	-	1.4	2.4	4.6	7	8.5
		4	400~5,500	-	0.2	0.3	0.6	0.9	1.2
Backlash ⁽³⁾	arcmin	2,3,4	≤ 4						
Torsional Rigidity	Nm/arcmin	2	16~55	27	56	112	389	642	1,275
		3	64~385	-	56	112	389	642	1,275
		4	400~5,500	-	45	85	310	535	1,050
Nominal Input Speed n_{1N}	rpm	2	16~55	3,000	2,800	2,700	2,200	2,100	2,000
		3	64~385	-	3,000	2,800	2,700	2,200	2,100
		4	400~5,500	-	5,500	4,600	4,600	4,000	3,700
Max. Input Speed n_{1B}	rpm	2	16~55	6,000	6,000	4,500	4,500	4,000	3,000
		3	64~385	-	6,000	6,000	4,500	4,500	4,000
		4	400~5,500	-	7,000	7,000	7,000	6,000	5,500
Max. Axial Load F_{2a} ⁽⁴⁾	N	2,3,4	16~5,500	10,600	15,700	20,100	43,100	61,000	83,500
Max. Tilting Moment M_{2k} ⁽⁴⁾	Nm	2,3,4	16~5,500	1,300	2,180	3,600	10,600	18,400	21,900
Operating Temp.	°C	2,3,4	-10° C ~ 90° C						
Degree of Gearbox Protection		2,3,4	IP67						
Lubrication		2,3,4	Synthetic lubrication grease						
Mounting Position		2,3,4	All directions						
Running Noise ⁽²⁾	dB(A)	2,3,4	16~5,500	≤ 68	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72
Efficiency η	%	2	16~55	≥ 94%					
		3	64~385	≥ 92%					
		4	400~5,500	≥ 90%					

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

(2) The values are measured by gearbox with ratio 55 (2-stage), 385 (3-stage) or ratio 5,500 (4-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.

By lower ratio and/or higher RPM, the values could be higher.

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

(4) Applied to the output flange/curvic center at 100 rpm. The calculation formula please refer to page (19)

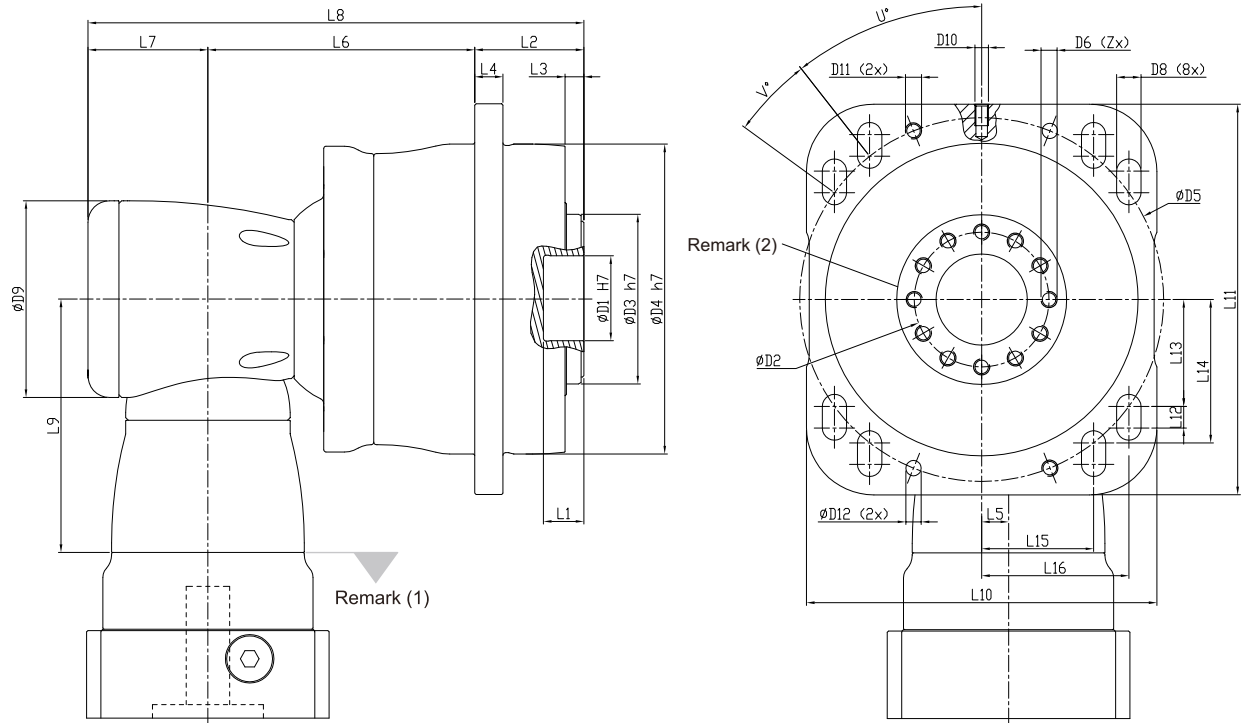
(5) Continuous operation is not recommended.

Max. Inertia - MGHK / MGHCK Gearbox

Model No.	MGHK/MGHCK 115	MGHK/MGHCK 140			MGHK/MGHCK 170			MGHK/MGHCK 240			MGHK/MGHCK 285			MGHK/MGHCK 320			
$\varnothing^{(A)}$	Stage	2	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4
8	kg.cm ²	-	-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-
11		-	-	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-
14		0.37	-	0.37	-	-	-	0.42	-	-	-	-	-	-	-	-	-
19		0.6	1.61	0.6	-	-	1.61	0.66	-	-	1.83	-	-	-	-	-	-
24		-	3.9	-	-	4.01	3.9	3.94	-	4.01	4.11	-	-	4.61	-	-	-
28		-	-	-	-	5.53	5.15	-	-	5.53	-	-	5.61	6.14	-	-	-
32		-	-	-	-	7.57	-	-	8.11	7.57	-	-	8.11	8.17	-	-	-
35		-	-	-	-	14.95	-	-	15.32	14.95	-	15.32	15.32	15.54	-	15.32	15.54
38		-	-	-	-	17.58	-	-	17.72	17.58	-	17.72	17.72	18.19	18.52	17.72	18.19
42		-	-	-	-	-	-	-	22.95	-	-	22.95	-	-	23.74	22.95	23.2
48		-	-	-	-	-	-	-	52.74	-	-	52.74	-	-	53.49	52.74	52.42
55		-	-	-	-	-	-	-	-	-	-	-	-	-	87.34	-	-

(A) \varnothing = Input shaft diameter.

Dimension - MGHK (2 Stage) Gearbox (Ratio $i = 16 \sim 55$)

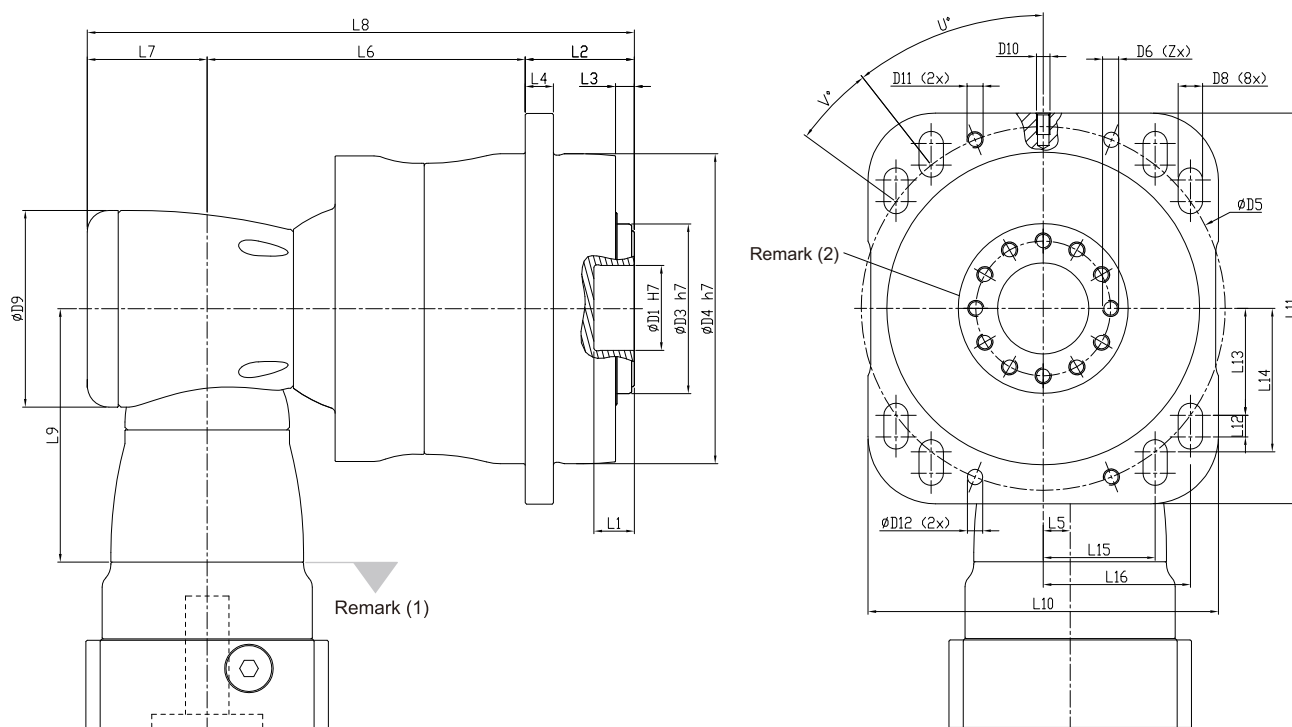


Dimension	MGHK115	MGHK140	MGHK170	MGHK240	MGHK285	MGHK320
D1 H7	31.5	40	50	80	100	100
D2	50	63	80	125	140	160
D3 h7	63	85	100	160	186	208
D4 h7	115	140	170	240	285	320
D5	135	167	200	276	327	368
D6 x Pitch x Deep.	M6x1Px11	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37
D8	9	11	13.5	17.5	22	26
D9	94	116	163	210	210	255
D10 x Pitch	M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	5.7	7.7	9.7	11.7	15.7	15.7
L1	15	15	15	16	16	16
L2	30	41	48	60	70	79.9
L3	7	7	7.5	10	13.5	16.5
L4	10.5	12	15	17	22	25
L5	13	17	25	31	31	36
L6	118	120	156.5	189.9	242.8	272.9
L7	53	68.3	89	115	115	131
L8	201	229.3	293.5	364.9	427.8	483.8
L9	114.5	129	173.5	228	228	265.5
L10 h8	130	160	190	260	315	350
L11	145	180	215	280	335	390
L12	8	10	12	14	18	22
L13	39.7	49.1	58.8	79.2	91.4	108.2
L14	53.2	65.8	78.8	104.1	123.4	143
L15	41.6	51.4	61.6	90.5	107.3	115.8
L16	54.6	67.6	80.9	113	135.5	148.9
X in Degree	30	30	22.5	22.5	24	26
Y in Degree	30	30	22.5	22.5	24	26
Z	12	12	16	16	12	12
U in Degree	38	38	38	41	41	39
V in Degree	16	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Dimension - MGHK (3 Stage) Gearbox (Ratio i = 64 ~ 385)

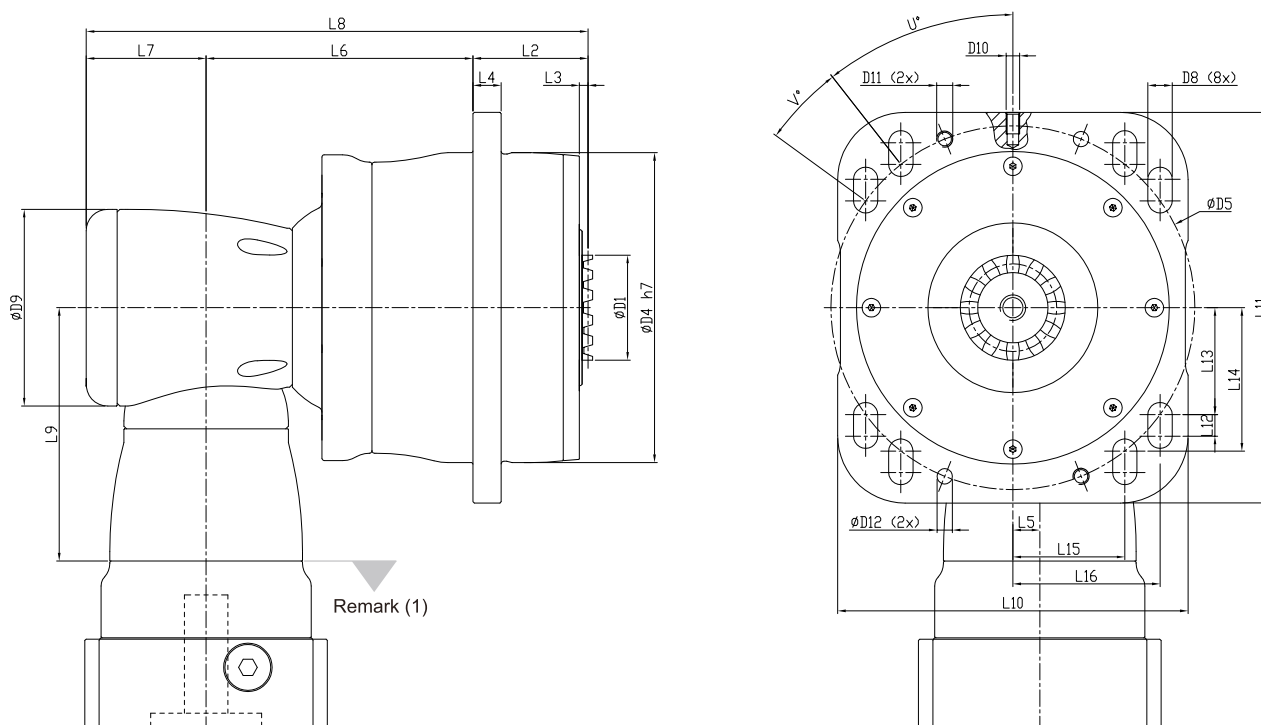


Dimension	MGHK140	MGHK170	MGHK240	MGHK285	MGHK320
D1 H7	40	50	80	100	100
D2	63	80	125	140	160
D3 h7	85	100	160	186	208
D4 h7	140	170	240	285	320
D5	167	200	276	327	368
D6 x Pitch x Deep.	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37
D8	11	13.5	17.5	22	26
D9	94	116	163	210	210
D10 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	7.7	9.7	11.7	15.7	15.7
L1	15	15	16	16	16
L2	41	48	60	70	79.9
L3	7	7.5	10	13.5	16.5
L4	12	15	17	22	25
L5	13	17	25	31	31
L6	138	173	231.4	305.8	323.4
L7	53	68.3	89	115	115
L8	232	289.3	380.4	490.8	518.3
L9	114.5	129	173.5	228	228
L10 h8	160	190	260	315	350
L11	180	215	280	335	390
L12	10	12	14	18	22
L13	49.1	58.8	79.2	91.4	108.2
L14	65.8	78.8	104.1	123.4	143
L15	51.4	61.6	90.5	107.3	115.8
L16	67.6	80.9	113	135.5	148.9
X in Degree	30	22.5	22.5	24	26
Y in Degree	30	22.5	22.5	24	26
Z	12	16	16	12	12
U in Degree	38	38	41	41	39
V in Degree	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Dimension - MGHCK (2 Stage) Gearbox (Ratio $i = 16 \sim 55$)

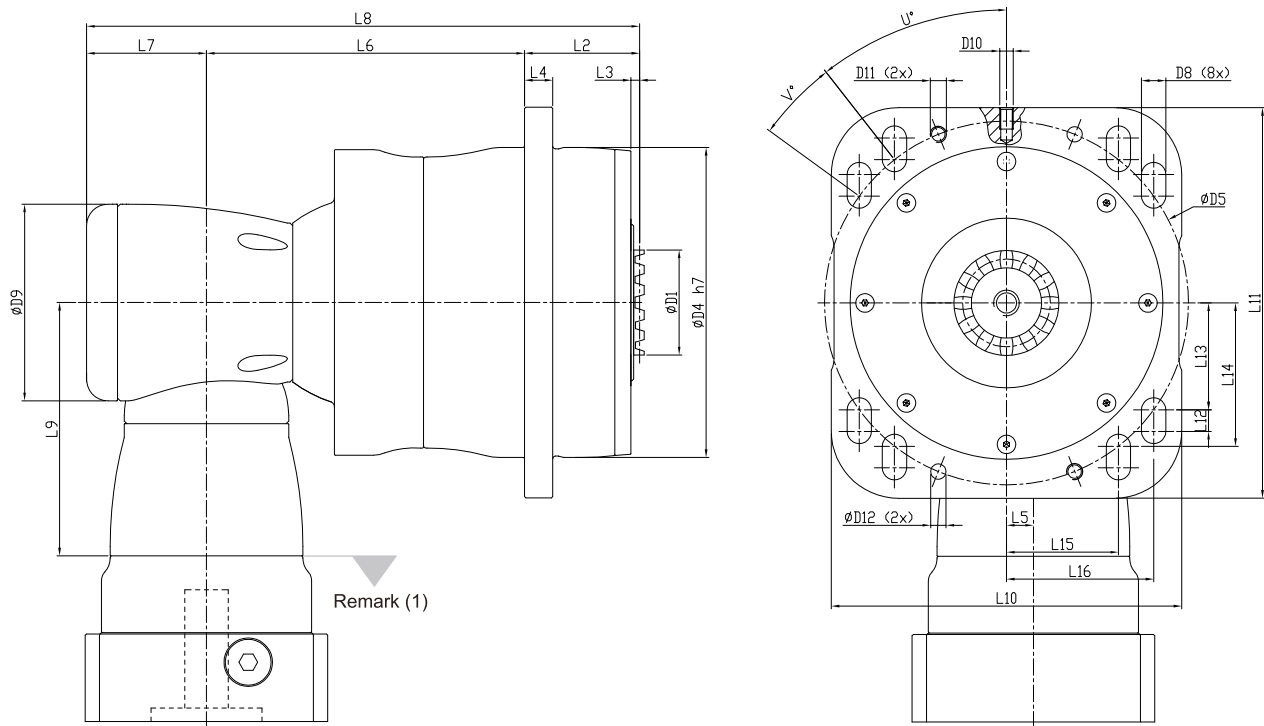


Dimension	MGHCK115	MGHCK140	MGHCK170	MGHCK240	MGHCK285	MGHCK320
D1	36	46	68	108	120	132
D4 h7	115	140	170	240	285	320
D5	135	167	200	276	327	368
D8	9	11	13.5	17.5	22	26
D9	94	116	163	210	210	255
D10 x Pitch	M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	5.7	7.7	9.7	11.7	15.7	15.7
L2	32.5	46.5	54.5	70	80.5	90.4
L3	3.5	6.5	7.5	11	11.5	11.5
L4	10.5	12	15	17	22	25
L5	13	17	25	31	31	36
L6	118	120	156.5	189.9	242.8	272.9
L7	53	68.3	89	115	115	131
L8	203.5	234.8	300	374.9	438.3	494.3
L9	114.5	129	173.5	228	228	265.5
L10 h8	130	160	190	260	315	350
L11	145	180	215	280	335	390
L12	8	10	12	14	18	22
L13	39.7	49.1	58.8	79.2	91.4	108.2
L14	53.2	65.8	78.8	104.1	123.4	143
L15	41.6	51.4	61.6	90.5	107.3	115.8
L16	54.6	67.6	80.9	113	135.5	148.9
U in Degree	38	38	38	41	41	39
V in Degree	16	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Dimension - MGHC (3 Stage) Gearbox (Ratio $i = 64 \sim 385$)

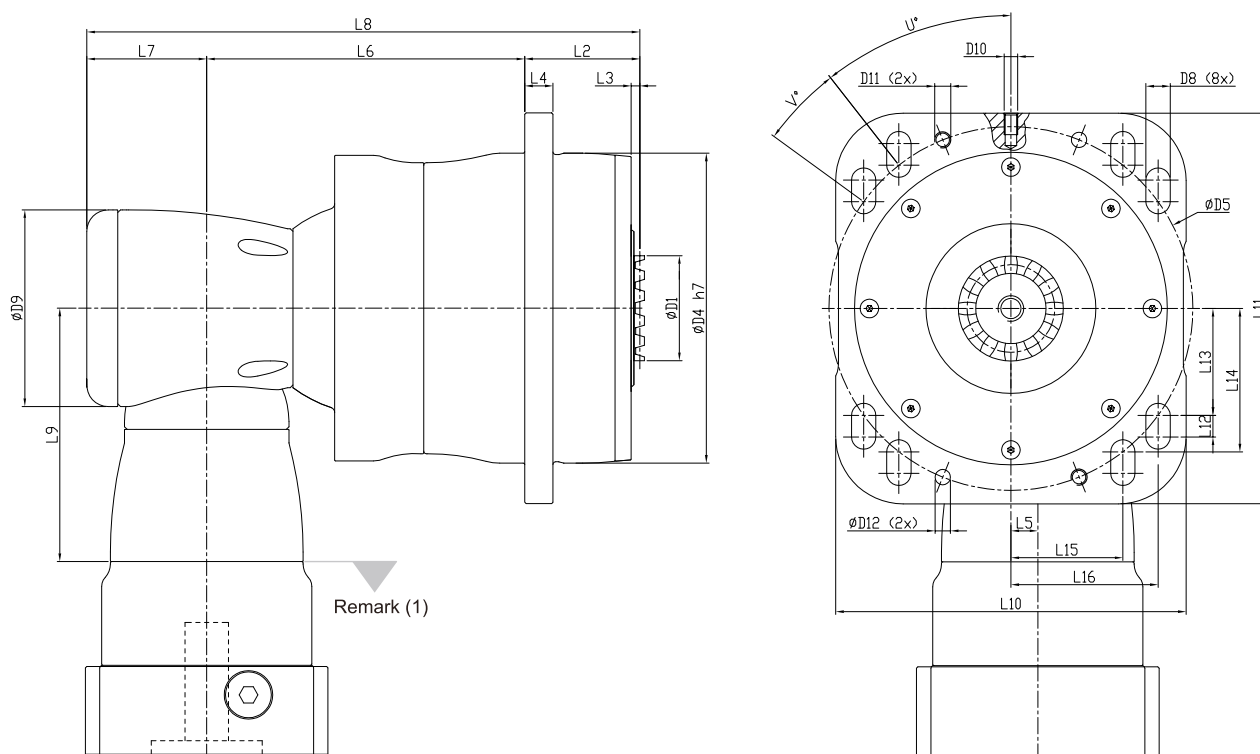


Dimension	MGHC140	MGHC170	MGHC240	MGHC285	MGHC320
D1	46	68	108	120	132
D4 h7	140	170	240	285	320
D5	167	200	276	327	368
D8	11	13.5	17.5	22	26
D9	94	116	163	210	210
D10 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	7.7	9.7	11.7	15.7	15.7
L2	46.5	54.5	70	80.5	90.4
L3	6.5	7.5	11	11.5	11.5
L4	12	15	17	22	25
L5	13	17	25	31	31
L6	138	173	231.4	305.8	323.4
L7	53	68.3	89	115	115
L8	237.5	295.8	390.4	501.3	528.8
L9	114.5	129	173.5	228	228
L10 h8	160	190	260	315	350
L11	180	215	280	335	390
L12	10	12	14	18	22
L13	49.1	58.8	79.2	91.4	108.2
L14	65.8	78.8	104.1	123.4	143
L15	51.4	61.6	90.5	107.3	115.8
L16	67.6	80.9	113	135.5	148.9
U in Degree	38	38	41	41	39
V in Degree	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Dimension - MGHCK (4 Stage) Gearbox (Ratio $i = 400 \sim 5,500$)



Remark (1)

Dimension	MGHCK140	MGHCK170	MGHCK240	MGHCK285	MGHCK320
D1	46	68	108	120	132
D4 h7	140	170	240	285	320
D5	167	200	276	327	368
D8	11	13.5	17.5	22	26
D9	94	116	163	210	210
D10 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	7.7	9.7	11.7	15.7	15.7
L2	46.5	54.5	70	80.5	90.4
L3	6.5	7.5	11	11.5	11.5
L4	12	15	17	22	25
L5	13	17	25	31	31
L6	138	173	231.4	305.8	323.4
L7	53	68.3	89	115	115
L8	237.5	295.8	390.4	501.3	528.8
L9	114.5	129	173.5	228	228
L10 h8	160	190	260	315	350
L11	180	215	280	335	390
L12	10	12	14	18	22
L13	49.1	58.8	79.2	91.4	108.2
L14	65.8	78.8	104.1	123.4	143
L15	51.4	61.6	90.5	107.3	115.8
L16	67.6	80.9	113	135.5	148.9
U in Degree	38	38	41	41	39
V in Degree	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Performance - MGHK / MGHCK (2 Stage) Gearbox (Ratio i = 4 ~ 11)

Model No.		Stage	Ratio ⁽¹⁾	MGHK 115 MGHCK 115	MGHK 140 MGHCK 140	MGHK 170 MGHCK 170	MGHK 240 MGHCK 240	MGHK 285 MGHCK 285	MGHK 320 MGHCK 320
Nominal Output Torque T_{2N} By n_{1N}	Nm	2	4	75	510	845	1,728	2,805	5,545
			5.5	105	440	745	1,665	2,590	4,700
			8	150	525	845	1,584	2,610	5,680
			11	210	455	765	1,710	2,655	4,800
Emergency Stop Torque T_{2NOT}	Nm	2	4~11	2 times T_{2N}					
Max. Acceleration Torque T_{2B}	Nm	2	4~11	1.5 times T_{2N}					
No Load Running Torque ⁽²⁾	Nm	2	4~11	2.5	5.8	12	25	48	95
Backlash ⁽³⁾	arcmin	2	4~11	≤ 4					
Torsional Rigidity	Nm/arcmin	2	4~11	27	56	112	389	642	1,275
Nominal Input Speed n_{1N}	rpm	2	4~11	3,600	3,000	2,300	1,800	1,500	1,100
Max. Input Speed n_{1B}	rpm	2	4~11	6,000	5,500	4,500	3,500	3,000	2,200
Max. Axial Load F_{2a} ⁽⁴⁾	N	2	4~11	10,600	15,700	20,100	43,100	61,000	83,500
Max. Tilting Moment M_{2K} ⁽⁴⁾	Nm	2	4~11	1,300	2,180	3,600	10,600	18,400	21,900
Operating Temp.	°C	2	4~11	-10° C ~ 90° C					
Degree of Gearbox Protection		2	4~11	IP67					
Lubrication		2	4~11	Synthetic lubrication grease					
Mounting Position		2	4~11	All directions					
Running Noise ⁽²⁾	dB(A)	2	4~11	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74
Efficiency η	%	2	4~11	≥ 95%					

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

(2) The values are measured by gearbox with ratio 11 (2-stage), no loading at 3,000 RPM or at the respective Nominal Input Speed by bigger model size.
By lower ratio and/or higher RPM, the values could be higher.

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

(4) Applied to the output flange/curvic center at 100 rpm. The calculation formula please refer to page (19).

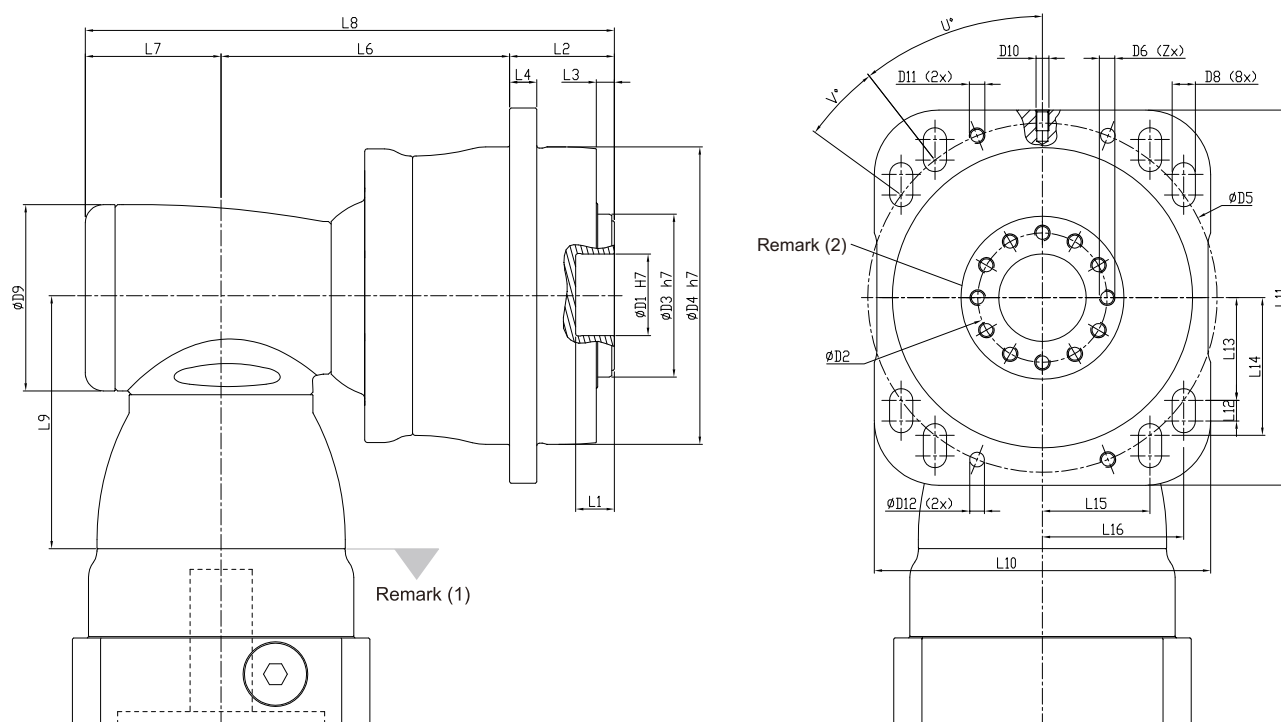
(5) Continuous operation is not recommended.

Max. Inertia - MGHK / MGHCK (2 Stage) Gearbox (Ratio i = 4 ~ 11)

Model No.		MGHK/MGHCK 115	MGHK/MGHCK 140	MGHK/MGHCK 170	MGHK/MGHCK 240	MGHK/MGHCK 285	MGHK/MGHCK 320
$\varnothing^{(A)}$	Stage	2st	2st	2st	2st	2st	2st
11	kg.cm ²	0.41	-	-	-	-	-
14		0.41	-	-	-	-	-
19		1.61	1.61	-	-	-	-
24		3.9	4.01	5.61	-	-	-
28		-	5.53	5.61	-	-	-
32		-	7.57	8.11	-	-	-
35		-	14.95	15.32	15.32	-	-
38		-	17.58	17.72	17.72	-	-
42		-	-	22.95	22.95	23.74	-
48		-	-	52.74	52.74	53.49	55.14
55		-	-	-	-	87.34	89.59
60		-	-	-	-	-	113.06

(A) \varnothing = Input shaft diameter.

Dimension - MGHK (2 Stage) Gearbox (Ratio $i = 4 \sim 11$)

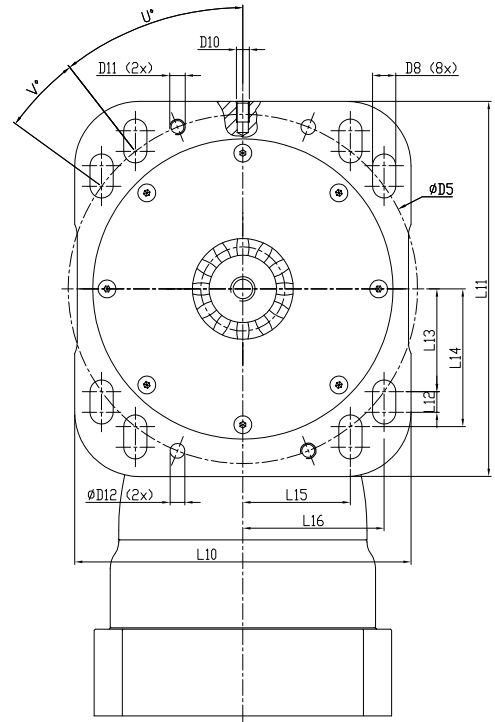
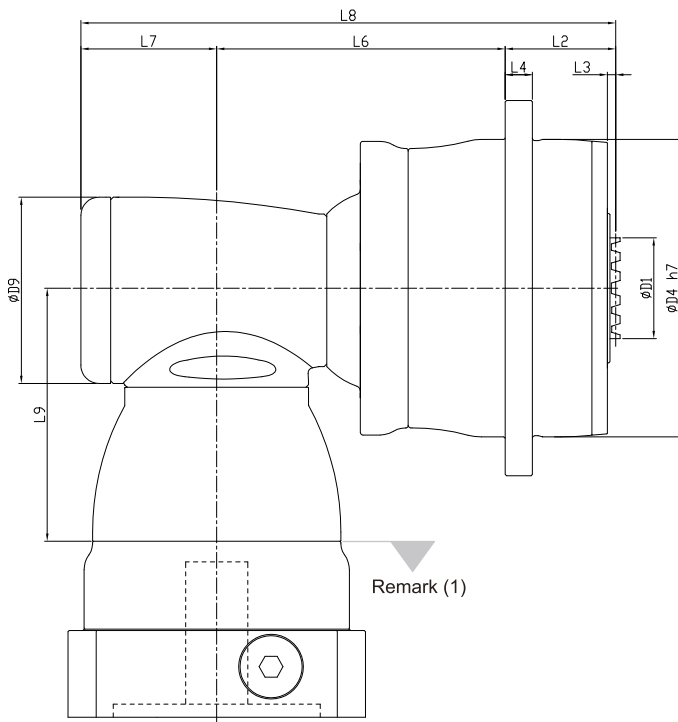


Dimension	MGHK115	MGHK140	MGHK170	MGHK240	MGHK285	MGHK320
D1 H7	31.5	40	50	80	100	100
D2	50	63	80	125	140	160
D3 h7	63	85	100	160	186	208
D4 h7	115	140	170	240	285	320
D5	135	167	200	276	327	368
D6 x Pitch x Deep.	M6x1Px11	M8x1.25Px12	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M24x3Px37
D8	9	11	13.5	17.5	22	26
D9	92	116	156	156	195	240
D10 x Pitch	M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	5.7	7.7	9.7	11.7	15.7	15.7
L1	15	15	15	16	16	16
L2	30	41	48	60	70	79.9
L3	7	7	7.5	10	13.5	16.5
L4	10.5	12	15	17	22	25
L6	128	130.5	184.5	199.9	250.3	228.9
L7	61.5	76	97.5	97.5	105.5	141
L8	219.5	247.5	330	357.4	425.8	509.8
L9	113.5	147.5	196.5	196.5	229	260
L10 h8	130	160	190	260	315	350
L11	145	180	215	280	335	390
L12	8	10	12	14	18	22
L13	39.7	49.1	58.8	79.2	91.4	108.2
L14	53.2	65.8	78.8	104.1	123.4	143
L15	41.6	51.4	61.6	90.5	107.3	115.8
L16	54.6	67.6	80.9	113	135.5	148.9
X in Degree	30	30	22.5	22.5	24	26
Y in Degree	30	30	22.5	22.5	24	26
Z	12	12	16	16	12	12
U in Degree	38	38	38	41	41	39
V in Degree	16	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Dimension - MGHCK (2 Stage) Gearbox (Ratio i = 4 ~ 11)

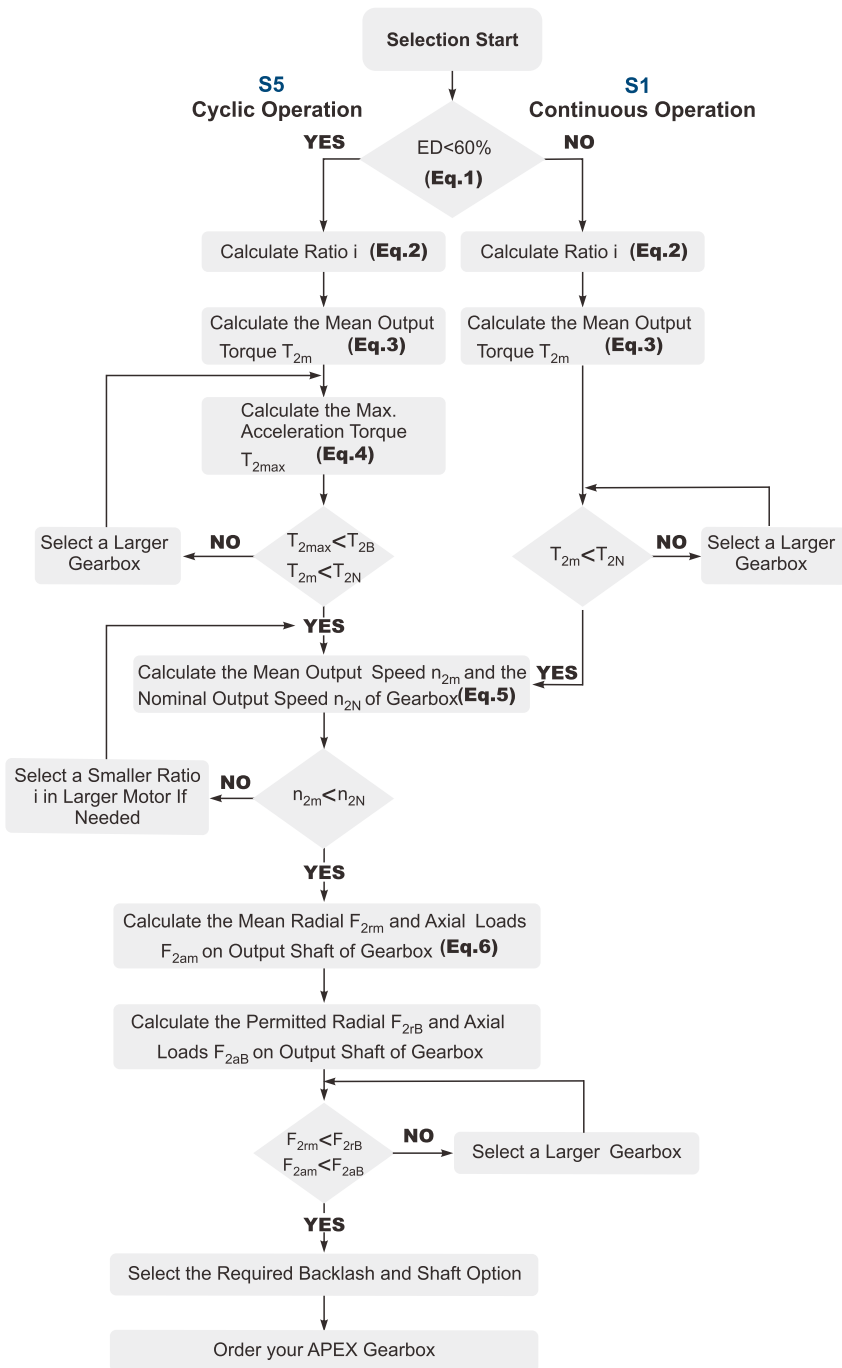


Dimension	MGHCK115	MGHCK140	MGHCK170	MGHCK240	MGHCK285	MGHCK320
D1	36	46	68	108	120	132
D4 h7	115	140	170	240	285	320
D5	135	167	200	276	327	368
D8	9	11	13.5	17.5	22	26
D9	92	116	156	156	195	240
D10 x Pitch	M5x0.8P	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P
D11 x Pitch	M6x1P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M16x2P
D12	5.7	7.7	9.7	11.7	15.7	15.7
L2	32.5	46.5	54.5	70	80.5	90.4
L3	3.5	6.5	7.5	11	11.5	11.5
L4	10.5	12	15	17	22	25
L6	128	130.5	184.5	199.9	250.3	228.9
L7	61.5	76	97.5	97.5	105.5	141
L8	222	253	336.5	367.4	436.3	520.3
L9	113.5	147.5	196.5	196.5	229	260
L10 h8	130	160	190	260	315	350
L11	145	180	215	280	335	390
L12	8	10	12	14	18	22
L13	39.7	49.1	58.8	79.2	91.4	108.2
L14	53.2	65.8	78.8	104.1	123.4	143
L15	41.6	51.4	61.6	90.5	107.3	115.8
L16	54.6	67.6	80.9	113	135.5	148.9
U in Degree	38	38	38	41	41	39
V in Degree	16	16	16	14	15	15

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

(2) Refer to the MGH series (Page 21) for flange interface.

Selection of the optimum gearbox



Recommended (for S5 Cycle Operation)

The general design is given for

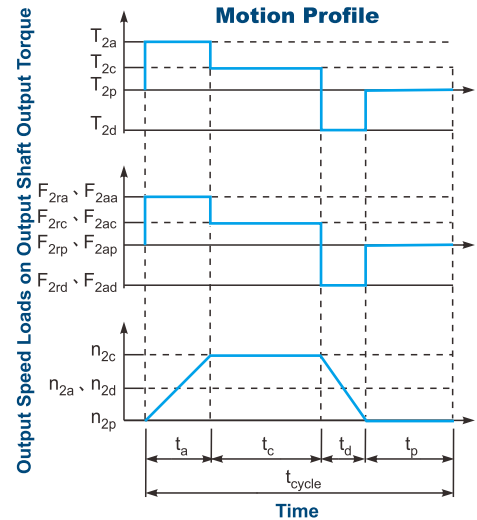
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

The optimal design is given for

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

J_L Load Inertia

J_m Motor Inertia



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

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)**

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

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

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

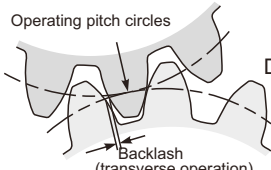
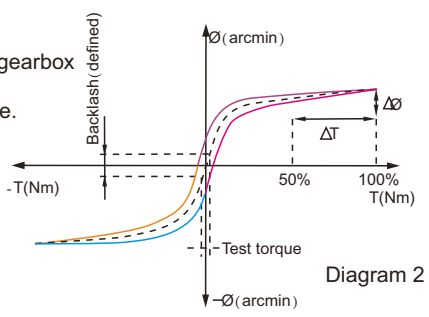
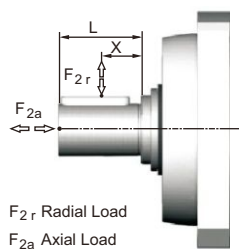
(Eq. 5)

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

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

(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	<p>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'.</p>  <p style="text-align: right;">Diagram 1</p>
Torsional Rigidity	Nm/arcmin	<p>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.</p> <p>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.</p>  <p style="text-align: right;">Diagram 2</p>
Radial Load And Axial Load	N	<p>The permitted radial and axial loads on output shaft of the gearbox depend on the design of the gearbox supporting bearings.</p> <p>For more information, please refer to APEX website.</p>  <p style="text-align: right;">F_{2r} Radial Load F_{2a} Axial Load</p>
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 IP67 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 J_1 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-2024-06-MGH/MGHK/MGHC/MGHCK SERIES-

Printed in Taiwan



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