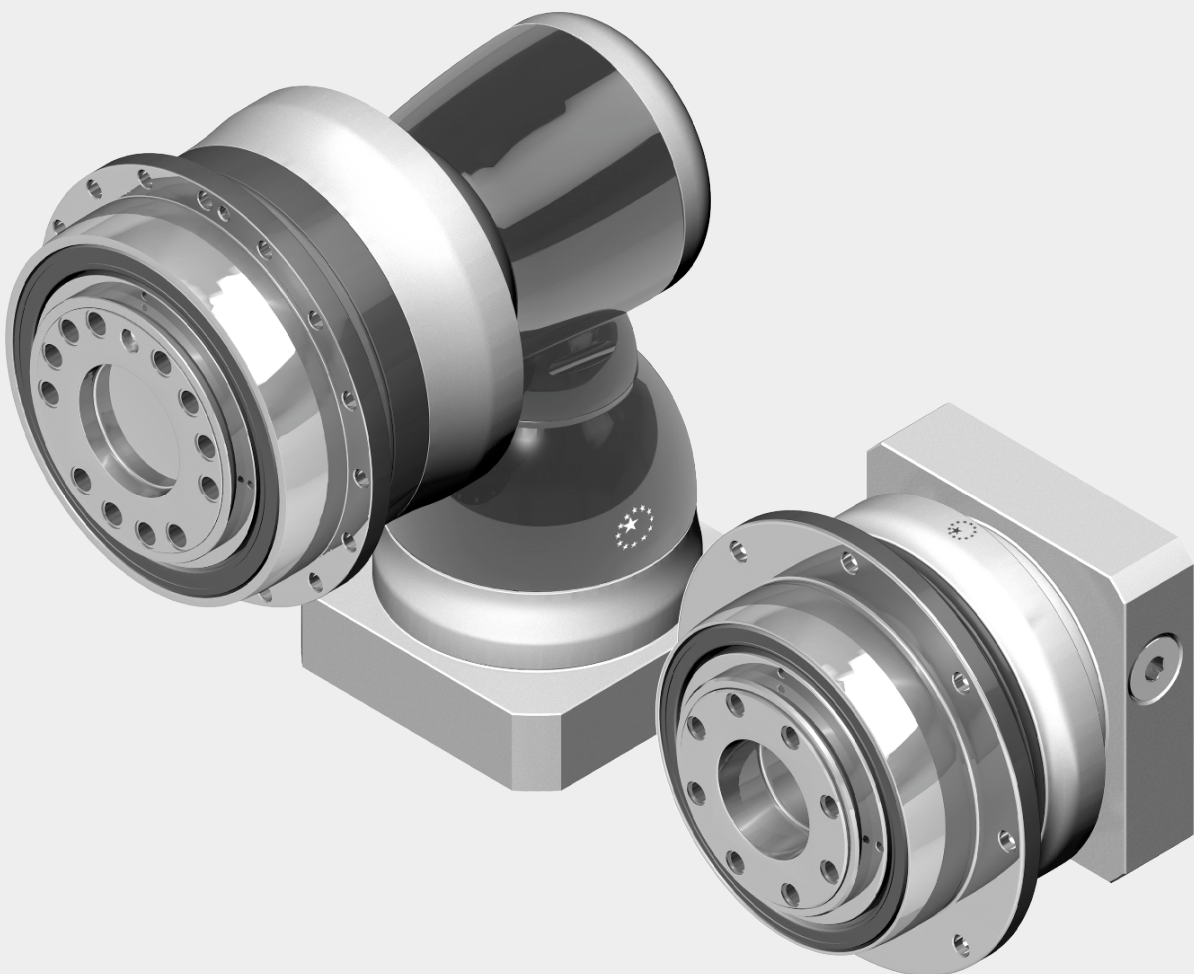




**APEX DYNAMICS, INC.**

**NEW GENERATION  
PLANETARY GEARBOX**

**MD / MDK Series**



## Gearbox Series - MD / MDK

### ► Features:

High Rigidity

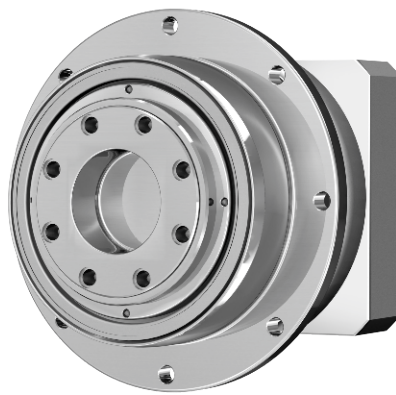
High Torque

High Precision

High Efficiency

Persistence of Low Backlash

Long Life-Time



# Ordering Code - MD / MDK Series

MD090	—	005 <sup>(1)</sup>	/	MOTOR
MDS090	—	005 <sup>(1)</sup>	— SI	
MDK090	—	005 <sup>(1)</sup>	/	MOTOR
MDKA285 <sup>(3)</sup>				Motor Type
MDKB090 <sup>(3)</sup>				Shaft Type
				Ratio
				Gearbox Size

MDS is the MD version with input “SHAFT” instead of input “HUB”<sup>(4)</sup>

**Gearbox Size**  
MD 064 / 090 / 110 / 140 / 200 / 255 / 285 / 355 / 450  
MDK 064 / 090 / 110 / 140 / 200 / 255 / 285 / 355 / 450

**Ratio<sup>(2)</sup>**  
MD (1 Stg.) 4 / 5 / 7 / 10  
(2 Stg.) 16 / 20 / 21 / 25 / 28 / 31 / 35 / 40 / 46 / 50 / 61 / 70 / 91 / 100  
MDK (2 Stg.) 12 / 15 / 16 / 20 / 25 / 28 / 35 / 40 / 49 / 50 / 70 / 100  
MDKA (3 Stg.) 100 / 125 / 140 / 175 / 200 / 250 / 350 / 500 / 700 / 1,000  
MDKB (3 Stg.) 64 / 84 / 100 / 125 / 140 / 175 / 200 / 250 / 280 / 350 / 400 / 500 / 700 / 1,000  
MDK (4 Stg.) 1,225 / 1,400 / 1,750 / 2,000 / 2,800 / 3,500 / 5,000 / 7,000 / 10,000  
MDKC 4 / 5 / 7 / 8 / 10 / 21 / 31 / 46 / 61 / 91

**Shaft Type : SI = Smooth input shaft**  
**S2 = Input shaft with key**

**Motor Type**  
**Manufacturer and Model**

(1) Ratio (I=Nin/Nout).  
(2) Please refer to the specifications for the ratios provided in each series.  
(3) Please refer to page 06.  
(4) The customization detail please contact with APEX sales.



# Performance - MD Gearbox

Model No.		Stage	Ratio <sup>(1)</sup>	MD064	MD090	MD110	MD140	MD200	MD255	MD285	MD355	MD450
Nominal Output Torque $T_{2N}$ By $n_{1N}$	Nm	1	4	100	205	380	765	1,415	2,190	4,035	-	-
			5	85	185	325	660	1,225	1,905	3,505	6,250	12,105
			7	60	135	260	515	980	1,530	2,530	5,045	10,260
			10	24	55	160	315	700	1,070	1,810	3,345	7,160
		2	16	85	195	385	805	1,485	2,295	4,215	-	-
			20	80	190	370	795	1,495	1,990	3,660	-	-
			21	90	195	345	700	1,295	2,005	3,685	6,525	12,495
			25	90	195	345	700	1,295	2,005	3,685	-	-
			28	60	180	345	755	1,510	2,335	4,290	-	-
			31	60	135	280	560	1,050	1,620	2,590	5,280	10,595
			35	75	195	350	705	1,310	2,030	3,725	-	-
			40	40	96	220	615	1,260	2,360	4,280	-	-
			46	24	55	160	335	660	1,005	1,700	3,400	7,125
			50	50	120	275	715	1,325	2,050	3,765	-	-
			61	60	135	285	585	1,095	1,670	2,675	5,445	10,895
			70	60	135	285	585	1,095	1,670	2,675	-	-
			91	24	55	160	345	660	1,005	1,700	3,400	7,000
			100	24	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 <sup>(3)</sup>	Nm	1	4~10	0.45	0.7	1.4	3.5	7	11	14	25	40
		2	16~100	0.2	0.3	0.6	1.3	2.2	3.5	4.5	13	21
Backlash <sup>(2)</sup>	arcmin	1	4~10	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3	≤ 3
		2	16~100	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	1,2	4~100	8	22	60	115	395	650	1,050	2,850	5,700
Nominal Input Speed $n_{1N}$	rpm	1	4~10	5,000	3,600	3,600	3,000	2,700	2,400	2,100	1,500	1,000
		2	16~100	5,000	4,600	4,600	4,000	3,700	3,400	3,100	2,500	2,000
Max. Input Speed $n_{1B}$	rpm	1	4~10	7,000	6,000	6,000	5,000	4,500	4,000	3,500	3,000	2,500
		2	16~100	7,000	7,000	7,000	6,000	5,500	5,000	4,500	4,000	3,500
Max. Axial Load $F_{2a}$ <sup>(4)</sup>	N	1,2	4~100	1,690	2,220	4,070	8,530	17,000	26,900	39,200	101,500	143,700
Max. Tilting Moment $M_{2K}$ <sup>(4)</sup>	Nm	1,2	4~100	120	280	480	1,310	3,530	5,920	9,230	29,100	63,300
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 <sup>(3)</sup>	dB(A)	1	4~10	≤ 58	≤ 59	≤ 64	≤ 65	≤ 66	≤ 66	≤ 66	≤ 68	≤ 70
		2	16~100	≤ 58	≤ 59	≤ 60	≤ 63	≤ 66	≤ 66	≤ 66	≤ 68	≤ 70
Efficiency $\eta$	%	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.

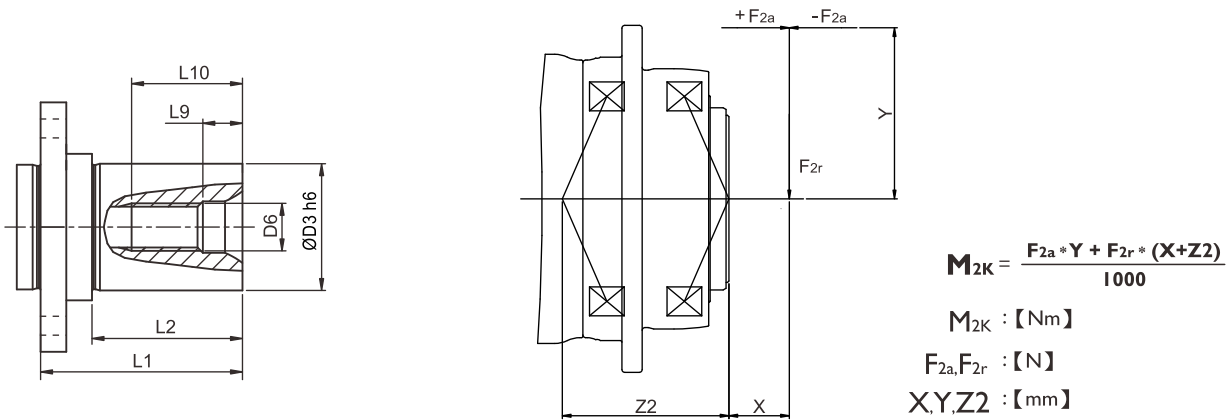


Inertia - MD Gearbox

Model No.		MD064		MD090		MD110		MD140		MD200		MD255		MD285		MD355		MD450	
Ø <sup>(A)</sup> (C3)		1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.	1-st.	2-st.
8	kg.cm <sup>2</sup>	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11		0.17	0.16	-	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14		0.21	0.2	0.53	0.21	-	0.53	-	-	-	-	-	-	-	-	-	-	-	-
19		0.63	-	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	-	23.6	-	-
42		-	-	-	-	-	-	23.2	-	25.4	23.2	25.5	25.4	30.52	28.95	-	25.37	-	30.37
48		-	-	-	-	-	-	56.07	-	61.02	56.07	61.22	61.02	66.85	64.66	-	89.35	-	96.45
55		-	-	-	-	-	-	-	-	88.51	-	88.86	-	94.91	-	122.51	102	188.32	109.06
60		-	-	-	-	-	-	-	-	-	-	-	-	117.73	-	131.35	-	188.32	117.75

(A) Ø = Input shaft diameter.

Flange Shaft - MD



Dimension	L1	L2	D3 h6	D6	L9	L10	Order Code
MD064	33	23	16	M5	4.8	12.5	FLS-AH064-S16
			22	M8	7.2	19	FLS-AH064-S22
MD090	41	30	22	M8	7.2	19	FLS-AH090-S22
			32	M12	10	28	FLS-AH090-S32
MD110	51	38	32	M12	10	28	FLS-AH110-S32
			40	M16	12	36	FLS-AH110-S40
MD140	54	38	40	M16	12	36	FLS-AH140-S40
			55	M20	15	42	FLS-AH140-S55
MD200	73	52	55	M20	15	42	FLS-AH200-S55
			75	M20	15	42	FLS-AH200-S75
MD255	150	123	90	M24	18	50	FLS-AH255-S90

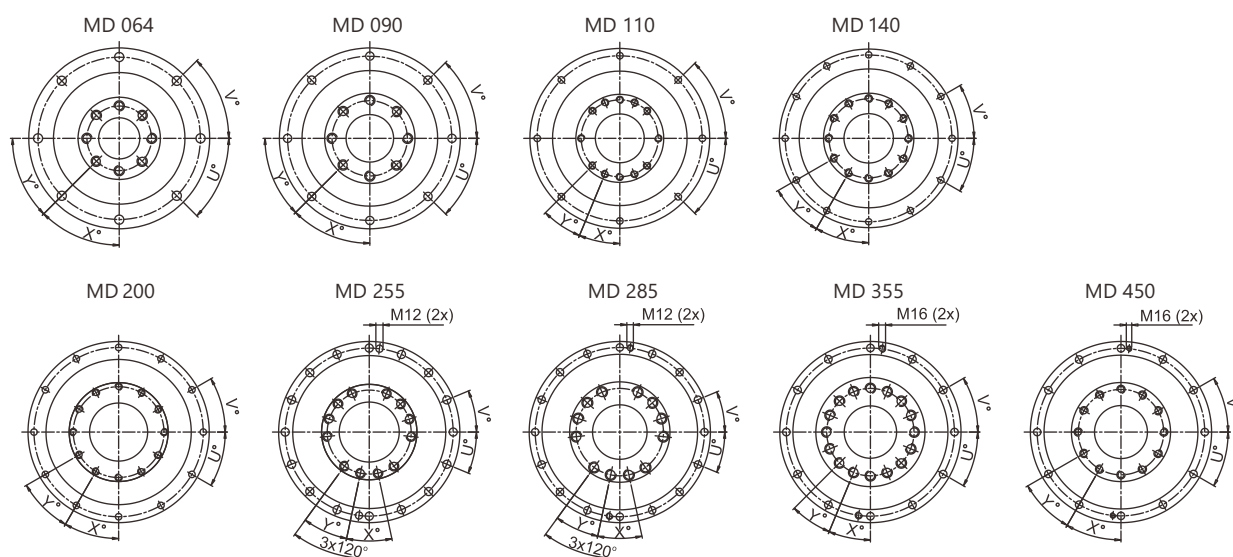
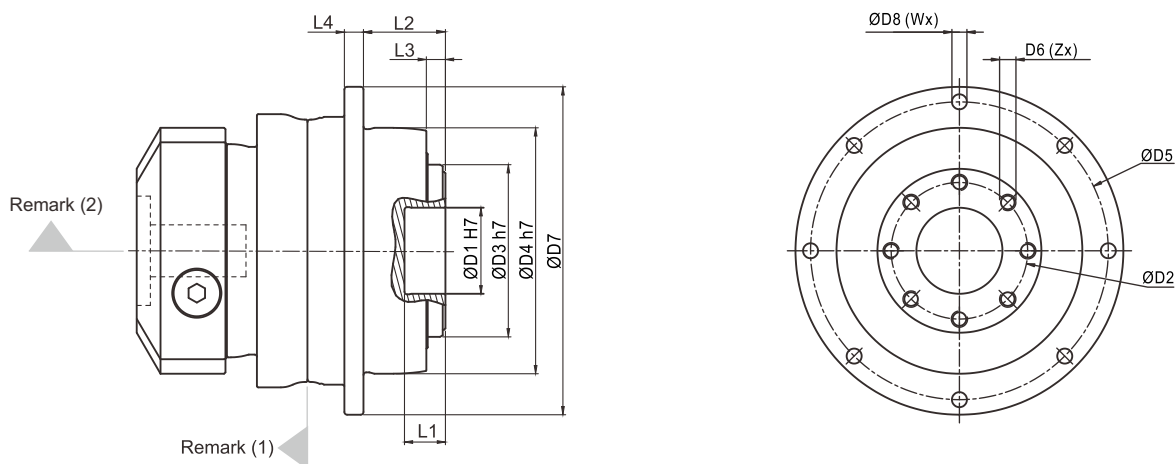
Note: Dimensions are related to gearbox flange interface.

M2K

MD / MDK	064	090	110	140	200	255	285	355	450
Z2 [mm]	63.7	84.5	106.2	90	122.8	133.2	175.5	220.6	275.3

Note : Applied to the output flange center at 100 rpm

# Dimension - MD Gearbox

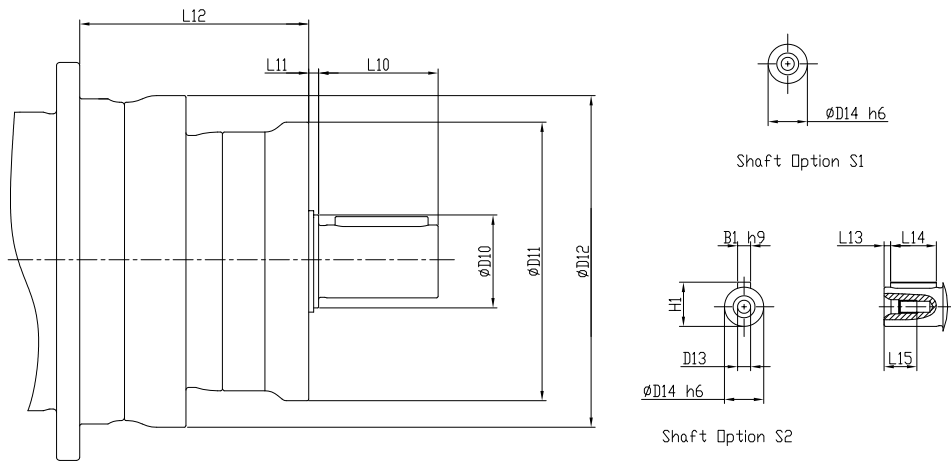


Dimension		MD064	MD090	MD110	MD140	MD200	MD255	MD285	MD355	MD450
D1	H7	20	31.5	40	50	80	100	100	120	155
D2		31.5	50	63	80	125	140	160	200	250
D3	h7	40	63	80	100	160	180	200	250	315
D4	h7	64	90	110	140	200	255	285	355	450
D5		79	109	135	168	233	280	310	385	490
D6 x Pitch x Deep		M5x0.8Px8	M6x1Px10	M6x1Px11	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M20x2.5Px31	M24x3Px32	M30x3.5Px40
D7		88	120	147	180	249.5	302	332	415	530
D8		4.5	5.5	5.5	6.6	9	13.5	13.5	17.5	22
L1		8	15	15	15	16	16	16	35	24
L2		19.5	30	29	38	50	66	75	80	85
L3		4	7	7	7.5	8.5	13.5	16.5	20	20
L4		5	7	8	10	12	18	20	45	60
X in Degree		45	45	22.5	30	30	24	24	22.5	30
Y in Degree		45	45	22.5	30	30	24	24	22.5	30
Z		8	8	12	12	12	12	12	16	12
U in Degree		45	45	45	30	30	22.5	22.5	30	30
V in Degree		45	45	45	30	30	22.5	22.5	30	30
W		8	8	8	12	12	16	16	12	12

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

(2) As alternative to input "HUB", input "SHAFT" is also available, please find in page 06.

Dimension - MDS (Input Shaft as Option)



Dimension	Stage	MDS064	MDS090	MDS100	MDS140	MDS200	MDS255	MDS285	MDS355	MDS450
D10	1	20	28	35	50	70	70	75	-	-
	2	17	20	28	35	50	70	70	75	75
D11	1	68	84	93	118	178	180	225	-	-
	2	60	68	84	93	118	178	180	225	225
D12	1,2	76	100	132	160	232	262	301.5	362	466
D13	1	M4x0.7P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M20x2.5P	M20x2.5P	-	-
	2	M3x0.5P	M4x0.7P	M8x1.25P	M10x1.5P	M12x1.75P	M16x2P	M20x2.5P	M20x2.5P	M20x2.5P
D14 h6	1	12	22	28	38	45	55	60	-	-
	2	10	12	22	28	38	45	55	55	60
L10	1	18	36	42	58	82	82	105	-	-
	2	15	18	36	42	58	82	82	82	105
L11	1	3	3	4	5	10	11	11	-	-
	2	3	3	3	4	5	10	11	11	11
L12	1	57.5	69	88	107.5	151.5	149	216	-	-
	2	73	85	110	136	174.5	210	255.5	278.5	374
L13	1	2	3	5	5	5	6	2.5	-	-
	2	2	2	3	5	5	5	6	6	2.5
L14	1	14	28	32	40	65	70	100	-	-
	2	10	14	28	32	40	65	70	70	100
L15	1	10	19	22	28	36	42	42	-	-
	2	9	10	19	22	28	36	42	42	42
B1 h9	1	4	6	8	10	14	16	18	-	-
	2	3	4	6	8	10	14	16	16	18
H1	1	13.5	24.5	31	41	48.5	59	64	-	-
	2	11.2	13.5	24.5	31	41	48.5	59	59	64

Performance - MDS (Input Shaft as Option)

Model No.		Stage	Ratio <sup>(1)</sup>	MDS064	MDS090	MDS100	MDS140	MDS200	MDS255	MDS285	MDS355	MDS450
Max. Radial Load $F_{1rB}^{(2)}$	N	1	4~10	460	600	800	1,025	2,720	2,940	3,620	-	-
		2	16~100	275	460	600	800	1,025	2,720	2,940	3,240	3,620
Max. Axial Load $F_{1aB}^{(2)}$	N	1	4~10	230	300	400	512	1,360	1,470	1,810	-	-
		2	16~100	137	230	300	400	512	1,360	1,470	1,620	1,810
Moment of Inertia	Kg·cm <sup>2</sup>	1	4~10	0.19	0.62	1.78	7.72	44.73	55.41	133.12	-	-
		2	16~100	0.06	0.19	0.62	1.78	7.72	44.73	53.41	133.12	111.15

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

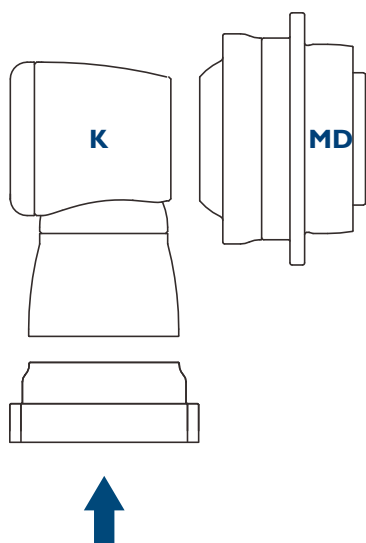
(2) Applied to the input shaft center at 1000 rpm

(3) The customization detail please contact with APEX sales.

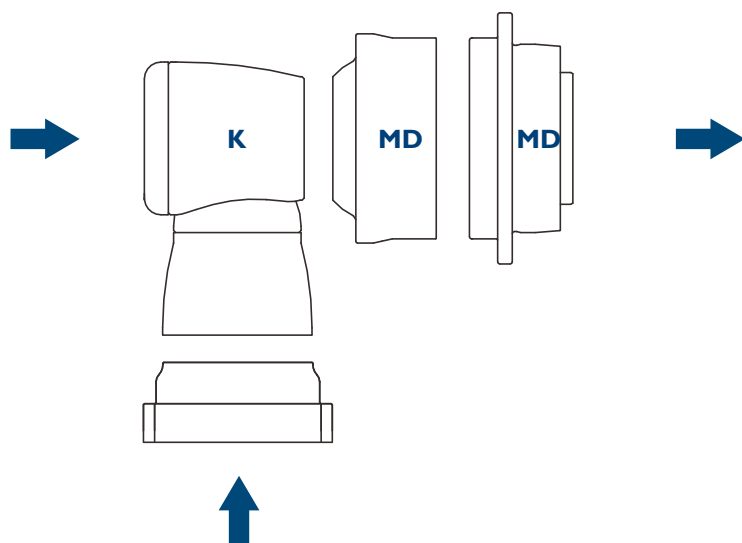
# MDK Gearbox Structure

## MDK Structure

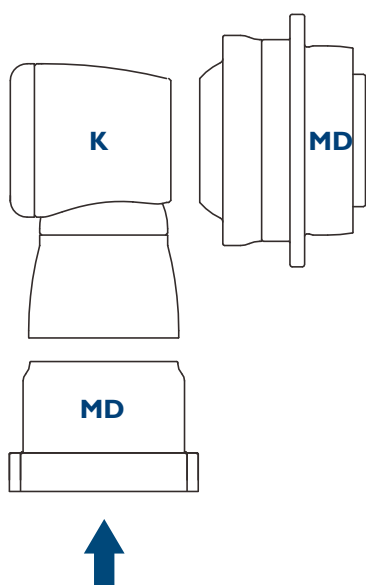
### (I) MDK-2 Stage



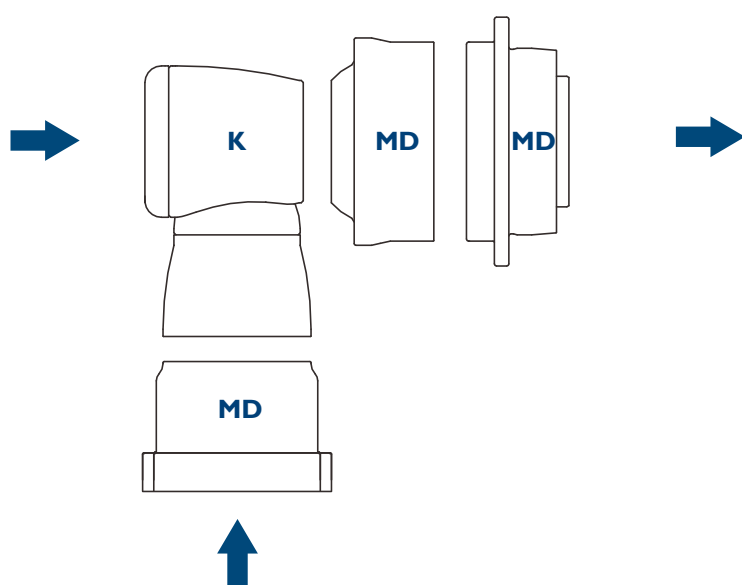
### (II) MDK-3 Stage



### (III) MDK-3 Stage



### (IV) MDK-4 Stage



Performance - MDK (2 Stage) Gearbox

Model No.		Stage	Ratio <sup>(1)</sup>	MDK064	MDK090	MDK110	MDK140	MDK200	MDK255	MDK285	MDK355
Nominal Output Torque $T_{2N}$ By $n_{IN}$	Nm	2	12	80	195	365	805	1,495	1,680	3,280	-
			15	-	-	-	-	-	2,005	3,675	6,510
			16	80	185	350	775	1,510	1,680	3,280	-
			20	75	180	335	750	1,520	1,780	3,710	6,570
			25	80	195	350	710	1,320	1,775	3,735	6,615
			28	75	170	320	720	1,465	1,560	3,000	-
			35	80	190	355	715	1,330	1,950	3,750	6,675
			40	72	160	305	680	1,405	1,440	2,400	-
			49	63	135	290	585	1,105	1,680	2,685	5,470
			50	85	185	345	725	1,345	1,800	3,000	5,500
			70	63	135	295	600	1,130	1,710	2,730	5,560
			100	24	57	160	350	605	915	1,590	3,315
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 <sup>(3)</sup>	Nm	2	12~100	1	1.3	2	3.1	6	13	16	20
Backlash <sup>(2)</sup>	arcmin	2	12~100	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	2	12~100	12	27	56	112	389	642	1,275	2,500
Nominal Input Speed $n_{IN}$	rpm	2	12~100	3,000	3,000	2,800	2,700	2,200	2,100	2,000	1,600
Max. Input Speed $n_{IB}$	rpm	2	12~100	6,000	6,000	6,000	4,500	4,500	4,000	3,000	2,500
Max. Axial Load $F_{2a}$ <sup>(4)</sup>	N	2	12~100	1,690	2,220	4,070	8,530	17,000	26,900	39,200	101,500
Max. Tilting Moment $M_{2K}$ <sup>(4)</sup>	Nm	2	12~100	120	280	480	1,310	3,530	5,920	9,230	29,100
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 <sup>(3)</sup>	dB(A)	2	12~100	≤ 64	≤ 66	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74
Efficiency $\eta$	%	2	12~100	≥ 94%							

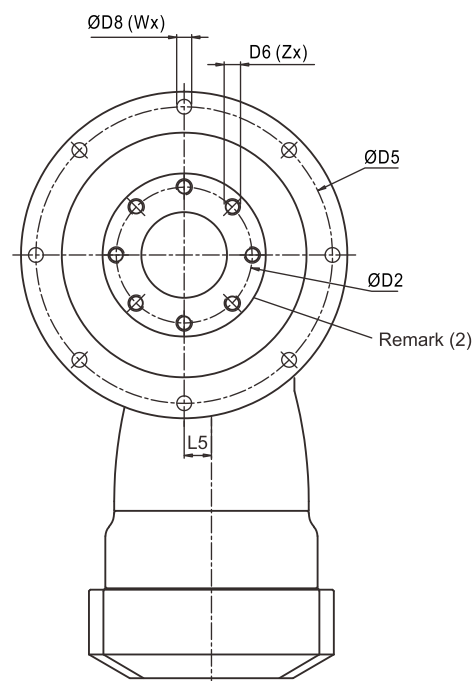
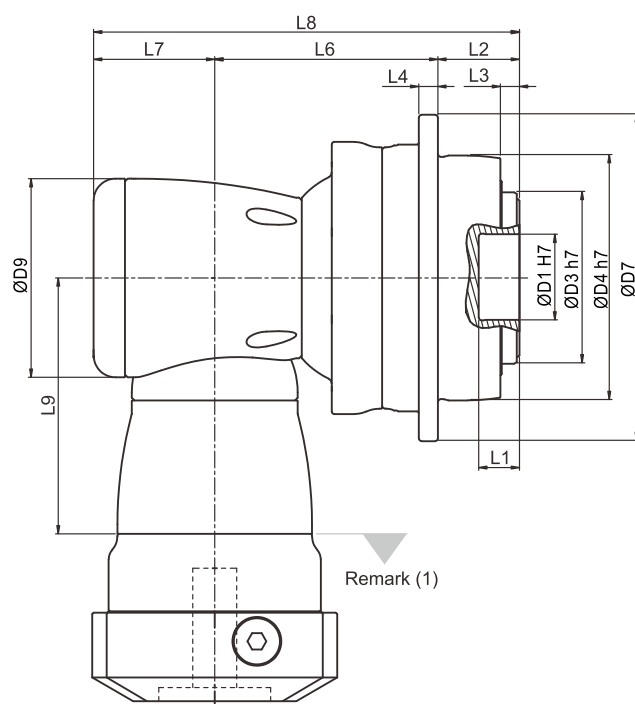
- (1) Ratio (  $i = N_{in} / N_{out}$  ) .
- (2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$  .
- (3) The values are measured by gearbox with ratio 100 (2-stage), no loading at 3,000 RPM  
or at the respective Nominal Input Speed by bigger model size.  
By lower ratio and/or higher RPM, the values could be higher.
- (4) Applied to the output flange center at 100 rpm.
- (5) Continuous operation is not recommended.

Inertia - MDK (2 Stage) Gearbox

Model No.		MDK064	MDK090	MDK110	MDK140	MDK200	MDK255	MDK285	MDK355
Input Shaft (C3) $\varnothing^{(A)}$									
8	kg.cm <sup>2</sup>	0.1	-	-	-	-	-	-	-
11		0.17	0.18	-	-	-	-	-	-
14		0.21	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	23.46
42		-	-	-	-	22.83	22.83	23.59	25.28
48		-	-	-	-	58.45	58.45	59.3	61.61
55		-	-	-	-	-	-	-	89.67

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

# Dimension - MDK (2 Stage) Gearbox (Ratio i =12~100)



Dimension	MDK064	MDK090	MDK110	MDK140	MDK200	MDK255	MDK285	MDK355
D1 H7	20	31.5	40	50	80	100	100	120
D2	31.5	50	63	80	125	140	160	200
D3 h7	40	63	80	100	160	180	200	250
D4 h7	64	90	110	140	200	255	285	355
D5	79	109	135	168	233	280	310	385
D6 x Pitch x Deep	M5x0.8Px8	M6x1Px10	M6x1Px11	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M20x2.5Px31	M24x3Px32
D7	88	120	147	180	249.5	302	332	415
D8	4.5	5.5	5.5	6.6	9	13.5	13.5	17.5
D9	73	94	116	163	210	210	255	300
L1	8	15	15	15	16	16	16	35
L2	19.5	30	29	38	50	66	75	80
L3	4	7	7	7.5	8.5	13.5	16.5	20
L4	5	7	8	10	12	18	20	45
L5	10	13	17	25	31	31	36	43
L6	87	90.5	114	147.5	175	191.5	249.5	290
L7	44.5	53	68.3	89	115	115	131	165
L8	151	173.5	211.3	274.5	340	372.5	455.5	535
L9	94	114.5	129	173.5	228	228	265.5	294.5
X in Degree	45	45	22.5	30	30	24	24	22.5
Y in Degree	45	45	22.5	30	30	24	24	22.5
Z	8	8	12	12	12	12	12	16
U in Degree	45	45	45	30	30	22.5	22.5	30
V in Degree	45	45	45	30	30	22.5	22.5	30
W	8	8	8	12	12	16	16	12

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

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

Performance - MDKA (3 Stage) Gearbox

Model No.		Stage	Ratio <sup>(1)</sup>	MDKA285	MDKA355	MDKA450
Nominal Output Torque T <sub>2N</sub> By n <sub>IN</sub>	Nm	3	100	3,875	6,815	12,930
			125	3,900	6,855	12,995
			140	3,910	6,870	13,030
			175	3,930	6,910	13,090
			200	3,945	6,930	12,000
			250	3,970	6,970	13,195
			350	4,000	7,030	12,650
			500	4,035	5,350	9,050
			700	3,090	6,190	11,960
			1,000	1,770	3,400	7,055
Emergency Stop Torque T <sub>2NOT</sub>	Nm	3	100~1,000	2 times T <sub>2N</sub>		
Max. Acceleration Torque T <sub>2B</sub>	Nm	3	100~1,000	1.5 times T <sub>2N</sub>		
No Load Running Torque <sup>(3)</sup>	Nm	3	100~1,000	6	6	13
Backlash <sup>(2)</sup>	arcmin	3	100~1,000	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	3	100~1,000	1,275	2,500	5,100
Nominal Input Speed n <sub>IN</sub>	rpm	3	100~1,000	2,100	2,100	2,000
Max. Input Speed n <sub>IB</sub>	rpm	3	100~1,000	4,000	4,000	3,000
Max. Axial Load F <sub>2a</sub> <sup>(4)</sup>	N	3	100~1,000	39,200	101,500	143,700
Max. Tilting Moment M <sub>2K</sub> <sup>(4)</sup>	Nm	3	100~1,000	9,230	29,100	63,300
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 <sup>(3)</sup>	dB(A)	3	100~1,000	≤ 72	≤ 74	≤ 76
Efficiency η	%	3	100~1,000	≥ 92 %		

- (1) Ratio ( i = N<sub>in</sub> / N<sub>out</sub> ) .
- (2) Backlash is measured at 2% of Nominal Output Torque T<sub>2N</sub> .
- (3) The values are measured by gearbox with ratio 1,000 (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.
- (4) Applied to the output flange center at 100 rpm.
- (5) Continuous operation is not recommended.

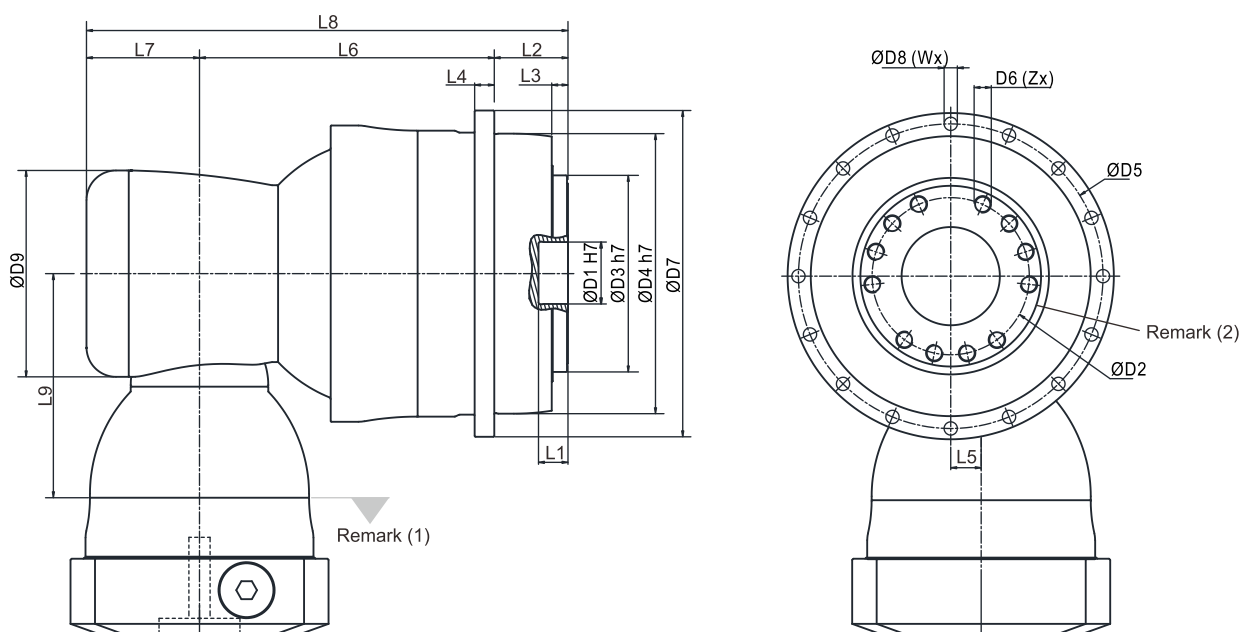
Inertia - MDKA (3 Stage) Gearbox

Model No.		MDKA285	MDKA355	MDKA450
Input Shaft (C3) Ø <sup>(A)</sup>				
32	kg.cm <sup>2</sup>	10.18	10.18	-
35		15.21	15.21	15.68
38		20.7	20.7	21.69
42		22.83	22.83	23.59
48		58.45	58.45	59.3
55		-	-	86.95

(A) Ø = Input shaft diameter.



# Dimension - MDKA (3 Stage) Gearbox (Ratio i =100~1,000)



Dimension	MDKA285	MDKA355	MDKA450
D1 H7	100	120	155
D2	160	200	250
D3 h7	200	250	315
D4 h7	285	355	450
D5	310	385	490
D6 x Pitch x Deep	M20x2.5Px31	M24x3Px32	M30x3.5Px40
D7	332	415	530
D8	13.5	17.5	22
D9	210	210	255
L1	16	35	24
L2	75	80	85
L3	16.5	20	20
L4	20	45	60
L5	31	31	36
L6	300	332	447.5
L7	115	115	131
L8	490	527	663.5
L9	228	228	265.5
X in Degree	24	22.5	30
Y in Degree	24	22.5	30
Z	12	16	12
U in Degree	22.5	30	30
V in Degree	22.5	30	30
W	16	12	12

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

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

Performance - MDKB (3 Stage) Gearbox

Model No.		Stage	Ratio <sup>(1)</sup>	MDKB090	MDKB110	MDKB140	MDKB200	MDKB255	MDKB285	MDKB355
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	6,745
			125	190	330	730	1,355	2,095	3,850	6,785
			140	170	285	630	1,310	2,100	3,860	6,805
			175	190	325	705	1,370	2,115	3,885	6,845
			200	175	290	605	1,265	2,100	3,900	6,865
			250	195	335	680	1,380	2,135	3,920	6,905
			280	180	300	610	1,230	1,560	3,000	-
			350	200	345	705	1,395	1,950	3,750	6,965
			400	160	330	670	1,330	1,440	2,400	-
			500	200	380	760	1,405	1,800	3,000	5,050
			700	135	325	670	1,240	1,875	3,005	6,060
			1,000	55	160	380	660	1,065	1,725	3,325
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 <sup>(3)</sup>	Nm	3	64~1,000	0.2	0.2	0.3	0.4	1	1.2	1.5
Backlash <sup>(2)</sup>	arcmin	3	64~1,000	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	3	64~1,000	27	56	112	389	642	1,275	2,500
Nominal Input Speed $n_{1N}$	rpm	3	64~1,000	5,500	4,600	4,600	4,000	3,700	3,400	3,100
Max. Input Speed $n_{1B}$	rpm	3	64~1,000	7,000	7,000	7,000	6,000	5,500	5,000	4,500
Max. Axial Load $F_{2a}$ <sup>(4)</sup>	N	3	64~1,000	2,220	4,070	8,530	17,000	26,900	39,200	101,500
Max. Tilting Moment $M_{2K}$ <sup>(4)</sup>	Nm	3	64~1,000	280	480	1,310	3,530	5,920	9,230	29,100
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 <sup>(3)</sup>	dB(A)	3	64~1,000	≤ 66	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74
Efficiency $\eta$	%	3	64~1,000	≥ 92%						

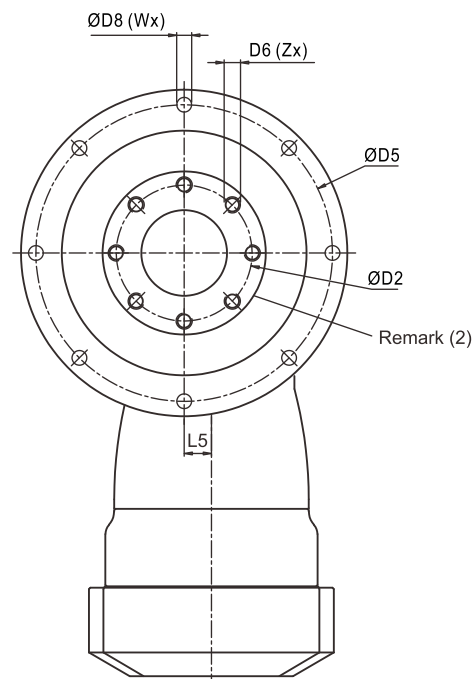
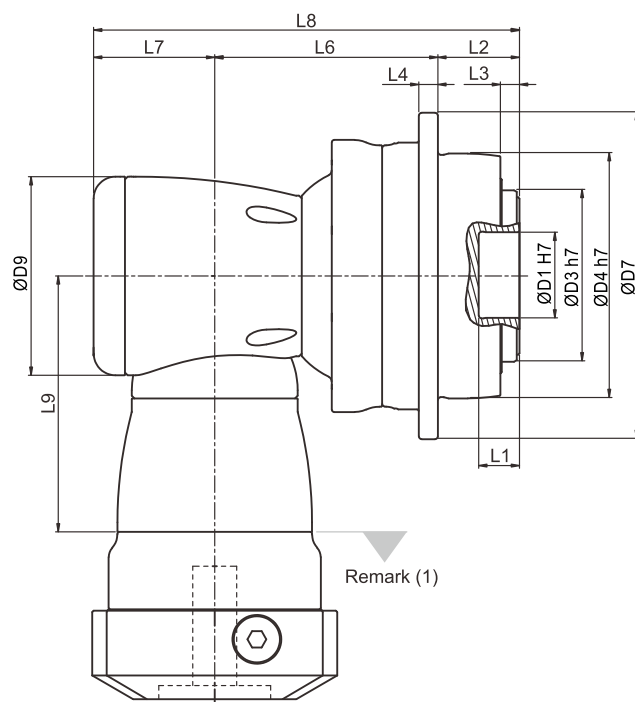
- (1) Ratio (  $i = N_{in} / N_{out}$  ) .
- (2) Backlash is measured at 2% of Nominal Output Torque  $T_{2N}$  .
- (3) The values are measured by gearbox with ratio 1,000 (3-stage), no loading at 3,000 RPM  
or at the respective Nominal Input Speed by bigger model size.  
By lower ratio and/or higher RPM, the values could be higher.
- (4) Applied to the output flange center at 100 rpm.
- (5) Continuous operation is not recommended.

Inertia - MDKB (3 Stage) Gearbox

Model No.		MDKB090	MDKB110	MDKB140	MDKB200	MDKB255	MDKB285	MDKB355
Input Shaft (C3) $\varnothing^{(A)}$								
8	kg.cm <sup>2</sup>	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	17.35
38		-	-	-	21.32	21.32	23.26	23.61
42		-	-	-	-	23.2	25.4	25.5
48		-	-	-	-	56.07	61.02	61.22

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

# Dimension - MDKB (3 Stage) Gearbox (Ratio i =64~1,000)



Dimension	MDKB090	MDKB110	MDKB140	MDKB200	MDKB255	MDKB285	MDKB355
D1 H7	31.5	40	50	80	100	100	120
D2	50	63	80	125	140	160	200
D3 h7	63	80	100	160	180	200	250
D4 h7	90	110	140	200	255	285	355
D5	109	135	168	233	280	310	385
D6 x Pitch x Deep	M6x1Px10	M6x1Px11	M8x1.25Px15	M10x1.5Px20	M16x2Px25	M20x2.5Px31	M24x3Px32
D7	120	147	180	249.5	302	332	415
D8	5.5	5.5	6.6	9	13.5	13.5	17.5
D9	94	116	163	210	210	255	300
L1	15	15	15	16	16	16	35
L2	30	29	38	50	66	75	80
L3	7	7	7.5	8.5	13.5	16.5	20
L4	7	8	10	12	18	20	45
L5	13	17	25	31	31	36	43
L6	90.5	114	147.5	175	191.5	249.5	290
L7	53	68.3	89	115	115	131	165
L8	173.5	211.3	274.5	340	372.5	455.5	535
L9	114.5	129	173.5	228	228	265.5	294.5
X in Degree	45	22.5	30	30	24	24	22.5
Y in Degree	45	22.5	30	30	24	24	22.5
Z	8	12	12	12	12	12	16
U in Degree	45	45	30	30	22.5	22.5	30
V in Degree	45	45	30	30	22.5	22.5	30
W	8	8	12	12	16	16	12

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

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

Performance - MDK (4 Stage) Gearbox

Model No.		Stage	Ratio <sup>(1)</sup>	MDK285	MDK355	MDK450
Nominal Output Torque T <sub>2N</sub> By n <sub>IN</sub>	Nm	4	1,225	4,070	7,145	13,490
			1,400	4,085	7,170	13,535
			1,750	4,100	7,200	13,585
			2,000	4,120	7,200	12,000
			2,800	3,185	6,320	12,145
			3,500	4,180	7,330	12,650
			5,000	4,285	5,350	9,050
			7,000	3,445	6,780	12,670
			10,000	2,240	4,425	9,370
Emergency Stop Torque T <sub>2NOT</sub>	Nm	4	1,225~10,000			
Max. Acceleration Torque T <sub>2B</sub>	Nm	4	1,225~10,000			
No Load Running Torque <sup>(3)</sup>	Nm	4	1,225~10,000			
Backlash <sup>(2)</sup>	arcmin	4	1,225~10,000			
Torsional Rigidity	Nm/arcmin	4	1,225~10,000			
Nominal Input Speed n <sub>IN</sub>	rpm	4	1,225~10,000			
Max. Input Speed n <sub>IB</sub>	rpm	4	1,225~10,000			
Max. Axial Load F <sub>2a</sub> <sup>(4)</sup>	N	4	1,225~10,000			
Max. Tilting Moment M <sub>2K</sub> <sup>(4)</sup>	Nm	4	1,225~10,000			
Operating Temp	° C	4	1,225~10,000			
Degree of Gearbox Protection		4	1,225~10,000			
Lubrication		4	1,225~10,000			
Mounting Position		4	1,225~10,000			
Running Noise <sup>(3)</sup>	dB(A)	4	1,225~10,000			
Efficiency η	%	4	1,225~10,000			

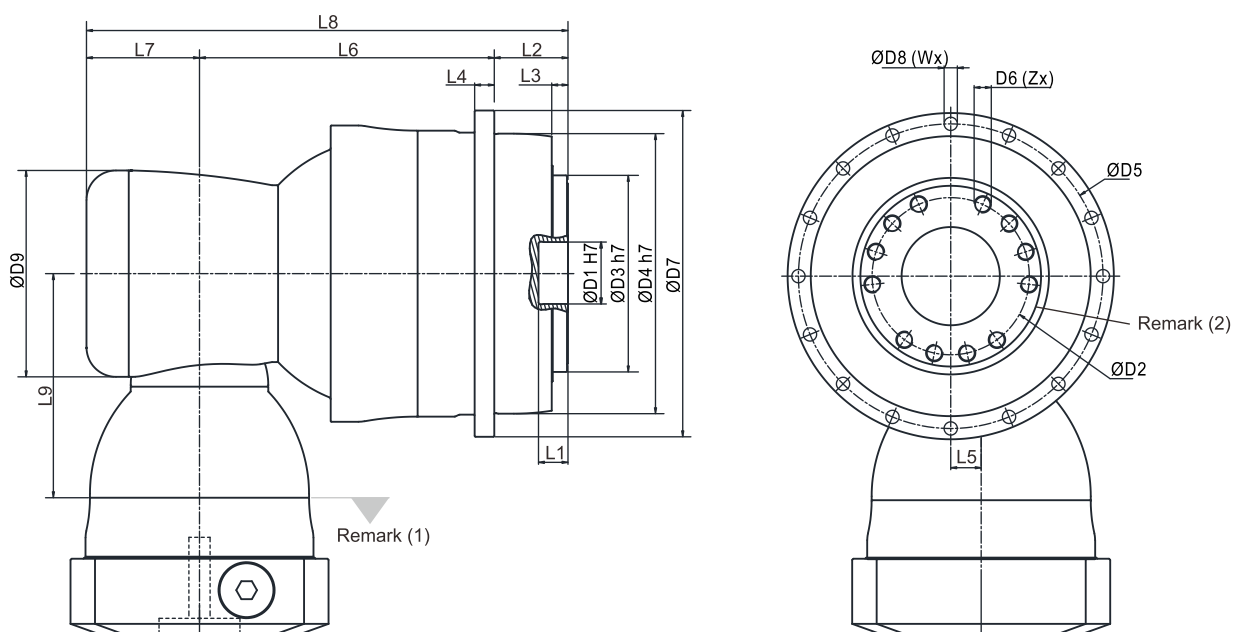
(1) Ratio ( i = N<sub>in</sub> / N<sub>out</sub> ) .  
(2) Backlash is measured at 2% of Nominal Output Torque T<sub>2N</sub> .  
(3) The values are measured by gearbox with ratio 10,000 (4-stage), no loading at 3,000 RPM  
or at the respective Nominal Input Speed by bigger model size.  
By lower ratio and/or higher RPM, the values could be higher.  
(4) Applied to the output flange center at 100 rpm.  
(5) Continuous operation is not recommended.

Inertia - MDK (4 Stage) Gearbox

Model No.		MDK285	MDK355	MDK450
Input Shaft (C3) Ø <sup>(A)</sup>				
24	kg.cm <sup>2</sup>	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

(A) Ø = Input shaft diameter.

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



Dimension	MDK285	MDK355	MDK450
D1 H7	100	120	155
D2	160	200	250
D3 h7	200	250	315
D4 h7	285	355	450
D5	310	385	490
D6 x Pitch x Deep	M20x2.5Px31	M24x3Px32	M30x3.5Px40
D7	332	415	530
D8	13.5	17.5	22
D9	210	210	255
L1	16	35	24
L2	75	80	85
L3	16.5	20	20
L4	20	45	60
L5	31	31	36
L6	300	332	447.5
L7	115	115	131
L8	490	527	663.5
L9	228	228	265.5
X in Degree	24	22.5	30
Y in Degree	24	22.5	30
Z	12	16	12
U in Degree	22.5	30	30
V in Degree	22.5	30	30
W	16	12	12

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

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

Performance - MDKC Gearbox

Model No.		Stage	Ratio <sup>(1)</sup>	MDKC064	MDKC090	MDKC110	MDKC140	MDKC200	MDKC255	MDKC285	MDKC355	MDKC450
Nominal Output Torque T <sub>2N</sub> By n <sub>1N</sub>	Nm	2	4	100	205	380	775	1,440	2,240	4,160	-	-
			5	85	185	330	670	1,250	1,930	3,610	-	-
			7	60	135	260	525	1,000	1,565	2,535	-	-
			8	96	205	395	800	1,320	2,300	4,260	-	-
			10	90	190	340	690	1,290	2,000	3,700	-	-
		3	21	-	195	345	700	1,310	2,045	3,750	6,590	12,630
			31	-	135	275	565	1,070	1,665	2,660	5,400	10,800
			46	-	57	160	340	660	1,000	1,710	3,375	6,945
			61	-	135	285	590	1,115	1,720	2,750	5,580	11,110
91	-	57	160	350	660	985	1,600	3,375	6,430			
Emergency Stop Torque T <sub>2NOT</sub>	Nm	2,3	4~91	2 times T <sub>2N</sub>								
Max. Acceleration Torque T <sub>2B</sub>	Nm	2,3	4~91	1.5 times T <sub>2N</sub>								
No Load Running Torque <sup>(3)</sup>	Nm	2	4~10	2	2.5	5.8	12	25	48	95		
		3	21~91	1	1.5	2.5	4	9	18.5	35	75	148
Backlash <sup>(2)</sup>	arcmin	2	4~10	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	-	-
		3	21~91	-	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4	≤ 4
Torsional Rigidity	Nm/arcmin	2,3	4~91	12	27	56	112	389	642	1,275	2,500	5,100
Nominal Input Speed n <sub>1N</sub>	rpm	2	4~10	5,000	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	1,500	1,100
Max. Input Speed n <sub>1B</sub>	rpm	2	4~10	7,000	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	3,000	2,200
Max. Axial Load F <sub>2a</sub> <sup>(4)</sup>	N	2,3	4~91	1,690	2,220	4,070	8,530	17,000	26,900	39,200	101,500	143,700
Max. Tilting Moment M <sub>2K</sub> <sup>(4)</sup>	Nm	2,3	4~91	120	280	480	1,310	3,530	5,920	9,230	29,100	63,300
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 <sup>(3)</sup>	dB(A)	2	4~10	≤68	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74	-	-
		3	21~91	-	≤ 68	≤ 68	≤ 70	≤ 70	≤ 72	≤ 74	≤ 74	≤ 76
Efficiency η	%	2	4~10	≥ 95%								
		3	21~91	≥ 93%								

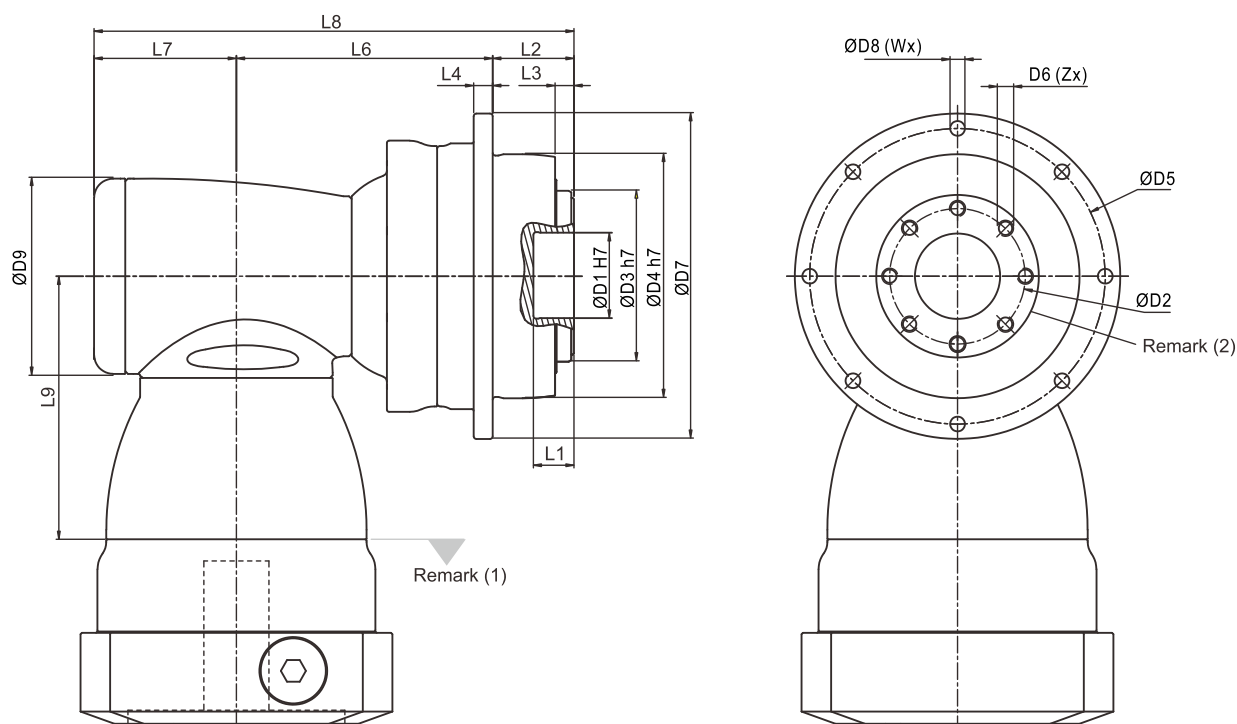
- (1) Ratio ( i = N<sub>in</sub> / N<sub>out</sub> ) .  
(2) Backlash is measured at 2% of Nominal Output Torque T<sub>2N</sub> .  
(3) The values are measured by gearbox with ratio 10 (2-stage) or ratio 91 (3-stage), no loading at 3,000 RPM  
or at the respective Nominal Input Speed by bigger model size.  
By lower ratio and/or higher RPM, the values could be higher.  
(4) Applied to the output flange center at 100 rpm.  
(5) Continuous operation is not recommended.

Inertia MDKC Gearbox (Ratio i=4~10 / 21~91)

Model No.		MDKC064		MDKC090		MDKC110		MDKC140		MDKC200		MDKC255		MDKC285		MDKC355	MDKC450
Ø <sup>(A)</sup> (C3)		2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	3-st.	3-st.
8	kg.cm <sup>2</sup>	0.1	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-
11		0.17	0.52	0.17	-	-	-	-	-	-	-	-	-	-	-	-	-
14		0.21	0.52	0.21	-	0.52	-	-	-	-	-	-	-	-	-	-	-
19		0.62	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	21.69	-	-
42		-	-	-	-	-	22.83	-	22.83	22.83	23.59	22.83	25.28	23.59	23.59	23.59	25.28
48		-	-	-	-	-	58.45	-	58.45	58.45	59.3	58.45	61.61	59.3	59.3	59.3	61.61
55		-	-	-	-	-	-	-	-	86.95	-	89.67	-	-	86.95	-	89.67
60		-	-	-	-	-	-	-	-	-	-	112.49	-	-	-	-	112.49

(A) Ø = Input shaft diameter.

# Dimension - MDKC Gearbox (Ratio i =4~10 / 21~91)



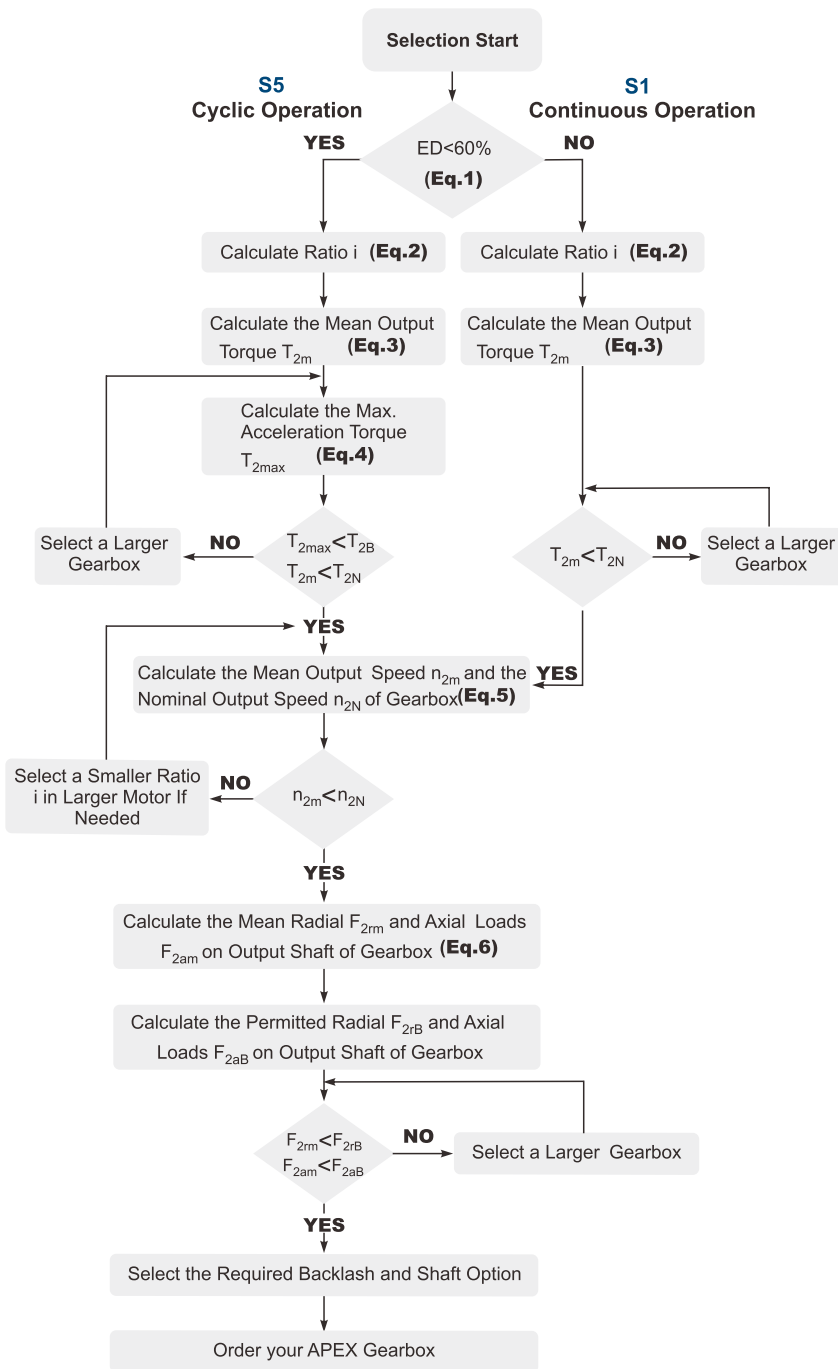
Dimension	MDKC064	MDKC090		MDKC110		MDKC140		MDKC200		MDKC255		MDKC285		MDKC355	MDKC450
	2-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	2-st.	3-st.	3-st.	3-st.
D1 H7	20	31.5		40		50		80		100		100		120	155
D2	31.5	50		63		80		125		140		160		200	250
D3 h7	40	63		80		100		160		180		200		250	315
D4 h7	64	90		110		140		200		255		285		355	450
D5	79	109		135		168		233		280		310		385	490
D6 x Pitch x Deep	M5x0.8Px8	M6x1Px10		M6x1Px11		M8x1.25Px15		M10x1.5Px20		M16x2Px25		M20x2.5Px31		M24x3Px32	M30x3.5Px40
D7	88	120		147		180		249.5		302		332		415	530
D8	4.5	5.5		5.5		6.6		9		13.5		13.5		17.5	22
D9	64	92	64	116	92	156	116	156	156	195	156	240	195	195	240
L1	8	15		15		15		16		16		16		35	24
L2	19.5	30		29		38		50		66		75		80	85
L3	4	7		7		7.5		8.5		13.5		16.5		20	20
L4	5	7		8		10		12		18		20		45	60
L6	92	100.5	121.5	124.5	142	175.5	174.5	185	244.5	199	264.5	265.5	307.5	339.5	463.5
L7	46.5	61.5	46.5	76	61.5	97.5	76	97.5	97.5	105.5	97.5	141	105.5	105.5	141
L8	158	192	198	229.5	232.5	311	288.5	332.5	392	370.5	428	481.5	488	525	689.5
L9	81.5	113.5	81.5	147.5	113.5	196.5	147.5	196.5	196.5	229	196.5	260	229	229	260
X in Degree	45	45		22.5		30		30		24		24		22.5	30
Y in Degree	45	45		22.5		30		30		24		24		22.5	30
Z	8	8		12		12		12		12		12		16	12
U in Degree	45	45		45		30		30		22.5		22.5		30	30
V in Degree	45	45		45		30		30		22.5		22.5		30	30
W	8	8		8		12		12		16		16		12	12

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

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



# Selection of the optimum gearbox



## Recommended (for S5 Cycle Operation)

The general design is given for

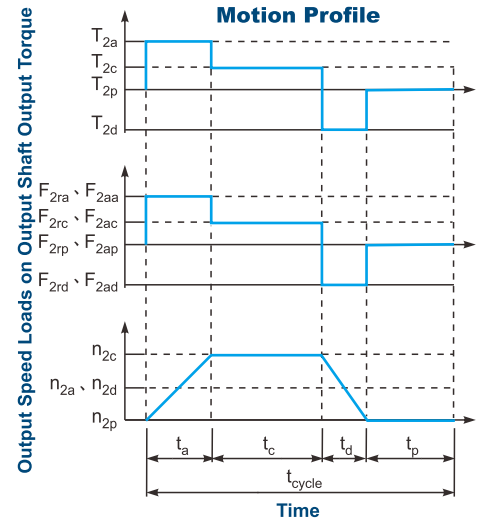
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

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

$\eta$  Efficiency of the Gearbox

(Eq.4)

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

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

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

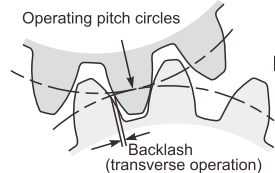
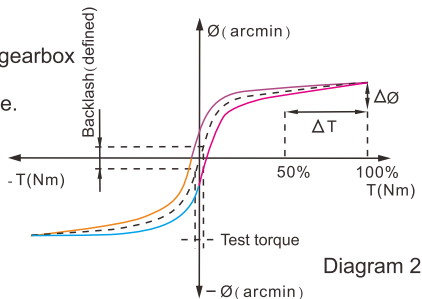
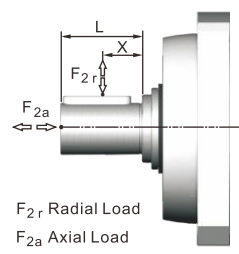
(Eq.5)

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

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

(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	<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>Diagram 1</p>
Torsional Rigidity	Nm/arcmin	<p>Torsional Rigidity is the quotient (<math>\Delta T / \Delta \theta</math>) 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 <math>T_{2B}</math> 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>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><math>F_{2r}</math> Radial Load <math>F_{2a}</math> Axial Load</p>
Efficiency $\eta$	%	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 <sup>2</sup>	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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