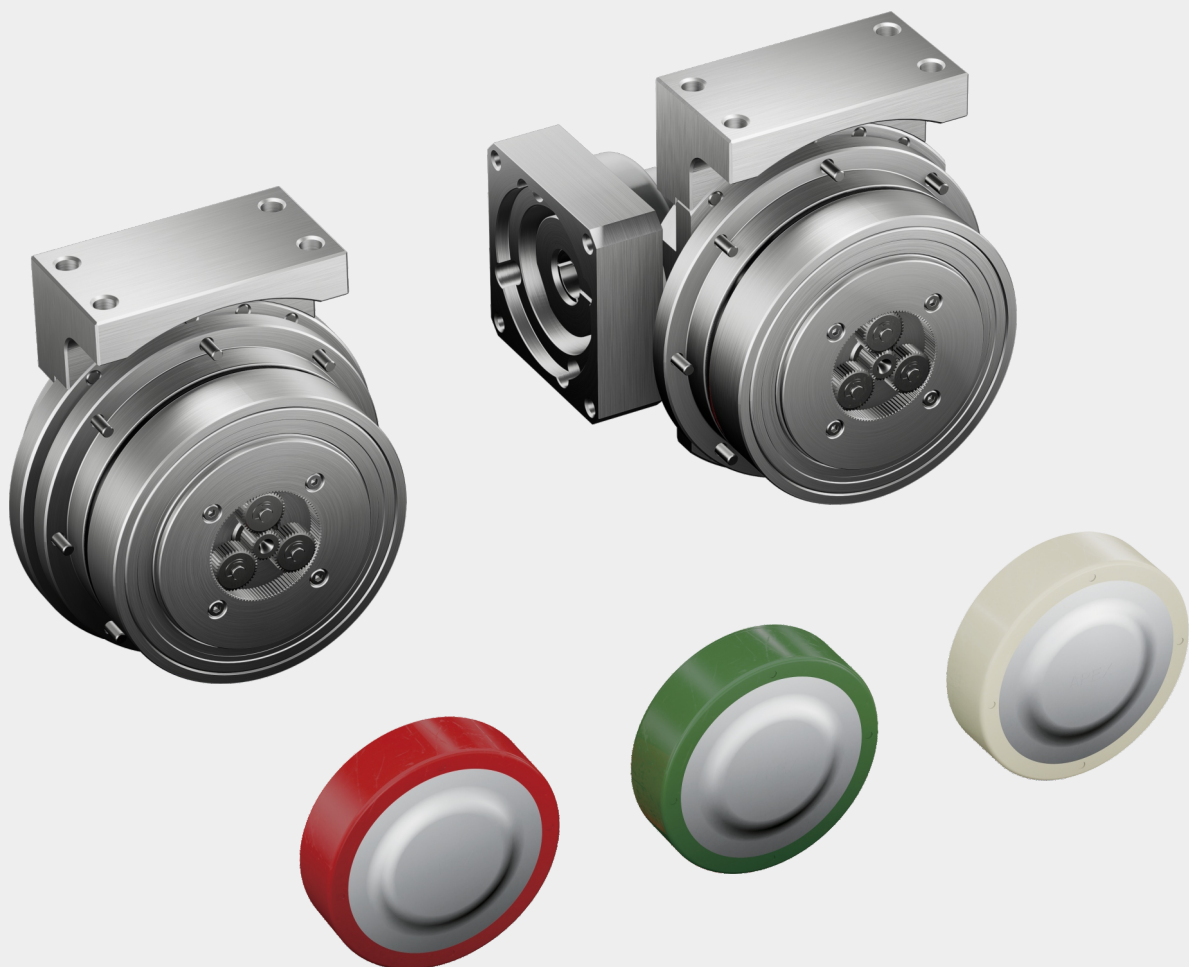




APEX DYNAMICS, INC.

**NEW GENERATION
PLANETARY GEARBOX**

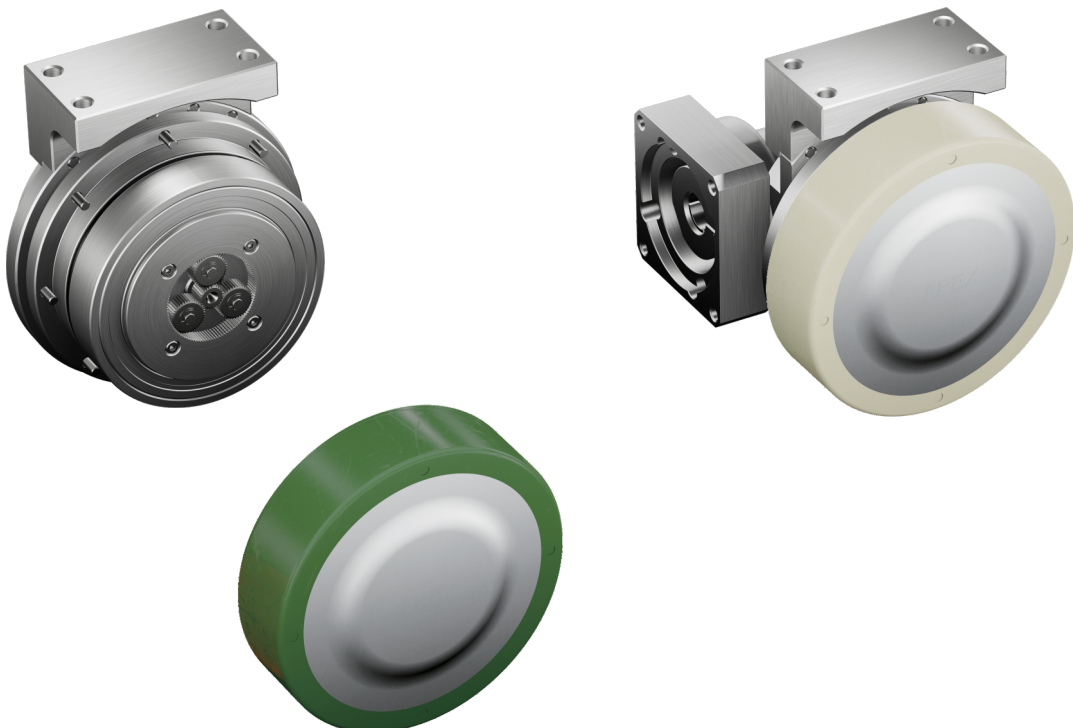
**GV / GVR Series
for AGV Application**



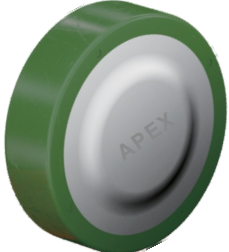


Gearbox Series - GV / GVR

► Features:

- Special Design for AGV Application
- Minimized Gearbox Length for High Reduction Ratio
Optimizing Space Arrangement inside AGV
- Ring-Gear Housing Rotation
- High Torque / High Driving Transmission
- High Efficiency / Optimized Inertia Moment
- High Torsional Rigidity
- High-Strength Bearing and Wheel Hub
Supporting High Vertical Load Capacity
- Long Service Life



Technical Data - Rims

Rims			
Type	A	B	E
Color	Green	Red	Cream
Hardness	64 Sh-D	98 Sh-A	64 Sh-D
Material	TPU	TPU	Hytrel
Temperature Range °C	-30 to +120	-30 to +100	-50 to +150
Properties	Low Noise Wear-Resistant High Loading Capacity Floor Protection	Low Noise Wear-Resistant High Loading Capacity Floor Protection	Low Noise Best Wear-Resistant High Loading Capacity Floor Protection

Size	GV098	GV130	GV165
Diameter [mm]	140	180	220
Weight [Kg]	0.52	1.13	2.1
Inertia J [kg.cm ²]	16.7	60.9	173.4

Ordering Example : EP-GV098-A

Performance - GV / GVR Gearbox

Model No.		Stage	Ratio ⁽¹⁾	Type	GV098 GVR098	GV130 GVR130	GV165 GVR165
Nominal Output Torque T _{2N}	Nm	2	22.5	ALL	76	237	418
			31.5		54	180	396
Emergency Stop Torque T _{2NOT}	Nm	2	22.5~31.5	ALL	3 times T _{2N}		
Max. Acceleration Torque T _{2B}	Nm	2	22.5~31.5	ALL	1.8 times T _{2N}		
No Load Running Torque ⁽²⁾	Nm	2	22.5~31.5	GV	0.3	0.4	0.8
		2	22.5~31.5	GVR	1.58	2.5	3
Backlash ⁽³⁾	arcmin	2	22.5~31.5	GV	≤ 8	≤ 8	≤ 8
				GVR	≤ 12	≤ 12	≤ 12
Torsional Rigidity	Nm/arcmin	2	22.5~31.5	ALL	8	12	16
Nominal Input Speed n _{1N}	rpm	2	22.5~31.5	ALL	3,600	3,600	2,500
Max. Input Speed n _{1B}	rpm	2	22.5~31.5	ALL	6,000	4,800	3,600
Max. Vertical Load	kg	2	22.5~31.5	ALL	580	1,000	1,450
Max. Tilting Moment M _{2K} ⁽⁴⁾	Nm	2	22.5~31.5	ALL	115	250	470
Operating Temp	°C	2	22.5~31.5	ALL	0° C ~ 90° C		
Degree of Gearbox Protection		2	22.5~31.5	ALL	IP54		
Lubrication		2	22.5~31.5	ALL	Lubricant		
Mounting Position		2	22.5~31.5	ALL	All directions		
Running Noise ⁽²⁾	dB(A)	2	22.5~31.5	GV	≤ 64	≤ 66	≤ 68
				GVR	≤ 74	≤ 75	≤ 77
Efficiency η	%	2	22.5~31.5	GV	≥ 94%		
				GVR	≥ 90%		

- (1) Ratio (i = N_{in} / N_{out}).
- (2) The values are measured by gearbox with ratio 31.5 (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 center at 100 rpm. The calculation formula please refer to Fig 1.

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

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

GV / GVR	098	130	165
Z2 [mm]	37.5	49.5	63

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

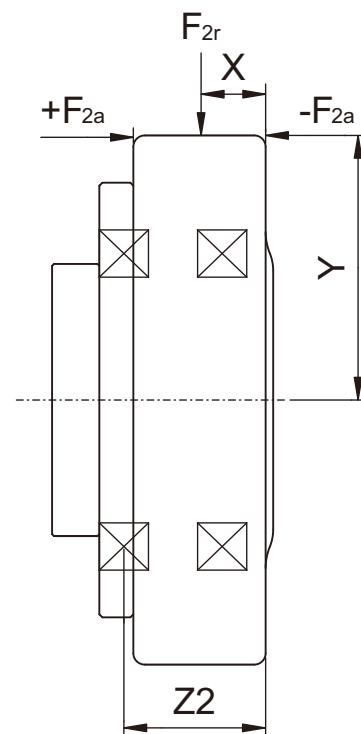


Fig.1

Inertia - GV / GVR Gearbox

Model No.		GV098		GV130		GV165	
$\varnothing^{(A)}$ (C3)	Ratio	22.5	31.5	22.5	31.5	22.5	31.5
8	kg.cm ²	0.14	0.14	0.58	0.58	-	-
11		0.14	0.14	0.58	0.57	-	-
14		0.13	0.13	0.56	0.56	2.60	2.58
19		-	-	0.52	0.52	2.55	2.53
24		-	-	-	-	2.44	2.42
28		-	-	-	-	2.30	2.28

(A) \varnothing = Input shaft diameter.

Model No.		GVR098	GVR130	GVR165
$\varnothing^{(A)}$ (C3)	Stage	2-stage	2-stage	2-stage
8	kg.cm ²	0.18	0.36	-
11		0.20	0.39	-
14		0.24	0.43	1.87
19		-	1.24	2.67
24		-	-	2.97
28		-	-	3.47

(A) \varnothing = Input shaft diameter.

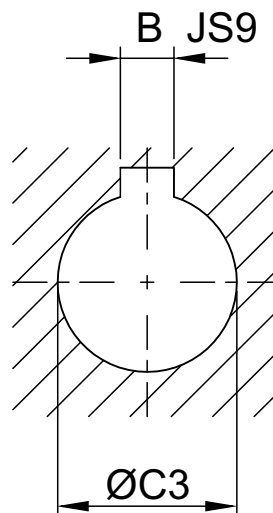
Dimension - GV Keyway

B ⁽¹⁾	Dimension
2	$6 \leq \varnothing C3 \leq 8$
3	$8 < \varnothing C3 \leq 10$
4	$10 < \varnothing C3 \leq 12$
5	$12 < \varnothing C3 \leq 17$
6	$17 < \varnothing C3 \leq 22$
8	$22 < \varnothing C3 \leq 30$

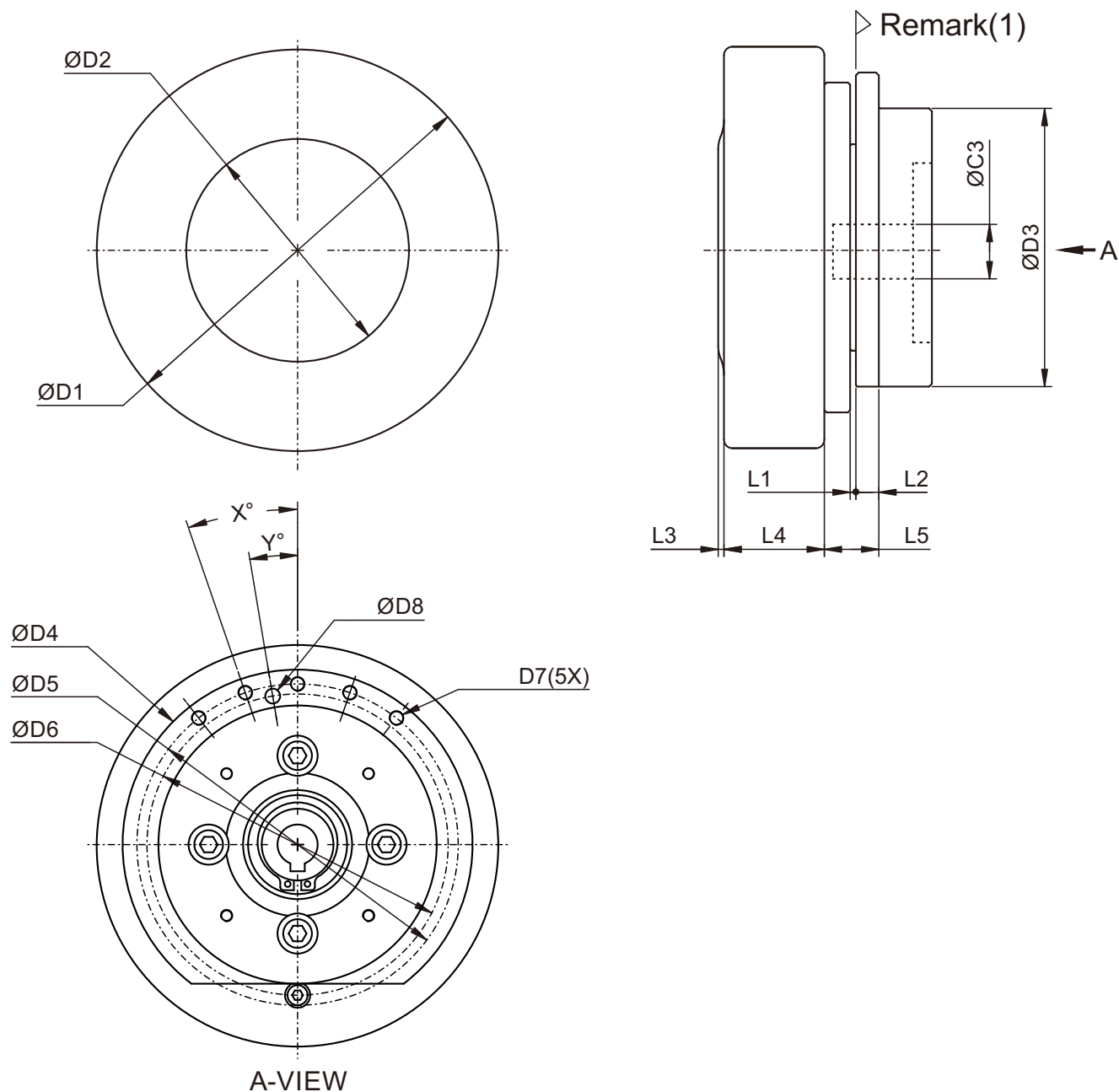
(1) Finish bore with keyway which $\geq \varnothing 6$, acc. to DIN 6885/1 JS9.

Please apply motor key with suitable strength.

★ Please Note, GV can only be combined to a motor with key and keyway.
For motor without key & keyway, please contact APEX Sales.



Dimension - GV Gearbox



Dimension	GV098	GV130	GV165
D1 h11	140	180	220
D2	75	95	110
D3	97	128	162
D4 g6	122	158	200
D5	112	148	185
D6	105	138.5	176.5
D7	M5x0.8Px8L	M6x1Px12L	M8x1.25Px16L
D8	5.2	6.4	9
L1	2	3	4
L2	8	12	16
L3	2	4.5	5
L4	35	48	60
L5	19	25.5	33
X in Degree	19	18	19
Y in Degree	9.5	9	9.5

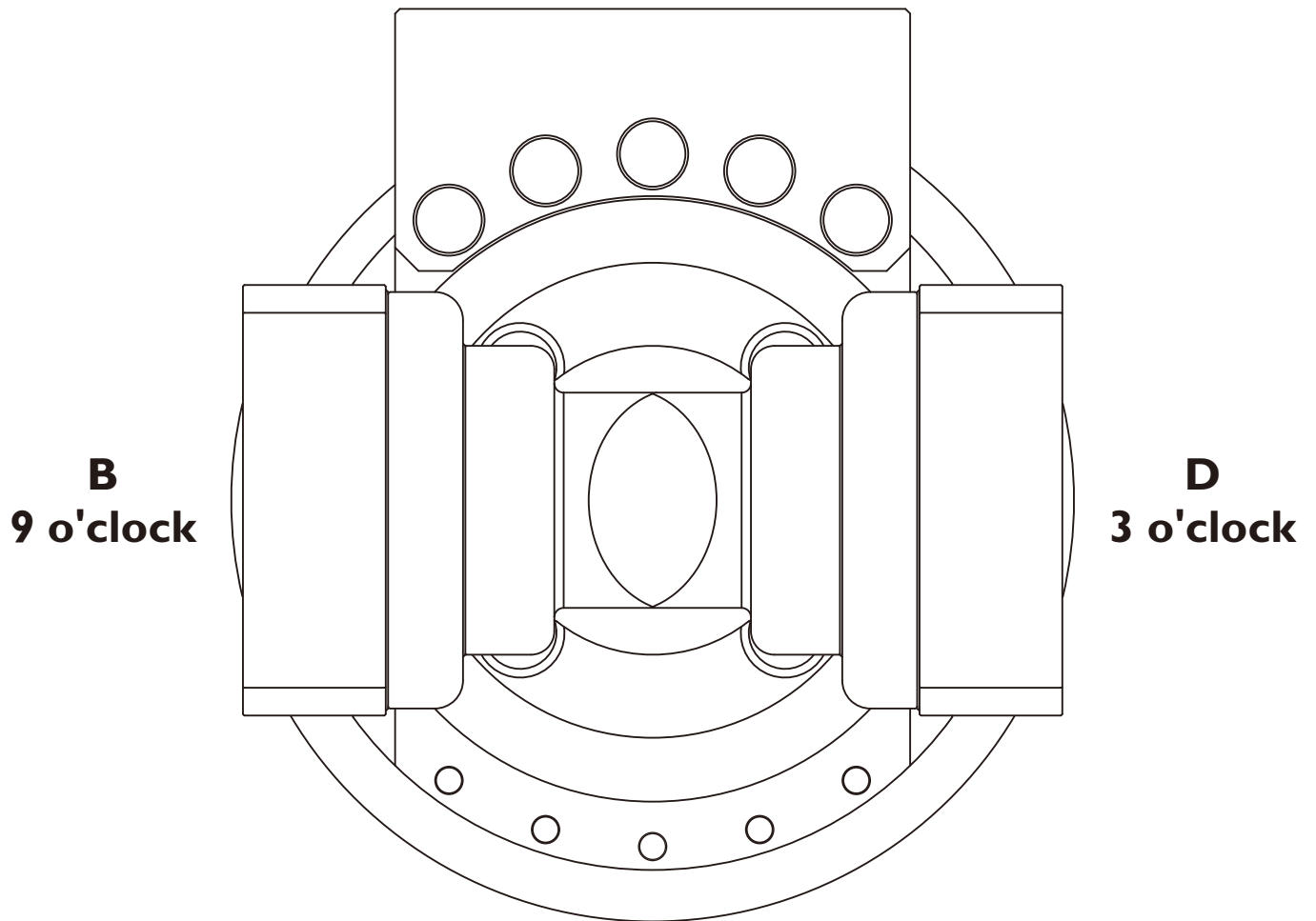
(1) Dimensions are related to motor interface. Please contact APEX for details.

(2) Finish bore with keyway which $\geq \text{Ø}6$ keyway, according to DIN 6885/1, dimensional tolerance is JS9.

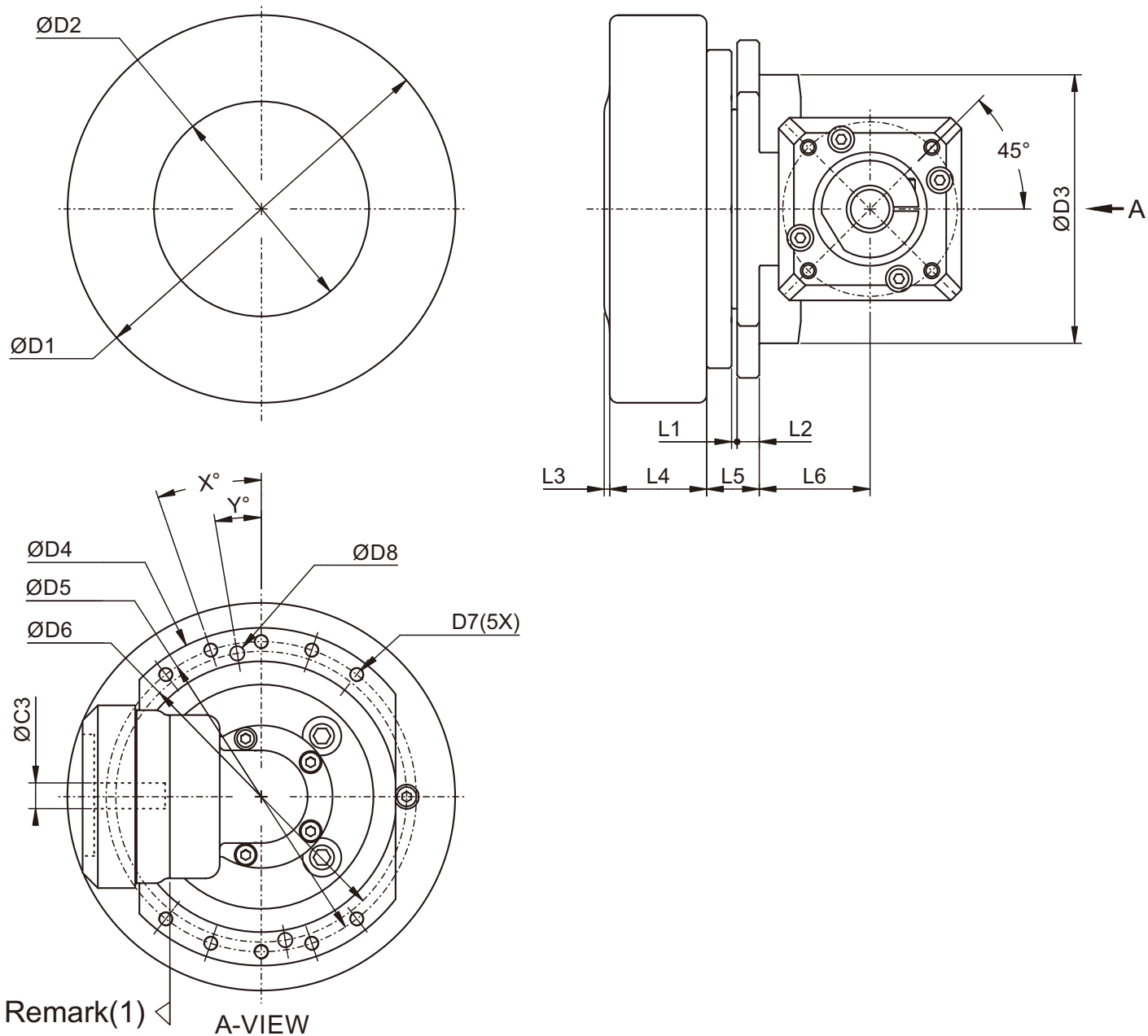
Please refer to page 05 for keyway dimensions corresponding to each bore diameter.

Application Direction - GVR Gearbox

Ordering Code : GVR165 - 031.5 - A - BP - D / MOTOR
GVR165 - 031.5 - A - BP - B / MOTOR



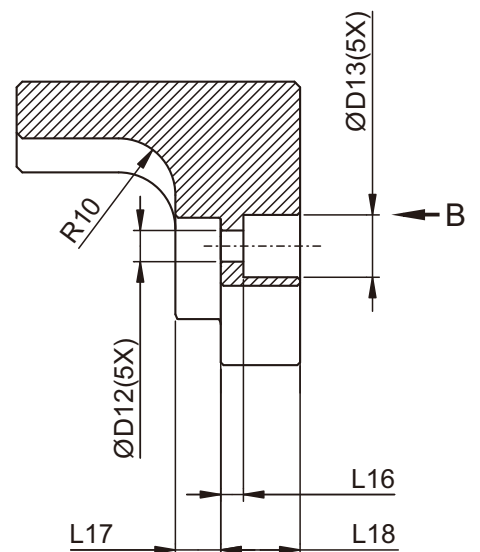
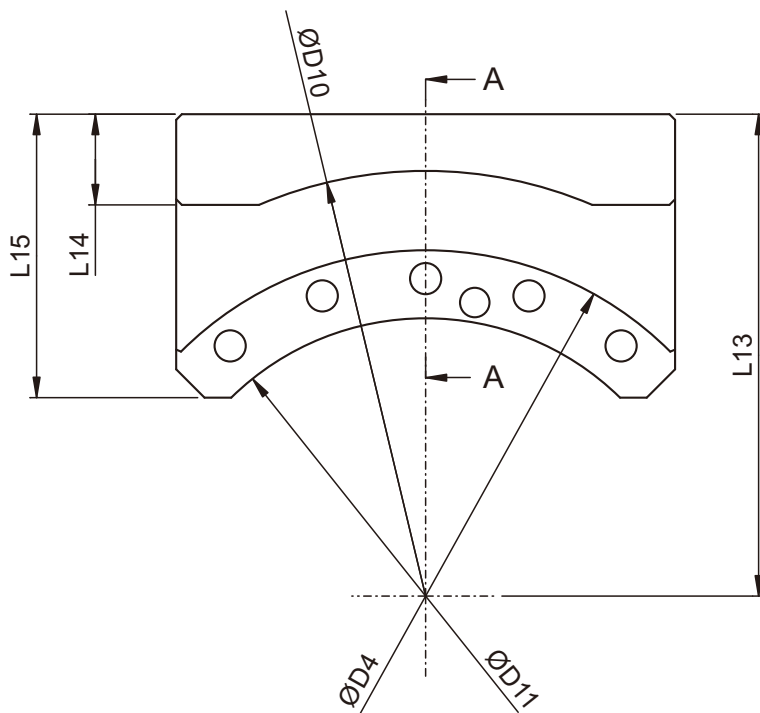
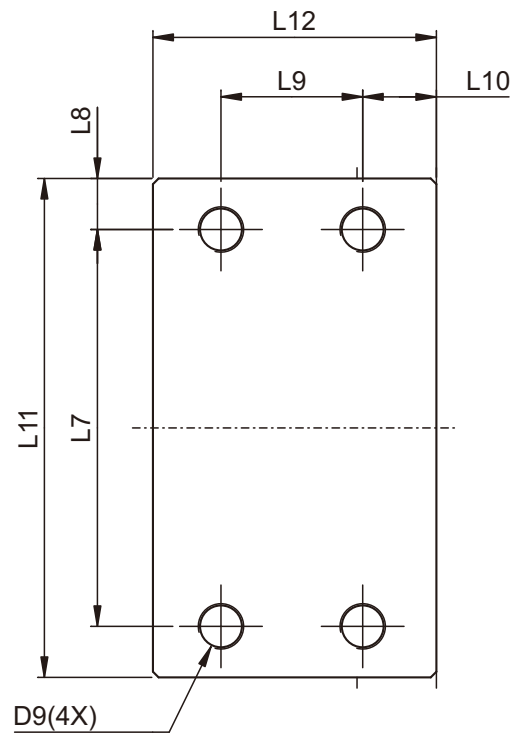
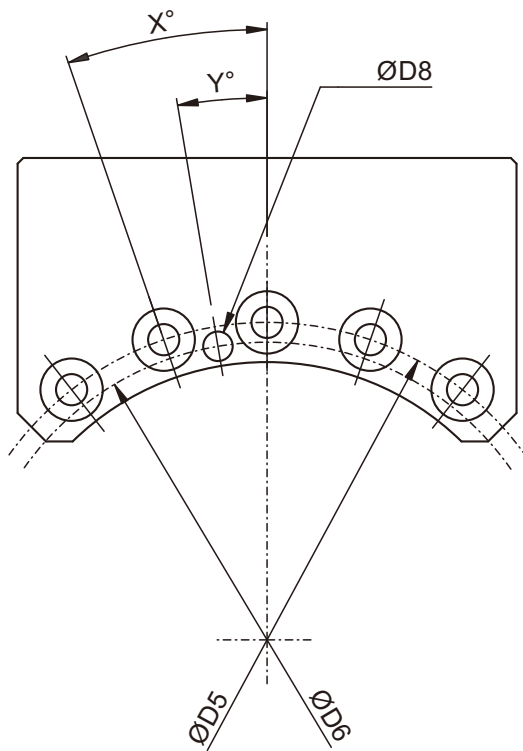
Dimension - GVR Gearbox



Dimension		GVR098	GVR130	GVR165
D1	h11	140	180	220
D2		75	95	110
D3		97	128	162
D4	g6	122	158	200
D5		112	148	185
D6		105	138.5	176.5
D7		M5x0.8Px8L	M6x1Px12L	M8x1.25Px16L
D8		5.2	6.4	9
L1		2	3	4
L2		8	12	16
L3		2	4.5	5
L4		35	48	60
L5		19	25.5	33
L6		40	53	64
X in Degree		19	18	19
Y in Degree		9.5	9	9.5

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

Base-Plate for Mounting - GV / GVR Gearbox

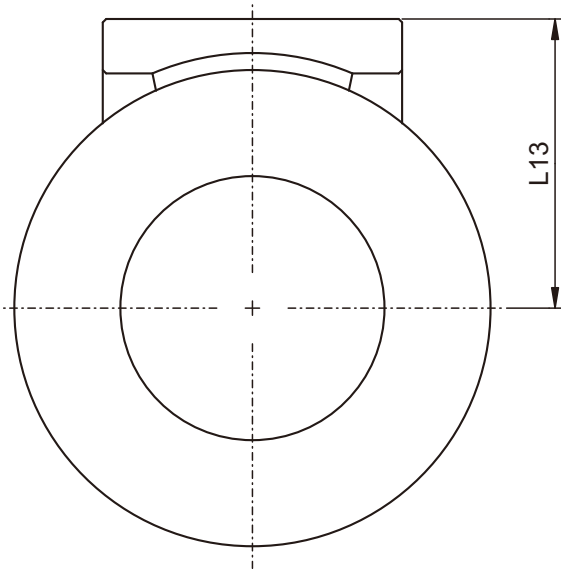


Base-Plate for Mounting - GV / GVR Gearbox

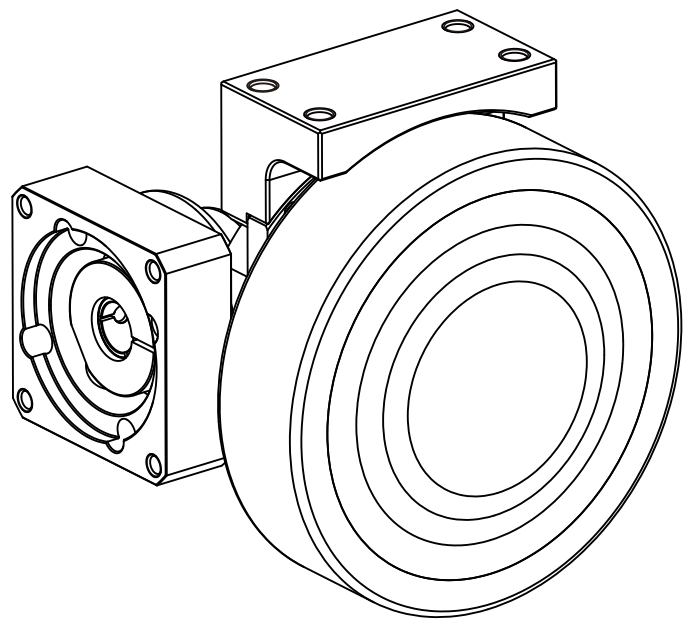
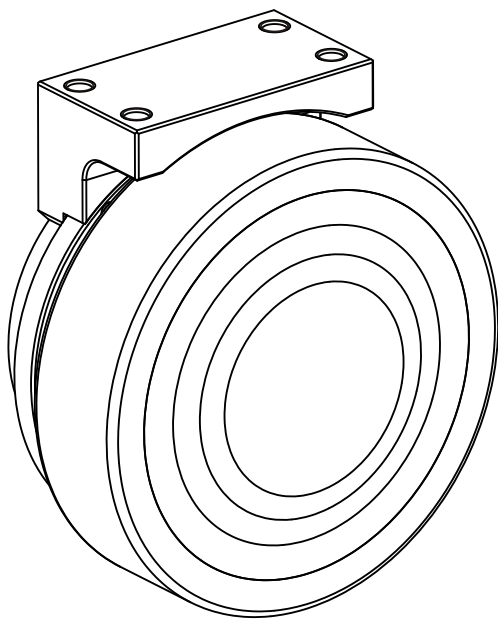
Dimension	GV098 / GVR098	GV130 / GVR130	GV165 / GVR165
D4 H7	122	158	200
D5	112	148	185
D6	105	138.5	176.5
D8	5.2	6.4	9
D9	M8x1.25x15L	M10x1.5Px18L	M12x1.75Px22L
D10	150	190	230
D11	98	130	163
D12	5.5	6.6	9
D13	11	14	17.5
L7	70	90	120
L8	9	10	11
L9	25	34	50
L10	13	13	15
L11	88	110	142
L12	50	60	80
L13	85	105	130
L14	16	20	25
L15	50	56	70
L16	4	4.5	8
L17	8	12	16
L18	14	16.5	22
X in Degree	19	18	19
Y in Degree	9.5	9	9.5

Ordering Example : BP - GV098

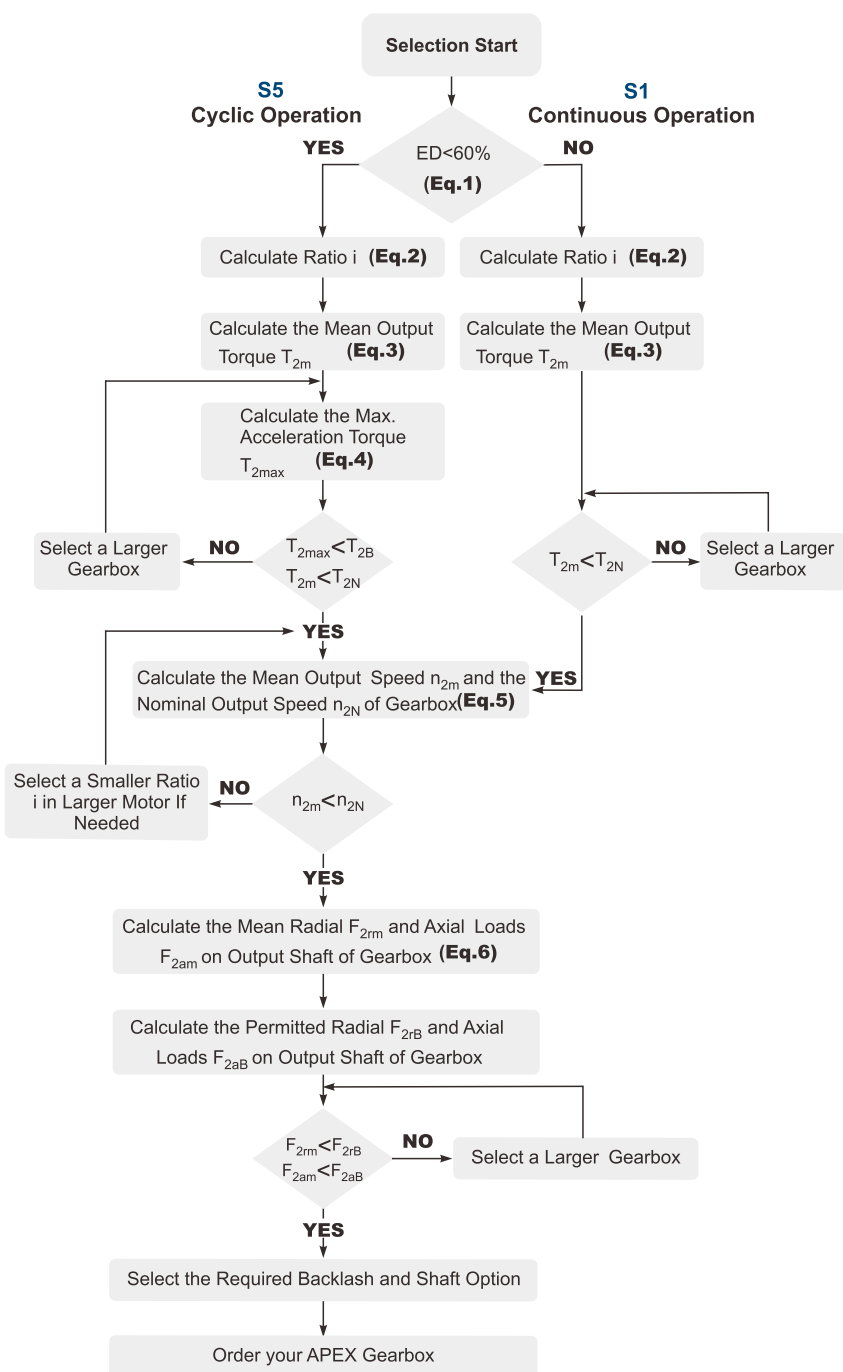
Base-Plate for Mounting - GV / GVR Gearbox



Dimension	GV098 / GVR098	GV130 / GVR130	GV165 / GVR165
L13	85	105	130



Selection of the optimum gearbox



Recommended (for S5 Cycle Operation)

The general design is given for

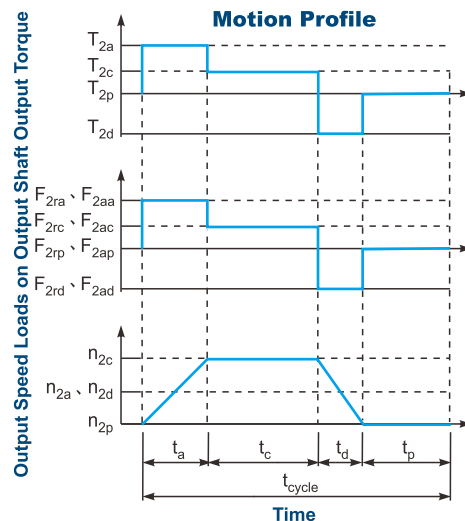
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

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)

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

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

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

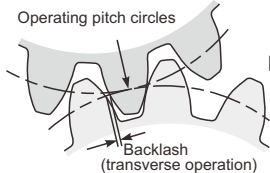
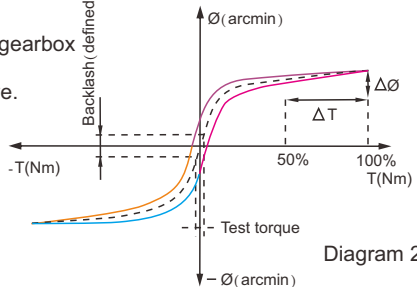
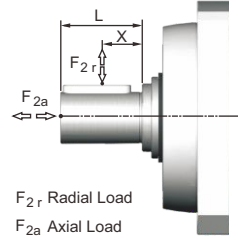
(Eq.5)

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

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

(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> 
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> 
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> 
Efficiency η	%	The transmission efficiency of the gears inside a gearbox (without friction).
Operating Temperature	°C	The Operating Temperature indicates the temperature of gearbox housing.
Degree of Protection		IP code stands for International Protection standard. The IP65 as example: the first IP number stands for protection degree against dust; the second IP number stands for protection against liquid.
Lubrication		APEX uses synthetic lubrication grease. Alternate greases are available, please contact APEX.
Running Noise	dB(A)	The Running Noise is measured depends on gearbox size, the ratio and the speed*. Higher speed usually induces higher noise level, while higher ratio induces lower noise level.
Moment of Inertia J_1	kg.cm ²	The Moment of Inertia J1 is a measurement of the effort applied to an object to maintain its momentary condition at rest or rotating.
Breakaway Torque	Nm	The Breakaway Torque is the minimum torque to start the rotation from the input side of gearbox. A smaller size or a higher ratio gearbox requests less Breakaway Torque.
Back Driving Torque	Nm	The Back Driving Torque is the minimum torque to start the rotation from the output side of gearbox. A larger size or a higher ratio gearbox requires greater Back Driving Torque.

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

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**APEX TAIWAN NORTH
ANDTEK AUTOMATION CO.,LTD**
TEL +886-02-82262655
13F-5, NO.2, Jian 8th Rd., Jhonghe Dist., New
Taipei City 235, TAIWAN
sales@andtek.com.tw
www.apexdyan.com



**APEX TAIWAN CENTRAL
ANDTEK AUTOMATION CO.,LTD**
TEL +886-04-23594286
9F-6, NO.325, Sec.4, Taiwan Blvd., Xitun Dist.
Taichung City 407, TAIWAN
sales@andtek.com.tw
www.apexdyan.com



**APEX TAIWAN SOUTH
MEN JENN ELECTRIC CO., LTD.**
TEL +886-06-2337332*6
NO.774, Zhonghua Rd., Yongkang Dist., Tainan
City 710, TAIWAN
menjenn@ms24.hinet.net
www.apexdyan.com



APEX TAIWAN INC. SHANGHAI
TEL +86-21-69220577
NO.128 ZHUYING Road QINGPU Industry Area,
Shanghai, CHINA
sales@apexdyna.cn
www.apexdyan.cn



APEX DYNAMICS SHENZHEN, LTD.
TEL +86-755-84516325
NO. 1102A of D area, CFG mansion, Bao Yuan
Road, Bao' an District, Shenzhen, CHINA.
sales@szapexdyna.com
www.szapexdyna.com



APEX DYNAMICS BEIJING, LTD.
TEL +86-10-69570691
NO. 1, Yao Ping Road, Song Zhuang Town, Tongzhou
District, Beijing, CHINA.
bjapexdyna@163.com
www.bjapex.cn



CHONGQING APEX DYNAMICS CO., LTD.
TEL +86-23-67686860
406, Building 5, NO. 68, Jinyu Avenue, Beibu New
Area, Chongqing, CHINA
sales@cqapexdyna.com
www.apexdyna.com



APEX (XIAMEN) DYNAMICS TECHNOLOGY CO., LTD.
TEL +86-0592-720-5279
Unit B-3, 1F., NO. 129, Jingquan Road, Jimei District,
Xiamen, Fujian, CHINA
sales@xmapexdyan.com
www.xmapexdyna.com



APEX DYNAMICS USA, INC.
TEL +1-631-2449040
885 Marconi Avenue Ronkonkoma, NY 11779
U.S.A.
sales@apexdynamicsusa.com
www.apexdynamicsusa.com



APEX DYNAMICS KOREA INC
TEL +82-31-8179992
7-5, Aenigol-gil, Ilsandong-gu, Goyang-si, Gyeonggi-do,
Republic of Korea 10301
sales@apexdynakorea.co.kr
www.apexdynakorea.co.kr



APEX DYNAMICS JAPAN
TEL +88-092-4511202
1-3-46, Hamnichibasi, Hakata-ku, Fukuoka,
812-0897, JAPAN
sales@apexdyna.jp
www.apexdyna.jp



APEX DYNAMICS SINGAPORE PTE LTD
TEL +65-626228
3 South Buona Vista Road, #05-15 & #06-15.
SINGAPORE 118136
sales@apexdyna.com.sg
www.apexdyna.com.sg



APEX DYNAMICS (THAILAND) CO., LTD.
TEL +66-2-1812317
87 Soi Ladkrabang 30, Ladkrabang, Ladkrabang,
Bangkok 10520, Thailand
Apexthai2010@gmail.com
www.apexdyna.co.th



APEX DYNAMICS BV
TEL +31-492-509995
Churchillaan 101 5705 BK Helmond, NETHERLANDS
sales@apexdyna.nl
www.apexdyna.be



**APEX DYNAMICS
POLSKA SP. Z O.O.**
TEL +48-12-6304728
Ul. Krakowska 50, 32-083 Balice, Poland
sales@apexdyna.pl
www.apexdyna.pl



APEX DYNAMICS SPAIN, S.L.
TEL +34-93-6562990
Carrereta Laureà Miró, 407
08980 - Sant Feliu de Llobregat, Barcelona, SPAIN
apexdyna@apexdyna.es
www.apexdyna.es



Big Diamond Trading Company LLC
TEL +968-94268885
2nd floor, Regus, Tamimah building, Al
Wattayah, Muscat, Oman
ar.gorji@diamondtradings.com



APEKS DINAMIK REDUKTOR DISLI SAN TIC AS
TEL +90-232-4589960
10053 SOKAK NO: 9 A.O.S.B. CIGLI -IZMIR -TURKEY
sales@apexdyna.com.tr
www.apexdyna.com.tr



APEX DYNAMICS AUSTRALIA PTY LTD.
TEL +613-95-852739
36 Taunton Drive, Cheltenham, Victoria 3192
AUSTRALIA.
sales@apexdyna.com.au
www.apexdyna.com.au



APEX DYNAMICS (I) JV
TEL +91-9607927142
Shop No. 02, S. No. 100/5, Pune-Satara Highway,
Ambegaon Khurd, Pune-411046 Maharashtra, India
sales@apexdyna.co.in
www.apexdyna.co.in



APEX DYNAMICS FRANCE SAS
TEL +33-160-135097
11 - Burospace - 91570 - Bièvres, France
info@apexdyna.fr
www.apexdyna.fr



APEX DYNAMICS SWEDEN AB
TEL +46-75-242444
Fredrikbergsgatan 2 SE-573 92 Tranås, SWEDEN
sales@apexdyna.se
www.apexdyna.se



PT.APEX DYNAMICS INDONESIA
TEL +62 21 2928 3681
Rukan Aralia Blok HY43 no.11, Harapan Indah II,
Bekasi - Jawa Barat, INDONESIA 17214
sales@apexdyna.co.id
www.apexdyna.co.id



APEX DYNAMICS GERMANY GMBH
TEL +49-7171 798069-0
Marie-Curie-Straße 25 D-73529 Schwäbisch Gmünd
werner.langer@apexdynamics.de
www.apexdynamics.de



APEX DYNAMICS CZECH S.R.O.
TEL +420-577-663877
tř. Tomáše Bati 1851 765 02 Otrokovice Česká
REPUBLIKA
info@apexdynaczech.cz
www.apexdynaczech.cz



APEX DYNAMICS РОССИЯ
TEL +7-495-2255452
TEL +7-495-6462422
г.Москва, ул. Южнопортовая, дом 7, строение
"С", 3-й этаж
info@apexdynarussia.ru
www.apexdynarussia.ru



APEX DYNAMICS MIDLANDS LTD
TEL +44-0121-737-1170
Heath House, Cheadle RD, Uttoxeter,
ST14 7BY, UK
mikeg@apexdynauk.com
www.apexdynauk.com



APEX DYNAMICS SWITZERLAND AG
TEL +41-55-4517020
Obergasse 40, CH-8854 Galgenen, Switzerland
info@apexdyna.ch
www.apexdyna.ch



APEX DYNAMICS MOTION (M) SDN BHD
TEL +60 7267 4228
Block A1-2, #35-03, Mercu 1 Jalan Tanjung Puteri 1,
R & F Tanjung Puteri, Johor Bahru 80300, Johor.
sales@apexdyna.com.sg
www.apexdyna.com.sg



APEX DYNAMICS BRAZIL
TEL +55-47-30298700
Rua Senador Petrônio Portela, 47-Bloco 5, Zona
Industrial Norte-CEP 89218-575-Joinville (SC)
lucan@neoyama.com.br
adriano.duarte@neoyama.com.br
www.neoyama.com.br



APEX DYNAMICS ITALY SRL
TEL +39 02 36634521
VIA E. DE AMICIS, 2-20091 BRESSO (MI)
info@apexdynamics.it
www.apexdynamics.it



APEX DYNAMICS AUSTRIA GmbH
TEL +43 720788416
Dr. Hans-Lechner-Strasse 6,
5071 Wals-Siezenheim
info@apexdynamics.at
www.apexdynamics.at



UAB " APEX DYNAMICS "
TEL +370 52078165
Medaus g. 28A,
Medininku k., Vilniaus r. Sav.
LT-13192
info@apexdyna.lt
www.apexdyna.lt



APEX DYNAMICS DENMARK
TEL +45 73121260
Grundtvigs Allé 165, 6400
Sønderborg, Denmark
sales@apexdyna.dk
www.apexdyna.dk



APEX DYNAMICS ISRAEL
TEL +972-3-6470471
17 Hamefalsim St., Kiryat Arye,
Petach-Tikva 4951447
Sales@apexdynamics.co.il
www.apexdynamics.co.il



APEX DYNAMICS SLOVAKIA S.R.O.
TEL +421919400476
Trenčianska cesta 887/52, 957 01
Bánovce nad Bebravou, Slovak republic
office@apexdyna.sk
www.apexdyna.sk



APEX DYNAMICS, INC.

No10. Keyuan 3rd RD.Situn District, Taichung City 40763, Taiwan (R.O.C)
Tel:886-4-24650219 | Fax:886-4-24650118
sales@apexdyna.com | <http://www.apexdyna.com>

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APEX DYNAMICS VIETNAM TRADING SERVICES CO., LTD
TEL +84-028-35350628
267 Duong so 7, P. Binh Tri Dong B, Q, Binh Tan,
Thanh pho Ho Chi Minh,Vietnam
Sales@apexdyna.vn
www.apexdyna.vn

