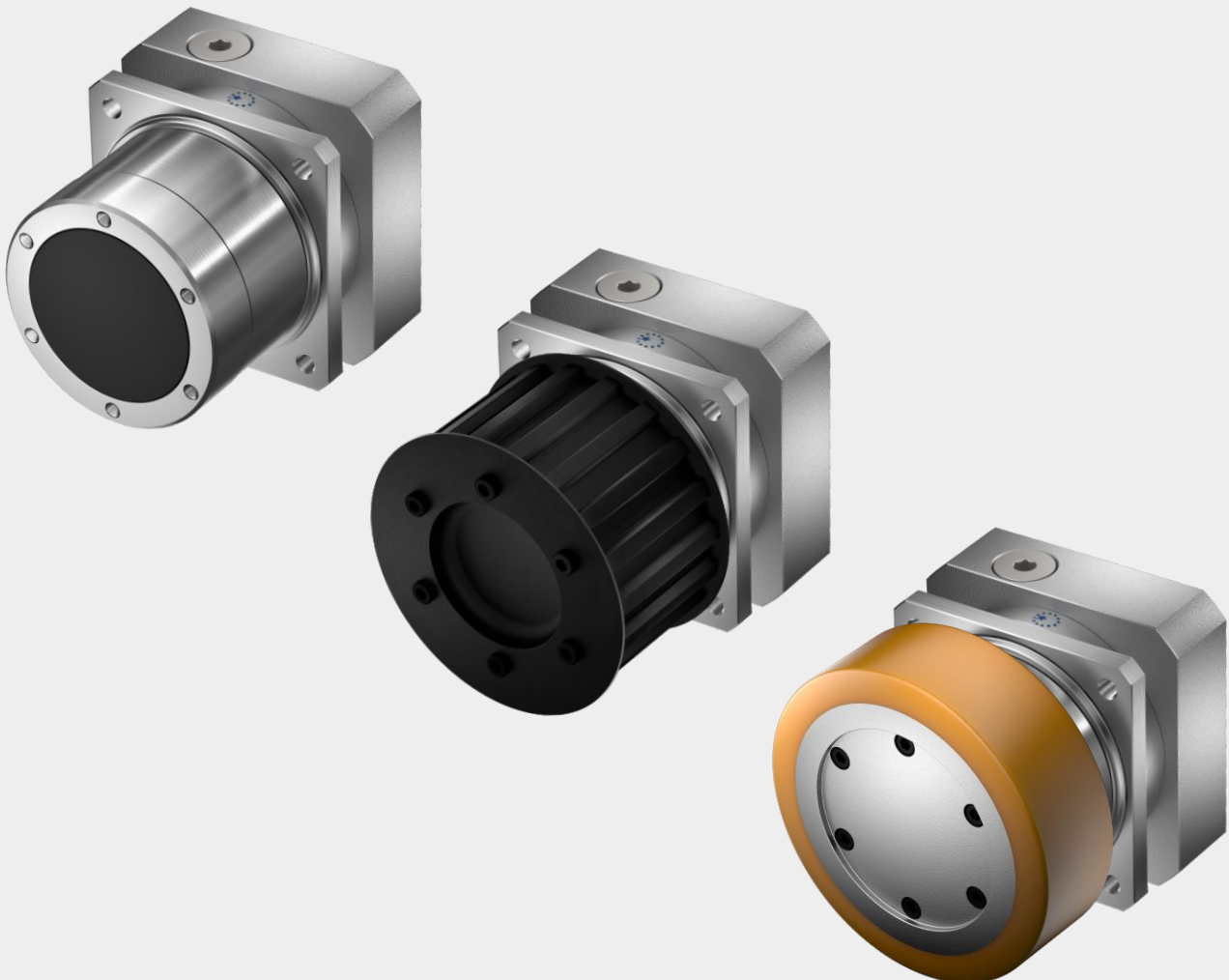




**APEX DYNAMICS, INC.**

**NEW GENERATION  
PLANETARY GEARBOX**

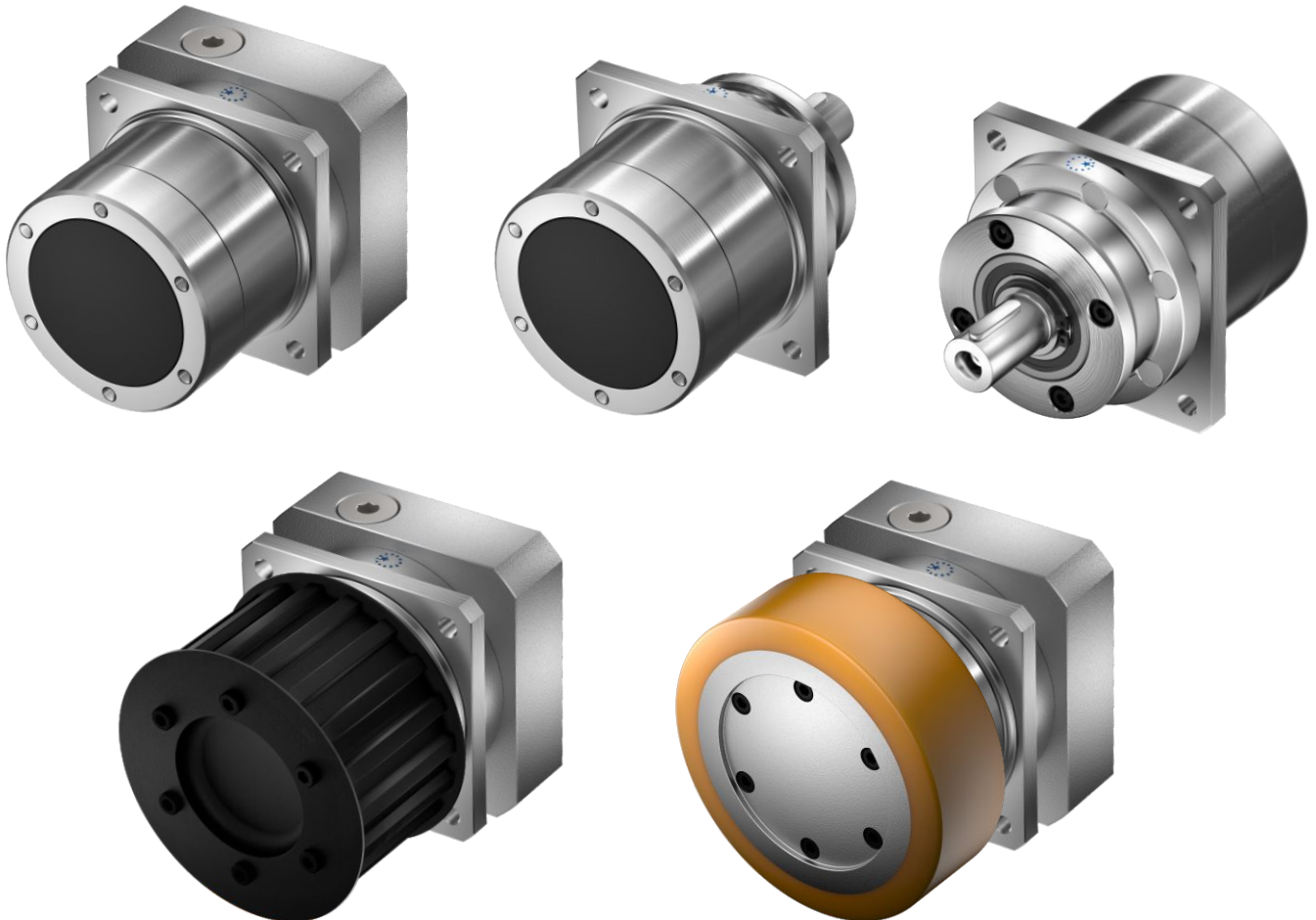
**GL / GLS - SERIES**



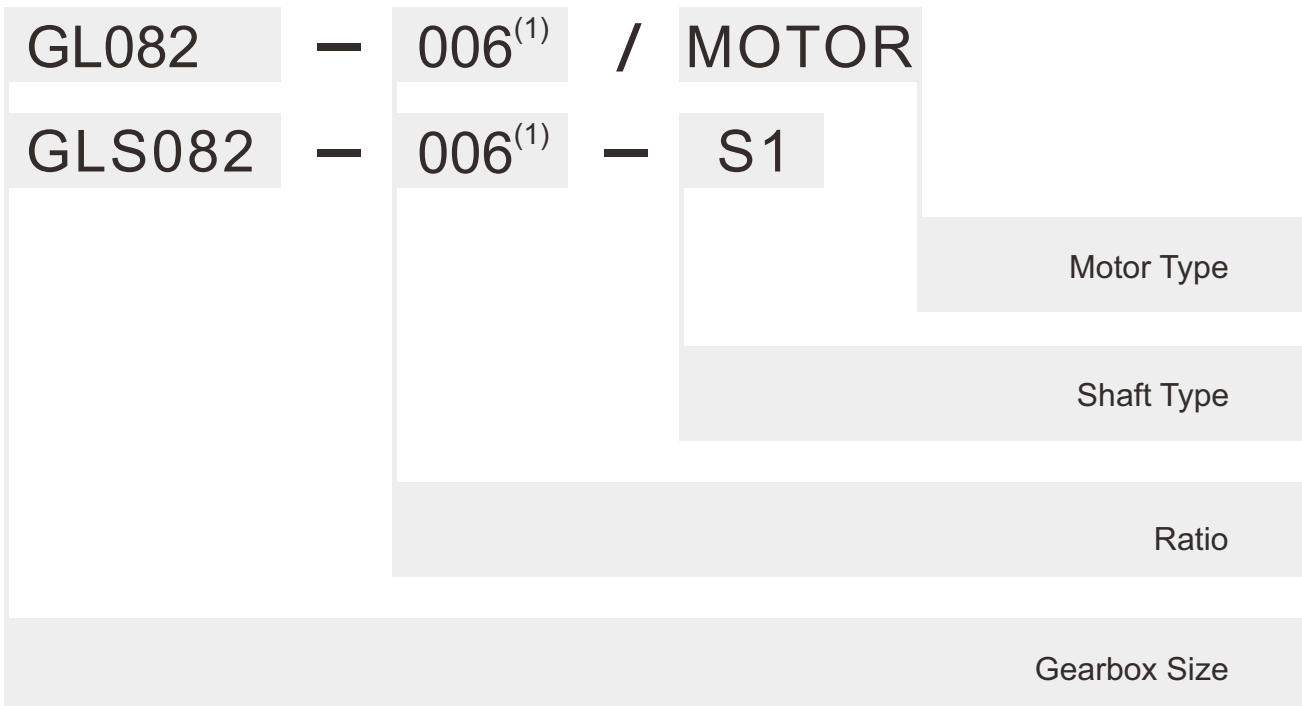
## Gearbox Series - GL

### ► Features:

- High radial load
- Rotating housing
- High efficiency
- Low noise
- Reduced backlash
- Optimized Inertia moment
- Limited temperature rise
- Long service life
- Optimized output torque



# Ordering Code - GL / GLS Gearbox



GLS is the GL version with option input “SHAFT” instead of input “HUB”

For blackening as option on the housing and flange, please contact APEX

#### Gearbox Size

GL 082 / 100 / 132  
GLS 082 / 100 / 132

#### Ratio<sup>(2)</sup>

GL 2 / 3 / 4 / 6 / 9  
10 / 15 / 20 / 24 / 30 / 36 / 40 / 45 / 60 / 90  
GLS 3 / 4 / 6 / 9  
10 / 15 / 20 / 24 / 30 / 36 / 40 / 45 / 60 / 90

Shaft Type : S1 = Smooth Input Shaft  
S2 = Input Shaft with Key

Motor Type  
Manufacturer and Model

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

(2) Please refer to the specifications for the ratios provided in each series.



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# Performance - GL Gearbox

| Model No.                                   |           | Stage | Ratio <sup>(1)</sup> | GL082                        | GL100     | GL132     |
|---|-----------|-------|----------------------|------------------------------|-----------|-----------|
| Nominal Output Torque $T_{2N}$              | Nm        | 1     | 2                    | 60                           | 102       | 280       |
|   |           |       | 3                    | 90                           | 155       | 355       |
|   |           |       | 4                    | 83                           | 168       | 308       |
|   |           |       | 6                    | 54                           | 115       | 252       |
|   |           |       | 9                    | 21                           | 50        | 145       |
|   |           | 2     | 10                   | 60                           | 102       | 280       |
|   |           |       | 15                   | 90                           | 155       | 355       |
|   |           |       | 20                   | 83                           | 168       | 308       |
|   |           |       | 24                   | 54                           | 115       | 252       |
|   |           |       | 30                   | 54                           | 115       | 252       |
|   |           |       | 36                   | 21                           | 50        | 145       |
|   |           |       | 40                   | 53                           | 96        | 229       |
|   |           |       | 45                   | 21                           | 50        | 145       |
|   |           |       | 60                   | 54                           | 115       | 252       |
|   |           |       | 90                   | 21                           | 50        | 145       |
| Emergency Stop Torque $T_{2NOT}$            | Nm        | 1,2   | 2~90                 | 3 times $T_{2N}$             |           |           |
| Max. Acceleration Torque $T_{2B}$           | Nm        | 1,2   | 2~90                 | 1.5 times $T_{2N}$           |           |           |
| No Load Running Torque <sup>(2)</sup>       | Nm        | 1     | 2~9                  | 0.45                         | 0.7       | 1.4       |
|   |           | 2     | 10~90                | 0.2                          | 0.3       | 0.6       |
| Backlash <sup>(3)</sup>                     | arcmin    | 1     | 2~9                  | $\leq 3$                     | $\leq 3$  | $\leq 3$  |
|   |           | 2     | 10~90                | $\leq 5$                     | $\leq 5$  | $\leq 5$  |
| Torsional Rigidity                          | Nm/arcmin | 1,2   | 2~90                 | 8                            | 22        | 60        |
| Nominal Input Speed $n_{1N}$                | rpm       | 1     | 2~9                  | 5,000                        | 3,600     | 3,600     |
|   |           | 2     | 10~90                | 5,000                        | 4,600     | 4,600     |
| Max. Input Speed $n_{1B}$                   | rpm       | 1     | 2~9                  | 7,000                        | 6,000     | 6,000     |
|   |           | 2     | 10~90                | 7,000                        | 7,000     | 7,000     |
| Max. Radial Load $F_{2r}$ <sup>(4)</sup>    | N         | 1,2   | 2~90                 | 2,860                        | 3,400     | 7,200     |
| Max. Axial Load $F_{2a}$ <sup>(4)</sup>     | N         | 1,2   | 2~90                 | 1,430                        | 1,700     | 3,600     |
| Max. Tilting Moment $M_{2k}$ <sup>(4)</sup> | Nm        | 1,2   | 2~90                 | 117                          | 155       | 452       |
| Operating Temp                              | °C        | 1,2   | 2~90                 | -10° C ~ 90° C               |           |           |
| Degree of Gearbox Protection                |           | 1,2   | 2~90                 | IP65                         |           |           |
| Lubrication                                 |           | 1,2   | 2~90                 | Synthetic lubrication grease |           |           |
| Mounting Position                           |           | 1,2   | 2~90                 | All directions               |           |           |
| Running Noise <sup>(2)</sup>                | dB(A)     | 1     | 2~9                  | $\leq 58$                    | $\leq 59$ | $\leq 64$ |
|   |           | 2     | 10~90                | $\leq 58$                    | $\leq 59$ | $\leq 60$ |
| Efficiency $\eta$                           | %         | 1     | 2~9                  | $\geq 97\%$                  |           |           |
|   |           | 2     | 10~90                | $\geq 94\%$                  |           |           |

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

(2) The dB values are measured by gearbox with ratio 9 (1-stage) or ratio 90(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 noise level could be 3 to 5 dB(A) 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.

(5) Continuous operation is not recommended.

# Inertia - GL Gearbox

| Model No.        | GL082    |          | GL100    |          | GL132    |          |
|------------------|----------|----------|----------|----------|----------|----------|
| ∅ <sup>(A)</sup> | 1-stage. | 2-stage. | 1-stage. | 2-stage. | 1-stage. | 2-stage. |
| 8                | -        | 0.1      | -        | -        | -        | -        |
| 11               | 0.21     | 0.16     | -        | 0.17     | -        | -        |
| 14               | 0.24     | 0.2      | 0.54     | 0.21     | -        | 0.42     |
| 19               | 0.64     | -        | 0.79     | 0.6      | 2.51     | 0.66     |
| 24               | -        | -        | 4.06     | -        | 4.78     | 3.94     |
| 28               | -        | -        | -        | -        | 6.15     | -        |
| 32               | -        | -        | -        | -        | 8.03     | -        |
| 35               | -        | -        | -        | -        | 14.72    | -        |
| 38               | -        | -        | -        | -        | 17.38    | -        |
| 42               | -        | -        | -        | -        | -        | -        |
| 48               | -        | -        | -        | -        | -        | -        |

(A) ∅ = Input shaft diameter.

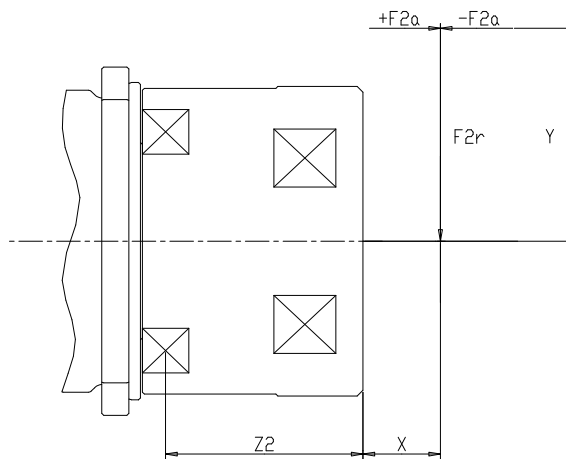


Fig.1

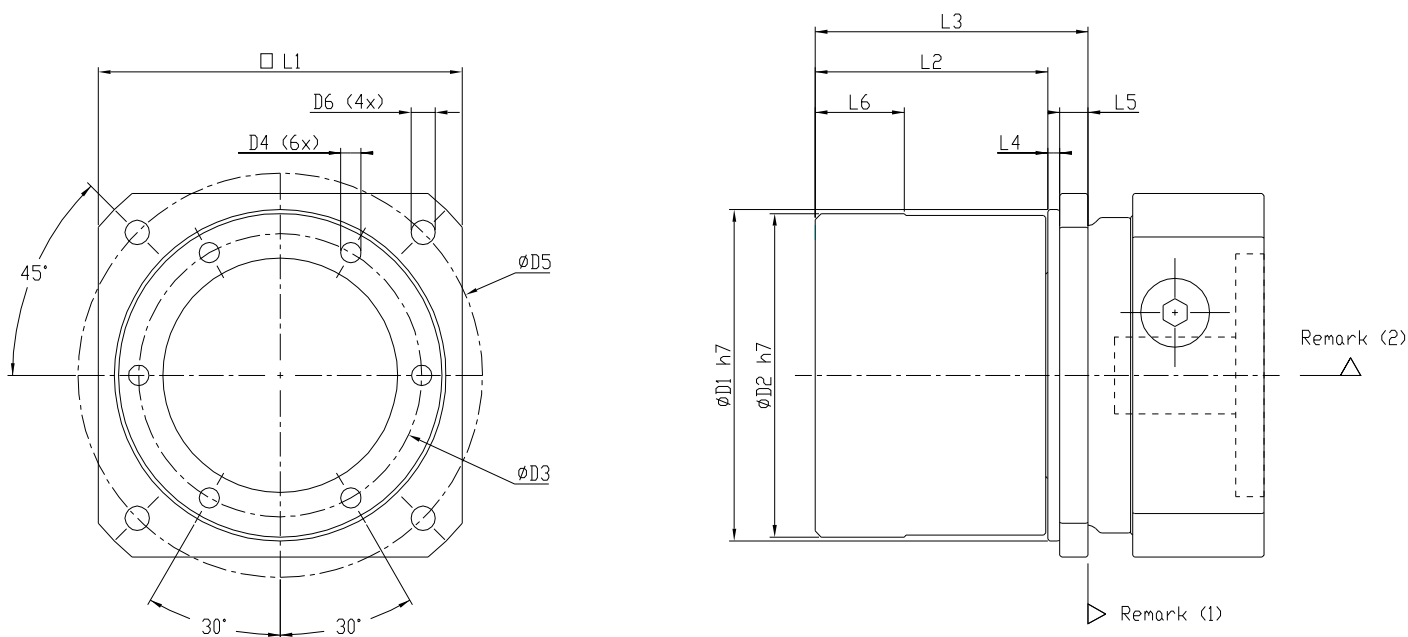
$$\text{Max. Tilting Moment } M_{2K} = \frac{F_{2a} * Y + F_{2r} * (X + Z2)}{1000}$$

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

| GL      | 082 | 100 | 132  |
|---------|-----|-----|------|
| Z2 [mm] | 51  | 57  | 78.5 |

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

# Dimension - GL Gearbox

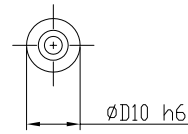
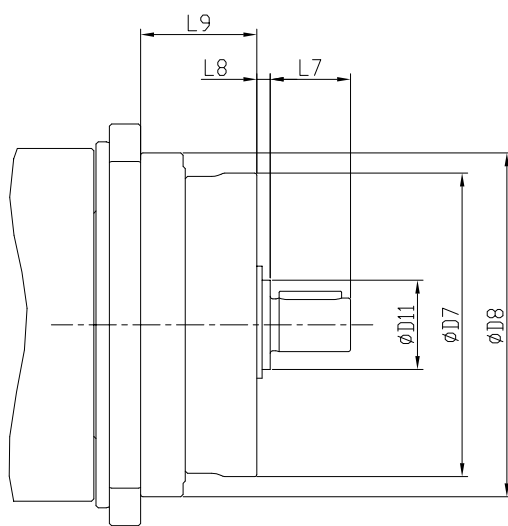


| Dimension         | GL082     | GL100    | GL132         |
|-------------------|-----------|----------|---------------|
| D1 h7             | 82        | 100      | 132           |
| D2 h7             | 80        | 96       | 128           |
| D3                | 70        | 84       | 114           |
| D4 x Pitch x Deep | M5x0.8Px8 | M6x1Px10 | M8x1.25Px12.5 |
| D5                | 100       | 122      | 166           |
| D6                | M6x1P     | M8x1.25P | M10x1.5P      |
| L1                | 90        | 108      | 140           |
| L2                | 57.5      | 62.5     | 85.5          |
| L3                | 67.5      | 75.5     | 101.5         |
| L4                | 3         | 3.5      | 4             |
| L5                | 7         | 9.5      | 12            |
| L6                | 22        | 24       | 34            |

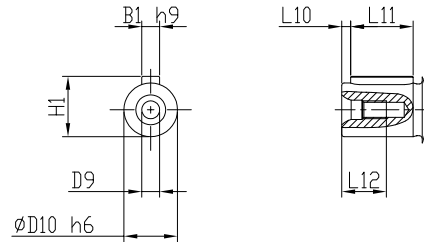
(1) Dimensions are related to motor interface. Please contact APEX for details.

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

# Dimension - GLS (Input Shaft as Option)



Shaft Option S1



Shaft Option S2

| Dimension | Stage | GLS082  | GLS100   | GLS132   |
|-----------|-------|---------|----------|----------|
| D7        | 1     | 68      | 84       | 93       |
|           | 2     | 60      | 68       | 84       |
| D8        | 1,2   | 77      | 100      | 136      |
| D9        | 1     | M4x0.7P | M8x1.25P | M10x1.5P |
|           | 2     | M3x0.5P | M4x0.7P  | M8x1.25P |
| D10 h6    | 1     | 12      | 22       | 28       |
|           | 2     | 10      | 12       | 22       |
| D11       | 1     | 20      | 28       | 35       |
|           | 2     | 17      | 20       | 28       |
| L7        | 1     | 18      | 36       | 42       |
|           | 2     | 15      | 18       | 36       |
| L8        | 1     | 3       | 3        | 4        |
|           | 2     | 3       | 3        | 3        |
| L9        | 1     | 26      | 38       | 45.5     |
|           | 2     | 44.5    | 54       | 67.5     |
| L10       | 1     | 2       | 3        | 5        |
|           | 2     | 2       | 2        | 3        |
| L11       | 1     | 14      | 28       | 32       |
|           | 2     | 10      | 14       | 28       |
| L12       | 1     | 10      | 19       | 22       |
|           | 2     | 9       | 10       | 19       |
| B1 h9     | 1     | 4       | 6        | 8        |
|           | 2     | 3       | 4        | 6        |
| H1        | 1     | 13.5    | 24.5     | 31       |
|           | 2     | 11.2    | 13.5     | 24.5     |

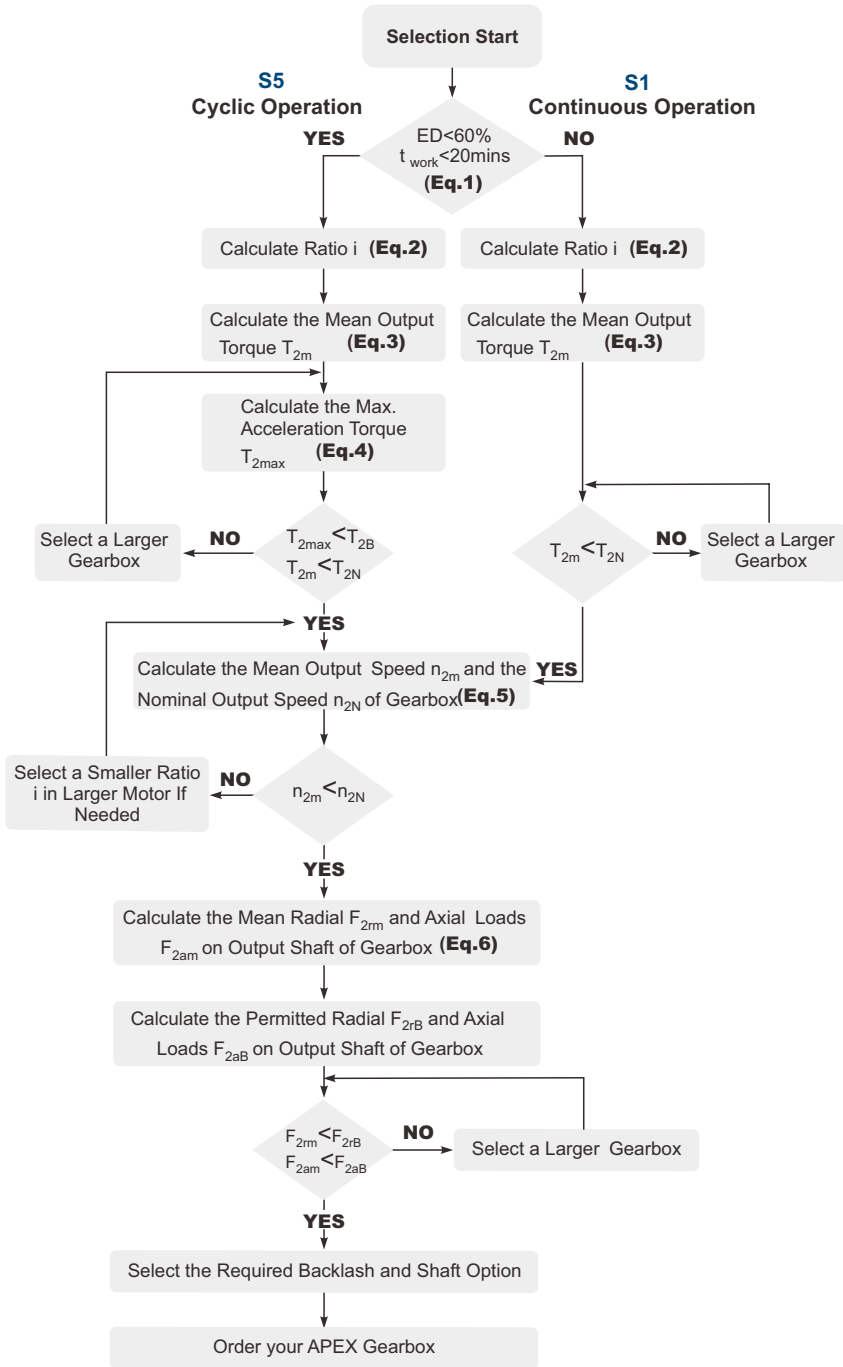
# Performance - GLS (Input Shaft as Option)

| Model No.                                 | Stage              | Ratio <sup>(1)</sup> | GLS082 | GLS100 | GLS132 |
|---|--------------------|----------------------|--------|--------|--------|
| Max. Radial Load $F_{1rB}$ <sup>(2)</sup> | N                  | 1                    | 460    | 600    | 800    |
|   |                    | 2                    | 275    | 460    | 600    |
| Max. Axial Load $F_{1aB}$ <sup>(2)</sup>  | N                  | 1                    | 230    | 300    | 400    |
|   |                    | 2                    | 137    | 230    | 300    |
| Moment of Inertia                         | kg.cm <sup>2</sup> | 1                    | 0.19   | 0.62   | 1.78   |
|   |                    | 2                    | 0.06   | 0.19   | 0.62   |

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

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

# Selection of the optimum gearbox



**Recommended (for S5 Cycle Operation)**

The general design is given for

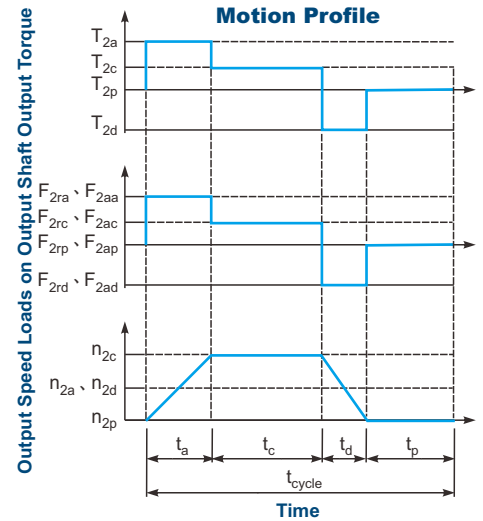
$$\frac{J_L}{i^2} \leq 4 \times J_m$$

The optimal design is given for

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

$J_L$  Load Inertia

$J_m$  Motor Inertia



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

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

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

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

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

**(Eq.3)**

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

where  $K_s$  is

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

$T_{mB}$  Max. Output Torque of the Motor

$\eta$  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)**

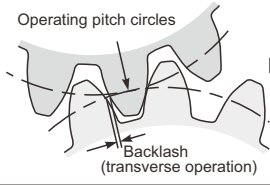
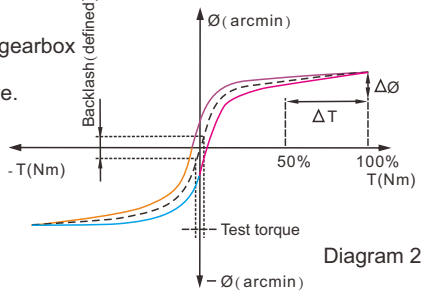
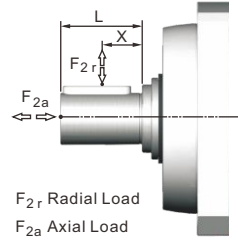
$$6. F_{2rm} = 3 \sqrt{\frac{n_{2a} \times t_a \times F_{2ra}^3 + n_{2c} \times t_c \times F_{2rc}^3 + n_{2d} \times t_d \times F_{2rd}^3}{n_{2a} \times t_a + n_{2c} \times t_c + n_{2d} \times t_d}}$$

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

**(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>   |
| 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<br/>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>  |
| 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 $\eta$                 | %                  | 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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**APEX-2020-10-GL / GLS Series - 1.0**

Printed in Taiwan

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