Electric actuator
Motor specification

FGRC

Rotary Type

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FGRC System Table

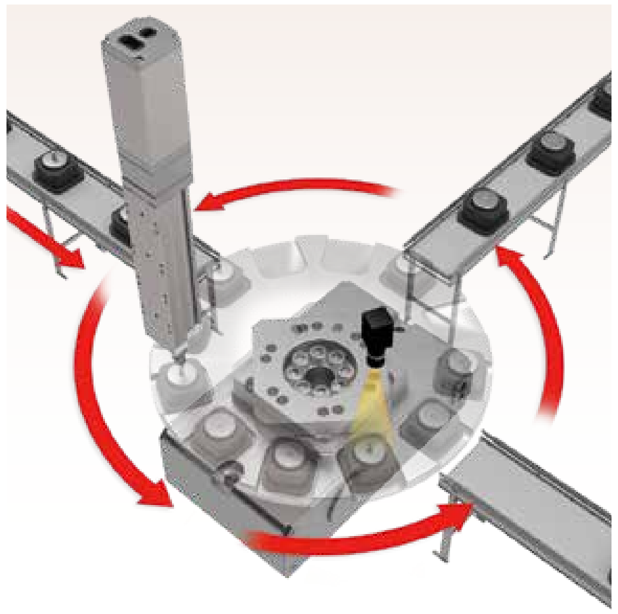
Model No.	Motor Size	Max. Torque (N·m)	Max. Angular Velocity (deg/s)
FGRC-10	□20	0.89	200
FGRC-30	□25	2.71	
FGRC-50	□35	4.66	

Rotary FGRC Series

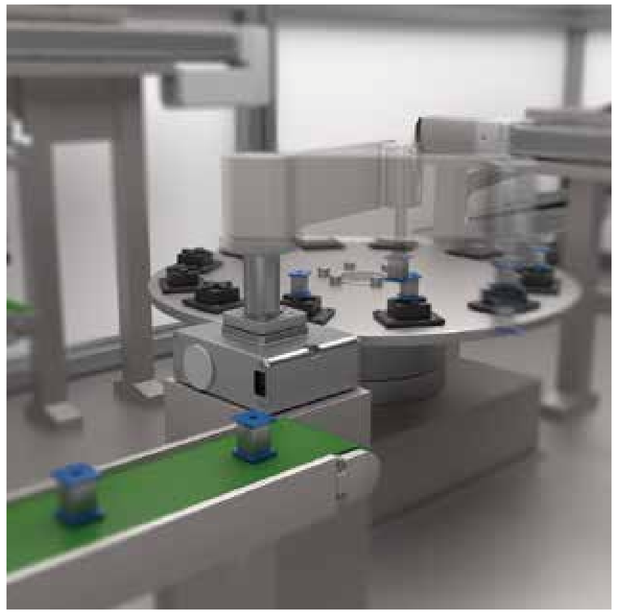
For indexing operations and workpiece reversal

Application examples

Indexing operation to each position, such as assembly and simple inspection processes.



Also for oscillating applications that transfer workpieces.

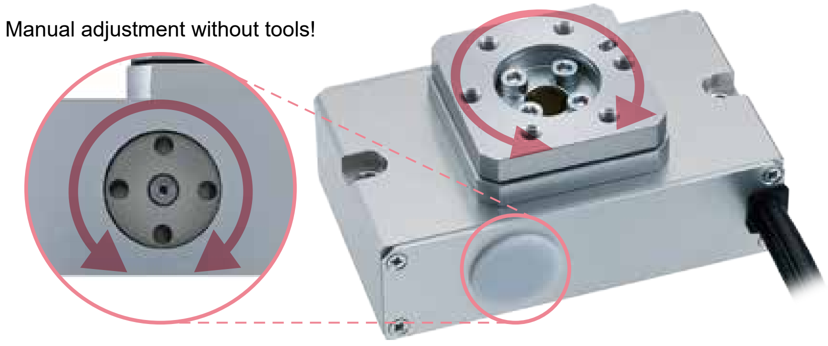


Easy maintenance

Manual operation and self-locking mechanisms

Equipped with a manual operation mechanism that can be operated without tools.
The position of the rotary table held by the self-lock can be adjusted.

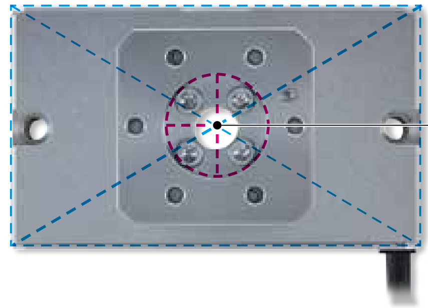
Manual adjustment without tools!



Reduced design

Coaxial design

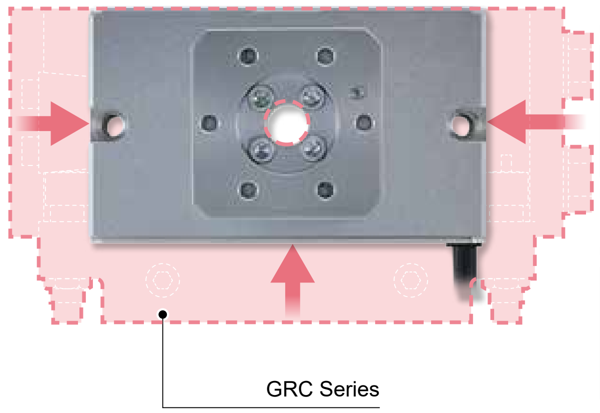
Since the center of the rotating part and the center of the actuator body are coaxial, layout conception is easy.



Space saving

Compact body

Since FGRC performs acceleration/deceleration operations, installation of a shock absorber is not necessary.



Maintenance parts
Reduced

Footprint
Up to 35% Reduced!

F Series
FLCR
FGRC
FLSH
FFLD
Ending

Electric Actuator Rotary Type

FGRC-10

□20 Stepping motor

CE UK CA RoHS

For compatible detailed model Nos., please visit the CKD website.

Model No. Notation Method

FGRC - 10 G 360 N C N - F S03

❶ Size

❶Size
10

❷Supported controllers*1	
G	ECMG/ECG-B
Blank	ECR

❸Encoder	
C	Incremental Encoder

❹Relay cable	*2
N00	None
S01	Fixing cable 1 m
S03	Fixing cable 3 m
S05	Fixing cable 5 m
S10	Fixing cable 10 m
R01	Movable cable 1 m
R03	Movable cable 3 m
R05	Movable cable 5 m
R10	Movable cable 10 m

*1 Select the controller from page 529.

* 2 For Dimensions diagram of the relay cable, refer to page 607 for ECR or page 592 for ECMG/ECG.

Specifications

Connected Controller	ECMG, ECG-B, ECR
Motor	□20 Stepping motor
Encoder Type	Incremental Encoder
Drive Method	Worm gear + belt
Travel angle *1	360
Max. output torque *2 N·m	0.89
Repeatability deg	±0.05
Backlash *3 deg	±0.3
Lost motion deg	0.3 or less
Operation angular speed range deg/s	20 to 200
Pressing operation angular speed range deg/s	20 to 30
Allowable moment of inertia *2 kg·m²	0.0057
Allowable thrust load N	80
Allowable radial load N	80
Allowable moment N·m	2.5
Motor power supply voltage *4	24 VDC ±10% or 48 VDC ±10%
Insulation resistance	10 MΩ, 500 VDC
Dielectric Strength	500 VAC for 1 minute
Operating Ambient Temperature, Humidity	0 to 40°C (no freezing) 35 to 80% RH (no condensation)
Storage Ambient Temperature, Humidity	-10 to 50°C (no freezing) 35 to 80% RH (no condensation)
Atmosphere	No corrosive gas, explosive gas, or dust
Protection Structure	IP40
Weight kg	0.65

*1 The angle that can be moved with the move command is 359.9 degrees.

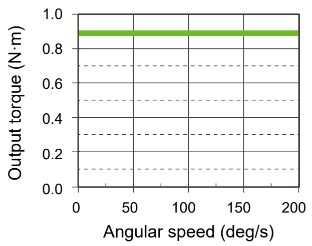
*2 Rotation torque and allowable moment of inertia vary depending on the angular speed and angular acceleration/deceleration. Refer to the table at right for details.

*3 When stopping precision is required, use an external stopper, etc., and complete positioning with pressing operation.

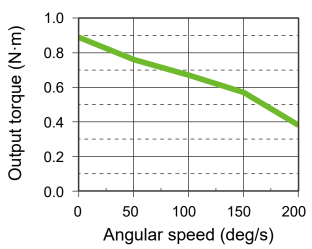
*4 48 VDC is only compatible with Controllers ECR.

Angular velocity and output torque

[At 48 VDC]

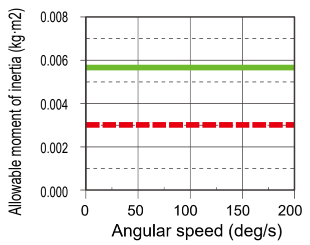


[At 24 VDC]

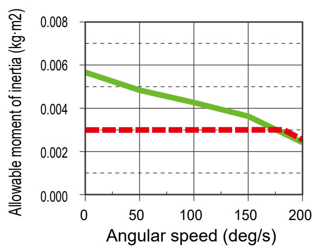


Angular velocity and allowable moment of inertia

[At 48 VDC]

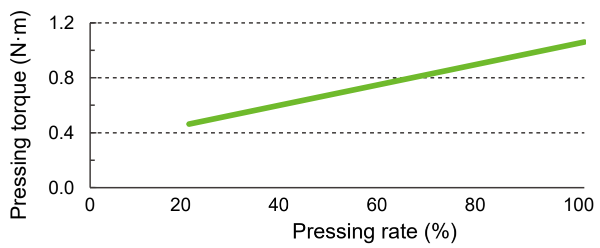


[At 24 VDC]



* If the angular acceleration/deceleration is 1700 deg/s² and over, use with a stroke less than the broken line.

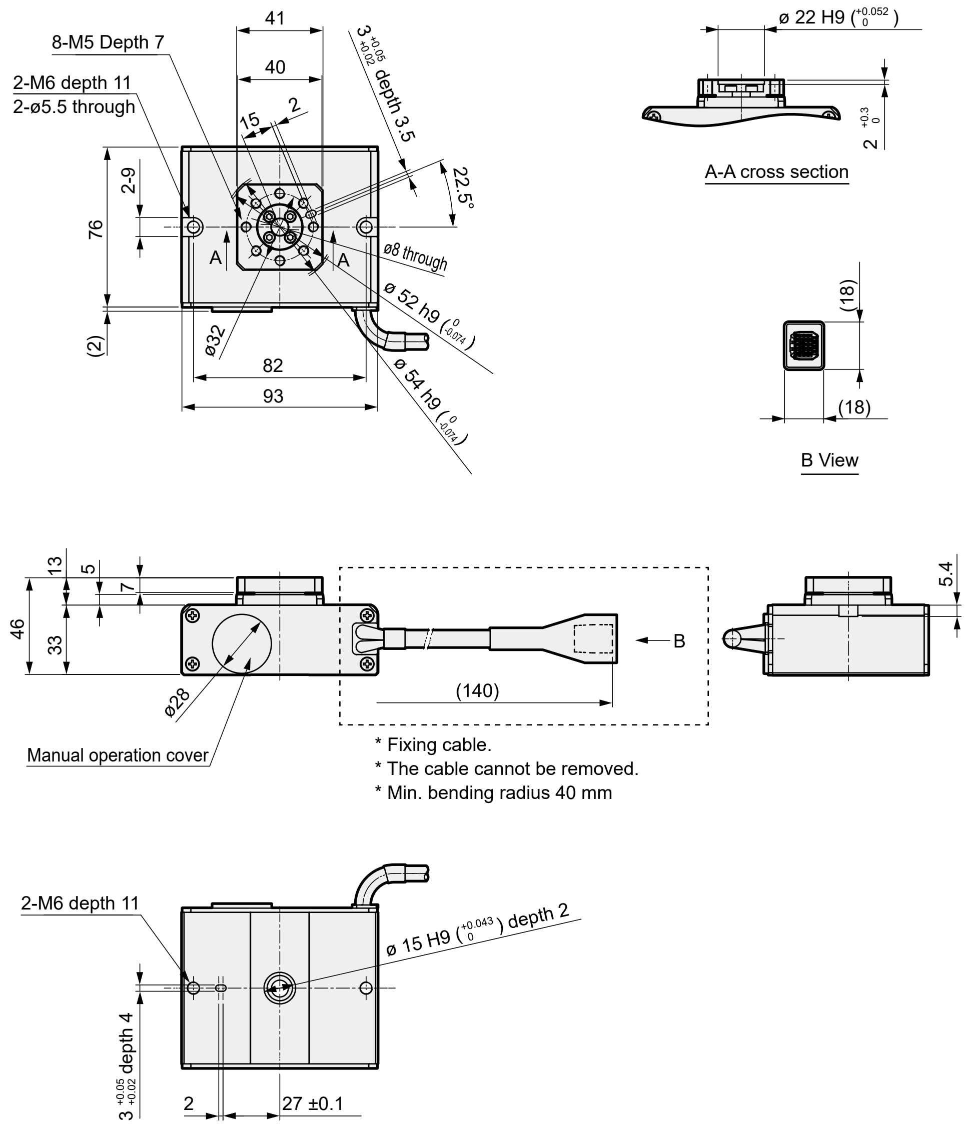
Pushing Torque



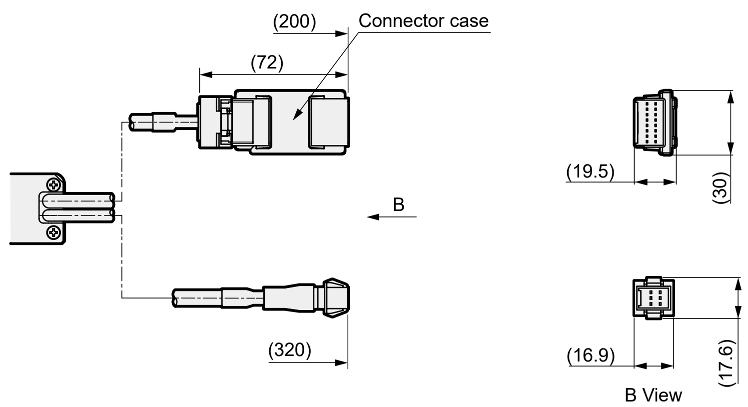
* The pressing torque and pressing rate indicate a guideline. Even with the same pushing rate, errors will occur with the actual numbers due to individual differences in motors and variations in mechanical efficiency.

Outline Dimension Drawing

● FGRC-10

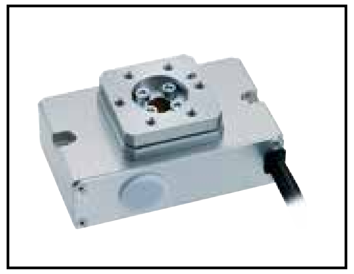


* When an ECR is connected, the dotted line area is as shown below.



F Series

FLCR | FGRC | FLSH | FFLD | Ending



Electric Actuator Rotary Type
FGRC-30
□25 Stepping motor

For compatible detailed model Nos., please visit the CKD website.

Model No. Notation Method

FGRC - 30 G 360 N C N - F S03

❶ Size

❶Size
30

❷ Connected Controllers*1

G	ECMG/ECG-B
Blank	ECR

❸ Encoder

C	Incremental Encoder

❹ Relay cable *2

N00	None
S01	Fixing cable 1 m
S03	Fixing cable 3 m
S05	Fixing cable 5 m
S10	Fixing cable 10 m
R01	Movable cable 1 m
R03	Movable cable 3 m
R05	Movable cable 5 m
R10	Movable cable 10 m

*1 Select the controller from page 529.
* 2 For Dimensions diagram of the relay cable, refer to page 607 for ECR or page 592 for ECMG/ECG.

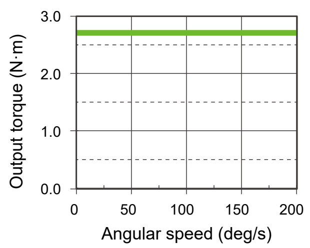
Specifications

Connected Controller	ECMG, ECG-B, ECR
Motor	□25 Stepping motor
Encoder Type	Incremental Encoder
Drive Method	Worm gear + belt
Travel angle *1	360
Max. output torque *2 N·m	2.71
Repeatability deg	±0.05
Backlash *3 deg	±0.2
Lost motion deg	0.3 or less
Operation angular speed range deg/s	20 to 200
Pressing operation angular speed range deg/s	20 to 30
Allowable moment of inertia * 2 kg·m²	0.0173
Allowable thrust load N	200
Allowable radial load N	200
Allowable moment N·m	5.5
Motor power supply voltage *4	24 VDC ±10% or 48 VDC ±10%
Insulation resistance	10 MΩ, 500 VDC
Dielectric Strength	500 VAC for 1 minute
Operating Ambient Temperature, Humidity	0 to 40°C (no freezing) 35 to 80% RH (no condensation)
Storage Ambient Temperature, Humidity	-10 to 50°C (no freezing) 35 to 80% RH (no condensation)
Atmosphere	No corrosive gas, explosive gas, or dust
Protection Structure	IP40
Weight kg	1.05

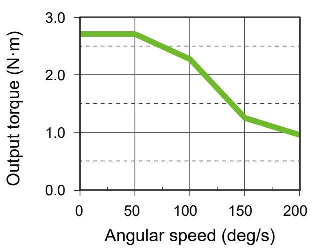
*1 The angle that can be moved with the move command is 359.9 degrees.
*2 Rotation torque and allowable moment of inertia vary depending on the angular speed and angular acceleration/deceleration. For details, please refer to the table on the right.
*3 When stopping precision is required, use an external stopper, etc., and complete positioning with pressing operation.
*4 48 VDC is only compatible with Controllers ECR.

Angular velocity and output torque

[At 48 VDC]

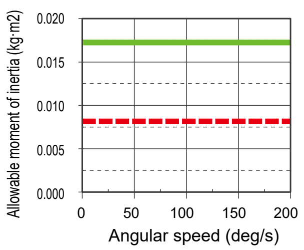


[At 24 VDC]

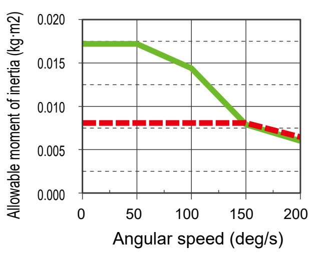


Angular velocity and allowable moment of inertia

[At 48 VDC]

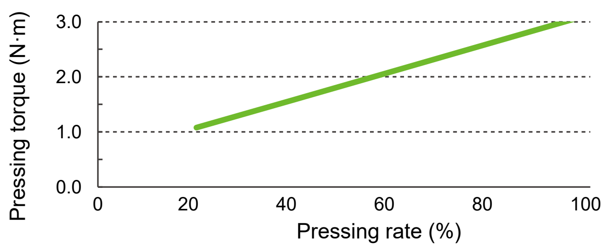


[At 24 VDC]



* If the angular acceleration/deceleration is 1700 deg/s² and over, use with a stroke less than the broken line.

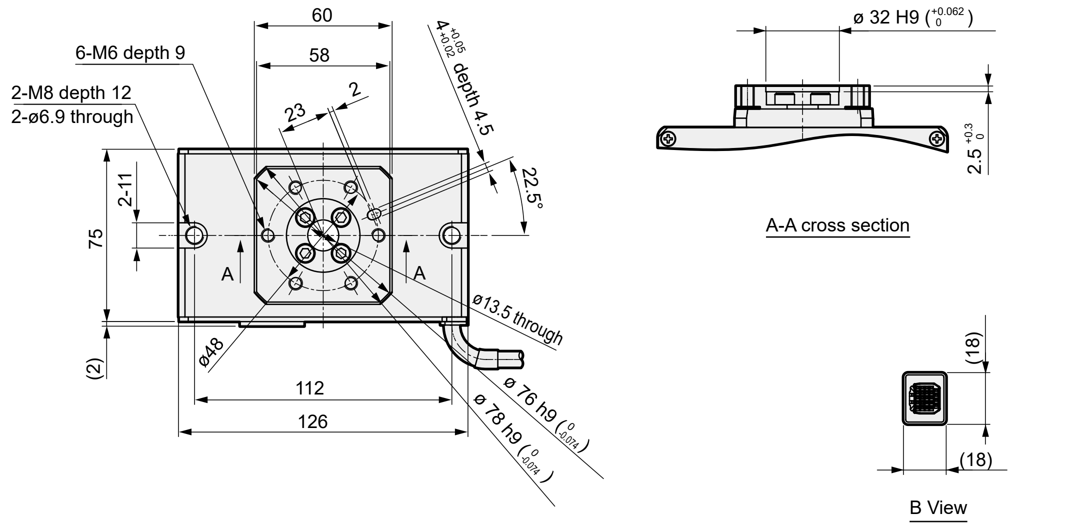
Pushing Torque

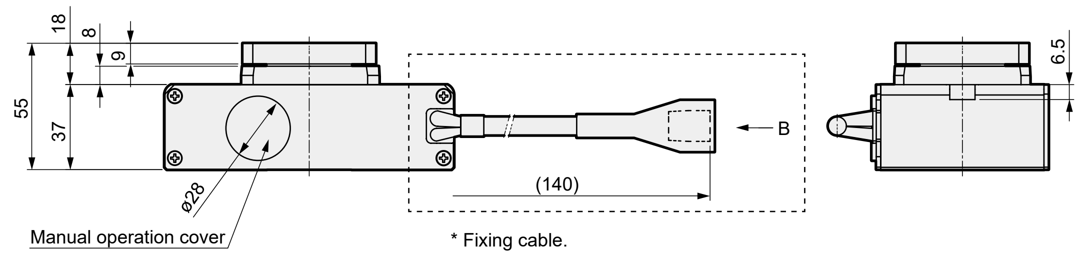


* The pressing torque and pressing rate indicate a guideline. Even with the same pushing rate, errors will occur with the actual numbers due to individual differences in motors and variations in mechanical efficiency.

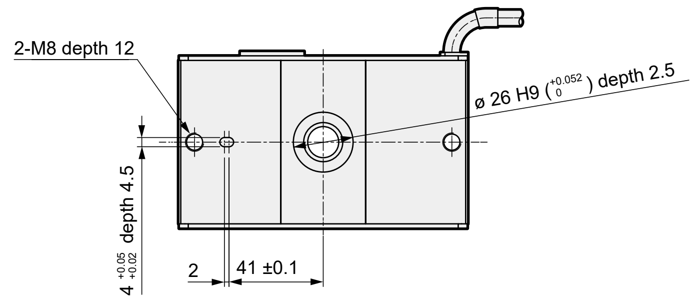
Outline Dimension Drawing

● FGRC-30

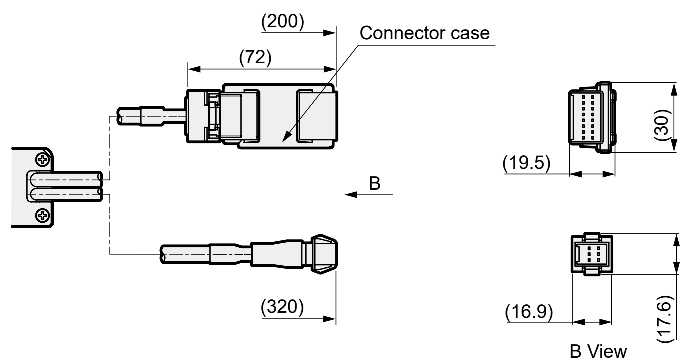




* Fixing cable.
* The cable cannot be removed.
* Min. bending radius 40 mm



*When an ECR is connected, the dotted line area is as shown below.



Electric Actuator Rotary Type

FGRC-50

□35 Stepping motor

For compatible detailed model Nos., please visit the CKD website.

Model No. Notation Method

FGRC - 50 G 360 N C N - F S03

❶ Size

❶Size
50

❷Connected Controllers* 1	
G	ECMG/ECG-B
Blank	ECR

❸Encoder	
C	Incremental Encoder

❹Relay cable * 1 * 2	
N00	None
S01	Fixing cable 1 m
S03	Fixing cable 3 m
S05	Fixing cable 5 m
S10	Fixing cable 10 m
R01	Movable cable 1 m
R03	Movable cable 3 m
R05	Movable cable 5 m
R10	Movable cable 10 m

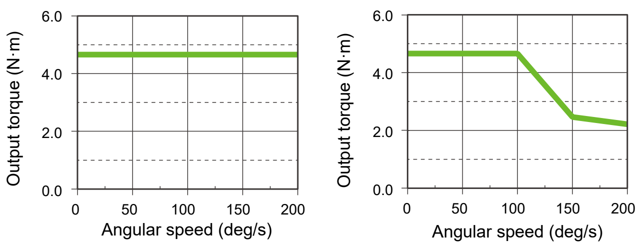
*1 Select the controller from page 529.
* 2 For Dimensions diagram of the relay cable, refer to page 607 for ECR or page 592 for ECMG/ECG.

Specifications

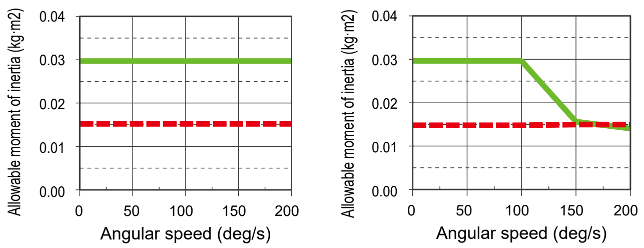
Connected Controller	ECMG, ECG-B, ECR
Motor	□35 Stepping motor
Encoder Type	Incremental Encoder
Drive Method	Worm gear + belt
Travel angle * 1	360
Max. output torque * 2 N·m	4.66
Repeatability deg	±0.05
Backlash * 3 deg	±0.2
Lost motion deg	0.3 or less
Operation angular speed range deg/s	20 to 200
Pressing operation angular speed range deg/s	20 to 30
Allowable moment of inertia * 2 kg·m²	0.0297
Allowable thrust load N	450
Allowable radial load N	320
Allowable moment N·m	10
Motor power supply voltage * 4	24 VDC ±10% or 48 VDC ±10%
Insulation resistance	10 MΩ, 500 VDC
Dielectric Strength	500 VAC for 1 minute
Operating Ambient Temperature, Humidity	0 to 40°C (no freezing) 35 to 80% RH (no condensation)
Storage Ambient Temperature, Humidity	-10 to 50°C (no freezing) 35 to 80% RH (no condensation)
Atmosphere	No corrosive gas, explosive gas, or dust
Protection Structure	IP40
Weight kg	1.85

*1 The angle that can be moved with the move command is 359.9 degrees.
*2 Rotation torque and allowable moment of inertia vary depending on the angular speed and angular acceleration/deceleration. Refer to the table at right for details.
*3 When stopping precision is required, use an external stopper, etc., and complete positioning with pressing operation.
*4 48 VDC is only compatible with Controllers ECR.

Angular velocity and output torque

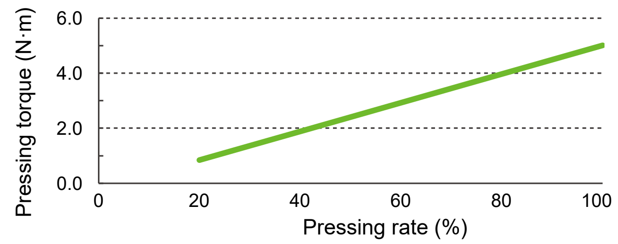


Angular velocity and allowable moment of inertia



* If the angular acceleration/deceleration is 1700 deg/s² and over, use with a stroke less than the broken line.

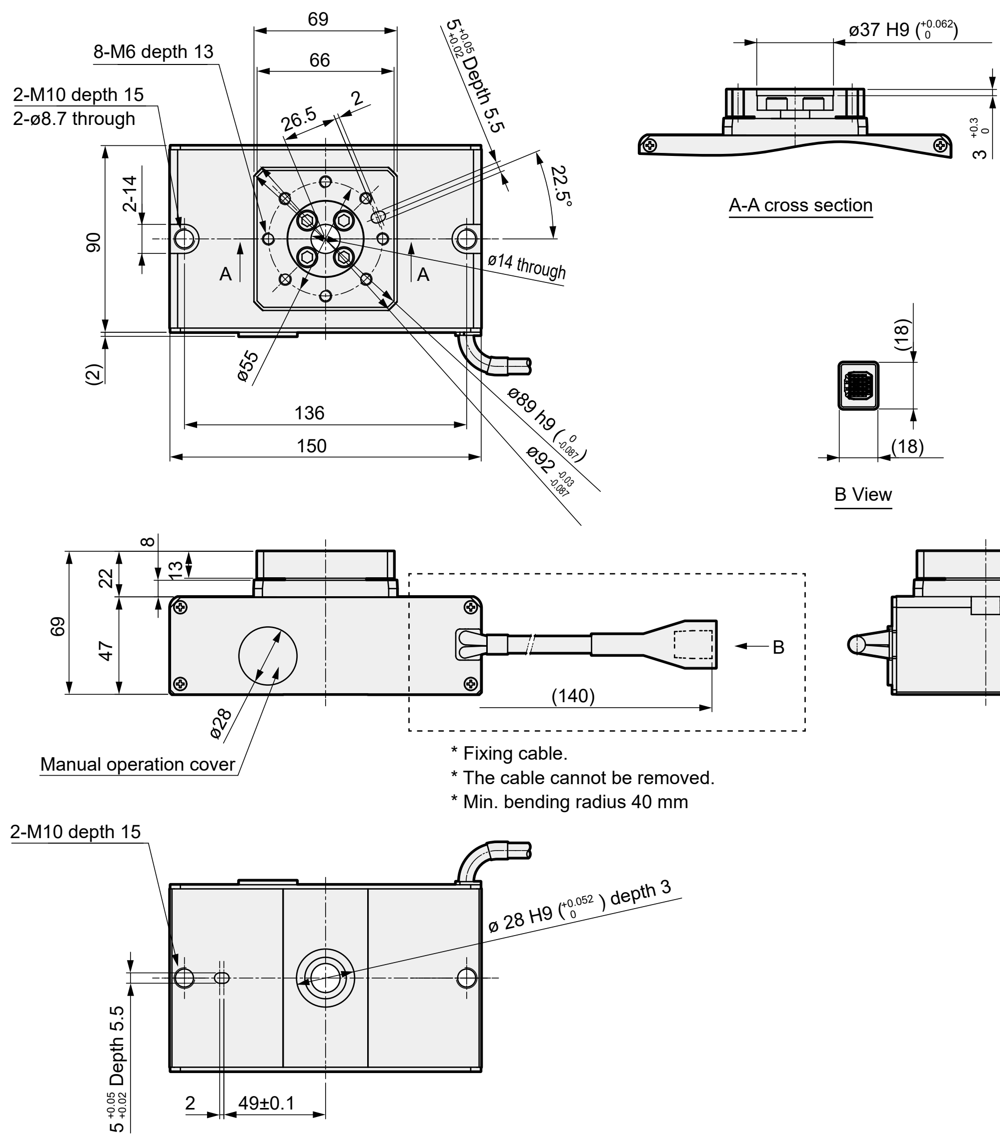
Pushing Torque



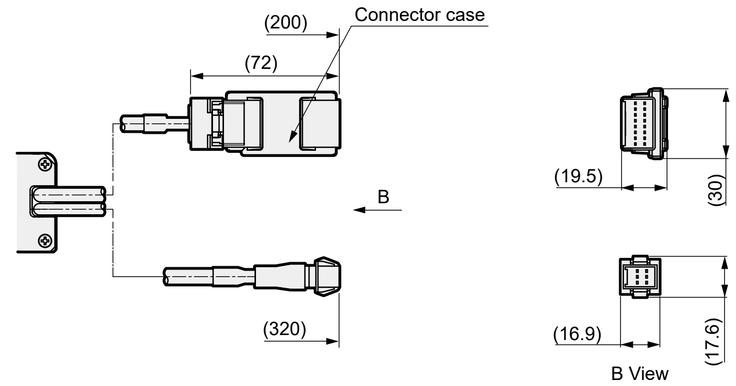
*The pressing torque and pressing rate indicate a guideline. Even with the same pushing rate, errors will occur with the actual numbers due to individual differences in motors and variations in mechanical efficiency.

Outline Dimension Drawing

● FGRC-50



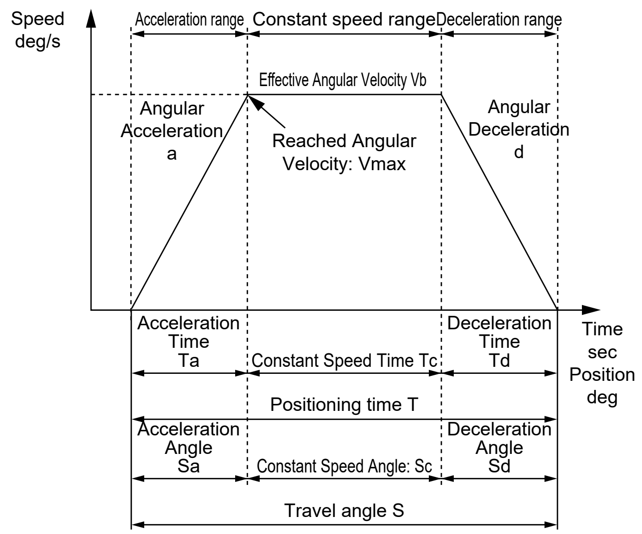
* When an ECR is connected, the dotted line area is as shown below.



STEP1 Confirmation of Positioning Time

Calculate the positioning time for the selected product according to the example below and check if it meets the required tact time.

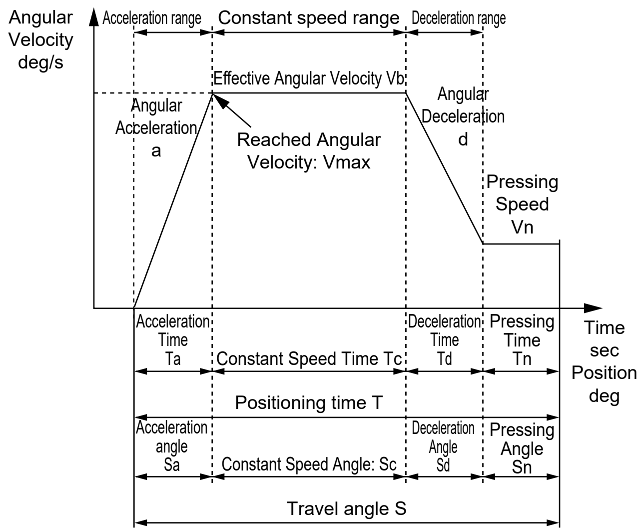
Positioning time for general transfer operations



Item		Code	Unit	Remarks
Setting Value	Set Angular Velocity	V	deg/s	
	Set Angular Acceleration	a	deg/s^2	
	Set Angular Deceleration	d	deg/s^2	
	Travel Angle	S	deg	
Calculated Value	Reached Angular Velocity	Vmax	deg/s	$= [2 \times a \times d \times S/(a + d)]^{1/2}$
	Effective Angular Velocity	Vb	deg/s	The smaller of V and Vmax
	Acceleration Time	Ta	s	= Vb / a
	Deceleration Time	Td	s	= Vb / d
	Constant Speed Time	Tc	s	= Sc / Vb
	Acceleration Angle	Sa	deg	$= (a \times Ta^2) / 2$
	Deceleration Angle	Sd	deg	$= (d \times Td^2) / 2$
	Constant Speed Angle	Sc	deg	= S - (Sa + Sd)
	Positioning Time	T	s	= Ta + Tc + Td

* Do not use at angular speeds that exceed the specifications. Depending on angular acceleration/deceleration and travel angle, the trapezoid speed waveform may not be formed (the set angular speed may not be achieved). In that case, select the smaller of the set angular velocity (V) and the reached angular velocity (Vmax) as the effective angular velocity (Vb).
* Use the at angular acceleration and deceleration of 3000 deg/s^2 or less.
* While settling time depends on working conditions, it may take 0.2 seconds or so.
* 1G≈9800 deg/s^2

Positioning time for pushing operations

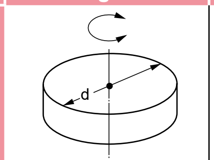
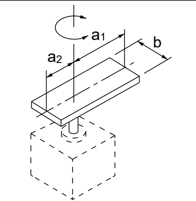


Item		Code	Unit	Remarks
Setting Value	Set Angular Velocity	V	deg/s	
	Set Angular Acceleration	a	deg/s^2	
	Set angular deceleration	d	deg/s^2	
	Travel Angle	S	deg	
	Pushing Speed	Vn	deg/s	
	Pushing Angle	Sn	deg	
Calculated Value	Reached Angular Velocity	Vmax	deg/s	$=[2 \times a \times d \times (S-Sn+Vn^2/2/d)/(a + d)]^{1/2}$
	Effective Angular Velocity	Vb	deg/s	The smaller of V and Vmax
	Acceleration Time	Ta	s	= Vb / a
	Deceleration Time	Td	s	= (Vb - Vn) / d
	Constant Speed Time	Tc	s	= Sc / Vb
	Pushing Time	Tn	s	= Sn / Vn
	Acceleration Angle	Sa	deg	$= (a \times Ta^2) / 2$
	Deceleration Angle	Sd	deg	$= ((Vb + Vn) \times Td) / 2$
	Constant Speed Angle	Sc	deg	= S - (Sa + Sd + Sn)
	Positioning Time	T	s	= Ta + Tc + Td + Tn

* Do not use at angular speeds that exceed the specifications.
* Depending on angular acceleration/deceleration and travel angle, the trapezoid speed waveform may not be formed (the set angular speed may not be achieved). In that case, select the smaller of the set angular velocity (V) and the reached angular velocity (Vmax) as the effective angular velocity (Vb).
* Use the at angular acceleration and deceleration of 3000 deg/s^2 or less.
* While settling time depends on working conditions, it may take 0.2 seconds or so.
* 1G≈9800 deg/s^2

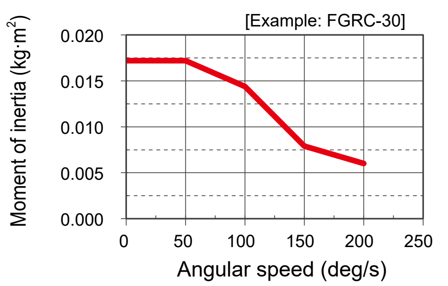
STEP2 Confirmation of Moment of Inertia of Load

Calculate the moment of inertia of the load and select a model from the graph of angular velocity and allowable moment of inertia.

Shape	Schematic Diagram	Required Items	Moment of inertia I $kg \cdot m^2$	Radius of gyration
Dial plate		● Diameter d (m) ● Weight M (kg)	$I = \frac{Md^2}{8}$	$\frac{d^2}{8}$
Thin rectangle plate (rectangular parallelepiped)		● Plate length a_1, a_2 ● Side length b ● Weight M_1, M_2	$I = \frac{M1}{12}(4a_1^2+b^2) + \frac{M2}{12}(4a_2^2 + b^2)$	$\frac{(4a_1^2 + b2) + (4a_2^2 + b^2)}{12}$

*Refer to P. 263.

[24 VDC]
Angular speed and allowable moment of inertia



*Refer to P. 250, 252 and 254.

STEP3 Confirmation of Required Torque

Use the following equations to determine the maximum load torque, and then refer to the angular speed and output torque graph to select the Applicable models.

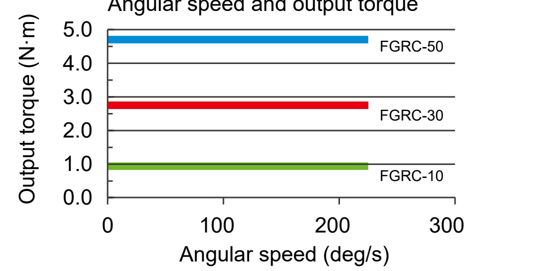
Largely divided into 3 types depending on the load type. Calculate the required torque for each case. For combined load, sum each torque to get the required torque.

①Static load (Ts)
When static pressing force is required, such as clamping
$T_S = F_S \times L$
T_S: Required torque (N·m)
F_S: Required thrust (N)
L: Length from the center of rotation to the point of action (m)

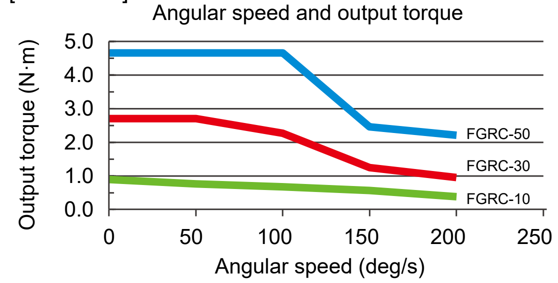
②Resistance load (TR)
When force due to friction, gravity, or other external forces is applied
$T_R = 3 \times F_R \times L$
T_R: Required torque (N·m)
F_R: Required thrust (N)
L: Length from the center of rotation to the point of action (m)

③Inertia load (TA)
When rotating an object
$T_A = 3 \times I \times \dot{\omega}$
T_A: Required torque (N·m)
I: Moment of inertia ($kg \cdot m^2$)
$\dot{\omega}$: Set angular acceleration/deceleration (rad/s^2)
θ: Travel Angle (rad)
t: Travel time (s)
* $\dot{\omega}$ Calculate with the higher of angular acceleration/deceleration.
The formula for converting from degrees (deg) to radians (rad) is as follows.
rad = deg x (π/180)
Refer to the moment of inertia and travel time. (Pages 250, 252 and 254), Or figure for moment of inertia calculation (P. 263) for calculation.

[At 48 VDC]
Angular speed and output torque



[At 24 VDC]
Angular speed and output torque



STEP4 Confirmation of Allowable Load

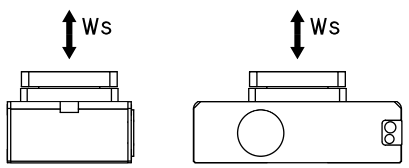
If a load is applied directly to the table, ensure that it is within the allowable values in Table 1.
For combined loads, ensure the total is 1.0 or less.

Table 1

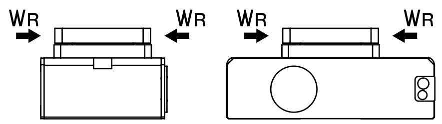
Model No.	W_S max	W_R max	M max
FGRC-10	80	80	2.5
FGRC-30	200	200	5.5
FGRC-50	450	320	10

W_S : Thrust Load (N)
W_R : Radial Load (N)
M : Moment Load (N·m)
$W_S$max : Allowable Thrust Load (N)
W_R max : Allowable Radial Load (N)
Mmax : Allowable moment load (N·m)

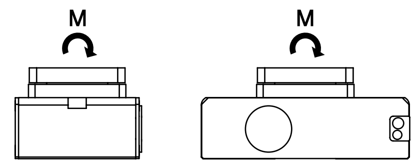
①Thrust load (axial load)



②Radial load (lateral load)



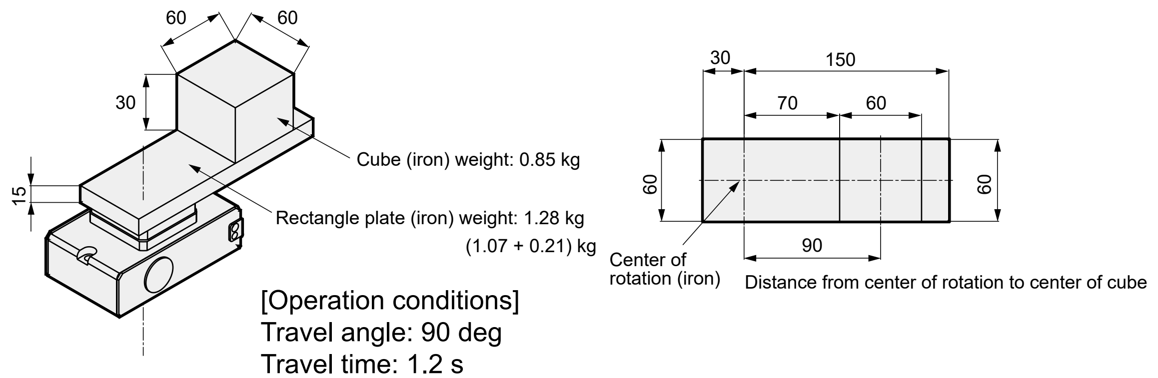
③Moment load



In Case of Combined Load
After calculating each load, substitute into the following formula to confirm.

$$\frac{W_S}{W_S max} + \frac{W_R}{W_R max} + \frac{M}{Mmax} \leq 1.0$$

Selection Example [Horizontal]



[Operation conditions]
Travel angle: 90 deg
Travel time: 1.2 s
Angular acceleration/deceleration: 1000 deg/s^2 (0.1G)

STEP1 Confirmation of Positioning Time

From the operating conditions, the positioning time is 1.09 s.
Since the required travel time is 1.2 s or less, proceed to the next step.

Set value

Angular Velocity	V	90 deg/s
Angular Acceleration	a	1000 deg/s^2
Angular Deceleration	d	1000 deg/s^2
Travel Angle	S	90 deg

Calculated value

Reached Angular Velocity	Vmax	300 deg/s
Effective Angular Velocity	Vb	90 deg/s
Acceleration Time	Ta	0.09 s
Deceleration Time	Td	0.09 s
Constant Speed Time	Tc	0.91 s
Positioning Time	T	1.09 s

STEP2 Confirmation of Moment of Inertia of Load

Calculate the moment of inertia I, and then temporarily select a model from the angular speed and allowable moment of inertia graph.

[Rectangular Plate]

$$I1=1.07\times\frac{4\times0.15^2+0.06^2}{12}+0.21\times\frac{4\times0.03^2+0.06^2}{12}=0.00847$$

[Cube]

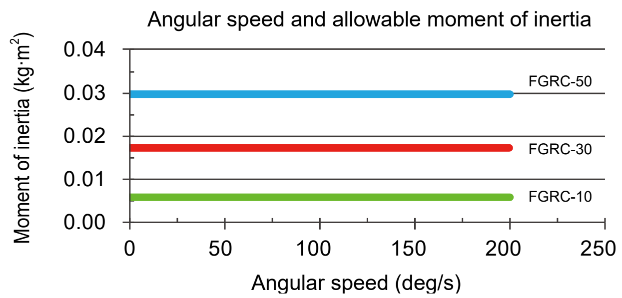
$$I2=0.85\times\left[\frac{0.06^2+0.06^2}{12}+0.09^2\right]=0.00740$$

The total moment of inertia I is as follows.

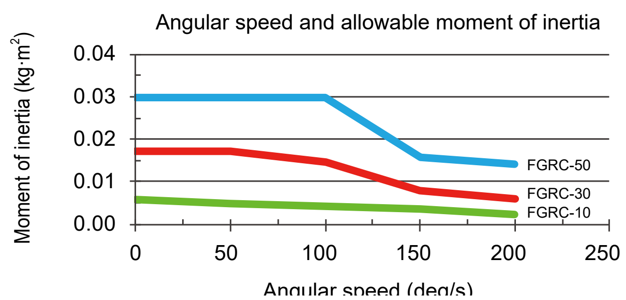
I = I1+I2=0.01587 (kg·m^2)...①

From the angular speed and allowable moment of inertia graph, select FGRC-30 [48 VDC] that satisfies the allowable moment of inertia at angular speed 90 deg/s.

[At 48 VDC]



[At 24 VDC]



STEP3 Confirmation of Required Torque

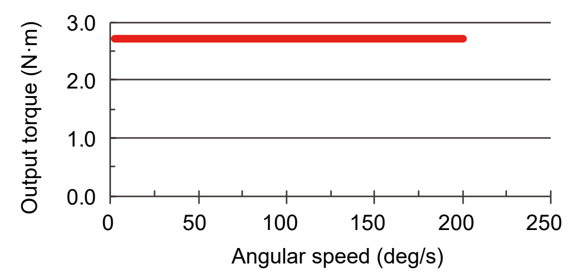
Calculate the load torque and confirm that it is within the range in the graph of angular speed and output torque.
Set acceleration/deceleration from a = d = 1000 deg/s^2

$$\dot{\omega}=1000\times\frac{\pi}{180}$$

=17.45 rad/s^2...②

① and ② inertia load (TA) is
TA=3×0.01587×17.45
=0.831 (N·m)

[At 48 VDC] [FGRC-30]

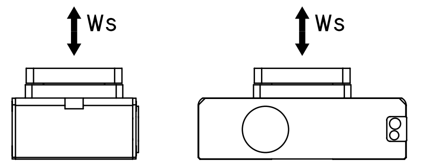


The intersection of angular velocity V = 90 (deg/s) and TA = 0.598 (N·m) is inside the graph, so it is usable.

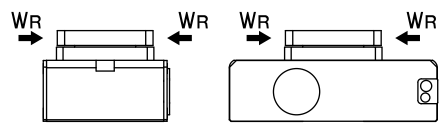
STEP4 Confirmation of Allowable Load

Finally, check if value is within allowable load range after load value applied to table is calculated.

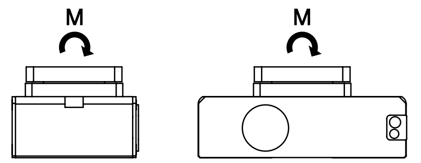
①Thrust load (axial load)



②Radial load (axial load)



③Moment load (axial load)



[Thrust Load]
Total weight
1.07+0.21+0.85=2.13(kg)
Thus, thrust load (Ws)
Ws = 2.13 × 9.8 = 20.9 (N)

[Radial Load]
Since no radial load is applied
WR = 0 (N)

[Moment Load]
Moment load (M1) of rectangle plate
1.07×9.8=10.5 (N)
0.21 × 9.8 = 2.06 (N)
Therefore,
M1 = 10.5 × 0.075 - 2.06 × 0.015 = 0.76 (N·m)

Moment load (M2) of rectangular parallelepiped
0.85×9.8=8.3 (N)
Therefore,
M2 = 8.3 × 0.09 = 0.75 (N·m)

Therefore, the sum of M1 and M2
M=0.76+0.75=1.51 (N·m)

$$\frac{Ws}{Wsmax}+\frac{WR}{WRmax}+\frac{M}{Mmax}$$

$$\frac{20.9}{200}+\frac{0}{200}+\frac{1.51}{5.5}=0.4\leq 1.0$$

From the above, since the total load value is within the allowable load value, FGRC-30 can be selected.

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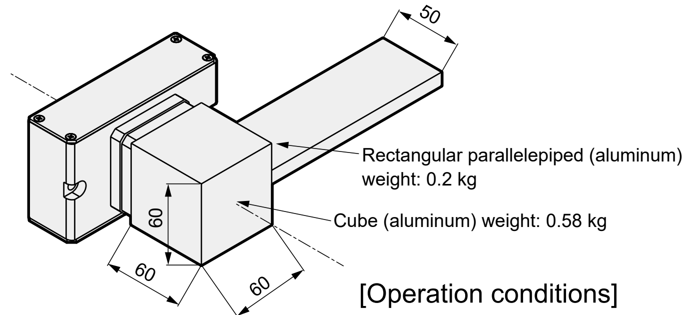
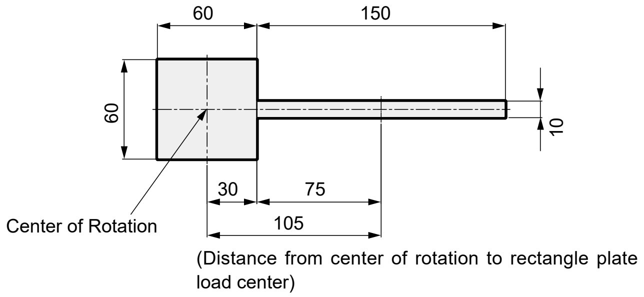
Selection Example [Wall Mount]



Load Details



[Operation conditions]
Travel angle: 180 deg
Travel time: 1.8 s
Angular acceleration/deceleration: 1000 deg/s² (0.1G)

STEP1 Confirmation of Positioning Time

From the operating conditions, the positioning time is 1.57 s.
This is lower than the required travel time of 1.8 s, so proceed to the next step.

Set value

Angular Velocity	V	125 deg/s
Angular Acceleration	a	1000 deg/s²
Angular Deceleration	d	1000 deg/s²
Travel Angle	S	180 deg

Calculated value

Reached Angular Velocity	Vmax	424.3 deg/s
Effective Angular Velocity	Vb	125 deg/s
Acceleration Time	Ta	0.125 s
Deceleration Time	Td	0.125 s
Constant Speed Time	Tc	1.315 s
Positioning Time	T	1.57 s

STEP2 Confirmation of Moment of Inertia of Load

Calculate the moment of inertia I, and then temporarily select a model from the angular speed and allowable moment of inertia graph.

[Rectangular Parallelepiped]

$$I_1 = 0.2 \times \frac{(0.01^2 + 0.15^2)}{12} + 0.2 \times 0.105^2 = 0.00258\ (kg\cdot m^2)$$

[Cube]

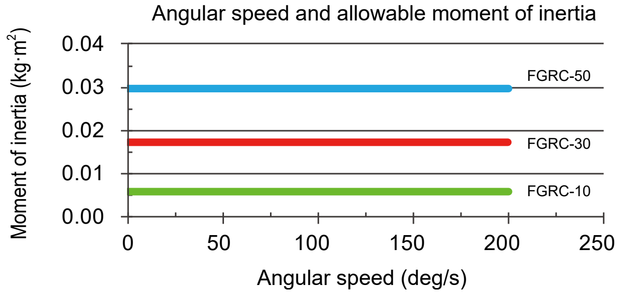
$$I_2 = 0.58 \times \frac{(0.06^2 + 0.06^2)}{12} = 0.00035\ (kg\cdot m^2)$$

The total moment of inertia is as follows.

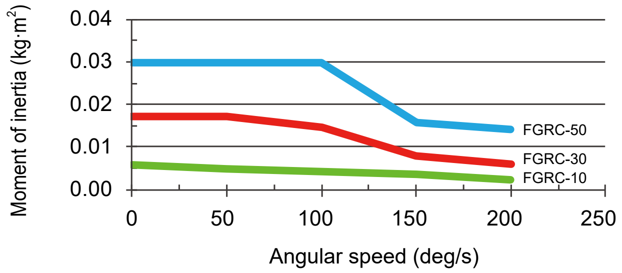
$I = I_1 + I_2 = 0.00293\ (kg\cdot m^2)$...①

From the angular speed and allowable moment of inertia graph, select FGRC-10 [48 VDC] that satisfies the allowable moment of inertia at angular speed 125 deg/s.

[At 48 VDC]



[At 24 VDC]



STEP3 Confirmation of Required Torque

Calculate the load torque and confirm that it is within the range in the graph of angular speed and output torque.
Calculate the load torque using the gravitational resistance load (T_R) and inertia load (T_A).

[Resistive Load]
$T_R = 3 \times 0.2 \times 9.8 \times 0.105$
$= 0.617\ (N\cdot m)$ ...②

[Inertial Load]
Set acceleration/deceleration from a = d = 1000 deg/s²

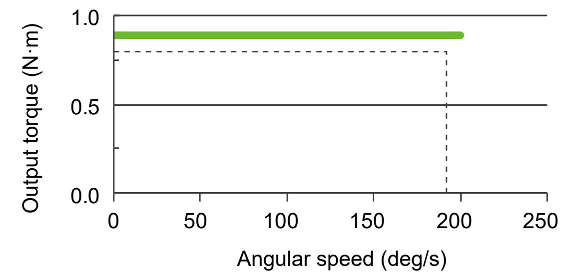
$$\dot{\omega} = 1000 \times \frac{\pi}{180}$$

$= 17.45\ rad/s^2$...③

① and ③ inertia load (T_A) is
$T_A = 3 \times 0.00293 \times 17.45$
$= 0.153\ (N\cdot m)$ ...④

② and ④ thereby total load torque (T) is
$T = T_R + T_A = 0.617 + 0.153 = 0.77\ (N\cdot m)$

[At 48 VDC] [FGRC-10]



The intersection of angular velocity V = 180 (deg/s) and T = 0.77 (N·m) is inside the graph, so it is usable.

STEP4 Confirmation of Allowable Load

Finally, check if value is within allowable load range after load value applied to table is calculated.

[Thrust Load]
Since no thrust load is applied
$W_S = 0\ (N)$

[Radial Load]
Total weight
0.2+0.58=0.78 (kg)
Therefore, radial load (W_R) is
$W_R = 0.78 \times 9.8 = 7.64\ (N)$

[Moment Load]
Moment load (M) from the figure below right
$M = 0.03 \times (0.2 + 0.58) \times 9.8 = 0.23\ (N\cdot m)$

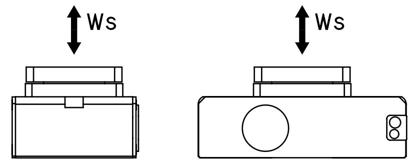
Therefore,

$$\frac{W_S}{W_{Smax}} + \frac{W_R}{W_{Rmax}} + \frac{M}{M_{max}}$$

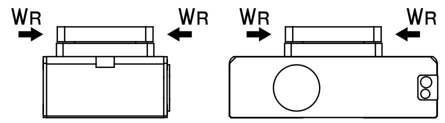
$$\frac{0}{80} + \frac{7.64}{80} + \frac{0.23}{2.5} = 0.19 \leq 1.0$$

The total load value is within the allowable load value.
FGRC-10 can be selected.

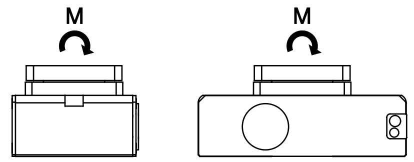
①Thrust load (axial load)



②Radial load (axial load)



③Moment load (axial load)



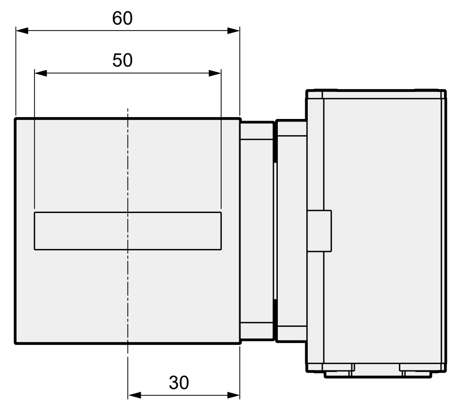


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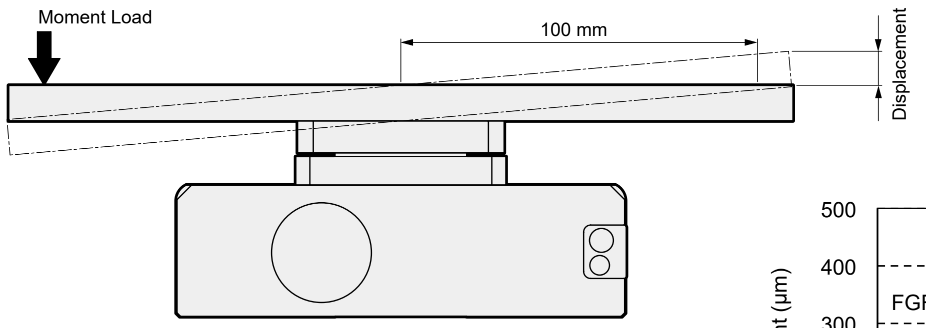
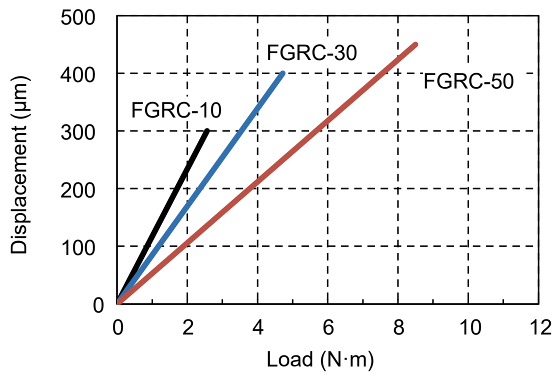
Table deflection *Reference value

Displacement of the table at a point 100 mm away from the center of rotation when a moment load is applied to the FGRC. (It is assumed that the table is in a non-rotating stationary state.)

Table Displacement Amount





Runout accuracy: Displacement when 180 deg is moved * Reference value

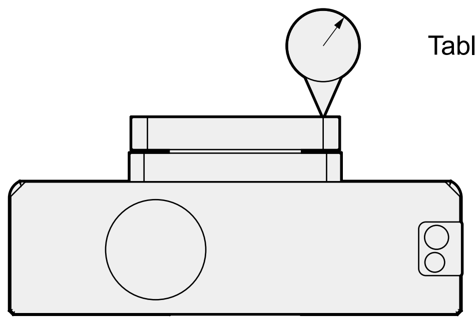


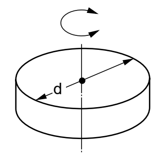
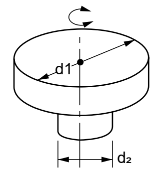
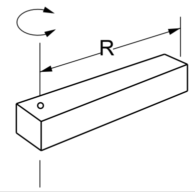
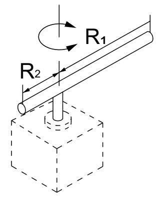
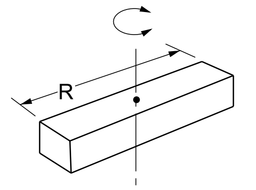
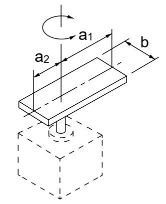
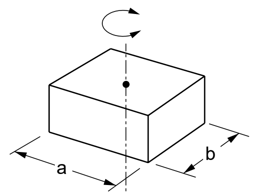
Table top surface runout

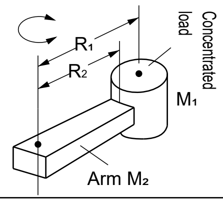
(mm)

Measurement Location	FGRC
Runout of the top surface of the table	0.1

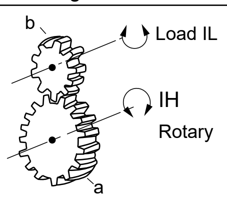
Diagram for calculating moment of inertia

When the rotating shaft passes through the workpiece

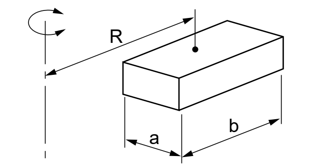
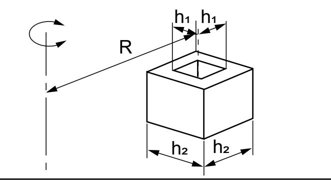
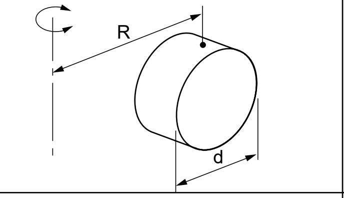
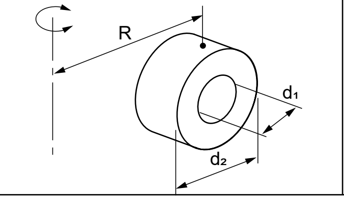
Shape	Diagram	Required Items	Moment of inertia I kg·m²	Radius of gyration K_1^2	Remarks
Dial plate		● Diameter d (m) ● Weight M (kg)	$I = \frac{Md^2}{8}$	$\frac{d^2}{8}$	● No mounting direction ● For sliding use, contact CKD.
Stepped disc		● Diameter d_1 (m), d_2 (m) ● Weight d_1 section M_1 (kg), d2 section M_2 (kg)	$I = \frac{1}{8}(M1d_1^2 + M_2d_2^2)$	$\frac{d_1^2 + d_2^2}{8}$	● Ignore when the d_2 section is extremely small compared to the d_1 section
Bar (center of rotation at end)		● Bar length R (m) ● Weight M (kg)	$I = \frac{MR^2}{3}$	$\frac{R^2}{3}$	● Mounting direction is horizontal ● Oscillating time changes when the mounting direction is vertical
Thin rod		● Bar length R_1, R_2 ● Weight M_1, M_2	$I = \frac{M_1/R_1^2}{3} + \frac{M_2/R_2^2}{3}$	$\frac{R_1^2 + R_2^2}{3}$	● Mounting direction is horizontal ● Oscillating time changes when the mounting direction is vertical
Bar (center of rotation at center of gravity)		● Bar length R (m) ● Weight M (kg)	$I = \frac{MR^2}{12}$	$\frac{R^2}{12}$	● No mounting direction
Thin rectangle plate (rectangular parallelepiped)		● Plate length a_1, a_2 ● Side length b ● Weight M_1, M_2	$I = \frac{M_1}{12}(4a_1^2 + b^2) + \frac{M_2}{12}(4a_2^2 + b^2)$	$\frac{(4a_1^2+b^2)+(4a_2^2+b^2)}{12}$	● Mounting direction is horizontal ● Oscillating time changes when the mounting direction is vertical
Cuboid		● Side length a (m), b (m) ● Weight M (kg)	$I = \frac{M}{12}(a^2 + b^2)$	$\frac{a^2 + b^2}{12}$	● No mounting direction ● For sliding use, contact CKD.

Concentrated loa		● Shape of concentrated load ● Length to center of gravity of concentrated load R1 ● Arm length R_2 (m) ● Concentrated load weight M1 (kg) ● Arm weight M2 (kg)	$I = M1(R_1^2 + k_1^2) + \frac{M_2R_2^2}{3}$	k_1^2 is common Calculate by load shape	● Mounting direction is horizontal ● M_2 is M_1 in comparison toa very small placeis M2=0 Calculated as It's fine

Method of converting the load JL via gears to the rotary actuator shaft axis

Gear		● Gear Rotary side (tooth number) a Load side (No. of teeth) b ● Inertia of Load Moment N·m	Moment of Inertia of Load around Rotary Shaft $I_H = \left(\frac{a}{b}\right)^2 I_L$		● When gear shape is larger, gear moment of inertia should be considered.

Rotary shaft offsets from workpiece

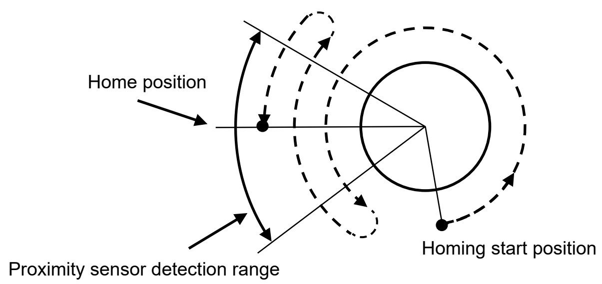
Shape	Diagram	Required Items	Moment of inertia I kg·m2	Remarks
Cuboid		● Side length a (m) ● Distance from rotary shaft to load center b (m) R (m) ● Weight M (kg)	$I = \frac{M}{12}(a^2 + b^2) + MR^2$	● Same for cube
Hollow Rectangular Parallelepiped		● Side length h_1 (m) h_2 (m) ● Distance from rotary shaft to load center R (m) ● Weight M (kg)	$I = \frac{M}{12}(h_1^2+h_2^2)+MR^2$	● Cross section is for cube only
Cylinder		● Diameter d (m) ● Distance from rotary shaft to load center R (m) ● Weight M (kg)	$I = \frac{Md^2}{16}+MR^2$	
Hollow Cylinder		● Diameter d_1 (m) d_2 (m) ● Distance from rotary shaft to load center R (m) ● Weight M (kg)	$I = \frac{M}{16}(d_1^2 + d_2^2) + MR^2$	

* When determining the moment of inertia, first model the load, jigs, etc., convert the shape to a simple one, and then perform calculations. In the case of a composite load, calculate the individual moments of inertia and sum them.

Homing Method

● Sensor detection method

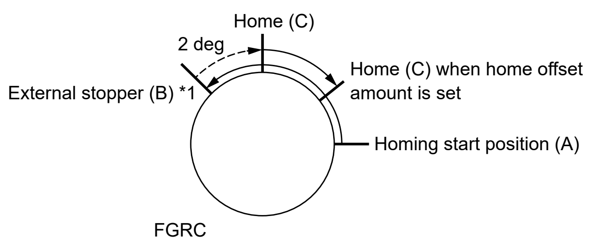
The FGRC series recognizes the home position by detecting the proximity sensor inside the actuator. Therefore, depending on the homing start position, the actuator may move more than one rotation during homing. In addition, with the FGRC-10, after detecting the proximity sensor, the actuator operates within a range of ±45 deg around the sensor. After that, the homing operation is completed.



*The angle at which the unit operates around the sensor varies somewhat for each product due to factors such as how the sensor is fixed.

● Pushing method

When it presses against the external stopper outside the actuator and reaches a certain current value, it recognizes the position reversed by 2 deg from that position as the home position. Please provide the external stopper with sufficient rigidity. If the rigidity is insufficient, a deviation in the home position may occur.



*1 External stoppers and locating jigs are to be prepared by the customer.

MEMO

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To Use This Product Safely

Be sure to read this before use.
Refer to Intro 17 for general information on electric actuators.

Individual Precautions: Electric actuator FGRC Series

During Design / Selection

1. Common

DANGER

■ Do not use in places where dangerous goods such as ignitable substances, inflammable substances or explosives are present.
There is a risk of ignition, fire, or explosion.

■ Ensure that the product is free of water droplets and oil droplets.
This can cause fire or malfunction.

■ When mounting the product, be sure to securely hold and fix (including the workpiece) it.
There is a risk of injury due to the product tipping over, falling, malfunctioning, etc. As a general rule, please fix the product using all mounting holes.

Warning

■ Use within the product's specified operating range.

■ Provide a safety fence to prevent entry to the movable range of the electric actuator. In addition, install the emergency stop button switch as a device in a location which is easy to operate in an emergency situation. The emergency stop push button must have a structure and wiring that does not automatically reset and cannot be carelessly reset by a person.

■ If the moving workpiece poses a possible risk to personnel or if fingers could be caught, take safety measures.

■ It may take several seconds to complete an emergency stop, depending on the travel speed and load.

■ If the machine stops in the event of a system failure such as emergency stop or power outage, equipment damage or injury do not occur. Design a safety circuit or device.

■ Install indoors with low humidity.
In places where it is exposed to rainwater or in humid places (humidity of 85% or more, places with condensation), there is a risk of electric leakage or fire. Oil drops and oil mist are also strictly prohibited. Use in such an environment will cause damage and malfunction.

■ Make sure that the product is D type grounded (ground resistance of 100 Ω or less).
If an electric leakage occurs, there is a risk of electric shock or malfunction.

■ Use and store in accordance with the working/storage temperatures and where there is no condensation.
(Storage Temperature: -10°C to 50°C, Storage Humidity: 35% to 80%, Operating Temperature: 0°C to 40°C, Operating Humidity: 35% to 80%) It may cause abnormal shutdown of the product or decrease its service life. Ventilate if heat builds up.

■ Do not use this product in a location where the ambient temperature could suddenly change and cause dew to condense.

■ Install in a location free from direct sunlight, dust, and corrosive gas/explosive gas/inflammable gas/combustibles, and away from heat sources. In addition, this product has not been considered for chemical resistance.
This can cause malfunction, explosion, or fire.

■ Use and store in locations free from strong electromagnetic waves, ultraviolet rays, or radiation.
This can cause malfunction or failure.

■ Take possibility of power source breakdown into consideration.
Take measures to ensure that even if a failure occurs in the power source, it does not cause injury or damage to people or equipment.

■ Take the operational status into consideration if the machine is reactivated after emergency or abnormal stops.
Design it so that restarting does not cause harm to people or equipment. Also, if it is necessary to reset the electric actuator to the starting position, design a safe control device. Consider the possibility of failure of the installed motor. Take measures to ensure that even if a failure occurs in the power source, it does not cause harm to people or equipment.

■ Avoid using this product where vibration and impact are present.

■ Do not apply a load to the product that is greater than or equal to the allowable load listed in the materials for selection.

■ Use a safe design that takes load fluctuation, rising/lowering operation (wall-mounted), and changes in frictional resistance into consideration. The operating speed will increase, which can cause injury to people or damage to machinery.

■ The pressing torque may decrease during a power outage or similar. Use a safe design that takes this into consideration. When used in a clamping mechanism, the clamping force may decrease due to power outages, etc., and the workpiece may come off, so please incorporate a safety device to prevent injury to people or damage to machinery.

■ Sudden stops during table rotation may generate load torque larger than the theoretical value. Please design with safety in mind.

■ Backlash may cause vibration when stopping or increased positioning time. When stopping precision is required, use an external stopper, etc., and complete positioning with pressing operation.

Caution

■ Never disassemble or modify the product.

■ The customer is responsible for the compatibility of CKD products with the customer's systems, machines and equipmentfor details.

■ For UL compatibility, use a Class2 power supply unit conforming to UL1310 for the combination DC power supply.

■ Set up the wiring so as not to apply inductive noise.
Avoid places where large currents or strong magnetic fields are generated. Do not use the same wiring as the power lines for large motors other than this product. Do not use the same wiring as the inverter power supply and wiring part used for robots, etc., apply a frame ground to the power supply, and insert a filter in the output part.

■ Be sure to separate the power supply of the output of this product and the power supply of inductive loads that generate surges, such as solenoid valves and relays.
If the power supply is shared, surge current will flow into the output part, causing damage. If a separate power supply cannot be used, connect a surge absorbing element directly in parallel to all inductive loads.

■ Select a power supply which provides ample capacity based on the number of installed products. If there is not enough capacity, it may malfunction.

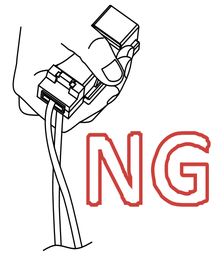
■ Fix the fixing cable so that it does not easily move, as it cannot be used in applications involvingrepeated bending. For use in locations involving repeated bending, please use a flexible cable.

■ Use movable/fixed cables with a bending radius of 63 mm or more.
The bending radius cannot accommodate bending of the connector part, so it is recommended to fix it near the connector.

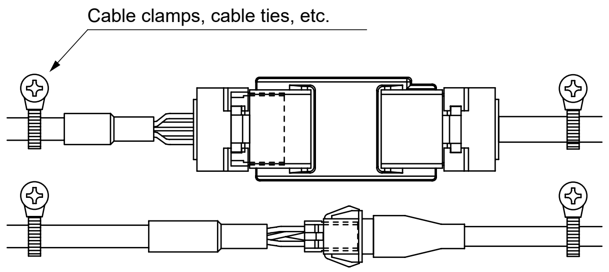
■ The origin position is recognized when the power supply is turned ON. If an external stopper or holding mechanism (brake, etc.) is attached, an unintended position may be recognized as the origin position. After turning on the power, please pay attention to the placement of external stoppers, etc., so that the home position can be reliably detected.

■ Use a cable within 10 m to connect the IF connector.

■ Do not hold the product's movable parts or cables during transportation and installation.
This can cause injury or disconnection.



■ Do not move the cable leading out of the actuator. Fix the cable part. Furthermore, use cables with a bending radius of 40 mm or more.



■ Do not fix the cable leading out of the actuator in a pulled state.
This may lead to damage to the internal parts of the actuator.

For precautions regarding mounting, installation, adjustment, operation, and maintenance, please refer to the CKD Equipment Product Site (https: //www.ckd.co.jp/kiki/en/) → 'model No.' → Instruction Manual

F Series
FLCR
FGRC
FLSH
FFLD
Ending

FGRC Series Model Selection Checklist → CKD (Contact)

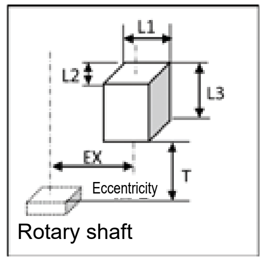
Fill in the form and send to the nearest CKD Sales Office. We will reply with the model selection results.

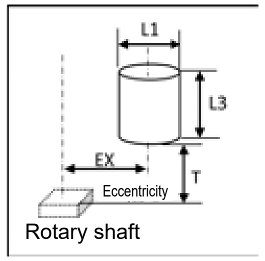
Customer:

Company		Department	
Name		E-mail	
TEL		FAX	

Selection Conditions:

<table>
<tr><td>Desired Model</td><td></td></tr>
<tr><td rowspan="5">Operating Conditions</td><td>Travel Angle deg, travel time: s</td></tr>
<tr><td>Set angular speed: deg/s</td></tr>
<tr><td>Set angular acceleration/deceleration: deg/s^2
(set angular acceleration/deceleration time: s)</td></tr>
<tr><td>Repeatability: ± deg</td></tr>
<tr><td>Mounting orientation:
Horizontal / Wall-mounted / Other</td></tr>
<tr><td rowspan="3">Load Conditions</td><td>[Static Load]
Pushing Force: N, distance from center of rotation to pressure cone apex: mm</td></tr>
<tr><td>[Resistance Load]
Load fluctuation: No / Yes
Weight, external force, frictional force: kg, distance from center of rotation to pressure cone apex: mm</td></tr>
<tr><td>[Inertial Load]
L1 : mm, L2: mm
L3 : mm, EX: mm
T : mm

Quantity: pcs., material:




*Please inquire about other load shapes.</td></tr>
<tr><td rowspan="2">Operating Environment</td><td>Ambient Temperature: °C, ambient humidity: %</td></tr>
<tr><td>Atmosphere:</td></tr>
<tr><td>Interface Specifications</td><td>Parallel I/O / IO-Link / CC-Link / EtherCAT / EtherNet/IP</td></tr>
<tr><td>Special Notes</td><td></td></tr>
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MEMO

F Series
FLCR
FGRC
FLSH
FFLD
Ending