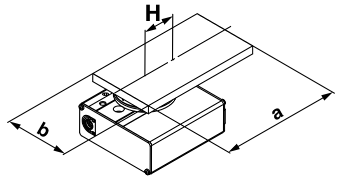
Rotary Table
LER Series

Model Selection

LER□E Series ▶p. 779

Selection Procedure

Operating conditions



- Electric rotary table: LER50EJ
- Mounting position: Horizontal
- Load type: Inertial load Ta
- Configuration of load: 150 mm x 80 mm (Rectangular plate)
- Rotation angle θ: 180°
- Angular acceleration/angular deceleration $\dot{\omega}$: 1000°/s²
- Angular speed ω: 420°/s
- Load mass m: 6.0 kg
- Distance between shaft and center of gravity H: 40 mm

Step 1 Moment of inertia—Angular acceleration/deceleration

① **Calculation of moment of inertia**

② **Moment of inertia—Check the angular acceleration/deceleration**
Select a model based on the moment of inertia and angular acceleration and deceleration while referencing the (Moment of Inertia—Angular Acceleration/Deceleration graph).

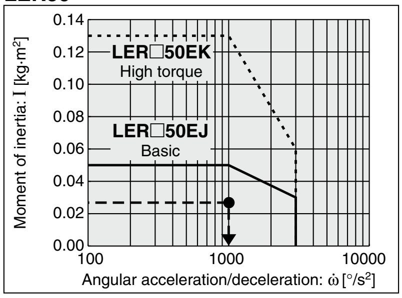
Formula

$I = m \times (a^2 + b^2)/12 + m \times H^2$

Selection example

$I = 6.0 \times (0.15^2 + 0.08^2)/12 + 6.0 \times 0.04^2$
$= 0.0241\ \text{kg·m}^2$

LER50



Step 2 Necessary torque

① **Load type**
- Static load: Ts
- Resistance load: Tf
- Inertial load: Ta

② **Check the effective torque**
Confirm whether it is possible to control the speed based on the effective torque corresponding with the angular speed while referencing the (Effective Torque—Angular Speed graph).

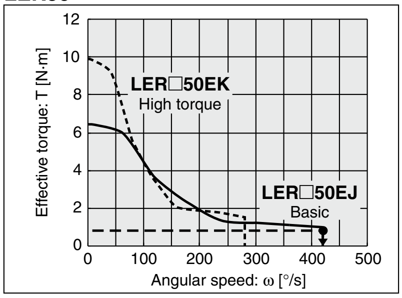
Formula

Effective torque ≥ Ts
Effective torque ≥ Tf x 1.5
Effective torque ≥ Ta x 1.5

Selection example

Inertial load: Ta
$Ta \times 1.5 = I \times \dot{\omega} \times 2\pi/360 \times 1.5$
$= 0.0241 \times 1000 \times 0.0175 \times 1.5$
$= 0.63\ \text{N·m}$

LER50



Step 3 Allowable load

① **Check the allowable load**
- Radial load
- Thrust load
- Moment

Formula

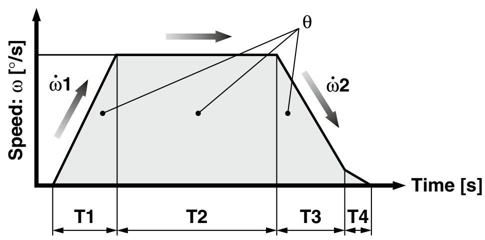
Allowable thrust load ≥ m x 9.8
Allowable moment ≥ m x 9.8 x H

Selection example

- Thrust load
  6.0 x 9.8 = 58.8 N < Allowable load OK
- Allowable moment
  6.0 x 9.8 x 0.04
  = 2.352 N·m < Allowable moment OK

Step 4 Rotation time

① **Calculation of cycle time (rotation time)**



θ: Rotation angle [°]	T1: Acceleration time [s]	··· Time until reaching the set speed
ω: Angular speed [°/s]	T2: Constant speed time [s]	··· Time while the actuator is operating at a constant speed
$\dot{\omega}1$: Angular acceleration [°/s²]	T3: Deceleration time [s]	··· Time from the beginning of the constant speed operation to stop
$\dot{\omega}2$: Angular deceleration [°/s²]	T4: Settling time [s]	··· Time until positioning is completed

Formula

Angular acceleration time $T1 = \omega/\dot{\omega}1$
Angular deceleration time $T3 = \omega/\dot{\omega}2$
Constant speed time $T2 = \{\theta - 0.5 \times \omega \times (T1 + T3)\}/\omega$
Settling time $T4 = 0.2$ [s]
Cycle time $T = T1 + T2 + T3 + T4$

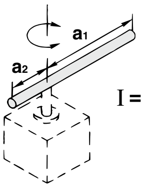
Selection example

- Angular acceleration time T1 = 420/1000 = 0.42 s
- Angular deceleration time T3 = 420/1000 = 0.42 s
- Constant speed time
  T2 = {180 – 0.5 x 420 x (0.42 + 0.42)}/420
  = 0.009 s
- Cycle time T = T1 + T2 + T3 + T4
  = 0.42 + 0.009 + 0.42 + 0.2
  = 1.049 [s]

Formulas for Moment of Inertia (Calculation of moment of inertia I)

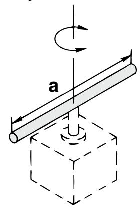
I: Moment of inertia [kg·m²]   m: Load mass [kg]

1. Thin bar
Position of rotation shaft: Perpendicular to a bar through one end



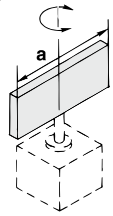
$$I = m_1 \cdot \frac{a_1^2}{3} + m_2 \cdot \frac{a_2^2}{3}$$

2. Thin bar
Position of rotation shaft: Passes through the center of gravity of the bar.



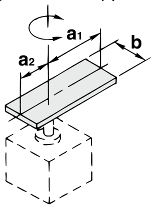
$$I = m \cdot \frac{a^2}{12}$$

3. Thin rectangular plate (cuboid)
Position of rotation shaft: Passes through the center of gravity of a plate.



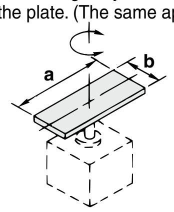
$$I = m \cdot \frac{a^2}{12}$$

4. Thin rectangular plate (cuboid)
Position of rotation shaft: Perpendicular to the plate and passes through one end. (The same applies to thicker cuboids.)



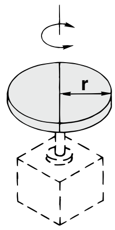
$$I = m_1 \cdot \frac{4a_1^2 + b^2}{12} + m_2 \cdot \frac{4a_2^2 + b^2}{12}$$

5. Thin rectangular plate (cuboid)
Position of the rotation shaft: Passes through the center of gravity of the plate and perpendicular to the plate. (The same applies to thicker cuboids.)



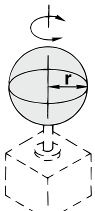
$$I = m \cdot \frac{a^2 + b^2}{12}$$

6. Cylindrical shape (including a thin disk)
Position of rotation shaft: Center axis



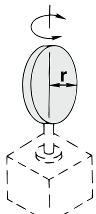
$$I = m \cdot \frac{r^2}{2}$$

7. Sphere
Position of rotation shaft: Diameter



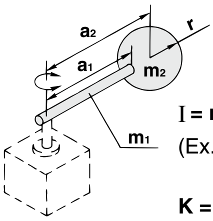
$$I = m \cdot \frac{2r^2}{5}$$

8. Thin disk (mounted vertically)
Position of rotation shaft: Diameter



$$I = m \cdot \frac{r^2}{4}$$

9. When a load is mounted on the end of the lever

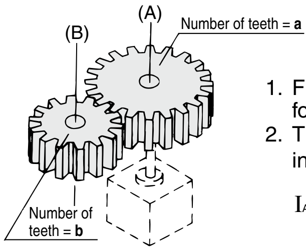


$$I = m_1 \cdot \frac{a_1^2}{3} + m_2 \cdot a_2^2 + K$$

(Ex.) Refer to **7** when the shape of m_2 is spherical.

$$K = m_2 \cdot \frac{2r^2}{5}$$

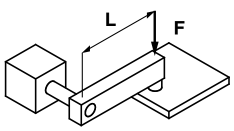
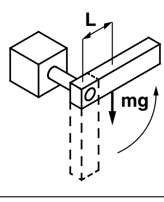
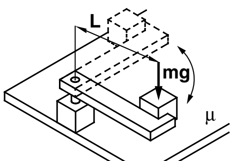
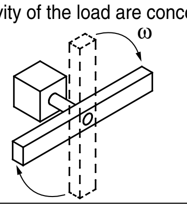
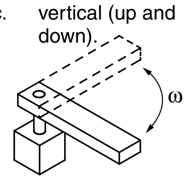
10. Gear transmission



1. Find the moment of inertia I_B for the rotation of shaft (B).
2. Then, replace the moment of inertia I_B around the shaft (A) by I_A,

$$I_A = \left(\frac{a}{b}\right)^2 \cdot I_B$$

Load Type

Load type			
Static load: Ts	**Resistance load: Tf**		**Inertial load: Ta**
Only pressing force is necessary. (e.g. for clamping)	Gravity or friction force is applied to rotating direction.		Rotate the load with inertia.
	Gravity is applied. 	Friction force is applied. 	Center of rotation and center of gravity of the load are concentric.  Rotation shaft is vertical (up and down). 
Ts = F·L **Ts:** Static load [N·m] **F :** Clamping force [N] **L :** Distance from the rotation center to the clamping position [m]	Gravity is applied to rotating direction. **Tf = m·g·L**	Friction force is applied to rotating direction. **Tf = μ·m·g·L**	**Ta = $I \cdot \dot{\omega} \cdot$ 2 π/360** **(Ta = $I \cdot \dot{\omega} \cdot$ 0.0175)** **Ta:** Inertial load [N·m] I **:** Moment of inertia [kg·m²] $\dot{\omega}$ **:** Angular acceleration/deceleration [°/s²] ω **:** Angular speed [°/s]
	Tf: Resistance load [N·m] **m :** Load mass [kg] **g :** Gravitational acceleration 9.8 [m/s²] **L :** Distance from the rotation center to the point of application of the gravity or friction force [m] μ **:** Friction coefficient		
Necessary torque: **T = Ts**	Necessary torque: **T = Tf x 1.5**∗1		Necessary torque: **T = Ta x 1.5**∗1

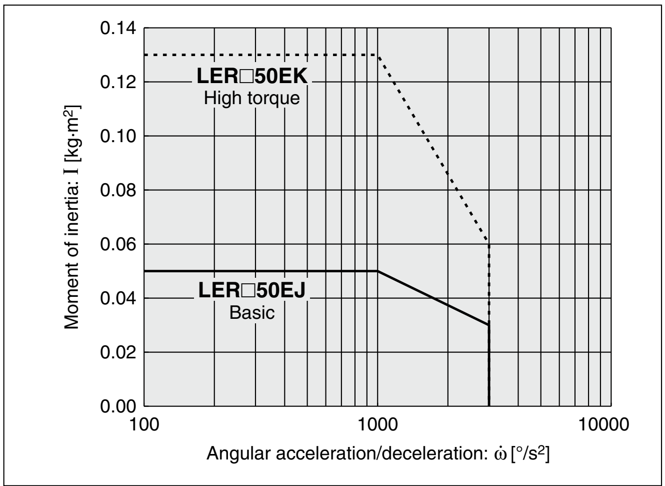
- **Resistance load: Gravity or friction force is applied to rotating direction.**
  - Ex. 1) Rotation shaft is horizontal (lateral), and the rotation center and the center of gravity of the load are not concentric.
  - Ex. 2) Load moves by sliding on the floor.
    - ∗ The total of resistance load and inertial load is the necessary torque. **T = (Tf + Ta) x 1.5**
- **Not resistance load: Neither gravity or friction force is applied to rotating direction.**
  - Ex. 1) Rotation shaft is vertical (up and down).
  - Ex. 2) Rotation shaft is horizontal (lateral), and rotation center and the center of gravity of the load are concentric.
    - ∗ Necessary torque is inertial load only. **T = Ta x 1.5**

∗1 To adjust the speed, margin is necessary for **Tf** and **Ta**.

Battery-less Absolute (Step Motor 24 VDC)

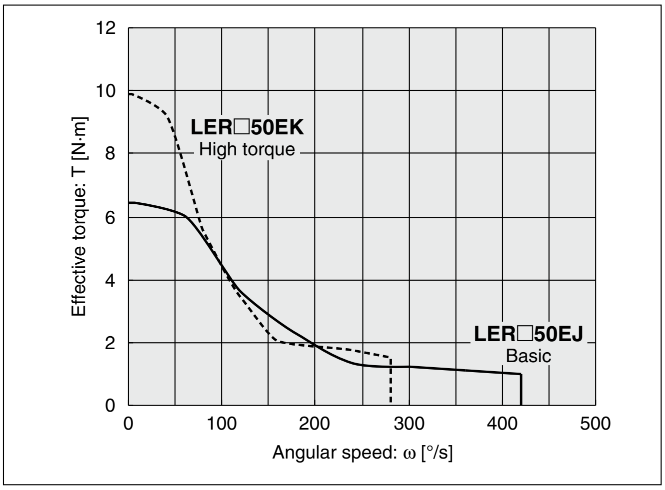
Moment of Inertia—Angular Acceleration/Deceleration

LER50

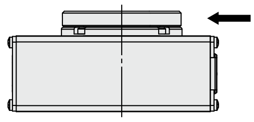
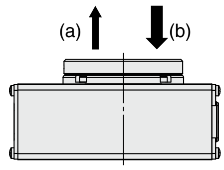


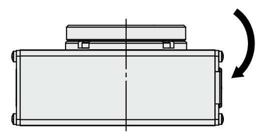
Effective Torque—Angular Speed

LER50



Allowable Load

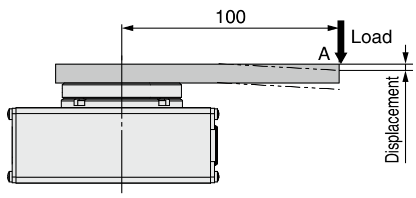





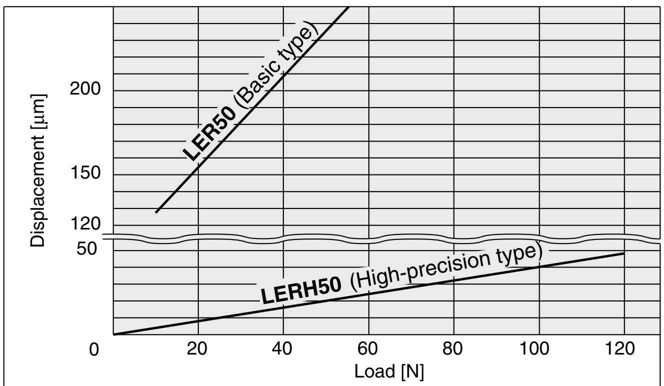
Size	Allowable radial load [N]		Allowable thrust load [N]				Allowable moment [N·m]	
			(a)		(b)			
	Basic type	High-precision type	Basic type	High-precision type	Basic type	High-precision type	Basic type	High-precision type
50	314	378	296		398	517	9.7	12.0

Table Displacement (Reference Value)

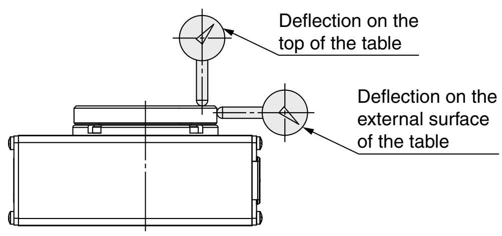
• Displacement at point A when a load is applied to point A 100 mm away from the rotation center.



LER□50



Deflection Accuracy: Displacement at 180° Rotation (Guide)



[mm]

Measured part	**LER** (Basic type)	**LERH** (High-precision type)
Deflection on the top of the table	0.1	0.03
Deflection on the external surface of the table	0.1	0.03

Battery-less Absolute (Step Motor 24 VDC)

Rotary Table

LER Series LER50

* For details, refer to page 1343 and onward.

How to Order

LER ☐ 50 E K – ☐ ☐ – R1 CD17T

❶ ❷ ❸ ❹ ❺ ❻ ❼ ❽

For details on controllers, refer to the next page.

❶ Table accuracy

Nil	Basic type
H	High-precision type

❷ Size

50

❸ Motor type

Symbol	Type	Compatible controllers/drivers		
E	Battery-less absolute (Step motor 24 VDC)	JXC51	JXCP1	JXCEF
		JXC61	JXCD1	JXC9F
		JXCE1	JXCL1	JXCPF
		JXC91	JXCM1	JXCLF

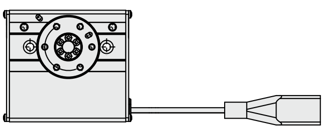
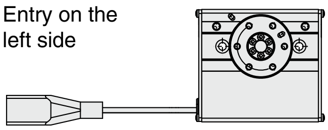
❹ Max. rotating torque [N·m]

K	High torque	10
J	Basic	6.6

❺ Rotation angle [°]

Nil	320
2	External stopper: 180
3	External stopper: 90

❻ Motor cable entry

Nil	Basic type (entry on the right side) 
L	Entry on the left side 

❼ Actuator cable type/length

Robotic cable [m]

Nil	None	**R8**	8*1
R1	1.5	**RA**	10*1
R3	3	**RB**	15*1
R5	5	**RC**	20*1

8 Controller

Nil	Without controller
C□1□□	With controller

C D 1 7 T

Interface (Communication protocol/Input/Output)

Symbol	Type	Number of axes, Special specification: Standard	With STO sub-function
5	Parallel input (NPN)	●	
6	Parallel input (PNP)	●	
E	EtherCAT	●	●
9	EtherNet/IP™	●	●
P	PROFINET	●	●
D	DeviceNet®	●	
L	IO-Link	●	●
M	CC-Link	●	

Mounting

7	Screw mounting
8*2	DIN rail

Number of axes, Special specification

Symbol	Number of axes	Specification
1	Single axis	Standard
F	Single axis	With STO sub-function

Communication plug connector, I/O cable*3

Symbol	Type	Applicable interface
Nil	Without accessory	—
S	Straight type communication plug connector	DeviceNet® CC-Link Ver. 1.10
T	T-branch type communication plug connector	
1	I/O cable (1.5 m)	Parallel input (NPN) Parallel input (PNP)
3	I/O cable (3 m)	
5	I/O cable (5 m)	

*1 Produced upon receipt of order
*2 The DIN rail is not included. It must be ordered separately.
*3 Select “Nil” for anything other than DeviceNet®, CC-Link, or parallel input.
Select “Nil,” “S,” or “T” for DeviceNet® or CC-Link.
Select “Nil,” “1,” “3,” or “5” for parallel input.

⚠Caution

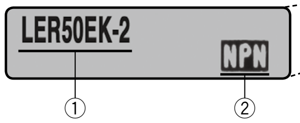
[CE/UKCA-compliant products]
EMC compliance was tested by combining the electric actuator LER series and the controller JXC series.
The EMC depends on the configuration of the customer’s control panel and the relationship with other electrical equipment and wiring. Therefore, compliance with the EMC directive cannot be certified for SMC components incorporated into the customer’s equipment under actual operating conditions. As a result, it is necessary for the customer to verify compliance with the EMC directive for the machinery and equipment as a whole.

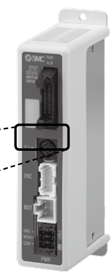
[Precautions relating to differences in controller versions]
When the JXC series is to be used in combination with the battery-less absolute encoder, use a controller that is version V3.4 or S3.4 or higher. For details, refer to pages 1077 and 1078.

[UL certification]
The JXC series controllers used in combination with electric actuators are UL certified.

The actuator and controller are sold as a package.
Confirm that the combination of the controller and actuator is correct.

<Check the following before use.>
① Check the actuator label for the model number. This number should match that of the controller.
② Check that the Parallel I/O configuration matches (NPN or PNP).





* Refer to the Operation Manual for using the products.
Please download it via our website: https://www.smcworld.com

Type	Step data input type	EtherCAT direct input type	EtherCAT direct input type with STO sub-function	EtherNet/IP™ direct input type	EtherNet/IP™ direct input type with STO sub-function	PROFINET direct input type	PROFINET direct input type with STO sub-function	DeviceNet® direct input type	IO-Link direct input type	IO-Link direct input type with STO sub-function	CC-Link direct input type
											
Series	JXC51 JXC61	JXCE1	JXCEF	JXC91	JXC9F	JXCP1	JXCPF	JXCD1	JXCL1	JXCLF	JXCM1
Features	Parallel I/O	EtherCAT direct input	EtherCAT direct input with STO sub-function	EtherNet/IP™ direct input	EtherNet/IP™ direct input with STO sub-function	PROFINET direct input	PROFINET direct input with STO sub-function	DeviceNet® direct input	IO-Link direct input	IO-Link direct input with STO sub-function	CC-Link direct input
Compatible motor	Battery-less absolute (Step motor 24 VDC)										
Max. number of step data	64 points										
Power supply voltage	24 VDC										
Reference page	1017	1063									

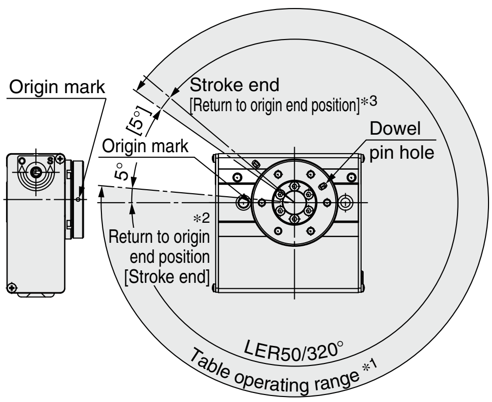
Specifications

Battery-less Absolute (Step Motor 24 VDC)

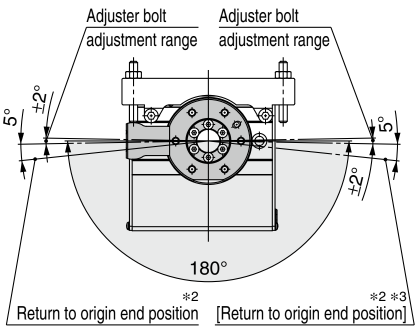
	Model		LER□50EK	LER□50EJ
Actuator specifications / Basic type	Rotation angle [°]		320	
	Lead [°]		7.5	12
	Max. rotating torque [N·m]		10	6.6
	Max. pushing torque 40 to 50% [N·m]*1 *3		4.0 to 5.0	2.6 to 3.3
	Max. moment of inertia [$kg \cdot m^2$]*2 *3		0.13	0.05
	Angular speed [°/s]*2 *3		20 to 280	30 to 420
	Pushing speed [°/s]		20	30
	Max. angular acceleration/deceleration [$°/s^2$]*2		3000	
	Backlash [°]	Basic type	±0.2	
		High-precision type	±0.1	
	Positioning repeatability [°]	Basic type	±0.05	
		High-precision type	±0.03	
	Lost motion [°]*4	Basic type	0.3 or less	
		High-precision type	0.2 or less	
	Impact/Vibration resistance [m/s^2]*5		150/30	
	Actuation type		Special worm gear + Belt drive	
	Max. operating frequency [c.p.m]		60	
	Operating temp. range [°C]		5 to 40	
	Operating humidity range [%RH]		90 or less (No condensation)	
	Enclosure		IP20	
	Weight [kg]	Basic type	2.2	
		High-precision type	2.4	
External stopper type	Rotation angle [°]	-2/ arm (1 pc.)	180	
		-3/ arm (2 pcs.)	90	
	Repeatability at the end [°]/ with external stopper		±0.01	
	External stopper setting range [°]		±2	
	Weight [kg] -2/external arm (1 pc.)	Basic type	2.5	
		High-precision type	2.7	
	Weight [kg] -3/external arm (1 pc.)	Basic type	2.6	
		High-precision type	2.8	
Electric specifications	Motor size		□42	
	Motor type		Battery-less absolute (Step motor 24 VDC)	
	Encoder		Battery-less absolute	
	Power supply voltage [V]		24 VDC ±10%	
	Power [W]*6		Max. power 57	

*1 Pushing force accuracy is LER50: ±20% (F.S.).
*2 The angular acceleration, angular deceleration, and angular speed may fluctuate due to variations in the moment of inertia.
Refer to the "Moment of Inertia—Angular Acceleration/ Deceleration, Effective Torque—Angular Speed" graphs on page 773 for confirmation.
*3 The speed and force may change depending on the cable length, load, and mounting conditions. Furthermore, if the cable length exceeds 5 m, then it will decrease by up to 10% for each 5 m. (At 15 m: Reduced by up to 20%)
*4 A reference value for correcting errors in reciprocal operation
*5 Impact resistance: No malfunction occurred when the actuator was tested with a drop tester in both an axial direction and a perpendicular direction to the lead screw. (The test was performed with the actuator in the initial state.)
Vibration resistance: No malfunction occurred in a test ranging between 45 to 2000 Hz. The test was performed in both an axial direction and a perpendicular direction to the lead screw. (The test was performed with the actuator in the initial state.)
*6 Indicates the max. power during operation (including the controller)
This value can be used for the selection of the power supply.

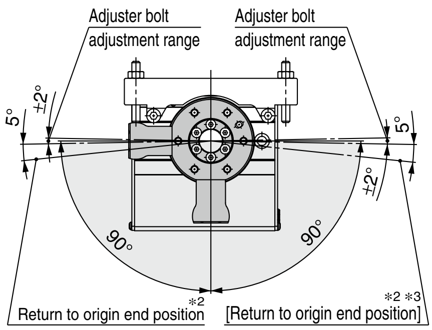
Table Rotation Angle Range



External stopper: 180°



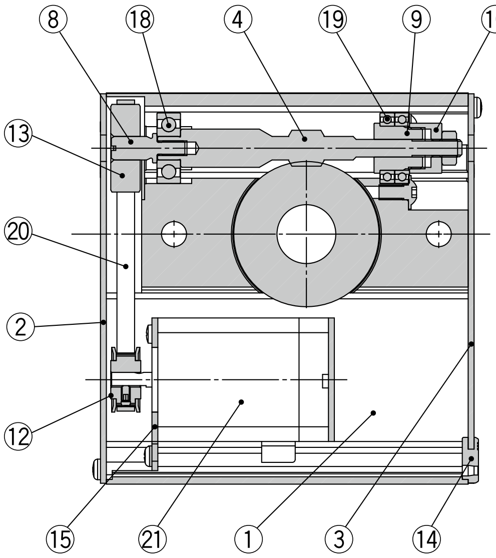
External stopper: 90°



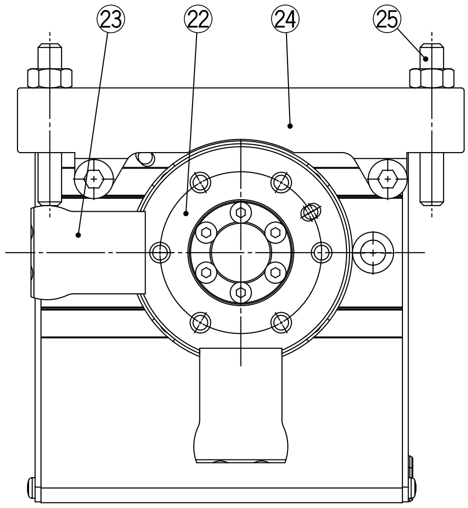
* The figures show the origin position for each actuator.

*1 This is the range within which the table can move when it returns to origin.
Make sure that workpieces mounted on the table do not interfere with other workpieces or the facilities around the table.
*2 Position after returning to origin. The position varies depending on whether there is an external stopper.
*3 [ ] for when the direction of return to origin has changed

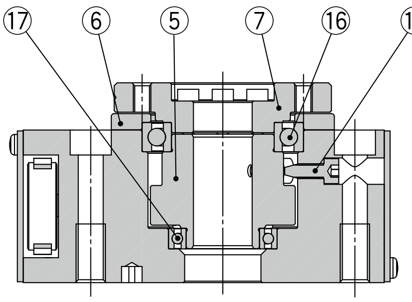
Construction



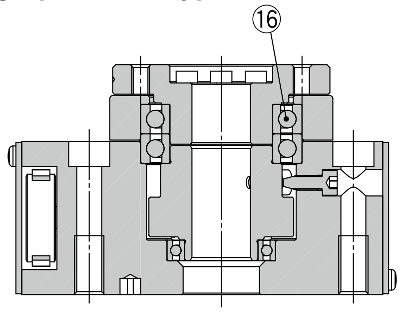
External stopper type



Basic type



High-precision type



Component Parts

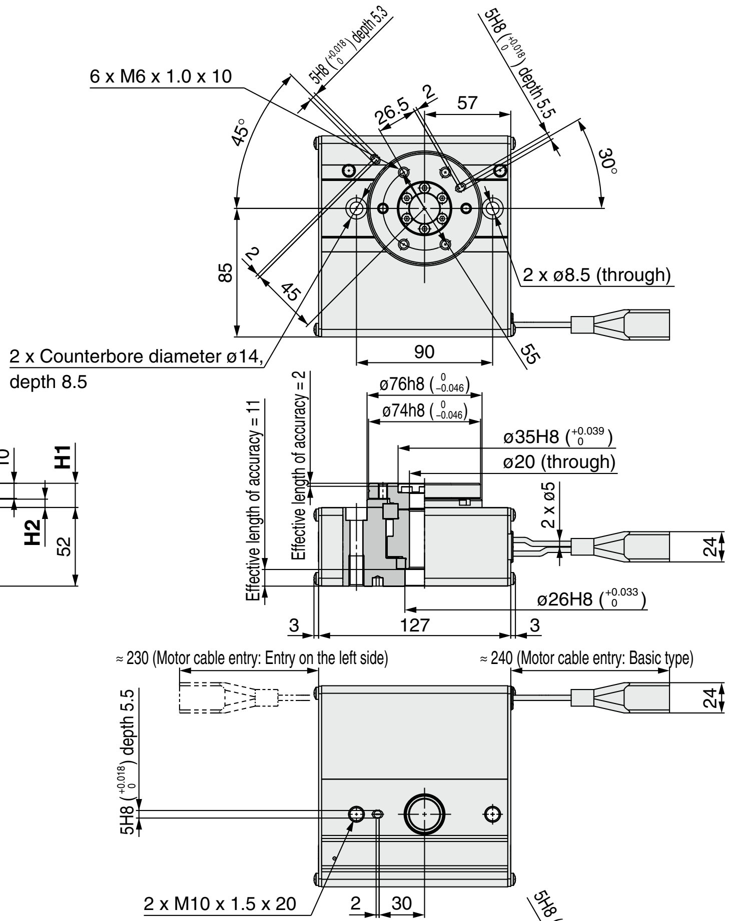
No.	Description	Material	Note
1	**Body**	Aluminum alloy	Anodized
2	**Side plate A**	Aluminum alloy	Anodized
3	**Side plate B**	Aluminum alloy	Anodized
4	**Worm screw**	Stainless steel	Heat treatment + Special treatment
5	**Worm wheel**	Stainless steel	Heat treatment + Special treatment
6	**Bearing cover**	Aluminum alloy	Anodized
7	**Table**	Aluminum alloy	
8	**Joint**	Stainless steel	
9	**Bearing holder**	Alloy steel	
10	**Bearing stopper**	Alloy steel	
11	**Origin bolt**	Carbon steel	
12	**Pulley A**	Aluminum alloy	
13	**Pulley B**	Aluminum alloy	
14	**Grommet**	NBR	
15	**Motor plate**	Carbon steel	
16	**Basic type**: Deep groove ball bearing	—	
	High-precision type: Special ball bearing		
17	**Deep groove ball bearing**	—	
18	**Deep groove ball bearing**	—	
19	**Deep groove ball bearing**	—	
20	**Belt**	—	
21	**Battery-less absolute (Step motor 24 VDC)**	—	

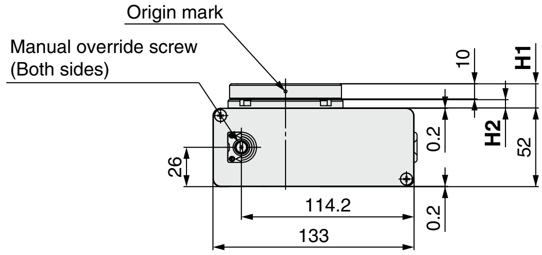
Component Parts

No.	Description	Material	Note
22	**Table**	Aluminum alloy	Anodized
23	**Arm**	Carbon steel	Heat treatment + Electroless nickel treated
24	**Holder**	Aluminum alloy	Anodized
25	**Adjuster bolt**	Carbon steel	Heat treatment + Chromating

Dimensions

LER□50E□ (Rotation angle: 320°)

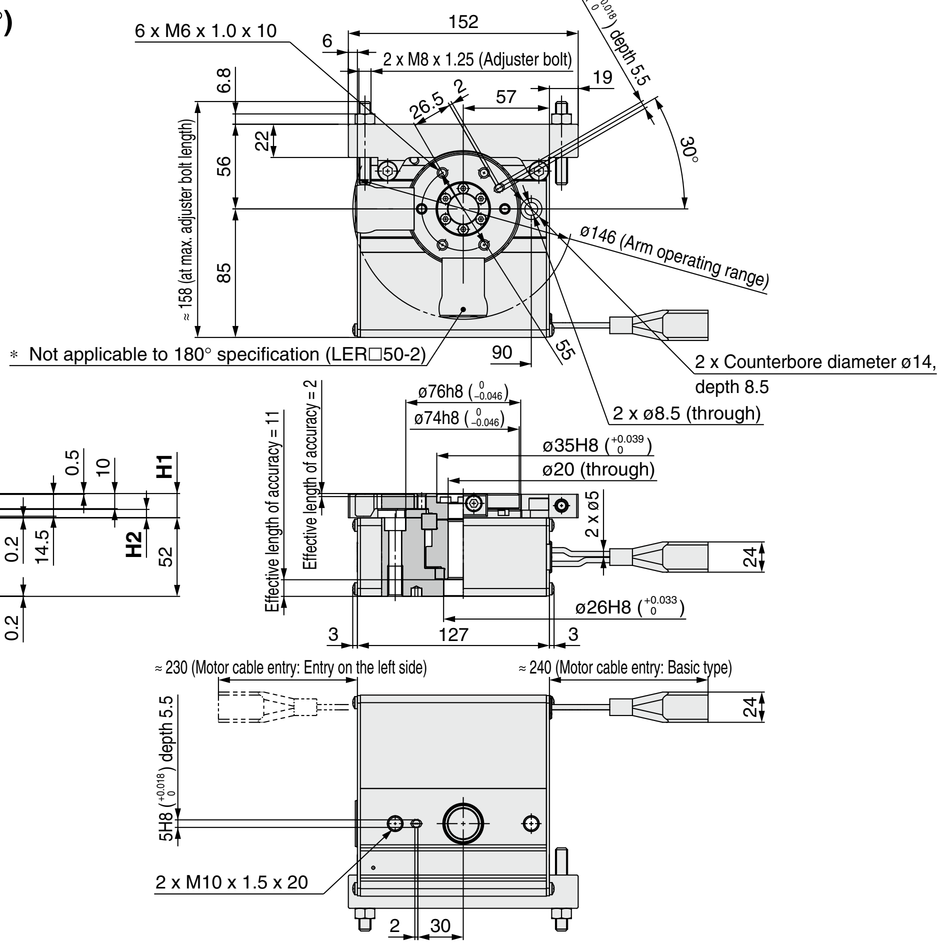


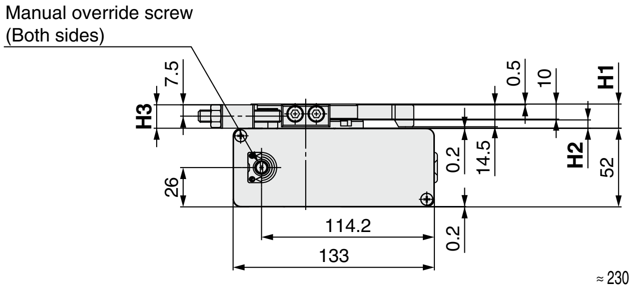


Dimensions [mm]

Model	H1	H2
LER50	16	5.5
LERH50	26	15.5

LER□50E-2 (Rotation angle: 180°)
LER□50E-3 (Rotation angle: 90°)





Dimensions [mm]

Model	H1	H2	H3
LER50	16	5.5	15.5
LERH50	26	15.5	25.5

SMC

LER Series
Battery-less Absolute Encoder Type Specific Product Precautions

Be sure to read this before handling the products. Refer to page 1351 for safety instructions and pages 1352 to 1357 for electric actuator precautions.

Handling

⚠Caution

1. Absolute encoder ID mismatch error at the first connection

In the following cases, an “ID mismatch error” alarm occurs after the power is turned ON. Perform a return to origin operation after resetting the alarm before use.

· When an electric actuator is connected and the power is turned ON for the first time after purchase∗1

· When the actuator or motor is replaced

· When the controller is replaced

∗1 If you have purchased an electric actuator and controller with the set part number, the pairing may have already been completed and the alarm may not be generated.

“ID mismatch error”

Operation is enabled by matching the encoder ID on the electric actuator side with the ID registered in the controller. This alarm occurs when the encoder ID is different from the registered contents of the controller. By resetting this alarm, the encoder ID is registered (paired) to the controller again.

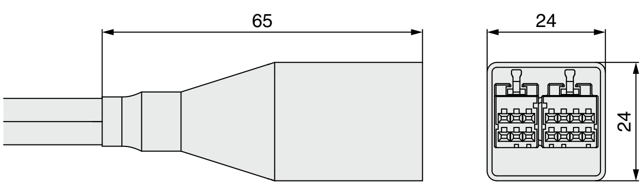
When a controller is changed after pairing is completed				
	Encoder ID no. (∗ Numbers below are examples.)			
Actuator	17623	17623	17623	17623
Controller	17623	17699	17699	17623
ID mismatch error occurred?	No	Yes	Error reset ⇒ No	

2. In environments where strong magnetic fields are present, use may be limited.

A magnetic sensor is used in the encoder. Therefore, if the actuator motor is used in an environment where strong magnetic fields are present, malfunction or failure may occur.
Do not expose the actuator motor to magnetic fields with a magnetic flux density of 1 mT or more.
When installing an electric actuator and an air cylinder with an auto switch (ex. CDQ2 series) or multiple electric actuators side by side, maintain a space of 40 mm or more around the motor. Refer to the construction drawing of the actuator motor.

3. The connector size of the motor cable is different from that of the electric actuator with an incremental encoder.

The motor cable connector of an electric actuator with a battery-less absolute encoder is different from that of an electric actuator with an incremental encoder. As the connector cover dimensions are different, take the dimensions below into consideration during the design process.



Battery-less absolute encoder connector cover dimensions