ROBO CYLINDER

Direct Drive Motor

Instruction Manual

Fourth Edition

IAI America, Inc.

Please Read Before Use

Thank you for purchasing our product.

This Instruction Manual describes all necessary information to operate this product safely such as the operation procedure, structure and maintenance procedure.
Before operation, read this manual carefully and fully understand it to operate this product safely.

The DVD that comes with the product contains instruction manuals for IAI products.
For a use of the products, print out or display on your personal computer the necessary pages of the applicable Instruction Manuals.

After reading the Instruction Manuals, be sure to keep them in a convenient place easily accessible to the personnel using this product.

[Important]

- This Instruction Manual is original.
- This product is not to be used for any other purpose from what is noted in this Instruction Manual. IAI shall not be liable whatsoever for any loss or damage arising from the result of using the product for any other purpose from what is noted in the manual.
- The information contained in this Instruction Manual is subject to change without notice for the purpose of production improvement.
- If you have any question or finding regarding the information contained in this Instruction Manual, contact our customer center or our sales office near you.
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Table of Contents

Safety Guide

“Safety Guide” has been written to use the machine safely and so prevent personal injury or property damage beforehand. Make sure to read it before the operation of this product.

Safety Precautions for Our Products

The common safety precautions for the use of any of our robots in each operation.

No.	Operation Description	Description
1	Model Selection	● This product has not been planned and designed for the application where high level of safety is required, so the guarantee of the protection of human life is impossible. Accordingly, do not use it in any of the following applications. 1) Medical equipment used to maintain, control or otherwise affect human life or physical health. 2) Mechanisms and machinery designed for the purpose of moving or transporting people (For vehicle, railway facility or air navigation facility) 3) Important safety parts of machinery (Safety device, etc.) ● Do not use the product outside the specifications. Failure to do so may considerably shorten the life of the product. ● Do not use it in any of the following environments. 1) Location where there is any inflammable gas, inflammable object or explosive 2) Place with potential exposure to radiation 3) Location with the ambient temperature or relative humidity exceeding the specification range 4) Location where radiant heat is added from direct sunlight or other large heat source 5) Location where condensation occurs due to abrupt temperature changes 6) Location where there is any corrosive gas (sulfuric acid or hydrochloric acid) 7) Location exposed to significant amount of dust, salt or iron powder 8) Location subject to direct vibration or impact ● For an actuator used in vertical orientation, select a model which is equipped with a brake. If selecting a model with no brake, the moving part may drop when the power is turned OFF and may cause an accident such as an injury or damage on the work piece.

No.	Operation Description	Description
2	Transportation	● When carrying a heavy object, do the work with two or more persons or utilize equipment such as crane. ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When in transportation, consider well about the positions to hold, weight and weight balance and pay special attention to the carried object so it would not get hit or dropped. ● Transport it using an appropriate transportation measure. The actuators available for transportation with a crane have eyebolts attached or there are tapped holes to attach bolts. Follow the instructions in the instruction manual for each model. ● Do not step or sit on the package. ● Do not put any heavy thing that can deform the package, on it. ● When using a crane capable of 1t or more of weight, have an operator who has qualifications for crane operation and sling work. ● When using a crane or equivalent equipments, make sure not to hang a load that weighs more than the equipment's capability limit. ● Use a hook that is suitable for the load. Consider the safety factor of the hook in such factors as shear strength. ● Do not get on the load that is hung on a crane. ● Do not leave a load hung up with a crane. ● Do not stand under the load that is hung up with a crane.
3	Storage and Preservation	● The storage and preservation environment conforms to the installation environment. However, especially give consideration to the prevention of condensation. ● Store the products with a consideration not to fall them over or drop due to an act of God such as earthquake.
4	Installation and Start	(1) Installation of Robot Main Body and Controller, etc. ● Make sure to securely hold and fix the product (including the work part). A fall, drop or abnormal motion of the product may cause a damage or injury. Also, be equipped for a fall-over or drop due to an act of God such as earthquake. ● Do not get on or put anything on the product. Failure to do so may cause an accidental fall, injury or damage to the product due to a drop of anything, malfunction of the product, performance degradation, or shortening of its life. ● When using the product in any of the places specified below, provide a sufficient shield. 1) Location where electric noise is generated 2) Location where high electrical or magnetic field is present 3) Location with the mains or power lines passing nearby 4) Location where the product may come in contact with water, oil or chemical droplets

No.	Operation Description	Description
4	Installation and Start	(2) Cable Wiring ● Use our company's genuine cables for connecting between the actuator and controller, and for the teaching tool. ● Do not scratch on the cable. Do not bend it forcibly. Do not pull it. Do not coil it around. Do not insert it. Do not put any heavy thing on it. Failure to do so may cause a fire, electric shock or malfunction due to leakage or continuity error. ● Perform the wiring for the product, after turning OFF the power to the unit, so that there is no wiring error. ● When the direct current power (+24V) is connected, take the great care of the directions of positive and negative poles. If the connection direction is not correct, it might cause a fire, product breakdown or malfunction. ● Connect the cable connector securely so that there is no disconnection or looseness. Failure to do so may cause a fire, electric shock or malfunction of the product. ● Never cut and/or reconnect the cables supplied with the product for the purpose of extending or shortening the cable length. Failure to do so may cause the product to malfunction or cause fire.
		(3) Grounding ● The grounding operation should be performed to prevent an electric shock or electrostatic charge, enhance the noise-resistance ability and control the unnecessary electromagnetic radiation. ● For the ground terminal on the AC power cable of the controller and the grounding plate in the control panel, make sure to use a twisted pair cable with wire thickness 0.5mm^2 (AWG20 or equivalent) or more for grounding work. For security grounding, it is necessary to select an appropriate wire thickness suitable for the load. Perform wiring that satisfies the specifications (electrical equipment technical standards). ● Perform Class D Grounding (former Class 3 Grounding with ground resistance 100Ω or below).

No.	Operation Description	Description
4	Installation and Start	(4) Safety Measures ● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● When the product is under operation or in the ready mode, take the safety measures (such as the installation of safety and protection fence) so that nobody can enter the area within the robot's movable range. When the robot under operation is touched, it may result in death or serious injury. ● Make sure to install the emergency stop circuit so that the unit can be stopped immediately in an emergency during the unit operation. ● Take the safety measure not to start up the unit only with the power turning ON. Failure to do so may start up the machine suddenly and cause an injury or damage to the product. ● Take the safety measure not to start up the machine only with the emergency stop cancellation or recovery after the power failure. Failure to do so may result in an electric shock or injury due to unexpected power input. ● When the installation or adjustment operation is to be performed, give clear warnings such as "Under Operation; Do not turn ON the power!" etc. Sudden power input may cause an electric shock or injury. ● Take the measure so that the work part is not dropped in power failure or emergency stop. ● Wear protection gloves, goggle or safety shoes, as necessary, to secure safety. ● Do not insert a finger or object in the openings in the product. Failure to do so may cause an injury, electric shock, damage to the product or fire. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity.
5	Teaching	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the teaching operation from outside the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the "Stipulations for the Operation" and make sure that all the workers acknowledge and understand them well. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign "Under Operation" at the position easy to see. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.

No.	Operation Description	Description
6	Trial Operation	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● After the teaching or programming operation, perform the check operation one step by one step and then shift to the automatic operation. ● When the check operation is to be performed inside the safety protection fence, perform the check operation using the previously specified work procedure like the teaching operation. ● Make sure to perform the programmed operation check at the safety speed. Failure to do so may result in an accident due to unexpected motion caused by a program error, etc. ● Do not touch the terminal block or any of the various setting switches in the power ON mode. Failure to do so may result in an electric shock or malfunction.
7	Automatic Operation	● Check before starting the automatic operation or rebooting after operation stop that there is nobody in the safety protection fence. ● Before starting automatic operation, make sure that all peripheral equipment is in an automatic-operation-ready state and there is no alarm indication. ● Make sure to operate automatic operation start from outside of the safety protection fence. ● In the case that there is any abnormal heating, smoke, offensive smell, or abnormal noise in the product, immediately stop the machine and turn OFF the power switch. Failure to do so may result in a fire or damage to the product. ● When a power failure occurs, turn OFF the power switch. Failure to do so may cause an injury or damage to the product, due to a sudden motion of the product in the recovery operation from the power failure.

No.	Operation Description	Description
8	Maintenance and Inspection	● When the work is carried out with 2 or more persons, make it clear who is to be the leader and who to be the follower(s) and communicate well with each other to ensure the safety of the workers. ● Perform the work out of the safety protection fence, if possible. In the case that the operation is to be performed unavoidably inside the safety protection fence, prepare the “Stipulations for the Operation” and make sure that all the workers acknowledge and understand them well. ● When the work is to be performed inside the safety protection fence, basically turn OFF the power switch. ● When the operation is to be performed inside the safety protection fence, the worker should have an emergency stop switch at hand with him so that the unit can be stopped any time in an emergency. ● When the operation is to be performed inside the safety protection fence, in addition to the workers, arrange a watchman so that the machine can be stopped any time in an emergency. Also, keep watch on the operation so that any third person can not operate the switches carelessly. ● Place a sign “Under Operation” at the position easy to see. ● For the grease for the guide or ball screw, use appropriate grease according to the Instruction Manual for each model. ● Do not perform the dielectric strength test. Failure to do so may result in a damage to the product. ● When releasing the brake on a vertically oriented actuator, exercise precaution not to pinch your hand or damage the work parts with the actuator dropped by gravity. ● The slider or rod may get misaligned OFF the stop position if the servo is turned OFF. Be careful not to get injured or damaged due to an unnecessary operation. ● Pay attention not to lose the cover or untightened screws, and make sure to put the product back to the original condition after maintenance and inspection works. Use in incomplete condition may cause damage to the product or an injury. * Safety protection Fence : In the case that there is no safety protection fence, the movable range should be indicated.
9	Modification and Dismantle	● Do not modify, disassemble, assemble or use of maintenance parts not specified based at your own discretion.
10	Disposal	● When the product becomes no longer usable or necessary, dispose of it properly as an industrial waste. ● When removing the actuator for disposal, pay attention to drop of components when detaching screws. ● Do not put the product in a fire when disposing of it. The product may burst or generate toxic gases.
11	Other	● Do not come close to the product or the harnesses if you are a person who requires a support of medical devices such as a pacemaker. Doing so may affect the performance of your medical device. ● See Overseas Specifications Compliance Manual to check whether complies if necessary. ● For the handling of actuators and controllers, follow the dedicated instruction manual of each unit to ensure the safety.

Alert Indication

The safety precautions are divided into “Danger”, “Warning”, “Caution” and “Notice” according to the warning level, as follows, and described in the Instruction Manual for each model.

Level	Degree of Danger and Damage	Symbol
Danger	This indicates an imminently hazardous situation which, if the product is not handled correctly, will result in death or serious injury.	 Danger
Warning	This indicates a potentially hazardous situation which, if the product is not handled correctly, could result in death or serious injury.	 Warning
Caution	This indicates a potentially hazardous situation which, if the product is not handled correctly, may result in minor injury or property damage.	 Caution
Notice	This indicates lower possibility for the injury, but should be kept to use this product properly.	 Notice

Caution in Handling

1. Ensure use of the product in the specified conditions, environments and ranges.
   Not doing so may cause a drop in performance or malfunction of the product.

2. Do not attempt to handle or operate in a way not described in this instruction manual.

3. Make sure to attach the actuator properly by following this instruction manual.
   Using the product with the actuator not being certainly retained or affixed may cause abnormal noise, vibration, malfunction or shorten the product life.

4. It is recommended to apply our products for the wiring between the actuator and the controller.

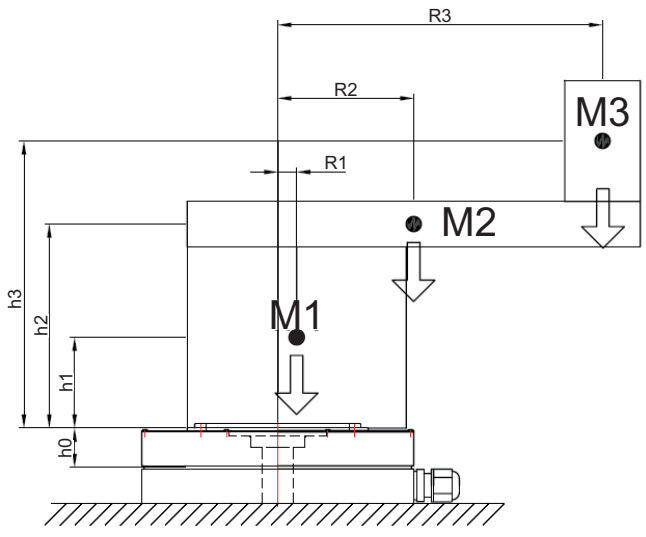
5. To have an optimized operation, make sure to input the gain parameters that suit to the mounted load inertia.
   In case of optimized selection of gain parameters not being made, it may cause an unexpected operation error such as vibration or overshoot.
   [Refer to Section 4.2]

6. Use this product in a condition that it is installed on a surface that possesses a characteristic of heat radiation equivalent to an aluminum plate sized 400 × 400 × t10.
   Contact us in case the heat radiation condition for installation is worse than described above.

7. The temperature on the surface gets high while in an operation. (It rises up to around approximately 70°C even with a heatsink plate described in 6 depending on the condition of use.) Be careful.

8. The product possesses magnetic field of approximately 30 [mT] in the hollow area due to the impact of the magnet inside.

9. Use the product below the allowable load.
   Pay special attention to the load moment, load inertia and thrust load applied to the rotary table. [Refer to Section 1.3]
   If moment load is applied, the rotary table will generate a wobble caused by the moment stiffness of the product.



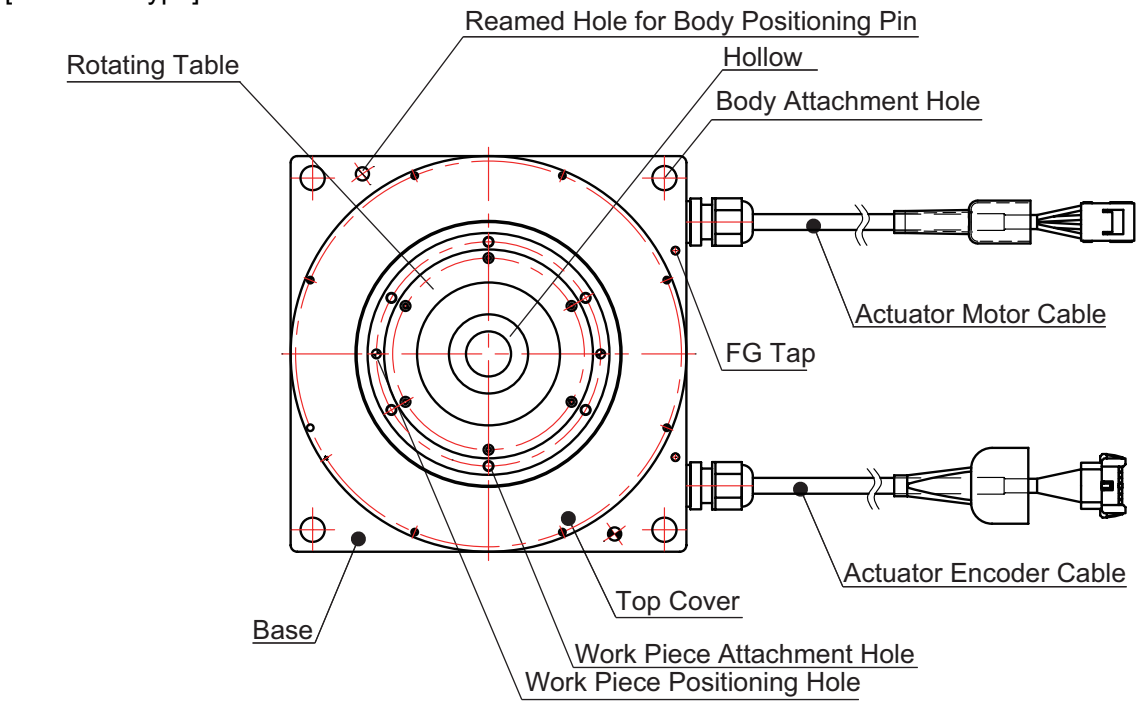
International Standards Compliances

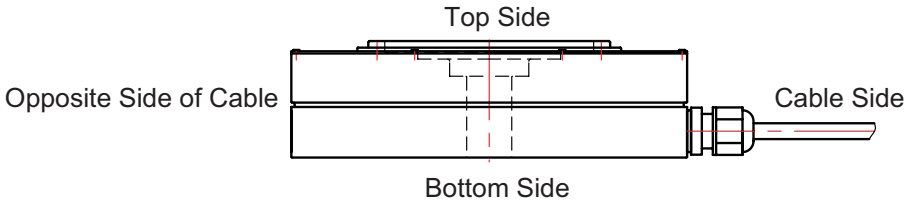
This actuator complies with the following overseas standards.

RoHS Directive	CE Marking	UL
○	Acquirement planned	×

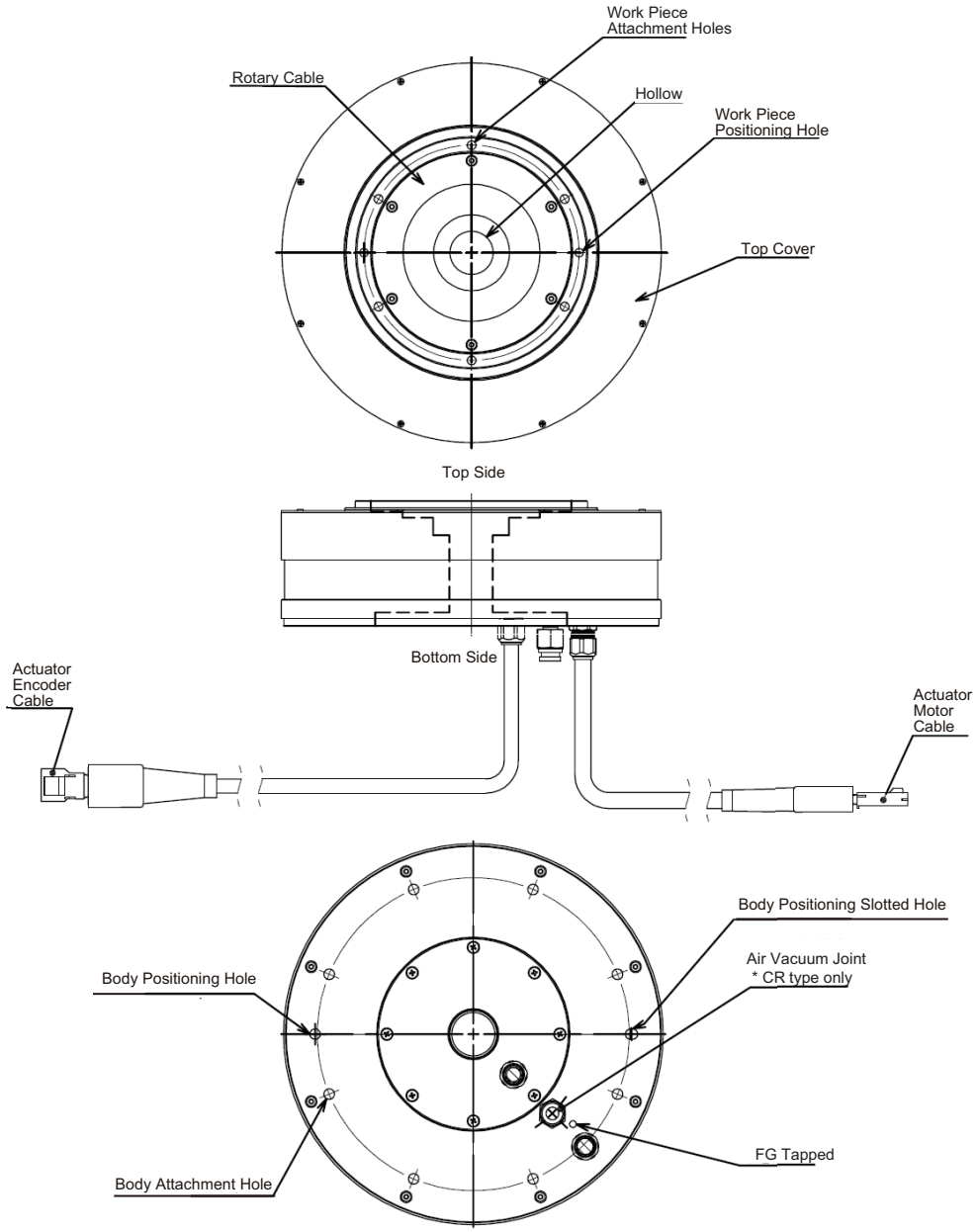
Names of the Parts

[Standard Type]





[Flangeless Type]



1. Specifications Check

1.1 Checking the Product

The standard configuration of this product is comprised of the following parts.
See the component list for the details of the enclosed components. If you find any fault or missing parts, contact your local IAI distributor.

1.1.1 Parts

No.	Name	Model number	Quantity	Remarks
1	Actuator	Refer to “How to Read the Model Nameplate” and “How to Read the Model Number.”	1	
Accessories				
2	Motor Robot Cables (Note 1)	CB-X-MA□□□	1	
3	Encoder Robot Cables	CB-X3-PA□□□	1	
4	First Step Guide		1	
5	Operation Manual (DVD)		1	
6	Safety Guide		1	

Note 1 Package might be separately provided in some cases depending on the cable length of your order.

1.1.2 Instruction Manuals Related to This Product

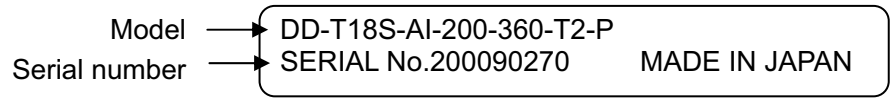
(1) X-SEL P/Q R/S Controllers

No.	Name	Control No.
1	XSEL-P/Q Controller Instruction Manual	ME0148
2	XSEL-R/S Controller Instruction Manual	ME0313
3	XSEL-P/Q/PX/QX Controller Gateway Function Instruction Manual	ME0188
4	X-SEL Controller P/Q Vision System I/F Function Instruction Manual	ME0269
5	XSEL-P/Q R/S Function of Electronic Cam Instruction Manual	ME0246
6	PC Software IA-101-X-MW/IA-101-X-USBMW Instruction Manual	ME0154
7	Teaching Pendant TB-01 Instruction Manual	ME0325
8	Teaching Pendant SEL-T/TD/TG Instruction Manual	ME0183
9	Teaching Pendant IA-T-X/XD Instruction Manual	ME0160
10	DeviceNet Instruction Manual	ME0124
11	CC-Link Instruction Manual	ME0123
12	PROFIBUS Instruction Manual	ME0153
13	XSEL Ethernet Instruction Manual	ME0140

(2) SCON-CA Controller

No.	Name	Control No.
1	SCON-CA Controller Instruction Manual	ME0243
2	PC Software RCM-101-MW/RCM-101-USB Instruction Manual	ME0155
3	Teaching Pendant TB-01 Instruction Manual	ME0325
4	Teaching Pendant CON-T/TG Instruction Manual	ME0178
5	Touch Panel Teaching CON-PT/PD/PG Instruction Manual	ME0227
6	DeviceNet Instruction Manual	ME0124
7	CC-Link Instruction Manual	ME0123
8	PROFIBUS Instruction Manual	ME0153

1.1.3 How to Read the Model Nameplate



1.1.4 How to Read the Model Number

DD - T18S - AI – 200 - 360 - T2 - P - **

<Series Name>
DD : Standard Type
DDCR : Cleanroom Type

<Type>
T18S : Standard opening diameter slim type Standard type (17bit encoder)
T18P : Standard opening diameter slim type High resolution type (20bit encoder)
H18S : Standard opening diameter high torque type Standard type (17bit encoder)
H18P : Standard opening diameter high torque type High resolution type (20bit encoder)
LT18S : Large opening diameter slim type Standard type (17bit encoder)
LT18P : Large opening diameter slim type High resolution type (20bit encoder)
LH18S : Large opening diameter High Torque Type Standard type (17bit encoder)
LH18P : Large opening diameter high torque type High resolution type (20bit encoder)
T18CS : Standard opening diameter slim flangeless type Standard type (17bit encoder)
T18CP : Standard opening diameter slim flangeless type High resolution type (20bit encoder)
H18CS : Standard opening diameter high torque flangeless type Standard type (17bit encoder)
H18CP : Standard opening diameter high torque flangeless type High resolution type (20bit encoder)
LT18CS : Large opening diameter slim flangeless type Standard type (17bit encoder)
LT18CP : Large opening diameter slim flangeless type High resolution type (20bit encoder)
LH18CS : Large opening diameter high torque flangeless type Standard type (17bit encoder)
LH18CP : Large opening diameter high torque flangeless type High resolution type (20bit encoder)

Identification for IAI use only (Note 1)

<Cable Length>
N : None
S : 3m
M : 5m
X□□ : Length specification

<Applicable Controller>
T2 : XSEL-P/Q/R/S SCON-CA
* 20-bit encoder is applicable only to SCON-CA.

<Stroke>
360 : 360 deg

<Motor Output>
200 : Applicable for 200W motor
600 : Applicable for 600W motor

<Encoder Type>
AI : Index absolute type
AM : Multi-rotation absolute type

Note 1 Identification for IAI use only: This may be marked for the purpose of IAI. It is not an ID to describe the model type.

1.2 Specification

1.2.1 Basic Specifications

Item		Specification	
		Slim Type (T18, LT18)	High Torque Type(H18, LH18)
Rotating Angle		359.999 deg	
Rated Torque		8.4N·m	25N·m
Instantaneous Max. Torque		25.2N·m	75N·m
Rated Angular Velocity		1,080 deg/sec	1,440 deg/sec 800 deg/sec (Flangeless)
Maximum Angular Velocity		1,800 deg/sec	1,440 deg/sec
Maximum Acceleration/ Deceleration Speed (Reference)		Refer to Section 4.2.2 Load Inertia - Gain Parameter List	
Allowable Thrust Load (Note 1)		3,400N (346.9kgf) Positive Direction (Note 3) / 250N(25.5kgf) Negative Direction (Note 3) (resolution: 17bit) 3,100N (316.3kgf) Positive Direction (Note 3) / 250N(25.5kgf) Negative Direction (Note 3) (resolution: 20bit)	
Allowable Moment Load		80N·m (Note 1)	
Rotor Inertia		0.001984kg·m^2	0.0106kg·m^2
Allowable Load Inertia		0.6kg·m^2 (=maximum torque/0.21G)	1.8kg·m^2 (=maximum torque/0.21G)
Positioning Repeatability		±0.0055 deg (resolution: 17bit) ±0.00103 deg (resolution: 20bit)	
Lost Motion		0.011 deg Max. (resolution: 17bit) 0.00206 deg Max. (resolution: 20bit)	
Loss Torque		4.0N·m max (Note 2)	
Encoder Resolution		131,072pulse/rev (17bit), 1,048,576pulse/rev (20bit)	
Usage Ambient Temp.		0 to 40°C	
Usage Ambient Humidity		20 to 85%	
Storage Ambient Temp.		-20 to 85°C	
Storage Ambient Humidity		20 to 85%	
Protection Class		IP40	
Mass	Standard	5.6kg (Standard opening diameter) 6.2kg (Large opening diameter)	13.6kg (Standard opening diameter) 13.2kg (Large opening diameter)
	Flangeless	5.6kg (Standard opening diameter) 5.8kg (Large opening diameter)	13.2kg (Standard opening diameter) 12.8kg (Large opening diameter)
Thrust (Axial) Rotary Wobble		30μm	
Radial Rotary Wobble		30μm	
Operation Range		0 to 359.999 deg (maximum ±9,999 deg (resolution: 17bit)) 0 to 359.999 deg (maximum ±2,520 deg (resolution: 20bit))	
Cleanliness (Cleanroom Specifications Only)		Class 10 (Note 4)	

Note 1 Load to make the product life L10 for 5 years under the condition of the rated rotation speed 8h/day and the load factor 1.2

Note 2 The motor is driven with a support of another device in the rated rotation speed and measure the maximum output torque with a torque motor

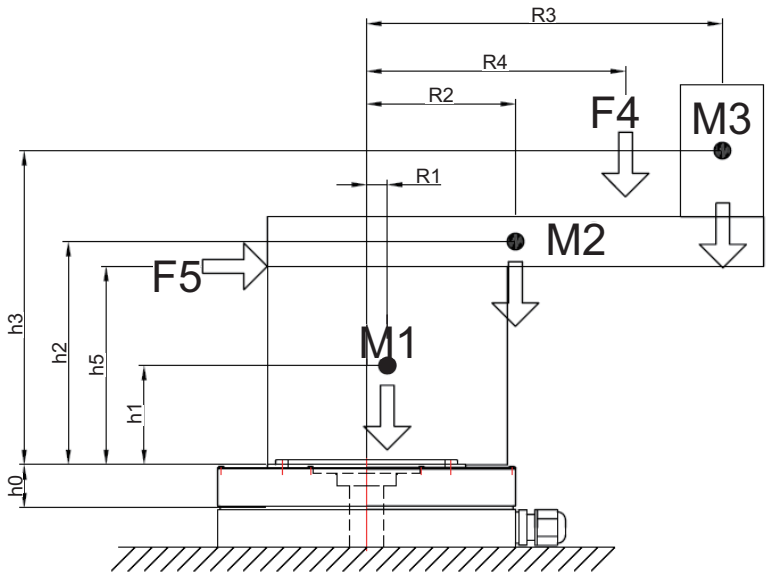
Note 3 Forward : Direction to press the rotor along the rotary axis towards the body side
Backward : Direction to pull the rotor along the rotary axis against the body side

Note 4 Vacuum Volume : at 35NL/min

1.3 Conditions for Selection

It is necessary to calculate the following three conditions of the mounted load when determining if this product can be used or not or when studying the operation patterns. Thrust load and load moment can give an impact to the product life while load inertia can give an impact to the operational characteristics.

1. Thrust load
2. Load moment
3. Load inertia



M1, M2, M3	:	Mounted Mass	[kg]
F4	:	Axial External Force	[N]
F5	:	Radial External Force	[N]

In the following, explains about the each Item.

1.3.1 Thrust Load

It is the sum of the gravity applied to the mounted load and the thrust external force applied to the mounted load.
Thrust Load = M1 + M2 + M3 + F4

Allowable Thrust Load：3,400N (346.9kgf)

1.3.2 Load Moment

It is the sum of the moment load applied to the bearings in this product. It is the total value of the figures calculated for the following items.

- Moment caused by the gravity applied to the mounted load
- Moment caused by the centrifugal force of the rotary movement during the operation
- Moment caused by the thrust external force
- Moment caused by the radial external force

Load moment [N•m] = Make sure the moment generated by gravity + Moment caused by centrifugal force + Moment caused by the axial external force + Moment caused by the radial external force

Make sure the moment generated by gravity = $M1 \times R1 + M2 \times R2 + M3 \times R3$

Moment caused by centrifugal force = $M1 \times R1 \times \omega^2 \times (h0 + h1) + M2 \times R2 \times \omega^2 \times (h0 + h2) + M3 \times R3 \times \omega^2 \times (h0 + h3)$

Moment caused by the axial external force = $F4 \times R4$

Moment caused by the radial external force = $F5 \times h5$

Angular velocity: ω [rad/s]
Mass of loaded piece: M1, M2, M3 [kg]
Rotation radius of the center of gravity of mounted load: R1, R2, R3 [m]
Height of the center of gravity of mounted load from work piece attachment surface: h1, h2, h3 [m]
Height from the center of bearing to work piece attachment surface: h0 [m]
Axial external force: F4[N]
Radial external force: F5[N]
Distance of axial external force center: R4 [m]
Height of radial external force: h5 [m]

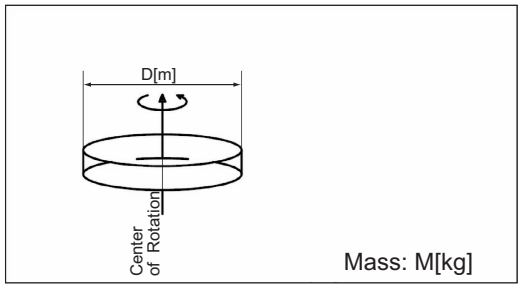
Allowable moment load: 80N•m

1.3.3 Load Inertia

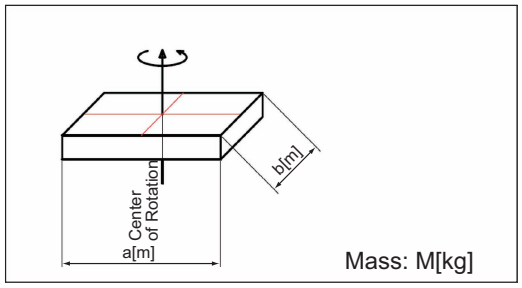
It is the inertia of the mounted load for the center of the rotary table. The settings for the angular acceleration, angular velocity and the gain parameters of the rotary table are established based on this value. In this instruction manual, the inertia is expressed in the unit of kg•m^2.

[Calculation of Load Inertia]

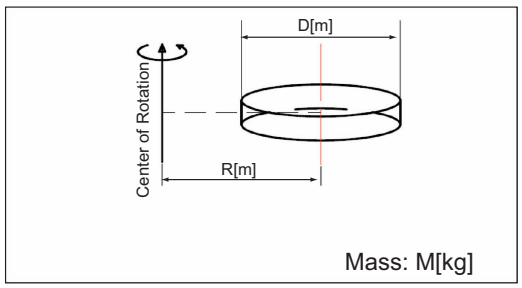
To set up the driver parameter appropriately, it is necessary to figure out the load inertia. Calculate the load inertia for the center of rotation by referring to a textbook that describes general formulas.
Shown below is a typical formula to calculate the load inertia.



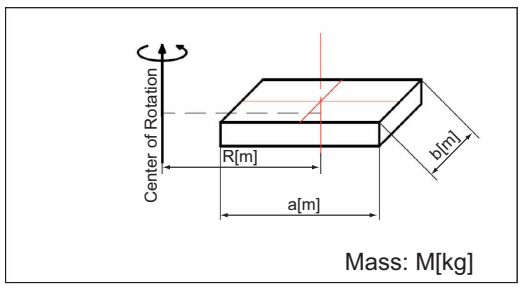
$J = 1/8 \times M \times D^2$ [kg•m^2]



$J = 1/12 \times M \times (a^2 + b^2)$ [kg•m^2]



$J = M \times R^2 + 1/8 \times M \times D^2$ [kg•m^2]



$J = M \times R^2 + 1/12 \times M \times (a^2 + b^2)$ [kg•m^2]

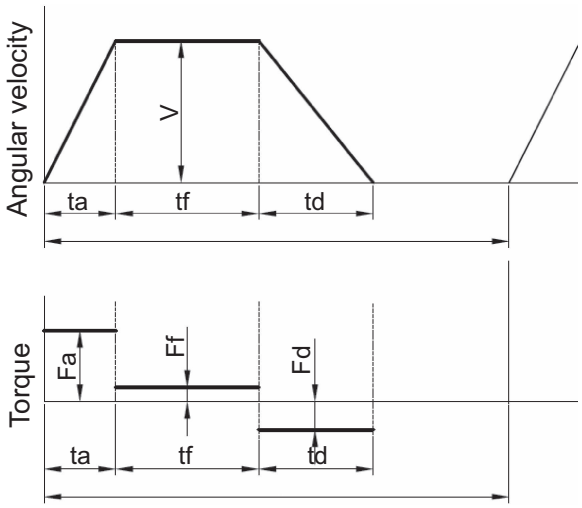
Allowable load inertia : 0.6 kg•m^2 (=Maximum torque/0.21G)

1.3.4 Calculation for Operation Mode

Follow the steps below for the study of the operation mode.

1. Tentatively set operation mode
2. Calculate acceleration from operation mode
3. Calculate continuous operation mode from operation mode
4. Calculate continuous operation speed from operation mode

1. Set the operation mode tentatively as shown in the figure below.



t : Operation time in one cycle [sec]
ta : Acceleration time [sec]
tf : Operation time with rated speed [sec]
td : Deceleration time [sec]
V : Velocity

Fa : Torque required for acceleration [N•m]
Ff : Loss torque [N•m]
Fd : Torque required for deceleration [N•m]

2. Check on Acceleration/Deceleration

Make sure the acceleration set tentatively in the operation mode above is below the available acceleration figured out from the motor characteristics.

2-1 Tentative Acceleration = V/ta [deg/s^2]
Tentative Deceleration = V/td [deg/s^2]

2-2 Available Acceleration (Tmax – Tf) / (Ji + Jd) × K

Ji : Load inertia [kg·m^2]
Jd : Rotor inertia [kg·m^2]
Tmax : Max. motor torque [N·m]
Tf : Loss torque Calculate with the formula below.
Tf = 0.048 × (V / 360 × 2π) +0.5 [N•m]
K : Margin factor (ordinary set to 0.6)

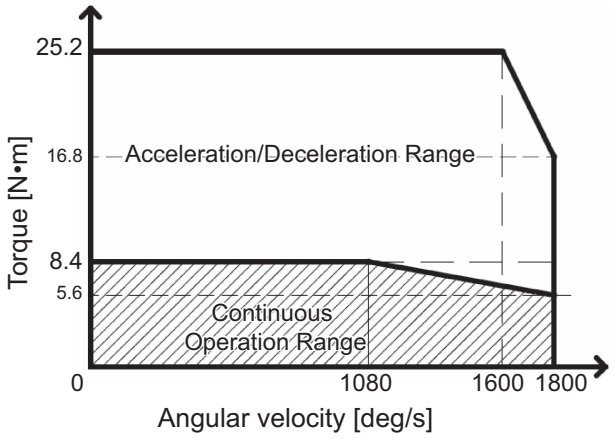
◆Available Acceleration ≥ Tentative Acceleration

3. Check on Availability of Continuous Operation

Check that the product can perform the continuous operation with the operation pattern (including the cycle time) set tentatively.
The continuous operation is available if the continuous operation torque and the continuous operation speed are in the continuous operation range shown below.

3-1 Figure out the continuous operation torque Trms with the following formula.
$Trms=[(Ta^2 \times ta + Tf^2 \times tb + Td^2 \times td) / t]^{0.5}$

3-2 Figure out the continuous operation speed Vrms with the following formula.
$Vrms=[(ta / 3 + tf + td / 3) \times V^2 / t]^{0.5}$

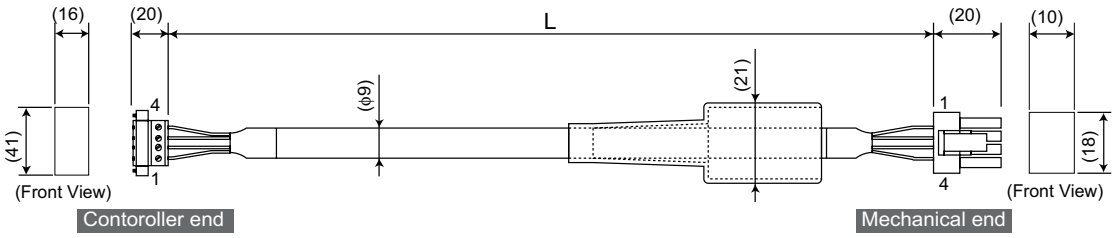


*Contact IAI when the continuous operation speed exceeds 1,080deg/s

1.4 Motor • Encoder Cables

1.4.1 Motor Cable

Model : CB-X-MA□□□
□□□ indicates the cable length (L) (Example: 030=3m), Max.20m



Width	Signal name	No.
0.75sq	PE	1
	U	2
	V	3
	W	4

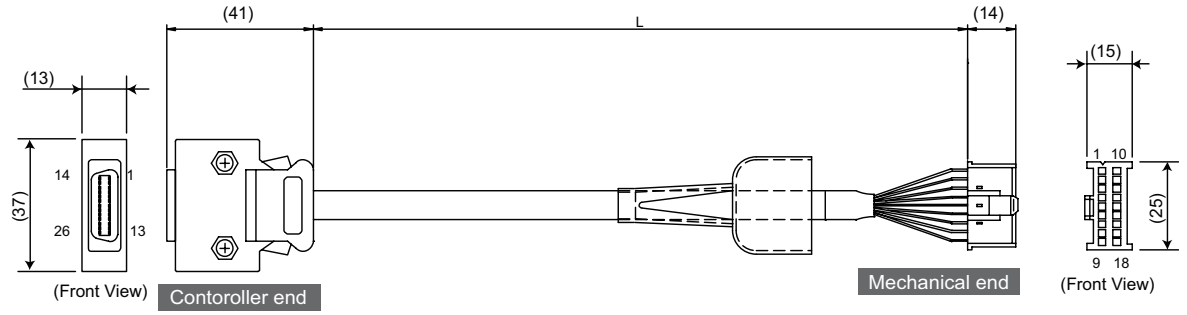
No.	Width	Signal name
1	U	0.75sq (Solderless)
2	V	
3	W	
4	PE	

Bending redius : 51mm

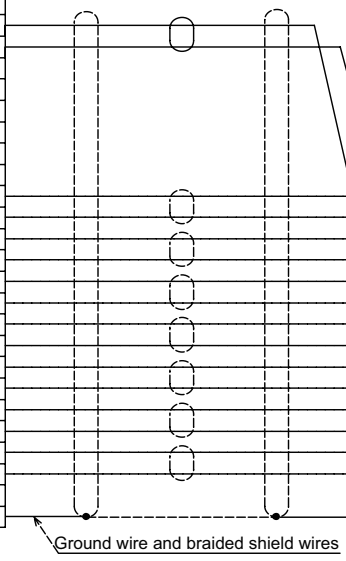
1.4.2 Encoder Cable

Model : CB-X3-PA□□□

□□□ indicates the cable length (L) (Example: 030=3m), Max.20m



Width	signal name	Color	No.
AWG26 (Soldered)	-	-	10
	-	-	
	E24V	-	12
	0V	GY/WT	13
	LS	BR/WT	26
	CLEEP	-	25
	OT	-	24
	RSV	-	23
	-	-	9
	-	-	18
	-	-	19
	A+	PK	1
	A-	PL	2
	B+	WT	3
	B-	BL/RD	4
	Z+	OR/WT	5
	Z-	GN/WT	6
	SRD+	BL	7
	SRD-	OR	8
	BAT+	BK	14
	BAT-	YW	15
	VCC	GN	16
	GND	BR	17
	BKR-	GY	20
	BKR+	RD	21
	-	-	22
The shield is clamped to the hood			



No.	Color	Signal name	Width
1	PK	A	AWG26 (Solderless)
2	PL	$\overline{A}$	
3	WT	B	
4	BL/RD	$\overline{B}$	
5	OR/WT	Z	
6	GN/WT	$\overline{Z}$	
7	BR/WT	LS+	
8	-	-	
9	Drain	FG	
10	BL	SD	
11	OR	$\overline{SD}$	
12	BK	BAT+	
13	YW	BAT-	
14	GN	VCC	
15	BR	GND	
16	GY/WT	LS-	
17	GY	BK-	
18	RD	BK+	

Bending radius : 58mm

2. Installation

2.1 Transportation

Unless otherwise specified, the actuators are wrapped individually when the product is shipped out.

[1] Handling of the Packed Product

- Do not damage or drop. The package is not applied with any special treatment that enables it to resist an impact caused by a drop or crash.
- An operator should never attempt to carry a heavy package on their own. Also, use an appropriate way for transportation.
- If the shipping box is to be left standing, it should be in a horizontal position. Follow the instruction if there is any for the packaging condition.
- Do not step or sit on the package.
- Do not put any load that may cause a deformation or breakage of the package.

[2] Handling after Unpackaged

- Do not carry the actuator by holding the cable, or do not move it by pulling the cable.
- Hold the body base when transporting the actuator.
- Do not hit or drop the product while carrying.
- Do not give any excessive force to any of the sections in the actuator.
- Do not hold the hollowed area.

2.2 Installation and Storage • Preservation Environment

[1] Installation Environment

Do not use this product in the following environments.
Also make sure to keep enough work space necessary for maintenance.

- Location exposed to radiant heat from a huge heat source such as the heat treatment
- Location where the surrounding air temperature exceeds the range of 0 to 40°C
- Location where condensation occurs due to abrupt temperature changes
- Location where relative humidity smaller than 20% or larger than 85%RH
- Location exposed to direct sunlight
- Location exposed to corrosive gases or combustible gases
- Location exposed to significant amount of dust, salt or iron powder (Outside of an ordinary assembly plant)
- Location where water, oil (includes oil mist and cutting fluid) or a chemical is splashed
- Location where the product main body receives vibration or hit impact
- Where the altitude is more than 2000m

When using the product in any of the locations specified below, provide a sufficient shield.
- Place subject to electrostatic noise
- Location where exposed to the influence of strong electric or magnetic field
- Location where exposed to the influence of ultraviolet or radiant rays

[2] Storage • Preservation Environment

- The storage and preservation environment should comply with the same standards as those for the installation environment. In particular, when the machine is to be stored for a long time, pay close attention to environmental conditions so that no dew condensation forms.
- Unless specially specified, moisture absorbency protection is not included in the package when the machine is delivered. In the case that the machine is to be stored and preserved in an environment where dew condensation is anticipated, take the condensation preventive measures from outside of the entire package, or directly after opening the package.
- For storage and preservation temperature, the machine withstands temperatures up to 60°C for a short time, but in the case of the storage and preservation period of 1 month or more, control the temperature to 50°C or less.
- Storage and preservation should be performed in the horizontal condition. In the case it is stored in the packaged condition, follow the orientation instruction if any displayed on the package.

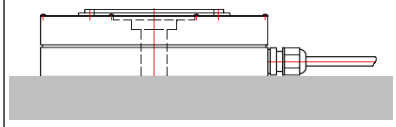
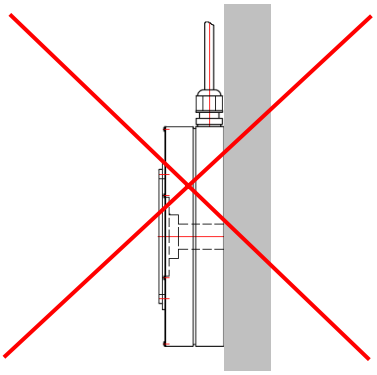
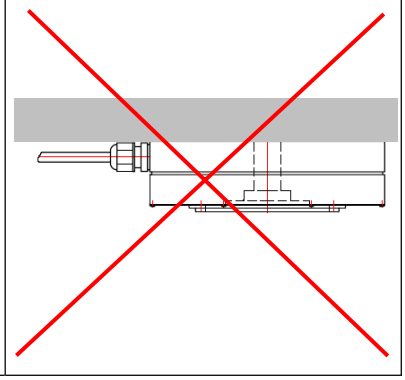
2.3 How to Installation

Shown below is how to install the Direct Drive Motors to the machinery equipment.

2.3.1 Installation Posture

Use in arbitrary orientations as well as horizontal mount is available.
(Vertical/Horizontally Oriented Wall Mount, Ceiling Mount)

Installation Posture

Horizontal Mount	Vertical/Horizontally Oriented Wall Mount	Ceiling Mount
		

2.3.2 Installation of the Main Unit

The surface to mount the main unit should be a machined surface or a plane that possesses an equivalent accuracy and the flatness should be within 0.05mm/m.

For the platform, ensure the structure that possesses enough stiffness to avoid vibration being generated.

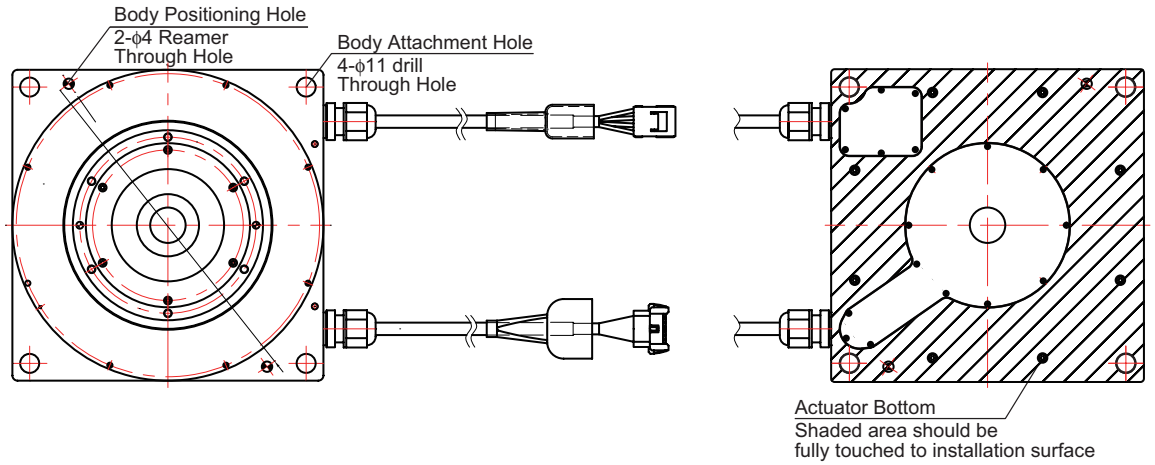
To have heat radiation performed well, make the bottom surface of the base fully touched to the attachment surface.

The body can be fixed from the top side.
There is a reamed hole on the base for a positioning pin.

About Tightening Screws

- Use a hex socket head cap screw for the attachment to the base.
- It is recommended to use high-tensile bolts with ISO-10.9 or more.
- Make sure to have the effective length of screw engagement described below or more for the tightening of a bolt and a female screw.
  When female screw is on steel → Thread length same as nominal diameter
  When female screw is on aluminum → Thread length 2 times longer them nominal diameter

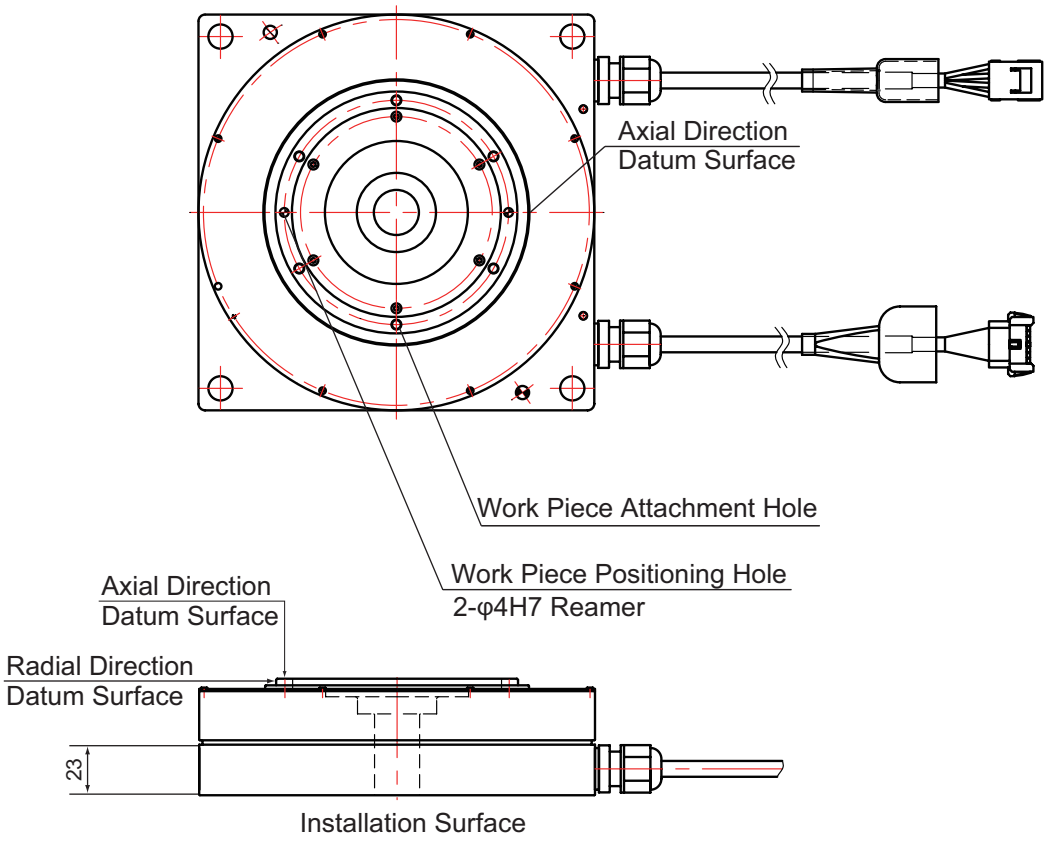
Type	Screw nominal diameter	Tightening Torque	Threaded Hole Effective Depth
T18/LT18 H18/LH18	M10	59N·m (when screws seat is made of steel) 12.5N·m (when screws seat is made of aluminum)	10mm (when screws seat is made of steel) 20mm (when screws seat is made of aluminum)
T18C/LT18C	M6	2.6 N·m	12mm
H18C/LH18C	M8	6.2 N·m	16mm



⚠ Caution: Use this product in a condition that it is installed on a surface that possesses a characteristic of heat radiation equivalent to an aluminum plate sized 400 × 400 × t10. Contact us in case the heat radiation condition for installation is worse than described above.

2.3.3 Attachment of Work Piece

- There are screw holes on the rotary table. Fix the work piece on those holes.
- The datum surfaces for radial direction and axis direction are as shown in the figure below.
- The way to affix follows the installation of the main unit.
- There are two holes on the rotary table for positioning. Utilize them when repeatability of attachment and detachment is necessary.



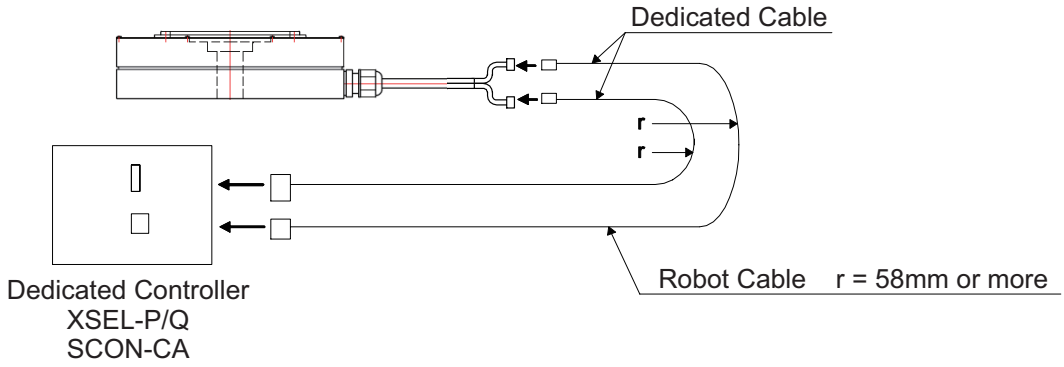
- **Work piece attachment holes**

Type	Screw nominal diameter	Tightening Torque	Threaded Hole Effective Depth
T18/LT18	M5	3.0N·m	5mm
H18/LH18	M6	5.2N·m	9mm

3. Connection to the Controller

Use the dedicated connection cables provided by us for the connection between a controller and an actuator.

- In a use of the actuator with the dedicated connection cables not fixed, consider to ease the load to the dedicated connection cables by using the actuator in the range of the cable bends only with its weight or by using a stand-alone cable hose to gain a large radius bending.
- Do not attempt to cut and extend the cable, or short-circuit or re-joint it.
- Do not attempt to pull or bend the dedicated connection cables forcefully.
- The actuator cable out of the motor unit is a fixed type cable. Fix the cable so it would not be bent repeatedly.

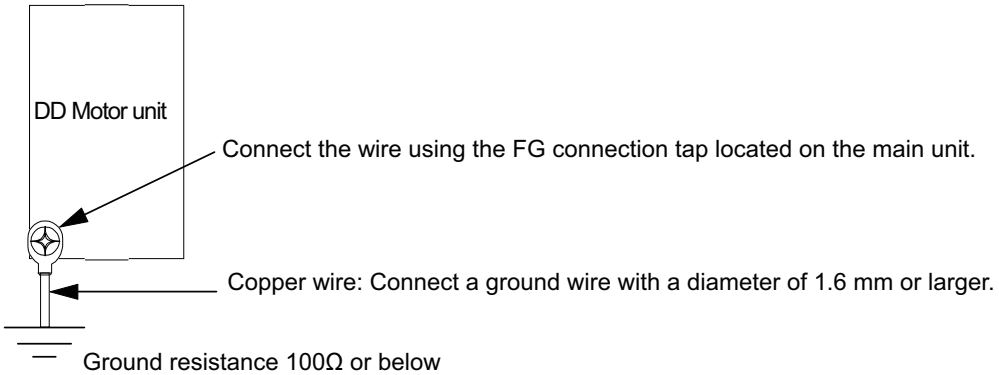


Dedicated Cable

- Motor Cable CB-X-MA□□□
- Encoder Cable CB-X3-PA□□□

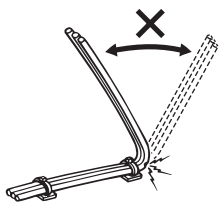
□□□ indicates the cable length
Example: 080＝8m

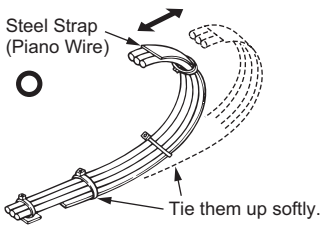
• Noise Elimination Grounding (Frame Ground)



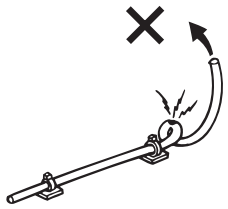
⚠ Warning: For wiring, please follow the warnings stated below. When constructing a system as the machinery equipment, pay attention to the wiring and connection of each cable so they are conducted properly. Not following them may cause not only a malfunction such as cable breakage or connection failure, or an operation error, but also electric shock or electric leakage, or may even cause a fire.

- Use dedicated cables of IAI indicated in this instruction manual. Contact us if you wish to have a change to the specifications of the dedicated cables.
- Make sure to turn the power off in the process of power line or cable connection or disconnection.
- Do not attempt to cut a dedicated cable with connectors on both ends to extend, shorten or re-joint it.
- Hold the dedicated cable to avoid mechanical force being applied to the terminals and connectors.
- Use a cable pipe or duct to have an appropriate protection when there is a possibility of mechanical damage on a dedicated cable.
- In case a dedicated cable is to be used at a moving part, make sure to lay out the cable without applying any force to pull the connector or extreme bend on the cable. Do not attempt to use the cable with a bending radius below the allowable value.
- Make certain that the connectors are plugged properly. Insufficient connection may cause an operation error, thus it is extremely risky.
- Do not lay out the cables to where the machine runs over them.
- Pay attention to the cable layout so it would not hit peripherals during an operation. In case it does, have an appropriate protection such as a cable track.
- When a cable is used hanging on the ceiling, prevent an environment that the cable swings with acceleration or wind velocity.
- Make sure there is not too much friction inside the cable storage equipment.
- Do not apply radiated heat to power line or cables.
- Have a sufficient radius for bending, and avoid a bend concentrating on one point.

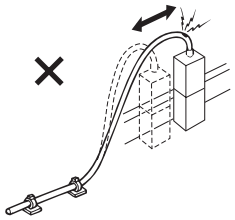




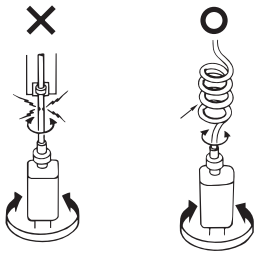
- Do not let the cable bend, kink or twist.



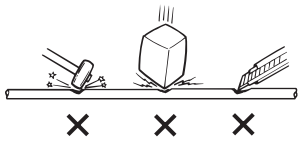
- Do not pull the cable with a strong force.



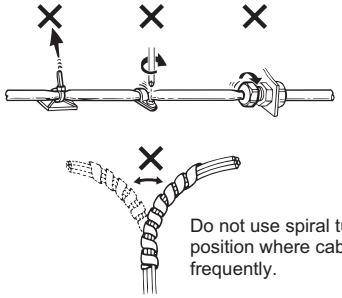
- Pay attention not to concentrate the twisting force to one point on a cable.



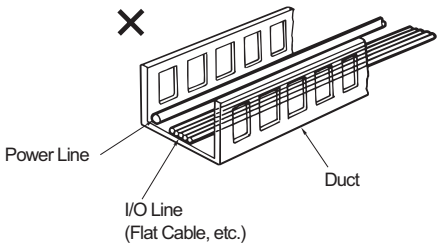
- Do not pinch, drop a heavy object onto or cut the cable.



- When a cable is fastened to affix, make sure to have an appropriate force and do not tighten too much.

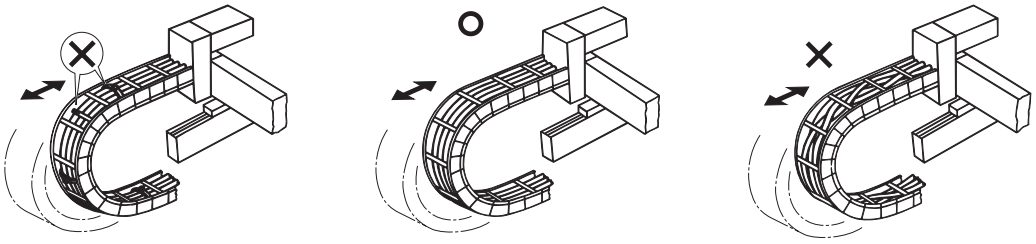


- PIO line, communication line, power and driving lines are to be put separately from each other and do not tie them together. Arrange so that such lines are independently routed in the duct.



Follow the instructions below when using a cable track.

- If there is an indication to the cable for the space factor in a cable track, refer to the wiring instruction given by the supplier when storing the cable in the cable track.
- Avoid the cables to get twined or twisted in the cable track, and also to have the cables move freely and do not tie them up. (Avoid tension being applied when the cables are bent.)
  Do not pile up cables. It may cause faster abrasion of the sheaths or cable breakage.



4. Operation

4.1 Operation Type

Operation type is set to what was selected at the order out of the two operation types described below.
Check the characteristics and points of caution for each type before start using.

4.1.1 Index Absolute Type

XSEL can operate in 180deg at maximum in one operation and SCON in 360deg in maximum, and they are capable to operate in one direction with no limitation.
This mode is available when there is no cable or wiring on the rotary table and no interference with peripherals when the rotary table turns 360°.

4.1.2 Multi-Rotation Absolute Type

This mode is available when there are cables or wirings on the rotary table or there is interference with peripherals when the rotary table turns 360°.
Operation can be performed for ±9999deg (approx. 27 turns) from the coordinates the absolute reset was conducted, and no further operation can be performed.

Note Contact us if a change in the operation mode after delivery is required.

Operation Type	Index Absolute Type	Multi-Rotation Absolute Type
Motion Range	0 to 359.999deg (XSEL) 0 to 359.99deg (SCON)	-9999.99 to 9999.99deg
Maximum movable amount in one operation command	Shortcut control 180deg (Note1) (XSEL) Shortcut control 360deg (Note1) (SCON) (when in non-shortcut control)	Operation range described above
Infinite rotation	Available (Note2)	Unavailable
Home-return operation	Not required	Not required (Note3)
Usage condition	• Should be no external wiring or piping • Should be no interference in operation range	Absolute battery needs to be connected • Should be no external wiring or piping • Should be no interference in operation range

Note 1 In Index Absolute Type, the rotation is made in the direction of smaller movement amount to reach to the target position when it is more than 180deg for the movement from the current position.Therefore, be careful of the rotary direction change due to the current position.
Use the multi-rotation absolute type in case you desire the movement always in one direction.

Note 2 Index Absolute Type can rotate in one direction with no limitation, and the movement amount in one operation is 180deg at maximum for XSEL and 360deg at maximum for SCON.
Please note that it cannot perform rotation continuously without a pause in one direction like a motor does.

Note 3 For Multi-rotation absolute type, it is necessary to home-return after the setting is established for the first time and every time the absolute battery is replaced.

4.2 Gain Parameter Settings

Gain parameter is determined due to the load inertia that you would mount. Set an appropriate gain parameter that suits to the load inertial from Load inertia − Gain Parameter List.

> ⚠ Caution: The product may perform an unexpected movement if the gain parameter is inappropriate. Have the parameter setting work under the condition that safety is secured enough in the way that there is no interference to the peripherals in the range of operation or no one can step into the range.

4.2.1 Calculation of Load Inertia

Calculate the load inertia applied to the rotary center of the load mounted on the rotary table. [Refer to Section 1.3.3]

4.2.2 Gain Parameter Settings

Select the gain parameter that suits to your load inertia by referring to the tables in the following pages.

Load Inertia - Gain Parameter List (Slim Type)

When connecting DD-T18S or LT18S to XSEL-P/Q and R/S

Bottom Limit of Load Inertia [kg•m²]	0	0.005	0.01	0.02	0.03	0.04	0.05	0.06
Top Limit of Load Inertia [kg•m²]	0.005	0.01	0.02	0.03	0.04	0.05	0.06	0.07
Position Gain Each Axis Parameter No.60	125	125	125	125	125	125	110	94
Velocity Loop Gain Driver parameter No.43	15112	25937	47588	69239	90889	112540	117615	117615
Velocity Loop Integrated Time Constant Driver parameter No.44	8	8	8	8	8	8	9	11
torque filter time constant Driver parameter No.45	3	3	3	3	3	3	3	4
Current Control Band Number Driver parameter No.46	4	4	4	4	4	4	4	4

Bottom Limit of Load Inertia [kg•m²]	0.07	0.08	0.09	0.1	0.2	0.3	0.4	0.5
Top Limit of Load Inertia [kg•m²]	0.08	0.09	0.1	0.2	0.3	0.4	0.5	0.6
Position Gain Each Axis Parameter No.60	83	74	67	34	22	17	14	11
Velocity Loop Gain Driver parameter No.43	117615	117615	117615	117615	117615	117615	117615	117615
Velocity Loop Integrated Time Constant Driver parameter No.44	12	14	15	30	44	59	74	89
torque filter time constant Driver parameter No.45	4	5	5	10	15	20	25	30
Current Control Band Number Driver parameter No.46	4	4	4	4	4	4	4	4

(Note) Refer to the instruction manual of the controller and a teaching tool such as PC software for how to change the parameter.
Also, the applicable versions of teaching tools are as listed below:

- PC software(IA-101-X□□□): Ver,9.0.0.0 or later)
- Teaching pendant (IA-T-X, IA-T-XD): Ver.1.52 or later)
- Teaching pendant (SEL-T, SEL-TD): Ver.1.12 or later)

When connecting DD-T18S or LT18S to SCON-CA

Bottom Limit of Load Inertia [kg•m²]	0	0.005	0.01	0.02	0.03	0.04	0.05	0.06
Top Limit of Load Inertia [kg•m²]	0.005	0.01	0.02	0.03	0.04	0.05	0.06	0.07
Servo Gain Number Parameter No.7	24	24	24	24	24	24	21	18
Velocity Loop Proportional Gain Parameter No.31	15112	25937	47588	69239	90889	112540	117615	117615
Velocity Loop Integrated Gain Parameter No.32	188902	324218	594851	865484	1136117	1406750	1288578	1109559
torque filter time constant Parameter No.33	3	3	3	3	3	3	3	4
Current Control Band Number Parameter No.54	4	4	4	4	4	4	4	4

Bottom Limit of Load Inertia [kg•m²]	0.07	0.08	0.09	0.1	0.2	0.3	0.4	0.5
Top Limit of Load Inertia [kg•m²]	0.08	0.09	0.1	0.2	0.3	0.4	0.5	0.6
Servo Gain Number Parameter No.7	18	14	12	6	3	3	2	1
Velocity Loop Proportional Gain Parameter No.31	117615	117615	117615	117615	117615	117615	117615	117615
Velocity Loop Integrated Gain Parameter No.32	974214	868298	783154	395416	264475	198682	159102	132672
torque filter time constant Parameter No.33	4	5	5	10	15	20	25	30
Current Control Band Number Parameter No.54	4	4	4	4	4	4	4	4

When connecting DD-T18P or LT18P to SCON-CA

Bottom Limit of Load Inertia [kg•m^2]	0	0.005	0.01	0.02	0.03	0.04	0.05	0.06
Top Limit of Load Inertia [kg•m^2]	0.005	0.01	0.02	0.03	0.04	0.05	0.06	0.07
Servo Gain Number Parameter No.7	-	24	24	24	24	24	21	18
Velocity Loop Proportional Gain Parameter No.31	-	25937	47588	69239	90889	112540	117615	117615
Velocity Loop Integrated Gain Parameter No.32	-	324218	594851	865484	1136117	1406750	1288578	1109559
Torque filter time constant Parameter No.33	-	3	3	3	3	3	3	4
Current Control Band Number Parameter No.54	-	4	4	4	4	4	4	4

Bottom Limit of Load Inertia [kg•m^2]	0.07	0.08	0.09	0.1	0.2	0.3	0.4	0.5
Top Limit of Load Inertia [kg•m^2]	0.08	0.09	0.1	0.2	0.3	0.4	0.5	0.6
Servo Gain Number Parameter No.7	16	14	12	6	3	3	2	1
Velocity Loop Proportional Gain Parameter No.31	117615	117615	117615	117615	117615	117615	117615	117615
Velocity Loop Integrated Gain Parameter No.32	974214	868298	783154	395416	415965	553710	691456	829202
Torque filter time constant Parameter No.33	4	5	5	10	15	20	25	30
Current Control Band Number Parameter No.54	4	4	4	4	4	4	4	4

*Contact IAI when usage is necessary in the range of 0 to 0.005 [kg•m^2].

(Note) Refer to the instruction manual of the controller and a teaching tool such as PC software for how to change the parameter.
Also, the applicable versions of teaching tools are as listed below:

- PC software (RCM-101-□□□): Ver.9.03.00.00 or later
- Teaching pendant (CON-PTA/PDA/PGA): Ver.1.30 or later
- Teaching pendant (CON-T/TG): To be decided

Load Inertia Acceleration Correspondence Table for DD-T18 Series

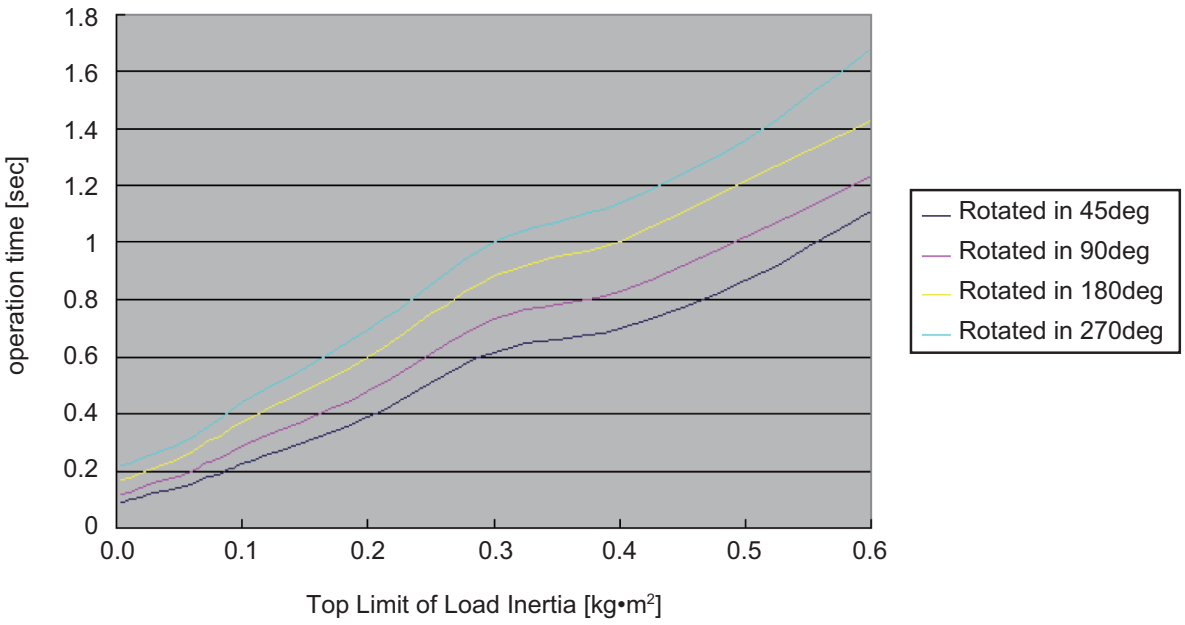
Rotor Inertia = 0.001987 [kg•m^2]

Bottom Limit of Load Inertia [kg•m^2]	0	0.005	0.01	0.02	0.03	0.04	0.05	0.06
Top Limit of Load Inertia [kg•m^2]	0.005	0.01	0.02	0.03	0.04	0.05	0.06	0.07
Rated Acceleration [G] *	9.99	4.10	2.23	4.53	1.17	0.94	0.79	0.68
Recommended Max. Acceleration (Rating×1.8) [G] *	9.99	7.37	4.02	2.76	2.10	1.70	1.43	1.23

Bottom Limit of Load Inertia [kg•m^2]	0.07	0.08	0.09	0.1	0.2	0.3	0.4	0.5
Top Limit of Load Inertia [kg•m^2]	0.08	0.09	0.1	0.2	0.3	0.4	0.5	0.6
Rated Acceleration [G] *	0.60	0.53	0.48	0.24	0.16	0.12	0.10	0.08
Recommended Max. Acceleration (Rating×1.8) [G] *	1.08	0.96	0.87	0.44	0.29	0.22	0.18	0.15

* 1G = 9806.65deg/s^2

[DD-T18 Series Takt Time (Reference)]



(Note) Acceleration and takt time are reference. Adjust them as necessary considering the characteristics of the load.

Load Inertia - Gain Parameter List (High Torque Type)

When connecting DD-H18S or LH18S to XSEL-P/Q and R/S

Bottom Limit of Load Inertia [kg•m²]	0	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.10
Top Limit of Load Inertia [kg•m²]	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.1	0.15
Position Gain Each Axis Parameter No.60	125	125	125	125	125	125	125	125	125	125
Velocity Loop Gain Driver parameter No.43	18013	23787	29560	35334	46881	58428	81522	104616	127710	185445
Velocity Loop Integrated Time Constant Driver parameter No.44	8	8	8	8	8	8	8	8	8	8
torque filter time constant Driver parameter No.45	3	3	3	3	3	3	3	3	3	3
Current Control Band Number Driver parameter No.46	4	4	4	4	4	4	4	4	4	4

Bottom Limit of Load Inertia [kg•m²]	0.15	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.4
Top Limit of Load Inertia [kg•m²]	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.8
Position Gain Each Axis Parameter No.60	117	79	60	40	30	24	20	17	14
Velocity Loop Gain Driver parameter No.43	227423	227423	227423	227423	227423	227423	227423	227423	227423
Velocity Loop Integrated Time Constant Driver parameter No.44	9	13	17	25	33	41	49	57	74
torque filter time constant Driver parameter No.45	4	5	7	10	13	17	20	23	30
Current Control Band Number Driver parameter No.46	4	4	4	4	4	4	4	4	4

(Note) Refer to the instruction manual of the controller and a teaching tool such as PC software for how to change the parameter.
Also, the applicable versions of teaching tools are as listed below:

- PC software(IA-101-X□□□): Ver,9.0.0.0 or later)
- Teaching pendant (IA-T-X, IA-T-XD): Ver.1.52 or later)
- Teaching pendant (SEL-T, SEL-TD): Ver.1.12 or later)

When connecting DD-H18S or LH18S to SCON-CA

Bottom Limit of Load Inertia [kg•m²]	0	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.10
Top Limit of Load Inertia [kg•m²]	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.1	0.15
Servo Gain Number Parameter No.7	24	24	24	24	24	24	24	24	24	24
Velocity Loop Proportional Gain Parameter No.31	18013	23787	29560	35334	46881	58428	81522	104616	127710	185445
Velocity Loop Integrated Gain Parameter No.32	225167	297335	369504	441673	586011	730348	1019023	1307698	1596373	2318061
torque filter time constant Parameter No.33	3	3	3	3	3	3	3	3	3	3
Current Control Band Number Parameter No.54	4	4	4	4	4	4	4	4	4	4

Bottom Limit of Load Inertia [kg•m²]	0.15	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.4
Top Limit of Load Inertia [kg•m²]	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.8
Servo Gain Number Parameter No.7	22	15	11	7	5	4	3	2	2
Velocity Loop Proportional Gain Parameter No.31	227423	227423	227423	227423	227423	227423	227423	227423	227423
Velocity Loop Integrated Gain Parameter No.32	2658588	1802636	1363611	916965	690721	554026	462497	396922	309234
torque filter time constant Parameter No.33	4	5	7	10	13	17	20	23	30
Current Control Band Number Parameter No.54	4	4	4	4	4	4	4	4	4

When connecting DD-H18P or LH18P to SCON-CA

Bottom Limit of Load Inertia [kg•m²]	0	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.10
Top Limit of Load Inertia [kg•m²]	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.1	0.15
Servo Gain Number Parameter No.7	24	24	24	24	24	24	24	24	24	24
Velocity Loop Proportional Gain Parameter No.31	18013	23787	29560	35334	46881	58428	81522	104616	127710	185445
Velocity Loop Integrated Gain Parameter No.32	225167	297335	369504	441673	586011	730348	1019023	1307698	1596373	2318061
Torque filter time constant Parameter No.33	3	3	3	3	3	3	3	3	3	3
Current Control Band Number Parameter No.54	4	4	4	4	4	4	4	4	4	4

Bottom Limit of Load Inertia [kg•m²]	0.15	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.4
Top Limit of Load Inertia [kg•m²]	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.8
Servo Gain Number Parameter No.7	22	15	11	7	5	4	3	2	2
Velocity Loop Proportional Gain Parameter No.31	227423	227423	227423	227423	227423	227423	227423	227423	227423
Velocity Loop Integrated Gain Parameter No.32	2658588	1802636	1363611	916965	690721	554026	462497	396922	309234
Torque filter time constant Parameter No.33	4	5	7	10	13	17	20	23	30
Current Control Band Number Parameter No.54	4	4	4	4	4	4	4	4	4

(Note) Refer to the instruction manual of the controller and a teaching tool such as PC software for how to change the parameter.
Also, the applicable versions of teaching tools are as listed below:

- PC software (RCM-101-□□□): Ver.9.03.00.00 or later
- Teaching pendant (CON-PTA/PDA/PGA): Ver.1.30 or later
- Teaching pendant (CON-T/TG): To be decided

Load Inertia Acceleration Correspondence Table for DD-H18 Series

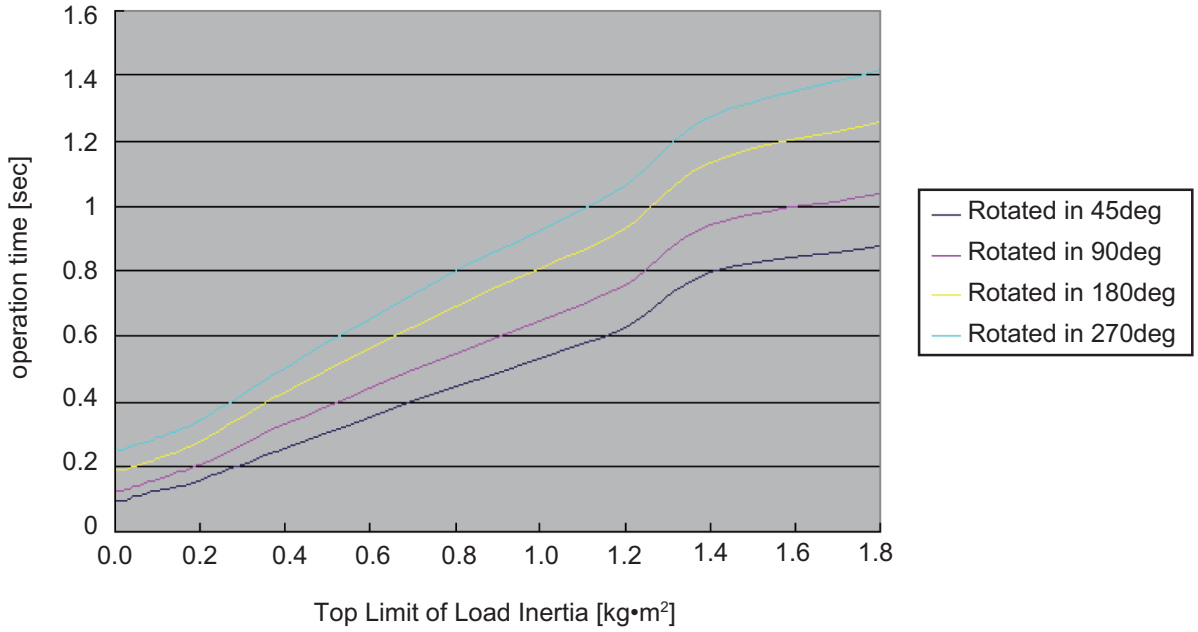
Rotor Inertia = 0.001987 [kg•m^2]

Bottom Limit of Load Inertia [kg•m^2]	0	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.10
Top Limit of Load Inertia [kg•m^2]	0.005	0.01	0.015	0.02	0.03	0.04	0.06	0.08	0.1	0.15
Rated Acceleration [G] *	9.36	7.09	5.71	4.77	3.60	2.89	2.07	1.61	1.32	0.91
Recommended Max. Acceleration (Rating×1.8) [G] *	9.99	9.99	9.99	8.59	6.48	5.20	3.72	2.90	2.38	1.64

Bottom Limit of Load Inertia [kg•m^2]	0.15	0.2	0.3	0.4	0.6	0.8	1.0	1.2	1.4
Top Limit of Load Inertia [kg•m^2]	0.2	0.3	0.4	0.6	0.8	1	1.2	1.4	1.8
Rated Acceleration [G] *	0.69	0.47	0.36	0.24	0.18	0.14	0.12	0.10	0.08
Recommended Max. Acceleration (Rating×1.8) [G] *	1.25	0.85	0.64	0.43	0.32	0.26	0.22	0.19	0.15

* 1G = 9806.65deg/s^2

[DD-H18 Series Takt Time (Reference)]



(Note) Acceleration and takt time are reference. Adjust them as necessary considering the characteristics of the load.

4.3 Home Return

Perform home return by following the steps below.

1) Setting for the rotation direction in home-return operation can be established in Each Axis Parameter No. 11 for XSEL and User Parameter No. 5 for SCON.
2) Rotary table turns in the indicated direction (counterclockwise in initial setting) and the position that the encoder detected the home signal is defined as the datum point.
3) In addition, the home position is to be determined by rotating for the amount of offset set in Each Axis Parameter No. 12 for XSEL and User Parameter No. 22 for SCON.

4.3.1 Fine-Tuning of Home Position

The rotary table turns 360deg at maximum after the home signal search operation has started by the home return command before the encoder detecting (Note 1) home signal, and rotates for the amount of offset that you have set up in addition.

As long as the home return direction is the same, fine-tuning of the rotary table home position can be conducted by changing the amount of offset. Conduct fine-tuning by following the steps below.

1) Have a home-return operation to confirm the home position.
2) After that, rotate the table to the desired home position, check the difference and adjust the offset. The setting of offset can be changed to the positive of the moving direction. (Changing to negative cannot be done.)

Note 1 Home signal detected position cannot be changed.

4.4 Caution for Operation

⚠Caution:

- It is necessary to lower the rated load level when operation is conducted continuously with the angular velocity 1,080deg/s or more. Please contact us.
- The product may get damaged with unexpected heat generation in case of use in an environment that the condition of heat radiation is not good. The reference for the temperature on the top surface of the base while in a continuous operation is 65°C. Please contact us if the temperature exceeds it.
- If the product is used only in a specific small range, have an additional one turn operation of approximately 180° in a day for the purpose of preventing oil shortage on the bearings. Not having this operation may shorten the product life or lower the operation accuracy.

4.5 About Cleanroom Specifications

- It is necessary to vacuum the air inside the main unit when using as Cleanliness Class 10.
- Conduct vacuuming at 35NL/min (L/min) of vacuum volume from the vacuum joint on the base area for air vacuuming.
- As a vacuuming tube, use a product listed in the table below or a tube in the equivalent usage temperature range.

Supplier	Series	Temperature Range for Usage [°]	Tube O. D. [mm]
SMC	TH Series	-20 to 200	ϕ6
PISCO	SET Series	-65 to 200	ϕ6

5. Maintenance Inspection

5.1 Appearance Inspection

Even though this product is designed maintenance-free, it is recommended to have appearance visual inspection regularly for the items listed below to ensure safety.

Body	Looseness of attachment screws
Cable	Scratches, proper connection of connectors
Temperature	Temperature on body while in continuous operation and ambient temperature
Overall	abnormal noise, vibration

⚠ Caution:
If the product is used only in a specific small range, have an additional one turn operation of approximately 180° in a day for the purpose of preventing oil shortage on the bearings. Not having this operation may shorten the product life or lower the operation accuracy.

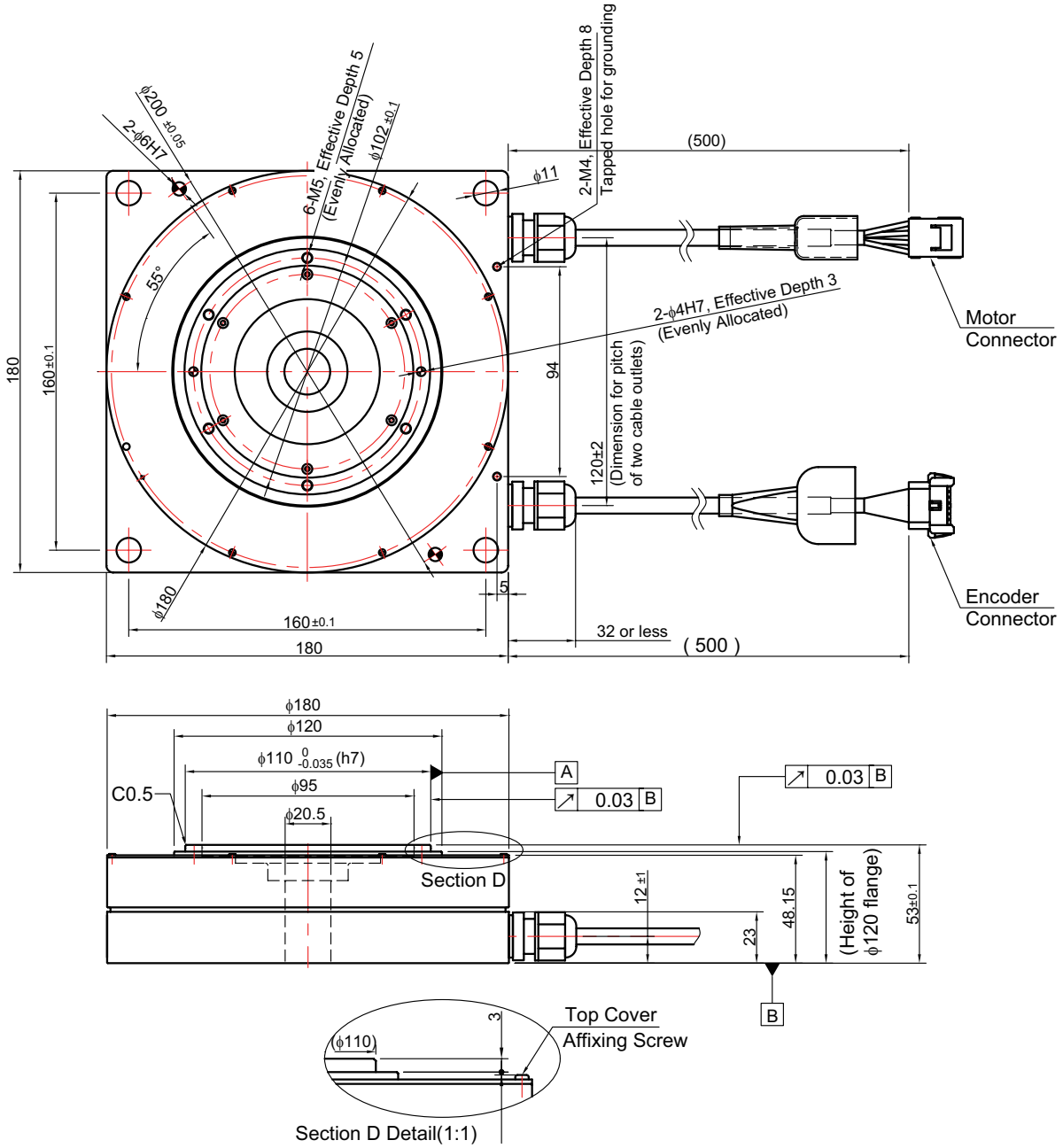
5.2 Cleaning

- When cleaning, wipe with a soft cloth to remove dust and dirt.
- Do not attempt to blow compressed air to avoid dust from getting into small gaps.
- Do not apply oil type solvent, neutral detergent or alcohol.
- When it is extremely dirty, have neutral detergent applied on a soft cloth, and wipe off the dirt firmly.

6. External Dimensions

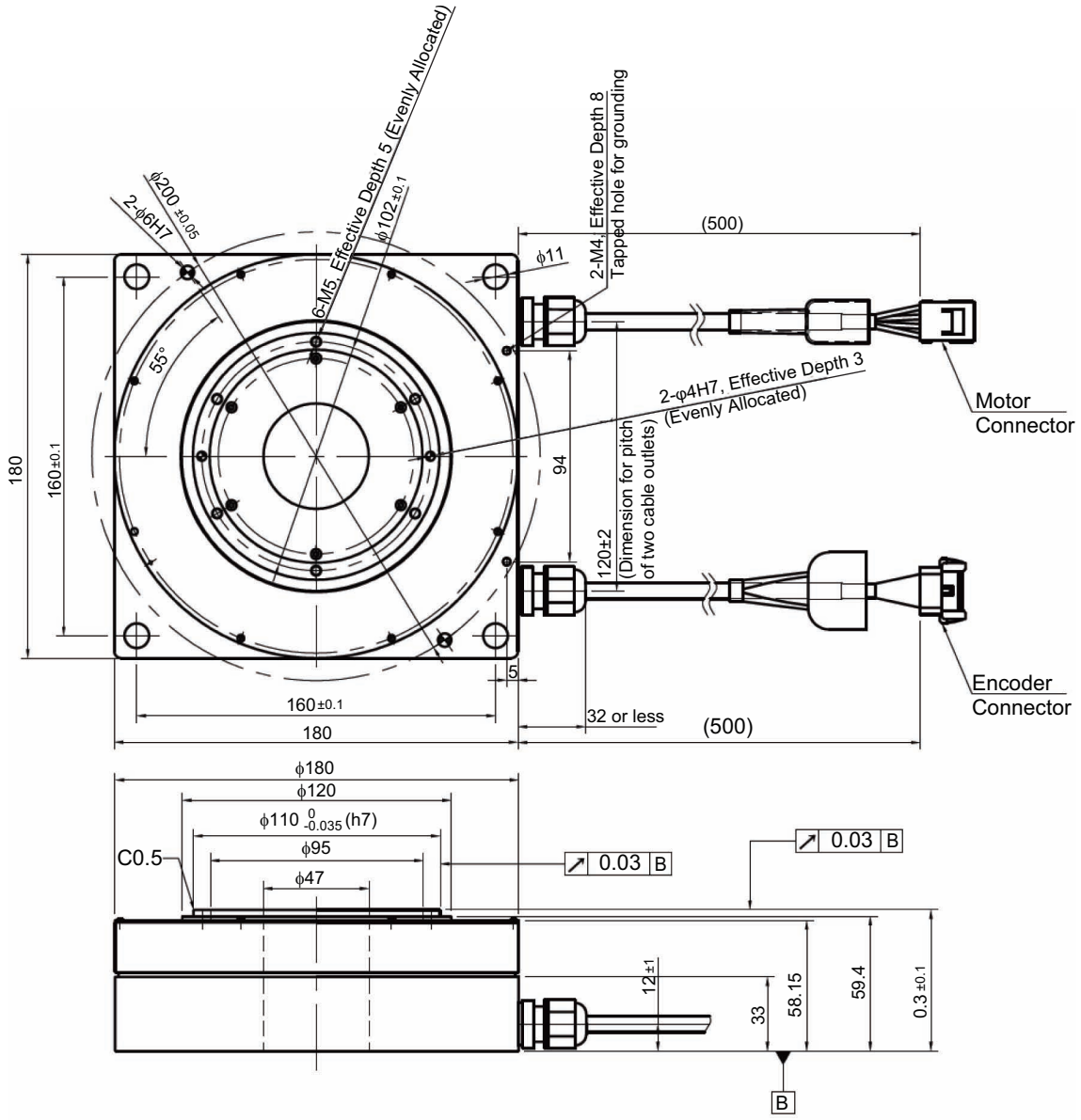
6.1 Standard

6.1.1 Standard Opening Diameter Slim Type (DD-T18S, DD-T18P)



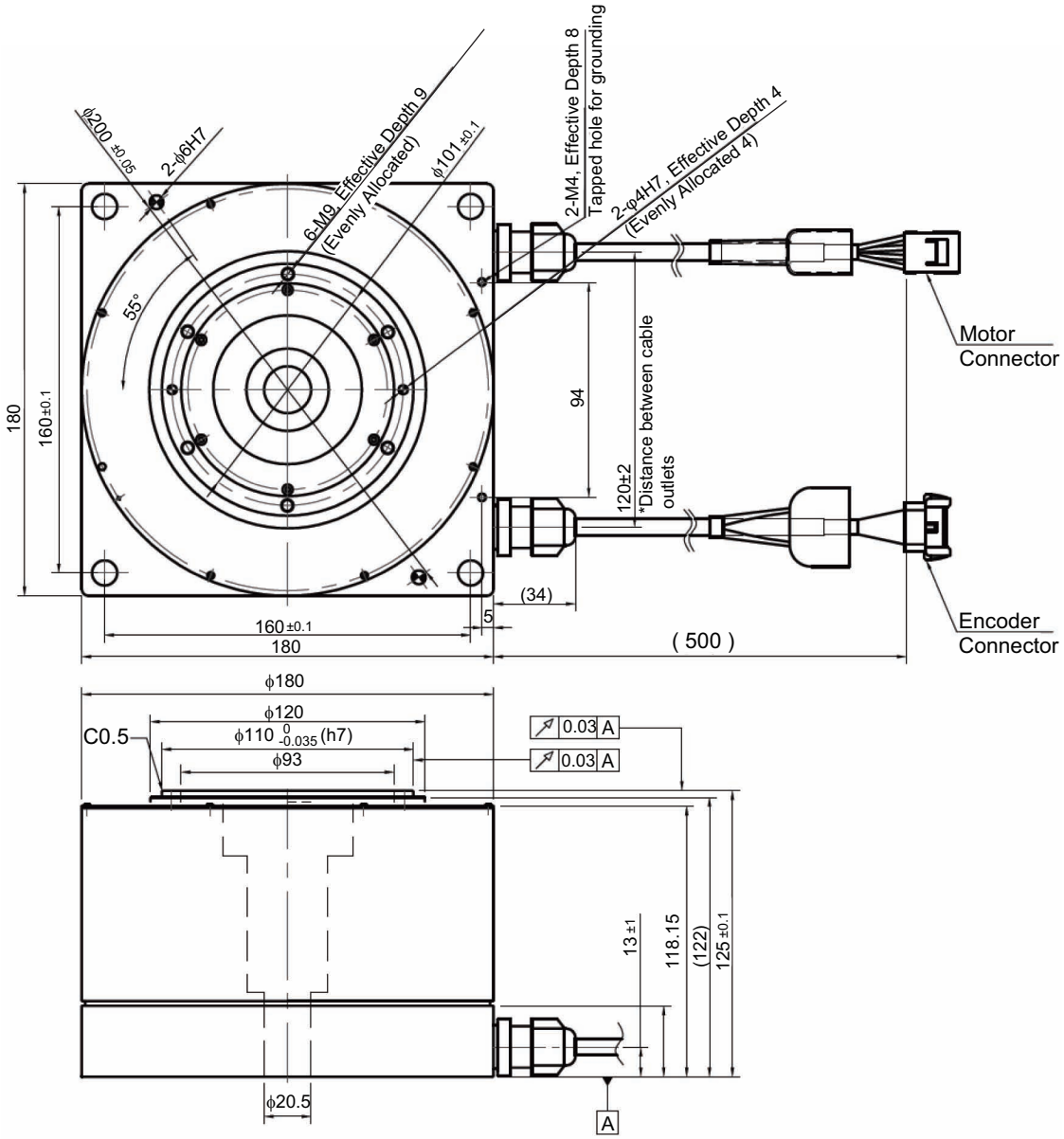
Mass [kg]	5.6

6.1.2 Large Opening Diameter Slim Type (DD-LT18S, DD-LT18P)



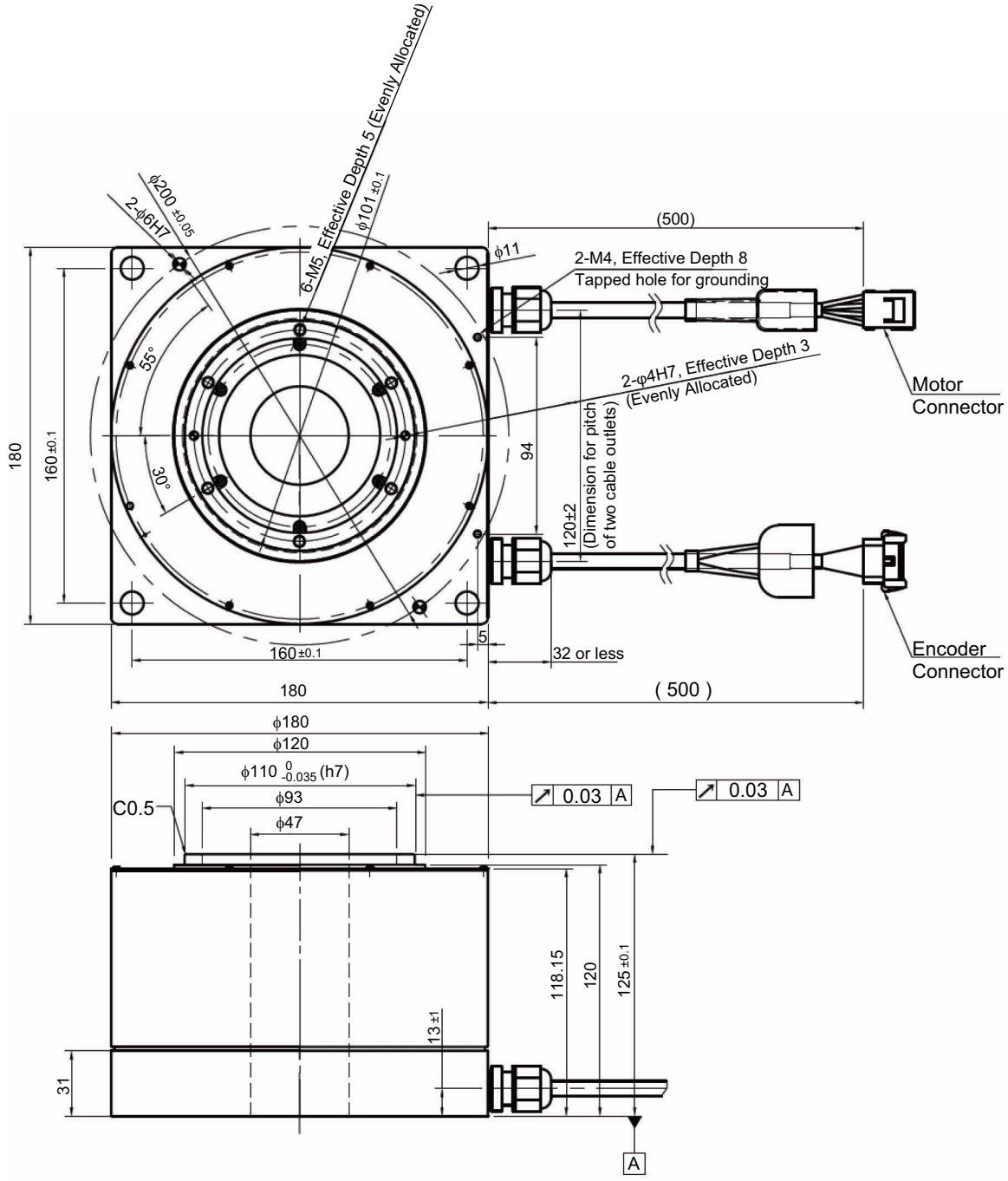
Mass [kg]	6.2

6.1.3 Standard Opening Diameter High Torque Type (DD-H18S, DD-H18P)



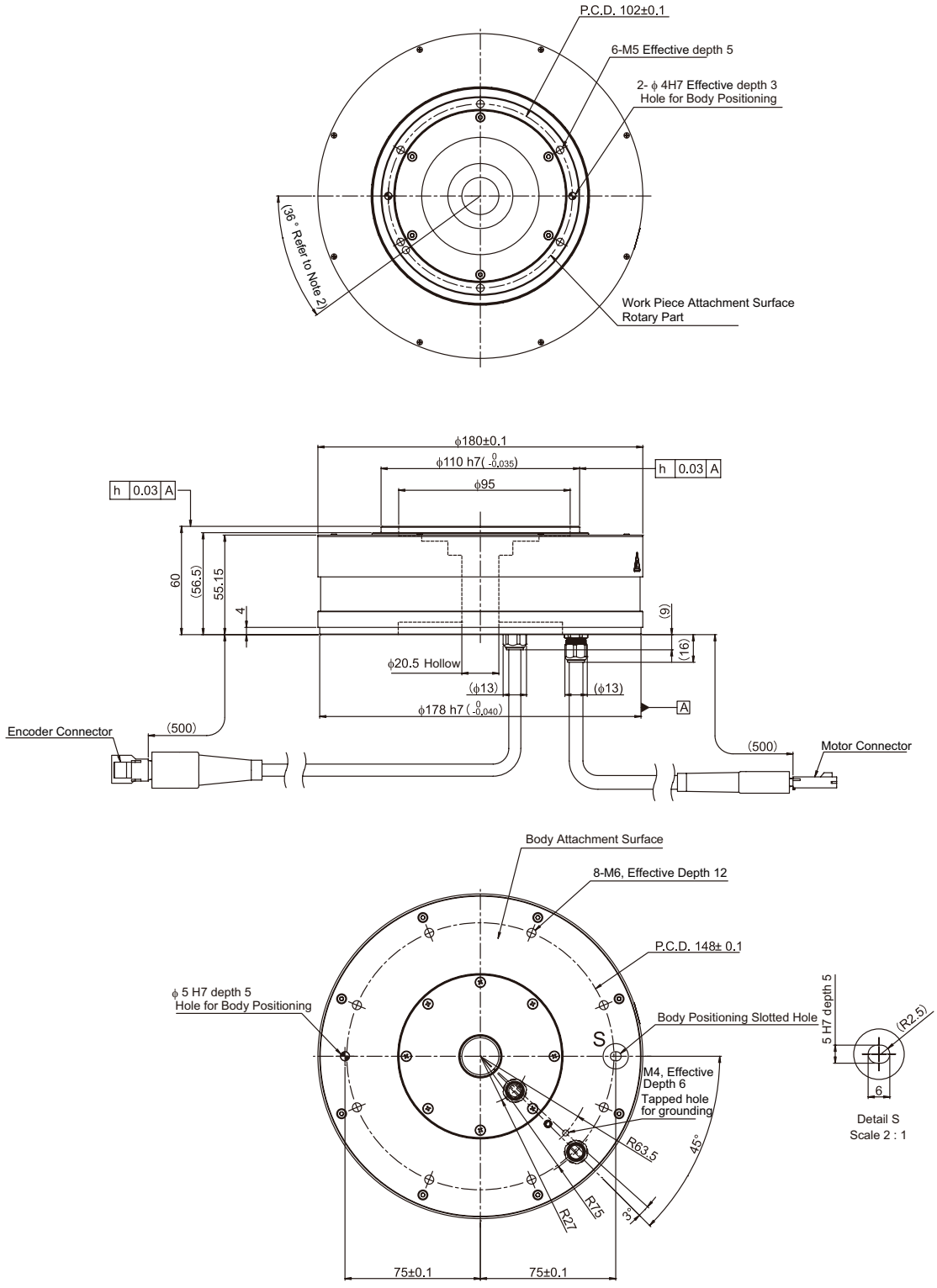
Mass [kg]	13.6

6.1.4 Large Opening Diameter High Torque Type (DD-LH18S, DD-LH18P)



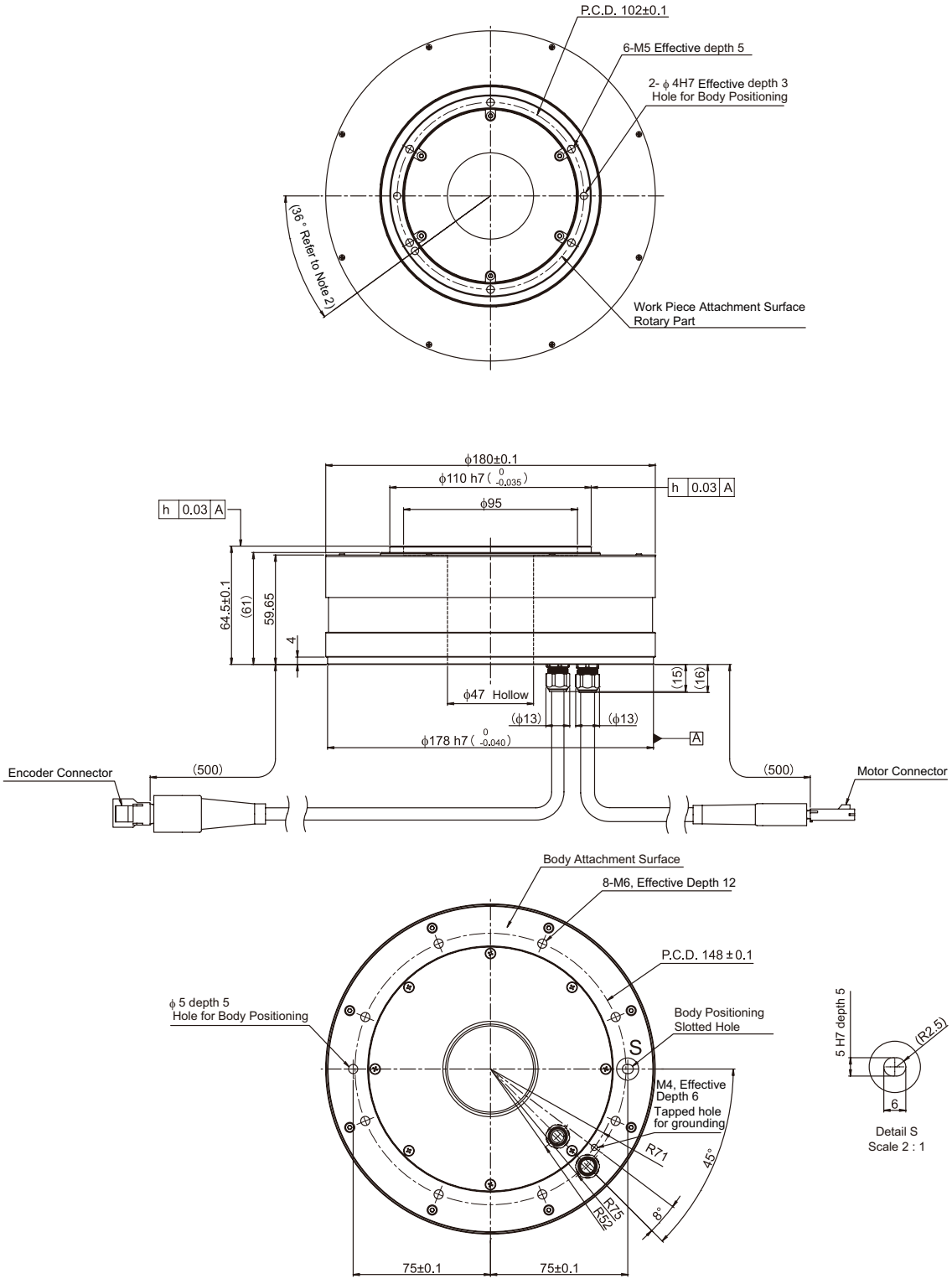
Mass [kg]	13.2

6.1.5 Standard Opening Diameter Slim Flangeless Type (DD-T18CS, DD-T18CP)



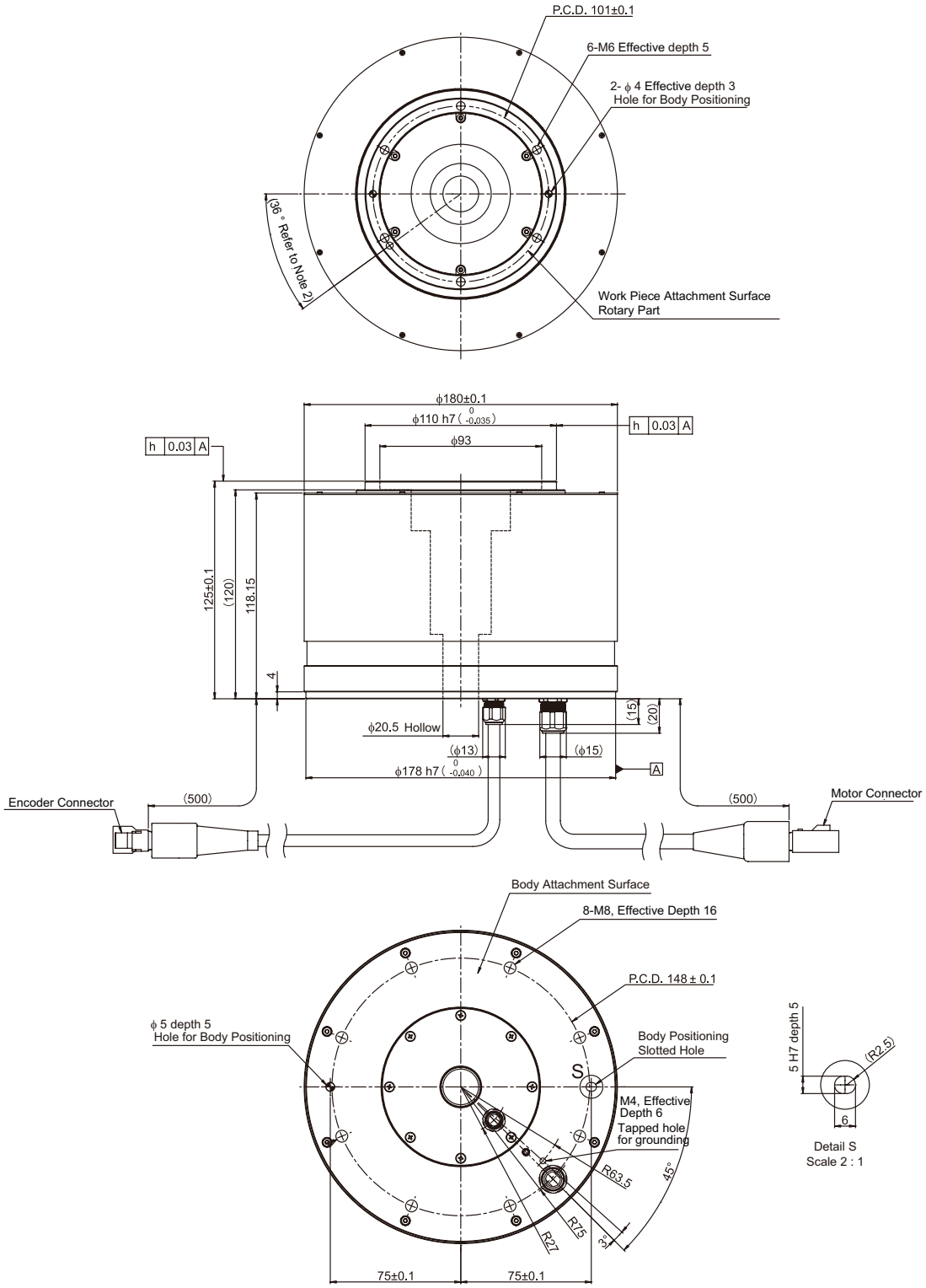
Mass [kg]	5.6

6.1.6 Large Opening Diameter Slim Flangeless Type (DD-LT18CS, DD-LT18CP)



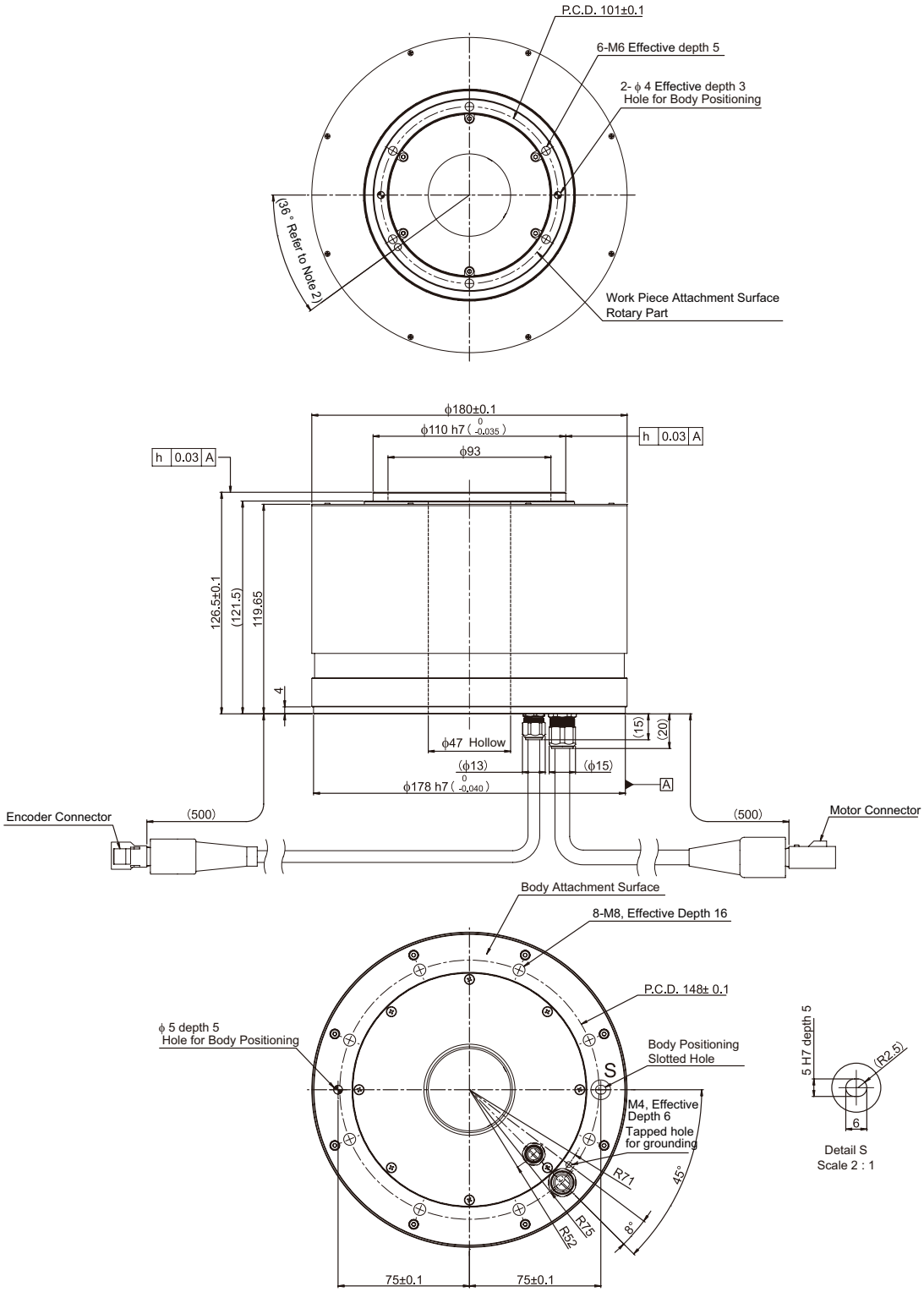
Mass [kg]	5.8

6.1.7 Standard Opening Diameter High Torque Flangeless Type (DD-H18CS, DD-H18CP)



Mass [kg]	13.2

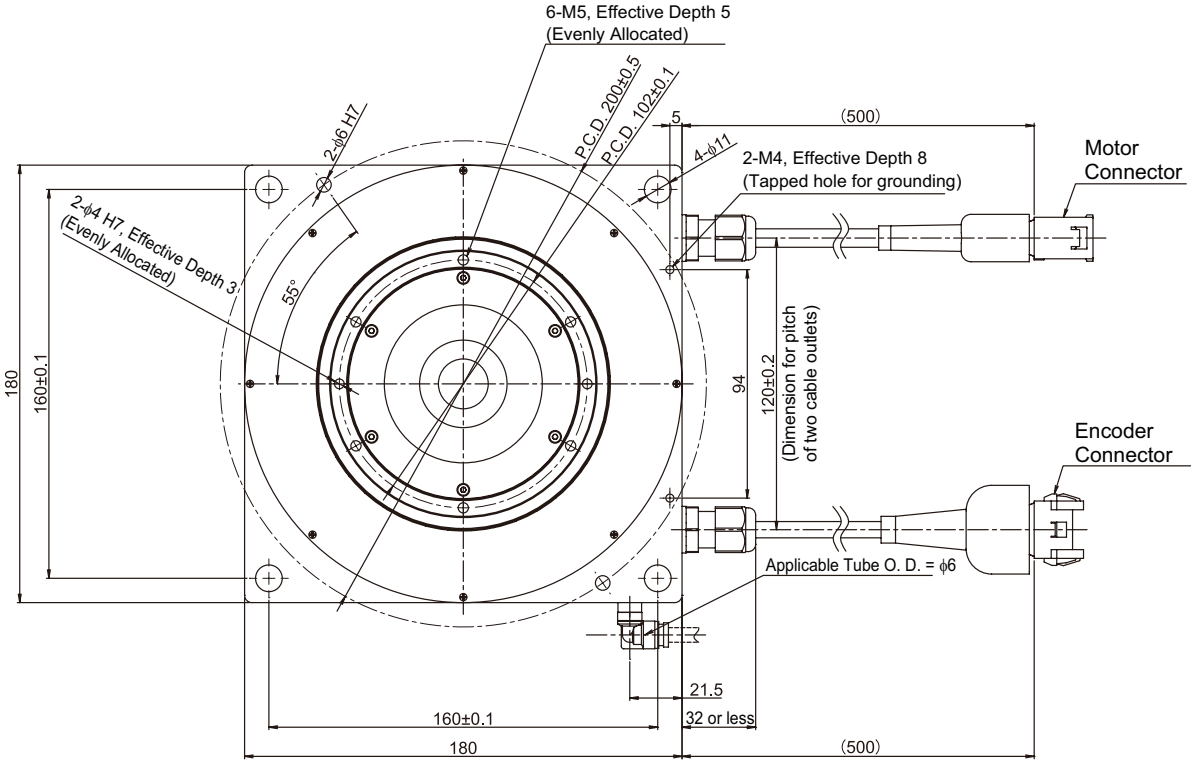
6.1.8 Large Opening Diameter High Torque Flangeless Type (DD-LH18CS, DD-LH18CP)

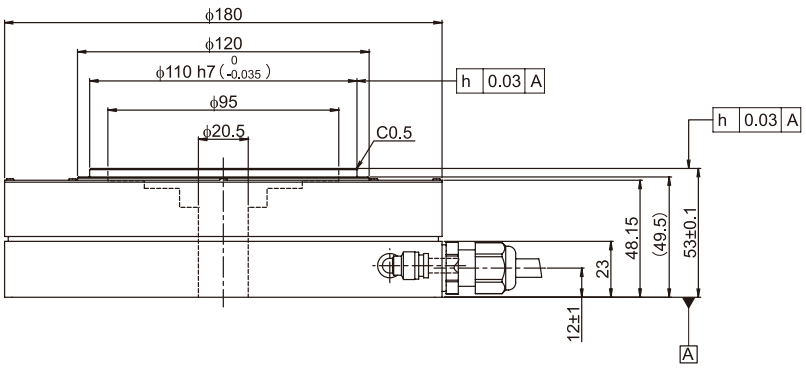


Mass [kg]	12.8

6.2 About Cleanroom

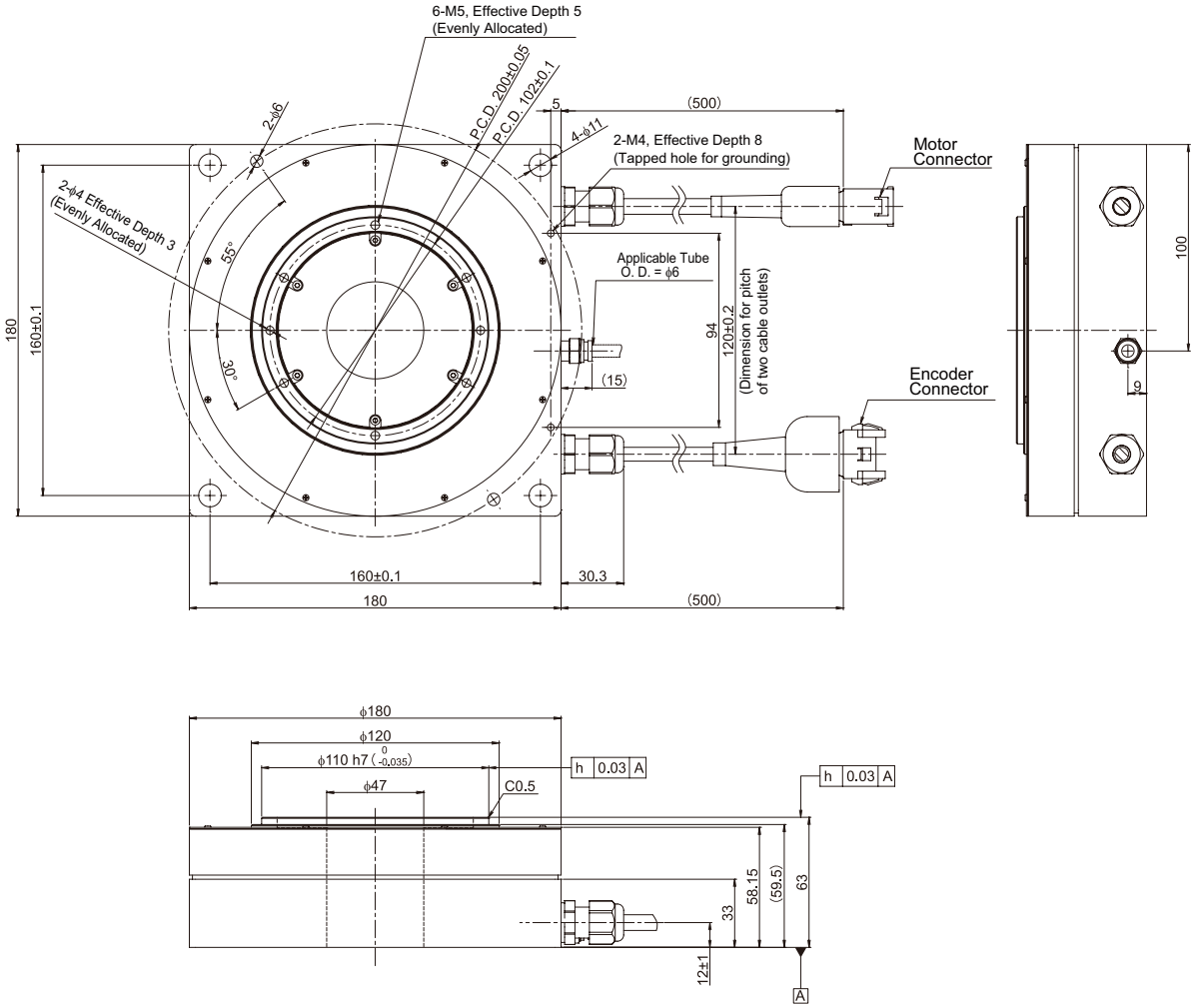
6.2.1 Standard Opening Diameter Slim Type (DDCR-T18S, DDCR-T18P)





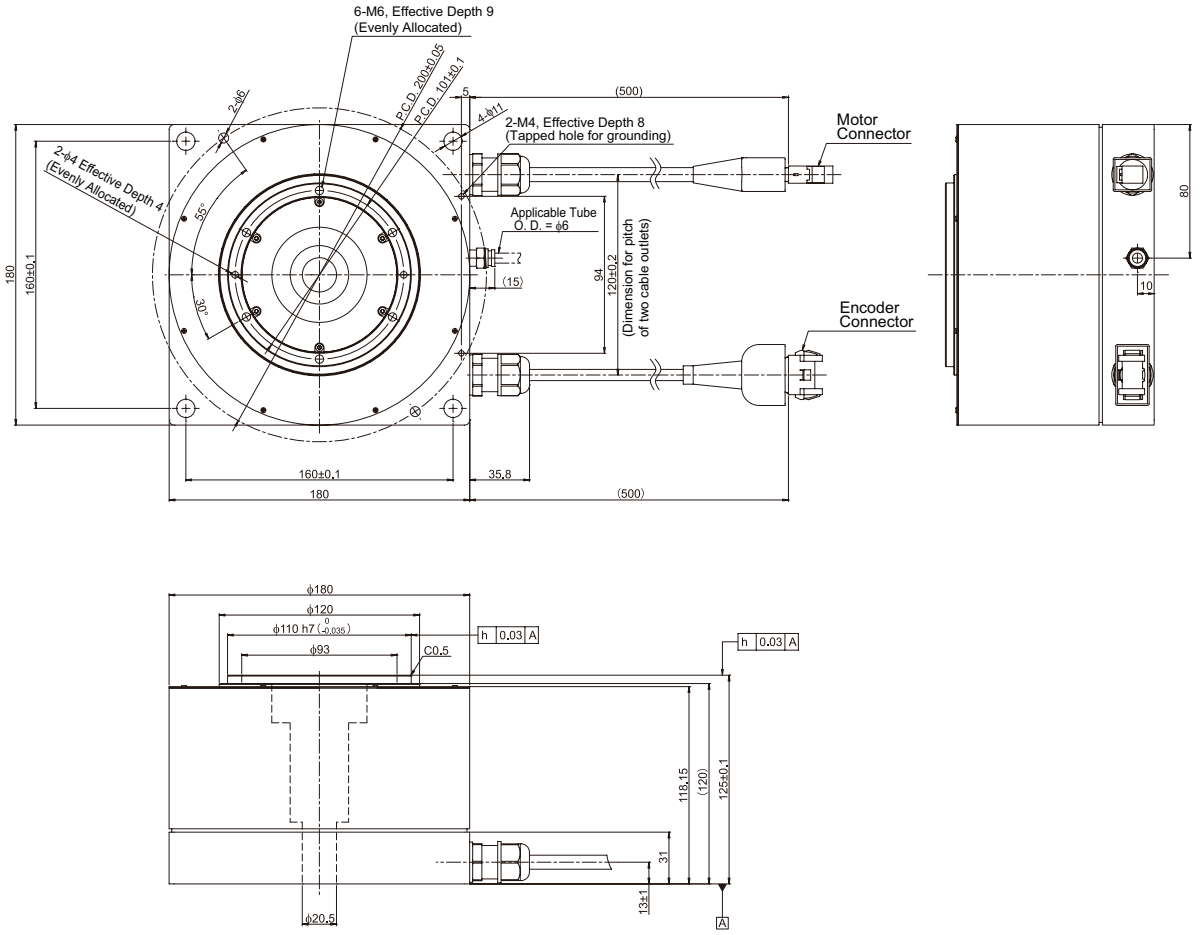
Mass [kg]	5.6

6.2.2 Large Opening Diameter Slim Type (DDCR-LT18S, DDCR-LT18P)



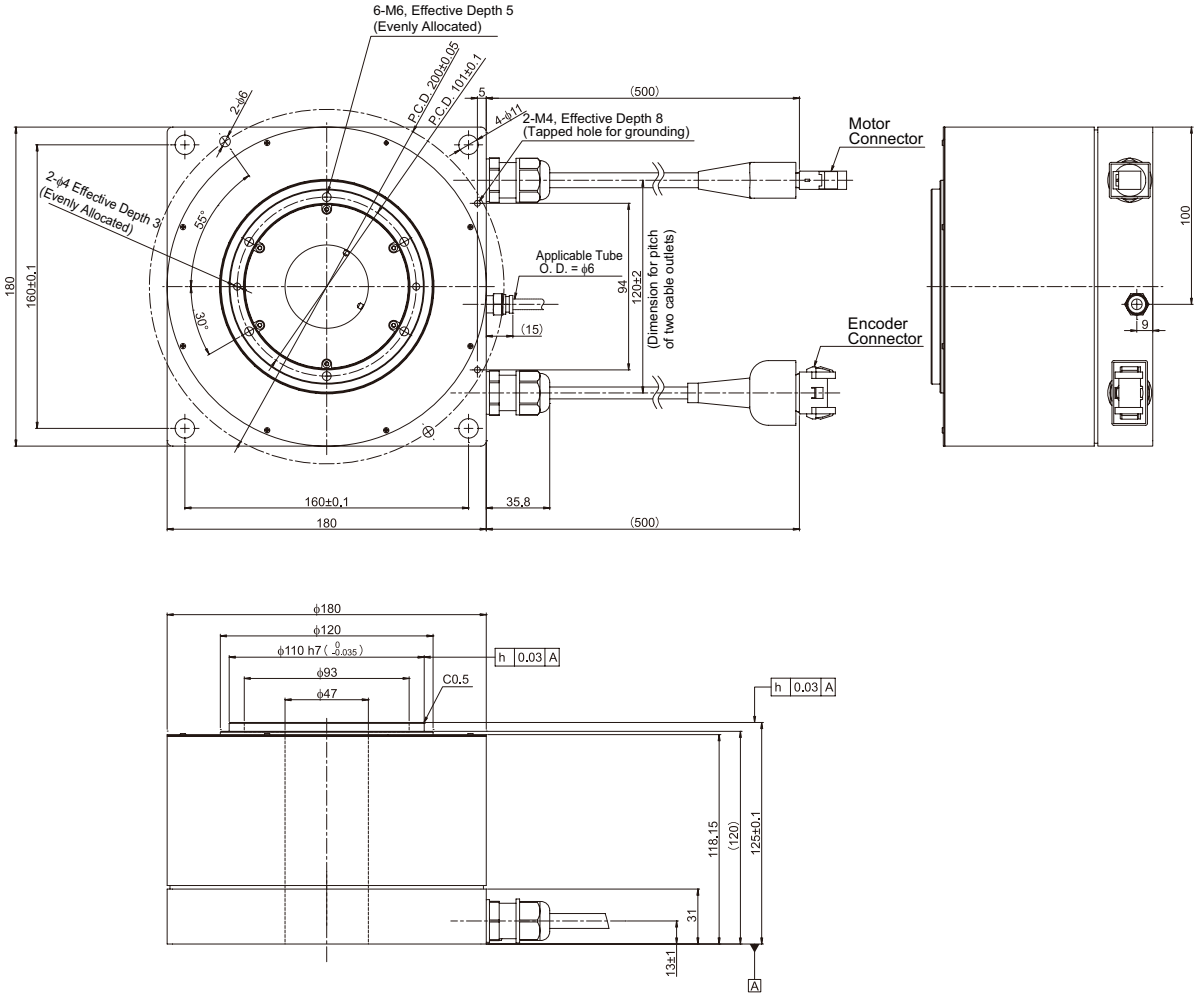
Mass [kg]	6.2

6.2.3 Standard Opening Diameter High Torque Type (DDCR-H18S, DDCR-H18P)



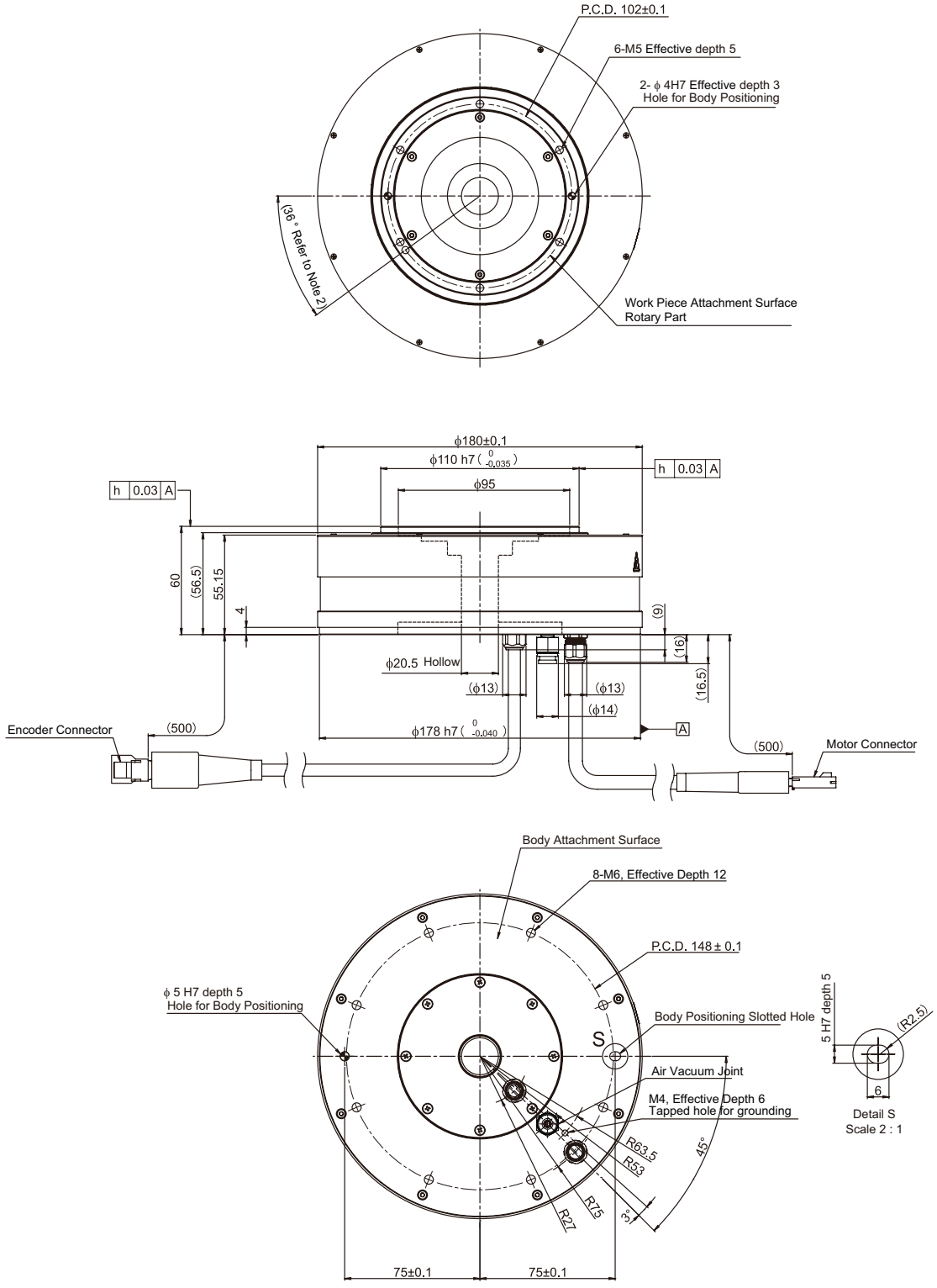
Mass [kg]	13.6

6.2.4 Large Opening Diameter High Torque Type (DDCR-LH18S, DDCR-LH18P)



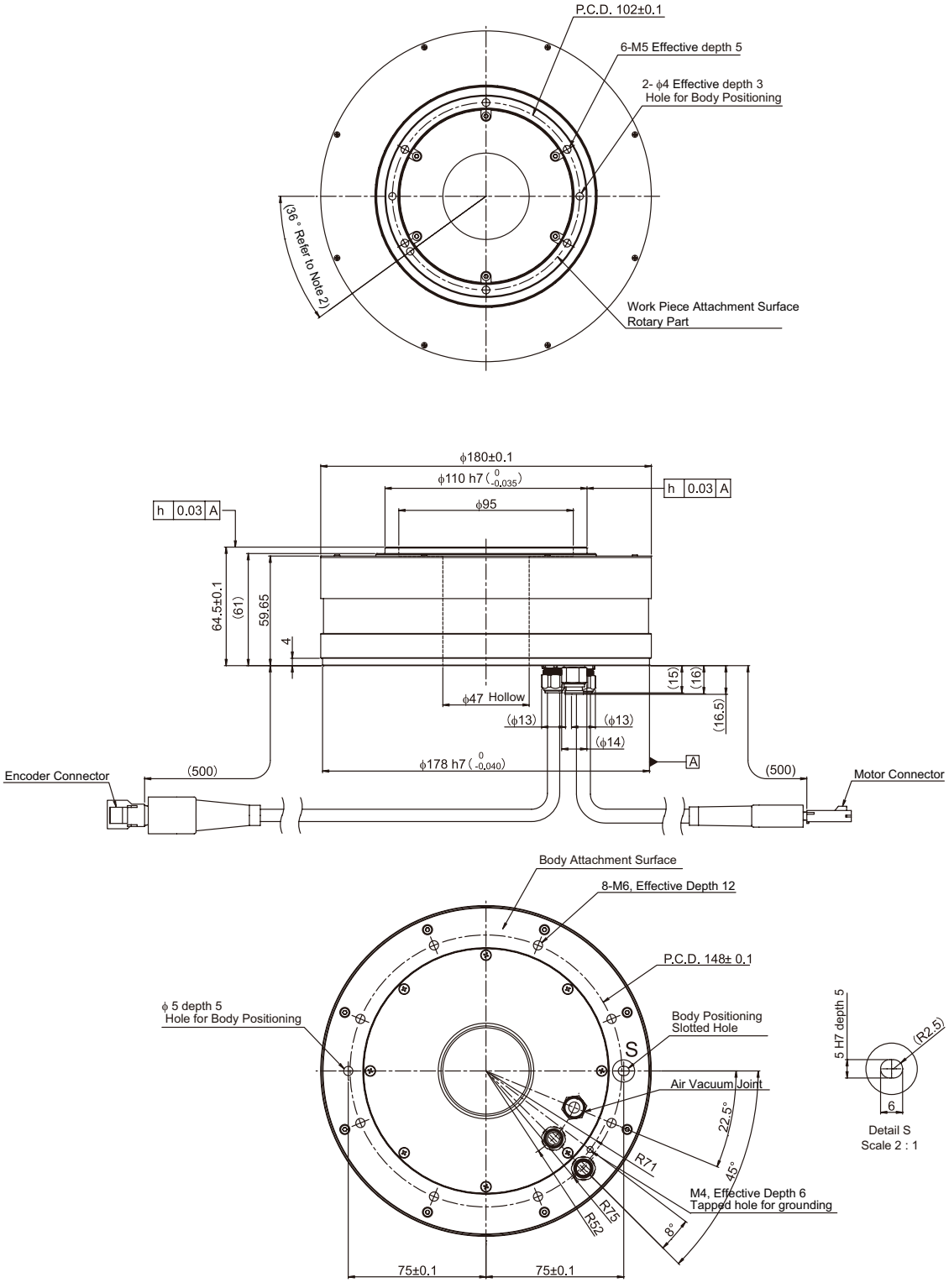
Mass [kg]	13.2

6.2.5 Standard Opening Diameter Slim Flangeless Type (DDCR-T18CS, DDCR-T18CP)



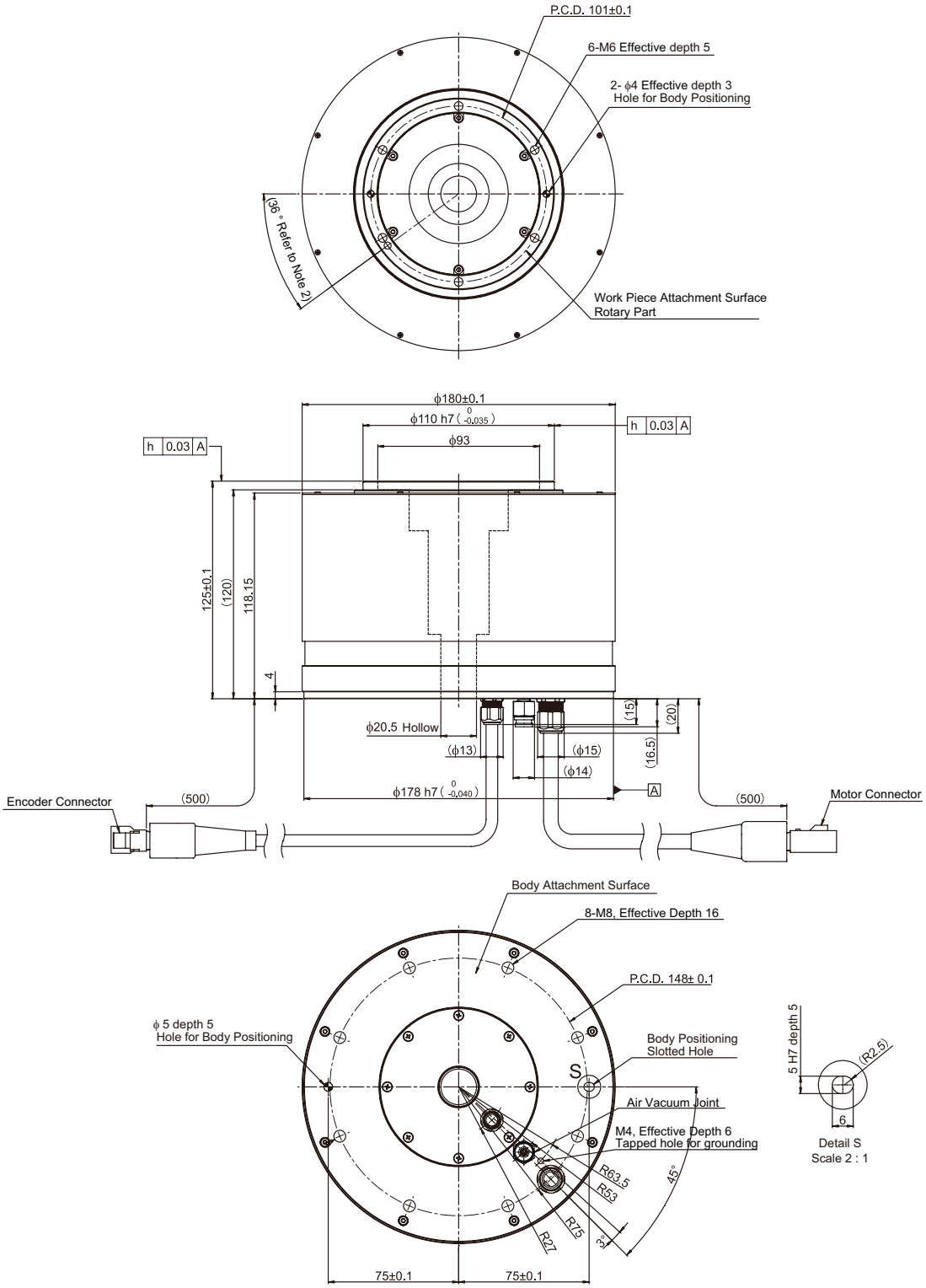
Mass [kg]	5.6

6.2.6 Large Opening Diameter Slim Flangeless Type (DDCR-LT18CS, DDCR-LT18CP)



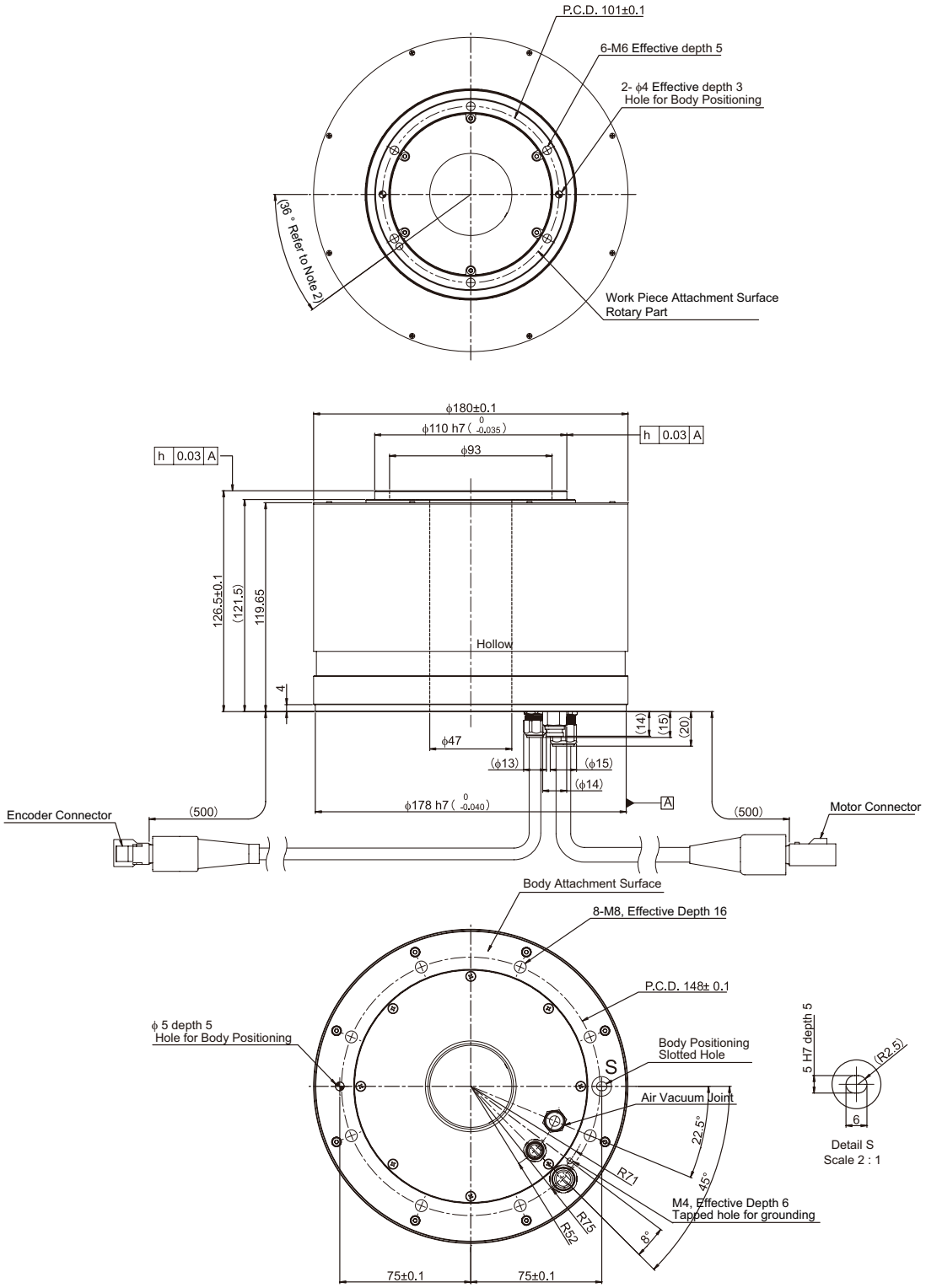
Mass [kg]	5.8

6.2.7 Standard Opening Diameter High Torque Flangeless Type (DDCR-H18CS, DDCR-H18CP)



Mass [kg]	13.2

6.2.8 Large Opening Diameter High Torque Flangeless Type (DDCR-LH18CS, DDCR-LH18CP)



Mass [kg]	12.8

7. Product Life

For the product life, it is assumed 5 years (reference) under the condition that it is operated 24hrs/day with maximum allowable load moment.

8. Warranty

8.1 Warranty Period

One of the following periods, whichever is shorter:
- 18 months after shipment from IAI
- 12 months after delivery to the specified location
- 2,500 hours of operation

8.2 Scope of the Warranty

Our products are covered by warranty when all of the following conditions are met. Faulty products covered by warranty will be replaced or repaired free of charge:
(1) The breakdown or problem in question pertains to our product as delivered by us or our authorized dealer.
(2) The breakdown or problem in question occurred during the warranty period.
(3) The breakdown or problem in question occurred while the product was in use for an appropriate purpose under the conditions and environment of use specified in the instruction manual and catalog.
(4) The breakdown of problem in question was caused by a specification defect or problem, or by a quality issue with our product.

Note that breakdowns due to any of the following reasons are excluded from the scope of warranty:
[1] Anything other than our product
[2] Modification or repair performed by a party other than us (unless we have approved such modification or repair)
[3] Anything that could not be easily predicted with the level of science and technology available at the time of shipment from our company
[4] A natural disaster, man-made disaster, incident or accident for which we are not liable
[5] Natural fading of paint or other symptoms of aging
[6] Wear, depletion or other expected result of use
[7] Operation noise, vibration or other subjective sensation not affecting function or maintenance

Note that the warranty only covers our product as delivered and that any secondary loss arising from a breakdown of our product is excluded from the scope of warranty.

8.3 Honoring the Warranty

As a rule, the product must be brought to us for repair under warranty.

8.4 Limited Liability

(1) We shall assume no liability for any special damage, consequential loss or passive loss such as a loss of expected profit arising from or in connection with our product.
(2) We shall not be liable for any program or control method created by the customer to operate our product or for the result of such program or control method.

8.5 Conditions of Conformance with Applicable Standards/Regulations, Etc., and Applications

(1) If our product is combined with another product or any system, device, etc., used by the customer, the customer must first check the applicable standards, regulations and/or rules. The customer is also responsible for confirming that such combination with our product conforms to the applicable standards, etc. In such a case we will not be liable for the conformance of our product with the applicable standards, etc.
(2) Our product is for general industrial use. It is not intended or designed for the applications specified below, which require a high level of safety. Accordingly, as a rule our product cannot be used in these applications. Contact us if you must use our product for any of these applications:
    [1] Medical equipment pertaining to maintenance or management of human life or health
    [2] A mechanism or mechanical equipment intended to move or transport people (such as a vehicle, railway facility or aviation facility)
    [3] Important safety parts of mechanical equipment (such as safety devices)
    [4] Equipment used to handle cultural assets, art or other irreplaceable items
(3) Contact us at the earliest opportunity if our product is to be used in any condition or environment that differs from what is specified in the catalog or instruction manual.

8.6 Other Items Excluded from Warranty

The price of the product delivered to you does not include expenses associated with programming, the dispatch of engineers, etc. Accordingly, a separate fee will be charged in the following cases even during the warranty period:

[1] Guidance for installation/adjustment and witnessing of test operation
[2] Maintenance and inspection
[3] Technical guidance and education on operating/wiring methods, etc.
[4] Technical guidance and education on programming and other items related to programs

Change History

Revision Date	Description of Revision
2012.12	First edition
2013.09	Second edition • SCON-CA added to applicable controllers Change and addition made related to it
2014. 3	Third edition • Large opening diameter and high torque types added Contents changed and added in relation to it
2014. 5	Edition 3B • Pg. 12 Motor output value added
2015. 01	Fourth edition • Cleanroom Specifications added Flangeless Type added

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