CKD

New Products

SCARA robot

KHL Series
KHE Series

More options for the design.

Flexible space and time at high speeds

CKD Corporation

CC-1436A 1

SCARA ROBOT

Compactness and high performance

KHL SERIES

KHL-300

KHL-400

KHE SERIES

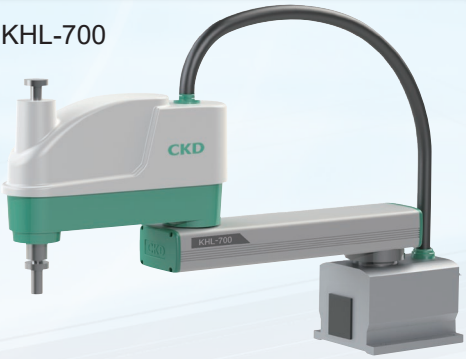
- High cycle
- High precision

KHE-400

KHL-500

KHL-600

KHL-700



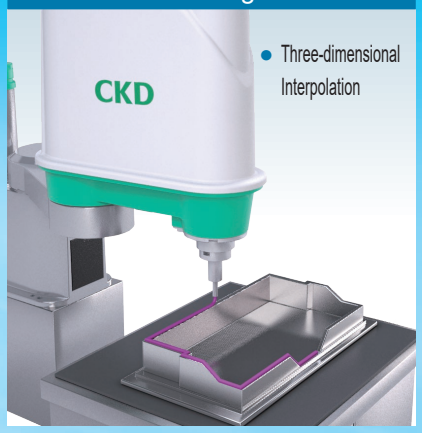
KHL / KHE SERIES

Application examples of SCARA

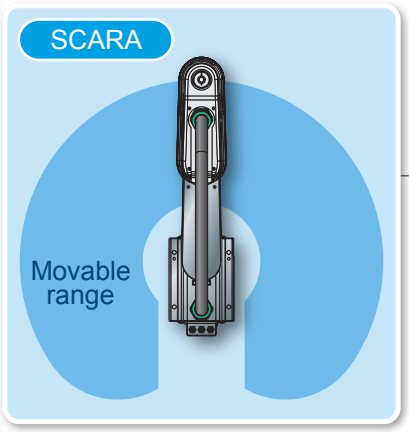
Pick and Place

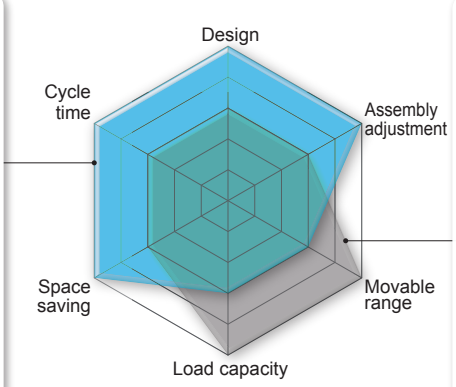
Palletizing

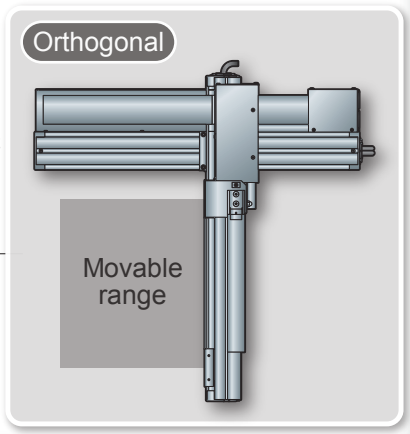
Sealing



Advantages of SCARA to Orthogonal







Enhanced standard functions

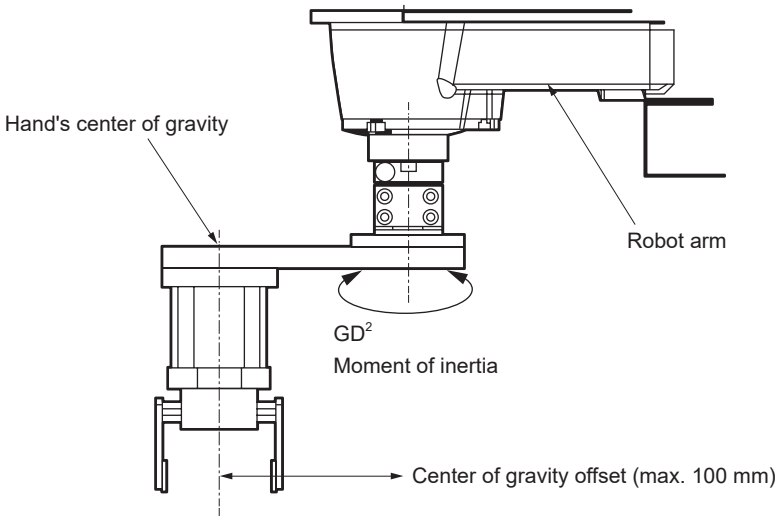
- **Z-axis brake release switch**
  Brake can be released with one touch
- **Torque control**
  Can be applied for workpiece and hand protection, press-fitting, etc. (Some restrictions apply.)
- **Constant speed control**
  Smooth operation is possible at a constant speed, making it effective for sealing
- **Multitasking**
  Parallel processing of robot operation and control tasks of I/O and peripheral components, reduces lost time
- **PLC function**
  Peripheral components, touch panel control enabled

All types of networks

(Option)

- **Saves wiring with high-speed communication. Compatible with all types of networks**
  - Ethernet
  - PROFIBUS
  - DeviceNet
  - CC-Link
  - EtherNet/IP
  - EtherCAT
  - PROFINET

Selection condition: Select a size that satisfies the following allowable values



	KHL-300 KHL-400	KHL-500 KHL-600 KHL-700	KHE-400
Load weight kg	Maximum 5 (Rating 2)	Maximum 10 (Rating 2)	Maximum 5 (Rating 1)
Load moment of inertia kg·m²	Max. 0.05	Max. 0.20	Max. 0.06
Center of gravity of load offset mm	Max. 100	Max. 100	Max. 100

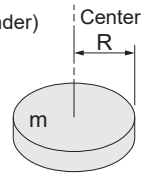
The robot cannot be used in conditions that exceed the allowable values
Contact CKD when working beyond these conditions

Moment of inertia formula

[m: Weight of body (kg)]

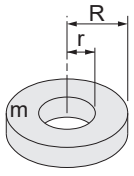
●A When the center of rotation is the actuator's own axis

1. Disk (cylinder)



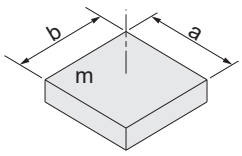
$$I = \frac{mR^2}{2}$$

2. Hollow disk (Hollow cylinder)



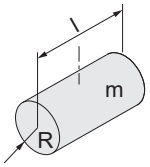
$$I = \frac{m(R^2+r^2)}{2}$$

3. Rectangular parallelepiped



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

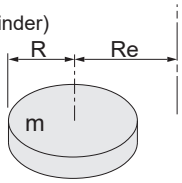
4. Cylinder



$$I = \frac{m(3R^2+l^2)}{12}$$

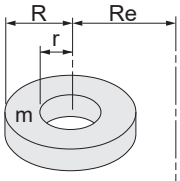
●B When the center of rotation is not the actuator's own axis

1. Disk (cylinder)



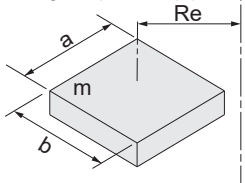
$$I = m\left(\frac{R^2}{2}+Re^2\right)$$

2. Hollow disk (Hollow cylinder)



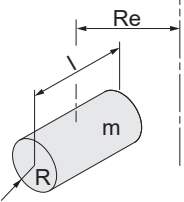
$$I = m\left(\frac{R^2+r^2}{2}+Re^2\right)$$

3. Rectangular parallelepiped



$$I = m\left(\frac{a^2+b^2}{12}+Re^2\right)$$

4. Cylinder



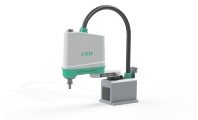
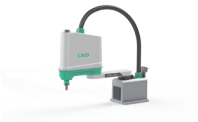
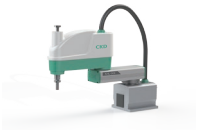
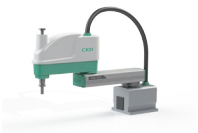
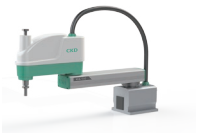
$$I = m\left(\frac{3R^2+l^2}{12}+Re^2\right)$$

KHL

SCARA robot

CONTENTS

Model selection

Model No.		Arm length mm	Operating range				
			1-axis deg	2-axis deg	3-axis (Z-axis) mm	4-axis (Z-axis rotation) deg	
	KHL-300	300 (125+175)	±125	±145	0 to 160	±360	
	KHL-400	400 (225+175)	±125	±145	0 to 160	±360	
	KHL-500	500 (200+300)	±125	±145	0 to 150	±360	
	KHL-600	600 (300+300)	±125	±145	0 to 150	±360	
	KHL-700	700 (400+300)	±125	±145	0 to 150	±360	

How to order

■ Main unit + controllerv

KHL - 600 Z BNN - KSL3 P NN CC - 2 1

(A) (B) (C) (D) (E) (F) (G) (H)

(A) Arm length

300	300
400	400
500	500
600	600
700	700

(B) Z-axis stroke

*1	**N**	Standard
*2	**Z**	300

(C) Option

	NNN	None
*4	**BNN**	Lower bellows
	CNN	Upper cap
*3	**TNN**	Ceiling mount
*3 *4	**BCN**	Lower bellows, top cap
*3 *4	**BTN**	Lower bellows, ceiling mount
*3 *4	**BCT**	Lower bellows, top cap, ceiling mount
*3	**CTN**	Top cap, ceiling mount
	SCN	Simple clean-room

(D) External signal polarity

N	N-Type (standard)
P	P-Type

(E) Robot controller cable

NN	3.5 m (standard)
05	5 m
08	8 m
10	10 m
15	15 m

(F) Network

NN	None
CC	CC-Link
DN	DeviceNet
PB	PROFIBUS
EN	EtherNet/IP
EC	EtherCAT
PN	PROFINET

(G) Expansion IO unit *5

N	0 units
1	1 units
2	2 units

(H) IO cable *6

N	None
1	1 set
2	2 set
3	3 set

*1 KHL-300/400 has 160 strokes, and 500/600/700 has 150 strokes.
*2 Does not support KHL-300/400.
*3 Does not support KHL-300.
*4 KHL-TF (tool flange) is also required.
*5 A unit with 28 inputs and 20 outputs.
*6 A 2-piece set with 6m cable length.

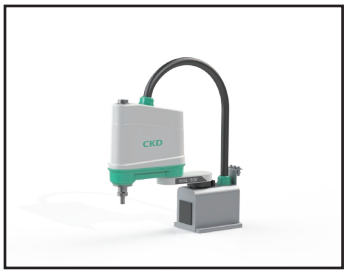
	Max. speed *1					*2 Cycle time (2 kg load) s	Max. load capacity (Rating) kg	Allowable moment of inertia kg/m²	Listed Page
	1-axis deg/s	2-axis deg/s	3-axis (Z-axis) mm/s	4-axis (Z-axis rotation) deg/s	Synthesis m/s				
	660	660	1120	1500	5.1	0.48	5 (2)	0.05	4
	660	660	1120	1500	6.3	0.47	5 (2)	0.05	6
	450	450	2000	1700	6.3	0.45	10 (2)	0.2	8
	450	450	2000	1700	7.1	0.45	10 (2)	0.2	10
	450	450	2000	1700	7.9	0.50	10 (2)	0.2	12

*1 There are restrictions on speed and acceleration depending on the operation pattern, load weight and degree of offset.
*2 300 mm in horizontal direction, 25 mm in vertical direction (reciprocating), rough positioning. Continuous operation exceeding the effective load factor is not allowed.

Option list

Model No.	Z-axis long stroke length	Z-axis bottom bellows	Z-axis top cap	Ceiling mount specifications	Cable extension (longest)	For mounting hand tool flange	Simple clean-room
KHL-300	X	OK	OK	X	15 m	OK	OK
KHL-400	X	OK	OK	OK	15 m	OK	OK
KHL-500	OK (300 mm)	OK	OK	OK	15 m	OK	OK
KHL-600	OK (300 mm)	OK	OK	OK	15 m	OK	OK
KHL-700	OK (300 mm)	OK	OK	OK	15 m	OK	OK

OK: Compatible X: Not compatible



SCARA robot

KHL-300

● Arm length: 300 mm (125 mm + 175 mm)

How to order

KHL - 300 (A) N (B) NNN (C) - KSL3 N (D) NN (E) NN (F) - N (G) N (H)

(A) Arm length

300 mm

(B) Z-axis stroke

*1	N	Standard

(C) Option

	NNN	None
*4	BNN	Lower bellows
	CNN	Upper cap
	SCN	Simple clean-room

(D) External signal polarity

N	N-Type (standard)
P	P-Type

(E) Robot controller cable

NN	3.5 m (standard)
05	5 m
08	8 m
10	10 m
15	15 m

(F) Network

NN	None
CC	CC-Link
DN	DeviceNet
PB	PROFIBUS
EN	EtherNet/IP
EC	EtherCAT
PN	PROFINET

(G) Expansion IO unit

*2	N	0 units
	1	1 units
	2	2 units

(H) IO cable

	N	None
*3	1	1 set
	2	2 set
	3	3 set

*1 160 stroke.
*2 A unit with 28 inputs and 20 outputs.
*3 A 2-piece set with 6 m cable length.
*4 KHL-TF (tool flange) is also required.

Product subject to the EAR (EAR99)

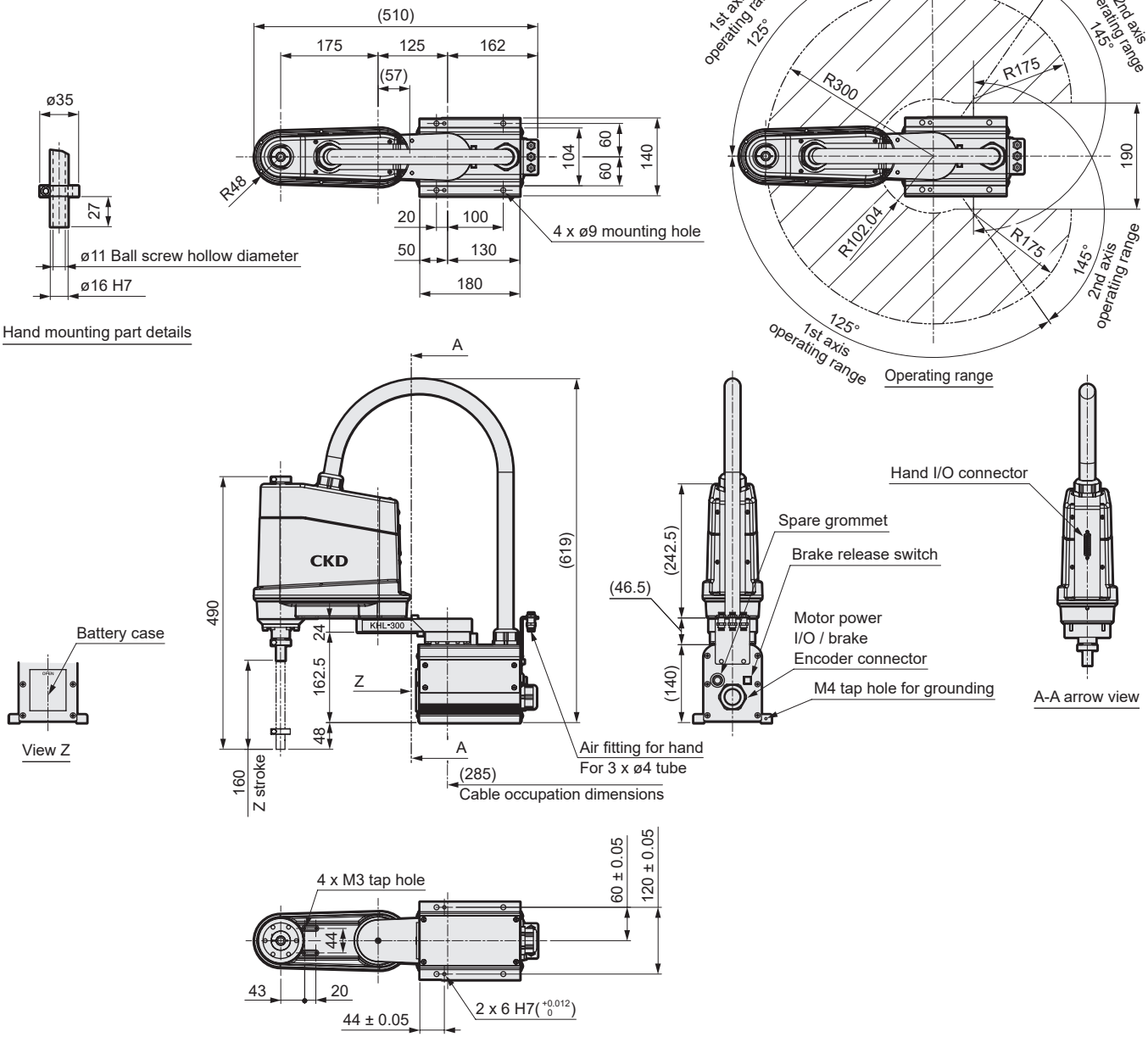
Specifications

Model No.			KHL-300
Type			Horizontal articulation
Number of axes			4
Arm length		mm	300 (125+175)
Operating range	1-axis	deg	±125
	2-axis	deg	±145
	3-axis (Z-axis)	mm	0 to 160
	4-axis (Z-axis rotation)	deg	±360
Max. speed	1-axis	deg/s	660
	2-axis	deg/s	660
	3-axis (Z-axis)	mm/s	1120
	4-axis (Z-axis rotation)	deg/s	1500
*1	Synthesis	m/s	5.1
Cycle time (2kg load) *2		s	0.48
Max. load capacity		kg	5 (Rating 2)
Allowable moment of inertia		kg·m²	0.05
Position repeat Accuracy *3	X-Y	mm	±0.01
	Z (3-axis)	mm	±0.015
	4-axis (Z-axis rotation)	deg	±0.007
Hand wiring			8 input points/8 output points
Hand fitting *4			ø4 x 3 pcs
Position detection method			Absolute method
Robot controller cable		m	3.5
Power capacity		kVA	0.7
Body weight		kg	12

*1 There are restrictions on speed and acceleration depending on the operation pattern, load weight and degree of offset.
*2 300 mm in horizontal direction, 25 mm in vertical direction (reciprocating), rough positioning. Continuous operation exceeding the effective load factor is not allowed.
*3 One-way positioning repeatability when the ambient temperature and airframe temperature are constant. Not the absolute positioning accuracy. For X-Y and C, the values are at the Z upper limit. The track accuracy is not guaranteed.
*4 A fitting for hand piping is available on the base side. Customers are responsible for piping.

Dimensions

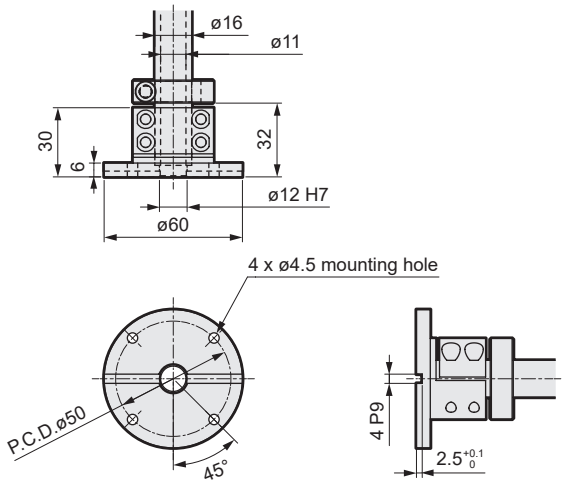
● KHL-300



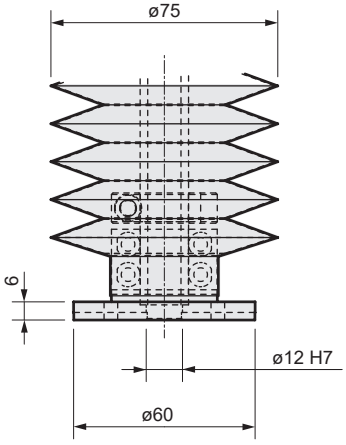
Optional dimensions

● Tool flange

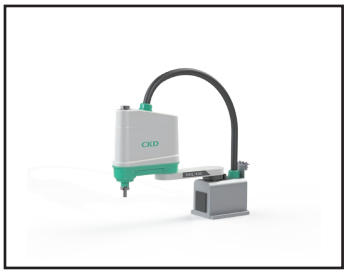
Model No.: KHL-TF3



● Bellows



Note: When ordering the SCARA robot body and the tool flange at the same time, the tool flange will be "assembled at shipment".



SCARA robot

KHL-400

● Arm length: 400 mm (225 mm + 175 mm)

How to order

KHL - 400 (A) N (B) NNN (C) - KSL3 N (D) NN (E) NN (F) - N (G) N (H)

(A) Arm length

400 mm

(B) Z-axis stroke

*1	**N**	Standard

(C) Option

	NNN	None
*5	**BNN**	Lower bellows
	CNN	Upper cap
	TNN	Ceiling mount
*2	**BCN**	Lower bellows, top cap
*2	**BTN**	Lower bellows, ceiling mount
*2	**BCT**	Lower bellows, top cap, ceiling mount
	CTN	Top cap, ceiling mount
	SCN	Simple clean-room

(D) External signal polarity

N	N-Type (standard)
P	P-Type

(E) Robot controller cable

NN	3.5 m (standard)
05	5 m
08	8 m
10	10 m
15	15 m

(F) Network

NN	None
CC	CC-Link
DN	DeviceNet
PB	PROFIBUS
EN	EtherNet/IP
EC	EtherCAT
PN	PROFINET

(G) Expansion IO unit

N	0 units
1	1 units
2	2 units

(H) IO cable

N	None	*4
1	1 set	
2	2 set	
3	3 set	

*1 160 stroke.
*2 KHL-TF (tool flange) is also required.
*3 A unit with 28 inputs and 20 outputs.
*4 A 2-piece set with 6 m cable length.
*5 KHL-TF (tool flange) is also required.

Product subject to the EAR (EAR99)

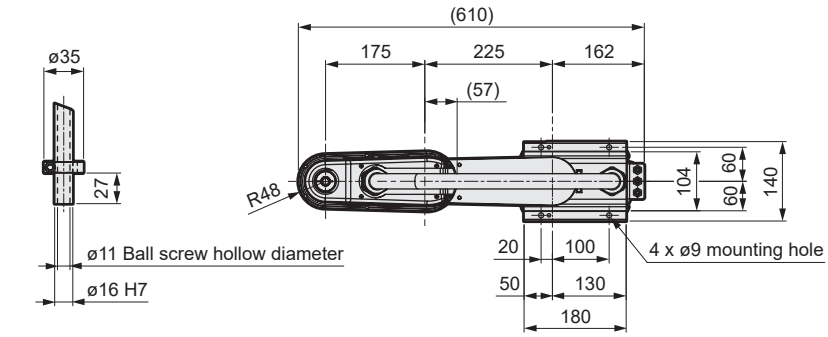
Specifications

Model No.			KHL-400
Type			Horizontal articulation
Number of axes			4
Arm length		mm	400 (225+175)
Operating range	1-axis	deg	±125
	2-axis	deg	±145
	3-axis (Z-axis)	mm	0 to 160
	4-axis (Z-axis rotation)	deg	±360
Max. speed	1-axis	deg/s	660
	2-axis	deg/s	660
	3-axis (Z-axis)	mm/s	1120
	4-axis (Z-axis rotation)	deg/s	1500
*1	Synthesis	m/s	6.3
Cycle time (2kg load) *2		s	0.47
Max. load capacity		kg	5 (Rating 2)
Allowable moment of inertia		kg·m^2	0.05
Position repeat Accuracy *3	X-Y	mm	±0.01
	Z (3-axis)	mm	±0.015
	4-axis (Z-axis rotation)	deg	±0.007
Hand wiring			8 input points/8 output points
Hand fitting *4			ø4 x 3 pcs
Position detection method			Absolute method
Robot controller cable		m	3.5
Power capacity		kVA	0.7
Body weight		kg	13

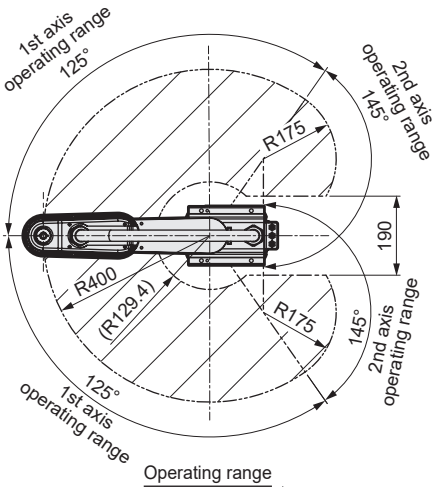
*1 There are restrictions on speed and acceleration depending on the operation pattern, load weight and degree of offset.
*2 300 mm in horizontal direction, 25 mm in vertical direction (reciprocating), rough positioning. Continuous operation exceeding the effective load factor is not allowed.
*3 One-way positioning repeatability when the ambient temperature and airframe temperature are constant. Not the absolute positioning accuracy. For X-Y and C, the values are at the Z upper limit. The track accuracy is not guaranteed.
*4 A fitting for hand piping is available on the base side. Customers are responsible for piping.

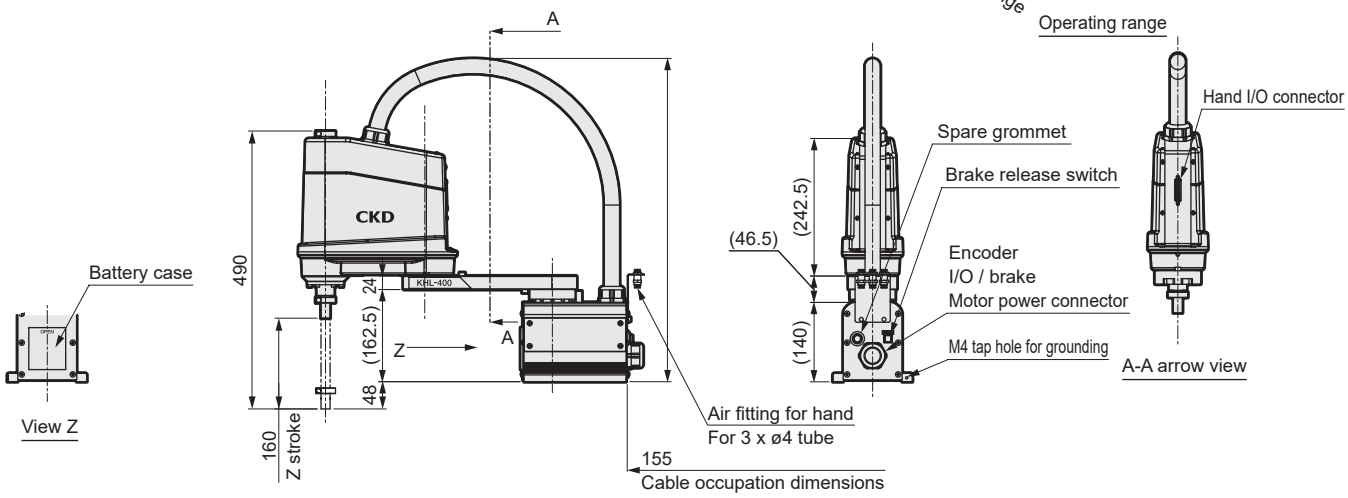
Dimensions

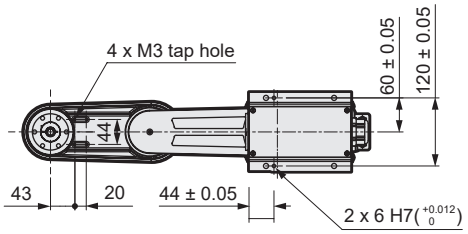
KHL-400



Hand mounting part details



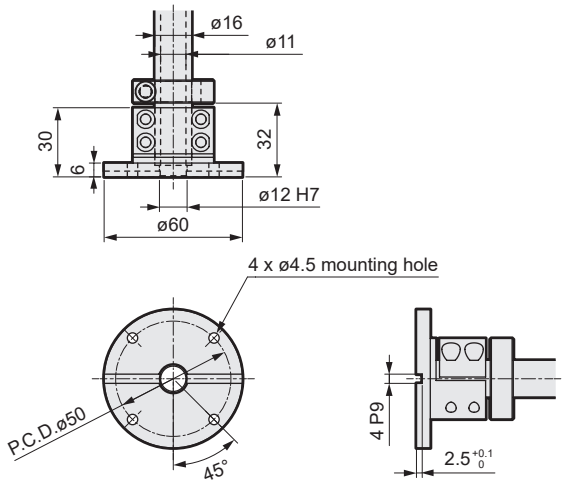




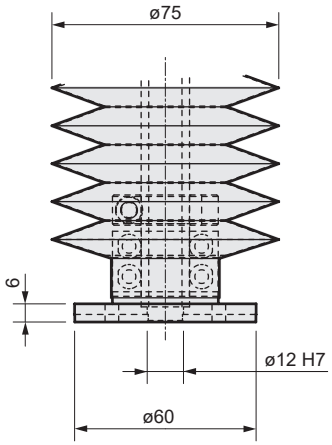
Optional dimensions

Tool flange

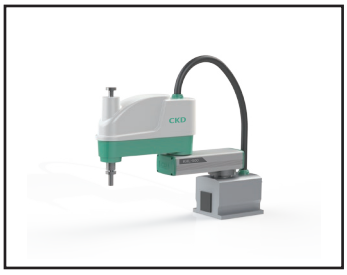
Model No.: KHL-TF3



Bellows



Note: When ordering the SCARA robot body and the tool flange at the same time, the tool flange will be "assembled at shipment".



SCARA robot

KHL-500

● Arm length: 500 mm (200 mm + 300 mm)

How to order

KHL - 500 (A) N (B) NNN (C) - KSL3 N (D) NN (E) NN (F) - N (G) N (H)

(A) Arm length

500 mm

(B) Z-axis stroke

*1	**N**	Standard
	Z	300

(C) Option

	NNN	None
*5	**BNN**	Lower bellows
	CNN	Upper cap
	TNN	Ceiling mount
*2	**BCN**	Lower bellows, top cap
*2	**BTN**	Lower bellows, ceiling mount
*2	**BCT**	Lower bellows, top cap, ceiling mount
	CTN	Top cap, ceiling mount
	SCN	Simple clean-room

(D) External signal polarity

N	N-Type (standard)
P	P-Type

(E) Robot controller cable

NN	3.5 m (standard)
05	5 m
08	8 m
10	10 m
15	15 m

(F) Network

NN	None
CC	CC-Link
DN	DeviceNet
PB	PROFIBUS
EN	EtherNet/IP
EC	EtherCAT
PN	PROFINET

(G) Expansion IO unit

N	0 units
1	1 units
2	2 units

(H) IO cable

	N	None
*4	**1**	1 set
	2	2 set
	3	3 set

*1 150 stroke.
*2 KHL-TF (tool flange) is also required.
*3 A unit with 28 inputs and 20 outputs.
*4 A 2-piece set with 6 m cable length.
*5 KHL-TF (tool flange) is also required.

Product subject to the EAR (EAR99)

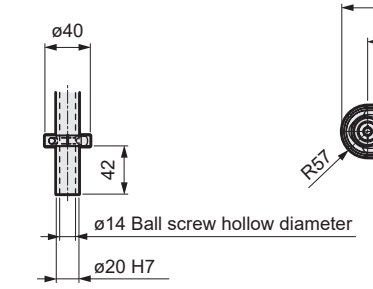
Specifications

Model No.			KHL-500
Type			Horizontal articulation
Number of axes			4
Arm length		mm	500 (200+300)
Operating range	1-axis	deg	±125
	2-axis	deg	±145
	3-axis (Z-axis)	mm	0 to 150
	4-axis (Z-axis rotation)	deg	±360
Max. speed	1-axis	deg/s	450
	2-axis	deg/s	450
	3-axis (Z-axis)	mm/s	2000
	4-axis (Z-axis rotation)	deg/s	1700
*1	Synthesis	m/s	6.3
Cycle time (2kg load) *2		s	0.45
Max. load capacity		kg	10 (Rating 2)
Allowable moment of inertia		kg·m^2	0.2
Position repeat Accuracy *3	X-Y	mm	±0.01
	Z (3-axis)	mm	±0.015
	4-axis (Z-axis rotation)	deg	±0.007
Hand wiring			8 input points/8 output points
Hand fitting *4			ø6 x 3 pcs
Position detection method			Absolute method
Robot controller cable		m	3.5
Power capacity		kVA	1.4
Body weight		kg	22

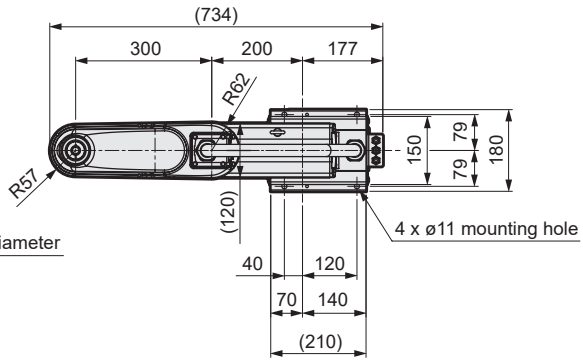
*1 There are restrictions on speed and acceleration depending on the operation pattern, load weight and degree of offset.
*2 300 mm in horizontal direction, 25 mm in vertical direction (reciprocating), rough positioning. Continuous operation exceeding the effective load factor is not allowed.
*3 One-way positioning repeatability when the ambient temperature and airframe temperature are constant. Not the absolute positioning accuracy. For X-Y and C, the values are at the Z upper limit. The track accuracy is not guaranteed.
*4 A fitting for hand piping is available on the base side. Customers are responsible for piping.

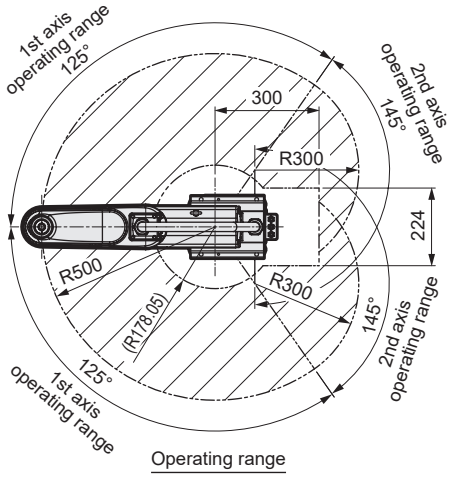
Dimensions

● KHL-500

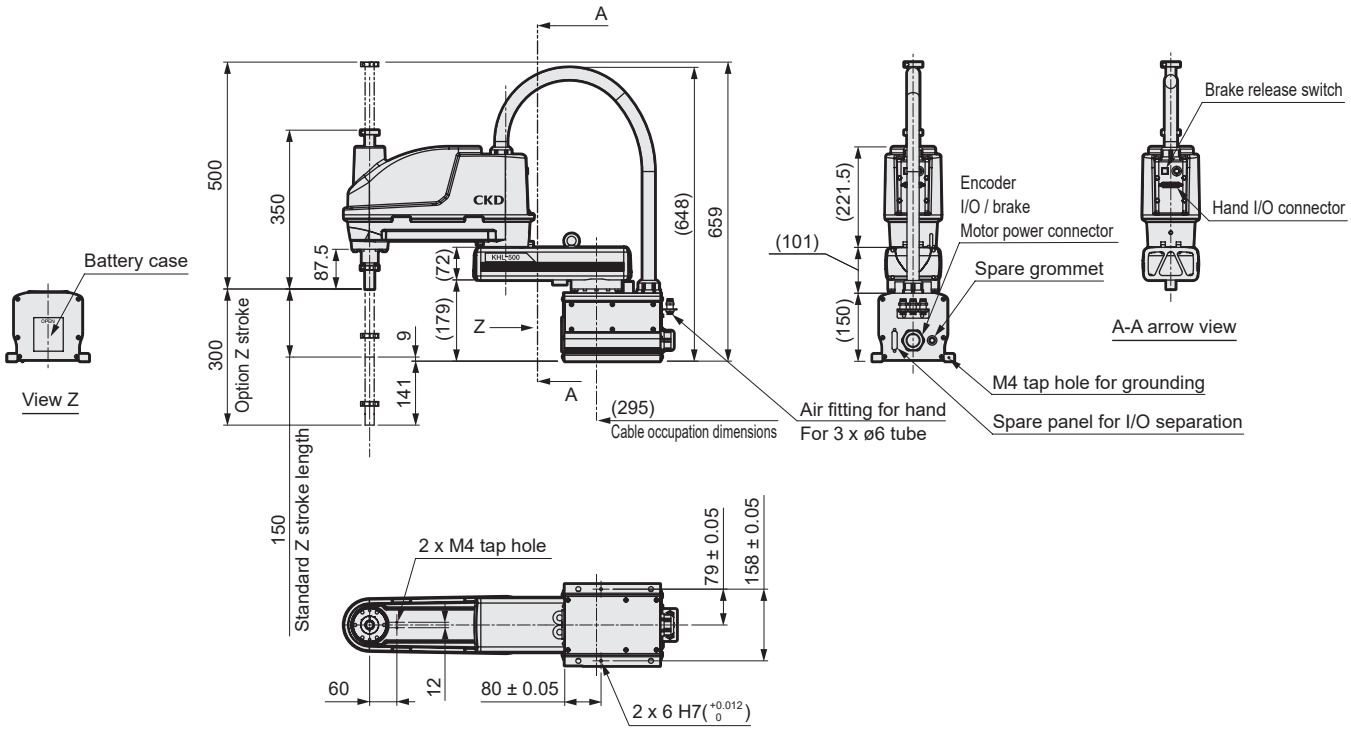


Hand mounting part details





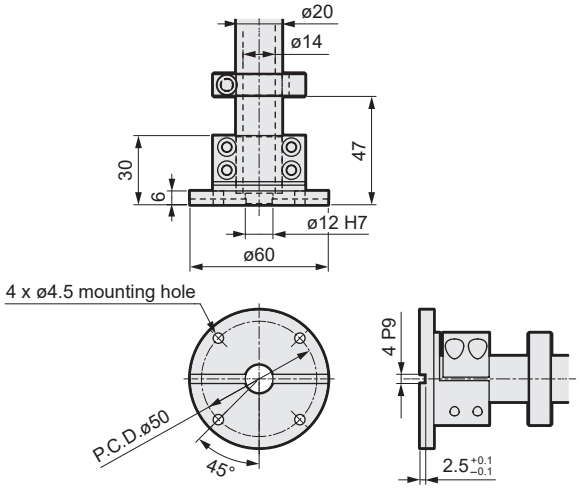
Operating range



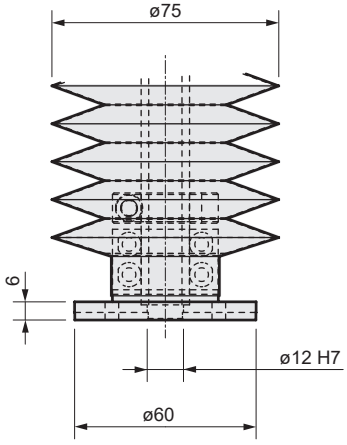
Optional dimensions

● Tool flange

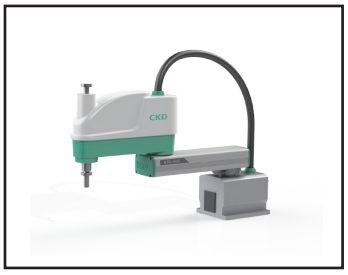
Model No.: KHL-TF5



● Bellows



Note: When ordering the SCARA robot body and the tool flange at the same time, the tool flange will be "assembled at shipment".



SCARA robot

KHL-600

●Arm length: 600 mm (300 mm + 300 mm)

How to order

KHL - 600 (A) N (B) NNN (C) - KSL3 N (D) NN (E) NN (F) - N (G) N (H)

(A) Arm length

600 mm

(B) Z-axis stroke

*1	**N**	Standard
	Z	300

(C) Option

	NNN	None
*5	**BNN**	Lower bellows
	CNN	Upper cap
	TNN	Ceiling mount
*2	**BCN**	Lower bellows, top cap
*2	**BTN**	Lower bellows, ceiling mount
*2	**BCT**	Lower bellows, top cap, ceiling mount
	CTN	Top cap, ceiling mount
	SCN	Simple clean-room

(D) External signal polarity

N	N-Type (standard)
P	P-Type

(E) Robot controller cable

NN	3.5 m (standard)
05	5 m
08	8 m
10	10 m
15	15 m

(F) Network

NN	None
CC	CC-Link
DN	DeviceNet
PB	PROFIBUS
EN	EtherNet/IP
EC	EtherCAT
PN	PROFINET

(G) Expansion IO unit

N	0 units
1	1 units
2	2 units

(H) IO cable

	N	None
*4	**1**	1 set
	2	2 set
	3	3 set

*1 150 stroke.
*2 KHL-TF (tool flange) is also required.
*3 A unit with 28 inputs and 20 outputs.
*4 A 2-piece set with 6 m cable length.
*5 KHL-TF (tool flange) is also required.

Product subject to the EAR (EAR99)

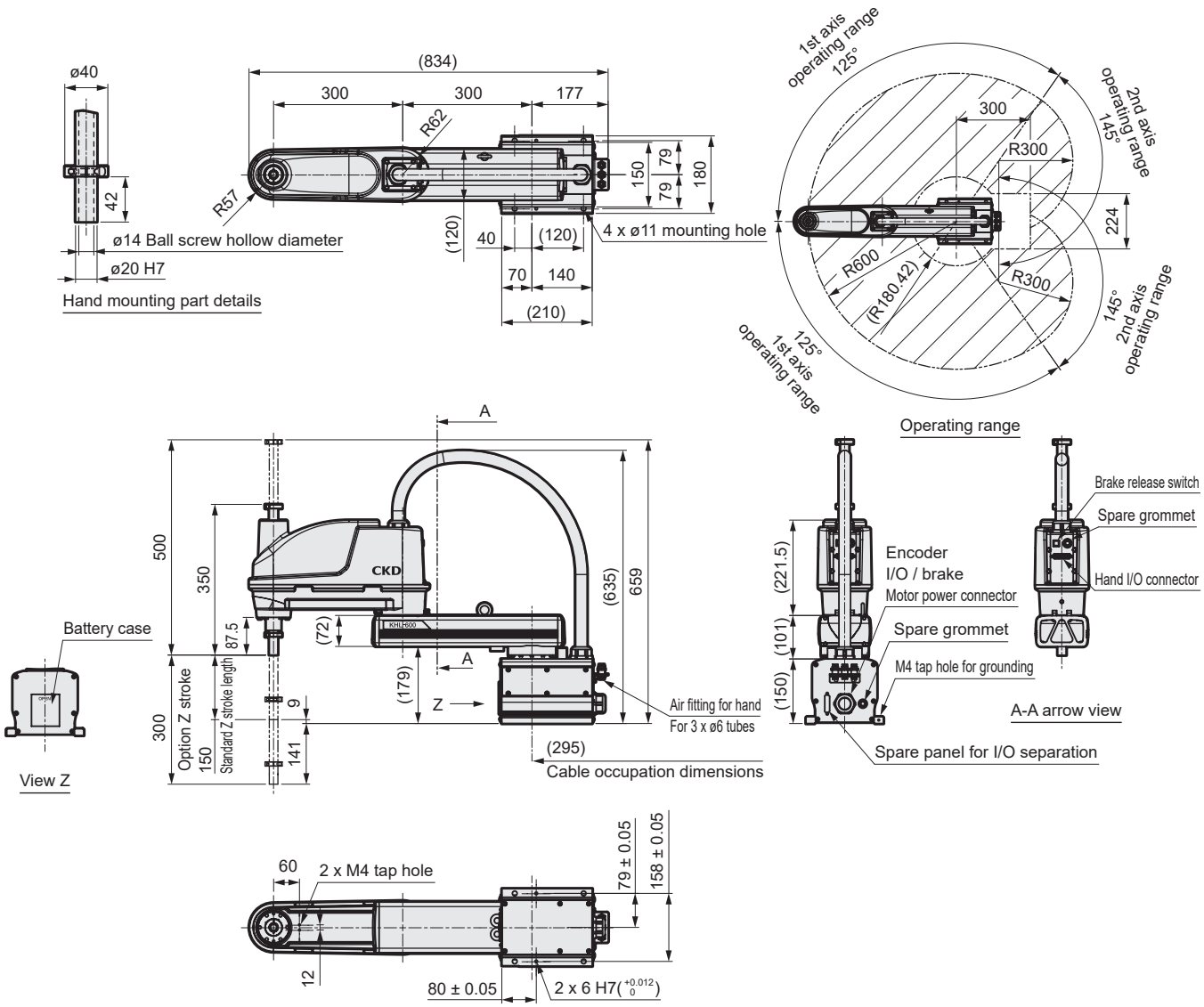
Specifications

Model No.			KHL-600
Type			Horizontal articulation
Number of axes			4
Arm length		mm	600 (300+300)
Operating range	1-axis	deg	±125
	2-axis	deg	±145
	3-axis (Z-axis)	mm	0 to 150
	4-axis (Z-axis rotation)	deg	±360
Max. speed	1-axis	deg/s	450
	2-axis	deg/s	450
	3-axis (Z-axis)	mm/s	2000
	4-axis (Z-axis rotation)	deg/s	1700
*1	Synthesis	m/s	7.1
Cycle time (2kg load) *2		s	0.45
Max. load capacity		kg	10 (Rating 2)
Allowable moment of inertia		kg·m^2	0.2
Position repeat Accuracy *3	X-Y	mm	±0.01
	Z (3-axis)	mm	±0.015
	4-axis (Z-axis rotation)	deg	±0.007
Hand wiring			8 input points/8 output points
Hand fitting *4			ø6 x 3 pcs
Position detection method			Absolute method
Robot controller cable		m	3.5
Power capacity		kVA	1.4
Body weight		kg	23

*1 There are restrictions on speed and acceleration depending on the operation pattern, load weight and degree of offset.
*2 300 mm in horizontal direction, 25 mm in vertical direction (reciprocating), rough positioning. Continuous operation exceeding the effective load factor is not allowed.
*3 One-way positioning repeatability when the ambient temperature and airframe temperature are constant. Not the absolute positioning accuracy. For X-Y and C, the values are at the Z upper limit. The track accuracy is not guaranteed.
*4 A fitting for hand piping is available on the base side. Customers are responsible for piping.

Dimensions

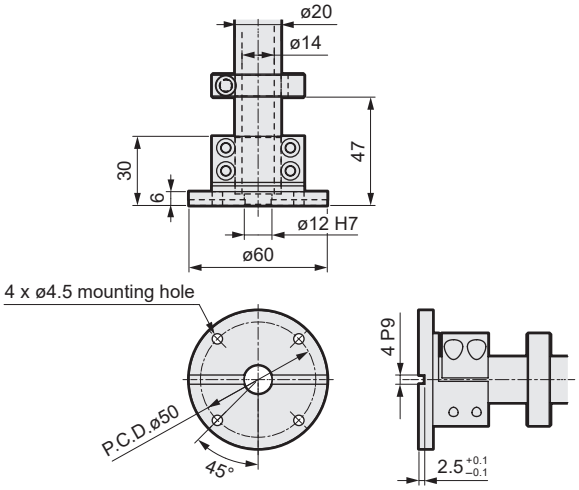
● KHL-600



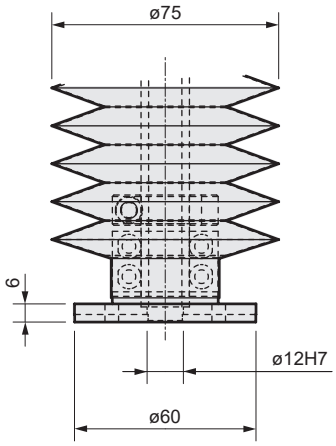
Optional dimensions

● Tool flange

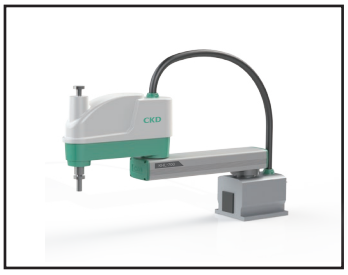
Model No.: KHL-TF5



● Bellows



Note: When ordering the SCARA robot body and the tool flange at the same time, the tool flange will be "assembled at shipment".



SCARA robot

KHL-700

●Arm length: 700 mm (400 mm + 300 mm)

How to order

KHL - 700 N NNN - KSL3 N NN NN - N N

(A) (B) (C) (D) (E) (F) (G) (H)

(A) Arm length

700	700 mm

(B) Z-axis stroke

*1	N	Standard
	Z	300

(C) Option

	NNN	None
*5	BNN	Lower bellows
	CNN	Upper cap
	TNN	Ceiling mount
*2	BCN	Lower bellows, top cap
*2	BTN	Lower bellows, ceiling mount
*2	BCT	Lower bellows, top cap, ceiling mount
	CTN	Top cap, ceiling mount
	SCN	Simple clean-room

(D) External signal polarity

N	N-Type (standard)
P	P-Type

(E) Robot controller cable

NN	3.5 m (standard)
05	5 m
08	8 m
10	10 m
15	15 m

(F) Network

NN	None
CC	CC-Link
DN	DeviceNet
PB	PROFIBUS
EN	EtherNet/IP
EC	EtherCAT
PN	PROFINET

(G) Expansion IO unit

N	0 units
1	1 units
2	2 units

(H) IO cable

	N	None
*4	1	1 set
	2	2 set
	3	3 set

*1 150 stroke.
*2 KHL-TF (tool flange) is also required.
*3 A unit with 28 inputs and 20 outputs.
*4 A 2-piece set with 6 m cable length.
*5 KHL-TF (tool flange) is also required.

Product subject to the EAR (EAR99)

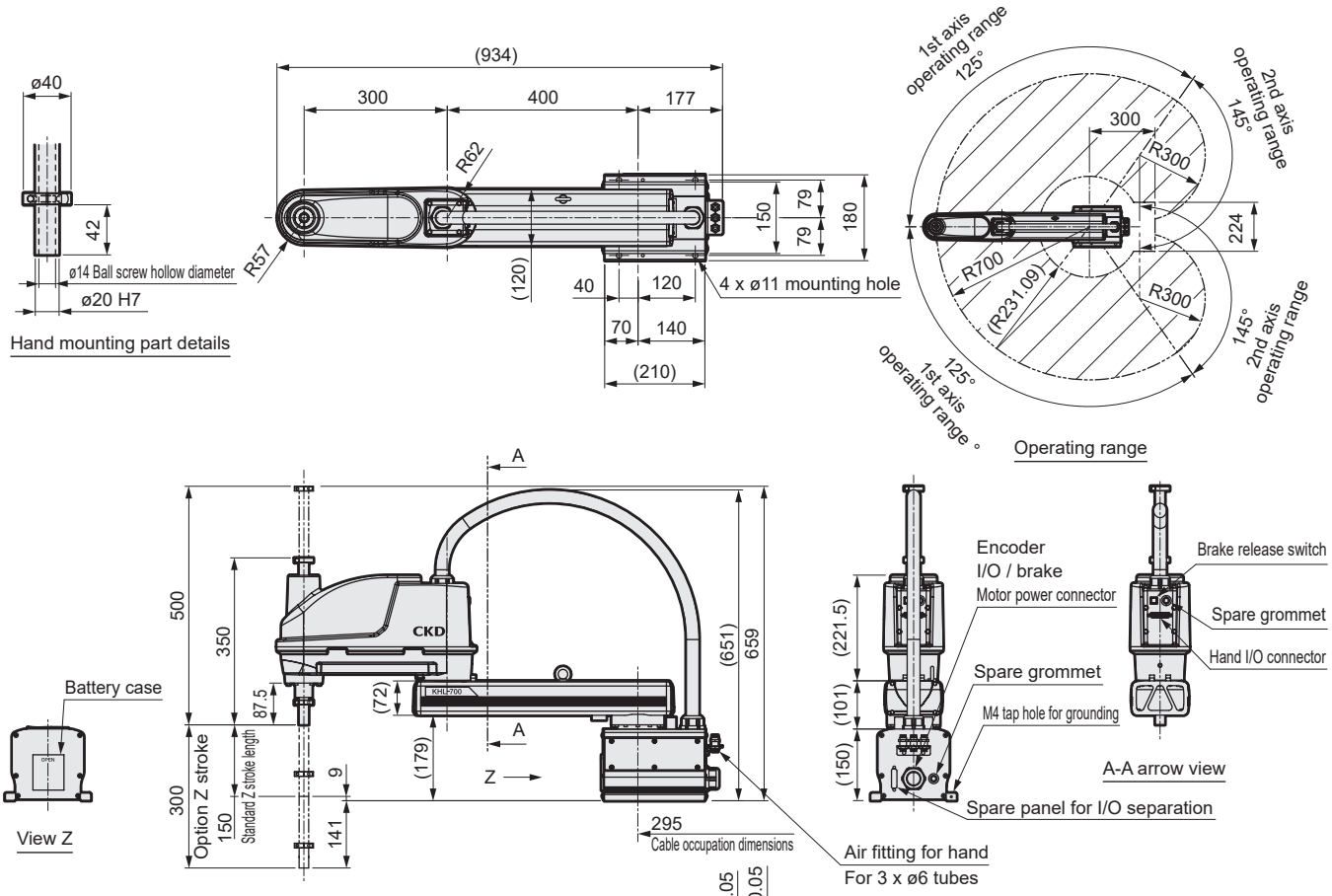
Specifications

Model No.			KHL-700
Type			Horizontal articulation
Number of axes			4
Arm length		mm	700 (400+300)
Operating range	1-axis	deg	±125
	2-axis	deg	±145
	3-axis (Z-axis)	mm	0 to 150
	4-axis (Z-axis rotation)	deg	±360
Max. speed	1-axis	deg/s	450
	2-axis	deg/s	450
	3-axis (Z-axis)	mm/s	2000
	4-axis (Z-axis rotation)	deg/s	1700
*1	Synthesis	m/s	7.9
Cycle time (2kg load) *2		s	0.50
Max. load capacity		kg	10 (Rating 2)
Allowable moment of inertia		kg·m^2	0.2
Position repeat Accuracy *3	X-Y	mm	±0.01
	Z (3-axis)	mm	±0.015
	4-axis (Z-axis rotation)	deg	±0.007
Hand wiring			8 input points/8 output points
Hand fitting *4			ø6 x 3 pcs
Position detection method			Absolute method
Robot controller cable		m	3.5
Power capacity		kVA	1.4
Body weight		kg	24

*1 There are restrictions on speed and acceleration depending on the operation pattern, load weight and degree of offset.
*2 300 mm in horizontal direction, 25 mm in vertical direction (reciprocating), rough positioning. Continuous operation exceeding the effective load factor is not allowed.
*3 One-way positioning repeatability when the ambient temperature and airframe temperature are constant. Not the absolute positioning accuracy. For X-Y and C, the values are at the Z upper limit. The track accuracy is not guaranteed.
*4 A fitting for hand piping is available on the base side. Customers are responsible for piping.

Dimensions

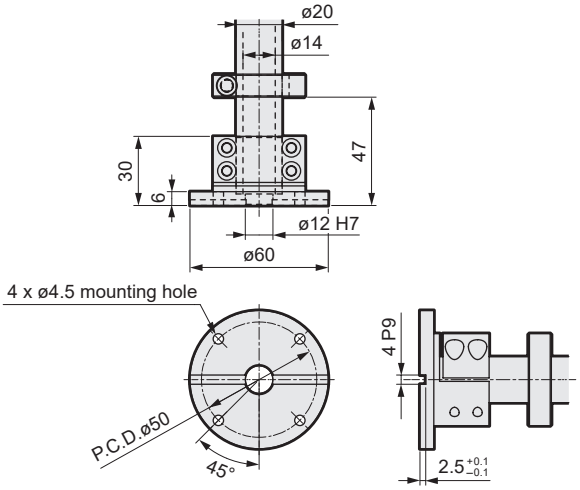
● KHL-700



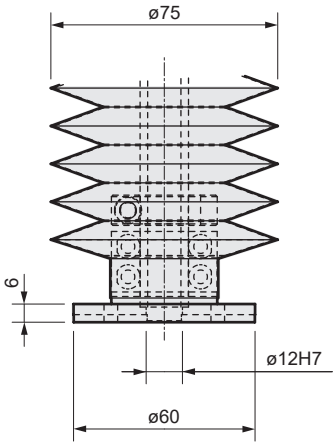
Optional dimensions

● Tool flange

Model No.: KHL-TF5

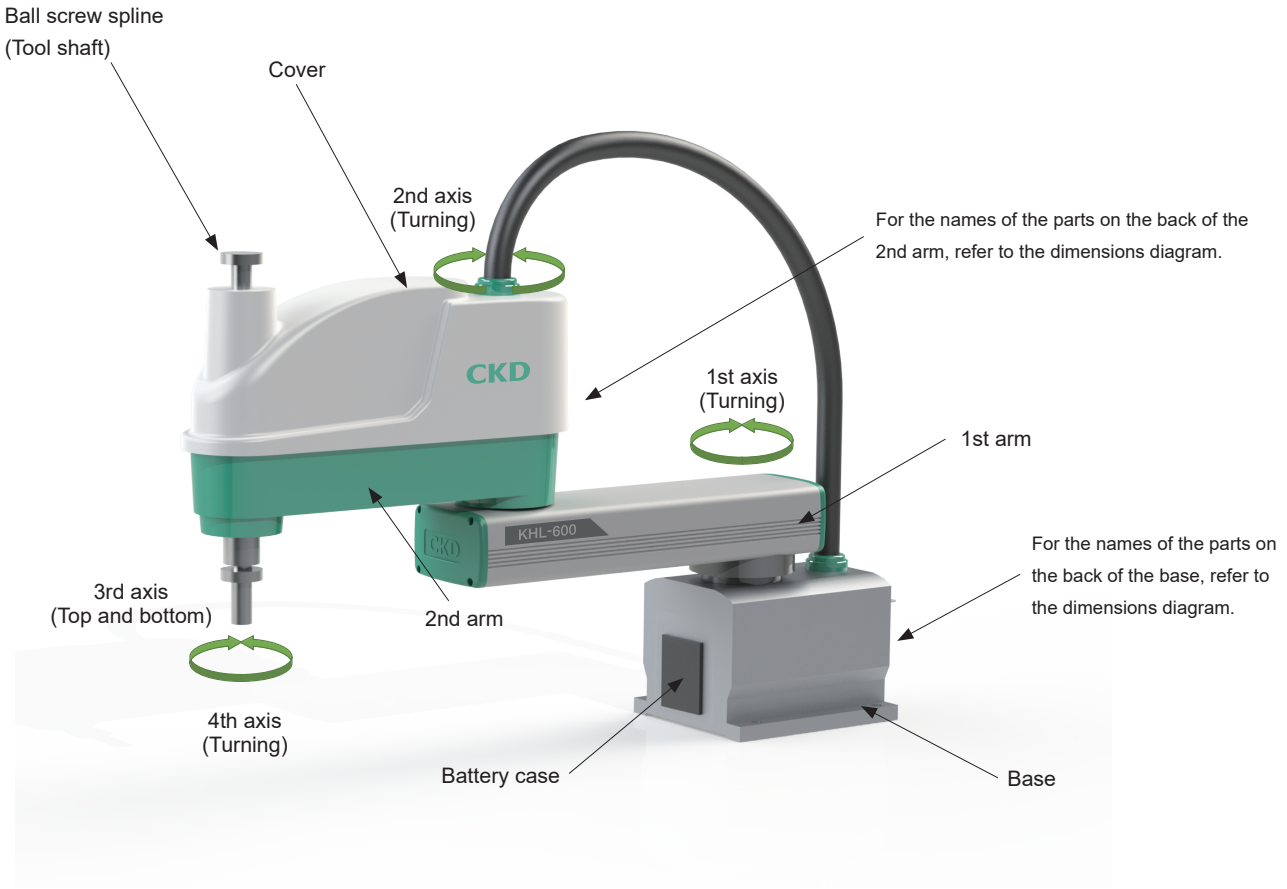


● Bellows

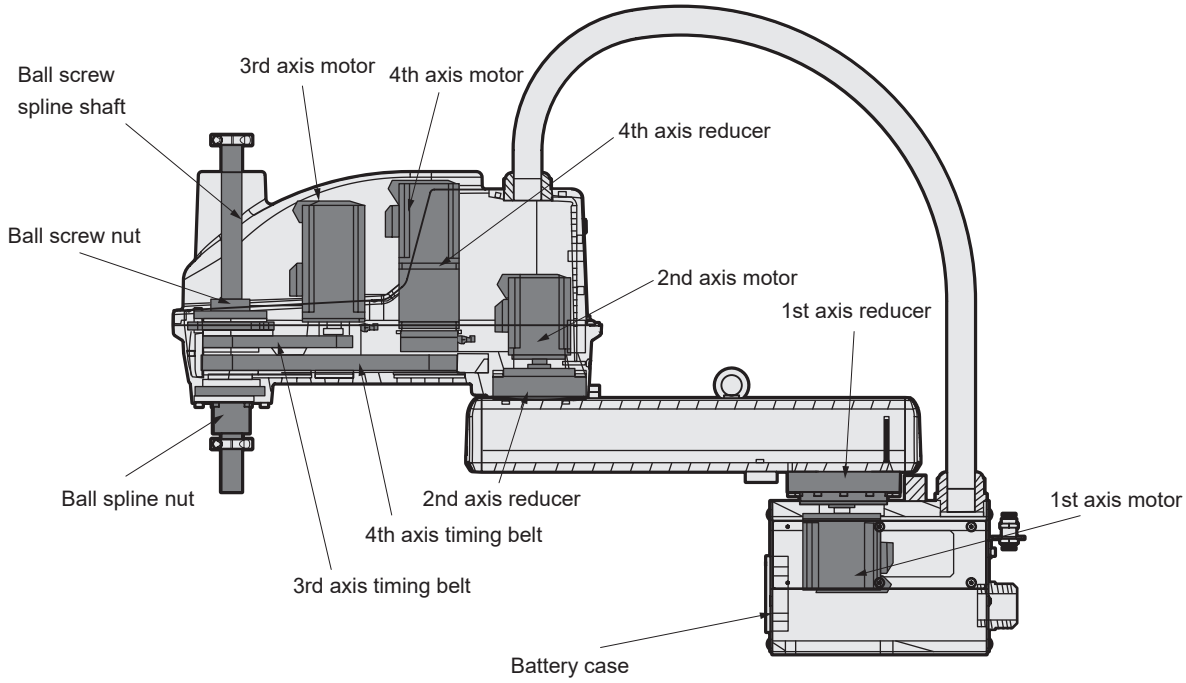


Note: When ordering the SCARA robot body and the tool flange at the same time, the tool flange will be "assembled at shipment".

Section names



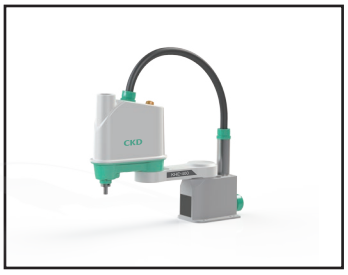
Internal structure



KHE

SCARA robot

CONTENTS



SCARA robot

KHE-400

● Arm length: 400 mm (225 mm + 175 mm)

How to order

KHE - 400 (A) N (B) BNN (C) - KSL3 P (D) NN (E) NN (F) - N (G) N (H)

A Arm length

400 mm

B Z-axis stroke

*1	N	Standard

C Option

	NNN	None
*4	BNN	Lower bellows
	CNN	Upper cap
	TNN	Ceiling mount
	WSN	Z-axis wiring shaft
*4	BCN	Lower bellows, top cap
*4	BCT	Lower bellows, top cap, ceiling mount
*4	BWS	Lower bellows, shaft for Z-axis wiring
*4	BTN	Lower bellows, ceiling mount
	CTN	Top cap, ceiling mount
	TWS	Z-axis wiring shaft, ceiling mount

D External signal polarity

N	N-Type (standard)
P	P-Type

E Robot controller cable

NN	3.5 m (standard)
05	5 m
08	8 m
10	10 m
15	15 m

F Network

NN	None
CC	CC-Link
DN	DeviceNet
PB	PROFIBUS
EN	EtherNet/IP
EC	EtherCAT
PN	PROFINET

G Expansion IO unit

*2 N	0 units
1	1 units
2	2 units

H IO cable

N	None	*3
1	1 set	
2	2 set	
3	3 set	

*1 160 stroke.
*2 A unit with 28 inputs and 20 outputs.
*3 A 2-piece set with 6m cable length.
*4 KHL-TF (tool flange) is also required.

Product subject to the EAR (EAR99)

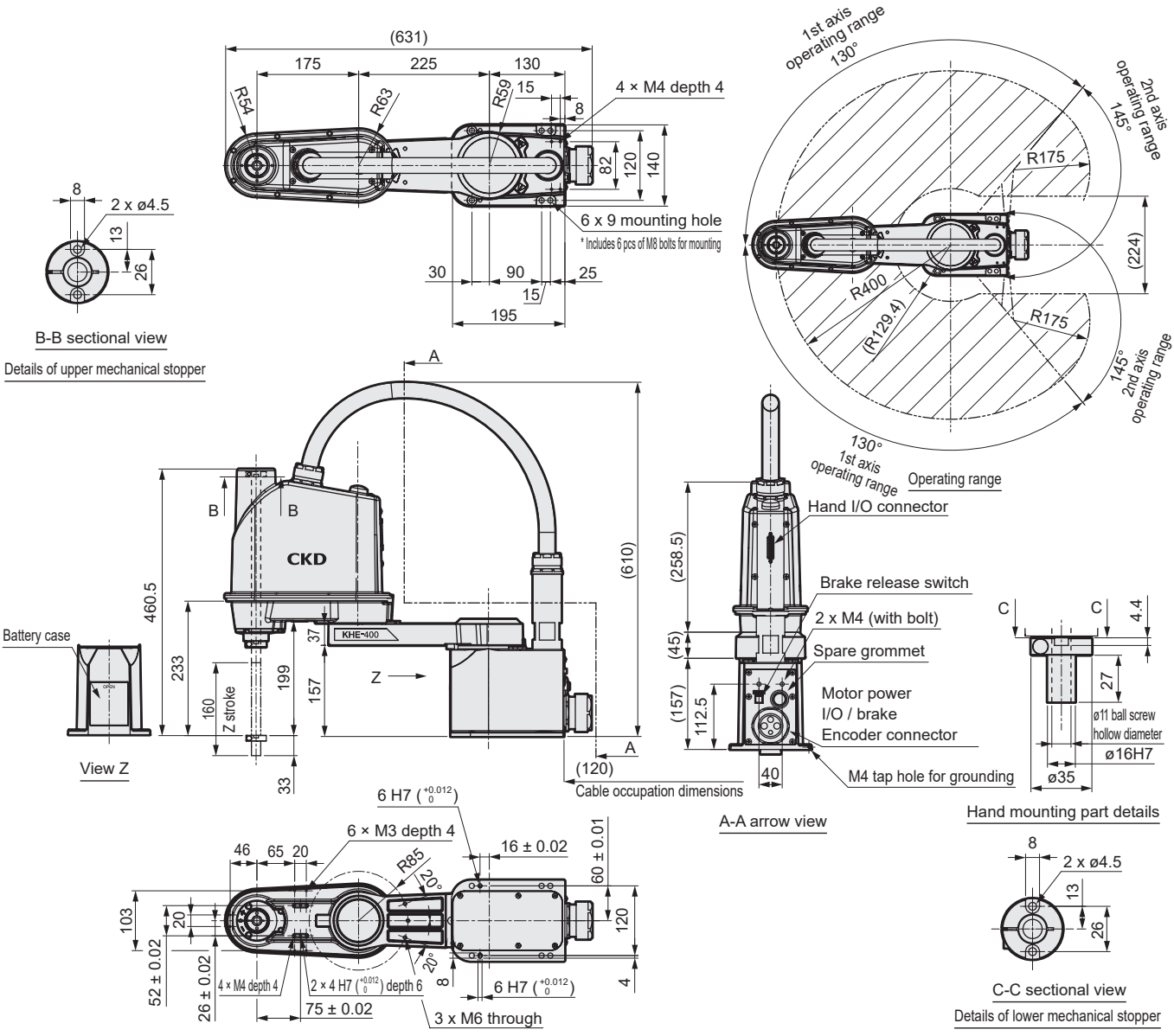
Specifications

Model No.			KHE-400
Type			Horizontal articulation
Number of axes			4
Arm length		mm	400 (225+175)
Operating range	1-axis	deg	±130
	2-axis	deg	±145
	3-axis (Z-axis)	mm	0 to 160
	4-axis (Z-axis rotation)	deg	±360
Max. speed	1-axis	deg/s	672
	2-axis	deg/s	780
	3-axis (Z-axis)	mm/s	1120
	4-axis (Z-axis rotation)	deg/s	1800
*1	Synthesis	m/s	7.0
Cycle time (2kg load) *2		s	0.39
Max. load capacity		kg	5 (Rating 1)
Allowable moment of inertia		$kg \cdot m^2$	0.06
Position repeat Accuracy *3	X-Y	mm	±0.01
	Z (3-axis)	mm	±0.01
	4-axis (Z-axis rotation)	deg	±0.007
Hand wiring			8 input points/8 output points
Hand fitting			To be prepared by the customer
Position detection method			Absolute method
Robot controller cable		m	3.5
Power capacity		kVA	2.6
Body weight		kg	15

*1 There are restrictions on speed and acceleration depending on the operation pattern, load weight and degree of offset.
*2 300 mm in horizontal direction, 25 mm in vertical direction (reciprocating), rough positioning. Continuous operation exceeding the effective load factor is not allowed.
*3 One-way positioning repeatability when the ambient temperature and airframe temperature are constant. Not the absolute positioning accuracy. For X-Y and C, the values are at the Z upper limit. The track accuracy is not guaranteed.

Dimensions

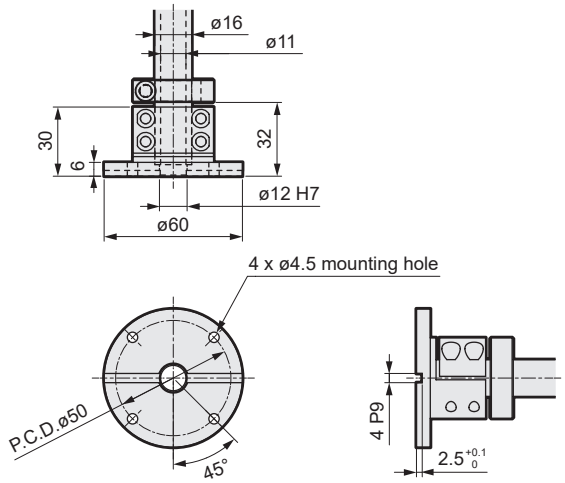
● KHE-400



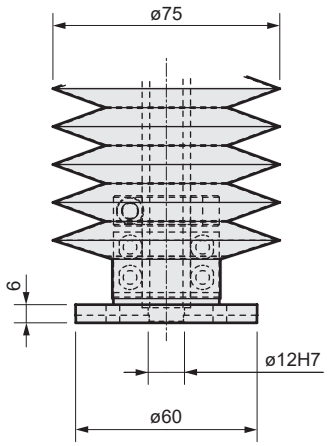
Optional dimensions

● Tool flange

Model No.: KHL-TF3



● Bellows



Note: When ordering the SCARA robot body and the tool flange at the same time, the tool flange will be "assembled at shipment".

Option

Various options are available for use in a wide range of applications.

Z-axis long stroke length

Compatible models: KHL-500, KHL-600, KHL-700　Optional stroke: 300 mm

This is an optional specification with the Z-axis operating range extended.
It enables work with high vertical difference and handling of long workpieces.

Z-axis lower bellows

Compatible with all models of the KHL Series. (Same for KHE Series)

Protects the lower side of the Z-axis shaft in environments where liquids or cutting chips are scattered.
Note: The cycle time and Z-axis operating range differ from the standard specifications. Contact CKD for details.

Z-axis top cap

Compatible with all models of the KHL Series. (Same for KHE Series)

Protects the upper side of the Z-axis shaft in environments where liquids or chips are scattered.
It also prevents peripheral components such as cables from being caught.

Ceiling mount specification

Compatible models: KHL-400, KHL-500, KHL-600, KHL-700

The robot can be hung and installed above the work area.
Enables effective use of space.
Note: The operating area differs from the standard specifications. Contact CKD for details.

Cable length change

The cable length between the robot and controller can be changed to up to 15 m for all models of the KHL Series .

Tool flange for mounting the hand

Compatible with all models of the KHL Series. (Same for KHE Series)

A tool flange for fixing the hand.

Note 1: The photo on the right shows the hand mounting tool flange for KHL-500 to 700.
The shape of the hand mounting tool flange for KHL-300 and 400 is different from the one on the right.

Note 2: When ordering the SCARA robot body and the tool flange at the same time, the tool flange will be "assembled at shipment" it will be .

Simple clean-room specification

Compatible with all models of the KHL Series.

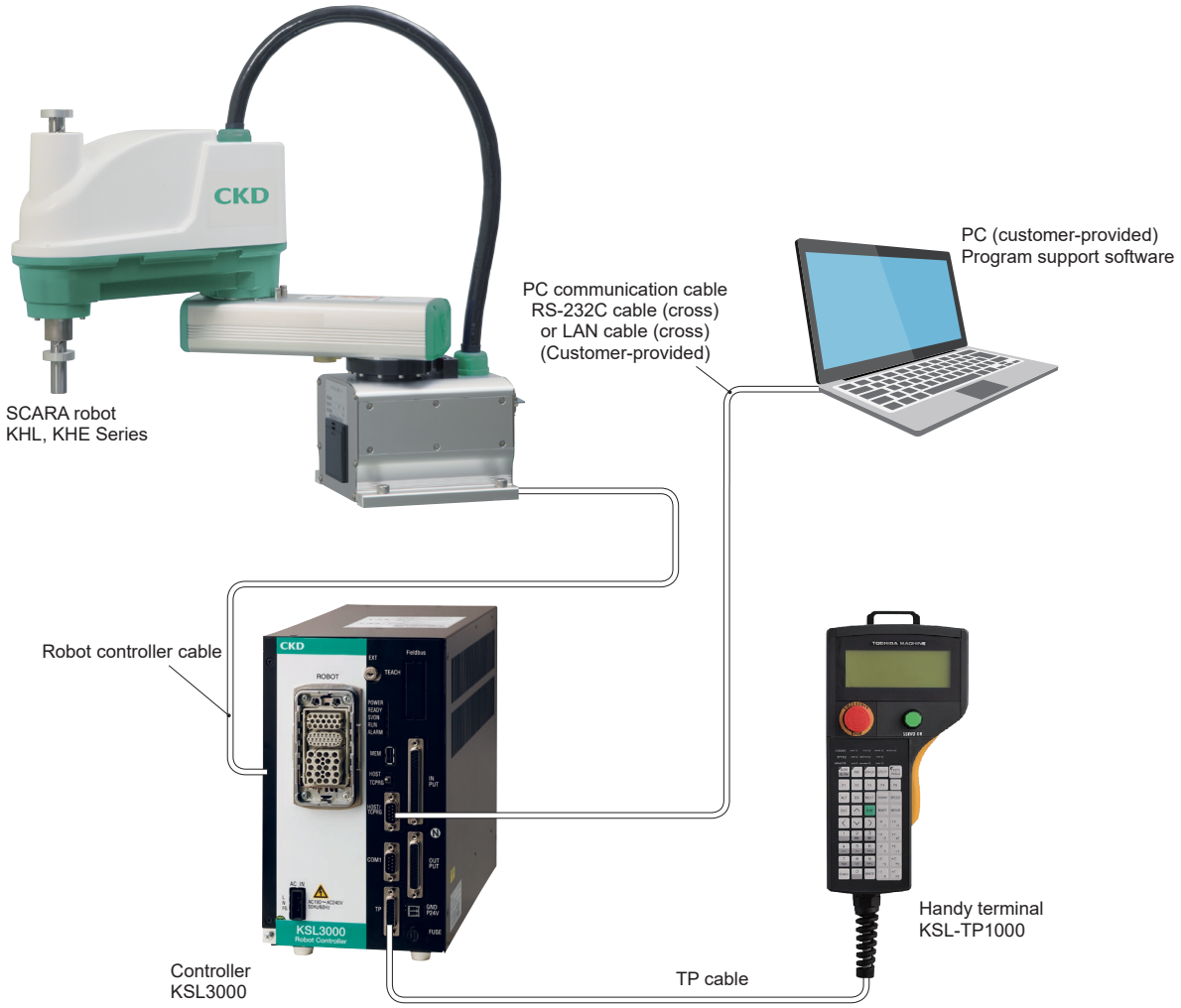
Clean-room specification that corresponds to ISO clean-room class 5.
It can be used in the manufacturing process such as semiconductors and liquid crystal related products for which dust must be avoided.

Option list

Model No.	Z-axis	Z-axis bottom bellows	Z-axis top cap	Ceiling mount specifications	Cable extension (longest)	For mounting hand tool flange	Simple clean-room
KHL-300	X	OK	OK	X	15 m	OK	OK
KHL-400	X	OK	OK	OK	15 m	OK	OK
KHL-500	OK (300 mm)	OK	OK	OK	15 m	OK	OK
KHL-600	OK (300 mm)	OK	OK	OK	15 m	OK	OK
KHL-700	OK (300 mm)	OK	OK	OK	15 m	OK	OK

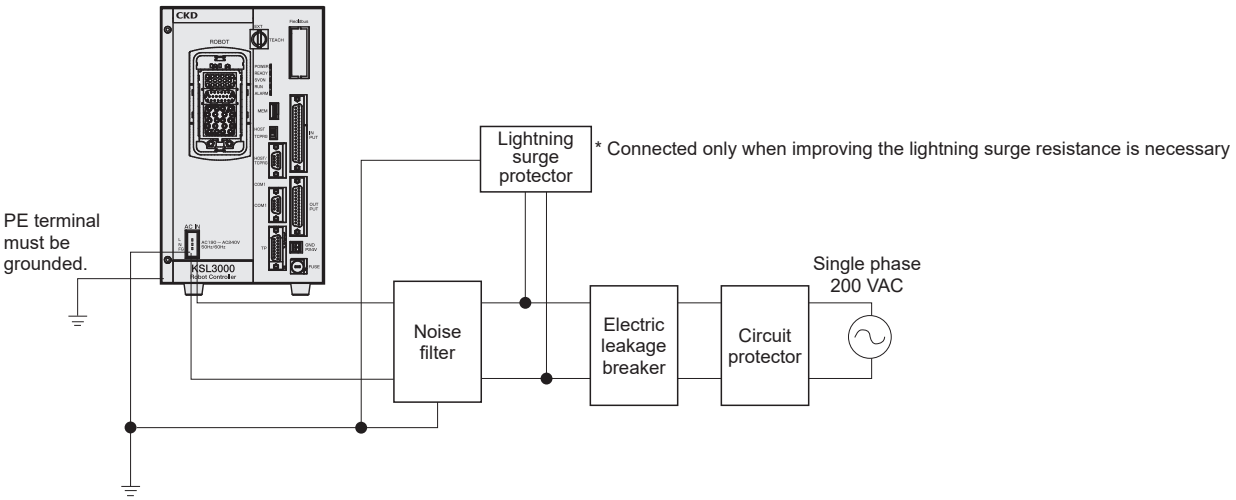
OK: Compatible X: Not compatible

System configuration



■ Power line connection example

An example of connecting the KSL3000 power line is shown below.



Leakage breaker	Specifications	Single phase 20 A, sensitivity current 30 mA leakage breaker
	Recommended product	BKW2203CCK Panasonic Co., Ltd.
Noise filter	Recommended product	SUPF-EX20-ER-6 Okaya Electric Industries Co., Ltd.

- The KSL3000 does not have a protective device, so be sure to install a leakage breaker, noise filter, etc.
- Refer to "Installation/Transportation" in the instruction manual for details on connecting the power line.

Control-related

CONTENTS

Controller

KSL3000

A controller for SCARA robots.
Compatible with all field networks.

Note: The set model number of the main body and controller is mainly used. Contact CKD for controller model numbers.

Specifications

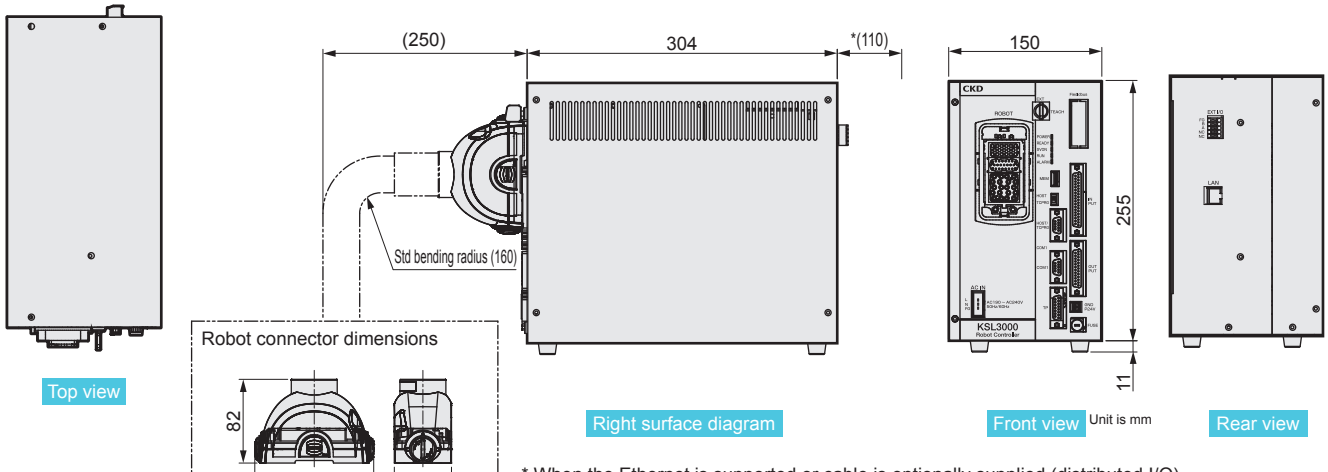
No. of control axes		Max. number of axes: 4
Operation mode		PTP, CP (straight, arc), shortcut, arch movement
Storage capacity		Total: Approx. 6400 points + 12800 steps 1 program: Approx. 2000 points + 3000 steps
Number of registered programs		Up to 256 (user files: 247, system files: 9)
Programming language		Technical term "SCOL"
Teaching device (optional)		Handy terminal: KSL-TP1000 Program creation by PC software TSAssist (model No. KSL-TSA)
External I/O signal		8 input points/8 output points
Hand control signal		8 input points/8 output points
External operation signal	Input	Program selection, startup, stop, program reset, etc.
	Output	Servo ON, operation ready, failure, cycle stop, etc.
Communication port		RS-232C 1 port (HOST/TCPRG, switch change) only RS-232C 1 port (COM1) general purpose RS-485 1 port for distributed I/O only RS-422 1 port for KSL-TP1000 only Ethernet
Other functions and features		Torque limit, interrupt function, self-diagnosis, operating signal / communication processing, coordinate calculation, built-in PLC, fanless design, etc.
Power supply		Single-phase 190 to 240 VAC 50/60 Hz
Dimensions and weight *1		150 (W) x 266 (H) x 304 (D) mm, 7 kg
PC software (Option)		KSL-TSA: Program creation support software High-performance 3D simulation High-performance program editor, teaching function, etc. KSL-TCP: Program editor for built-in PLC
Option *2		External signal polarity (“N-type”, “P-type”), I/O signal expansion, Fieldbus function added (PROFIBUS, DeviceNet, CC-Link, EtherNet/IP, EtherCAT, PROFINET), external input signal cable External output signal cable, controller mounting bracket

*1 Height H is the dimension including rubber feet. Installation requires peripheral space for cable wiring, etc. Contact CKD for details on dimensions.

*2 Ethernet is a registered trademark of XEROX Corp. of the United States. CC-Link is a registered trademark of CC-Link Association. DeviceNet and EtherCAT are registered trademarks of ODVA. PROFIBUS and PROFINET are registered trademarks of PROFIBUS User Organization. EtherCAT® is a patented technology licensed by Beckhoff Automation GmbH, Germany, and is a registered trademark.

Product subject to the EAR (EAR99)

Dimensions

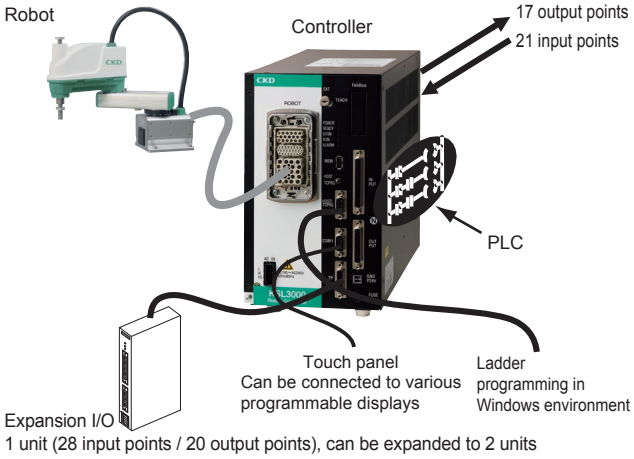


* When the Ethernet is supported or cable is optionally supplied (distributed I/O).

Built-in PLC function

The controller has a built-in simple PLC (Tcmini).
I/O signals can be controlled by the ladder program regardless of robot operation.

- TCmini can control the standard I/O, expansion I/O and touch panel I/O with a ladder program and pass them to the robot program.
- It expands the flexibility of system design and allows peripheral devices to be controlled without using a commercially available PLC, making it extremely cost effective.
- Ladder programs can also be created, monitored and debugged using the PC software TCPRGS-W (model No. KSL-TCP) (sold separately).
- The scan time is 5 ms for 1K words. It can be connected to various programmable controllers and displays.
- Expansion I/O is sold separately.



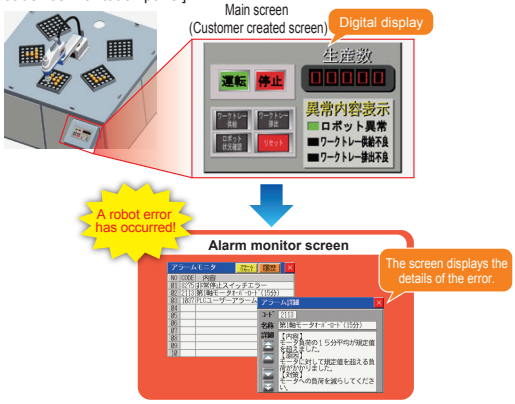
Compatible with digital cockpit parts

The status of the robot can be checked on the touch panel display.

- When an error occurs in the robot, the error details can be checked on the alarm monitor screen.
- In addition, the robot I/O monitor, current position monitor, I/O time chart, connected component data transfer function and various other screens are available.

- The above robot screen can be downloaded free of charge from the Digital Electronics Corporation website. As screen creation does not take a long time, it can be used on the day of purchase.
  http://www.proface.co.jp/otasuke/sample/download/common/connection_robot_con_ts_j.html
- Even a person who cannot operate the handy terminal can check the status of the robot.
- The robot and device information are displayed on the same display, allowing the cause of the trouble to be easily investigated.

[Robot device with touch panel]



*A joint system of Toshiba Machine Corporation and Digital Electronics Corporation.
*Contact Digital Electronics Corporation for details of touch panel products compatible with this system.
http://www.proface.co.jp/otasuke/sample/detail/common/connection_robot_con_ts_j.html

Connection with image processing system

Allows direct connection with image processing systems manufactured by Keyence Corporation, OMRON Corporation and Panasonic Corporation. Contact CKD for details.

Handy terminal

KSL-TP1000

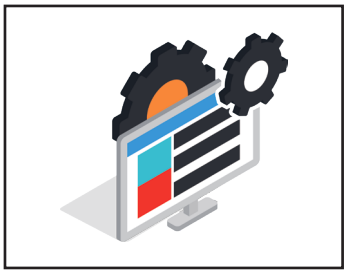
It can be connected to the controller to perform operations such as program and parameter input, jog, inching and servo free.
Equipped with an enable switch for safety.

How to order

KSL - TP1000 NN

Product subject to the EAR (EAR99)

Cable length	
NN	5 m (Standard)
10	10 m
15	15 m



PC software

A support tool that allows system upgrade to be performed efficiently in a short time. Compatible with all field networks.

How to order

KSL - TSA

PC software	
TSA	TS Assist
TCP	TCPRGOS-W

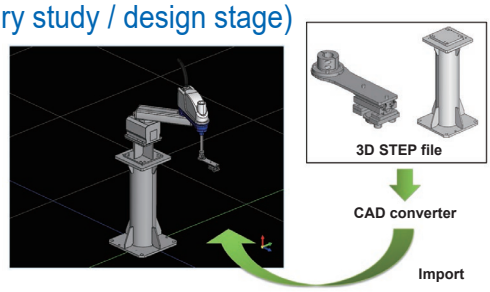
KSL-TSA

1. High-performance 3D simulation　Can be used offline (preliminary study / design stage)

Interference check, trajectory display, accurate simulation by timer (cycle time measurement), placement of simple workpieces and simple models, importing 3D CAD data, saving 3D simulation video files, multi-angle view

These functions enable high-precision and high-quality estimations for automation. From simple simulations for grasping images to accurate simulations that are close to the actual equipment, they provide powerful support from the conceptualization and planning of pre-introduction studies for automation using robots to their implementation, as well as work to improve and convert existing automation equipment.

* Dedicated conversion software (Virfit Agent) is required to import 3D CAD data.

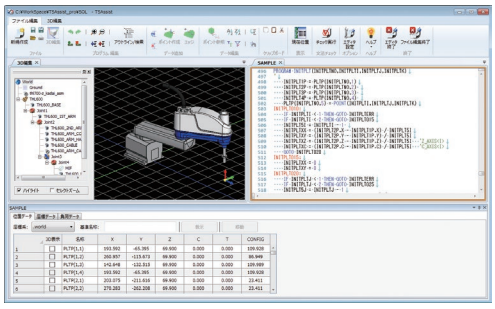


2. High-performance program editor

Language input support function (keyword suggestion function), outline display, split screen display

The point data edit screen (operation teaching position information) offers sort, search and filter functions. In the "3D edit" mode, the robot can be guided by mouse, and teaching points can be created by clicking on the model surface. These functions eliminate complicated teaching point calculation.

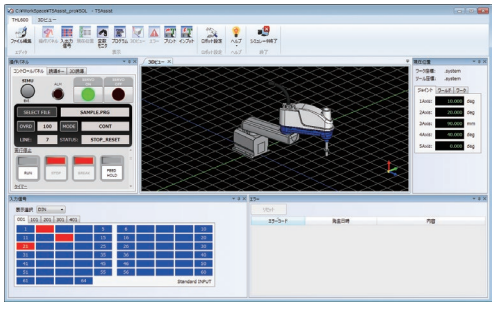
These convenient functions enable efficient programming. It also reduces coding errors.



3. Easy to operate and ready to use

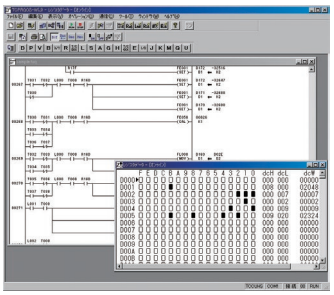
Easy to see and understand screen design, ribbon interface, window dock function that enables customization of the operation panel

It is easy to understand for robot programming beginners, allowing one to quickly learn the programming skills. Experienced robot users can customize their screens and use the functions of the program editor to improve programming efficiency.



KSL-TCP sequence program creation (software for built-in PLC function)

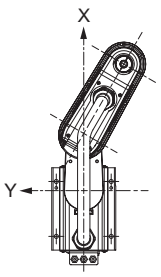
1. Can be easily programed in ladder language without the knowledge of C or assembly language.
2. In addition to program creation, it can be used to monitor the ladder program and I/O online, which can greatly reduce the development and debugging period.
3. Various functions such as address map display, comment display and search are available.



Program examples

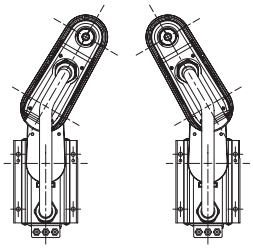
Teaching point

The teaching points of the robot are shown below.
Teaching point A1 = X Y Z C T CONFIG (posture)



1-, 2-axis coordinates

3-, 4-axis coordinates



Left-handed LEFTY　Right-handed RIGHTY

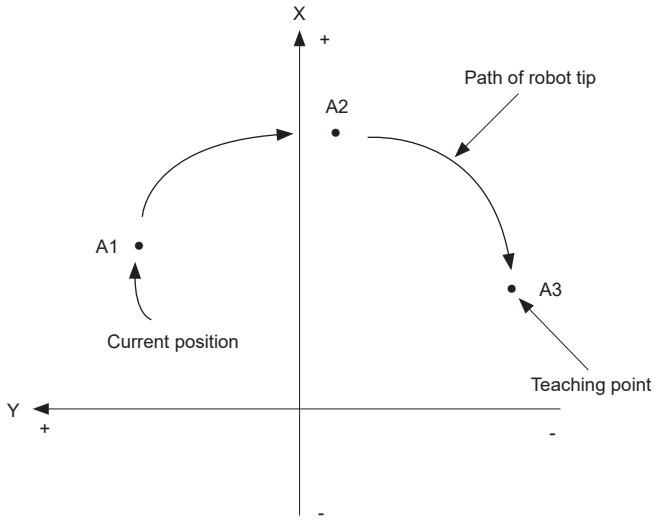
CONFIG (robot posture)

PTP (Point to Point) movement

The MOVE command is used to move from the current position to the specified position.

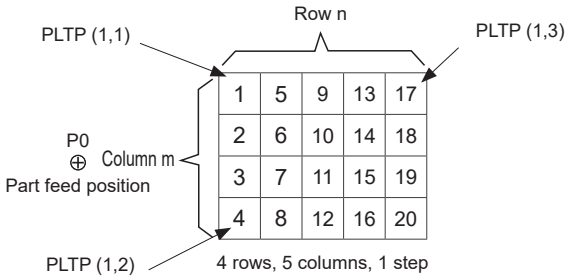
Text	Explanation
"MOVE position"	· Moves from the current position to the specified position. · All axes of the robot start moving at the same time. Since the robot moves along an easy-to-move path, the tip of the robot does not move in a straight path. · Set the teaching point name starting with an alphabet character and make it no longer than 10 characters.

Program examples	Explanation
PROGRAM MAIN	
MOVE A1	← Moves to teaching point A1 from the current position
MOVE A2	← Moves to teaching point A2 from the current position
MOVE A3	← Moves to teaching point A3 from the current position
END	



Palletizing

Palletizing is to move to target positions arranged in a grid. If the pallet has one step, there are only three teaching points.



Program examples	Explanation
GLOBAL	
LOADLIB PALLET.LIB	← Loads pallet library *1
DIM PLTP(1,7) AS POINT	← Declares pallet point
END	The "1" in (1,7) is the number of pallets, "7" is a constant
PROGRAM MAIN	
INITPLT(1,4,5,1)	←INITPLT(k,m,n,p)
FOR J=1 TO 20 STEP 1	Initial pallet setting: kth sheet, row m, column n, step p
MOVE P0	← Moves to P0
'HAND CLOSE	← Grips parts
MOVE P0+POINT(0,0,30)	← Retracts by 30 mm
MOVEPLT(1,J,0,0,30,0)	← Jth position of the pallet, moves 30 mm above
MOVEPLT(1,J,0,0,0,0)	← Extends by 30 mm
'HAND OPEN	← Places parts
MOVEPLT(1,J,0,0,30,0)	← Returns to 30 mm above
NEXT J	
END	

*1 Pallet library: Pallet coordinate calculation software

Safety Precautions

Always read this section before use.

When designing equipment using electric actuators, the manufacturer is obligated to ensure that the safety of the mechanism and the electrically controlled system are secured.
It is important to select, use, handle and maintain CKD products appropriately to ensure their safe usage.
Observe warnings and precautions to ensure device safety.
Check that device safety is ensured and a safe device is manufactured.

WARNING

1 This product is designed and manufactured as a general industrial machine part.
It must be handled by an operator having sufficient knowledge and experience in handling.

2 Use the product within specifications range.

This product must be used within its stated specifications. It must not be modified or machined additionally.
This product is intended for use as a device or part for general-purpose industrial machinery. It is not intended for use outdoors (except for outdoor type) or for use under the following conditions or environment.
(Note that this product can be used under the following conditions only when CKD is consulted prior to use and the customer consents to CKD product specifications. The customer must provide safety measures to avoid risks in the event of problems.)

❶ Use for special applications which require the safety, including nuclear energy, railways, aircrafts, marine vessels, vehicles, medicinal devices, devices or applications coming into contact with beverages or foodstuffs, amusement devices, emergency operations (cutoff circuits, opening etc.) circuits, press machines, brake circuits, or safety devices or applications.

❷ Use for applications where life or assets could be adversely affected and special safety measures are required.

3 Observe organization standards and regulations, etc. related to the safety of device design.

4 Never remove devices before confirming safety.

❶ Inspect and service on the machine and devices after confirming safety of the entire system related to this product.

❷ Note that there may be hot or charged sections even after operation is stopped.

❸ When inspecting or maintaining device, be sure to shut down the power supply of the equipment and the relevant power supply, using caution to avoid electric shock.

5 Observe instruction manual and precautions attached the product surely to prevent accidents.

❶ The product could operate unexpectedly during teaching operation or trial operation. Be especially careful not to touch the actuator. If operating the product from a position where the shaft body cannot be seen, be sure to first confirm that the safety is secured even if the actuator moves.

6 Observe precautions to prevent electric shock.

❶ Do not touch the heat sink, cement friction, or motor inside the controller.
These will heat up, and could cause burns. Wait an appropriate amount of time prior to performing inspections or other tasks.
A high voltage is applied until the electrical load stored in the internal capacitors is discharged after the power is turned OFF.
Do not touch for around three minutes after the power OFF.

❷ Make sure to turn the switch on the controller power supply source OFF, before maintenances and inspections.
There is a danger of high voltage electric shocks.

❸ Do not attach or remove connector, while the power is on. Otherwise, this may cause malfunction, failure, or electric shock.

7 Install overcurrent protector.

The wiring of the connector should be in accordance with JIS B 9960-1:2008 Safety of Machinery - Electrical Equipment of Machines - Part 1: General Requirements. Install an overcurrent protector (a shutoff mechanism for wiring or a circuit protector) for inputs (power supply connector, power supply terminal) and controls (input/output connector) power primary side.

(Extracted from JIS B 9960-1 7.2.1, General Requirements)
Overcurrent protection must be installed if the circuit current inside a machine (electrical equipment) could exceed the rated value of the components or the allowable current capacity of the conductor (whichever is smaller).

8 Observe precautions below to prevent accidents.

■ The precautions are ranked as "DANGER", "WARNING" and "CAUTION" in this section.

DANGER: When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries, and when there is a high degree of emergency to a warning.

WARNING: When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries.

CAUTION: When a dangerous situation may occur if handling is mistaken leading to minor injuries or physical damage.

Note that some items described as "CAUTION" may lead to serious results depending on the situation.
Every item provides important information and must be observed.

Warranty

1 Warranty period

The product specified herein is warranted for one (1) year from the date of delivery to the location specified by the customer.

2 Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified above, CKD will promptly provide a replacement for the faulty product or a part thereof or repair the faulty product at one of CKD's facilities free of charge.

However, following failures are excluded from this warranty:

1) Failure caused by handling or use of the product under conditions and in environments not conforming to those stated in the catalog, the Specifications, or the Instruction Manual.
2) Failure caused by use of the product exceeding its durability (cycles, distance, time, etc.) or caused by consumable parts.
3) Failure not caused by the product.
4) Failure caused by use not intended for the product.
5) Failure caused by modifications/alterations or repairs not carried out by CKD.
6) Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
7) Failure caused by acts of nature and disasters beyond control of CKD.

The warranty stated herein covers only the delivered product itself. Any loss or damage induced by failure of the delivered product is excluded from this warranty.

Note: For details on the durability and consumable parts, contact your nearest CKD sales office.

3 Compatibility confirmation

The customer is responsible for confirming the compatibility of CKD products with the customer's systems, machines and equipment.

4 Range of service

The delivered product price does not include engineer dispatch service fees. Separate fees will be charged in the following cases.

(1) Instruction of installation and adjustment, and presence on test operation
(2) Maintenance and inspection, adjustment, and repair
(3) Technical instructions and technical education (operation, program, wiring method, safety education, etc.)

Precautions for export

Products and related technologies in this catalog
Those of the products and related technologies in this catalog which are subject to US Export Administration Regulations
(EAR) are marked on the product page as "Product subject to the EAR (EAR99) or (EAR99 and 3A991)".
For export or provision of products or related technologies subject to EAR regulations, we request that the US Export Administration Regulations (EAR) be observed appropriately.

Main standards and laws regarding safety of industrial robots

The international industrial standard ISO/DIS12100 "Safety of Machinery" defines the risk reduction measures for machines.
Step 1: Intrinsically safe design … Power, speed, energy limits, etc.
Step 2: Safety protection … Installation of safety fences, etc.
Additional protective measures … Installation of emergency stop devices, etc.
Step 3: Information on use … Warning sign, alarm, instruction manual, etc.

Based on this, the international standards ISO/IEC define what is called "Guide 51", which is a classification of various standards in a hierarchical structure.
Safety standards for industrial robots are standardized in Tier C, individual machine safety standards.

- ISO 10218, ISO 10218-1

Providing users with residual risk information after conducting a risk assessment is standardized.

- IEC 82079-1

Be sure to follow the standards and laws in each country where the industrial robot is used.

The major standards and laws for industrial robots in Japan are as follows.

Safety standards for industrial robots have been stipulated in the Japanese Industrial Standard (JIS) without changing the technical details and configurations in ISO 10218 and ISO 10218-1.

- JIS B 8433, JIS B 8433-1

The laws and regulations in Japan regarding the safety of industrial robots are as follows.

- Industrial Safety and Health Law: Article 59 (Safety and Health Education)

"A company must provide special education on safety or hygiene to workers engaged in dangerous or harmful work."

The duties that require special education in handling industrial robots are defined as follows.

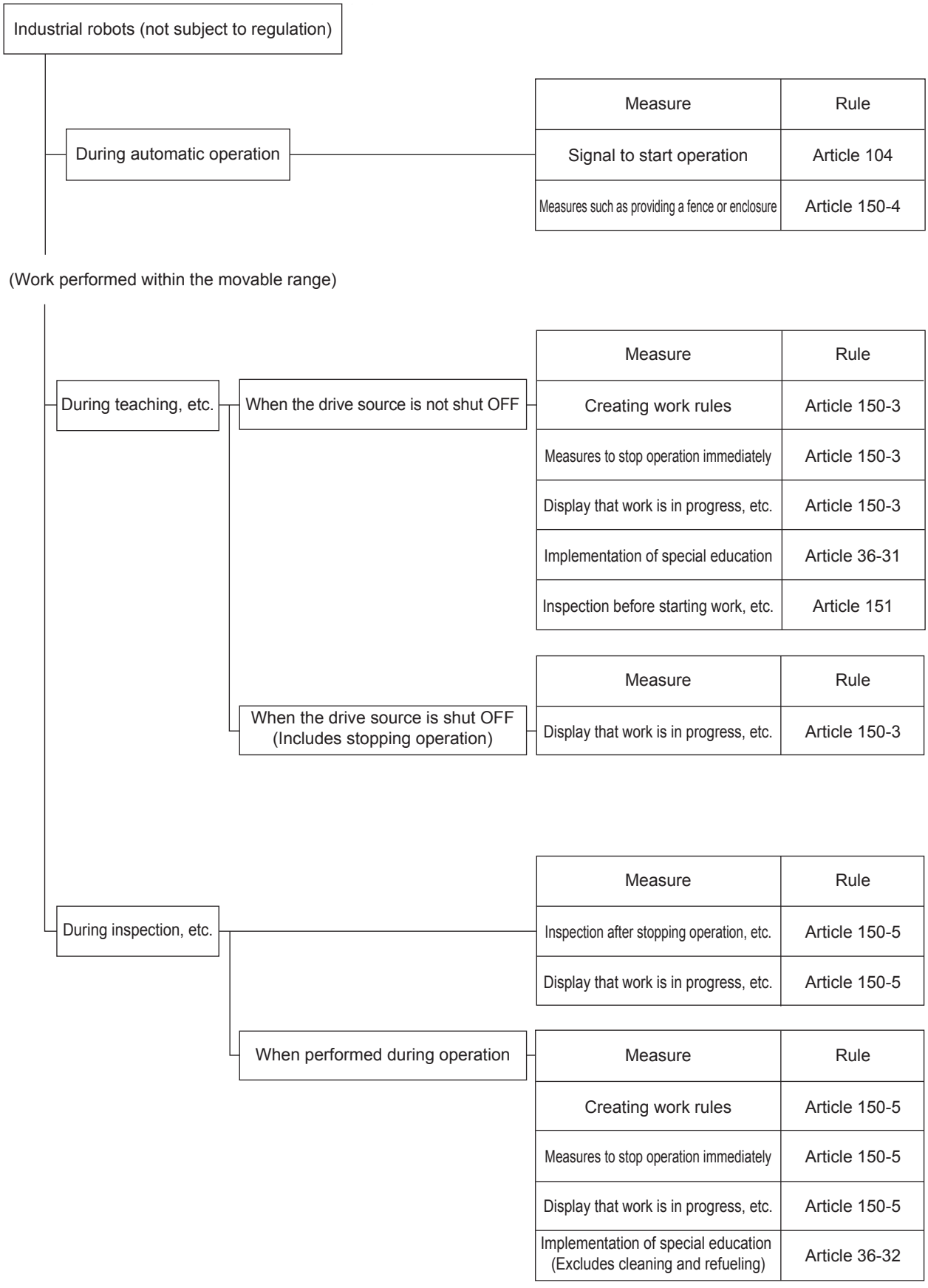
- Ordinance on Industrial Safety and Health … Article 36 (Businesses requiring special education)
  - No. 31 … Duties such as teaching industrial robots
  - No. 32 … Duties such as inspecting industrial robots

The measures to be taken in order to prevent danger in handling industrial robots are as follows.

- Ordinance on Industrial Safety and Health … Section 9 (Industrial robots)
  - Article 150-3 … Teaching, etc.
  - Article 150-4 … Preventing danger while driving
  - Article 150-5 … Inspection, etc.
  - Article 151 … Inspection

The provision of residual risk information is stipulated by law as an effort to "notify the other company to whom the machine is transferred or loaned regarding the danger of the machine".

- Ordinance on Industrial Safety and Health … Article 24-13 (Notifying dangers related to the machine, etc.)
- Guidelines for promoting the transferrer, etc. to notify of dangers, etc. related to the machine as established based on the paragraph 2 above



System diagram for Ordinance on Industrial Safety and Health

Safety Precautions

Be sure to read this section before use.

Product-specific cautions: SCARA robot KHL/KHE Series

Design/selection

⚠DANGER

- Do not install and operate the product if it is found to be damaged when it is delivered or parts such as accessories are missing.
  Doing so may cause electric shock, fire or failure.
- Do not install the product where it will be exposed to liquids such as water.
  Doing so may cause electric shock, fire or failure.
- Do not place flammable materials nearby.
  If there is an ignition due to a failure, etc., it may cause a fire.
- Use at the specified power supply voltage and power capacity.
  Failure to do so may lead to failure or fire.
- Be sure to use the specified electric wire.
  Failure to do so may cause a fire or an accident.
- Be careful not to make a mistake when connecting the connector and electric wiring in the terminal array.
  Check with a tester after connecting.
- When moving the robot by hand while the power is ON, be sure to ensure safety and set it to the emergency stop state.
- When working with the 3rd axis brake release switch pressed, be sure to do so with two people.
  One person should perform the work while the other person observes from outside the dangerous area.
- The observer should monitor the work and be ready to shut OFF the controller power immediately in the event of a problem.
  When the controller power is shut OFF, the motor brake will activate even if the 3rd axis brake release switch is pressed.
- If the 3rd axis brake release switch is pressed while the robot is holding a heavy object, the 3rd axis may drop suddenly.
- Workers engaged in tasks related to industrial robots must receive safety education as specified by the laws and regulations of their respective country.
- Do not enter the dangerous area around the robot while it is operating.
  Doing so could lead to serious injury.
- Do not leave any equipment in the work space that may disrupt operation.
  If it leads to an error with the device, it may result in injury or accidents.
- Do not let anyone other than the operator approach the equipment.
  Unexpected behavior such as unknowingly touching a hazardous section of the device may result in injuries or serious accidents.
- Do not perform inappropriate operations not described in the instruction manual.
  Inappropriate operation may cause the equipment to malfunction, resulting in injuries or serious accidents.
- If you feel any danger or abnormality in the operation of the equipment, engage the emergency stop to stop the equipment.
  Otherwise, injuries or serious accidents may result.
- Be sure to keep the device cover closed during operation.
  Opening the device cover during operation may cause electric shock or injury.
- Only well-trained personnel should operate the device.
  Inappropriate operation may cause the equipment to malfunction, resulting in injuries or serious accidents.
- In the event of a failure, shut OFF the power, eliminate the cause of the problem, perform maintenance on the peripheral components, and operate at low speeds until after confirming the issue is completely resolved.
  If any problem remains unresolved, the device may malfunction and cause a serious accident.

⚠WARNING

- Do not enter the robot's movable range.
  There is a risk of personal injury.
- Keep your hands away from the movable parts of the robot.
  There is a risk of injury if caught.

⚠CAUTION

- When changing the operating range, design and manufacture a mechanical stopper according to the usage conditions.
- When changing the mechanical stopper and the movement range, be sure to change the software limit to prevent contact with the mechanical stopper while operating the robot.
- The mechanical stopper does not reliably limit the robot's movable range.
  When robot is powered, never enter the robot's operating area.
- If the robot collides with the mechanical stopper, the robot will detect the collision and stop, but there is a risk that the mechanical stopper will become damaged.
  Do not reuse the mechanical stopper.

- Use the lower limit mechanical stopper to change the operating range.
  If the operating range is changed with the upper limit mechanical stopper, it will be in a similar state as the Z-axis being extended. Operating the 1st, 2nd or 4th axes in this state may prematurely damage the ball screw spline.
- When installing a chuck on the hand, use wiring or air piping that ensures the workpiece is not released when the power is turned OFF.
  By not using such wiring and air piping for the chuck may result in the workpiece being released when the power goes OFF or when the emergency stop switch is pressed. This may result in damaging the robot or workpiece.
- The customer must prepare the solenoid valve and air tubes.
- Wiring tied to the main harness may apply excessive force to the main harness, which may result in disconnection.
- Never use the robot under conditions that exceed the tolerance values.
  Robot service life and safety is not guaranteed under such circumstances.
- Be sure to use the PAYLOAD command.
  Failure to do so may cause failures and shorten the mechanical service life. It may also damage the mechanical parts in some cases.
- Even when using the PAYLOAD command, be sure to make adjustments with the SPEED or DECEL command while checking the movement of the workpiece to be handled.
- Even if there is no offset in the center of gravity of load, the robot may vibrate if the moment of inertia is large.
  Calculate the virtual center of gravity offset L (mm) from the moment of inertia J ($kg \cdot m^2$) and weight M (kg), and specify the PAYLOAD.
- If the load weight or center of gravity offset is large when manually guiding, the robot may vibrate.
  Set and switch to a servo gain that matches the load conditions.
- If a current exceeding the rated output current is applied, the controller may be damaged or the internal base may be burnt out, so be sure to use the unit within the rated output current. The hand output signal total for 8 points must be 0.8 A or less.
- Be sure to connect the connectors securely.
  Failure to do so may result in malfunction.
- Use a flexible robot cable and fix it at the bottom of the arm with a cable clamp, etc.
  Failure to use the robot cable may cause disconnection.
- For wiring and piping of tools, the customer must carefully consider the measures against disconnection due to rubbing, etc.
- Be careful not to apply a load on the connector while the robot is operating.
- When operating the robot, make sure that the fixing stay does not interfere with the 1st arm, etc.
- Moving the 1st and 2nd axes near the operating range limit and releasing the hand may cause the 1st and 2nd axes to move due to the reaction force of the cable.
- In accordance with the requirements in the ISO10218-1 Industrial Robots -Safety Requirements- "5.6.2 Deceleration control operation", the arm tip speed during test operation is set not to exceed 250 mm/sec.
- At initial setting, the speed of automatic operation is 100% of the robot max. speed.
  When the servo of the robot is turned OFF, the arm may move due to the reaction force of the twisting of the main harness.
- Do not change the data in the system configuration file.
  Changing it may cause the robot to malfunction and result in an accident or failure.
- For the controller, be sure to maintain a designated ventilation space.
  Heat generated from the controller may cause failure.
- If the main power supply is not supplied to the controller normally due to phase loss or voltage drop, "8-027 Slow charge error" will occur when the servo is turned ON.
  If this error occurs, check if the power supply voltage at the controller power supply connector meets the controller's input power specifications and that it is stable.
- Be sure to supply the external power supply (24 VDC).
  Failure to do so will disable the safety signal and the controller servo power will not turn ON.
- Make and install a push button for the control unit that is to be attached to the robot controller in such a way that it will prevent accidental activation, such as by installing a guard to prevent accidental operation.
- If there are multiple controllers in the device, make sure that the robot operates only in the same operation mode. Also, be sure to have the operation mode of each controller displayed on the operating device.

Mounting, installation and adjustment

⚠DANGER

- When transporting the robot, be sure to fix it with the supplied fixing brackets.
  Failure to do so may cause the arm to move and cause injury when the robot is lifted.
- Install the unit before wiring.
  Wiring before installation may result in electric shock or injury.
- Use the specified electric wire for the power supply line.
  Use of non-specified items may result in fire or failure.
- Be sure to connect the ground wire securely.
  Failure to do so may lead to electric shock or fire in the event of failure or electrical leakage. In addition, noise may result in malfunctions.

⚠CAUTION

- Do not lift the 2nd arm cover during transportation.
  Otherwise, excessive force will be applied to the robot's main mechanism, which may result in failure.
- When storing the robot, be sure to firmly fix it to the base.
  Placing the robot without fixing it may make it unstable and cause it to fall.
- When operating the robot after it has been stopped at low temperatures (10°C or less) for long periods, be sure to perform continuous operation at a low speed (about 20% of the max. speed) for several minutes before full operation.
  If continuous operation is not performed at a low speed, motor overload error may occur due to grease being solidified.
- Depending on the posture of the robot, slight vibrations may occur at the tip of the robot hand.
  If slight vibrations occur, be sure to reduce the acceleration before use.
- Move the 1st, 2nd and 4th axes with the Z-axis (3rd axis) retracted as much as possible.
  Operating the 1st, 2nd and 4th axes in with the Z-axis extended may prematurely damage the ball screw spline. If the 1st, 2nd and 4th axes need to be operated while the Z-axis is extended, adjust the operation speed and acceleration with the SPEED and ACCEL/DECEL commands so that the ball screw spline does not vibrate. When moving the 1st, 2nd and 4th axes with the Z-axis extended, make sure that it does not collide with an obstacle.
- Even if the 1st, 2nd and 4th axes are operated at a low speed, the ball screw spline (Z-axis shaft) may be damaged before the alarm is issued due to collision with an obstacle.
- When manually transporting the robot, be careful not to get hands or feet caught.
- Be sure to transport it with two or more people.
- Never touch the ball screw spline shaft with bare hands.
  Touching with bare hands may lead to premature rusting. Be sure to wear gloves.
- If the battery for motor position detection is alkaline (standard specification) and the unit is used at high temperatures, the risk of battery heat generation, liquid leakage and explosion increases.
  Contact CKD when using the robot in a high temperature environment.
- Operating the unit at high speed at startup in a low temperature environment may cause the torque to increase and cause an error to occur.
  When operating the robot in a low-temperature environment, be sure to perform continuous operation at a low speed for several minutes at startup to soften the grease before transitioning to a high speed.
- The robot operates with extreme acceleration/deceleration. When installing the unit on a base, make sure that the base is sufficiently rigid.
  If it is installed on a base that is not rigid, vibration may occur while the robot is operating or failure may occur. When installing the unit on the floor, be sure to firmly fix it with foundation bolts, etc.
- Install the robot on a level surface.
  Failure to do so may cause performance degradation or failure.
- Fix the base to the exterior (floor or wall).
- Some errors may occur depending on the adjustment method.
  In some cases, it may be necessary to re-teach the teaching points.

Use/maintenance

⚠DANGER

- Do not incinerate, disassemble or charge the battery.
  Otherwise, it may result in damage.
- When approaching the robot for maintenance and inspection, remove the power plug of the controller from the power supply before starting the work.
- When moving the robot by hand while the power is connected, be sure to ensure safety and set it to the emergency stop state.
- When opening the cover, be careful not to let water or foreign matter get inside the robot.
  It is extremely dangerous to energize the unit with water or foreign matter inside, as it may cause electric shock or failure.
- Be sure to disconnect the power plug of the controller before replacement.
  Doing so while the power is ON may cause electric shock or failure and is extremely dangerous.
- When placing the controller on the floor, be careful not to get your hands or feet caught.

- If the power is kept ON, the servo power supply circuit board, servo circuit board, switching power supply etc., remain energized.
  To avoid electric shock, be sure to disconnect the power plug before starting the work.
- When disposing of the battery, be sure to follow the regulations of your company.

⚠CAUTION

- The parts should not be replaced or modified by the customer.
  Doing so may cause performance degradation, failure or an accident.
- Use the specified spare parts when replacing parts.
- Periodically perform maintenance and inspection.
  Failure to do so may cause equipment failure or an accident.
- Since the 4th axis motor does not have a brake, the axis may rotate when the servo is turned OFF due to the weight of the tool or hand, the state of the offset or being touched.
  Be careful not to get your hands or feet caught as the rotation of the 4th axis will cause the 3rd axis to move up and down.
- A brake release switch is installed on the back of the base.
  Pressing the switch with a heavy object such as a hand or workpiece attached to the 3rd axis will cause it to drop. Be careful not to get your hands or feet caught at this time.
- After unpacking the unit, be sure to dispose of cardboard, plastic bags, cushioning materials, etc. that are no longer needed according to your company's regulations.
- Be sure to firmly fix the base to prevent the unit from falling.
  Placing the robot without fixing it may make it unstable and cause it to fall.
- Store the robot away from direct sunlight, high temperatures, and high humidity.
  The resin cover and timing belt are prone to deterioration.
- When storing the robot, seal it in a plastic bag with a desiccant to prevent rust and dust from entering.
  As the ball screw spline shaft is prone to rusting, be sure to apply a anti-rust agent in advance, or apply grease to the entire ball screw spline shaft.
- Apply grease to the ball screw spline shaft before use.
- When operating the unit, be sure to perform a full break-in.
- Backup battery life is shortened during storage so replacing it before use is recommended.
- When installing the 2nd arm cover and base cover, be careful not to pinch the cables.
  Forcibly bending the cable and pushing it in may cause disconnection. Since the cable is fixed to the sheet metal with a cable tie, etc., check the cable position when removing the cover, and replace it so that the wiring is not strained.
- When replacing the motor, be careful not to apply a large impact to the motor shaft.
  The impact may damage the motor and encoder.
- Never disassemble the motor and encoder.
  Otherwise, they may become misaligned and unusable.
- When the motor is replaced, the mechanical origin will shift and normal control will not be possible.
  After replacing the motor, origin return must be performed.
- Be careful not to forget to attach the O-ring.
  Failure to do so may cause the grease to leak from the motor mounting surface.
- The 3rd axis motor has a brake. This brake will not work when replacing the 3rd axis motor, so be sure to lower the ball screw spline to the lower limit before starting.
  There is a risk that the shaft will drop due to the weight of the shaft and workpiece, which may cause your hands or fingers to get caught.
- When the timing belt is removed, the mechanical origin will shift and normal control will not be possible.
  After replacing the timing belt, it is necessary for the motor to be returned to the origin.
- It is structurally necessary to disassemble the 3rd axis when the 4th axis timing belt is replaced.
  Be sure to strictly observe the precautions for replacing the 3rd axis timing belt and motor.
- Be careful not to pull out the ball screw spline shaft from the ball screw nut, and remove them together as a unit.
  If separated, the balls in the ball screw nut will pop out which makes the product unusable.
- Be careful not to get your hands or fingers caught when moving the ball screw up or down by hand.
- Make sure to cover the peripherals to prevent grease from dripping on them.
- Make sure that the grease does not run out, as it may cause the slide, etc., to get damaged, which causes deterioration in performance.
- Apply an anti-rust agent when it drys out.
  If a rust preventive agent is not applied, the spline unit may become rusted.
- Be sure to handle the ball screw spline unit with care.
  The unit may become unusable due to the impact upon falling or the application of an excessive external force.
- Replacing the ball screw spline unit involves attaching and removing the 3rd and 4th axis motors and timing belts.
  Be sure to strictly observe the precautions in each section.
- When the motor, timing belt, nuts and pulleys are removed, the mechanical origin will shift and normal control will not be possible.
  After replacing the ball screw spline unit, it is necessary to perform origin return for the 3rd and 4th axes.
- When the reducer is removed, the mechanical origin will shift and normal control will not be possible.
  After replacing the reducer, it is necessary for the motor to be returned to the origin.
- Be sure to install and remove the arm with two or more people. Removing the arm mounting bolts may cause the arm to fall, which is dangerous.
  Excessive impact on the arm may cause failure.
- Be sure to handle the reducer with care.
  The unit may become unusable due to the impact upon falling or the application of an excessive external force.
- Be sure to use the elliptical cam that came with the new reducer.
  Using an old elliptical cam without considering the compatibility with the new reducer may not only cause abnormal noise, but also shorten the service life and positioning accuracy.

■ Use the new O-ring that is included with the reducer. Be careful not to forget to insert it.
Forgetting to insert the O-ring will cause the grease to leak from the mounting surface of the 2nd axis reducer. When installing the reducer, make sure that the O-ring does not break.

■ Be sure to use the specified grease.
A high internal pressure may adversely affect the starting torque and damage the internal seal. Be sure to apply the proper amount of grease.

■ Be careful not to forget to tighten the coupling that connects the reducer and motor shaft.

■ When the battery voltage drops, a "battery alarm" will occur. If the battery is replaced immediately after the "battery alarm" occurs, the battery voltage will return to normal and the "battery alarm" will be automatically reset.
If the battery is not replaced immediately after the "battery alarm" occurs, the battery voltage will drop further and a "battery error" will occur.
Since the position data detected by the encoder in this state cannot be trusted, a position detection error will occur and the robot will enter the emergency stop state in which the servo cannot be turned ON. If the power is turned OFF in this state, the position data will be lost. Be sure to replace the battery during the annual inspection.

■ For safety, replace the battery with the power turned ON and in the emergency stop state.

■ Do not change the data in the system parameter file other than with USER.PAR and without permission.
Otherwise, it may cause the robot to malfunction and result in an accident or failure.

■ As a general rule, teaching operations should be performed outside the robot's dangerous area. When it is necessary to perform teaching within the dangerous area, take the following measures.

(1) Be sure to work with two people. One person should perform the work and the other person should observe from outside the dangerous area. They should prevent each other from making any mistakes.
(2) To prevent the unit from being operated by a third party when performing teaching in the dangerous area, the worker must keep the controller master key and handy terminal in their possession.
(3) The worker should be able to press the emergency stop button at any time. It is also necessary for the worker to thoroughly check the robot's operating area and for any obstacles, and work in a position where they can immediately evacuate in the event of an abnormality.
(4) The observer must monitor the work from a position overlooking the entire robot and be ready to immediately press the emergency stop button in the event of an abnormality. Also, be sure to keep other people away from the dangerous area.

■ If an abnormality occurs when turning the device ON, or if the "POWER LED" of the controller does not light up, turn OFF the power immediately and check the wiring.
This may cause electric shock or fire.

■ If the robot does not move in the specified direction during manual guidance, perform an emergency stop of the device.
This may cause an accident or failure.

■ Be sure to visually confirm the button operation of the handy terminal.
Misoperation may cause an accident.

■ When the power is turned ON, be sure to reset the program before starting automatic operation.
If the program execution environment is continued, it may interfere with peripheral components and cause equipment failure or an accident.

■ Before operating the device, be sure to perform the following preliminary inspections. Failure to do so may cause device failure or an accident.

(1) Make sure that the appearance of the robot, controller, peripheral components and cables are normal.
(2) Make sure that there are no obstacles in or near the operating range of the robot and peripheral components.
(3) Make sure that the emergency stop and other safety measures are working properly.
(4) Make sure that there is no abnormal noise or vibration when the robot operates.

■ When disassembling or disposing of the unit, be sure to wear protective safety gear (safety glasses, protective footwear, gloves, etc.).
When disassembling the unit, broken pieces may fly into eyes, corner sections of parts may cut fingers, and raised parts may fall on hands or feet.

■ Store the controller away from direct sunlight.
Failure to do this may cause the temperature inside the controller to rise, which may cause failure.

■ When storing the controller, seal it in a plastic bag with a desiccant to prevent rust and dust from entering.

■ Be sure to dedicate space for ventilation on the side of the controller so that the vent holes are not blocked. Also, leave enough space on the bottom surface for the length of the rubber feet.
Failure to do so may cause the cooling capacity to drop and the controller to fail.

■ Do not stack the controllers.

■ Do not place anything on top of the controller.

■ If the control panel, etc., is completely sealed, make a vent hole to prevent heat from being trapped in the control panel, perform forced ventilation with a fan, or provide indirect cooling.
Failure to do so may cause heat to be trapped inside the control panel and controller, which may result in failure.

■ When removing the controller cover for maintenance and inspection, remove the power plug of the controller from the power supply before starting. When connecting or disconnecting the power line, be sure to also turn OFF the breaker for the power supply.

■ Do not touch the servo driver for 2 minutes after the power is turned OFF.
The voltage remaining in the large-capacity capacitor in the servo driver may cause electric shock.

■ Do not remove the battery connector except when replacing the battery.
Otherwise, the files stored in the storage device will be erased.

■ Be sure to turn OFF the power before replacing the switching power supply.

■ The switching power supplies for PS1 and PS2 have the same mounting pitch.
Install them so that the top, bottom, left and right are not reversed, and ensure that PS1 and PS2 are not reversed.

■ To prevent direct and indirect contacts, take protective measures such as incorporating the robot controller in an enclosure, and ensure that there is sufficient distance from the operator.

■ When installing in an enclosure, use a structure with a fixed cover or a key so that the enclosure cannot be opened and closed freely. In addition, provide protective measures at the cable port to the enclosure to prevent damage to the cables.

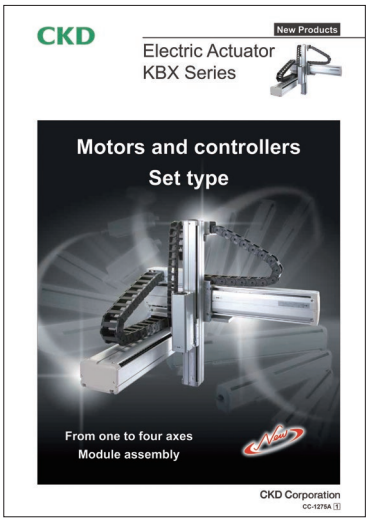
■ If a current exceeding the rated output current is applied, the controller may be damaged or the internal base may be burnt out, so be sure to use the unit within the rated output current.

■ The hand output signal total for 8 points must be 0.8 A or less. When using the hand I/O function, connect from the P24 V supply line for I/O on the front of the controller.

Related products

Electric actuator　KBX Series

Catalog No. CC-1275A



Module assembly method from single axis to 4 axes

■ Electric actuator

Equipped with small to large shafts (50 to 750 w)

Max. load capacity 250 kg (ball screw drive)

Maximum stroke length 4450 mm (timing belt drive)

Long term maintenance-free unit (uses a no lubrication sealant)

■ Controller

Just connect the single-axis controller with the link cable

Supports up to 4-axis controller

Electric actuator　EBS-M/EBR-M Series

Catalog No. CC-1422A

■ Slider EBS-M Series
High speed transport

■ Rod with built-in guide EBR-M Series
For press fitting and hoisting

■ Controller ECR Series
"One controller" that connects to any actuator

Electric actuator　FLSH/FLCR/FGRC Series

Catalog No. CC-1444A

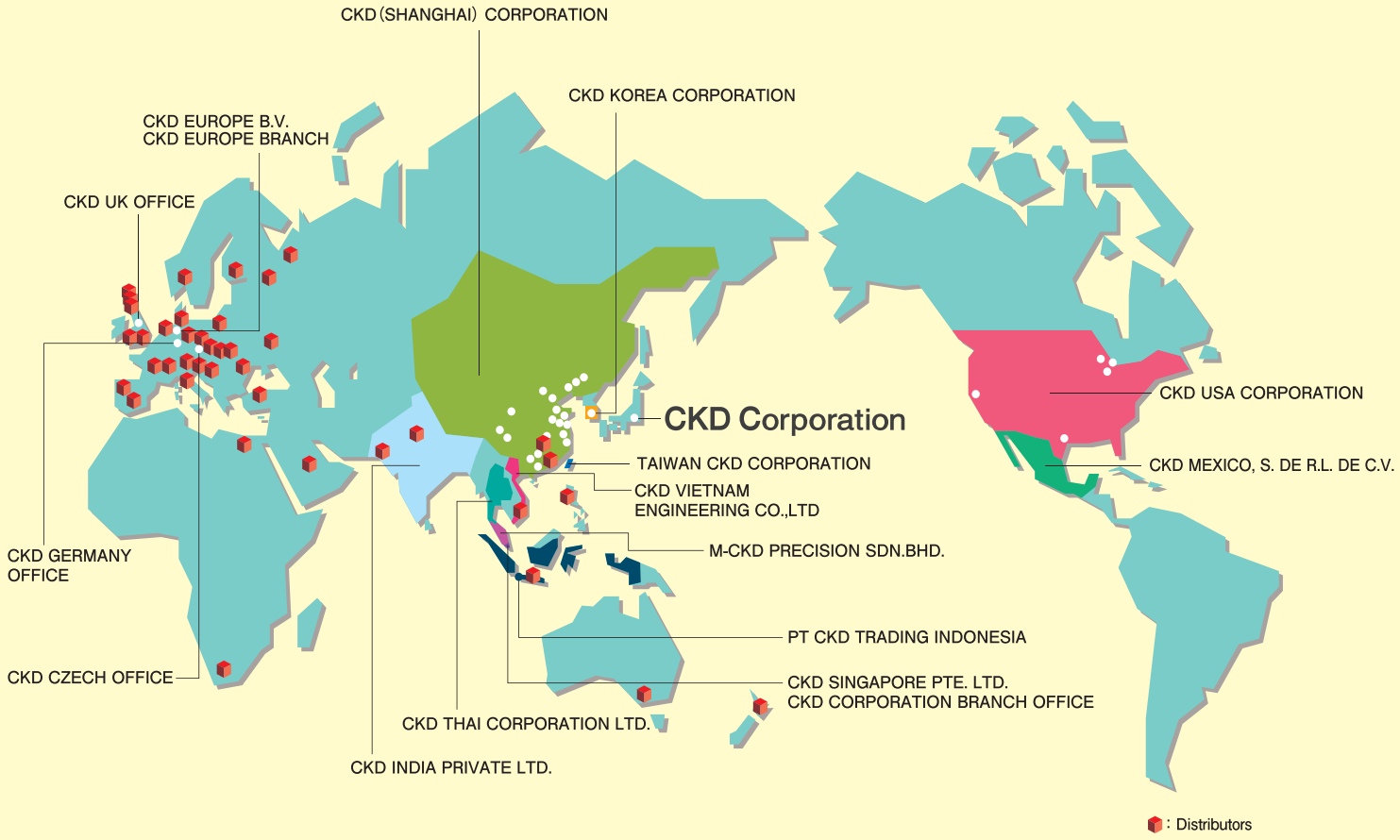
■ 2-Finger Gripper FLSH Series
For soft handling of multi-model workpieces

■ Table FLCR Series
For short-stroke workpiece transport and positioning

■ Rotary FGRC Series
For indexing operation and workpiece inversion

■ Controller ECR Series
"One controller" that connects to any actuator

WORLD-NETWORK



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