ALL TYPES OF INFORMATION

INFORMATION

CONTENTS

Robot cable table

The robot cable is a cable joining the robot to the controller.

Single-axis robot cable

TS-S/TS-S2/TS-SD cable

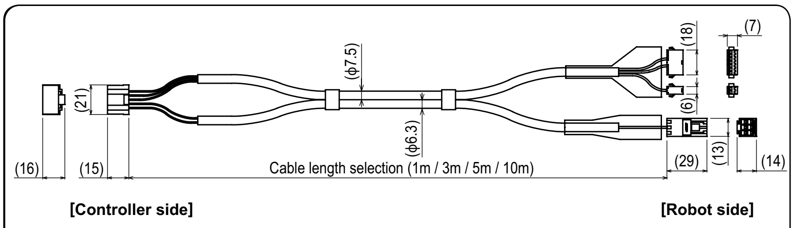
[Flexible cable]

Connected robot ▷ **TRANSERVO**

Set	Single item	
-	Composite wire	KCK-M4751-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
1	1m
3	3m
5	5m
A	10m



⟨Composite wire: KCK-M4751-□0⟩

TS-S2S cable

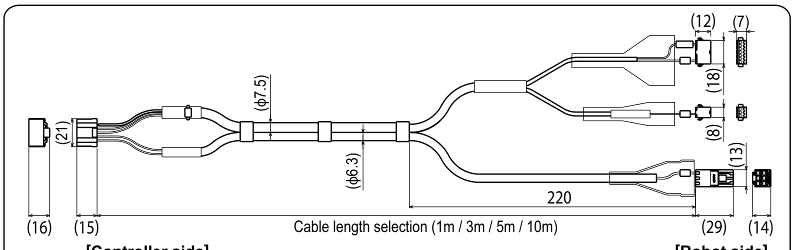
[Flexible cable]

Connected robot ▷ **TRANSERVO**
(RF Type Sensor specification)

Set	Single item	
-	Composite wire	KCK-M4752-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
1	1m
3	3m
5	5m
A	10m



⟨Composite wire: KCK-M4752-□0⟩

TS-X cable

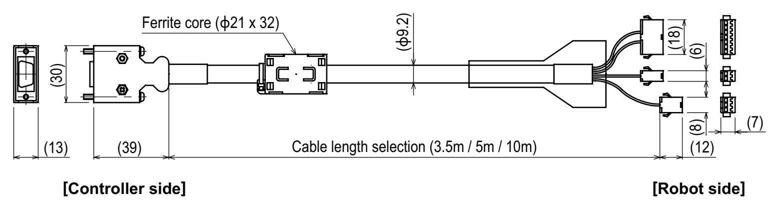
[Standard cable]

Connected robot ▷ **FLIP-X**

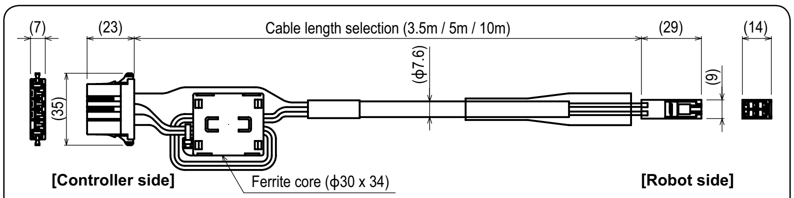
Set	Single item	
KBY-M4710-□0	Signal wire	KBY-M4751-□0
	Motor wire	KX7-M4752-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



⟨Signal wire: KBY-M4751-□0⟩



⟨Motor wire: KX7-M4752-□0⟩

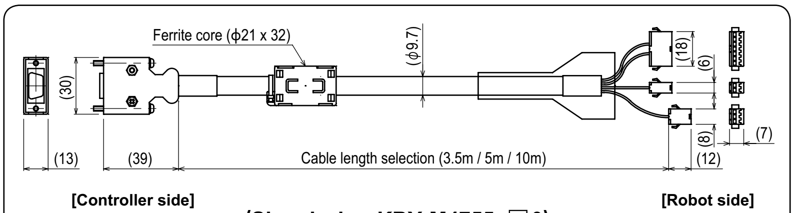
[Flexible cable]

Connected robot ▷ **FLIP-X**

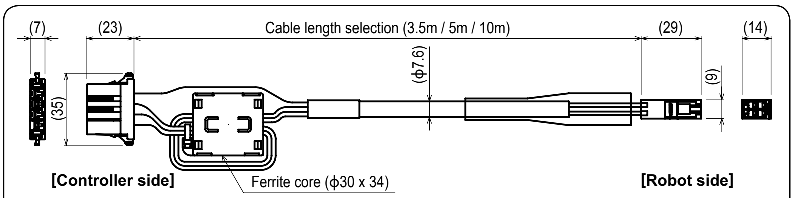
Set	Single item	
KBY-M4720-□0	Signal wire	KBY-M4755-□0
	Motor wire	KX7-M4752-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



⟨Signal wire: KBY-M4755-□0⟩



⟨Motor wire: KX7-M4752-□0⟩

TS-P cable

[Standard cable]

Connected robot ▷ **PHASER**

Set	Single item	
KBS-M4710-□0	Signal wire	KBS-M4751-□1
	Motor wire	KAU-M4752-□1

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Flexible cable]

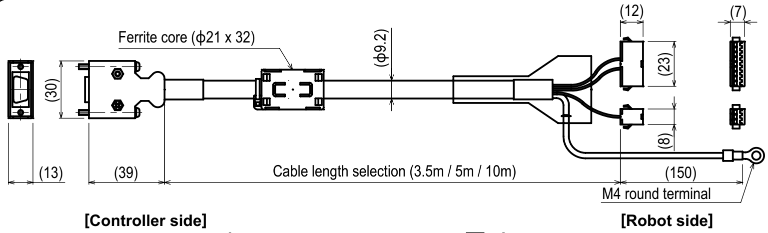
Connected robot ▷ **PHASER**

Set	Single item	
KBS-M4720-□0	Signal wire	KBS-M4755-□1
	Motor wire	KAU-M4752-□1

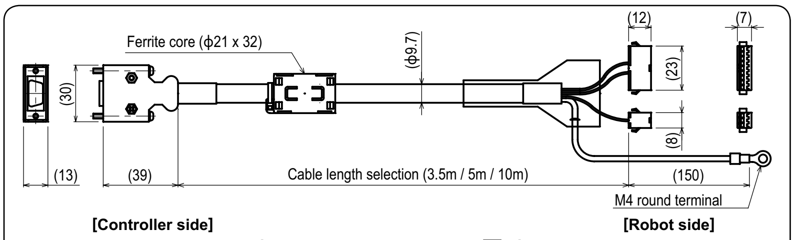
Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Signal wire]

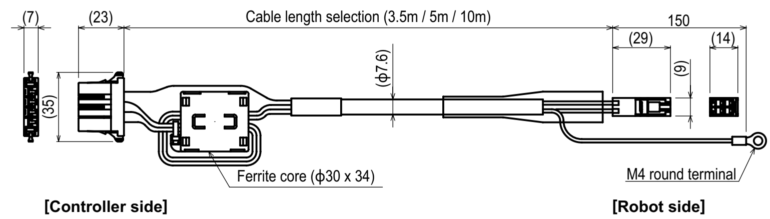


⟨Standard: KBS-M4751-□1⟩



⟨Flexible: KBS-M4755-□1⟩

[Motor wire]



⟨Motor wire: KAU-M4752-□1⟩

RDV-X cable (No-brake specifications)

[Standard cable]

Connected robot ▷ **FLIP-X**

Set	Single item	
KEF-M4710-□0	Signal wire	KBH-M4751-□0
	Motor wire	KEF-M4752-□0
	I/O connector	KBH-M4420-00

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Flexible cable]

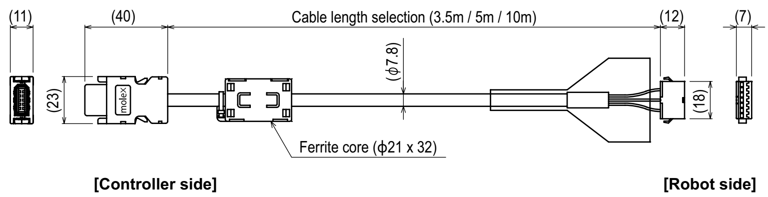
Connected robot ▷ **FLIP-X**

Set	Single item	
KEF-M4730-□0	Signal wire	KBH-M4756-□0
	Motor wire	KEF-M4752-□0
	I/O connector	KBH-M4420-00

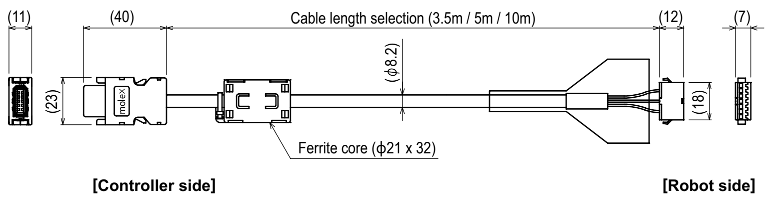
Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Signal wire]

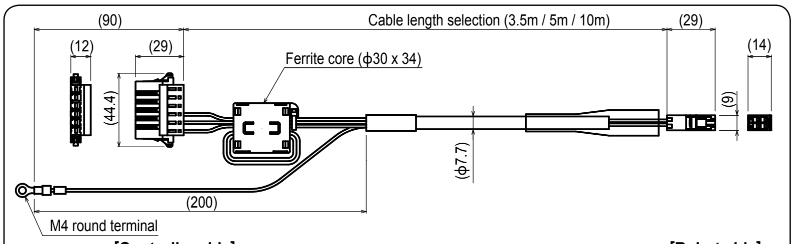


⟨Standard: KBH-M4751-□0⟩



⟨Flexible: KBH-M4756-□0⟩

[Motor wire]



⟨Standard: KEF-M4752-□0⟩

Robot cable table

RDV-X cable (models with brake and sensor)

[Standard cable]

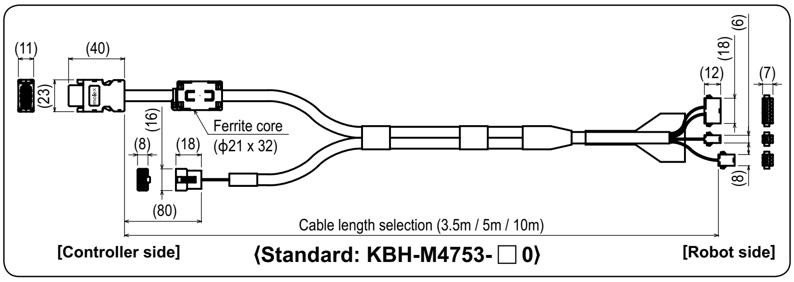
Connected robot ▷ **FLIP-X**

Set	Single item	
KEF-M4720-□0	Signal wire	KBH-M4753-□0
	Motor wire	KEF-M4752-□0
	ORG, BK wires	KBH-M4421-00

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Signal wire]



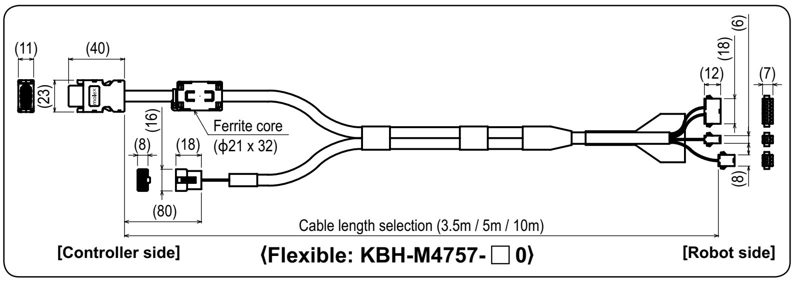
[Flexible cable]

Connected robot ▷ **FLIP-X**

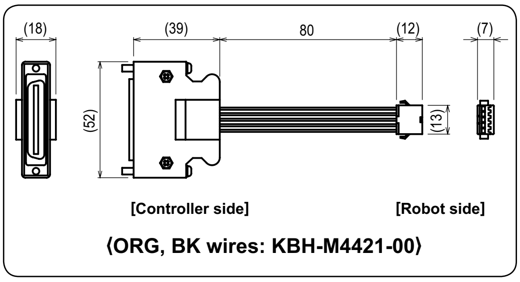
Set	Single item	
KEF-M4740-□0	Signal wire	KBH-M4757-□0
	Motor wire	KEF-M4752-□0
	ORG, BK wires	KBH-M4421-00

Note. Notation within slot in model types is as shown at right.

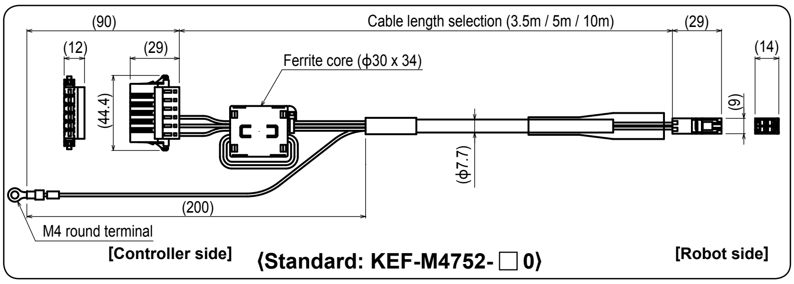
Within □	Cable length
3	3.5m
5	5m
A	10m



[ORG, BK wires]



[Motor wire]



RDV-P cable

[Standard cable]

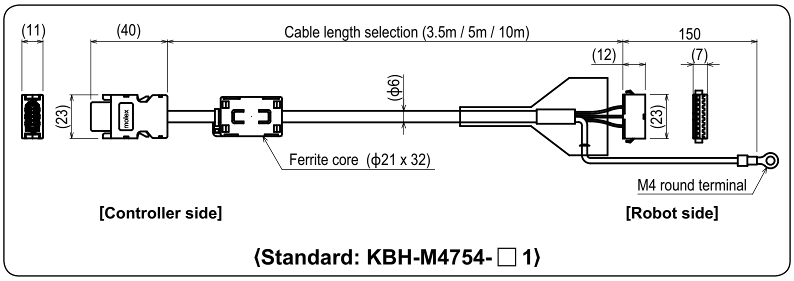
Connected robot ▷ **PHASER**

Set	Single item	
KEF-M4711-□0	Signal wire	KBH-M4754-□1
	Motor wire	KEF-M4755-□0
	I/O connector	KBH-M4420-00

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Signal wire]



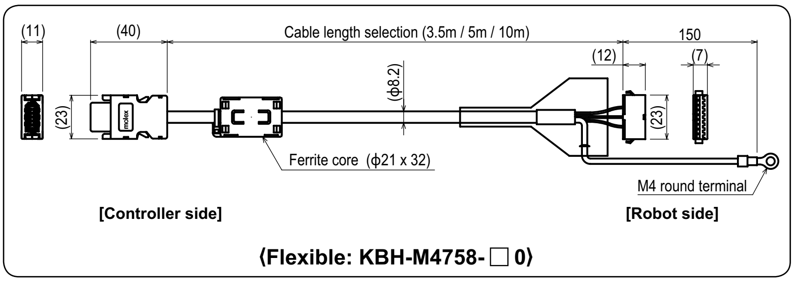
[Flexible cable]

Connected robot ▷ **PHASER**

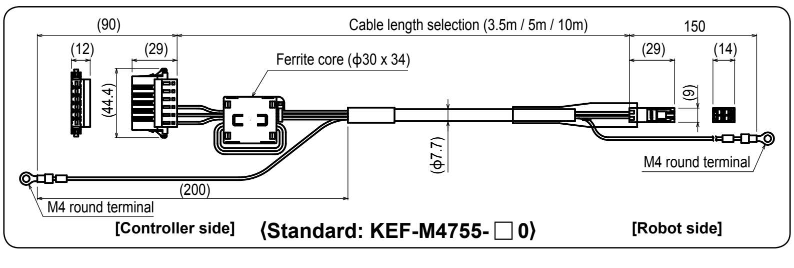
Set	Single item	
KEF-M4712-□0	Signal wire	KBH-M4758-□0
	Motor wire	KEF-M4755-□0
	I/O connector	KBH-M4420-00

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



[Motor wire]



SR1-X cable

[Standard cable]

Connected robot ▷ **FLIP-X**

Set	Single item	
KX7-M4710-□0	Signal wire	KX7-M4751-□1
	Motor wire	KX7-M4752-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Flexible cable]

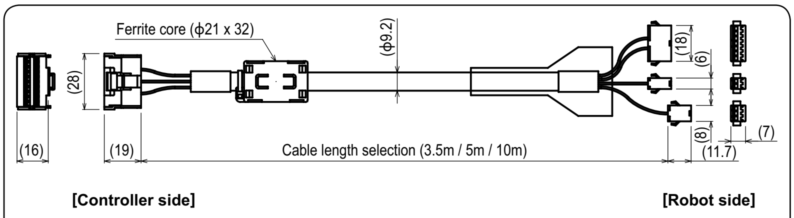
Connected robot ▷ **FLIP-X**

Set	Single item	
KX7-M4720-□0	Signal wire	KX7-M4755-□0
	Motor wire	KX7-M4752-□0

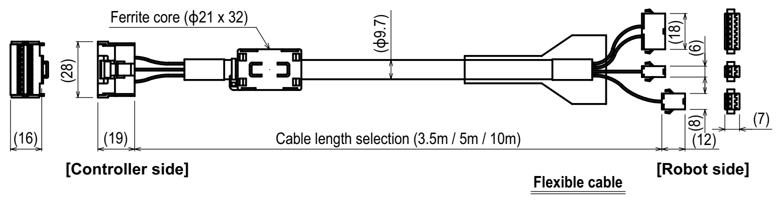
Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Signal wire]

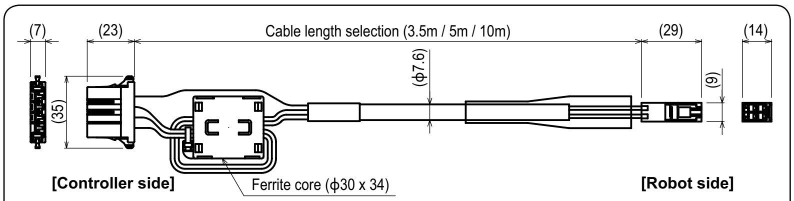


⟨Standard: KX7-M4751-□1⟩



⟨Flexible: KX7-M4755-□0⟩

[Motor wire]



⟨Motor wire: KX7-M4752-□0⟩

SR1-P cable

[Standard cable]

Connected robot ▷ **PHASER**

Set	Single item	
KAU-M4710-□0	Signal wire	KAU-M4751-□4
	Motor wire	KAU-M4752-□1

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Flexible cable]

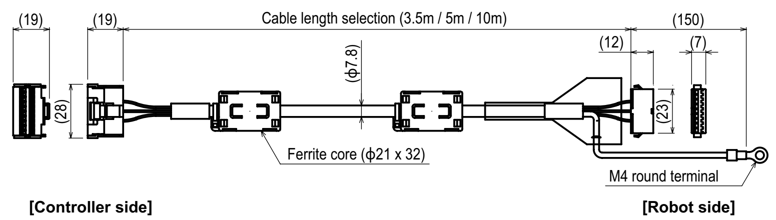
Connected robot ▷ **PHASER**

Set	Single item	
KAU-M4720-□0	Signal wire	KAU-M4755-□0
	Motor wire	KAU-M4752-□1

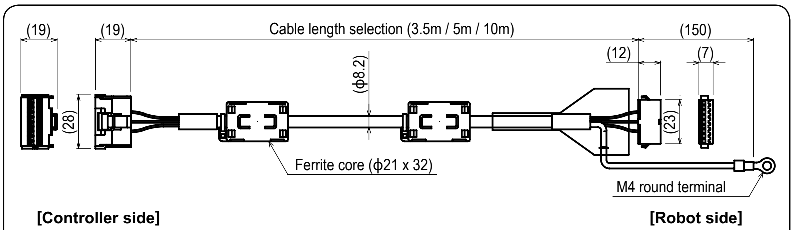
Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m

[Signal wire]

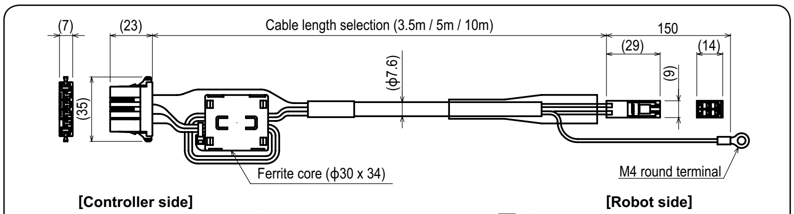


⟨Standard: KAU-M4751-□4⟩



⟨Flexible: KAU-M4755-□0⟩

[Motor wire]



⟨Motor wire: KAU-M4752-□1⟩

Robot cable table

ERCD / ERCX cable

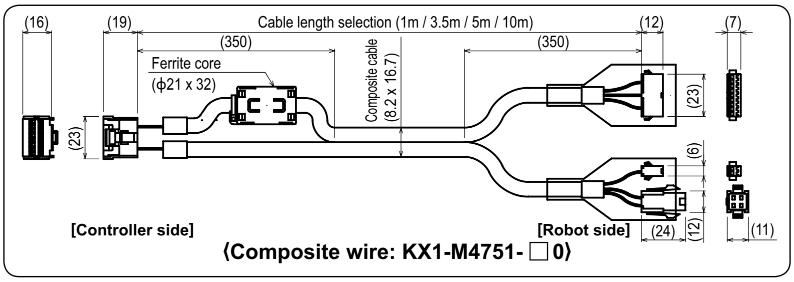
[Standard cable]

Connected robot ▷ **FLIP-X**

Set	Single item	
-	Composite wire	KX1-M4751-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
1	1m
3	3.5m
5	5m
A	10m



⟨Composite wire: KX1-M4751-□0⟩

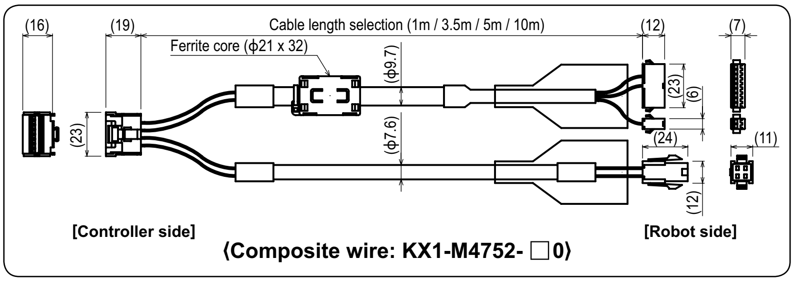
[Flexible cable]

Connected robot ▷ **FLIP-X**

Set	Single item	
-	Composite wire	KX1-M4752-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
1	1m
3	3.5m
5	5m
A	10m



⟨Composite wire: KX1-M4752-□0⟩

Multi-robot cable

Single axis multi-robot cable

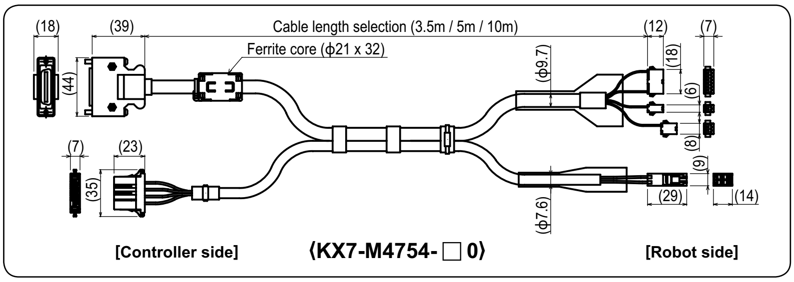
[Flexible cable]

Connected controller ▷ **RCX240**

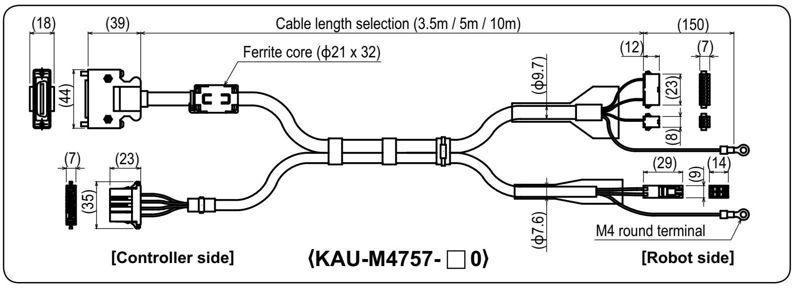
Robot	Cable type
FLIP-X	KX7-M4754-□0
PHASER	KAU-M4757-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



⟨KX7-M4754-□0⟩



⟨KAU-M4757-□0⟩

2-axes multi-robot cable

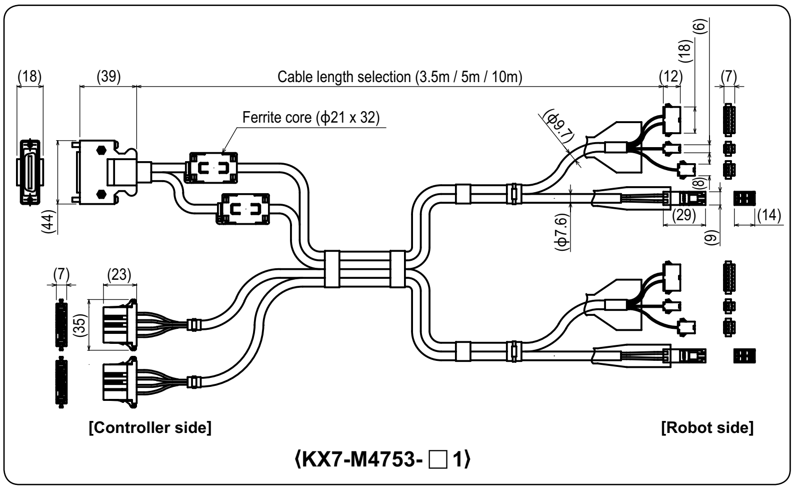
[Flexible cable]

Connected controller ▷ • **RCX221/RCX222**
• **RCX240/RCX340**
• **DRCX**

Robot combinations		Cable type
First axis	Second axis	
FLIP-X	FLIP-X	KX7-M4753-□1

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



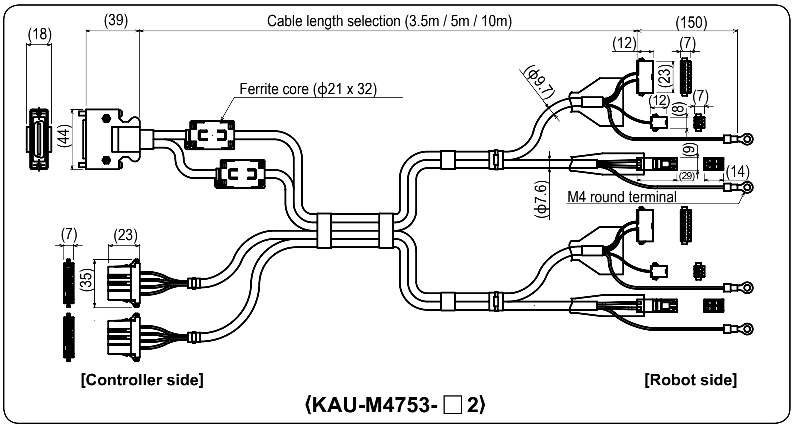
[Flexible cable]

Connected controller ▷ **RCX221 / RCX240**

Robot combinations		Cable type
First axis	Second axis	
PHASER	PHASER	KAU-M4753-□2

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



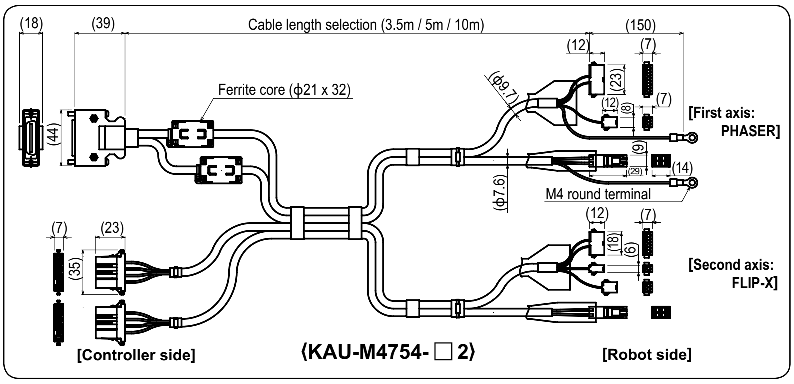
[Flexible cable]

Connected controller ▷ **RCX221 / RCX240**

Robot combinations		Cable type
First axis	Second axis	
PHASER	FLIP-X	KAU-M4754-□2

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



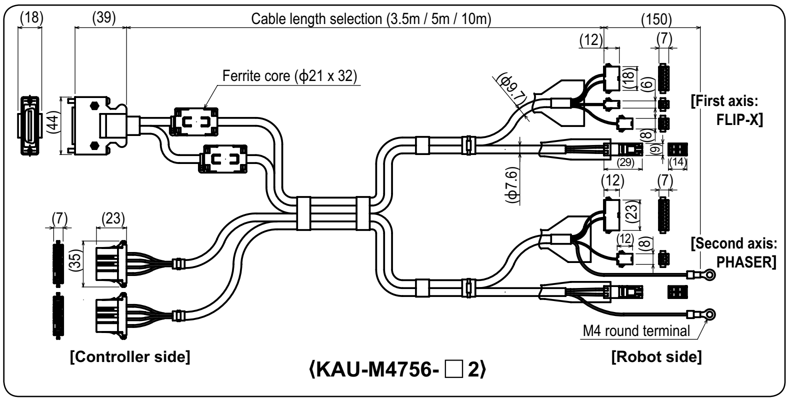
[Flexible cable]

Connected controller ▷ **RCX221 / RCX240**

Robot combinations		Cable type
First axis	Second axis	
FLIP-X	PHASER	KAU-M4756-□2

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



Cartesian robot cable

Cartesian 2-axes cable

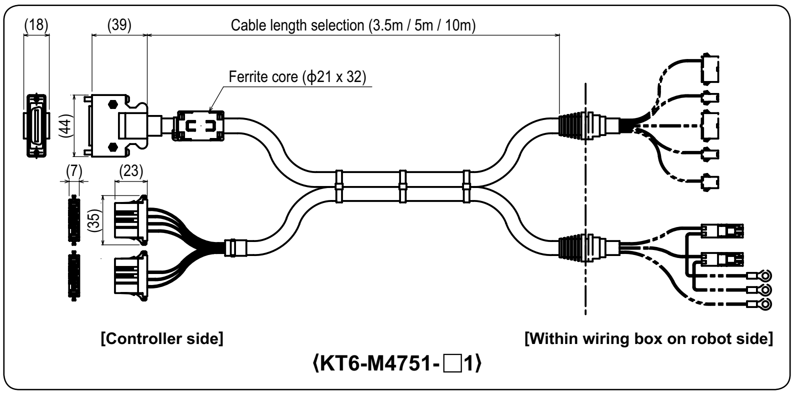
[Standard cable]

Connected controller ▷ **DRCX / RCX222 / RCX340**

Type	KT6-M4751-□1

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



Cartesian 3-axes cable

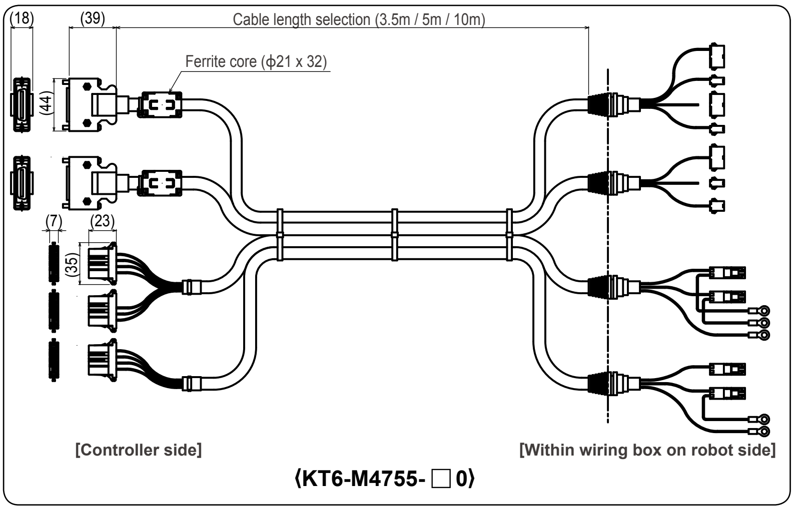
[Standard cable]

Connected controller ▷ **RCX142 / RCX240 / RCX340**

Type	KT6-M4755-□0

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



Cartesian 4-axes cable

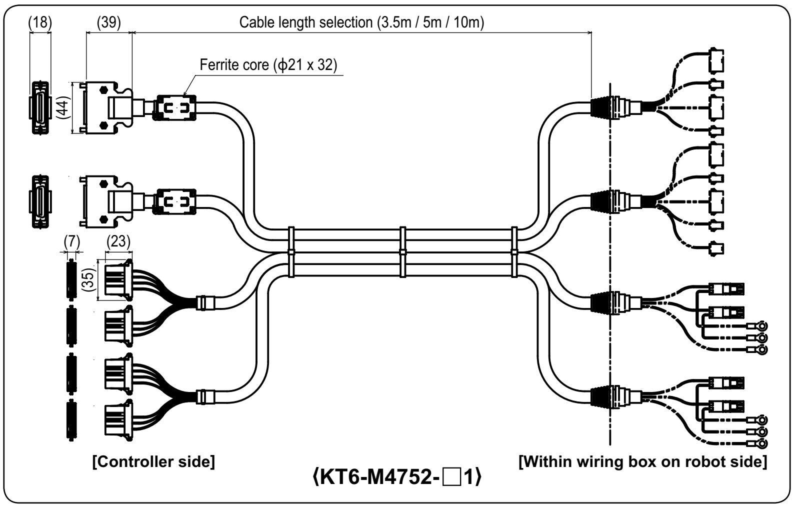
[Standard cable]

Connected controller ▷ **RCX142 / RCX240 / RCX340**

Type	KT6-M4752-□1

Note. Notation within slot in model types is as shown at right.

Within □	Cable length
3	3.5m
5	5m
A	10m



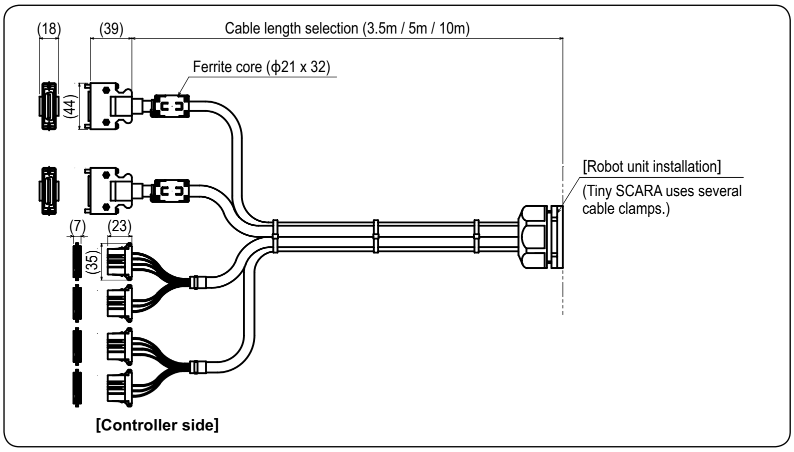
SCARA robot cable

Note. SCARA robot cables all use the same size connectors but different models use different cables.

[Standard cable]

Connected robot ▷ • **YK-XG (No including YK120XG / YK150XG / YK180XG)**
• **YK-XGS**
• **YK-TW**
• **YK400XR**

Cable length	Type
3.5m	KBF-M6211-00
5m	KBF-M6211-10
10m	KBF-M6211-20



Connected robot ▷ • **YK120XG**
• **YK150XG**
• **YK180XG**

Cable length	Type
2m	KCB-M6211-31
3.5m	KCB-M6211-01
5m	KCB-M6211-11
10m	KCB-M6211-21

Connected robot ▷ • **YK-XGP**
• **YK-XGC**

Cable length	Type
3.5m	KDP-M6211-00
5m	KDP-M6211-10
10m	KDP-M6211-20

Connected robot ▷ • **YK-XC (Large type)**
• **YK-XS**
• **YK-XP**

Cable length	Type
3.5m	KN3-M6211-00
5m	KN3-M6211-10
10m	KN3-M6211-20

Connected robot ▷ • **YK1200X**

Cable length	Type
3.5m	KN6-M6211-00
5m	KN6-M6211-10
10m	KN6-M6211-20

Connected robot ▷ • **YK180X**
• **YK220X**
• **YK180XC**
• **YK220XC**

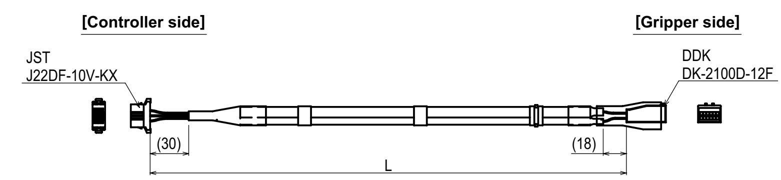
Cable length	Type
3.5m	KBE-M6211-00
5m	KBE-M6211-10
10m	KBE-M6211-20

Gripper cable

Note. Be sure to adjust the total length of the robot (for gripper) cable and relay cable to 14m or less.

● Robot cable
[Flexible cable]

Cable length	Type
3.5m	KCF-M4751-31
5m	KCF-M4751-51
10m	KCF-M4751-A1

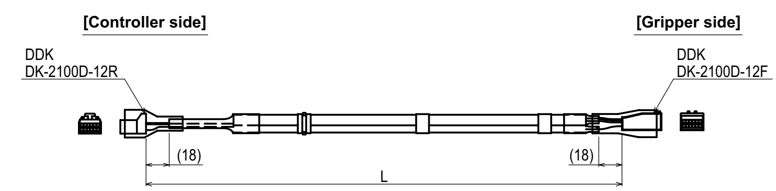


⟨KCF-M4751-□ 1⟩

● Relay cable
[Flexible cable]

Type	KCF-M4811-□ 1

Within □	1	2	3	4	5	6	7	8
Length (mm)	0.5	1	1.5	2	2.5	3	3.5	4



⟨KCF-M4811-□ 1⟩

Cable terminal table

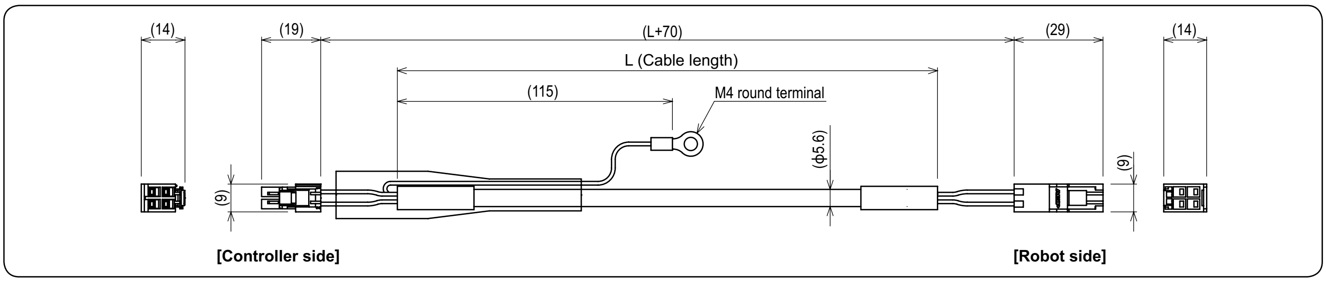
This is a relay cable used between the robot body and the robot cable such cable carrier wiring, etc.

PHASER relay cable

Motor wire (350mm to 1450mm) Note. Common to MR types and MF types

Type	KAU-M4813-□0

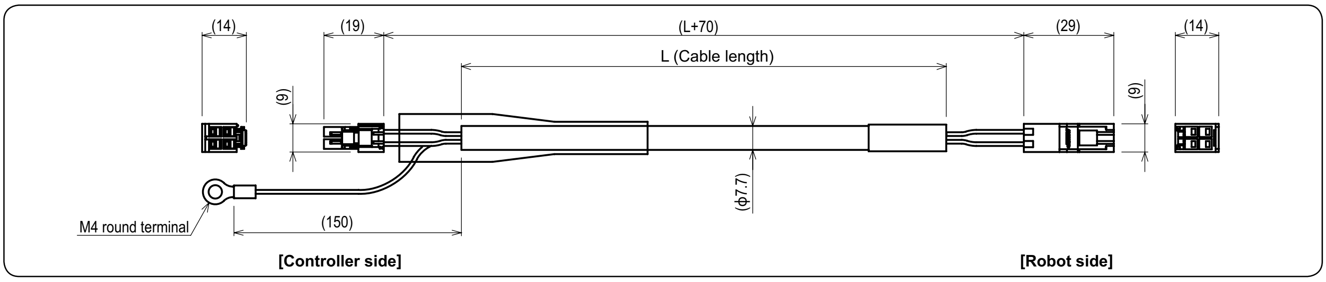
Within □	1	2	3	4	5	6	7	8	9	A	B	C
Length (mm)	350	450	550	650	750	850	950	1050	1150	1250	1350	1450



Motor wire (1500mm to 2600mm) Note. Not usable on MR type

Type	KBD-M4813-□0

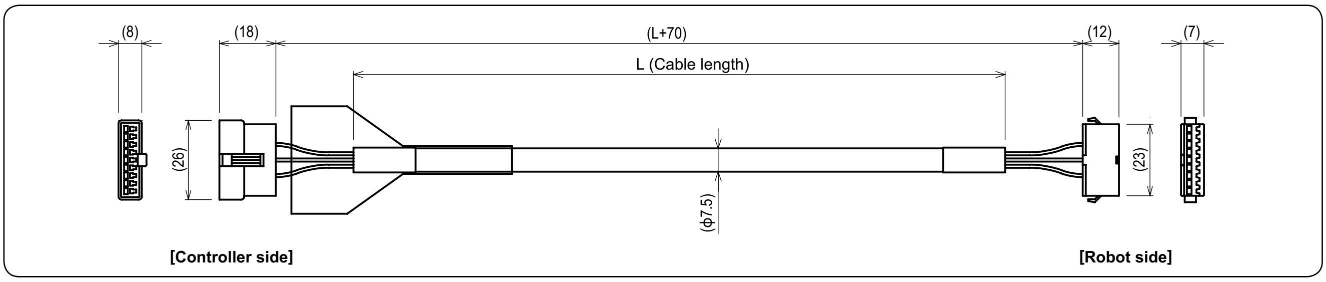
Within □	6	7	8	9	A	B	C	D	E	F	G	M
Length (mm)	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600



Signal cable (350mm to 1450mm) Note. Common to MR types and MF types

Type	KAU-M4812-□1

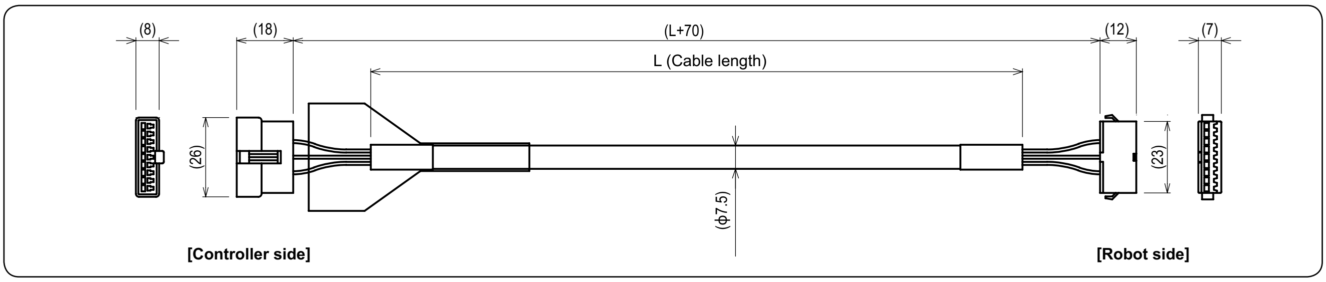
Within □	1	2	3	4	5	6	7	8	9	A	B	C
Length (mm)	350	450	550	650	750	850	950	1050	1150	1250	1350	1450



Signal cable (1500mm to 2600mm) Note. Common to MR types and MF types

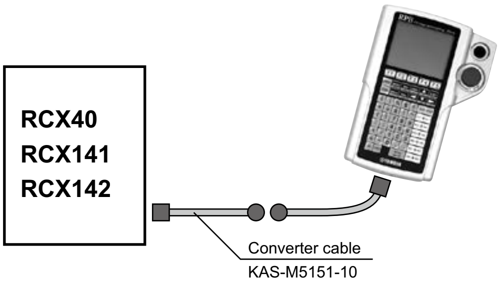
Type	KBD-M4812-□1

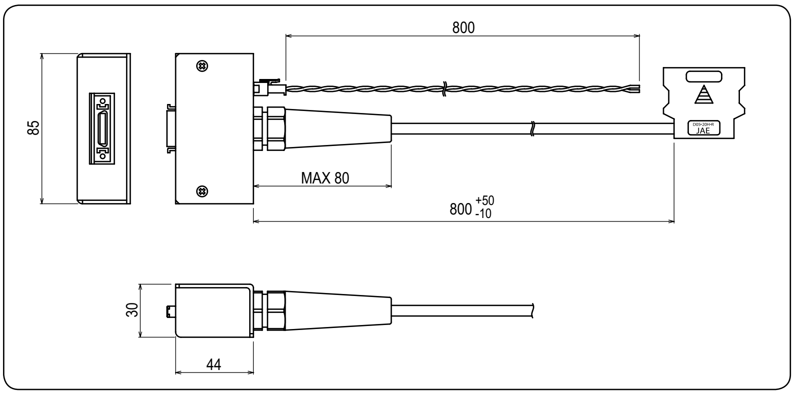
Within □	6	7	8	9	A	B	C	D	E	F	G	J
Length (mm)	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600



Connector converter cable

Programming box converter cable

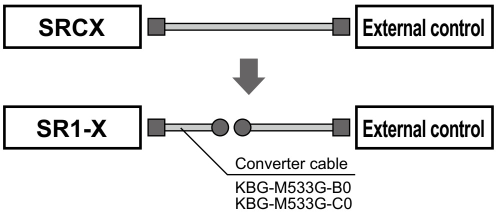




Converter cable for operating the RCX40, RCX141, RCX142 by RPB.

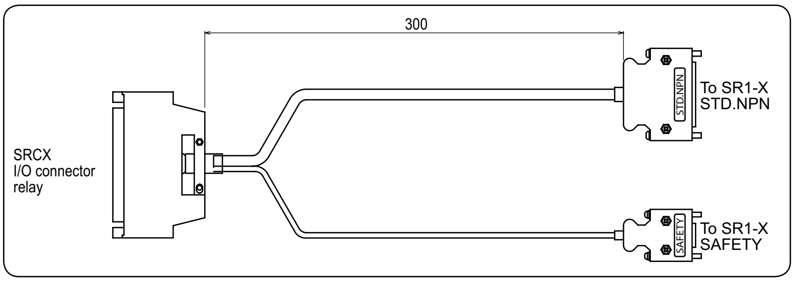
Type	KAS-M5151-10

I/O control converter cable



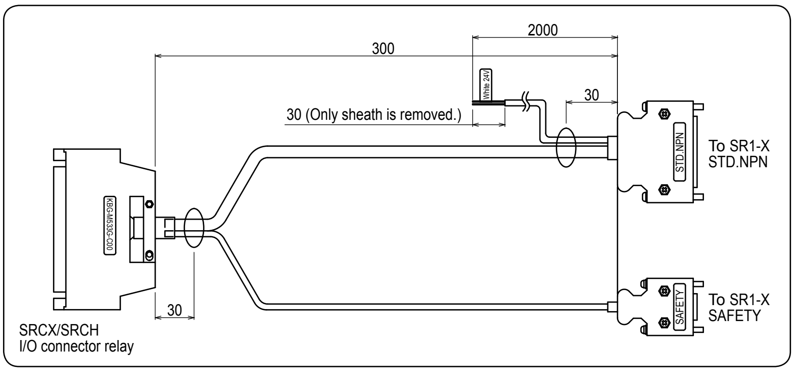
Converter cable allows connecting to the SRCX connector when system using the SRCX was changed to the SR1-X.

External power supply is used for the I/O power supply.



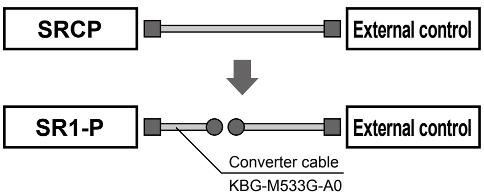
Type	KBG-M533G-B0

Internal power supply of the SRCX is used for the I/O power supply.

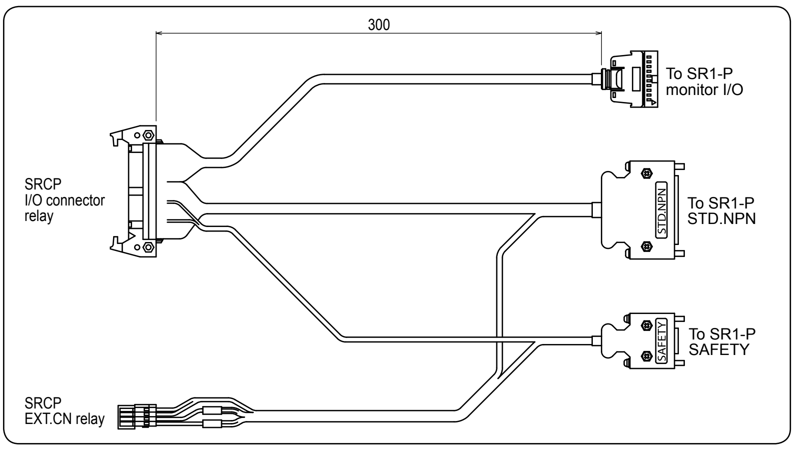


Note. It is necessary to input the 24V-power supply from the outside.

Type	KBG-M533G-C0



Converter cable allows connecting to the SRCP connector when system using the SRCP was changed to the SR1-P.

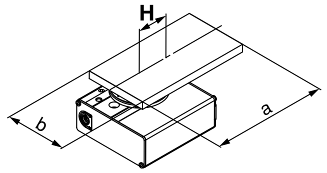


Type	KBG-M533G-A0

TRANSERVO RF type model selection

Selecting a model

Operating conditions



Rotary type: RF03
Installation posture: Horizontal
Kind of load: Inertial load Ta
Shape of load: 150 mm x 80 mm (rectangular plate)
Oscillating angle θ: 180°

Acceleration/deceleration $\dot{\omega}$: 1,000 °/sec^2
Speed ω: 420 °/sec
Load mass m: 2.0 kg
Distance between shaft and center of gravity H: 40 mm

Step 1 Moment of inertia Acceleration/deceleration

1. Calculating the moment of inertia.
2. Checking the moment of inertia vs. acceleration/deceleration.
   Select an appropriate model from the moment of inertia vs. acceleration/deceleration while referring to the moment of inertia vs. acceleration/deceleration graph.

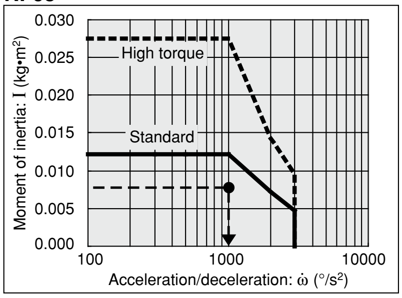
Calculation formula

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

Selection example

$I = 2.0 \times (0.15^2+0.08^2)/12 + 2.0 \times 0.04^2$
$= 0.00802 kg \cdot m^2$

RF03



Step 2 Selecting a torque

1. Kinds of loads
   - Static load: Ts
   - Resistance load: Tf
   - Inertial load: Ta
2. Checking the effective torque
   Check that the speed can be controlled by the effective torque by the speed while referring to the effective torque vs. speed graph.

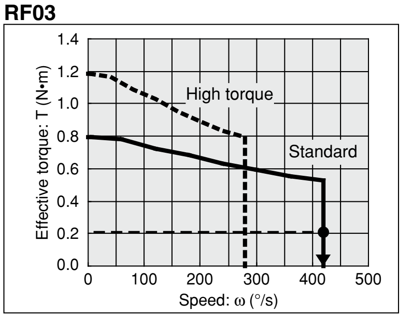
Calculation formula

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

Selection example

Inertial load: Ta
$Ta \times 1.5 = I \times \dot{\omega} \times 2\pi/360 \times 1.5$
$= 0.00802 \times 1{,}000 \times 0.0175 \times 1.5$
$= 0.21 N \cdot m$

RF03



Step 3 Allowable load

1. Checking the allowable load
   - Radial load
   - Thrust load
   - Moment

Calculation formula

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

Selection example

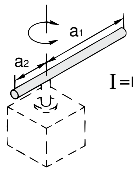
Thrust load
2.0×9.8=19.6N<Allowable load OK
Allowable moment
2.0×9.8×0.04
=0.784N•m<Allowable moment OK

List of moment of inertia calculation formulas (Calculation of moment of inertia I)

I: Moment of inertia m: Load mass

1 Thin rod

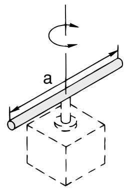
Position of rotation axis:
Passes through one end perpendicularly to the rod.



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

2 Thin rod

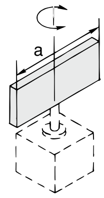
Position of rotation axis:
Passes through the center of gravity of the rod.



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

3 Thin rectangular plate (rectangular parallelepiped)

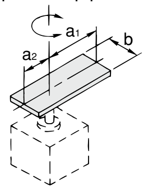
Position of rotation axis:
Passes through the center of gravity of the rod.



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

4 Thin rectangular plate (rectangular parallelepiped)

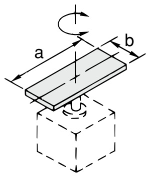
Position of rotation axis:
Passes through one end perpendicularly to the plate.
(Same position for the rectangular parallelepiped with the plate thickened.)



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

5 Thin rectangular plate (rectangular parallelepiped)

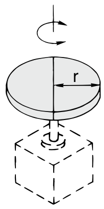
Position of rotation axis:
Passes through one end perpendicularly to the plate.
(Same position for the rectangular parallelepiped with the plate thickened.)



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

6 Cylinder (including thin disc)

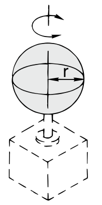
Position of rotation axis:
Central axis



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

7 Solid ball

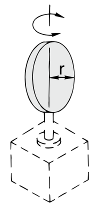
Position of rotation axis:
Diameter



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

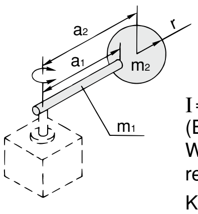
8 Thin disc

Position of rotation axis:
Diameter



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

9 Load at lever tip

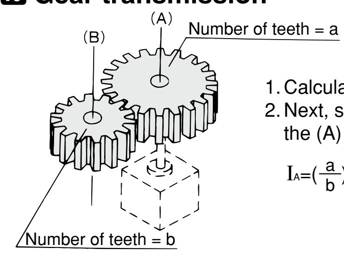


$$I = m_1 \cdot \frac{a_1^2}{3} + m_2 \cdot a_2^2 + K$$

(Example)
When the shape of m_2 is a ball, refer to [7] to obtain the following.

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

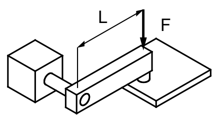
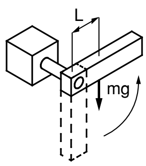
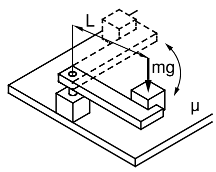
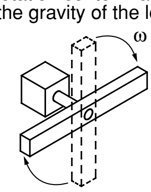
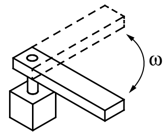
10 Gear transmission



1. Calculate the moment of inertia I_B around the (B) axis.
2. Next, substitute I_B for the moment of inertia around the (A) axis to calculate I_A as follows.

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

Kinds of loads

Kinds of loads		
Static load: Ts	**Resistance load: Tf**	**Inertial load: Ta**
Only push force is needed (clamp, etc.).	Gravity or friction force applies in the rotation direction.	Load with inertia needs to be rotated.
	<Gravity applies.>  <Friction force applies.> 	<Rotation center matches to the gravity of the load.>  <Rotation axis is in the vertical direction.> 
Ts = F•L Ts : Static load (N•m) F : Clamp force (N) L : Distance from oscillating center to clamp position (m)	Gravity applies in the rotation direction. Tf = m•g•L Friction force applies in the rotation direction. Tf = μ•m•g•L Tf : Resistance load (N•m) m : Mass of load (kg) g : Gravity acceleration 9.8 (m/s²) L : Distance from oscillating center to gravity or friction force action point (m) μ : Friction coefficient	Ta = I • ώ • 2 π / 360 (Ta = I • ώ • 0.0175) Ta: Inertial load (N•m) I : Moment of inertia (kg•m²) ώ : Acceleration/deceleration (°/sec²) ω : Speed (°/sec)
Required torque T = Ts	Required torque T = Tf × 1.5 Note 1)	Required torque T = Ta × 1.5 Note 1)

- **Load becomes the resistance load.**
  Gravity or friction force applies in the rotation direction.
  Example 1) The rotation center of the rotation axis does not match to the center of gravity of the load in the horizontal direction.
  Example 2) The load slips on the floor to move it.
  The required torque is the total of the resistance load and inertial load.
  T = (Tf + Ta) × 1.5

- **Load does not become the resistance load.**
  Gravity or friction force does not apply in the rotation direction.
  Example 1) The rotation axis is vertical.
  Example 2) The rotation center of the rotation axis does not match to the center of gravity of the load in the horizontal direction.
  The required torque is only the inertial load.
  T = Ta × 1.5

Note 1) An allowance is required for Tf and Ta to make the speed adjustment.

When using the RCX240

R-axis tolerable moment of inertia and acceleration coefficient

The RCX340 automatically specifies the acceleration coefficient according to the parameter settings.

The moment of inertia of a load (end effector and workpiece) that can be attached to the R-axis is limited by the strength of the robot drive unit and residual vibration during positioning. It is therefore necessary to reduce the acceleration coefficient in accordance with the moment of inertia.

[Example: YK500XG]

If there is a payload of 1.5kg installed on the R axis then the inertia moment in the R axis vicinity is 0.1kgm^2 (1.0kgfcmsec^2). The tip payload set at this time is 2kg. As shown on the graph, the robot can be operated with the X axis, Y axis and R axis acceleration coefficients reduced to 62%. Always select a tip payload and acceleration coefficient parameter that matches the payload and inertia moment before operating the robot. See your "YAMAHA Robot Controller Instruction Manual" when setting the tip payload and acceleration coefficient.

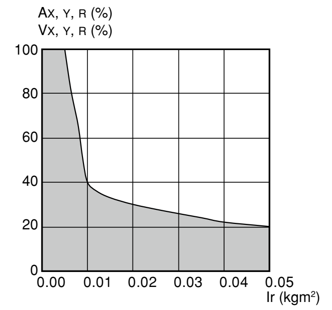
Note. The method for calculating the inertia moment load is shown on P.611. However, making an accurate calculation is difficult. If the actual inertia moment is larger than the calculated value and the robot is set for that calculated value then residual vibrations might occur.
If this happens, reduce the acceleration coefficient parameter more.

⚠ CAUTION

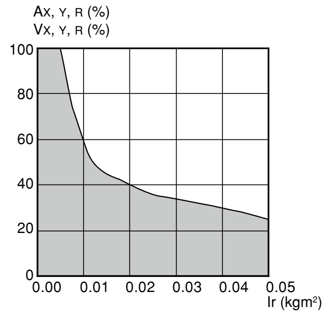
- The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If this is not observed, premature end to the life of the drive units, damage to the robot parts or residual vibration during positioning may result.
- Depending on the Z-axis position, vibration may occur when the X, Y or R-axis moves. If this happens, reduce the X, Y or R-axis acceleration to an appropriate level.
- If the moment of inertia is too large, vibration may occur on the Z-axis depending on its operation position. If this happens, reduce the Z-axis acceleration to an approriate level.

Acceleration coefficients for inertia moment in each SCARA robot YK-X series model

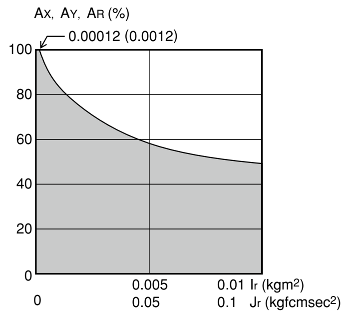
YK350TW



YK500TW

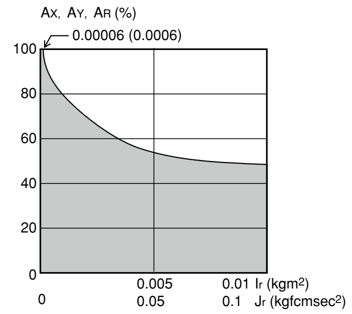


YK120XG

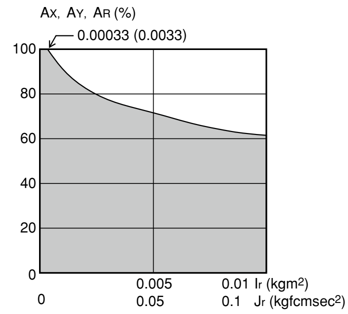


m=0.1~1.0kg

YK150XG

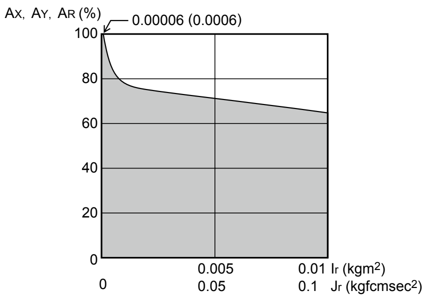


m=0.1~0.3kg

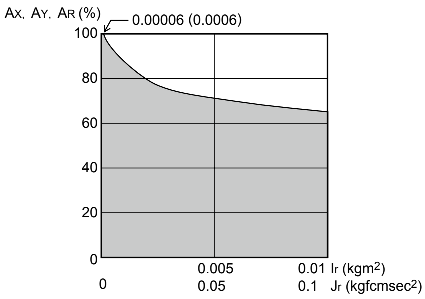


m=0.4~1.0kg

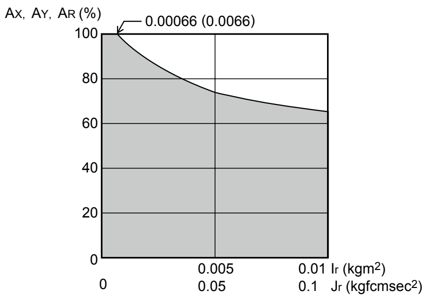
YK180XG



m=0.1 to 0.3kg



m=0.4 to 0.7kg

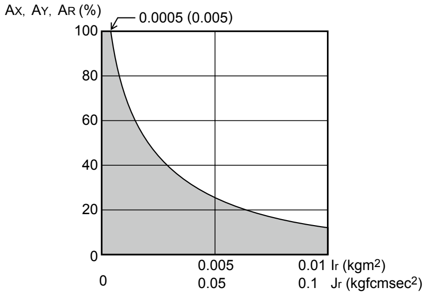


m=0.8 to 1.0kg

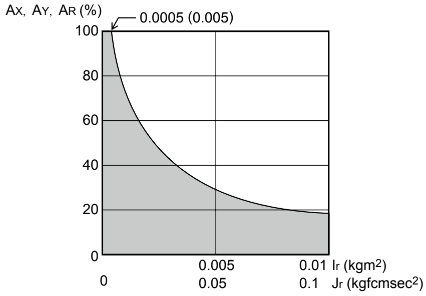
Graph notation description

- Ax, Ay, AR ➡ Acceleration coefficient for X axis, Y axis, R axis
- Ir, Jr ➡ Inertia moment in R axis load vicinity
- m ➡ Tip payload

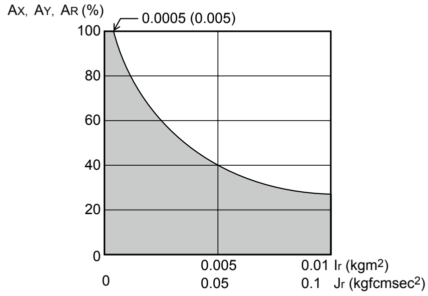
YK180X / YK220X



m=0.1 to 0.4kg

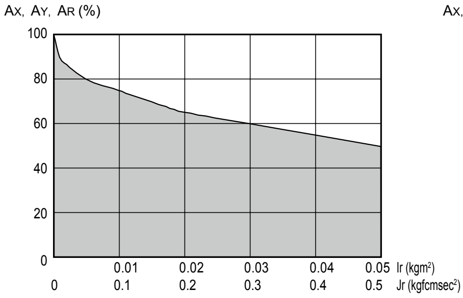


m=0.5 to 0.8kg

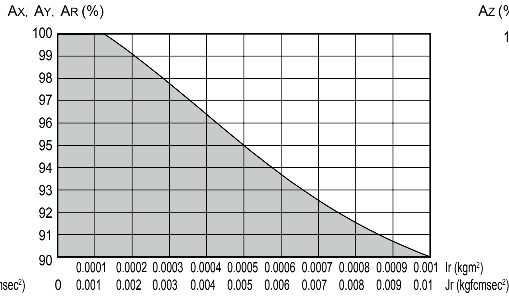


m=0.9, 1.0kg

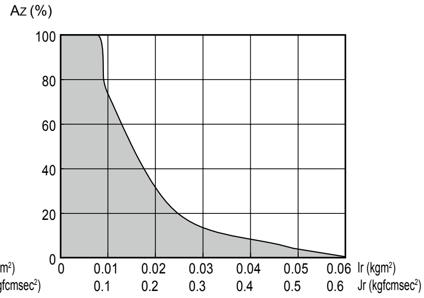
YK250XG/YK250XGP/YK250XGC



m=1 to 5kg

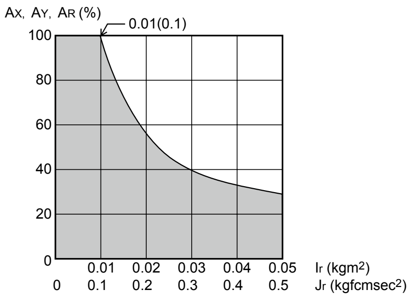


m=1 to 5kg

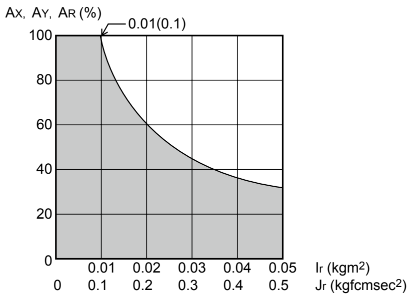


m=1 to 5kg

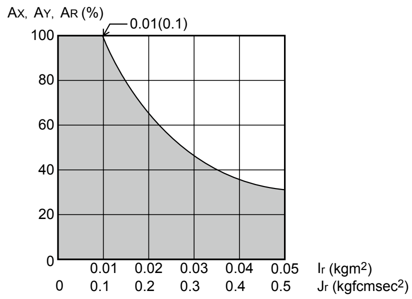
YK250XH



m=1kg

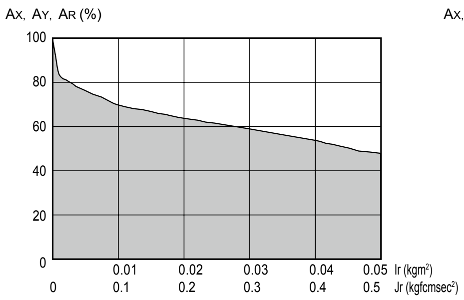


m=2kg

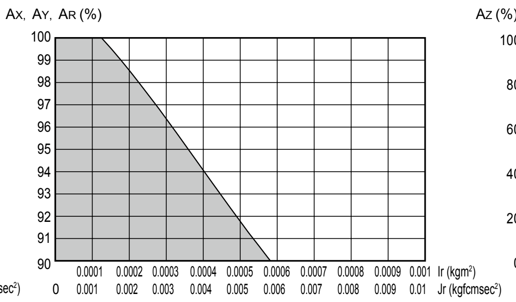


m=3kg

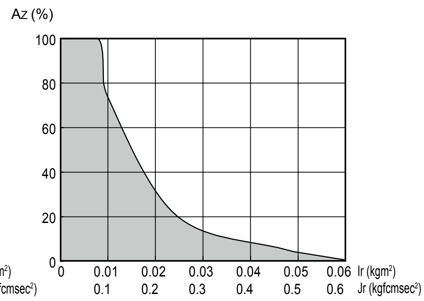
YK350XG/YK350XGP/YK350XGC/YK300XGS



m=1 to 5kg

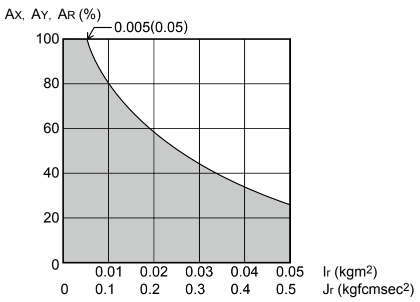


m=1 to 5kg

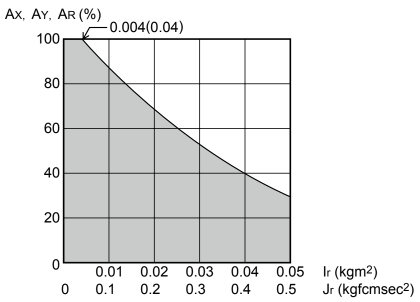


m=1 to 5kg

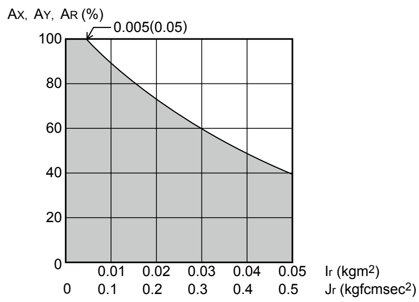
YK350XH



m=1kg



m=2kg



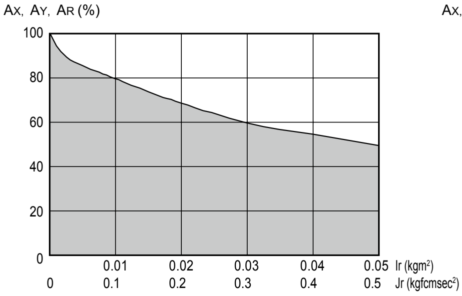
m=3kg

Graph notation description

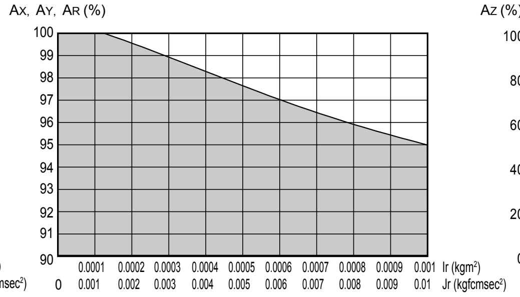
Ax, Ay, Ar ➡ Acceleration coefficient for X axis, Y axis, R axis
Ir, Jr ➡ Inertia moment in R axis load vicinity
m ➡ Tip payload

R-axis tolerable moment of inertia and acceleration coefficient

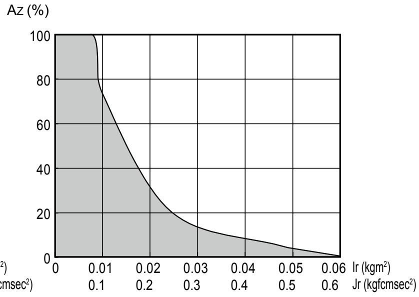
YK400XG/YK400XGP/YK400XGC/YK400XGS



m=1 to 5kg

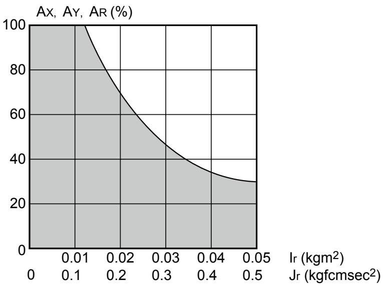


m=1 to 5kg

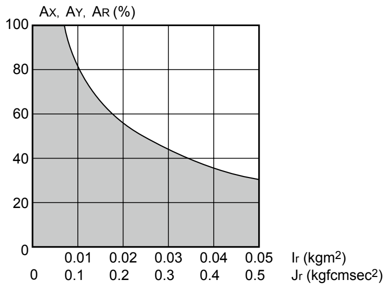


m=1 to 5kg

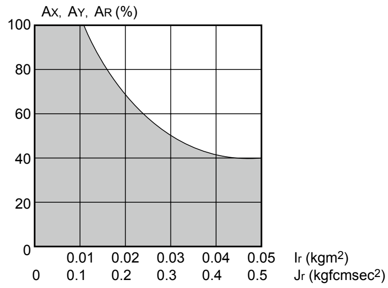
YK400XH



m=1kg

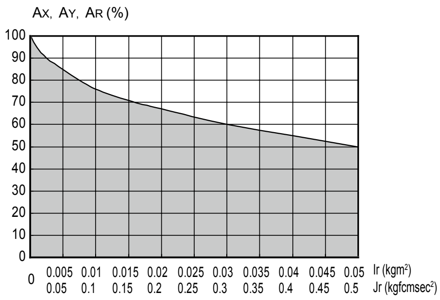


m=2kg

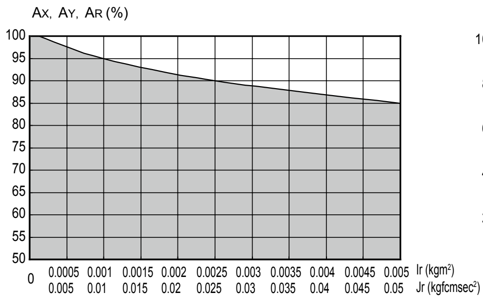


m=3kg

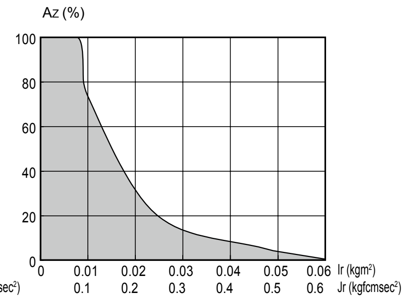
YK500XGL/YK500XGLP/YK500XGLC



m=1 to 5kg

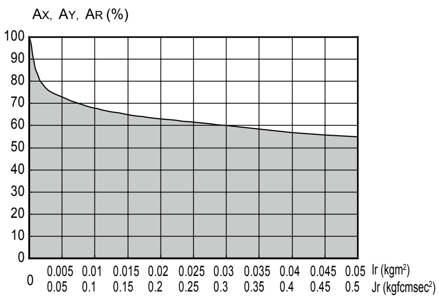


m=1 to 5kg

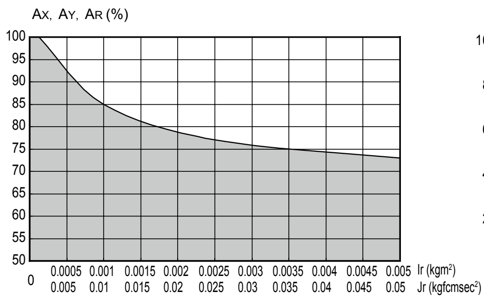


m=1 to 5kg

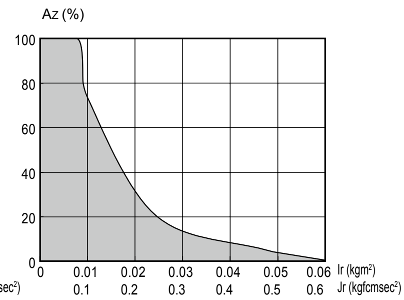
YK600XGL/YK600XGLP/YK600XGLC



m=1 to 5kg



m=1 to 5kg

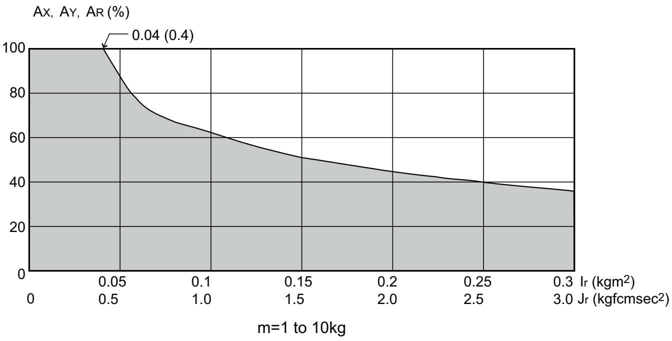


m=1 to 5kg

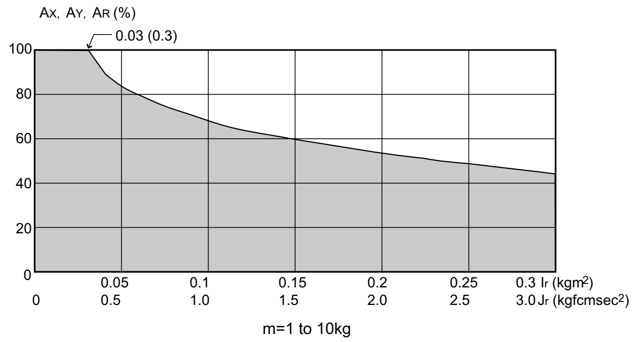
Graph notation description

- Ax, Ay, Ar ➡ Acceleration coefficient for X axis, Y axis, R axis
- Ir, Jr ➡ Inertia moment in R axis load vicinity
- m ➡ Tip payload

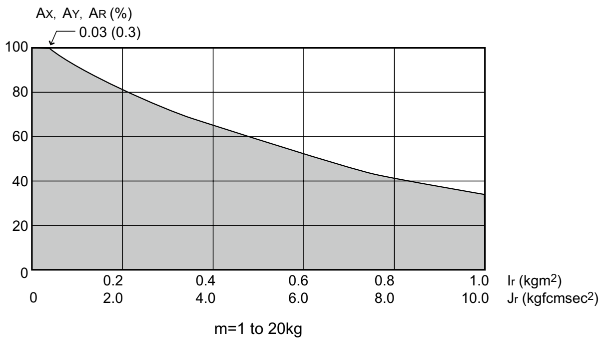
YK500XG/YK500XGS/YK500XGP



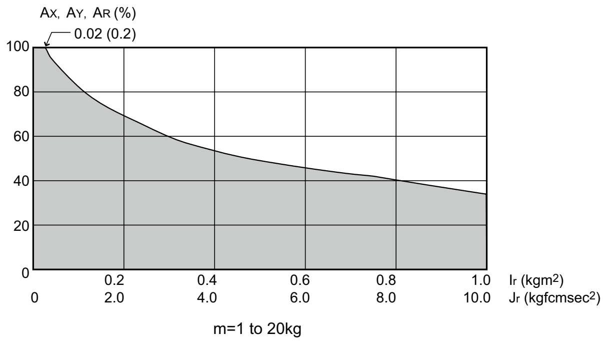
YK600XG/YK600XGS/YK600XGP



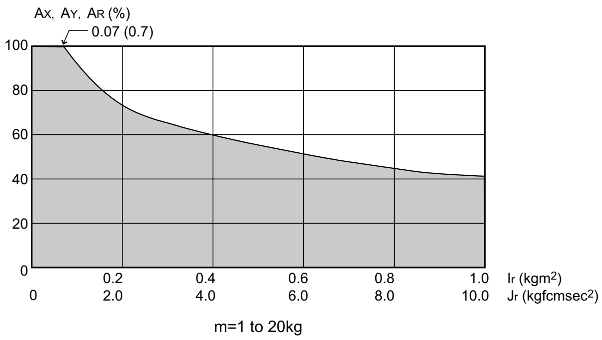
YK600XGH/YK600XGHP



YK700XG/YK700XGS/YK700XGP/YK800XG/ YK800XGS/YK800XGP



YK900XG/YK900XGS/YK900XGP/YK1000XG/ YK1000XGS/YK1000XGP



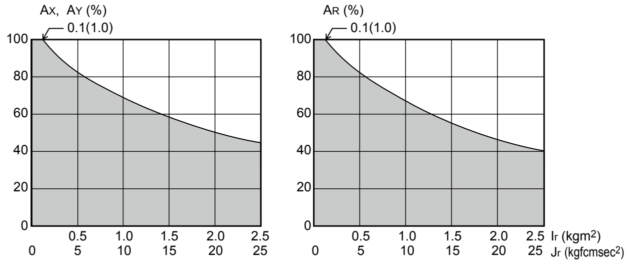
Graph notation description

A_X, A_Y, A_R ➡ Acceleration coefficient for X axis, Y axis, R axis
I_r, J_r ➡ Inertia moment in R axis load vicinity
m ➡ Tip payload

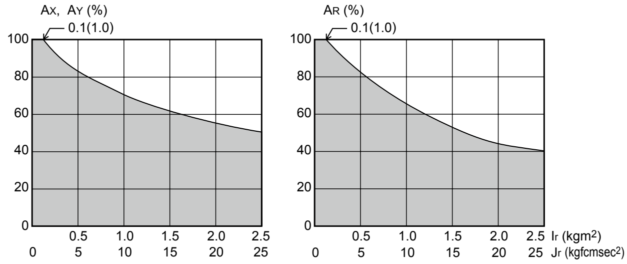
Articulated robots YA
Linear conveyor modules LCM100
Compact single-axis robots TRANSERVO
Single-axis robots FLIP-X
Linear motor single-axis robots PHASER
Cartesian robots XY-X
SCARA robots YK-X
Pick & place robots YP-X
CLEAN
CONTROLLER
INFORMATION
CABLE
TECHNICAL
INFORMATION

R-axis tolerable moment of inertia and acceleration coefficient

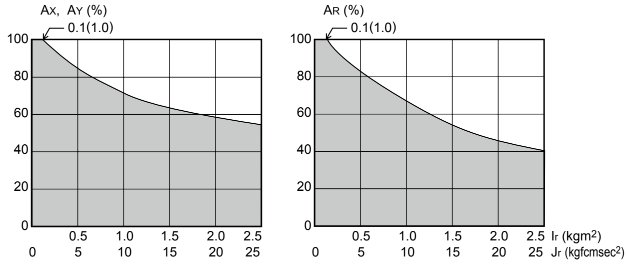
YK1200X



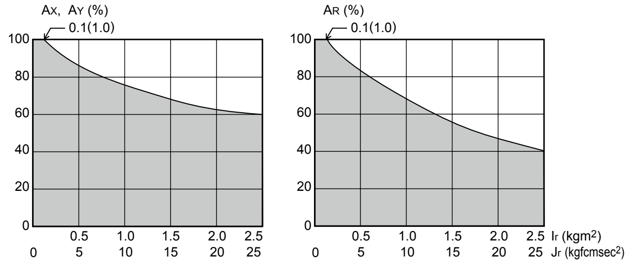
m=0 to 5kg



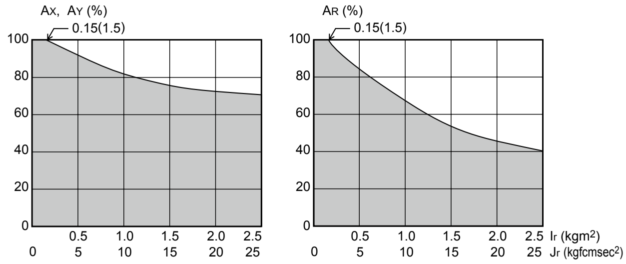
m=6 to 10kg



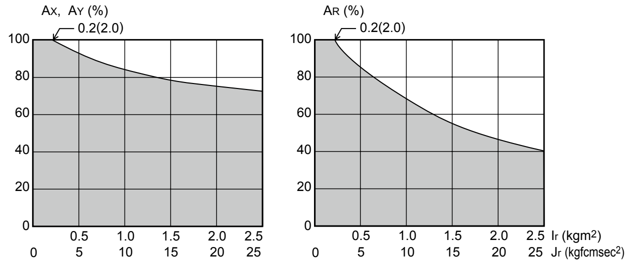
m=11 to 15kg



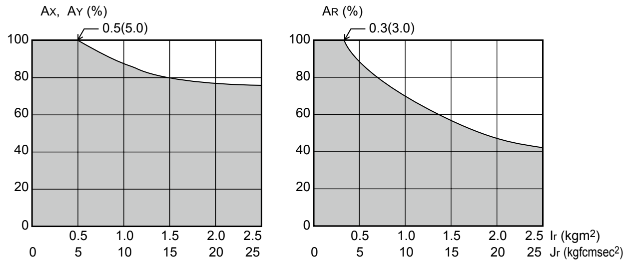
m=16 to 20kg



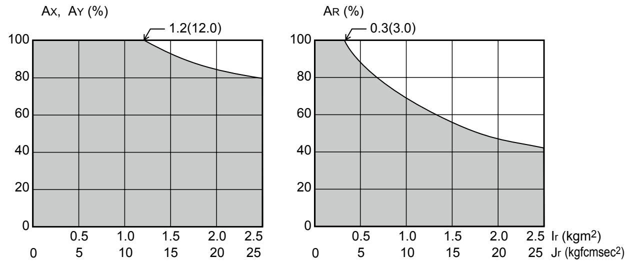
m=21 to 25kg



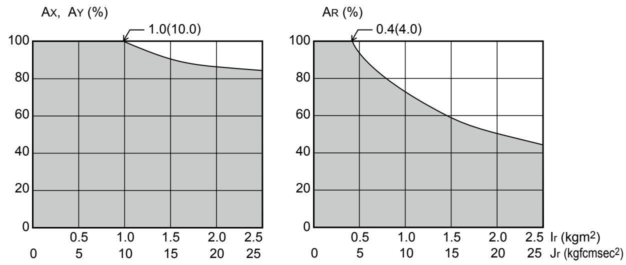
m=26 to 30kg



m=31 to 35kg



m=36 to 40kg



m=41 to 50kg

Graph notation description

AX, AY, AR ➡ Acceleration coefficient for X axis, Y axis, R axis
Ir, Jr ➡ Inertia moment in R axis load vicinity
m ➡ Tip payload

How to find the inertia moment

The tool and work are not usually a simple shape so calculating the inertia moment is not easy.
As a method, the load is replaced with several factors that resemble a simple form for which the moment of inertia can be calculated. The total of the moment of inertia for these factors is then obtained. The objects and equations often used for the calculation of the moment of inertia are shown below. Incidentally, there is the following relation: J (kgfcmsec^2) =I (kgm^2) x 10.2

[1] Moment of inertia for material particle

The equation for the moment of inertia for a material particle that has a rotation center such as shown in Fig. ① is as follows: This is used as an approximate equation when x is larger than the object size.

$$I = mx^2 \ (\text{kgm}^2)$$

$$J = \frac{Wx^2}{g} \ (\text{kgfcmsec}^2) \quad \text{... (3.1)}$$

g : Gravitational acceleration (cm/sec^2)
m : Mass of material particle (kg)
W : Weight of material particle (kgf)

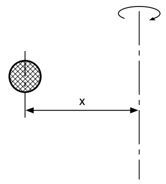


Fig.①

[2] Moment of inertia for cylinder (part 1)

The equation for the moment of inertia for a cylinder that has a rotation center such as shown in Fig. ② is given below.

$$I = \frac{\rho \pi D^4 h}{32} = \frac{mD^2}{8} \ (\text{kgm}^2)$$

$$J = \frac{\rho \pi D^4 h}{32g} = \frac{WD^2}{8g} \ (\text{kgfcmsec}^2) \quad \text{... (3.2)}$$

ρ: Density (kg/m^3, kg/cm^3)
g : Gravitational acceleration (cm/sec^2)
m : Mass of cylinder (kg)
W : Weight of cylinder (kgf)

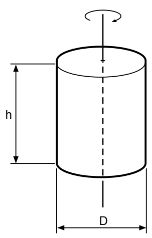


Fig.②

[3] Moment of inertia for cylinder (part 2)

The equation for the moment of inertia for a cylinder that has a rotation center such as shown in Fig. ③ is given below.

$$I = \frac{\rho \pi D^2 h}{16} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) = \frac{m}{4} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) \ (\text{kgm}^2)$$

$$J = \frac{\rho \pi D^2 h}{16g} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) = \frac{W}{4g} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) \ (\text{kgfcmsec}^2) \quad \text{... (3.3)}$$

ρ: Density (kg/m^3, kg/cm^3)
g : Gravitational acceleration (cm/sec2)
m : Mass of cylinder (kg)
W : Weight of cylinder (kgf)

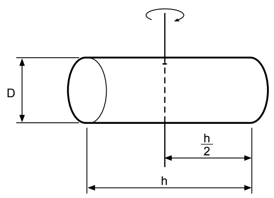


Fig.③

[4] Moment of inertia for prism

The equation for the moment of inertia for a prism that has a rotation center as shown in Fig. ④ is given as follows.

$$I = \frac{\rho abc\,(a^2 + b^2)}{12} = \frac{m\,(a^2 + b^2)}{12} \ (\text{kgm}^2)$$

$$J = \frac{\rho abc\,(a^2 + b^2)}{12g} = \frac{W\,(a^2 + b^2)}{12g} \ (\text{kgfcmsec}^2) \quad \text{... (3.4)}$$

ρ : Density (kg/m^3, kg/cm^3)
g : Gravitational acceleration (cm/sec^2)
m : Mass of prism (kg)
W : Weight of prism (kgf)

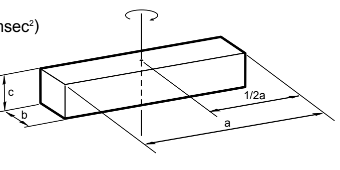


Fig.④

[5] When the object's center line is offset from the rotation center

The equation for the moment of inertia, when the center of the cylinder is offset by the distance "x" from the rotation center as shown in Fig.⑤, is given as follows.

$$I = \frac{\rho \pi D^4 h}{32} + \frac{\rho \pi D^2 h x^2}{4} = \frac{mD^2}{8} + mx^2 \ (\text{kgm}^2)$$

$$J = \frac{\rho \pi D^4 h}{32g} + \frac{\rho \pi D^2 h x^2}{4g}$$

$$= \frac{WD^2}{8g} + \frac{Wx^2}{g} \ (\text{kgfcmsec}^2) \quad \text{... (3.5)}$$

ρ: Density (kg/m^3, kg/cm^3)
g : Gravitational acceleration (cm/sec^2)
m : Mass of cylinder (kg)
W : Weight of cylinder (kgf)

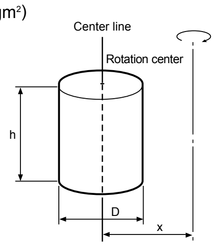


Fig.⑤

In the same manner, the moment of inertia of a cylinder as shown in Fig. ⑥ is given by

$$I = \frac{\rho \pi D^2 h}{16} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) + \frac{\rho \pi D^2 h x^2}{4} = \frac{m}{4} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) + mx^2 \ (\text{kgm}^2)$$

$$J = \frac{\rho \pi D^2 h}{16g} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) + \frac{\rho \pi D^2 h x^2}{4g}$$

$$= \frac{W}{4g} \left(\frac{D^2}{4} + \frac{h^2}{3}\right) + \frac{Wx^2}{g} \ (\text{kgfcmsec}^2) \quad \text{... (3.6)}$$

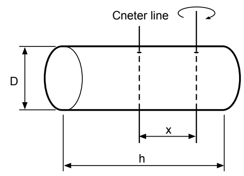


Fig.⑥

In the same manner, the moment of inertia of a prism as shown in Fig. ⑦ is given by

$$I = \frac{\rho abc\,(a^2 + b^2)}{12} + \rho abcx^2 = \frac{m\,(a^2 + b^2)}{12} + mx^2 \ (\text{kgm}^2)$$

$$J = \frac{\rho abc\,(a^2 + b^2)}{12g} + \frac{\rho abcx^2}{g}$$

$$= \frac{W\,(a^2 + b^2)}{12g} + \frac{Wx^2}{g} \ (\text{kgfcmsec}^2) \quad \text{... (3.7)}$$

m : Mass of prism (kg)
W : Weight of prism (kgf)

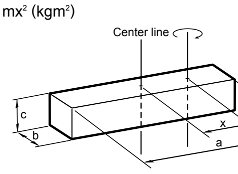


Fig.⑦

Example of moment of inertia calculation

Let's discuss an example in which the chuck and workpiece are at a position offset by 10cm from the R-axis by a stay, as shown in Fig. ⑧.
The moment of inertia is calculated with the following three factors, assuming that the load material is steel and its density ρ is 0.0078kg/cm^3.

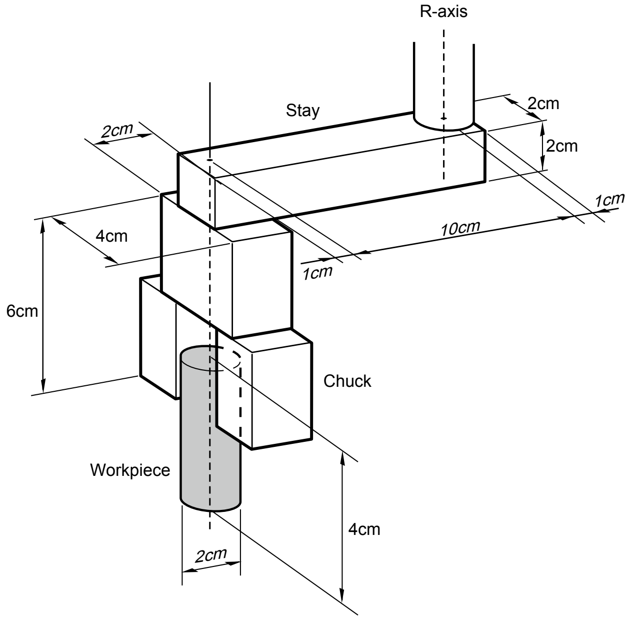


Fig. ⑧

[1] Moment of inertia of the stay

From Fig. ⑨, the weight of the stay (Ws) is given as follows :

Ws = ρabc=0.0078 x 12 x 2 x 2
= 0.37 (kgf)

The moment of inertia of the stay (Js) is then calculated from Eq. 3-7.

$$Js = \frac{0.37 \times (12^2 + 2^2)}{12 \times 980} + \frac{0.37 \times 5^2}{980} = 0.014 \text{ (kgfcmsec}^2\text{)}$$

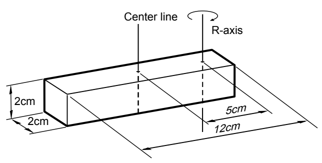


Fig. ⑨

[2] Moment of inertia of the chuck

When the chuck form resembles that shown in Fig. ⑩, the weight of the chuck (Wc) is

Wc =0.0078 x 2 x 4 x 6
=0.37 (kgf)

The moment of inertia of the chuck (Jc) is then calculated from Eq. 3-7.

$$Jc = \frac{0.37 \times (2^2 + 4^2)}{12 \times 980} + \frac{0.37 \times 10^2}{980} = 0.038 \text{ (kgfcmsec}^2\text{)}$$

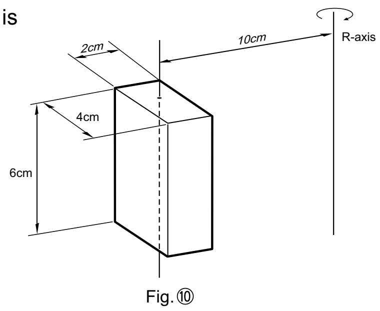


Fig. ⑩

[3] Moment of inertia of workpiece

When the workpiece form resembles that shown in Fig. ⑪, the weight of the workpiece (Ww) is

$$Ww = \frac{\rho \pi D^2 h}{4} = \frac{0.0078\pi \times 2^2 \times 4}{4} = 0.098 \text{ (kgf)}$$

The moment of inertia of the workpiece (Jw) is then calculated from Eq. 3-5.

$$Jw = \frac{0.097 \times 2^2}{8 \times 980} + \frac{0.097 \times 10^2}{980} = 0.010 \text{ (kgfcmsec}^2\text{)}$$

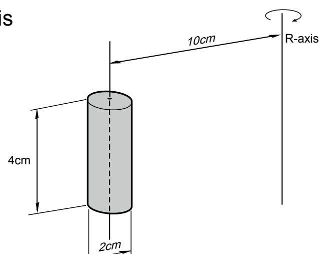


Fig. ⑪

[4] Total weight

W = Ws + Wc + Ww = 0.84 (kgf)

[5] Total moment of inertia

J = Js + Jc + Jw = 0.062 (kgfcmsec^2)

External safety circuit examples

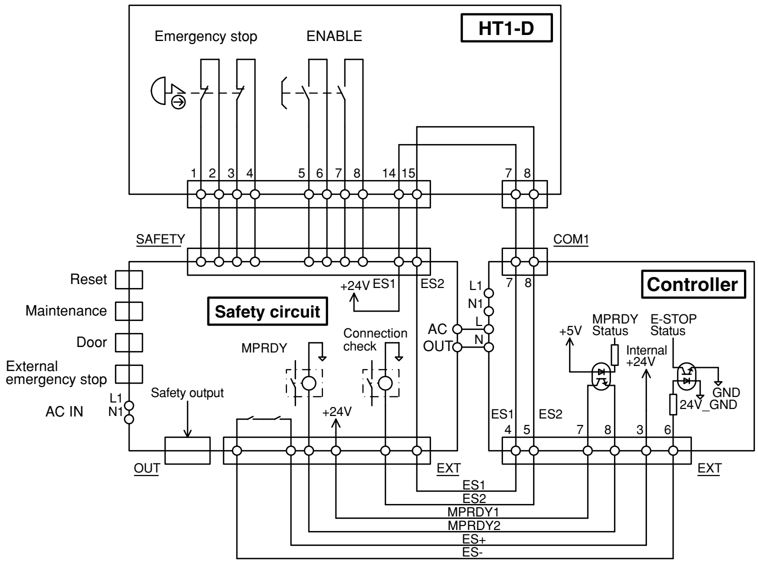
To ensure safe use of the robot, we request the customers make a risk assessment of their end equipment to decide what performance level is needed from safety circuits at the point. Customer should then install a safety circuit at the required performance level.

Here we show examples of category 4 circuits for the TS-X/TS-P, SR1 and RCX240 controllers using a programming box with an enable switch.

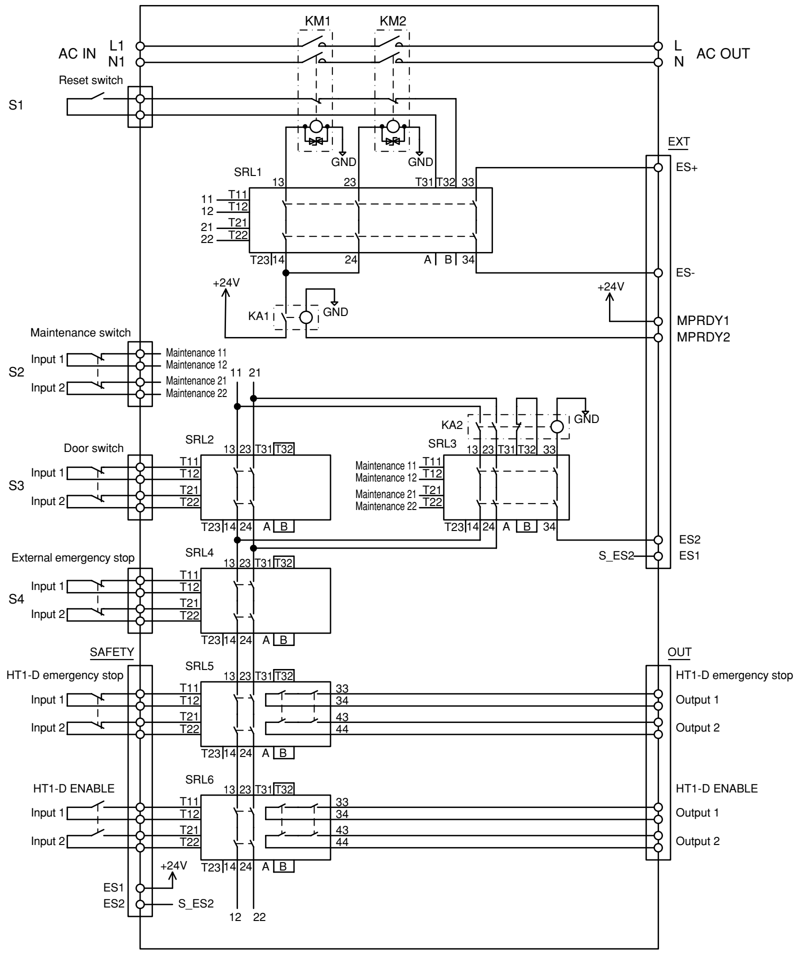
Safety circuits for other categories are described in the user' s manuals, so download them from our website if needed.

Circuit configuration examples (TS-X/TS-P)

General connection diagram

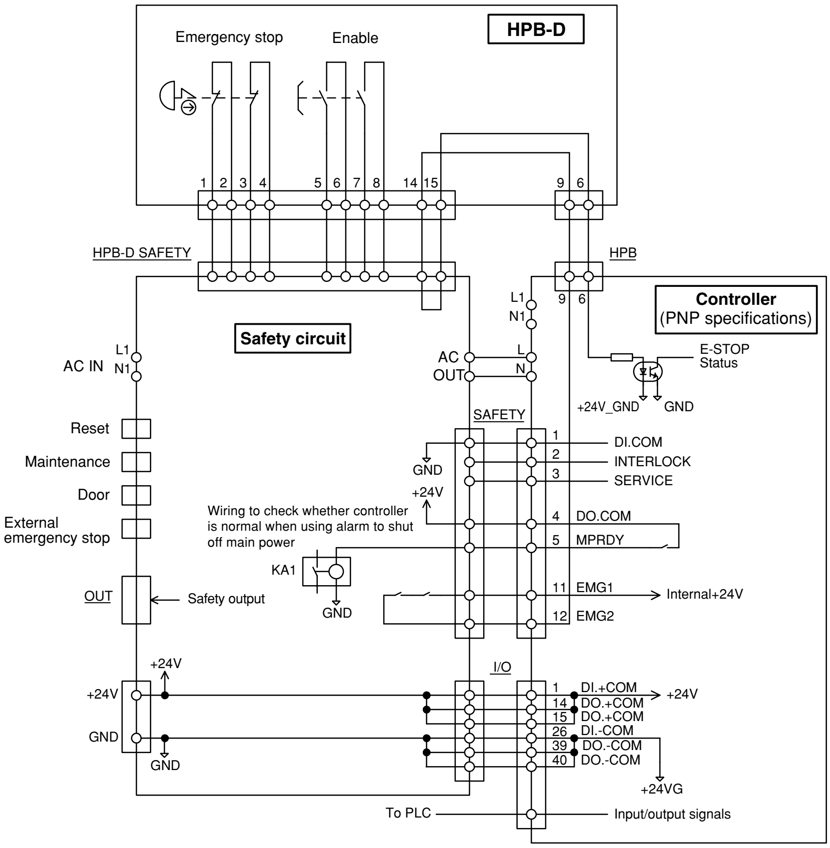


Category 4

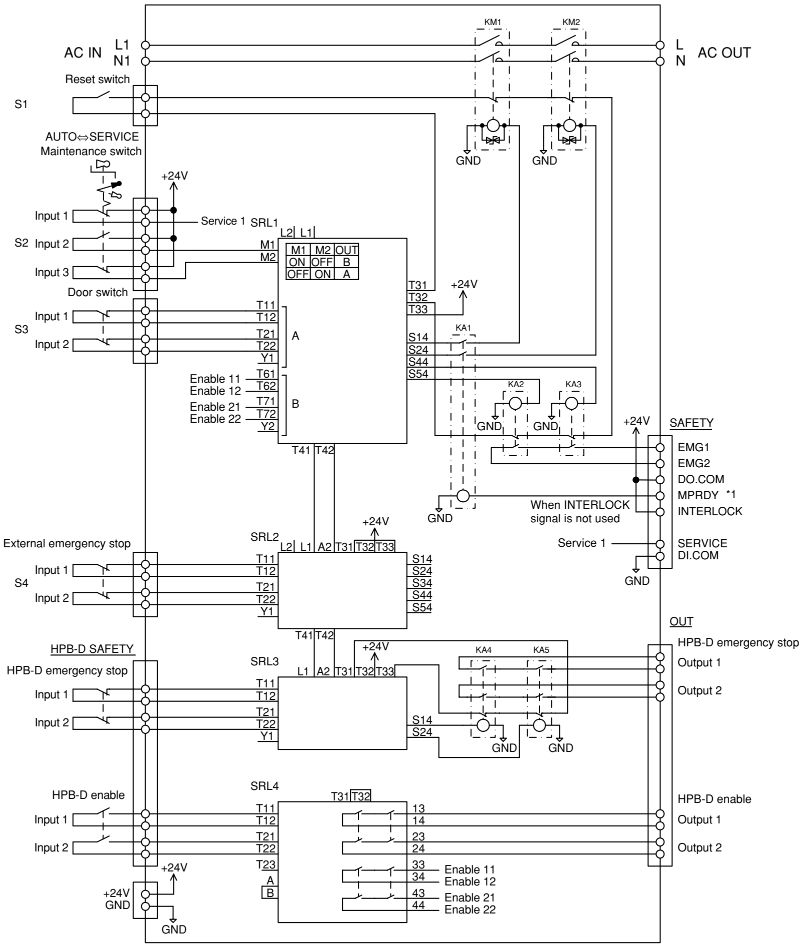


Circuit configuration examples (SR1)

General connection diagram



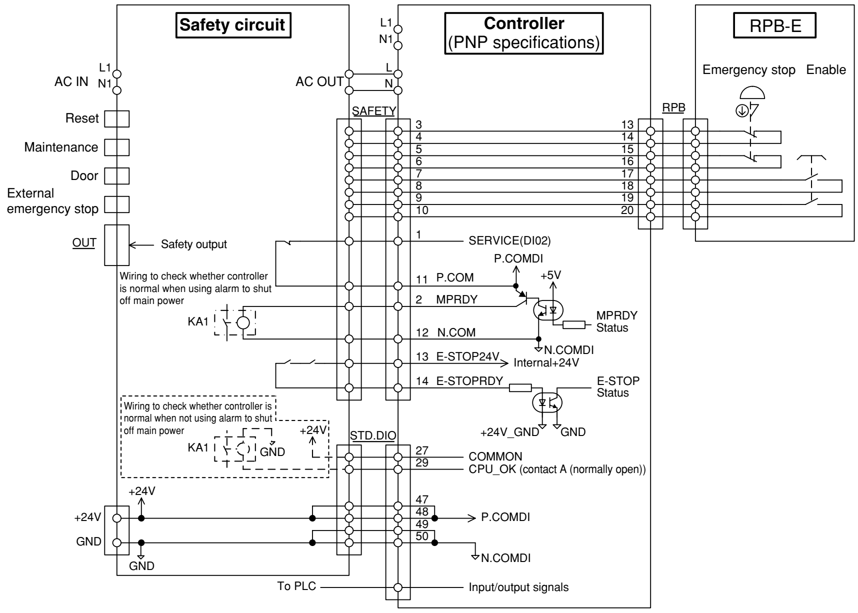
Category 4



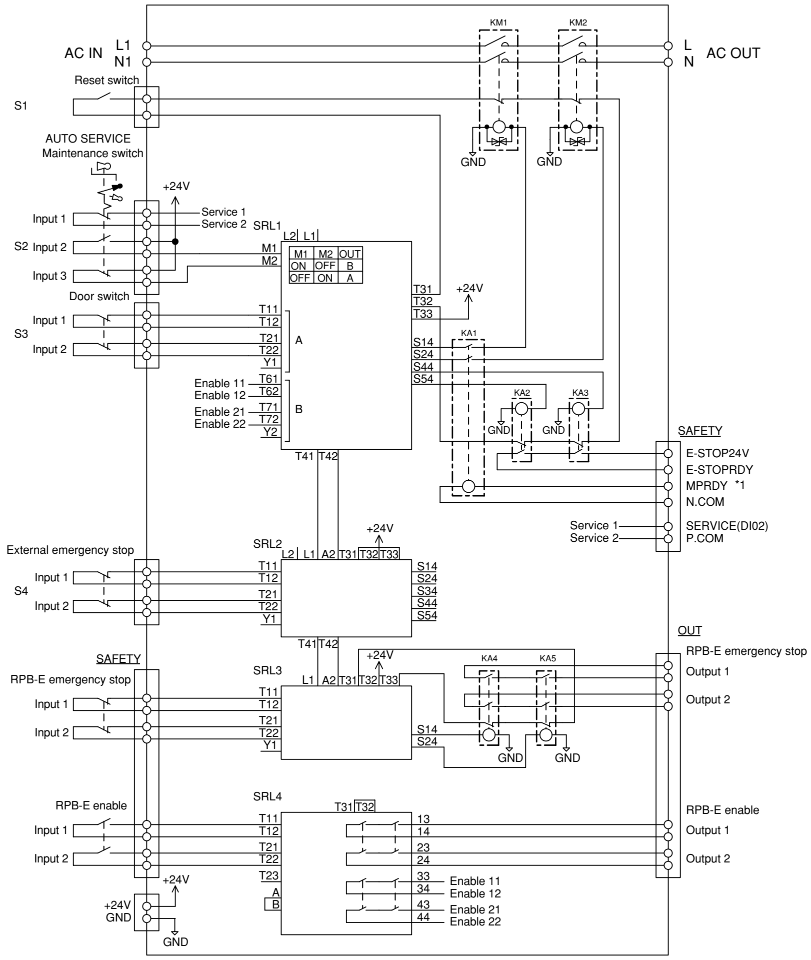
*1: Wiring to check whether the controller is normal when using an alarm to shut off the main power

Circuit configuration examples (RCX240)

General connection diagram



Category 4



*1: Wiring to check whether the controller is normal when using an alarm to shut off the main power

Parts Table

Circuit No.	Part Name	Circuit No.	Part Name
S1	Reset switch	KM1, 2	Contactor (mirror contact)
S2	Key-selector switch	KA1 to 5 *1	Safety relay
S3	Safety door switch	SRL1 to 4	Safety relay unit
S4	Emergency stop switch	SRL5, 6 *2	Safety relay unit

*1. TS-X and TS-P are KA1 to 2.
*2. Only TS-X and TS-P.

Cautions regarding CE specifications

CE marking

The YAMAHA robot (robot and controller) is one component that is incorporated into the customer's system (built-in equipment), and we declare that the YAMAHA robots conform to the EC Directives only within the scope of built-in equipment (semi-finished product). So, no CE marks are affixed to the YAMAHA robot products.

Cautions regarding compliance with EC Directives

The YAMAHA robot (robot and controller) is not, in itself, a robot system. The YAMAHA robot-series product is one component that is incorporated into the customer's system (built-in equipment), and we declare that the YAMAHA robots conform to the EC Directives only within the scope of built-in equipment. This does not therefore guarantee that the YAMAHA robot-series product conforms to the EC Directives if only the robot is used independently. The customer who incorporates YAMAHA robot products into the customer's final system, which will be shipped to or used in the European region, should verify that the overall system conforms to the EC Directives.

Applicable directives and their related standards

Directives applicable to YAMAHA robots and related standards are shown below.

TS-S2 / TS-X / TS-P / SR1-X / SR1-P / RCX221 / RCX222 / RDV-X / RDV-P

EC Directives	Related Standards
Machinery Directive 2006/42/EC	EN ISO12100 EN 60204-1
EMC Directive 2004/108/EC	EN 55011 EN 61000-6-2

RCX240 / RCX340

EC Directives	Related Standards
Machinery Directive 2006/42/EC	EN ISO12100 EN ISO10218-1 EN 60204-1
EMC Directive 2004/108/EC	EN 55011 EN 61000-6-2

Installation of external safety circuits

To comply with EC directives, customers using YAMAHA robots must always build and install their own external safety circuits after selecting product components (safety relays, etc.) according to performance levels and safety categories required by the customer equipment.

For details about examples of external safety circuits, the user's manual should be referred to.

Compliance with EMC Directives

In order to conform to the EMC Directives, the customer should evaluate the final system (overall system) and take necessary countermeasures. As examples of EMC countermeasures for single YAMAHA robot product are described in the user's manual, these descriptions should be referred to.

Cautions regarding official language of EU countries

Only English which is the official language of the EU is utilized in the manuals, warning labels, operating screens, and the Declaration of Incorporation for this product.

If warning text appears on the warning label, then Japanese may also sometimes be listed along with the English.

Cautions on KCs (Korean Certificate Safety) specifications

About KCs

KCs is a system that conforms to Korean Industrial Safety and Health Act and self-regulatory safety confirmation declaration of hazardous machines and devices. For machines specified in this system, the KCs mark needs to be indicated after conducting the forced certification or self-regulatory safety confirmation declaration. Industrial robots that have manipulators with 3 or more axes are specified as machines needing the self-regulatory safety confirmation declaration in South Korea's Ministry of Employment and Labor Notification No. 1201-46. Its safety standards are defined in separate table 2 of this notification.

About measures for KCs

For some YAMAHA robot models, this self-regulatory safety confirmation declaration is conducted to register these models. Additionally, the KCs mark is indicated on the robots that have been declared. When you investigate to purchase a robot to be used in South Korea, check whether or not this robot conforms to KCs and order it with the KCs specifications specified.

The YAMAHA robot is a unit that is incorporated into the customer's system. Therefore, when the customer incorporates the robot into the customer's system, additional safety measures need to be taken. For details, see "Safety standards application guide reference manual".

List of robots subject to KCs

Robot products may not be applicable to KCs depending on the customer's applications, operating conditions, or environments. Consult YAMAHA before purchasing a product.
Since a self-regulatory safety declaration has not been made for inapplicable models, these models cannot be used in Korea. Special-order robots are also unavailable. For details, please contact YAMAHA.

As of October, 2015
○ : subject to KCs
– : not subject to KCs

Product	Type	Model name	KCs registration	
			RCX240 (S)	RCX340
Cartesian robot	FXYx	3 axes	○	○
	SXYx	3 axes	○	○
		4 axes		
	SXYBx	3 axes	○	○
		4 axes		
	MXYx	3 axes	○	○
		4 axes		
	HXYx	3 axes	○	○
		4 axes		
	NXY	3 axes	–	–
		4 axes		
		6 axes		
	SXYxC	3 axes	–	–
		4 axes		
Pick & place robot	YP Series	3 axes	–	–
		4 axes		
SCARA robot	YK180X		–	–
	YK220X			
	YK120XG			
	YK150XG			
	YK180XG			
	YK250XG		○	–
	YK350XG			
	YK400XG			
	YK400XR		–	○
	YK500XGL		○	–
	YK600XGL			
	YK700XGL		–	–
	YK500XG		○	–
	YK600XG			
	YK600XGH			
	YK700XG			
	YK800XG			
	YK900XG			
	YK1000XG			
	YK1200X		–	–
	YK180XC		–	–
	YK220XC			

▶ Continues to the next page.

Cautions on KCs (Korean Certificate Safety) specifications

<table>
<tr><th rowspan="2">Product</th><th rowspan="2">Type</th><th rowspan="2">Model name</th><th colspan="2">KCs registration</th></tr>
<tr><th>RCX240 (S)</th><th>RCX340</th></tr>
<tr><td rowspan="27">SCARA robot</td><td colspan="2">YK250XGC</td><td rowspan="5">○</td><td rowspan="5">–</td></tr>
<tr><td colspan="2">YK350XGC</td></tr>
<tr><td colspan="2">YK400XGC</td></tr>
<tr><td colspan="2">YK500XGLC</td></tr>
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</table>

Cautions on Korean EMC specifications

About Korean KC

KC is a system based on the radio regulations of Korea. Devices specified by this system must certify compliance or register compliance, and indicate compliance. Applicable devices are defined by public announcement from the Korean National Radio Research Agency (NRRA).

About Korean KC compliance

Some models of YAMAHA robot (robots and controllers) are registered with the Korean National Radio Research Agency (NRRA) by self-test compliance registration. YAMAHA robots that have already been registered display the KC mark.
If you are considering the purchase of robots to be used in Korea, please check the table below for compliance before ordering the applicable product.

YAMAHA robots are devices for inclusion in a system; therefore, if you, the customer, build a complete system that includes robots, and ship that system as a final product to Korea or use it within Korea, you yourself must verify EMC compliance.
For TS series and TS-SD units, check "Examples of EMC countermeasures" within the user's manual; for other controllers, check this section within the "Safety standards application guide reference manual".

List of KC compliant robots

* Please consult with YAMAHA before purchase, since compliance might not be possible depending on your application, conditions of use, and environment.
* In the case of 3-axis or greater Cartesian robots and SCARA robots, the robot must be compliant with both KC and KCs.
  In conjunction with this table, refer also to the list of KCs compliant robots.

As of January 2016

Product	Model name	Registration number
Controller	ERCD	MSIP-REM-Y3M-ERCD
	TS-S2	MSIP-REM-Y3M-TSS
	TS-SD	MSIP-REM-Y3M-TSSD
	TS-SH	MSIP-REM-Y3M-TSSH
	TS-X	MSIP-REM-Y3M-TSX
	TS-P	MSIP-REM-Y3M-TSP
	RDV-X	MSIP-REM-Y3M-RDVX
	RDV-P	MSIP-REM-Y3M-RDVP
	SR1-X	MSIP-REM-Y3M-SR1X
	SR1-P	MSIP-REM-Y3M-SR1P
	RCX221	MSIP-REM-Y3M-X221
	RCX222	MSIP-REM-Y3M-X222
	RCX240(S)	MSIP-REM-Y3M-X240
	RCX340	MSIP-REM-Y3M-X340
	LCC140	MSIP-REM-Y3M-C140
Robot	TRANSERVO series	MSIP-REM-Y3M-TR
	FLIP-X series	MSIP-REM-Y3M-FXL
		MSIP-REM-Y3M-FX
	PHASER series	MSIP-REM-Y3M-PH
	XY-X series	MSIP-REM-Y3M-XY
	YK series	MSIP-REM-Y3M-YK
Linear conveyor	Linear Conveyor Module	MSIP-REM-Y3M-M100

About non-compliant models

The following robots are subject to the KC system; however, since self-test compliance registration has not been done at the present time, they cannot be used in Korea. Additionally, special-order robots are also not compliant with the KC system.
Even for the various series listed in the table, some new models might not have been registered.
(Contact YAMAHA for details.)

Pick and place robots: YP-X series
General-purpose assembly base machines: YSC series

Warranty

For information on the warranty period and terms, please contact our distributor where you purchased the product.

This warranty does not cover any failure caused by:

1. Installation, wiring, connection to other control devices, operating methods, inspection or maintenance that does not comply with industry standards or instructions specified in the YAMAHA manual;
2. Usage that exceeded the specifications or standard performance shown in the YAMAHA manual;
3. Product usage other than intended by YAMAHA;
4. Storage, operating conditions and utilities that are outside the range specified in the manual;
5. Damage due to improper shipping or shipping methods;
6. Accident or collision damage;
7. Installation of other than genuine YAMAHA parts and/or accessories;
8. Modification to original parts or modifications not conforming to standard specifications designated by YAMAHA, including customizing performed by YAMAHA in compliance with distributor or customer requests;
9. Pollution, salt damage, condensation;
10. Fires or natural disasters such as earthquakes, tsunamis, lightning strikes, wind and flood damage, etc;
11. Breakdown due to causes other than the above that are not the fault or responsibility of YAMAHA;

The following cases are not covered under the warranty:

1. Products whose serial number or production date (month & year) cannot be verified.
2. Changes in software or internal data such as programs or points that were created or changed by the customer.
3. Products whose trouble cannot be reproduced or identified by YAMAHA.
4. Products utilized, for example, in radiological equipment, biological test equipment applications or for other purposes whose warranty repairs are judged as hazardous by YAMAHA.

THE WARRANTY STATED HEREIN PROVIDED BY YAMAHA ONLY COVERS DEFECTS IN PRODUCTS AND PARTS SOLD BY YAMAHA TO DISTRIBUTORS UNDER THIS AGREEMENT. ANY AND ALL OTHER WARRANTIES OR LIABILITIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXPRESSLY DISCLAIMED BY YAMAHA. MOREOVER, YAMAHA SHALL NOT BE HELD RESPONSIBLE FOR CONSEQUENT OR INDIRECT DAMAGES IN ANY MANNER RELATING TO THE PRODUCT.

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Repeatability positioning accuracy

The “repeatability positioning accuracy” cannot be guaranteed for the accuracy conditions listed below.

(1) Factors involving absolute accuracy

- Under conditions requiring accuracy between the robot controller internal coordinate position (command position) and real space position (movement position).

(2) Operating pattern factors

- Under conditions including a motion approaching close to a teaching point (position) from different directions during repeating operation.
- Under conditions where power was turned off or operation was stopped, even when approaching a teaching position from same direction.
- Under conditions where movement to a teaching position uses a hand system (left-handed or right-handed system) different from that during teaching. (SCARA robots)

(3) Temperature factors

- Under conditions subject to drastic changes in ambient temperature.
- Under conditions where temperature of robot unit fluctuates.

(4) Fluctuating load factors

- Under conditions where load conditions fluctuate during operation (load fluctuates due to workpiece or no workpiece).

MEMO