SINGLE-AXIS ROBOTS

General-purpose single-axis robots can be used for various applications, such as assembly and inspection work.
6 types and 29 models ranging from compact size to long-stroke robots are available.

Various custom specifications are also supported.

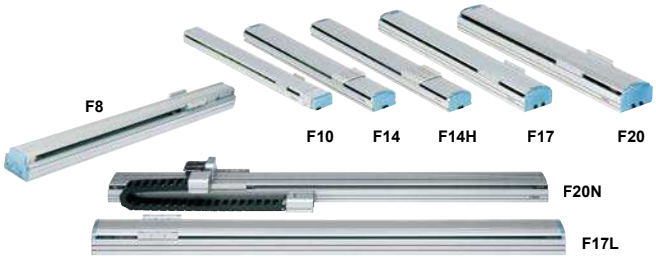
Various custom specifications, such as double-slider and wide slider are also supported.
For details, please consult YAMAHA.

Six types with high reliability and durability

T type Frame-less structure model P.174

- Double appeal of compact body and low price.
- Ideal in applications as an actuator directly installed on an installation base.

F type Model with high rigidity frame P.181

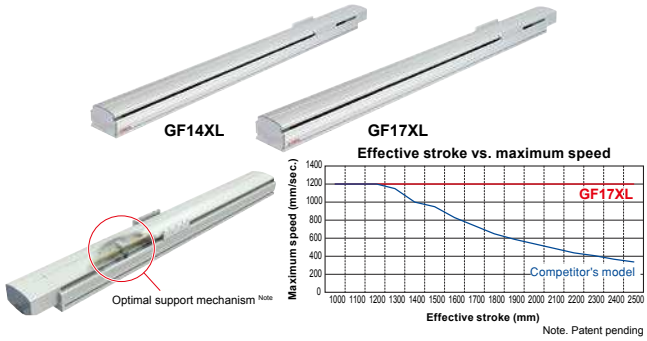


- Tolerable load moment is large and highly resistant to the offset load.
- Suitable for Cartesian robots needing rigid arm or moving arms that move the entire axis.

R type Rotation axis model P.212

- Repeated positioning accuracy +/- 30 sec. (0.0083 °)
- The robot can be used as the rotation axis when combined with other robots or utilized for a wide variety of applications, such as index tables.
- High rigidity and high accuracy by harmonic drive.

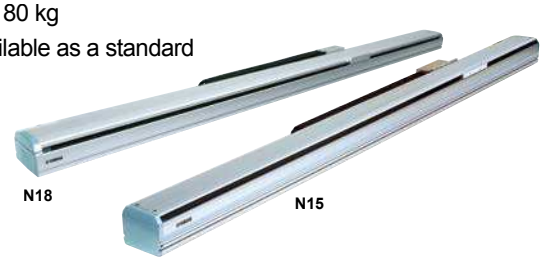
GF type Long stroke model with high rigidity frame P.190

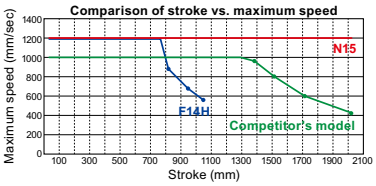


- Movable at 1200 mm/sec. in the whole area without critical speed.
- Suitable for long distance transfer.

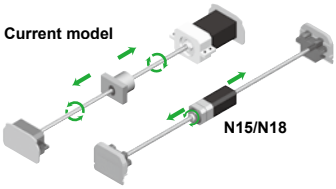
N type Nut rotation type model P.198

- Repeated positioning accuracy +/- 0.01 mm
- Maximum payload 80 kg
- Double-carrier available as a standard

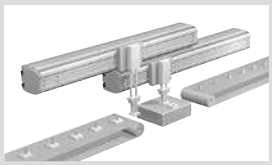




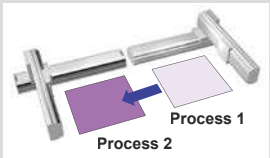
Critical speed is not restricted and high-speed transfer is possible.
Stroke: 2500 mm
Maximum speed: 1200 mm/sec.



In this structure, the hollow motor is connected to the nut of the ball screw and the nut is rotated with the screw shaft secured to perform the movement.



Layout using two conventional single-axis robots

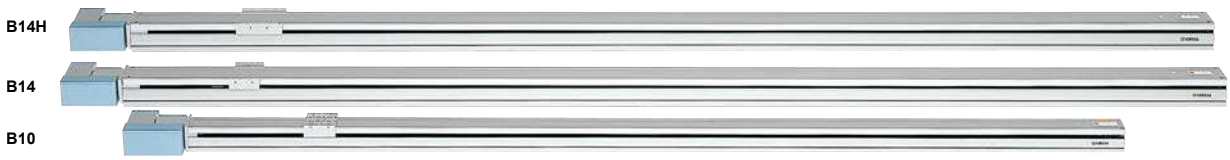


Layout using two conventional cartesian robots

Space saving using double-carrier of N15/N18

Space saving and process integration using double-carrier of N15/N18

B type Timing belt drive model P.206



- Maximum stroke is 3050 mm. Long-distance transfer between the processes is possible.

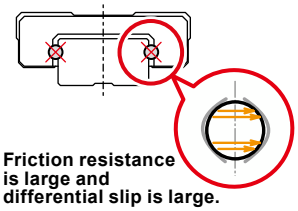
POINT 1

4-row circular arc groove type 2-point contact guide that is resistant to large moment load is adopted.[Note 1]

4-row circular arc groove type 2-point contact guide with less differential slip is used for the linear guide. This guide has less ball differential slip due to its structure when compared to the 2-row Gothic arch type 4-point contact guide and maintains a satisfactory rolling movement even if a large moment load is applied or the installation surface precision is poor. The guide has characteristics that are difficult to malfunction, such as unusual wear and provides excellent reliability.

Note 1. Except for T4L/T4LH and T5L/T5LH

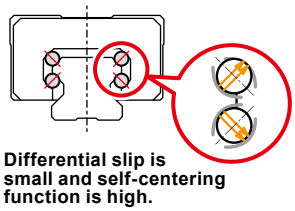
2-row gothic arch groove type 4-point contact guide



Friction resistance is large and differential slip is large.

- Easy to receive adverse effects of installation surface accuracy, friction, and elastic deformation.
- Breakage may occur before expiration of calculation service life.

4-row circular arc groove type 2-point contact guide

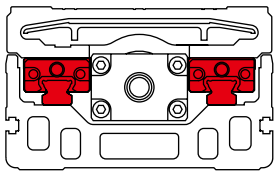


Differential slip is small and self-centering function is high.

- Resistant to alignment changes and moment loads.
- Difficult to break.

F/N/B type [Note 2]

For the F type, N type, and B type, two guide frames are laid out on the high rigidity aluminum extruded material frame. Two bearing units per rail, four bearing units in total, support a large load firmly. As a large moment load is mainly converted into vertical force, the moment applied to one bearing unit becomes small to ensure excellent durability.

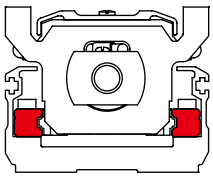


(F14)

Note 2. Except for F8 series/F10/B10.

F8 series

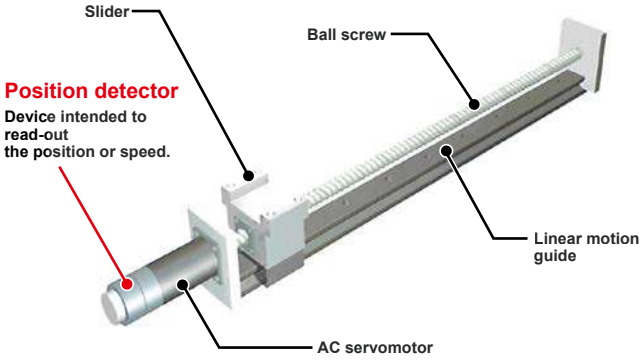
The F8 series uses a newly developed module guide to greatly reduce the cross-sectional area (70 % when compared to F10). The rail is laid out in the full width of the frame to ensure the high rigidity even with compact design. Of course, this series also uses the 4-row circular arc groove type 2-point contact guide.



(F8)

POINT 2

Resolver with excellent environment resistance is used for the position detector.



Optical encoder

- Optical type
- Electronic components are required and structure is complicated.
- Damaged easily by electronic component breakdown, dew condensation on or oil sticking to the disk.

Detection failure

Resolver

- Magnetic type
- Simple structure only with iron core and winding has less potential failure factors.
- Immune to shock and electric noise.

High reliability

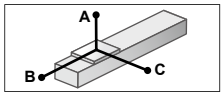
A resolver is used for the position detector. The resolver has a simple and rigid structure without using electronic components and optical elements. Detection problems due to electronic component breakdown, dew condensation on or oil sticking to the disk that may occur in optical encoders do not occur in the resolver. The resolver provides excellent durability. Additionally, as the absolute specifications and incremental specifications use the same mechanical specifications and common controller, desired specifications can be selected only by setting parameters. Furthermore, even when the absolute battery is consumed completely, the robot can still operate as the incremental specifications. So, even if a trouble occurs, the line stop is not needed to ensure the safe production line. Furthermore, the backup circuit has been completely renovated and now has a backup period of one year in the non-energizing state.

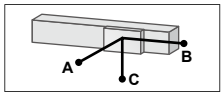
POINT 3

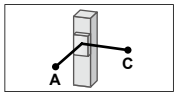
Long service life greatly reduces the maintenance cost.

As the acceleration is determined by the weight parameter, the service life can be assured when the weight and position of center of gravity are known.

Allowable overhang Note







Horizontal installation (Unit: mm)

		A	B	C
Lead 30	5kg	864	501	383
	15kg	491	156	140
Lead 20	5kg	1292	505	462
	15kg	572	158	151
	30kg	455	73	75
Lead 10	20kg	617	119	127
	40kg	422	53	59
	55kg	420	36	40
Lead 5	50kg	722	42	47
	60kg	657	33	37
	80kg	577	23	25

Wall installation (Unit: mm)

		A	B	C
Lead 30	5kg	348	384	776
	15kg	87	40	306
Lead 20	5kg	416	388	1186
	15kg	92	42	386
	30kg	0	0	61
Lead 10	10kg	193	132	910
	20kg	53	0	400
	30kg	0	0	109
Lead 5	10kg	197	133	2360
	20kg	54	0	985
	30kg	0	0	427

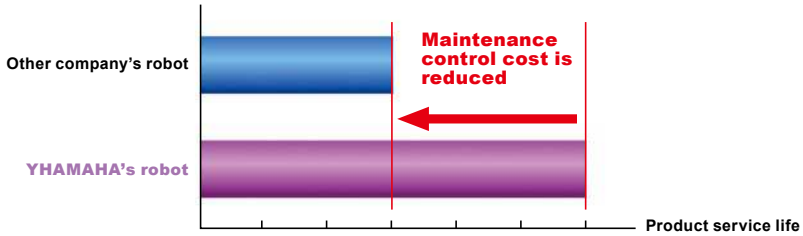
Vertical installation (Unit: mm)

		A	C
Lead 20	1kg	600	600
	2kg	1098	1098
	4kg	545	545
Lead 10	4kg	594	594
	8kg	280	280
	10kg	217	217
Lead 5	10kg	221	221
	15kg	135	135
	20kg	92	92

Note. Distance from center of slider top to center of gravity of object being carried at a guide service life of 10,000 km.

As YAMAHA's robot uses high rigidity ball screw or guide, it provides excellent durability. This greatly contributes to reduction of the customer's maintenance cost.

Cost reduction by high durability



POINT 4

Controllers suitable for applications are prepared.

In addition to the robot program operation and pulse train control, a positioner that is operated by specifying a point number was added to the product lineup. Additionally, multi specifications that control multiple robots using one controller are also supported. You can select an optimal controller suitable for your application.

Program				I/O point trace (Positioner)	Pulse-train control
SR1-X	RCX222	RCX240/ RCX240S	RCX340	TS-X	RDV-X
					
P.516	P.524	P.532	P.542	P.490	P.504

POINT 5

Various custom specifications are supported.

YAMAHA supports custom orders flexibility to meet the customers' various needs.

Addition of free slider	Free slider is added. Various applications, such as rigidity increase or use of two heads are supported.
Wide slider	To increase the slider rigidity, the standard slider is processed to the wide slider.
Specified stroke	A stroke smaller than the minimum stroke may be supported. For details, please consult YAMAHA.
Lead beyond catalog	The lead may be changed to that not stated in the catalog. For details, please consult YAMAHA.
Origin non-motor specifications	Even when not stated in the catalog, the origin may be changed to the non-motor side. For details, please consult YAMAHA.

YAMAHA has a wide variety of custom order results other than those shown above. If you have any requirement or request, please feel free to contact YAMAHA.

Type	Size (mm) Note 1	Model	Lead (mm)	Maximum payload (kg)		Maximum speed (mm/sec.)	Stroke (mm)	Page
				Horizontal	Vertical			
T type Frame-less structure model	W45 × H53	T4L/T4LH	12	4.5	1.2	720	50 to 400	T4L: P.174
			6	6	2.4	360		T4LH: P.175
			2	6	7.2	120		
	W55 × H52	T5L/T5LH	20	3	-	1200	50 to 800	T5L: P.176
			12	5	1.2	800		T5LH: P.177
			6	9	2.4	400		
	W65 × H56	T6L	20	10	-	1333	50 to 800	P.178
			12	12	4	800		
			6	30	8	400		
	W94 × H98	T9 (Standard)	30	15	-	1800	150 to 1050	P.179
			20	30	4	1200		
			10	55	10	600		
			5	80	20	300		
		T9H (High thrust)	30	25	-	1800	150 to 1050	P.180
			20	40	8	1200		
			10	80	20	600		
			5	100	30	300		
F type Model with high rigidity frame	W80 × H65	F8	20	12	-	1200	150 to 800	P.181
			12	20	4	720		
			6	40	8	360		
	W80 × H65	F8L	30	7	-	1800	150 to 1050	P.182
			20	20	4	1200		
			10	40	8	600		
			5	50	16	300		
	W80 × H65	F8LH	20	30	-	1200	150 to 1050	P.184
			10	60	-	600		
			5	80	-	300		
	W110 × H71	F10 (Standard)	30	15	-	1800	150 to 1050	P.185
			20	20	4	1200		
			10	40	10	600		
			5	60	20	300		
		NEW F10H (High thrust)	30	25	-	1800	150 to 1000	P.186
			20	40	8	1200		
			10	80	20	600		
			5	100	30	300		
	W136 × H83	F14 (Standard)	30	15	-	1800	150 to 1050	P.188
			20	30	4	1200		
			10	55	10	600		
			5	80	20	300		
		F14H (High thrust)	30	25	-	1800		P.189
			20	40	8	1200		
			10	80	20	600		
			5	100	30	300		
	W168 × H100	F17L	50	50	10	2200	1100 to 2050	P.193
		F17	40	40	-	2400	200 to 1450	P.191
			20	80	15	1200	200 to 1250	
			10	120	35	600		
	W202 × H115	F20	40	60	-	2400	200 to 1450	P.195
			20	120	25	1200	200 to 1250	
			10	-	45	600		
	W202 × H120	F20N	20	80	-	1200	1150 to 2050	P.197
GF type	W140 × H91.5	GF14XL	20	45	-	1200	750 to 2000	P.190
	W168 × H105.5	GF17XL	20	90	-	1200	850 to 2500	P.194
N type Nut rotation type model	W145 × H120	N15 (Single-carrier)	20	50	-	1200	500 to 2000	P.198
		N15D (Double-carrier)					250 to 1750	P.200
	W180 × H115	N18 (Single-carrier)		80	-		500 to 2500	P.202
		N18D (Double-carrier)					250 to 2250	P.204
B type Timing belt drive model	W100 × H81	B10	Belt drive	10	-	1875	150 to 2550	P.206
	W146 × H94	B14 (Standard)	Belt drive	20	-	1875	150 to 3050	B14: P.208
		B14H (High thrust)	Belt drive	30	-	1875		B14H: P.210
R type Rotation axis model	-	R5	-	0.12 kgm^2	-	360 °/sec	360 °	P.212
		R10		0.36 kgm^2	-			P.213
		R20		1.83 kgm^2	-			P.214

Note 1. The size shows approximate maximum cross sectional size.

Multi-robot

MULTI-FLIP/MULTI-PHASER

This robot has multi specifications that control multiple robots using one controller.

Advantages of control with multi-axis controller

- Sequence control is easy. System upgrades are easy at less expensive price.
- Compact and space saving when compared to the operation with multiple single-axis controllers.
- More advanced control is possible.
- RCX221, RCX240, RCX240S, and RCX340 provide mixed control of the FLIP-X series and PHASER series (linear single-axis).

Multi-robot ordering method

MLTX Note 1	–	1st unit Note 2	–	2nd unit Note 2	–	3rd unit Note 2	• • •	–		–		–	
Multi-robot model prefix	–	1st unit robot type	–	2nd unit robot type	–	3rd unit robot type		–	Cable length 3K: 3.5 m 5K: 5 m 10K: 10 m	–	Controller RCX221/HP RCX222/HP RCX240/S RCX340	–	Controller option

Up to 8 units can be controlled.

Note 1. When ordering a multi-robot, prefix "MLTX" to the top of the order model.
Note 2. Select either MULTI-FLIP or MULTI-PHASER shown below.
Note 3. For details about the controller and controller option models, please refer to relevant page of each controller.

MULTI-FLIP

Type	Model	Lead (mm)	Stroke (mm)
T type Frame-less structure model	T4L/T4LH	12 6 2	50 to 400
	T5L/T5LH	20 12 6	50 to 800
	T6L	20 12 6	50 to 800
	T9 (Standard)	30 20 10 5	150 to 1050
	T9H (High thrust)	30 20 10 5	150 to 1050
F type Model with high rigidity frame	F8	20 12 6	150 to 800
	F8L	30 20 10 5	150 to 1050
	F8LH	20 10 5	150 to 1050
	F10 (Standard)	30 20 10 5	150 to 1050
	NEW F10H (High thrust)	30 20 10 5	150 to 1000
	F14 (Standard)	30 20 10 5	150 to 1050
	F14H (High thrust)	30 20 10 5	150 to 1050
	F17L	50	1100 to 2050
	F17	40 20 10	200 to 1450 200 to 1250
	F20	40 20 10	200 to 1450 200 to 1250
	F20N	20	1150 to 2050
GF type	GF14XL	20	750 to 2000
	GF17XL	20	850 to 2500
N type Nut rotation type model	N15 (Single-carrier)	20	500 to 2000
	N15D (Double-carrier)		250 to 1750
	N18 (Single-carrier)		500 to 2500
	N18D (Double-carrier)		250 to 2250
B type Timing belt drive model	B10	Belt drive	150 to 2550
	B14 (Standard)	Belt drive	150 to 3050
	B14H (High thrust)	Belt drive	
R type Rotation axis model	R5	-	360 °
	R10		
	R20		

Type	Model	Lead (mm)	Stroke (mm)
C type Clean room model	C4L C4LH	12 6 2	50 to 400
	C5L C5LH	20 12 6	50 to 800
	C6L	20 12 6	50 to 800
	C8	20 12 6	150 to 800
	C8L	20 10 5	150 to 1050
	C8LH	20 10 5	150 to 1050
	C10	20 10 5	150 to 1050
	C14	20 10 5	150 to 1050
	C14H	20 10 5	150 to 1050
	C17	20 10	250 to 1250
	C17L	50	1150 to 2050
	C20	20 10	250 to 1250

MULTI-PHASER

Type	Model	Carrier	Stroke (mm)
MF type Flat type with core Linear motor specifications	MF7	Single	100 to 4000
	MF7D	Double	100 to 3800
	MF15	Single	300 to 4000
	MF15D	Double	100 to 3800
	MF20	Single	150 to 4050
	MF20D	Double	150 to 3850
	MF30	Single	100 to 4000
	MF30D	Double	150 to 3750
	MF75	Single	1000 to 4000
	MF75D	Double	680 to 3680
MR type Shaft type Linear motor specifications	MR12	Single	50 to 1050
	MR12D	Double	50 to 1050

Robot settings

2-robot settings

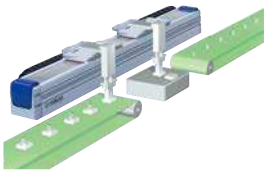
Use of 2-robot settings and multi-task program makes it possible to perform asynchronous independent operation. As the auxiliary axis setting is used together, more free axis assignment can be made.

Main auxiliary axis setting

This auxiliary axis setting is used when it is inconvenient that two axes move simultaneously by the MOVE command. The axis set for the main auxiliary axis does not operate by the MOVE command and it operates only by the DRIVE command (movement command in axis units). This setting is recommended for the axis that needs to be operated asynchronously from the main robot.

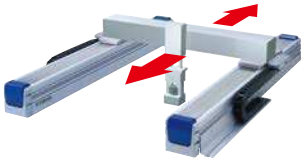
Double-carrier

In robot types that the motor runs separately, such as linear motor single-axis PHASER series or N type (nut rotation type) of FLIP-X series, two motors can be added to one axis.



Dual setting

This setting is used when performing the dual drive (2-axis synchronous control). This setting is used when the gantry type Cartesian robot with a long Y-axis stroke stabilizes the high acceleration/deceleration or when a high load or high thrust is needed.



Applicable controllers

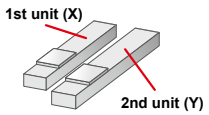
Name		1 to 2 axes controller		1 to 4 axes controller	1 to 4 axes controller
		RCX221	RCX222	RCX240/RCX240S	RCX340
Appearance		 P.524	 P.524	 P.532	 P.542
Position detection		Incremental	Absolute	Incremental/Absolute	Incremental/Absolute
Control model		FLIP-X and PHASER can be mixed.	FLIP-X	FLIP-X and PHASER can be mixed.	FLIP-X and PHASER can be mixed.
Maximum number of programs		100 programs		100 programs	100 programs
Maximum number of points		10,000 points		10,000 points	30,000 points
Number of input/output points	Standard	Dedicated input 10 points/ dedicated output 12 points General-purpose input 16 points/ general-purpose output 8 points		Dedicated input 10 points/ dedicated output 11 points General-purpose input 16 points/ general-purpose output 8 points	Dedicated input 8 points/ dedicated output 9 points General-purpose input 16 points/ general-purpose output 8 points
	Expansion	General-purpose input 24 points/ general-purpose output 16 points		General-purpose input 24 points/ general-purpose output 16 points	General-purpose input 24 points/ general-purpose output 16 points
Network option		CC-Link, DeviceNet™, Ethernet, PROFIBUS		CC-Link, DeviceNet™, EtherNet/IP™, Ethernet, PROFIBUS	CC-Link, DeviceNet™, EtherNet/IP™, Ethernet, PROFIBUS, PROFINET

Examples of multi-robot ordering methods

Separate single axes

<Example> F14H and F10 are installed separately.

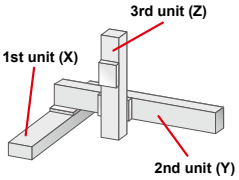
MLTX - F14H - 20 - U - 500 — 1st unit
- F10 - 20 - 300 — 2nd unit
- 5K - RCX222 - N - N1 — Controller



3 axes combination

<Example> C17L, C14H, and C14H are used for the X-axis, Y-axis, and Z-axis, respectively to form a 3-axis XYZ combination.

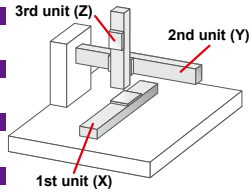
MLTX - C17L - 50 - Z - 1500 — 1st unit
- C14H - 20 - 450 — 2nd unit
- C14H - 10 - BK - 150 — 3rd unit
- 3K - RCX240 - R - N - BB — Controller



2 axes + 1 axis

<Example> T6 is installed on the base for the 1st axis, C6 is secured to the upper portion for the 2nd axis, and CH4 is secured to the upper portion for the 3rd axis to assemble the C6 and C4H to the XZ. (Either 2 axes + 1 axis or 3 axes simultaneous control can be made by the setting.)

MLTX - T6 - 6 - 300 — 1st unit
- C6 - 6 - 300 — 2nd unit
- C4H - 6 - BK - 100 — 3rd unit
- 3K - RCX240S - N - BB — Controller



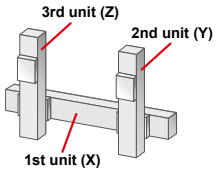
Note. When the customer combines each axis, it is recommended to use the cable terminal (relay cable) for the wiring among axes. For details about cable terminal, please contact YAMAHA.

Double-carrier

Example of 4-axis control

<Example> Two T6 are assembled to the double-carrier of the MF20A, and they are used as XZ type and controlled using one controller.

MLTX - MF20AD - W - M - 850 — 1st unit
- T6 - 12 - BK - 100 — 2nd unit
- T6 - 12 - BK - 100 — 3rd unit
- 3K - RCX240S - N1 - B — Controller



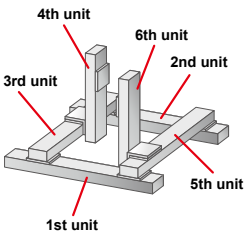
Note. For the double-carrier, since one robot occupies two axes of the controller, the number of robots may differ from the number of controllable axes.

Double-carrier/dual drive (2-axis simultaneous control)

Example of 8-axis control

<Example> Two double-carriers of the MF30 are arranged in parallel and two MF20 installed on the top are moved by the dual-drive.
T6 is attached to each tip of the MF20 and the robots are controlled using two controllers.

MLTX - MF30D - H - L - 950 — 1st unit
- MF30D - H - L - 950 — 2nd unit
- MF20 - H - 1350 — 3rd unit
- T6 - 6 - BK - 100 — 4th unit
- MF20 - H - 1350 — 5th unit
- T6 - 6 - BK - 100 — 6th unit
- 3K - RCX240 - R - N — Controller Note



Note. For this specification, when writing one controller model, two controller will be arranged automatically.

CAUTION

Conditions needing regenerative unit on multi-robot

- The total motor capacity exceeds 450 W.
- The total motor capacity of the vertical axis exceeds 240 W.
- The B14H performs the operation at a maximum speed of more than 1250 mm/s.
- When the vertical axis is 240 W or less, the conditions shown below are satisfied.
  - There is a 200 W-vertical axis.
  - A 100 W-vertical axis has a stroke of 700 mm or more.
  - There are two 100 W-vertical axes with a 5 mm-lead.

FLIP-X terminology

High lead

This term indicates models supporting ball screw leads that exceed the standard lead (12 mm or 20 mm). (The standard lead of the F17L and C17L is 50.)

Origin on non-motor side

This term indicates models that are applicable to the origin non-motor specifications as standard. The origin on the non-motor side in the standard state is not supported with a lead not stated in the catalog. If special specifications are needed, please consult YAMAHA.

Maximum speed

This term indicates the maximum transfer speed. YAMAHA's single-axis robots can transfer a workpiece at this speed regardless of the transfer weight as long as it is within the maximum payload. However, as the workpiece is heavier, the acceleration/deceleration curve becomes gentle. If the movement distance is short, the speed does not reach the maximum speed stated in the catalog.

CAUTION
When the stroke of the ball screw drive type is long, noise or vibration is produced due to resonance of the ball screw if moved at the maximum speed. If this happens, lower the speed to that stated in the note column. (It is also possible to lower the transfer speed of the entire program using the SPEED setting or make the adjustment for each movement command.)

Maximum payload

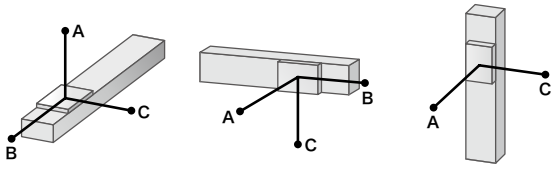
This term indicates the maximum weight that can be loaded on the slider and transferred. Select an appropriate model so that the total weight of the customer's tools (air cylinder or chuck) and workpiece is less than this data. When the center of gravity of the tool or workpiece is offset from the center of the slider, the allowable overhang needs to be taken into consideration. Additionally, when entering the total weight of the tool and workpiece for the payload parameter of the controller, optimal acceleration/deceleration and servo parameter are automatically set.

Rated thrust

This term indicates the force to be applied in the slider advancing direction in the slider stationary (hold) state. When using vertically, the weight of the loaded workpiece is subtracted from this value (when the force is applied downward from the top). The slider can move only at a low speed (approximately 10 % of the maximum speed), but this value becomes lower than the specification value. Additionally, the type B of the timing belt drive cannot be used for applications, in which thrust is applied.

Allowable overhang

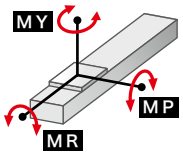
This term indicates an allowable overhang of an object to be transferred. In the specification data, this indicates the distance from the center of the top face of the slider to the center of gravity of an object to be transferred by the weight. This value is determined according to the service life of the linear guide. Under normal operation conditions[Note], the 90 %-service life of the linear guide is 10,000 km or more if gravity centers of the workpiece and tool are kept within the allowable overhang. When using with an overhang amount exceeding the specification data, it is necessary to install a separate support guide or restrict operating conditions (speed, acceleration) so that a load is not applied to the linear guide of the single-axis robot. For detail, please consult YAMAHA.



Note. Speed, acceleration 100 % (It is preconditioned that the weight parameters are set correctly.)
There shall be no impact load or excessive vibration during operation.
Additionally, the alignment is correct.

Static tolerance moment

This term indicates the load moment applied to the slider in the robot stationary state.



Critical speed

When the stroke of the ball screw drive type is long, noise or vibration is produced due to resonance of the ball screw if moved at the maximum speed. If this happens, lower the speed to that stated in the note column. (It is also possible to lower the transfer speed of the entire program using the SPEED setting or make the adjustment for each movement command.)