KM Cartesian Robots

Introduction to Hiwin KM Cartesian Robots

Hiwin KM Cartesian robots are designed to be a high quality and cost effective solution for companies to integrate into their OEM systems or in house production systems. The value of these robots is that they save the customer from using their own valuable employee resources to design, source parts, and assemble their own Cartesian robot. The KM Cartesian robots utilize high quality components to maximize quality, reliability, and performance of the system.

The KM Cartesian robots are multi-axis robots consisting of KK single axis robots as their core component. They are integrated into a system with mounting brackets, sensors, cable chains, couplings, cables, motors, and drives.

The KM Cartesian robots in this catalog are divided into a few categories by size: KMS, KMM, KMXM, KML, KMXL. The systems were designed to use the same common parts across all sizes which allow for interchangeability of KK robots to give a broad range of strokes and load capacities. The main advantages of the common parts is to allow for interchangeability by the customer, reduce lead times, and reduce cost.

The systems in this catalog are not a complete representation of all motion systems that Hiwin is capable of making. If you don't see what you need in this catalog please contact Hiwin. Let us know your application needs to see if we can quote a system that will work for you.

Features

- Saves on cost of engineering resources
- Saves on cost of assembly
- Saves time sourcing multiple components for system
- *Hiwin* servo motors and servo drives available
- Incorporates rigid and low profile KK single axis robots
- Available in 5 standard platform sizes
- Common parts across platform sizes
- System risers available
- Includes cable management
- Includes limit and home sensors

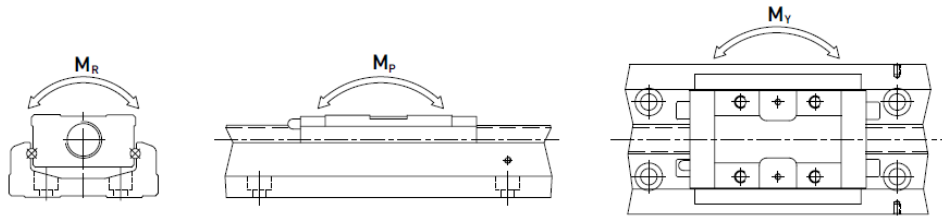## Applications

- Pick and place
- Dispensing
- Inspection
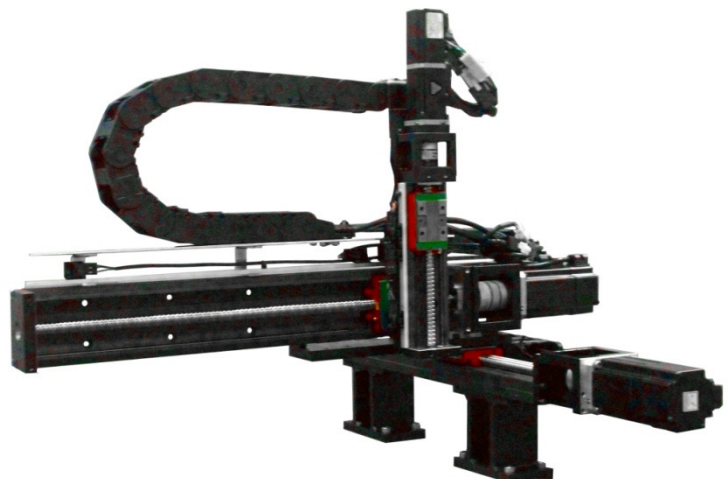
Core Component: KK Single Axis Robots

The core component of a KM Cartesian robot is the *Hiwin* KK single axis robot. The core material of a KK industrial robot is high strength steel. This allows for the KK robot to have a compact design and still maintain high rigidity. The KK robot is driven by a precision ballscrew which allows the robot to have high accuracy and repeatability. The nut of the ballscrew is integrated with the sliding carriage to give a compact design. The carriage slides efficiently and smoothly on recirculating bearings. The KK robot's design lends itself to be a good choice to integrate into a Cartesian robot system.

Load Ratings for KK Single Axis Robots

Model No.		Ballscrew				Guideway							
		Nominal Diameter (mm)	Lead (mm)	Basic Dynamic Load (N)	Basic Static Load (N)	Basic Dynamic Load (N)	Basic Static Load (N)	Static Rated Moment					
								Allowable Static Moment M_p (N-m) (pitching)		Allowable Static Moment M_y (N-m) (yawing)		Allowable Static Moment M_r (N-m) (rolling)	
						Block A	Block A	Block A1	Block A2	Block A1	Block A2	Block A1	Block A2
KK60	Precision	12	5	3744	6243	13230	21462	152	760	152	760	419	838
	Normal			3377	5625								
KK60	Precision	12	10	2410	3743	13230	21462	152	760	152	760	419	838
	Normal			2107	3234								
KK86	Precision	15	10	7144	12642	31458	50764	622		622		1507	
	Normal			6429	11387								
KK86	Precision	15	20	4645	7655	31458	50764	622		622		1507	
	Normal			4175	6889								
KK100	Precision	20	20	7046	12544	39200	63406	960		960		2205	
	Normal			4782	9163								

Life Calculations

$$L = \left(\frac{ft}{fw} * \frac{C}{Pn}\right)^3 \text{ x 50 km}$$

L: Life Rating (km)
C: Basic Dynamic Load Rating (N)
ft: Contact Coefficient (ref. Table 1)
Pn: Calculated Loading (N)
fw: Loading Coefficient (ref. Table 2)

Table 1:

Block Type	Contact Coefficient, ft
A1	1.0
A2	0.81

Table 2:

Operating Condition		Loading Coefficient, fw
Thrust and Vibration	Velocity (v)	
No Thrust	V<15m/min	1.0-1.5
Low Vibration	15m/min<V<60m/min	1.5-2.0
High Vibration	V>60m/min	2.0-3.5

$$L = \left(\frac{1}{fw} * \frac{Ca}{Pa,n}\right)^3 \text{ x } 10^6 \text{ rev}$$

L: Life Rating (rev.)
Ca: Basic Dynamic Load Rating (N)
fw: Loading Coefficient (ref. Table 2)
Pa,n: Axial Loading (N)

Lubrication

It is recommended to lubricate the carriages every 100km. Both the guide block and ballscrew are lubricated through the same port. A Lithium soap based NLGI grade 2 grease is recommended for operating speeds less than 60m/min. Higher viscosity grease is recommended for faster speeds.

1 Block

Grease nipple

2 Blocks

Grease nipple

Grease nipple
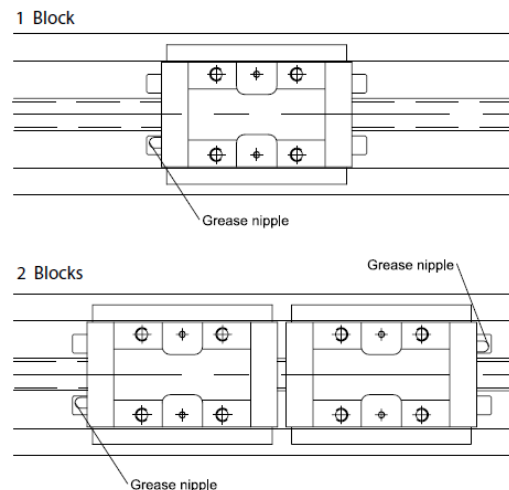
Max Speed

Model	Ballscrew Lead (mm)	Rail Length (mm)	Speed (mm/sec)	
			Precision	Normal
KK60	05	150	550	390
		200	550	390
		300	550	390
		400	550	390
		500	550	390
		600	340	390
	10	150	1100	790
		200	1100	790
		300	1100	790
		400	1100	790
		500	1100	790
		600	670	670
KK86	10	340	740	520
		440	740	520
		540	740	520
		640	740	520
		740	740	520
		940	610	430
	20	340	1480	1050
		440	1480	1050
		540	1480	1050
		640	1480	1050
		740	1480	1050
		940	1220	870
KK100	20	980	1120	800
		1080	980	800
		1180	750	750
		1280	510	630
		1380	440	530

Max Acceleration

The maximum recommended acceleration for each axis is 0.5G, where 1G is 9.8m/s^2.

Repeatability, Accuracy, Starting Torque

Model	Rail Length (mm)	Repeatability (mm)		Accuracy (mm)		Running Parallelism (mm)		Starting Torque (N-cm)	
		Precision	Normal	Precision	Normal	Precision	Normal	Precision	Normal
KK60	150	±0.003	±0.01	0.020	-	0.010	-	15	7
	200								
	300								
	400								
	500	±0.003	±0.01	0.025	-	0.015	-	15	7
	600								
KK86	340	±0.003	±0.01	0.025	-	0.015	-	15	10
	440								
	540								
	640								
	740	±0.003	±0.01	0.030	-	0.020	-	17	10
	940	±0.003	±0.01	0.040	-	0.030	-	25	10
KK100	980	±0.005	±0.01	0.035	-	0.025	-	17	12
	1080								
	1180	±0.005	±0.01	0.040	-	0.03	-	20	12
	1280	±0.005	±0.01	0.045	-	0.035	-	23	15
	1380			0.05		0.04		25	

KK60
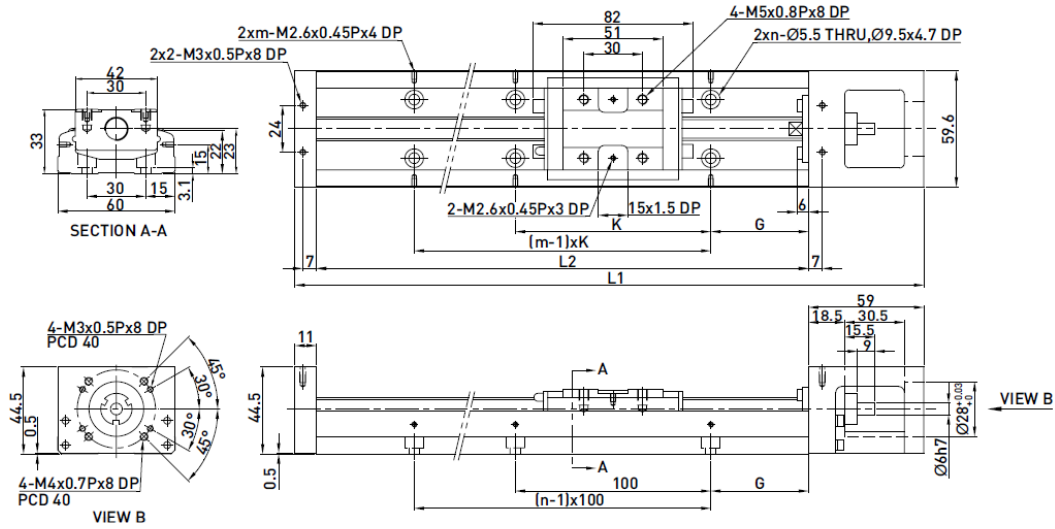
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)		G (mm)	K (mm)	n	m	Mass (kg)	
		A1 Block	A2 Block					A1 Block	A2 Block
150	220	60	-	25	100	2	2	1.5	-
200	270	110	-	50	100	2	2	1.8	-
300	370	210	135	50	200	3	2	2.4	2.7
400	470	310	235	50	100	4	4	3	3.3
500	570	410	335	50	200	5	3	3.6	3.9
600	670	510	435	50	100	6	6	4.2	4.6

KK86
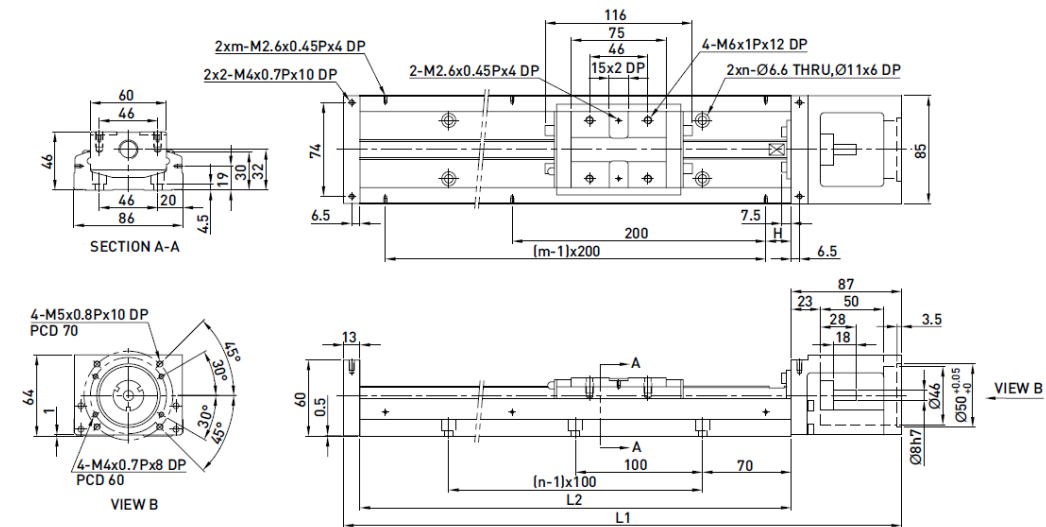
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm)	H (mm)	n	m	Mass (kg)
		A1 Block				A1 Block
340	440	210	70	3	2	5.7
440	540	310	20	4	3	6.9
540	640	410	70	5	3	8.0
640	740	510	20	6	4	9.2
740	840	610	70	7	4	10.4
940	1040	810	70	9	5	11.6

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KK100
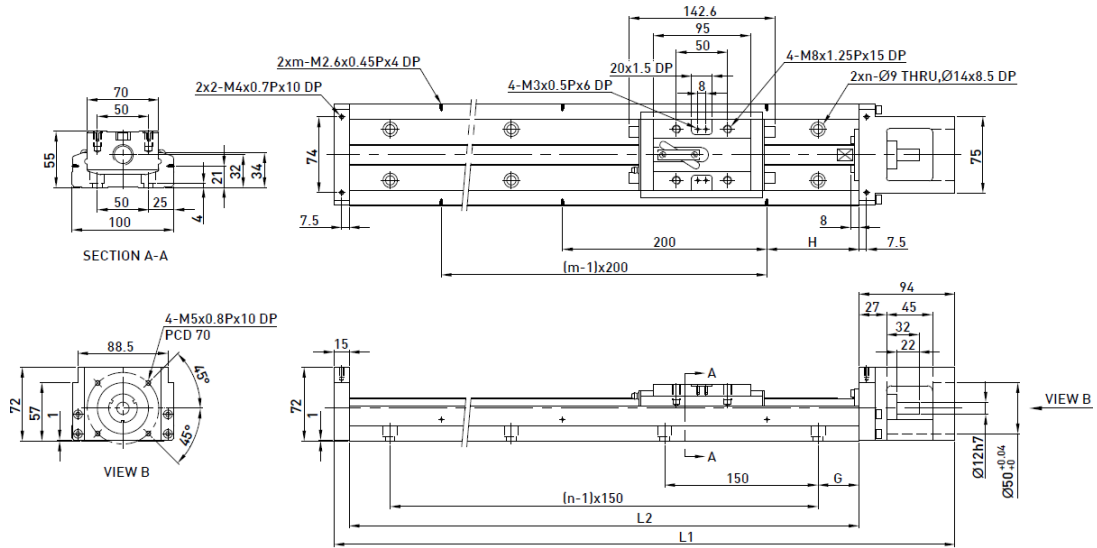
Rail Length L2 (mm)	Total Length L1 (mm)	Maximum Stroke (mm) A1 Block	G (mm)	H (mm)	n	m	Mass (kg) A1 Block
980	1089	828	40	90	7	5	18.6
1080	1189	928	15	40	8	6	20.3
1180	1289	1028	65	90	8	6	22.0
1280	1389	1128	40	40	9	7	23.6
1380	1489	1228	15	90	10	7	25.3

Risers

Risers are a simple way to elevate your system without needing to design extra parts for your system. The x-axis KK industrial robot mounts directly to the risers and the risers can mount directly to your base plate. They are currently offered with a height range of 50 to 200mm. Risers are made of a rigid steel construction.
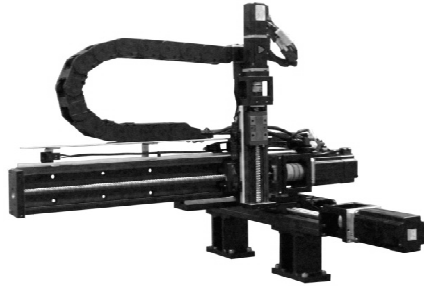
Kits

Hiwin offers the option of purchasing a kit to be assembled by the customer. This kit includes all the components needed to make a KM Cartesian system: brackets, sensors, cable chains, motors, couplings, screws, cables, motors, drives, etc. If interested please ask to be quoted an unassembled kit.
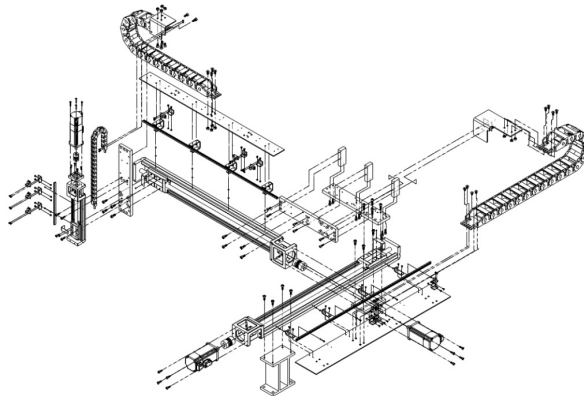
Custom KM Cartesian Robot

The standard KM Cartesian robots should be able to encompass a large percentage of application needs but may not fit the needs for all applications. If the system needed is not found in this catalog we can provide customers with custom systems as well. Please contact *Hiwin* to discuss your custom motion system options.

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Model Number of KM Cartesian Robot

1	2	-	3	-	4	-	5	6	-	7	8	-	9	10	-	11	-	12	-	13	-	14	15

[1] Size:
KMS
KMM
KMXM
KML
KMXL

[2] Type:
C: Cantilever

[3] Configuration:
XYZ: 3-axis
XY: 2-axis

[4] Accuracy Grade:
C: Normal
P: Precision

[5] Ballscrew Lead X-axis (mm):
KMS (KK60): **05, 10**
KMM, KMXM (KK86): **10, 20**
KML, KMXL (KK100): **20**

[7] Ballscrew Lead Y-axis (mm):
KMS, KMM (KK60): **05, 10**
KMXM, KML, KMXL (KK86): **10, 20**

[9] Ballscrew Lead Z-axis (mm):
KMS (KK60): **05, 10**
KMM, KMXM, KML(KK60): **05, 10**
KMXL (KK86): **10, 20**

[6] Rail Length X (mm):
KMS (KK60):
150, 200, 300, 400, 500, 600
KMM, KMXM (KK86):
340, 440, 540, 640, 740, 940
KML, KMXL (KK100):
980, 1180, 1380, 1680

[8] Rail Length Y(mm):
KMS, KMM (KK60):
150, 200, 300, 400, 500, 600
KMXM, KML, KMXL (KK86):
340, 440, 540, 640, 740, 940

[10] Rail Length Z (mm):
KMS, KMM, KMXM (KK60):
150, 200, 300, 400, 500, 600
KML (KK60 single or double carriage):
150, 200, 300, 400, 500, 600 *
*Add **A1**(single carriage) or **A2** (double carriage) after rail length of KML type to designate # of carriages
KMXL (KK86):
340, 440, 540, 640, 740, 940

[11] AC Servo Motor Sizes:
M (x-axis) (y-axis) (z-axis)
1-50W
2-100W
3-200W
4-400W
5-750W
(Leave Blank): without motors

Example: **M221** for system with 100W motors for x- and y- axis and 50W motor for z-axis

[12] Encoder Resolution:
13: 13 bit (10,000 cnts/rev)
17: 17 bit (131,072 cnts/rev)
(leave blank**):** without motors

*D2 drive needed for 17-bit encoder

[13] D2 drive:
D2: with D2 drives
(leave blank**):** without D2 drives

[14] Risers:
R: with risers
(leave blank**):** without risers

[15] Riser Height(mm):
50-200: range of riser height
(leave blank**):** without risers

Example

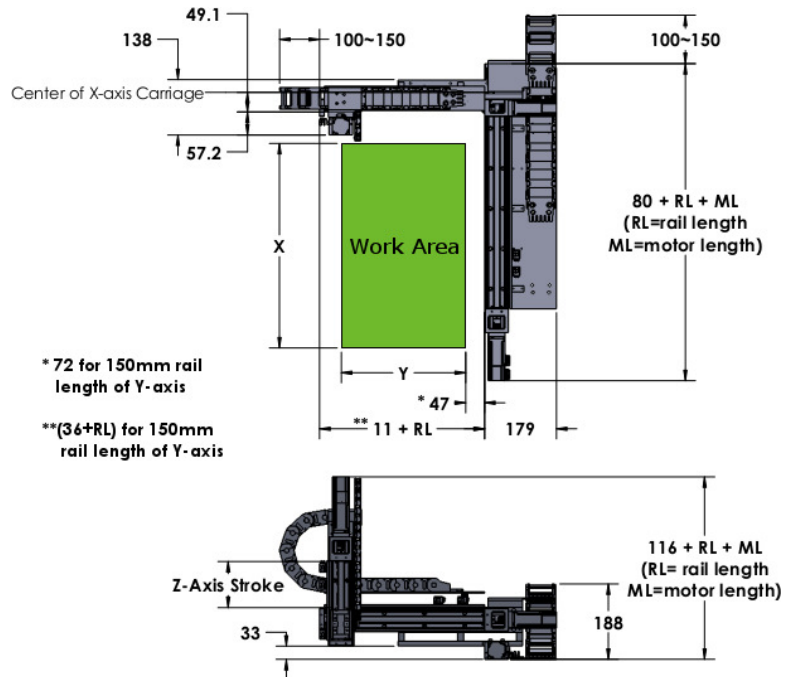| KMS	C	-	XYZ	-	C	-	05	400	-	05	400	-	05	150	-	M221	-	13	D2	-	R	50

KMS

The KMS Cartesian system is the smallest size we offer in our current standard systems. These work well for applications with light loads and small work areas.

The KMS consists of the following KK robots for each axis:

- X-axis: KK60
- Y-axis: KK60
- Z-axis: KK60

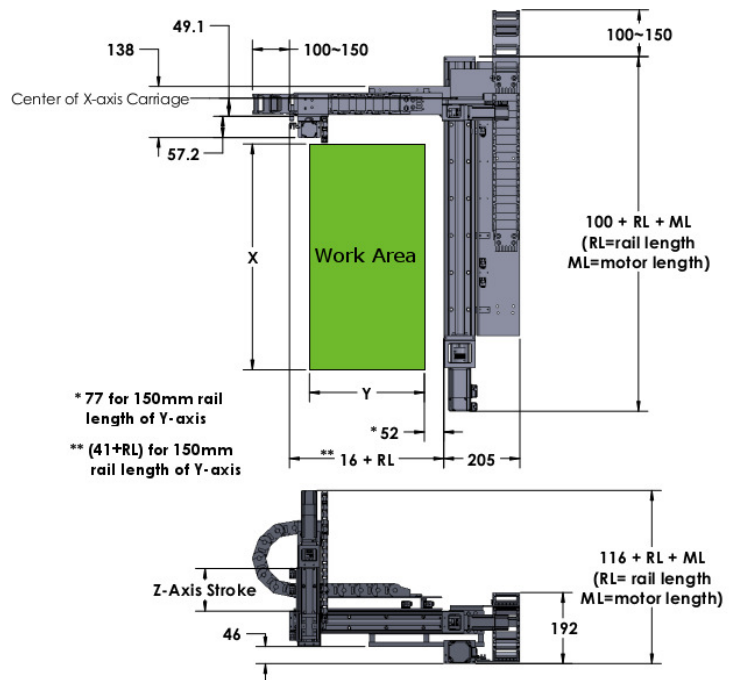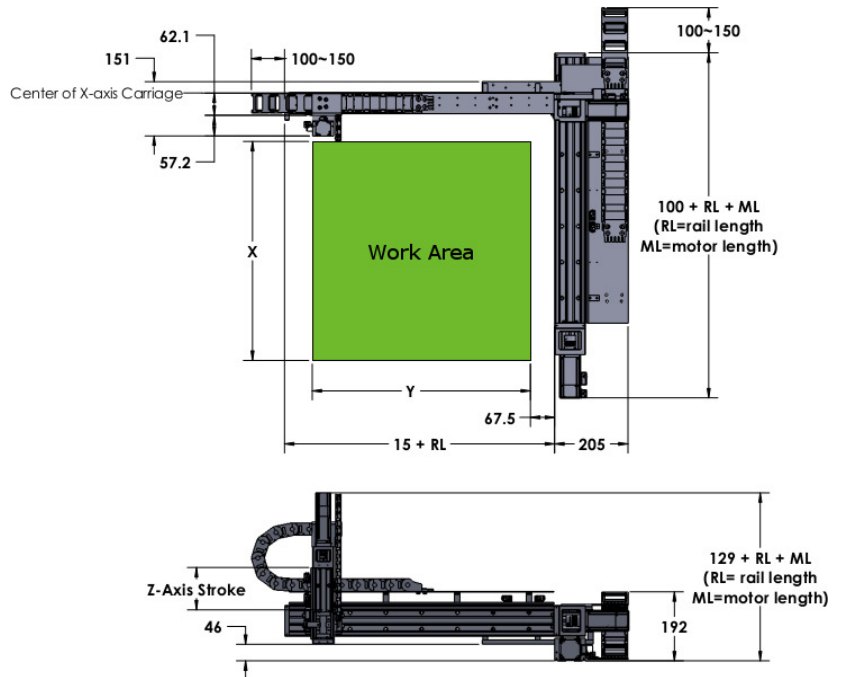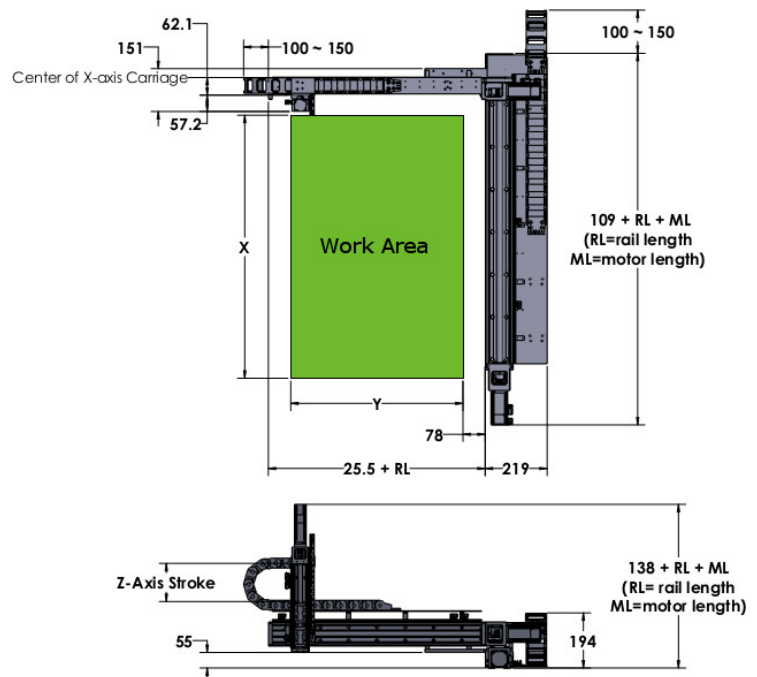For help determining the correct system for your application please contact *Hiwin* engineering.

KMM

The KMM Cartesian system is the smaller of the medium sized systems we offer in our current standard systems. These work well for applications that have higher loads than is allowed by KMS but don't need the increased stroke availability of the KMXM in the y-axis. The x-axis is capable of larger strokes than the KMS.

The KMM consists of the following KK robots for each axis:

- X-axis: KK86
- Y-axis: KK60
- Z-axis: KK60

For help determining the correct system for your application please contact *Hiwin* engineering.

KMXM

The KMXM Cartesian system is the larger of the medium sized systems we offer in our current standard systems. These work well for applications that need a longer stroke in y-axis than what is offered in the KMM but do not need the load capacity of the larger KML.

The KMXM consists of the following KK robots for each axis:

- X-axis: KK86
- Y-axis: KK86
- Z-axis: KK60

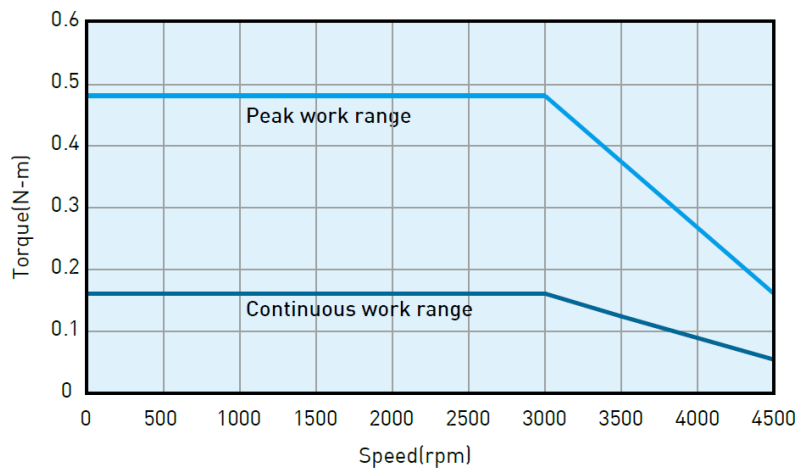For help determining the correct system for your application please contact *Hiwin* engineering.

KML

The KML Cartesian system is the second to largest size we offer in our current standard systems. These allow for longer reach in the y-direction while carrying larger loads, reducing the need for gantry configurations. They offer the capability of a larger work area. The z-axis is available in single or double slider for higher moment capacity in the z-axis.

The KML consists of the following KK robots for each axis:
- X-axis: KK100
- Y-axis: KK86
- Z-axis: KK60 single slider or
                KK60 double slider

For help determining the correct system for your application please contact *Hiwin* engineering.

KMXL

The KMXL Cartesian system is the largest size we offer in our current standard systems. These allow for longer reach in the y-direction while carrying larger loads, reducing the need for gantry configurations. They offer the largest work area capacity of all the standard systems. The z-axis of this configuration is a size KK86 which allows for faster speeds with heavier loads in the z-direction.

The KMXL consists of the following KK robots for each axis:

- X-axis: KK100
- Y-axis: KK86
- Z-axis: KK86

For help determining the correct system for your application please contact *Hiwin* engineering.
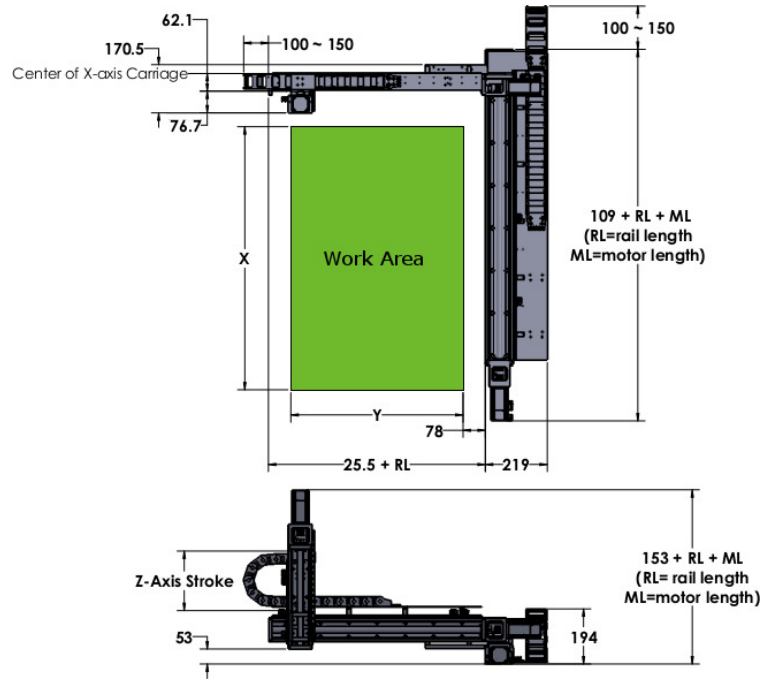
AC Servo Motors

Hiwin offers a full line of AC servo motors to drive each axis of the KM Cartesian robots. The servo motor power range is from 50W to 1kW. The wattage need for our standard systems is usually less than 750W. Each servo motor has the option of 13 bit or 17 bit resolution. 17 bit resolution will give a resolution of 131,072counts/rev. The rated speed of most of the servo motor line is 3000rpm with a max no load speed up to 4500rpm. Each servo motor has the option to be equipped with an electro-mechanical brake. This option may be required for many vertical applications to prevent back driving.

50W

Note : ()Include Brake Size
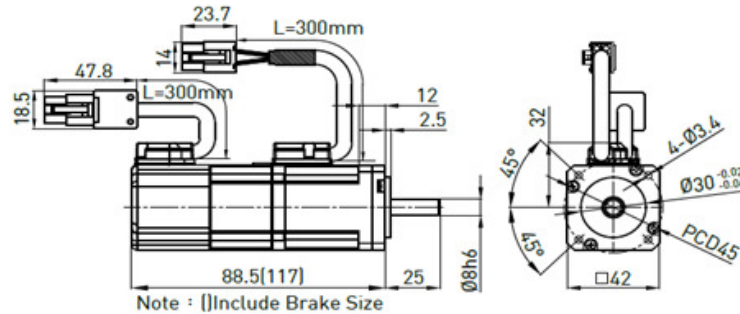
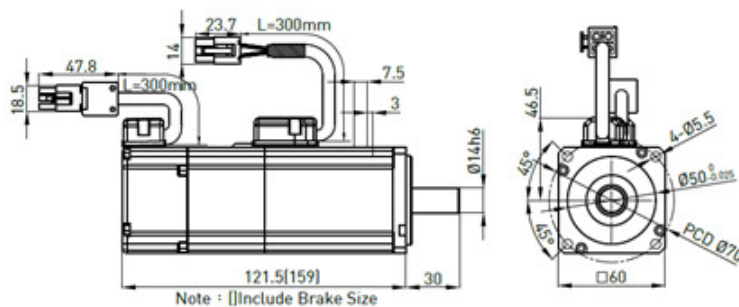| Parameters	Symbol	Unit	FRLS052□□A4□
Driver Input Voltage	V	V	AC220
Rated Power	W	W	50
Rated Torque	Tc	N.m	0.16
Rated Current	Ic	A(rms)	0.9
Peak Max. Torque	Tp	N.m	0.48
Peak Max. Current	Ip	A(rms)	2.7
Rated Speed	ωc	rpm	3000
No Load Max. Speed	ωp	rpm	4500
Torque Constant	Kt	N.m/Arms	0.178
Back EMF Constant	Ke	Vrms/krpm	10.74
Resistance (line to line)	R	Ω	4.7
Inductance (line to line)	L	mH	4.7
Inertia of Rotating Parts (with Brake)	J	kg-m^2 (x10^{-4})	0.02(0.022)
Weight (with Brake)	M	kg	0.45(0.58)
Brake Keep Torque	Tb	N.m	0.32
Brake Voltage	V	V	DC24±10%
Motor Insulation Grade	Class A		
Motor Protection	Total enclosed, self-cooled, IP54/IP65 (except for shaft and connector)		

HIWIN FRLS50W Torque-Speed Curve

Peak work range

Continuous work range

Torque(N-m)

Speed(rpm)

100W

Note：()Include Brake Size
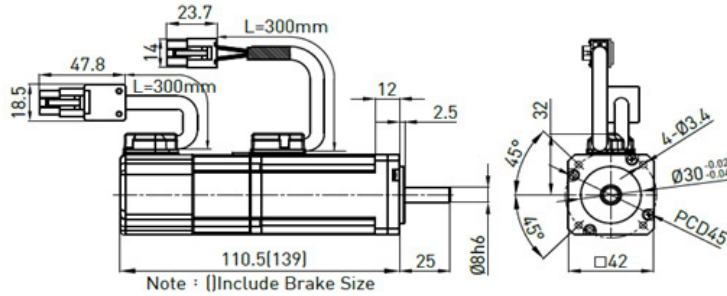
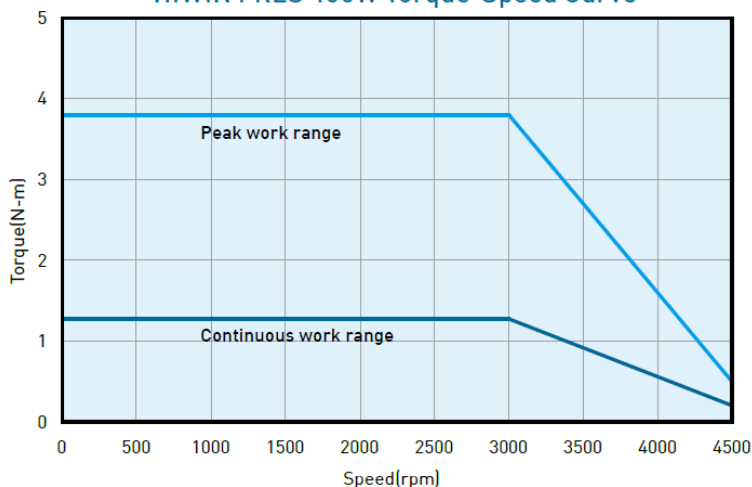| Parameters	Symbol	Unit	FRLS102□□A4□
Input Voltage	V	V	AC220
Rated Power	W	W	100
Rated Torque	Tc	N.m	0.32
Rated Current	Ic	A(rms)	0.9
Peak Max. Torque	Tp	N.m	0.96
Peak Max. Current	Ip	A(rms)	2.7
Rated Speed	ωc	rpm	3000
No Load Max. Speed	ωp	rpm	4500
Torque Constant	Kt	N.m/Arms	0.356
Back EMF Constant	Ke	Vrms/krpm	21.98
Resistance (line to line)	R	Ω	8
Inductance (line to line)	L	mH	8.45
Inertia of Rotating Parts (with Brake)	J	kg-m²(x10⁻⁴)	0.036 (0.038)
Weight (with Brake)	M	kg	0.63(0.76)
Brake Keep Torque	Tb	N.m	0.32
Brake Voltage	V	V	DC24±10%
Motor Insulation Grade		Class A	
Motor Protection		Total enclosed, self-cooled, IP54/IP65 (except for shaft and connector)	

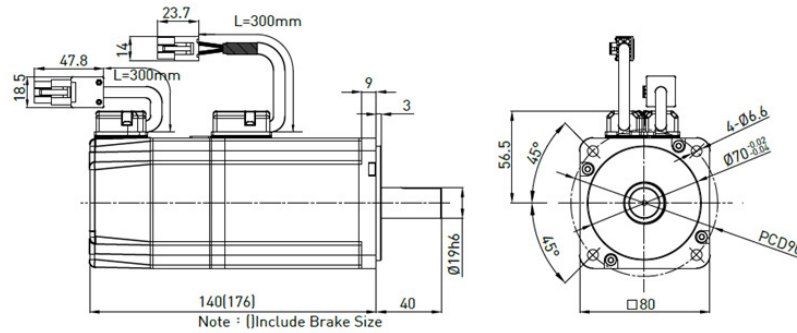## HIWIN FRLS100W Torque-Speed Curve

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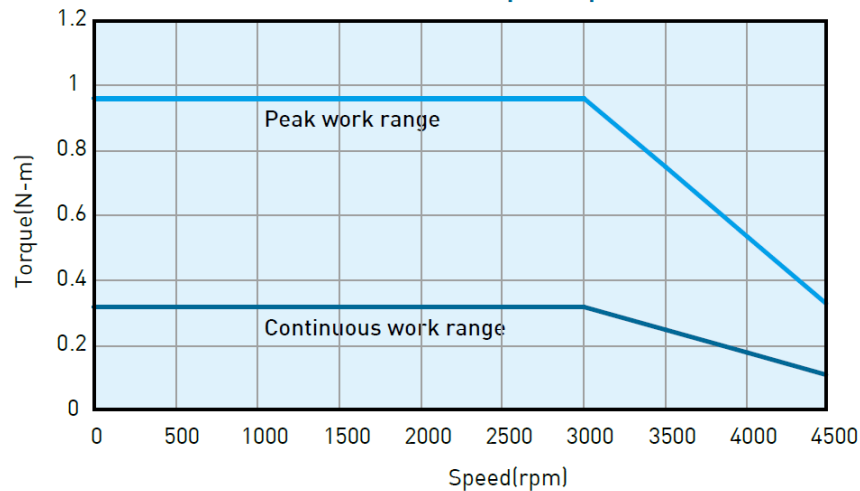
200W
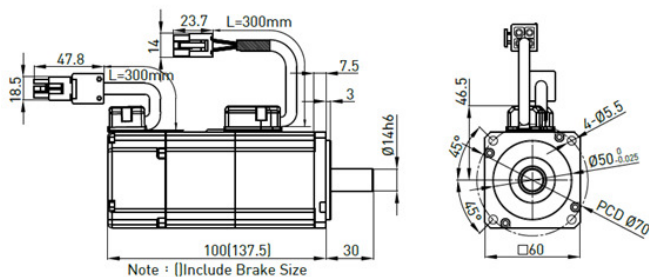
| Parameters	Symbol	Unit	FRLS202□□06□
Input Voltage	V	V	AC220
Rated Power	W	W	200
Rated Torque	Tc	N.m	0.64
Rated Current	Ic	A(rms)	1.7
Peak Max. Torque	Tp	N.m	1.92
Peak Max. Current	Ip	A(rms)	5.1
Rated Speed	ωc	rpm	3000
No Load Max. Speed	ωp	rpm	4500
Torque Constant	Kt	N.m/Arms	0.43
Back EMF Constant	Ke	Vrms/krpm	26
Resistance (line to line)	R	Ω	4.3
Inductance (line to line)	L	mH	13
Inertia of Rotating Parts (with Brake)	J	kg-m^2(x10^{-4})	0.17(0.21)
Weight (with Brake)	M	kg	0.95(1.5)
Brake Keep Torque	Tb	N.m	1.3
Brake Voltage	V	V	DC24±10%
Motor Insulation grade			Class A
Motor Protection			Total enclosed, self-cooled, IP54/IP65 (except for shaft and connector)

HIWIN FRLS200W Torque-Speed Curve

400W

Note：[]Include Brake Size
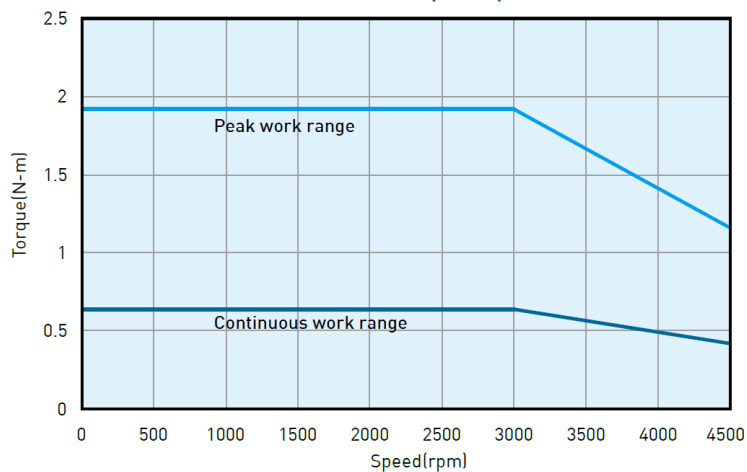
Parameters	Symbol	Unit	FRLS402□□06□
Input Voltage	V	V	AC220
Rated Power	W	W	400
Rated Torque	Tc	N.m	1.27
Rated Current	Ic	A(rms)	2.5
Peak Max. Torque	Tp	N.m	3.81
Peak Max. Current	Ip	A(rms)	7.5
Rated Speed	ωc	rpm	3000
No Load Max. Speed	ωp	rpm	4500
Torque Constant	Kt	N.m/Arms	0.53
Back EMF Constant	Ke	Vrms/krpm	31.9
Resistance (line to line)	R	Ω	3.5
Inductance (line to line)	L	mH	13
Inertia of Rotating Parts (with Brake)	J	kg-m^2(x10^{-4})	0.27(0.31)
Weight (with Brake)	M	kg	1.31(1.86)
Brake Keep Torque	Tb	N.m	1.3
Brake Voltage	V	V	DC24±10%
Motor Insulation grade		Class A	
Motor Protection		Total enclosed, self-cooled, IP54/IP65 (except for shaft and connector)	

HIWIN FRLS 400W Torque-Speed Curve

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750W

Parameters	Symbol	Unit	FRMS752□□08□
Input Voltage	V	V	AC220
Rated Power	W	W	750
Rated Torque	Tc	N.m	2.4
Rated Current	Ic	A(rms)	5.1
Peak Max. Torque	Tp	N.m	7.2
Peak Max. Current	Ip	A(rms)	15.3
Rated Speed	ωc	rpm	3000
No Load Max. Speed	ωp	rpm	4500
Torque Constant	Kt	N.m/Arms	0.47
Back EMF Constant	Ke	Vrms/krpm	28.4
Resistance (line to line)	R	Ω	0.813
Inductance (line to line)	L	mH	3.4
Inertia of Rotating Parts (with Brake)	J	kg-m^2(x10^{-4})	1.4(1.46)
Weight (with Brake)	M	kg	2.66(3.32)
Brake Keep Torque	Tb	N.m	2.4
Brake Voltage	V	V	DC24±10%
Motor Insulation grade		Class A	
Motor Protection		Total enclosed, self-cooled, IP54/IP65 (except for shaft and connector)	

HIWIN FRMS 750W Torque-Speed Curve
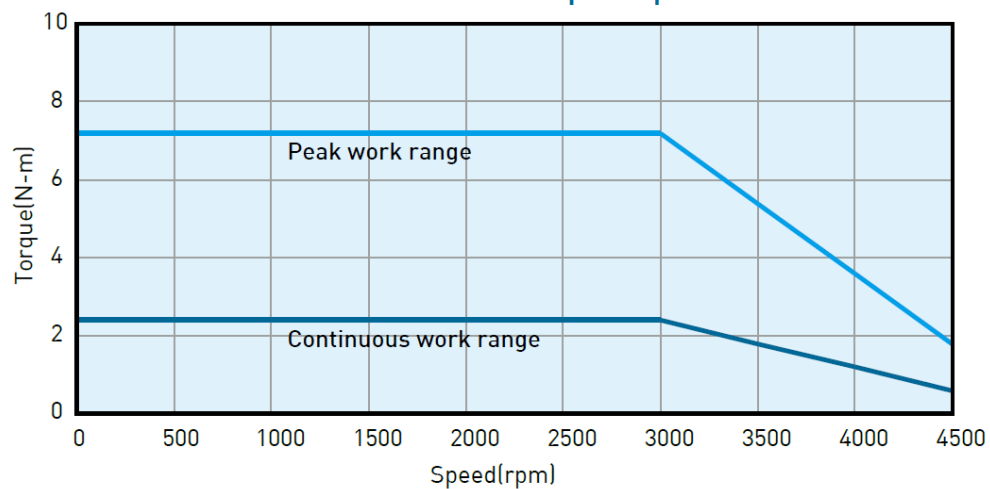
D2 Servo Drive

Hiwin offers a full line of AC servo drives to drive each axis of a KM Cartesian robot. These drives originated from the hi-tech semiconductor industry. As a result, they have many advanced features to give them superior performance. Despite the advanced technology incorporated in the drives, they are easy to use. Drive's are setup with a free graphical user interface software. The software doesn't have long parameter lists that can be confusing. They are instead organized into categorized windows and tabs to be more intuitive. The software has a scope which plots drive parameters to assist in diagnostics. Gains and parameters can be changed on the fly to show the user an instantaneous increase or decrease of performance. D2 drives have an LCD display which shows the user diagnostic messages of errors for troubleshooting. Gains can also be adjusted through the LCD panel. Drives have the option to be equipped with EtherCAT to interface with EtherCAT controls.

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D2 Servo Drive Features

Free Lightening user interface software
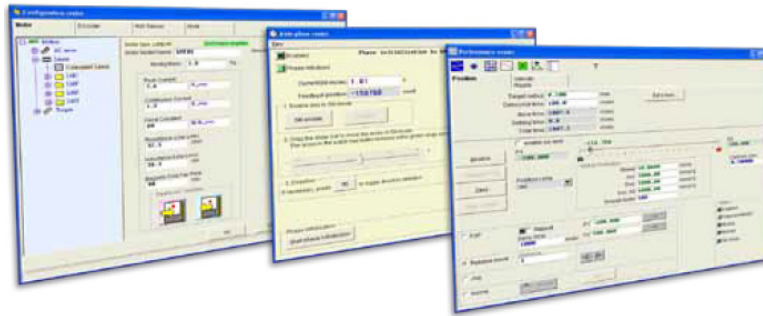
LCD display

Low pass and notch filters
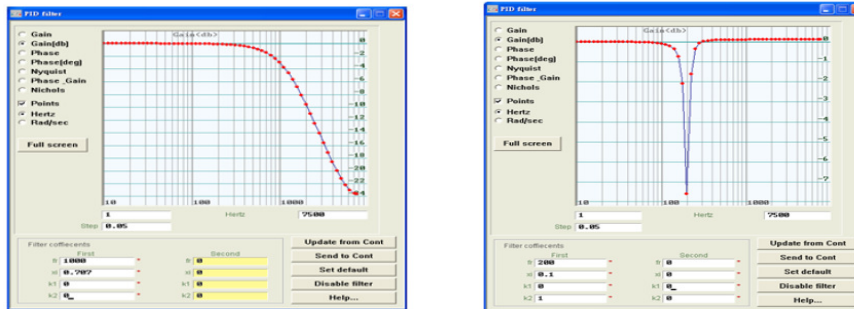
Scope for tuning and diagnostics

Error compensation

Without compensation
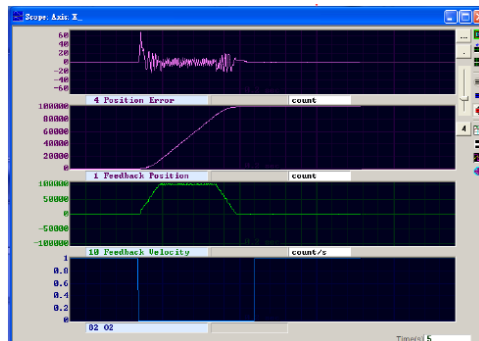
With compensation
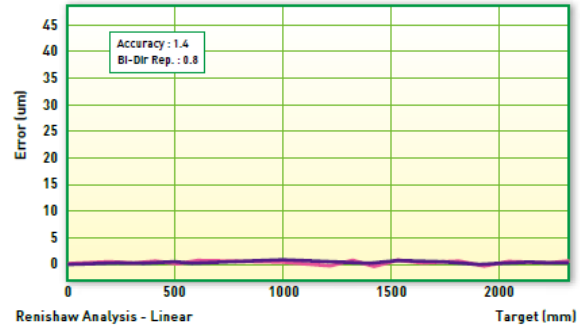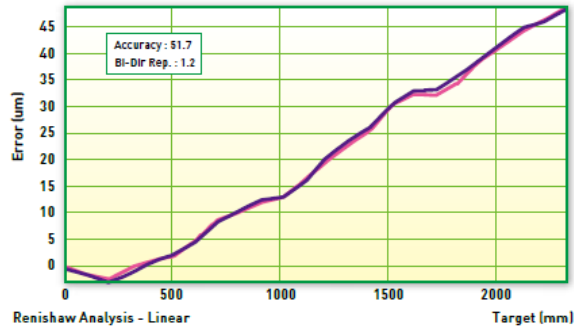
Preprogrammed and programmable I/O functions

Vibration suppression

Without suppression

With suppression

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