HIWIN®
Motion Control and System Technology

AC Servo Motor & Drive

Technical Information

HIWIN®

Motion Control and System Technology

High speed | High precision | Multifunctional integration | Ecology first | Humanistic technology

TAIWAN EXCELLENCE 2012
TAIWAN EXCELLENCE
GOLD AWARD 2012, 2011, 2009, 2008
TAIWAN EXCELLENCE
SILVER AWARD 2006, 2001, 1993

TAIWAN EXCELLENCE 2006

Ballscrews

Ground/Rolled

- High Speed (High Dm-N Value/Super S Series)
- Heavy Load (Cool type II)
- Ecological & Economical lubrication Module E2
- Rotating Nut (R1)
- Energy-Saving & Thermal-Controlling (C1)
- Recirculation Divide Series (RD)

TAIWAN EXCELLENCE 2002

Linear Actuator

- LAN for Hospital
- LAM for Industrial
- LAS Compact Size
- LAK Controller

TAIWAN EXCELLENCE 2004
TAIWAN EXCELLENCE
GOLD AWARD 2004

Linear Synchronous Motor

- Coreless Type (LMC)

TAIWAN EXCELLENCE 2009
TAIWAN EXCELLENCE
SILVER AWARD 2009

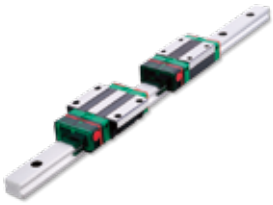
Linear Motor
Air Bearing Platform

TAIWAN EXCELLENCE 2010
TAIWAN EXCELLENCE
GOLD AWARD 2010, 2003

Industrial Robot

- For Semiconductor & Electronic (KK Series)
- For Automation (KS, KA Series)

Positioning
Measurement System



TAIWAN EXCELLENCE 2008
TAIWAN EXCELLENCE
GOLD AWARD 2008
TAIWAN EXCELLENCE
SILVER AWARD 2007, 2002

TAIWAN EXCELLENCE 2007

Linear Guideway

HG/EG/RG/MG Type

- Ecological & Economical lubrication Module E2
- Low Noise (Q1)
- Air Jet (A1)

AC Servo Motor & Drive

TAIWAN EXCELLENCE 2006
TAIWAN EXCELLENCE
SILVER AWARD 2006

TMS Torque Motor
Rotary Table

Linear Motor X-Y Robot

TAIWAN EXCELLENCE 2004

Positioning Guideway

Linear Motor Gantry

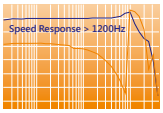
Contents

With the implementation of Mega-fabs control technology
accomplish a great cost-performance ratio for a complete motor drive solution.

AC Servo Motor & Drive

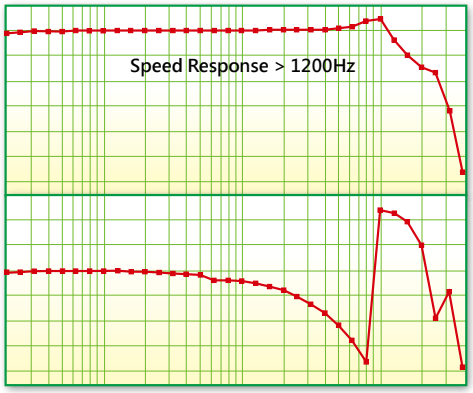
Feature

Excellent Performance



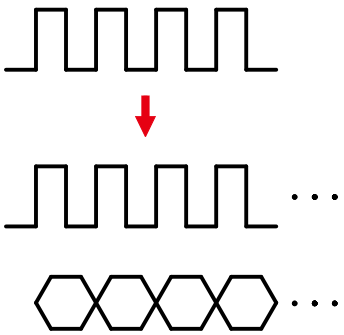
Excellently high speed response

With help of semiconductor high-end motion control algorithm and advanced common gain concept, the high speed response is achieved, therefore satisfying all of the motion control needs.



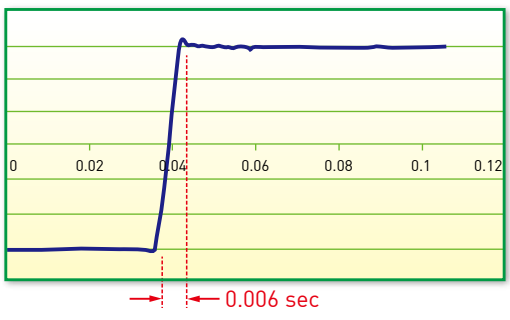
17bit High resolution encoder

Thanks to the advanced serial encoder technology, a resolution of 131072 count/rev is reached. It guarantees the performance of most demanded motions.



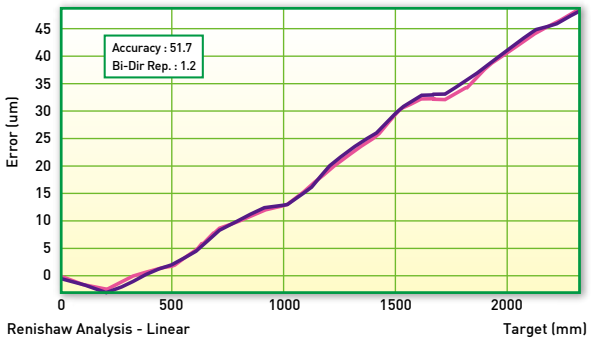
High acceleration responses

Using advanced WizAlg controller design tools, plus space vector current control technology, servo performance has been achieved to the highest level. To change motor speed from -3000 to +3000 rpm, it takes as low as 0.006 second.

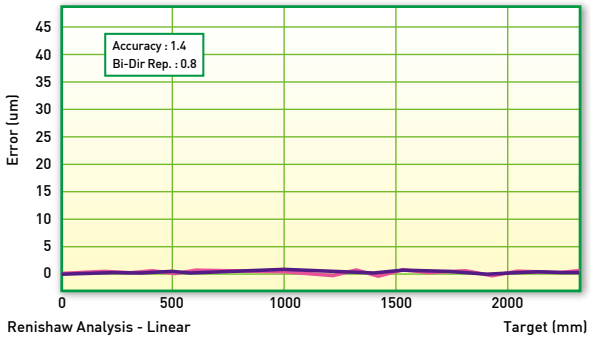


Built-in accuracy improvement features

D2 drive includes features to improve total positioning accuracy of the mechanical system. The table size can be up to 16000 points. It is implemented in all control modes to optimize system behavior.



Without compensation

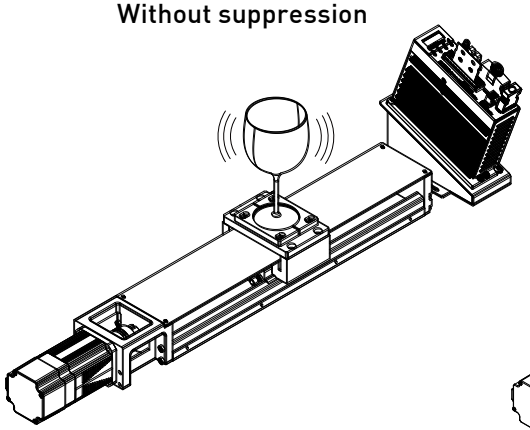


With compensation

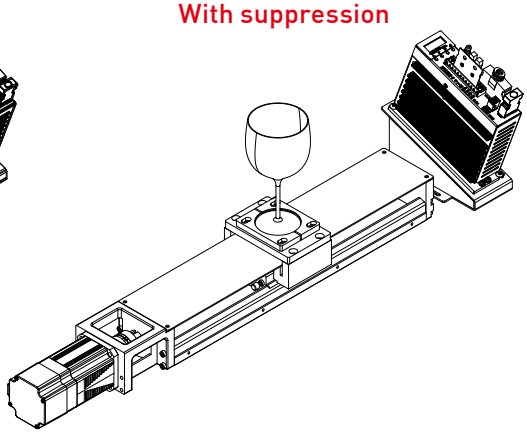
Vibration Suppression Feature

D2 drive can remove the vibration frequency that occurs during movement. It reduces vibrations caused by system's structure and improve the machine's production efficiency.

Without suppression



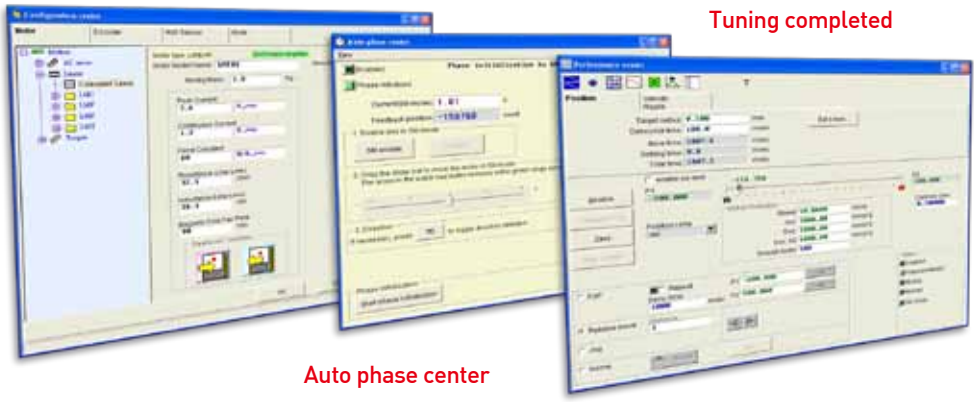
With suppression



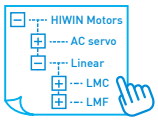
Simple Operation

Simple setup

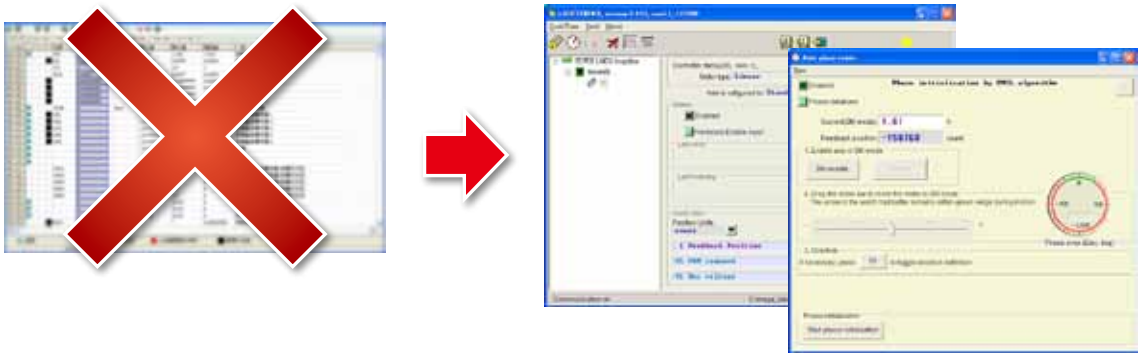
Three Steps



Easy operation



Parameters are categorized according to features, only necessary ones are shown at the right time. No confusing parameter list.



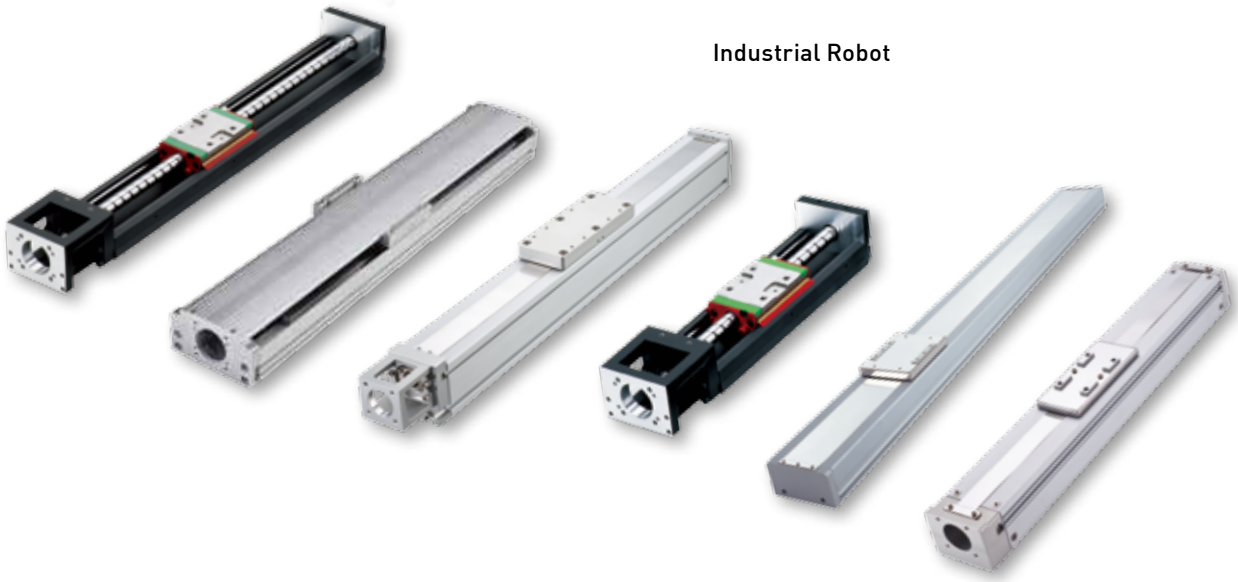
LCD display

Without PC and user's interface, it is possible to complete basic settings. The LCD display shows the necessary error or warning information and statuses. With push buttons on the panel, it is possible to set gains and test run.

Easy Integration

The total solution

HIWIN provides positioning modules, motors, and the best servo drive solution from mega-fabs. According to customer's requirements we can integrate all that are required for user's easiness of application.



Industrial Robot

Mega-Fabs Drive

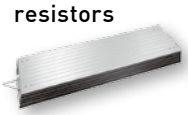
AC servo Motor

Line Filter

Ferrite core

STDO terminal

Regenerative resistors



Complete Tool Sets

Real time scope, frequency analysis tool, gain scheduling tools, I/O settings, electronic gear tools, encoder output scale etc makes the complete tools for motion control in diverse fields.

Accuracy enhancement

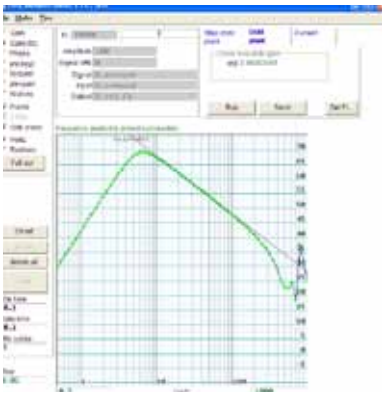
To improve on the positioning accuracy of motion systems, the D2 amplifier is featured with an error compensation function. By taking the measurements from a laser interferometer, the positioning error table can be built inside the D2, so that high positioning accuracy is achieved.

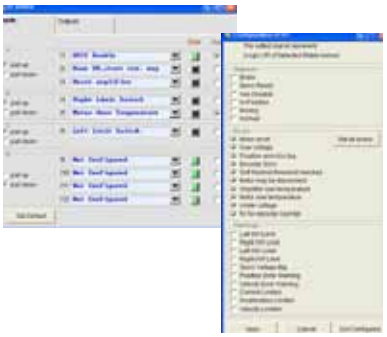
Advanced gain scheduling feature

After setting gains through optimization tools, there is only one value to adjust: the common gain. During motion, the D2 drive provides a gain scheduling function. You can adjust the gain according to different phases of motion, such as moving phase, settling phase, and in-position phase.

Optimization tools

The D2 provides a powerful and easy to use tool for optimization. You can use the frequency analysis tools to display the real response in the form of a graph. You can easily set the best gain value for the system based on the real response, even first time users can easily get started.



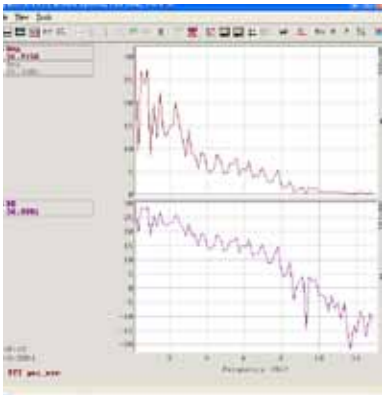


Variety of I / O functions

In response to a number of different functions, you are free to configure the I / O pin functionality and adapt different hardware interface needs. This satisfies diverse requirements for different motion controllers with regards to their pin assignments and hardware interfaces.

Analysis Tools

To solve a resonance problem, the D2 drive offers a filter design tool for improving the control performance, a Fast Fourier Transform (FFT) and other mathematical operation tools.. You can use the functions to calculate the resonant frequency of the system easily, and to make the filter design more accurate.

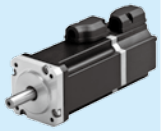
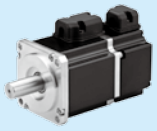
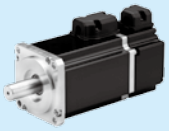


Application international safety standards

CE

		Drive	Motor
EC Directives	EMC Directives	EN55011 EN61000-6-2 EN61000-6-4 EN61000-3-2 EN61000-3-3	EN55011 EN61000-6-2 EN61000-6-4
	Low-Voltage Directives	EN61800-5-1	EN60034-1 EN60034-5

Motor line-up / Application

Motor			Voltage	Rated Output (W)	Rated Rotational Speed(Max Speed)(rpm)	Rotary Encoder		Enclosure Rating	Application
						13-bit	17-bit		
Low Inertia	FRLS		220V	50W	3000 4500	◎	◎	IP54/IP65	◆Semiconductor equipment ◆Packing machines ◆SMT machines ◆Food machines ◆LCD equipment
			220V	100W	3000 4500	◎	◎		
			220V	200W	3000 4500	◎	◎		
			220V	400W	3000 4500	◎	◎		
Middle Inertia	FRMS		220V	750W	3000 4500	◎	◎	IP54/IP65	◆Semiconductor equipment ◆Packing machines ◆SMT machines ◆Food machines ◆LCD equipment
	FRMM		220V	1000W	2000 3000	◎	◎	IP54/IP65	◆Machine tools ◆Conveyors ◆Textile machines ◆Robots

Model designation

Drive-Series of D2

D2	04	2	3	S	B	0
1st+2nd	3rd+4th	5th	6th	7th	8th	9th

1st+2nd	
D2	HIWIN Drive-Series of D2

3rd+4th	Rated Output
01	50W / 100W
04	200W / 400W
10	750W / 1000W

5th	Phase
2	Single Phase / 3Phase

6th	Voltage Range
3	110V / 220V

9th	Encoder Type
0	13-bit Incremental
4	17-bit Incremental

8th	Frame
A	Frame A
B	Frame B
C	Frame C

7th	Interface
P	Pulse
S	Full Function

Servo motor

FR	LS	40	2	0	4	06	A
1st+2nd	3rd+4th	5th+6th	7th	8th	9th	10th+11th	12th

1st+2nd	
FR	HIWIN AC Servo Motor Series

3rd+4th	Motor type
LS	Low Inertia Small Capacity
MS	Middle Inertia Small Capacity
MM	Middle Inertia Middle Capacity

5th+6th	Output Power
05	50W
10	100W
20	200W
40	400W
75	750W
1K	1000W

7th	Drive Input Voltage
2	220V

12th	Shaft		Oil Seal	
	Round	Key, Center tap	With	Without
A	◎			◎
B	◎		◎	
C		◎		◎
D		◎	◎	

10th+11th	Frame Size
A4	42mm
06	60mm
08	80mm
13	130mm

9th	Encoder Type
5	13-bit Incremental
3	17-bit Incremental

8th	Brake Option
0	Without Brake
B	With Brake

Motor cable & Brake cable

HVP	S	04	A	A	05M	A
1st+2nd+3rd	4th	5th+6th	7th	8th	9th+10th+11th	12th

1st+2nd+3rd
HIWIN Power Extension Cable

4th	Capacity Type
Code	Specification
S	Small Capacity (0.05KW~0.75KW)
M	Middle Capacity (1KW)

5th+6th	Number of pin
Code	Specification
04	Power
06	Brake & Power

7th	Motor Side Connector
Code	Specification
A	AMP Connector
B	Straight Connector
C	L-Shaped Connector

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

8th	Driver Side Connector
Code	Specification
A	Rod terminal

Encoder cable

HVE	17A	A	B	05M	A
1st+2nd+3rd	4th+5th+6th	7th	8th	9th+10th+11th	12th

1st+2nd+3rd
HIWIN Encoder Extension Cable

4th+5th+6th	Encoder Type
Code	Specification
13I	13-bit Incremental
17I	17-bit Incremental

7th	Encoder Side Connector
Code	Specification
A	AMP Connector
B	Straight Connector
C	L-Shaped Connector

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

8th	Driver Side Connector
Code	Specification
B	SCR Connector

Overing wiring

Connector type (110/220V: A to C- Frame)

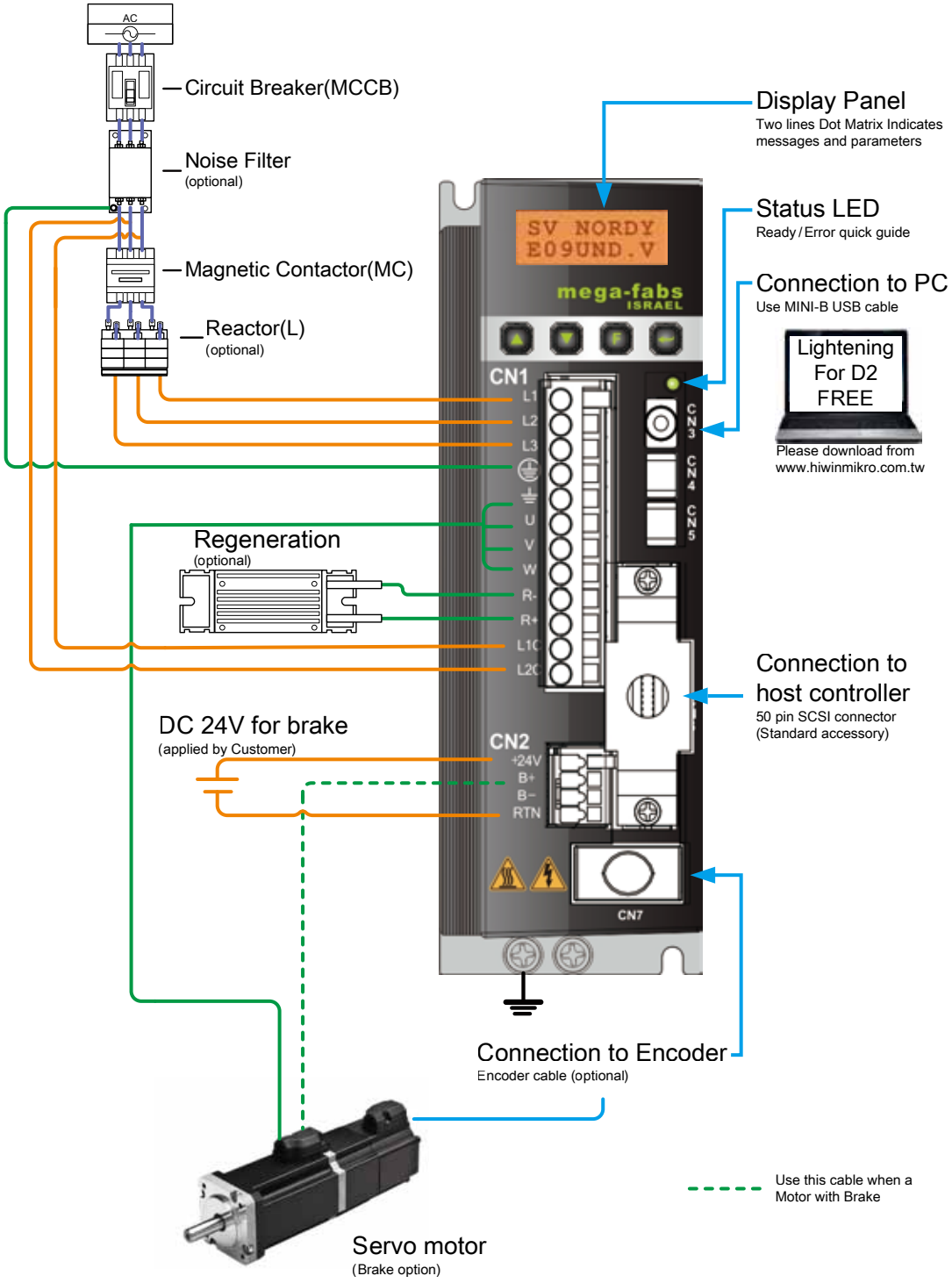


Table of Part Numbers and Options

AC50W~AC750W-13bit Incremental

Motor					Drive			Power capacity (Rated load)		Optional parts						
Motor Series		Power supply	Output (W)	Part No. (Note 1)	Part No. (Full function type)	Part No. (Pulse type Only)	Frame			Motor cable(Note 2)		Encoder cable	D2 drive accessories			
										without brake	with brake	13bit incremental (Note 2)	Control Signal Cable	1 phase EMC Pack (Note 3)	3 phase EMC Pack (Note 3)	External Regenerative Resistor
Low Inertia	FRLS	single phase/ 3phase 220V	50	FRLS05205A4△	D2-0123-S-A0	D2-0123-P-A0	Frame A	Approx. 0.4kVA		HVPS04AA□□□◇	HVPS06AA□□□◇	HVE13IAB□□□◇	LMACK02D	D2-EMC1	D2-EMC2	050100700001
				FRLS052B5A4△												
			100	FRLS10205A4△												
				FRLS102B5A4△												
			200	FRLS2020506△	D2-0423-S-B0	D2-0423-P-B0	Frame B	Approx. 0.9kVA								
				FRLS202B506△												
			400	FRLS4020506△												
				FRLS402B506△												
Middle inertia	FRMS		750	FRMS7520508△	D2-1023-S-C0	D2-1023-P-C0	Frame C	Approx. 1.8kVA						D2-EMC3		
				FRMS752B508△												

(Note 1) △ : Shaft End & Oil Seal Specification (Please refer to p.9)
(Note 3) : EMC pack model (please refer to p.30)

(Note 2) : Selection of cable for FRMS motor

◆Motor Cable(without brake)

HVPS04AA□□□◇

Cable Length — Cable Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

◆Motor Cable(with brake)

HVPS06AA□□□◇

Cable Length — Cable Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

◆Encoder Cable(13bit-Incremental)

HVE13IAB□□□◇

Cable Length — Cable Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

HIWIN
R99TE04-1210

AC1KW-13bit Incremental

Motor					Drive			Power capacity (Rated load)		Optional parts						
Motor Series		Power supply	Output (W)	Part No. (Note 1)	Part No. (Full function type)	Part No. (Pulse type Only)	Frame			Motor cable(Note 2)		Encoder cable	D2 drive accessories			External Regenerative Resistor
										without brake	with brake	13bit incremental (Note 2)	Control Signal Cable	1 phase EMC Pack (Note 3)	3 phase EMC Pack (Note 3)	
Middle inertia	FRMM	single phase/ 3phase 220V	1000	FRMM1K20513△	D2-1023-S-C0	D2-1023-P-C0	Frame C	Approx. 1.8kVA		HVPM04☆A□□□◇	HVPM06☆A□□□◇	HVE13I○B□□□◇	LMACK02D	D2-EMC3	D2-EMC2	050100700001
				FRMM1K2B513△												

(Note 1) △ : Shaft End & Oil Seal Specification (Please refer to p.9)
(Note 3) : EMC pack model (please refer to p.30)

(Note 2) : Motor Cable (without brake & without brake)

HVPM04☆A□□□ ◇

Motor Side Connector

7th	Motor Side Connector(Note 2)
Code	Specification
B	Straight Type
C	L-Shaped Type

Cable Bendable Type

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

Cable Length

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

◆Encoder Cable(13bit-Incremental)

HVE13I○B□□□ ◇

Hirose Connectors

7th	Encoder Side Connector(Note 3)
Code	Specification
B	Straight Type
C	L-Shaped Type

Cable Bendable Type

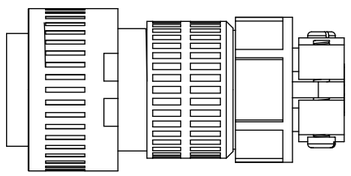
12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

Cable Length

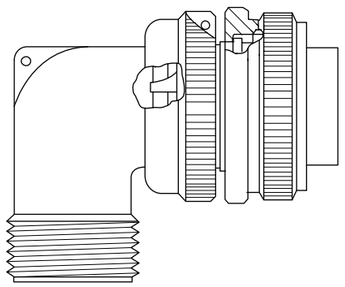
9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

◆Motor Side Connector

● Straight Type

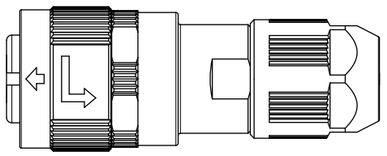


● L-Shaped Type

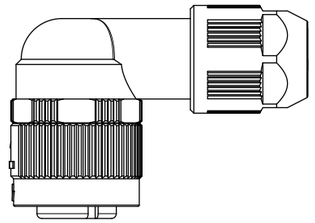


◆Encoder Side Connector

● Straight Type



● L-Shaped Type



HIWIN
R99TE04-1210

AC50W~AC750W-17bit Incremental

Motor				Drive			Power capacity (Rated load)		Optional parts						
Motor Series		Power supply	Output (W)	Part No. (Note 1)	Part No. (Full function type)	Part No. (Pulse type Only)	Frame		Motor cable(Note 2)		Encoder cable	D2 drive accessories			External Regenerative Resistor
									without brake	with brake	17bit incremental (Note 2)	Control Signal Cable	1 phase EMC Pack (Note 3)	3 phase EMC Pack (Note 3)	
Low Inertia	FRLS	single phase/ 3phase 220V	50	FRLS05203A4△	D2-0123-S-A4	D2-0123-P-A4	Frame A	Approx. 0.4kVA	HVPS04AA□□□◇	HVPS06AA□□□◇	HVE17IAB□□□◇	LMACK02D	D2-EMC1	D2-EMC2	050100700001
				FRLS052B3A4△											
			100	FRLS10203A4△											
				FRLS102B3A4△											
			200	FRLS2020306△	D2-0423-S-B4	D2-0423-P-B4	Frame B	Approx. 0.9kVA							
				FRLS202B306△											
			400	FRLS4020306△											
				FRLS402B306△											
Middle inertia	FRMS		750	FRMS7520308△	D2-1023-S-C4	D2-1023-P-C4	Frame C	Approx. 1.8kVA					D2-EMC3		
				FRMS752B308△											

(Note 1) △ : Shaft End & Oil Seal Specification (Please refer to p.9)
(Note 3) : EMC pack model (please refer to p.30)

(Note 2) : Selection of cable for FRMS motor

◆Motor Cable(without brake)

HVPS04AA□□□◇

Cable Length — Cable Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

◆Motor Cable(with brake)

HVPS06AA□□□◇

Cable Length — Cable Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

◆Encoder Cable(17bit-Incremental)

HVE17IAB□□□◇

Cable Length — Cable Bendable Type

9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

HIWIN
R99TE04-1210

AC1KW-17bit Incremental

Motor					Drive			Power capacity (Rated load)		Optional parts						
Motor Series		Power supply	Output (W)	Part No. (Note 1)	Part No. (Full function type)	Part No. (Pulse type Only)	Frame			Motor cable(Note 2)		Encoder cable	D2 drive accessories			External Regenerative Resistor
										without brake	with brake	17bit incremental (Note 2)	Control Signal Cable	1 phase EMC Pack (Note 3)	3 phase EMC Pack (Note 3)	
Middle inertia	FRMM	single phase/ 3phase 220V	1000	FRMM1K20313△ FRMM1K2B313△	D2-1023-S-C4	D2-1023-P-C4	Frame C	Approx. 1.8kVA		HVPM04☆A□□□◇	HVPM06☆A□□□◇	HVE17I○B□□□◇	LMACK02D	D2-EMC3	D2-EMC2	050100700001

(Note 1) △ : Shaft End & Oil Seal Specification (Please refer to p.9)
(Note 3) : EMC pack model (please refer to p.30)

(Note 2) : Motor Cable (without brake & without brake)

HVPM04☆A□□□ ◇

Motor Side Connector

7th	Motor Side Connector(Note 2)
Code	Specification
B	Straight Type
C	L-Shaped Type

Cable Bendable Type

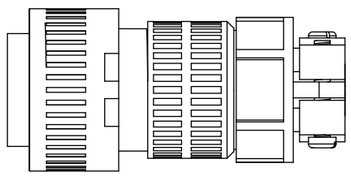
12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

Cable Length

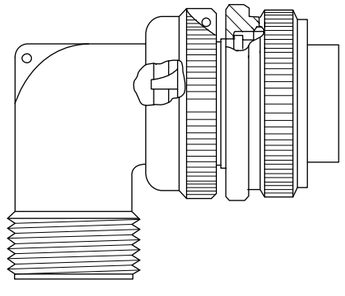
9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

◆Motor Side Connector

● Straight Type



● L-Shaped Type



◆Encoder Cable(17bit-Incremental)

HVE17I○B□□□ ◇

Hirose Connectors

7th	Encoder Side Connector(Note 3)
Code	Specification
B	Straight Type
C	L-Shaped Type

Cable Bendable Type

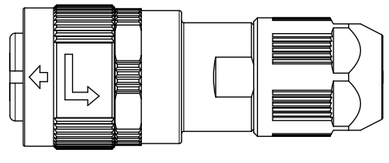
12th	Cable Type
Code	Specification
A	Standard
B	Highly Bendable Type

Cable Length

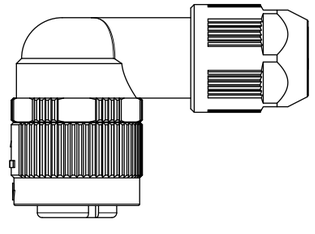
9th+10th+11th	Length of Cable
Code	Specification
03M	3M
05M	5M
07M	7M
10M	10M

◆Encoder Side Connector

● Straight Type



● L-Shaped Type



Servo Drive

1.1 Basic Specifications of Servo Drive for full function

Input power	220V	Main circuit	A to C-frame	Single/3-phase, 200 to 240V 50/60Hz
		Control circuit	A to C-frame	Single phase, 200 to 240V 50/60Hz
Environment		Temperature		Operation Temperature: 0℃~40℃ (if over 55℃, forced ventilation is needed) Storage Temperature: -20℃~65℃
		Humidity		0 to 90%RH
		Altitude		Under 1000 Meters
		Vibration		1G (10 to 500Hz)
Control method				IGBT PWM space vector control
Encoder feedback				13-bit (10000 cnt/rev) incremental encoder, 9-wire serial 17-bit (131072 cnt/rev) incremental encoder, 5-wire serial
Parallel I/O connector	Control signal		Input	General purpose 9 inputs
			Output	General purpose 4 outputs
	Analog signal		Input	1 input (12bit A/D)
			Output	2 outputs (Analog monitor: 2 outputs)
	Pulse signal		Input	2 inputs (Low speed channel, High speed channel)
			Output	4 outputs (Line driver: 3output, open collector: 1 output)
Brake connector	Control signal		output	Used for direct brake connection. (no need of extra relay for brake) Also programmable for general purpose output
Communication function			USB	Connection with PC, 115200bps
Front panel				Dot matrix 8*2 characters LCD with 4 buttons LED(green, red)
Regeneration				A, B-frame: No built-in regenerative resistor (external) C-frame: Built-in regenerative resistor (external resistor is also available)
Dynamic brake				External only (Option)
Control mode				Switching among the following modes is possible (1)Position control (2)Velocity control (3)Torque control (4)Position/Velocity control (5)Position/Torque control (6)Velocity/Torque control

Functions

Position control	Control input		(1)Inhibit pulse command, (2)Clear position error, (3)Axis Enable, (4)Switch between 1st and 2nd CG, (5)Electronic Gear Select, (6)Left Limit Switch, (7)Switch between 1st and 2nd mode, (8)Clear Error, (9)Right Limit Switch etc.
	Control output		(1)Servo Ready, (2)Errors, (3)In-Position, (4)Zero Speed Detected etc.
	Pulse input	Max. command pulse frequency	Dedicated interface for Photo-coupler(single end input): 500kpps Dedicated interface for line driver(differential input): 4Mpps(16M cnt/s with AqB)
		Input pulse signal format	(1) Pulse and Direction, (2) Pulse Up/Pulse Down(3) Quadrature(AqB)
		Electronic gear (Division/ Multiplication of command pulse)	Gear ratio: pulses/counts pulses: 1~2147483647, counts: 1~2147483647
		Smoothing filter	Smooth factor : 1~500 (0: no smoothing filter)
	Vibration suppression filter(VSF)		VSF can remove the vibration frequency that occurs during movement. It can reduce the vibration caused by the system' s structure and improve the machine' s productivity.
Velocity control	Control input		(1)Zero Speed Clamp, (2)Axis Enable, (3)Switch between 1st and 2nd CG, (4)Left Limit Switch, (5)Switch between 1st and 2nd mode, (6)Clear Error, (7)Right Limit Switch etc.
	Control output		(1)Servo Ready, (2)Errors, (3)In-Velocity, (4)Zero Speed Detected etc.
	PWM input	Velocity command input	Speed command input can be provided by means of duty cycle of PWM input. Parameter are used for scale setting and command polarity.
	Analog Input	Velocity command input	Speed command input can be provided by means of analog voltage. Parameter are used for scale setting and command polarity.
	Zero speed clamp		Zero speed clamp input is possible.
Torque control	Control input		(1)Zero Speed Clamp, (2)Axis Enable, (3)Switch between 1st and 2nd CG, (4)Left Limit Switch, (5)Switch between 1st and 2nd mode, (6)Clear Error, (7)Right Limit Switch etc.
	Control output		(1)Servo Ready, (2)Errors, (3)In-Velocity, (4)Zero Speed Detected etc.
	PWM input	Torque command input	Torque command input can be provided by means of duty cycle of PWM input. Parameter are used for scale setting and command polarity.
	Analog Input	Torque command input	Torque command input can be provided by means of analog voltage. Parameter are used for scale setting and command polarity.
	Speed limit function		Speed limit value with parameter is possible
Common	Auto tune		The AutoTune procedure runs automatically after started and identify the load inertia, so that no user setting is required. All necessary gains are set with one click from the LCD panel.
	Emulated encoder feedback output		Set up of any value is possible (frequency up to 18M cnt/s)
	Protective function		(1)Motor short detected, (2)Over voltage detected, (3)Position error too big, (4) Encoder error, (5)Soft-thermal threshold reached, (6)Motor maybe disconnected, (7)Amplifier over temperature, (8)Under voltage detected, (9)5V for encoder Card fail, (10)Phase initialization error, (11)Serial encoder communication error
	Error log		Errors and warnings are saved in non-volatile memory
	Error Mapping		Method: Established compensation table to compensate encoder error by linear interpolation
			Samples: Maximum 16,000 point
			Storage: Flash ROM, Disc file
			Unit: um, count
			Activation: Activated internally by home complete, or activated externally by input signal
	Others		Friction compensation, Backlash compensation

1.2 Basic Specifications of Servo Drive for pulse type

Input power	220V	Main circuit	A to C-frame	Single phase, 200 to 240V 50/60Hz
		Control circuit	A to C-frame	Single phase, 200 to 240V 50/60Hz
Environment		Temperature		Operation Temperature: 0℃~40℃ (if over 55℃, forced ventilation is needed) Storage Temperature: -20℃~65℃
		Humidity		0 to 90%RH
		Altitude		Under 1000 Meters
		Vibration		1G (10 to 500Hz)
Control method				IGBT PWM space vector control
Encoder feedback				13-bit (10000 cnt/rev) incremental encoder, 9-wire serial 17-bit (131072 cnt/rev) incremental encoder, 5-wire serial
Parallel I/O connector	Control signal		Input	General purpose 9 inputs
			Output	General purpose 4 outputs
	Pulse signal		Input	2 inputs (Low speed channel, High speed channel)
			Output	4 outputs (Line driver: 3output, open collector: 1 output)
Brake connector	Control signal		output	Used for direct brake connection. (no need of extra relay for brake) Also programmable for general purpose output
Communication function			USB	Connection with PC, 115200bps
Front panel				Dot matrix 8*2 characters LCD with 4 buttons LED(green, red)
Regeneration				A, B-frame: No built-in regenerative resistor (external) C-frame: Built-in regenerative resistor (external resistor is also available)
Dynamic brake				External only (Option)
Control mode				Position control only

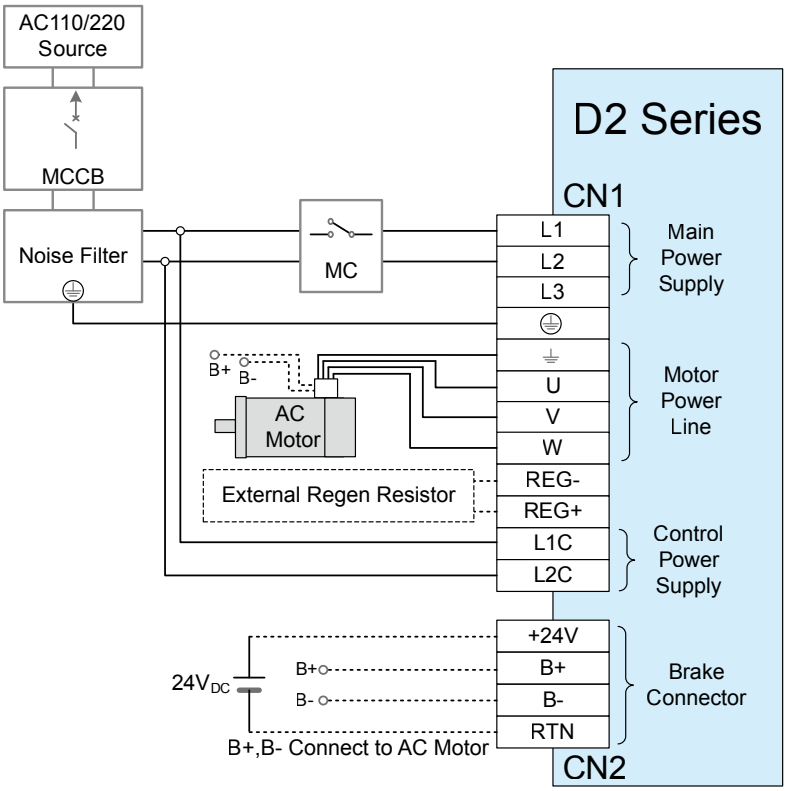
Functions

Position control	Control input		(1)Inhibit pulse command, (2)Clear position error, (3)Axis Enable, (4)Switch between 1st and 2nd CG, (5)Electronic Gear Select, (6)Left Limit Switch, (7)Switch between 1st and 2nd mode, (8)Clear Error, (9)Right Limit Switch etc.
	Control output		(1)Servo Ready, (2)Errors, (3)In-Position, (4)Zero Speed Detected etc.
	Pulse input	Max. command pulse frequency	Dedicated interface for Photo-coupler(single end input): 500kpps Dedicated interface for line driver(differential input): 4Mpps(16M cnt/s with AqB)
		Input pulse signal format	(1) Pulse and Direction, (2) Pulse Up/Pulse Down, (3) Quadrature(AqB)
		Electronic gear (Division/ Multiplication of command pulse)	Gear ratio: pulses/counts pulses: 1~2147483647, counts: 1~2147483647
		Smoothing filter	Smooth factor : 1~500 (0: no smoothing filter)
	Vibration suppression filter(VSF)		VSF can remove the vibration frequency that occurs during movement. It can reduce the vibration caused by the system' s structure and improve the machine' s productivity.
Common	Auto tune		The AutoTune procedure runs automatically after started and identify the load inertia, so that no user setting is required. All necessary gains are set with one click from the LCD panel.
	Emulated encoder feedback output		Set up of any value is possible (frequency up to 18M cnt/s)
	Protective function		(1)Motor short detected, (2)Over voltage detected, (3)Position error too big, (4) Encoder error, (5)Soft-thermal threshold reached, (6)Motor maybe disconnected, (7)Amplifier over temperature, (8)Under voltage detected, (9)5V for encoder Card fail, (10)Phase initialization error, (11)Serial encoder communication error
	Error log		Errors and warnings are saved in non-volatile memory
	Error Mapping		Method: Established compensation table to compensate encoder error by linear interpolation
			Samples: Maximum 16,000 point
			Storage: Flash ROM, Disc file
			Unit: um, count
			Activation: Activated internally by home complete, or activated externally by input signal
	Others		Friction compensation, Backlash compensation

Wiring diagram

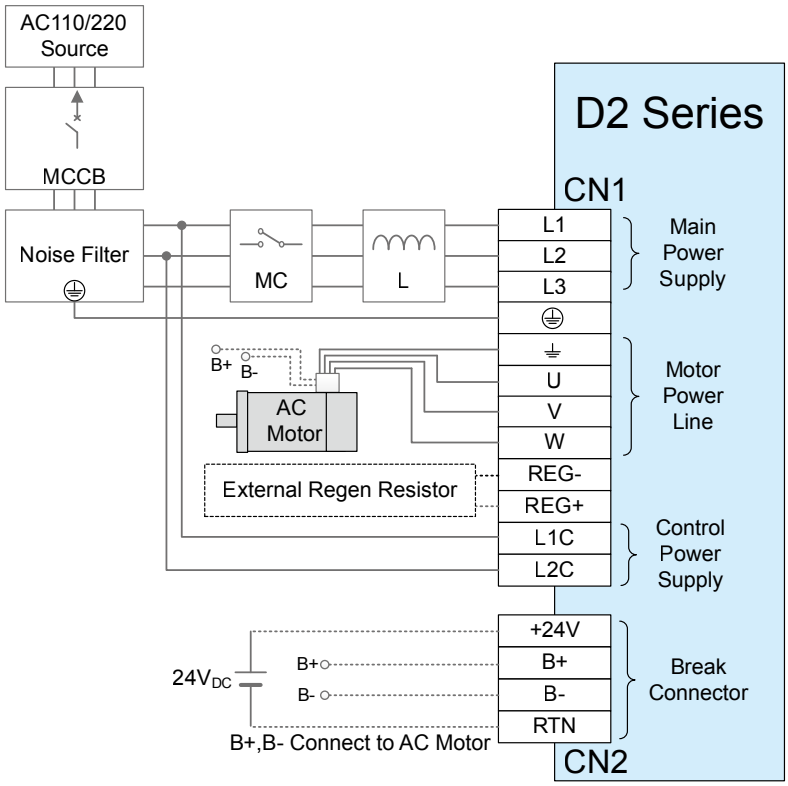
Wiring to Connector CN1 and CN2

A. Single-phase(Brake without relay, using HIWIN motor)



--------- : Optional connected(Brake, Regen)

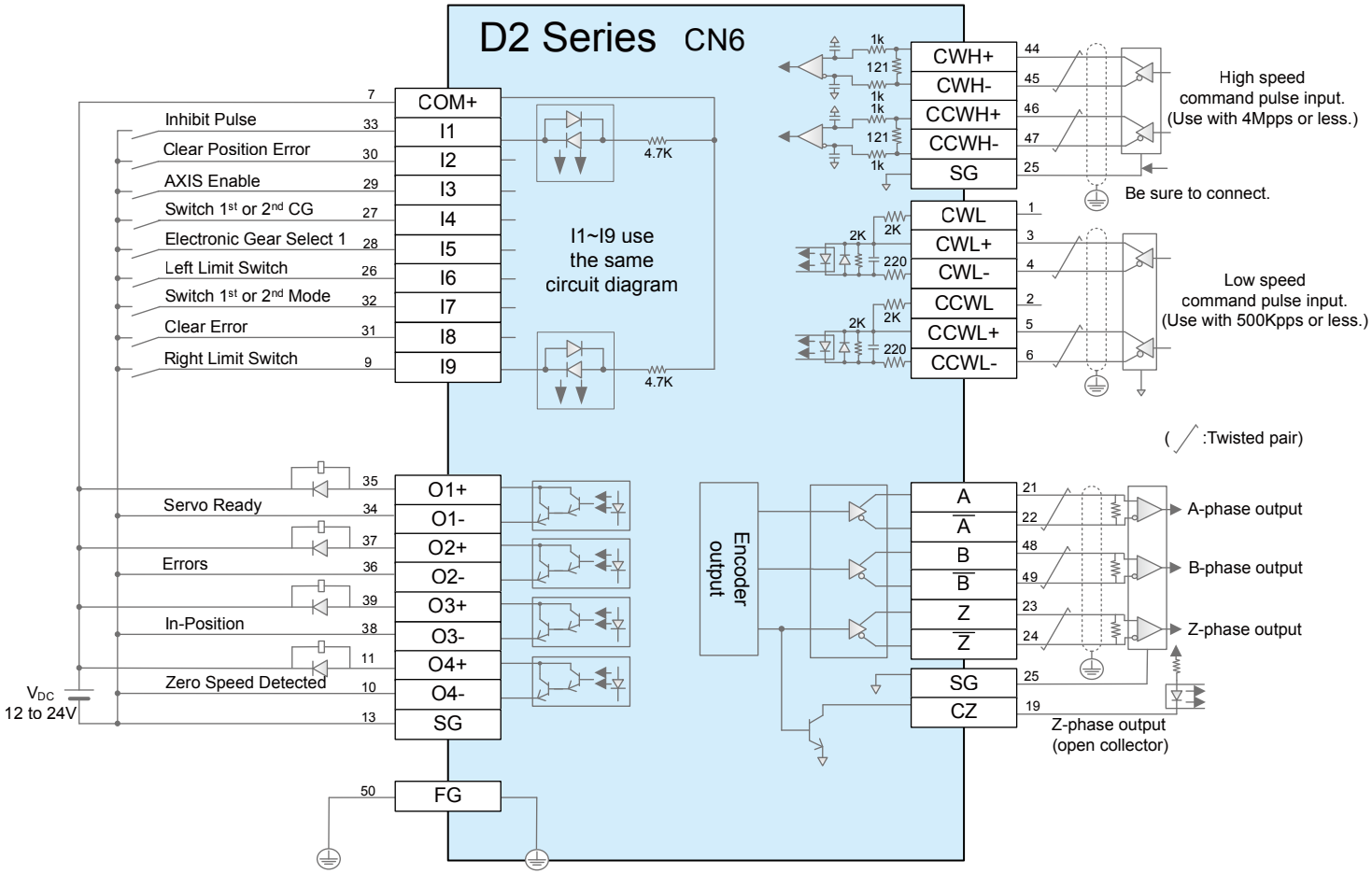
B. Three-phase(Brake without relay, using HIWIN motor)



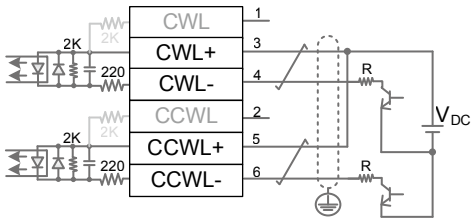
--------- : Optional connected(Brake, Regen)

1.3 Control circuit

A. Wiring Example of Position Control Mode



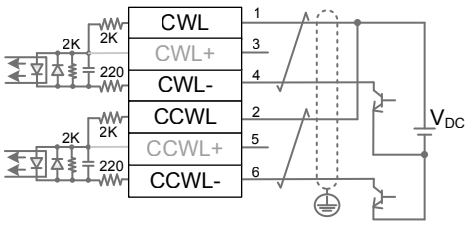
Low speed command pulse input.(Use with 500Kpps or less.)



V_{DC}	Specifications of R
12V	1k ohm 1/2 W
24V	2k ohm 1/2 W

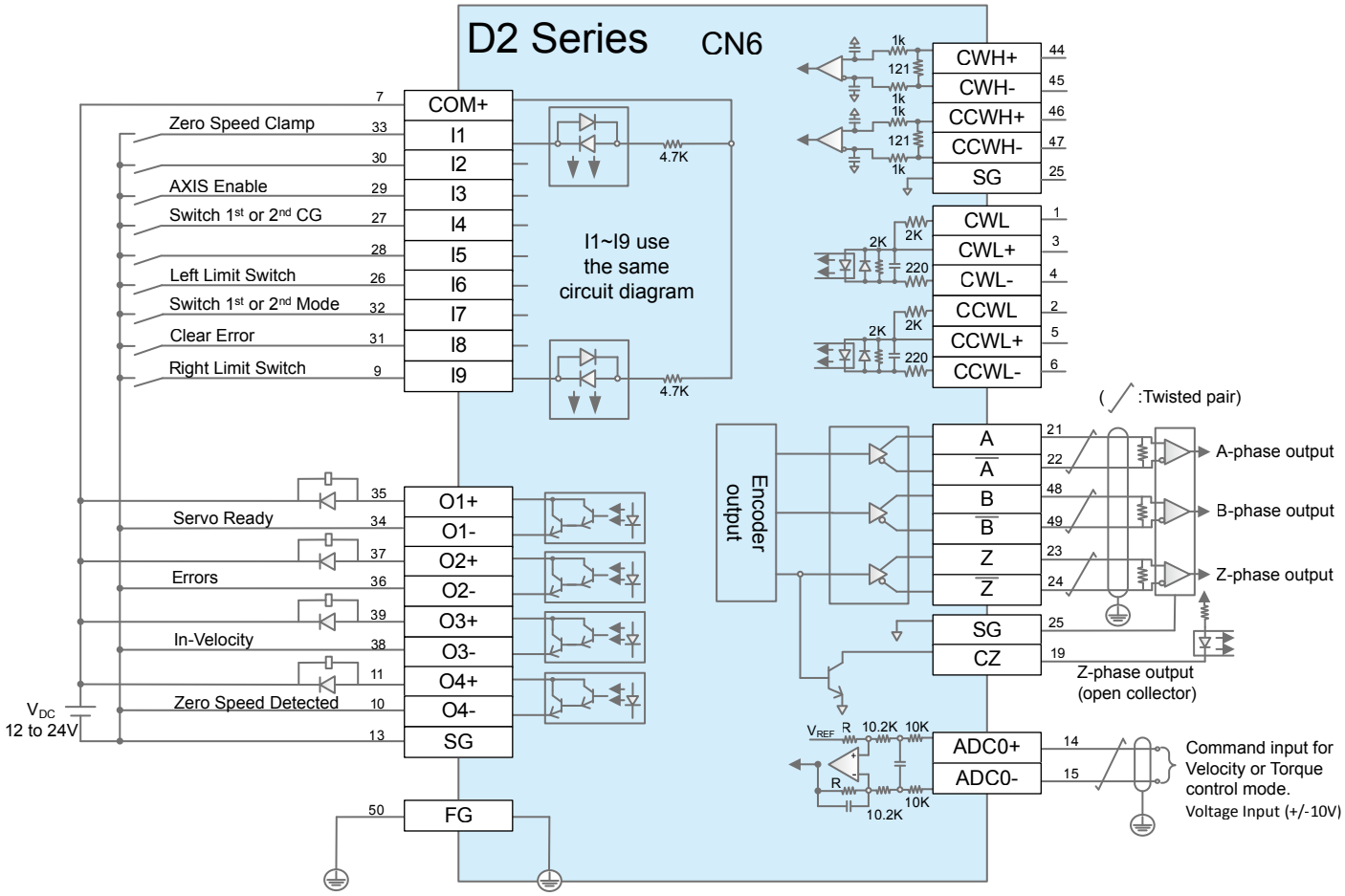
$$\frac{V_{DC} - 1.5}{R + 220} \approx 10mA$$

(1) When you use the external resistor with 12V and 24V power supply



(2) When you do not use the external resistor with 24V power supply

B. Wiring Example of Velocity/Torque Control Mode



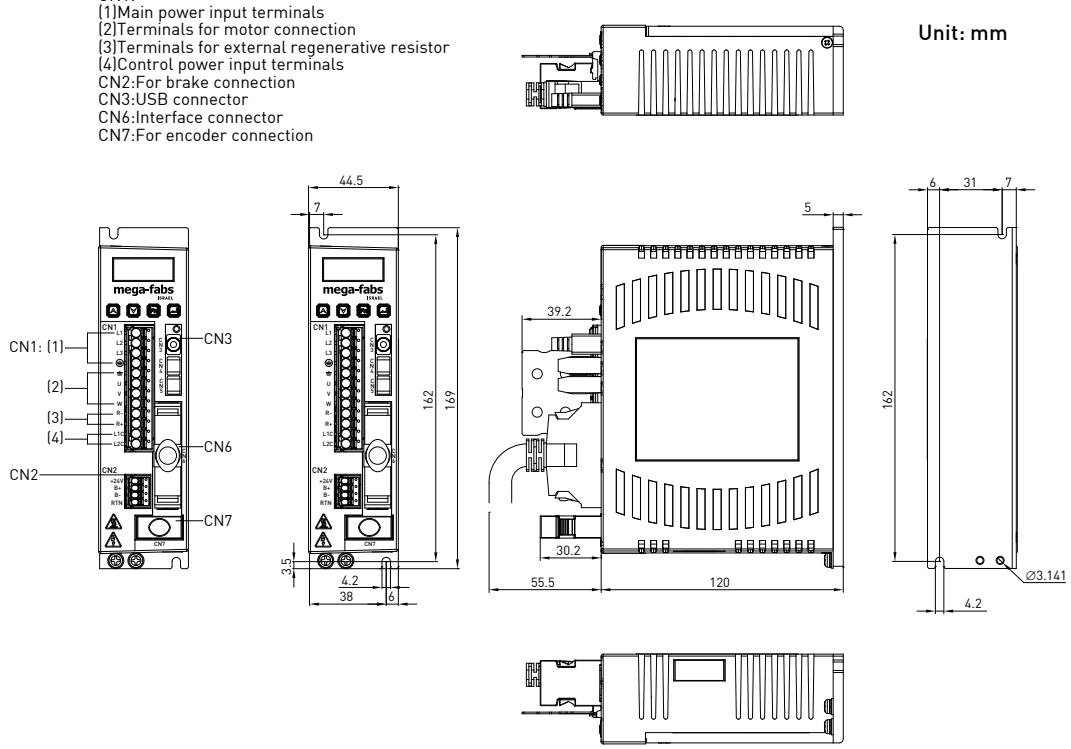
Velocity and Torque control Mode use the ADC0+(14) and ADC0-(15).
(Velocity and Torque control Mode must be enable from software(lightening)

1.4 Dimensions of drive

Frame A

CN1:
(1)Main power input terminals
(2)Terminals for motor connection
(3)Terminals for external regenerative resistor
(4)Control power input terminals
CN2:For brake connection
CN3:USB connector
CN6:Interface connector
CN7:For encoder connection

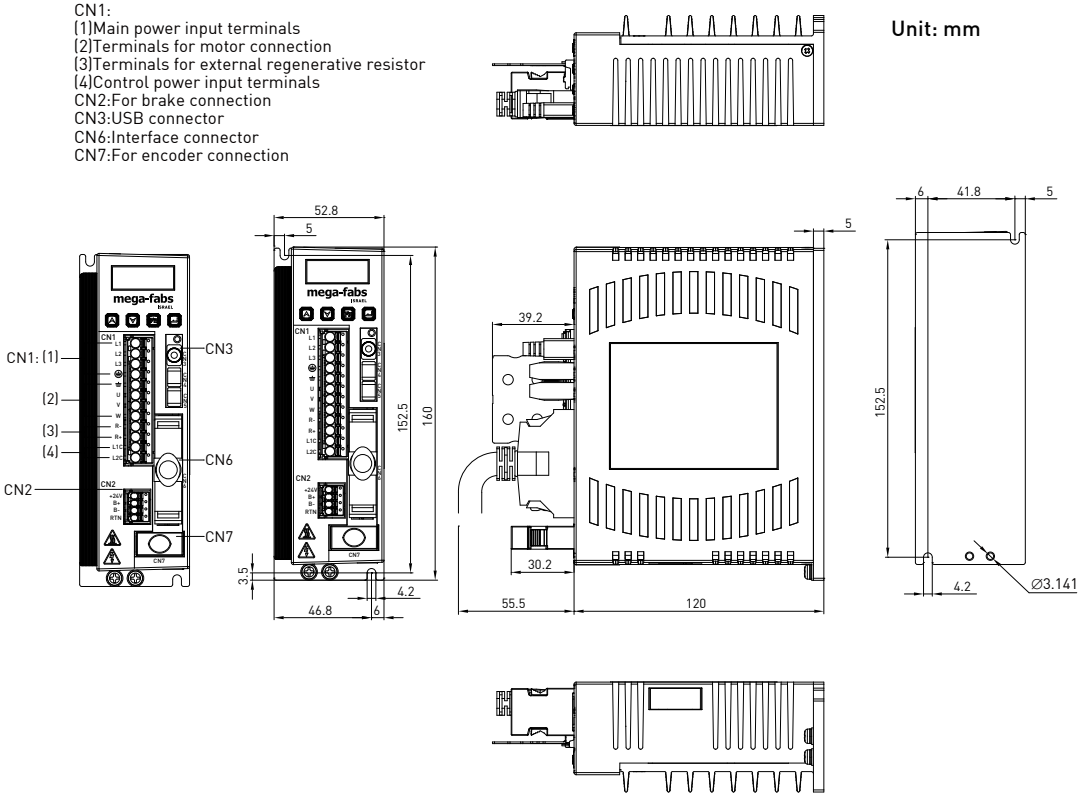
Unit: mm



Frame B

CN1:
(1)Main power input terminals
(2)Terminals for motor connection
(3)Terminals for external regenerative resistor
(4)Control power input terminals
CN2:For brake connection
CN3:USB connector
CN6:Interface connector
CN7:For encoder connection

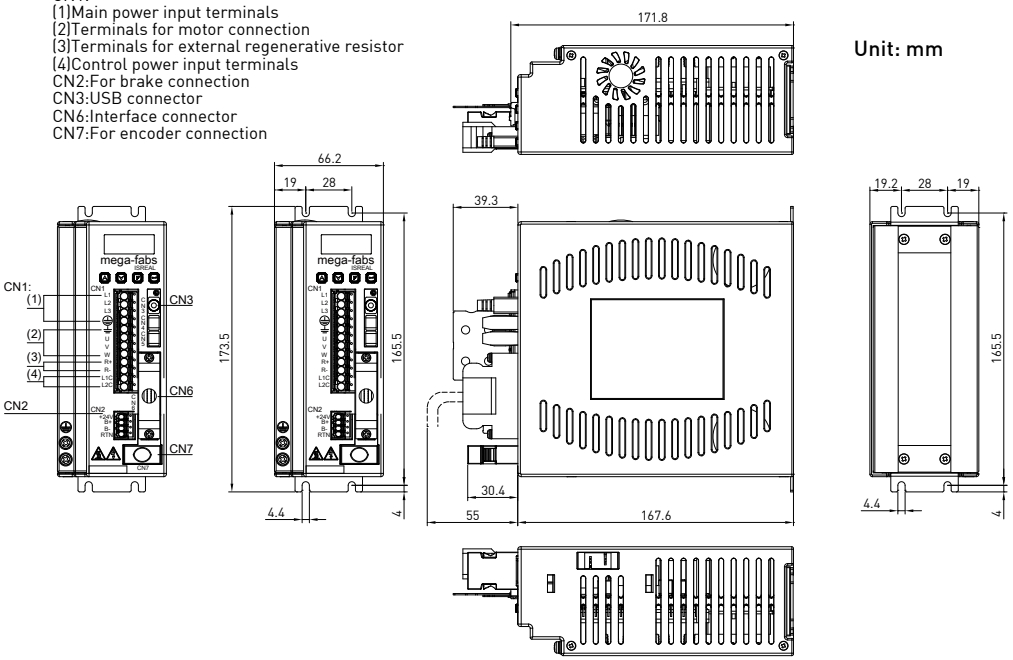
Unit: mm



Frame C

CN1:
(1)Main power input terminals
(2)Terminals for motor connection
(3)Terminals for external regenerative resistor
(4)Control power input terminals
CN2:For brake connection
CN3:USB connector
CN6:Interface connector
CN7:For encoder connection

Unit: mm



1.5 Composition of Peripheral Equipments

Connector Kit

Part Name	Model	Description	Quantity
D2 drive connectors	D2-CK3	CN1: AC power, motor power, Regen resistor and control power connector: 12 pins, pitch 5mm. Wago 721-112/026-000	1
		CN2: Brake connector: 4pins, pitch 3.5mm. Wago734-104	1
		CN6: Control signal connector: 50 pins welded type. 3M 10150-3000PE+10350-52A0-008	1
		CN1 connector fixture: Wago 231-131	1
		CN2 connector fixture: Wago 734-230	1

EMC Accessory Pack

Part Name	Model	Description	Quantity
D2 EMC accessory pack for single phase	D2-EMC1	Single phase filter FN2090-6-06 for 50W to 400W (Rated current:6A, leakage current: 0.67mA)	1
		EMI core KCF-130-B	2
	D2-EMC3	Single phase filter FN2090-10-06 for 750W and 1KW (Rated current:10A, leakage current: 0.67mA)	1
		EMI core KCF-130-B	2
D2 EMC accessory pack for three phase	D2-EMC2	Three phase filter FN3025HL-20-71 (Rated current:20A, leakage current:0.4mA)	1
		EMI core KCF-130-B	2

EMI core for all cables.(power cable, motor cable, encoder cable and control signal cable)

Regenerative Resistor

Part Name	Model	Description
Regenerative resistor	050100700001	68Ω. Rated power 100W and peak 500W

Motor line-up/ Environment

Motor			Voltage	Rated Output (W)	Rated Rotational Speed(Max Speed)(rpm)	Rotary Encoder		Enclosure Rating	Environment
						13-bit	17-bit		
Low Inertia	FRLS		220V	50W	3000 4500	◎	◎	IP54/IP65	**Ambient Temperature:** 0˚C~40˚C **Storage Temperature:** -15˚C~70˚C **Ambient Humidity:** 80% RH down **Storage Humidity:** 80% RH down **Storage Environment:** Indoor & keep off Causticity gas, Inflammable gas, oil and dust **Elevation:** 1000m down **Vibration Resistance:** 49m/s^2 down
			220V	100W	3000 4500	◎	◎		
			220V	200W	3000 4500	◎	◎		
			220V	400W	3000 4500	◎	◎		
Middle Inertia	FRMS		220V	750W	3000 4500	◎	◎		
	FRMM		220V	1000W	2000 3000	◎	◎	IP54/IP65	

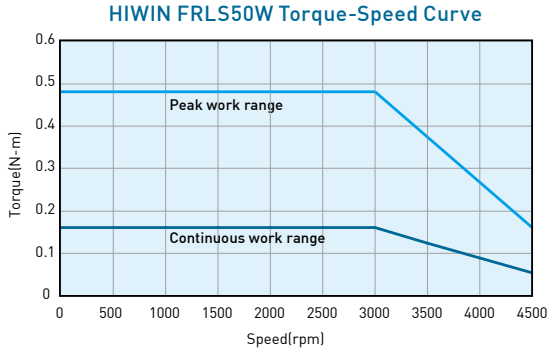
2.1 Model of AC Servo motor

AC 50W (Low inertia, Small capacity)

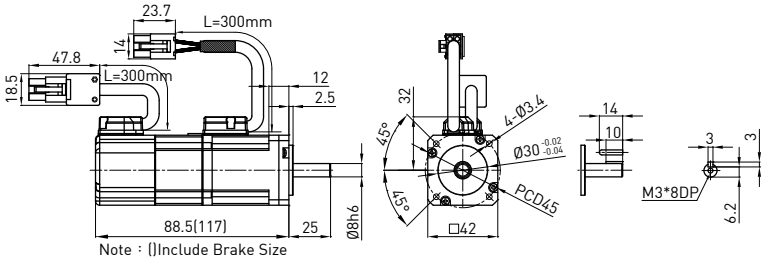
● Specification

Parameter	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-m²(×10⁻⁴)	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 protect	Total enclosed, self-cooled, IP54/IP65 (Except for shaft and connector)		

● Torque-Speed Curve



● Dimensions



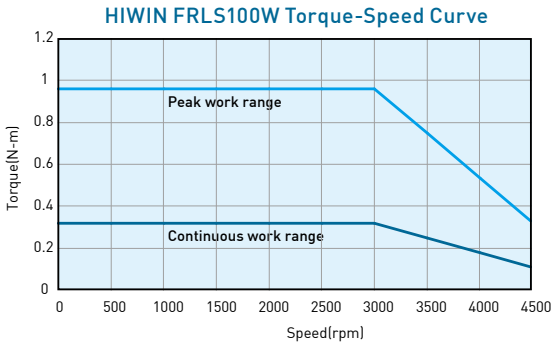
Note：()Include Brake Size

AC 100W (Low inertia, Small capacity)

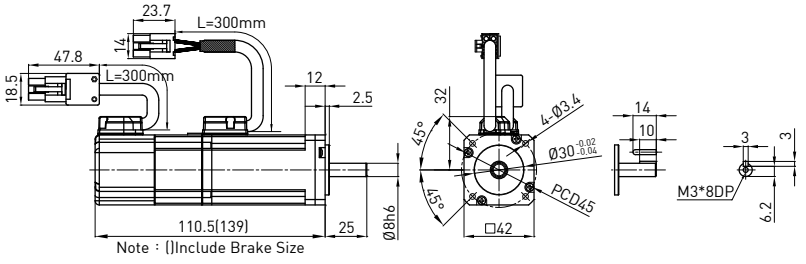
Specification

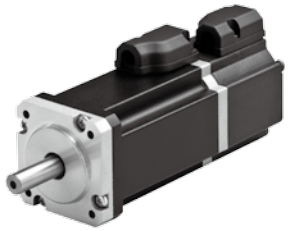
Parameter	Symbol	Unit	FRLS102□□A4□
Driver Input Voltage	V	V	AC220
Rated Power	W	W	100
Rated Torque	Tc	N.m	0.32
Rated Current	Ic	A(rms)	0.9
Peak Max. Torque	Tp	N.m	0.96
Peak Max. Current	Ip	A(rms)	2.7
Rated Speed	ωc	rpm	3000
No Load Max. Speed	ωp	rpm	4500
Torque Constant	Kt	N.m / Arms	0.356
Back EMF Constant	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(×10⁻⁴)	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 protect	Total enclosed, self-cooled, IP54/IP65 (Except for shaft and connector)		

Torque-Speed Curve



Dimensions



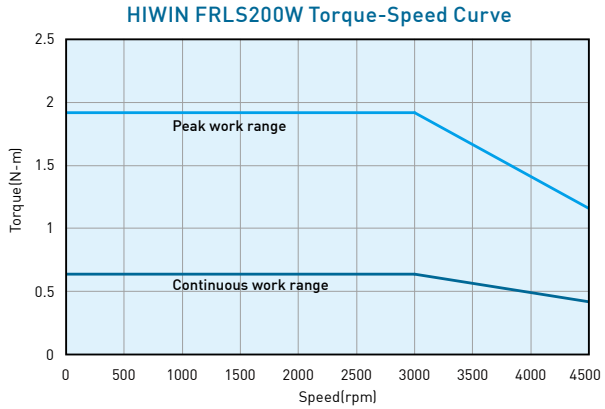


AC 200W (Low inertia, Small capacity)

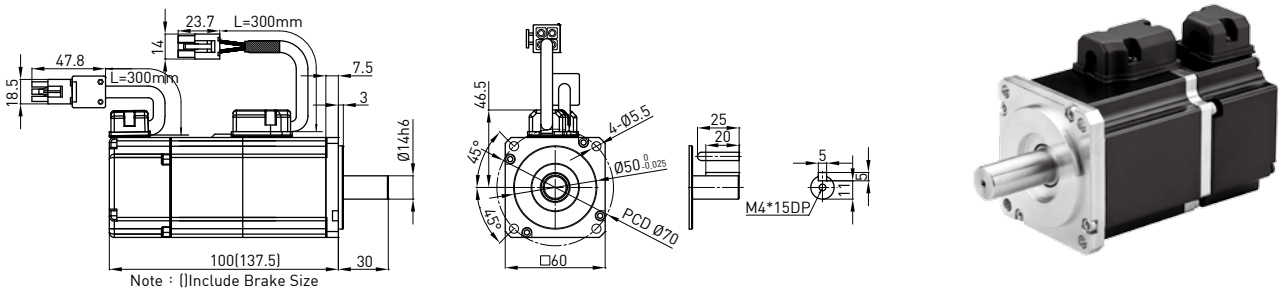
Specification

Parameter	Symbol	Unit	FRLS202□□06□
Driver 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-m²(×10⁻⁴)	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 protect	Total enclosed, self-cooled, IP54/IP65 (Except for shaft and connector)		

Torque-Speed Curve



Dimensions

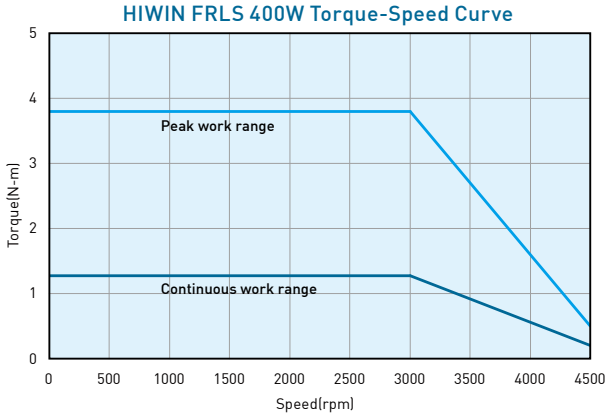


AC 400W (Low inertia, Small capacity)

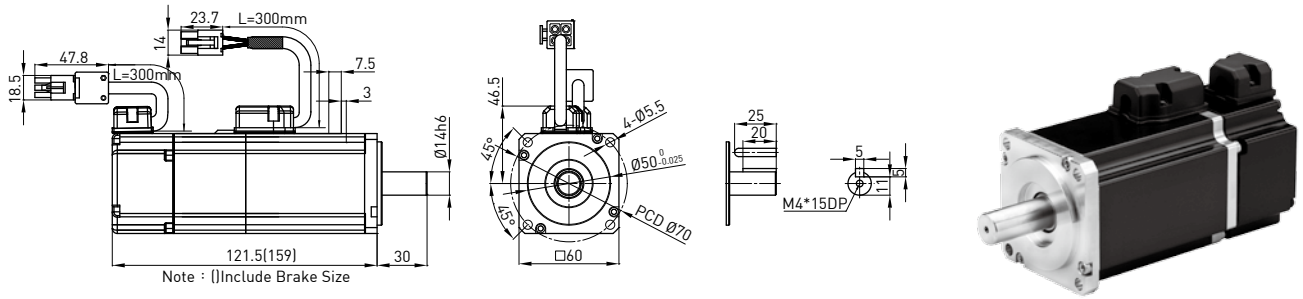
Specification

Parameter	Symbol	Unit	FRLS402□□06□
Driver 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-m²(×10⁻⁴)	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 protect	Total enclosed, self-cooled, IP54/IP65 (Except for shaft and connector)		

Torque-Speed Curve



Dimensions

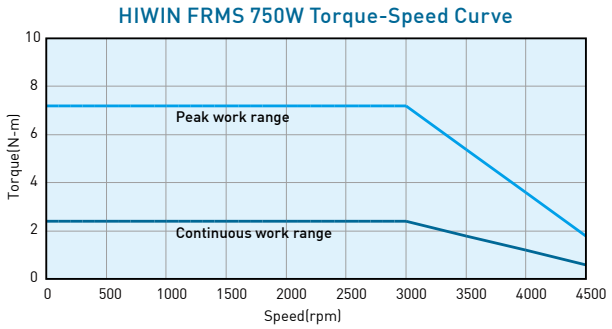


AC 750W (Middle inertia, Small capacity)

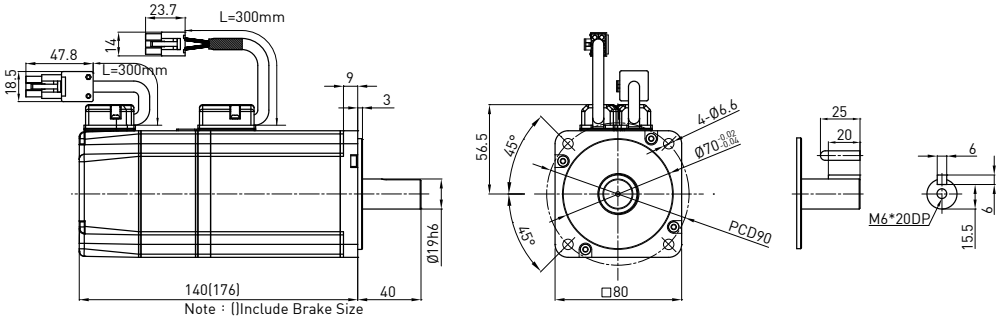
Specification

	Symbol	Unit	FRMS752□□08□
Driver 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-m²(×10⁻⁴)	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 protect	Total enclosed, self-cooled, IP54/IP65 (Except for shaft and connector)		

Torque-Speed Curve



Dimensions

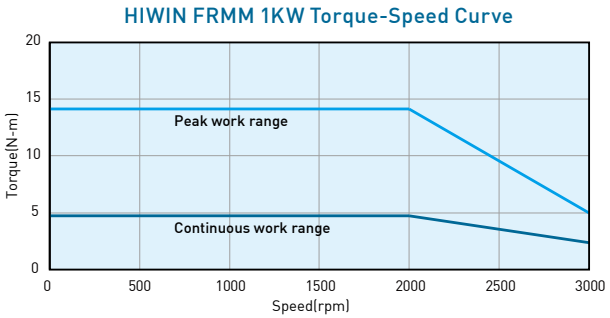


AC 1KW (Middle inertia, Middle capacity)

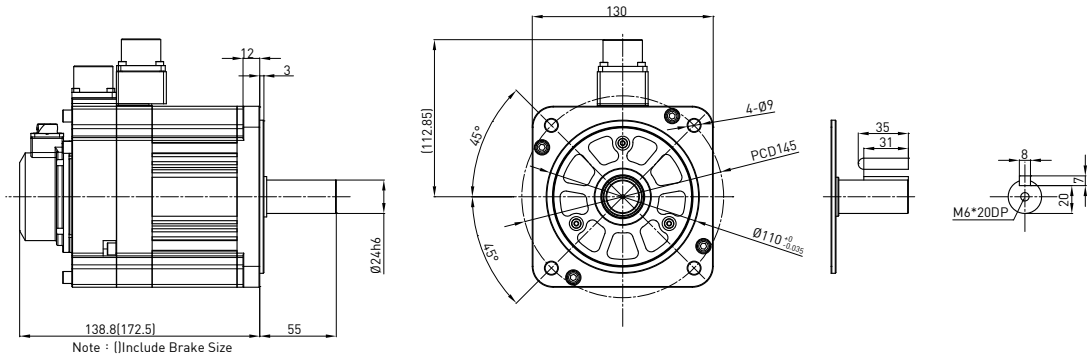
Specification

	Symbol	Unit	FRMM1K2□□13□
Driver Input Voltage	V	V	AC220
Rated Power	W	W	1000
Rated Torque	Tc	N.m	4.77
Rated Current	Ic	A(rms)	5.1
Peak Max. Torque	Tp	N.m	14.3
Peak Max. Current	Ip	A(rms)	15.3
Rated Speed	ωc	rpm	2000
No Load Max. Speed	ωp	rpm	3000
Torque Constant	Kt	N.m / Arms	0.94
Back EMF Constant	Ke	Vrms / krpm	54.7
Resistance (line to line)	R	Ω	0.81
Inductance (line to line)	L	mH	8
Inertia of Rotating Parts (with brake)	J	kg-m²(×10⁻⁴)	7.6(8.7)
Weight(with brake)	M	kg	5.4(6.2)
Brake Keep Torque	Tb	N.m	10
Brake Voltage	V	V	DC24±10%
Motor Insulation Grade	Class A		
Motor protect	Total enclosed, self-cooled, IP54/IP65 (Except for shaft and connector)		

Torque-Speed Curve



Dimensions



2.2 Encoder Type

13-bit Incremental

Encoder Specification

- 10000 pulse/rev
- Work temperature for -20°C~+85°C.
- 200KHz frequency response.
- Work voltage DC+5V±5%.
- RoHs.

17-bit Incremental

Encoder Specification

- 131072 pulse/rev
- Work temperature for -10°C~ +85°C.
- 13MHz frequency response.
- Work voltage DC+5V±5%.
- RoHs.

2.3 Motor Power Connector & Encoder Connector

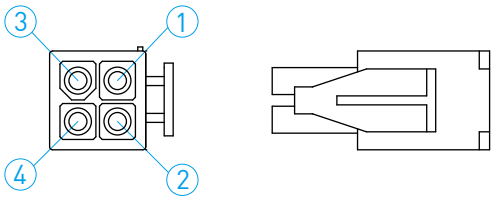
2.3.1 Motor Power Connector

● Small Capacity Series(AC50W~AC750W)

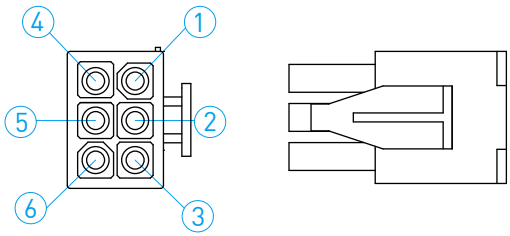
Signal	Color	AMP-172167-1 (without brake)	AMP-172168-1 (with brake)
U	Red	3	3
V	White	2	2
W	Black	1	1
GND	Green	4	4
B+	Black	--	5
B-	White	--	6

Connect Pins Position Definition(without brake & with brake)

AMP-172167-1(without brake)



AMP-172168-1(with brake)

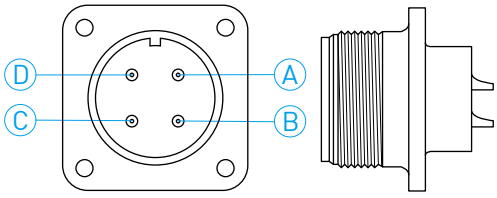


● Middle Capacity Series(AC1KW)

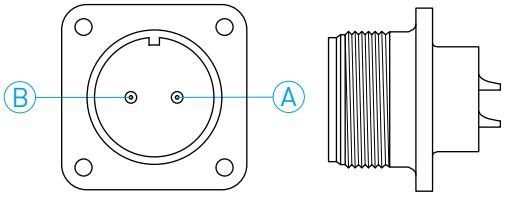
Signal	Color	MS3102A18-10P	MS3102A14-9P
U	Red	A	--
V	White	B	--
W	Black	C	--
GND	Green	D	--
B+	Black	--	A
B-	Black	--	B

Connect Pins Position Definition(without brake & with brake)

MS3102A18-10P



MS3102A14-9P



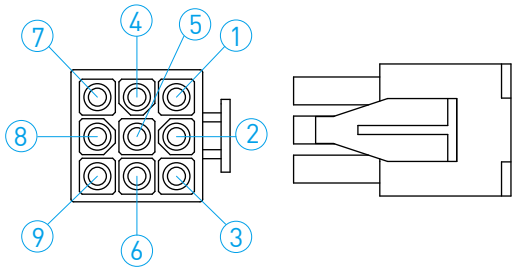
Note: By brake Type, two connectors must be used simultaneously

2.3.2 Encoder Connector

13-bit Incremental : AC50W~AC750W

Function	Signal		AMP-172169-1
Power	5V±5%		1
	0V		2
Incremental Signal	A	+	3
	A	-	4
	B	+	5
	B	-	6
Reference signal	Z	+	7
	Z	-	8
Shielding	Shielding		9

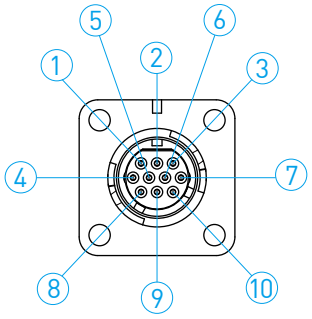
AMP-172169-1



13-bit Incremental : AC1KW

Function	Signal		HR34B-12WRA-10P
Power	5V±5%		1
	0V		2
Incremental Signal	A	+	3
	A	-	4
	B	+	5
	B	-	6
Reference signal	Z	+	7
	Z	-	8
Shielding	Shielding		9

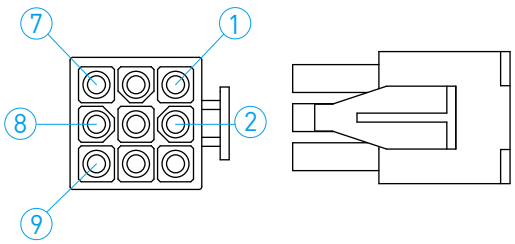
HR34B-12WRA-10P



17-bit Incremental encoder : AC50W~AC750W

Function	Signal		AMP-1-172169-9
Power	5V±5%		1
	0V		2
Serial Data Signal	SD	+	7
	$\overline{SD}$	-	8
Shielding	Shielding		9

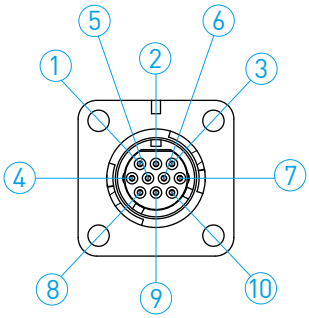
AMP-1-172169-9



17-bit Incremental encoder : AC50W~AC750W

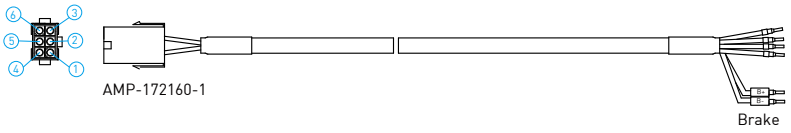
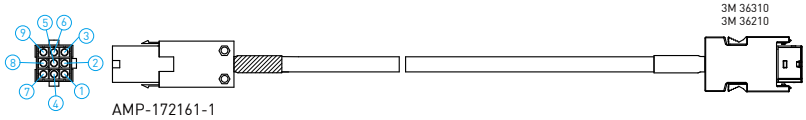
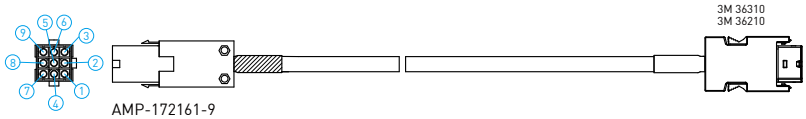
Function	Signal		HR34B-12WRA-10P
Power	5V±5%		1
	0V		2
Serial Data Signal	SD	+	7
	$\overline{SD}$	-	8
Shielding	Shielding		9

HR34B-12WRA-10P

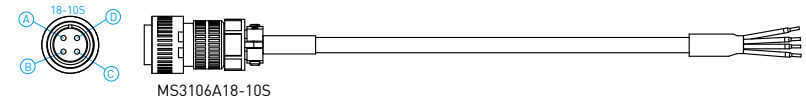
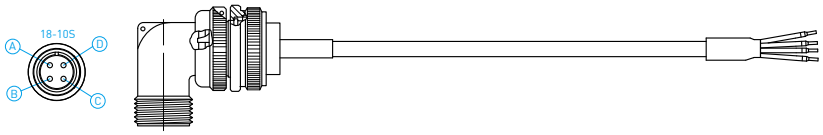
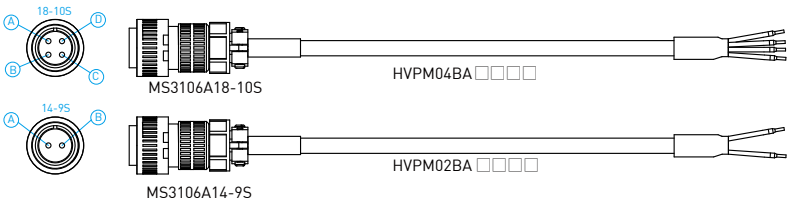
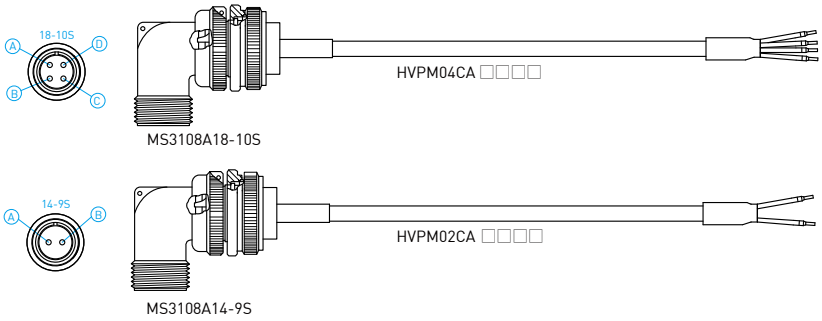
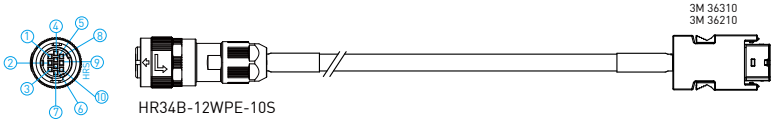
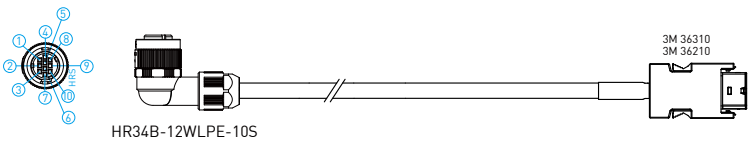
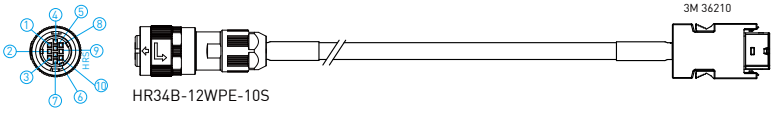
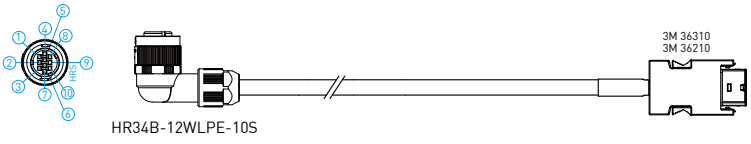


2.4 AC Servo Motor Accessories

Small Capacity

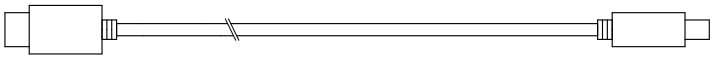
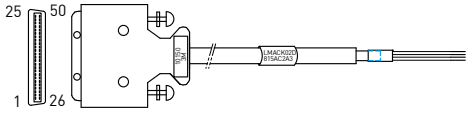
Name	Type	Connect	Description
AC Servo Motor Power Cable	HVPS04AA□□□A HVPS04AA□□□B (highly bendable)	CN1	
AC Servo Motor Power Cable (Brake)	HVPS06AA□□□A HVPS06AA□□□B (highly bendable)		
AC Servo Motor Encoder Cable (13bit-Incremental)	HVE13IAA□□□A HVE13IAA□□□B (highly bendable)	CN7	
AC Servo Motor Encoder Cable (17bit-Incremental)	HVE17IAA□□□A HVE17IAA□□□B (highly bendable)		

Middle Capacity

Name	Type	Connect	Description
AC Servo Motor Power Cable	HVPM04BA□□□A HVPM04BA□□□B (Highly Bendable)	CN1	
	HVPM04CA□□□A HVPM04CA□□□B (Highly Bendable)		
AC Servo Motor Power Cable (with brake)	HVPM06BA□□□A HVPM06BA□□□B (Highly Bendable)	CN1	
	HVPM06CA□□□A HVPM06CA□□□B (Highly Bendable)		
AC Servo Motor Encoder Cable (13bit-Incremental)	HVE13IBA□□□A HVE13IBA□□□B (Highly Bendable)	CN7	
	HVE13ICA□□□A HVE13ICA□□□B (Highly Bendable)		
AC Servo Motor Encoder Cable (17bit-Incremental)	HVE17IBA□□□A HVE17IBA□□□B (Highly Bendable)		
	HVE17ICA□□□A HVE17ICA□□□B (Highly Bendable)		

Note: For middle capacity motors with brake, please remember to use power cable and brake cable simultaneously.

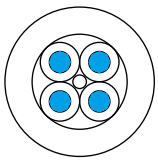
Drive Cable

Name	Type	Connect	Description
Mini USB Cable	051700800366	CN3	
Interface Cable	HE00815AC200	CN6	

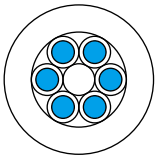
2.5 Power External Cables & Encoder External Cables

2.5.1 Power Cables

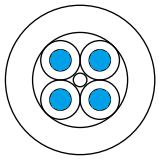
Cable Specification : For Small Capacity type(without brake)

Items	HVPS04AA□□□A	HVPS04AA□□□B
Specification	UL2517(Rated Tem. :105℃) AWG18×4C	UL2517(Rated Tem. :105℃ AWG18×4C
Finished Dimensions	8.0 dia. mm	
Internal Configuration		
Standard Length	Cable Length:3m, 5m, 7m, 10m	

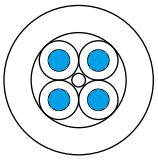
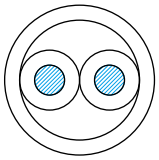
Cable Specification : For Small Capacity type(with brake)

Items	HVPS06AA□□□A	HVPS06AA□□□B
Specification	UL2517(Rated Tem. :105℃) AWG18×6C	UL2517(Rated Tem. :105℃ AWG18×6C
Finished Dimensions	10.0 dia. mm	
Internal Configuration		
Standard Length	Cable Length:3m, 5m, 7m, 10m	

Cable Specification : For Middle Capacity type(without brake)

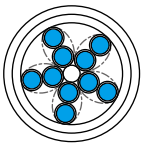
Items	HVPS04BA□□□A	HVPS04BA□□□B
Specification	UL2586(Rated Tem. :105℃) AWG14×4C	UL2586(Rated Tem. :105℃ AWG14×4C
Finished Dimensions	10.5 dia. mm	
Internal Configuration		
Standard Length	Cable Length:3m, 5m, 7m, 10m	

Cable Specification: For Middle Capacity(with brake)

Items	HVPM04□A□□□A HVPM04□A□□□B	HVPS02□A□□□A HVPS02□A□□□A
Specification	UL2586(Rated Tem. :105℃) AWG14×4C	UL2517(Rated Tem. :105℃) AWG18×2C
Finished Dimensions	10.5 dia. mm	7.0 dia. mm
Internal Configuration		
Standard Length	Cable Length:3m, 5m, 7m, 10m	

2.5.2 Encoder Cables

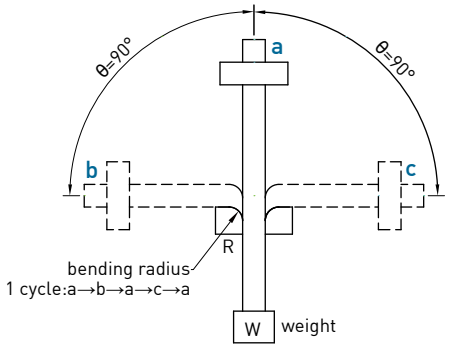
Cable Specification : For Small Capacity type

Items	HVE□□□AB□□□A	HVE□□□AB□□□B
Specification	UL2464(Rated Tem. :80℃) AWG24×5P	UL2464(Rated Tem. :80℃ AWG24×5P
Finished Dimensions	8.0 dia. mm	
Internal Configuration		
Standard Length	Cable Length:3m, 5m, 7m, 10m	

Cable Specification: For Middle Capacity type

Items	HVE□□□BB□□□A	HVE□□□BB□□□B
Specification	UL2464(Rated Tem. :80℃) AWG24×4P	UL2464(Rated Tem. :80℃ AWG24×4P
Finished Dimensions	7.0 dia. mm	
Internal Configuration		
Standard Length	Cable Length:3m, 5m, 7m, 10m	

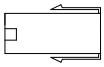
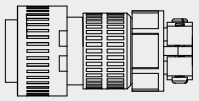
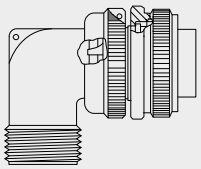
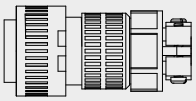
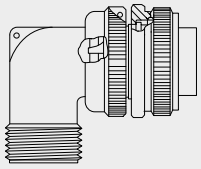
2.5.3 Highly Bendable Test

Testing Conditions	Bending Angle(θ)	Left-Right 90 degree
	Bending Radius(R)	Diameter of 12.5 times
	Bending velocity	30 times(one minute)
	Weight(W)	100 g
Bending Life	Number of bending(with weight)	3,000,000 cycles
	Number of bending(with no weight)	5,000,000 cycles
Highly Bendable Test		

Note: Bending life with the recommended bending radius R under the following testing conditions and the flexible test.

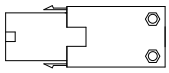
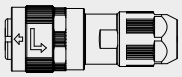
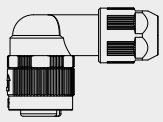
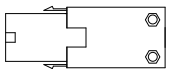
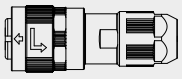
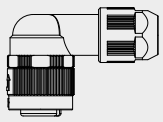
2.5.4 Table of selecting extension cables

● Power Extension Cable

Name	Servomotor Rate Output	Shape	Length	Order No.	
				Standard Type	Highly Bendable Type*
Power Extension Cable (without Brake)	50W~750W		3m	HVPS04AA03MA	HVPS04AA03MB
			5m	HVPS04AA05MA	HVPS04AA05MB
			7m	HVPS04AA07MA	HVPS04AA07MB
			10m	HVPS04AA10MA	HVPS04AA10MB
	1KW		3m	HVPM04BA03MA	HVPM04CA03MB
			5m	HVPM04BA05MA	HVPM04CA05MB
			7m	HVPM04BA07MA	HVPM04CA07MB
			10m	HVPM04BA10MA	HVPM04CA10MB
			3m	HVPM04CA03MA	HVPM04CA03MB
			5m	HVPM04CA05MA	HVPM04CA05MB
			7m	HVPM04CA07MA	HVPM04CA07MB
			10m	HVPM04CA10MA	HVPM04CA10MB
Power Extension Cable (with Brake)	50W~750W		3m	HVPS06AA03MA	HVPS06AA03MB
			5m	HVPS06AA05MA	HVPS06AA05MB
			7m	HVPS06AA07MA	HVPS06AA07MB
			10m	HVPS06AA10MA	HVPS06AA10MB
	1KW		3m	HVPM02BA03MA	HVPM06BA03MB
			5m	HVPM02BA05MA	HVPM06BA05MB
			7m	HVPM02BA07MA	HVPM06BA07MB
			10m	HVPM02BA10MA	HVPM06BA10MB
			3m	HVPM02CA03MA	HVPM06CA03MB
			5m	HVPM02CA05MA	HVPM06CA05MB
			7m	HVPM02CA07MA	HVPM06CA07MB
			10m	HVPM02CA10MA	HVPM06CA10MB

*1: Use Highly Bendable cables for movable sections such as robot arms.

Encoder Extension Cable

Name	Servomotor Rate Output	Shape	Length	Order No.	
				Standard Type	Highly Bendable Type*
13-bit Encoder Extension Cable	50W~750W		3m	HVE13IAB03MA	HVE13IAB03MB
			5m	HVE13IAB05MA	HVE13IAB05MB
			7m	HVE13IAB07MA	HVE13IAB07MB
			10m	HVE13IAB10MA	HVE13IAB10MB
	1KW		3m	HVE13IBB03MA	HVE13IBB03MB
			5m	HVE13IBB05MA	HVE13IBB05MB
			7m	HVE13IBB07MA	HVE13IBB07MB
			10m	HVE13IBB10MA	HVE13IBB10MB
			3m	HVE13ICB03MA	HVE13ICB03MB
			5m	HVE13ICB05MA	HVE13ICB05MB
			7m	HVE13ICB07MA	HVE13ICB07MB
			10m	HVE13ICB10MA	HVE13ICB10MB
17-bit Encoder Extension Cable	50W~750W		3m	HVE17IAB03MA	HVE17IAB03MB
			5m	HVE17IAB05MA	HVE17IAB05MB
			7m	HVE17IAB07MA	HVE17IAB07MB
			10m	HVE17IAB10MA	HVE17IAB10MB
	1KW		3m	HVE17IBB03MA	HVE17IBB03MB
			5m	HVE17IBB05MA	HVE17IBB05MB
			7m	HVE17IBB07MA	HVE17IBB07MB
			10m	HVE17IBB10MA	HVE17IBB10MB
			3m	HVE17ICB03MA	HVE17ICB03MB
			5m	HVE17ICB05MA	HVE17ICB05MB
			7m	HVE17ICB07MA	HVE17ICB07MB
			10m	HVE17ICB10MA	HVE17ICB10MB

*1: Use Highly Bendable cables for movable sections such as robot arms.

2.6 Safety Precautions

Thank you for purchasing HIWIN's AC servo motor. Installation and operation of the motor must be in accordance with the HIWIN manual. Before using the servo motor, please read these safety instructions and precautions carefully.

★ Unpacking instructions

1. Before using the servo motor, please read these safety instructions and precautions carefully. HIWIN is not responsible for any damage, accident, or injury caused by incorrect handling.
2. Examine the appearance of the motor for any unusual marks or damage from shipment.
3. Inspect the wires for damage.
4. Do not disassemble the motor. Since the product design has been based on structure calculations, computer simulations, and prototype testing, do not disassemble the product without the permission of HIWIN engineers.
5. Supervise children when handling this product.
6. People with psychosomatic illness or insufficient experience should not handle this product, unless under the direct supervision of managers or product narrators.

If any items are damaged or incorrect, please contact your distributor or HIWIN sales representative.

★ Safety instructions

1. The product can only be repaired by HIWIN engineers. Please send the product back to us if there is any unusual phenomenon.
2. Do not hold the motor by its wire harness or shaft.
3. Do not hit the motor or shaft. Shock can damage the encoder inside the motor.
4. Do not apply loads to the motor shaft that are in excess of the specified value.
5. Protect the motor and encoder from high electrical noise, vibration, and unusual temperatures.
6. Do not change the motor parts or disassemble the screws. HIWIN will not be responsible for any damages, injuries, or accidents that may occur.

★ Wiring instructions

1. Ensure the specified power input value before using the product, and verify that the proper power supply is being used.
2. Before operation, please ensure that the motor, brake, and encoder are connected correctly. Incorrect wiring may cause abnormal motor operation or even cause permanent damage to the motor.
3. To avoid voltage coupling and electrical noise on the encoder, ensure adequate separation of the motor power wires and the encoder wires.
4. Ensure that the motor ground wire is connected to the ground terminal on the servo drive.
5. Do not perform a dielectric voltage-withstand test on any encoder terminal. The test may cause damage to the encoder.

★ Operation instructions

1. Higher than maximum specified current may cause demagnetization of magnetic components inside the motor.
2. The AC servo motor is designed to operate through a dedicated servo drive. Do not connect to a commercial power source (100/200V AC, 50/60 HZ). The motor will not operate correctly and may cause permanent damage.
3. The motor must be operated within its specified range.
4. Attention should be given to ensure adequate cooling and ventilation of the motor during operation.
5. For long term use, the motor shaft should be resupplied with proper and sufficient oil during the period of operation.
6. If any abnormal odor, noise, smoke, temperature rise or vibration is detected, stop the motor immediately. Remove power from the servo drive and isolated the motor.

★ Motor International Standard

CE Certification

LVD：EN60034-1
EN60034-5

EMC：EN55011
EN61000-6-2
EN61000-6-4

★ Maintenance and Storage instructions

1. Do not store the product in an inflammable environment or that with chemical agents.
2. Store the product in a place without humidity, dust, harmful gases, or liquids.
3. The motor shaft opening is neither waterproof nor oil-proof. Do not install the motor in an environment where there is harmful gas, liquid, excessive moisture, or water vapor.
4. Do not store the servo motor where it will be subjected to vibration or shock in excess of the specified limit.
5. The storage and transportation temperature of this product: -10℃~+50℃
6. Clean：Wipe with Alcohol (70%)
7. Before shipping, the motor shaft is coated with antirust oil to protect the motor shaft against rust formation. However, the material of the motor shaft is not entirely rust-proof. When the motor storage time has exceeded six months, please inspect and examine the motor shaft and resupply with proper and sufficient antirust oil at least once every three months thereafter.
8. Product abandoned：Follow the local laws and regulations for recycling.

A one year guarantee is provided from the date of delivery. For product damage caused by improper operation (Please refer to the notes and instructions in this operation manual). HIWIN will not be held responsible for replacing or maintaining the product as a result of any natural disasters that may occur during this period.


Warning：For the proper use of the HIWIN AC servo motor read these safety precautions carefully before installation, operation, and maintenance.

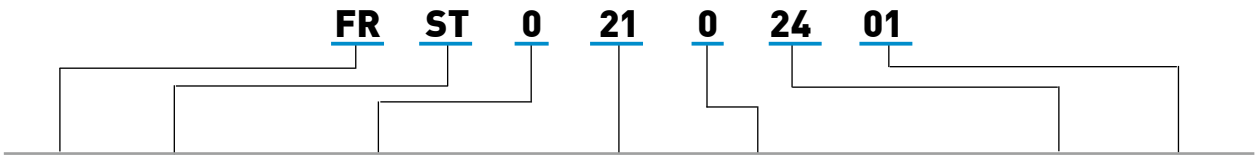

Warning：Do not touch when motor operating to avoid being scalded.

Caution：Please read these safety precautions before using the product.
Caution：Do not alter the instrument without the permission of the manufacturer.
Caution： Remove the broken power line buckle carefully.
Caution：The product cannot be used in an inflammable environment.
Caution：Remove the power before cleaning.
Caution：Overload cause motor temperature rising.
Caution：There may be potential difficulties in ensuring electromagnetic compatibility in other enviroments.
Caution：Do not knock shaft and encoder ends.

Stepping System

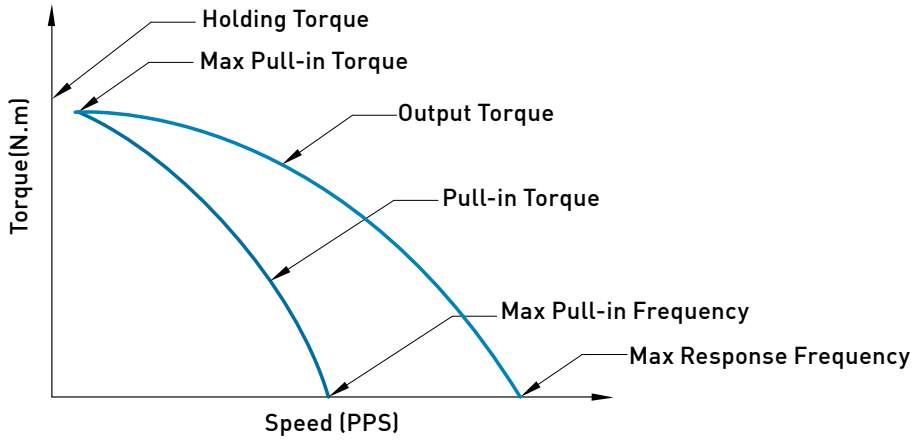
Two Phase Stepping Motor

Stepping Motor Ordering Information



Product	Model	Phase/Shaft	Type	Step Angle	Voltage	Serial number
Brushless Motor	ST: Stepping Motor	0 : 2S (2 phase/single axis) 1 : 2D (2 phase/double axis)	1X : ST40 2X : ST55	0 : F (stepping angle 1.8 meh.)	24V	01~99

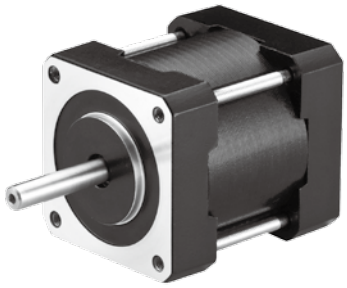
Characteristic Curves of Stepping Motor

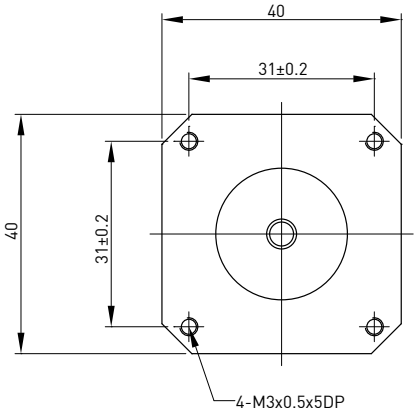


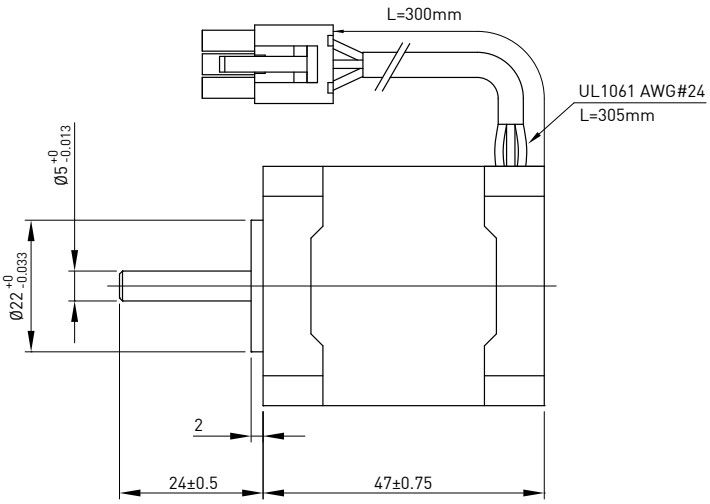
- **Pull-in Torque**
  It is the Max. torque that stepping motor and input signal are starting, stop synchronously. The range under of pull-in torque that motor can starting, stop synchronously and forward/reverse. The range is Starting rang oneself.
- **Max Pull-in Torque**
  It is the starting pulse frequency lower than 10 pps, the Max torque of stepping motor can input signal for starting, stop synchronously.
- **Max Pull-in Frequency**
  It is the Max input pulse rate of motor at no load that motor can stop, start in instant.
- **Max Pull-in Torque**
  It is the motor and input signal for work synchronously, but can't start ,stop in instant for Max torque. The torque larger than output torque that motor be not work. The output torque below and start torque above of region in the meantime, the motor can't start or stop in instant that region is call slew region. It must be relay start region oneself at start and stop in slew region, otherwise has out of set.
- **Max Response Frequency**
  The output torque is equal zero for Max input frequency in motor at no load that calls it. In instant the Motor can't start or stop at the moment.
- **Holding Torque**
  It is exerting max torque for extra add load to change rotor position in rotor keep motionless that motor stator winding is enable.

3.1 Model of Stepping Motor

40mm Step Angle 1.8° ST40 Series

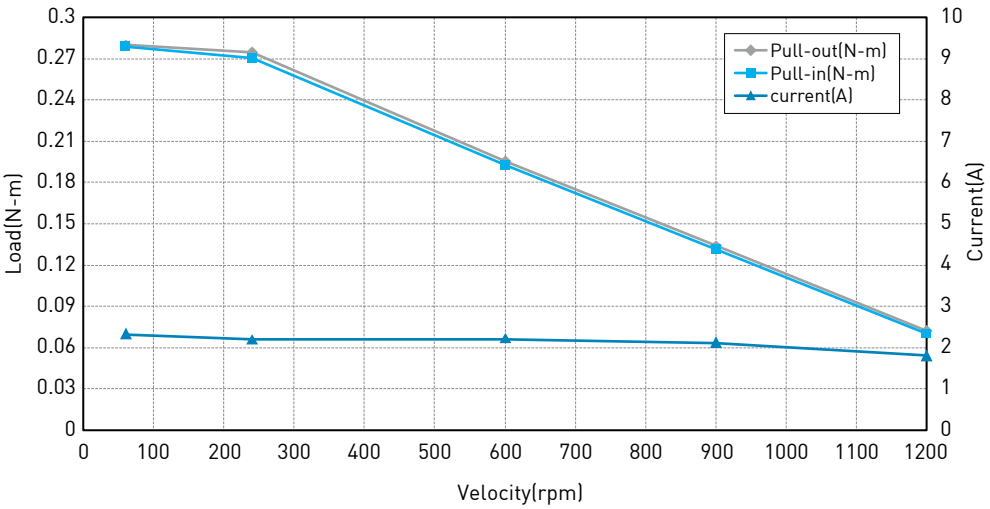




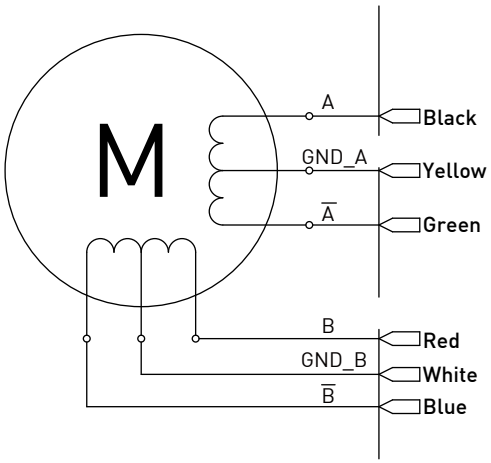


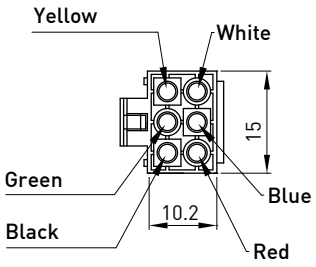
Model	Winding Type	Holding Torque	Current	Resistance	Inductance	Rotor Inertia	Leads	Motor Length	Input Voltage
Single axis		N.m	A/phase	Ω/phase	mH/phase	g-cm2		(L)mm	Vdc
FRST01102401	Single Pole	0.27	0.95	3.3	3.5	19	6	47	4

Torque- Speed Curve



Wiring Diagram

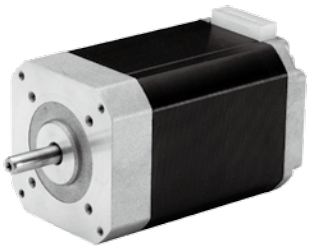


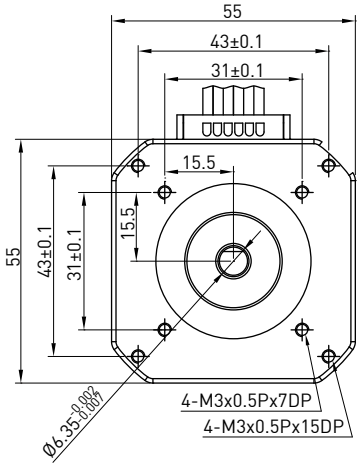


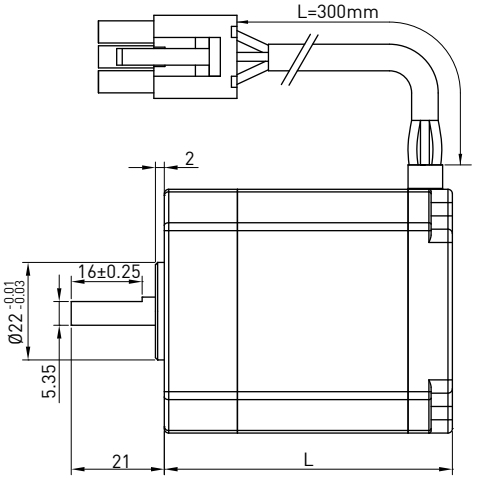
(6 Pin male connector)

Notice:
★ Please use the wire which is larger than 0.5㎜^{2} and as short as possible for power and motor connection.
★ Support 2 phase stepping motor (6 lead wire).

55mm Step Angle 1.8° ST55 Series



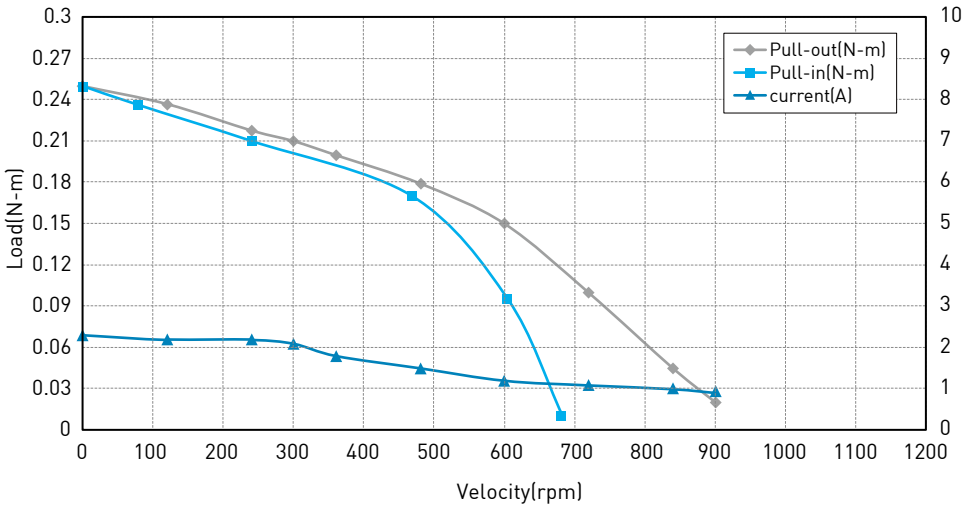




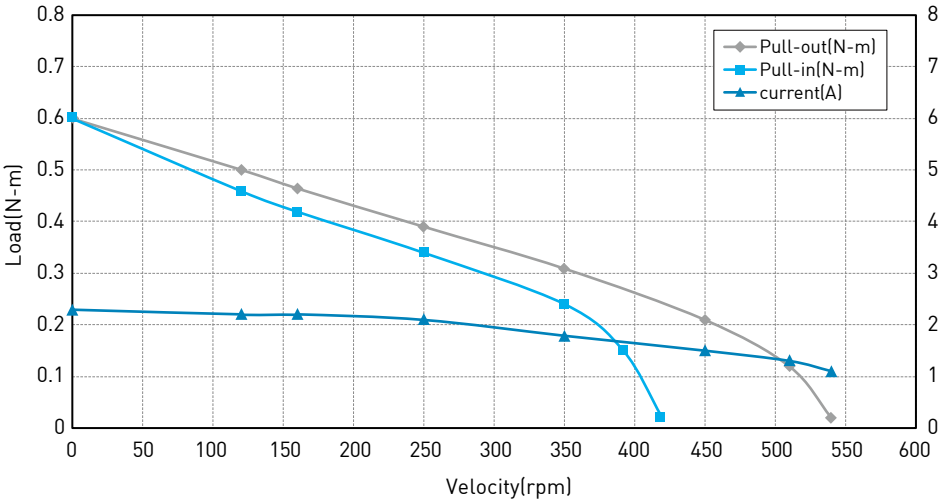
Model		Winding Type	Holding torque	Current	Resistance	Inductance	Rotor Inertia	Leads	Motor Length	Input Voltage
Single axis	Double axis		N.m	A/phase	Ω/phase	mH/phase	g-m2		(L)mm	Vdc
FRST02102401	FRST12102401	Single Pole	0.25	1.3	2.8	3.3	90	6	50.5	3
FRST02202401	FRST12202401	Single Pole	0.6	1.3	4.0	7.0	171	6	65	4
FRST02302401	FRST12302401	Single Pole	1.05	1.2	5.6	13.0	290	6	87	5.3

Torque- Speed Curve

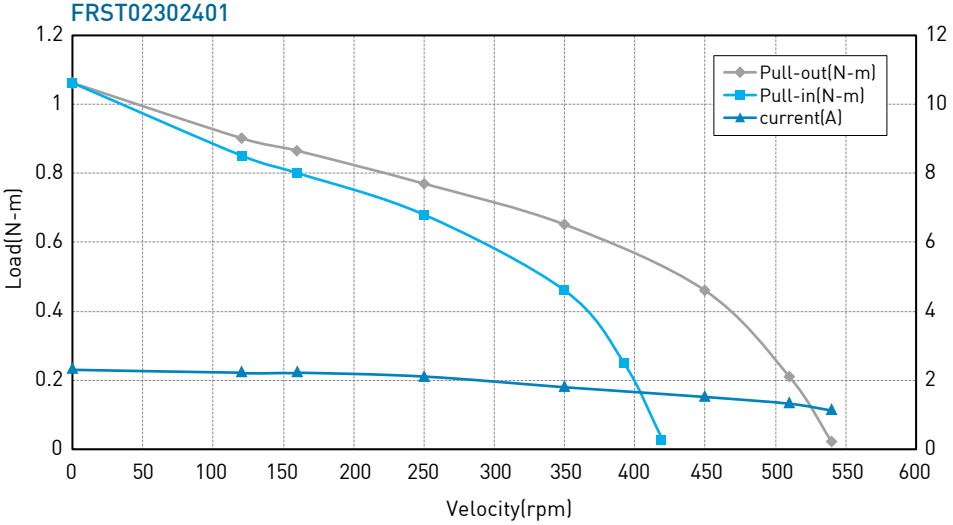
FRST02102401



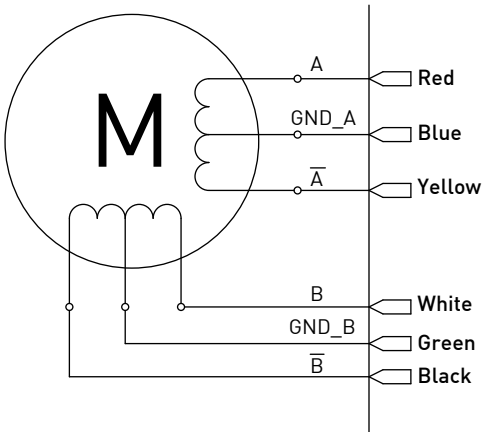
FRST02202401

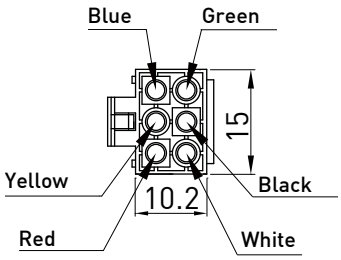


FRST02302401



Wiring Diagram





(6 Pin male connector)

Notice:
★ Please use the wire which is larger than 0.5㎜^{2} and as short as possible for power and motor connection.
★ Support 2 phase stepping motor (6 lead wire).

3.2 Model of Stepping Driver (STD-24A)

Specification

- 2 phase stepping motor (6 lead wire)
- Signal Pole current driver
- Micro-stepping driver function
- Constant output current 0.2A~2A
- Max Frequency response 150000Hz
- Support Pulse/Direction Pulse (1P)
- Support CW/CCW Pulse (2P)
- Support Quadrature Pulse (A/B)
- Additional Positive/Negative pole limit control
- Motor exciting release
- RoHS certificate
- CE safe characteristic

Connect and Setting

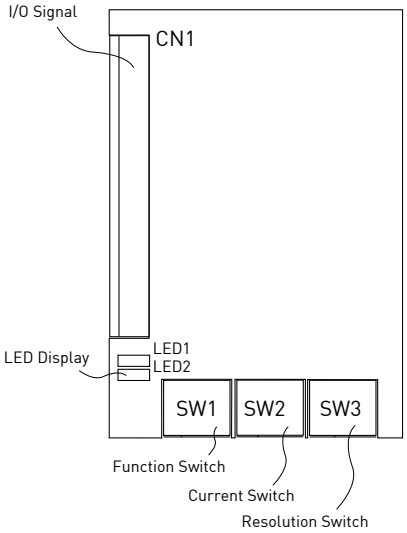
1. LED State

- LED display

Display	Color	function
LED1	Red	Power light
LED2	Green	State light

- State light Information

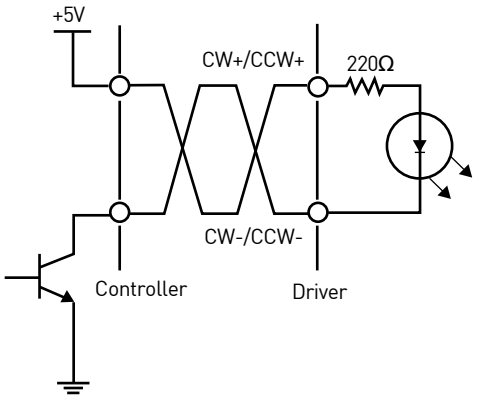
Drive State	LED State
Forward	low speed flash (0.5s/per)
Reverse	high speed flash (0.2s/per)
Limit Input	low speed flash (1s/per)
Exciting release	dark
Stand by	light

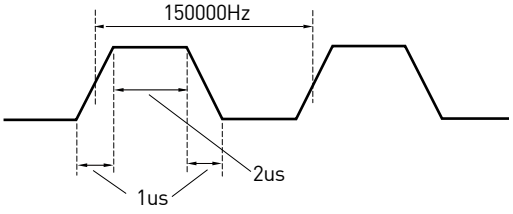


2. Input / Output

Interface	Pin	Input / Output	Mark
(CN1)	1	Power Input	DC24V
	2		Power Input
	3	Motor connect	COM A
	4	Motor connect	COM B
	5	Motor connect	A +
	6	Motor connect	A -
	7	Motor connect	B +
	8	Motor connect	B -
	9	Pulse single Input	CW -
	10	Pulse single Input	CW +
	11	Pulse single Input	CCW -
	12	Pulse single Input	CCW +
	13	Control single	MF
	14	Control single	LSF
	15	Control single	LSR
	16	No use	NC

Input Pulse Single Wiring Diagram





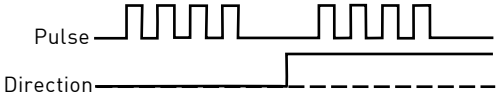
Notice:

※ Please use the wire which is larger than 0.5㎟ and as short as possible for power and motor connection.

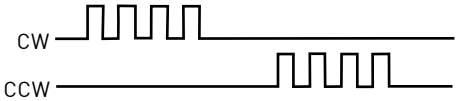
※ Pulse width please corresponds to the sketch.

※ These signal types are accepted by driver：

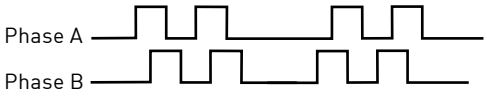
A. Pulse/Direction (1P)



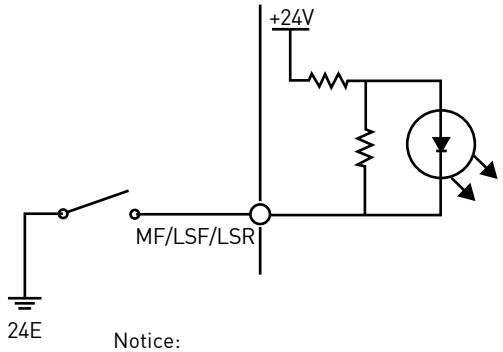
B. CW/CCW (2P)



C. Quadrature (A/B)

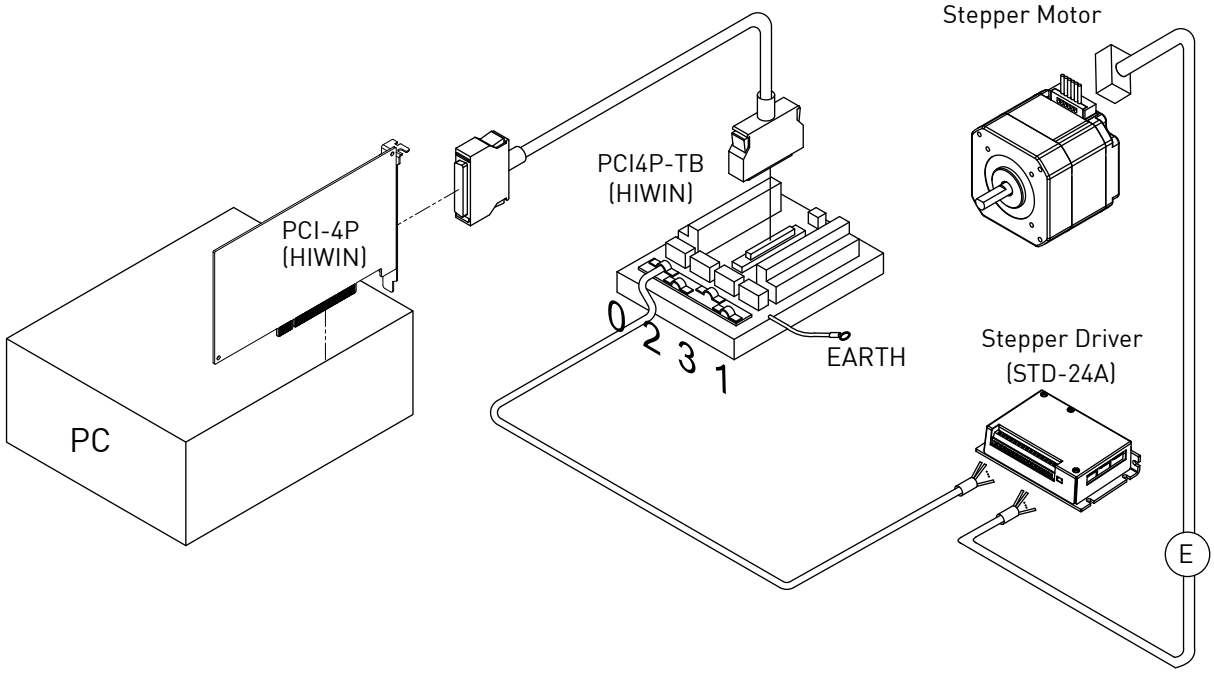


● Limit Input、Motor Disable Wiring Diagram

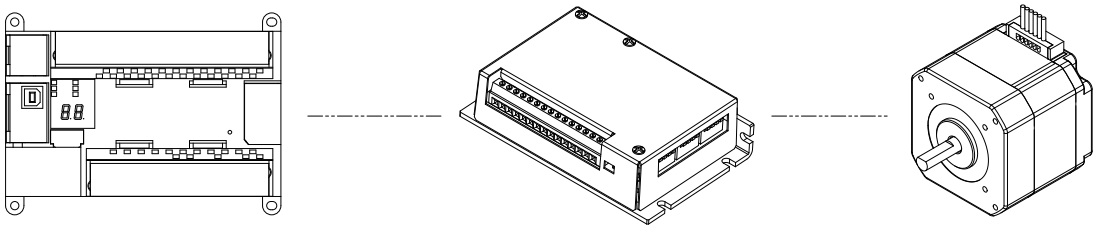


Notice:
※ The function was triggered by closing the switch (ON).
※ The forward limit signal is ON，motor will not rotate even receiving forward pulse command. Furthermore, The reverse limit signal is ON，motor will not rotate even receiving reverse pulse command.
※ Motor release signal is ON, exciting release.

HIWIN PCI-4P Wiring Example

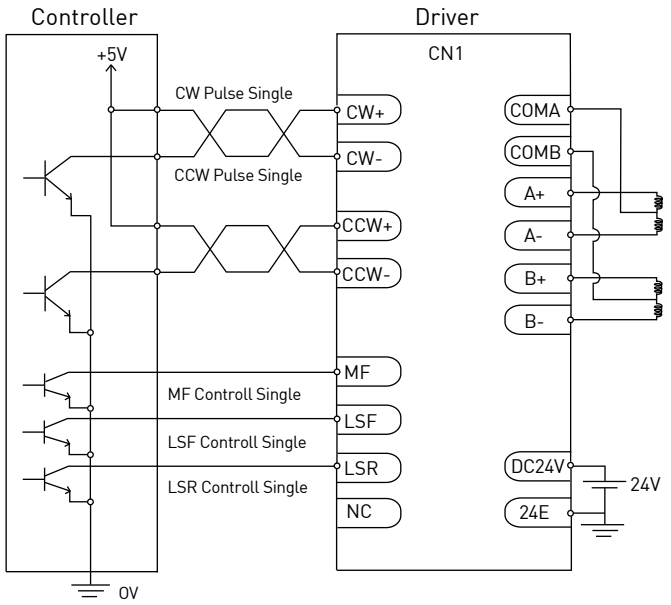


PLC Wiring Example



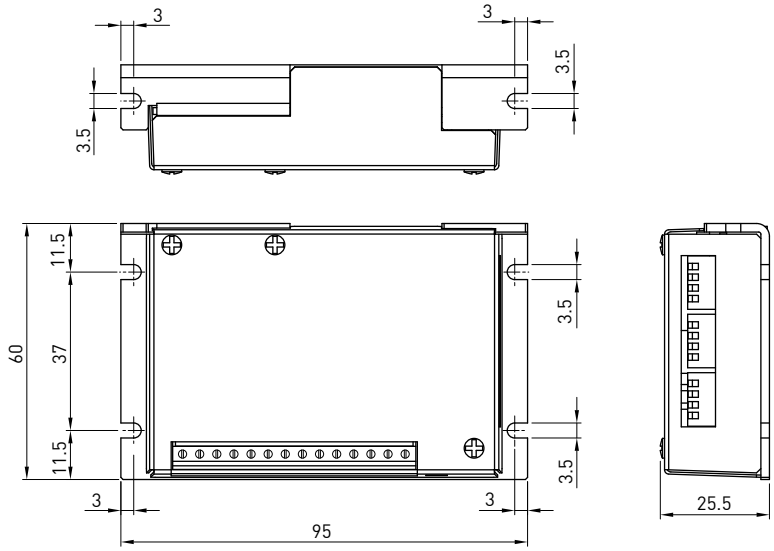
PLC Motion Controller　　Stepper Motor Driver (STD-24A)　　Stepper Motor

Connect Diagram

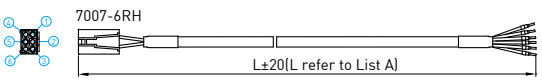


Notice:
※ Please input DC+5V pulse.
※ Please use twisted line or shading line as signal line which is as short as possible.

Size Diagram



Stepping Motor Accessories

Name	Type	Connect	Description	Signal	Color	7007-6RH	cord-end sleeve terminal
Ⓔ Stepping Motor External Cable	HV00FRSTP□□A	MOTOR OUTPUTS		COM A	Blue	1	COM A
				A-	Yellow	2	A-
				A+	Red	3	A+
				COM B	Green	4	COM B
				B-	Black	5	B-
				B+	White	6	B+

List A

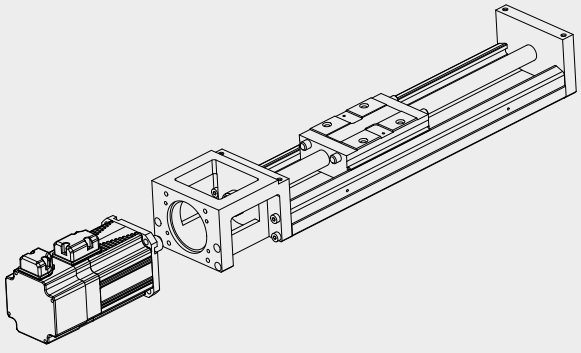
□□	30	50	70	A0
L (m)	3	5	7	10

HIWIN Robot and Motor adaptor Flange

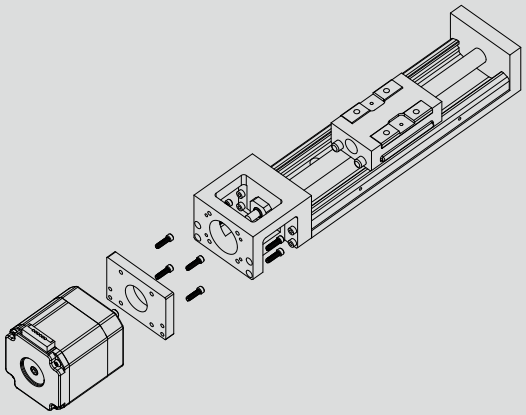
Motor Flange List

	Motor Type								
Model	AC 50W	AC 100W	AC 200W	AC 400W	AC 750W	ST40-11	ST55-21	ST55-22	ST55-23
KK40	F2	F2	-	-	-	F3	F3	F3	F3
KK50	F2	F2	-	-	-	F3	F3	F3	F3
KK60	F2	F2	-	-	-	F5	F5	F5	F5
KK86	-	-	F0	F0		-	-	-	-
KK100	-	-	F0	F0	F1	-	-	-	-
KK130	-	-	F1	F1	F0	-	-	-	-
SK60	F2	F2	F0	F0		F5	F5	F5	F5
SK86	F3	F3	F0	F0		-	-	-	-
KA100	F1	F1	-	-	-	-	-	-	-
KA136	F3	F3	F0	F0	-	-	-	-	-
KA170	-	-	F0	F0	F1	-	-	-	-
KA200	-	-	F1	F1	F0				
KS100	-	-	-	-	-	-	-	-	-
KS140	-	-	F0	F0	-	-	-	-	-
KS180	-	-	-	-	-	-	-	-	-
KU60	KA100-F1	KA100-F1	-	-	-	KK60-F5	KK60-F5	KK60-F5	KK60-F5
KU80	KK86-F3	KK86-F3	F0	F0		-	-	-	-
KE50	KA100-F1	KA100-F1	-	-	-	KK60-F5	KK60-F5	KK60-F5	KK60-F5
KE65	KA100-F1	KA100-F1	-	-	-	KK60-F5	KK60-F5	KK60-F5	KK60-F5

Robot connect Servo Motor



Robot connect Stepping Motor



Selecting servo motor capacity guide

Guide for motor selection

1. Definition of mechanism to be driven by the motor.

Define detail dimension of individual mechanical components (ex: ball screw length, lead and pulley diameter)
Typical servo mechanisms are listed as follow:
[Ball screw mechanism]
[Belt mechanism]
[Rack and pinion mechanism]
[Reduction gear mechanism]

2. Definition of operating pattern (motion velocity profile).

The operating pattern can be defined by the following parameters: acceleration/deceleration time, constant-velocity time, stop time, cycle time, travel distance.

3. Calculation of load inertia and motor inertia ratio.

Calculate load inertia for each mechanical component. (Refer to "General inertia calculation method" described later.)
Then, divide the calculated load inertia by the inertia of the selected motor the check the inertia ratio. Note that the ratio should less than 15, if the selected motor is less than 750W. If the power of selected motor is higher than 1000W, the ratio should less than 10.

4. Calculation of motor velocity.

Calculate that motor velocity from the moving distance, acceleration/deceleration time and constant-velocity time.

5. Calculation of torque.

Calculate the required motor torque from the load inertia, acceleration/deceleration time and constant-velocity time.

6. Calculation of motor

Select a motor that meets the above 3 to 5 requirements.

5.1 Description of the items related to motor selection

1. Torque

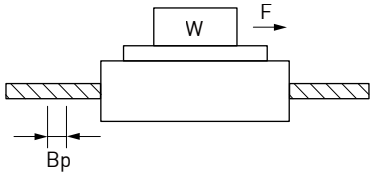
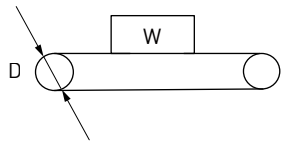
(1) Peak torque

Peak torque indicates the maximum torque that the motor requires during operation (mainly in acceleration and deceleration steps). The reference value is 80% or less of the maximum motor torque. If the torque is a negative value, a regenerative discharge resistor may be required.

(2) Traveling torque, stop holding torque

Traveling torque indicates the torque that the motor requires for a long time. Stop holding torque indicates that the amount of torque required for a motor to remain in a fixed position.

Traveling torque calculation formula for each mechanism.

Ball screw mechanism 	**Traveling torque** $T_f = \frac{B_P}{2\pi B_{eff}} \mu g W + F$
Belt mechanism 	**Traveling torque** $T_f = \frac{D}{2\pi B_{eff}} \mu g W + F$

List of symbol：
W：Workpiece weight [kg]
B_P：Lead [m]
D：Pulley diameter [m]
F：External force [N]
B_{eff}： Mechanical efficiency
μ：Coefficient of friction
g: Acceleration of gravity 9.8[m/s²]

(3) Effective torque

Effective torque indicates a root-mean- square value of the total required for running and stopping the motor per unit time. The reference value is approximate 80% or less of the rated motor torque.

$$T_{rms} = \sqrt{\frac{T_a^2 \times t_a + T_f^2 \times t_b + T_d^2 \times t_d}{t_c}}$$

T_a: Acceleration torque [N-m]
T_f: Traveling torque [N-m]
T_d: Deceleration torque [N-m]
t_c: Cycle time [s] (Run time + Stop time)
t_a: Acceleration time [s]
t_b: constant-velocity time [s]
t_d: Deceleration time [s]

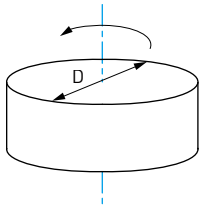
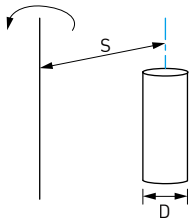
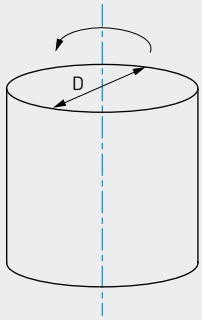
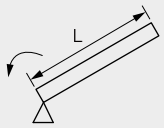
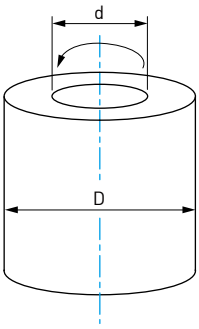
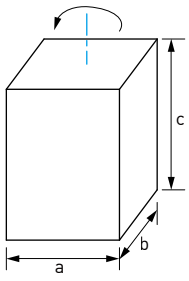
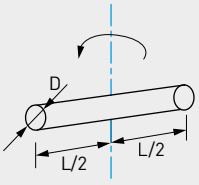
2. Motor velocity

Maximum velocity of motor in operation: The reference value is the rated velocity or lower value. When the motor operates at the maximum velocity, you must pay attention to the motor torque and temperature rise.

3. Load inertia and motor inertia ratio

Inertia is like the force to retain the current moving condition. Inertia ration is calculated by dividing load inertia by rotor inertia. Generally, for motor with 750W or lower capacity, the inertia ratio should be “15” or less. For motor with 1000W or higher capacity, the inertia ratio should be “10” or less. If the system need quicker response, a lower inertia ratio is required.

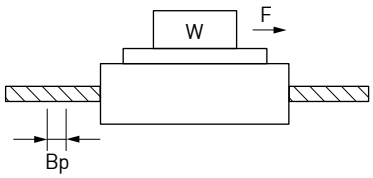
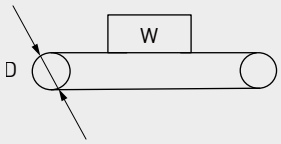
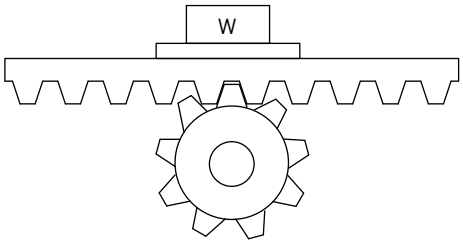
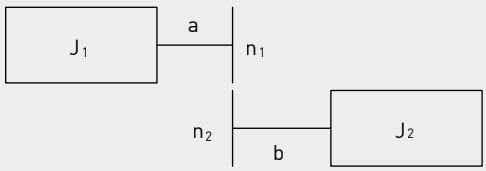
5.2 General inertia calculation for various rigid object of uniform composition

Shape	J calculation formula	Shape	J calculation formula
Disk 	$J=\frac{1}{8}MD^2$	Separated rod 	$J=\frac{1}{8}MD^2+MS^2$
Solid cylinder 	$J=\frac{1}{8}MD^2$	Straight rod 	$J=\frac{1}{3}ML^2$
Hollow cylinder 	$J=\frac{1}{8}M(D^2+d^2)$	Prism 	$J=\frac{1}{12}M(a^2+b^2)$
Uniform rod 	$J=\frac{1}{48}M(3D^2+4L^2)$		

List of symbol：
J : Inertia [kg-m^2]
M : Mass [kg]
D : Outer diameter [m]
d : Inner diameter [m]
L : Length [m]
a, b, c : Side length [m]
S : Distance [m]

If mass (M [kg]) is unknown, calculate it with the following formula：
Mass M[kg] = Density ρ [kg/m^3] Volume V[m^3]
Density of each material
Iron ρ = 7.9 x 10^3 [kg/m^3]
Brass ρ = 8.5 x 10^3 [kg/m^3]
Aluminum ρ = 2.8 x 10^3 [kg/m^3]

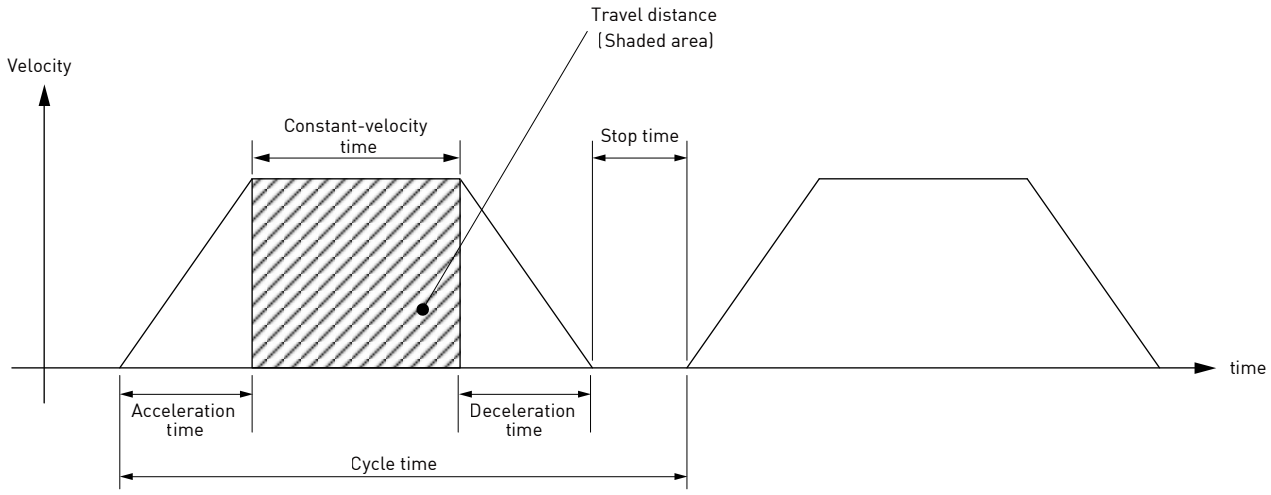
5.3 Equivalent inertia calculation for mechanism

Mechanism	J calculation formula
Ball screw 	$J = J_B + \frac{MB_P^2}{4\pi^2}$
Belt(Conveyor) 	$J = \frac{1}{4} W_b D^2$ *Excluding drum J
Rack and pinion 	$J = J_p + (M_r + W_r) \frac{D^2}{4}$
Reduction gear 	$J = J_1 + (\frac{n_2}{n_1})^2 J_2$ Inertia on shaft "a"

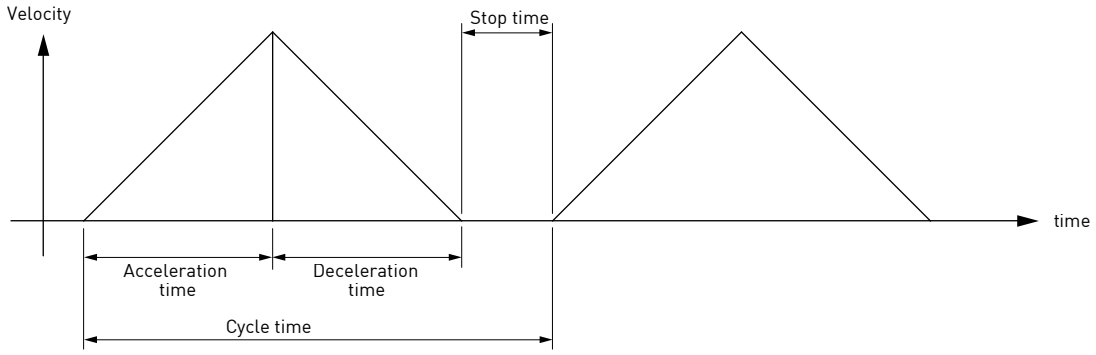
List of symbol:
J : Inertia [kg-m^2]
J_B : J of ball screw
J_P : J of pinion
M : Mass [kg]
M_r : Mass of rack [kg]
W_b : Workpiece weight on belt [kg]
W_r : Workpiece weight on rack [kg]
P : Lead
D : Drum diameter [m]
n_1 : A rotational speed of a shaft [r/min]
n_2 : A rotational speed of b shaft [r/min]

5.4 Operating pattern (motion velocity profile)

Trapezoidal profile



Triangle profile

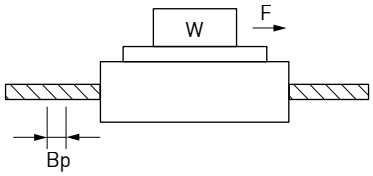


List of symbol:
Acceleration time ta
Constant-velocity time tb
Deceleration time td
Cycle time tc
Travel distance

Example of motor selection

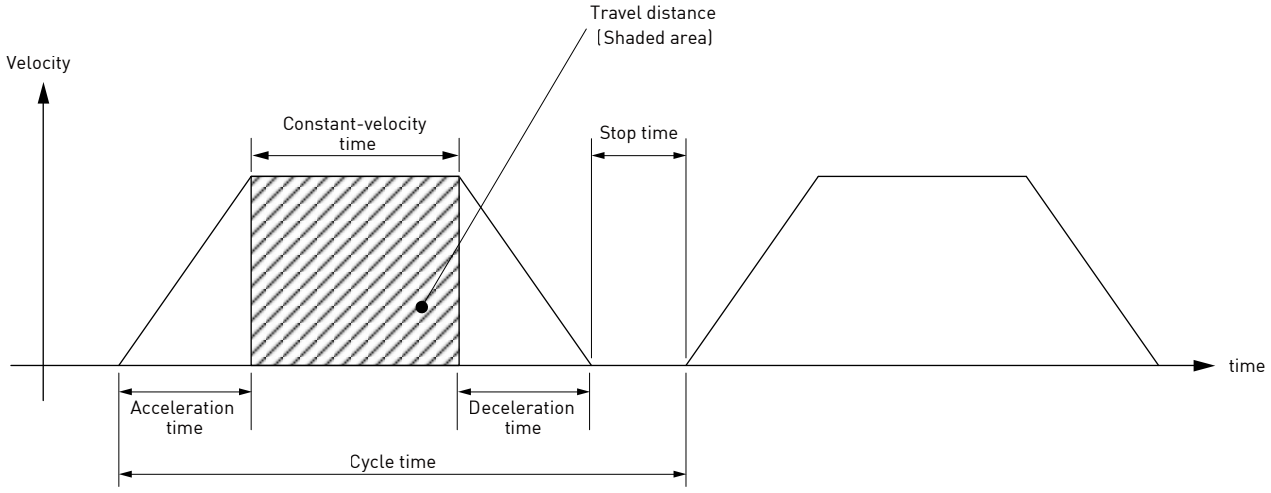
To drive ball screw mechanism

1. Example of motor selection for driving ball screw mechanism



Workpiece weight W = 10 [kg]
Ball screw length B_L = 0.5 [m]
Ball screw diameter B_D = 0.02 [m]
Ball screw lead B_P = 0.02 [m]
Ball screw efficiency B_{eff} = 0.9
Travel distance 0.3 [m]
Coupling inertia $J_C = 10 \times 10^{-6}$ [kg-m^2]

2. Running pattern(velocity profile)



Acceleration time t_a = 0.1 [s]
Constant-velocity time t_b = 0.8 [s]
Deceleration time t_d = 0.1 [s]
Cycle time t_c = 2 [s]
Travel distance 0.3[m]

3. Ball screw weight

$$B_W = \rho \times \pi \times \frac{B_D^2}{2} \times B_L$$
$$= 7.9 \times 10^3 \times \pi \times \frac{0.02^2}{2} \times 0.5$$
$$= 1.24\,[kg]$$

4. Load inertia

$$J_L = J_C + J_B = J_C + \frac{1}{8} B_W \times B_D^2 + \frac{W \times B_P^2}{4\pi^2}$$

$$= 0.00001 + \frac{1.24 \times 0.02^2}{8} + \frac{10 \times 0.02^2}{4\pi^2}$$

$$= 1.73 \times 10^{-4} \ [kg-m^2]$$

5. Provisional motor selection

Choose Hiwin 200W Servo motor : $J_M = 0.14 \times 10^{-4} \ [kg-m^2]$

6. Calculation of inertia ratio

$$\frac{J_L}{J_M} = \frac{1.73 \times 10^{-4}}{0.14 \times 10^{-4}} = 12.3$$

The inertia ratio is less than 30.

7. Calculation of maximum velocity (Vmax)

$$\frac{1}{2} \times t_a \times V_{max} + t_b \times V_{max} + \frac{1}{2} \times t_d \times V_{max} = \text{Travel distance}$$

$$\frac{1}{2} \times 0.1 \times V_{max} + 0.8 \times V_{max} + \frac{1}{2} \times 0.1 \times V_{max} = 0.3$$

$$V_{max} = 0.334 \ [m/s]$$

8. Calculation of motor velocity (N [r/min])

Ball screw lead BP = 0.02 [m]

$$N = \frac{V_{max}}{B_P} = \frac{0.334}{0.02} = 16.7 \left[{}^{rad}/_{s} \right] = 1002[\text{ rpm}]$$

1002[rpm] is less than 3000[rpm] (rated velocity of Hiwin 200W Servo motor)

9. Calculation of torque

Traveling torque

$$T_f = \frac{B_P}{2\pi B_{eff}}(\mu gW + F) = \frac{0.02}{2\pi 0.9}(0.1 \times 9.8 \times 10 + 0) = 0.035\ [N-m]$$

Acceleration torque

$$T_a = \frac{(J_L + J_M)}{t_a} + \text{Traveling torque}$$

$$= \frac{(1.73 \times 10^{-4} + 0.14 \times 10^{-4}) \times 2\pi \times 1.67}{0.1} + 0.035$$

$$= 0.231\ [N-m]$$

Deceleration torque

$$T_d = \frac{(J_L + J_M)}{t_d} - \text{Traveling torque}$$

$$= \frac{(1.73 \times 10^{-4} + 0.14 \times 10^{-4}) \times 2\pi \times 1.67}{0.1} - 0.035$$

$$= 0.161\ [N-m]$$

10. Verification of maximum torque

Ta = 0.231 [N-m] is less than 1.91 [N-m] (Maximum torque of Hiwin 200W Servo motor)

11. Verification of effective torque

$$T_{rms} = \sqrt{\frac{T_a^2 \times t_a + T_f^2 \times t_b + T_d^2 \times t_d}{t_c}}$$

$$= \sqrt{\frac{0.231^2 \times 0.1 + 0.035^2 \times 0.8 + 0.161^2 \times 0.1}{2}}$$

$$= 0.067\ [N-m]$$

0.067 [N-m] is less than 0.64 [N-m] (rated torque of Hiwin 200W Servo motor)

12. Evaluation

Judging from the inertia ratio calculated above, selection of 200 W motor is preferable, although the torque margin is significantly large.

DC Brush motor

Ordering Information

FB 01 0 01 012 01

Product	Model	Accessory	Type	Voltage	Serial number
Brush Motor	01 : DC Brush Motor	0 : only motor	01 : AM1	012 : 12V	01~99
		1 : motor + gear	03 : AM3	024 : 24V	
		2 : motor + encoder	06 : AM6	MAX : 100V	
		3 : motor + gear + encoder	07 : AM7		

Illustration for Characteristic Curves of Motor

According to the customer use for meeting the main value of the motor load moment demand specifications, corresponds to the characteristic curve in the rotational speed (ns), the electric current (I) , the power (P) and so on, can obtain the final operation range. Like the chart shows, when customers choose motor operation and the load moment is A, may obtain coordinates position B, C, D respectively be the rotational speed, electric current and power value.

For example:
Torque position A requirement is：2.8N.m
By position C to obtain speed is：2200rpm
At this time corresponds to position B、D respectively be the current and power value is 9A and 63W.

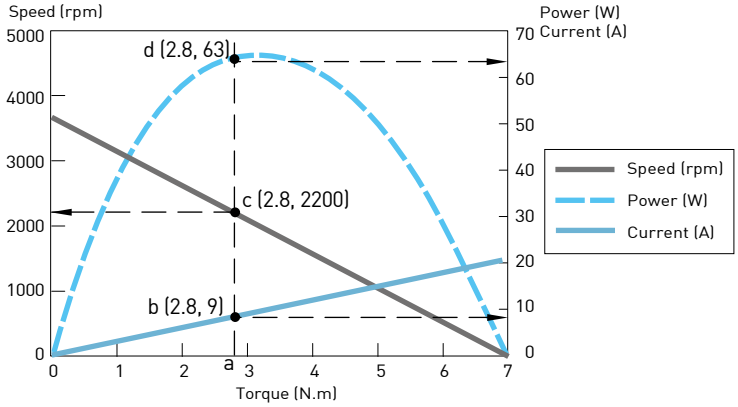


Illustration for Capability of Encoder

Inductive Principle
of the Hall Sensor (CW)

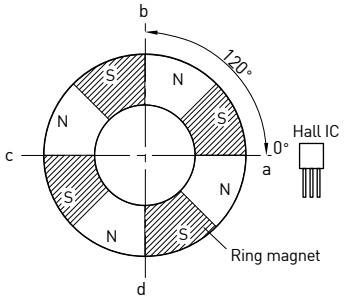


figure 1

Output Voltage
of the Hall Sensor

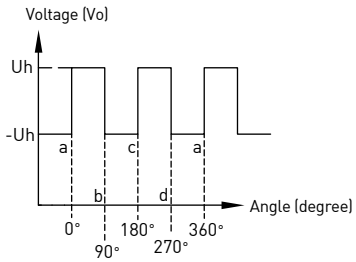


figure 2

※The principle of picking out the Hall IC

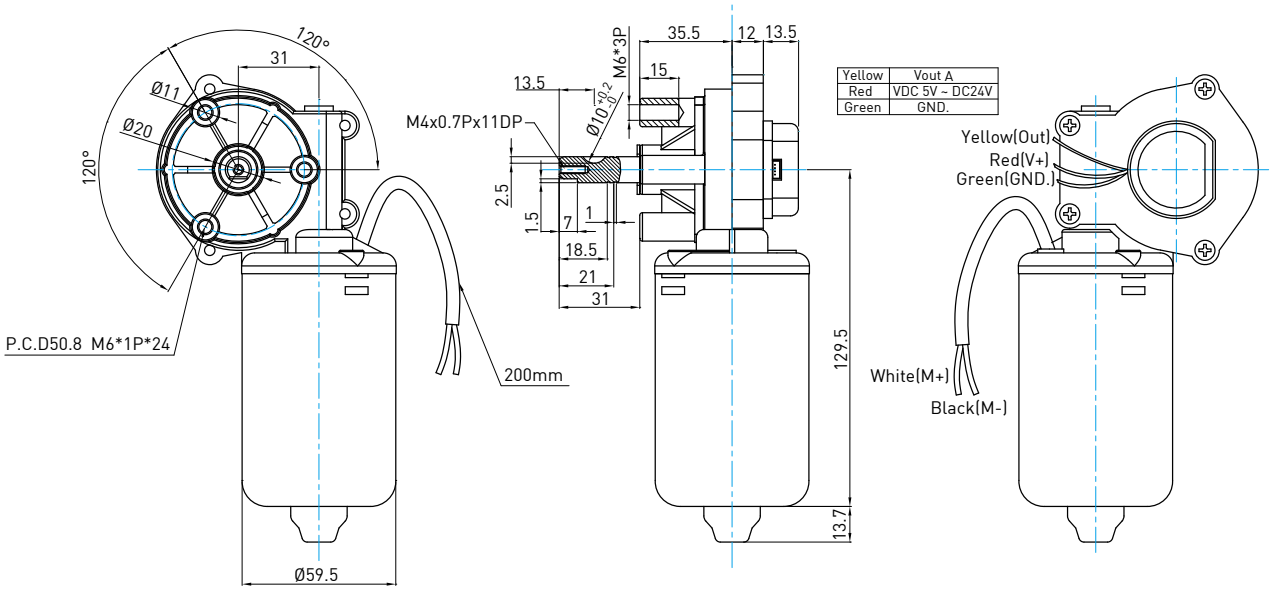
The voltage input range of Hall IC is about 2.4V~26V.The Hall IC will create the induced voltage signal (See Fig 1) through the NS magnetic field of circular magnet. (See Fig 2).The NS poles of circular magnet will decide the signal frequency which is interrelated to the numbers of magnet pole and the rotational speed of motor. As shows on Fig 1, there are 8 poles of circular magnet to induce on one piece Hall IC. When the magnet operates one cycle, the output will obtain the voltages between Uh~-Uh from Hall IC. The 5 points (a, b, c, d, a) are located respectively in the measure positions from the circular magnet of Hall IC. The motor rotation circumference can be divided into 8 equal portions and obtains pulse signal precisely, as shows on Fig 2.

Cautions

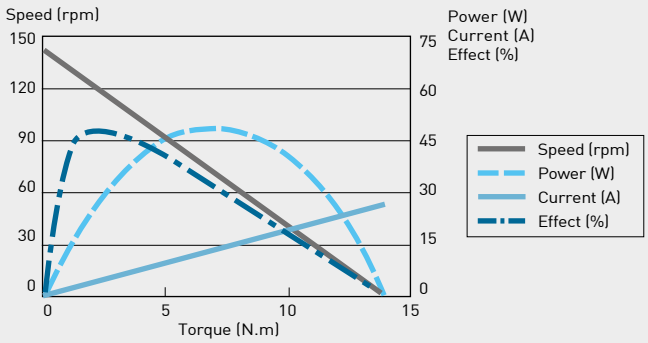
1. Please avoid any mechanical interference when motor operates. Otherwise it will break down the motor.
2. Please follow the voltage specification to input DC voltage. Then the DC voltage can be able to provide with the current under maximum loading which named “Duty maximum current”.
3. When switch the +/- power supply, the motor will operate reverse movement.
4. Please don’t exceed the standardized motor maximum loading.
5. Please follow the waterproof specification use.

6.1 Model of DC Brush Motor

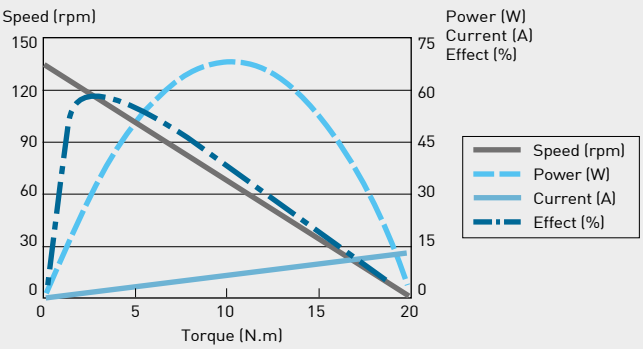
Dimensions for AM1 Type



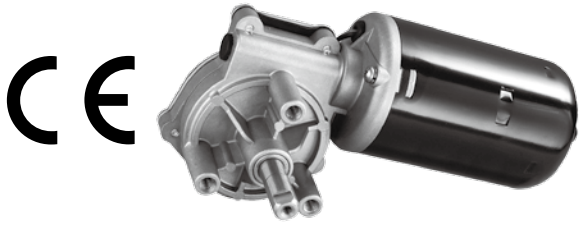
DC 12V	72W
No load current	1.5A (max.)
No load speed	140 rpm
Nominal torque	3.0 N.m
Nominal speed	110 rpm
Nominal current	6.0A (max.)
Maximum current	26A
Breaking torque	14 N.m
Reduction ratio	2 : 52
Resolution	15 pulse/rev
Rated duty	S1
Weight	1200 g
Number	FB0130101201

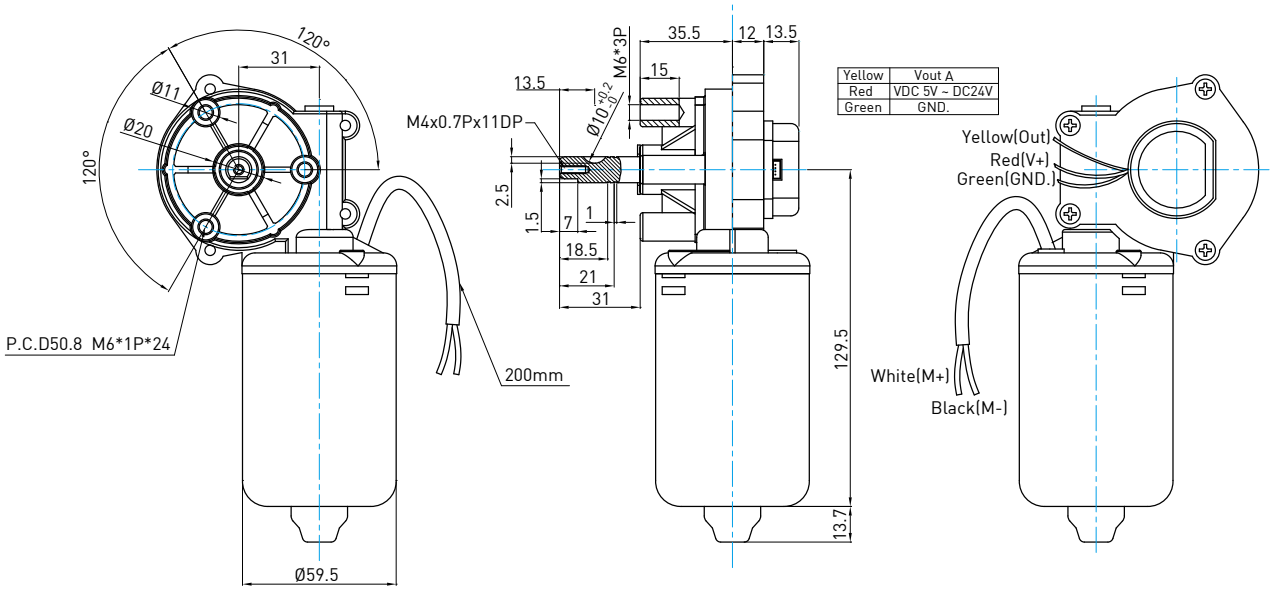


DC 24V	60W
No load current	0.8A (max.)
No load speed	135 rpm
Nominal torque	3.0 N.m
Nominal speed	115 rpm
Nominal current	2.5A (max.)
Maximum current	15A
Breaking torque	20 N.m
Reduction ratio	2 : 52
Resolution	15 pulse/rev
Rated duty	S1
Weight	1200 g
Number	FB0130102401

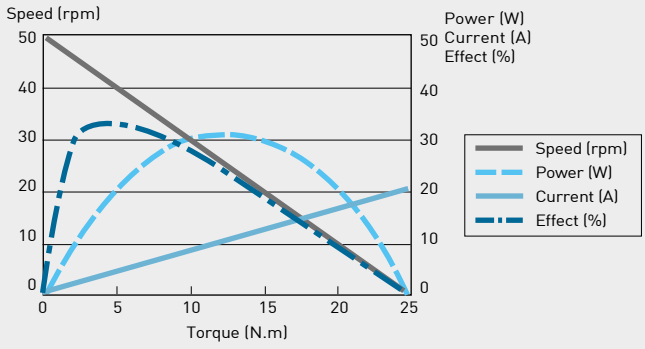


Dimensions for AM1 Type

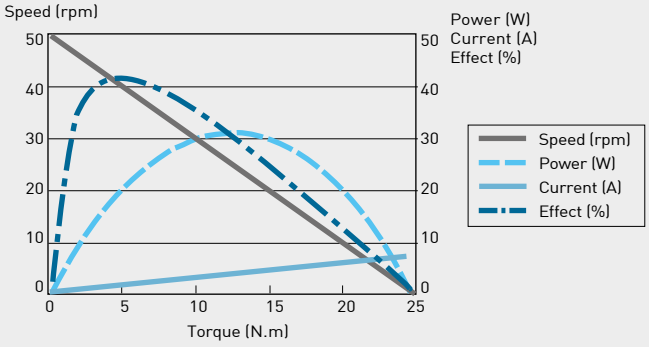




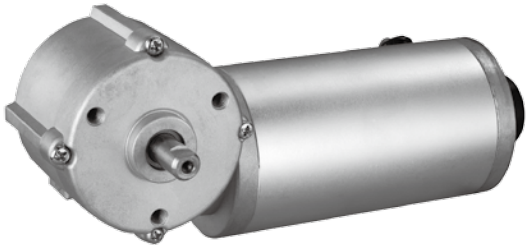
DC 12V	72W
No load current	1.5A (max.)
No load speed	50 rpm
Nominal torque	5.0 N.m
Nominal speed	40 rpm
Nominal current	6.0A (max.)
Maximum current	21A
Breaking torque	25 N.m
Reduction ratio	1 : 52
Resolution	15 pulse/rev
Rated duty	S1
Weight	1200 g
Number	FB0130101202

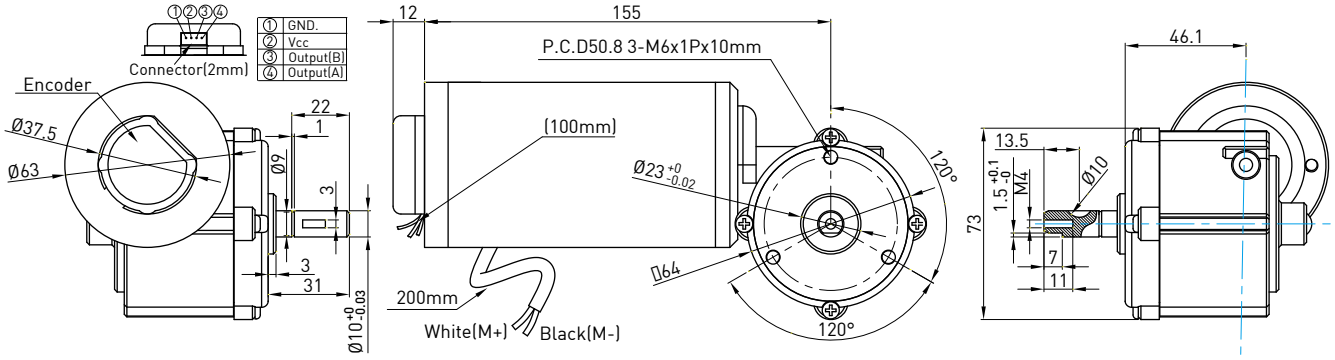


DC 24V	60W
No load current	0.8A (max.)
No load speed	50 rpm
Nominal torque	5.0 N.m
Nominal speed	40 rpm
Nominal current	2.5A (max.)
Maximum current	8A
Breaking torque	25 N.m
Reduction ratio	1 : 52
Resolution	15 pulse/rev
Rated duty	S1
Weight	1200 g
Number	FB0130102402

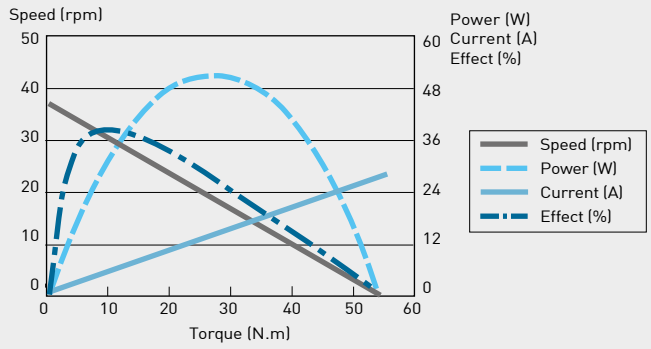


Dimensions for AM3 Type

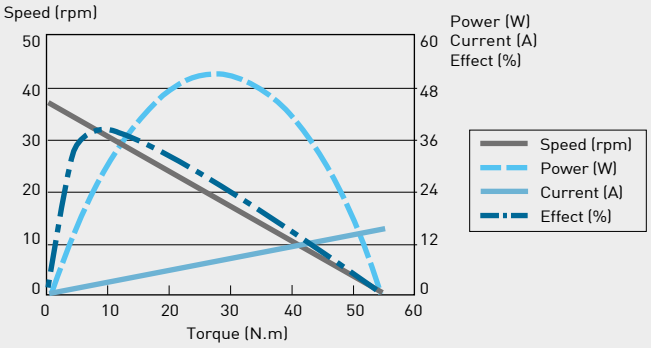




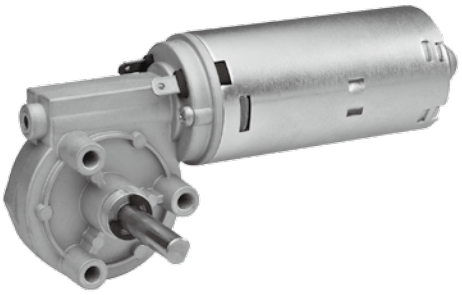
DC 12V	66W
No load current	2.0A (max.)
No load speed	37 rpm
Nominal torque	5.0 N.m
Nominal speed	33 rpm
Nominal current	5.5A (max.)
Maximum current	30A
Breaking torque	55 N.m
Reduction ratio	1 : 65.33
Resolution	980 pulse/rev
Rated duty	S1
Weight	1950 g
Number	FB0130301201

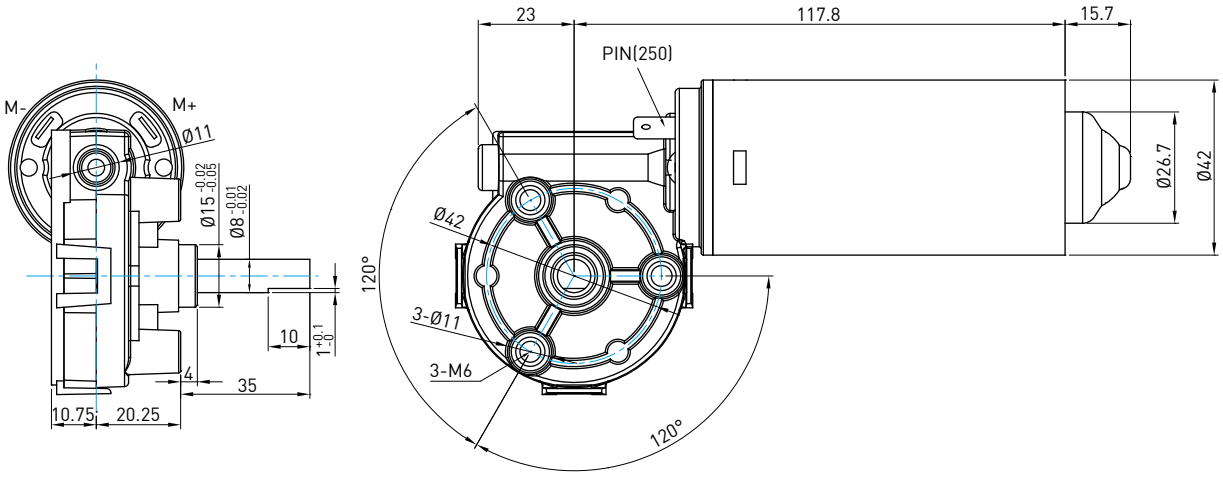


DC 24V	60W
No load current	1.5A (max.)
No load speed	37 rpm
Nominal torque	5.0 N.m
Nominal speed	33 rpm
Nominal current	2.5A (max.)
Maximum current	15A
Breaking torque	55 N.m
Reduction ratio	1 : 65.33
Resolution	980 pulse/rev
Rated duty	S1
Weight	1950 g
Number	FB0130302401

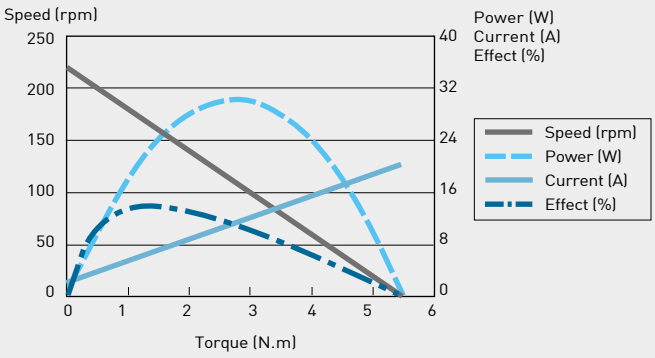


Dimensions for AM4 Type

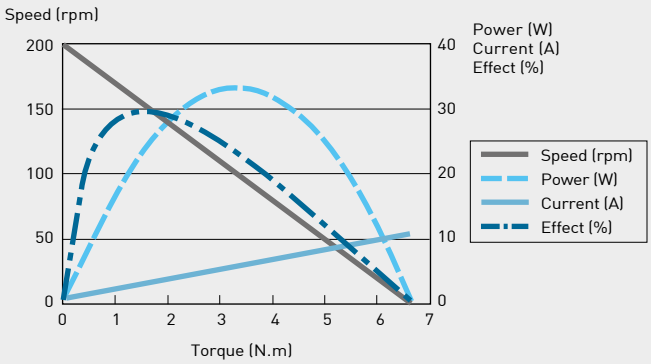




DC 12V	66W
No load current	2.5A (max.)
No load speed	220 rpm
Nominal torque	1.0 N.m
Nominal speed	180 rpm
Nominal current	5.5A (max.)
Maximum current	20A
Breaking torque	5.5 N.m
Reduction ratio	2 : 49
Resolution	-
Rated duty	S1
Weight	600 g
Number	FB0110401201



DC 24V	60W
No load current	1.5A (max.)
No load speed	200 rpm
Nominal torque	1.0 N.m
Nominal speed	170 rpm
Nominal current	2.5A (max.)
Maximum current	11A
Breaking torque	6.5 N.m
Reduction ratio	2 : 49
Resolution	-
Rated duty	S1
Weight	600 g
Number	FB0110402401



Rotary Motor Requirements List

Customer : Email : Tel : Fax :		Date : Contact Person : Appointment :
Motor Type	☐ AC Servo Motor ☐ Stepping Motor ☐ DC Motor	Note :
AC Motor Series	Low inertia : ☐ 50W ☐ 100W ☐ 200W ☐ 400W Middle inertia : ☐ 200W ☐ 400W ☐ 750W ☐ 1KW	
Stepping Motor Series	☐ ST40 ☐ ST55	
DC Motor Series	☐ AM1 ☐ AM3 ☐ AM4	
Input Voltage(V)	AC : ☐ 110V ☐ 220V DC : ☐ 12V ☐ 24V ☐ other_____	
Driver Series	☐ Servo motor Driver ☐ Stepping Motor Driver	
Servo Motor Accessories	**Power Terminal** Brake : ☐ Yes ☐ No Highly Bendable : ☐ Yes ☐ No Cable Length : ☐ 3M ☐ 5M ☐ 7M ☐ 10M **Encoder Terminal** Type : ☐ 13-bit Incremental ☐ 17-bit Incremental Highly Bendable : ☐ Yes ☐ No Cable Length : ☐ 3M ☐ 5M ☐ 7M ☐ 10M	
Special Need		
1. Application		
2. Budget cost		
3. Motor quantity		
4. Operation environment		
5. Size		
6. Rated Current(Arms)		
7. Rated Speed(rpm)		
8. Rated Torque(N-m)		

The information below is to be filled out by HIWIN or authorized agents.

Recommended specifications :

Manager : Salesperson :

MEMO

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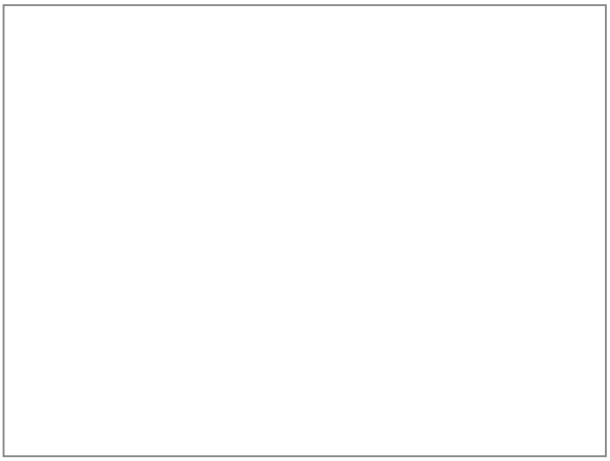

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