(Q) Stepping Motor & Driver & Motion Controller

(A)
Photo electric sensor

(B)
Fiber optic sensor

(C)
Door/Area sensor

(D)
Proximity sensor

(E)
Pressure sensor

(F)
Rotary encoder

(G)
Connector/ Socket

(H)
Temp. controller

(I)
SSR/ Power controller

(J)
Counter

(K)
Timer

(L)
Panel meter

(M)
Tacho/ Speed/ Pulse meter

(N)
Display unit

(O)
Sensor controller

(P)
Switching power supply

(Q)
Stepping motor & Driver & Controller

(R)
Graphic/ Logic panel

(S)
Field network device

(T)
Production stoppage models & replacement

NEW

2-Axis high speed interpolation/mormal motion controller PMC-2HSP/PMC-2HSN

NEW

5-Phase multi-Axis board type stepping motor driver MD5-HD14-2X, 3X

2-Phase stepping motor driver MD2U Series

5-Phase Stepping Motor and Driver Specifications

(○ : General specifications, ◎ : High-torque specifications)

Motor					Driver		
Type		Model	Torque (kgf·cm)	A/phase (A)	MD5-HD14/MD5-ND14/ MD5-HD14-2X(3X)	MD5-HF14	MD5-HF28
24 Square	Shaft type	02K-S523(W)	0.18	0.75	○	◎	
		04K-S525(W)	0.28	0.75	○	◎	
42 Square	Shaft type	A1K-S543(W)	1.3	0.75	○	◎	
		A2K-S544(W)	1.8	0.75	○	◎	
		A3K-S545(W)	2.4	0.75	○	◎	
	Hollow shaft type	AH1K-S543	1.3	0.75	○	◎	
		AH2K-S544	1.8	0.75	○	◎	
		AH3K-S545	2.4	0.75	○	◎	
	Geared built-in type	A10K-S545(W)-G5	10	0.75	○	◎	
		A15K-S545(W)-G7.2	15	0.75	○	◎	
		A15K-S545(W)-G10	15	0.75	○	◎	
60 Square	Shaft type / Shaft + Brake built-in type	A4K-S564(W)-[B]	4.2	0.75	○	◎	
		A4K-M564(W)-[B]	4.2	1.4	○	◎	
		A8K-S566(W)-[B]	8.3	0.75	○	◎	
		A8K-M566(W)-[B]	8.3	1.4	○	◎	
		A16K-M569(W)-[B]	16.6	1.4	○	◎	
		A16K-G569(W)-[B]	16.6	2.8			◎
	Hollow shaft type	AH4K-S564(W)	4.2	0.75	○	◎	
		AH4K-M564(W)	4.2	1.4	○	◎	
		AH8K-S566(W)	8.3	0.75	○	◎	
		AH8K-M566(W)	8.3	1.4	○	◎	
		AH16K-M569(W)	16.6	1.4	○	◎	
		AH16K-G569(W)	16.6	2.8			◎
	Geared built-in type/ Geared + Brake built-in type	A35K-M566(W)-G[B]5	35	1.4	○	◎	
		A40K-M566(W)-G[B]7.2	40	1.4	○	◎	
		A50K-M566(W)-G[B]10	50	1.4	○	◎	
	Rotary actuator type/ Rotary actuator + Brake built-in type	A35K-M566(W)-R[B]5	35	1.4	○	◎	
		A40K-M566(W)-R[B]7.2	40	1.4	○	◎	
		A50K-M566(W)-R[B]10	50	1.4	○	◎	
85 Square	Shaft type / Shaft + Brake built-in type	A21K-M596(W)-[B]	21	1.4	◎	◎	
		A21K-G596(W)-[B]	21	2.8			◎
		A41K-M599(W)-[B]	41	1.4	○	◎	
		A41K-G599(W)-[B]	41	2.8			◎
		A63K-M5913(W)-[B]	63	1.4	○	◎	
		A63K-G5913(W)-[B]	63	2.8			◎
	Hollow shaft type	AH21K-M596(W)	21	1.4	○	◎	
		AH21K-G596(W)	21	2.8			◎
		AH41K-M599(W)	41	1.4	○	◎	
		AH41K-G599(W)	41	2.8			◎
		AH63K-M5913(W)	63	1.4	○	◎	
		AH63K-G5913(W)	63	2.8			◎
	Geared built-in type/ Geared + Brake built-in type	A140K-M599(W)-G[B]5	140	1.4	○	◎	
		A140K-G599(W)-G[B]5	140	2.8			◎
		A200K-M599(W)-G[B]7.2	200	1.4	○	◎	
		A200K-G599(W)-G[B]7.2	200	2.8			◎
		A200K-M599(W)-G[B]10	200	1.4	○	◎	
		A200K-G599(W)-G[B]10	200	2.8			◎

※**(W)** stands for dual shaft of motor. The brake built-in type provides single shaft only.
※The motor has a big difference in torque by the characteristics of the driver.
　Please refer to the graph in this catalogue that shows the characteristics of motors and drivers.
　For MD5-HD14, MD5-ND14, the high-speed region torque characteristics are better at 35VDC than at 20VDC.
　In addition, MD5-HF14, MD5-HF28 have further improved torque characteristics in the high-speed area than using DC type driver.

5-Phase Stepping Motor Driver

## Small, light and high speed and torque 5-phase stepping motor driver

■Features

- ●Bipolar constant pentagon drive method
- ●Includes Auto Current Down and self-diagnosis function
- ●Low speed rotation and high accuracy controlling with microstep-driving (MD5-HD14, MD5-HF14, MD5-HF28) [Max. resolution – 250 division / In case of 5-phase stepping motor of which basic step angle is 0.72°, it enables to control up to 0.00288° per pulse and it requires 125,000 pulses per rotation.
- ●Photo coupler insulation for input signals to minimize the influence of external noise

⚠ Please read "Caution for your safety" in operation manual before using.

MD5-HF28 MD5-HF14 MD5-HD14 MD5-ND14

CE c**RU**us
(Except for MD5-HD14, ND14)
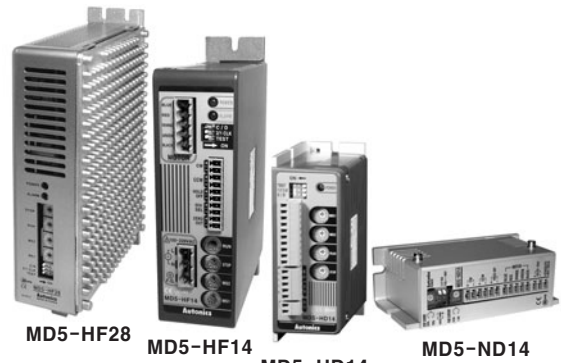
■Ordering information

| MD | 5 | – | H | F | 14 |

RUN current	14	1.4A/Phase
	28	2.8A/Phase
Power supply	D	20-35VDC
	F	100-220VAC
Step type (Resolution)	H	Microstep(250divisions)
	N	Normal step
Motor phase	5	5-Phase
Item	MD	Motor Driver

※**KR-55MC can be replaced with MD5-HD14.**
※**KR-5MC can be replaced with MD5-ND14.**
※**MD5-MF14 can be replaced with MD5-HF14.**
※**KR-505G can be replaced with MD5-HF28.**

■Specifications

Model	MD5-HD14	MD5-HF14	MD5-HF28	MD5-ND14
Power supply	(※1) 20-35VDC 3A	100-220VAC 50/60Hz		20-35VDC 3A
RUN current	0.4 to 1.4A / Phase		1.0 to 2.8A / Phase	0.5 to 1.5A / Phase
RUN method	Bipolar constant pentagon drive			
Basic step angle	0.72° / 1Phase			
Resolution	1, 2, 4, 5, 8, 10, 16, 20, 25, 40, 50, 80, 100, 125, 200, 250 division (0.72° to 0.00288° / 1Phase)			1, 2 division (0.72°, 0.36° / 1Phase)
Input pulse width	Min. 0.5μs			Min. 10μs
Pulse duty	Max. 50%			
Rising/Falling time	Max. each 120ns			
Max. input pulse frequency	(※2) 1MHz			50kHz
Input voltage level	High : 4-8VDC, Low : 0-0.5VDC			
Input resistance	270Ω (CW, CCW) 390Ω (HOLD OFF, DIVISION SELECTION)			390Ω (CW, CCW, HOLD OFF)
Ambient temperature	0 to 40℃ (at non-freezing status)	0 to 50℃ (at non-freezing status)	0 to 40℃ (at non-freezing status)	
Ambient humidity	35 to 85%RH			
Approval	CE	CE c**RU**us		CE
Unit weight	Approx. 220g	Approx. 650g	Approx. 1kg	Approx. 120g

※(※1)When using over 30VDC, it should be mounted at ventilated place due to increasing heat.
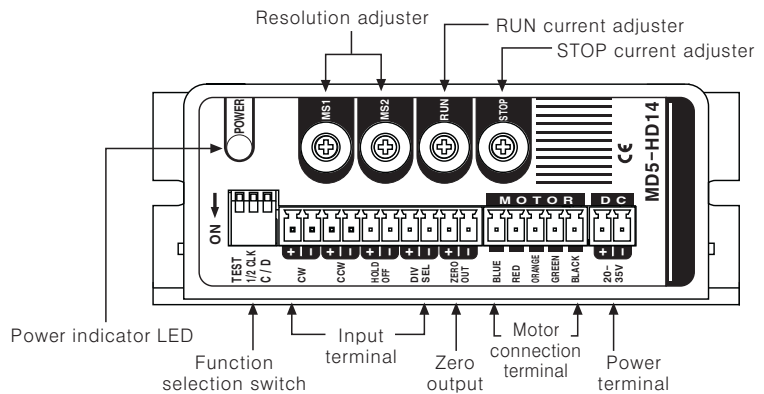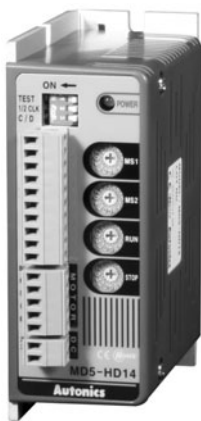※(※2)Max. pull-out frequency and max. slewing frequency are variable depending on resolution, or load.

MD5 Series

5-Phase microstepping motor driver [MD5-HD14]

Resolution adjuster — RUN current adjuster — STOP current adjuster

Power indicator LED — Function selection switch — Input terminal — Zero output — Motor connection terminal — Power terminal

◎Function selection switch

NO	Name	Function	Switch position	
			ON	OFF
1	TEST	Self-diagnosis	Rotate in 30rpm	——
2	1/2 CLK	Pulse input method	1 Pulse input	2 Pulse input
3	C/D	Auto current down	Not using	Using

● TEST
※Self-diagnosis function is to test motors and drivers.
※Motors rotate with 30 rpm in full-step. Motor rotation speed is subject to change depending on resolution setting.
※Rotation speed = 30 rpm / resolution
※The motor will rotate in CCW direction when in 1-pulse input mode and in CW direction when in 2-pulse input mode.
Note) Make sure that TEST switch is set to OFF before supplying the power.
It may cause injury or danger if TEST switch is set to ON when power is supplied.

● 1/2 CLK
※1/2 CLK switch is to select pulse input mode.
※1-pulse input mode : CW → operation command pulse input, CCW → rotation direction pulse input
([H] : CW rotation, [L] : CCW rotation)
※2-pulse input mode : CW → CW direction rotation pulse input, CCW → CCW direction rotation pulse input

● C/D (Auto current down)
※This function is reducing current automatically according to STOP current setting value in order to suppress generated heat when motor is stop.
※It activates when there is no pulse input of motor operation for over 200ms.

◎RUN current setting

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Current (A/Phase)	0.4	0.5	0.57	0.63	0.71	0.77	0.84	0.9	0.96	1.02	1.09	1.15	1.22	1.27	1.33	1.4

※RUN current is a phase current provided to 5-phase stepping motor.
※Be sure to set RUN current at the rated current or below. If not, it may cause heat generation, loss of torque or step-out.
※Adjust the RUN current in case severe heat generation occurs. Be sure that torque decreasing may occur when adjusting the current.
※RUN current setting value may have some deviation depending on motor's running frequency.
Note)Be sure to adjust RUN current while motor is running.

◎STOP current setting

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
%	27	31	36	40	45	50	54	58	62	66	70	74	78	82	86	90

※STOP current is a phase current provided to 5-phase stepping motor at standstill.
※It will be activated when C/D (Auto current down) is set to ON. By setting STOP current, it is possible to suppress the heat generation at motor standstill.
※STOP current setting value is the ratio of RUN current setting value (%).
Ex)In case RUN current setting value is set to 1.4A and STOP current setting value is set to 50%, auto current down current is set to 0.7A.
※STOP current setting value may have some deviation depending on resistance impedance of motor.
※Auto current down function will be activated when HOLD OFF signal is [L]. When HOLD OFF signal is [H], the function is not activated since the current provided to each phase is cut off.
Note)Be sure to adjust STOP current while motor is at standstill.

5-Phase Stepping Motor Driver

(A)
Photo electric sensor

(B)
Fiber optic sensor

(C)
Door/Area sensor

(D)
Proximity sensor

(E)
Pressure sensor

(F)
Rotary encoder

(G)
Connector/Socket

(H)
Temp. controller

(I)
SSR/Power controller

(J)
Counter

(K)
Timer

(L)
Panel meter

(M)
Tacho/Speed/Pulse meter

(N)
Display unit

(O)
Sensor controller

(P)
Switching power supply

(Q)
Stepping motor & Driver & Controller

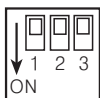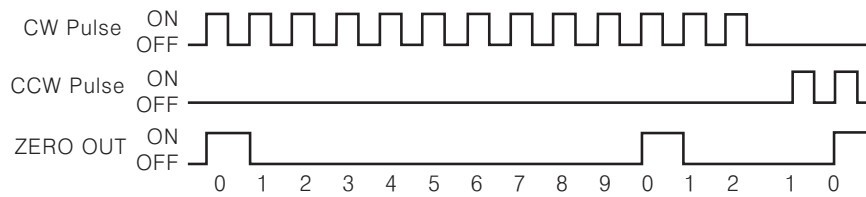(R)
Graphic/Logic panel

(S)
Field network device

(T)
Production stoppage models & replacement

◎Zero point excitation output signal (ZERO OUT)

※The signal is output to indicate when the motor excitation status is in the initial stage. / Used to check the rotation position of motor's axis
※In case of full step, the signal is output every 7.2°.(50 times / rotation)
EX)Full step (0.72°/Step) : Signal is output every 10 pulses.
　20 divisions (0.036°/Step) : Signal is output every 200 pulses.

◎HOLD OFF function
※When HOLD OFF input signal is [H], motor excitation is released.
　When HOLD OFF input signal is [L], motor excitation is in a normal status.
※A function used to rotate motor's axis using external force or used for manual positioning.
※HOLD OFF Input signal [H] and [L] represent photocoupler ON/OFF in a circuit.
※Please do not use for stopping motor.

◎Setting microstep(Microstep : Resolution)

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Resolution	1	2	4	5	8	10	16	20	25	40	50	80	100	125	200	250
Step angle	0.72°	0.36°	0.18°	0.144°	0.09°	0.072°	0.045°	0.036°	0.0288°	0.018°	0.0144°	0.009°	0.0072°	0.00576°	0.0036°	0.00288°

●Resolution setting(Same as MS1, MS2)
※It is set to MS1 when division selection signal is [L], and MS2 when division selection signal is [H].
※Two different micro step can be set using DIVISION SELECTION. Users can select one of them via external input signals.
※Microstepping is to make basic step angle of 5-phase motors (0.72°) divided into smaller angle according to setting values.
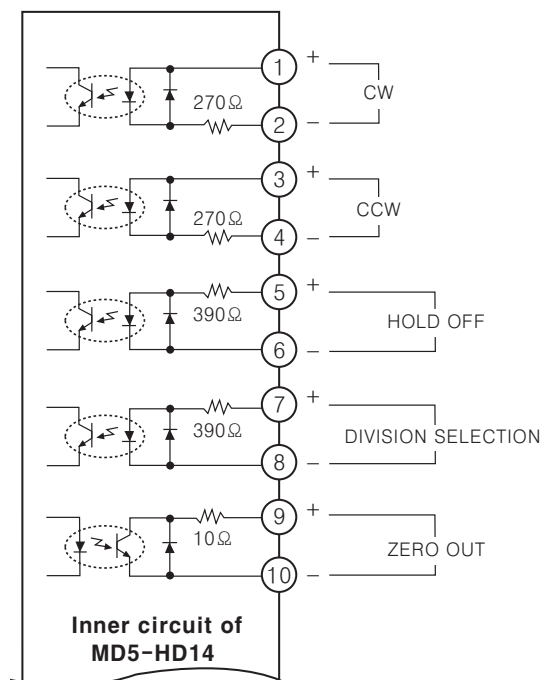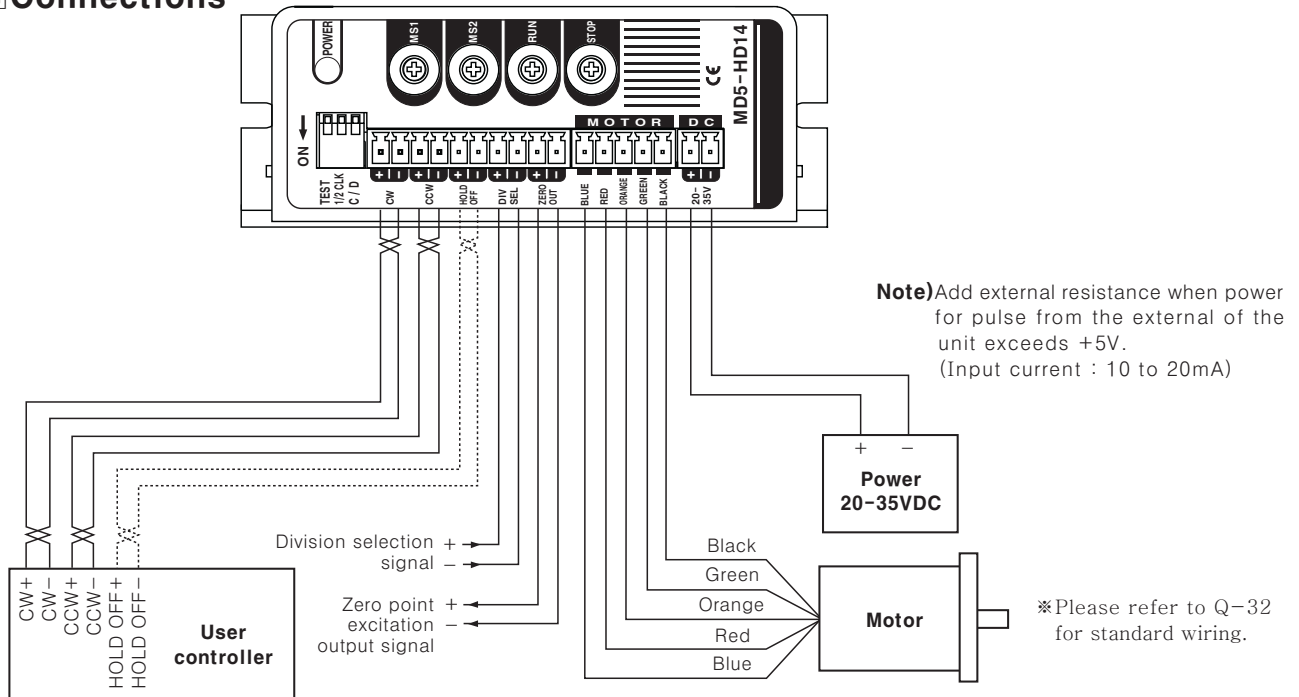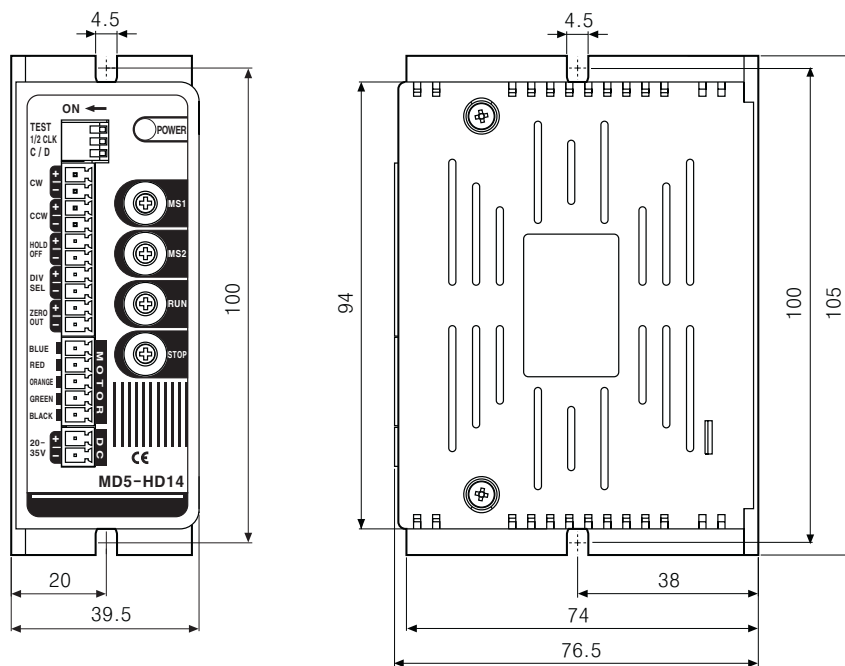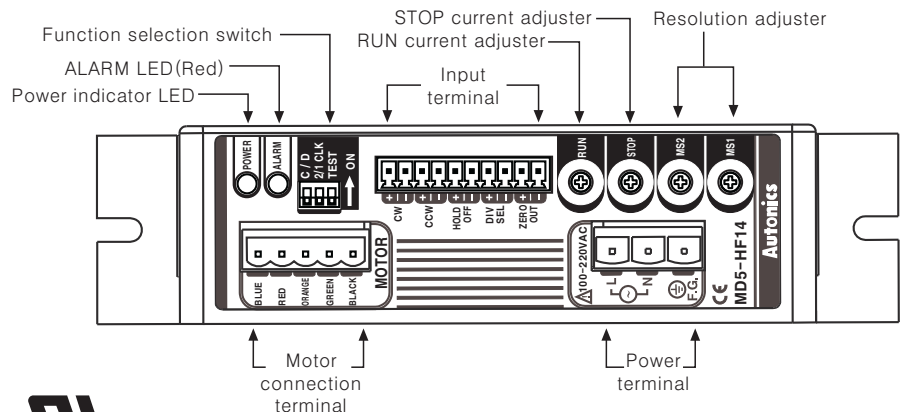※The formula for microstep angle is ;

$$\text{Motor revolution angle (5-phase motors)} = \frac{\text{Basic step angle}(0.72°)}{\text{Resolution}}$$

※In case of geared motors, step angle shall be determined by dividing step angle by gear ratio.
EX) 0.72°/ 10 (1:10) = 0.072 °
※It may cause step-out if resolution is changed while motor is running.

■ Input · Output diagram

Inner circuit of MD5-HD14

※CW
　2-pulse input mode − CW direction rotation pulse input
　1-pulse input mode − Operation command pulse input

※CCW
　2-pulse input mode − CCW direction rotation pulse input
　1-pulse input mode − Rotation direction pulse input
　[H] : CW, [L] : CCW

※HOLD OFF
　Motor excitation OFF control signal
　[H] : Motor excitation OFF

※DIVISION SELECTION
　Division selection signal
　→ [L] : Operated by MS1 setting resolution.
　　 [H] : Operated by MS2 setting resolution.

※ZERO OUT
　Zero point excitation output signal ON for zero point excitation

MD5 Series

▣Connections

Note) Add external resistance when power for pulse from the external of the unit exceeds +5V.
(Input current : 10 to 20mA)

Power 20-35VDC

Motor

Division selection + / signal −

Zero point + / excitation − / output signal

Black
Green
Orange
Red
Blue

User controller

CW+
CW−
CCW+
CCW−
HOLD OFF+
HOLD OFF−

※Please refer to Q−32 for standard wiring.

▣Dimensions

(Unit:mm)

5-Phase Stepping Motor Driver

5-Phase microstepping motor driver [MD5-HF14]

Function selection switch
STOP current adjuster
RUN current adjuster
Resolution adjuster
ALARM LED(Red)
Power indicator LED
Input terminal

Motor connection terminal
Power terminal

(A) Photo electric sensor

(B) Fiber optic sensor

(C) Door/Area sensor

(D) Proximity sensor

(E) Pressure sensor

(F) Rotary encoder

(G) Connector/ Socket

(H) Temp. controller

(I) SSR/ Power controller

(J) Counter

(K) Timer

(L) Panel meter

(M) Tacho/ Speed/ Pulse meter

(N) Display unit

(O) Sensor controller

(P) Switching power supply

(Q) Stepping motor & Driver & Controller

(R) Graphic/ Logic panel

(S) Field network device

(T) Production stoppage models & replacement

◎Function selection switch

No	Name	Function	Switch position	
			ON	OFF
1	TEST	Self-diagnosis	Rotate in 30rpm	——
2	2/1 CLK	Pulse input method	1 Pulse input	2 Pulse input
3	C/D	Auto current down	Not using	Using

●TEST
 ※Self-diagnosis function is to test motors and drivers.
 ※Motors rotate with 30 rpm in full-step. Motor rotation speed is subject to change depending on resolution setting.
 ※Rotation speed = 30 rpm / resolution
 ※The motor will rotate in CCW direction when in 1-pulse input mode and in CW direction when in 2-pulse input mode.
 Note)Make sure that TEST switch is set to OFF before supplying the power.
    It may cause injury or danger if TEST switch is set to ON when power is supplied.

●1/2 CLK
 ※1/2 CLK switch is to select pulse input mode.
 ※1-pulse input mode : CW → operation command pulse input, CCW → rotation direction pulse input
              ([H]: CW rotation, [L]: CCW rotation)
 ※2-pulse input mode : CW → CW direction rotation pulse input, CCW → CCW direction rotation pulse input

●C/D (Auto current down)
 ※This function is reducing current automatically according to STOP current setting value in order to suppress generated heat when motor is stop.
 ※It activates when there is no pulse input of motor operation for over 200ms.

◎RUN current setting

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Current (A/Phase)	0.4	0.5	0.57	0.63	0.71	0.77	0.84	0.9	0.96	1.02	1.09	1.15	1.22	1.27	1.33	1.4

 ※RUN current is a phase current provided to 5-phase stepping motor.
 ※Be sure to set RUN current at the rated current or below. If not, it may cause heat generation, loss of torque or step-out.
 ※Adjust the RUN current in case severe heat generation occurs. Be sure that torque decreasing may occur when adjusting the current.
 ※RUN current setting value may have some deviation depending on motor's running frequency.
 Nete)Be sure to adjust RUN current while motor is running.

◎STOP current setting

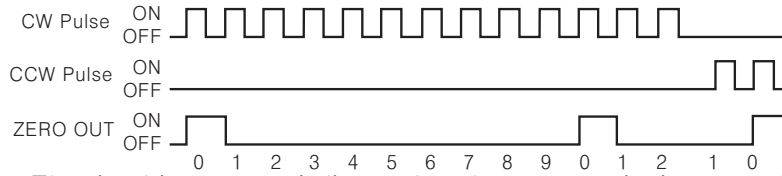| Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
%	27	31	36	40	45	50	54	58	62	66	70	74	78	82	86	90

 ※STOP current is a phase current provided to 5-phase stepping motor at standstill.
 ※It will be activated when C/D (Auto current down) is set to ON. By setting STOP current, it is possible to suppress the heat generation at motor standstill.
 ※ STOP current setting value is the ratio of RUN current setting value (%).
 Ex)In case RUN current setting value is set to 1.4A and STOP current setting value is set to 50%, auto current down current is set to 0.7A.
 ※STOP current setting value may have some deviation depending on resistance impedance of motor.
 ※Auto current down function will be activated when HOLD OFF signal is [L]. When HOLD OFF signal is [H], the function is not activated since the current provided to each phase is cut off.
 Note)Be sure to adjust STOP current while motor is at standstill.

MD5 Series

◎Zero point excitation output signal (ZERO OUT)

CW Pulse ON/OFF

CCW Pulse ON/OFF

ZERO OUT ON/OFF

0 1 2 3 4 5 6 7 8 9 0 1 2 1 0

※The signal is output to indicate when the motor excitation status is in the initial stage. / Used to check the rotation position of motor's axis
※In case of full step, the signal is output every 7.2˚. (50 times / rotation)
EX)Full step (0.72˚/Step): Signal is output every 10 pulses.
20 divisions (0.036˚/Step): Signal is output every 200 pulses.

◎HOLD OFF function
※When HOLD OFF input signal is [H], motor excitation is released.
When HOLD OFF input signal is [L], motor excitation is in a normal status.
※A function used to rotate motor's axis using external force or used for manual positioning.
※HOLD OFF Input signal [H] and [L] represent photocoupler ON/OFF in a circuit.
※Please do not use for stopping motor.

◎Setting microstep(Microstep : Resolution)

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Resolution	1	2	4	5	8	10	16	20	25	40	50	80	100	125	200	250
Step angle	0.72˚	0.36˚	0.18˚	0.144˚	0.09˚	0.072˚	0.045˚	0.036˚	0.0288˚	0.018˚	0.0144˚	0.009˚	0.0072˚	0.00576˚	0.0036˚	0.00288˚

●Resolution setting(Same as MS1, MS2)
※It is set to MS1 when division selection signal is [L], and MS2 when division selection signal is [H].
※Two different micro step can be set using DIVISION SELECTION. Users can select one of them via external input signals.
※Microstepping is to make basic step angle of 5-phase motors (0.72˚) divided into smaller angle according to setting values.
※The formula for microstep angle is ;

$$\text{Motor revolution angle (5-phase motors)} = \frac{\text{Basic step angle}(0.72˚)}{\text{Resolution}}$$

※In case of geared motors, step angle shall be determined by dividing step angle by gear ratio.
EX) 0.72˚/ 10 (1:10) = 0.072 ˚
※It may cause step-out if resolution is changed while motor is running.
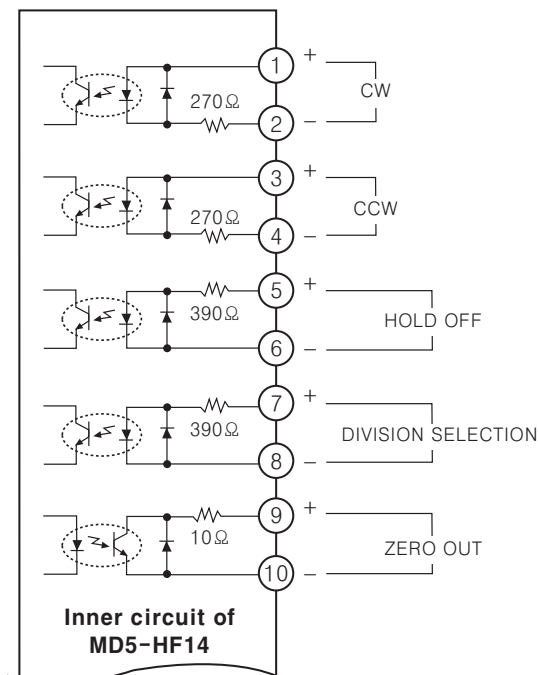
◎ALRAM Function
※Over heat : When the temperature in driver BASE is over 80℃, Alarm LED will be ON and motor will stop with holding the torque. Remove the Over Heat Alarm causing factors and reset the power in order to reset alarm function.
※Overcurrent : When overcurrent is applied to the motor due to driver damage or errors, Alarm LED will be flickering. In case of overcurrent, the motor will be HOLD OFF. Cut off the power and remove overcurrnet-causing factors in order to resume normal operation.

■Input · Output diagram

Inner circuit of MD5-HF14

① + ② − CW 270Ω
③ + ④ − CCW 270Ω
⑤ + ⑥ − HOLD OFF 390Ω
⑦ + ⑧ − DIVISION SELECTION 390Ω
⑨ + ⑩ − ZERO OUT 10Ω

※CW
2-pulse input mode − CW direction rotation pulse input
1-pulse input mode − Operation command pulse input

※CCW
2-pulse input mode − CCW direction rotation pulse input
1-pulse input mode − rotation direction pulse input
[H] : CW, [L] : CCW

※HOLD OFF
Motor excitation OFF control signal
[H] : Motor excitation OFF

※DIVISION SELECTION
Division selection signal
→ [L] : Operated by MS1 setting resolution.
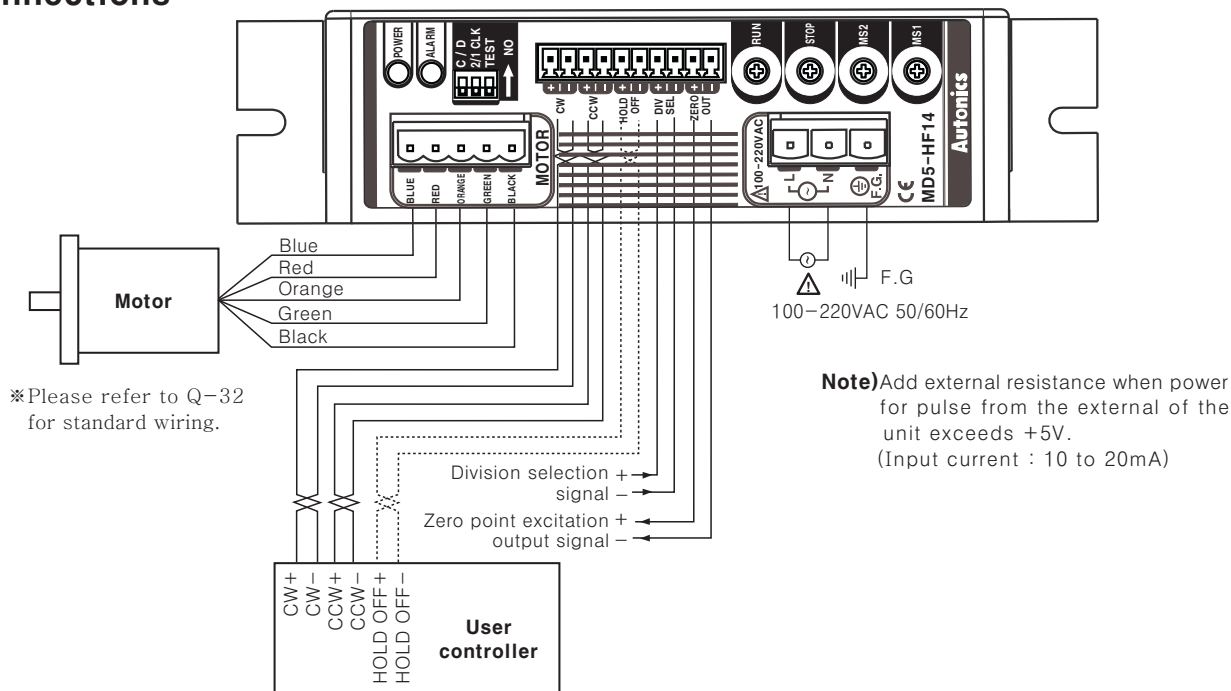[H] : Operated by MS2 setting resolution.

※ZERO OUT
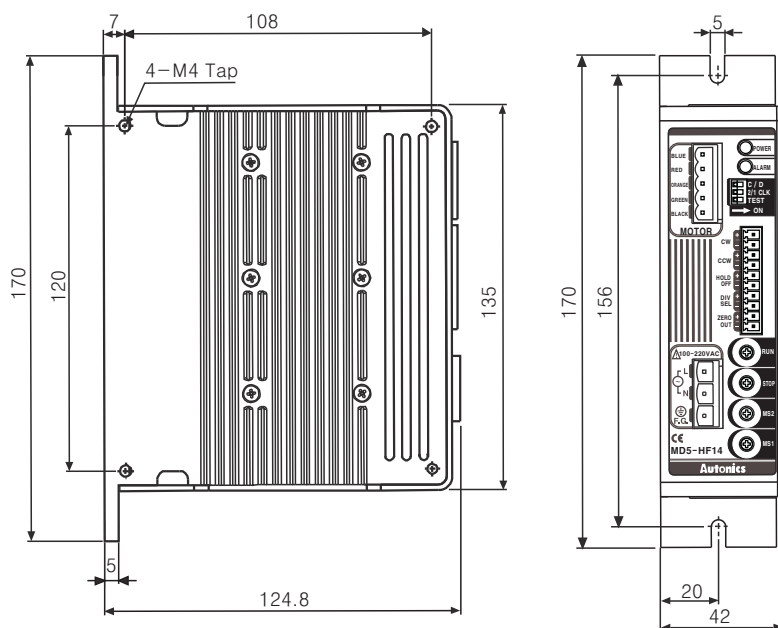Zero point excitation output signal ON for zero point excitation
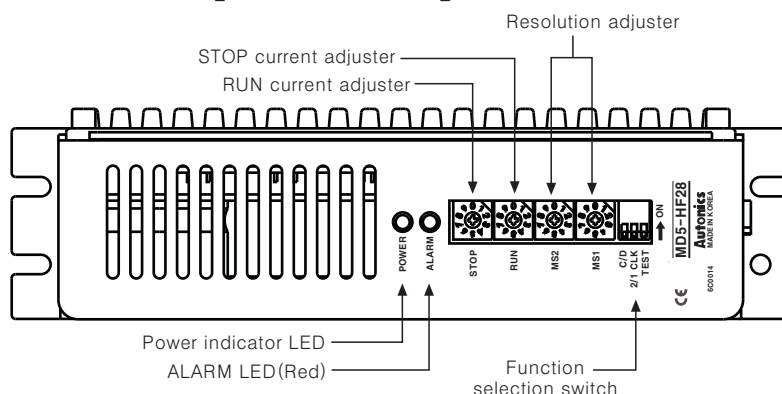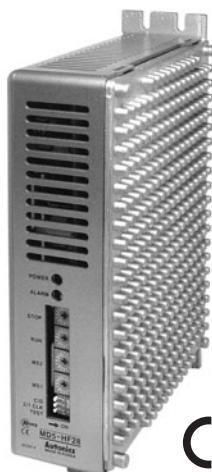
5-Phase Stepping Motor Driver

■Connections

Blue
Red
Orange
Green
Black

Motor

※Please refer to Q−32 for standard wiring.

100−220VAC 50/60Hz

F.G

Note) Add external resistance when power for pulse from the external of the unit exceeds +5V.
(Input current : 10 to 20mA)

Division selection +
signal −
Zero point excitation +
output signal −

CW+
CW−
CCW+
CCW−
HOLD OFF+
HOLD OFF−

User controller

■Dimensions

7
108
4−M4 Tap
170
120
135
5
124.8

5
170
156
20
42

(Unit:mm)

5-Phase microstepping motor driver [MD5-HF28]

Resolution adjuster
STOP current adjuster
RUN current adjuster
Power indicator LED
ALARM LED(Red)
Function selection switch

※**KR-505G is changed as MD5-HF28.**
※**Power supply 100-220VAC and connected socket are upgraded.**

◎Function selection switch
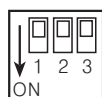
No	Name	Function	Switch position	
			ON	OFF
1	TEST	Self-diagnosis	Rotate in 30rpm	───
2	2/1 CLK	Pulse input method	1 Pulse input	2 Pulse input
3	Current down	Auto current down	Using	Not using

●TEST
 ※Self-diagnosis function is to test motors and drivers.
 ※Motors rotate with 30 rpm in full-step. Motor rotation speed is subject to change depending on resolution setting.
 ※Rotation speed = 30 rpm / resolution
 ※The motor will rotate in CCW direction when in 1-pulse input mode and in CW direction when in 2-pulse input mode.
 Note)Make sure that TEST switch is set to OFF before supplying the power.
　　　It may cause injury or danger if TEST switch is set to ON when power is supplied.

●1/2 CLK
 ※1/2 CLK switch is to select pulse input mode.
 ※1-pulse input mode : CW → operation command pulse input, CCW → rotation direction pulse input
　　　　　　　　　　　　([H]: CW rotation, [L]: CCW rotation)
 ※2-pulse input mode : CW → CW direction rotation pulse input, CCW → CCW direction rotation pulse input

●C/D (Auto current down)
 ※This function is reducing current automatically according to STOP current setting value in order to suppress generated heat when motor is stop.
 ※It activates when there is no pulse input of motor operation for over 200ms.

◎RUN current setting

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Current (A/Phase)	1.14	1.25	1.36	1.50	1.63	1.74	1.86	1.97	2.10	2.20	2.30	2.40	2.50	2.60	2.78	2.88

 ※RUN current is a phase current provided to 5-phase stepping motor.
 ※Be sure to set RUN current at the rated current or below. If not, it may cause heat generation, loss of torque or step-out.
 ※Adjust the RUN current in case severe heat generation occurs. Be sure that torque decreasing may occur when adjusting the current.
 ※RUN current setting value may have some deviation depending on motor's running frequency.
 Note)Be sure to adjust RUN current while motor is running.

◎STOP current setting

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
%	27	31	36	40	45	50	54	58	62	66	70	74	78	82	86	90

 ※STOP current is a phase current provided to 5-phase stepping motor at standstill.
 ※It will be activated when C/D (Auto current down) is set to ON. By setting STOP current, it is possible to suppress the heat generation at motor standstill.
 ※STOP current setting value is the ratio of RUN current setting value (%).
 Ex)In case RUN current setting value is set to 1.4A and STOP current setting value is set to 50%, auto current down current is set to 0.7A.
 ※STOP current setting value may have some deviation depending on resistance impedance of motor.
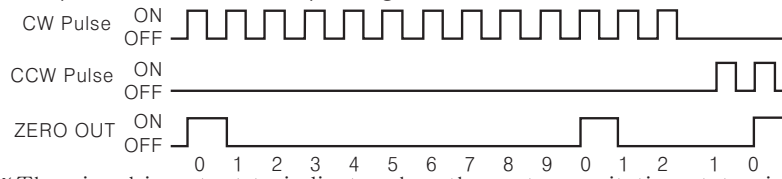 ※Auto current down function will be activated when HOLD OFF signal is [L]. When HOLD OFF signal is [H], the function is not activated since the current provided to each phase is cut off.
 Note)Be sure to adjust STOP current while motor is at standstill.

◎Zero point excitation output signal (ZERO OUT)

CW Pulse — ON / OFF

CCW Pulse — ON / OFF

ZERO OUT — ON / OFF

0 1 2 3 4 5 6 7 8 9 0 1 2 1 0

※The signal is output to indicate when the motor excitation status is in the initial stage. / Used to check the rotation position of motor's axis

※In case of full step, the signal is output every 7.2˚. (50 times / rotation)

EX) Full step (0.72˚/Step) : Signal is output every 10 pulses.
　　 20 divisions (0.036˚/Step) : Signal is output every 200 pulses.

◎HOLD OFF function

※When HOLD OFF input signal is [H], motor excitation is released.
　When HOLD OFF input signal is [L], motor excitation is in a normal status.

※A function used to rotate motor's axis using external force or used for manual positioning.

※HOLD OFF Input signal [H] and [L] represent photocoupler ON/OFF in a circuit.

※Please do not use for stopping motor.

◎Setting microstep (Microstep : Resolution)

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Resolution	1	2	4	5	8	10	16	20	25	40	50	80	100	125	200	250
Step angle	0.72˚	0.36˚	0.18˚	0.144˚	0.09˚	0.072˚	0.045˚	0.036˚	0.0288˚	0.018˚	0.0144˚	0.009˚	0.0072˚	0.00576˚	0.0036˚	0.00288˚

● Resolution setting (Same as MS1, MS2)

※It is set to MS1 when division selection signal is [L], and MS2 when division selection signal is [H].

※Two different micro step can be set using DIVISION SELECTION. Users can select one of them via external input signals.

※Microstepping is to make basic step angle of 5−phase motors (0.72˚) divided into smaller angle according to setting values.

※The formula for microstep angle is ;

$$\text{Motor revolution angle (5-phase motors)} = \frac{\text{Basic step angle}(0.72˚)}{\text{Resolution}}$$

※In case of geared motors, step angle shall be determined by dividing step angle by gear ratio.

EX) 0.72˚/ 10 (1:10) = 0.072 ˚

※It may cause step−out if resolution is changed while motor is running.

◎ALRAM Function

※Over heat : When the temperature in driver BASE is over 80℃, Alarm LED will be ON and motor will stop with holding the torque. Remove the Over Heat Alarm causing factors and reset the power in order to reset alarm function.

※Overcurrent : When overcurrent is applied to the motor due to driver damage or errors, Alarm LED will be flickering. In case of overcurrent, the motor will be HOLD OFF. Cut off the power and remove overcurrnet−causing factors in order to resume normal operation.

■ Input · Output diagram

Inner circuit of MD5−HF28

※CW
　2−pulse input mode − CW direction rotation pulse input
　1−pulse input mode − Operation command pulse input

※CCW
　2−pulse input mode − CCW direction rotation pulse input
　1−pulse input mode − Rotation direction pulse input
　[H] : CW, [L] : CCW

※HOLD OFF
　Motor excitation OFF control signal
　[H] : Motor excitation OFF

※DIVISION SELECTION
　Division selection signal
　→ [L] : Operated by MS1 setting resolution.
　　 [H] : Operated by MS2 setting resolution.

※ZERO OUT
　Zero point excitation output signal ON for zero point excitation

MD5 Series

▣Connections

Note) Add external resistance when power for pulse from the external of the unit exceeds +5V.
(Input current : 10 to 20mA)

※Please refer to Q−32 for standard wiring.

▣Dimensions

(Unit:mm)

5-Phase stepping motor driver [MD5-ND14]

◎Function selection switch

NO	Name	Function	Switch position	
			ON	OFF
1	1/2 CLK	Pulse input method	1 Pulse input	2 Pulse input
2	FULL ↔ HALF	Resolution Setting	×1(0.72˚)	×2(0.36˚)

● 1/2 CLK
   ※1/2 CLK switch is to select pulse input mode.
   ※1-pulse input mode : CW → operation command pulse input, CCW → rotation direction pulse input
                     ([H]: CW rotation, [L]: CCW rotation)
   ※2-pulse input mode : CW → CW direction rotation pulse input, CCW → CCW direction rotation pulse input

● FULL ↔ HALF
   ※FULL ↔ HALF switch is to select pulse input mode.
   ※If changing resolution while the motor is running, it may cause step-out.

◎RUN current setting
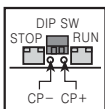
RUN CURRENT

   ※RUN current is a phase current provided to 5-phase stepping motor.
   ※Be sure to set RUN current at the rated current or below. If not, it may cause heat generation, loss of torque or step-out.
   ※RUN current setting range: 0.5 to 1.5A
   ※When changing RUN current, connect CP+ to voltmeter (+) terminal and CP- to voltmeter (-) terminal, then adjust the volume.
   ※The formula for phase-current setting is ;

$$\text{Setting current(A)} = \frac{\text{CP Input Voltage(V)}}{2}$$

   ※Adjust the RUN current in case severe heat generation occurs. Be sure that torque decreasing may occur when adjusting the current.
   ※RUN current setting value may have some deviation depending on motor's running frequency.
   Note)Be sure to adjust RUN current while motor is running.

◎STOP current setting

STOP CURRENT

25%   75%

   ※STOP current is a phase current provided to 5-phase stepping motor at standstill.
   ※A function to reduce the current in order to suppress the heat generation at motor standstill / STOP current setting range : 25 to 75% of RUN current using VR
   ※In case Run current setting value is set to 1.0A and STOP current setting value is set to 50%, STOP current is set to 0.5A.
   ※STOP current setting value may have some deviation depending on resistance impedance of motor.
   ※STOP current function will be activated when HOLD OFF signal is [L]. When HOLD OFF signal is [H], the function is not activated since the current provided to each phase is cut off.
   ※STOP current function will be activated when no operation command pulse is input within 500ms.
   Note)Be sure to adjust STOP current while motor is at standstill.

◎HOLD OFF function
   ※When HOLD OFF input signal is [H], motor excitation is released.
     When HOLD OFF input signal is [L], motor excitation is in a normal status.
   ※A function used to rotate motor's axis using external force or used for manual positioning.
   ※HOLD OFF Input signal [H] and [L] represent Photocoupler ON/OFF in a circuit.
   ※Please do not use for stopping motor.

MD5 Series

▣Input diagram

Inner circuit of MD5-ND14
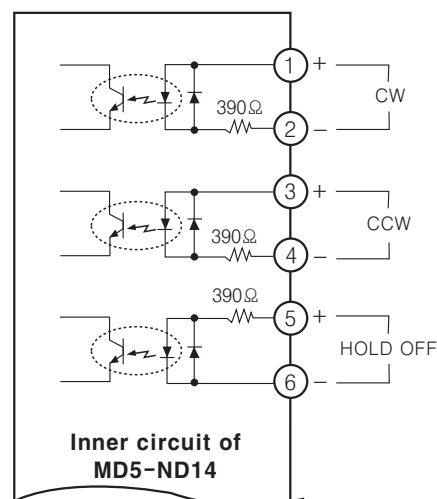
※CW
  2 pulse input method(CW direction rotation pulse input)
  1 pulse input method(Operating command pulse input)
Note)If the power for driving pulse from external is over than +5V,
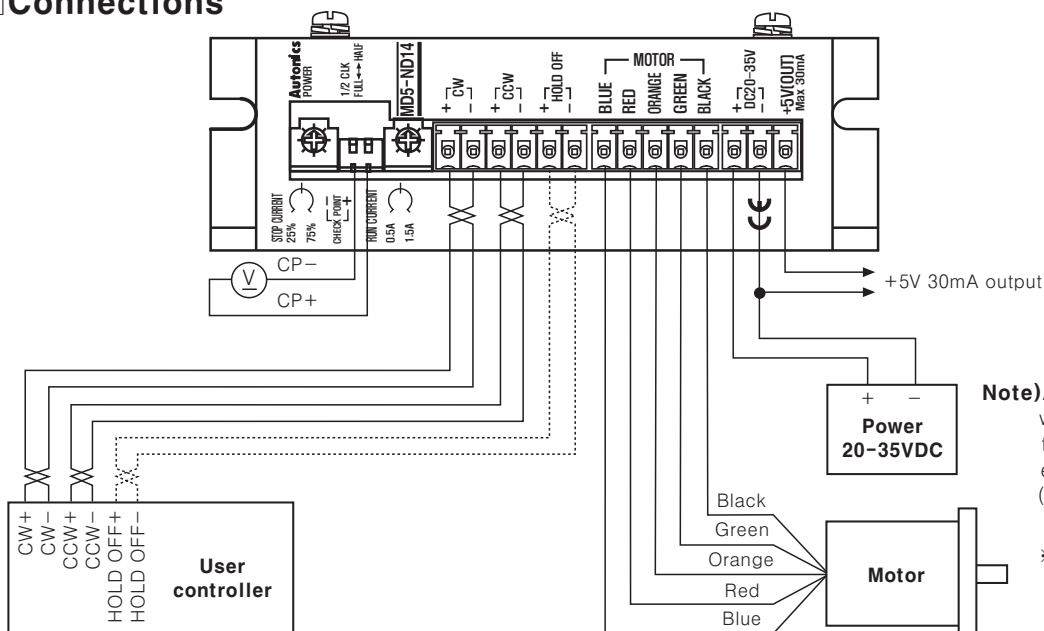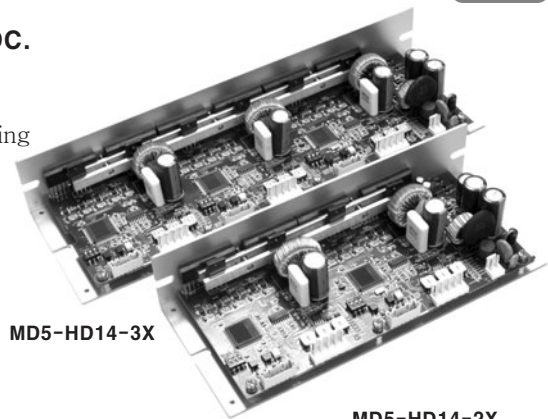   please connect resistor.

※CCW
  2 pulse input method(CCW direction rotation pulse input)
  1 pulse input method(Rotating direction pulse input)
   → [H] : CW, [L] : CCW

※HOLD OFF
  The control signal for hold off of Motor → [H] : Motor Hold OFF

▣Connections

+5V 30mA output

Power 20-35VDC

User controller

Motor

Black
Green
Orange
Red
Blue

Note) Add external resistance when power for pulse from the external of the unit exceeds +5V. (Input current:10 to 20mA)

※Please refer to Q-32 for standard wiring.

▣Dimensions

22.5
45
4.5
80
87

93
87
4.5
20
32

55.5
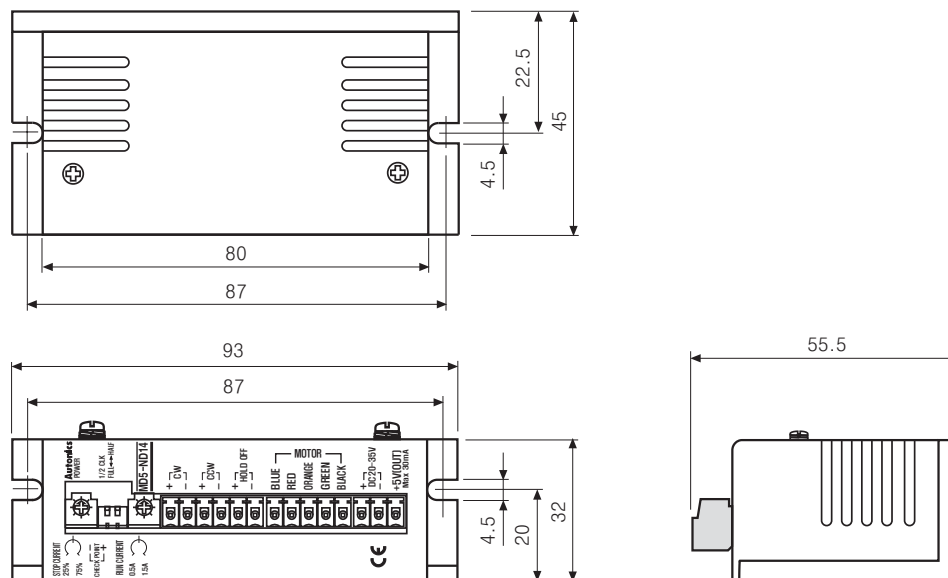
(Unit:mm)

Multi-Axis 5-Phase Stepping Motor Driver

Low noise, low vibration multi axis 5-phase stepping motor driver

■Features

NEW

- **Simultaneous operation of 2, 3-axis by single 24-35VDC.**
- Small, light weight and advanced quality by custom IC and surface mounted circuit.
- Realizing low noise, low vibration rotation with microstep-driving
- Low speed rotation and high accuracy controlling with microstep-driving
- Max. resolution - 250 division : In case of 5-phase stepping motor of which basic step angle is 0.72°, it enables to control up to 0.00288° per pulse and it requires 125,000 pulses per rotation.
- Includes auto current down and self-diagnosis function
- Photocoupler input insulation method to minimize the effects from external noise.

⚠ **Please read "Caution for your safety" in operation manual before using.**

CE

MD5-HD14-3X

MD5-HD14-2X

■Ordering information

MD **5** – **H** **D** **14** – **2X**

| Axis | 2X | 2-Axis |
| | 3X | 3-Axis |

| RUN current | 14 | 1.4A/Phase |

| Power supply | D | 20-35VDC |

| Step type (Resolution) | H | Micro Step(250divisions) |

| Motor phase | 5 | 5-Phase |

| Item | MD | Motor Driver |

※Bulit-in zero point excitation output signal is optional.

■Specifications

Model	MD5-HD14-2X	MD5-HD14-3X
Power supply	(※1) 20-35VDC 5A Max.(-10%, +20%)	20-35VDC 7A Max.(-10%, +20%)
RUN current	0.4 to 1.4A / Phase	
RUN method	Bipolar constant current pentagon drive	
Basic step angle	0.72° / 1Step	
Resolution	1, 2, 4, 5, 8, 10, 16, 20, 25, 40, 50, 80, 100, 125, 200, 250 division (0.72° to 0.00288° / 1Step)	
Input pulse width	Min. 0.5μs	
Pulse duty	Max. 50%	
Rising/Falling time	Max. each 120ns	
Max. input ulse frequency	1MHz	
Input voltage level	High : 4-8VDC, Low : 0-0.5VDC	
Input resistance	270Ω (CW, CCW), 390Ω (HOLD OFF)	
Ambient temperature	0 to 40℃ (Storage condition : -20 to 60℃ at non-freezing status)	
Ambient humidity	30 to 85%RH (at non-freezing status)	
Approval	CE	
Unit weight	Approx. 292g	Approx. 411g

※(※1)When using over 30VDC, it should be mounted at ventilated place due to increasing heat.

MD5-HD14-2X, 3X

◎Function selection switch

NO	Name	Function	Switch position	
			ON	OFF
1	TEST	Self-diagnosis	Rotate in 30rpm	――
2	1/2 CLK	Pulse input method	1 Pulse input	2 Pulse input
3	C/D	Auto current down	Not using	Using

● TEST
　※Self-diagnosis function is to test motors and drivers.
　※Motors rotate with 30 rpm in full-step. Motor rotation speed is subject to change depending on resolution setting.
　※Rotation speed = 30 rpm / resolution
　※The motor will rotate in CCW direction when in 1-pulse input mode and in CW direction when in 2-pulse input mode.
　Note) Make sure that TEST switch is set to OFF before supplying the power.
　　　　It may cause injury or danger if TEST switch is set to ON when power is supplied.

● 1/2 CLK
　※1/2 CLK switch is to select pulse input mode.
　※1-pulse input mode : CW → operation command pulse input, CCW → rotation direction pulse input
　　　　　　　　　　　　　　([H] : CW rotation, [L] : CCW rotation)
　※2-pulse input mode : CW → CW direction rotation pulse input, CCW → CCW direction rotation pulse input

● C/D (Auto current down)
　※This function is reducing current automatically according to STOP current setting value in order to suppress generated heat when motor is stop.
　※It activates when there is no pulse input of motor operation for over 200ms.

◎RUN current setting

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Current (A/Phase)	0.4	0.5	0.57	0.63	0.71	0.77	0.84	0.9	0.96	1.02	1.09	1.15	1.22	1.27	1.33	1.4

　※RUN current is a phase current provided to 5-phase stepping motor.
　※Be sure to set RUN current at the rated current or below. If not, it may cause heat generation, loss of torque or step-out.
　※Adjust the RUN current in case severe heat generation occurs. Be sure that torque decreasing may occur when adjusting the current.
　※RUN current setting value may have some deviation depending on motor's running frequency.
　Note)Be sure to adjust RUN current while motor is running.

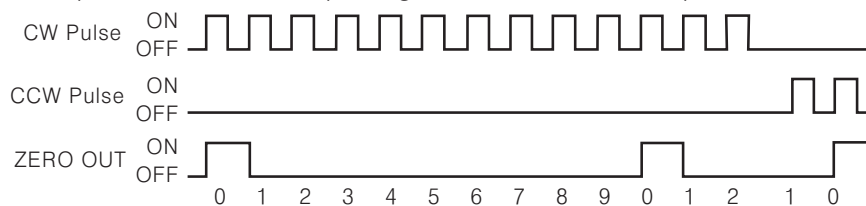◎STOP current setting

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
%	27	31	36	40	45	50	54	58	62	66	70	74	78	82	86	90

　※STOP current is a phase current provided to 5-phase stepping motor at standstill.
　※It will be activated when C/D (Auto current down) is set to ON. By setting STOP current, it is possible to suppress the heat generation at motor standstill.
　※STOP current setting value is the ratio of RUN current setting value (%).
　Ex)In case RUN current setting value is set to 1.4A and STOP current setting value is set to 50%, auto current down current is set to 0.7A.
　※STOP current setting value may have some deviation depending on resistance impedance of motor.
　※Auto current down function will be activated when HOLD OFF signal is [L]. When HOLD OFF signal is [H], the function is not activated since the current provided to each phase is cut off.
　Note)Be sure to adjust STOP current while motor is at standstill.

◎Zero point excitation output signal (ZERO OUT) [※Option]

CW Pulse

CCW Pulse

ZERO OUT

0 1 2 3 4 5 6 7 8 9 0 1 2 1 0

　※The signal is output to indicate when the motor excitation status is in the initial stage. / Used to check the rotation position of motor's axis
　※In case of full step, the signal is output every 7.2°. (50 times / rotation)
　EX)Full step (0.72°/Step) : Signal is output every 10 pulses.
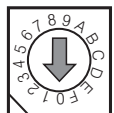　　　20 divisions (0.036°/Step) : Signal is output every 200 pulses.

Autonics

Multi-Axis 5-Phase Stepping Motor Driver

(A)
Photo
electric
sensor

(B)
Fiber
optic
sensor

(C)
Door/Area
sensor

(D)
Proximity
sensor

(E)
Pressure
sensor

(F)
Rotary
encoder

(G)
Connector/
Socket

(H)
Temp.
controller

(I)
SSR/
Power
controller

(J)
Counter

(K)
Timer

(L)
Panel
meter

(M)
Tacho/
Speed/
Pulse
meter

(N)
Display
unit

(O)
Sensor
controller

(P)
Switching
power
supply

(Q)
Stepping
motor &
Driver &
Controller

(R)
Graphic/
Logic
panel

(S)
Field
network
device

(T)
Production
stoppage
models &
replacement

◎HOLD OFF function

※When HOLD OFF input signal is [H], motor excitation is released.
  When HOLD OFF input signal is [L], motor excitation is in a normal status.
※A function used to rotate motor's axis using external force or used for manual positioning.
※HOLD OFF Input signal [H] and [L] represent Photocoupler ON/OFF in a circuit.
※Please do not use for stopping motor.

◎Setting microstep(Microstep : Resolution)

Switch No.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Resolution	1	2	4	5	8	10	16	20	25	40	50	80	100	125	200	250
Step angle	0.72°	0.36°	0.18°	0.144°	0.09°	0.072°	0.045°	0.036°	0.0288°	0.018°	0.0144°	0.009°	0.0072°	0.00576°	0.0036°	0.00288°

●Resolution setting(Same as MS1, MS2)

※Microstepping is to make basic step angle of 5-phase motors (0.72°) divided into smaller angle according
  to setting values.
※The formula for microstep angle is ;

$$\text{Motor revolution angle (5-phase motors)} = \frac{\text{Basic step angle}(0.72°)}{\text{Resolution}}$$

※In case of geared motors, step angle shall be determined by dividing step angle by gear ratio.
EX) 0.72 °/ 10 (1:10) = 0.072°
※It may cause step-out if resolution is changed while motor is running.

▣Input · Output diagram

⟨Inner circuit of MD5-HD14-2X/3X⟩

[Signal] I/O terminal connection diagram

※CW
  2-pulse input mode – CW direction rotation pulse input
  1-pulse input mode – Operation command pulse input

※CCW
  2-pulse input mode – CCW direction rotation pulse input
  1-pulse input mode – Rotation direction pulse input
  [H] : CW, [L] : CCW

※HOLD OFF
  Motor excitation OFF control signal [H] Motor excitation OFF

※ZERO OUT[※Option]
  Zero point excitation output signal ON for zero point excitation

[Motor] Motor connection diagram and power supply

※Please refer to Q-32 for standard wiring.

Note) Add external resistance when power for pulse from the external of the unit exceeds +5V. (Input current:10 to 20mA)
Note) 2/3-axis use power supply in common and input/output terminals are proportional to the number of axises of model.

MD5-HD14-2X, 3X

▣Dimensions

◎MD5-HD14-2X
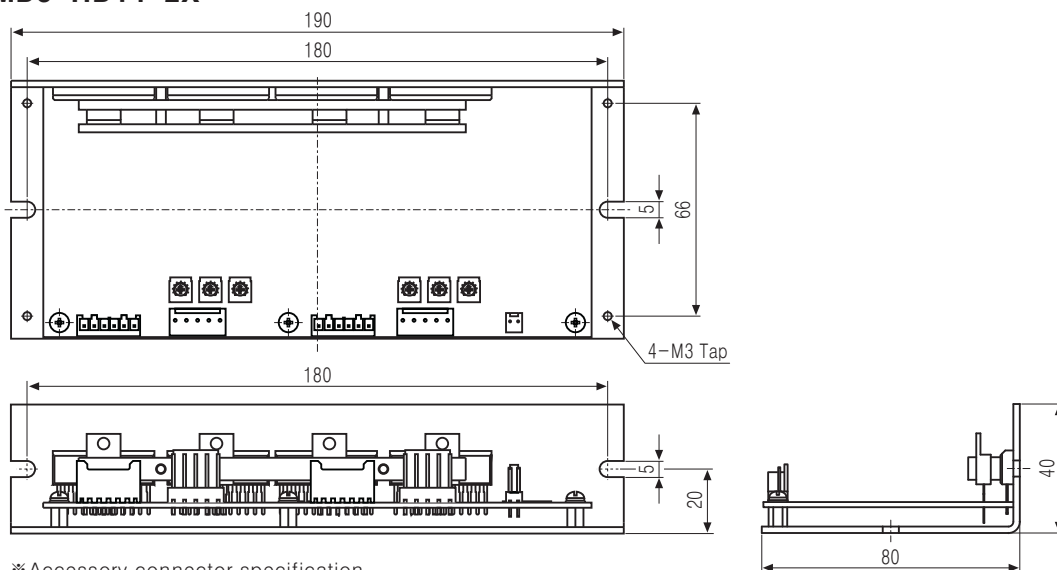
※Accessory connector specification

	Connector		Qty
	Manufacturer	Model No.	
Power 2P Housing	Yeonho electronics	YH396−02V	1
Motor 5P Housing	Yeonho electronics	YH396−05V	2
Signal 6P Housing	JST	XAP−06V−1	2
Power/Motor Terminal Pin	Yeonho electronics	YT396	12
Signal Terminal Pin	JST	SXA−001T−P0.6	12

◎MD5-HD14-3X
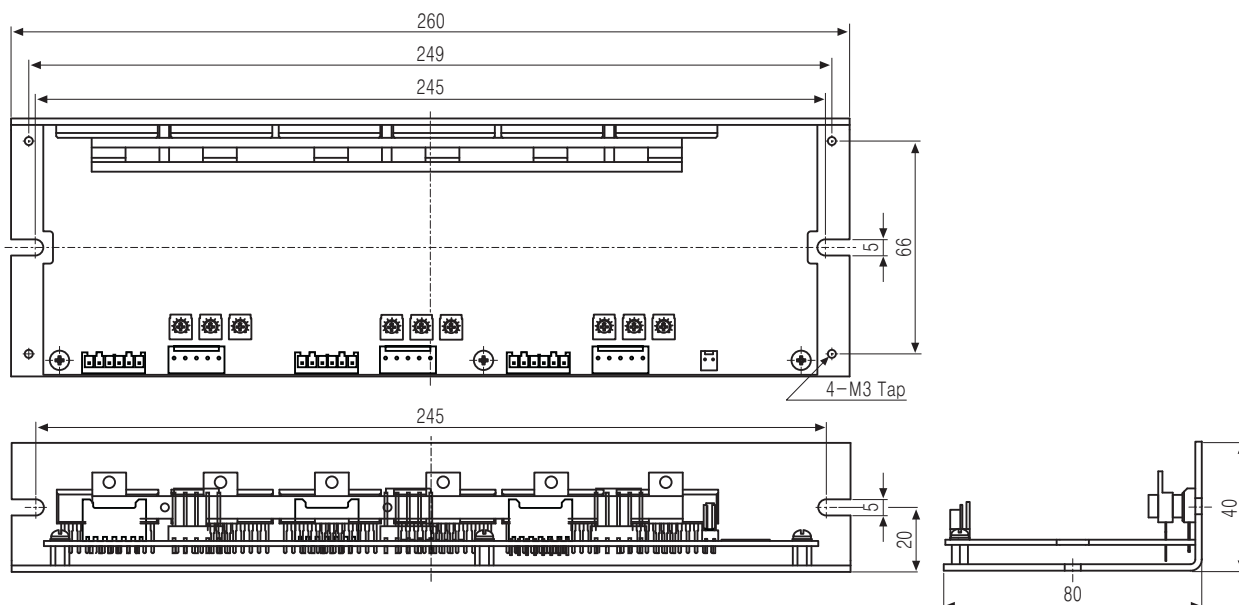
※Accessory connector specification

	Connector		Qty
	Manufacturer	Model No.	
Power 2P Housing	Yeonho electronics	YH396−02V	1
Motor 5P Housing	Yeonho electronics	YH396−05V	3
Signal 6P Housing	JST	XAP−06V−1	3
Power/Motor Terminal Pin	Yeonho electronics	YT396	17
Signal Terminal Pin	JST	SXA−001T−P0.6	18

(Unit:mm)

Autonics

5-Phase Stepping Motor

■Ordering information

● Application model : Shaft type, Hollow shaft type, Shaft type+Brake built-in type

A □ □ K − S 5 4 4 □ − □ □

Brake built-in	Blank	Standard type
(※)	B	Brake built-in type
Wire connection	Blank	Pentagon wiring
	S	Standard wiring(Option)
Motor shaft (※)	Blank	Single shaft
	W	Dual shaft

Motor length(mm)

	Motor frame size(mm)		
2	24mm (24mm×24mm)	3	30.5mm
		5	46.5mm
4	42mm (42mm×42mm)	3	33mm
		4	39mm
		5	47mm
6	60mm (60mm×60mm)	4	48.5mm
		6	59.5mm
		9	89mm
9	85mm (85mm×85mm)	6	68mm
		9	98mm
		13	128mm

Motor phase	5	5 phase

Rated current	S	0.75A / Phase
	M	1.4 A/ Phase
	G	2.8 A/ Phase

Max. holding torque	Square	kgf • cm (Refer to motor specification)

Motor type	Blank	Shaft type
	H	Hollow shaft type

Item		

Series		

※Brake built-in type provides single shaft type only.

● Application model : Geared built-in type, Geared+Brake built-in type, Rotary actuator,
   Rotary actuator+Brake built-in type

A □ K − S 5 4 5 □ − G 5

Gear ratio	5	1 : 5
	7.2	1 : 7.2
	10	1 : 10

Features	G	Geared built-in type
	GB	Geared-Brake built-in type
	R	Rotary actuator built-in type
	RB	Rotary actuator-Brake built-in type

Motor shaft	Blank	Single shaft
	W	Dual shaft

Motor length(mm)	5	47mm
	6	59.5mm
	9	98mm

Motor frame size	4	42mm
	6	60mm
	9	85mm

Motor phase	5	5 Phase

Rated current	S	0.75A/Phase
	M	1.4A/Phase
	G	2.8A/Phase

Max. holding torque	10	10kgf • cm	50	50kgf • cm
	15	15kgf • cm	140	140kgf • cm
	35	35kgf • cm	200	200kgf • cm
	40	40kgf • cm		

Item		

Series		

5-Phase Stepping Motor

■Specifications

Type		Model	A/phase (A)	Max. holding torque (kgf·cm)	Max. allowable torque (kgf·cm)	Moment of rotor inertia (g·cm²)	Winding resistance(Ω)	Motor length (mm)
24 Square	Shaft type	02K-S523(W)	0.75	0.18	−	4.2	1.1	30.5
		04K-S525(W)	0.75	0.28	−	8.2	1.7	46.5
42 Square	Shaft type	A1K-S543(W)	0.75	1.3	−	35	1.7	33
		A2K-S544(W)	0.75	1.8	−	54	2.2	39
		A2K-M544(W)	1.4	1.8	−	54	2.2	39
		A3K-S545(W)	0.75	2.4	−	68	2.2	47
	Hollow shaft type	AH1K-S543	0.75	1.3	−	35	1.7	33
		AH2K-S544	0.75	1.8	−	54	2.2	39
		AH3K-S545	0.75	2.4	−	68	2.2	47
	Geared built−in type	A10K-S545(W)-G5	0.75	−	10	68	1.7	74.5
		A15K-S545(W)-G7.2	0.75	−	15	68	2.2	74.5
		A15K-S545(W)-G10	0.75	−	15	68	2.2	74.5
60 Square	Shaft type / Shaft + Brake built−in type	A4K-S564(W)-B	0.75	4.2	−	175	2.6	48.5
		A4K-M564(W)-B	1.4	4.2	−	175	0.8	48.5
		A8K-S566(W)-B	0.75	8.3	−	280	4.0	59.5
		A8K-M566(W)-B	1.4	8.3	−	280	1.1	59.5
		A16K-M569(W)-B	1.4	16.6	−	560	1.8	89
		A16K-G569(W)-B	2.8	16.6	−	560	0.56	89
	Hollow shaft type	AH4K-S564(W)	0.75	4.2	−	175	2.6	48.5
		AH4K-M564(W)	1.4	4.2	−	175	0.8	48.5
		AH8K-S566(W)	0.75	8.3	−	280	4.0	59.5
		AH8K-M566(W)	1.4	8.3	−	280	1.1	59.5
		AH16K-M569(W)	1.4	16.6	−	560	1.8	89
		AH16K-G569(W)	2.8	16.6	−	560	0.56	89
	Geared built−in type	A35K-M566(W)-G5	1.4	−	35	280	1.1	94.5
		A40K-M566(W)-G7.2	1.4	−	40	280	1.1	94.5
		A50K-M566(W)-G10	1.4	−	50	280	1.1	94.5
	Geared + Brake built−in type	A35K-M566-GB5	1.4	−	35	280	1.1	136
		A40K-M566-GB7.2	1.4	−	40	280	1.1	136
		A50K-M566-GB10	1.4	−	50	280	1.1	136
	Rotary actuator type	A35K-M566(W)-R5	1.4	−	35	280	1.1	93.5
		A40K-M566(W)-R7.2	1.4	−	40	280	1.1	93.5
		A50K-M566(W)-R10	1.4	−	50	280	1.1	93.5
	Rotary actuator + Brake built−in type	A35K-M566-RB5	1.4	−	35	280	1.1	136
		A40K-M566-RB7.2	1.4	−	40	280	1.1	136
		A50K-M566-RB10	1.4	−	50	280	1.1	136
85 Square	Shaft type / Shaft + Brake built−in type	A21K-M596(W)-B	1.4	21	−	1400	1.76	68
		A21K-G596(W)-B	2.8	21	−	1400	0.4	68
		A41K-M599(W)-B	1.4	41	−	2700	2.6	98
		A41K-G599(W)-B	2.8	41	−	2700	0.58	98
		A63K-M5913(W)-B	1.4	63	−	4000	3.92	128
		A63K-G5913(W)-B	2.8	63	−	4000	0.86	128
	Hollow shaft type	AH21K-M596(W)	1.4	21	−	1400	1.76	68
		AH21K-G596(W)	2.8	21	−	1400	0.4	68
		AH41K-M599(W)	1.4	41	−	2700	2.6	98
		AH41K-G599(W)	2.8	41	−	2700	0.58	98
		AH63K-M5913(W)	1.4	63	−	4000	3.92	128
		AH63K-G5913(W)	2.8	63	−	4000	0.86	128
	Geared built−in type	A140K-M599(W)-G5	1.4	−	140	2700	2.6	145
		A140K-G599(W)-G5	2.8	−	140	2700	0.58	145
		A200K-M599(W)-G7.2	1.4	−	200	2700	2.6	145
		A200K-G599(W)-G7.2	2.8	−	200	2700	0.58	145
		A200K-M599(W)-G10	1.4	−	200	2700	2.6	145
		A200K-G599(W)-G10	2.8	−	200	2700	0.58	145
	Geared + Brake built−in type	A140K-M599-GB5	1.4	−	140	2700	2.6	182
		A140K-G599-GB5	2.8	−	140	2700	0.58	182
		A200K-M599-GB7.2	1.4	−	200	2700	2.6	182
		A200K-G599-GB7.2	2.8	−	200	2700	0.58	182
		A200K-M599-GB10	1.4	−	200	2700	2.6	182
		A200K-G599-GB10	2.8	−	200	2700	0.58	182

※**(W)** stands for dual shaft of motor. The brake built−in type provides single shaft type only.
※Motor length was measured without shaft.
※Hollow shaft type with standard wiring is customizable.(Except for 24mm)

Autonics

5-Phase Stepping Motor

■Specifications

●24 square

Model	02K-S523(W)	04K-S525(W)
Max. holding torque	0.18 kgf・cm (0.018N・m)	0.28kgf・cm (0.028 N・m)
Moment of rotor inertia	4.2 g・cm² (4.2×10^{-7}kg・m²)	8.2 g・cm² (8.2×10^{-7}kgf・m²)
Rated current	0.75A/Phase	
Basic step angle	0.72°／0.36° (Full step/Half step)	
Insulation class	CLASS B type(130℃)	
Insulation resistance	Min. 100MΩ(at 500VDC megger) between motor coil-case	
Dielectric strength	1Min. at 0.5kVAC 50/60Hz between motor coil-case	
Ambient temperature	−10 to 50℃(Storage condition : −25 to 85℃)	
Ambient humidity	35 to 85%RH(at non-freezing status)	
Protection	IP30(IEC34-5 standard)	
Unit weight	Approx. 0.07kg	Approx. 0.12kg
Reference	**Q-23 to 31**	

●42 square

Model	Shaft type	A1K-S543(W)	A2K-S544(W)	A2K-M544(W)	A3K-S545(W)	———	———	———
	Hollow shaft type	AH1K-S543	AH2K-S544	———	AH3K-S545	———	———	———
	Shaft type＋Geared buit-in type	———	———	———	———	A10K-S545(W)-G5	A15K-S545(W)-G7.2	A15K-S545(W)-G10
Max. allowable torque		———	———	———	———	10kgf・cm (1.0 N・m)	15kgf・cm (1.5 N・m)	15kgf・cm (1.5 N・m)
Max. holding torque		1.3kgf・cm (0.13 N·m)	1.8kgf・cm (0.18 N・m)		2.4kgf・cm (0.24 N・m)	———	———	———
Moment of rotor inertia		35g・cm² (35×10^{-7}kg·m²)	54g・cm² (54×10^{-7}kg·m²)		68g・cm² (68×10^{-7}kg·m²)	68g・cm² (68×10^{-7}kg·m²)		
Rated current		0.75A/Phase		1.4A/Phase	0.75A/Phase			
Basic step angle		0.72°／0.36(Full／Half step)				0.144°／0.072° (Full/Half step)	0.1°／0.05° (Full/Half step)	0.072°／0.036° (Full/Half step)
Gear ratio		———				1：5	1：7.2	1：10
Allowable speed range		———				0 to 360rpm	0 to 250rpm	0 to 180rpm
Backlash[min]		———				±35' (0.58°)		
Insulation class		CLASS B type(130℃)						
Insulation resistance		Min. 100MΩ(at 500VDC megger) between motor coil-case						
Dielectric strength		1Min. at 1kVAC(0.5kVAC for 0.75A/Phase) 50/60Hz between Motor coil-case						
Ambient temperature		−10 to 50℃(Storage condition : −25 to 85℃)						
Ambient humidity		35 to 85%RH(at non-freezing status)						
Protection		IP30(IEC34-5 standard)						
Unit weight		Approx. 0.25kg	Approx. 0.3kg		Approx. 0.4kg	Approx. 0.58kg		
Reference		**Q-23 to 31**						

(A) Photo electric sensor
(B) Fiber optic sensor
(C) Door/Area sensor
(D) Proximity sensor
(E) Pressure sensor
(F) Rotary encoder
(G) Connector/ Socket
(H) Temp. controller
(I) SSR/ Power controller
(J) Counter
(K) Timer
(L) Panel meter
(M) Tacho/ Speed/ Pulse meter
(N) Display unit
(O) Sensor controller
(P) Switching power supply
(Q) Stepping motor & Driver & Controller
(R) Graphic/ Logic panel
(S) Field network device
(T) Production stoppage models & replacement

5-Phase Stepping Motor

▣Specifications

●60 square

		A4K-S564(W)	A4K-M564(W)	A8K-S566(W)	A8K-M566(W)	A16K-M569(W)	A16K-G569(W)
Model	Shaft type	A4K-S564(W)	A4K-M564(W)	A8K-S566(W)	A8K-M566(W)	A16K-M569(W)	A16K-G569(W)
	Hollow shaft type	AH4K-S564(W)	AH4K-M564(W)	AH8K-S566(W)	AH8K-M566(W)	AH16K-M569(W)	AH16K-G569(W)
	Shaft type+ Brake buit-in type	A4K-S564-B	A4K-M564-B	A8K-S566-B	A8K-M566-B	A16K-M569-B	A16K-G569-B
Max. holding torque		4.2kgf•cm(0.42N•m)		8.3kgf•cm(0.83N•m)		16.6kgf•cm(1.66N•m)	
Moment of rotor inertia		175g•cm² $(175×10^{-7}$kg•m²$)$		280g•cm² $(280×10^{-7}$kg•m²$)$		560g•cm² $(560×10^{-7}$kg•m²$)$	
Rated current		0.75A/Phase	1.4A/Phase	0.75A/Phase	1.4A/Phase	1.4A/Phase	2.8A/Phase
Basic step angle		0.72° / 0.36(Full/Half step)					
Electro magnetic brake	Rated excitation voltage	24VDC(non-polarity)					
	Rated excitation current	0.33A					
	Static friction torque	4kgf•cm					
	Rotation part inertia	$2.5×10^{-6}$kgf•cm²					
	Operating time	Max. 22ms					
	Releasing time	Max. 37ms					
Insulation class		CLASS B type(130℃)					
Insulation resistance		Min. 100MΩ (at 500VDC megger) between motor coil-case					
Dielectric strength		1Min. at 1kVAC(0.5kVAC for 0.75A/Phase) 50/60Hz between motor coil-case					
Ambient temperature		-10 to 50℃ (Storage condition : -25 to 85℃)					
Ambient humidity		35 to 85%RH(at non-freezing status)					
Protection		IP30(IEC34-5 standard)					
Unit weight		Standard type : 0.6kg, Brake built-in type : 0.9kg		Standard type : 0.8kg, Brake built-in type : 1.1kg		Standard type : 1.3kg, Brake built-in type : 1.6kg	
Reference		**Q-23 to 28**					

●60 square

		A35K-M566(W)-G5	A40K-M566(W)-G7.2	A50K-M566(W)-G10
Model	Shaft type+ Geared buit-in type	A35K-M566(W)-G5	A40K-M566(W)-G7.2	A50K-M566(W)-G10
	Geared type+ Brake built-in type	A35K-M566-GB5	A40K-M566-GB7.2	A50K-M566-GB10
	Rotary actuator type	A35K-M566(W)-R5	A40K-M566(W)-R7.2	A50K-M566(W)-R10
	Rotary actuator type+ Brake built-in type	A35K-M566-RB5	A40K-M566-RB7.2	A50K-M566-RB10
Max. holding torque		35kgf•cm(3.5N•m)	40kgf•cm(4.0 N•m)	50kgf•cm(5.0 N•m)
Moment of rotor inertia		280 g•cm² $(280×10^{-7}$kg•m²$)$		
Rated current		1.4A/Phase		
Basic step angle		0.144° / 0.072° (Full/Half step)	0.1° / 0.05° (Full/Half step)	0.072° / 0.036° (Full/Half step)
Gear ratio		1 : 5	1 : 7.2	1 : 10
Allowable speed range		0 to 360rpm	0 to 250rpm	0 to 180rpm
Backlash[min]		±20' (0.33°)		
Electro magnetic brake	Rated excitation voltage	24VDC(non-polarity)		
	Rated excitation current	0.33A		
	Static friction torque	4kgf•cm		
	Rotation part inertia	$2.5×10^{-6}$kgf•cm²		
	Operating time	Max. 22ms		
	Releasing time	Max. 37ms		
Absolute position error (★1)		±20 minute(0.33°)		
Lost motion (★1)		±20 minute(0.33°)		
Insulation class		CLASS B type(130℃)		
Insulation resistance		Min. 100MΩ (at 500VDC megger) between motor coil-case		
Dielectric strength		1Min. at 1kVAC 50/60Hz between motor coil-case		
Ambient temperature		-10 to 50℃ (Storage condition : -25 to 85℃)		
Ambient humidity		35 to 85%RH(at non-freezing status)		
Protection		IP30(IEC34-5 standard)		
Unit weight		Geared type:1.3kg, Geared+Brake type:1.4kg, Rotary actuator type:1.5kg, Rotary actuator+Brake type:1.8kg		
Reference		**Q-29 to 31**		

※(★1) It is only available for rotary actuator type.

Autonics

5-Phase Stepping Motor

■Specifications

●85 square

		A21K-M596(W)	A21K-G596(W)	A41K-M599(W)	A41K-G599(W)	A63K-M5913(W)	A63K-G5913(W)
Model	Shaft type	A21K-M596(W)	A21K-G596(W)	A41K-M599(W)	A41K-G599(W)	A63K-M5913(W)	A63K-G5913(W)
	Hollow shaft type	AH21K-M596(W)	AH21K-G596(W)	AH41K-M599(W)	AH41K-G599(W)	AH63K-M5913(W)	AH63K-G5913(W)
	Shaft type+ Brake buit-in type	A21K-M596-B	A21K-G596-B	A41K-M599-B	A41K-G599-B	A63K-M5913-B	A63K-G5913-B
Max. holding torque		21kgf • cm(2.1 N • m)		41kgf • cm(4.1 N • m)		63kgf • cm(6.3 N • m)	
Moment of rotor inertia		1400 g • cm² (1400×10⁻⁷kg • m²)		2700 g • cm² (2700×10⁻⁷kg • m²)		4000 g • cm² (4000×10⁻⁷kg • m²)	
Rated current		1.4A/Phase	2.8A/Phase	1.4A/Phase	2.8A/Phase	1.4A/Phase	2.8A/Phase
Basic step angle		0.72° / 0.36° (Full/Half step)					
Electro magnetic brake	Rated excitation voltage	24VDC(non-polarity)					
	Rated excitation current	0.62A					
	Static friction torque	40kgf • cm					
	Rotation part inertia	42.5×10⁻⁶kgf • cm²					
	Operating time	Max. 80ms					
	Releasing time	Max. 70ms					
Insulation class		CLASS B type(130℃)					
Insulation resistance		Min. 100MΩ (at 500VDC megger) between motor coil-case					
Dielectric strength		1Min. at 1kVAC 50/60Hz between motor coil-case					
Ambient temperature		−10 to 50℃(Storage condition : −25 to 85℃)					
Ambient humidity		35 to 85%RH(at non-freezing status)					
Protection		IP30(IEC34−5 standard)					
Unit weight		Standard type : 1.7kg, Brake built-in type : 2.9kg		Standard type : 2.8kg, Brake built-in type : 4.0kg		Standard type : 3.8kg, Brake built-in type : 5.0kg	
Reference		**Q-23 to 28**					

●85 square

		A140K-M599(W)-G5	A140K-G599(W)-G5	A200K-M599(W)-G7.2	A200K-G599(W)-G7.2	A200K-M599(W)-G10	A200K-G599(W)-G10
Model	Shaft type+ Geared buit-in type	A140K-M599(W)-G5	A140K-G599(W)-G5	A200K-M599(W)-G7.2	A200K-G599(W)-G7.2	A200K-M599(W)-G10	A200K-G599(W)-G10
	Geared type+ Brake buit-in type	A140K-M599-GB5	A140K-G599-GB5	A200K-M599-GB7.2	A200K-G599-GB7.2	A200K-M599-GB10	A200K-G599-GB10
Max. holding torque		140kgf • cm(14 N • m)		200kgf • cm(20 N • m)		200kgf • cm(20 N • m)	
Moment of rotor inertia		2700 g • cm² (270×10⁻⁷ kg • m²)					
Rated current		1.4A/Phase	2.8A/Phase	1.4A/Phase	2.8A/Phase	1.4A/Phase	2.8A/Phase
Basic step angle		0.144° / 0.072° (Full/Half step)		0.1° / 0.05° (Full/Half step)		0.072° / 0.036° (Full/Half step)	
Gear ratio		1 : 5		1 : 7.2		1 : 10	
Allowable speed range		0 to 360rpm		0 to 250rpm		0 to 180rpm	
Backlash[min]		±15' (0.25°)					
Electro magnetic brake	Rated excitation voltage	24VDC(non-polarity)					
	Rated excitation current	0.62A					
	Static friction torque	40kgf • cm					
	Rotation part inertia	42.5×10⁻⁶ kgf • cm²					
	Operating time	Max. 80ms					
	Releasing time	Max. 70ms					
Insulation class		CLASS B type(130℃)					
Insulation resistance		Min. 100MΩ (at 500VDC megger) between motor coil-case					
Dielectric strength		1Min. at 1kVAC 50/60Hz between motor coil-case					
Ambient temperature		−10 to 50℃(Storage condition : −25 to 85℃)					
Ambient humidity		35 to 85%RH(at non-freezing status)					
Protection		IP30(IEC34−5 standard)					
Unit weight		Geared type : 4.4kg, Geared+Brake type : 5.6kg					
Reference		**Q-29 to 31**					

(A) Photo electric sensor
(B) Fiber optic sensor
(C) Door/Area sensor
(D) Proximity sensor
(E) Pressure sensor
(F) Rotary encoder
(G) Connector/ Socket
(H) Temp. controller
(I) SSR/ Power controller
(J) Counter
(K) Timer
(L) Panel meter
(M) Tacho/ Speed/ Pulse meter
(N) Display unit
(O) Sensor controller
(P) Switching power supply
(Q) Stepping motor & Driver & Controller
(R) Graphic/ Logic panel
(S) Field network device
(T) Production stoppage models & replacement

AK Series

□24mm/□42mm/□60mm/□85mm Shaft type
□60mm/□85mm Shaft type+Brake built-in type

▣Features

- Compact design and light weight with high accuracy, speed and torque
- Suitable for small−sized equipment applications
- Brake □60mm, □85mm of shaft type for compact equipment (AK−B Series)
- Brake force is released(AK−B Series) when applying power on brake wire. (24VDC non−polar type)
- Cost−effective

24 Square 42 Square

85 Square

60 Square 60 Square Brake built-in type 85 Square Brake built-in type

| ⚠ | Please read "Caution for your safety" in operation manual before using. |

CE

▣Dimensions

◎24 Square

4−M2.6 Effective depth 2.5
□24 ±0.3
19 ±0.25
19 ±0.25
AWG26 UL3265

4.5 ±0.2
Sectioned A-A'

15 ±0.5 L ±1 10 ±1
1.5
10 ±0.5
ø18 −0.025 0
ø5 −0.012 0
ø5 −0.012 0
Min.200
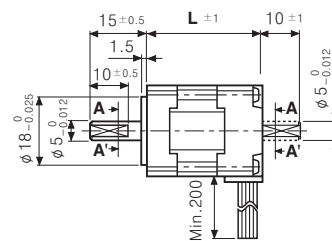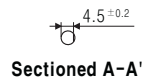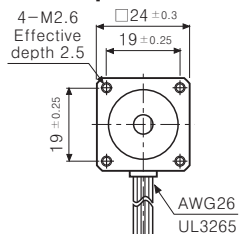
(Unit:mm)

MODEL	L
02K−S523(W)	30.5
04K−S525(W)	46.5

※These dimensions are for dual shaft models. For single shaft models, ignore dotted line (⋯⋯) part.

◎42 Square

4−M3 Effective depth 4.5
□42
31 ±0.2
31 ±0.2
AWG26 UL3266

4.5 ±0.15
Sectioned A-A'

20 ±0.5 L ±1 15 ±1
2
15 ±0.25
ø22 −0.021 0
ø5 −0.012 0
ø5 −0.012 0
Min.600
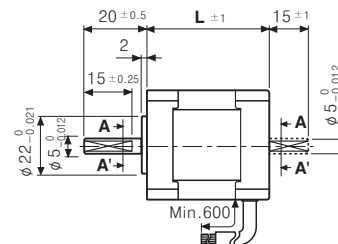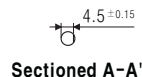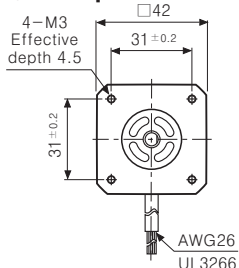
(Unit:mm)

MODEL	L
A1K−S543(W)−□	33
A2K−S544(W)−□	39
A3K−S545(W)−□	47

※These dimensions are for dual shaft models. For single shaft models, ignore dotted line (⋯⋯) part.

◎60 Square

4−ø4.5 Hole
□60
50 ±0.3
50 ±0.3
AWG24 UL3266

90° 7.5 ±0.15
7.5 ±0.15
Sectioned A-A'

24 ±1 L ±1 21 ±1
1.5 7
20 ±0.25
ø36 −0.039 0
ø8 −0.015 0
ø8 −0.015 0
20 ±0.25
Min.600

〈Shaft type〉
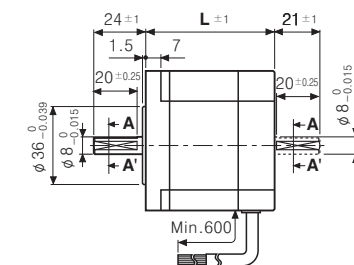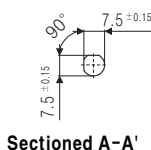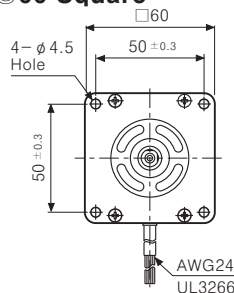
(Unit:mm)

MODEL	L
A4K−□564(W)−□B	48.5
A8K−□566(W)−□B	59.5
A16K−□569(W)−□B	89

※These dimensions are for dual shaft models. For single shaft models, ignore dotted line (⋯⋯) part.

24 ±1 L ±1 41.5
1.5 7
20 ±0.25
ø36 −0.039 0
ø8 −0.015 0
ø60
Min.600 Min.600
Electronic Brake Lead 2−wire (Non−polar type)

〈Brake built-in type〉

SW1
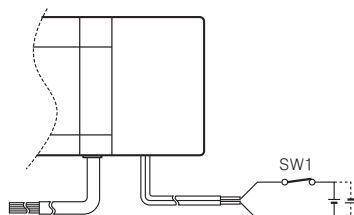
※Brake is non−polar "B" type.
  Be sure to observe rated excitation voltage (24VDC).
※SW1 ON−Brake release / SW1 OFF−Brake execute
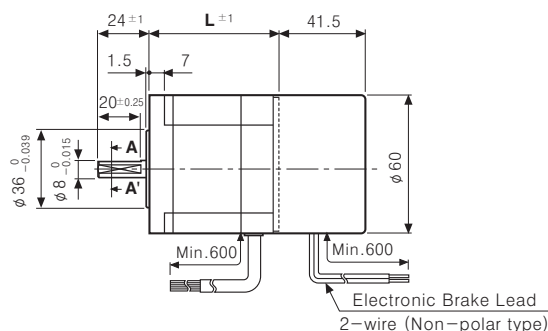
5-Phase Stepping Motor

▣ Dimensions

◎ 85 Square

□85

4−φ6.5 HOLE

70 ±0.3

70 ±0.3

90°

13 ±0.15

13 ±0.15

Sectioned A-A'

AWG22
UL3266

37 ±1   L ±1   32 ±1

2   10

25 ±0.25

25 ±0.25

φ60 0/−0.046

φ14 0/−0.018

φ14 0/−0.018

A
A'

A
A'

Min.600

⟨Shaft type⟩
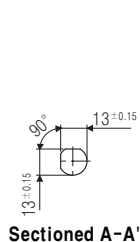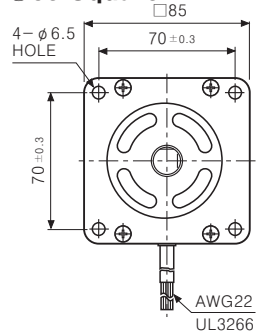
(Unit:mm)

MODEL	L
A21K−□596(W)−□B	68
A41K−□599(W)−□B	98
A63K−□5913(W)−□B	128

※These dimensions are for dual shaft models. For single shaft models, ignore dotted line (·······) part.

37 ±1   L ±1   37

2   10

25 ±0.25

φ60 0/−0.046

φ14 0/−0.018

A
A'

SW1

Min.600   Min.600

Electronic Brake Lead
2−wire (Non−polar type)
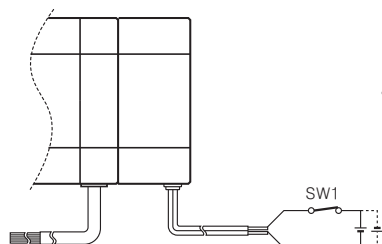
※Brake is non−polar "B" type.
Be sure to observe rated excitation voltage (24VDC).
※SW1 ON−Brake Release / SW1 OFF−Brake Execute

⟨Brake built-in type⟩
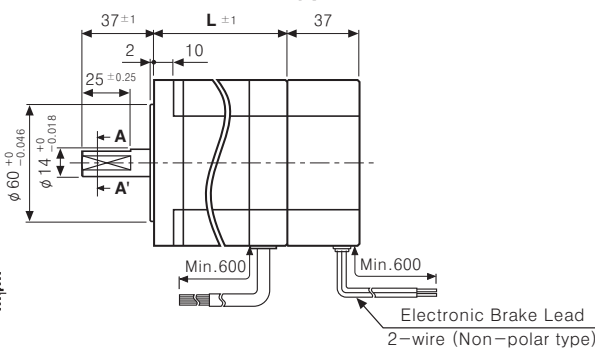
▣ Characteristic

● 02K−S523

Torque(gf · cm)

※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC
Setting current 0.75A/Phase
②Driver MD5−HD14, Power 24VDC
Setting current 0.75A/Phase
③Driver MD5−HF14, Power 220VAC
Setting current 0.75A/Phase

FULL STEP
HALF STEP

400
300
200
100
0

10² 10³ 10⁴   Speed(PPS)

①fs Full Step:3.6kpps, Half Step:7.1kpps
②fs Full Step:3.7kpps, Half Step:7.2kpps
③fs Full Step:3.8kpps, Half Step:7.5kpps

● 04K−S525

Torque(gf · cm)

※fs : Max. starting torque

FULL STEP
HALF STEP

400
300
200
100
0

①Driver MD5−ND14, Power 24VDC
Setting current 0.75A/Phase
②Driver MD5−HD14, Power 24VDC
Setting current 0.75A/Phase
③Driver MD5−HF14, Power 220VAC
Setting current 0.75A/Phase

10² 10³ 10⁴   Speed(PPS)

①fs Full Step:3.1kpps, Half Step:6.1kpps
②fs Full Step:3.2kpps, Half Step:6.3kpps
③fs Full Step:3.3kpps, Half Step:6.5kpps

● A1K−S543

Torque(kgf · cm)

※fs : Max. starting torque

FULL STEP
HALF STEP

2.0
1.5
1.0
0.5
0

①Driver MD5−ND14, Power 24VDC
Setting current 0.75A/Phase
②Driver MD5−HD14, Power 24VDC
Setting current 0.75A/Phase
③Driver MD5−HF14, Power 220VAC
Setting current 0.75A/Phase

10² 10³ 10⁴   Speed(PPS)

①fs Full Step:3.3kpps, Half Step:6.6kpps
②fs Full Step:3.4kpps, Half Step:6.7kpps
③fs Full Step:3.5kpps, Half Step:6.8kpps

● A2K−□544

Torque(kgf · cm)

※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC
Setting current 0.75A/Phase
②Driver MD5−HD14, Power 24VDC
Setting current 0.75A/Phase
③Driver MD5−HF14, Power 220VAC
Setting current 0.75A/Phase

FULL STEP
HALF STEP

4
3
2
1
0

10² 10³ 10⁴   Speed(PPS)

①fs Full Step:3.2kpps, Half Step:6.3kpps
②fs Full Step:3.3kpps, Half Step:6.5kpps
③fs Full Step:3.4kpps, Half Step:6.7kpps

(A) Photo electric sensor
(B) Fiber optic sensor
(C) Door/Area sensor
(D) Proximity sensor
(E) Pressure sensor
(F) Rotary encoder
(G) Connector/ Socket
(H) Temp. controller
(I) SSR/ Power controller
(J) Counter
(K) Timer
(L) Panel meter
(M) Tacho/ Speed/ Pulse meter
(N) Display unit
(O) Sensor controller
(P) Switching power supply
(Q) Stepping motor & Driver & Controller
(R) Graphic/ Logic panel
(S) Field network device
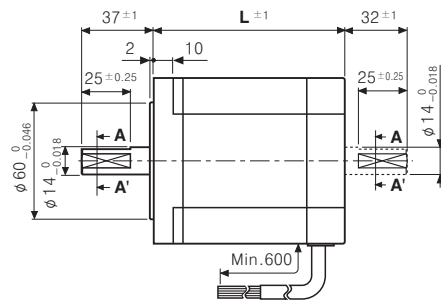(T) Production stoppage models & replacement

AK Series

■Characteristic

● A3K-S545

Torque(kgf·cm) ※fs : Max. starting torque

① Driver MD5-ND14, Power 24VDC
Setting current 0.75A/Phase
② Driver MD5-HD14, Power 24VDC
Setting current 0.75A/Phase
③ Driver MD5-HF14, Power 220VAC
Setting current 0.75A/Phase

— FULL STEP
···· HALF STEP

Speed(PPS)

① fs Full Step:3kpps,
Half Step:5.9kpps
② fs Full Step:3.1kpps,
Half Step:6.1kpps
③ fs Full Step:3.2kpps,
Half Step:6.4kpps

● A4K-M564 / A4K-M564-B

Torque(kgf·cm) ※fs : Max. starting torque

① Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
② Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③ Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase

— FULL STEP
···· HALF STEP

Speed(PPS)

① fs Full Step:2.7kpps,
Half Step:5.3kpps
② fs Full Step:2.7kpps,
Half Step:5.8kpps
③ fs Full Step:3.7kpps,
Half Step:7.2kpps

● A8K-M566 / A8K-M566-B

Torque(kgf·cm) ※fs : Max. starting torque

① Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
② Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③ Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase

— FULL STEP
···· HALF STEP

Speed(PPS)

① fs Full Step:2.1kpps,
Half Step:4.1kpps
② fs Full Step:2.1kpps,
Half Step:4.2kpps
③ fs Full Step:3.2kpps,
Half Step:6.3kpps

● A16K-□569 / A16K-□569-B

Torque(kgf·cm) ※fs : Max. starting torque

— FULL STEP
···· HALF STEP

Speed(PPS)

① fs Full Step:1.8kpps,
Half Step:3.5kpps
② fs Full Step:1.9kpps,
Half Step:3.5kpps
③ fs Full Step:2.6kpps,
Half Step:5.2kpps
④ fs Full Step:3.4kpps,
Half Step:6.8kpps
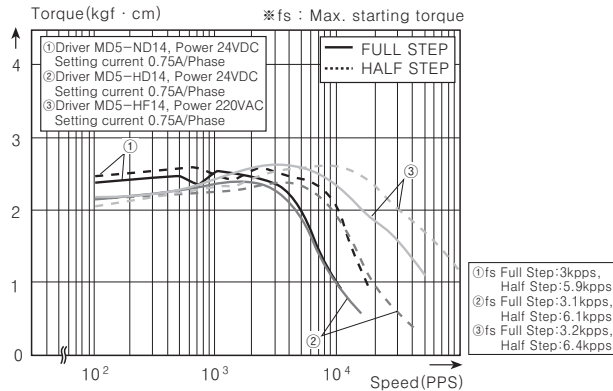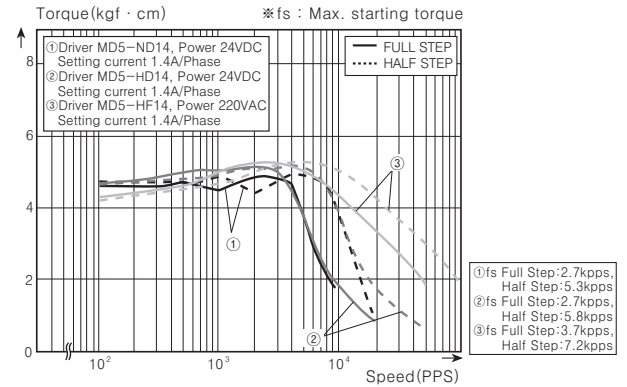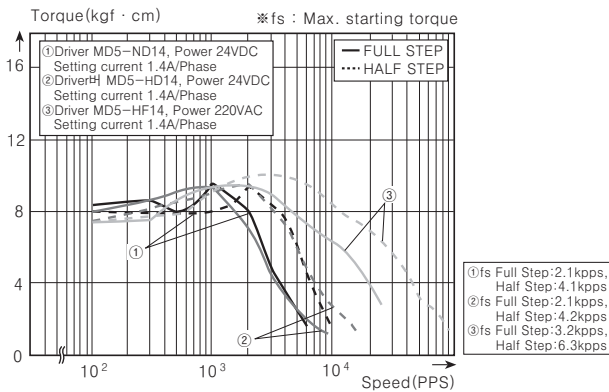
① Driver MD5-ND14, Power 24VDC, Setting current 1.4A/Phase
② Driver MD5-HD14, Power 24VDC, Setting current 1.4A/Phase
③ Driver MD5-HF14, Power 220VAC, Setting current 1.4A/Phase
④ Driver MD5-HF28, Power 220VAC, Setting current 2.8A/Phase

● A21K-□596 / A21K-□596-B

Torque(kgf·cm) ※fs : Max. starting torque

① Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
② Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③ Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase
④ Driver MD5-HF28, Power 220VAC
Setting current 2.8A/Phase

— FULL STEP
···· HALF STEP

Speed(PPS)

① fs Full Step:1.5kpps,
Half Step:2.9kpps
② fs Full Step:1.6kpps,
Half Step:3.1kpps
③ fs Full Step:2.2kpps,
Half Step:4.4kpps
④ fs Full Step:2.3kpps,
Half Step:4.6kpps

● A41K-□599 / A41K-□599-B

Torque(kgf·cm) ※fs : Max. starting torque

① Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
② Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③ Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase
④ Driver MD5-HF28, Power 220VAC
Setting current 2.8A/Phase

— FULL STEP
···· HALF STEP

Speed(PPS)

① fs Full Step:1.4kpps,
Half Step:2.7kpps
② fs Full Step:1.5kpps,
Half Step:2.9kpps
③ fs Full Step:1.8kpps,
Half Step:3.6kpps
④ fs Full Step:2.1kpps,
Half Step:4.3kpps

● A63K-G5913 / A63K-G5913-B

Torque(kgf·cm) ※fs : Max. starting torque

— FULL STEP
···· HALF STEP

Speed(PPS)

① Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
② Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③ Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase
④ Driver MD5-HF28, Power 220VAC
Setting current 2.8A/Phase

① fs Full Step:1kpps,   Half Step:2.1kpps
② fs Full Step:1.1kpps, Half Step:2.2kpps
③ fs Full Step:1.8kpps, Half Step:3.6kpps
④ fs Full Step:1.9kpps, Half Step:3.8kpps

AHK Series   5-Phase Stepping Motor

□42mm/□60mm/□85mm Hollow shaft type

■Features

- ●Compact design and light weight with high accuracy, speed and torque
- ●Suitable for small-sized equipment applications
- ●Remove the coupling connecting Ball-screw, TM-screw directly.
- ●Remove resonance(vibration · noise) without coupling.
- ●Cost-effective

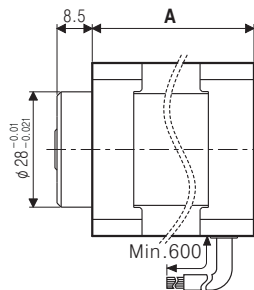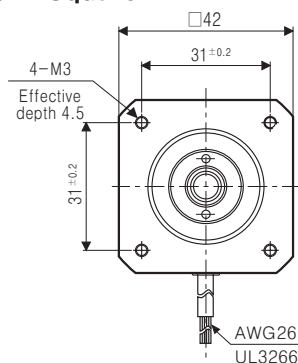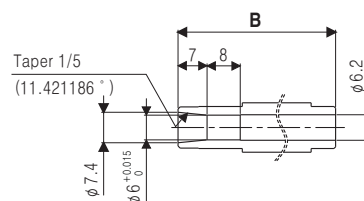⚠ Please read "Caution for your safety" in operation manual before using.

CE

42 Square

60 Square

85 Square

■Dimensions

◎42 Square

□42
4-M3
Effective depth 4.5
31±0.2
31±0.2
8.5
A
φ28⁻⁰·⁰¹₋₀.₀₂₅
Min.600
AWG26 UL3266

●Hole Dimensions

Taper 1/5 (11.421186°)
7 8
B
φ6.2
φ7.4
φ6⁺⁰·⁰¹⁵₀

MODEL	A	B
AH1K-S543	33	38
AH2K-S544	39	44
AH3K-S545	47	52

(Unit:mm)

◎60 Square

□60
4-φ4.5 Hole
50±0.3
50±0.3
7.5
A
1.5
7
φ36⁻⁰·⁰¹₋₀.₀₂₅
φ36⁻⁰·⁰¹₋₀.₀₂₅
Min.600
AWG24 UL3266

●Hole Dimensions

Taper 1/5 (11.421186°)
10 10
B
3.5
φ11
φ9⁺⁰·⁰¹⁵₀
φ9.2
φ12.2⁺⁰·²₀
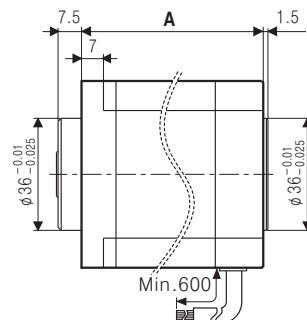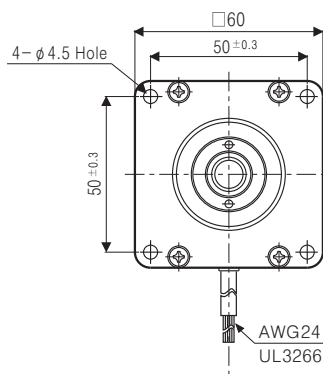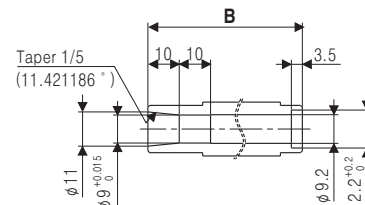
MODEL	A	B
AH4K-□564	48.5	49.3
AH8K-□566	59.5	60.3
AH16K-□569	89	89.8

(Unit:mm)

◎85 Square

□85
4-φ6.5 Hole
70±0.3
70±0.3
9
A
10
φ60⁻⁰·⁰¹₋₀.₀₄
Min.600
AWG22 UL3266

●Hole Dimensions

Taper 1/5 (11.421186°)
15 18
B
φ14.8
φ10⁺⁰·⁰¹⁵₀
φ10.2⁺⁰·¹₀
φ16.2⁺⁰·¹₀
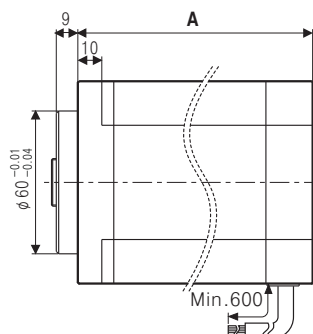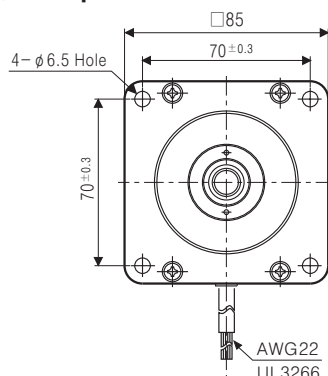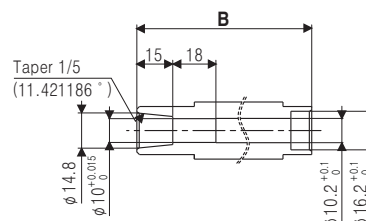
MODEL	A	B
AH21K-□596	68	73
AH41K-□599	98	102.5
AH63K-□5913	128	133

(Unit:mm)

※Depending on processing of shaft to be assembled, hollow shaft type can be used both single and dual shaft.

AHK Series

▣Characteristic

●AH1K-S543

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC
Setting current 0.75A/Phase
②Driver MD5-HD14, Power 24VDC
Setting current 0.75A/Phase
③Driver MD5-HF14, Power 220VAC
Setting current 0.75A/Phase

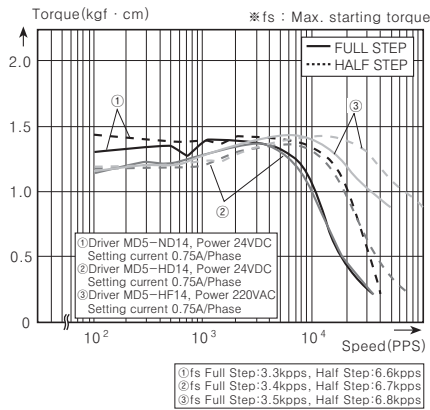①fs Full Step:3.3kpps, Half Step:6.6kpps
②fs Full Step:3.4kpps, Half Step:6.7kpps
③fs Full Step:3.5kpps, Half Step:6.8kpps

●AH2K-S544

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC
Setting current 0.75A/Phase
②Driver MD5-HD14, Power 24VDC
Setting current 0.75A/Phase
③Driver MD5-HF14, Power 220VAC
Setting current 0.75A/Phase

①fs Full Step:3.2kpps, Half Step:6.3kpps
②fs Full Step:3.3kpps, Half Step:6.5kpps
③fs Full Step:3.4kpps, Half Step:6.7kpps

●AH3K-S545

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC
Setting current 0.75A/Phase
②Driver MD5-HD14, Power 24VDC
Setting current 0.75A/Phase
③Driver MD5-HF14, Power 220VAC
Setting current 0.75A/Phase

①fs Full Step:3kpps, Half Step:5.9kpps
②fs Full Step:3.1kpps, Half Step:6.1kpps
③fs Full Step:3.2kpps, Half Step:6.4kpps

●AH4K-M564

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
②Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase

①fs Full Step:2.7kpps, Half Step:5.3kpps
②fs Full Step:2.7kpps, Half Step:5.8kpps
③fs Full Step:3.7kpps, Half Step:7.2kpps

●AH8K-M566

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
②Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase

①fs Full Step:2.1kpps, Half Step:4.1kpps
②fs Full Step:2.1kpps, Half Step:4.2kpps
③fs Full Step:3.2kpps, Half Step:6.3kpps

●AH16K-M(G)569

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC, Setting current 1.4A/Phase
②Driver MD5-HD14, Power 24VDC, Setting current 1.4A/Phase
③Driver MD5-HF14, Power 220VAC, Setting current 1.4A/Phase
④Driver MD5-HF28, Power 220VAC, Setting current 2.8A/Phase

①fs Full Step:1.8kpps, Half Step:3.5kpps
②fs Full Step:1.9kpps, Half Step:3.5kpps
③fs Full Step:2.6kpps, Half Step:5.2kpps
④fs Full Step:3.4kpps, Half Step:6.8kpps

●AH21K-M(G)596

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
②Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase
④Driver MD5-HF28, Power 220VAC
Setting current 2.8A/Phase

①fs Full Step:1.5kpps, Half Step:2.9kpps
②fs Full Step:1.6kpps, Half Step:3.1kpps
③fs Full Step:2.2kpps, Half Step:4.4kpps
④fs Full Step:2.3kpps, Half Step:4.6kpps

●AH41K-M(G)599

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC
Setting current 1.4A/Phase
②Driver MD5-HD14, Power 24VDC
Setting current 1.4A/Phase
③Driver MD5-HF14, Power 220VAC
Setting current 1.4A/Phase
④Driver MD5-HF28, Power 220VAC
Setting current 2.8A/Phase

①fs Full Step:1.4kpps, Half Step:2.7kpps
②fs Full Step:1.5kpps, Half Step:2.9kpps
③fs Full Step:1.8kpps, Half Step:3.6kpps
④fs Full Step:2.1kpps, Half Step:4.3kpps

●AH63K-G5913

Torque(kgf · cm)   ※fs : Max. starting torque

①Driver MD5-ND14, Power 24VDC, Setting current 1.4A/Phase
②Driver MD5-HD14, Power 24VDC, Setting current 1.4A/Phase
③Driver MD5-HF14, Power 220VAC, Setting current 1.4A/Phase
④Driver MD5-HF28, Power 220VAC, Setting current 2.8A/Phase

①fs Full Step:1kpps,   Half Step:2.1kpps
②fs Full Step:1.1kpps, Half Step:2.2kpps
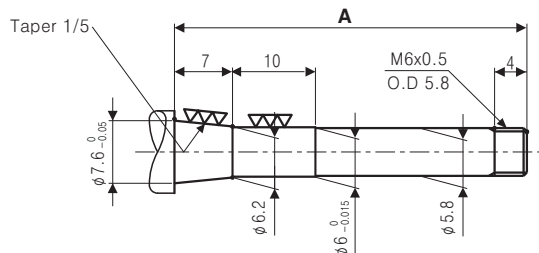③fs Full Step:1.8kpps, Half Step:3.6kpps
④fs Full Step:1.9kpps, Half Step:3.8kpps

Autonics

■Processing example for shaft assembly

In order to assemble external shafts into Autonics motors, the shafts must be processed as shown in the figures below.
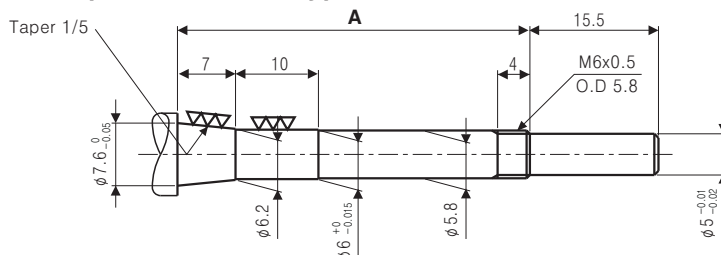
●42 Square single shaft type

Taper 1/5, A, 7, 10, M6x0.5 O.D 5.8, 4, φ7.6 0/−0.05, φ6.2, φ6 0/−0.015, φ5.8

(Unit:mm)

MODEL	A
AH1K-S543	42.5
AH2K-S544	48.5
AH3K-S545	56.5

※Lock Nut is included.

●42 Square dual shaft type

Taper 1/5, A, 15.5, 7, 10, 4, M6x0.5 O.D 5.8, φ7.6 0/−0.05, φ6.2, φ6 +0/−0.015, φ5.8, φ5 −0.01/−0.02

(Unit:mm)

MODEL	A
AH1K-S543W	42.5
AH2K-S544W	48.5
AH3K-S545W	56.5

※Lock Nut is included.

●60 Square single shaft type

Taper 1/5, A, 10, 12, M5x0.8 DP 8, φ11.2 0/−0.05, φ9.2, φ9 0/−0.015, φ8.8
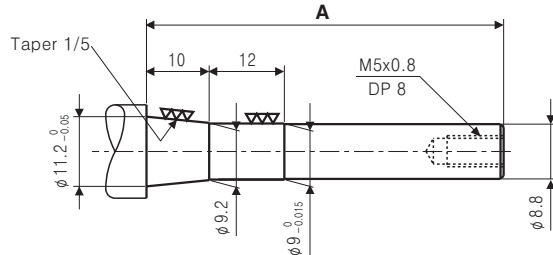
(Unit:mm)

MODEL	A
AH4K-□564	46
AH8K-□566	57
AH16K-□569	86.5

※Hexagon wrench bolt, Flat washer, Spring washer and Lock Nut are included.
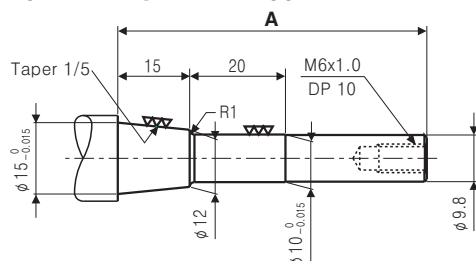
●60 Square dual shaft type

Taper 1/5, A, 22, 10, 12, 7, M9x0.5 O.D 8.8, φ11.2 0/−0.05, φ9.2, φ9 0/−0.015, φ8.8, φ8 −0.01/−0.025
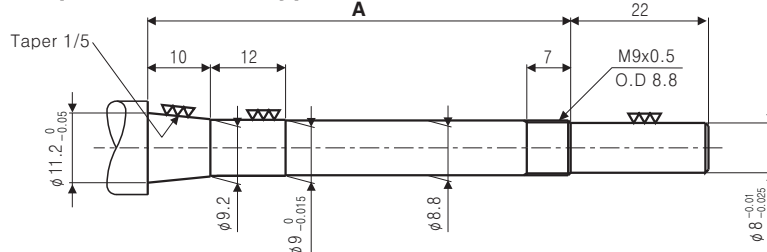
(Unit:mm)

MODEL	A
AH4K-□564W	56.5
AH8K-□566W	67.5
AH16K-□569W	97

※Lock Nut is included.

●85 Square single shaft type

Taper 1/5, A, 15, 20, M6x1.0 DP 10, R1, φ15 0/−0.015, φ12, φ10 0/−0.015, φ9.8
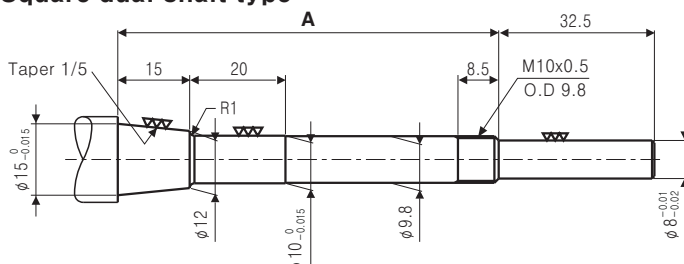
(Unit:mm)

MODEL	A
AH21K-□596	64.5
AH41K-□599	94
AH63K-□5913	124.5

※Hexagon wrench bolt, Flat washer, Spring washer and Lock Nut are included.

●85 Square dual shaft type

Taper 1/5, A, 32.5, 15, 20, 8.5, M10x0.5 O.D 9.8, R1, φ15 0/−0.015, φ12, φ10 0/−0.015, φ9.8, φ8 −0.01/−0.02

(Unit:mm)

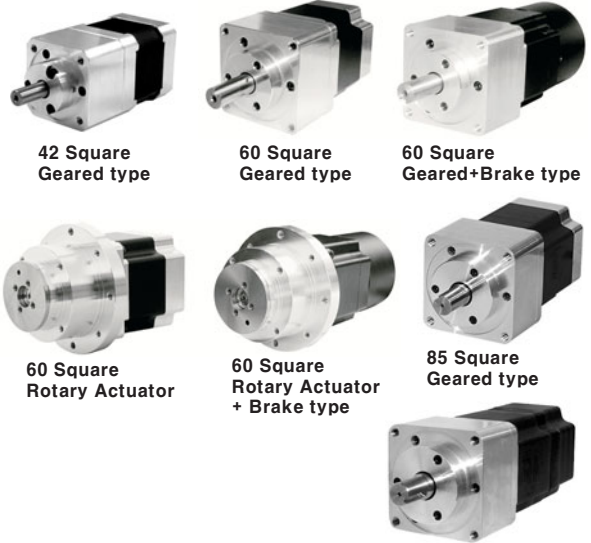| MODEL	A
AH21K-□596W	79.5
AH41K-□599W	109.5
AH63K-□5913W	139.5

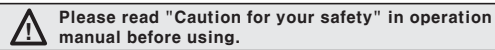※Lock Nut is included.

AK-G/AK-GB/AK-R/AK-RB Series

□42mm/□60mm/□85mm Geared type/Geared+Brake built-in type
□60mm Rotary actuator type/ Rotary actuator+Brake built-in type

■Features

- ●Compact design and light weight with high accuracy, speed and torque
- ●Cost-effective
- ●Backlash
  : □42mm ☞ ±35' (0.58°), □60mm ☞ ±20' (0.33°)
  □85mm ☞ ±15' (0.25°)
- ●Brake force is released when applying power on brake wire.(24VDC non-polar type)
- ●Basic step angle
  : 1:5 ☞ 0.144°, 1:7.2 ☞ 0.1°, 1:10 ☞ 0.072°
- ●Allowable speed
  : 1:5 ☞ 0 to 360rpm, 1:7.2 ☞ 0 to 250rpm,
  1:10 ☞ 0 to 180rpm
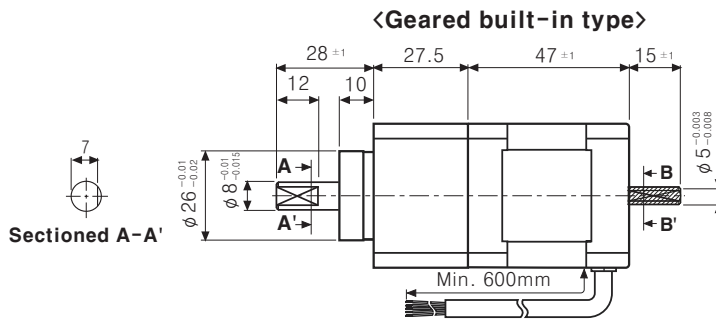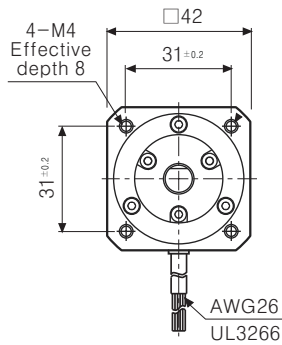
42 Square Geared type

60 Square Geared type

60 Square Geared+Brake type

60 Square Rotary Actuator

60 Square Rotary Actuator + Brake type

85 Square Geared type

85 Square Geared+Brake type

⚠ **Please read "Caution for your safety" in operation manual before using.**

CE

■Dimensions

◎42 Square

4-M4 Effective depth 8

□42

31 ±0.2

31 ±0.2

AWG26 UL3266

7

Sectioned A-A'

〈Geared built-in type〉

(Unit:mm)

28 ±1   27.5   47 ±1   15 ±1

12   10

$\phi 26^{-0.01}_{-0.02}$ $\phi 8^{-0.01}_{-0.015}$

A   A'
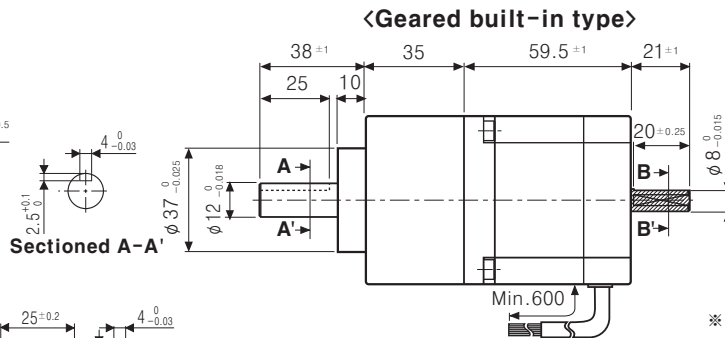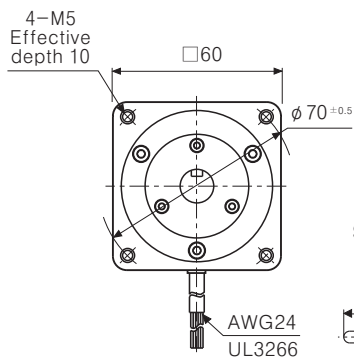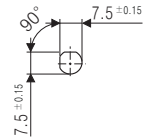
B   B'

$\phi 5^{-0.003}_{-0.008}$

Min. 600mm

4.5

Sectioned B-B'

※This is dual shaft type of dimension. In case of single shaft, there is no shaft of sectioned B.
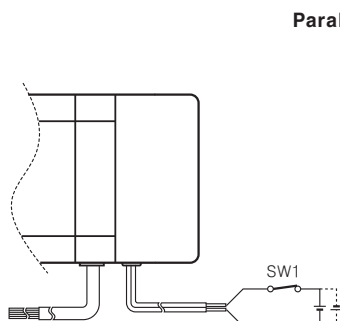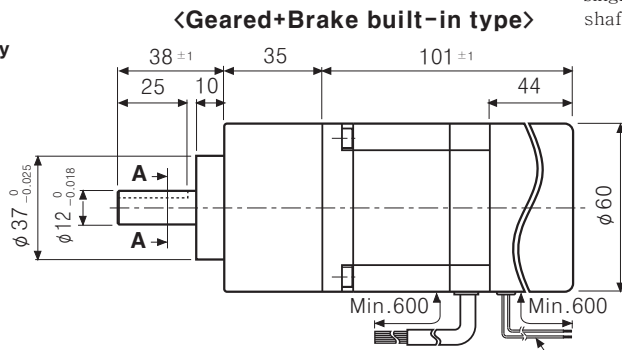
◎60 Square

4-M5 Effective depth 10

□60

$\phi 70^{±0.5}$

AWG24 UL3266

$4^{0}_{-0.03}$

2.5 ±0.1

Sectioned A-A'

25 ±0.2 $4^{0}_{-0.03}$

$4^{0}_{-0.03}$

Parallel Key

〈Geared built-in type〉

(Unit:mm)

38 ±1   35   59.5 ±1   21 ±1

25   10

$\phi 37^{0}_{-0.025}$ $\phi 12^{0}_{-0.018}$

A   A'

20 ±0.25

B   B'

$\phi 8^{0}_{-0.015}$

Min.600

90°   7.5 ±0.15

7.5 ±0.15

Sectioned B-B'

※This is dual shaft type of dimension. In case of single shaft, there is no shaft of sectioned B.

〈Geared+Brake built-in type〉

38 ±1   35   101 ±1

25   10   44

$\phi 37^{0}_{-0.025}$ $\phi 12^{0}_{-0.018}$

A   A

$\phi 60$

Min.600   Min.600

Electronic Brake Lead 2-wire (Non-polar type)

SW1

※Brake is non-polar "B" type.
  Be sure to observe rated excitation voltage (24VDC).
※SW1 ON-Brake Release / SW1 OFF-Brake Execute

# 5-Phase Stepping Motor

▣Dimensions

(A) Photo electric sensor

(B) Fiber optic sensor

(C) Door/Area sensor

(D) Proximity sensor

(E) Pressure sensor

(F) Rotary encoder

(G) Connector/ Socket

(H) Temp. controller

(I) SSR/ Power controller

(J) Counter

(K) Timer

(L) Panel meter

(M) Tacho/ Speed/ Pulse meter

(N) Display unit

(O) Sensor controller

(P) Switching power supply

(Q) Stepping motor & Driver & Controller

(R) Graphic/ Logic panel

(S) Field network device

(T) Production stoppage models & replacement

◎60 Square

(Unit:mm)

〈Rotary actuator type〉

Sectioned B-B'

※This is dual shaft type of dimension. In case of single shaft, there is no sectioned B.

〈Rotary actuator+Brake built-in type〉
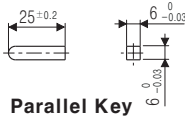
Electronic Brake Lead
2-wire (Non-polar type)
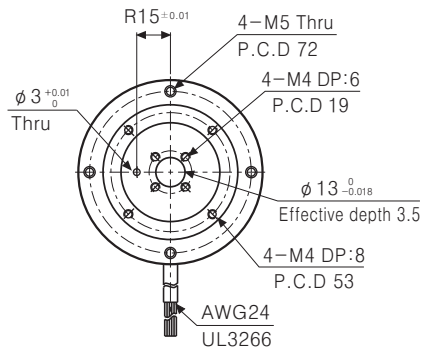
※Brake is non-polar "B" type.
Be sure to observe rated excitation voltage (24VDC).
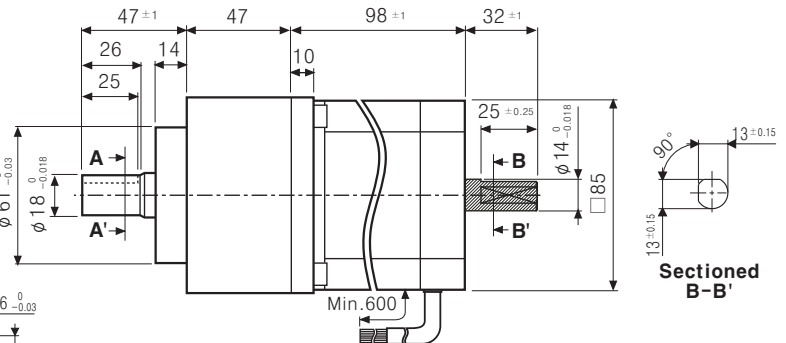※SW1 ON-Brake Release / SW1 OFF-Brake Execute

◎85 Square

(Unit:mm)

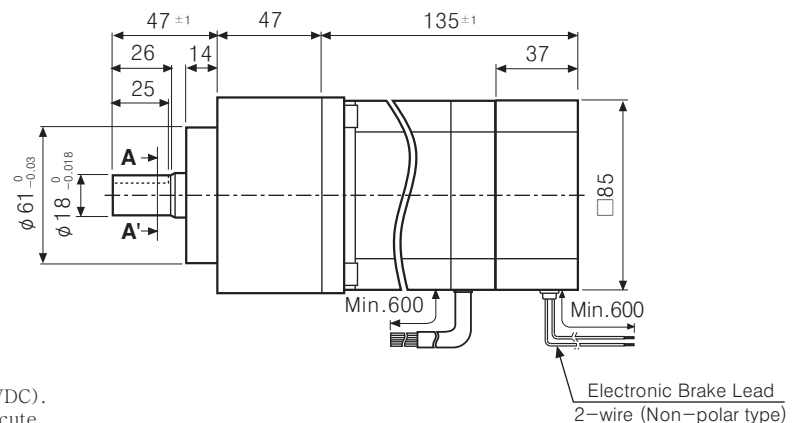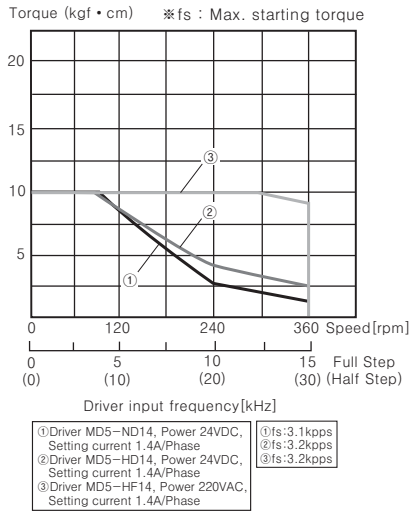**〈Geared type〉**

Sectioned A-A'

Parallel Key

Sectioned B-B'

※This is dual shaft type of dimension. In case of single shaft, there is no sectioned B.

〈Geared+Brake built-in type〉

※Brake is non-polar "B" type.
Be sure to observe rated excitation voltage (24VDC).
※SW1 ON-Brake Release / SW1 OFF-Brake Execute

Electronic Brake Lead
2-wire (Non-polar type)

Autonics

AK-G/AK-GB/AK-R/AK-RB Series

■Characteristic

●A10K-S545(W)-G5

Torque (kgf · cm)   ※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC, Setting current 1.4A/Phase	①fs:3.1kpps
②Driver MD5−HD14, Power 24VDC, Setting current 1.4A/Phase	②fs:3.2kpps
③Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase	③fs:3.2kpps

●A15K-S545(W)-G7.2

Torque (kgf · cm)   ※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC, Setting current 1.4A/Phase	①fs:3.2kpps
②Driver MD5−HD14, Power 24VDC, Setting current 1.4A/Phase	②fs:3.3kpps
③Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase	③fs:3.4kpps

●A15K-S545(W)-G10

Torque (kgf · cm)   ※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC, Setting current 1.4A/Phase	①fs:3.3kpps
②Driver MD5−HD14, Power 24VDC, Setting current 1.4A/Phase	②fs:3.3kpps
③Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase	③fs:3.4kpps

●A35K-M566(W)-□5
A35K-M566-□B5

Torque (kgf · cm)   ※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC, Setting current 1.4A/Phase	①fs:2.3kpps
②Driver MD5−HD14, Power 24VDC, Setting current 1.4A/Phase	②fs:2.3kpps
③Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase	③fs:2.6kpps

●A40K-M566(W)-□7.2
A40K-M566-□B7.2

Torque (kgf · cm)   ※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC, Setting current 1.4A/Phase	①fs:2.2kpps
②Driver MD5−HD14, Power 24VDC, Setting current 1.4A/Phase	②fs:2.3kpps
③Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase	③fs:2.6kpps

●A50K-M566(W)-□10
A50K-M566-□B10

Torque (kgf · cm)   ※fs : Max. starting torque

①Driver MD5−ND14, Power 24VDC, Setting current 1.4A/Phase	①fs:2.3kpps
②Driver MD5−HD14, Power 24VDC, Setting current 1.4A/Phase	②fs:2.3kpps
③Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase	③fs:2.8kpps

●A140K-□599(W)-G5
A140K-□599-GB5

Torque (kgf · cm)   ※fs : Max. starting torque

| ①Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase | ①fs:1.8kpps |
| ②Driver MD5−HF28, Power 220VAC, Setting current 2.8A/Phase | ②fs:2.1kpps |

●A200K-□599(W)-G7.2
A200K-□599-GB7.2

Torque (kgf · cm)   ※fs : Max. starting torque

| ①Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase | ①fs:1.8kpps |
| ②Driver MD5−HF28, Power 220VAC, Setting current 2.8A/Phase | ②fs:2.1kpps |

●A200K-□599(W)-G10
A200K-□599-GB10

Torque (kgf · cm)   ※fs : Max. starting torque

| ①Driver MD5−HF14, Power 220VAC, Setting current 1.4A/Phase | ①fs:1.9kpps |
| ②Driver MD5−HF28, Power 220VAC, Setting current 2.8A/Phase | ②fs:2.1kpps |

■Connection diagram of 5-phase stepping motor

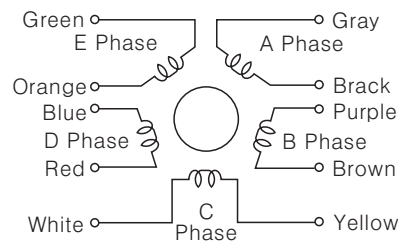Refer to below for correlations of motor's each phase(coil) and the color of lead wire.
Note that pentagon connection type is a standard model. (Standard connection type is an option model.)

●Pantagon wiring(Standard)

Blue
E Phase   A Phase
Black   Red
D Phase   B Phase
Green   Orange or Yellow
C Phase
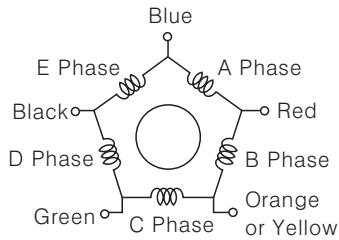
In case of connecting standard connection type models to motor drivers, make sure that motor's lead wire connection must be made as specified in the table.

●Standard wiring(Option)

Green   Gray
E Phase   A Phase
Orange   Brack
Blue   Purple
D Phase   B Phase
Red   Brown
White   Yellow
C Phase

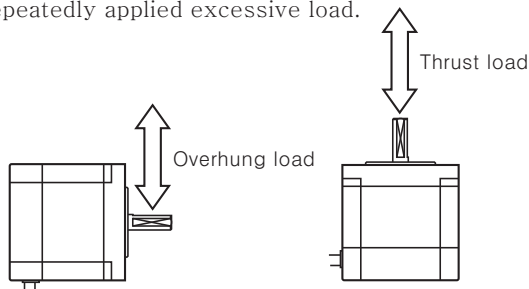| Lead wire color for standard connection type	Lead wire color for pentagon connection type
Gray+Red	Blue
Yellow+Black	Red
Orange+White	Orange
Brown+Green	Green
Blue+Purple	Black

■Motor Installation

◎Shaft type stepping motor

●Mounting direction

Motors can be mounted in any directions − facing up, facing down and sideways. No matter which direction motors to be mounted, be sure not to apply overhung or thrust load on the shaft.

1) Overhung load : A type of load to be applied in vertical directions on the shaft having effect on output shaft and bearings to shorten its lifecycle. In case excessive overhung load is applied on the shaft, it may cause bearing damage, output shaft bending or fatigue failure caused by repeatedly applied excessive load.
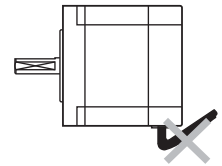
2) Thrust load : A type of load to be applied in parallel directions on the shaft having direct effect on output shaft and bearings to shorten its lifecycle. In case excessive thrust load is applied on the shaft, it may cause bearing damage, output shaft bending or fatigue failure caused by repeatedly applied excessive load.

Thrust load

Overhung load

Refer to the table below for allowable shaft overhung load / thrust load.

Motor type	Allowable overhung load per certain distance(mm) from the end of shaft					Allowable thrust load
	0	5	10	15	20	
20 Square	20[N] 2[kgf]	25[N] 2.5[kgf]	34[N] 3.4[kgf]	—	—	Under the load of Motor
42 Square	20[N] 2[kgf]	25[N] 2.5[kgf]	34[N] 3.4[kgf]	52[N] 5.2[kgf]	—	
60 Square	63[N] 6.3[kgf]	75[N] 7.5[kgf]	95[N] 9.5[kgf]	130[N] 13[kgf]	190[N] 19[kgf]	
85 Square	260[N] 26[kgf]	290[N] 29[kgf]	340[N] 34[kgf]	390[N] 39[kgf]	480[N] 48[kgf]	

Do not apply excessive force on motor cable when installing motors.
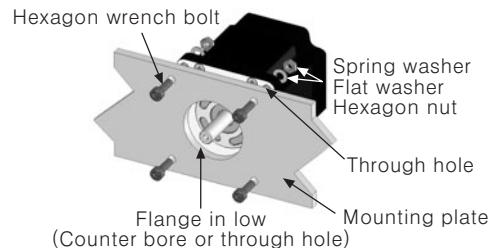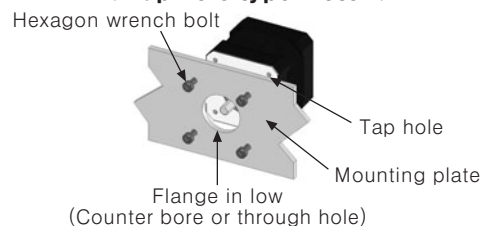It may cause disconnection of motor cable.

●Mounting method

With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum.
When mounting motors, use hexagon wrench bolts, spring washers or flat washers.
Refer to the table below for allowable thickness of mounting plate and bolt size.

⟨ Through hole type motor ⟩

Hexagon wrench bolt
Spring washer
Flat washer
Hexagon nut
Through hole
Flange in low (Counter bore or through hole)
Mounting plate

⟨ Tap hole type motor ⟩

Hexagon wrench bolt
Tap hole
Mounting plate
Flange in low (Counter bore or through hole)

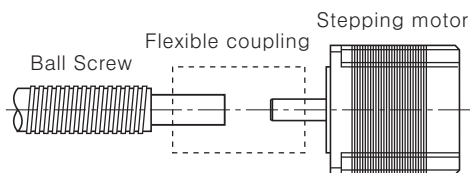| Motor size	Thickness of mounting plate	Using bolt
24 Square	Min. 3mm	M2.6
42 Square	Min. 4mm	M3
60 Square	Min. 5mm	M4
85 Square	Min. 8mm	M6

AK-G/AK-GB/AK-R/AK-RB Series

● **Connection with load**

In case of using motors with connecting a load—Ball screw or TM-screw — to motor's shaft, make sure to use flexible couplings as shown in the figure below.

If the center of the load is not matched to that of shaft, it may cause severe vibration, shaft damage or shortened lifecycle of bearings.

Do not disassemble or modify motor shaft in order to connect a load. Contact us if it is required.

In case of making connection with a pulley or a belt, be sure to observe allowable Thrust load and Radial load. Make sure no severe vibration applied on shaft.
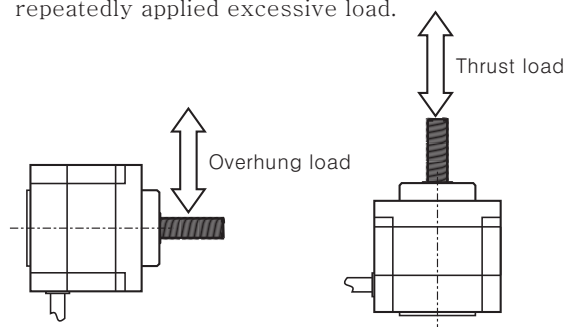

◎ **Hole type stepping motor**

● **Mounting direction**

Motors can be mounted in any directions — facing up, facing down and sideways. No matter which direction motors to be mounted, be sure not to apply overhung or thrust load on the shaft.

1) Overhung load: A type of load to be applied in vertical directions on the shaft having effect on output shaft and bearings to shorten its lifecycle. In case excessive overhung load is applied on the shaft, it may cause bearing damage, output shaft bending or fatigue failure caused by repeatedly applied excessive load.

2) Thrust load: A type of load to be applied in parallel directions on the shaft having direct effect on output shaft and bearings to shorten its lifecycle. In case excessive thrust load is applied on the shaft, it may cause bearing damage, output shaft bending or fatigue failure caused by repeatedly applied excessive load.

Do not apply excessive force on motor cable when installing motors.
It may cause disconnection of motor cable.
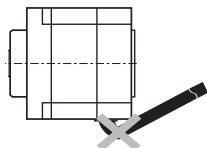
● **Shaft assembly for hollow shaft motor**

Make sure that external shaft assembly into motors must be made as sturdy as possible. If not, motor's torque might not be thoroughly transmitted to the shaft. In case no additional shaft assembly changes would be made, it is recommended to apply adhesives on bolt fixing part.
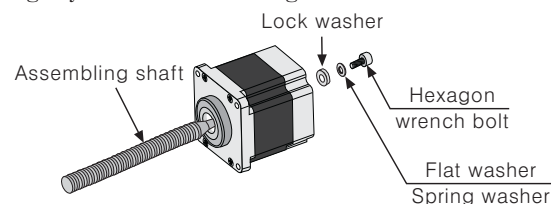
1. TAP hole type motor

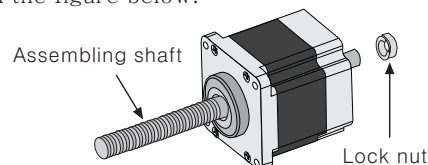Use pliers to fasten Lock Nut tightly as shown in the figure below.
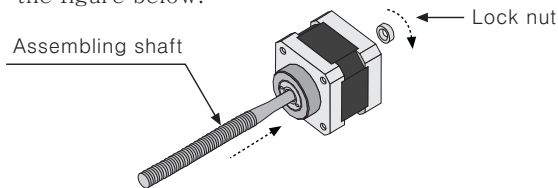
2. Through hole type motor with single shaft

Use hexagon wrench bolts, spring washers, flat washers and Lock washers to fasten the shaft tightly as shown in the figure below.

3. Through hole type motor with dual shaft

Use a Lock nut to fasten the shaft tightly as shown in the figure below.

● **Mounting method**

With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum.
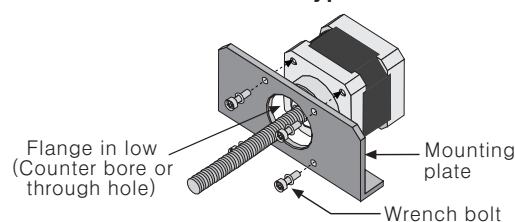
When mounting motors, use hexagon wrench bolts, spring washers or flat washers.

Refer to the table below for allowable thickness of mounting plate and bolt size.

< Through hole type >
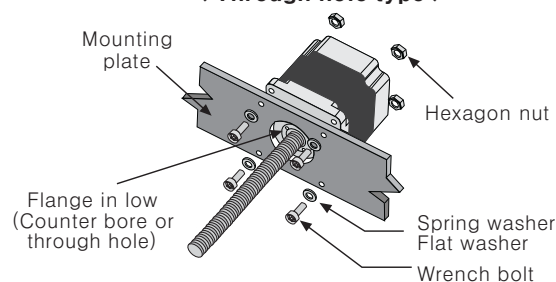
< TAP hole type >

Model	Thickness of mounting plate	Using bolt
AH□K−□54□Series	Min. 4mm	M3
AH□K−□56□Series	Min. 5mm	M4
AH□K−□59□Series	Min. 8mm	M6

Autonics
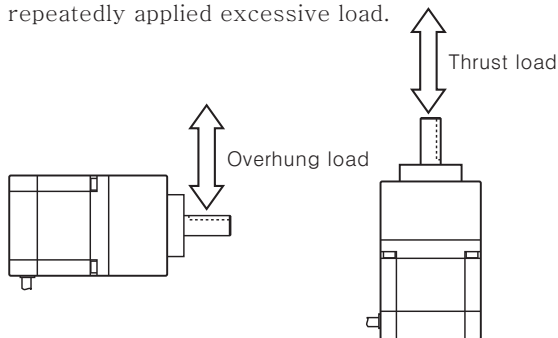
◎**Geared type stepping motor**

●**Mounting direction**

Motors can be mounted in any directions — facing up, facing down and sideways. No matter which direction motors to be mounted, be sure not to apply overhung or thrust load on the shaft.

1) Overhung load : A type of load to be applied in vertical directions on the shaft having effect on output shaft and bearings to shorten its lifecycle. In case excessive overhung load is applied on the shaft, it may cause bearing damage, output shaft bending or fatigue failure caused by repeatedly applied excessive load.

2) Thrust load : A type of load to be applied in parallel directions on the shaft having direct effect on output shaft and bearings to shorten its lifecycle. In case excessive thrust load is applied on the shaft, it may cause bearing damage, output shaft bending or fatigue failure caused by repeatedly applied excessive load.

Refer to the table below for allowable shaft overhung load / thrust load.

Motor type	Allowable overhung load per certain distance(mm) from the end of shaft					Allowable thrust load
	0	5	10	15	20	
42 Square	73[N] 7.3[kgf]	84[N] 8.4[kgf]	100[N] 10[kgf]	123[N] 12.3[kgf]	—	50[N] 5[kgf]
60 Square	250[N] 25[kgf]	270[N] 27[kgf]	300[N] 30[kgf]	340[N] 34[kgf]	390[N] 39[kgf]	100[N] 10[kgf]
85 Square	480[N] 48[kgf]	540[N] 54[kgf]	600[N] 60[kgf]	680[N] 68[kgf]	790[N] 79[kgf]	300[N] 30[kgf]

Do not apply excessive force on motor cable when installing motors.
It may cause disconnection of motor cable.
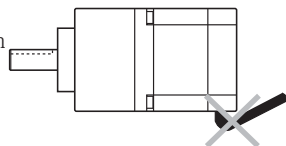
●**Mounting method**

With considering heat radiation and vibration isolation, mount the motor as tight as possible against a metal panel having high thermal conductivity such as iron or aluminum.
When mounting motors, use hexagon wrench bolts, spring washers or flat washers.
Refer to the table below for allowable thickness of mounting plate and bolt size.
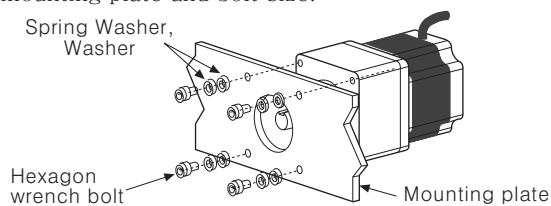
| Motor type	Thickness of mounting plate	Using bolt
42 Square	Min. 5mm	M4
60 Square	Min. 8mm	M5
85 Square	Min. 12mm	M8

●**Connection with load**

In case of using motors with connecting a load— Ball screw or TM-screw — to motor's shaft, make sure to use flexible couplings as shown in the figure below.
If the center of the load is not matched to that of shaft, it may cause severe vibration, shaft damage or shortened lifecycle of bearings.
Do not disassemble or modify motor shaft in order to connect a load. Contact us if it is required.
In case of making connection with a pulley or a belt, be sure to observe allowable Thrust load and Radial load. Make sure no severe vibration applied on shaft.
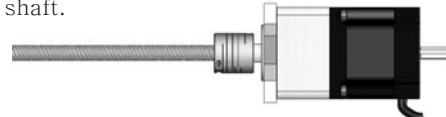
◎**Rotary actuator type stepping motor**

●**Installation of motor**

① With considering heat radiation and vibration isolation, make sure the motor's inrow to be kept as close as possible against a metal panel having high thermal conductivity such as iron or aluminum. Make sure to use mounting plates with thickness more than 8mm.

② As shown in the figure below, total 4 mounting Tap holes on F1 and F2 are used to fix rotary actuator. In case of using M4, screw connecting torque is 2[N.m] and 4.4[N.m] when using M5.
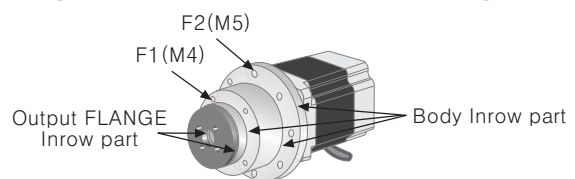
③ Do not apply excessive force on motor cable when installing rotary actuators. Do not forcibly pull or insert the cable. It may cause poor connection or disconnection of the cable. In case of frequent cable movement required application, proper safety countermeasures must be ensured.

●**Accessory mounting (Table or Arm)**

① Mount the accessory (table or arm) on output axis flange using M4 screw. Note that ϕ13 Inrow part is processed with c0.3. It is necessary to process the accessory under c0.2 to mount. Place a positioning pin on flange's positioning hole and push it in. Make sure not to place the pin on output flange.

② Do not use a hammer to mount the accessory (table or arm). It may cause product damage. Mount the accessory with hands in a gentle manner.

③ Make sure that accessory mounted on output axis to be fixed as tight as possible. It may cause an accident if an actuator is detached from the motor while driving.

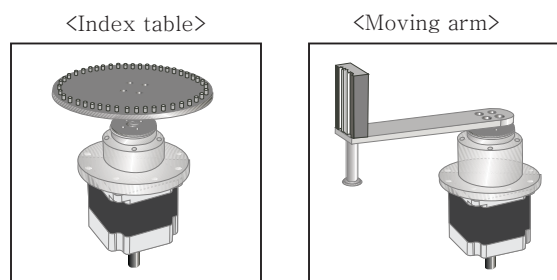●**Proper use of product**

Observe the rated product specification.
① Do not apply rotational load on the motor while it stops.
② Do not apply excessive load on the motor while driving. It may cause motors to miss a step.
③ Use a sensor for home searching or division completed position detecting.

AK-G/AK-GB/AK-R/AK-RB Series

● **Application example**

　　　　　　　　　<Index table>　　　　　　<Moving arm>

● **Sensor Installation examples**

　　　　　　　　<Index table>　　　　　　<Moving arm>

Sensor bracket

Sensor bracket

Table

Moving arm

Detection pin

Detection pin

Autonics photoelectric sensor BS5-L2M

Autonics photoelectric sensor BS5-T2M
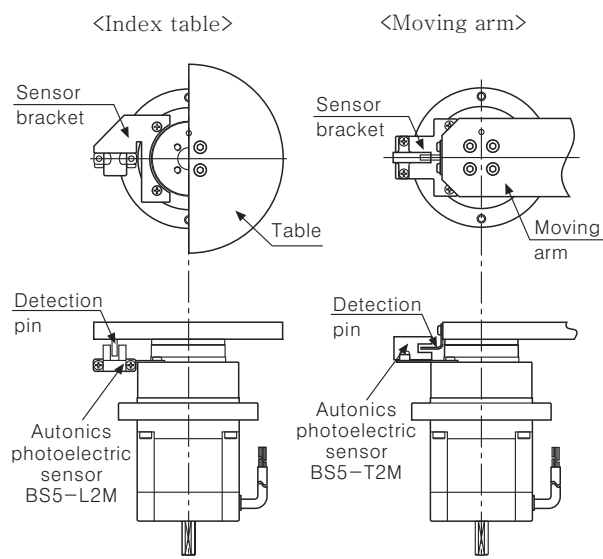
※Install an additional sensor to detect home position and to ensure motor's positioning, number of rotation and its speed.

■Caution for using

● **Installation condition**

: Install the motor in a place that meets certain conditions specified below. It may cause product damage if instructions are not following.

①It shall be used indoors.
(This product is designed / manufactured to be installed on machinery as a part.)

②Within −10 to 50℃(at non-freezing status) of ambient temperature

③Within 85%RH (at non-dew status) of ambient humidity

④The place without explosive, flammable and corrosive gas

⑤The place without direct ray of light

⑥The place without dust, dregs etc.

⑦The place without water, oil etc.

⑧The place where easy heat dissipation could be made

⑨The place where no continuous vibration or severe shock

⑩The place with less salt content

⑪The place with less electronic noise occurred by welding machine, motor etc.

⑫The place where no radioactive substances and magnetic fields exist. It shall be no vacuum status as well.

● **Do not disassemble or modify the product.**

It may cause a malfunction due to small dregs. Once disassembling the motor, its performance would significantly decline.

● **Do not impact the motor.**

The air-gap, the distance between rotator and stator is processed as 0.05mm, but if it is impacted, the balance of air-gap can be broken and it may cause a malfunction.

● **Use the motor within the rated torque range.**

The rated torque range indicates the maximum value of mechanical strength of gear part and the total of ac/deceleration torque of start/stop and friction torque shall not be exceed the rated torque range, or, it may cause the breakdown of gear.

● **Use the motor within the rated speed range.**

The rated speed range includes the revolution number of gear and pulse speed of motor. Use the motor within the rated speed range, or, it may shorten the life cycle of gear part. (Back-lash is increased.)

● **Be careful of backlash when positioning the motors in both CW/CCW directions.**

Backlash refers to the displacement occurred on motor's output shaft while gear's input axis is fixed. Geared type stepping motors are to realize high accuracy and low backlash. When positioning the motors in both CW/CCW directions, however, backlash may possibly occur. Therefore, make sure that motor positioning will be made in one single direction in case of geared type motors.

● **Temperature rise**

The surface temperature of motor shall be under 100℃ and it can be significantly increased in case of running motor by constant current drive. In this case, use the fan to lower the temperature forcedly.

● **Using at low temperature**

Using motors at low temperature may cause reducing maximum starting / driving characteristics of the motor as ball bearing's grease consistency decreases due to low temperature. (Note that the lower the bearing's grease consistency, the higher the bearing's friction torques.) Start the motor in a steady manner since motor's torque is not to be influenced.

● **Clack sound when using electromagnetic brake**

In case of brake built-in type motors, there occurs certain sound while turning on/off the power to the motor. This is not a product failure symptom. Do not strike or disassemble the product for this.

● **Using electromagnetic brake**

Release brake force first by supplying the power to brake before starting the motor. If not, it may cause product malfunction and shortened lifecycle of brake due to brake pad wear-out.

MD2U Series   2-Phase Stepping Motor Driver

Compact and high-performance of 2-phase stepping motor driver

▣Features

- Unipolar constant current drive type
- Enable to brake when it stops by STOP current adjustment.
- Low speed and precise control with microstep
- Insulate using photocoupler to minimize the influence by external noise.
- Power supply : 24−35VDC

⚠ **Please read "Caution for your safety" in operation manual before using.**

CE

MD2U-MD20   MD2U-ID20

▣Ordering information

MD 2 U − M D 20

Run current	
	20	2A/Phase
Power supply	
	D	24−35VDC
Operation type	
	M	Microstep
	I	Intelligent type
Run method	
	U	Unipolar drive
Motor phase	
	2	2 Phase
Item	
	MD	Motor Driver

▣Specifications

Model	MD2U-MD20	MD2U-ID20
Power supply	(★1) 24−35VDC 3A	
RUN current	0.5 to 2.0A / Phase	
RUN method	Unipolar constant current drive	
Resolution	1, 2, 4, 5, 8, 10, 16, 20 division	———
Input pulse width	Min. 10μs	———
Pulse duty	Max. 50%	———
Rising/falling time	Max. 0.5μs	———
Max. input pulse frequency	(★2) 50kHz	———
Input voltage	High : 4−8VDC, Low : 0−0.5VDC	———
Input resistance	300Ω (CW, CCW), 390Ω (HOLD OFF)	3.3kΩ (CW/CCW, RUN/STOP, HOLD OFF)
Insulation resistance	Min. 200MΩ (atn 500VDC megger)	
Dielectric strength	1000VDC 60Hz for 1 minute	
Vibration	1.5mm amplitude at frequency of 10 to 55Hz in each of X, Y, Z directions for 2 hours	
Shock	300m/s² (30G) in X, Y, Z directions for 3 times	
Ambient temperature	0 to 50℃ (at non−freezing status)	
Storage temperature	−20 to 60℃ (at non−freezing status)	
Ambient humidity	35 to 85%RH	
Approval	CE	
Unit weight	Approx. 180g	Approx. 190g

※(★1) When using over 30VDC, it should be mounted at ventilative place due to increasing heat.
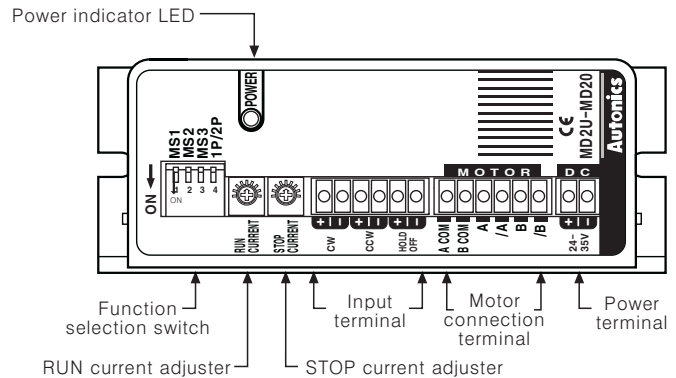※(★2) Max. input pulse frequency is subject to change depending on resolution.

MD2U Series

2-Phase microstepping driver [MD2U-MD20]

◎Function selection switch

●Setting microstep

	MS1	MS2	MS3	Resolution	Step angle
ON 1 2 3	ON	ON	ON	Full-step	1.8 °
ON 1 2 3	ON	ON	OFF	2 division	0.9 °
ON 1 2 3	ON	OFF	ON	4 division	0.45 °
ON 1 2 3	ON	OFF	OFF	5 division	0.36 °
ON 1 2 3	OFF	ON	ON	8 division	0.225 °
ON 1 2 3	OFF	ON	OFF	10 division	0.18 °
ON 1 2 3	OFF	OFF	ON	16 division	0.1125 °
ON 1 2 3	OFF	OFF	OFF	20 division	0.09 °

●Setting input type

	1P / 2P
ON 4	1 Pulse input
ON 4	2 Pulse input

●Resolution setting(MS1/ MS2/ MS3)

※A switch to select micro step angle to drive a motor.

※Microstepping is to make basic step angle of 2-phase motors (1.8°) divided into smaller angle according to setting values

※The formula for microstep angle is;

$$\text{Rotation angle per pulse of 2-phase}[°] = \frac{1.8° \text{ or } 0.9°}{\text{Resolution}}$$

※It may cause step-out if resolution is changed while motor is running.
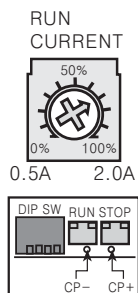
●1P/2P

※A switch to select pulse input type

※1-pulse input mode

CW : Operation command pulse input, CCW : Rotation direction pulse input([H] : CW, [L] : CCW)

※2-pulse input mode

CW : CW direction rotation pulse input, CCW : CCW direction rotation pulse input

◎RUN current setting

※RUN current is a phase current provided to 2-phase stepping motor.

※Be sure to set RUN current at the rated current or below. If not, it may cause heat generation, loss of torque or step-out.

※RUN current setting range : 0.5 to 2.0A

※RUN current setting : Measure the voltage by connecting a DC voltage meter to both CT+ and CT- terminals while the motor is running (Max. 150rpm).

Ex)Input Voltage(3V) × 2 / 3 = 2A(Motor's excitation current)

※Adjust the RUN current in case severe heat generation occurs.

Be sure that torque decreasing may occur when adjusting the current.

※RUN current setting value may have some deviation depending on motor's running frequency.

Note)Be sure to adjust RUN current while motor is running.

2-Phase Stepping Motor Driver

(A)
Photo
electric
sensor

(B)
Fiber
optic
sensor

(C)
Door/Area
sensor

(D)
Proximity
sensor

(E)
Pressure
sensor

(F)
Rotary
encoder

(G)
Connector/
Socket

(H)
Temp.
controller

(I)
SSR/
Power
controller

(J)
Counter

(K)
Timer

(L)
Panel
meter

(M)
Tacho/
Speed/
Pulse
meter

(N)
Display
unit

(O)
Sensor
controller

(P)
Switching
power
supply

(Q)
Stepping
motor &
Driver &
Controller

(R)
Graphic/
Logic
panel

(S)
Field
network
device

(T)
Production
stoppage
models &
replacement

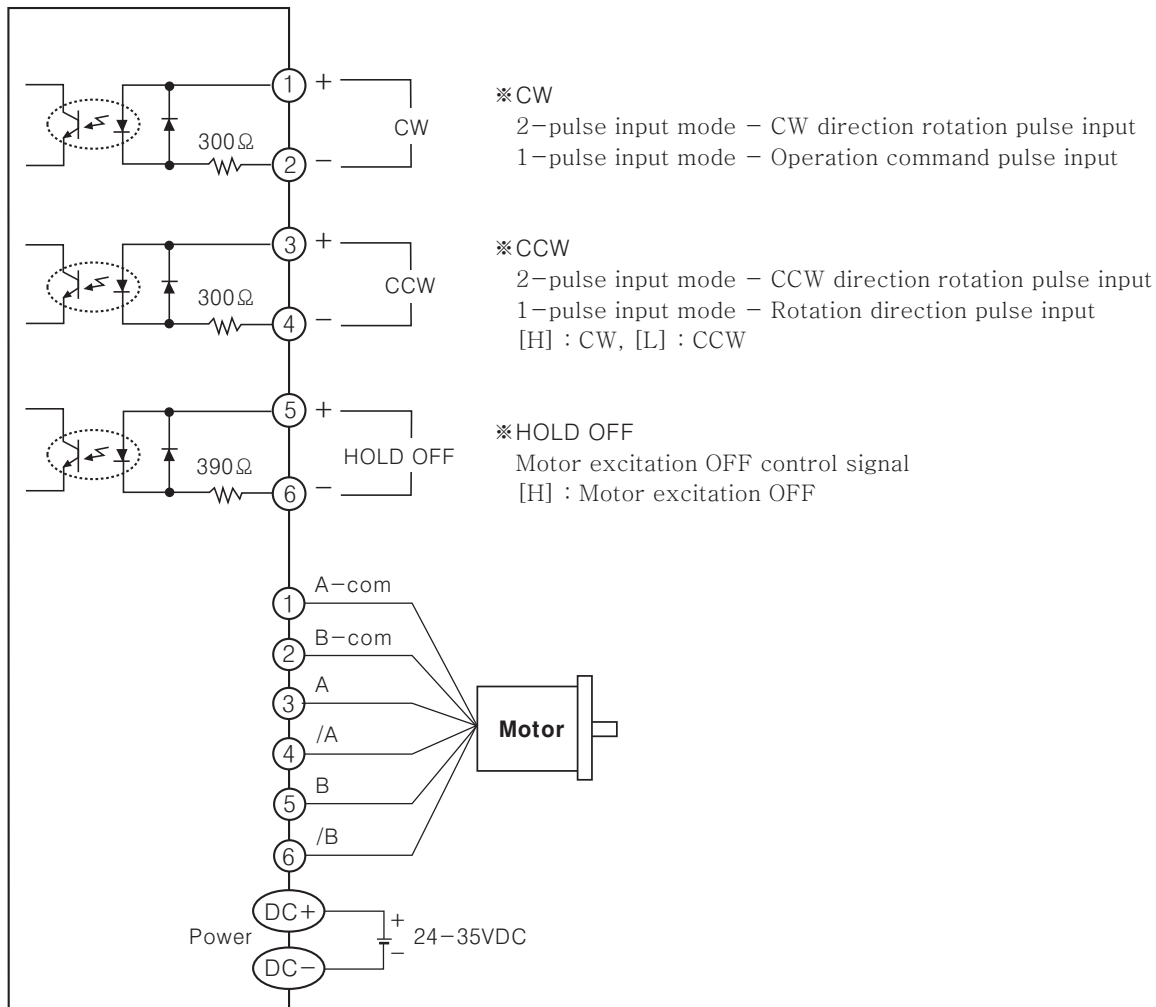◎STOP current setting

STOP CURRENT

50%

0%   100%

20% 70%

※Stop current is a phase current provided to 2-phase stepping motor at standstill.
※A function to reduce the current in order to suppress the heat generation at motor standstill /
  Use variable resistance ratio within 0 to 100% of RUN current to set STOP current (Actual setting
  range is 20 to 70% of RUN current).
Ex)If RUN current setting value is 2A and STOP current setting value is 0%, STOP current will be
   set to 0.4A.
※STOP current setting value may have some deviation depending on resistance impedance of motor.
※Auto current down function will be activated when HOLD OFF signal is [L]. When HOLD OFF signal
  is [H], the function is not activated since the current provided to each phase is cut off.
Note)Be sure to adjust STOP current while motor is at standstill.

◎HOLD OFF function

※When HOLD OFF input signal is [H], motor excitation is released.
  When HOLD OFF input signal is [L], motor excitation is in a normal status.
※A function used to rotate motor's axis using external force or used for manual positioning.
※HOLD OFF Input signal [H] and [L] represent Photocoupler ON/OFF in a circuit.
※Please do not use for stopping motor.

■Input · Output diagram and connections

※CW
  2-pulse input mode − CW direction rotation pulse input
  1-pulse input mode − Operation command pulse input

※CCW
  2-pulse input mode − CCW direction rotation pulse input
  1-pulse input mode − Rotation direction pulse input
  [H] : CW, [L] : CCW

※HOLD OFF
  Motor excitation OFF control signal
  [H] : Motor excitation OFF

Note) Add external resistance when power for pulse from the external of the unit exceeds +5V.
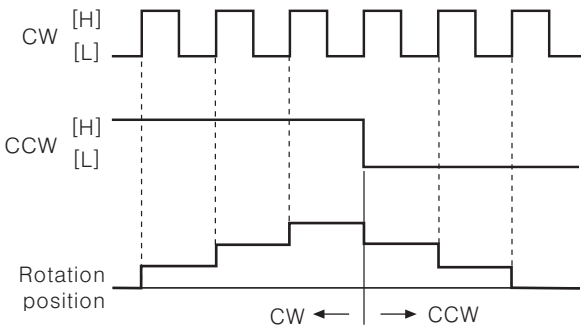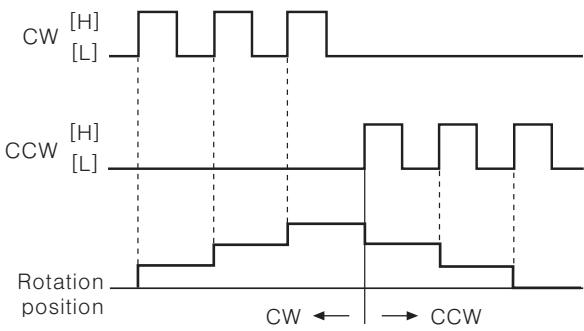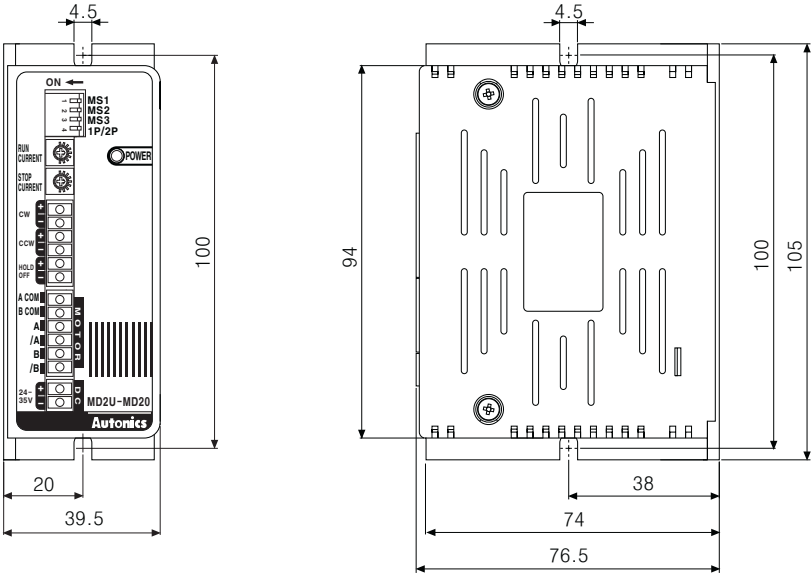   (Input power : Max. DC24V, Input current : 10 to 20mA)

MD2U Series

▣Time chart

● 1 Pulse input

CW [H] [L]

CCW [H] [L]

Rotation position

CW ← | → CCW

● 2 Pulse input

CW [H] [L]

CCW [H] [L]

Rotation position

CW ← | → CCW

▣Dimensions

4.5

ON ←
MS1
MS2
MS3
1P/2P

RUN CURRENT

STOP CURRENT

CW
CCW
HOLD OFF

A COM
B COM
A
/A
B
/B

24-35V

MOTOR

DC

POWER

MD2U-MD20

Autonics

100

20

39.5

4.5

94

100

105

38

74

76.5

(Unit:mm)

Autonics
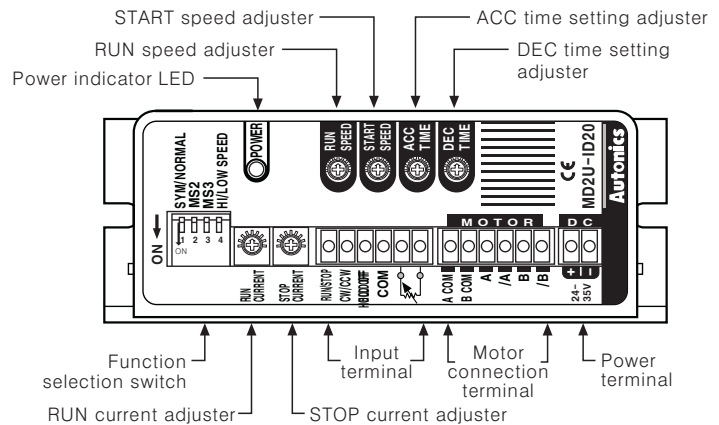
2-Phase Stepping Motor Driver

2-Phase intelligent stepping motor driver [MD2U-ID20]

◎Intelligent type stepping motor driver?

MD2U-ID20 is an intelligent type stepping motor driver including all features to control 2-phase stepping motors so that no controllers are required.
- Realizing AC motor's driving features to stepping motors
- Controlling START speed, RUN speed and ACC/DEC speed
- User-friendly design to realize various functions (front switch and volume)
- Realizing low vibration driving with microstepping

◎Function selection switch

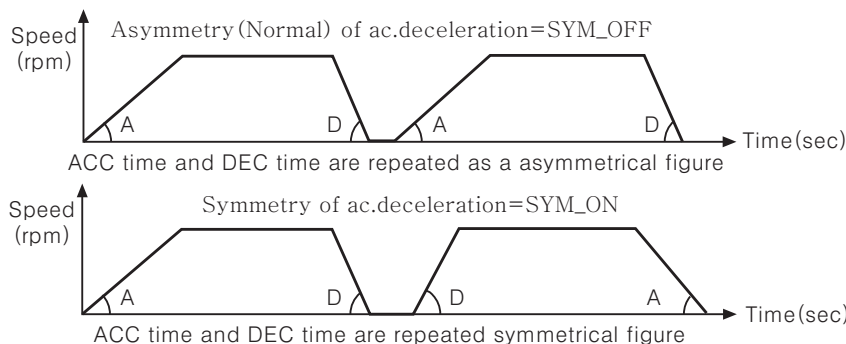| S/W No.	1	2	3	4	Max. speed (rpm)
Name	SYM/NORMAL	MS2	MS3	Hi/Low speed	
Switch	ON: Symmetry OFF:Asymmetry (Normal)	ON	ON	ON: Hi speed	1500
		ON	OFF		1350
		OFF	ON		1000
		OFF	OFF		500
	D (Note1)	D (Note1)	D (Note1)	OFF: Low speed	150

※(Note1)D=Don't care

※Reset the power after changing function selection switch operations.

◎Selection of Symmetry/Asymmetry

※A function to make the ACC/DEC time of run-speed as asymmetry or symmetry using DIP switch No. 1.

Speed (rpm) — Asymmetry(Normal) of ac.deceleration=SYM_OFF

ACC time and DEC time are repeated as a asymmetrical figure — Time(sec)

Speed (rpm) — Symmetry of ac.deceleration=SYM_ON

ACC time and DEC time are repeated symmetrical figure — Time(sec)

※It is able to set the gradient(acceleration and deceleration time) as ACC/DEC time.

◎Selection of max. speed(MS2, MS3)

※A function to select the max. speed of motors.
※The max. speed of stepping motor is changed by MS2/MS3 and Hi/Low speed.
※The features of run and vibration are able to change depending on MS2, MS3.
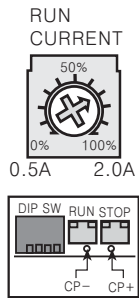※Lower the max. speed to run a motor smoothly.

◎Selection of Hi/Low speed

※Hi/Low speed mode selection switch : Ac.deceleration control is not available in Low speed mode since all sections are included in Pull-in range.
※Low speed mode : It is able to drive a motor up to 150rpm of max. drive speed.
※Hi speed mode : It is able to drive a motor up to 1500rpm of max. drive speed.

MD2U Series

◎RUN current setting

RUN
CURRENT

0.5A   2.0A

DIP SW RUN STOP

CP− CP+

※RUN current is a phase current provided to 2-phase stepping motor.
※Be sure to set RUN current at the rated current or below. If not, it may cause heat generation, loss of torque or step-out.
※RUN current setting range : 0.5 to 2.0A
※RUN current setting : Measure the voltage by connecting a DC voltage meter to both CT+ and CT− terminals while the motor is running (Max. 150rpm).
Ex) Input Voltage(3V) × 2 / 3 = 2A(Motor's excitation current)
※Adjust the RUN current in case severe heat generation occurs.
　Be sure that torque decreasing may occur when adjusting the current.
※RUN current setting value may have some deviation depending on motor's running frequency.
Note) Be sure to adjust RUN current while motor is running.

◎STOP current setting

STOP
CURRENT

20%   70%

※Stop current is a phase current provided to 2-phase stepping motor at standstill.
※A function to reduce the current in order to suppress the heat generation at motor standstill / Use variable resistance ratio within 0 to 100% of RUN current to set STOP current (Actual setting range is 20 to 70% of RUN current).
Ex) If RUN current setting value is 2A and STOP current setting value is 0%, STOP current will be set to 0.4A.
※STOP current setting value may have some deviation depending on resistance impedance of motor.
※Auto current down function will be activated when HOLD OFF signal is [L]. When HOLD OFF signal is [H], the function is not activated since the current provided to each phase is cut off.
Note) Be sure to adjust STOP current while motor is at standstill.

◎RUN speed setting

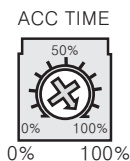RUN SPEED

0%   100%
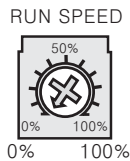
※It sets max. RUN speed.
※Max. RUN speed can be different depending on max. speed setting (MS2, MS3) and driving mode setting (Hi/Low speed).
※Consider motor type and its RUN current when setting max. RUN speed. Missing step could occur due to max. input pulse frequency of motors.
※Set the value when the motor stops.

◎START speed setting

START SPEED

0%   100%
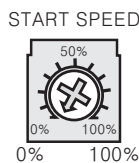
※It sets desired START speed.
※Max. START speed value is same with RUN speed value.
※START speed must be set within max. starting frequency. It is recommended to set up START speed within 0 to 50% for stable driving.
※Set the value when the motor stops.

◎ACC time setting

ACC TIME

0%   100%

※It sets the acceleration time from START speed to max. driving speed.
※AT_1 operation mode when ACC time is under 33.3%, AT_2 operation mode when ACC time is under 66.6% and AT_3 operation mode when ACC time is over 66.6%.
※AT_1 is 0.5 sec. when RUN speed=100%, START speed=0%.
※AT_2 is 1 sec. when RUN speed=100%, START speed=0%.
※AT_3 is 2 sec. when RUN speed=100%, START speed=0%.
※Set the value when the motor stops.

◎DEC time setting

DEC TIME

0%   100%
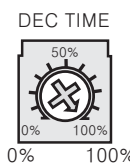
※It sets the deceleration time from max. RUN speed to STOP.
※DT_1 operation mode when DEC time is under 33.3%, DT_2 operation mode when DEC time is under 66.6% and DT_3 operation mode when DEC time is over 66.6%.
※DT_1 is 0.5 sec. when RUN speed=100%, START speed=0%.
※DT_2 is 1 sec. when RUN speed=100%, START speed=0%.
※DT_3 is 2 sec. when RUN speed=100%, START speed=0%.
※Set the value when the motor stops.

※ACC Time and DEC Time are declined in proportion to the setting value of START speed.
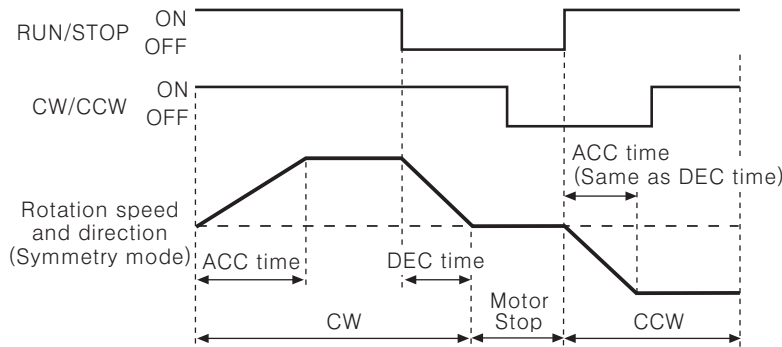
◎HOLD OFF function

※When HOLD OFF input signal is [H], motor excitation is released.
　When HOLD OFF input signal is [L], motor excitation is in a normal status.
※A function used to rotate motor's axis using external force or used for manual positioning.
※HOLD OFF input signal [H] and [L] represent Photocoupler ON/OFF in a circuit.
※Please do not use for stopping motor.

Autonics

2-Phase Stepping Motor Driver

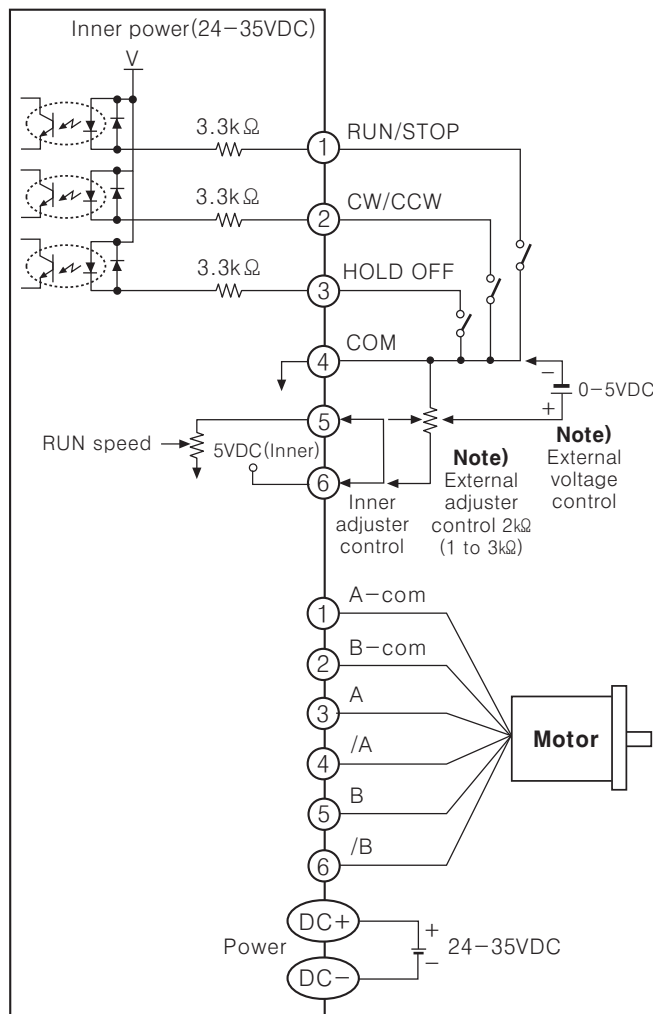| (A) Photo electric sensor |
| (B) Fiber optic sensor |
| (C) Door/Area sensor |
| (D) Proximity sensor |
| (E) Pressure sensor |
| (F) Rotary encoder |
| (G) Connector/ Socket |
| (H) Temp. controller |
| (I) SSR/ Power controller |
| (J) Counter |
| (K) Timer |
| (L) Panel meter |
| (M) Tacho/ Speed/ Pulse meter |
| (N) Display unit |
| (O) Sensor controller |
| (P) Switching power supply |
| (Q) Stepping motor & Driver & Controller |
| (R) Graphic/ Logic panel |
| (S) Field network device |
| (T) Production stoppage models & replacement |

■Time chart

● High speed

It accelerates up to RUN speed during ACC time after RUN signal is ON and decelerates during DEC time after it is OFF. It is disable to change the direction during the signal is ON and it takes 0.5sec. for deceleration when DEC time is "0%".

● Low speed

Max. RUN speed is 150rpm and ACC and DEC time are not available.
It is same with Hi speed to change RUN/STOP and direction.

■Input · Output diagram and connections

RUN/STOP signal input
→ [ON] : RUN, [OFF] : STOP

Direction signal input
→ [ON] : CW, [OFF] : CCW

HOLD OFF signal iuput
→ [ON] : HOLD OFF, [OFF] : HOLD ON

● Inner adjuster control (Adjusting RUN speed with front VR)
Make the connection between terminal No.5 and No.6.

● External adjuster control (Adjusting RUN speed with connecting external variable resistance)
Connect variable resistance 2kΩ(1 to 3kΩ) for external adjuster control. If variable resistance is too low, full range setting might not be possible. Make sure to adjust RUN speed VR to maximum for external adjuster control.

● External voltage control (Adjusting RUN speed with external voltage input)
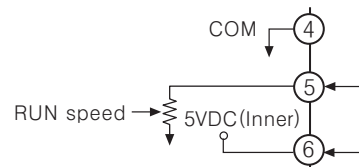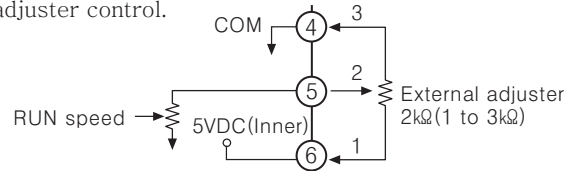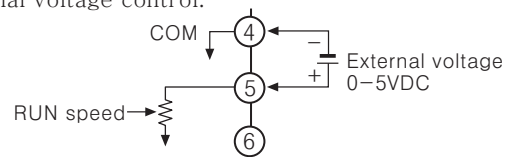Make sure to adjust RUN speed VR to maximum external voltage control.
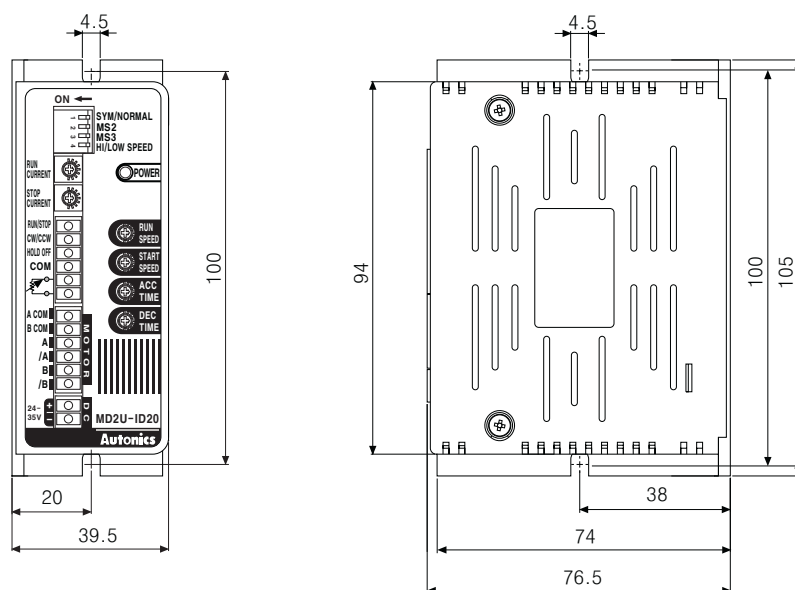

Note) Inner adjuster is correlated to external adjuster control and external voltage control. Make sure that inner adjuster must be set to maximum in order to set maximum RUN speed using external adjuster and external voltage.

MD2U Series

▣Dimensions

(Unit:mm)

▣Proper usage

◎Failure diagnosis and management
- ●Check the connection of controller and driver, if motor does not rotate.
- ●Check the DIR input of driver, if motor rotates as a reverse direction, it is CW for [ON] and CCW for [OFF].
- ●If motor does not work properly,
- ①Check the connection of driver and motor.
- ②Check driver output current and RUN current of motor depending on current adjuster are correct.

◎Caution for using
- ●Do not change DIR signal during the operation.
- ●Set RUN current as under the rated current of motor, or it emits heat too much.
- ●When using over 30VDC, it should be mounted at ventilative place due to increasing heat.
- ●Use twisted pair（Min. 0.2㎟）for the signal wire should be shorter than 2m.
- ●Use an electric wire thicker than the motor lead wire when extending the motor wires.
- ●Install a heat sink on metal surface closely.
- ●Installation environment
- ①It shall be used indoor.
- ②Altitude Max.2000m
- ③Pollution Degree 2
- ④Installation CategoryⅡ

Autonics

1・2-Axis High Speed Programmable Motion Controller

1・2-Axis high speed programmable motion controller

■Features

- Max. 4Mpps high-speed operation
- 4 operation modes : Scan, Continuous, Index, Program
- 12 control command and 64 steps of operations
- Parallel I/O terminal built in which is connectable on PLC
- Operation program by exclusive switch, making and editing parameter
- Easy to operation of X, Y stage with joy stick
- RS232C port for all types
- Teaching and monitoring function by using teaching unit (PMC-2TU-232)

> ⚠ Please read "Caution for your safety" in operation manual before using.
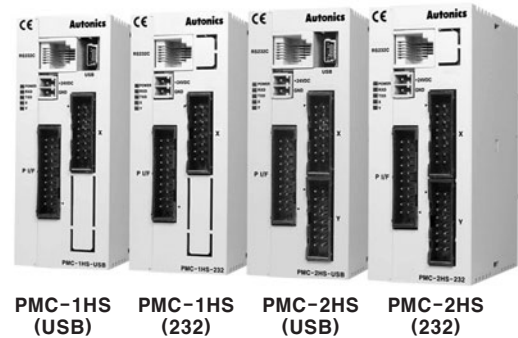
CE

PMC-1HS (USB) **PMC-1HS (232)** **PMC-2HS (USB)** **PMC-2HS (232)**

●Teaching unit(Sold separately)

PMC-2TU-232

※Visit our web site (www.autonics.com) to download user manual and software [MotionStudio].

■Ordering information

| PMC | – | 2HS | – | USB |

	Communication type	232	RS232C
		USB	USB / RS232C
	Axis/Type	1HS	1-Axis high speed stand-alone
		2HS	2-Axis high speed stand-alone
	Item	PMC	Programmable Motion Controller

■Specifications

Model	PMC-1HS-232	PMC-1HS-USB	PMC-2HS-232	PMC-2HS-USB
Control axis	1-Aixs		2-Aixs (Each axis can be independently programmed)	
Motor for control	Pulse string input stepping motor or servo motor			
Power supply	24VDC ±10%			
Power consumption	Max. 6W			
Operation mode	Scan / Continuous / Index / Program			
Positioning type	Absolute position / Relative position			
Index step numbers	64 indexes per each axis			
Positioning range	−8,388,608 to 8,388,607 (Available pulse scaling function)			
Drive speed numbers	4EA			
Range for the drive speed configuration	1 pps to 4 Mpps (1 to 8,000 × Magnification 1 to 500)			
Output pulse type	2 Pulse output (Line driver)			
Home search mode	High speed near home search (Step1) → Low speed home search (Step2) → Low speed Z-phase search (Step3) → High speed offset movement (Step4). Configuring the detection method and Enable/Disable in each step.			
Program function	Memory	EEPROM			
	Step	64 Steps			
	Control	ABS, INC, HOM, IJP, OUT, OTP, JMP, REP, RPE, END, TIM, NOP (12 EA)			
	Start	Power ON program auto-start function			
	Home search	Power ON home search auto-start function			

PMC-2HS/PMC-2HS Series

▣Specifications

Model	PMC-1HS-232	PMC-1HS-USB	PMC-2HS-232	PMC-2HS-USB
Teaching unit (Sold separately)	Adding operation mode, parameter, program drive handling (Scan operation, program execution, home search, etc)			
Common output	1 point		2 points	
Control interface	Parallel I/F			
Ambient temperature	0 to 45℃ (at non-freezing status)			
Ambient humidity	35 to 85%RH			
Accessory Common	Manual book & CD			
Accessory Power connector	CN1 : MC1,5/2-ST-3.5(PHOENIX) 1EA			
Accessory RS232C connector	CN2 : RS-232C communication cable(1.5m) 1EA			
Accessory P I/F connector	CN3 : 20P MIL standard, 2.54mm connector 1EA			
Accessory X axis input/ output connector	CN4 : 16P MIL standard, 2.54mm connector 1EA(2HS : 2EA)			
Accessory Y axis input/ output connector	———		CN5 : 16P MIL standard, 2.54mm connector 1	
Accessory USB connector	———	Included(★1)	———	Included(★1)
Unit weight	Approx. 96g		Approx. 102g	

※(★1)USB connector → USB communication cable(1m) 1EA

▣Driver operation

- ●Operation by Parallel I/F
  Connect sequence controller or switch to Parallel I/F.
- ●Operation by PC
  Connect PC and controller with communication cable and run dedicated program (MotionStudio).
- ●Operation by teaching unit(PMC-2TU-232)
  Connect teaching unit cable and install JOG output, HOME search using operation button.
- ●Operation by serial communication (Using serial communication protocol)
  Using serial communication protocol, operate according to program writing by user.

▣Commands in the operation program

Command type	Code	Description
Drive commands	ABS	Move absolute position
	INC	Move relative position
	HOM	Home search
I/O commands	IJP	Jump input condtion
	OUT	ON/OFF of output port
	OTP	ON pulse from output port
Program control commands	JMP	Jump
	REP	Start repetition
	RPE	End repetition
	END	End program
Others	TIM	Timer
	NOP	No operation

▣Part descriptions
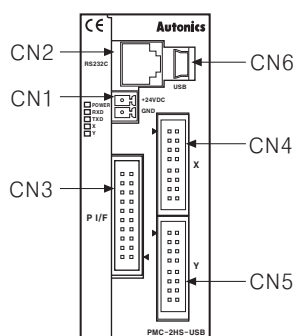
Connector No	Description
CN1	Power connector
CN2	RS232C connector(Connect to PMC-2TU-232)
CN3	Parallel I/F connector
CN4	X-Axis I/O connector
CN5	Y-Axis I/O connector
CN6	USB connector

※PMC-1HS type does not have I/O connector(CN5) of Y axis.

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1・2-Axis High Speed Programmable Motion Controller

■Power connector(CN1)

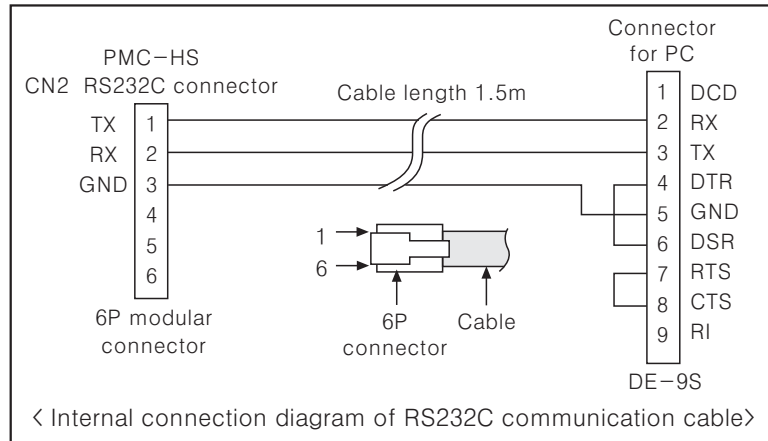| Pin No.	Signal name
1	24VDC
2	GND(0V)

■RS232C serial I/F connector(CN2)

Pin No.	Signal name	Input/Output	Description
1	TXD	Output	Receiving data
2	RXD	Input	Transmitting data
3	GND	——	Ground
4	——	——	No-connection
5	——	——	No-connection
6	——	——	No-connection

(Note) The internal connection diagram of RS232C communication cable is shown as below.

<CN3 Pin No>

< Internal connection diagram of RS232C communication cable>

■Parallel I/F connector (CN3)

The Parallel I/F connector which is connected with a sequencer or mechanical contacts operates motion controller same as PC program. When input signal is ON, the input signal terminal and GEX terminal are connected by mechanical contacts or open collector output etc. and open collector output transistor is ON when the output signal is ON.

Pin No.	Signal name	Input/Output	Description
1	RESET	Input	Reset
2	HOME	Input	Home search start command
3	STORE	Input	Drive start command
4	X/SCANY +	Input	X-axis specification/Scan Y+
5	Y/SCANY −	Input	Y-axis specification/Scan Y−
6	REGSL0/RUN+/SCANX+	Input	Register specification 0/Run+/Scan X+
7	REGSL1/RUN−/SCANX−	Input	Register specification 1/Run−/Scan X−
8	REGSL2/SPD0	Input	Register specification 2/Drive speed specification 0
9	REGSL3/SPD1	Input	Register specification 3/Drive speed specification 1
10	REGSL4/SPD2	Input	Register specification 4/Scan specification
11	REGSL5/STOP	Input	Register specification 5/Drive stop
12	MODE0	Input	Operation mode specification 0
13	MODE1	Input	Operation mode specification 1
14	XDRIVE/END	Output	X-axis drive/Drive end pulse
15	YDRIVE/END	Output	Y-axis drive/Drive end pulse
16	XERROR	Output	X-axis error
17	YERROR	Output	Y-axis error
18	GEX	0V	Ground
19	GEX	0V	Ground
20	VEX	+24V	Power supply for sensor(24VDC, Max. 100mA)

(A) Photo electric sensor
(B) Fiber optic sensor
(C) Door/Area sensor
(D) Proximity sensor
(E) Pressure sensor
(F) Rotary encoder
(G) Connector/ Socket
(H) Temp. controller
(I) SSR/ Power controller
(J) Counter
(K) Timer
(L) Panel meter
(M) Tacho/ Speed/ Pulse meter
(N) Display unit
(O) Sensor controller
(P) Switching power supply
(Q) Stepping motor & Driver & Controller
(R) Graphic/ Logic panel
(S) Field network device
(T) Production stoppage models & replacement

PMC-2HS/PMC-2HS Series
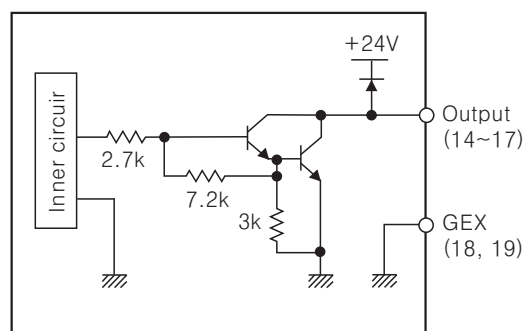
▣Input/Output connections(CN3)
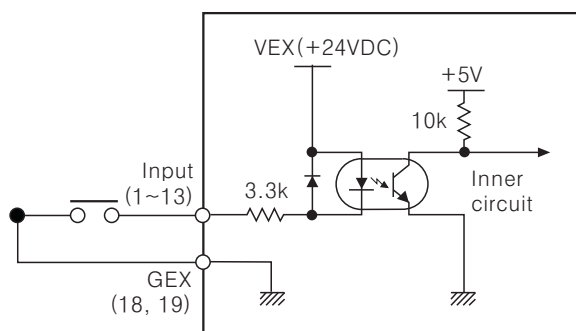
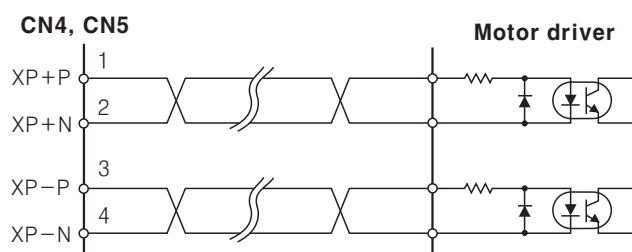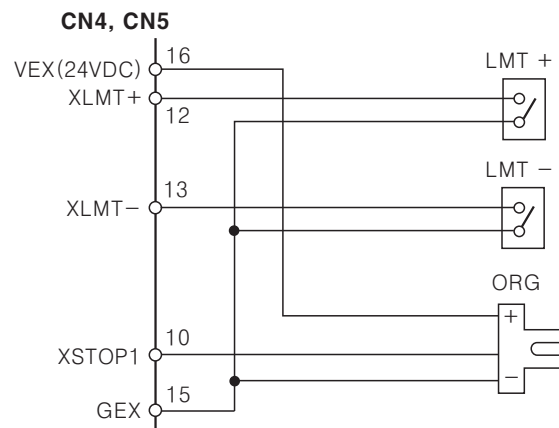< CN3 control input connections >

< CN3 control output connections >

▣X, Y-Axis Input/Output connector(CN4, CN5)

CN4 and CN5 are I/O signals for X-Axis and Y-Axis respectively. The pin arrangement of CN4 and CN5 are equal. PMC-1HS does not have CN5. 'n' in the table means X for CN4 and Y for CN5.

Pin No.	Signal name	Input/Output	Description
1	n P+P	Output	Drive pulse in the + direction
2	n P+N	Output	Drive pulse in the + direction
3	n P-P	Output	Drive pulse in the - direction
4	n P-N	Output	Drive pulse in the - direction
5	n OUT0	Output	General output0/DCC
6	n INPOS	Input	Finish the servo inposition
7	n ALARM	Input	Servo alarm
8	GEX	0V	Ground
9	n STOP2	Input	Encoder Z-phase
10	n STOP1	Input	Home
11	n STOP0	Input	Near Home
12	n LMT+	Input	LMT+
13	n LMT-	Input	LMT-
14	EMG	Input	Emergency stop
15	GEX	0V	Ground
16	VEX	+24V	Power supply for sensor(24VDC, Max. 100mA)

< Motor driver connection exemple >
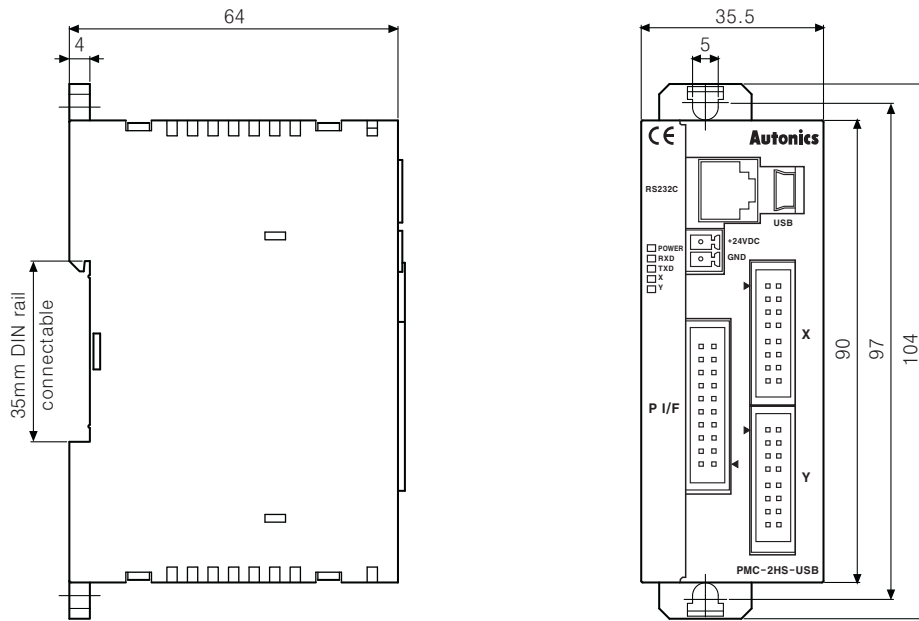

< LMT and HOME sensor connection exemple >

Autonics

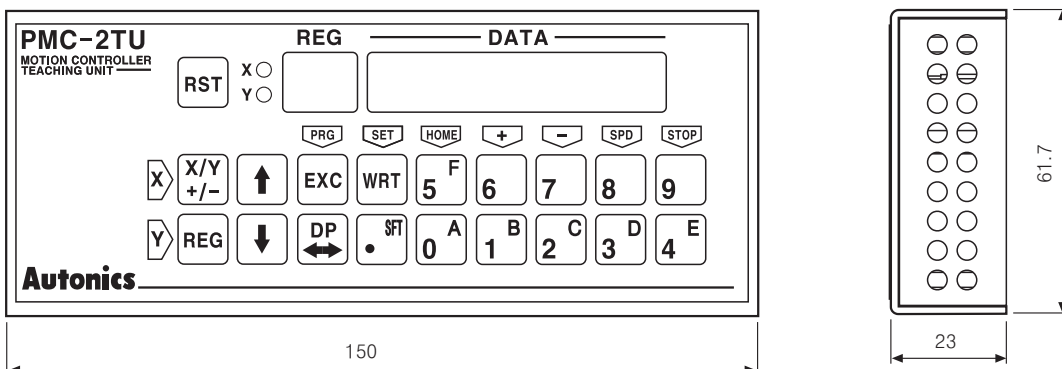# 1・2-Axis High Speed Programmable Motion Controller

▣Connections

5-Phase stepping motor

LMT−
sensor

HOME sensor

LMT+
sensor

5-Phase microstepping
motor driver

CW+
CW−
CCW+
CCW−

xLMT−
+
xP+P
xP−P
xP+N
xP−N

xSTOP1

xLMT−
+

**PMC-1HS/
PMC-2HS**

RS232C
USB

PC

〈 Basic configuration of the motion controller(Configuration only for X−axis) 〉

▣Dimensions

64

4

35mm DIN rail
connectable

35.5

5

RS232C

USB

POWER
RXD
TXD
X
Y

+24VDC
GND

X

P I/F

Y

90
97
104

PMC-2HS-USB

▣Teaching unit PMC-2TU-232(Sold separately)

PMC-2TU
MOTION CONTROLLER
TEACHING UNIT

REG — DATA —

RST

X ○
Y ○

PRG   SET   HOME   +   −   SPD   STOP

X   X/Y
+/−   ↑   EXC   WRT   5 F   6   7   8   9

Y   REG   ↓   DP ↔   SFT •   0 A   1 B   2 C   3 D   4 E

Autonics

150

61.7

23

(Unit:mm)

PMC-2HS/PMC-2HS Series

▣ Teaching unit PMC-2TU-232 (Sold separately)

Teaching unit (PMC-2TU-232) is a device to arrange the operation mode, parameter and operation program without PC and it is also able to install start the operation program, HOME search and JOG operation. Connect to RS232C connector (CN2) using a cable (1.5m)

PMC-2TU-232
connection cable (Accessary)
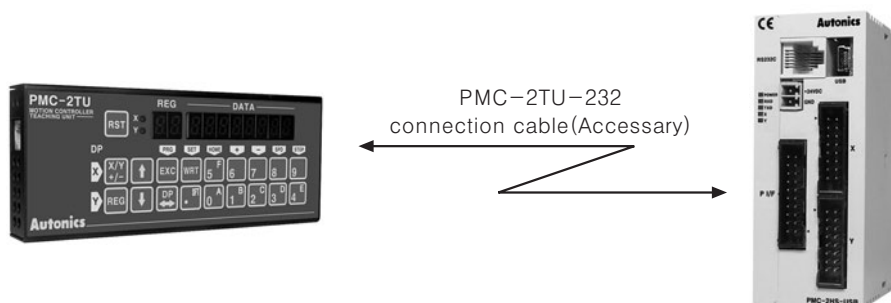
Teaching unit is divided into data edit mode and drive operation mode. The register number is displayed on REG of data edit mode and dp (drive operation) is displayed in drive operation mode and it will be a drive operation status when applying power. Use DP key to convert the status of data edit mode and drive operation mode.

Mode	Operation	REG display
Data edit	• Record operation mode parameter and operation program • Installation of index drive	Register number
Drive handling	• Displaying the current position • JOG operation • HOME search • Installation of program	dP (drive operation)

The front panel of the teaching unit shown as below;
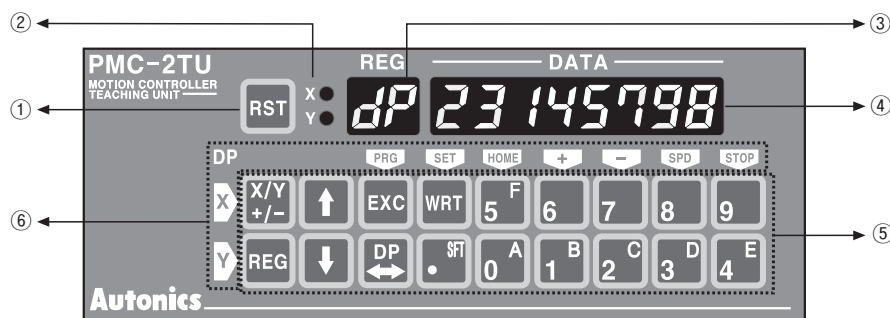
① **Reset** : Reset the controller and teaching unit.

② **X/Y display** : Display the current axis.

③ **Register number display/dp** : Display the current register number when editing data and dp when operating drive.

④ **Data display** : Display the data of each register when data editing and the current position of the axis when operating drive.

⑤ **Input key**

● X/Y : Convert the axis and the sign of input value and it is used to change mode data when inputting mode.

● REG : Input the register number to display and it is returned to previous step pressing a key during data input.

● ↑ ↓ : Increase or decrease the current register number.

● EXC : Install the current command, but, ABS, INC, OUT, OTP, HOM1 to 4 are only valid.

● DP : Convert the status of driver operation and data edit.

● WRT : Enter a value when editing data.

⑥ **Display the key for drive operation** :

Display the key function on a left and upside of the key as a yellow letter and the upper part operates X axis and the lower part operates Y axis.

2-Axis High Speed Interpolation/Normal Motion Controller

2-Axis high speed interpolation/mormal motion controller

■Features

NEW

- Independent 2-axis controlling with high operating speed of max. 4Mpps
- Linear/Circular interpolation control (PMC-2HSP)
- Realizing a wide variety of operation up to 200 steps using 17 different operation programs (13 commands except circular/linear interpolation command for PMC-2HSN series)
- Various control interface available (USB, RS232C, RS485, Parallel I/F)
- Controlling up to 32 axis (16 units) via RS485 serial communication (Modbus RTU)
- 4 operation modes : Jog, Continuous, Index, Program mode
- Symmetrical/asymmetrical trapezoid, S-shaped de/acceleration driving function

PMC-2HS□-USB PMC-2HS□-485

⚠ Please read "Caution for your safety" in operation manual before using.

CE C✓ (Except for PMC-2HS□-485)

■User manual

- Please refer to user manual for detailed instructions and specifications.
- Visit our web site (www.autonics.com) to download user manual and software [MotionStudio].
- User manual describes installing software, setting parameter and program, operation mode, and multi-axis operation, etc. to operate motion controller.

■Software (MotionStudio)

MotionStudio is the windows software designed to operate motion control for PMC-2HSP/2HSN series.
- Compatible Microsoft Windows 98, NT, 2000, XP (32bit, 64bit), Vista (32bit, 64bit) and 7 (32bit, 64bit)
- Supports 9,600, 19,200, 38,400, 57,600, 115,200 bps transmission speeds
- Available to use on all OS supported COM ports (COM1 to COM256)
- Multilingual support (Korean, English)
- Provides a calculator for convenience (Calculates PPS, center of interpolation, end coordinates)

■Ordering information

PMC - 2HSP - USB

| Communication type | 485 | RS485 / RS232C |
| | USB | USB / RS232C |

| Axis/Type | 2HSP | 2-Axis high speed interpolation |
| | 2HSN | 2-Axis high speed normal |

| Item | PMC | Programmable Motion Controller |

■Specifications

Model	PMC-2HSP-USB	PMC-2HSP-485	PMC-2HSN-USB	PMC-2HSN-485
Control axis	2-Aixs			
Motor for control	Pulse string input stepping motor or servo motor			
Power supply	24VDC			
Power consumption	Max. 6W			
Inposition range	−8,388,608 to 8,388,607 (Selectable Absolute/Relative value, Available pulse-scaling function)			
Range for the drive speed	1 pps to 4 Mpps (1 to 8,000pps × Magnification 1 to 500)			
RUN mode	Scan / Continuous / Index (Number of index : 64EA)			

Program mode:

Power on program start function / Program step : 200 step

ABS	Move absolute position	RID	2-axis CCW arc interpolation(★)	IRD	Stand-by external input
INC	Move relative positon	TIM	Timer	OPC	ON/OFF output port
HOM	Home search	JMP	Jump	OPT	ON pulse from output port
LID	2-axis CCW linear interpolation(★)	REP	Start repetition	NOP	No Operation
CID	2-axis CW circular interpolation(★)	RPE	End repetition	END	End program
FID	2-axis CW arc interpolation(★)	ICJ	Jump input condition		

| Home search mode | 4 Step : High speed near home search, low speed home search, low speed Z-phase search, High speed offset movement |
| | Power on home search function |

| I / O | • Parallel I/F (CN3) : Input 13EA, Output 4EA
• X-axis (CN 4) / Y-axis (CN 5) : Input 8EA, Output 6EA (General-purpose I/O, 2EA each) |

Ambient temperature	0 to 45℃ (at non-freezing status)			
Storage temperature	−15 to 70℃ (at non-freezing status)			
Ambient humidity	20 to 90%RH			
Accessory	• [Common] Pwer connector, I/O connector (P I/F, X-axis, Y-axis), RS232C communication cable (1.5m) 1EA, Manual • [USB type] USB communication cable 1m 1EA • [RS485 type] RS485 connector 1EA			
Unit weight	Approx. 102g	Approx. 101g	Approx. 102g	Approx. 101g

※(★)These commands are only for PMC-2HSP series.

PMC-2HSP/PMC-2HSN Series

▣Basic operation

There are two way to operate motion controller.
- ●Using PC (MotionStudio)

  Operates by connecting PC and the motion controller with communication cable and running MotionStudio.
- ●Using Parallel I/F

  Operates by connecting sequence controller or switch to Parallel I/F.

▣Commands in the operation program

Command type	Code	Description
Drive commands	ABS	Move absolute position
	INC	Move relative positon
	HOM	Home search
	LID	2-axis CCW linear interpolation (★)
	CID	2-axis CW circular interpolation (★)
	FID	2-axis CW arc interpolation　(★)
	RID	2-axis CCW arc interpolation　(★)
I/O commands	ICJ	Jump input condition
	IRD	Stand-by external input
	OPC	ON/OFF output port
	OPT	ON pulse from output port
Program control commands	JMP	Jump
	REP	Start repetition
	RPE	End repetition
	END	End program
Others	TIM	Timer
	NOP	No operation

※(★)These commands are only for PMC-2HSP series.

▣Part descriptions
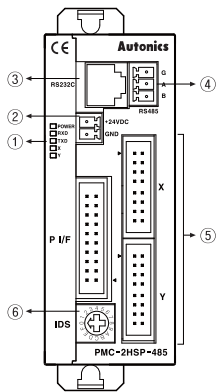
① Power / Status indicator
   Used to indicate power, controller's communication status and operation status for each axis

② Power connector terminal
   Used to connect power for controller

③ RS232C connector terminal
   Used to connect RS232 serial(RJ12-DSUB9) connection cable

④ USB/RS485 connector terminal
   Used to connect USB and RS485 connection cable

⑤ Esternal I/O connector terminal
   Used to operate various drives through input and output of Parallel I/F, X, Y

⑥ ID select switch
   Used to set unique ID for each node in case of RS485 communication

▣Explanation of Input/Output terminal

●PMC-2HS□-USB　　　●PMC-2HS□-485
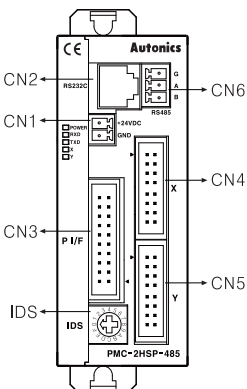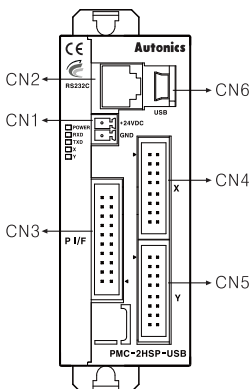
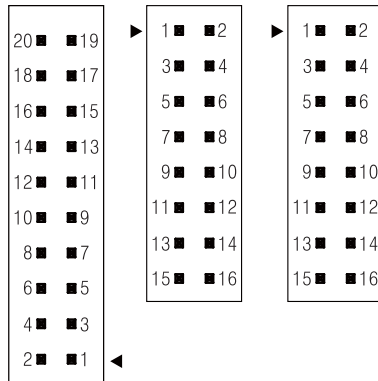| Connector No.	Description
CN1	Power connector
CN2	RS232C connector
CN3	Parallel I/F connector
CN4	X-Axis I/O connector
CN5	Y-Axis I/O connector
CN6	PMC-2HSP/2HSN-USB : USB connector
	PMC-2HSP/2HSN-485 : RS485 connector
IDS	ID selection switch

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2-Axis High Speed Interpolation/Normal Motion Controller
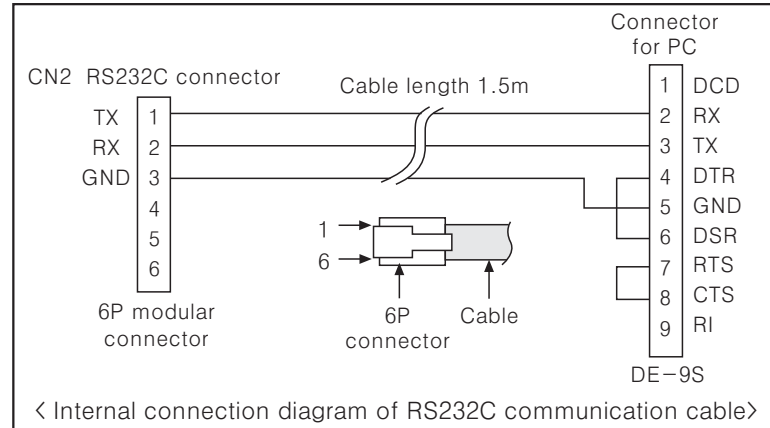
▣ Power connector(CN1)

Pin No.	Signal name
1	24VDC
2	GND(0V)

▣ RS232C connector(CN2)

Pin No.	Signal name	Input/Output	Description
1	TXD	Output	Receiving data
2	RXD	Input	Transmitting data
3	GND	——	Ground
4	——	——	No−connection
5	——	——	No−connection
6	——	——	No−connection

(Note) The internal connection diagram of RS232C communication cable is shown as below.

<CN3 Pin No> <CN4 Pin No> <CN5 Pin No>

< Internal connection diagram of RS232C communication cable>

▣ Parallel I/F connector(CN3)

The Parallel I/F connector which is connected with a sequencer or mechanical contacts operates motion controller same as PC program. When input signal is ON, the input signal terminal and GEX terminal are connected by mechanical contacts or open collector output etc. and open collector output transistor is ON when the output signal is ON.

Pin No.	Signal name	Input/Output	Description
1	RESET	Input	Reset
2	HOME	Input	Home search start command
3	STORE	Input	Drive start command
4	X/SCANY +	Input	X−axis specification/Scan Y+
5	Y/SCANY −	Input	Y−axis specification/Scan Y−
6	REGSL0/RUN+/SCANX+	Input	Register specification 0/Run+/Scan X+
7	REGSL1/RUN−/SCANX−	Input	Register specification 1/Run−/Scan X−
8	REGSL2/SPD0	Input	Register specification 2/Drive speed specification 0
9	REGSL3/SPD1	Input	Register specification 3/Drive speed specification 1
10	REGSL4/SPD2	Input	Register specification 4/Scan specification
11	REGSL5/STOP	Input	Register specification 5/Drive stop
12	MODE0	Input	Operation mode specification 0
13	MODE1	Input	Operation mode specification 1
14	XDRIVE/END	Output	X−axis drive/Drive end pulse
15	YDRIVE/END	Output	Y−axis drive/Drive end pulse
16	XERROR	Output	X−axis error
17	YERROR	Output	Y−axis error
18	GEX	0V	Ground
19	GEX	0V	Ground
20	VEX	+24V	Power supply for sensor(24VDC, Max. 100mA)

(A) Photo electric sensor
(B) Fiber optic sensor
(C) Door/Area sensor
(D) Proximity sensor
(E) Pressure sensor
(F) Rotary encoder
(G) Connector/ Socket
(H) Temp. controller
(I) SSR/ Power controller
(J) Counter
(K) Timer
(L) Panel meter
(M) Tacho/ Speed/ Pulse meter
(N) Display unit
(O) Sensor controller
(P) Switching power supply
(Q) Stepping motor & Driver & Controller
(R) Graphic/ Logic panel
(S) Field network device
(T) Production stoppage models & replacement

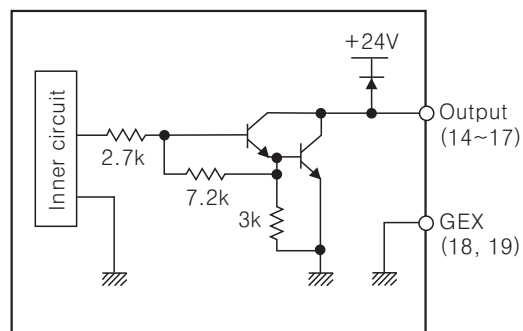# PMC-2HSP/PMC-2HSN Series

▣ Input/Output connections(CN3)
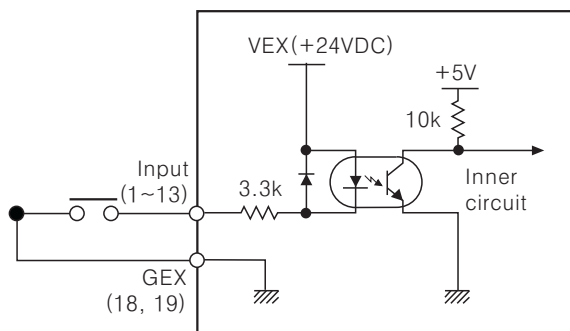
< CN3 control input connections >

< CN3 control output connections >

## ▣ X, Y-Axis Input/Output connector(CN4, CN5)

CN4 and CN5 are I/O signals for X-Axis and Y-Axis respectively.
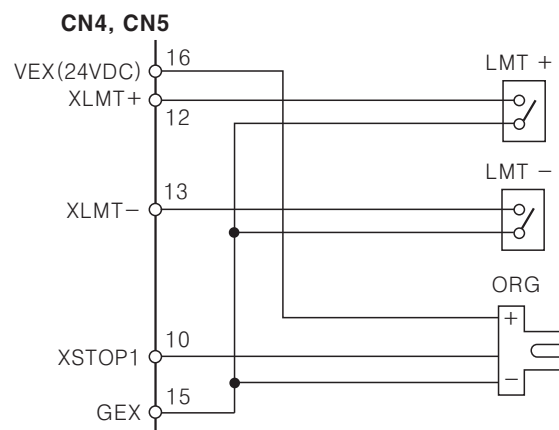The pin arrangement of CN4 and CN5 are equal. 'n' in the table means X for CN4 and Y for CN5.

Pin No.	Signal name	Input/Output	Description
1	n P+P	Output	Drive pulse in the + direction
2	n P+N	Output	Drive pulse in the + direction
3	n P-P	Output	Drive pulse in the - direction
4	n P-N	Output	Drive pulse in the - direction
5	n OUT0	Output	General output0
6	n OUT1	Input	General output1
7	n IN0	Input	General input0
8	n IN1	Input	General input1
9	n STOP2	Input	Encoder Z-phase
10	n STOP1	Input	Home
11	n STOP0	Input	Near Home
12	n LMT+	Input	LMT+
13	n LMT-	Input	LMT-
14	EMG	Input	Emergency stop
15	GEX	0V	Ground
16	VEX	+24V	Power supply for sensor(24VDC, Max. 100mA)

※CN4, 5 input/output is same as CN3 input/output connections.
Drive pulse output of motion controller which is inputted to motor driver is line driver output.
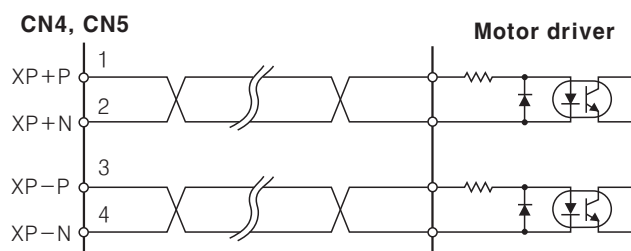
< Motor driver connection exemple >

< LMT and HOME sensor connection exemple >

Autonics

2-Axis High Speed Interpolation/Normal Motion Controller

(A) Photo electric sensor

(B) Fiber optic sensor

(C) Door/Area sensor

(D) Proximity sensor

(E) Pressure sensor

(F) Rotary encoder

(G) Connector/ Socket

(H) Temp. controller

(I) SSR/ Power controller

(J) Counter

(K) Timer

(L) Panel meter

(M) Tacho/ Speed/ Pulse meter

(N) Display unit

(O) Sensor controller

(P) Switching power supply

(Q) Stepping motor & Driver & Controller

(R) Graphic/ Logic panel

(S) Field network device

(T) Production stoppage models & replacement

▣ RS485 connector(CN6)

Pin No.1	Signal name	Input/Output	Description
2	B(−)	I/O	Transmitting / Receiving data
3	A(+)	I/O	Transmitting / Receiving data
	G	—	**(Note1)**

※**(Note1)** : Connect the ground when it is required depending on communication environments.

▣ Connections
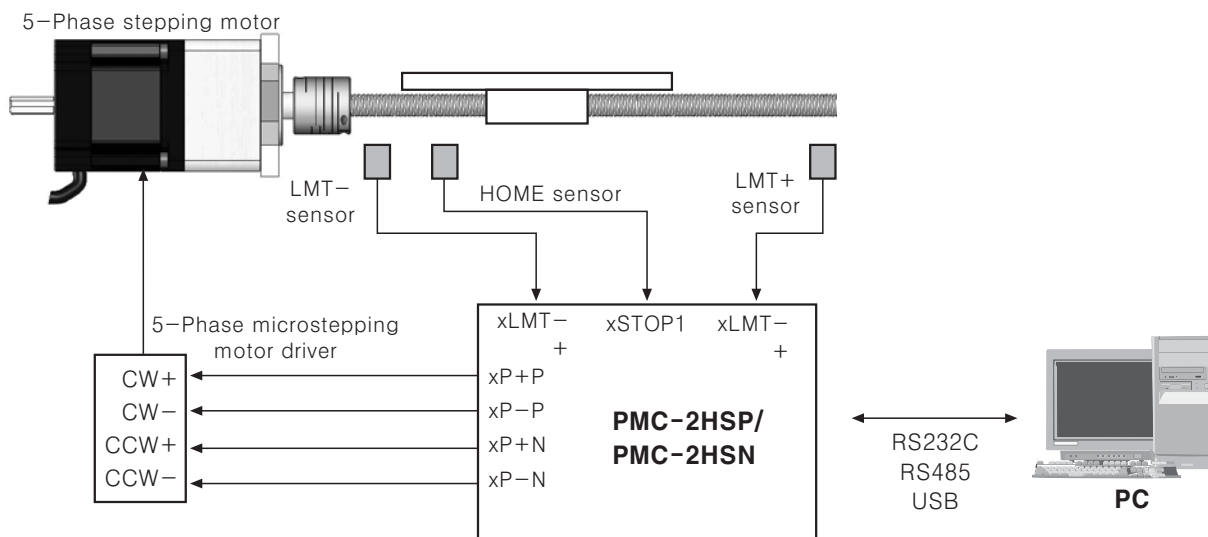
⟨ Basic configuration of the motion controller(Configuration only for X−axis) ⟩
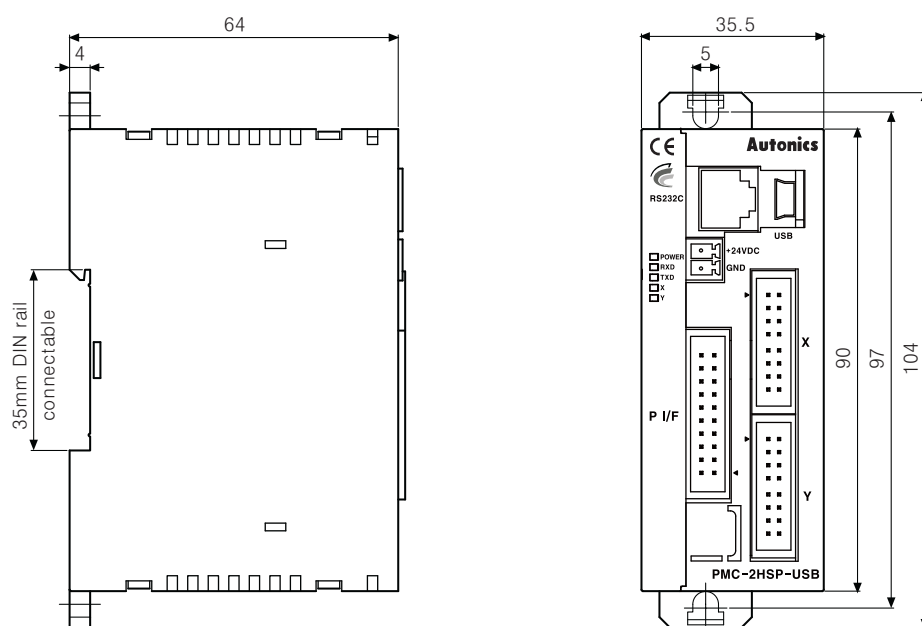
▣ Dimensions

(Unit:mm)

PMC-4B-PCI

4-Axis board type programmable motion controller

▣ Features

- Available to control 4-Axis independent AC servo motor and stepping motor
- PC-PCI card
- Auto home search and synchronous operation
- Interpolation on circular/linear, bit pattern/continuous/ ac・deceleration drive
- 2/3-Axis constant linear velocity.
- Compatible with windows 98, NT, 2000, XP
- Apply the library which can be operated in C++
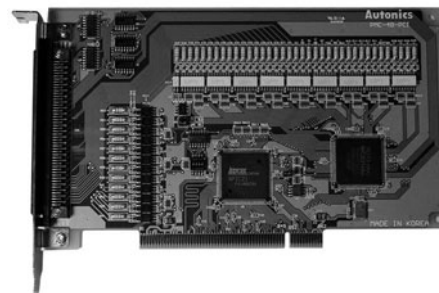
> ⚠ **Please read "Caution for your safety" in operation manual before using.**

CE   MIC

▣ Ordering information

| PMC | − | 4B | − | PCI |

Connection type

PCI	PCI
4B	4-Axis Board type
PMC	Programmable Motion Controller

Axis/Type

Item

▣ Specifications

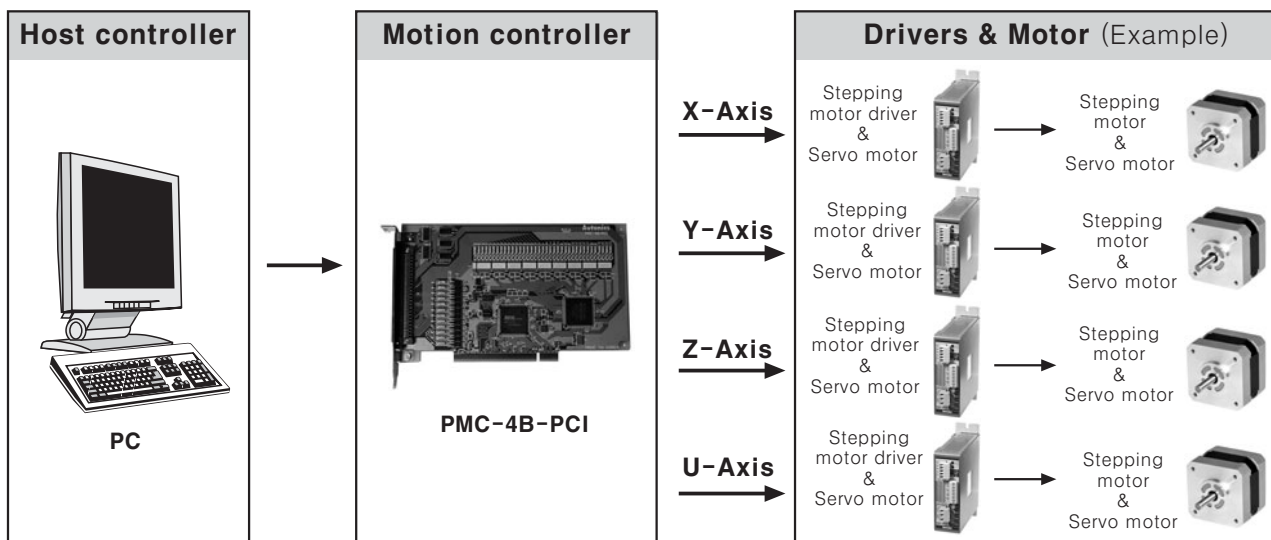| Model		PMC-4B-PCI
Control axis		4-Axis
CPU data bus		8/16 Bit selectable
2/3-Axis linear interpolation	Interpolation range	Axis −2,147,483,648 to 2,147,483,647
	Interpolation speed	1pps to 4 Mpps
	Shortcut position accuracy	Max. ±0.5LSB(Within interpolation range)
Circular interpolation	Interpolation range	Axis −2,147,483,648 to 2,147,483,647
	Interpolation speed	1pps to 4 Mpps
	Shortcut position accuracy	Max. ±1 LSB(Within the whole interpolation range)
2/3-Axis bit pattern interpolation speed		1~4MPPS(Dependent only on CPU data setup)
Other interpolation function		Selectable axis, linear speed, continuous interpolation, Interpolation step(Command, external signal)
Driver pulse output (X, Y common specifications)		Output speed range : 1 pps to 4 Mpps
		Output speed accuracy : Max ±0.1%(For setting value)
		Speed rate : 1 to 500
		S-curve acceleration/deceleration driving : 954 to $62.5×10^6$ pps/sec. (At rate=1) (Rate of increase) $477×10^3$ to $31.25×10^9$ pps/sec. (At rate=500)
		Ac.deceleration : 125 to $1×10^6$ pps/sec. (At rate=1) $62.5×10^3$ to $500×10^6$ pps/sec. (At rate=500)
		Drive speed : 1 to 8,000pps (At rate=1) 500 to $4×10^6$ pps (At rate=500)
		Output pulse : 0 to 4,294,967,295(Fixed pulse driving)
		Speed curve:Constant speed/linear ac.deceleration/parabola S-curve ac.deceleration drive
		Deceleration mode of fixed pulse drive(Asymmetry linear accelevation / deceleration available) / Manual deceleration
		Output pulse on driving, available to change drive speed
		Selectable dependent 2pulse / 1pulse direction type
		Selectable logic level, changeable output terminal
Encoder input pulse		2-Phase pulse / Up down pulse input, 2-Phase pulse 1, 2, 4 magnifying selectable

Autonics

▣ Specifications

Position vounter	Logic position counter (For output pulse) count range : −2,147,483,648 to 2,147,483,647 Real position counter (For input pulse) count range : −2,147,483,648 to 2,147,483,647
Compare register	COMP+ register position campare range : −2,147,483,648 to 2,147,483,647
	COMP− register position campare range : −2,147,483,648 to 2,147,483,647
	Status output and signal output the magnitude with position counter
	Available operating as a software limit
Reference point return	High speed reference point adjacent search (Step 1) → Low speed reference point search (Step 2) → Low speed Z phase search (Step 3) → High speed offset movement (Step 4)
Interrupt function (Except for interpolation)	• 1drive pulse output • On changing position counter ≥ COMP− • On changing position counter 〈 COMP− • Starting fixed speed on ac.deceleration drive • On changing position counter ≥ COMP+ • On changing position counter 〈 COMP+ • Completing fixed speed on ac.deceleration drive • On drive ending
Drive control external signal	Able to drive fixed quantity • continual speed of +/− direction by EXPP, EXPM signal
	2−Phase encoder signal mode (Encoder input) drive
E decelerate stop / Immediate stop signal	IN0 to 3 axis 4 points
	Selectable enable/disable signal and detection of direction, able to use as a common input
Input signal for servo motor	Selectable enable/disable signal and detection direction
Output signal for common	OUT4 to 7square axis 4points (Multiple 4 combines MULT CHIP shortcut signal and terminal)
Signal output on drive	ASND (Ascend speed), DSND (Descend speed)
	CMPP (Position ≥ COMP+), CMPM (Position 〈 COMP−)
	DRIVE (Driver pulse output), Read at status register
Overrun limit signal input	Direction +, − each one, Selectable logic level
	Selectable emergency stop/deceleration stop for active
Emergency stop signal input	EMG 1point in all axis, make drive pulse of all axis immediately stop
Integral type filter built−in	Built−in integration filter on each input terminal, selectable passing time (8 hours)
Etc.	Selectable axis, constant linear speed, continuous interpolation, Interpolation step transmission (Command, external signal)
Power supply	5VDC (Using PC inner power)
External power supply	12−24VDC
Allowable voltage fluctuation range	90 to 100% of power supply
Operation temp. range	0 to 45℃ (at non−dew or non−freezing status)
Storage temperature	−10 to 55℃ (at non−dew or non−freezing status)
Ambient humidity	35 to 85%RH

▣ System

Host controller	Motion controller	Drivers & Motor (Example)
PC	PMC-4B-PCI	X-Axis / Y-Axis / Z-Axis / U-Axis : Stepping motor driver & Servo motor → Stepping motor & Servo motor

PMC-4B-PCI

▣ Dimensions
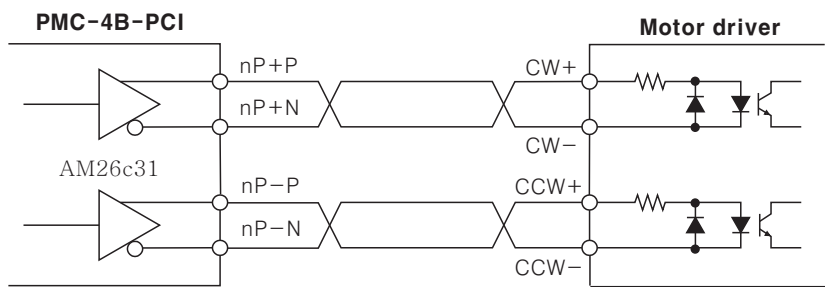

174.6

106.7

(Unit:mm)

▣ Connections

◎ Connection of pulse output signal for operating driver

PMC-4B-PCI outputs pulse for operating driver as +/- of CW/CCW output using Line driver (AM26c31) and refer to the follows connections of motor driver with photocoupler and line driver input.
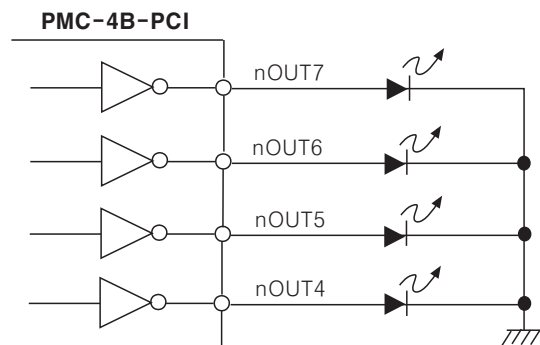
● Connection to motor driver with photocoupler

● Connection to motor driver with line driver
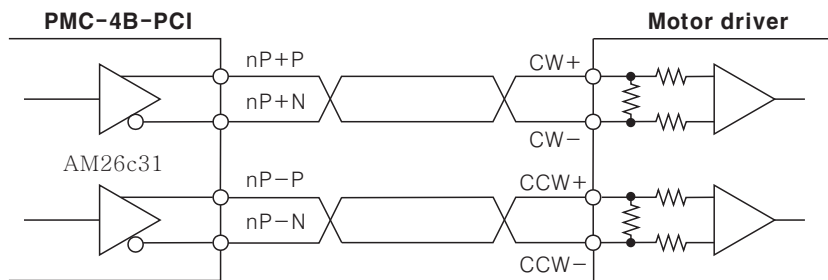
※ It is recommended to use twisted pair shield wire for pulse output signal of driver operation regarding EMC.

◎ Connection of common output signal (nOUT4 to 7)

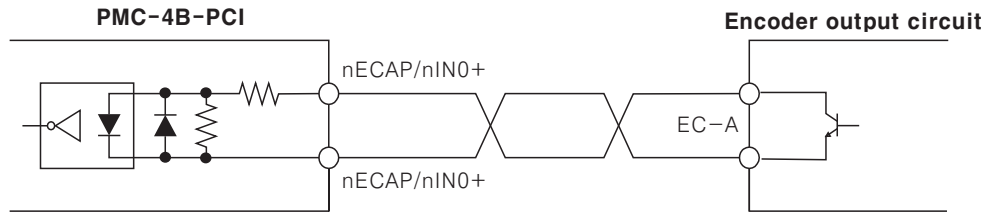Output signal is outputted by buffer(74LS06), and all outputs are OFF after reset.

Autonics

4-Axis Motion Controller

◎**Connection of encoder input signal(nECAP/N, nECBP/N) and nIN0+/- signal**

●**Connection of encoder input signal and auto output line driver**

PMC-4B-PCI

Encoder output circuit

nECAP/nIN0+

nECAP/nIN0+

EC-A

※All A, B, Z-phases are having same connections.

◎**Example for the connection of encoder input signal and NPN open collector output encoder**

PMC-4B-PCI

R VEX

GND **External power**

nECAP/nIN0+

nECAN/nIN0−

Encoder output circuit

EC-A
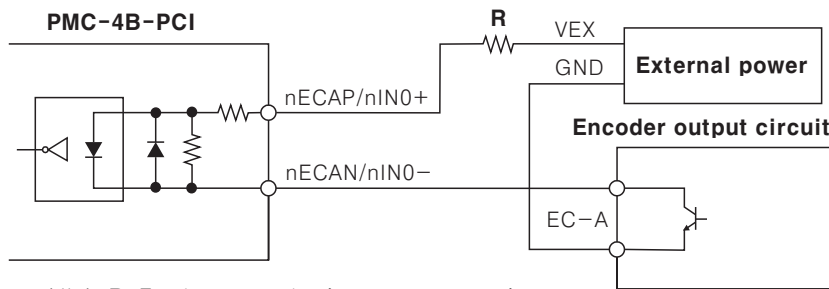
External power supply	Resistance(**R**)
5V	0
12V	820 1/4W
24V	2k 12W

※All A, B, Z-phases are having same connections.

◎**Connection of input signal (nIN1 to 3, nINPOS, nALRAM, nEXP+/−, EMG)**

PMC-4B-PCI

+5V

VEX

Input signal

GND
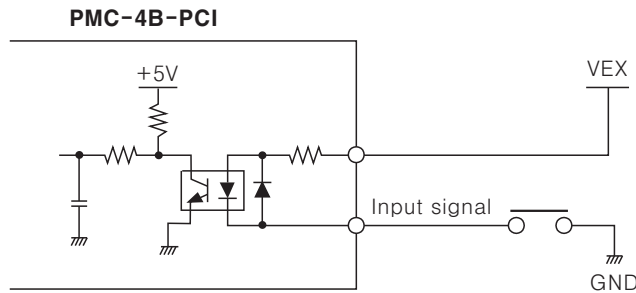
◎**Connection of limit input signal(nLMIT+/−)**

The outgoing cable of limit signal can be affected by noise, it can not be removed only with photocoupler, so, the filter circuit is built in and set enough passing time. (FL=2, 3)
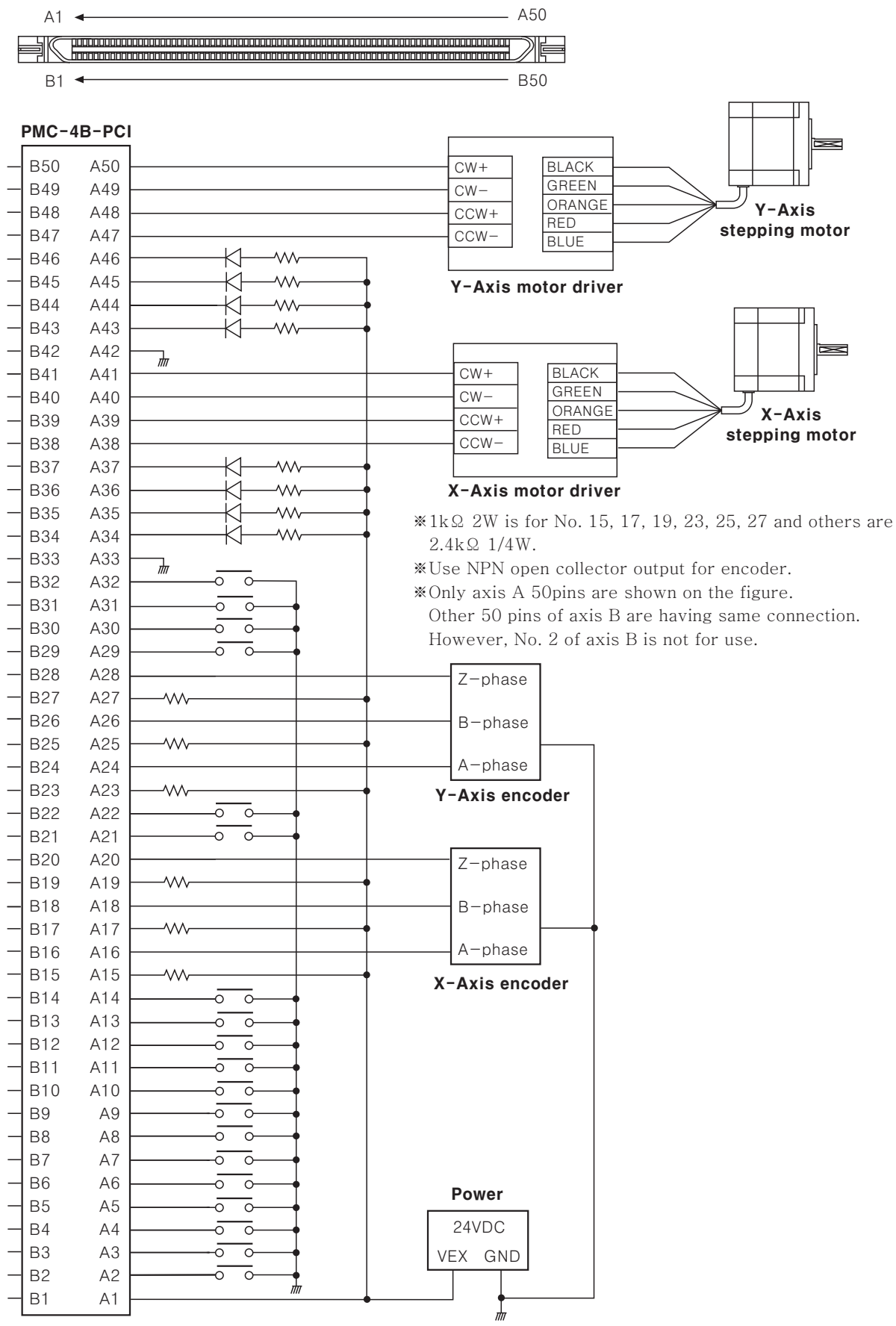
PMC-4B-PCI

VEX

GND **External power**

VEX

Noise removal filter

XLIT+

+

OUT

−

PMC-4B-PCI

▣ Entire I/O connections

A1 ◄───────────────────────────── A50

B1 ◄───────────────────────────── B50

PMC-4B-PCI

B50	A50		CW+		BLACK
B49	A49		CW−		GREEN
B48	A48		CCW+		ORANGE
B47	A47		CCW−		RED
					BLUE

Y-Axis motor driver

Y-Axis stepping motor

B46 A46
B45 A45
B44 A44
B43 A43
B42 A42
B41 A41 — CW+ — BLACK
B40 A40 — CW− — GREEN
B39 A39 — CCW+ — ORANGE
B38 A38 — CCW− — RED
— BLUE

X-Axis motor driver

X-Axis stepping motor

B37 A37
B36 A36
B35 A35
B34 A34
B33 A33

※1kΩ 2W is for No. 15, 17, 19, 23, 25, 27 and others are 2.4kΩ 1/4W.
※Use NPN open collector output for encoder.
※Only axis A 50pins are shown on the figure. Other 50 pins of axis B are having same connection. However, No. 2 of axis B is not for use.

B32 A32
B31 A31
B30 A30
B29 A29
B28 A28 — Z-phase
B27 A27
B26 A26 — B-phase
B25 A25
B24 A24 — A-phase

Y-Axis encoder

B23 A23
B22 A22
B21 A21
B20 A20 — Z-phase
B19 A19
B18 A18 — B-phase
B17 A17
B16 A16 — A-phase
B15 A15

X-Axis encoder

B14 A14
B13 A13
B12 A12
B11 A11
B10 A10
B9 A9
B8 A8
B7 A7
B6 A6
B5 A5

Power

B4 A4
B3 A3
B2 A2 — 24VDC
B1 A1 — VEX GND

▣ I/O specifications

Pin No.	Signal	Description	Pin No.	Signal	Description
A1	VEX	12-24VDC	B1	VEX	12-24VDC
A2	EMG	Emergency stop (4-axis stop)	B2	–	Non-using
A3	XLMIT+	Axis X +limit	B3	ZLMIT+	Axis Z +limit
A4	XLMIT-	Axis X -limit	B4	ZLMIT-	Axis Z -limit
A5	XIN1	Axis X input signal(home)	B5	ZIN1	Axis Z input signal(home)
A6	XIN0	Axis X input signal(near home)	B6	ZIN0	Axis Z input signal(near home)
A7	XIN3	Axis X input signal(encoder Z phase signal)	B7	ZIN3	Axis Z input signal(encoder Z phase signal)
A8	YLMIT+	Axis Y +limit	B8	ULMIT+	Axis U +limit
A9	YLMIT-	Axis Y -limit	B9	ULMIT-	Axis U -limit
A10	YIN1	Axis Y input signal(home)	B10	UIN1	Axis U input signal(home)
A11	YIN0	Axis Y input signal(near home)	B11	UIN0	Axis U input signal(near home)
A12	YIN3	Axis Y input signal(encoder Z phase signal)	B12	UIN3	Axis U input signal(encoder Z phase signal)
A13	XINPOS	Axis X input inposition	B13	ZINPOS	Axis Z input inposition
A14	XALRAM	Axis X alarm input	B14	ZALRAM	Axis Z alarm input
A15	XECAP	Axis X Encoder phase A+	B15	ZECAP	Axis Z Encoder phase A+
A16	XECAN	Axis X Encoder phase A-	B16	ZECAN	Axis Z Encoder phase A-
A17	XECBP	Axis X Encoder phase B+	B17	ZECBP	Axis Z Encoder phase B+
A18	XECBN	Axis X Encoder phase B-	B18	ZECBN	Axis Z Encoder phase B-
A19	XECZP	Axis X Encoder phase Z+	B19	ZECZP	Axis Z Encoder phase Z+
A20	XECZN	Axis X Encoder phase Z-	B20	ZECZN	Axis Z Encoder phase Z-
A21	YINPOS	Axis Y input inposition	B21	UINPOS	Axis U input inposition
A22	YALARM	Axis Y alarm input	B22	UALARM	Axis U alarm input
A23	YECAP	Axis Y Encoder phase A+	B23	UECAP	Axis U Encoder phase A+
A24	YECAN	Axis Y Encoder phase A-	B24	UECAN	Axis U Encoder phase A-
A25	YECBP	Axis Y Encoder phase B+	B25	UECBP	Axis U Encoder phase B+
A26	YECBN	Axis Y Encoder phase B-	B26	UECBN	Axis U Encoder phase B-
A27	YECZP	Axis Y Encoder phase Z+	B27	UECZP	Axis U Encoder phase Z+
A28	YECZN	Axis Y Encoder phase Z-	B28	UECZN	Axis U Encoder phase Z-
A29	XEXP+	Axis X manual +drive	B29	ZEXP+	Axis Z manual +drive
A30	XEXP-	Axis X manual -drive	B30	ZEXP-	Axis Z manual -drive
A31	YEXP+	Axis Y manual +drive	B31	UEXP+	Axis U manual +drive
A32	YEXP-	Axis Y manual -drive	B32	UEXP-	Axis U manual -drive
A33	GND	GND	B33	GND	GND
A34	XOUT4/CMPP	Axis X general output	B34	ZOUT4/CMPP	Axis Z general output
A35	XOUT5/CMPM	Axis X general output	B35	ZOUT5/CMPM	Axis Z general output
A36	XOUT6/ASND	Axis X general output	B36	ZOUT6/ASND	Axis Z general output
A37	XOUT7/DSND	Axis X general output	B37	ZOUT7/ DSND	Axis Z general output
A38	XP+P	Axis X +CW drive signal output	B38	ZP+P	Axis Z +CW +drive signal output
A39	XP+N	Axis X -CW drive signal output	B39	ZP+N	Axis Z +CW -drive signal output
A40	XP-P	Axis X +CCW drive signal output	B40	ZP-P	Axis Z +CCW +drive signal output
A41	XP-N	Axis X -CCW drive signal output	B41	ZP-N	Axis Z -CCW -drive signal output
A42	GND	GND	B42	GND	GND
A43	YOUT4/CMPP	Axis Y general output	B43	UOUT4/CMPP	Axis U general output
A44	YOUT5/CMPM	Axis Y general output	B44	UOUT5/CMPM	Axis U general output
A45	YOUT6/ASND	Axis Y general output	B45	UOUT6/ASND	Axis U general output
A46	YOUT7/DSND	Axis Y general output	B46	UOUT7/DSND	Axis U general output
A47	YP+P	Axis Y +CW drive signal output	B47	UP+P	Axis U +CW +drive signal output
A48	YP+N	Axis Y -CW drive signal output	B48	UP+N	Axis U +CW -drive signal output
A49	YP-P	Axis Y +CCW drive signal output	B49	UP-P	Axis U +CCW +drive signal output
A50	YP-N	Axis Y -CCW drive signal output	B50	UP-N	Axis U -CCW -drive signal output

Applications

▣Applications

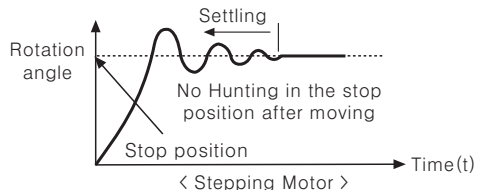| Inspection facilities	Inspection facilities
CCD camera Low speed Stepping motor	Brake type stepping motor
Belt drive	**Label position control in packaging machine**
Stepping motor	Label Stepping motor
Ball screw drive	**Wafer transfer robot control**
Stepping motor	Stepping motor
Index table	**Cutting position control**
Actuator type stepping motor	Stepping motor

Autonics

Technical Description

■Overview

Stepping motor is a high accuracy position control motor which digital control rotating by a set mechanical angle decided by input pulses is available. It is available to control a rotation angle and speed accurately and it has lots of proper applications to be used. We have hybrid stepping motor with high characteristic such as a high accuracy and torque, which is used in a wide range of FA to OA field. Also, we have the driver (MD5/MD2U series) and controllers(PMC series) in order to get a high efficiency with our stepping motor.

Rotor core — Shaft
Rotor teeth — Bearing
Bobbin
Stator core — Coil
Stator teeth

Shaft — Bearing
Rotor core
Coil
Cover
Stator core
Flange
Permanent magnet
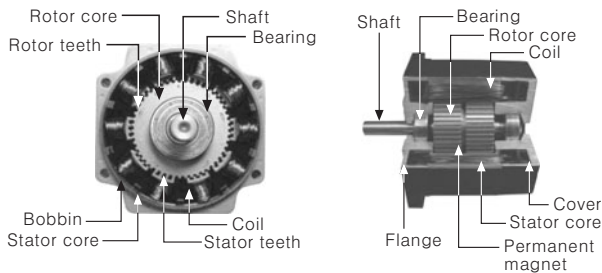
■Features

◎It is available to control a rotation angle and speed easily.
5−phase stepping motor is available to control the rotation angle and speed easily by electrical pulse (digital) signal as it is the motor rotating by a set mechanical angle decided by input pulse(digital) signal.

◎It is a high torque and response motor.
Stepping motor is small & light and can get a high torque. Also, rapid starting/stopping and reversing are available due to rapid acceleration as it has a stopping and starting torque.

◎It is available to control a position in a high resolution and accuracy.
Our 5−phase hybrid stepping motor rotates by $0.72°$ / pulse and it is a high−resolution motor, which is available to rotate by $0.00288°$/pulse when using micro step driver with 250 division. And, it stops in a high accuracy of $±3min(0.05°$ at non−load) when driving by $0.72°$/pulse.

◎It has a self−holding torque.
5−phase stepping motor has a high holding torque when stopped in power on.
Therefore, it is available to hold a stop position without mechanical break or control signal.

◎Settling time is short and there is no hunting status when stopped.
Settling time which motor axis is stopped after normal and reverse rotation by load inertia is short when motor is stopped at a stop position.
There is no hunting which motor axis is stopped with delicate normal and reverse rotation when holding a stop position after settling time.
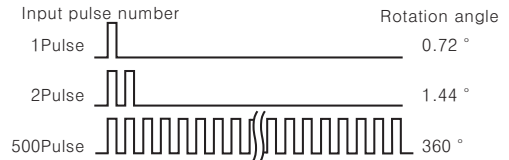
Rotation angle
Settling
No Hunting in the stop position after moving
Stop position
Time(t)
〈 Stepping Motor 〉

Rotation angle
Settling   Hunting
There is hunting in the stop position after moving
Stop position
Time(t)
〈 Servo Motor 〉
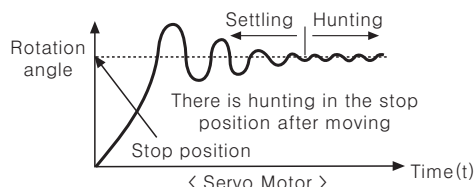
■Usage of stepping motor

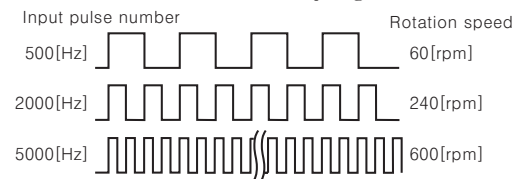◎Stepping motor can control a rotation angle and speed easily by number and speed of input pulse as follows.

●Rotation angle control

Rotation angle$[°]=$Step angle$[°]×$Pulse number

Input pulse number	Rotation angle
1Pulse	0.72°
2Pulse	1.44°
500Pulse	360°

〈 5 phase Stepping Motor$(0.72°)$ Full Step operation 〉

●Rotation speed control

Rotation speed$[rpm]=\dfrac{\text{Pulse speed}[Hz]}{360°/\text{Step angle}[°]}×60[sec]$

Input pulse number	Rotation speed
500[Hz]	60[rpm]
2000[Hz]	240[rpm]
5000[Hz]	600[rpm]

〈 5 phase Stepping Motor$(0.72°)$ Full step operation 〉

◎A driver only for the stepping motor and the controller only for controlling the driver are necessary in order to drive the stepping motor.

●Stepping motor

Autonics has various stepping motor to meet customer's needs.

Shaft type AK−Series
Hollow type AHK−Series
Geared type AK−G Series
Brake type AK−B Series
Geared+Brake type AK−GB Series

●Driver

It is an exclusive driving circuit to drive the stepping motor and provides power to the motor in the order of the motor phase. We have the driver(MD series) only for 5−phase stepping motor.
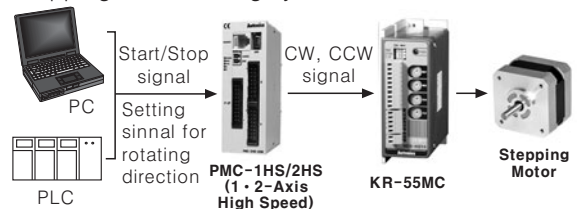
MD5−ND14   MD5−HD14   MD5−HD14−2X/3X   MD5−HF14   MD5−HF28

●Controller

It controls a rotation angle and speed etc. of the stepping motor. We have the controller(PMC series).

PMC−1HS/2HS (1・2−Axis High Speed)
PMC−2HSP/2HSN (2−Axis high speed Interpolation/Normal)
PMC−4B−PCI (4−Axis Board type)

●Stepping Motor driving system

PC
Start/Stop signal
Setting sinnal for rotating direction
PLC
PMC−1HS/2HS (1・2−Axis High Speed)
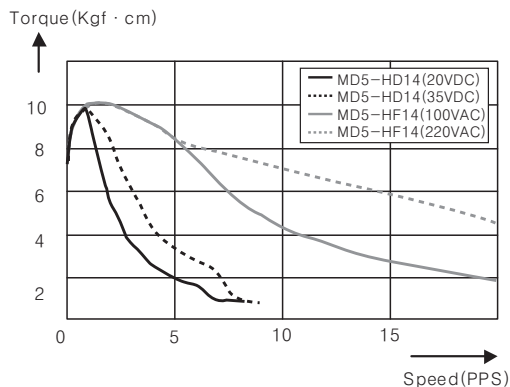CW, CCW signal
KR−55MC
Stepping Motor

Technical Description

▣Micro stepping?

Microstepping is a way to divide the basic step angle of the motor into smaller steps by decreasing the current to one phase. Microstepping has the better resonance and vibration characteristics. It realizes high-accuracy controlling with smaller step angles divided by controlling coil current.

- Realizing low-speed / low-vibration and low noise driving
- Dividing motor's basic step angle into 250 divisions (0.72° to 0.00288°)

▣DC Driver VS. AC Driver

Torque(Kgf · cm)

DC Driver		AC Driver
● DC20 to 35V		● AC100 to 220V
● Relatively low torque characteristics	**VS**	● High torque characteristics
● Simple circuit structure		● Relatively complex circuit structure due to DC to AC conversion circuit
● Cost effective		● Expensive

◎Major features
- In case of AC power supply, the higher the speed, the better torque characteristics.
- Under the same driver conditions, the higher the power supply, the better torque characteristics motors can have. Proper safety countermeasures must be ensured when applying high power supply. It may cause high heat generation.

▣Glossary

Torque(Kgf · cm)
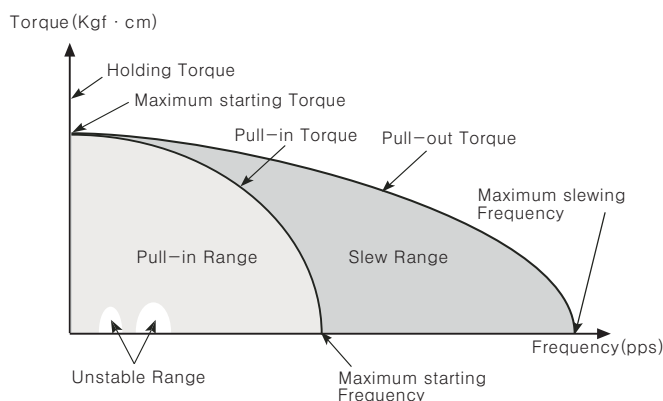
- Refer to torque-frequency reference below. 1) to 6) have direct effect on driver's performance.

1) Maximum starting frequency

Maximum frequency is required for stepping motors to start & stop and forward & reverse rotation without de/acceleration in the state of no load. If it is required to drive a motor with higher frequency than max. starting frequency, drive a motor from max. starting frequency and do de/acceleration driving.

2) Pull-in torque

Max. torque to drive a load within starting frequency range

3) Pull-in range(Max. starting range)

Max. torque range that a stepping motor can drive a load with a certain frequency lower than max. starting frequency. It is allowed for the load to start & stop and forward & reverse rotation without de/acceleration within pull-in range. In case of driving a motor out of pull-in range, start a motor within pull-in range and do de/acceleration driving.

4) Maximum slewing frequency

Max. frequency at which a stepping motor can rotate without fail to synchronize when driving a motor within max. starting frequency range in order to increase input frequency

5) Pull-out torque

Max. torque required for a stepping motor to drive without pull-out within maximum starting frequency

6) Slew range (Pull-out range)

Max. torque range required for a stepping motor to drive without pull-out within maximum starting frequency

7) Holding torque

The amount of torque the motors produce at standstill while rated current is applied to the motors. In general, it is referred to as stepping motor's driving capacity.
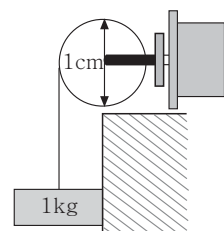
8) Torque

Torque, moment of force, is the tendency of a force to rotate an object.
※ Torque unit: N · m / kgf · cm
(1 N · m = 10.1972 kgf · cm)
※ Required torque to rotate a rotator of which radius is 1cm in case 1kg of weight is applied (The weight of rotator itself is negligible.)

▪Failure Diagnosis and Countermeasures

1) Resonance

The motor will exhibit much wilder vibrations when the input pulse frequency matches the natural frequency of the motor. This is resonance.

● 5−phase stepping motor driver resonance area: Approx. 300 to 500 pps

◎ How to improve vibration characteristics
① Adjusting RUN current
② Changing input pulse frequency
③ Applying microstepping function
④ Selecting geared type motors
⑤ Using DAMPER
⑥ Using anti−vibration rubber
⑦ Using elastic couplings

2) Heat generation

Possible causes for heat generation include applying higher power supply, driving with higher RUN current than rated current and long time & continuous driving without stops.

◎ How to improve heat generation characteristics
① Adjusting RUN current
② Adjusting RUN DUTY ratio
(Setting STOP time longer than RUN time.)
③ Mounting heat prevention panels
④ Applying Auto current down, HOLD OFF funtions
⑤ Using a fan

3) Missing step

A phenomenon that a stepping motor is incapable of rotating as the frequency of input pulse

Major Causes	Troubleshooting
Motor failure	Change a motor
Rapid De/Acceleration of Motor	Reduce driving speed / Make motor's acceleration time longer
Improper motor torque selecting for load	Change a motor having high torque. Select a geared type motor
Wrong driving speed setting (lower than max. starting frequency)	Drive a motor within starting frequency band. (Refer to motor's characteristics.)
Low input current	Increase input current

▪Calculation method for selecting stepping motor

It shows calculation method required in the selecting order. In real calculation it is impossible to get mechanical constant in many cases. Therefore, simple calculations are shown herewith.

◎ Decision of driving pattern

It is shown as the drawing converting the operation of the driving equipment to the rotating operation of the motor in the equipment using stepping motor. The below chart by starting speed acceleration /deceleration time, driving speed and position decision time of motor. The stepping motor is selected based on driving pattern chart.

⟨ Driving Pattern ⟩
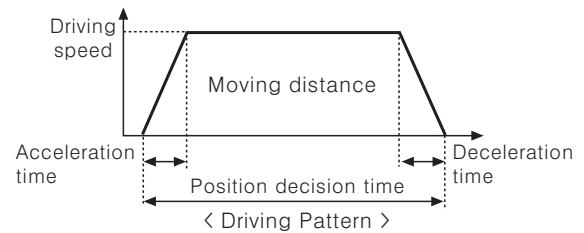
● **Calculation of Necessary pulse number**

It is the number of the pulse that should be input to stepping motor in order to transfer an object from starting position to target position by the carrying equipment.
It is calculated as follows.

Necessary pulse number

$$= \frac{\text{Moving distance of object}}{\text{Moving distance for 1 revolution}} \times \frac{360°}{\text{Step angle}}$$

● **Calculation of the Driving pulse speed**

It is the necessary pulse speed in order to rotate as much as the necessary pulse number in the set position decision time.
The necessary pulse number, the position decision time and the acceleration/deceleration time calculate the driving pulse speed.

1) For start−stop driving

Start−stop driving is what the stepping motor stops after revolving as much as the necessary pulse number for the position decision time operating in the driving pulse speed without acceleration/ deceleration on the motor driving.
Start−stop driving is used when driving a motor in low speed. Also, it needs high acceleration/deceleration torque as it needs a rapid speed change. The driving pulse speed of start−stop driving is calculated as follows:

$$\text{Driving pulse speed[Hz]} = \frac{\text{Necessary pulse number[Pulse]}}{\text{Positioning time[sec]}}$$

⟨ Start−stop driving pattern ⟩
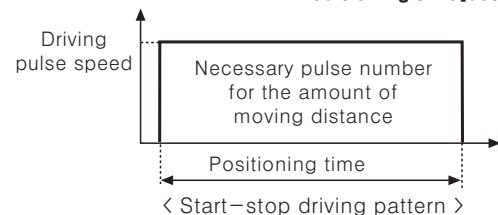
2) For acceleration/deceleration driving

Acceleration/deceleration driving is what stepping motor stops decelerating the speed into the starting region after driving at the pulse speed for certain time when driving in accelerating the rotation speed of the motor by changing slowly the driving pulse speed in the starting region for the positioning time. Acceleration/deceleration time should be set properly depending on the carrying distance/speed and positioning time. In case of acceleration/deceleration driving it needs lower acceleration/deceleration torque than self−start driving as its speed changes gently. The driving pulse speed of acceleration /deceleration is calculated as below.
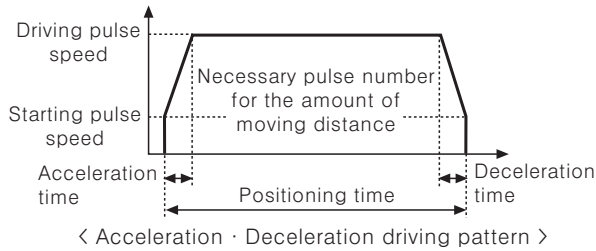
Driving pulse speed[Hz]

$$= \frac{\text{Necessary pulse number} - \text{Starting pulse speed [Hz]} \times \text{Acceleration} \cdot \text{Deceleration time[[sec]}}{\text{Positioning time[sec]} - \text{Acceleration} \cdot \text{Deceleration time[sec]}}$$

Technical Description

< Acceleration · Deceleration driving pattern >

◎Simple calculation of the necessary motor torque

The necessary motor torque=
(Load torque + Acceleration · Deceleration torque)
× Safety rate

● **Calculation of Load torque(T$_L$)**

Load torque indicates the friction power of a contacting part of the carrying equipment and this torque is always needed when the motor is driving.

Load torque is changed by the kinds of carrying equipment and the weight of an object. The calculation of load torque according to the kinds of carrying equipment is as below. Simple calculations without considering the constant are shown as below because it is impossible to get mechanical constant in many cases. Load torque can be calculated referring to below figures and numerical formulas.

1) Ball−Screw driving
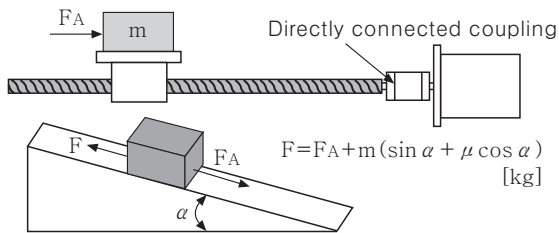
$$F = F_A + m(\sin\alpha + \mu\cos\alpha) \ [kg]$$

※Calculation of load torque
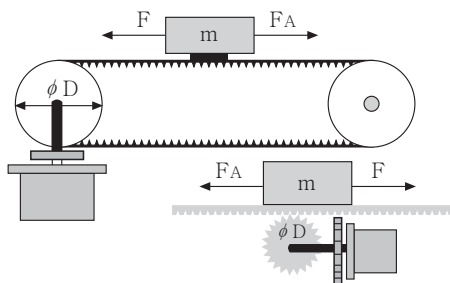
$$T_L = \left(\frac{F \cdot P_B}{2\pi\eta} + \frac{\mu_0 F_0 P_B}{2\pi} \right) \times \frac{1}{i} \ [kgf \cdot cm]$$

※Simple calculation of load torque

$$T_L = \frac{m \cdot P_B}{2\pi\eta} \times \frac{1}{i} \ [kgf \cdot cm] \ \text{(Horizontal load)}$$

$$T_L = \frac{m \cdot P_B}{2\pi\eta} \times \frac{1}{i} \times 2 \ [kgf \cdot cm] \ \text{(Vertical load)}$$

2) Wire · Belt/Rack · Pinion driving

※Calculation of load torque

$$T_L = \frac{F}{2\pi\eta} \times \frac{\pi D}{i} = \frac{FD}{2\pi\eta i} \ [kgf \cdot cm]$$

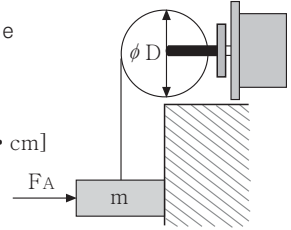$$F = F_A + m(\sin\alpha + \mu\cos\alpha) \ [kg]$$

※Simple calculation of load torque

$$T_L = \frac{D}{2} \times m \times \frac{1}{\eta} \times \frac{1}{i} \ [kgf \cdot cm] \ \text{(Horizontal load)}$$

$$T_L = \frac{D}{2} \times m \times \frac{1}{\eta} \times \frac{1}{i} \times 2 \ [kgf \cdot cm] \ \text{(Vertical load)}$$
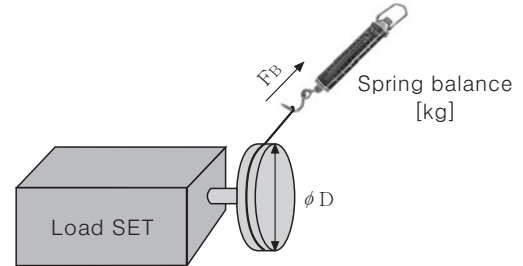
3) Pulley driving

※Calculation of load torque

$$T_L = \frac{\mu F_A + m}{2\pi} \times \frac{\pi D}{i}$$

$$= \frac{(\mu F_A + m)D}{2i} \ [kgf \cdot cm]$$

※ Simple calculation of load torque

$$T_L = \frac{D}{2} \times m \times \frac{1}{i} \ [kgf \cdot cm]$$

4) By real measurement

It is the calculation method by reading the scale mark of the spring balance at the time when the pulley is rotated when drawing the spring balance slowly. It is available to get more accuracy load torque than by the calculation.

It is available to calculate the load torque as follows with the value (F$_B$) calculated by the spring balance.

$$T_L = \frac{F_B D}{2} \ [kgf \cdot cm]$$

[Note]

F : Load of axis direction [kg]
η : Efficiency ratio (0.85 to 0.95)
F$_A$: External force [kg]
μ : Friction coefficient
μ_0 : Internal friction coefficient of prepressure NUT (0.1 to 0.3)
P$_B$: Ball−screw pitch [cm/rev]
F$_B$: The force when starting the revolution of main shaft [kg]
D : Outside diameter of pulley

F$_0$: Prepressure load [kg] ($\cong$ 1/3 F)
i : Deceleration rate
m : The total weight of work and table [kg]
α : Slop angle [°]

● **Calculation of Acceleration/Deceleration torque(T$_a$)**

Acceleration · deceleration torque is for accelerating or decelerating the carrying equipment connected to the motor. It changes largely depending on the time of acceleration · deceleration and the value of load inertia moment of the carrying equipment. Therefore, the torque between self−start driving and acceleration · deceleration driving will show a big difference. Acceleration · Deceleration Torque is calculated as follows:

※For start−stop driving (High Acceleration · Deceleration Torque is required)

Acceleration · Deceleration Torque [kgf · cm]

$$= \frac{\text{Rotator inertia moment[kgm}^2\text{]} + \text{Load inertia moment[kgm}^2\text{]}}{\text{Gravitational acceleration[cm/sec}^2\text{]}}$$

$$\times \frac{\pi \times \text{Step angle[°]} \times \text{Driving frequency}^2 \text{[Hz]}}{180 \times 3.6 / \text{Step angle[°]}}$$

※Acceleration/Deceleration driving

Acceleration · Deceleration Torque [kgf · cm]

$$= \frac{\text{Rotator inertia moment[kgm}^2\text{]} + \text{Load inertia moment[kgm}^2\text{]}}{\text{Gravitational acceleration[cm/sec}^2\text{]}}$$

$$\times \frac{\pi \times \text{Step angle[°]}}{180°} \times \frac{\text{Driving frequency[Hz]} - \text{Starting frequency[Hz]}}{\text{Acceleration · Deceleration time[sec]}}$$

Autonics

Technical Description

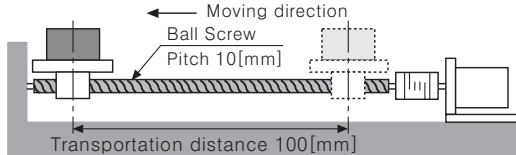## ■Calculation example for motor selection

◎Calculation of the number of the necessary pulse and the speed of the driving pulse.

These are practical examples for the number of the necessary pulse and the speed of the driving pulse with 5−phase stepping motor as belows.

●When driving the Ball−Screw

When carrying an object as follow figure for 1sec. by using 5−phase stepping motor(0.72° /step), the number of the necessary pulse and the speed of the driving pulse are calculated as follows:

$$\text{Necessary pulse number} = \frac{100}{10} \times \frac{360°}{0.72°} = 5,000 \,[\text{Pulse}]$$

Moving direction ←

Ball Screw
Pitch 10[mm]

Transportation distance 100[mm]

If it executes start−stop driving for a second the speed of the driving pulse is calculated as 5,000 [Pulse]/1[sec]=5[kHz] but, the start−stop driving is impossible at 5[kHz] and it should be driven with acceleration · deceleration driving. If calculating with setting the acceleration · deceleration time as 25% of the position decision time and 500[Hz] of the starting pulse speed, it will be calculated as follows:

$$\text{Driving pulse speed}\,[\text{Hz}] = \frac{5,000\,[\text{Pulse}] - 500\,[\text{Hz}] \times 0.25\,[\text{sec}]}{1\,[\text{sec}] - 0.25\,[\text{sec}]}$$
$$= 6.5\,[\text{kHz}]$$

It will be figured as follows:

Driving pulse speed — 6.5[kHz]

Starting pulse speed — 500[Hz]
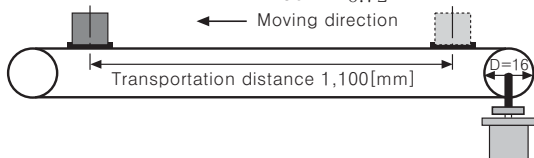
0.25[sec] 0.25[sec]

1[sec]

⟨Acceleration · Deceleration driving pattern⟩
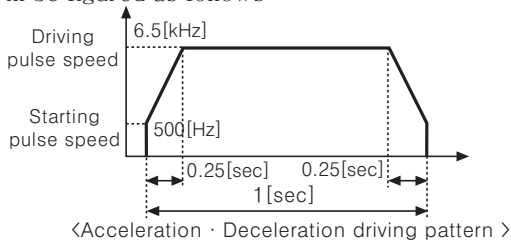
●When driving the Timing Belt

When carrying an object as following figure for 1sec. by using 5−phase stepping motor(0.72° /step), the moving distance/revolution is approx. 50[mm] by $2\pi r$ as the circumference of the pulley. As the moving distance/revolution is 50[mm] the number of the necessary pulse is calculated as follows:

$$\text{Necessary pulse number} = \frac{1,100}{50} \times \frac{360°}{0.72°} = 11,000\,[\text{Pulse}]$$

Moving direction ←

Transportation distance 1,100[mm]

D=16

If driving with acceleration · deceleration like the example of a ball−screw the driving pulse speed is calculated as follows:

$$\text{Driving pulse speed}\,[\text{Hz}] = \frac{11,000\,[\text{Pulse}] - 500\,[\text{Hz}] \times 0.25\,[\text{sec}]}{1\,[\text{sec}] - 0.25\,[\text{sec}]}$$
$$= 14.5\,[\text{kHz}]$$

It will be figured as follows:

Driving pulse speed — 14.5[kHz]

Starting pulse speed — 500[Hz]

0.25[sec] 0.25[sec]

1[sec]

⟨Acceleration · Deceleration driving pattern⟩
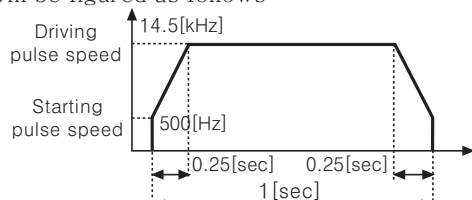
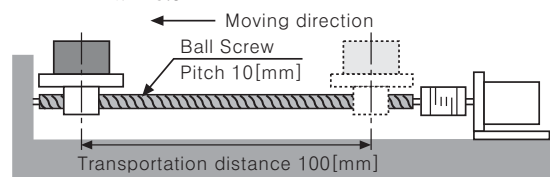◎Calculation example of load torque(T_L)

It is a real calculation example of load torque by using 5−phase stepping motor by simple numerical formulas.

●When using a Ball−Screw for driving a horizontal load

When carrying an object by using a ball−screw with 90[%] of efficiency and 40[kg] of the load weight as following figure, the load torque is calculated as follows;

$$T_L = \frac{m \cdot P_B}{2\pi\eta} \times \frac{1}{i}\,[\text{kgf} \cdot \text{cm}]$$

$$T_L = \frac{40\,[\text{kg}] \times 1\,[\text{cm}]}{2\pi \times 0.9} \times \frac{1}{i} = 7.07\,[\text{kgf} \cdot \text{cm}]$$

Moving direction ←

Ball Screw
Pitch 10[mm]

Transportation distance 100[mm]

●When using a Timing Belt for driving a horizontal load

When carrying an object by using a timing belt with 90[%] of efficiency, 16[mm] diameter of pulley and 9[kg] of the load weight as following figure, the load torque is calculated as follows;
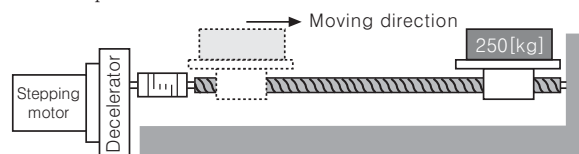
Moving direction ←

D=16
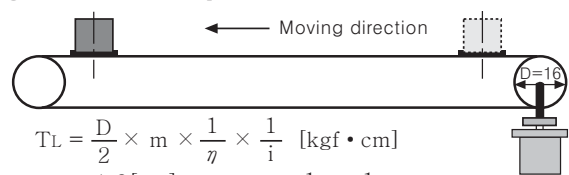
$$T_L = \frac{D}{2} \times m \times \frac{1}{\eta} \times \frac{1}{i}\,[\text{kgf} \cdot \text{cm}]$$

$$T_L = \frac{1.6\,[\text{cm}]}{2} \times 9\,[\text{kg}] \times \frac{1}{0.9} \times \frac{1}{1}$$
$$= 8\,[\text{kgf} \cdot \text{cm}]$$

●When using a Ball−Screw and a decelerator for driving a horizontal load

When carrying an object by using a ball screw with 5[mm] pitch, 90[%] of efficiency and 250 [kg] of the load weight as following figure, the load torque is calculated as follows;

Moving direction →

250[kg]

Stepping motor | Decelerator

Deceleration rate
1:10

$$T_L = \frac{m \cdot P_B}{2\pi\eta} \times \frac{1}{i}\,[\text{kgf} \cdot \text{cm}]$$

$$T_L = \frac{250\,[\text{kg}] \times 0.5\,[\text{cm}]}{2\pi \times 0.9} \times \frac{1}{10}$$
$$= 2.21\,[\text{kgf} \cdot \text{cm}]$$

The calculation result is for a horizontal load. Vertical load torque is 2 times of the horizontal load torque. Its result is only for load torque.

Acceleration · deceleration torque should be added for real necessary torque of the motor. But, it is very difficult to get the moment of load inertia in the calculation.

In order to solve the difficulty it will be easy to calculate applying the start−stop driving or a large safety rate when acceleration · deceleration is rapid at the calculated load torque.