Autonics

Controller Integrated 2-Phase Closed-Loop Stepper Motor Driver
AiC-D SERIES
INSTRUCTION MANUAL

CE

Thank you for choosing our Autonics product.
Please read the following safety considerations before use.

▣ Safety Considerations

※Please observe all safety considerations for safe and proper product operation to avoid hazards.
※⚠ symbol represents caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow these instructions may result in serious injury or death.
⚠ Caution Failure to follow these instructions may result in personal injury or product damage.

⚠ Warning

1. **Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.)**
   Failure to follow this instruction may result in fire, personal injury, or economic loss.
2. **Do not connect, repair, or inspect the unit while connected to a power source.**
   Failure to follow this instruction may result in fire.
3. **Install the unit after considering counter plan against power failure.**
   Failure to follow this instruction may result in personal injury, or economic loss.
4. **Check 'Connections' before wiring.**
   Failure to follow this instruction may result in fire.
5. **Do not disassemble or modify the unit.**
   Failure to follow this instruction may result in fire.
6. **Install the driver in the housing or ground it.**
   Failure to follow this instruction may result in electronic shock, personal injury.
7. **Do not touch the unit during or after operation for a while.**
   Failure to follow this instruction may result in burn due to high temperature of the surface.
8. **Emergency stop directly when error occurs.**
   Failure to follow this instruction may result in fire, or personal injury.

⚠ Caution

1. **When connecting the power input, use AWG 18(0.75mm²) cable or over.**
2. **Install over-current prevention device (e.g. the current breaker, etc) to connect the driver with power.**
   Failure to follow this instruction may result in fire.
3. **Check the control input signal before supplying power to the driver.**
   Failure to follow this instruction may result in personal injury or product damage by unexpected signal.
4. **Install a safety device to maintain the vertical position after turn off the power of this driver.**
   Failure to follow this instruction may result in personal injury or product damage by releasing holding torque of the motor.
5. **Use the unit within the rated specifications.**
   Failure to follow this instruction may result in fire or product damage.
6. **Use dry cloth to clean the unit, and do not use water or organic solvent.**
   Failure to follow this instruction may result in fire.
7. **Do not use the unit in the place where flammable/explosive/corrosive gas, humidity, direct sunlight, radiant heat, vibration, impact, or salinity may be present.**
   Failure to follow this instruction may result in fire or explosion.
8. **The driver may overheat depending on the environment.**
   Install the unit in the well ventilated place and forced cooling with a cooling fan.
   Failure to follow this instruction may result in product damage and degradation.
9. **Keep metal chip, dust, and wire residue from flowing into the unit.**
   Failure to follow this instruction may result in fire or product damage.
10. **Use the designated motor only.**
    Failure to follow this instruction may result in fire or product damage.

▣ Ordering Information

Ai C - D - 42 L A

Encoder resolution		**A**	10,000PPR (2,500PPR×4-multiply)
Motor length			
Motor frame size	**42** 42×42mm	**S**	67.5mm
		M	73.5mm
		L	81.5mm
	56 57.2×57.2mm	**S**	77.3mm
		M	90.3mm
		L	111.3mm
	60 60×60mm	**S**	81.9mm
		M	102.8mm
		L	119.8mm
Item		**D**	Driver
Category		**C**	Controller
Series		**AI**	Artificial Intelligence

Set	Driver	Motor
AiC-42SA	AiC-D-42SA	Ai-M-42SA
AiC-42MA	AiC-D-42MA	Ai-M-42MA
AiC-42LA	AiC-D-42LA	Ai-M-42LA
AiC-56SA	AiC-D-56SA	Ai-M-56SA
AiC-56MA	AiC-D-56MA	Ai-M-56MA
AiC-56LA	AiC-D-56LA	Ai-M-56LA
AiC-60SA	AiC-D-60SA	Ai-M-60SA
AiC-60MA	AiC-D-60MA	Ai-M-60MA
AiC-60LA	AiC-D-60LA	Ai-M-60LA

※The above specifications are subject to change and some models may be discontinued without notice.
※Be sure to follow cautions written in the instruction manual, user manual and the technical descriptions (catalog, homepage).

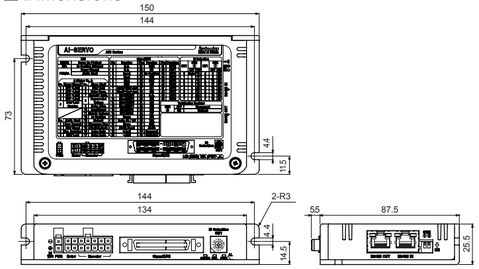
▣ Specifications

Model		AiC-D-42SA	AiC-D-42MA	AiC-D-42LA	AiC-D-56SA	AiC-D-56MA	AiC-D-56LA	AiC-D-60SA	AiC-D-60MA	AiC-D-60LA
Power supply		24VDC⎓								
Allowable voltage range		90 to 110% of the rated voltage								
Power consumption	STOP※1	Max. 10W			Max. 12W			Max. 15W		
	Max. during operation※2	Max. 60W			Max. 120W			Max. 240W		
Max. RUN current※3		1.7A/Phase			3.5A/Phase					
STOP current※4		20 to 100% of max. RUN current (factory default: 50%)								
Rotation speed		0 to 3000rpm								
Resolution※4		500 (factory default), 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000PPR								
Status indicator		● Power/Warning indicator: green LED ● Alarm indicator: red LED ● In-Position indicator: yellow LED ● Servo On/Off indicator: orange LED ● RS485 DATA IN/OUT indicator: green, yellow LED								
Positioning range		-2,147,483,648 to +2,147,483,647								
Speed filter※4		0 (disable), 2, 4, 6, 8 (factory default), 10, 20, 40, 60, 80, 100, 120, 140, 160, 180, 200 ms								
I/O voltage level		[H]: 5-30VDC⎓, [L]: 0-2VDC								
I/O	Input	Exclusive input: 20, general input: 9								
	Output	Exclusive output: 4, general output: 10								
External power supply		VEX (default: 24VDC⎓): 2, GEX (GND): 2								
Operation mode		Jog / Continuous / Index / Program mode								
Index step numbers		64 steps								
Program function	Step	256 steps								
	Control command	ABS (move absolute position), INC (move incremental position), HOM (home search), ICJ (jump input condition), IRD (waiting input), OPC (on/off of output port), OPT (on pulse from output port), JMP (jump), REP (start repetition), RPE (end repetition), END (end program), POS (position set), TIM (timer), CMP (compare output)								
	Start	Power ON program auto-start function								
	Home search	Power ON home search auto-start function								
Home search mode		Home, limit home, zero home, torque home								
Communication		RS485 Speed※4: 9600, 19200, 38400, 57900, 115200 (factory default) [bps]								
Multiaxial control		31-axis								
ID setting switch		16-bit rotary switch (0 to F), 1-bit piano switch								
Alarm output		Over current, over speed, position tracking, over load, over heat, motor connection, encoder connection, regenerative voltage, motor misalignment, command speed, input voltage, in-position, memory, emergency stop, program mode, index mode, home search mode								
Warning output		+software limit, +hardware limit, -software limit, -hardware limit, over load								
Insulation resistance		Over 100MΩ (at 500VDC megger)								
Dielectric strength		1,000VAC 60Hz for 1 min								
Vibration		1.5mm amplitude at frequency of 10 to 55Hz (for 1 min) in each X, Y, Z direction for 2 hours								
Shock		300m/s² (approx. 30G) in each X, Y, Z direction for 3 times								
Environment	Ambient temp.	0 to 50℃, storage: -10 to 60℃								
	Ambient humi.	35 to 85%RH, storage: 10 to 90%RH								
Approval		CE								
Protection structure		IP20 (IEC standard)								
Weight※5		Approx. 460g (approx. 300g)								

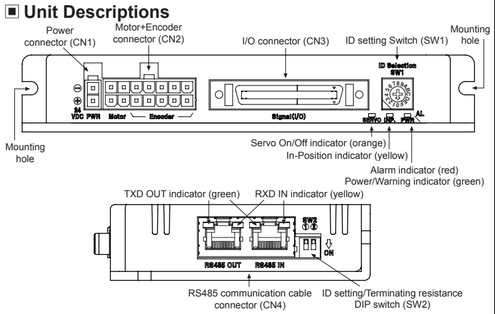
※1: Based on the ambient temperature 25℃, ambient humidity 55%RH, and STOP current 50%.
※2: Max. power consumption during operation. When changing the load rapidly, instantaneous peak current may increase. The capacity of power supply should be over 1.5 to 2 times of max. power consumption.
※3: RUN current varies depending on the input RUN frequency and max. RUN current at the moment varies also.
※4: Settable with the dedicated program.
※5: The weight includes packaging. The weight in parenthesis is for unit only.
※Environment resistance is rated at no freezing or condensation.

▣ Dimensions

(unit: mm)



▣ Unit Descriptions



▣ Status Indicators

Status indicator	Location	LED color	Function	Descriptions
PWR	Front	Green	Power indicator	Turns ON when the unit operates normally after supplying power.
			Warning indicator	Flashes when limit signal is input or over load status is maintained
AL		Red	Alarm indicator	When alarm occurs, it flashes in various ways depending on the situation. Refer to '■ Control Input/Output > ○ Output > **3. Alarm/Warning**'.
INP.		Yellow	In-Position indicator	Turns ON when motor is placed at command position after positioning input.
SERVO		Orange	Servo On/Off indicator	Turns ON when Servo is operating, turns OFF when servo is not operating.
RXD IN※1	Right side	Yellow	RS485 Data I/O display	Flashes when receiving data.
TXD OUT※1		Green		Flashes when sending data.

※1: Although RS485 OUT is disconnected, RXD IN/TXD OUT operates normally, if RS485 IN is communicating.

▣ Manual

For the detail information and instructions, please refer to user manual, user manual for communication, library manual, and quick manual and be sure to follow cautions written in the technical descriptions (catalog, homepage). Visit our homepage (www.autonics.com) to download manuals.

▣ Troubleshooting

1. When driver communication is failed
①Check whether the connection between driver and communication cable is correct.
②Check whether the port and communication speed is set correctly in the dedicated communication program.
2. When operation of motor is unstable
①Check whether driver and motor are connected correctly.
②Check whether operation command is set correctly (e.g. speed, accel/deceleration speed).

▣ Connection Connectors of Driver

○ **Connector function**

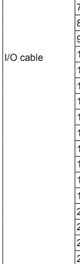
● **Power connector (CN1)**

Pin arrangement	Pin No.	Function
	2	GND
	1	24VDC

● **Motor+Encoder connector (CN2)**

Pin arrangement	Pin No.	Function	Pin No.	Function
	1	GND	8	+5VDC
	2	Encoder A	9	Encoder $\overline{A}$
	3	Encoder B	10	Encoder $\overline{B}$
	4	Encoder Z	11	Encoder $\overline{Z}$
	5	F.G.	12	N·C
	6	Motor A	13	Motor B
	7	Motor $\overline{A}$	14	Motor $\overline{B}$

● **I/O connector (CN3)**

Pin arrangement	Pin No.	I/O	Function	Pin No.	I/O	Function
	1	—	N·C	26	Input	IN0
	2	—	N·C	27	Input	IN1
	3	Input	Reset	28	Input	IN2
	4	Input	Start	29	—	N·C
	5	Input	Stop	30	Input	IN3
	6	Input	EMG	31	Input	IN4
	7	Input	Step0/+Run/+Jog	32	Input	IN5
	8	Input	Step1/-Run/-Jog	33	Input	IN6
	9	Input	Step2/SSP0	34	Input	IN7
	10	Input	Step3/SSP1	35	Input	IN8
	11	Input	Step4/MSP0	36	Input	VEX
	12	Input	Step5/MSP1	37	Input	GEX
	13	Input	MD0/HMD0	38	Output	Alarm
	14	Input	MD1/HMD1	39	Output	Compare1
	15	Input	Pause	40	Output	Compare2
	16	Input	Servo On/Off	41	Output	OUT0
	17	Input	Home	42	Output	OUT1
	18	Input	Alarm Reset	43	Output	OUT2
	19	Input	+Limit	44	Output	OUT3
	20	Input	-Limit	45	Output	OUT4
	21	Input	ORG	46	Output	OUT5
	22	Input	SD	47	Output	OUT6
	23	Output	In-Position	48	Output	OUT7
	24	Input	VEX	49	Output	OUT8
	25	Input	GEX	50	Output	OUT9

● **RS485 communication cable connector (CN4)**

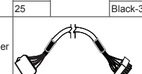
Pin arrangement	Pin No.	I/O	Function	Pin No.	I/O	Function
	1	—	N·C	5	—	N·C
	2	—	N·C	6	Input/Output	RS485 DATA-
	3	Input/Output	RS485 DATA+	7	—	N·C
	4	—	N·C	8	—	N·C

○ **Connector specifications**

Type		Specifications			Manufacture
		Connector	Connector terminal	Housing	
CN1	Driver	3930-1020 (5569-02A2)	—	—	Molex
	Power	CHD1140-02	CTD1140	—	HANLIM
CN2	Driver	35318-1420	—	—	Molex
	Motor+Encoder	5557-14R	5556T		
CN3	Driver	10250-52A2 PL	—	—	3M
	I/O connector	10150-3000PE		10350-52F0-008	
CN4	Driver	KRM-U-02-8-8-4-7M5	—	—	KINNEXA

※Above connectors are suitable for AiC Series. You can use equivalent or substitute connectors.

○ **Cable (sold separately)**

Type	Model					
I/O cable	CJ-MP50-HP□ (sold separately)※1					
	Pin No.	Cable color	Dot line color-numbers	Pin No.	Cable color	Dot line color-numbers
	1	Orange	Black-1	26	White	Red-3
	2		Red-1	27		Black-4
	3		Black-2	28		Red-4
	4		Red-2	29		Black-5
	5		Black-3	30		Red-5
	6		Red-3	31	Gray	Black-1
	7		Black-4	32		Red-1
	8		Red-4	33		Black-2
	9		Black-5	34		Red-2
	10		Red-5	35		Black-3
	11	Yellow	Black-1	36		Red-3
	12		Red-1	37		Black-4
	13		Black-2	38		Red-4
	14		Red-2	39		Black-5
	15		Black-3	40		Red-5
	16		Red-3	41	Pink	Black-1
	17		Black-4	42		Red-1
	18		Red-4	43		Black-2
	19		Black-5	44		Red-2
	20		Red-5	45		Black-3
	21	White	Black-1	46		Red-3
	22		Red-1	47		Black-4
	23		Black-2	48		Red-4
	24		Red-2	49		Black-5
	25		Black-3	50		Red-5
Motor+Encoder cable						
	Normal	C1D14M-□※2				
	Moving	C1DF14M-□※2				

※1: □ indicates cable length (010, 020, 030, 050, 070, 100)
E.g.) CJ-MP50-HP070: 7m I/O cable
※2: □ indicates cable length (1, 2, 3, 5, 7, 10)
E.g.) C1DF14M-10: 10m moving type motor+encoder cable.

▣ Driver Setting

○ **SW1: ID setting switch**
※Set Node ID of the driver.
※Depending on the I switch setting of the SW2, it is possible to connect max. 31-axis.

Setting switch	Setting	ID		Setting	ID	
		SW2 1 OFF	SW2 1 ON		SW2 1 OFF	SW2 1 ON
ID Selection SW1	0	Disable	16	8	8	24
	1	1 (factory default)	17	9	9	25
	2	2	18	A	10	26
	3	3	19	B	11	27
	4	4	20	C	12	28
	5	5	21	D	13	29
	6	6	22	E	14	30
	7	7	23	F	15	31

○ **SW2: ID setting/Terminating resistance DIP switch**
※Set Node ID of the driver.
※Set to use terminating resistance.

No.	Function	Switch position	
		ON	OFF (factory default)
1	ID setting	ID: 16 to 31	ID: 1 to 15
2	Terminating resistance	Use terminating resistance (120Ω)	Do not use terminating resistance

▣ Control Input/Output

Inner signal of all input/output consists of photocoupler.
ON, [H]: photocoupler power ON / OFF, [L]: photocoupler power OFF

○ **Input**

1. Exclusive input (20)

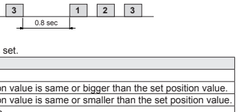
Signal name	Descriptions	Pin No.	Signal name	Descriptions	Pin No.
Reset	Reset command	3	MD0/HMD0	Operation mode designate 0 / Home search mode designate 0	13
Start	Drive start command	4	MD1/HMD1	Operation mode designate 1 / Home search mode designate 1	14
Stop	Drive stop command	5	Pause	Pause	15
EMG	Drive emergency stop command	6	Servo On/Off	Servo On/Off	16
Step0/+Run/+Jog	Step designate 0 / +Run / +Jog	7	Home	Home search	17
Step1/-Run/-Jog	Step designate 1 / -Run / -Jog	8	Alarm Reset	Alarm reset command	18
Step2/SSP0	Step designate 2 / Start speed designate 0	9	+Limit	+direction limit sensor	19
Step3/SSP1	Step designate 3 / Start speed designate 1	10	-Limit	-direction limit sensor	20
Step4/MSP0	Step designate 4 / Max speed designate 0	11	ORG	Home signal	21
Step5/MSP1	Step designate 5 / Max speed designate 1	12	SD	Deceleration (Deceleration stop) signal	22

2. General input (9)

Signal name	Descriptions	Pin No.
IN0 to 8	General input 0 to 8	26 to 28, 30 to 35

3. Example of input circuit connection
-All input circuits are insulated with photocoupler, and separate external power (default: 24VDC) is necessary.
-Case of using external power 24VDC does not require R_L.
-In case using external power over 24VDC, select R_L value that I_F (forward current of primary LED) of photocoupler to be around 2.5mA (max. 10mA).

※$R_L = \frac{VEX-1.25V}{0.0025A} - 10\times10^3\,\Omega$



※N: Input pin number of CN3

○ **Output**

1. Exclusive output (4)

Signal name	Descriptions	Pin No.	Signal name	Descriptions	Pin No.
In-Position	Drive ending pulse	23	Compare1 (Trigger)	Comparison output1	39
Alarm	Alarm output	38	Compare2 (Trigger)	Comparison output2	40

2. In-Position
-In-Position output represents output condition of positioning completion signal.
-If the gap between target position and real position is under In-Position setting value after position command pulse has finished, In-Position output turns to [H] and In-Position indicator turns ON.
-In reverse, when the gap is over In-Position setting value, In-Position output turns to [L] and In-Position indicator turns OFF.
-For accurate drive, check the In-Position output again and execute the next drive.
※Refer to example of output circuit connection.

Setting	Value	Setting	Value
Fast Response		Accurate Response	
0 (factory default)	0	8	0
1	1	9	1
2	2	10	2
3	3	11	3
4	4	12	4
5	5	13	5
6	6	14	6
7	7	15	7

3. Alarm/Warning
● Alarm
-This function stops motor to protect driver, depending on the error status such as over current or over speed.
-In case of normal status, output is [H], and in case of alarming status, output is [L].
-When supplying alarm reset, driver returns to the normal status.
※Refer to example of output circuit connection.
● Warning
-This function notices dangers with the alarm indicator prior to motor stop with limit signal or over load alarm.
-When turning out from the alarming condition, driver returns to the normal status automatically.

Alarm indicator	No. of flashing	Alarm type	Descriptions	Motor stop	Maintain torque
AL (red)	1	Over current error	When over current flows at motor RUN element	O	×
	2	Over speed error	When motor speed is over 4,000rpm		
	3	Position tracking error	When the gap between position command value and current position value is over 90˚		
	4	Over load error	When applying load over the rated load for over 1 sec.		
	5	Over heat error	When driver inner temperature is over 80˚C		
	6	Motor connection error	When motor cable connection error occurs at driver		
	7	Encoder connection error	When encoder cable connection error occurs at driver		
	8	Regenerative voltage error	When regenerative voltage is over 78V		
	9	Motor misalignment	When motor is in misalignment		
	10	Command speed error	When command speed is over 3,500rpm		
	11	Input voltage error	When input voltage is out of 24VDC±10%		
	12	In-Position error	When position error (over 1) is kept over 3 sec, after motor stopped.		
	13	Memory error	When memory error is detected as power supplied		
	14	Emergency stop	When emergently stopped with emergency stop command	O	O
	15	Program mode error	When 'END' command is not exist at the last step		
	16	Index mode error	When other commands is used but 'INC', 'ABS' When index command is not completed due to the stop command		
	17	Home search mode error	When failed to find home		

Warning indicator	No. of flashing	Warning type	Descriptions	Motor stop	Maintain torque
PWR (green)	1	+ software limit	When normal direction(CW) software limit is ON	O	O
	2	- software limit	When reverse direction(CCW) software limit is ON		
	3	+ hardware limit	When normal direction(CW) hardware limit is ON		
	4	- hardware limit	When reverse direction(CCW) hardware limit is ON		
	5	Over load warning	When maximum load is kept connected over 10 sec (motor or driver can be overheated)	×	O

※Although the driver normally operates in alarming status, the driver can be damaged. Please operate the driver, avoiding alarming situation.
※Depending on alarm/warning type, indicators flash with interval of 0.4 sec and turn OFF with interval of 0.8 sec.

<E.g. case of alarm 3>

4. Comparison output (Compare1, Compare2)
Outputs trigger pulse on the certain interval that user has set.

Mode	Descriptions
0	Outputs [L] without using comparison output.
1	Outputs [H] when the present absolute position value is same or bigger than the set position value.
2	Outputs [H] when the present absolute position value is same or smaller than the set position value.
3	Outputs trigger pulse on set interval and width.

※Please refer to the user manual to learn how to set.

5. General output (10)

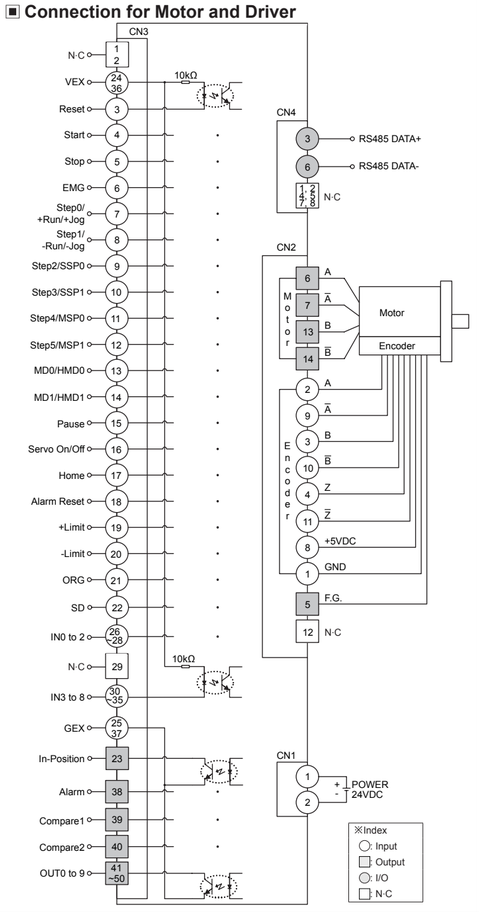
Signal name	Descriptions	Pin No.
OUT0 to 9	General output 0 to 9	41 to 50

6. Example of output circuit connection
-All output circuits are insulated with photocoupler.
-External power input is available from 5VDC to 80VDC with the open collector method. select R_L value that I_C (collector current of secondary LED) of photocoupler to be around 10mA.

※$R_L = \frac{VEX-0.7V}{0.01A}$

※N: Output pin number of CN3

▣ Connection for Motor and Driver



▣ Cautions during Use

1. Follow instructions in 'Cautions during Use'.
   Otherwise, It may cause unexpected accidents.
2. 24VDC power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
3. Re-supply power after min. 1 sec from disconnected power.
4. In case communication is unstable due to the noise generated by supplied power or peripheral device, use ferrite core at communication line.
5. It is recommended to use 485 converter with the separate power.
   (Autonics product, SCM-38I, recommended)
6. The thickness of cable should be same or thicker than the motor cable's when extending the motor cable.
7. Keep the distance between power cable and signal cable more than 10cm.
8. Motor vibration and noise can occur in specific frequency period
   ①Change motor installation method or attach the damper.
   ②Use the unit out of the dedicated frequence range when vibration and noise occurs due to changing motor RUN speed.
9. For using motor, it is recommended to maintenance and inspection regularly.
   ①Unwinding bolts and connection parts for the unit installation and load connection
   ②Strange sound from ball bearing of the unit
   ③Damage and stress of lead cable of the unit
   ④Connection error with motor
   ⑤Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
10. This product does not prepare protection function for a motor.
11. This unit may be used in the following environments.
    ①Indoors (in the environment condition rated in 'Specifications')
    ②Altitude max. 2,000m
    ③Pollution degree 2
    ④Installation category II

▣ Major Products

- Photoelectric Sensors
- Fiber Optic Sensors
- Door Sensors
- Door Side Sensors
- Area Sensors
- Proximity Sensors
- Pressure Sensors
- Rotary Encoders
- Connector/Sockets
- Switching Mode Power Supplies
- Control Switches/Lamps/Buzzers
- I/O Terminal Blocks & Cables
- Stepper Motors/Drivers/Motion Controllers
- Graphic/Logic Panels
- Field Network Devices
- Laser Marking System (Fiber, CO_2, Nd: YAG)
- Laser Welding/Cutting System
- Temperature Controllers
- Temperature/Humidity Transducers
- SSRs/Power Controllers
- Counters
- Timers
- Panel Meters
- Tachometer/Pulse (Rate) Meters
- Display Units
- Sensor Controllers

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