Autonics

Controller Integrated
2-Phase Closed-Loop Stepper Motor Driver
[DC type, Frame size 20/28/35/42/56/60, RS485 Comm.]

AiC-D Series

INSTRUCTION MANUAL

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 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 personal injury, economic loss or fire.
2. **Do not use the unit in the place where flammable/explosive/corrosive gas, high humidity, direct sunlight, radiant heat, vibration, impact or salinity may be present.**
Failure to follow this instruction may result in explosion or fire.
3. **Do not connect, repair or inspect the unit while connected to a power source.**
Failure to follow this instruction may result in fire or electric shock.
4. **Install the unit after considering counter plan against power failure.**
Failure to follow this instruction may result in personal injury, economic loss or fire.
5. **Check 'Connections' before wiring.**
Failure to follow this instruction may result in fire.
6. **Do not disassemble or modify the unit.**
Failure to follow this instruction may result in fire or electric shock.
7. **Install the driver in the housing or ground it.**
Failure to follow this instruction may result in personal injury, fire or electric shock.
8. **Do not touch the unit during or after operation for a while.**
Failure to follow this instruction may result in burn or electric shock due to high temperature of the surface.
9. **Emergency stop directly when error occurs.**
Failure to follow this instruction may result in personal injury or fire.

⚠ Caution

1. **When connecting the power input, use AWG 18(0.75mm²) cable or over.**
2. **Brake is non-polar. When conneting the brake, use AWG 24(0.2mm²) cabel or over.**
Failure to follow this instruction may result in fire or malfunction due to contact failure.
3. **To use the motor safely, do not apply external force to the motor.**
4. **It is recommended to use STOPPER for the vertical load.**
5. **Install overcurrent prevention device (e.g. the current breaker, etc) to connect the driver with power.**
Failure to follow this instruction may result in fire.
6. **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 driver movement.
7. **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.
8. **Use the unit within the rated specifications.**
Failure to follow this instruction may result in fire or product damage.
9. **Use a dry cloth to clean the unit and do not use water or organic solvent.**
Failure to follow this instruction may result in fire or electric shock.
10. **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 or degradation by heat.
11. **Keep the product away from metal chip, dust and wire residue which flow into the unit.**
Failure to follow this instruction may result in fire or product damage.
12. **Use the designated motor only.**
Failure to follow this instruction may result in fire or product damage.

▣ Product Components

Before use the product, check all components are contained.
The components are contained each one.
• Motor driver   • Instruction manual
• Power connector   • I/O connector

▣ Dimensions

(Unit: mm)
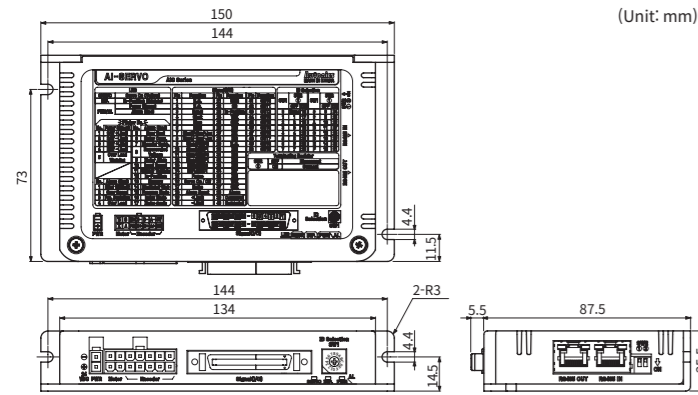
▣ Manual

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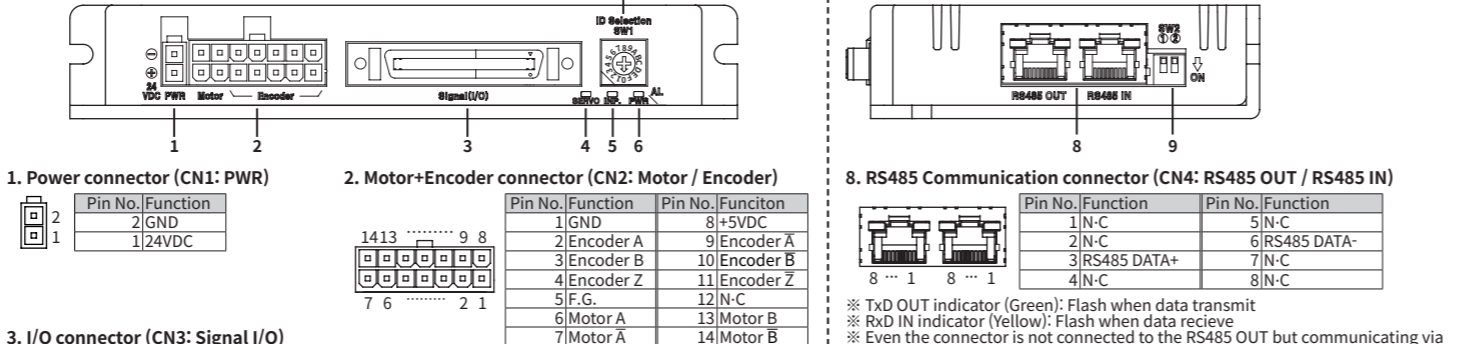Visit our website (www.autonics.com) to download manuals.

※**The above specifications, dimensions, etc. 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, website).**

▣ Specifications

Model[1]	AiC-D-20MA / AiC-D-20LA	AiC-D-28SB / AiC-D-28MB / AiC-D-28LB	AiC-D-35SB / AiC-D-35MB / AiC-D-35LB	AiC-D-42SA(-B) / AiC-D-42MA(-B) / AiC-D-42LA(-B)	AiC-D-56SA(-B) / AiC-D-56MA(-B) / AiC-D-56LA(-B)	AiC-D-60SA(-B) / AiC-D-60MA(-B) / AiC-D-60LA(-B)
Power supply	24VDC==					
Allowable voltage range	90 to 110% of the rated voltage					
Power Consumption	STOP[3]: Max. 10W			Max. 10W	Max. 12W	Max. 15W
	Max. during operation[3]: Max. 60W			Max. 60W	Max. 120W	Max. 240W
Max. RUN current[4]	0.6A/Phase		1.0A/Phase	1.2A/Phase	1.7A/Phase	3.5A/Phase
STOP current[5]	20 to 100% of max. RUN current (factory default: 50%)					
Rotation speed	0 to 3000rpm					
Resolution[5]	500 (factory default), 1000, 1600, 2000, 3600, 4000, 5000, 6400, 7200, 10000PPR	500 (factory default), 1000, 1600, 2000, 3600, 5000, 6400, 7200, 10000, 16000PPR		500 (factory default), 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000PPR		
Applied motor[1]	Ai-M-20MA / Ai-M-20LA	Ai-M-28SB / Ai-M-28MB / Ai-M-28LB	Ai-M-35SB / Ai-M-35MB / Ai-M-35LB	Ai-M-42SA(-B) / Ai-M-42MA(-B) / Ai-M-42LA(-B)	Ai-M-56SA(-B) / Ai-M-56MA(-B) / Ai-M-56LA(-B)	Ai-M-60SA(-B) / Ai-M-60MA(-B) / Ai-M-60LA(-B)
Speed filter[5]	0 (disable), 2, 4, 6, 8, 10, 20, 40, 60 (factory default), 80, 100, 120, 140, 160, 180, 200ms					
Positioning Gain[5]	(P Gain, I Gain)=(1, 1), (2, 1), (3, 1), (4, 1), (5, 1), (1, 2), (2, 2), (3, 2), (4, 2), (5, 2), (1, 3), (2, 3), (3, 3), (4, 3), (5, 3), user setting					
Positioning range	-2,147,483,648 to +2,147,483,647					
In-Position	Fast Response: 0 to 7, Accurate Response: 0 to 7					
Motor rotation direction[5]	CW, CCW					
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					
I/O voltage level	[H]: 5-30VDC==, [L]: 0-2VDC==					
I/O	Input[6]: Exclusive input: 20, general input: 9					
	Output: • Standard type - exclusive output: 4, general output: 10 • Built-in brake type - exclusive output: 6, general output: 9					
External power supply	VEX(recommended: 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					
RS485 comm.	Comm. speed[5]: 9600, 19200, 38400, 57600, 115200(factory default) bps					
Multiaxial control	31-axis					
ID setting switch	16-bit rotary switch (0 to F), 1-bit DIP switch (ON/OFF)					
Alarm output	Overcurrent, overspeed, position tracking, overload, overheat, 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, overload, position override					
Insulation resistance	Over 100MΩ (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°C, storage: -10 to 60°C					
	Ambient humi.: 35 to 85%RH, storage: 10 to 90%RH					
Protection structure	IP20(IEC standard)					
Sold separately	• Power cable: CJ-PW-□[7] • Communication cable: SCM-WF48, SCM-US48I, SCM-38I • I/O cable: CO50-MP□-R[8](standard: AiC TAG) • Motor+encoder cable - normal: C1D14M-□ / moving: C1DF14M-□[9]					
Approval	C€					
Weight[10]	Approx 460g (approx 300g)					

※1: The model name indicates driver type. (none: standard type, B: built-in brake type) E.g.) AiC-D-42LA-B: built-in brake type stepping motor driver.
※2: Based on the ambient temperature 25°C, ambient humidity 55%RH, and STOP current 50%.
※3: 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.
※4: Run current varies depending on the input RUN frequency and max. RUN current at the moment varies also.
※5: Settable with the edicated program (atMotion).
※6: Break ON/OFF function can be changed in general input IN8 in built-in brake type.
※7: □ of model name indicates cabel length (010, 020). E.g.)CJ-PW-010: 1m power cable.
※8: □ of model name indicates cable length (050, 070, 100, 150, 200). E.g.)CO50-MP070-R: 7m I/O cable.
※9: □ of model name indicates cable length (1, 2, 3, 5, 7, 10, 15, 20). E.g.)C1DF14M-10: 10m moving type motor+encoder cable.
※10: The weight includes packaging. The weight in parenthesis is for unit only.
※Environment resistance is rated at no freezing or condensation.

▣ Unit Descriptions

1. Power connector (CN1: PWR)

Pin No.	Function
2	GND
1	24VDC

2. Motor+Encoder connector (CN2: Motor / Encoder)

Pin No.	Function	Pin No.	Function
1	GND	8	+5VDC
2	Encoder Ā	9	Encoder A
3	Encoder B̄	10	Encoder B
4	Encoder Z̄	11	Encoder Z
5	F.G.	12	N-C
6	Motor A	13	Motor B
7	Motor Ā	14	Motor B̄

3. I/O connector (CN3: Signal I/O)

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

※1: Corresponding pins are N.C in standard type.
※2: It corresponds to OUT9 (general output) in standard type.
※3: Brake ON/OFF function can be changed in built-in brake type.
※The Connector table is base on built-in brake type.

4. Servo On/Off indicator (Servo, Orange)
: Turns ON when Servo is operating, turns OFF when Servo is not operating

5. In-Position indicator (INP., Yellow)
: Turns ON when motor is placed at command position after positioning input

6. Power/Alarm indicator (PWR/AL, Green/Red)
Green - Turns ON when the unit operates normally after supplying power
Flashes when limit signal is input or overload stauts is maintained
Red - When alarm occurs, it flashes in various ways depending on the situation. Refer to '▣ Alarm/Warning'.

7. Communication ID setting rotary switch (ID Selection SW1)

Setting	ID	Setting	ID
		SW2 OFF	SW2 ON		SW2 OFF	SW2 ON
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

※Set Node ID of the driver.
※Depending on the Communication ID setting/Terminating resistance setting DIP switch (SW2), it is able to connect max. 31-axis.

8. RS485 Communication connector (CN4: RS485 OUT / RS485 IN)

Pin No.	Function	Pin No.	Function
8	N-C	5	N-C
7	N-C	6	RS485 DATA-
2	RS485 DATA+	7	N-C
4	N-C	8	N-C

※ TxD OUT indicator (Green): Flash when data transmit
※ RxD IN indicator (Yellow): Flash when data recieve
※The connector is not connected to the RS485 OUT but communicating via RS485 IN, RxD IN / TxD OUT operates the same.

9. Communication ID setting/Terminating resistance setting DIP switch (SW2)

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

※Set Node ID of the driver.
※Set to use terminating resistance.

[Connector specifications]

Type			Specifications			
			Connector	Connector terminal	Housing	Manufacture
CN1	Driver		3930-1020 (5569-02A2)	—		Molex
	Power		CHD1140-02	CTD1140		HANLIM
CN2	Driver		35318-1420	—		Molex
	Motor+ Encoder	Frame size 20, 28, 35mm	5557-14R	—	5556T2 5556T	Molex
		Frame size 42, 56, 60mm				
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-D Series.
You can equivalent or substitute connectors.

▣ Configuration Diagram

AiC-D Series
(Controller Integrated Motor driver)

PLC
PC & atMotion
USB / RS232C / Wi-Fi
SCM Series communication covnerter
RS485
Settings of start, stop, rotation direction, etc.
I/O cable — External I/O
Motor+Encoder cable
Rated current
Power cable — Power

Ai-M Series (Motor)

▣ Alarm/Warning

○ Alarm
-This function stops motor to protect driver, depending on the error status such as overcurrent or overspeed.
-In case of normal status, output turns ON, and in case of alarming status, output turns OFF.
-When supplying alarm reset, driver returns to the normal status.

| Alarm indicator	No. of flashing	Alarm type	Descriptions	Motor status	Torque status	Brake Status
AL (red)	1	Overcurrent error	When overcurrent flows at motor RUN element	Stop	Release	Lock
	2	Overspeed 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	Overload error	When applying load over the rated load for over 1 sec.			
	5	Overheat error	When driver inner temperature is over 80°C			
	6	Motor connection error	When motor 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			
	15	Program mode error	When 'END' command is not exist at the last step	Stop	Remain	Release
	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			

※When 14 to 17 alarm occurs, the motor stops, but the current flowing into the motor is not blocked.

○ Warning
-This function notices dangers with the alarm indicator prior to motor stop with limit signal or overload alarm.
-When turning out from the alarming condition, driver returns to the normal status automatically.

Warning indicator	No. of flashing	Warning type	Descriptions	Motor status	Torque status	Brake stauts
PWR (green)	1	+ software limit	When normal direction(CW) software limit is ON	Stop	Remain	Release
	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	Overload warning	When maximum load is kept connected over 10 sec (motor or driver can be overheated)	Remain	Remain	Release
	6	Position override	When position override failed to operate	Stop	Remain	Release

※It is possible to operate even if the warning occurs and the motor current is not blocked.
※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>

▣ Connection for Motor and Driver
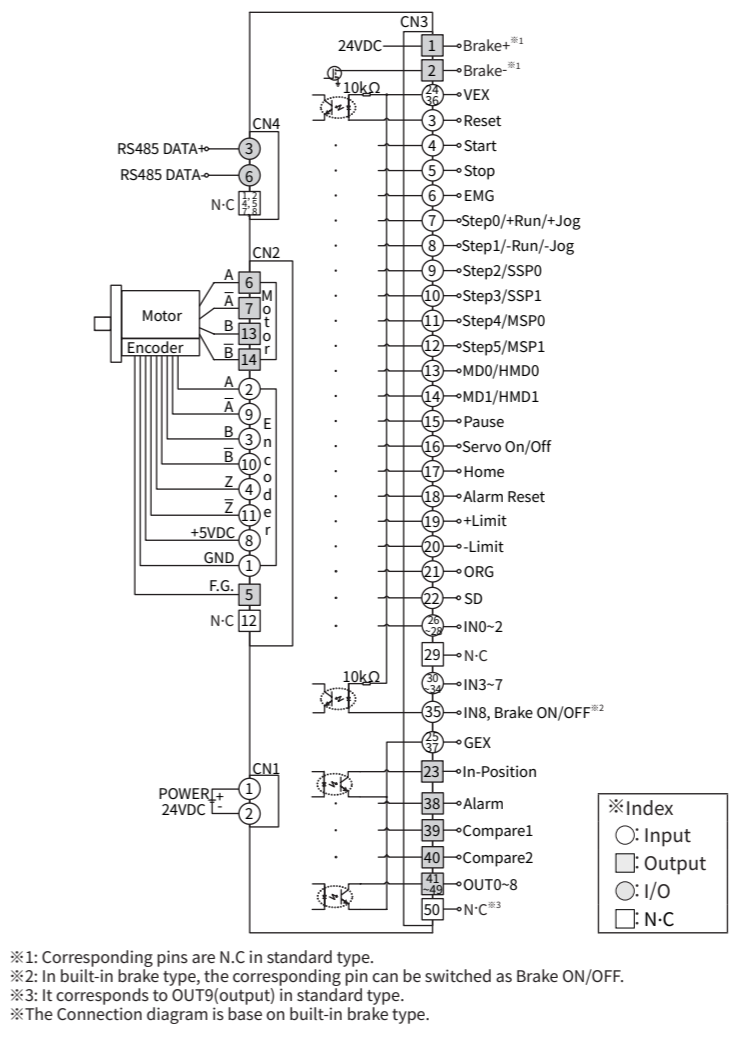
※1: Corresponding pins are N.C in standard type.
※2: In built-in brake type, the corresponding pin can be switched as Brake ON/OFF.
※3: It corresponds to OUT9(output) in standard type.
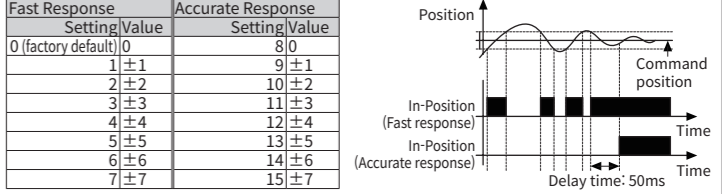※The Connection diagram is base on built-in brake type.

▣ Comparison Output (Compare1, Compare2)

Outputs trigger pulse on the certain interval that user has set.

Mode	Descriptions
0	Not use comparison output.
1	Comparison output turns ON when the present absolute position value is same or bigger than the set position value.
2	Comparison output turns ON when the present absolute position value is same or smaller than the set position value.
3	Trigger pulses output with the set interval and width.

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

▣ 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 ON and In-Position indicator turns ON.
• In reverse, when the gap is over In-Position setting value, In-Position output turns OFF and In-Position indicator turns OFF.
※For accurate check, check the In-Position output again and execute the next drive.

Fast Response		Accurate Response	
Setting Value		Setting Value	
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

Delay time: 50ms

▣ Motion Device Management Program [atMotion]

atMotion provides GUI control for easy and convenient parameter setting and monitoring data management of multiple devices.
Visit our website (www.autonics.com) to download the user manual and software.

Item	Minimum requirements
System	IBM PC compatible computer with Intel Pentium III or above
Operations	Microsoft Windows 98/NT/XP/Vista/7/8/10
Memory	256MB+
Hard disk	1GB+ of available hard disk space
VGA	Resolution: 1024x768 or higher
Others	RS232C serial port(9-pin), USB port

▣ Troubleshooting

Malfunction	Causes	Troubleshooting
When communication is not connected	The communication cable is not connected.	Check communication cable wiring. Check communication cable connection correctly.
	The communication port or speed settings are not correct.	Check communication port and speed settings are correct.
When motor does not excite	Servo is not On.	Check that servo On/Off input signal is Off. In case of On, servo is Off and excitation of motor is released.
	Alarm occurs.	Check the alarm type and remove the cause of alarm.
When motor rotates to the opposite direction of the designated direction	MotorDir parameter setting is not correct.	Check the MotorDir parameter settings.
When motor drive is unstable	Connection between motor and encoder is unstable.	Check the Motor+Encoder connection cable.
	Motor gain value is not correct.	Change the Motor Gain parameter as the certain value.

▣ 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 below specifications when connecting the cable for the connector.
① CN1 (power connector): AWG18
② CN2 (motor+encoder connector): AWG22, AWG24
③ CN3 (I/O connector): AWG28
7. Keep the distance between power cable and signal cable more than 10cm.
8. Motor vibration and noise can occur in specific frequency period
① Change motor installation method or attach the damper.
② Use the unit out of the dedicated frequency range when vibration and noise occurs due to changing motor RUN speed.
9. For using motor, it is recommended to maintenance and inspection regularly.
① Unwinding bolts and connection parts for the unit installation and load connection
② Strange sound from ball bearing of the unit
③ Damage and stress of lead cable of the unit
④ Connection error with motor
⑤ Inconsistency 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.
① Indoors (in the environment condition rated in 'Specifications')
② Altitude max. 2,000m
③ Pollution degree 2
④ Installation category II

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