

Autonics

2-Phase Closed-Loop Stepper Motor Driver AIS-D SERIES

INSTRUCTION MANUAL



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

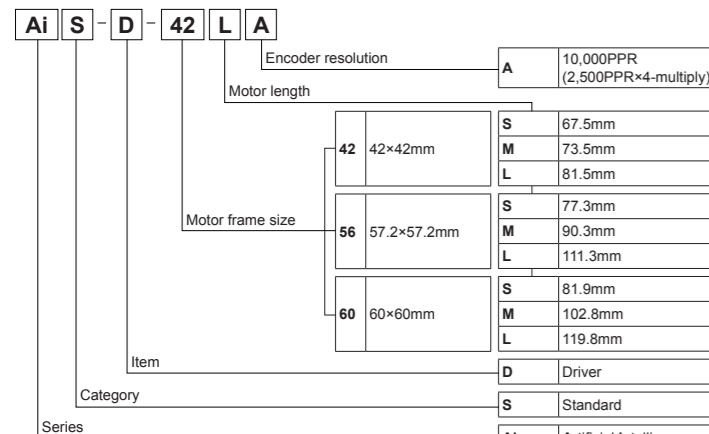
Safety Considerations

- Please observe all safety considerations for safe and proper 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.

- 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.
- Do not connect, repair, or inspect the unit while connected to a power source.** Failure to follow this instruction may result in fire.
- Install the unit after considering counter plan against power failure.** Failure to follow this instruction may result in personal injury, or economic loss.
- Check 'Connections' before wiring.** Failure to follow this instruction may result in fire.
- Do not disassemble or modify the unit.** Failure to follow this instruction may result in fire.
- Install the driver in the grounded housing or ground it directly.** Failure to follow this instruction may result in electronic shock, personal injury.
- 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.
- Emergency stop directly when error occurs.** Failure to follow this instruction may result in fire, or personal injury.

- Caution**
- When connecting the power input, use AWG 18(0.75mm²) cable or over.**
- 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.
- 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.
- 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.
- Use the unit within the rated specifications.** Failure to follow this instruction may result in fire or product damage.
- Use dry cloth to clean the unit, and do not use water or organic solvent.** Failure to follow this instruction may result in fire.
- 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.
- 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.
- Keep metal chip, dust, and wire residue from flowing into the unit.** Failure to follow this instruction may result in fire or product damage.
- Use the designated motor only.** Failure to follow this instruction may result in fire or product damage.

Ordering Information



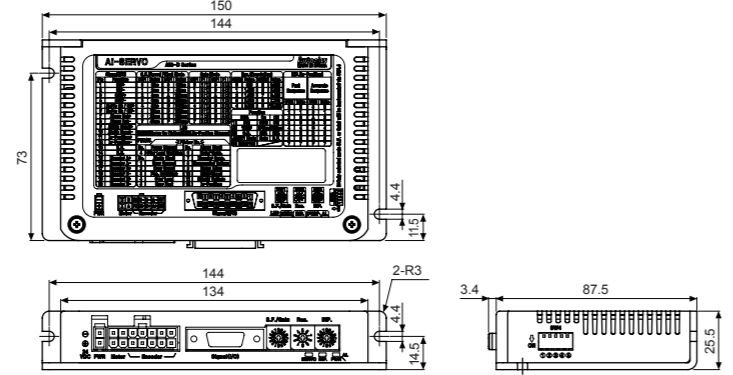
Set	Driver	Motor
AIS-42SA	AIS-D-42SA	AI-M-42SA
AIS-42MA	AIS-D-42MA	AI-M-42MA
AIS-42LA	AIS-D-42LA	AI-M-42LA
AIS-56SA	AIS-D-56SA	AI-M-56SA
AIS-56MA	AIS-D-56MA	AI-M-56MA
AIS-56LA	AIS-D-56LA	AI-M-56LA
AIS-60SA	AIS-D-60SA	AI-M-60SA
AIS-60MA	AIS-D-60MA	AI-M-60MA
AIS-60LA	AIS-D-60LA	AI-M-60LA

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 and the technical descriptions (catalog, homepage).

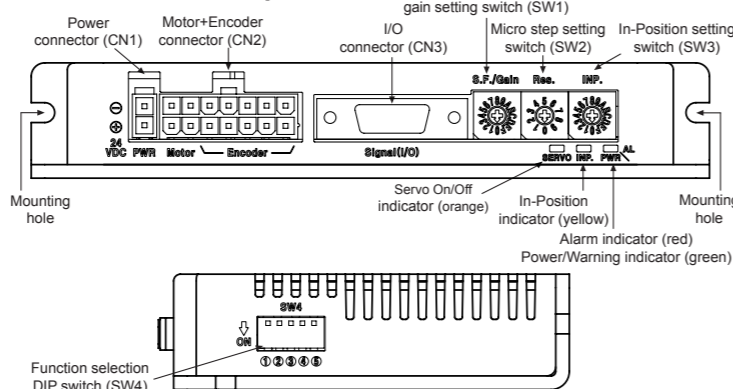
Specifications

Model	AIS-D-42SA	AIS-D-42MA	AIS-D-42LA	AIS-D-56SA	AIS-D-56MA	AIS-D-56LA	AIS-D-60SA	AIS-D-60MA	AIS-D-60LA	
Power supply	24VDC±									
Allowable voltage range	90 to 110% of the rated voltage									
Power consumption	STOP ¹⁾ Max. 7W	Max. 7.5W	Max. 8W	Max. 9.5W	Max. 10W	Max. 11W	Max. 12W	Max. 13W	Max. 14W	
Max. RUN current ²⁾	1.7A/Phase			3.5A/Phase						
STOP current	25% or 50% of max. RUN current (factory default: 50%)									
Rotation speed	0 to 3000rpm									
Resolution	500 (factory default), 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000PPR									
Speed filter	0 (disable), 2, 4, 6, 8, 10, 20, 40, 60 (factory default), 80, 100, 120, 140, 160, 180, 200ms									
Position control gain	(P Gain, I Gain)=(1, 1), (2, 1), (3, 1), (4, 1), (5, 1), (6, 1), (1, 2), (2, 2), (3, 2), (4, 2), (5, 2), (1, 3), (2, 3), (3, 3), (4, 3), (5, 3)									
In-Position	Within the range of Fast response: 0 to 7 or Accurate response: 0 to 7									
Pulse input method	1-pulse or 2-pulse input (factory default) method									
Motor rotation direction	CW (factory default), CCW									
Status indicator	Power/Warning indicator: green LED In-Position indicator: yellow LED Alarm indicator: red LED Servo On/Off indicator: orange LED									
Input signal	RUN pulse, Servo On/Off, alarm reset (photocoupler input)									
Output signal	Encoder signal (A, A ⁻ , B, B ⁻ , Z, Z phase, corresponding to 26C31) (line driver output)									
Pulse width	CW, CCW: Input pulse frequency duty 50%, Servo On/Off: min. 1ms, alarm reset: min. 20ms									
Rising/Falling time	CW, CCW: max. 0.5μs									
Pulse input voltage	CW, CCW - [H]: 4-8VDC, [L]: 0-0.5VDC Servo On/Off, alarm reset - [H]: 24VDC, [L]: 0-0.5VDC									
Max. input pulse freq.	CW, CCW: 500kHz									
Input resistance	220Ω (CW, CCW), 10kΩ (Servo On/Off, alarm reset)									
Insulation voltage	Over 100V (at 50VDC 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/s ² (approx. 30G) in each X, Y, Z direction for 3 times									
Environ-ment	0 to 50°C, storage: -10 to 60°C									
Ambient temp.	35 to 85%RH, storage: 10 to 90%RH									
Approval	CE									
Protection structure	IP20 (IEC standard)									
Weight ³⁾	Approx. 400g (approx. 290g)									

Dimensions



Driver Unit Descriptions



Driver Status Indicators

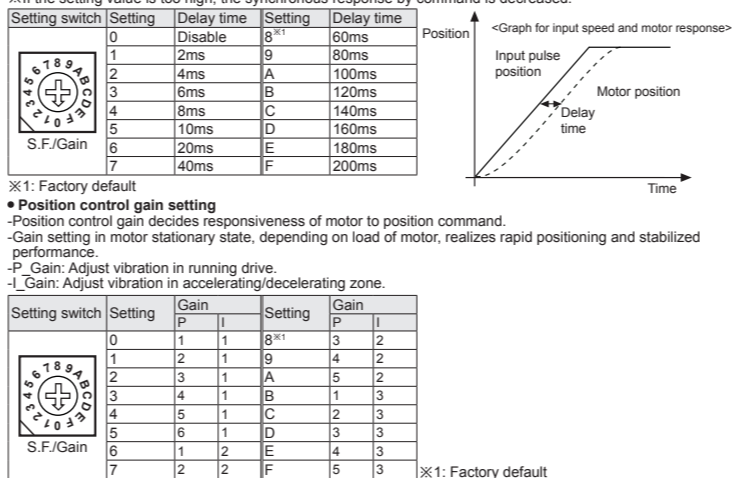
Status indicator	LED color	Function	Descriptions
PWR	Green	Power indicator	Turns ON when the unit operates normally after supplying power
PWR	Green	Warning indicator	Flashes when over load status is maintained
AL	Red	Alarm indicator	When alarm occurs, it flashes in various ways depending on the situation. Refer to 'Control Input/Output > 2. 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.

Connection Connectors of Driver

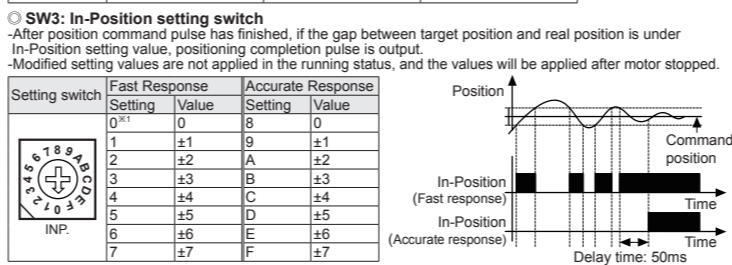
CN1: Power connector				CN2: Motor+Encoder connector			
Pin No.	Function	Pin No.	Function	Pin No.	Function	Pin No.	Function
2	GND	14	GND	8	+5VDC	10	Encoder B
1	24VDC	9	8	9	Encoder A	11	Encoder B
		10	7	10	Encoder Z	12	Encoder Z
		11	6	11	N-C	13	N-C
		12	5	12	F.G.	14	N-C
		13	4	13	Motor A	15	Encoder A
		14	3	14	Motor B	16	Encoder A
		15	2	15	Motor A	17	Encoder B
		16	1	16	Motor B	18	Encoder B
		17		17		19	Encoder Z
		18		18		20	Encoder Z
		19		19			
		20		20			

Driver Setting

- SW1: Speed filter setting switch or position control gain setting switch** - SW1 shifts its mode between the speed filter setting or position control gain setting, depending on 4th pin in SW4 as follows.
- Modified setting values are not applied in the running status, and the values will be applied after motor stopped.



- SW2: Resolution setting switch** - Set the resolution of driver. The number of pulses per 1 rotation by resolution is each 500, 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000. Modified setting values are not applied in the running status, and the values will be applied after motor stopped.
- SW3: In-Position setting switch** - After position command pulse has finished, if the gap between target position and real position is under In-Position setting value, positioning completion pulse is output. Modified setting values are not applied in the running status, and the values will be applied after motor stopped.



- SW4: Function selection DIP switch** - Set rotation direction, pulse input method, STOP current, SW1 setting, and test mode.
- 1-pulse input method** - When motor runs or stops, modified setting values will be applied immediately.
- 2-pulse input method** - When position error is over 25% of max. RUN current, the driver returns to the normal status.
- Alarm/Warning** - This function notices dangers with the alarm indicator prior to over load alarm. When turning out from the alarming condition, driver returns to the normal status automatically.

Type	Model	Specifications
Driver	CJ-IPW-	0039301020
Power	CHD1140-02	CTD1140
Driver	35318-1420	
Motor+Encoder	5557-14R	5556T
Driver	10220-52A2 PL	
I/O connector	CJ-MP20-HP	10120-3000PE

Type	Model	Specifications
Power cable	CJ-IPW-	0039301020
I/O cable	CJ-MP20-HP	10120-3000PE
Motor+Encoder cable	CJ-MP20-HP	10120-3000PE

Control Input/Output

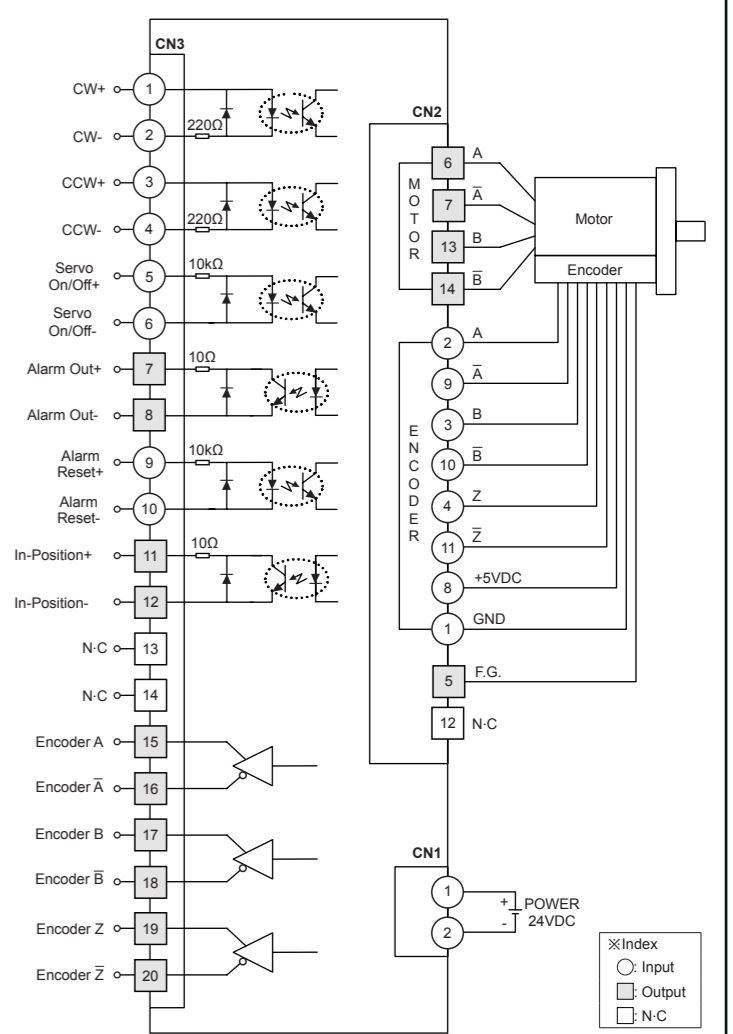
- Inner signal of all input/output consists of photocoupler.
- ON [H]: photocoupler power ON
- OFF [L]: photocoupler power OFF
- Input**
- 1. Position command pulse** - Pulse input is selectable from 1-pulse input method and 2-pulse input method. (Refer to 'SW4: Function selection DIP switch')
- 2. Servo On/Off** - This signal is for rotating axis of motor using external force or used for manual positioning. Servo On/Off signal maintains over 1ms as [H]. Regarded as Servo Off signal and phase current is cut to release torque. The Servo On indicator, the In-Position output and indicator turns OFF. Servo On/Off signal maintains over 1ms as [L]. Regarded as Servo On signal and phase current is supplied to gain torque. The Servo On indicator, the In-Position output and indicator turns ON. Use this function after stopping the motor. Refer to example of input circuit connection.
- 3. Alarm Reset** - This signal is for clearing the alarm. Alarm reset signal maintains over 20ms as [H]. Alarm is cleared, the alarm indicator and alarm output turns OFF, and the driver returns to normal status. Refer to example of input circuit connection.
- 4. Example of input circuit connection** - Input pulse (CW, CCW) - It is recommended to use 5VDC at V_{cc} and short the R_i. In case V_{cc} is over 5VDC, calculate R_i value using following formula and use V_{cc} below 30VDC. $R_i = \frac{V_{cc} - 2.1V}{0.011A}$
- External input (Servo On/Off, Alarm Reset)** - Pull-Up (+24VDC), Pull-Down (+24VDC), Circuit with NPN (not-reversed), Circuit with PNP (reversed).

- Output**
- 1. In-Position** - In-Position output is 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.
- 2. Alarm/Warning** - This function notices dangers with the alarm indicator prior to 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
	1	Over current error	When over current flows at motor RUN element		
	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		
AL (red)	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 pulse error	When input pulse 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.		
Warning indicator (green)	4	Over load warning	When maximum load is kept connected over 10 sec. (motor or driver can be overheated)	×	○

- Although the driver normally operates in alarming status, the driver can be damaged. Please operate the driver, avoiding alarming situation. Depending on the alarm/warning type, it flashes for 0.4 sec interval and it turns OFF for 0.8 sec repeatedly.
- 3. Example of output circuit connection** - It is recommended to use below 50VDC at V_{cc}. Use the R_i for I_c (collector current of secondary detector) of photocoupler inside the driver to be within 25mA following the below formula. $R_i = \frac{V_{cc} - 0.3V}{0.025A} - 10\Omega$
- 4. Encoder output waveforms** - Clockwise (CW), Counter-clockwise (CCW), In-Position (INP).

Connection for Motor and Driver



Troubleshooting

- When motor does not rotate**
 - Check the connection status between controller and driver, and pulse input specifications (voltage, width).
 - Check the pulse and direction signal are connected correctly.
- When motor rotates to the opposite direction of the designated direction**
 - When RUN mode is 1-pulse input method, CCW input [H] is for forward, [L] is for backward.
 - When RUN mode is 2-pulse input method, check CW and CCW pulse input are changed or not.
- When motor drive is unstable**
 - Check that driver and motor are connected correctly.
 - Check the driver pulse input specifications (voltage, width).

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- 24VDC power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Re-supply power after min. 1 sec from disconnected power.
- Do not input CW, CCW signal at the same time in 2-pulse input method.
- When the signal input voltage is exceeded the rated voltage, connect additional resistance at the outside.
- The thickness of cable should be same or thicker than the motor cable's when extending the motor cable.
- Keep the distance between power cable and signal cable more than 10cm.
- Motor vibration and noise can occur in specific frequency period
 - Change motor installation method or attach the damper.
 - Use the unit out of the dedicated frequency range when vibration and noise occurs due to changing motor RUN speed.
- For using motor, it is recommended to maintenance and inspection regularly.
 - Unwinding bolts and connection parts for the unit installation and load connection
 - Strange sound from ball bearing of the unit
 - Damage and stress of lead cable of the unit
 - Connection error with motor
 - Inconsistency between the axis of motor output and the center, concentric (eccentric, declination) of the load, etc.
- This unit may be used in the following environments.
 - Indoors (in the environment condition rated in 'Specifications')
 - Altitude max. 2,000m
 - Pollution degree 2
 - Installation category II

Major Products

- Photoelectric Sensors
- Fiber Optic Sensors
- Door Sensors
- Door Side Sensors
- Area Sensors
- Proximity Sensors
- Pressure Sensors
- Stepper Motors/Drivers/Motion Controllers
- IO Terminal Blocks & Cables
- Field Network Devices
- Laser Marking System (Fiber, CO, 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
- Switching Mode Power Supplies
- Control Switches/Lamps/Buzzers
- Graphic/Logic Panels
- Field Network Devices
- Laser Marking System (Fiber, CO, Nd: YAG)
- Laser Welding/Cutting System