

EtherCAT Comm. Type 2-Phase Closed-loop Stepper Motor Driver

AiC-D-EC Series

INSTRUCTION MANUAL

TCD210169AD

Autonics

Thank you for choosing our Autonics product.

Read and understand the instruction manual and manual thoroughly before using the product.

For your safety, read and follow the below safety considerations before using.

For your safety, read and follow the considerations written in the instruction manual, other manuals and Autonics website.

Keep this instruction manual in a place where you can find easily.

The specifications, dimensions, etc. are subject to change without notice for product improvement. Some models may be discontinued without notice.

Follow Autonics website for the latest information.

Safety Considerations

- Observe all 'Safety Considerations' for safe and proper operation to avoid hazards.
- ⚠ symbol indicates caution due to special circumstances in which hazards may occur.

⚠ Warning Failure to follow instructions may result in serious injury or death.

- 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.
- 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.
- 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.
- Install the unit after considering counter plan against power failure.**
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 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 or electric shock.
- Install the driver in the housing or ground it.**
Failure to follow this instruction may result in personal injury, fire or electronic shock.
- 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.
- Emergency stop directly when error occurs.**
Failure to follow this instruction may result in personal injury or fire.

⚠ Caution Failure to follow instructions may result in injury or product damage.

- When connecting the power input, use AWG18 (0.75 mm²) cable or over.**
- Brake is non-polar. When connecting the brake, use AWG24 (0.2 mm²) cable or over.**
Failure to follow this instruction may result in fire or malfunction due to contact failure.
- To use the motor safely, do not apply external force to the motor.**
- It is recommended to use STOPPER for the vertical load.**
- 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 driver movement.
- Install a safety device to maintain the vertical position after turn off the power of the 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 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.
- The driver may overheat depending on the environment. Install the unit at the well-ventilated environment and forced cooling with a cooling fan.**
Failure to follow this instruction may result in product damage or degradation by heat.
- 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.
- Use the designated motor only.**
Failure to follow this instruction may result in fire or product damage.

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Re-supply power after 1 sec from disconnected power.
- In case of unwanted noise generating from peripherals and power, use ferrite core in the wiring.
- Keep the distance between power cable and signal cable over 10 cm.
- The thickness of cable should be same or thicker than the below specifications when connecting the cable for connector.
 - Power connector (PWR): AWG18
 - Motor + Encoder connector (MOTOR): AWG22, AWG24
 - I/O connector (SIGNAL I/O): AWG28
 - Brake connector (BRAKE): AWG22
- Motor vibration and noise may occur in a specific frequency range.
 - Change the motor installation method or attach the damper.
 - Use the unit out of the corresponding frequency range due to changing motor RUN speed.
- Maintain and inspect regularly the following lists.
 - Unwinding bolts and connection parts for the unit installation and load connection
 - Abnormal 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 product does not contain a protection function for a motor unit.
- This unit may be used in the following environments.
 - Indoors (in the environment condition rated in 'Specifications')
 - Altitude max. 2,000 m
 - Pollution degree 2
 - Installation category II

Noise Measure

- If there is noise interference caused by motor drive, attach a ferrite core to the cable.
- In particular, USB communication is susceptible to external noise, so attach a ferrite core or separate the ground.

Ordering Information

This is only for reference, the actual product does not support all combinations.

For selecting the specified model, follow the Autonics website.

Select a model that matches the ordering information of the motor and the driver.

AiC - D - ① ② ③ - ④ - EC

① Frame size

Number: Frame size (mm)

③ Encoder resolution

| | □ 20 / 28 / 35 mm | □ 42 / 56 / 60 mm |
|----------|-------------------------------|-------------------------------|
| A | 4,000 PPR (1,000 PPR × 4) | 10,000 PPR (2,500 PPR × 4) |
| B | 16,000 PPR (4,000 PPR × 4) | - |

② Axial length

S: Short
M: Medium
L: Long

④ Motor type

No mark: Standard type
B: Built-in brake type

Product Components

- Product
- Instruction manual
- Power connector × 1
- I/O connector × 1
- Brake connector (AiC-D-B-EC Series) × 1

Manual

For proper use of the product, refer to the manuals and be sure to follow the safety considerations in the manuals.

Download the manuals from the Autonics website.

Software

Download the installation file and the manuals from the Autonics website.

■ atMotion

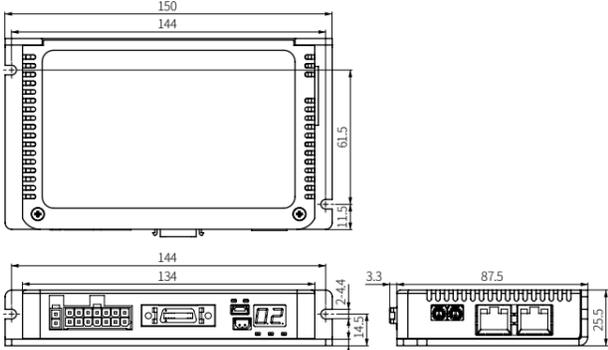
The program allows to manage the motor driver's parameter setting and monitoring data.

Sold Separately

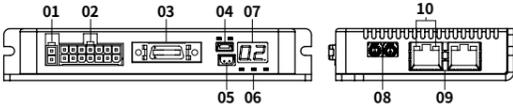
- Power cable: CO-PW-□
- I/O cable: CO20-MP□-R (specifications: AiC-EC TAG)
- Motor + Encoder cable: C1D14M(B)-□ (fixed type), C1DF14M(B)-□ (flexible type)

Dimensions

- Unit: mm, For the detailed drawings, follow the Autonics website.



Unit Descriptions



- 01. Power connector**
- 02. Motor + Encoder connector**
- 03. I/O connector**
- 04. USB connector**
- 05. Brake connector (AiC-D-B-EC Series)**
- 06. Status indicators**
- 07. Status display part**

- 08. Comm. ID setting rotary switch**
- 09. Comm. connector**
- 10. Comm. indicator**

Status Display Part / Indicators

| Display part / Indicator | Color | Descriptions |
|---|--------|---|
| Status display part (7-segment) | Red | Displays EtherCAT ID Displays the corresponding number, operation when alarm / warning occurs |
| Servo ON / OFF indicator (SERVO) | Orange | Turns ON when servo is ON, Turns OFF when servo is OFF |
| In-Position indicator (INP) | Yellow | Turns ON when motor is placed at command position after positioning input |
| Power / Alarm indicator (PWR/AL) | Green | Turns ON when the unit operates in normal after power is applied Flashes depending on the warning type |
| | Red | Flashes depending on the alarm type |
| EtherCAT Comm. status Error indicator (ERR) | Red | Turns ON or flashes depending on communication fail status (ERR) |
| EtherCAT Comm. status RUN indicator (RUN) | Green | Turns ON or flashes depending on communication normal status (RUN) |

Alarm / Warning

The status display part displays segment depending on Alarm / Warning type. Depending on the alarm / warning type, it flashes for 0.4 sec interval and it turns OFF for 0.8 sec repeatedly.

For more information of Alarm / Warning, refer to 'User manual'.

■ Alarm

| Display | Alarm type | Display | Alarm type |
|------------|--------------------------|------------|----------------------------|
| C.5 | EtherCAT comm. error | E.B | Regenerative voltage error |
| E.1 | Overcurrent error | E.9 | Motor alignment error |
| E.2 | Overspeed error | E.R | Input command error |
| E.3 | Position tracking error | E.b | Input voltage error |
| E.4 | Overload error | E.C | In-Position error |
| E.5 | Overheat error | E.d | Memory error |
| E.6 | Motor connection error | E.E | Emergency stop |
| E.7 | Encoder connection error | E.H | Home search error |

■ Warning

| Display | Warning type |
|------------|------------------|
| ⚠.1 | +Software limit |
| ⚠.2 | -Software limit |
| ⚠.3 | +Hardware limit |
| ⚠.4 | -Hardware limit |
| ⚠.5 | Overload warning |

Specifications

| Model | AiC-D-20□A-EC | AiC-D-28□B-EC | AiC-D-35□B-EC |
|--|--|---|---------------|
| Power supply | 24 VDC≒ | | |
| Permissible voltage range | 90 to 110% of rated voltage | | |
| Max. RUN power⁽⁰¹⁾ | ≤ 60 W | | |
| Stop power⁽⁰²⁾ | ≤ 10 W | | |
| Max. RUN current⁽⁰³⁾ | 0.6 A / Phase | 1.0 A / Phase | 1.2 A / Phase |
| Stop current | 20 to 100% of max. RUN current | | |
| Basic step angle | 1.8° / Phase | | |
| Resolution | 500, 1000, 1600, 2000, 3600, 4000, 5000, 6400, 7200, 10000 (factory default) PPR | 500, 1000, 1600, 2000, 3600, 5000, 6400, 7200, 10000 (factory default), 16000 PPR | |

| Model | AiC-D-42□A-□EC | AiC-D-56□A-□EC | AiC-D-60□A-□EC |
|--|--|----------------|----------------|
| Power supply | 24 VDC≒ | | |
| Permissible voltage range | 90 to 110% of rated voltage | | |
| Max. RUN power⁽⁰¹⁾ | ≤ 60 W | ≤ 120 W | ≤ 240 W |
| Stop power⁽⁰²⁾ | ≤ 10 W | ≤ 12 W | ≤ 15 W |
| Max. RUN current⁽⁰³⁾ | 1.7 A / Phase | 3.5 A / Phase | |
| Stop current | 20 to 100% of max. RUN current | | |
| Basic step angle | 1.8° / Phase | | |
| Resolution | 500, 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000 (factory default) PPR | | |

01) 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. RUN power.

02) Based on ambient temp. 25°C, ambient humi. 55%RH, stop current 50%

03) RUN current varies depending on the input RUN frequency and max. RUN current at the moment varies also.

| | |
|----------------------------|---|
| Run method | 2-phase bipolar closed-loop control method |
| Speed filter | Disable, 2, 4, 6, 8, 10, 20, 40, 60 (factory default), 80, 100, 120, 140, 160, 180, 200 ms |
| Control Gain | 0 (factory default) to 15, (15: Fine Gain) |
| Max. rotation speed | 3,000 rpm |
| In-Position | Fast Response: 0 (factory default) to 7, Accurate Response: 0 to 7 |
| Operation mode | CSP, CSV, PP, PV, HM |
| Home search | Homing on the negative limit switch and index pulse Homing on the positive limit switch and index pulse Homing on the home switch and index pulse (Positive) Homing on the home switch and index pulse (Negative) Homing without an index pulse (negative limit switch) Homing without an index pulse (positive limit switch) Homing without an index pulse (Positive and Home sensor ON) Homing without an index pulse (Negative and Home sensor ON) Homing on the index pulse (Negative) Homing on the index pulse (Positive) Set the Origin with Home offset Torque Homing Search- with Home offset Torque Homing Search+ with Home offset |

| | |
|-------------------------------|--|
| I/O voltage level | [H]: 5 - 30 VDC≒, [L]: 0 - 2 VDC≒ |
| Input | Exclusive input: 7, General input: 5 |
| Output | Exclusive output: 2, General output: 4 |
| External power supply | VEX (Default: 24 VDC≒), GEX (GND) |
| Insulation resistance | ≥ 100 MΩ (500 VDC≒ megger) |
| Dielectric strength | Between the all charging part and the case: 1,000 VAC~ 60 Hz for 1 minute |
| Vibration | 1.5 mm double amplitude at frequency 10 to 55 Hz in each X, Y, Z direction for 2 hours |
| Shock | 300 m/s ² (≈ 30 G) in each X, Y, Z direction for 3 times |
| Ambient temp. | 0 to 50°C, storage: -10 to 60°C (no freezing or condensation) |
| Ambient humi. | 35 to 85%RH, storage: 10 to 90%RH (no freezing or condensation) |
| Protection rating | IP20 (IEC standard) |
| Certification | CE, UL, RoHS |
| Unit weight (packaged) | ≈ 350 g (≈ 500 g) |

Communication Interface

■ EtherCAT

| | |
|--|---|
| Comm. specifications | EtherCAT |
| Association approval⁽⁰¹⁾ | EtherCAT [®] |
| Support protocol | CoE (support CiA402 profile) |
| Physical layer | 100BASE-TX (IEEE802.3) |
| Connection cable | CAT5e class or over (Shield type: SF/FTP, S/FTP, SF/UTP) |
| Max. comm. distance | Within 100 m distance between nodes |
| Baud rate | 10 / 100 Mbps |
| Distributed clock | DC cycle: 250 us, 500 us, 1 ms, 2 ms, 4 ms |
| Node ID setting | ECAT ID switch setting: 1 to 99 Physical address setting at Master: 1 to 65535 |
| Topology | Star, Line, Tree |

01) EtherCAT[®] is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

Troubleshooting

| Malfunction | Causes | Troubleshooting |
|--|--|--|
| When communication is not connected | The communication cable is not connected. | Check communication cable wiring. Check communication cable connected correctly. |
| | The communication port or period settings are not correct. | Check communication port and period settings are correct. |
| | XML file does not match. | Check provided XML file is correct. |
| When motor does not excite | Servo ON is not. | Check the Hold Off input signal. In case of ON, Servo is OFF and excitation of the motor is released. |
| | Alarm occurs. | Check the alarm type and remove the cause. |
| When motor rotates to the opposite direction of the designated direction | Polarity parameter setting is not correct. | Check the Polarity parameter settings. |
| When motor drives unstable | Connection between motor and encoder is unstable. | Check the driver and motor are connected correctly. |
| | Control Gain value is not correct. | Change the Control Gain parameter as the appropriate value. |