

# AC Power Input 2-Phase Closed-loop Stepper Motor Drivers



## AiCA-D Series PRODUCT MANUAL

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

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

### Features

- Closed-loop system with real-time position control
- High speed & high torque drive without missing steps
- Supports 200 - 240 VAC ~ AC power
- Motor driver+Controller integrated type
- Control up to 31 axes with RS-485 communication
- Windows-based software (atMotion) for easy parameter setting and monitoring
- 4 operation mode : Jog mode, Continuous mode, Index mode, Program Mode
- 7 segment display for alarm / status reading
- Supports torque mode
- Supports Auto Current Down mode
- Built-in brake type motors available (AiCA-D-B Series)

### 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.

- 01. 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.
- 02. 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.
- 03. 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.
- 04. Install the unit after considering counter plan against power failure.**  
Failure to follow this instruction may result in personal injury, economic loss or fire.
- 05. Re-supply power after min. 20 sec from disconnected power.**  
It may cause damage or malfunction of the product
- 06. Check 'Connections' before wiring.**  
Failure to follow this instruction may result in fire.
- 07. For installing the unit, ground it exclusively and use over AWG 18 (0.75 mm<sup>2</sup>) ground cable.**  
Failure to follow this instruction may result in electric shock.
- 08. Do not disassemble or modify the unit.**  
Failure to follow this instruction may result in fire or electric shock.
- 09. Insulate the connector not to be exposed.**  
Failure to follow this instruction may result in electric shock.
- 10. Install the driver in the housing or ground it.**  
Failure to follow this instruction may result in personal injury, fire or electronic shock.
- 11. 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.
- 12. Do not remove the connector during or after operation for a while.**  
Failure to follow this instruction may result in electric shock, or product damage.
- 13. 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.

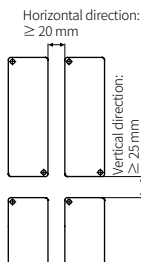
- 01. When connecting the power input, use AWG18 (0.75 mm<sup>2</sup>) cable or over.**
- 02. Brake is non-polar. When connecting the brake, use AWG24 (0.2 mm<sup>2</sup>) cable or over.**  
Failure to follow this instruction may result in fire or malfunction due to contact failure.
- 03. Install over-current prevention device (e.g. the current breaker, etc.) to connect the driver with power.**  
Failure to follow this instruction may result in fire.
- 04. 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.
- 05. 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.
- 06. Use the unit within the rated specifications.**  
Failure to follow this instruction may result in fire or product damage.
- 07. 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.
- 08. 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.
- 09. 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.
- 10. 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.
- Using USB type 485 converter may cause unstable communication. It is recommended to use 485 converter with separated power. (Autonics product SCM-38I is recommended.)
- Install vertically so that the alarm / warning status display part is located on top.
- In case of unwanted noise generating from peripherals and power, use ferrite core in the wiring.
- The thickness of cable should be same or thicker than the below specifications when connecting the cable for connector.
  - Motor + Encoder connector: AWG 22
  - Power connector: AWG 18
  - Communication connector: AWG 28
  - I/O connector: AWG 28
  - Brake connector: AWG 22
- Keep the distance between power cable and signal cable over 10 cm.
- Do not input external signal until the driver is initialized (In-Position LED ON) after power is applied.
- 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

## Cautions during Installation

- Install on the metal plate with high thermal conductivity for heat dissipation of the driver.
- Install in the well-ventilated area and install the cooling fan in the unventilated environment.
- Failure to heat dissipation may result in damage or malfunction due to the stress on the product.  
Check the environment of use within the specifications and install on the well-heat dissipated area
- In case of installing the drivers more than two, keep distance at least 20 mm in horizontal direction and at least 25 mm in vertical direction.



## 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.

## 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.

AiCA	-	D	-	①	②	③	-	④
<b>① Frame size</b> Number: Frame size (Unit: mm)				<b>③ Encoder resolution</b> A: 10,000 PPR (2,500 PPR × 4-multiply)				
<b>② Axial length</b> M: Medium L: Long				<b>④ Motor type</b> No mark: Standard type B: Built-in brake type				

## Product Components

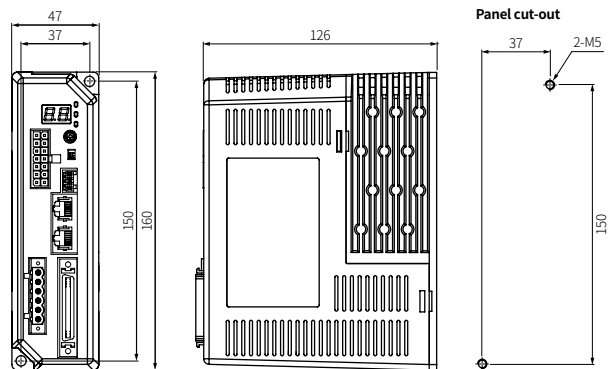
- Product
- Instruction manual
- RS485 comm. protective connector
- Power connector
- I/O connector
- Brake connector (AiCA-D-B Series)

## Sold Separately

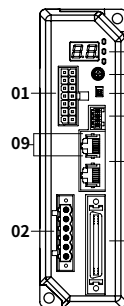
- Motor + Encoder cable: C1D14M-□ (fixed type), C1DF14M-□ (flexible type)
- I/O Cable: CO50-MP□-R (specifications: AiC TAG)

## Dimensions

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



## Unit Descriptions



- 01. Motor + Encoder connector**
- 02. Power connector**
- 03. Communication connector**
- 04. I/O connector**
- 05. Brake connector**
- 06. Comm. ID setting rotary switch**
- 07. Comm. ID setting / Terminating resistance DIP switch**
- 08. Status display part / indicators**
- 09. RS485 comm. indicator**

## Status Display Part / Indicators

Display part / Indicator	Color	Descriptions
Status display part (7 segment)	Red	Displays communication ID when normal status Displays the corresponding number, operation when alarm / warning occurs
Power / Warning 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
In-Position indicator (INP)	Orange	Turns ON when motor is placed at command position after positioning input Turns OFF when torque mode is ON
Servo ON / OFF indicator (SERVO)	Blue	Turns ON when servo is ON, Turns OFF when servo is OFF
RS485 Comm. indicator (RXD IN)	Yellow	Flashes when receiving data
RS485 Comm. indicator (TXD OUT)	Green	Flashes when transmitting data

## Alarm / Warning

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

### ■ Alarm

Display	No. of flashing	Alarm type	Display	No. of flashing	Alarm type
E 1	1	Overcurrent error	E R	10	Motor alignment error
E 2	2	Overspeed error	E b	11	Command speed error
E 3	3	Position tracking error	E C	12	In-Position error
E 4	4	Overload error	E d	13	Memory error
E 5	5	Overheat error	E E	14	Emergency stop
E 6	6	Motor connection error	E F	15	Program mode error
E 7	7	Encoder connection error	E G	16	Index mode error
E 8	8	Overvoltage error	E H	17	Home search mode error
E 9	9	Undervoltage error	E J	18	Brake connection error

### ■ Warning

Display	No. of flashing	Warning type
W 1	1	+Software limit
W 2	2	-Software limit
W 3	3	+Hardware limit
W 4	4	-Hardware limit
W 5	5	Overload warning
W 6	6	Override warning

Specifications					
Model		AiCA-D-60MA-□	AiCA-D-60LA-□	AiCA-D-86MA-□	AiCA-D-86LA-□
Main	Power supply	200 - 240 VAC ~ 50 / 60 Hz			
	Max. RUN power <sup>(01)</sup>	≤ 800 VA			
	Stop power <sup>(02)</sup>	≤ 60 VA		≤ 65 VA	
AUX <sup>(03)</sup>	Power supply	24 VDC≡			
	Input current	0.3 A		0.5 A	
Max. RUN current <sup>(04)</sup>		2.0 A / Phase			
Stop current		20 to 100% of max. RUN current			
Resolution		500 (factory default), 1000, 1600, 2000, 3200, 3600, 5000, 6400, 7200, 10000 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) Auxiliary power is only available in built-in brake type and not available in standard type.

04) 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 30, Fine Gain
Max. rotation speed	3000 rpm
Position setting range	-2,147,483,648 to +2,147,483,647
In-Position	Fast Response: 0 (factory default) to 7, Accurate Response: 0 to 7
Rotation direction	CW (factory default), CCW
Operation mode	Jog mode, Continuous mode, Index mode, Program mode
Home search mode	General mode, Limit mode, Zero point mode, Torque mode
Index step	64 step
Program step	256 step
Program function	Power On Program Start, Power On Home Search
Control command	ABS, INC, HOM, ICJ, IRD, OPC, OPT, JMP, REP, RPE, END, POS, TIM, CMP, TOQ

I/O voltage level	[H]: 5 - 30 VDC =, [L]: 0 - 2 VDC =
Input <sup>01)</sup>	Exclusive input: 20, General input: 9
Output	Exclusive output: 4, General output: 10
External power supply	VEX (24 VDC = fixed): 2, GEX (GND): 2
Input resistance	4.7 kΩ (Anode Pull-up)
Insulation resistance	≥ 200 MΩ (500 VDC = megger)
Dielectric strength	Between the all charging part and the case: 1,500 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 <sup>2</sup> (≈ 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 UK ENEC
Unit weight (packaged)	≈ 780 g (≈ 1,050 g)

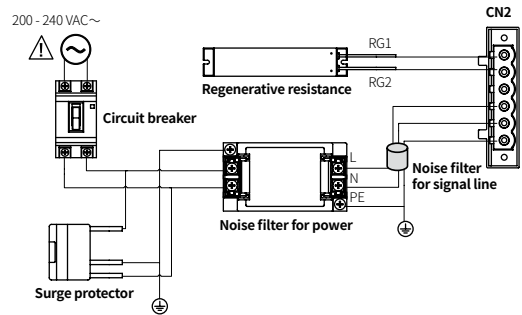
01) Brake ON/OFF function can be changed from general input IN8 in case of built-in brake type.

## Communication Interface

### ■ RS485

Comm. protocol	Modbus RTU
Applied standard	Compliance with EIA RS485
Max. connections	31 units (address: 01 to 31)
Synchronous method	Asynchronous
Comm. method	2-wire half duplex
Comm. distance	≤ 800 m
Baud rate	9600, 19200, 38400, 57600, 115200 (factory default) bps
Start bit	1 bit (fixed)
Data bit	8 bit (fixed)
Parity bit	None (factory default), Even, Odd
Stop bit	1 bit (factory default), 2 bit

## Power Supply Configuration Diagram



### ■ Noise filter for signal line

Connect to wiring to suppress external noise.  
Depending on frequency, filtered noise may differ.

Type	Model	Manufacture
Motor line, I/O signal line	28A5776-0A2	Lairdtech
Power line	28A5131-0A2	
Communication line	28A2025-0A2	

### ■ Noise filter for power

Connect the power to suppress external noise.  
The wires should be connected as short as possible and grounded.

Model	Specifications	Manufacture
RNS-2006	Rated voltage: 250 V Rated current: 6 A Max. leakage current: 1 mA	Orient Electronics

### ■ Regenerative resistance

Connect the pin 1, 2 on the power connector.  
Use in condition of the high inertia load or the short deceleration time.  
Forced cooling is required in condition of high surface temperature of regenerative resistance.

Model	Specifications	Manufacture
IRC100	Resistance: 100 Ω ±5%, Rated power: 60 W (standby), 100 W (heatsink attached)	Rara Electronics Corp.

### ■ Surge protector

Protect the product from external noise and surge by connecting power.  
Be sure to disconnect the surge protector when testing internal pressure.  
It may result in product damage.

Model	Specifications	Manufacture
LT-C12G801W	Nominal discharge current: 2500 A Max. discharge current: 5000 A Voltage protection level: 1.5 kV	OTOWA Electric Co. Ltd

## 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 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.
When motor rotates to the opposite direction of the designated direction	MotorDir parameter setting is not correct.	Check the MotorDir 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.

## Connectors

### Motor + Encoder connector

Pin	Function	Pin	Function
1	GND	8	+5 VDC
2	Encoder A	9	Encoder $\bar{A}$
3	Encoder B	10	Encoder $\bar{B}$
4	Encoder Z	11	Encoder $\bar{Z}$
5	PE	12	N · C
6	Motor A	13	Motor B
7	Motor $\bar{A}$	14	Motor $\bar{B}$

CN1

### Power connector

Pin	Function
1	Regenerative resistance
2	Regenerative resistance
3	N · C
4	AC power input
5	AC power input
6	PE

CN2

### RS485 communication connector

- Although RS485 OUT is disconnected, RXD IN / TXD OUT will operate normally since RS485 IN is in communication.

Pin	Function	Pin	Function
1	N · C	5	N · C
2	N · C	6	RS485 DATA-
3	RS485 DATA+	7	N · C
4	N · C	8	N · C

CN3

### I/O connector

Pin	Function	Pin	Function
1	N · C	26	IN0
2	N · C	27	IN1
3	Reset	28	IN2
4	Start	29	N · C
5	Stop	30	IN3
6	EMG	31	IN4
7	Step0/+Run/+Jog	32	IN5
8	Step1/-Run/-Jog	33	IN6
9	Step2/SSP0	34	IN7
10	Step3/SSP1	35	IN8, Brake ON/OFF <sup>01)</sup>
11	Step4/MSP0	36	VEX
12	Step5/MSP1	37	GEX
13	MD0/HMD0	38	Alarm
14	MD1/HMD1	39	Compare1 (Trigger)
15	Pause	40	Compare2 (Trigger)
16	Servo ON/OFF	41	OUT0
17	Home	42	OUT1
18	Alarm Reset	43	OUT2
19	+Limit	44	OUT3
20	-Limit	45	OUT4
21	ORG	46	OUT5
22	SD	47	OUT6
23	In-Position	48	OUT7
24	VEX	49	OUT8
25	GEX	50	OUT9

01) Brake ON/OFF function is available in built-in brake type.

### Brake connector

- Only available in built-in brake type.

Pin	Function
1	24 VDC
2	GND
3	Brake+
4	Brake-

CN5

### Suitable specifications

- The product performance can not be guaranteed when using other than the following connectors.

Type	Connector specifications	Manufacture
CN1	Motor + Encoder connector	5557-14R, connector terminal:5556T
CN2	Power connector	5ESDVM-06P-OR
CN3	RS485 comm. connector	RJ45
CN4	I/O connector	10150-3000PE, housing: 10350-52F0-008
CN5	Brake connector	ESC250V-S2330704P

## Switch

### Communication ID setting rotary switch

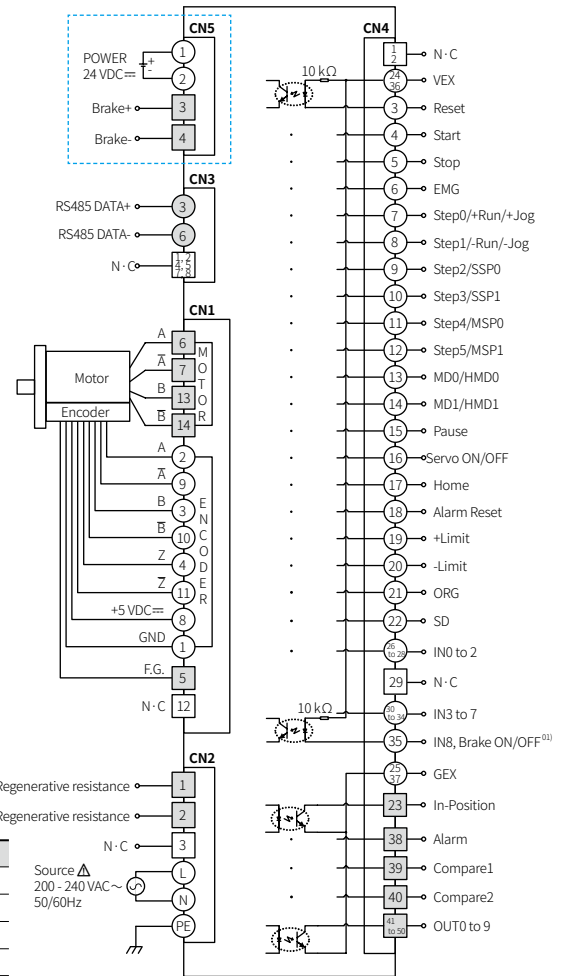
Setting	ID OFF	ID ON	Setting	ID OFF	ID ON
0	Disable	16	8	8	24
1	1 (factory default)	17	9	9	25
2	2	18	A	10	26
3	3	19	B	11	27
4	4	20	C	12	28
5	5	21	D	13	29
6	6	22	E	14	30
7	7	23	F	15	31

### Comm. ID setting / Terminating resistance DIP switch



No.	Function	ON	OFF (factory default)
1	Node ID setting	ID: 16 to 31	ID: 1 to 15
2	Terminating resistance (120 Ω)	Enable	Disable

## Connections



01)Brake ON/OFF function is available in built-in brake type.

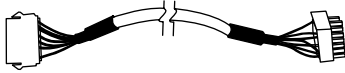
- is only available in built-in brake type.

Index
○ Input
□ Output
● I/O
□ N · C

Source  $\Delta$   
200 - 240 VAC ~  
50/60Hz

## Sold Separately : Motor + Encoder Cable

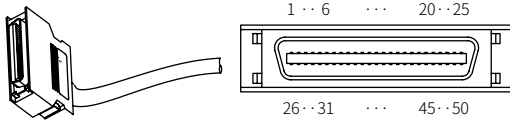
■ Fixed type: C1D14M-□, Flexible type: C1DF14M-□



- Recommended to use ferrite core at both ends of the cable.
- The model name is 1, 2, 3, 5, 7, 10, 15, 20 which indicates the cable length.  
E.g.) C1DF14M-10: 10 m flexible type, Motor + Encoder cable

## Sold Separately : I/O Cable

■ CO50-MP□-R (specifications: AiC TAG)



Pin	Function (Name TAG)	Cable Color	Dot line color- number	Pin	Function (Name TAG)	Cable Color	Dot line color- number
1	N·C	Orange	Black-1	26	IN0	White	Red-3
2	N·C		Red-1	27	IN1		Black-4
3	Reset		Black-2	28	IN2		Red-4
4	Start		Red-2	29	N·C		Black-5
5	Stop		Black-3	30	IN3		Red-5
6	EMG		Red-3	31	IN4	Gray	Black-1
7	Step0/+Run/+Jog		Black-4	32	IN5		Red-1
8	Step1/-Run/-Jog		Red-4	33	IN6		Black-2
9	Step2/SSP0		Black-5	34	IN7		Red-2
10	Step3/SSP1		Red-5	35	IN8, Brake ON/OFF		Black-3
11	Step4/MSP0	Yellow	Black-1	36	VEX		Red-3
12	Step5/MSP1		Red-1	37	GEX		Black-4
13	MD0/HMD0		Black-2	38	Alarm		Red-4
14	MD1/HMD1		Red-2	39	Compare1 (Trigger)		Black-5
15	Pause		Black-3	40	Compare2 (Trigger)		Red-5
16	Servo ON/OFF		Red-3	41	OUT0	Pink	Black-1
17	Home		Black-4	42	OUT1		Red-1
18	Alarm Reset		Red-4	43	OUT2		Black-2
19	+Limit		Black-5	44	OUT3		Red-2
20	-Limit		Red-5	45	OUT4		Black-3
21	ORG	White	Black-1	46	OUT5		Red-3
22	SD		Red-1	47	OUT6		Black-4
23	In-Position		Black-2	48	OUT7		Red-4
24	VEX		Red-2	49	OUT8		Black-5
25	GEX		Black-3	50	OUT9		Red-5

- Recommended to use ferrite core at both ends of the cable.
- The model name is 010, 020, 030, 050, 070, 100, 150, 200 which indicates the cable length.  
E.g.) CO50-MP070-R: 7 m I/O cable