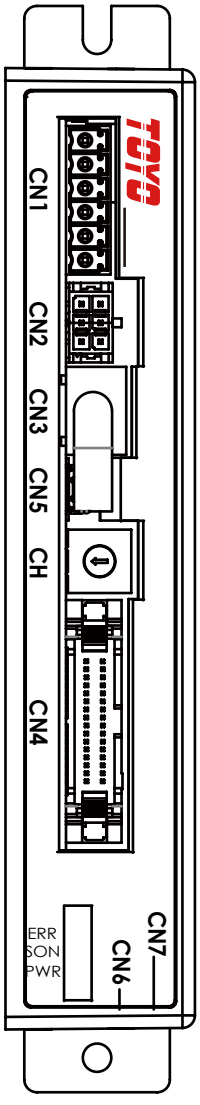
User's Manual

TOYO Servo Cylinder Controller

English User's Manual

V17.01

TC100 Series



About the product

About the product

- We are not liable for damages due to the infringement of third party patents, intellectual rights, or other rights, in connection with the use of the products manufactured by this product.
- This product is intended for general-purpose industrial equipment. It is not intended for the equipment (such as atomic energy control equipment, aerospace equipment, transmission equipment, traffic signal equipment, combustion control, medical life support equipment, various safety devices, etc.) which requires extremely high quality and reliability, and may cause direct physical injuries or property damage. The warranty does not apply to damage resulting from the use of this product for a purpose other than the intended purpose (hereinafter referred as to "specific-purpose"). The customer is solely responsible for using this product for particular purpose.
- This Manual does not constitute a guarantee of the implementation of other rights, such as industrial ones, or a commitment to licenses.

In addition, we are not liable for any problem associated with industrial rights arising out of the contents on this Manual.

Foreword

Thank you for using this product. This User's Manual provides the information about the TC100 Series Controller.

It includes:

- Installation and inspection of the step controller and step motor
- Overview of the step controller components
- Commissioning steps
- Overview of the control functions and adjustment methods of the step controller
- Description of all parameters
- Protocol description
- Inspection and maintenance
- Troubleshooting

This User's Manual is suitable for the following users:

- Designers of mechanical systems
- Installation or wiring personnel
- Commissioning personnel
- maintenance or inspection personnel

Before use the product, carefully read this Manual to ensure correct use. In addition, keep it in a safe place for future reference. Always follow the points below before finishing reading this Manual:

- The environment where the product will be installed should be dry without any corrosive and flammable gases.
- Grounding should be done properly.
- When energized, do not disassemble the drive or motor, or modify wiring.
- Before energized and operation, make sure that the emergency stop device functions properly.

If you still have any problem with the use, contact the dealer or our Customer Service Center.

Safety precautions

Before the installation, operation, maintenance, and inspection of this product, carefully read this User's Manual, and the instructions and related documents of any other equipment and axillary devices connected to it, to ensure correct use. Such operations should be performed only by the specialists with the knowledge of safety and equipment. The following notes are intended to ensure safety and correct use of this product to avoid physical injuries and property damage.

During the installation, wiring, operation, maintenance, and inspection, be aware of the following safety precautions. In this Manual, the safety precautions are categorized as "Danger," "Warning," "Caution," and "Tip."

⚠Danger	Incorrect operations will threaten life or cause serious injuries.
⚠Warning	Incorrect operations will cause death or serious injuries.
⚠Caution	Incorrect operations will cause injuries or property damages.
⚠Tip	While there is no possibility of injuries, you have to follow these tips for proper use of this product.

Failure to follow cautions or tips may result in serious consequences in some situations. The recorded contents are important. Carefully use the product after reading the Manual. This User's Manual should be kept in a readily accessible place and should be given to the end user.

⚠Danger

[General]

- Do not use the product for the following purposes.
  1. Any medical apparatus involving life and health maintenance and management.
  2. The equipment and mechanical devices intended for the movement or transportation of persons.
  3. The important safety parts of mechanical parts.

The product is not planned and designed for the usage that requires high degree of safety. We do not guarantee the product if it is used for any life support purpose. The guarantee only covers the product delivered.

[Installation]

- Do not use the product in a place with dangerous goods, such as flammable or combustible ones. Otherwise, it may cause fire or explosion.
- The main unit and controller should not be used in a place with water or oil droplets.
- Do not cut and re-connect cables to extend or reduce the length of cables for the products. Fire may occur.

[Operation]

- This product should not be come contact with water. Contact with water or washing may result in abnormal operations, leading to injuries, electric shock or fire.

[Maintenance, inspection, and repair]

- Do not modify the product. Otherwise, it may cause injuries, electric shock or fire due to abnormal operations.
- Do not assemble or disassemble the product. Otherwise, it may cause injuries, electric shock or fire.

Safety precautions

Warning

[General]

- Dot not operate the product beyond its specifications. If it is operated beyond its specifications, malfunction, failure or damage may occur In addition, the product may be shortened obviously. In particular, you should observe the maximum load and speed limits.

[Installation]

- Design a safety circuit or device to prevent device damages or physical injuries when the machine stops operating during an emergency stop or power failure.
- The drive shaft and controller must be grounded by a D-type grounding construction (the former third type grounding construction; grounding resistance under 100 Ω). Electric leakage may result in electric shock or false action.
- Before supplying electricity to or operating the products, always confirm safety of a surrounding area. If electricity is improperly supplied to the products, it may cause electric shocks or injuries by contacting operating parts.
- Avoid improper wiring by confirming proper wiring of the products with the "Operating Manual." A cable and a connector must be connected tightly. Otherwise, it may cause abnormal product operations or fire.

[Operation]

- Do not touch the terminal block and various switches when energized. Otherwise, it may cause electric shock or abnormal operations.
- Do not damage cables. If cables are damaged, forcefully bent, pulled, wound, or placed under a heavy object, they may cause fire, electric shock, or abnormal operations due to electric leakage or defective continuity.
- If the product generates abnormal heat, smoke, or smell, turn off power immediately. If you continue using the product, damages or fire to the product may occur.
- If a protection device (alarm) of the product goes off, disconnect power immediately. Otherwise, abnormal operations of the product may cause injuries, break down of or damages to the product. After turning off power, investigate the cause of the alarm, eliminate the cause, and turn on the power supply.
- Turn off power immediately if the LED of the product is not lit after turning on the power. The protective device (fuse, etc.) on the live side may remain active. Request repair to our sales office from which you purchased the product.

[Maintenance, inspection, and repair]

- The power supply must be completely off before maintenance inspection, adjustment, or replacement work begins on the product. Follow the instructions below during maintenance work.
  1. Post a sign such as, "Work in progress." or "Do not turn on power." in a visible place to prevent a third person from carelessly turning on power.
  2. When more than one person is doing a maintenance inspection, always confirm everyone's safety by vocally warning turning on and off the power switch.

[Disposal]

- Do not dispose the products in fire. Otherwise, the product may explode or generate toxic gas.

Safety precautions

Caution

[Installation]

- Do not expose the product to direct sunlight (ultraviolet rays), or place it near dust, salt, iron powder, humid environment, or in the atmosphere that contains organic solvent, phosphate ester working oil, sulfurous acid gas, chlorine gas, or acids.
- Do not place the product in an area where excessive vibration or shock (4.9m/s2 or more) occurs. Excessive vibration or shock may cause false actions.
- Place an emergency stop device in a suitable place where suspension can be commanded immediately in case of danger. Otherwise, it may cause injuries.
- Secure an extra space for maintenance when mounting the product. Failure to secure sufficient space disables daily inspection or maintenance and causes suspension of the device or damages to the product.
- Use only our genuine cables when connecting drive shafts and controllers. Always use our genuine accessories for component parts such as drive shafts, controllers, and teaching pendants.
- Before mounting or performing adjustment on the product, please post a sign such as "Work in progress." or "Do not turn on power." to prevent anyone from carelessly turning on the power.

If the power is turned on carelessly, the drive shaft suddenly starts operating and may cause electric shock or injuries.

[Operation]

- Please turn on power in commanding order of devices. Otherwise, the product may suddenly start operating and it may cause injuries or damage to the product.
- Do not insert a finger or an object in an opening part of the product. It may cause fire, electric shock, or injuries.

[Maintenance, inspection, and repair]

- Do not touch a terminal when performing the insulation resistance test. Otherwise, it may cause electric shock. (Do not perform the dielectric withstand test because the product uses the DC power supply.)

Safety precautions

Tip

[Installation]

- Do not place any obstacles that block air ventilation around the controller. Otherwise, it may cause poor ventilation.
- Do not configure a control circuit that will cause the workpiece to drop in case of power failure. Configure a control circuit that will prevent the bench or workpiece from dropping when the power to the machine is cut off or an emergency stop is actuated

[Installation, operation, and maintenance]

- When using the products, please secure your safety by wearing protective gloves, protective glasses, and safety shoes as required.

[Disposal]

- If the product becomes inoperable, please take an appropriate disposal method for industrial waste.

Other

- We shall not be responsible for your non-compliance with all "safety precautions."

We have made every effort to ensure accuracy and completeness when preparing this Manual, but there may still be errors or omissions. If you find any error, please contact us.

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1. Overview

1.1 Foreword

This product is a controller specially designed for the **CTH/CGH/CY/CGY/CTB/CS/CH** Series drive shafts and electric grippers.
It can perform control using the I/O control of the host controller (PLC), communication control, and pulse control functions.
In addition, this product also features the power-saving function to meet the increasing need for energy saving.

The following shows the key features and functions:

- Dedicated Homing Signal
  This signal supports our original homing operation based on push motion at the stroke end.
  With this signal, homing can be performed automatically without using a complex PLC programming controller or external sensor, etc.
- Brake Control Function
  The electromagnetic brake power is externally supplied with DC 24V via I/O. The external power should be supplied via I/O if you want to use the Brake Control function.
- Torque Limiting Function
  This controller allows you to limit torque using an external signal. A signal is output when the specified torque is reached. This function enables push-motion operation, press-fit operation, etc.
- Full Servo Control Function
  The step motor is servo-controlled to reduce the holding current.
  Although the exact degree of current reduction varies depending on the drive shaft type and load condition, the holding current decreases to approx. 1/2 to 1/4.

When you perform commissioning or experience any problems, refer to the manuals of the drive shaft, teaching pendant, and/or connection software, in addition to this Manual.

This Manual does not cover all possible abnormal operations or unexpected situations, such as complex signal changes during the critical points.
Therefore, the items not described in this Manual should be regarded as "Not Permitted."

* This Manual has been prepared with the utmost attention to ensure accuracy and completeness. However, there may still be inaccuracies and omissions. If you find any inaccuracies or errors, please contact us.
Keep this Manual in an accessible place for future reference.

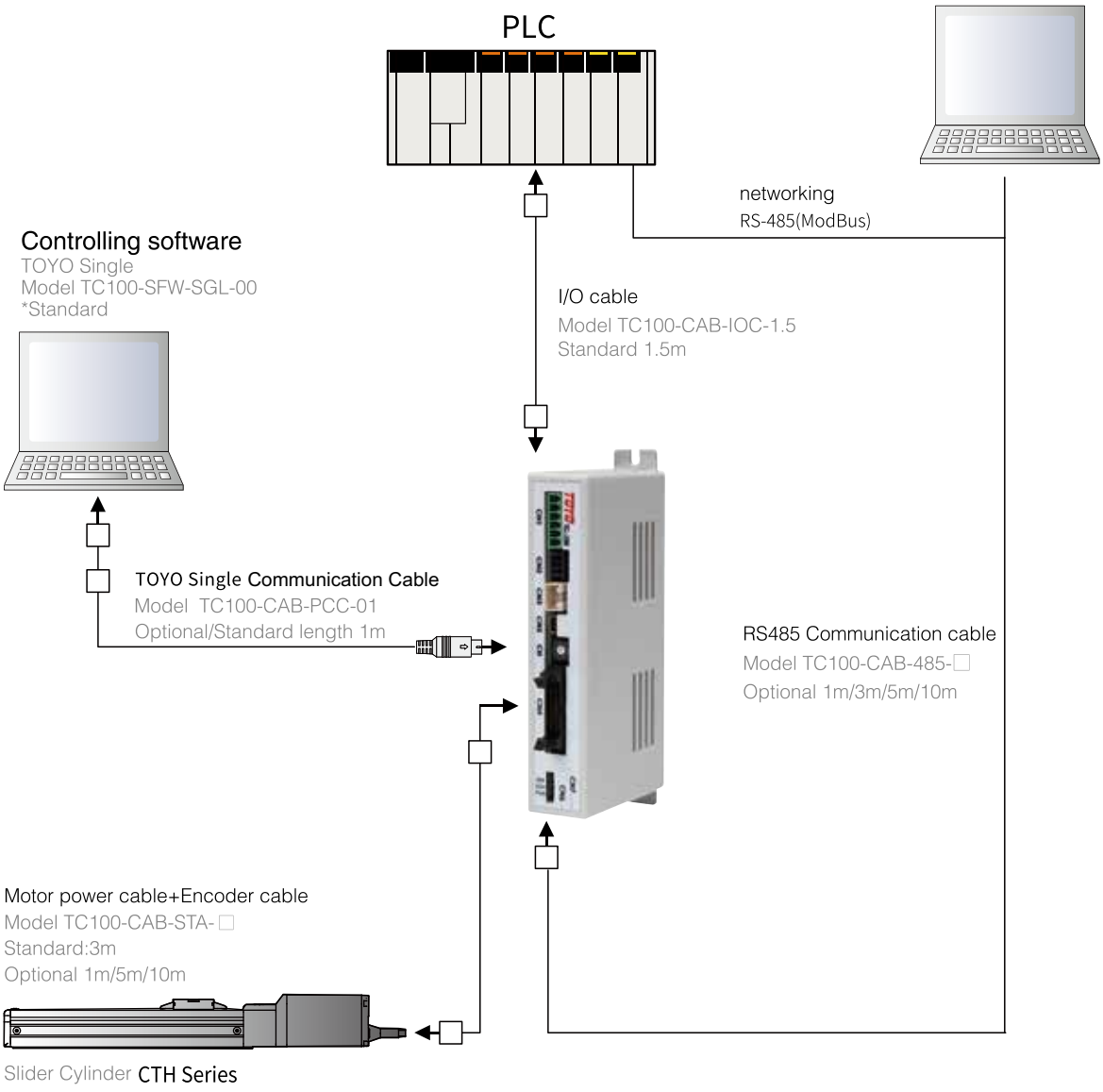
1.2 How to read the model specification

TC100-01

Controller model

Cable length
01 : 1m
03 : 3m
05 : 5m
10 : 10m

1.3 Components of the controller system

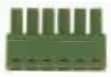


1.4 Steps from unpacking to commissioning

If you are using this product for the first time, refer to the steps below and make sure you have all necessary items and connect all required cables.

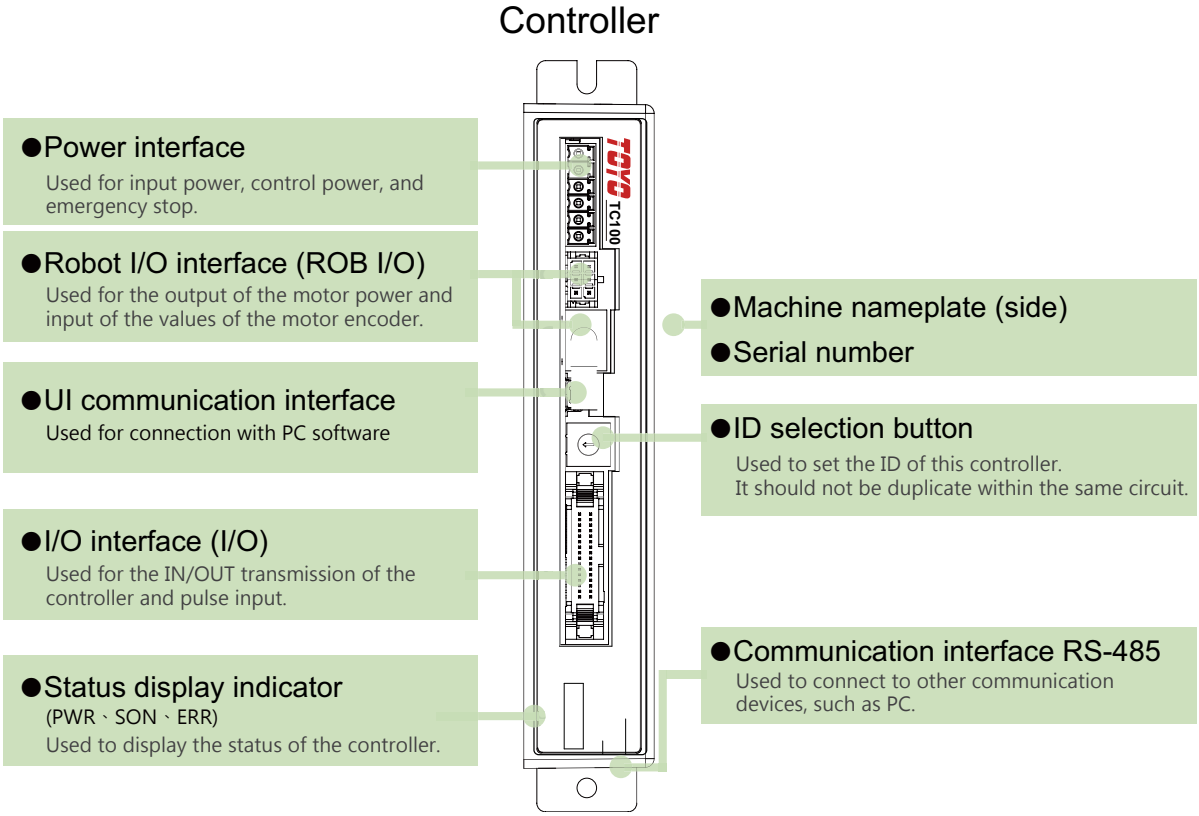
1. Check the items in the package

If you find any of the following items missing or of a wrong model type, please contact your dealer.

Item name	Quantities	Picture	Model No.
Controller	1		TC100
Drive shaft	1		As per customer request CTH/CGTH/CY/CGTY /CTB/CS/CH/CNT
I/O ribbon cable	1		TC100-CAB-IOC-1.5
Motor power cable	1		TC100-CAB-STA-□
Motor encoder cable	1		
Power connector	1		TC100-CON-POW-00

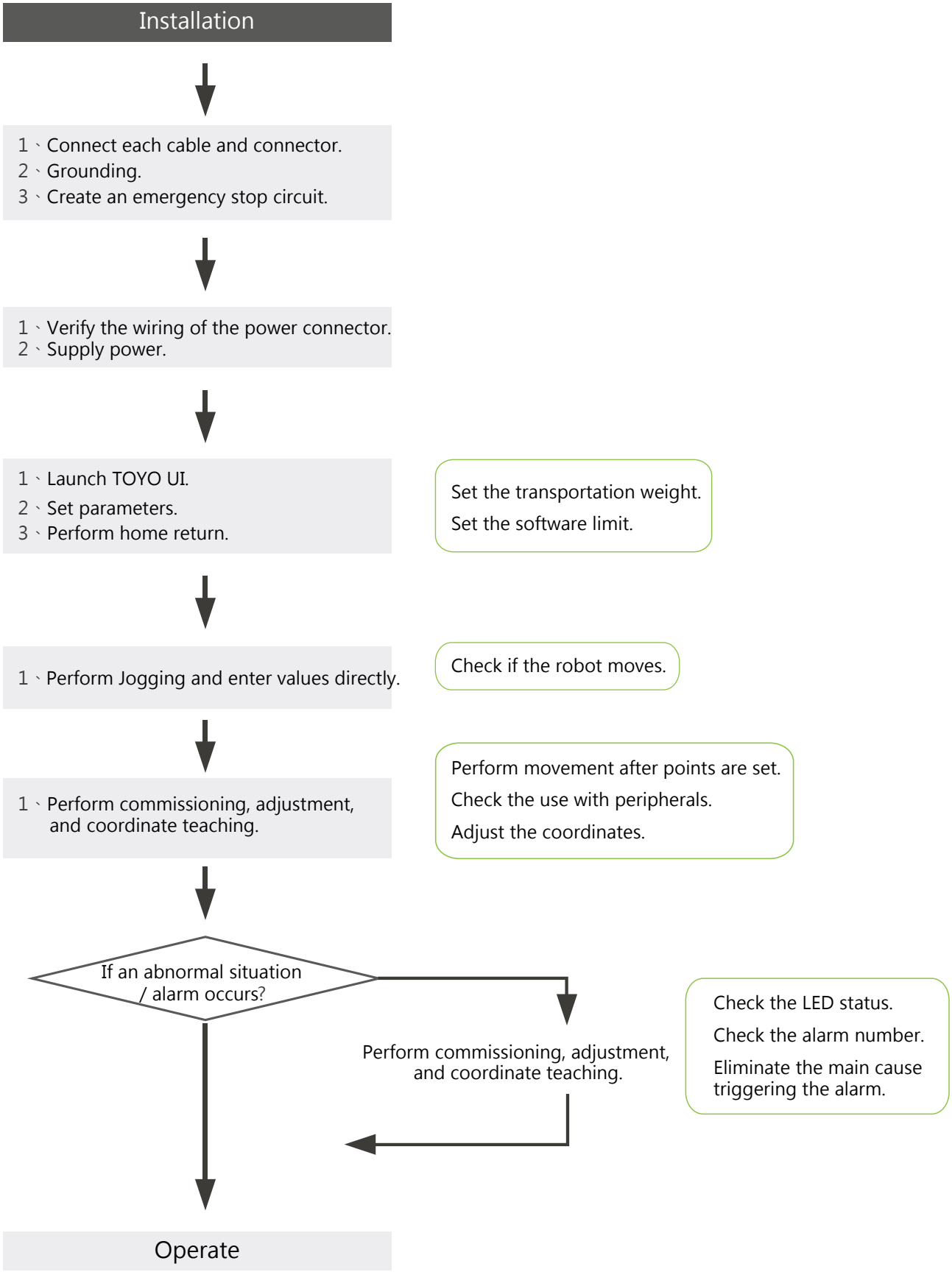
⚠ Caution:
The items in the package carton vary depending on the model you order.

2. Interface overview



3. Steps

The following shows the basic steps from controller installation to operation.



1.5 Warranty period and coverage

The controller you bought is strictly tested prior to shipment.
Its warranty is described as follows:

1. Warranty period

The warranty period shall be one of the following periods, whichever ends first:

- 18 months after shipment from our factory
- 12 months after delivery to a specified location

2. Scope of warranty

If an obvious manufacturing defect is found during the above period under normal use, we will repair the defect free of charge. Note that the following items are not covered by this warranty:

- Faded paint or other changes that occur naturally over time.
- Consumable components that wear out with use.
- The unit seems to be noisy or similar impressions that do not affect machinery performance.
- Damage resulting from improper handling by the user or lack of proper maintenance.
- Damage resulting from inappropriate or erroneous maintenance/inspection.
- Damage resulting from the use of a part other than our genuine accessories.
- Any alterations that are not approved by us or our dealers.
- Any damages caused by natural disasters, accidents, or fire.

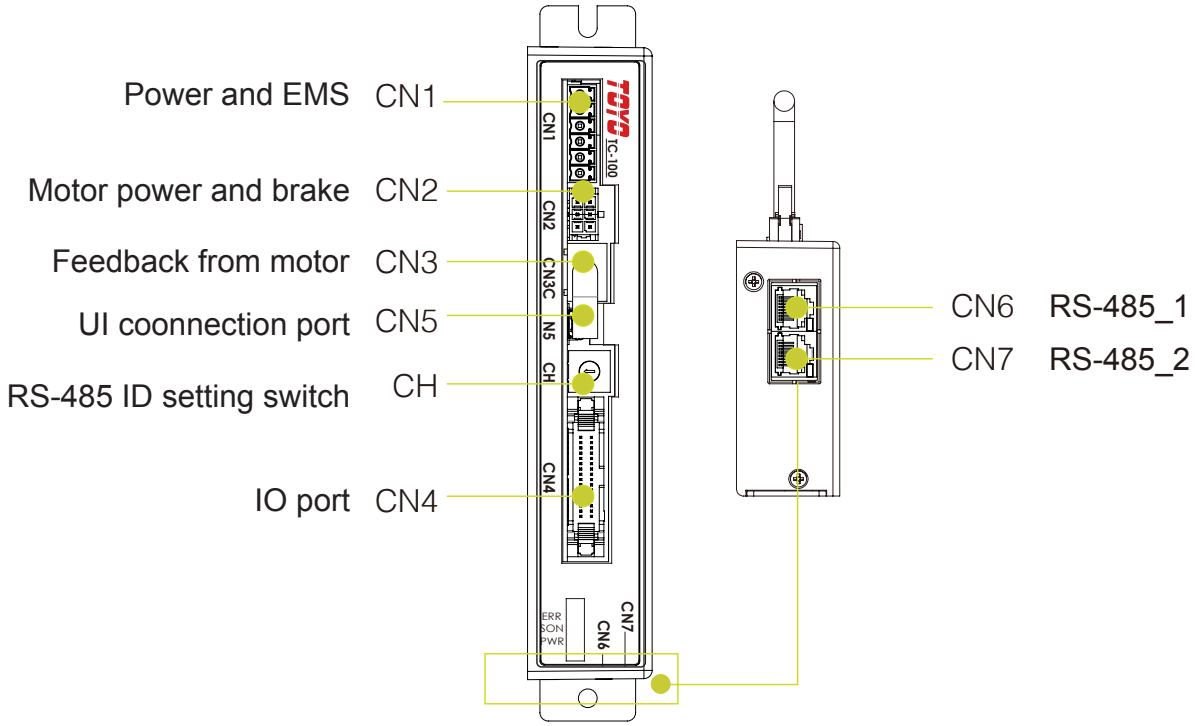
The warranty pertains to the delivered product itself and does not cover any damages that might arise from a breakdown of the product.
Return your defective to the dealer for repair.
The warranty is described as above.

2. Specifications

2.1 Basic specifications

Items		TC100
Input power	Control power	DC 24V (±10%)
	Power supply	DC 24V (±10%) / DC 48V (±10%)
Number of control axes		1 axis
Motor	Applicable motors	2-phase micro step motor
	Dimension	56, 42, 25 Type
	Rated output	2Ao-p (the peak value of sine wave current)
	Peak power output	3Ao-p (the peak value of sine wave current)
Action control mode		ABS operation
		INC operation
		Continuous operation
		Thrust operation
Position	Number of points	1~127 points (individual action)
	Point setting method	I/O point teaching for the position of the communication set points
Encoder	Position management	Incremental type
	Position detection	Optical rotary encoder
	Resolution	16000ppr (56, 42 Type) / 9600ppr (25 Type)
Common DI/DO signals		DI (12-point) / DO (10-point) NPN; definitions can be modified through parameters
Brake		Optional (select it before you buy)
Error history		Up to 50 error codes can be stored
Safety circuit		After emergency stop and push-in (Servo is OFF)
Communication		USB (Virtual COM port): mini USB / RS485 (half-duplex): RJ-45
LED status		**PWR:** Power (green): Lights up solid when drive + control power is supplied; when the drive power is turned off, the green indicator is flashing. **SON:** Servo (green): Lights up solid when Servo is ON; when an error occurs, it goes off. **ERR:** Abnormal situation (red): Determine the error message based on the flashing times.
ID settings		Rotary DIP switch (0~F), 16 stations

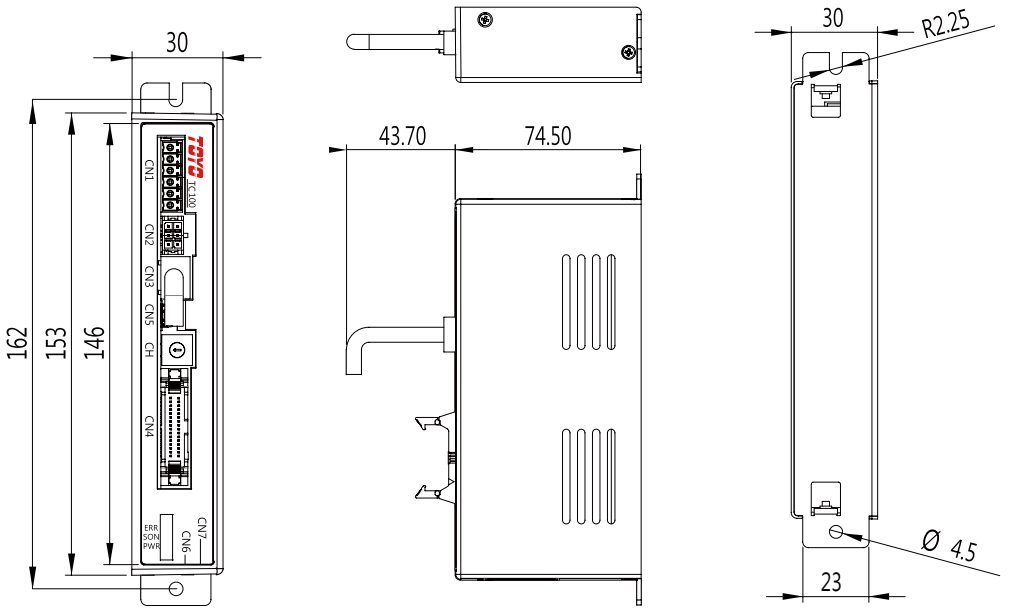
2.2 Name and description of each part of the controller



2.3 External dimensions of the controller

An external view and dimensions of the product are shown below.

(unit : mm)



3. Installation and wiring

Pay due attention to the installation environment of the controller.

3.1 Installation environment

- When performing installation and wiring of the controller, do not block the ventilation holes for cooling. (Insufficient ventilation not only prevents the controller from operating at full capacity, but also cause breakdown.)
- Prevent foreign matter from entering the controller through the ventilation holes. Since the enclosure of the controller is not dust-proof or waterproof (oil-proof), avoid using the controller in a place subject to significant dust, oil mist or splashes of cutting fluid.
- Do not expose the controller to direct sunlight or radiating heat from a large heat source such as a heat treatment furnace.
- Use the controller in an environment free from corrosive or inflammable gases, under a temperature of 0 ～ 40℃ and humidity of 85% or less (non-condensing).
- Use the controller in an environment where it will not receive any external vibration or shock.
- Prevent electrical noise from entering the controller or its cables.

3.2 Power Supply

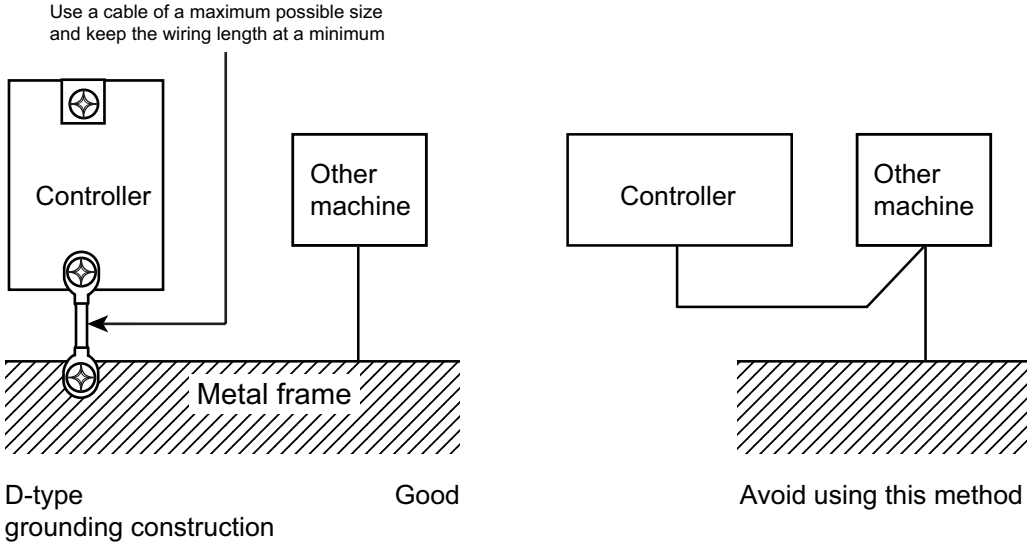
The power supply specification is DC24V±10%, DC48V±10%.
▲ Only DC24V±10% can be used as control power.

3.3 Noise elimination and grounding

The following describes how to eliminate noise when using of the controller.

1. Wiring and power supply

(1) Perform a D-type grounding construction for grounding.
Select cables with a size of 2.0 ～ 5.5mm2 for wiring.

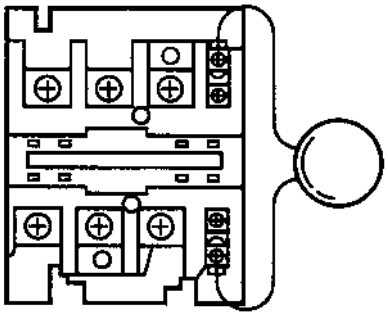


D-type grounding construction — Good — Avoid using this method

(2) Precautions regarding wiring method
Use a twisted cable for connection to the DC 24V external power supply.
Separate the controller cables from high-power lines such as a cable connecting to a power circuit. (Do not bundle them together. Do not place them in the same cable duct.)
When you need a longer motor cable or encoder cable, consult us.

2. Noise sources and elimination

Among the numerous noise sources, solenoid valves, magnetic switches and relays are of particular concern when building a system. Noise from these sources can be eliminated by implementing the measures specified below.
AC solenoid valves, magnet switches and relays are connected in parallel with coils and in parallel with the coil. Install a surge absorber.



← **Key point**
» **Install a surge absorber to each coil over a minimum wiring length.**
» **Installing a surge absorber to the terminal block will be less effective because of a longer distance from the coil.**

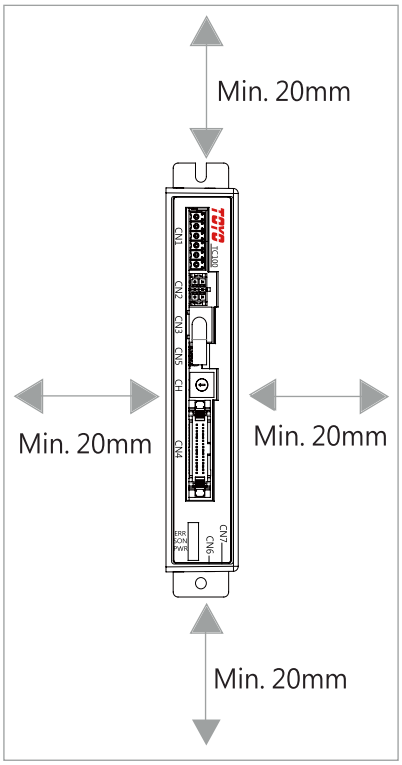
3.4 Heat dissipation and installation

When you design the distribution box, controller layout, and cooling method, attention should be paid to the following installation conditions under which the controller operates normally.

■■ Installation position
Install the controller to the control panel.

■■ Installation direction
Install the controller vertically on a wall.

■■ Surrounding area
Install the controller in a well-ventilated place and leave enough space around it. (see figure below)



Regardless of whether your system consists of a single controller or multiple controllers, leave sufficient space around each controller so that it can be installed/removed easily.

■■ Temperature and humidity

The temperature and humidity around the controller should meet following criteria.

- Ambient temperature: 0 ～ 50℃ (non-condensing)
- Ambient humidity: 35 ～ 85% RH (non-condensing)

■■ Avoid using in these environments

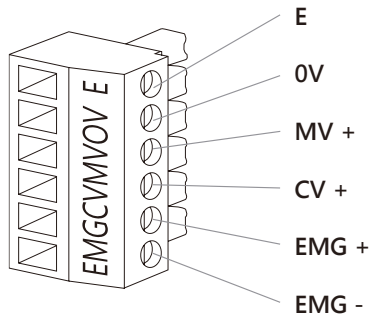
For normal operation of the controller, avoid using in these environments.

- Avoid an environment with sulfuric acid, hydrochloric acid, or corrosive gases, corrosive gases, or flammable gases.
- A dusty place.
- A place where it may be splashed by chips, oil, or water from other devices.
- A place which is exposed to strong vibration.
- A place which is exposed to electromagnetic noise or electrostatic noise.
- A place where it may be exposed to direct sunlight.

3.5 Power wiring diagram

Use the supplied power connector to connect to the power supply.

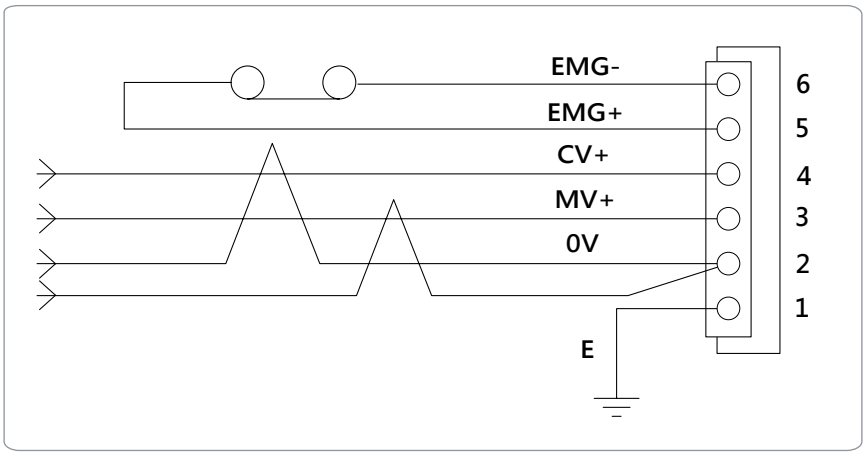
1. The name and functions of the terminals of the power connector



No.	Signal name	Description
1	E	Grounding (To avoid noise interference which may lead to false action, perform grounding properly.)
2	0 V	GND
3	MV+	Main power: DC 24V/DC 48V, ±10%
4	CV+	Control power: DC 24V, ±10%
5	EMG+	For emergency stop, use B contact (RELAY contact)
6	EMG-	

⚠Caution:
The rated current of the controller is 2A and its max current is 3A. Select a suitable power supply based on this specification.
To avoid false action caused by noise, be sure to connect the grounding terminal to earth ground.

2. Emergency stop and power wiring diagram



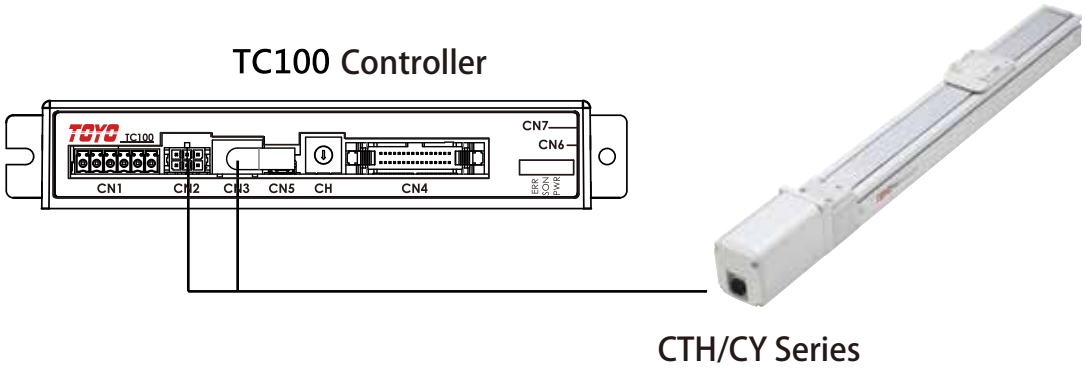
⚠Caution:
Do not connect the power voltage and terminal incorrectly. Otherwise, it may cause malfunction.

- PIN(E) on the power connector is the grounding terminal which should be connected.
- Use AWG#18(0.75mm2) cables.
- Install a filter at the input of wires to avoid false action caused by noise.
- Use AWG#18(0.75mm2) or above twisted cables and install a surge absorber to the relay or brake circuit.
- Only use DC24V when you perform the CV control power wiring.

3.6 Connection to the robot

Connect the robot cables to the connector interface on the front panel of the controller.

1. Connection method

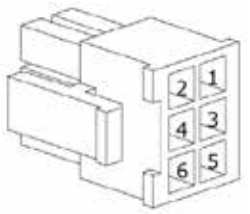


⚠Caution:

- Be sure to use the dedicated T100 cables to connect the robot.
- Make connections when the power is disconnected.
- Insert cables to the interface and make sure they are fully inserted.
- Do not connect it to a robot other than the specified one.
- When you insert or remove connectors, hold the connector, instead of pulling its cable.

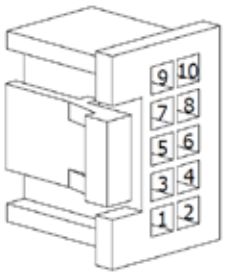
2. Robot connector (motor power and encoder pin assignments)

Motor power connector



No.	Signal name	Description
1	BK(-)	Brake power output (-)
2	BK(+)	Brake power input (-)
3	/B	Motor /B-phase
4	B	Motor B-phase
5	/A	Motor /A-phase
6	A	Motor A-phase

Motor encoder connector



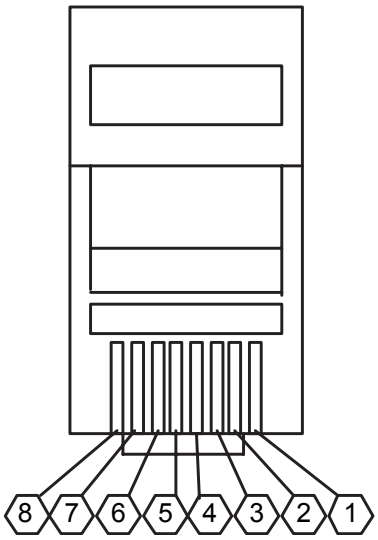
No.	Signal name	Description
1	+5 V	Power output +5 V
2	0V	Power output 0V
3	A+	ENCODER A-phase
4	A-	ENCODER /A-phase
5	B+	ENCODER B-phase
6	B-	ENCODER /B-phase
7	Z+	ENCODER Z-phase
8	Z-	ENCODER /Z-phase
9	---	-----
10	FG	Shielded grounding

3.7 Connection to the communication unit

Use the dedicated cables to connect to communication devices, such as PC/

■■ The name and functions of the terminals of the power connector

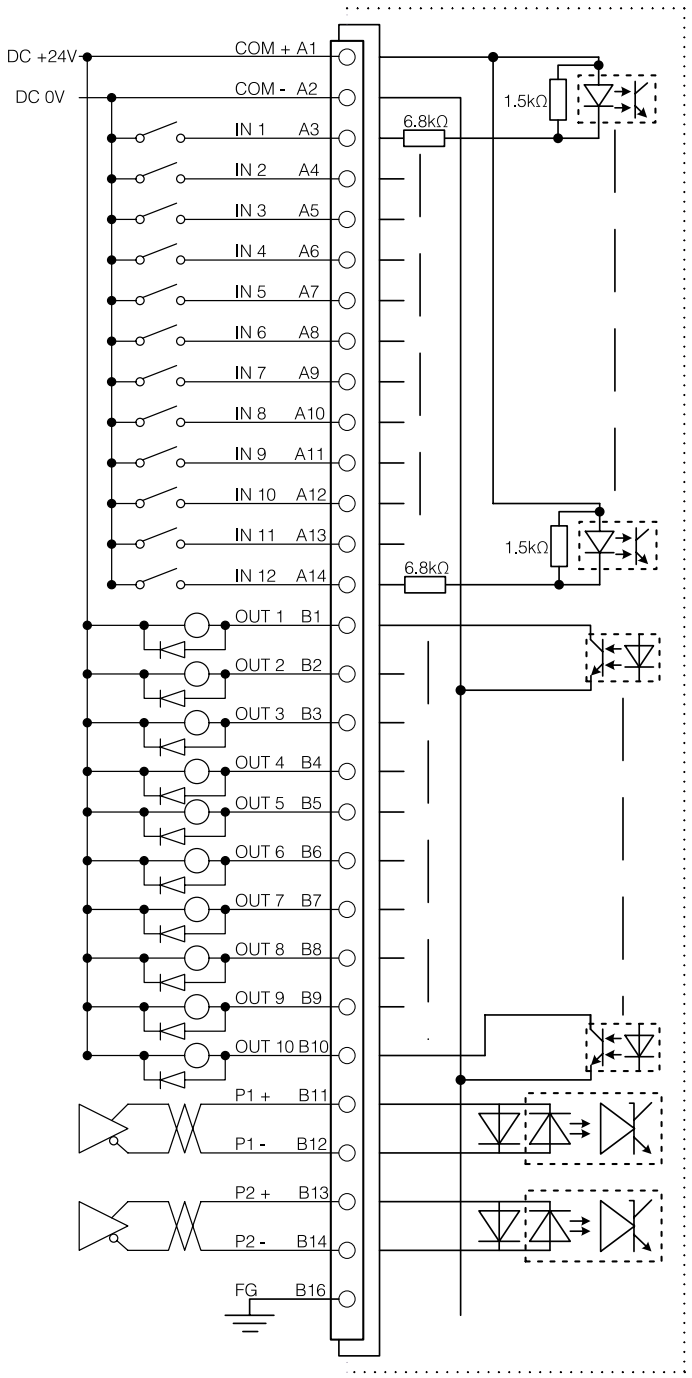
No.	Signal name	Description
1		
2	SG	Signal ground wire (knitted wire mesh)
3	SIG-A	DATA +
4		
5	SG	Signal ground wire (knitted wire mesh)
6	SIG-B	DATA -
7		
8	SG	Signal ground wire (knitted wire mesh)



3.8 IN/OUT signal wiring

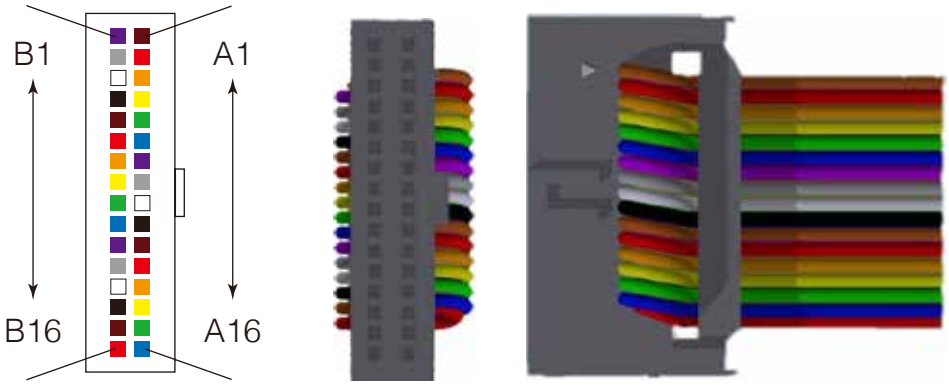
Connect the robot cables to the connector interface on the front panel of the controller.

1. Connection method (NPN)



Use the dedicated cables to connect to communication devices, such as PC

2. The name and functions of the terminals of the power connector



3. CN-4 IO pin assignments

NO	Color code	Signal	Content description	NO	Color code	Signal	Content description
A1	Brown	COM+	IO power +24V	B1	Purple	OUT 1	ORG-S
A2	Red	COM-	IO power 0V	B2	Gray	OUT 2	INP
A3	Orange	IN 1	ORG	B3	White	OUT 3	READY
A4	Yellow	IN 2	/SERVO	B4	Black	OUT 4	SERVO-S
A5	Green	IN 3	ALM_REAET	B5	Brown	OUT 5	PRGSEL0-S
A6	Blue	IN 4	START	B6	Red	OUT 6	PRGSEL1-S
A7	Purple	IN 5	PRGSEL0	B7	Orange	OUT 7	PRGSEL2-S
A8	Gray	IN 6	PRGSEL1	B8	Yellow	OUT 8	PRGSEL3-S
A9	White	IN 7	PRGSEL2	B9	Green	OUT 9	PRGSEL4-S
A10	Black	IN 8	PRGSEL3	B10	Blue	OUT 10	PRGSEL5-S
A11	Brown	IN 9	PRGSEL4	B11	Purple	P1+	CCW, B-phase, PULSE
A12	Red	IN 10	PRGSEL5	B12	Gray	P1-	
A13	Orange	IN 11	PRGSEL6	B13	White	P2+	CW, A-phase, DIR
A14	Yellow	IN 12	ORG-S	B14	Black	P2-	
A15	Green	Reserved	-	B15	Brown	Reserved	-
A16	Blue	Reserved	-	B16	Red	FG	Knitted wire mesh / grounding

4. Description of I/O functions

① DI definitions

If you want to use the controller functions, use the default I/O definitions. Do not modify them, or UI may be unavailable.

INPUT Digital Input Signal 12-point / IO functions are configurable / NPN		
NO.	I/O signals	Function description
1	ORG	Homing Start
2	/SERVO	Servo is ON
3	ALM RESET	Error Clear
4	START	Program Start
5	JOG+	Positive Jog Movement
6	JOG-	Negative Jog Movement
7	MANUAL	Manual Mode
8	TEACH	Point Teaching
9	LOCK	Interlocking / Pause
10	ORG_SIG	Homing Sensor Signal
11	BK_OFF	Brake Control (only when SERVO_OFF)
12	PRGSEL 0	Program Selection No.0~No.127 bit 0
13	PRGSEL 1	Program Selection No.0~No.127 bit 1
14	PRGSEL 2	Program Selection No.0~No.127 bit 2
15	PRGSEL 3	Program Selection No.0~No.127 bit 3
16	PRGSEL 4	Program Selection No.0~No.127 bit 4
17	PRGSEL 5	Program Selection No.0~No.127 bit 5
18	PRGSEL 6	Program Selection No.0~No.127 bit 6

② DO definitions

If you want to use the controller functions, use the default I/O definitions. Do not modify them, or UI may be unavailable.

OUTPUT Digital Output Signal 10-point / IO functions are configurable / NPN		
NO.	I/O signals	Function description
1	INP	Inposition Signal
2	ALARM	Error Output
3	READY	Ready to Complete
4	MOVE	In motion
5	ORG-S	Home Return Complete
6	SERVO-S	Servo Status
7	PRGSEL 0-S	Program Selection No.0~No.127 bit 0
8	PRGSEL 1-S	Program Selection No.0~No.127 bit 1
9	PRGSEL 2-S	Program Selection No.0~No.127 bit 2
10	PRGSEL 3-S	Program Selection No.0~No.127 bit 3
11	PRGSEL 4-S	Program Selection No.0~No.127 bit 4
12	PRGSEL 5-S	Program Selection No.0~No.127 bit 5
13	PRGSEL 6-S	Program Selection No.0~No.127 bit 6
14	INRANGE	Input Signal Within the Interval Range
15	TRQLIM	Setting Current Reach Output Signal
16	ERR 0	Error Code Output Display bit0
17	ERR 1	Error Code Output Display bit1
18	ERR 2	Error Code Output Display bit2

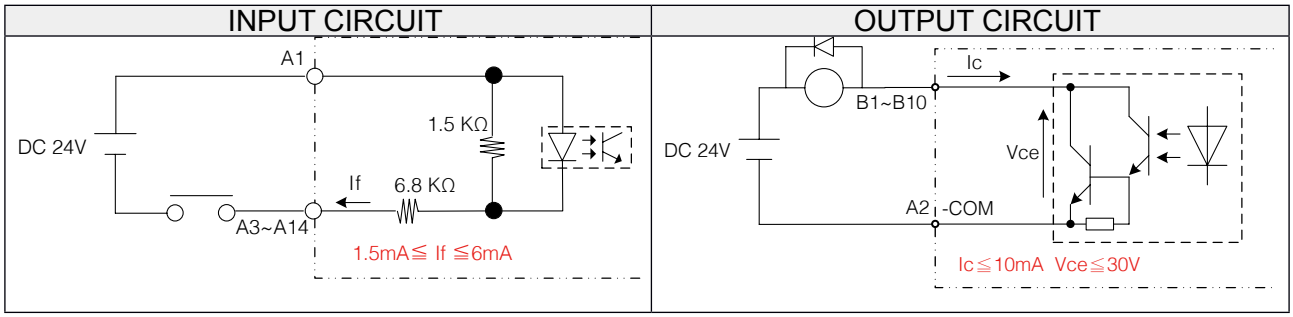
⚠Caution:

During the wiring, do not connect terminals incorrectly to avoid short circuit between them. Wrong wiring may lead to the damage to the controller.

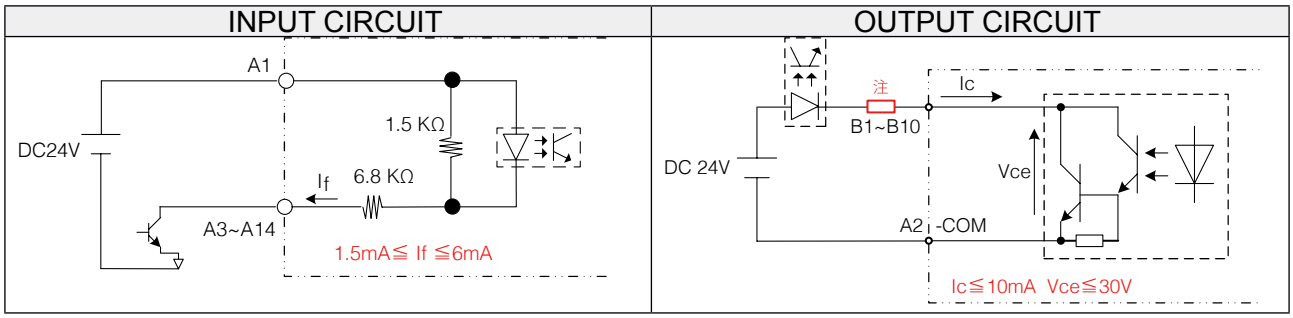
Carefully check the arrangement of terminals during the connection. Do not short circuit terminals.

3.9 Relay contact wiring diagram

1. Wiring of relay contacts

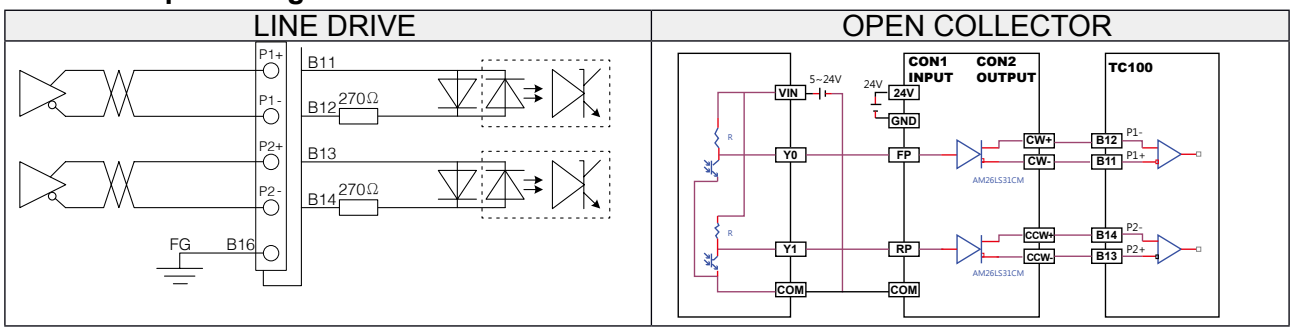


2. Wiring of transistor contacts



Note) Take the saturated voltage 1V (when the output current is 10mA) of the photo-coupler into account.

3. Pulse input wiring



Note) In External PULSE Mode, the existing position and current position of the command cannot be cleared to 0. This is normal and the transmission of PULSE will not be affected.

4. Data setting

If you want to operate a robot with the TC100 Series, you must set the coordinate data and parameter data.

4.1 Overview

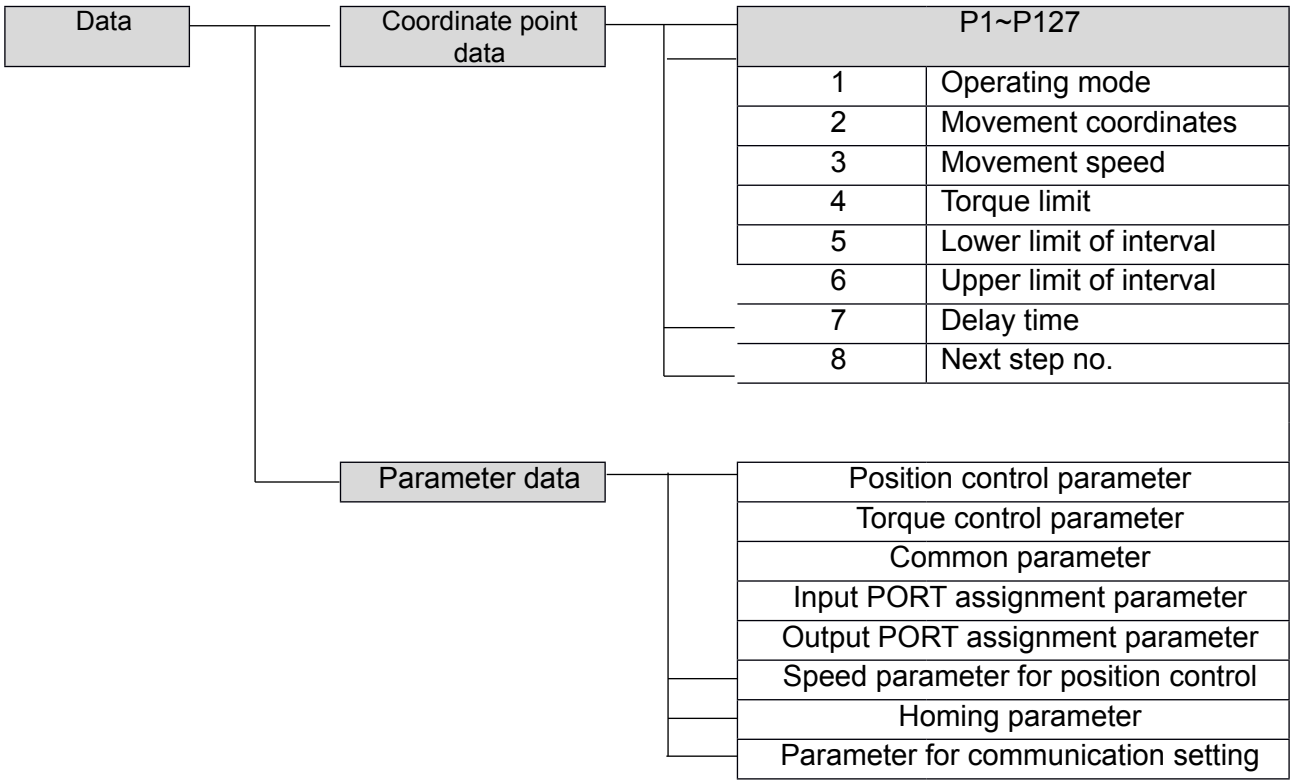
1. Setting of coordinate point data:

The coordinate point data is used to provide the "standard settings" of the optimum position by specifying the carrying weight. It can also be used for the "customized settings" (such as the speed and acceleration) based on the usage. The coordinate point data used for positioning include "Operating Type," "Position," and "Speed."
127 points can be registered in P1~P127.

2. Parameter data setting:

The parameter data include "Position Control Parameter," "Torque Control Parameter," "Common Parameter," "Input PORT Assignment Parameter," "Output PORT Assignment Parameter," "Speed Parameter for Speed Control," "Homing Parameter," and "Parameter for Communication Setting."

3. Data consists of:



4. Coordinate point data:

P1~P127					
Item		Content	Range	Unit	Initial value
1	Operation mode	Set the type of the position.	5 modes	-	1
2	Movement coordinates	Set the target position or amount of movement.	-9999.99~9999.99	mm	0.00
3	Movement speed	Set the operation speed (%)	1~100	%	100
4	Torque limit	Set the current limit value.	1~1000	0.1%	500
5	Lower limit of interval	Set the output range of "single zone output"	-9999.99~9999.99	mm	0.00
6	Upper limit of interval				
7	Delay	The delay time after movement	0 ~ 30000	ms	0
8	Next step no.	The number of the next step after movement.	1 ~ 127	-	-1

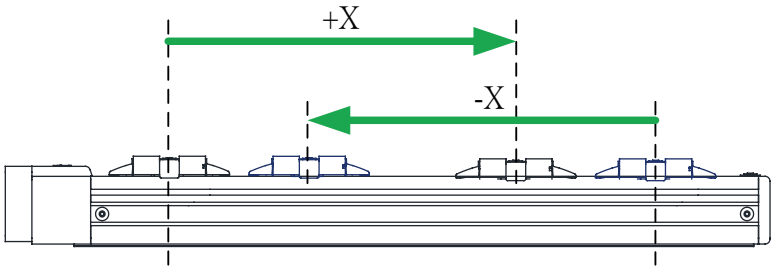
4.2 The detailed description of the coordinate point data

The following gives the detailed description of various aspects of the coordinate point data.

1. Description of each operating mode:

INC: Relative Position Movement

From the current position, move a specified amount (distance) X and position.



■■ Case 1

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000) x 0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC	0.00	100	500	0.00	0.00	0	-1
2	INC	250.00	100	500	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:

Point P2 moves 250mm positively by "Relative Position" with a movement speed of 100% and a torque of 50% during the process. If the torque exceeds 50%, it remains at 50% and output a signal indicating the output torque is reached.

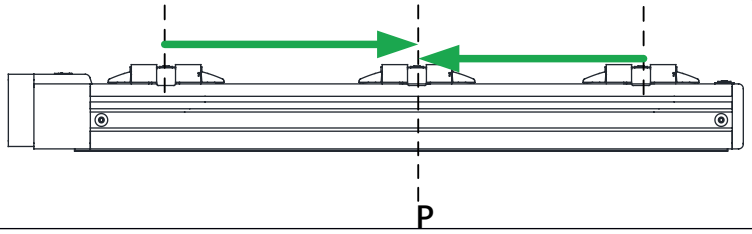
■■ **Case 2**

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC	0.00	100	500	0.00	0.00	0	-1
2	INC	250.00	100	500	0.00	0.00	0	-1
3	INC	-128.55	50	823	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
Point P3 moves 128.55mm negatively by "relative position" with a movement speed of 50% and a torque of 82.3% during the process. If the torque exceeds 82.3%, it remains at 82.3% and output a signal indicating the output torque is reached.

ABS: Absolute Position Movement

It moves to the absolute coordinates P with Home as reference and positioning is performed.



■■ **Case 1**

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC	0.00	100	500	0.00	0.00	0	-1
2	ABS	250.00	100	500	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
Point P2 moves to Position 250mm by "Absolute position" with a movement speed of 100% and a torque of 50% during the process. If the torque exceeds 50%, it remains at Forced Position 50% and output a signal indicating the output torque is reached.

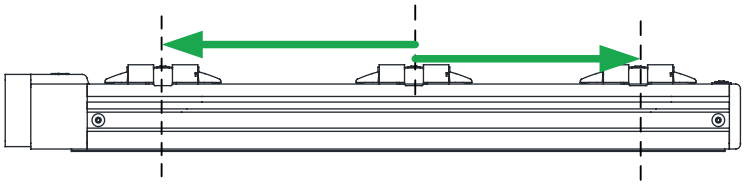
■■ **Case 2**

Point number		Movement	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC	0.00	100	500	0.00	0.00	0	-1
2	INC	250.00	100	500	0.00	0.00	0	-1
3	ABS	128.55	50	823	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
Point P3 moves to Position 128.55mm by "Absolute position" with a movement speed of 50% and a torque of 82.3% during the process. If the torque exceeds 82.3%, it remains at Forced Position 82.3% and output a signal indicating the output torque is reached.

ORG: Home Return Movement

It moves toward Home from the current position.



ORG: The Home position is based on the parameter settings.
It is classified as "Motor Side" and "Opposite Motor Side."

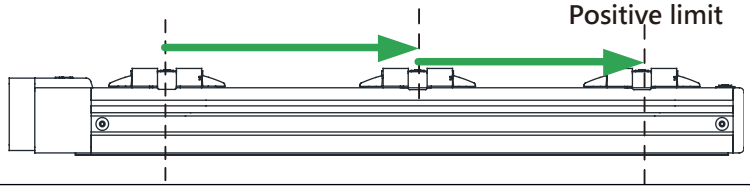
■■ **Case 1**

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC	0.00	100	500	0.00	0.00	0	-1
2	ORG	250.00	100	500	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
Point 2 moves toward Home from any position by "Home Return." During the movement, "ORG-S" OFF; After the movement, "ORG-S" ON.

+TSL: Positive Torque Search

It starts positive torque search from the current position.



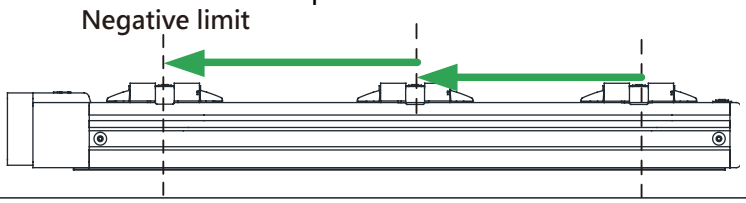
■■ **Case 1**

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC	0.00	100	500	0.00	0.00	0	-1
2	+TSL	250.00	100	335	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
Point 2 moves to the positive limit from any position by "Positive Torque Search." It stops until the torque 33.5% is reached. If no torque is detected, it stops at the "Limit" position.
Note) The Coordinate Movement parameter is invalid. This is based on the speed and torque and the parameter can be added with a signal indicating the torque is reached.

-TSL: Negative Torque Search

It starts negative torque search from the current position.



■■ **Case 1**

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC	0.00	100	500	0.00	0.00	0	-1
2	-TSL	250.00	100	445	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

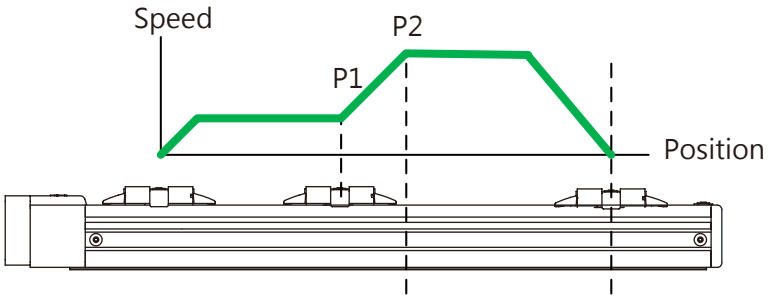
Descriptions:

Point 2 moves to the negative limit from any position by "Negative Torque Search." It stops until the torque 44.5% is reached; if no torque is detected, it stops at "Limit" position.

Note) The Coordinate Movement parameter is invalid. This is based on the speed and torque and the parameter can be added with a signal indicating the torque is reached.

ABS-R: Continuous Operation

Change the speed without stopping and operations are performed for several coordinate points.



Point P1 and Point P2 use the absolute coordinate system with Home as reference.
(1) It accelerates to the speed specified by Coordinate Point 2
(2) After P1 is reached, it continuously moves toward P2 without stopping.

■■ **Case 1**

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	ABS-R	100.00	30	1000	0.00	0.00	0	2
2	ABS-R	250.00	100	1000	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:

It moves to Point P1 from Home and accelerates (decelerates) to Point P2. (Non-stop between Point P1 and Point P2)

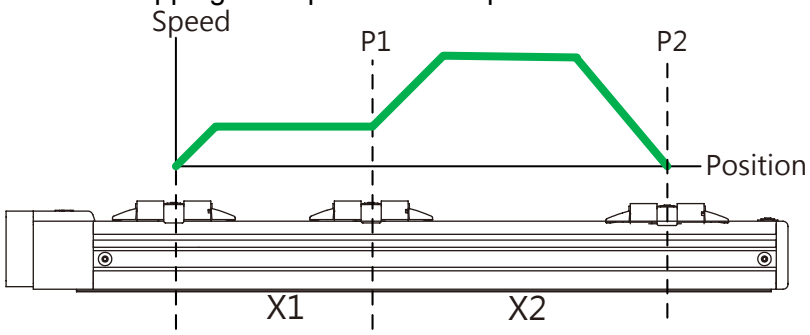
■■ Case 2

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	ABS-R	210.00	100	500	0.00	0.00	0	2
2	ABS-R	250.00	20	200	0.00	0.00	0	-1
3	ABS	200	50	823	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
With "Relative Position," Speed 100%, and Torque Limit 50%, it moves to Position 210mm. Afterwards, with "Absolute Position," Speed 20%, and Torque Limit 20%, it moves to Position 250mm. (Non-stop between Point P1 and Point P2)

INC-R: Continuous Operation

Change the speed without stopping and operations are performed for several coordinate points.



Several values of movement amount (distance) are specified for movement from the current position.
(1) It moves the specified amount of movement (X1)
(2) After the specified amount is reached for X1, it accelerates (decelerates) to the speed specified by Point P2 and moves to P2 the specified amount of movement X2.

■■Case 1

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC-R	100.00	30	1000	0.00	0.00	0	2
2	INC-R	250.00	100	1000	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
It moves the amount of movement from any point to Point P1 without stopping. (Non-stop between Point P1 and Point P2)

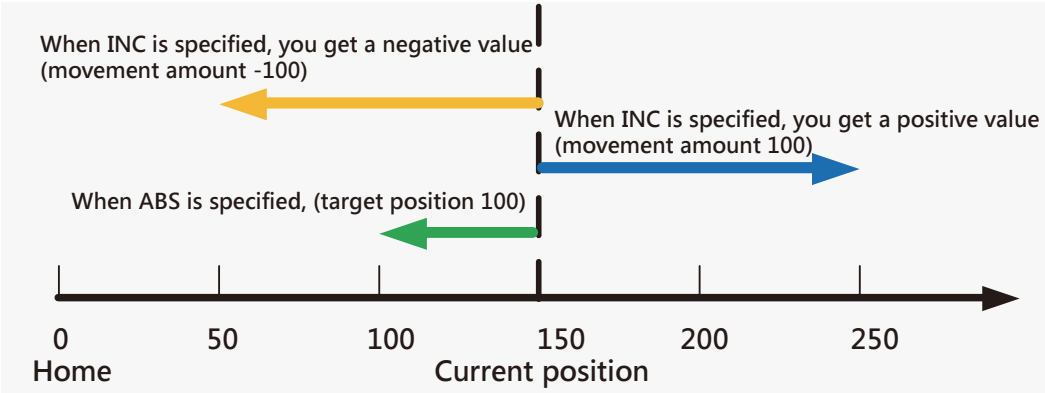
■■ **Case 2**

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	INC-R	210	100	500	0.00	0.00	0	2
2	INC-R	50.00	20	200	0.00	0.00	0	-1
3	ABS	200	50	823	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1
5	INC	0.00	100	500	0.00	0.00	0	-1
6	INC	0.00	100	500	0.00	0.00	0	-1

Descriptions:
With "Relative Position," Speed 100%, and Torque Limit 50%, it moves to Position 210mm. Afterwards, with "Absolute Position," Speed 20%, and Torque Limit 20%, it moves to Position 250mm. (Non-stop between Point P1 and Point P2)

4.3 Movement coordinates

They varies depending on the operating mode.
■■ ABS: Absolute position and the setting value is used as the target position.
■■ INC: Absolute position and the setting value is used as the signed amount of movement.
The figure shows the movement difference when 100 is set for the movement coordinates.



4.4 Movement speed

The speed used for movement setting. It is set based on the percentage (%) of the maximum speed of each robot.

⚠Caution:
In Torque Search Mode, reduce the speed to less than 30% to increase the accuracy of the torque reading.

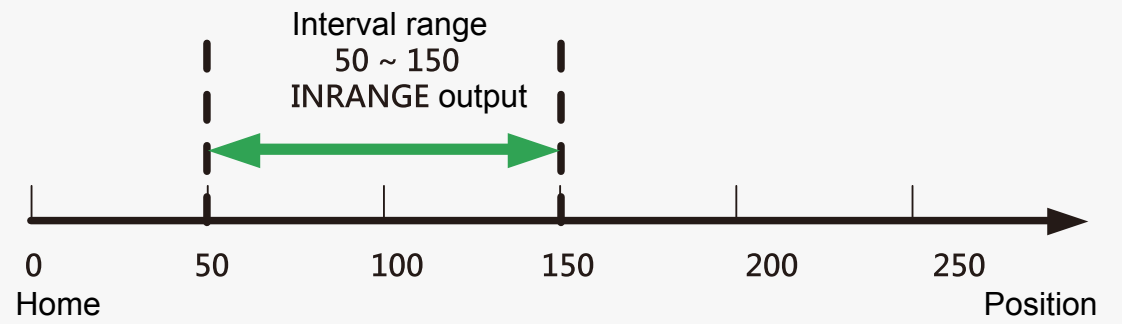
4.5 Torque limit

Set the current limit value for movement. It is set based on the percentage (%) of the rated current of each robot.

⚠Caution:
The setting value of the torque limit is measured in 0.1%. Therefore, 1000 represents 100% which indicates the rated current of each robot. For each robot, the current value varies depending on the hardware friction.

4.6 Interval range setting (upper / lower limit):

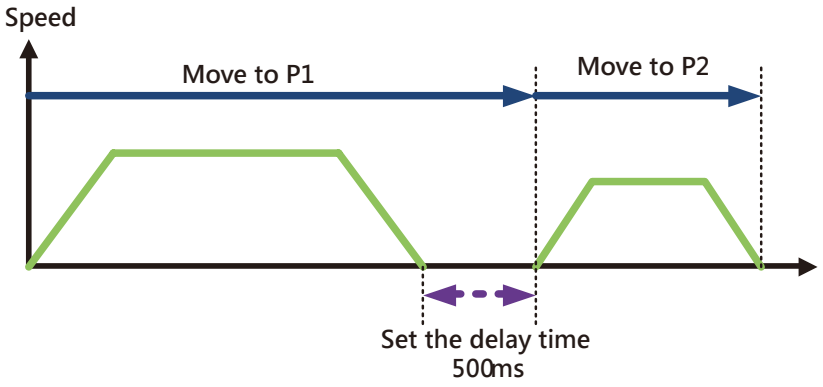
Set the upper limit and lower limit of the interval range. In the interval, the dedicated signal "INRANGE" can be output.
You have to set I/O parameters to be output before the dedicated signal is output.
The figure below shows the setting example of the interval 50~150 from Home of the absolution position.



4.7 Delay

■■ Case 1

Point number	Operating mode	Movement coordinates mm	Movement speed (1~100)%	Torque limit (1~1000)x0.01	Lower limit of the interval range mm	Upper limit of the interval range mm	Delay time ms	Next step no.
1	ABS	0.00	100	500	0.00	0.00	500	2
2	ABS	200	100	500	0.00	0.00	0	-1
3	INC	0.00	100	500	0.00	0.00	0	-1
4	INC	0.00	100	500	0.00	0.00	0	-1



Descriptions: Move Point P1 and move to Point P2 after 500ms.

5. Parameter data

5.1 Position Control Parameter

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
1	0108 H	2	FullCountValue	Alarm value of the counter overflow	Vary depending on the model	1~ 100000 pulse	o
2	010A H	1	InPositionZone	Reach the interval value	If the setting value is too large or the movement speed is too slow, the INPOSTION signal may become ON.	0 ~ 1000 pulse	o
3	010D H	1	OpenModeSwitch	Open-Circuit Mode switchover	0: Full-time closed-circuit mode (initial value) 1: Dual mode (Closed-circuit during the movement while open-circuit when stop)	0~1	o
4	010F H	1	AutoCrntDwnEnable	Automatic current decrease	0: Invalid (initial value) 1: valid.	0~1	o
5	0110 H	1	AutoCrntDwnRate	The current value for automatic current decrease	(Initial value 500)	1~1000 x0.1%	o
6	0111 H	1	AutoCrntDwnTime	During the delay time, automatic current decrease is performed when the current is too large	(Initial value 1000)	50~5000 msec	o
7	0112 H	1	OpenModeCrntRate	The current value in Open mode	(Initial value 1000)	1~1000 x0.1%	o
8	0113 H	1	CloseToOpenTime	The delay time when it switches to open-circuit from closed-circuit after the motor stop	010D H: OpenModeSwitch is set to 1; the switchover delay time after the motor stops (Initial value 100)	10~5000 msec	o
9	0114 H	1	PosDir	External pulse command, and specified rotary direction	0: Motor operation direction CW 1: Motor operation direction CCW	0 ~ 1	o
10	0115 H	1	SelComPulse	External pulse command type	0: CW/CCW (Initial value) 1: PULSE/DIR 2: A-phase / B-phase	0 ~ 2	o
11	0117 H	1	HoldAccuratePos	Position calibration selection for the open-circuit control	0: Position calibration is not performed. (Initial value) 1: Position calibration is performed.	0~1	o
12	0118 H	1	CorrectSpeed	Position calibration speed for the open-circuit control	Initial value 75	10~500 pps	x
13	0119 H	1	PosTolweance	Position calibration acceptable value for the open-circuit control	Initial value 0	0~100 pulse	x

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
14	011C H	1	CrntBoostRate	The current increase ratio of Full time Open-Circuit Mode during acceleration and deceleration	Initial value 100	100~150 %	x
15	011D H	1	NearZone	The range setting of the NEAR signal output	Initial value 4	0~10000 pulse	x

Note 1) The initial value varies depending on the motor.

Note 2) Modification of this parameter value will affect the vibration and run-out of the motor. Do not modify it yourself.

5.2 Thrust Control Parameter

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
1	0400 H	1	PushTrqRateCw	+ Directional push, torque value (*0.1%)	-	0 ~ 1000 ×0.1%	x
2	0401 H	1	PushTrqRateCcw	- Directional push, torque value (*0.1%)	-	0 ~ 1000 ×0.1%	x
3	0402 H	1	TrqLmtTime	Torque limit detection time (msec)	-	0 ~ 10000 msec	o
4	0406 H	1	RtnSpdLmtEnable	Select if the position adjustment speed limit is performed	0: Invalid (Initial value) 1: Valid	0~1	x
5	0407 H	1	RtnMaxSpd	Speed limit for position adjustment	(Initial value 10)	10~500	x

Note) The initial value of 0406h is 0. If it is set to 1, internal I/O is used to perform points. If the actuator continuously runs back and forth, noise may occurs. We recommend to use DELAY TIME or disable 0406h to correct this.

5.3 Common parameter

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
1	0500 H	1	MaxTrqRate	Maximum torque value (0.1%)	150% of the 100% rated torque	0 ~ 1000 ×0.1%	o
2	0501 H	1	FullTrqTime	Detection error cycle time (msec)	-	500 ~ 0000 msec	o
3	0505 H	1	BrakeOffDelay	Brake release delay time setting	Set the ratio of the rated current to the motor current when the brake is released.	0 ~ 100 %	o
4	050E H	1	SelRgBrake	Brake On/Off when Servo is OFF	0: Off; 1: On	0 ~ 1	o
5	0514 H	1	SelCommand	Command control selection	0: External PULSE command control; 1: Internal controller control	0 ~ 1	o
6	0515 H	1	ServoState	When power is on, the servo status setting	Setting of the action command 2011 H. 0: Servo is ON; 1: Servo is OFF	0 ~ 1	x

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
7	0517 H	1	InitializeDelay	When power is on, the delay time when the initialization is performed.	Set the delay time when initializing the 0506 H parameter	0 ~ 3 2 7 6 7 msec	o
8	0518 H	1	BrakeEnable	Brake function selection	0: Brake function off (initial value); 1: Brake function on	0~1	o
9	0519 H	1	BrakeOnDelay	Delay time when Brake ON	Set the delay time when Brake ON (initial value 0)	0 ~ 1 0 0 0 msec	x
10	051A H	1	BrakeOffDelay	Delay time when Brake OFF	Set the delay time when Brake OFF (initial value 0)	0 ~ 1 0 0 0 msec	x

5.4 Input Parameters

NO	Parameter	Number of words	Description	Remarks
1	0601 H	1	JOG+: + JOG movement	-
2	0602 H	1	JOG-: - JOG movement	-
3	0603 H	1	MANUAL: Manual mode	-
4	0604 H	1	TEACH: Save point positions	-
5	0607 H	1	LOCK: Pause / interlock	-
6	0609 H	1	CONT_MODE: Control mode selection	-
7	060F H	1	PRGSEL5: Program Selection No.0 ~ 127 Bit5	-
8	0610 H	1	PRGSEL6: Program Selection No.0 ~ 127 Bit6	-
9	0611 H	1	ORG_SIG: Detection signal for home return	-
10	0612 H	1	BK_OFF: Brake on/off signal (enabled when SERVO OFF)	-
11	0613 H	1	FULL_COUNT: Output when the position deviation is too large	-

Note) Reboot is required after modification of any IO parameter.

5.5 Output parameters

NO	Parameter	Number of words	Description	Remarks
1	0700 H	1	INP: Inposition signal	-
2	0701 H	1	ALARM: Error signal	-
3	0702 H	1	READY: SERVO READY	-
4	0703 H	1	MOVE: In motion	-
5	0705 H	1	SERVO-S: SERVO ON status	-
6	0706 H	1	PRGSEL0-S: Program Selection No.0 ~ 127 Bit0	-
7	0707 H	1	PRGSEL1-S: Program Selection No.0 ~ 127 Bit1	-
8	0708 H	1	PRGSEL2-S: Program Selection No.0 ~ 127 Bit2	-

9	0709 H	1	PRGSEL3-S: Program Selection No.0 ~ 127 Bit3	-
10	080A H	1	PRGSEL4-S: Program Selection No.0 ~ 127 Bit4	-
11	070B H	1	PRGSEL5-S: Program Selection No.0 ~ 127 Bit5	-
12	070C H	1	PRGSEL6-S: Program Selection No.0 ~ 127 Bit6	-
13	070D H	1	TRQLIM: Torque Limit	-
14	070E H	1	ERR0: Error Coding Bit0	-
15	070F H	1	ERR1: Error Coding Bit1	-
16	0710 H	1	ERR2: Error Coding Bit2	-
17	0711 H	1	ERR3: Error Coding Bit3	-
18	0712 H	1	INRANGE: Output when in the range of an interval	-
19	0713 H	1	NEAR: Output when moving to the range of the target position	-
20	0714 H	1	SOFTLMT: Software limit output indicator.	-

Note) Reboot is required after modification of any IO parameter.

5.6 Speed setting parameters

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
1	0800 H	2	LowSpeed	Activation speed setting	Motor activation speed setting Up to the first decimal place	pps	x
2	0802 H	2	HighSpeed	Set the highest speed during the operation	Set the highest operating speed for the motor. Up to the first decimal place.	pps	x
3	0804 H	2	AccelTim	Set the acceleration and deceleration time	Set the acceleration and deceleration time for the motor.	1 ~ 30000 msec	x
5	0807 H	2	TrqLimitPress	Set the torque limit during the thrust motion	During the torque search, set the number of pulses after the torque is reached	0.01mm/ pulse	x
6	080A H	1	MoveSttSet	Set the in-motion status	Set the action status. 0: In-motion status OFF after the specified PULSE is output. 1: Inposition ON and In-motion status OFF after the specified PULSE is output.	0 ~ 1	x
7	080F H	1	JogInchingSpd	Set the speed for JOG movement		1 ~ 100 %	x
8	0810 H	2	JogInchingData	Set the amount of movement for JOG movement			x
9	0812 H	1	JogInchingWait	Set the delay time after JOG movement		0 ~ 1000 msec	x
10	0813 H	2	PlusSoftLimit	Soft limit for + direction	Set the soft limit for + direction If the soft limit value for ± direction is 0, it is invalid.	0~ 21474836.47	x
11	0815 H	2	MinusSoftLimit	Soft limit for - direction	Set the soft limit for - direction If the soft limit value for ± direction is 0, it is invalid.	-21474836.48 ~0	x

5.7 Home setting parameters

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
1	0900 H	1	OrgDir	Home return mode and direction	Set the movement direction for home return. 0: Torque return + direction; 1: Torque return - direction; 2: After torque return + direction, find the Z-phase in an opposite way; 3: Find the Z-phase in an opposite way; 4: Toward + direction, find the ORG_SIG signal; 5: Toward - direction, find the ORG_SIG signal; 6: Toward + direction, find the ORG_SIG signal. After that, find the Z-phase in an opposite way; 7: Toward - direction, find the ORG_SIG signal. After that, find the Z-phase in an opposite way	0~7	x
2	0901 H	1	OrgSpeed	Home return speed	Set the movement speed for home return. The highest speed is 100%.	0 ~ 100%	x
3	0902 H	2	OrgOffset	Set the offset for home return.	During the torque homing, move one offset in an opposite way after the Z-phase is found. "400 h: DigPushTrqRateCw" and "401 h: DigPushTrqRateCcw" are the torques during the movement.		x
4	0904 H	1	OrgOffsetSpeed	The movement speed for the home return offset	During the torque homing, this is the movement speed at which it moves one offset in an opposite way after the torque is detected. The highest speed is 100%.	0 ~ 100%	x
5	0905 H	2	OrgData	The data of home return	The data used to set a position after the home return is finished		x
6	0907 H	1	OrgTrqLimit	Set the torque used during the home return	Set the torque limit for the home return	0 ~ 1000 0.1 %	x
7	0908 H	2	OrgOffset_Z	The offset before Z-phase is detected.	The offset before the Z-phase is found for the home return.		x
8	090A H	1	OrgTrqLmtTime	The torque detection time during the home return	Set the torque detection time when the home return is performed (Initial value 0)	0 ~ 1 0 0 0 0 msec	x
9	090B H	1	OrgSpeed_Z1	Z-phase detection speed _1	Adjust the speed of the Z-phase search during the home return. (100% setting value of 0802 H is used as reference) After the Z-phase is found at a speed specified in 090B H, find the Z-phase again in an opposite way at a speed specified in 090C H.	1~100 %	x
10	090C H	1	OrgSpeed_Z2	Z-phase detection speed _2		1~100 %	x

5.8 Communication setting parameters

NO	Parameter	Number of words	Abbreviation	Description	Remarks	Range	Reboot after modification
1	0A00 H	1	BaudRate	Communication rate	Set the communication rate 0: 9600bps 1: 19200bps 2: 38400bps 3: 57600bps	0~3	o
2	0A01 H	1	DataSize	String data bit setting	Set the number of the data bits in one string. 0: 8bit 1: 7bit	0 ~ 1	o
3	0A02 H	1	Parity	Parity	Parity setting. 0: None 1: Even 2: Odd	0 ~ 2	o
4	0A03 H	1	Broadcast	Broadcast setting	Broadcast setting. The message of the broadcast position will be ignored if it is invalid. 0: Invalid 1: Valid	0 ~ 1	o
5	0A04 H	1	Protocol	Communication protocol	Set the MODBUS protocol of RS485. 0: MODBUS-ASCII 1: MODBUS-RTU	0 ~ 1	o

Note) If a UI has to be used to cascade the TC100 controller, it should be in ASCII Mode.

6. Description of I/O functions

6.1 I/O specifications

TC100 can communication with peripherals with the IO interface.
I/O is interfaced with a 32-pin ribbon cable. You should select the length of your ribbon at the time of purchase.
I/O specifications: Transistor type (NPN).

32-pin ribbon cable {
- 10 IN DC24V, ±10%, 1.5~6mA/point, common anode.
- 12 OUT DC24V, ±10%, less than 10mA/point, common anode.
- PULSE +/-
- DIR +/-

6.2 I/O signal table

NO	Signal name	Content description	Remarks
A1	COM+	IO power +24V	+24V ±10%
A2	COM-	IO power 0V	
A3	IN 1	ORG	Unset parameters: LOCK MANUAL JOG+ JOG- TEACH BK_OFF CONT_MODE FULL_COUNT
A4	IN 2	SERVO	
A5	IN 3	ALM_REAET	
A6	IN 4	START	
A7	IN 5	PRGSEL0	
A8	IN 6	PRGSEL1	
A9	IN 7	PRGSEL2	
A10	IN 8	PRGSEL3	
A11	IN 9	PRGSEL4	
A12	IN 10	PRGSEL5	
A13	IN 11	PRGSEL6	
A14	IN 12	ORG_SIG	
A15	Reserved	-	
A16	Reserved	-	
B1	OUT 1	ORG-S	Unset parameters: ALARM MOVE PRGSEL6-S TRQLIM ERR0 : ERR3 INRANGE NEAR SOFTLMT
B2	OUT 2	INP	
B3	OUT 3	READY	
B4	OUT 4	SERVO-S	
B5	OUT 5	PRGSEL0-S	
B6	OUT 6	PRGSEL1-S	
B7	OUT 7	PRGSEL2-S	
B8	OUT 8	PRGSEL3-S	
B9	OUT 9	PRGSEL4-S	
B10	OUT 10	PRGSEL5-S	
B11	P1+	CCW, B-phase, PULSE	CW/CCW A/B-phase PULSE/DIR
B12	P1-		
B13	P2+	CW, A-phase, DIR	
B14	P2-		
B15	Reserved	-	
B16	FG	Knitted wire mesh/grounding	

6.3 Description of input signals

<table>
<tr><th>NO</th><th>Signal name</th><th>Description</th></tr>
<tr><td>1</td><td>ORG</td><td>Point coordinates are valid only when the home return is performed after booting.</td></tr>
<tr><td>2</td><td>ALM_RESET</td><td>When this signal is ON, perform the following steps:
When an alarm occurs, reset it. After the corresponding actions are taken, dismiss the alarm using this signal.</td></tr>
<tr><td>3</td><td>/SERVO</td><td>This signal represents Contact B. It is OFF when Servo is ON. It is ON when Servo is OFF.
Note: When an alarm or emergency stop occurs, the Servo is OFF and cannot be controlled.</td></tr>
<tr><td>4</td><td>/LOCK</td><td>This signal represents Contact B. During the operation, if it is ON, the robot will decelerate and come to a stop. If you want to activate it again, this signal should be OFF.
Note: Interlocking is not a safety switch. Do not use it for safety purposes. The Servo will not be OFF during the interlocking and remain in the current status.</td></tr>
<tr><td>5</td><td>START</td><td>Perform the positioning operation for the coordinate point data specified by the point number selection (PRGSEL0 ~ PRGSEL6).
Note: It is valid only when the Manual Mode (MANUAL) is OFF.</td></tr>
<tr><td>6</td><td>PRGSEL0
~
PRSEL6</td><td>Read the 7-digit point number in binary before using the “START“ or “TEACH“ signal.

PIN6 PIN0
0 1 0 1 0 0 1

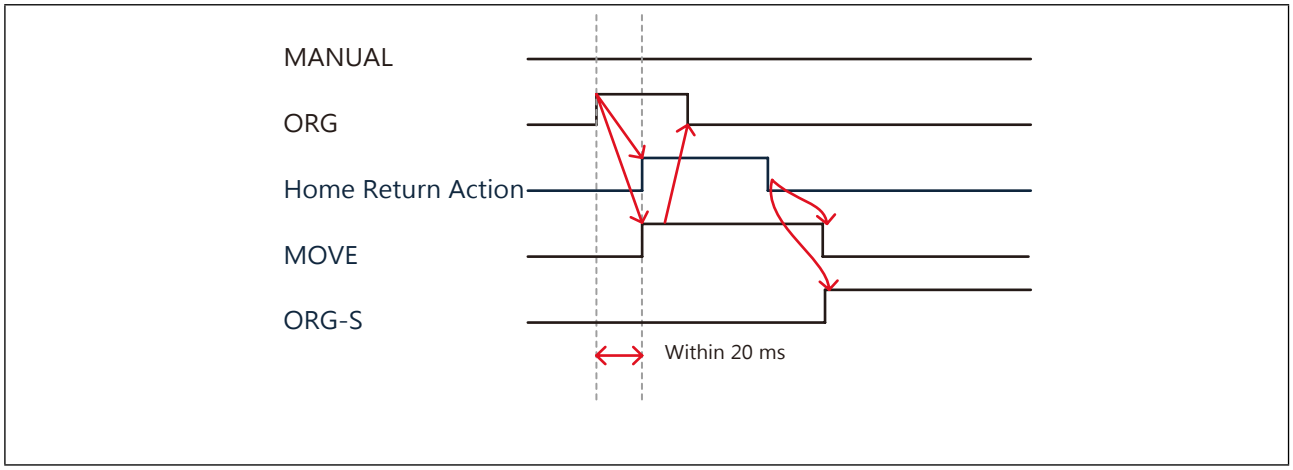
<table>
<tr><th>The sum value when ON</th><th colspan="2">Example</th></tr>
<tr><td>2^0</td><td>1</td><td rowspan="7">Total = 41
(Coordinate point no. 41)</td></tr>
<tr><td>2^1</td><td>0</td></tr>
<tr><td>2^2</td><td>0</td></tr>
<tr><td>2^3</td><td>8</td></tr>
<tr><td>2^4</td><td>0</td></tr>
<tr><td>2^5</td><td>32</td></tr>
<tr><td>2^6</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>7</td><td>JOG+ / JOG-</td><td>In Manual Mode, the motor moves in the specified direction when JOG(+/-) ON, until the signal is OFF or the soft limit is reached.</td></tr>
<tr><td>8</td><td>MANUAL</td><td>When this signal is ON, it enters Manual Mode.
The following actions can be performed in Manual Mode: JOG(+/-), TEACH, PRGSEL 0~PRGSEL 6, etc.</td></tr>
<tr><td>9</td><td>TEACH</td><td>When this signal is ON, the current position value is saved in the specified point position.</td></tr>
<tr><td>10</td><td>CONT_MODE</td><td>When 0503 H is 0, COUNT_MODE is set to ON which works as 0503 H =1.</td></tr>
<tr><td>11</td><td>FULL_COUNT</td><td>FULL_COUNT is set to ON. When ± TSL is performed and the torque is reached, the FULLCOUNT value will not be referred.</td></tr>
</table>

6.4 Description of output signals

<table>
<tr><th>NO</th><th>Signal name</th><th>Description</th></tr>
<tr><td>1</td><td>IN-POSITION</td><td>The InPositon signal is ON when the command position is identical to the current position. When the value of parameter InPositionZone is too large or it moves at a slower speed, the InPosition signal may often be ON.</td></tr>
<tr><td>2</td><td>ALARM</td><td>When there is a problem with the controller, the signal is ON.</td></tr>
<tr><td>3</td><td>READY</td><td>When the controller is in standby status, and can receive external signals or communication commands, the signal is ON.</td></tr>
<tr><td>4</td><td>MOVE</td><td>During the movement, the signal is ON.</td></tr>
<tr><td>5</td><td>ORG-S</td><td>After the home return is finished, the signal is ON. It is OFF during the home return.</td></tr>
<tr><td>6</td><td>SERVO-S</td><td>After the servo is excited, the signal is ON. If there is an emergency stop or an error, it is OFF.</td></tr>
<tr><td>7</td><td>PRGSEL0-S
~
PRGSEL6-S</td><td>PIN6 PIN0
0 1 0 1 0 0 1
<table><tr><th>The sum value when ON</th><th colspan="2">Example</th></tr><tr><td>2^0</td><td>1</td><td rowspan="7">Total = 45
(Coordinate point no. 45)</td></tr><tr><td>2^1</td><td>0</td></tr><tr><td>2^2</td><td>4</td></tr><tr><td>2^3</td><td>8</td></tr><tr><td>2^4</td><td>0</td></tr><tr><td>2^5</td><td>32</td></tr><tr><td>2^6</td><td>0</td></tr></table></td></tr>
<tr><td>8</td><td>TRQ_LMT</td><td>When the motor moves, this signal is ON if this current value reaches the set value.</td></tr>
<tr><td>9</td><td>ERR0 ~ ERR3</td><td>When there is a problem with the controller, the error code is output in binary. It shows 16 error statuses.</td></tr>
<tr><td>10</td><td>INRANGE</td><td>When the motor operates and enters the set range, this signal is ON.</td></tr>
<tr><td>11</td><td>NEAR</td><td>The point position is set to ABS or INC. When the command position changes and the actual position is within ± 011D range of the command position, it lights up and turns solid when in position. This is within its determined point of time.</td></tr>
<tr><td>12</td><td>SOFTLMT</td><td>If it exceeds the soft limit, it is ON. If not, it is OFF.</td></tr>
</table>

7. Action timing

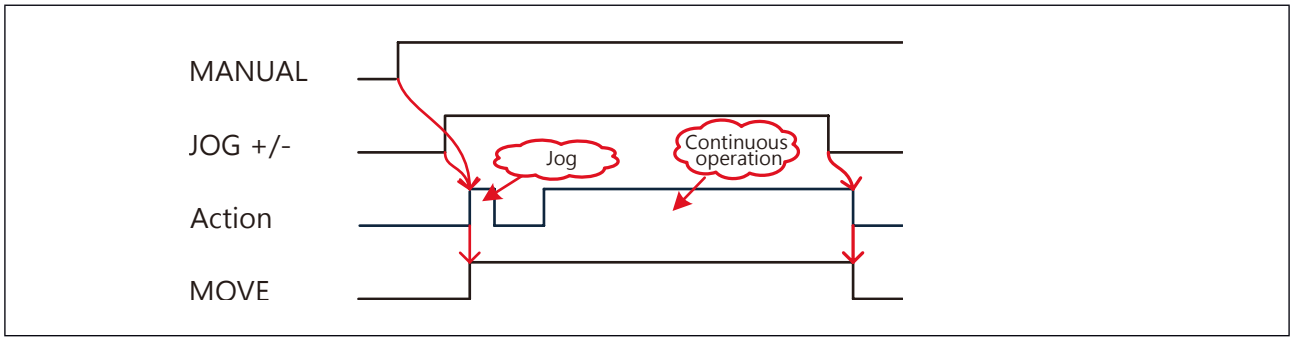
7.1 Home return



Description:

1. After normal booting, the servo signal is ON.
2. The signal "ORG" will be input and the signal is ON.
3. It starts to perform the home return and the "MOVE" signal is ON. Input "ORG" and the signal becomes OFF.
4. After the home return is finished, the "MOVE" signal is OFF and the "ORG-S" signal is ON. The home return is finished.

7.2 I/O control JOG action

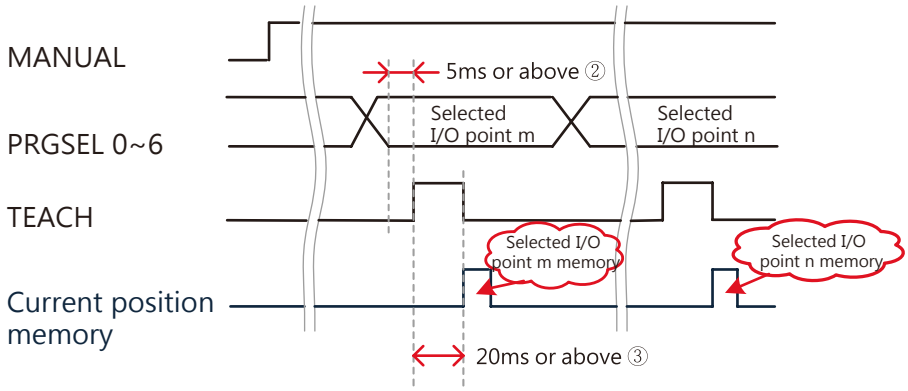


Description:

It is valid only when the "MANUAL" signal is ON.

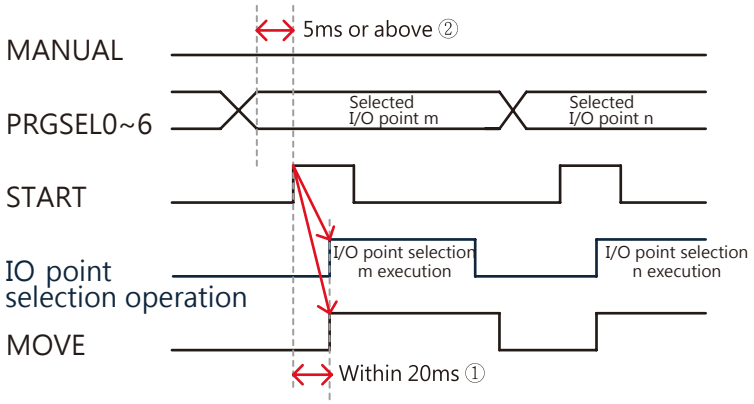
1. Set the "MANUAL" signal to ON.
1. "JOG +/-" signal is ON and the motor starts operation. "MOVE" is ON.
2. "JOG +/-" signal is OFF and the motor stops operation. "MOVE" is OFF.

7.3 I/O point teaching



Description:
It is valid only when "MANUAL" is ON.
1. Set the "MANUAL" signal to ON.
2. Determine and select a point position to be taught based on the signal "PRGSEL0 ～ 6" (in binary code).
3. Set the "TEACH" signal to ON and at least 20ms or above. Position memory now is finished.

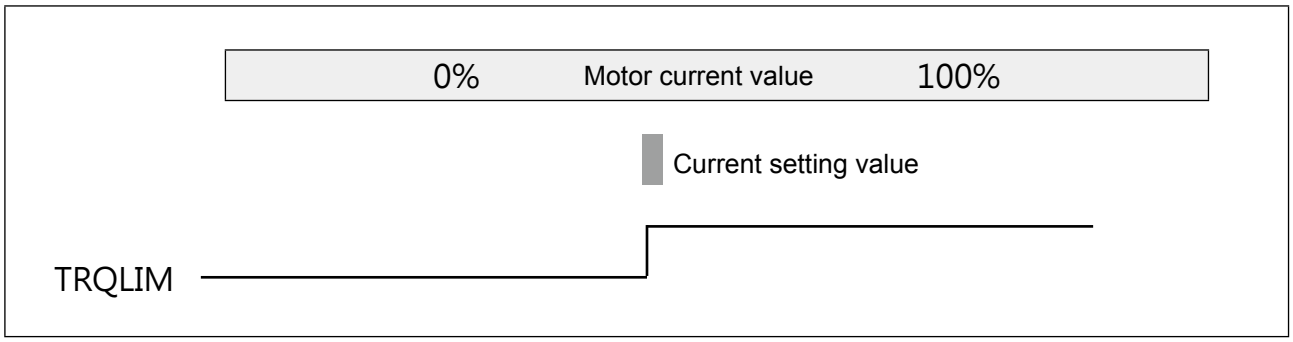
7.4 I/O point selection operation



Description:
It is valid only when "MANUAL" is ON.
1. Set the "MANUAL" signal to OFF.
2. Determine and select a point position to which you want to move based on the signal "PRGSEL0~6" (in binary code).
3. Enable the "START" signal to ON and the IO point selection is finished. The motor starts operating and the "MOVE" signal is ON.

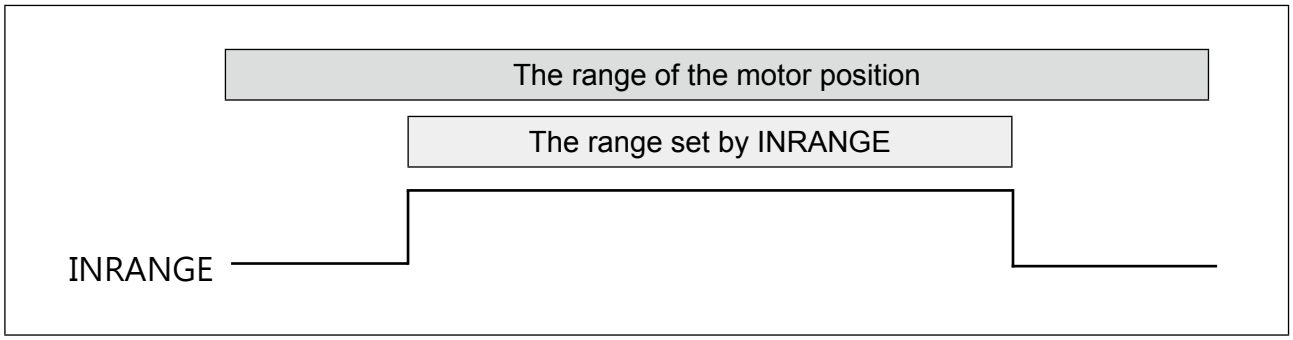
Note:
①. The minimum period of time which the ORG and START signals accept.
②. The time during which the PRGSEL n signal is stable.
③. The minimum period of time which the point memory signal accepts.
④. During the JOG operation, the fine-tune distance, delay time, and operating time can be set in parameters.

7.5 TRQLIM signal output



7.6 INRANGE signal output

During the setting of a point position, this signal will be output only when the motor moves to the range after the upper limit and lower limit of INRANGE are set.



7.7 The LED display on the controller

LED status	PWR: Power (green): Lights up when drive + control power is supplied; when the drive power is turned off, the green indicator is flashing. SON: Servo (green): Lights up when Servo is ON; when an error occurs, it goes off. ERR: Abnormal situation (red): Determine the error code based on the flashing times.

8. Communication _RS485

8.1 Communication specification

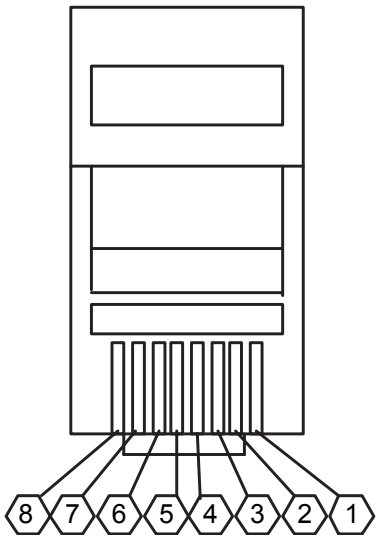
This unit communicates with other devices via MODBUS PROTOCOL.
There are two transfer modes: ASCII or RTU (binary) modes.

Item	ASCII Mode	RTU Mode
Communication protocol	MODBUS ASCII	MODBUS RTU
Communication method	RS-485 2-wire (half-duplex)	
	USB2.0	-
Communication distance	RS-485: Up to 500 meters when combined with cables	
	USB 2.0: 5 meters	-
Connection type	RS-485: One to Multiple (up to 16 units)	
	USB 2.0: One to One	-
Communication speed	9600, 19200, 38400 and 57600 bps	
Start bit	1 BIT	
Data length	7, 8 BIT	8 BIT
Parity	None, even parity, odd parity	
Stop bit	1 BIT	
Communication code	ASCII	Binary
Start code	" : " (3A H)	None
End code	CR+LF (0D H+0A H)	None
Check code	LRC	CRC-16
Maximum number of units	16 units	

Note) If a UI has to be used to cascade the TC100 controller, it should be in ASCII Mode.

■■ Pins assignments of the CN6 and CN7 (RJ-45) connectors are described as follows:

Pin	Signal name	Description
1		
2	SG	Signal ground wire (knitted wire mesh)
3	SIG-A	DATA +
4		
5	SG	Signal ground wire (knitted wire mesh)
6	SIG-B	DATA -
7		
8	SG	Signal ground wire (knitted wire mesh)



8.2 Data structure

■■ Read status

Position	Number of words	Abbreviation	Description	Remarks	Range / unit
1000 H	1	ActionStatus	Action status	0: Stop 1: Working 2: Abnormal stop	0~2
1001 H	1	InpStatus	Current status of the InPositon signal	0: The current position is not within the set range 1: The current position is within the target range	0~1
1004 H	1	TrqLmtStatus	Torque limit status	0: Not within the set range 1: Within the target range	
1005 H	1	AlarmStatus	Alarm status	0: No alarm 1: Over-torque 2: Position exceeded 3: Over speed 4: Poor gain adjustment 5: Over-voltage 6: Initialization abnormal 7: EEPROM abnormal 8: Low voltage of the main circuit 9: Over-current 10: Regeneration abnormal 11: In emergency stop 12~14: Not used 15: Power OFF/ON	
1006 H	1	MonSpeed	Motor rotational speed		rpm
1007 H	1	MonCurrent	Motor current value		*0.1%
1008 H	2	CmdNowPos	Current position of the command		
100A H	2	EcdPos	Encoder position		
100C H	1	ServoStatus	Servo Status	0: Servo is OFF 1: Servo is ON	0~1
100D H	1	ErrorStatus	Failure status	0: No failure 1: Working, feedback action command 2: Upper limit and lower limit error 3: Position error 4: Format error 5: Control mode error 6: Power OFF/ON 7: Torque detection not completed 8: Servo is ON or OFF error 9: LOCK signal error A: Soft limit	
100E H	1	StepNo	Program selection number	Display the number of the last executed program The program STEP that has never been executed is "-1"	-1~127
1020 H	1	PORT (OUT1~10)	Overall output status	Output bit 0 (OUT 1) ~ bit 9 (OUT 10) 0: OFF 1: ON	0~1023
1021 H	1	PORT (OUT 1)	Independent output status	Output status of OUT 1; 0: OFF 1: ON	0~1
1022 H	1	PORT (OUT 2)	Independent output status	Output status of OUT 2; 0: OFF 1: ON	0~1

Position	Number of words	Abbreviation	Description	Remarks	Range / unit
1023 H	1	PORT (OUT 3)	Independent output status	Output status of OUT 3; 0: OFF 1: ON	0~1
1024 H	1	PORT (OUT 4)	Independent output status	Output status of OUT 4; 0: OFF 1: ON	0~1
1025 H	1	PORT (OUT 5)	Independent output status	Output status of OUT 5; 0: OFF 1: ON	0~1
1026 H	1	PORT (OUT 6)	Independent output status	Output status of OUT 6; 0: OFF 1: ON	0~1
1027 H	1	PORT (OUT 7)	Independent output status	Output status of OUT 7; 0: OFF 1: ON	0~1
1028 H	1	PORT (OUT 8)	Independent output status	Output status of OUT 8; 0: OFF 1: ON	0~1
1029 H	1	PORT (OUT 9)	Independent output status	Output status of OUT 9; 0: OFF 1: ON	0~1
102A H	1	PORT (OUT 10)	Independent output status	Output status of OUT 10; 0: OFF 1: ON	0~1
1040 H	1	PORT (IN1~12)	Overall output status	Input bit 0 (IN 1) ~ bit 9 (IN 12) 0: OFF 1: ON	4095
1041 H	1	PORT (IN 1)	Independent output status	Input status of OUT 1; 0: OFF 1: ON	0~1
1042 H	1	PORT (IN 2)	Independent output status	Input status of OUT 2; 0: OFF 1: ON	0~1
1043 H	1	PORT (IN 3)	Independent output status	Input status of OUT 3; 0: OFF 1: ON	0~1
1044 H	1	PORT (IN 4)	Independent output status	Input status of OUT 4; 0: OFF 1: ON	0~1
1045 H	1	PORT (IN 5)	Independent output status	Input status of OUT 5; 0: OFF 1: ON	0~1
1046 H	1	PORT (IN 6)	Independent output status	Input status of OUT 6; 0: OFF 1: ON	0~1
1047 H	1	PORT (IN 7)	Independent output status	Input status of OUT 7; 0: OFF 1: ON	0~1
1048 H	1	PORT (IN 8)	Independent output status	Input status of OUT 8; 0: OFF 1: ON	0~1
1049 H	1	PORT (IN 9)	Independent output status	Input status of OUT 9; 0: OFF 1: ON	0~1
104A H	1	PORT (IN 10)	Independent output status	Input status of OUT 10; 0: OFF 1: ON	0~1
104B H	1	PORT (IN 11)	Independent output status	Input status of OUT 11; 0: OFF 1: ON	0~1
104C H	1	PORT (IN 12)	Independent output status	Input status of OUT 12; 0: OFF 1: ON	0~1

■■ Read 50 error histories

Position	Number of words	Abbreviation	Description
1060 H	1	AlarmList 01	50 error histories -01
1061 H	1	AlarmList 02	50 error histories -02
1062 H	1	AlarmList 03	50 error histories -03
1063 H	1	AlarmList 04	50 error histories -04
1064 H	1	AlarmList 05	50 error histories -05
1065 H	1	AlarmList 06	50 error histories -06
1066 H	1	AlarmList 07	50 error histories -07
1067 H	1	AlarmList 08	50 error histories -08
1068 H	1	AlarmList 09	50 error histories -09
1069 H	1	AlarmList 10	50 error histories -10
106A H	1	AlarmList 11	50 error histories -11
106B H	1	AlarmList 12	50 error histories -12
106C H	1	AlarmList 13	50 error histories -13
106D H	1	AlarmList 14	50 error histories -14
106E H	1	AlarmList 15	50 error histories -15
106F H	1	AlarmList 16	50 error histories -16
1070 H	1	AlarmList 17	50 error histories -17
1071 H	1	AlarmList 18	50 error histories -18
1072 H	1	AlarmList 19	50 error histories -19
1073 H	1	AlarmList 20	50 error histories -20
1074 H	1	AlarmList 21	50 error histories -21
1075 H	1	AlarmList 22	50 error histories -22
1076 H	1	AlarmList 23	50 error histories -23
1077 H	1	AlarmList 24	50 error histories -24
1078 H	1	AlarmList 25	50 error histories -25
1079 H	1	AlarmList 26	50 error histories -26
107A H	1	AlarmList 27	50 error histories -27
107B H	1	AlarmList 28	50 error histories -28
107C H	1	AlarmList 29	50 error histories -29
107D H	1	AlarmList 30	50 error histories -30
107E H	1	AlarmList 31	50 error histories -31
107F H	1	AlarmList 32	50 error histories -32
1080 H	1	AlarmList 33	50 error histories -33
1081 H	1	AlarmList 34	50 error histories -34
1082 H	1	AlarmList 35	50 error histories -35
1083 H	1	AlarmList 36	50 error histories -36
1084 H	1	AlarmList 37	50 error histories -37
1085 H	1	AlarmList 38	50 error histories -38
1086 H	1	AlarmList 39	50 error histories -39
1087 H	1	AlarmList 40	50 error histories -40
1088 H	1	AlarmList 41	50 error histories -41
1089 H	1	AlarmList 42	50 error histories -42
108A H	1	AlarmList 43	50 error histories -43
108B H	1	AlarmList 44	50 error histories -44
108C H	1	AlarmList 45	50 error histories -45
108D H	1	AlarmList 46	50 error histories -46
108E H	1	AlarmList 47	50 error histories -47
108F H	1	AlarmList 48	50 error histories -48
1090 H	1	AlarmList 49	50 error histories -49
1091 H	1	AlarmList 50	50 error histories -50

■■ Controller message

Position	Number of words	Abbreviation	Description	Remarks
10D0 H	1	MotorType	Motor model	Up to 31 characters (single-byte alphanumeric)
10E0 H	1	Controller	Controller model	"TC-100"
10F0 H	1	VerNo	Version number	HEX-ASCII format, 100 means Version 1.00

■■ Action

Position	Number of words	Abbreviation	Description	Remarks	Range / unit
2000 H	2	INCamount	Relative amount of movement	Set the relative movement distance (valid when position control and torque control) (initial value 0)	0.01mm/ 1pulse
2002 H	2	ABSamount	Absolute amount of movement	Set the absolute movement distance (valid when position control and torque control) (initial value 0)	0.01mm/ 1pulse

2005 H	1	TrqStopDir	Torque stop search direction	0: + direction; 1: - direction. Valid when the torque control is performed.	0~1
2006 H	2	PosAmount	Specified position data	Set the command and the current position data value (initial value 0)	0.01mm/ 1pulse
2011 H	1	Servo ON/OFF	Servo is ON/ OFF	0: Servo is ON; 1: Servo is OFF.	0~1
2012 H	1	SigSerachSet	Signal search criteria setting	Read the settings of the high and low bits at the input port (hexadecimal): 0: IN_1 High bit (initial value); C : IN_7 High bit 1: IN_1 Low bit; D: IN_7 Low bit 2: IN_2 High bit; E: IN_8 High bit 3: IN_2 Low bit; F: IN_8 Low bit 4: IN_3 High bit; 10: IN_9 High bit 5: IN_3 Low bit; 11 IN_9 Low bit 6: IN_4 High bit; 12: IN_10 High bit 7: IN_4 Low bit; 13: IN_10 Low bit 8: IN_5 High bit; 14: IN_11 High bit 9: IN_5 Low bit; 15: IN_11 Low bit A: IN_6 High bit; 16: IN_12 High bit B: IN_6 Low bit; 17: IN_12 Low bit	0~17
2013 H	1	SigSerachDir	Signal search direction	0: + direction; 1: - direction. (Initial value 0)	0~1
2014 H	1	MovSpeedSet	Action speed settings (Position/ torque control, relative position movement, absolute position movement, signal search)	The highest speed is set (assuming that the setting value of 0802 H is 100%) (initial value 100). If the setting value is 0%, movement is performed at initial speed (0800 H).	0~100%
201E H	1	MovType	Movement types	0: Relative position movement 1: Absolute position movement 2: Torque limit search movement (torque limit value refers to the settings of 0400 H and 0401 H) 3: Home return 4: Specify the command value and the value of the current position (the values refer to the setting of 2006 H) 5: Signal search 6: Alarm return 7: Deviation clear (which makes the command position is the identical to the current position) 8: Decelerates to stop 9: Emergency stop A: The initial setting (valid when 0506h AutoPfDetect = 1: Initial setting is performed upon booting. This communication position is required for SERVO ON) B: JOG + C: JOG -	0~C

■■ Description of the step commands

Position	Number of words	Step	Brief description	Content description	Range / unit
9010 H	1	First step	Movement Mode	Used to set the Movement Mode 0: INC Relative position movement (initial value) 1: ABS Absolute position movement 2: ORG Home return 3: +TSL Positive torque search movement 4: -TSL Negative torque search movement 5: Temporarily unavailable 6: Temporarily unavailable 7: Temporarily unavailable 8: Temporarily unavailable 9: Temporarily unavailable A: Temporarily unavailable B: Temporarily unavailable C: INC-R Relative position movement (continuous) D: ABS-R Absolute position movement (continuous) When "ModeSwitch" is OFF, "ModeSwitch" will be set to ON only when in Action Mode.	0~D
9011 H	2		Amount of movement / movement position	Set the amount of movement / movement position. Mode definition: ABS = Target position INC = Relative Position (amount of movement) ABS-R= Target position INC-R = Relative Position (amount of movement) Except for the above, other modes are invalid (initial value 0) * The max amount of movement per step ranges between - 2147483648 ~ 214748648	- 2147483648 ~ 214748648
9013 H	1		Movement speed	Set a movement speed. The setting value is the percentage of the max speed (0802 H). If it is set to 0%, the initial speed (0800 H) is used. If the following modes are used as movement mode (9000 H), this parameter is invalid. ORG: 2	0 ~ 100 %
9014 H	1		Torque limit	Except for the signal search mode, other movement modes are affected	0~1000 x0.1%
9015 H	1		Reserved		0
9016 H	2		Range L	The lower limit of the interval range. When the current position is less than the setting value, the I/O specified by INRANGE will output. (Initial value 0)	
9018 H	2	First step	Range H	The upper limit of the interval range. When the current position is more than the setting value, the I/O specified by INRANGE will output. (Initial value 0)	
901A H	1		Delay time	The delay time after the movement is finished. (Initial value 0)	0~30000 msec
901B H	1		Next step	It skips to the specified program at the end. (Initial value -1)	-1~127-1 end
9020 H ~ 902B H	12	The second step			
∫∫					

■■ Parameter comments and storage

Position	Number of words	Brief description	Content description	Range / unit
9991 H	8	Parameter comments	Up to 15 characters (single-byte alphanumeric)	
9999 H	1	Parameter storage	0: Current parameter; 1: Default parameter	0~1

■■ RTU Mode structure

01	06	20	1E	00	03	A2	0D
ID 1 Byte	Function code 1 Byte	Data 2~120 Byte				CRC-16 2 Byte	

■■ ASCII Mode structure

. . (3A H)	0	1	0	6	2	0	1	E	0	0	0	3	B	8		
Start code 1 Byte	ID 2 Byte		Function code 2 Byte		Data string 4~240 Byte								LRC 2 Byte		CR 1 Byte	LF 1 Byte

1.ID

Specify an ID to send data. Only the machine with the same ID will receive the data. Other machines with different IDs will ignore the data.

> ⚠**Caution:**
> The specified ID for communication is the setting value of the CH knob on the controller +1.
> For example, if the value of the external CH is "1," the specified ID will be "2."

2.Function code

Specified function number.

Function code	Function description
03 H	Data reading
06 H	Data writing
10 H	Continuous data writing

3.Data

To run the data required by the specified function code, the data structure varies depending on the specified function code.

Function code	Function description
03 H	Data position and the pieces of data are read
06 H	Data position and the pieces of data are written
10 H	Data position, and the pieces of data are written as well as the content is written

4.Check code

To make sure that all data are sent and no data is omitted, add confirmation to the end of the data.
RTU: Use the CRC-16 format.
ASCII: Use the LRC format.

8.3 Detailed error message

When an error other than the response conditions is detected, an error code corresponding to the error type is returned.

1. Function code error

① . If the function code entered is wrong, the received function code will respond "function code" + "80 H."

Example:

Character	:	0	1	0	4	2	0	1	E	0	0	0	3	B	A	CR	LF
ASC code	3A	30	31	30	34	32	30	31	45	30	30	30	33	42	41	0D	0A
	Start code	ID Controller knob + 1		Function code		Data position				Data action code				Verification code (LRC)		End code (CR/LF)	
						Data string											

Character	:	0	1	8	4	0	1	7	A	CR	LF
ASC code	3A	30	31	38	34	30	31	37	41	0D	0A
	Start code	ID Controller knob + 1		Function code		Error code		Verification code (LRC)		End code (CR/LF)	

② . If the error of the entered function code is more than "80 H," the received "function code" will respond with the original one.

Example:

Character	:	0	1	9	0	2	0	1	E	0	0	0	3	2	E	CR	LF
ASC code	3A	30	31	39	30	32	30	31	45	30	30	30	33	32	45	0D	0A
	Start code	ID Controller knob + 1		Function code		Data position				Data action code				Verification code (LRC)		End code (CR/LF)	
						Data string											

Character	:	0	1	9	0	0	1	6	E	CR	LF
ASC code	3A	30	31	39	30	30	31	36	45	0D	0A
	Start code	ID Controller knob + 1		Function code		Error code		Verification code (LRC)		End code (CR/LF)	

2. Error code

Error code	Description
01 H	Function code error. Receive any function code other than the specified ones.
02 H	Wrong ID. Read the dedicated writing position. Write the dedicated reading position. Read (or write) a non-existent position
03 H	Wrong data. The data written exceeds the valid range. The pieces of data read exceed the range. Write a parameter position that should not be modified. The data written does not match the specified number.

⚠Caution:

The smaller the value of an error code is, the higher its priority. If there are multiple errors, an error code with a higher priority will be replied first.

Example: When an error in a function code is detected, only "01" will be replied even though there is a data error or ID error.

8.4 RTU request message structure

1. WORD data reading

From the start position, read the number of WORDs to continuously read the WORD data.
After reading the WORD data, it is sent from high bytes to low bytes.

■■ Request message structure

ID		01 H~10 H
Function code		03 H
Starting position for reading	High	0000 H ~ FFFF H
	Low	
The number of WORDs read	High	0001 H ~ 0003 H
	Low	
CRC-16	High	0000 H ~ FFFF H
	Low	

■■ Response message structure

ID		01 H~10 H
Function code		03 H
Number of bytes read		02 H ~ 7F H
First WORD data	High	0000 H ~ FFFF H
	Low	
Next WORD data	High	0000 H ~ FFFF H
	Low	
:	:	:
:	:	:
Last WORD data	High	0000 H ~ FFFF H
	Low	
CRC-16	High	0000 H ~ FFFF H
	Low	

■■ Abnormal response message structure

ID		01 H ~ 10 H
Function code		83 H
Error code		01 H ~ 03 H
CRC-16	High	0000 H ~ FFFF H
	Low	

RTU reading example
Status: Read
Data position: 1000 H (action status data)
Number of WORDs: 1 word

Character	01	03	10	00	00	01	80	CA
	ID Controller knob + 1	Function code	Starting position for reading		The number of WORDs read		CRC-16	
			Data string					

2. WORD data writing

Specify the position to start writing the WORD data.
Send the written WORD data from high bytes to low bytes.

■■ Request message structure

ID		01 H ~ 10 H
Function code		06 H
Starting position for writing	High bytes	0000 H ~ FFFF H
	Low bytes	
Number of WORDs written	High bytes	0000 H ~ FFFF H
	Low bytes	
CRC-16	High bytes	0000 H ~ FFFF H
	Low bytes	

■■ Response message structure

ID		01 H ~ 10 H
Function code		06 H
Starting position for writing	High bytes	0000 H ~ FFFF H
	Low bytes	
Number of WORDs written	High bytes	0000 H ~ FFFF H
	Low bytes	
CRC-16	High bytes	0000 H ~ FFFF H
	Low bytes	

■■ Abnormal response message structure

ID		01 H ~ 10 H
Function code		86 H
Error code		01 H ~ 03 H
CRC-16	High bytes	0000 H ~ FFFF H
	Low bytes	

RTU writing example
Example: Home return
Data position: 201E H
Data action code: 0003 H (home return)

Character								
	01	06	20	1E	00	03	A2	0D
	ID Controller knob + 1	Function code	Starting position for reading		Read number of WORDs		CRC-16	
			Data string					

3. Continuous WORD data writing

The start position to write the number of WORDs and continuously write the WORD data.
Send the WORD data from high bytes to low bytes.

■■ Request message structure

ID		01 H~10 H
Function code		10 H
Starting position for writing	High bytes	0000 H ~ FFFF H
	Low bytes	
Number of WORDs written	High bytes	0001 H ~ 003F H
	Low bytes	
Number of bytes written		02 H ~ 7F H
First WORD data	High bytes	0000 H ~ FFFF H
	Low bytes	
Next WORD data	High bytes	0000 H ~ FFFF H
	Low bytes	
:	:	:
:	:	:
Last WORD data	High bytes	0000 H ~ FFFF H
	Low bytes	
CRC-16	High bytes	0000 H ~ FFFF H
	Low bytes	

■■ Response message structure

ID		01 H ~ 10 H
Function code		10 H
Starting position for writing	High bytes	0000 H ~ FFFF H
	Low bytes	
Number of WORDs written	High bytes	0001 H ~ 003F H
	Low bytes	
CRC-16	High bytes	0000 H ~ FFFF H
	Low bytes	

■■ Abnormal response message structure

ID		01 H ~ 10 H
Function code		86 H
Error code		01 H ~ 03 H
CRC-16	High bytes	0000 H ~ FFFF H
	Low bytes	

RTU continuous writing example
Example: Write relative movement data
Data position: 2000 H (set the relative movement distance)
Number of WORDs: 2 words

Character	01	10	20	00	00	02	04	00	00	00	64	6B	85
	ID Controller knob + 1	Function code	Starting position for writing		Number of WORDs written		Number of bytes written	First WORD data		Second WORD data		CRC-16	
			Data string										

4. The calculation example of CRC-16

CRC-16 is the error acknowledgment of 2 bytes (16 bits).
CRC-16 performs calculation from the ID position to the end of the data in sequence.

1. Declare CRC as FFFF H initial value.
2. Perform XOR on CRC and 1 byte in the first message. Substitute the calculated value into CRC.
3. Shift the CRC variable 1 bit (next bit) to the right.
4. If the carry flag "c_carry" is 1, CRC and A001 H perform "XOR" calculation.
5. Repeat step 3 and 4 for the results for 8 cycles.
6. XOR is performed on CRC and 1 byte in the first message. Substitute the calculated value into CRC.
7. Repeat step 3~6 for the values other than CRC.
8. After the last byte is calculated, they are sent from low to high of CRC variables.

■■ Take VB 6.0 for example. Calculate CRC-16:

Variables are declared as follows:

```
Dim CRC As Long
Dim i, j, arry_count As Integer
Dim c_next, c_carry As Long
Dim crc_arry(64) As Integer

i = 0
CRC = 65535
For i = 0 To arry_count
  c_next = crc_arry(i)
  CRC = (CRC Xor c_next) And 65535
  For j = 0 To 7
      c_carry = CRC And 1
      CRC = CRC \ 2
      If c_carry = 1 Then
            CRC = (CRC Xor &HA001) And 65535
      End If
  Next j
Next i
End
```

They are added to the end of error codes and messages. Please pay attention to the order of CRC low bits and high bits.

8.5 ASCII request message structure

1. WORD data reading

From the start position, read the number of WORDs to continuously read the WORD data.
After reading the WORD data, it is sent from high bytes to low bytes.

■■ Request message structure

Start code		" : "
ID		"0", "1"~"1", "0"
Function code		"0", "3"
Start position for reading	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
Read number of WORDs	High	"0", "0"~"0", '0"
	Low	"0", '0"~"3", "C"
Check code LRC		"0", "0"~"F", "F"
End code		CR, LF

■■ Response message structure

Start code		" : "
ID		"0", "1"~"1", "0"
Function code		"0", "3"
Number of bytes read		"0", "2"~"7", "F"
First WORD data	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
Next WORD data	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
:	:	:
:	:	:
Last WORD data	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
Check code LRC	High	"0", "0"~"F", "F"
End code	Low	CR, LF

■■ Abnormal response message structure

Start code		" : "
ID		"0", "1"~"1", "0"
Function code		"8", "3"
Error code		"0", "1"~"0", "3"
Check code LRC	High	"0", "0"~"F", "F"
End code	Low	CR, LF

ASCII reading example
Status: Reading
Data position: 1000 H (action status data)
Number of WORDs: 1 word

Character	:	0	1	0	3	1	0	0	0	0	0	0	1	E	B	CR	LF
ASC code	3A	30	31	30	33	31	30	30	30	30	30	30	31	45	42	0D	0A
	Start code	ID Controller knob + 1		Function code		Starting position for reading				Read number of WORDs				Verification code (LRC)		End code (CR/LF)	
						Data string											

2. WORD data writing

Specify the position to start writing the WORD data.
Send the written WORD data from high bytes to low bytes.

■■ Request message structure

Start code		" : "
ID		"0", "1"~"1", "0"
Function code		"0", "6"
Start position for reading	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
The number of WORDs read	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
Check code LRC		"0", "0"~"F", "F"
End code		CR, LF

■■ Response message structure

Start code		" : "
ID		"0", "1"~"1", "0"
Function code		"0", "6"
Start position for reading	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
The number of WORDs read	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
Check code LRC		"0", "0"~"F", "F"
End code		CR, LF

■■ Abnormal response message structure

Start code	" : "
ID	"0", "1"~"1", "0"
Function code	"8", "6"
Error code	"0", "1"~"0", "3"
Check code LRC	"0", "0"~"F", "F"
End code	CR, LF

ASCII writing example
Example: Home return
Data position: 201E H
Data action code: 0003 H (home return)

Character	:	0	1	0	6	2	0	1	E	0	0	0	3	B	8	CR	LF
ASC code	3A	30	31	30	36	32	30	31	45	30	30	30	31	42	38	0D	0A
	Start code	ID Controller knob + 1		Function code		Data position				Data action code				Verification code (LRC)		End code (CR/LF)	
						Data string											

3. Continuous WORD data writing

The start position to write the number of WORDs and continuously write the WORD data.
Send the WORD data from high bytes to low bytes.

■■ Request message structure

Start code		" : "
ID		"0", "1"~"1", "0"
Function code		"1", "0"
Start position for reading	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
The number of WORDs read	High	"0", "0"~"0", "0"
	Low	"0", "0"~"3", "C"
Number of bytes written		"0", "2"~"7", "6"
First WORD data	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
Next WORD data	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
:	:	:
:	:	:
Last WORD data	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
Check code LRC		"0", "0"~"F", "F"
End code		CR, LF

■■ Response message structure

Start code		" : "
ID		"0", "1"~"1", "0"
Function code		"1", "0"
Start position for reading	High	"0", "0"~"F", "F"
	Low	"0", "0"~"F", "F"
The number of WORDs read	High	"0", "0"~"0", "0"
	Low	"0", "1"~"3", "B"
Check code LRC		"0", "0"~"F", "F"
End code		CR, LF

■■ Abnormal response message structure

Start code	" : "
ID	"0", "1"~"1", "0"
Function code	"9", "0"
Error code	"0", "1"~"0", "3"
Check code LRC	"0", "0"~"F", "F"
End code	CR, LF

ASCII continuous data writing
Example: Write relative movement data
Data position: 2000 H (set the relative movement distance)
Number of WORDs: 2 words

Character	:	0	1	1	0	2	0	0	0	0	0	0	2	0	4	0	0	0	0	0	0	6	4	6	5	CR	LF
ASC code	3A	30	31	31	30	32	30	30	30	30	30	30	32	30	34	30	30	30	30	30	30	36	34	36	35	0D	0A
	Activation code	ID Controller knob + 1		Function code		Starting position for writing				Number of WORDs written				Number of bytes written		First WORD data				Second WORD data				Verification code (LRC)		End code (CR/LF)	
						Data string																					

4. LRC calculation example:

For LRC, calculation is performed from ID to the end of data.

1. The sum calculation is performed from the beginning of data (ID) to the end of data.
2. When the calculated result exceeds FF H, round off "1" if more than 100 H.
   (Example: 153 H=>53 H)
3. Calculate the complement for the result (reverse bits) and 1 is added to the result.
4. In the lrc_array, two characters are used as one set and its value are converted to decimal form for calculation.
   (Example: 0106201E0003=>01 06 20 1E 00 03)

● ■■Take VB 6.0 for example. Calculate LRC:

```
Dim LRC As Integer
Dim i As Integer
Dim arry_count As Integer
Dim lrc_arry(128) As Integer

For i = 0 To arry_count
      LRC = (LRC + lrc_arry(i)) And &HFF
Next i
LRC = ((Not LRC) + 1) And &HFF
```

9. TOYO-Single software operation

9.1 Getting started with TOYO-Single

1. Introduction

To make our customers use the products manufactured by Toyo Automation Co., Ltd. in a convenient way, we have independently developed TOYO-Single for TC100 for a better user experience.

2. Installation and software requirements

Minimum software requirements	
Operating system	Microsoft Windows 2000/XP/Vista/7/8.1
CPU	The environment recommended by OS
Memory	The environment recommended by OS
HDD space	More than 20MB free space
Communication port	RS-485, USB
Use with the controller	TC100

9.2. Installation and removal of TOYO-Single software

1. Installation

This chapter introduces how to install Toyo-Single. First, open the [Toyo-Single.exe] setup file, as shown in Figure (1).

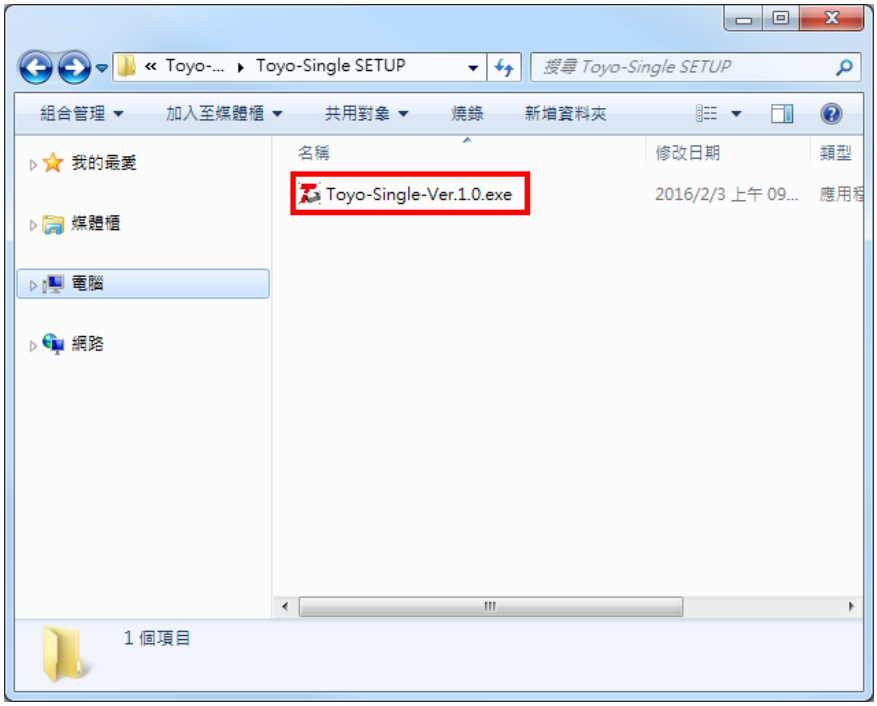


Figure (1) Toyo-Single.exe

① Framework detection

After opening the file, you will be asked to install Microsoft .NET Framework 4, if it is not installed on your PC, as shown Figure (2).

If this screen is not displayed, skip to Section 1.2 and continue the installation procedure. Click [Yes] to download or click [No] to exit the installation procedure. If you do not want to automatically install it, go to Microsoft's official website to download Microsoft .NET Framework 4 to install it.

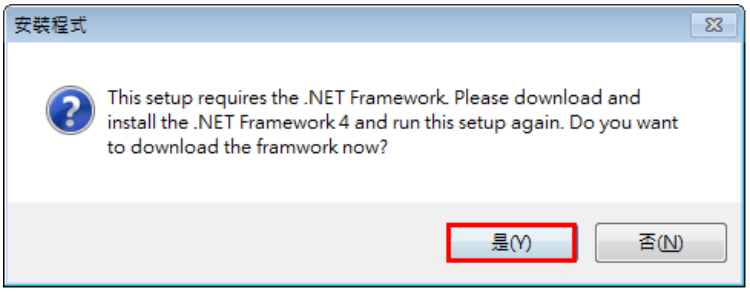


Figure (2) asks you to install Microsoft .NET Framework 4

After opening the setup file, carefully read the license agreement and check "I have read and agree to the license terms" and click [Install], as shown in Figure (3).

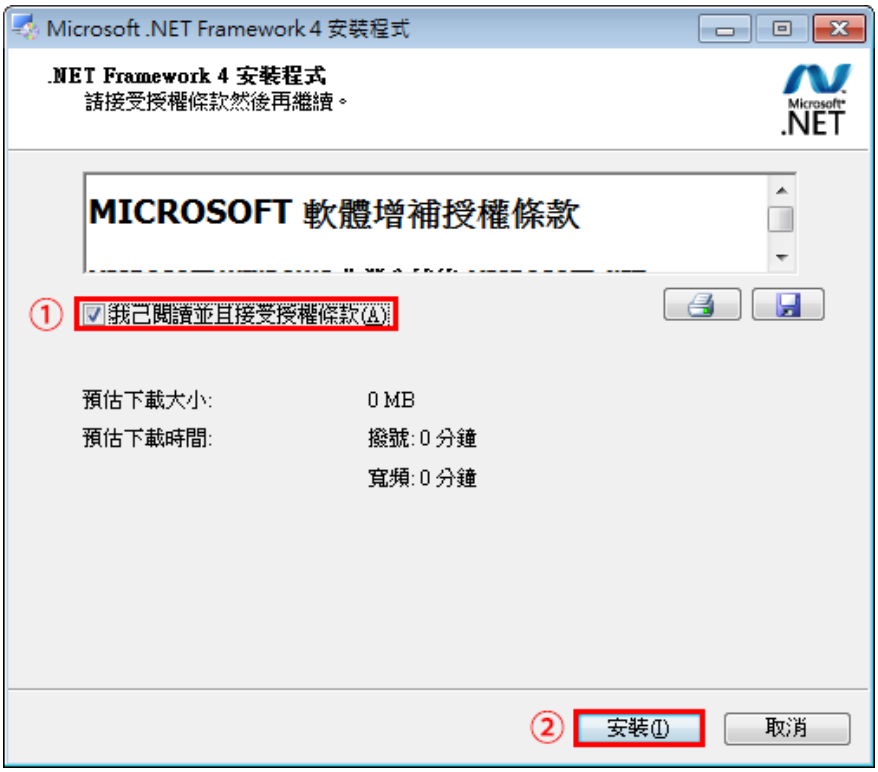


Figure (3) Microsoft .NET Framework 4 Installation Screen

It takes some time to perform the installation procedure. Please be patient, as shown in Figure (4).

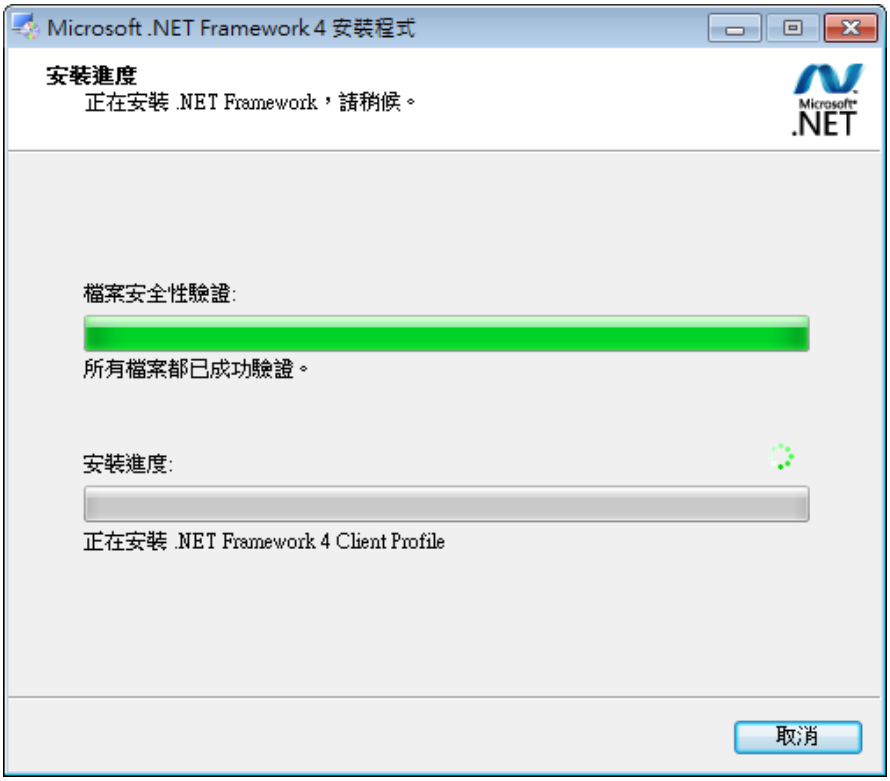


Figure (4) Installation procedure

Click [Finish] to finish the installation procedure, as shown in Figure (5).

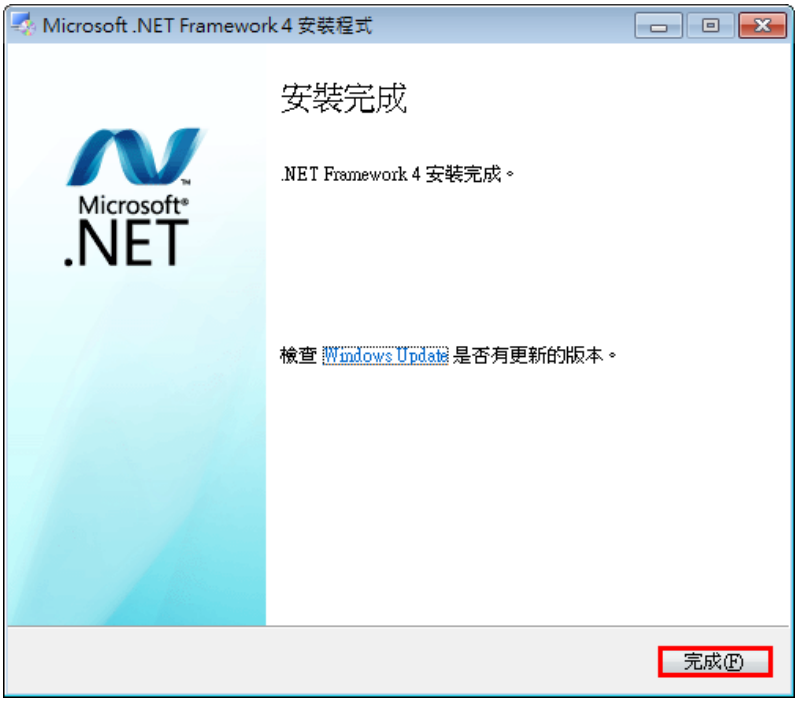


Figure (5) Completion of Framework installation

② Toyo-Single installation procedure

After opening the setup file, you will be asked to select the language that will be used during the installation. It can be switched based on the user preference. Click [OK], as shown in Figure (6).

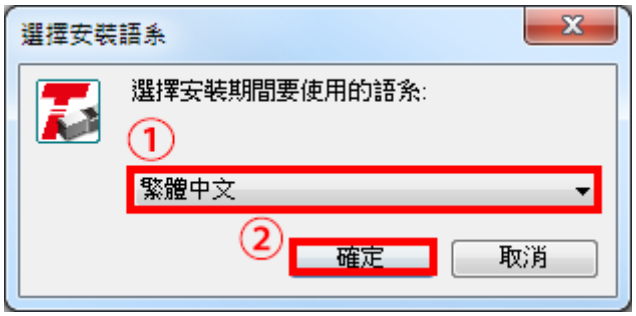


Figure (6) Installation language selection

The Welcome to installation screen is shown and click [Next] to proceed with the installation step, as shown in Figure (7).

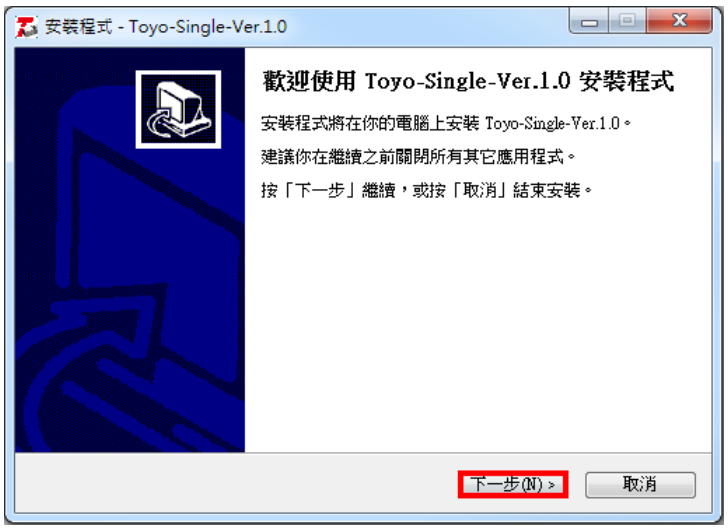


Figure (7) Welcome to the installation screen

The information screen is shown. After reading the Toyo Single software copyright notice, click [Next] to proceed with the installation step, as shown in Figure (8).

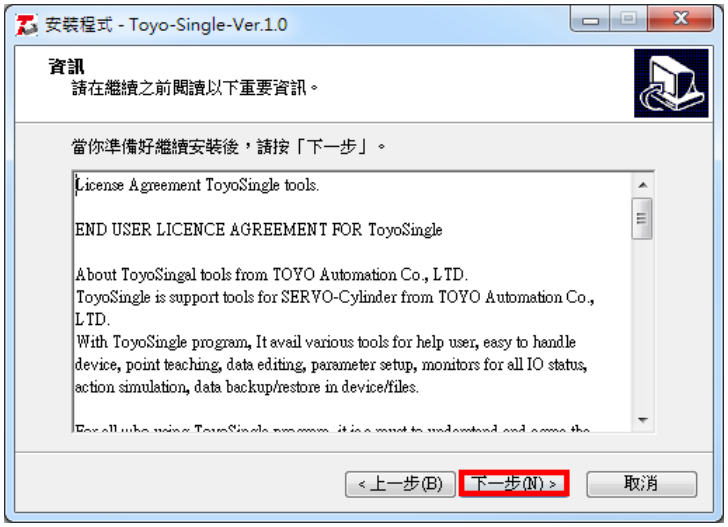


Figure (8) Copyright notice

You will see the screen where you can select an installation position. If you want to select another installation position, click [Browse] to select where you want to install files. It is recommended to use the default path. After selection, click [Next] to proceed with the installation step, as shown in Figure (9).

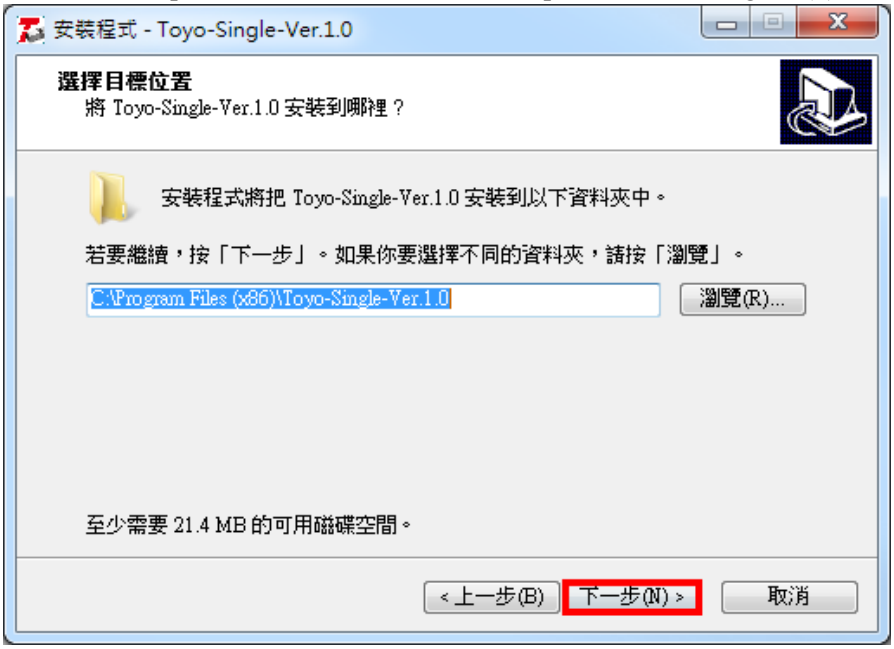


Figure (9) Installation position screen

You will see the screen where you can select an additional task. If no USBDriver is installed, check Install (recommended), or uncheck it. See Section 1.3 for the installation procedure. Next, check [Create desktop icon] if you want to create a desktop shortcut. Otherwise, uncheck it. After the setup and confirmation, click [Next] to proceed with the installation step, as shown in Figure (10).

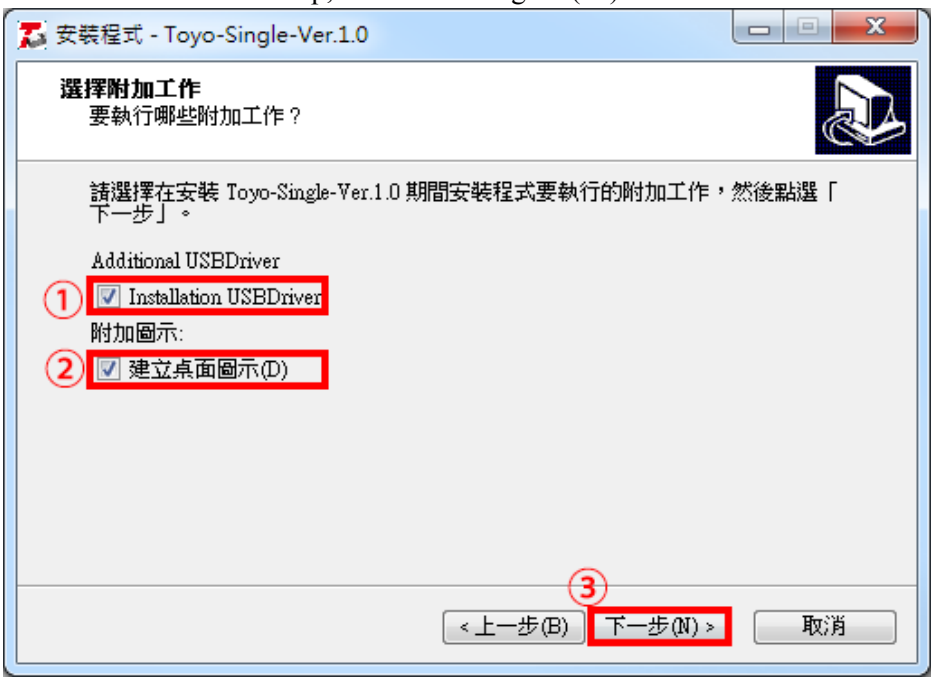


Figure (10) Desktop shortcut creation screen

When you go to the installation confirmation screen, click [Install] after you confirm the installation information, as shown in Figure (11).

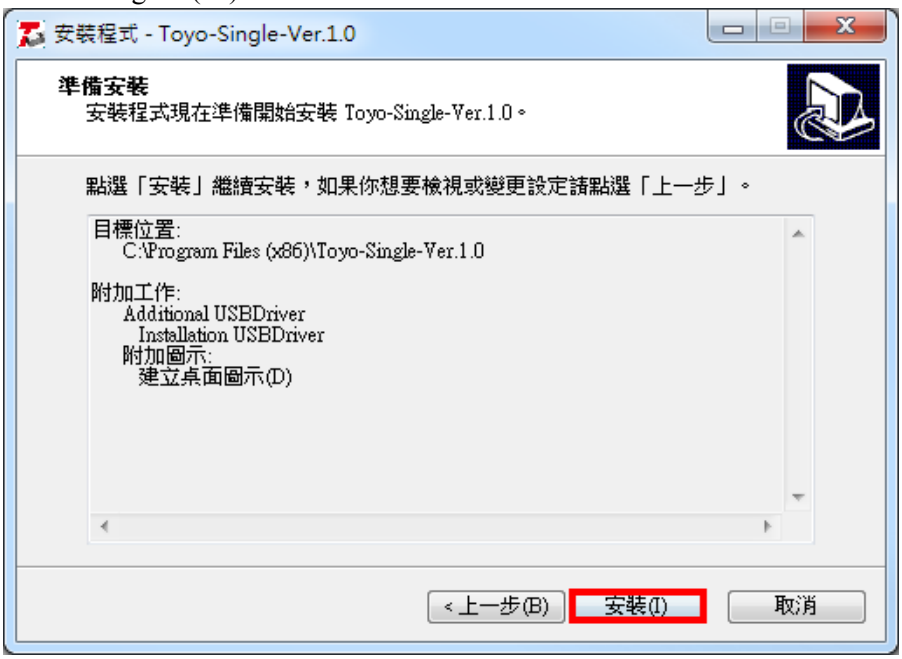


Figure (11) Installation confirmation screen

When you enter the installation completion screen, check [Run TC100] if you want to automatically launch Toyo-Single after installation. Otherwise, uncheck it. Finally, click [Finish] to finish the installation procedure, as shown in Figure (12).

Figure (12) Installation completion screen

③ USBDriver-FTDI

This chapter introduces how to install the FTDI driver. After entering the installation screen, click the [Extract] button, as shown in Figure (13).

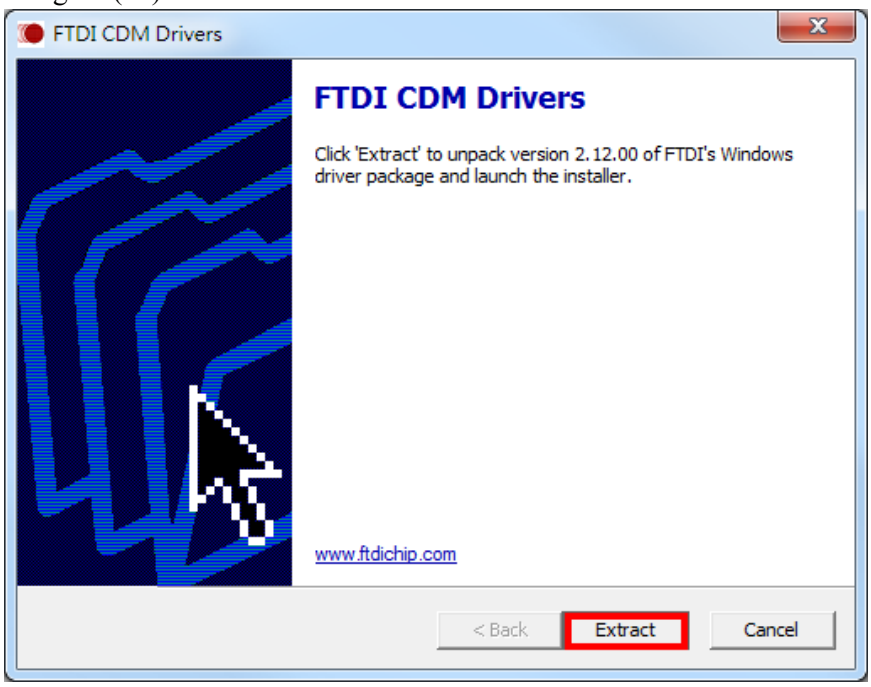


Figure (13) Enter the program screen

The driver installation wizard appears and click [Next], as shown in Figure (14).

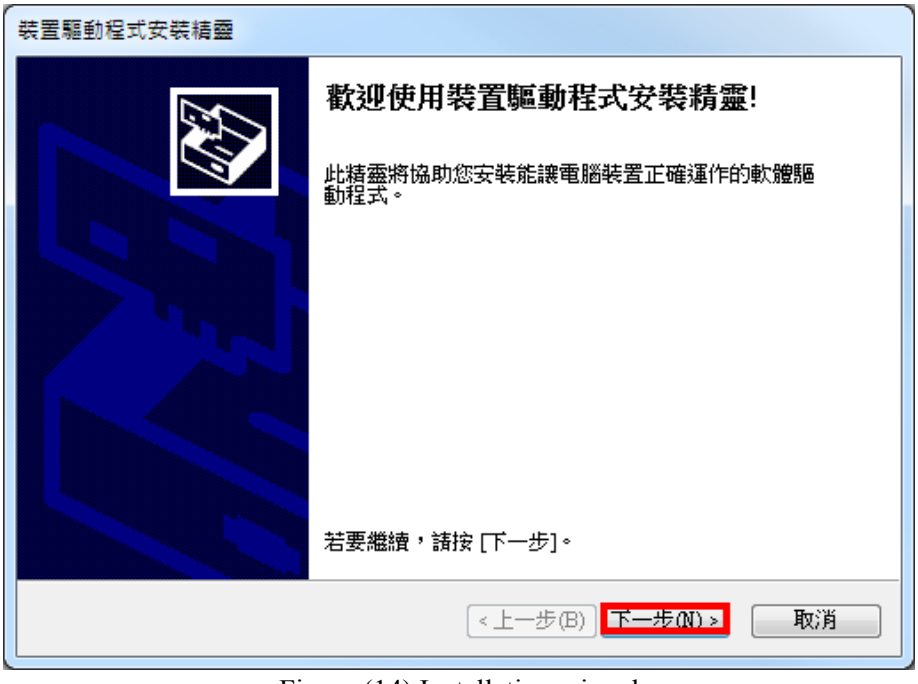


Figure (14) Installation wizard

The license agreement appears and carefully read the agreement. Next, check [I accept this agreement] and click [Next], as shown in Figure (15).

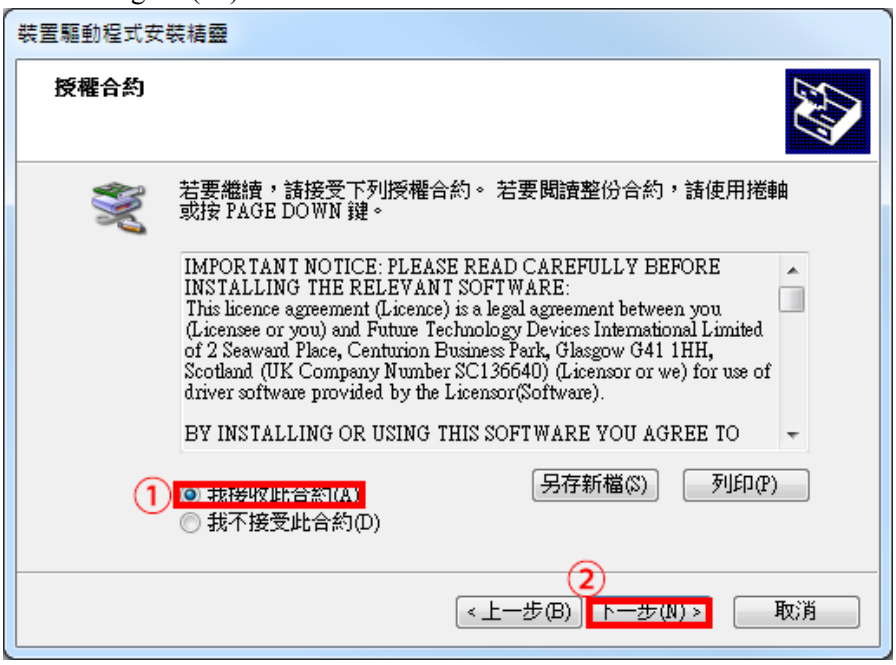


Figure (15) License screen

Finally, after confirming the status of the installation procedure, click the [Finish] button to end the installation procedure, as shown in Figure (16).

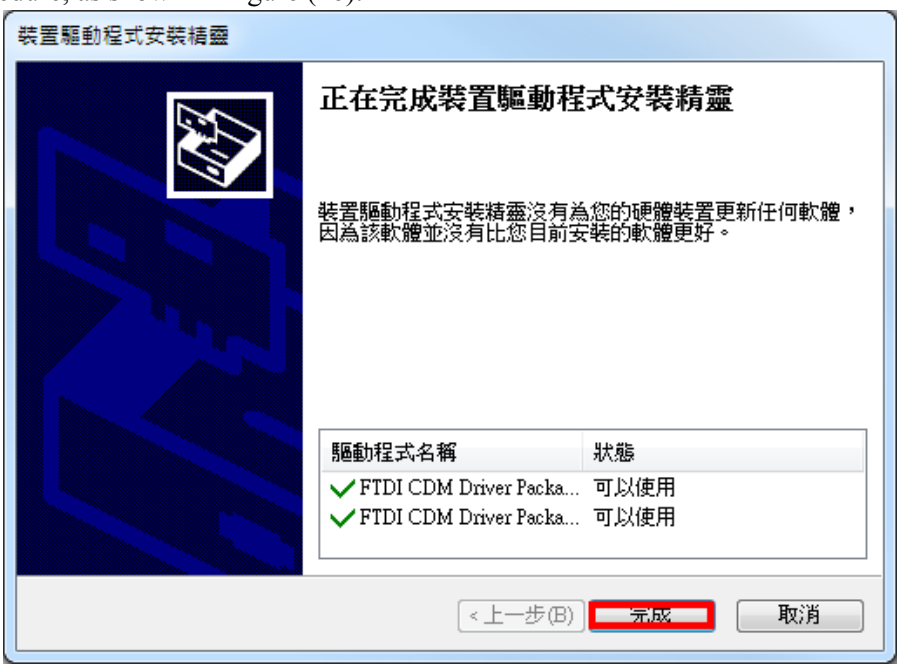


Figure (16) Installation completion screen

2. Removal

This chapter introduces how to remove Toyo-Single software. You can go to [Control Panel]->[Programs]->[Uninstall programs] and click [Uninstall or change a program]. Then select [Toyo-Single-Ver.1.0] to carry out software uninstallation, as shown in Figure (17).

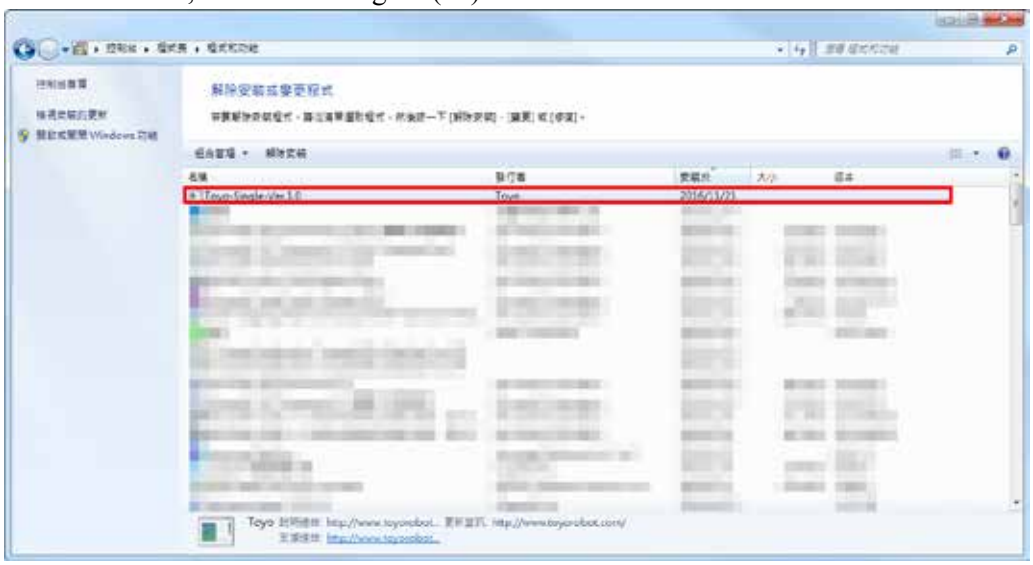


Figure (17) Uninstall or change programs screen

After the un-installation screen appears, the system will ask you whether to delete software or not. If yes, select [Yes] or select [No], as shown in Figure (18).

Figure (18) Screen asking whether to remove software

After software is removed, click [OK] to finish un-installation, as shown in Figure (19).

Figure (19) Screen showing successful un-installation of software

9.3 Introduction to TOYO-Single software interface

1. Initial screen

This chapter introduces the basic main connection screen as shown in Figure (1) according to different functions.

▼ Basic main connection screen

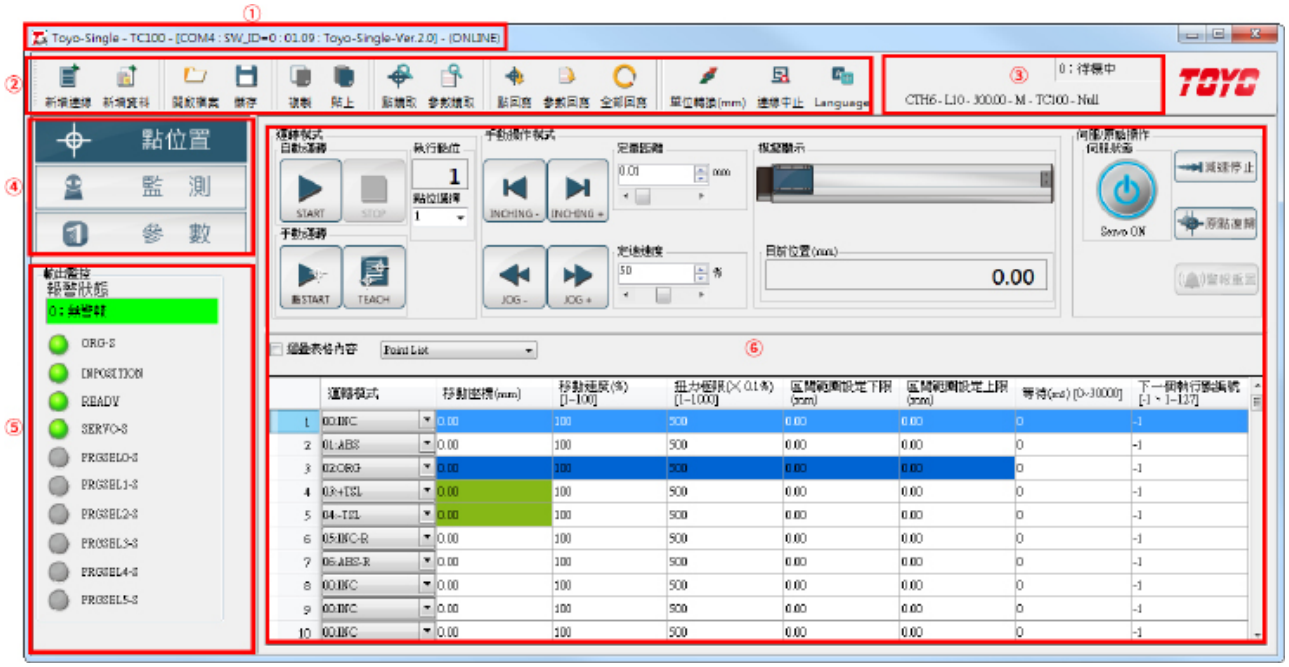


Figure (1) Initial system screen

① Basic status bar

Displays the current basic system status. From left to right they are: [Product Name], [Software Name], [COM], [SW_ID], [Firmware Version], [Software Version], [Connection Status], as shown in Figure (2).

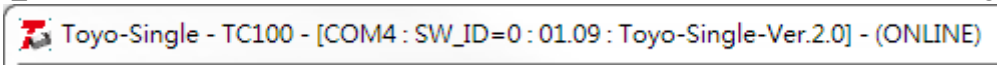


Figure (2) Basic status bar

② Toolbar

This area provides basic system functions, as shown in Figure (3). The following describes the individual functions:

1. Add connection: This function allows you to perform system connection. During the connection, the point position values and parameter values in the current controller are loaded. After the connection, you can go to the main screen to perform system operations.
2. Add data: This function allows you to add data locally. After adding data, you can output file contents for subsequent writing.
3. Open files: This function allows you to load the previously saved files for editing.
4. Save: This function allows you to save the file contents on the current page. The file contents which this system can save include the point position file (.prg) and parameter file (.par). You can click [Save] from the [Point Position Page] to use point position files or click [Save] from the [Parameter Page] to use parameter files.
5. Copy: You can copy the data contents from the currently selected row or several rows for the point positions. You can also use the hotkey (Ctrl + C).
6. Paste: You can paste the data content of the copied row for the point positions. You can also use the hotkey (Ctrl + V).
7. Point reading: You can perform this function after the connection and load the point position values in the current controller to the page.
8. Parameter reading: You can perform this function after the connection and load the parameter values in the current controller to the page.

9. Point write-back: You can write the modified point position values or all point position values on the current page to the controller.
10. Parameter write-back: You can write the modified parameter values or all parameter values on the current page to the controller.
11. All write-back: You can write the modified parameter values and all point position values on the current page to the controller.
12. Unit conversion: This function allows you to convert the system unit from mm to Pulse or vice versa.
13. Connection abort: This function allows you to abort the current system connection.
14. Language: This function allows you to switch between languages.

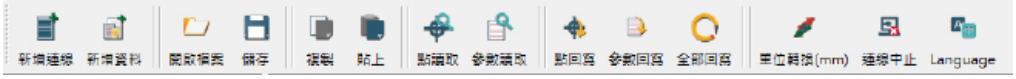


Figure (3) Toolbar

③ Other status bars

This area shows other statuses of the current system. The current operating mode is shown at the top right corner and the current model specification is shown at the bottom left. From left to right are [Actuator Model], [Lead], [Stroke], [Motor Direction], [Controller], and [Customization Code], as shown in Figure (4).

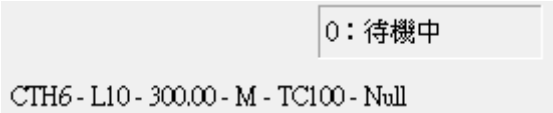


Figure (4) Other status bars

④ Function page

This area provides three system functions which can be switched, as shown in Figure (5). The following describes individual functions:

1. Point position: This function page allows you to control the actuator through the system and edit the content of the point position. The subsequent chapters will detail this function.
2. Monitor: This function page allows you to read controller values and monitor each value of the current actuator. The subsequent chapters will detail this function.
3. Parameter: This function page allows you to browse the current controller parameters and edit parameter contents. The subsequent chapters will detail this function.

Figure (5) Function page

⑤ Output monitoring

This area provides the feedback data of the controller, as shown in Figure (6).

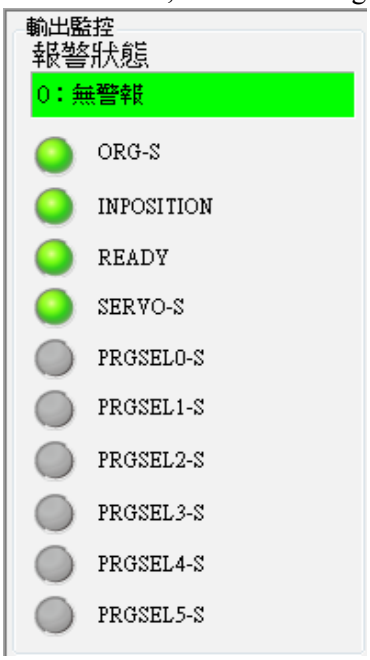


Figure (6) Output monitoring

⑥ Main operation area

The user can operate the actuator, edit point position values and parameter values, and monitor the feedback data of the controller in real time, as shown in Figure (7).

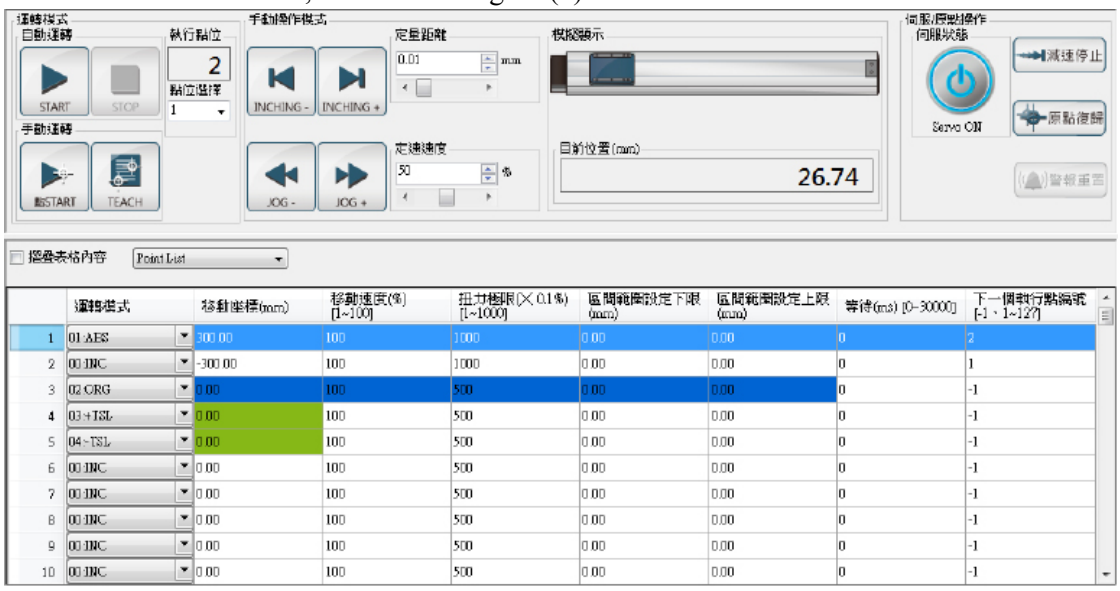


Figure (7) Main operation area

2. Description of the point position page

The point position page is mainly used to teach points of the actuator, as shown in Figure (8).
For your convenience, this system has different operating methods for the user to finish operations quickly. They are [Auto Operation], [Manual Operation], [Perform Points], [Manual Operation Mode], and [Servo / Home Operation]. You can edit point positions and switch to the oscilloscope in the bottom. In Local Mode, this page only shows the point position form for the user to edit.

▼ The point teaching screen for the actuator

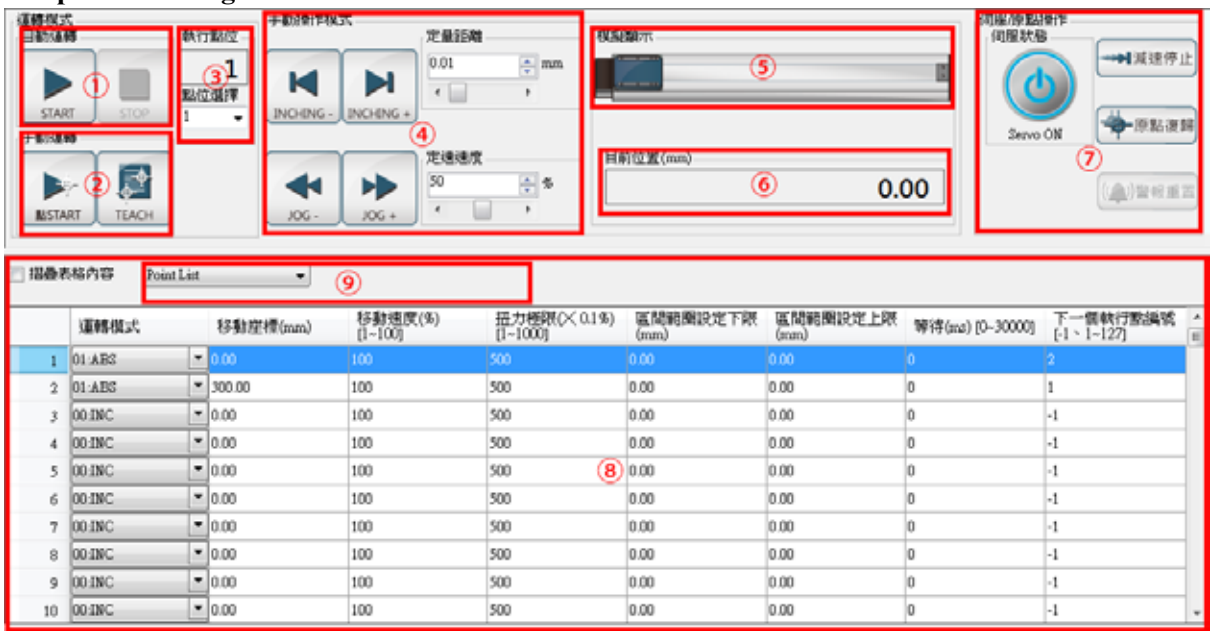


Figure (8) Point position page

① Auto operation

This function allows auto operation based on the operating mode of the currently selected point in the point position form, as shown in Figure (9).

Figure (9) Auto operation

② Manual operation

This function allows operation and point teaching based on the operating mode of the currently selected point in the point position form. The operating mode only allows [Movement Coordinate] and [Movement Speed] to perform the operation of single points, as shown in Figure (10).

Figure (10) Manual operation

③ Perform points

This function allows you to display and select currently performed points, as shown in Figure (11).

Figure (11) Perform points

④ Manual operation

This function allows the user to manually perform general operations, as shown in Figure (12).

Figure (12) Manual operation

⑤ Simulated display

This function enables simulated display of the current position of the physical actuator, and you can manually move the actuator to perform operations, as shown in Figure (13).

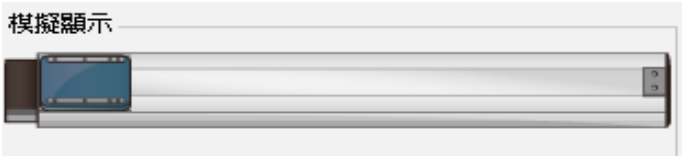


Figure (13) Simulated display

⑥ Current operation

This function allows you to display the information about the position of the actuator feedback by the controller, as shown in Figure (14).

Figure (14) Current operation

⑦ Servo / Home operation

This function allows you to perform Servo ON/OFF, deceleration to stop, home return, and alarm reset, as shown in Figure (15).

Figure (15) Servo / Home operation

⑧ Point position form

Display the data about 127 point positions in TOYO-Single, as shown in Figure (16).
The operating modes include INC, ABS, ORG, +TSL, -TSL, INC-R, and ABS-R where the operating conditions of ORG, +TSL, and -TSL do not refer to the colored items, while INC, ABS, INC-R, and ABS-R refer to all conditions. Attention should be paid to this during settings.

Figure (16) Point position form

⑨ Oscilloscope

This function is used for START and STOP under I/O control, as shown in Figure (17).
Under PULSE control, it shows the Start recording and Stop recording buttons, as shown in Figure (18).

Figure (17) Auto operation

Figure (18) Start recording / stop recording

This function has three display methods:
The first displays the values of the current recorded during the operation of the motor for 1 minute, as shown in Figure (19).
The second displays the RPM recorded during the operation of the motor for 1 minute, as shown in Figure (20).
The third displays the values of current and RPM recorded during the operation of the motor for 1 minute, as shown in Figure (21).
If you have to magnify the chart interval, horizontally drag the desired interval range on the chart. If you want to restore it to the original chart size, click the button at the bottom left corner, as shown in Figure (22).

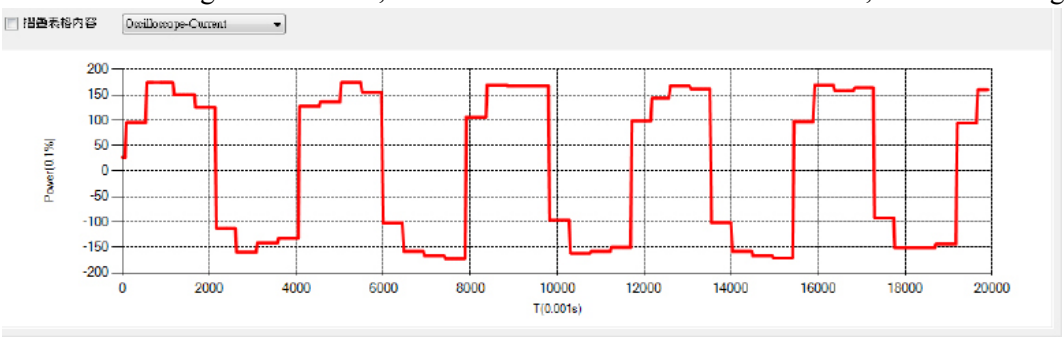


Figure (19) Oscilloscope-Current

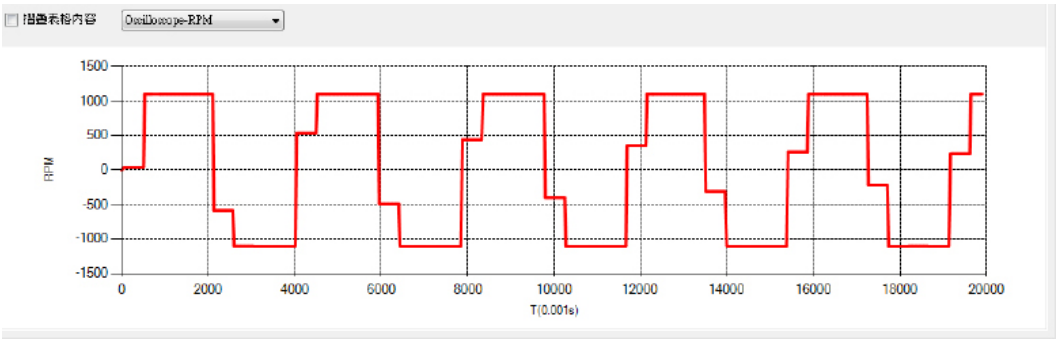


Figure (20) Oscilloscope-RPM

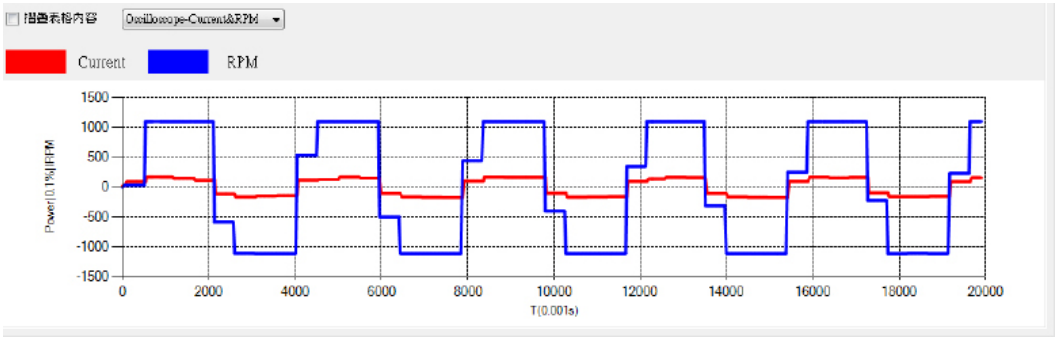


Figure (21) Oscilloscope-Current&RPM

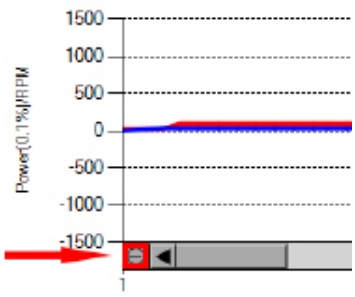


Figure (22) Restore chart button

3. Description of the Monitoring page

The Monitoring page is mainly used to monitor the current information about the actuator feedback the controller, and conduct point operations as well as read error messages using the input monitoring, as shown in Figure (23).

▼ Monitoring page

Figure (23) Monitoring page

① Input monitoring

This area allows you to monitor the controller input signals. The signal indicator shows when different communication methods are used. In addition, you can check corresponding functions, as shown in Figure (24).

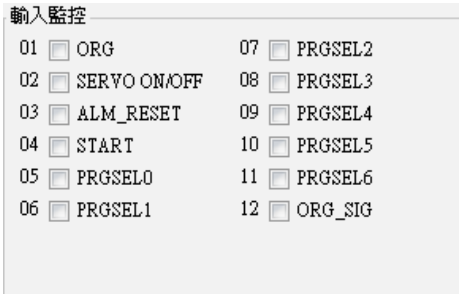


Figure (24) Input monitoring

② Output monitoring

This area allows you to monitor the controller output signals. The signal indicator shows when different communication methods are used, as shown in Figure (25).

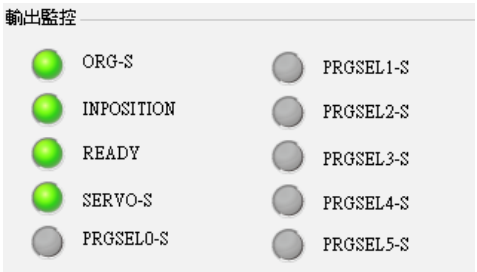


Figure (25) Output monitoring

③ Position / thrust (position) control

This area allows you to perform home return and torque limit control, as shown in Figure (26).

Figure (26) Position / thrust (position) control

④ Motor status monitoring

This area allows you to display of the information about the actuator feedback by the controller, as shown in Figure (27).

Figure (27) Motor status monitoring

⑤ Error message list

This area allows you to check the error messages when there is any error with the controller operations, as shown in Figure (28).

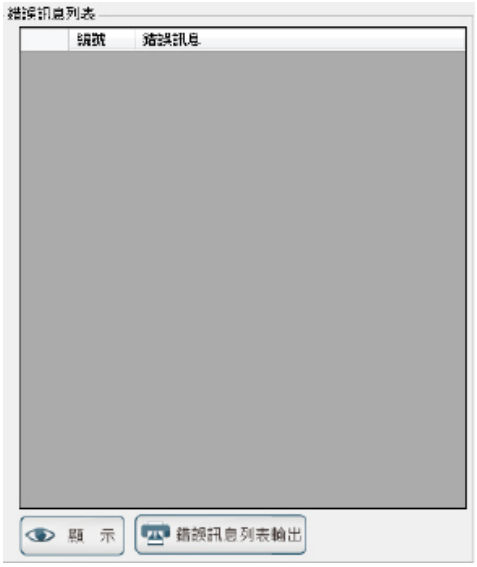


Figure (28) Error message list

4. Description of the Parameters page

The Parameters page is mainly used to display and set the relevant controller parameter, as shown in Figure (29).

This page has 8 parameter items. These are [Position Control], [Thrust Control Parameters], [Common Parameters], [Input Port Assignment], [Output Port Assignment], [Position Control Parameters], [Home Return Parameters], [Communication Setting Parameters] which are available for the user to set.

▼ Parameter page

參數位置	記號	內容	範圍	數值
0108h	FullCountValue	計數器溢位警報值	1~100000	1000
010Ah	InPositionZone	到達位置區間值	0~1000	1
010Dh	OpenModeSwitch	開回路模式切換	0~1	0
010Fh	AutoCrntDwnEnable	自動電流調降	0~1	0
0110h	AutoCrntDwnRate	自動電流調降的電流值(X0.1%)	1~1000	500
0111h	AutoCrntDwnTime	電流過大等待時間(msec)	50~5000	1000
0112h	OpenModeCrntRate	在開放模式時的電流值(X0.1%)	1~1000	1000
0113h	CloseToOpenTime	馬達停止後等待時間，後切換閉至開回路時間(msec)	10~5000	100
0114h	PosDir	外部脈沖指令，旋轉方向指定	0~1	0
0115h	SelComPulse	外部脈衝指令形式	0~2	0
0117h	HoldAccuratePos	開回路控制的位置校正選擇	0~1	0
0118h	CorrectSpeed	開回路控制時的位置校正速度	10~500	75
0119h	PosTolweance	開回路控制時的位置校正容許值	0~100	0
011Ch	CrntBoostRate	全時開回路模式在加減速時的電流增加率	100~150	100
011Dh	NearZone	NEAR 信號輸出的範圍設定	0~10000	4

Figure (29) Parameter page

The colors of the parameter fields are described in Table (1).

a.		You do not need to disconnect power and reboot when parameter writing is finished.
b.		You have to disconnect power and reboot when parameter writing is finished.
c.		When parameter writing is finished, the system automatically goes off-line and you have to disconnect the power and reboot.

Table (1) Description of the colors of parameter fields

9.4 How to operate TOYO-Single software

1. Controller connection

This section introduces how to connect software to the controller.
First, launch TOYO-Single software, as shown in Figure (30).

Figure (30) TOYO-Single software

Select the [Add connection] button on the [Toolbar], as shown in Figure (31).

Figure (31) Add connection button

Set the relevant ID, Com Port, and baud rate, as shown in Figure (32). Click the [Add connection] button.

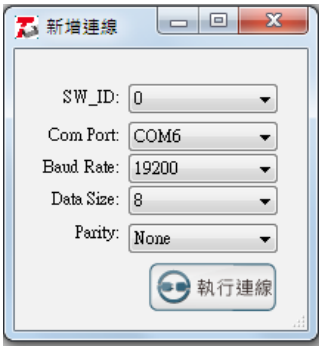


Figure (32) Add connection settings

Confirm the controller connection message, as shown in Figure (33). Click the [OK] button to read the point position values and parameter values.

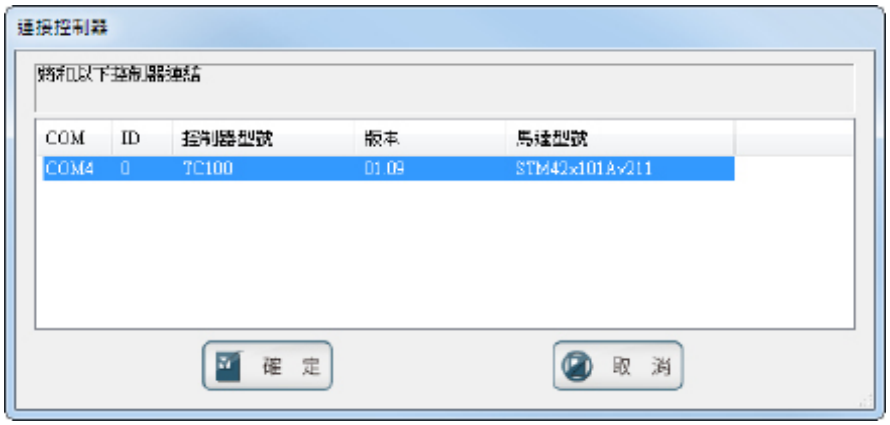


Figure (33) Controller connection message

After reading the point position values and parameter values, the initial system screen appears, as shown in Figure (34).

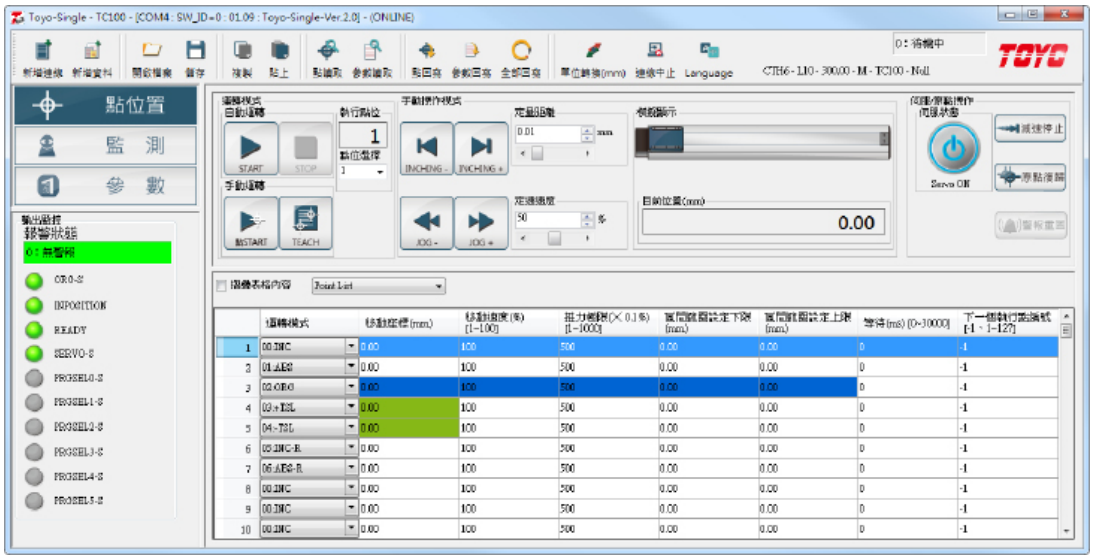


Figure (34) Initial system screen

2. Home return

Before operation, if the actuator does not return to home, the ORG-S indicator goes off. In this case, you have to perform home return, which will be described in the following.

If the ORG-S indicator to the left is not lit up, you have to perform home return, as shown in Figure (35).

(a)ORG-S indicator

(b) Home return button

Figure (35) Home return operations

After home return, a message is shown, as shown in Figure (36).

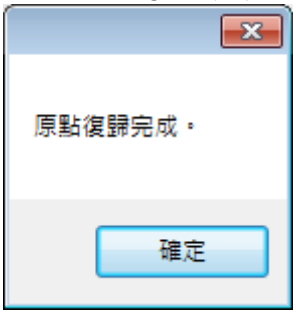


Figure (36) A message showing home return is completed.

After completion, the system screen appears, as shown in Figure (37).

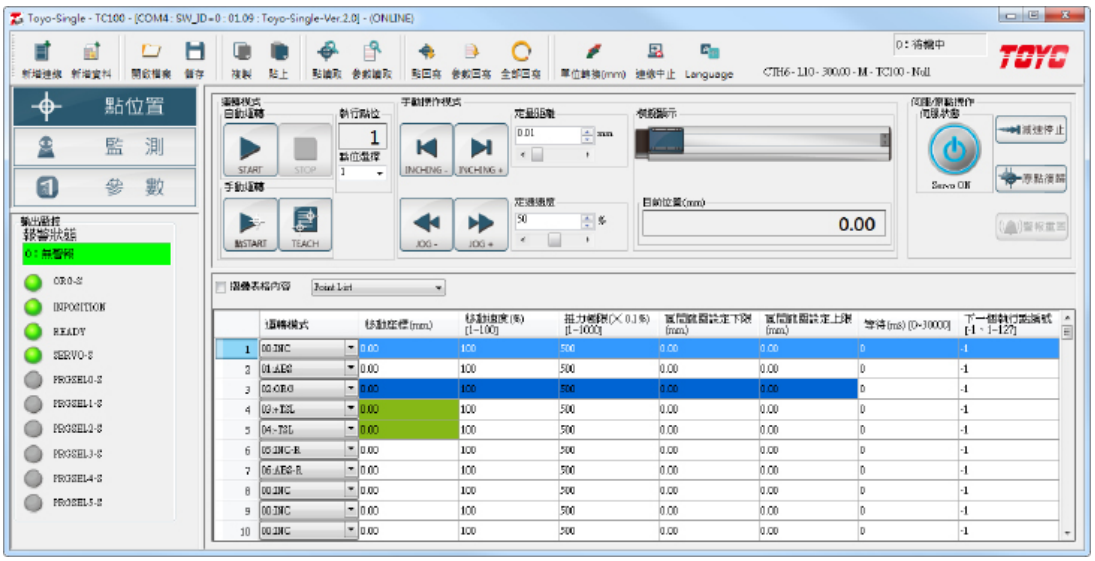


Figure (37) System screen

3. Point movement

Points can be moved automatically or manually. Auto operation allows you to track point movement based on the selected point, and detect the current point position. Manual operation allows you to move one point based on the selected point. The following describes these operations.

There are two ways to select points:

The first is to drag the scroll bar and select one, as shown in Figure (38).

The second is to directly clock the point position form, as shown in Figure (39).

(a) Before selection (b) After selection

Figure (38) Drag the scroll bar to select

Figure (39) Select on the form

For [Auto Operation], click the [START] button, as shown in Figure (40), to start auto operation of points.

Figure (40) START button

If you want to end the operation, click the [STOP] button, as shown in Figure (41).

Figure (41) STOP button

For [Manual Operation], after you select a point, click the [Point START] button, as shown in Figure (42), to start manual operation of points.

Figure (42) Point START button

4. Manual operation

Manual operation includes Inch, Jog, and Manual Movement, which will be described in the following.

① Inch

Before performing Inch, you can set the movement distance, as shown in Figure (43).

Figure (43) Constant distance

Next, perform Inch, as shown in Figure (44). Click the button to move as specified by [Constant Distance].

Figure (44) Inch button

② Jog

Before performing Jog, you can set the movement speed, as shown in Figure (45).

Figure (45) Constant speed

Next, perform Jog, as shown in Figure (46). Click the button to move as specified by [Constant Speed].

Figure (46) Jog button

③ Manual

Before performing Manual Movement, you can set the movement speed, as shown in Figure (47).

Figure (47) Constant speed

Next, perform Manual Movement, as shown in Figure (48). Move the actuator manually and it will move as specified by [Constant Speed].

Figure (48) Manual movement

5. Point teaching

After you finish the manual operation described in 1.3, you can perform point teaching using the TEACH button, which will be described in the following.

Select a point to be taught, as shown in Figure (49).

Figure (49) Select a point

Click the [TEACH] button to perform point teaching, as shown in Figure (50).

Figure (50) TEACH button

The system fill out the movement coordinate of the selected point based on the position value shown in Figure (51) and the operating mode changes to [ABS], as shown in Figure (52).

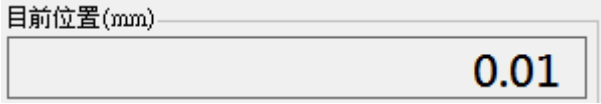


Figure (51) Current operation

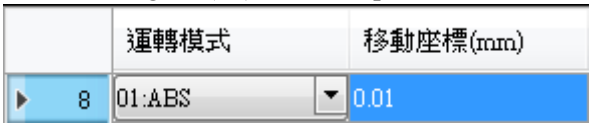


Figure (52) Completion of point teaching

6. Add data

The Add data function allows automatic setup of the initialized parameter values based on the actuator model, motor direction, and actuator load selected by the user for the convenience when he/she sets parameters. The following describes these operations.

First, select the [Add Data] button on the [Toolbar], as shown in Figure (53).

Figure (53) Add Data button

After selection, the [Add Data Settings] window appears, as shown in Figure (54).
The user has to set the relevant initial data in this window to general initialized parameter values. Click the [OK] button after setting.

Figure (54) Add Data Settings window

Then the system automatically generates the initialized point position table and the initialized parameter values based on the settings in the previous step, as shown in Figure (55).

	運轉模式	移動座標(mm)	移動速度(%) [1~100]	扭力極限(×0.1%) [1~1000]	區間範圍設定下限 (mm)	區間範圍設定上限 (mm)	等待(ms) [0~30000]	下一個執行點編號 [-1、1~127]
1	00:INC	0.00	100	500	0.00	0.00	0	-1
2	00:INC	0.00	100	500	0.00	0.00	0	-1
3	00:INC	0.00	100	500	0.00	0.00	0	-1
4	00:INC	0.00	100	500	0.00	0.00	0	-1
5	00:INC	0.00	100	500	0.00	0.00	0	-1
6	00:INC	0.00	100	500	0.00	0.00	0	-1
7	00:INC	0.00	100	500	0.00	0.00	0	-1
8	00:INC	0.00	100	500	0.00	0.00	0	-1
9	00:INC	0.00	100	500	0.00	0.00	0	-1
10	00:INC	0.00	100	500	0.00	0.00	0	-1
11	00:INC	0.00	100	500	0.00	0.00	0	-1
12	00:INC	0.00	100	500	0.00	0.00	0	-1
13	00:INC	0.00	100	500	0.00	0.00	0	-1
14	00:INC	0.00	100	500	0.00	0.00	0	-1
15	00:INC	0.00	100	500	0.00	0.00	0	-1
16	00:INC	0.00	100	500	0.00	0.00	0	-1
17	00:INC	0.00	100	500	0.00	0.00	0	-1
18	00:INC	0.00	100	500	0.00	0.00	0	-1
19	00:INC	0.00	100	500	0.00	0.00	0	-1

(a) Initialized point position table

馬達參數 | 推力參數 | 共通參數 | 輸入設定
輸出設定 | 速度參數 | 原點參數 | 通訊參數

參數位置	記號	內容	範圍	數值
0108h	FullCountValue	計數器溢位警報值	1~100000	1000
010Ah	InPositionZone	到達位置區間值	0~1000	1
010Dh	OpenModeSwitch	開回路模式切換	0~1	0
010Fh	AutoCrntDwnEnable	自動電流調降	0~1	0
0110h	AutoCrntDwnRate	自動電流調降的電流值(×0.1%)	1~1000	500
0111h	AutoCrntDwnTime	電流過大等待時間(msec)	50~5000	1000
0112h	OpenModeCrntRate	在開放模式時的電流值(×0.1%)	1~1000	1000
0113h	CloseToOpenTime	馬達停止後等待時間，後切換閉至開回路時間(msec)	10~5000	100
0114h	PosDir	外部脈沖指令，旋轉方向指定	0~1	0
0115h	SelComPulse	外部脈衝指令形式	0~2	0
0117h	HoldAccuratePos	開回路控制的位置校正選擇	0~1	0
0118h	CorrectSpeed	開回路控制時的位置校正速度	10~500	75
0119h	PosTolweance	開回路控制時的位置校正容許值	0~100	0
011Ch	CrntBoostRate	全時開回路模式在加減速時的電流增加率	100~150	100
011Dh	NearZone	NEAR 信號輸出的範圍設定	0~10000	4

(b) Initialized parameter values

Figure (55) Initialized parameter values

After the parameters are set, the message indicating the motor model is different may appear, as shown in Figure (56), if you want to write parameters.
This is because the system finds out that the motor model corresponding to the previously set actuator model does not match with that in the current controller. If the parameters are written back, improper operation may occur. Therefore, if you want to verify the actuator model to be modified, click the [OK] button to write the motor data, or select the [Cancel] button.

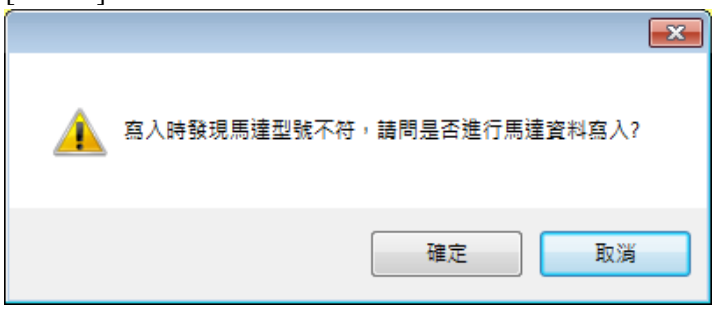


Figure (56) A message indicating unmatched motor model

After you click the [OK] button, disconnect the power and reboot according to the on-screen messages, as shown in Figure (57). After completion, the system continuously performs writing.

Figure (57) A message indicating disconnection of the power and reboot

Then disconnect the power and reboot according to the on-screen messages, as shown in Figure (58). After completion, the system continuously performs writing.

Figure (58) A message indicating disconnection of the power and reboot

The system asks you whether to write back parameters, as shown in Figure (59). If you select [Yes], the system will write all parameters, and write the [model specifications] (which is show in connection mode). If you do not need this, select [No].

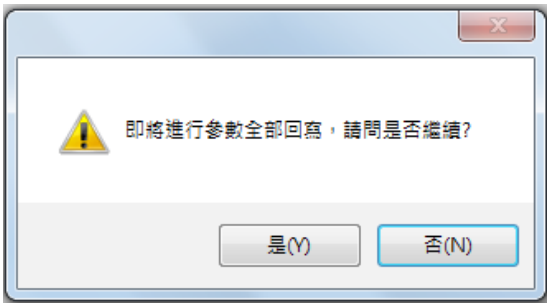


Figure (59) Confirmation of parameter write-back

10. Appendix

10.1 Overview of error messages

■■ Overview of controller LED indicators

LED name	Function description	LED colors
PWR	*When the main power and control power are supplied properly, it is lit up. When some parameters are written, it flashes if the power has to be reset.*	Green
SON	*When the servo is ON normally, it is lit up.*	Green
ERR	*When there is a problem with TC100, it is lit up.*	Red
	You can determine the failure cause based on the number of flashes.	
	The failure indicator flashes once per second in a 2-second interval.	

■■ Error indicator flashing

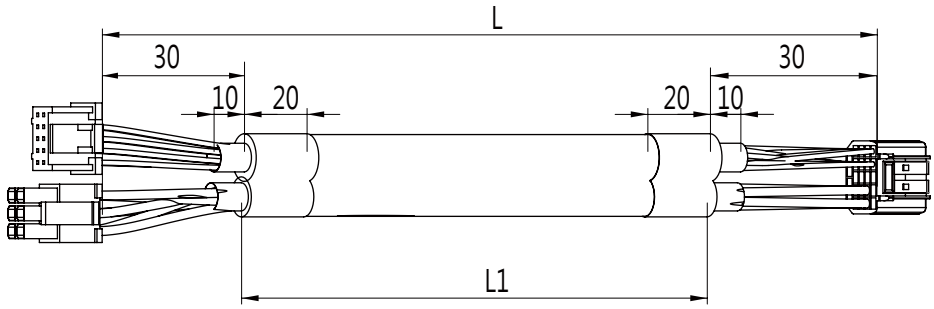
Number of flashes	Failure message	Cause	Solutions
2	Exceed the set torque	Overload (exceed the set value of the current).	Reduce load.
		During the position control, the motor speed cannot keep up with the command pulse speed.	Set the max wave number of the command pulse to be less than the max motor RPM.
3	Exceed the permissible InPosition error	Overload	Reduce the rated torque during the continuous operation.
		During the position control, the motor speed cannot keep up with the command pulse speed.	The wave number of the command pulse is set to be less than the rated speed of the motor. Modify the acceleration or deceleration.
4	Over speed	The motor speed is abnormal.	The max wave number of the command pulse is set to be less than the max motor RPM.
5	Poor gain adjustment	Due to poor adjustment, an abnormal vibration (resonance) occurs at the motor.	Adjust the gain.
		This may occur if the acceleration or deceleration is set to too low.	Adjust the acceleration or deceleration
6	Exceed the rated voltage	Because the internal voltage abnormally increases in the controller, the main circuit operates abnormally.	Reduce the inertial load and Adjust the acceleration or deceleration.
7	Abnormal initialization	Power is turned off during the data transmission.	Reset the data. If data cannot be reset, contract your dealer.
8	Abnormal EEPROM	There is abnormal data in EEPROM.	Contact your dealer.
9	Low voltage	The power voltage at the main circuit is low.	Check the power at the main circuit.
10	Over-current	The motor coils are short circuited or the controller circuit is damaged.	Replace the motor or controller with a new one.
11	Regeneration abnormal	The regenerative snubber circuit reaches its limit.	Reduce the inertial load and Adjust the acceleration or deceleration.
12	Emergency stop	The emergency stop is triggered.	Check the emergency stop circuit.

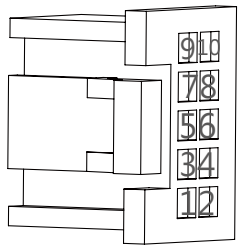
10. Appendix

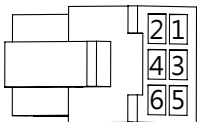
10.2 Cable data

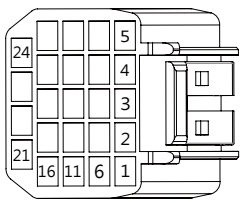
TC100 motor cable set			
Length	Model No.	Cable length (L1)	Unit
1 m	TC100-CAB-STA-01	940	mm
3 m	TC100-CAB-STA-03	2940	mm
5 m	TC100-CAB-STA-05	4940	mm
10 m	TC100-CAB-STA-10	9940	mm

■■ Motor cable set - Controller side



Connector 1	No.	Signal name	Description	HRS pin
 JST: PUDP-10V-S	1	+5 V	Power output +5 V	24-5
	2	0V	Power output 0V	24-4
	3	A+	ENCODER A-Phase	24-10
	4	A-	ENCODER / A-Phase	24-9
	5	B+	ENCODER B-Phase	24-15
	6	B-	ENCODER /B-phase	24-14
	7	Z+	ENCODER Z-phase	24-20
	8	Z-	ENCODER /Z-phase	24-19
	9			
	10	FG	Shielded grounding	24-24

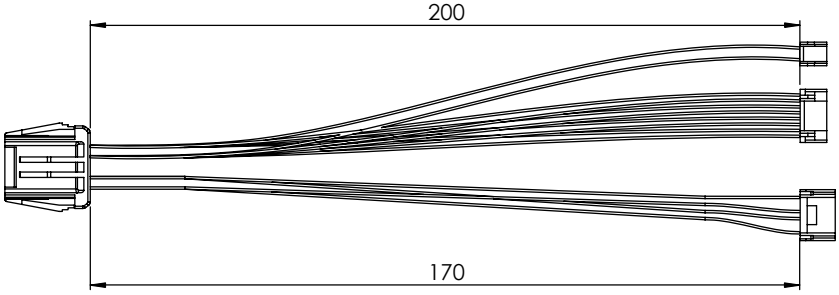
Connector 2	No.	Signal name	Description	HRS pin
 Cvilux: CP3506S0010	1	BK(-)	Brake power output (-)	24-2
	2	BK(+)	Brake power output (+)	24-1
	3	/B	Motor /B-phase	24-16
	4	B	Motor B-phase	24-17
	5	/A	Motor /A-phase	24-12
	6	A	Motor A-phase	24-11

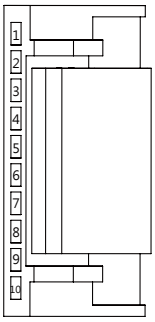
Connector 3
 HRS: DF62B-24S-2.2C

10. Appendix

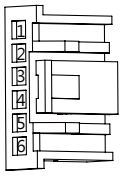
10.2 Cable data

■■ Motor cable set - Motor side



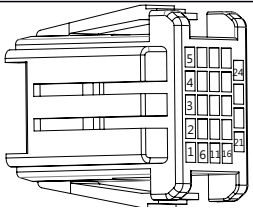
Connector 1	No.	Signal name	Description	HRS pin
	1	+5 V	Power output +5 V	24-5
	2	0V	Power output 0V	24-4
	3	A+	ENCODER A-Phase	24-10
	4	A-	ENCODER / A-Phase	24-9
	5	B+	ENCODER B-Phase	24-15
	6	B-	ENCODER /B-phase	24-14
	7	Z+	ENCODER Z-phase	24-20
	8	Z-	ENCODER /Z-phase	24-19
	9			
	10			

JST	25 Type	GHR-08V-S	SSHL-002T-P0.2
	42 Type	GHR-10V-S	SSHL-002T-P0.2
	56 Type		

Connector 2	No.	Signal name	Description	HRS pin
	1	/A	Motor /A-phase	24-12
	2			
	3	A	Motor A-phase	24-11
	4	B	Motor B-phase	24-17
	5			
	6	/B	Motor /B-phase	24-16

JST	25 Type	ZER-06-S	SZE-002T-P0.3
	42 Type	PAP-06V-S	SPHD-002T-P0.5
	56 Type	XAP-06V-S	SXA-001T-P0.6

HRS pin	Signal name	Description	HRS pin
24-2	BK(-)	Brake power output (-)	24-2
24-1	BK(+)	Brake power output (+)	24-1

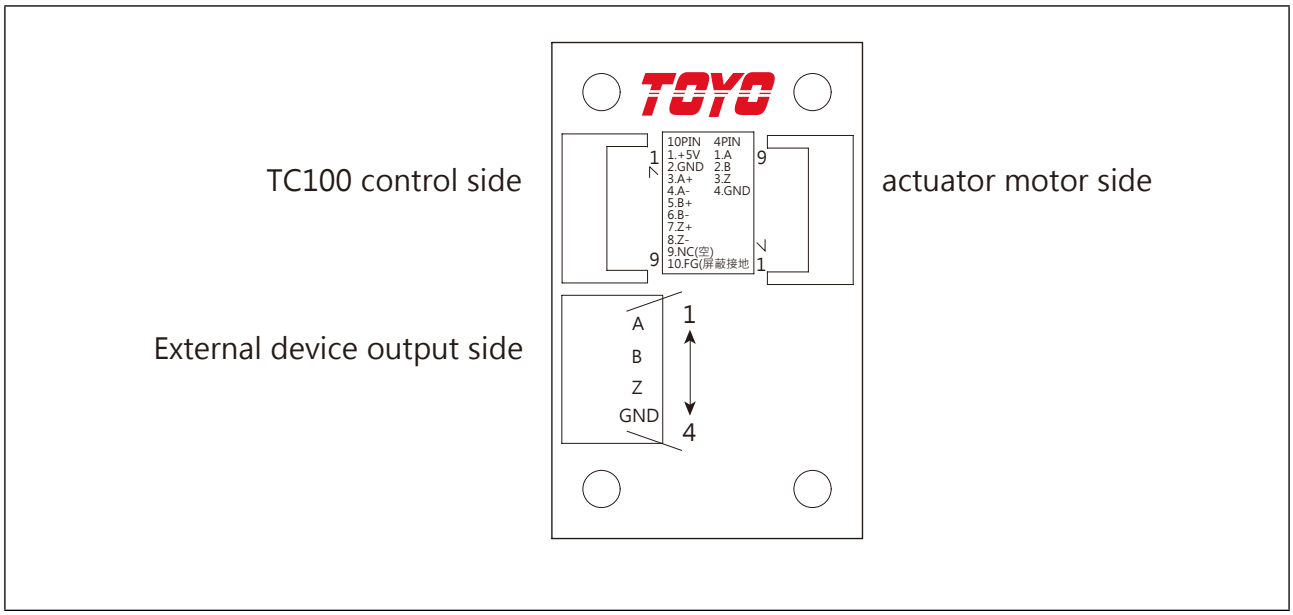
Connector 3

HRS: DF62P-24EP-2.2

10. Appendix

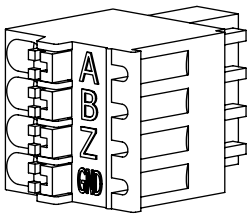
10.3 Expansion module data

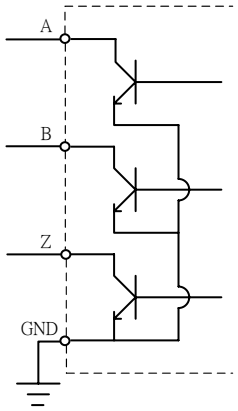
■■ PULSE board - Open Collect

Output module:



■■ Connector definitions

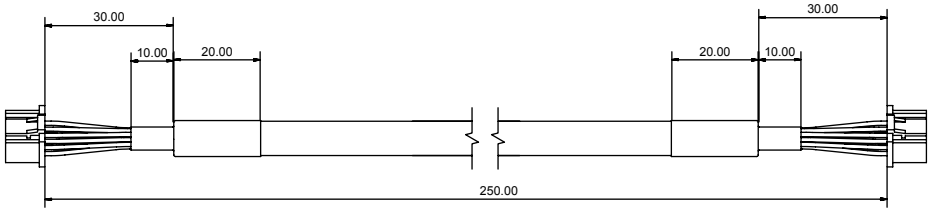


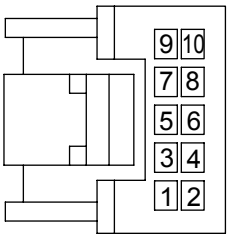
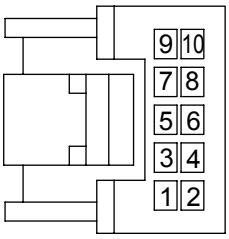


10. Appendix

10.3 Expansion module data

■■ PULSE board to counter cable set



Left connector	No.	Signal name	Description	No.	Right connector
 JST: HOUSING: PUDP-10V-S PIN: SPUD-002T-P0.5	1	+5 V	Power output +5 V	1	 JST: HOUSING: PUDP-10V-S PIN: SPUD-002T-P0.5
	2	0V	Power output 0V	2	
	3	A+	ENCODER A-Phase	3	
	4	A-	ENCODER / A-Phase	4	
	5	B+	ENCODER B-Phase	5	
	6	B-	ENCODER /B-phase	6	
	7	Z+	ENCODER Z-phase	7	
	8	Z-	ENCODER /Z-phase	8	
	9			9	
	10	FG	Shielded grounding	10	

(1,2), (3, 4), (5, 6), and (7, 8) pins are wired to a twisted pair with twisted cables.

User's Manual

TOYO

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