CKD

AXD SERIES

DRIVER FOR DIRECT DRIVE ACTUATOR

EtherCAT/EtherNet/IP Specifications

INSTRUCTION MANUAL

Before operating the product, read this instruction manual without fail.
Among all, carefully read the description related to safety.
Keep this instruction manual in a safe place so that you can read it at any time when necessary.

2025-04-28 SM-A63469-A/4

INTRODUCTION

Thank you for selecting our ABSODEX.

ABSODEX is a direct drive indexing unit developed to drive intermittently operated turntables or the like of general industrial assembling machines and testing machines flexibly and accurately.

This instruction manual is exclusively for ABSODEX AXD Series. It is inapplicable to other types.

If your use method or handling method is not appropriate, its functions cannot be performed fully, an unexpected accident may occur and the product life may be shortened.

Before starting operation of our product, read through this instruction manual to keep the initial performance and operate without failures.

The matters, specifications and appearance given in this instruction manual are subject to change without notice.

FOR SAFETY OPERATION

When designing or manufacturing equipment incorporating this product, you are obligated to manufacture safe equipment. To do so, check that the mechanism of the equipment and the electric control for controlling the mechanism assure the safety of the system.
For safety of the design or management of the equipment, strictly observe the organization standards and the regulations.
To operate our product safely, selection, operation and handling of the product, and adequate maintenance procedures are important.
Be sure to observe the description given under WARNING and precautions to assure safety of the equipment.
Various safety measures are taken for the product, however, handling that is not described in this instruction manual could lead to an accident. Before using the product, read this instruction manual carefully and gain full understanding of the contents.

To clearly indicate the degree of harm and damage and the possibility of their occurrence, precautions are divided into three categories: “DANGER,” “WARNING,” and “CAUTION.”

DANGER	A case where if handling is wrong, it is assumed that an imminent dangerous situation due to which a death or serious injury may be caused will occur.
WARNING	A case where if handling is wrong, it is assumed that a dangerous situation due to which a death or serious injury may be caused will occur.
CAUTION	A case where if handling is wrong, it is assumed that a risk due to which an injury or physical damage may be caused will occur.

Even items described under CAUTION may cause serious results.
Observe each item without fail because these safety precautions are important.

<Type of WARNING symbols>

	A general mark that indicates prohibited acts (what not to do).		A mark that prohibits the act of touching the device.
	A mark that prohibits the act of inserting a finger.		A general mark that indicates the danger of electric shock or burn.
	A mark that indicates the danger that occurs when an automated device is activated.		A general mark that instructs what you must do.
	A mark that instructs you to carefully read the instruction manual.		A mark that instructs you to connect a ground cable.

Precautions for the Product

DANGER

Do not attach or remove connectors with the power on.

- A malfunction, failure or electric shock may be caused.

Do not use the product for the following purposes:

- Medical appliances for maintaining or managing human life or body
- Mechanism or machine equipment intended for travel or transportation of people
- Important security parts of machine equipment

WARNING

Do not alter or additionally process the product.

- Alteration or additional processing not only leads to the risk of fire or electric shock but also to non-compliance with the specification described in the instruction manual.

Do not handle the product, attach or remove devices until the safety is confirmed.

- Inspect or maintain machines or equipment after confirming that the safety of all systems in which the product involves is ensured. Power off the equipment and the applicable facilities, and be careful not to get electric shock.
- Even after the operation stopped, there may be hot areas or energized parts. Be careful when handling the product, or attaching or removing devices.

WARNING

A person with sufficient knowledge and experience should handle the product.

- The product is designed and manufactured as equipment/component for general industrial machinery.

Observe the use of the product within the specification.

- The products cannot be used out of its intrinsic specification.
- As this product is intended for use in equipment/component for general industrial machinery, the uses under the following conditions or environments are not covered. If you consulted with our company for adoption and understood the specification of our product, such use is covered. However, in such cases, take safety measures to avoid dangers in case of failure.
  - ◎ Use in conditions or environments other than those specified in the specification, or outside.
  - ◎ Use in nuke, railways, aviation, ships, vehicles, medical appliances, and equipment or applications that come in direct contact with beverages, food, etc.
  - ◎ Use in applications that require safety, such as entertainment devices, emergency shut-off circuit, press machine, braking circuit, and safety measures.
  - ◎ Use in applications where significant impact on people and property are expected and safety is particularly required.

For safety related to equipment design, observe the organization standards, law, etc.

CONTENTS

1. PRODUCT CONFIGURATION

1.1. System Configuration

EtherCAT® is a patented technology licensed from Beckhoff Automation GmbH Germany and its registered trademark. EtherNet/IP™ is a registered trademark of ODVA. The corporate names and product names used herein are registered trademarks or trademarks of their respective companies.

BASIC SETTING ITEMS

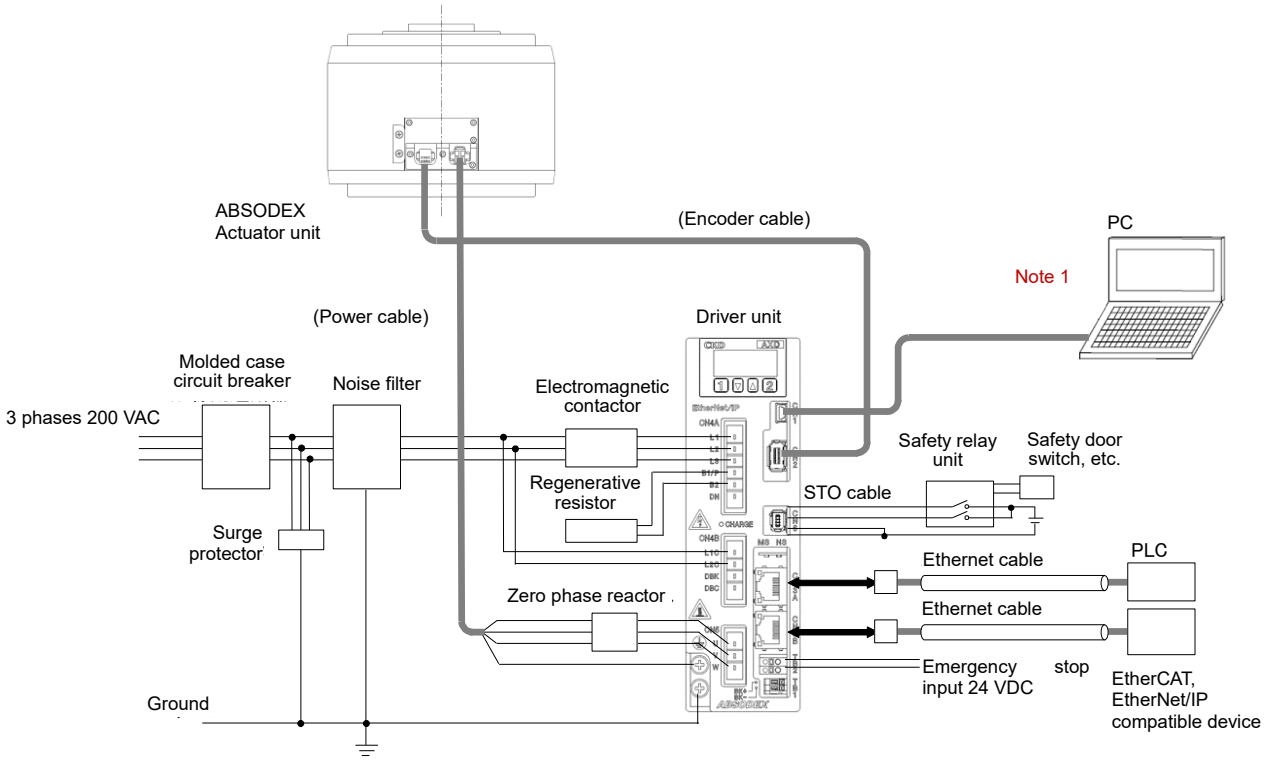
NC programs are input at a PC.
Required parameters are input in the same way.
Gain is adequately set.

BASIC DRIVE METHODS

A program to be executed is selected at the PLC.
Start signal is input at the PLC.

1.1.1. System Configuration Example

<System Configuration>



Note 1: Do not connect the Dialog Terminal unless for programming, parameter entry or test operation.

CAUTION

If a power cable noise filter is used, do not use a power line noise filter.

If other than the compatible driver is connected, the actuator may be burned.

If the main power is turned on while there is position deviation, the actuator will rotate due to the function to clear the position deviation caused.

- If the main power and control power are turned on separately, make sure that ABSODEX is in servo-off state before turning on power.
- When the control power is turned on again, a malfunction may be caused, so turn it on again with the main power off or turn the main power and control power on simultaneously again.

Route the power cables such as the power cable and power supply cable separately from the signal cables such as the encoder cable and I/O cable. Do not tie the cables belonging to different groups or do not route them in the same conduit.

A wrong combination between the actuator and driver will cause alarm 3 when the power is turned on.

- Check the combination between the actuator and driver.
- For details of alarm 3, refer to “12.ALARMS.”

Main power and control power must branch off from one power supply system; otherwise, the driver may breakdown.

To avoid accidents, install an over-current protective device in the main power and control power (L1, L2, L3, L1C and L2C).

When using a circuit breaker, select one that has high frequency counter measures for inverter use.

Turn on the control power supply before turning on the main power or at the same timign, and turn off the control power supply aftrer turning off the main power supply or at the same timing.

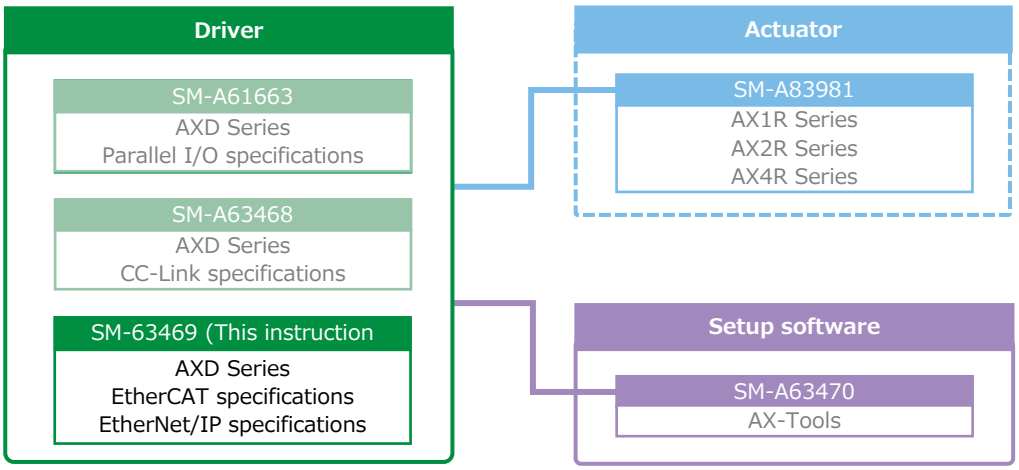
1.1.2. List of Peripheral Devices

	Components	Product Name, Model	Manufacturer
Product	Driver	AXD Series	CKD Corporation
Optionally available	Actuator	AX1R Series AX2R Series AX4R Series	
	Power cable	AXP-CBLM1-□□□	
	Encoder cable	AXP-CBLE1-□□□	
Free copy	PC setup software	AX-Tools Windows Version Ver. 3.*.*.* or later Note 1	

Note 1: The software may not run in some environments.

1.2. Instruction Manual for the Product

This instruction manual is “SM-A63469.”
The instruction manuals related to this product are as follows:



2. OPERATION FLOW

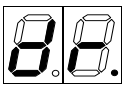
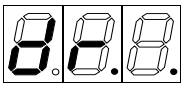
In this chapter, the purpose is to operate ABSODEX.

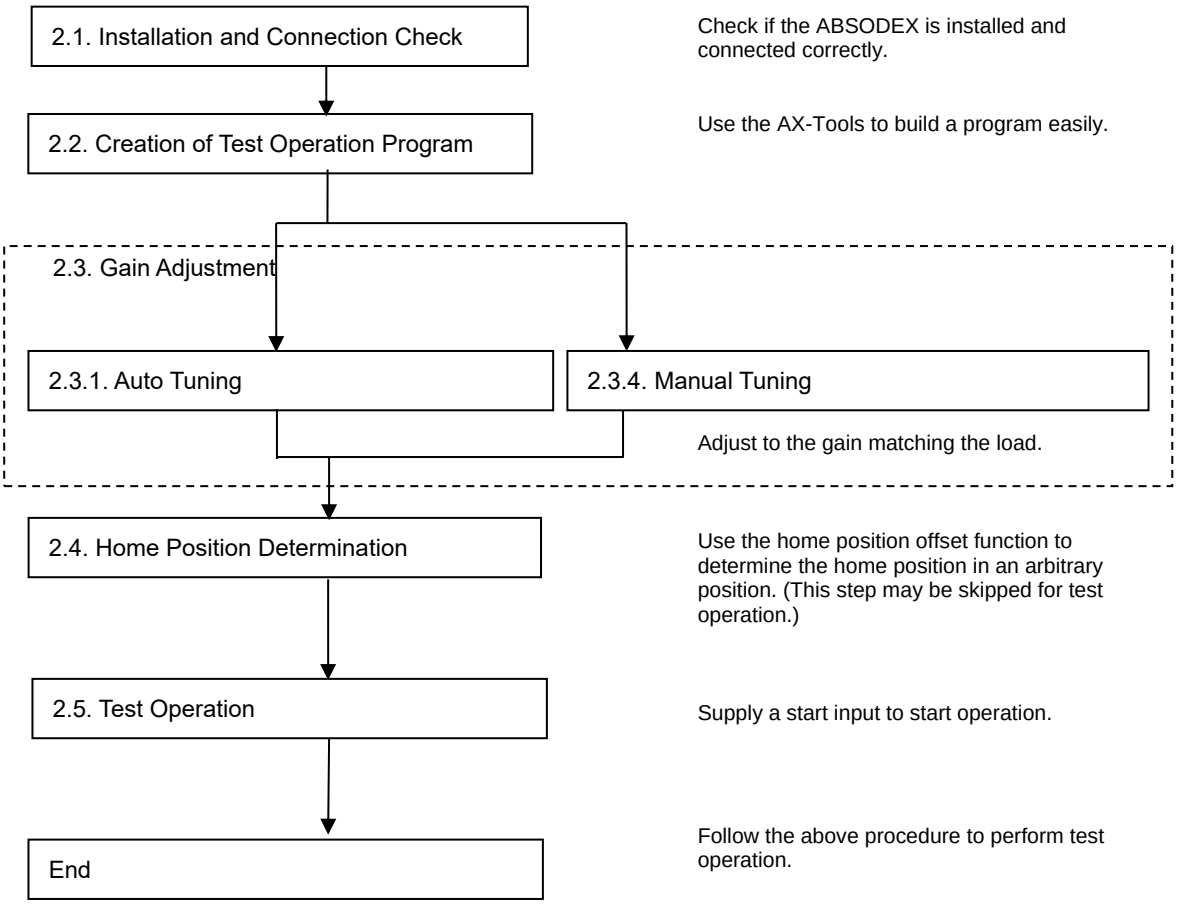
Functions are configured in the following way when the product is shipped from the factory.
Forced stop input (Input signal 1 - bit 12 / input data byte 1 - bit 4): Valid
In case of no input, forced stop (servo-off) 7-segment LED display 9.2.
Servo-on input (Input signal 1 - bit 9 / input data byte 1 - bit 1): Valid
In case of no input, (servo-off) 7-segment LED display .. (dot)

When test operation is conducted without I/O cables connected, functions can be invalidated temporarily, using the following communication commands.
To invalidate the forced stop input temporarily : L7M_23_2
To invalidate the servo-on input temporarily : L7M_52_999 (valid only in servo-off mode)

- The state before change is restored after the control power is turned off then on again.
- To invalidate the forced stop input temporarily, send the above-mentioned communication command (L7M_23_2) and then perform alarm reset (send “S7”).
- To invalidate the servo-on input temporarily, change to the servo-off mode first (by sending “M5”), and then send the above-mentioned communication command (L7M_52_999). Next, change to the automatic operation mode (by sending “M1”) and conduct test operation.

If you are not using the above functions, enter the following parameters.
Do not use the forced stop input: : L7_23_2
Do not use the servo-on input: : L7_52_1

- The setting remains effective even after the control power is turned off then on again.
- To invalidate the forced stop input, send the above-mentioned communication command (L7_23_2) and then perform alarm reset (send “S7”) or turn the control power off then on again.
- Turn the control power off then on again to switch the servo-on input function. After the function is switched, Input signal 1 - bit 9 / input data byte 1 - bit 1 is assigned to program stop input.
- The 7-segment LED shows  (a dr and a dot) at the third digit and the second digit from the right without an alarm. The 7-segment LED on the right side shows the operation mode.
- For servo off,  (dr and two dots) will be displayed.

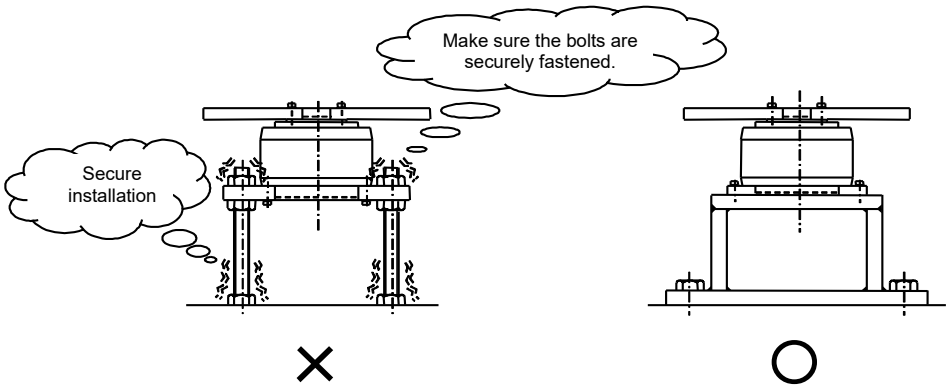

2.1. Installation and Connection Check
Check if the ABSODEX is installed and connected correctly.
2.2. Creation of Test Operation Program
Use the AX-Tools to build a program easily.
2.3. Gain Adjustment
2.3.1. Auto Tuning
2.3.4. Manual Tuning
Adjust to the gain matching the load.
2.4. Home Position Determination
Use the home position offset function to determine the home position in an arbitrary position. (This step may be skipped for test operation.)
2.5. Test Operation
Supply a start input to start operation.
End
Follow the above procedure to perform test operation.

2.1. Installation and Connection Check

Fix the ABSODEX unit securely.
The full performance of ABSODEX is not achieved with unstable installation or with a loose base or stand. Install the load securely, too.
A loosely installed load or one with loose bolts will cause oscillation. For details, refer to “3.INSTALLATION.”

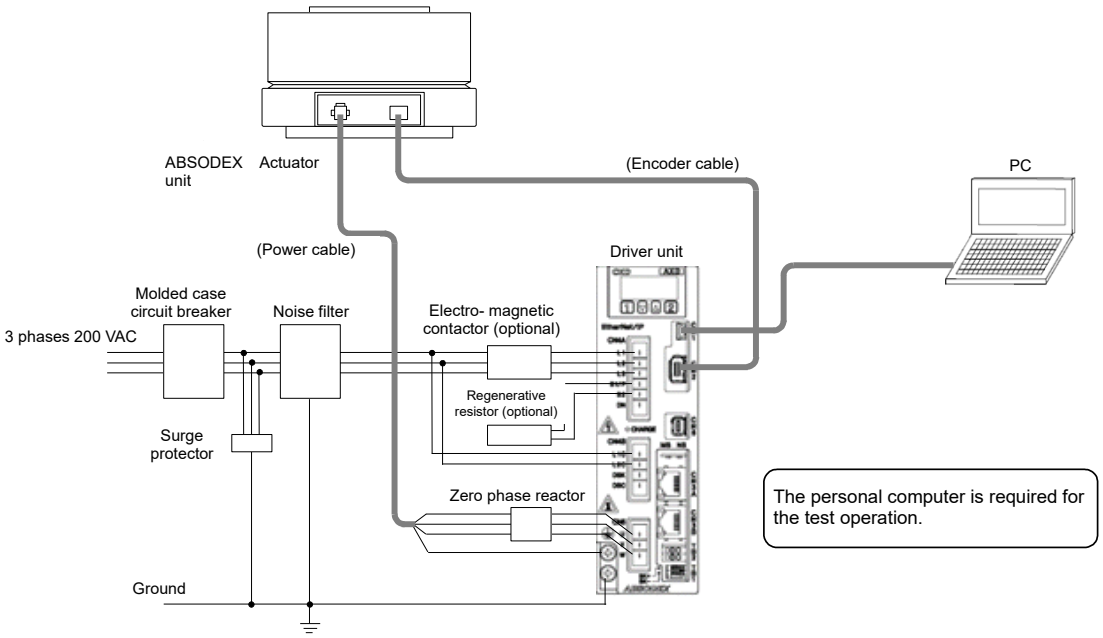
- Because the product is of a quick-response specification, the operation noise may be larger than earlier types when operation is made at a small rigidity.
  If you have problems with larger operation noises, install a vibration-preventive filter (PRM62 to PRM66).

<Unit Installation Example>



Next, connect all of the actuator, driver and power supply as well as peripheral devices. For details, refer to “1.PRODUCT CONFIGURATION.”

<Connection Example>



2.2. Creation of Test Operation Program

Gain adjustment is necessary for the operation of ABSODEX.
Gain adjustment is made for each load so that ABSODEX operates in the best state.
Create a four-segment program used for a gain adjustment and test operation using the AX-Tools.
For details, refer to the “AX-Tools instruction manual.”
Each time this program runs, the actuator turns clockwise by an indexing angle of 90° in a traveling time of 1 second.
After checking that there is no interfering matter when ABSODEX moves when the power is turned on, turn the power on.
If ABSODEX is driven by a force, alarm 1 is caused.
Turn the power off then on again and check that the alarm light is unlit.

CAUTION

The coordinates of the actuator position are recognized when the power is turned on. Be careful to avoid moving the output axis for several seconds since the power is turned on.

- If there is an external mechanical retention mechanism such as the brake, stagger the retention mechanism resetting timing from the power-on timing.
- If the output axis moves when the power is turned on, alarm F may be caused.

2.3. Gain Adjustment

WARNING

Keep hands away from the rotating part as sudden motion may take place during gain adjustments or trial run.

- Make sure of the safety in the full revolution of the actuator before turning it on to adjust.

Make sure that the safety is assured to operate the actuator in case the unit is operated from the place unable to confirm the motion.

CAUTION

The actuator may turn several turns during auto tuning.

- Remove wiring, piping and other interfering matters to allow it to rotate.

If removal of any interfering matter is impossible, manually adjust the gain.

- For manual tuning, refer to “8.GAIN ADJUSTMENT.”

If a work torque (external force to rotate the output axis of the actuator) acts as shown in “Action of Work Torque” of “2.3.1.Auto Tuning.”

- Use the manual gain adjustment method, too, in this case.

After checking that there is no interfering matter when ABSODEX moves when the power is turned on, turn the power on.

- If ABSODEX is driven by a force, alarm 1 is caused.
- Turn the power off then on again and check that the alarm light is unlit.

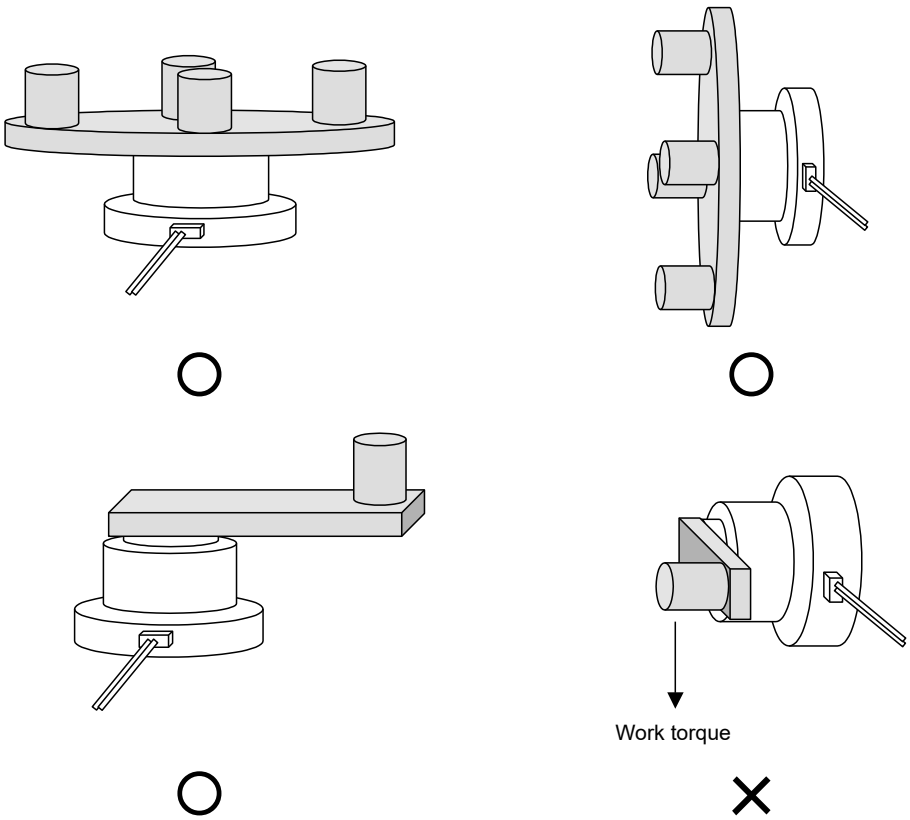
After the auto tuning command is sent (by pressing the Enter key), auto tuning begins. With this, the ABSODEX starts to oscillate.

- Several rotations may be caused according to some loads. Remove wiring, piping and other interfering matters carefully before pressing the Enter key.

2.3.1. Auto Tuning

Gain adjustment is necessary for the operation of ABSODEX.
Gain adjustment is made for each load so that ABSODEX operates in the best state.
Here, the gain adjustment method using the auto tuning function is described.

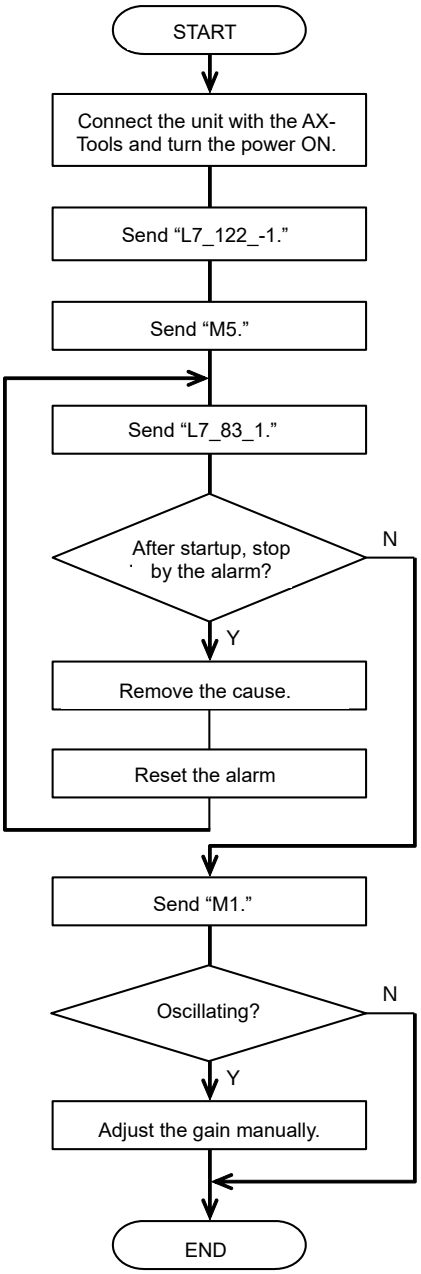
<Action of Work Torque>



2.3.2. Auto Tuning Flowchart

The flowchart of auto tuning is shown below.

<Auto Tuning Flowchart>



At the terminal mode of the AX-Tools, enter commands necessary for auto tuning.

Set PRM122 (G2) to “-1.”
Then auto tuning becomes effective.

Turn the servo off. (Send M5.)

Auto tuning oscillation starts.

Turn the servo on. (Send M1.)
After the actuator has stopped oscillating, tuning is finished.
(The cycle may take several tens of seconds according to the load.)
If the ABSODEX oscillates in this state, manual gain adjustment is necessary.
For details, refer to “8.GAIN ADJUSTMENT.”
If a wrong code is transmitted and “*” is received to cause alarm 7, reset from the alarm (send “S7”) and enter the correct code and send it again.

Enter the actual program to start operation.

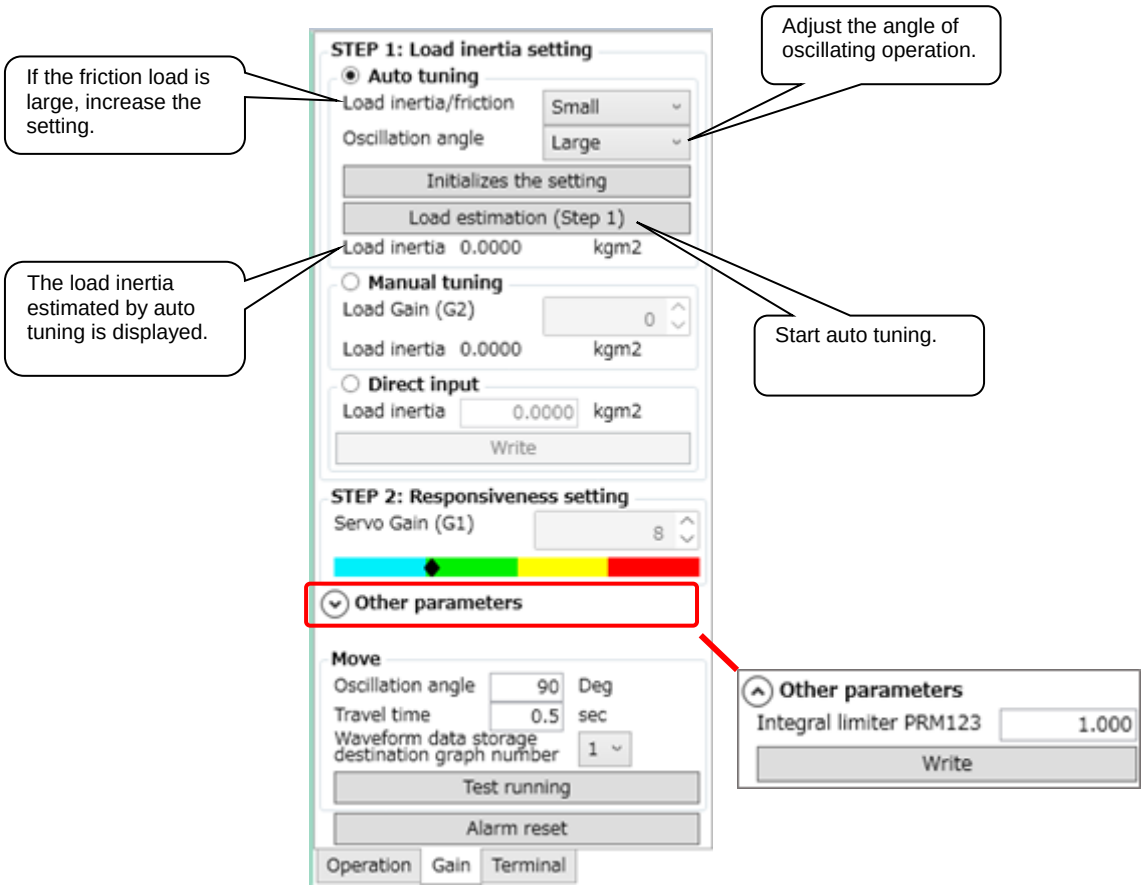
For manual adjustment, refer to “8.GAIN ADJUSTMENT.”

2.3.3. Auto Tuning Using AX-Tools

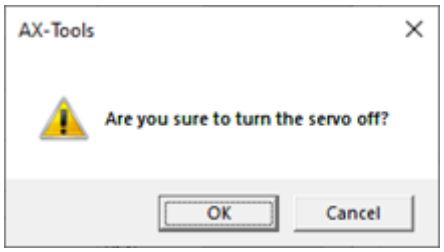
Use the “Tuning Function” of the AX-Tools to perform auto tuning more easily.

1. Launch the AX-Tools and open the tuning dialog box.

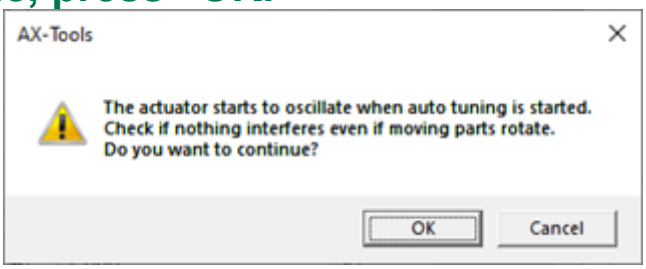
To start auto tuning, press the “Load Estimation (Step 1)” button.



2. A servo-off check is requested for. To continue, press “OK.”

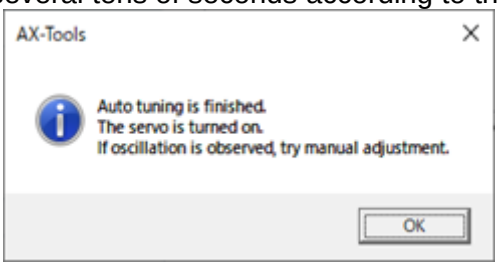


3. Before oscillation begins, confirmation is requested for. To continue, press “OK.”



4. After the actuator has stopped oscillating, auto tuning is finished.

(The cycle may take several tens of seconds according to the load.)

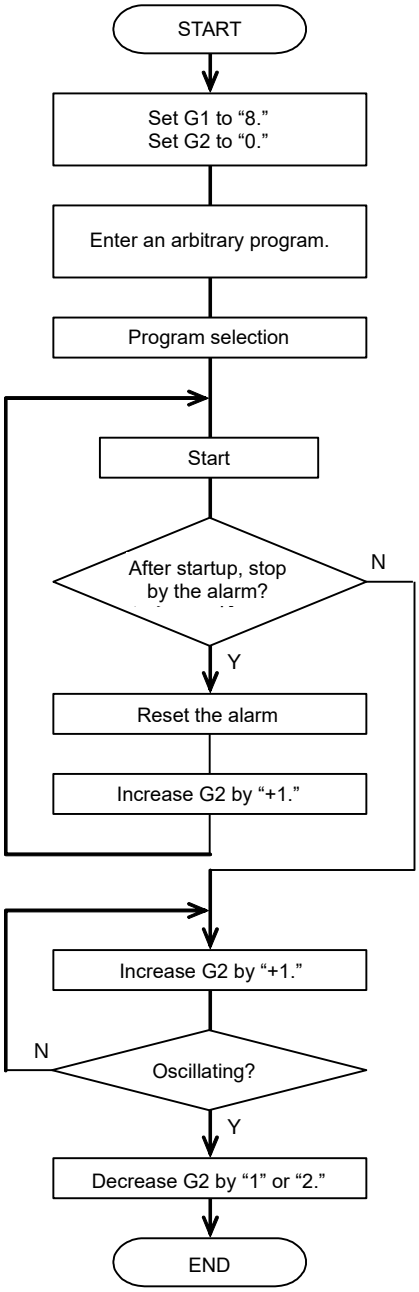


For details, refer to the “AX-Tools instruction manual.”

2.3.4. Manual Tuning

The gain adjustment flowchart is shown below.

<Manual Tuning Flow Chart>



With push buttons on the driver panel or AX-Tools, set G1 to “8,” and G2 to “0.”
The shipment settings are “8” (G1) and “-1” (G2.)
This setting assumes operation with almost no load.
The G2 setting is determined in principle according to the magnitude of the moment of inertia of the load.

For the entry, selection and starting procedures of the program, refer to “2.2.Creation of Test Operation Program.”

- If the moment of inertia of the load is large and the gain setting is too small, the actuator may swing or an alarm is caused to coast to stop due to inertial force when a start input is supplied.
- If the rigidity of the equipment is not large, vibration may be caused. If this is the case, reduce G1 and perform similar adjustment.
- If gain adjustment is unsuccessful, perform similar adjustment with a longer indexing time and a smaller rotation speed. Then gradually reduce the indexing time while observing the result.

Repeat similar adjustment while changing the G1 setting, to adjust the gain more accurately.
If the rigidity of the equipment is sufficiently high, increase the G1 setting even with a smaller G2 setting after the above adjustment to improve the action state further.

2.4. Home Position Determination

(Unnecessary for Test Operation)
The home position can be set at any position using the home position offset adjustment function of the AX-Tools.
For details, refer to the “AX-Tools instruction manual.”

2.5. Test Operation

Create a program for a test operation using the AX-Tools.
For details, refer to the “AX-Tools instruction manual.”

2.6. Wiring

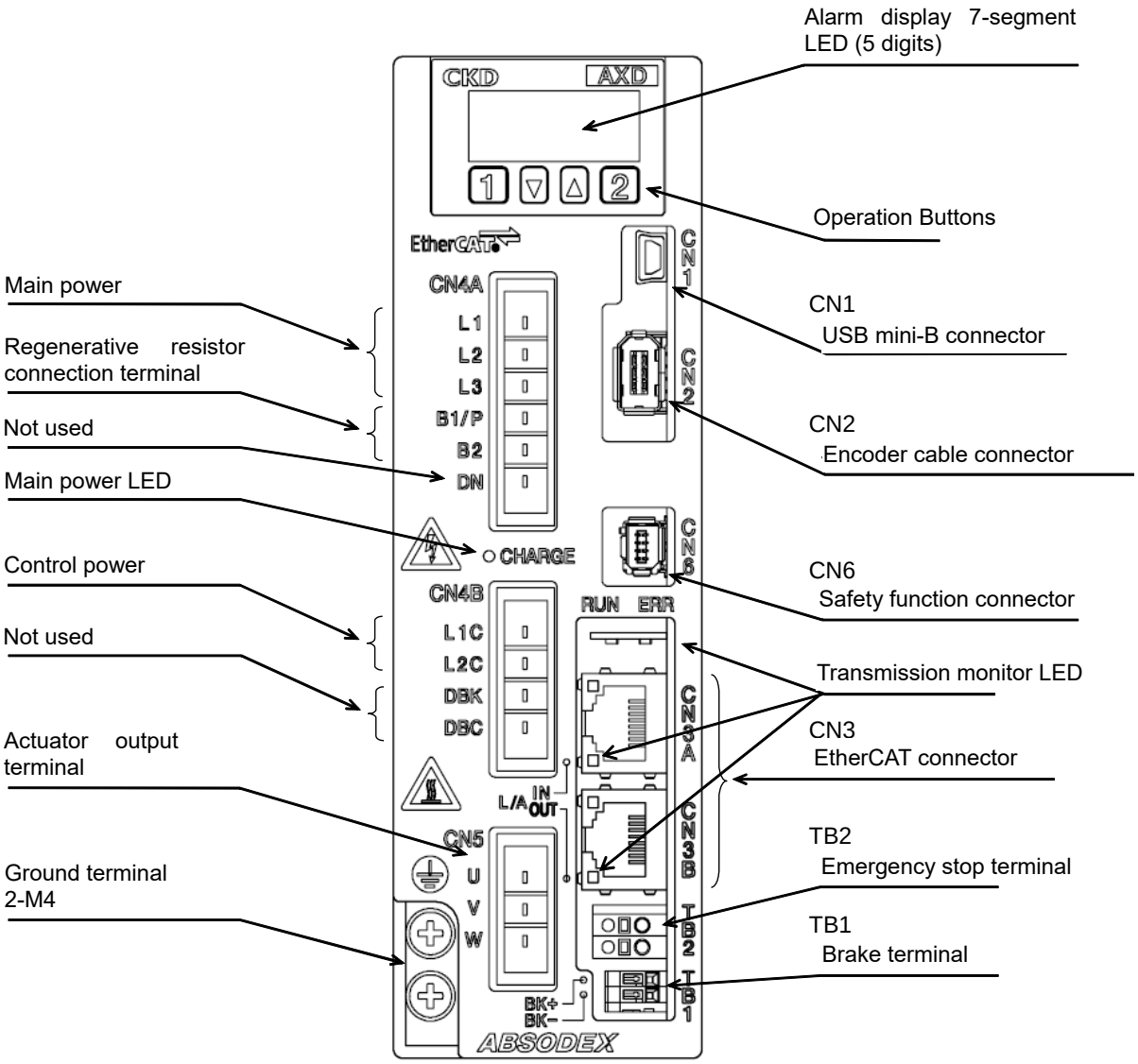
2.6.1. Driver Panel Description

A terminal strip and connectors, etc. are located on the front panel of the driver.

■ EtherCAT specifications

<AXD-S Type Driver Panel>

AXD-S AXD-H



CAUTION

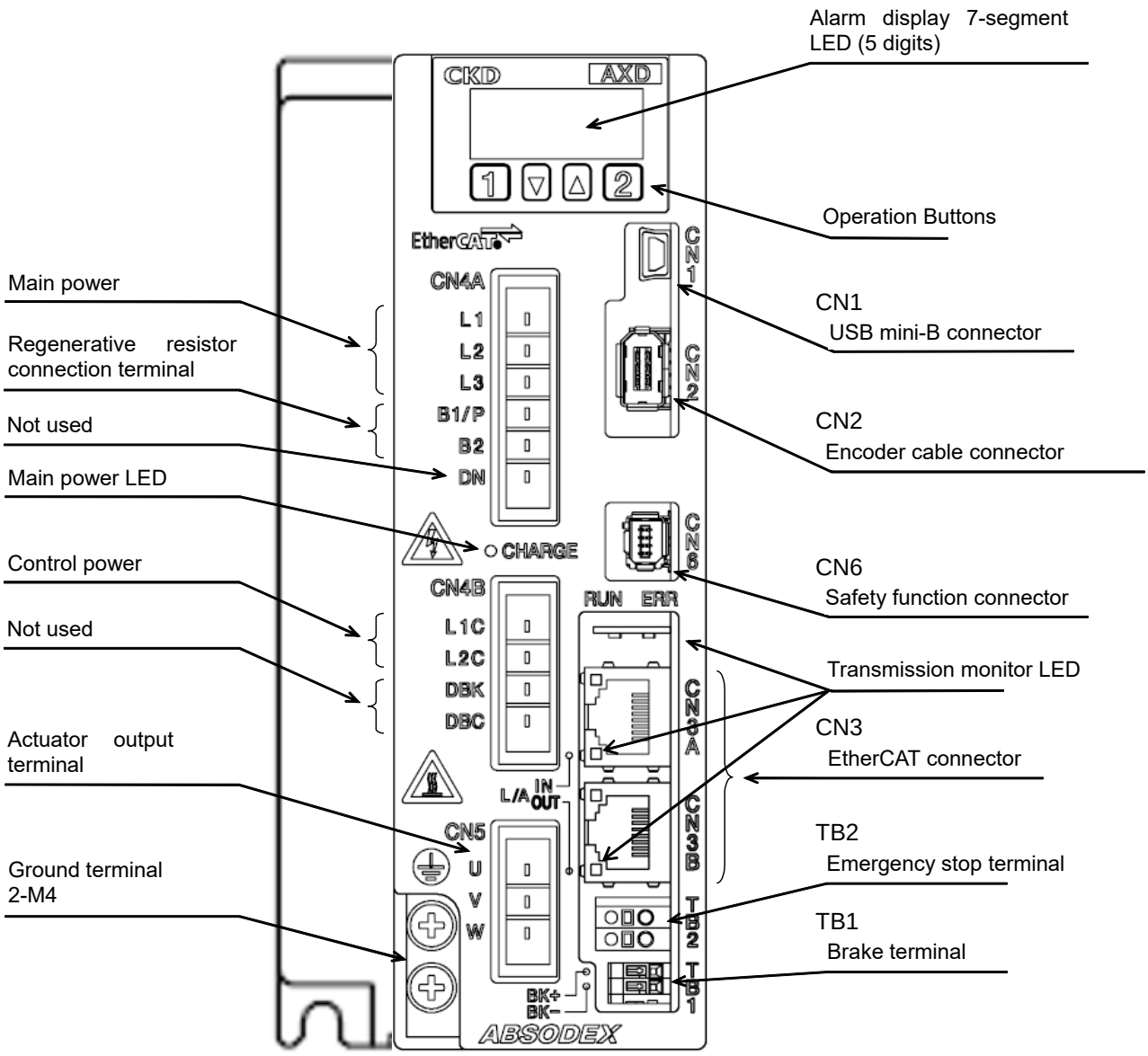
The main power LED (CHARGE) indicates the charging state of the main circuit.

- Keep away from the power terminals and actuator output terminals when the LED is lit.
- Keep away from these terminals for five minutes after the power is turned off, without relations to the lighting condition.

DO NOT TOUCH the heat dissipation fin of the driver during operation and even after power is disconnected until it is cooled down.

- To prevent burn injury, do not touch the hot surface.

<AXD-H Type Driver Panel>



CAUTION

The main power LED (CHARGE) indicates the charging state of the main circuit.

- Keep away from the power terminals and actuator output terminals when the LED is lit.
- Keep away from these terminals for five minutes after the power is turned off, without relations to the lighting condition.

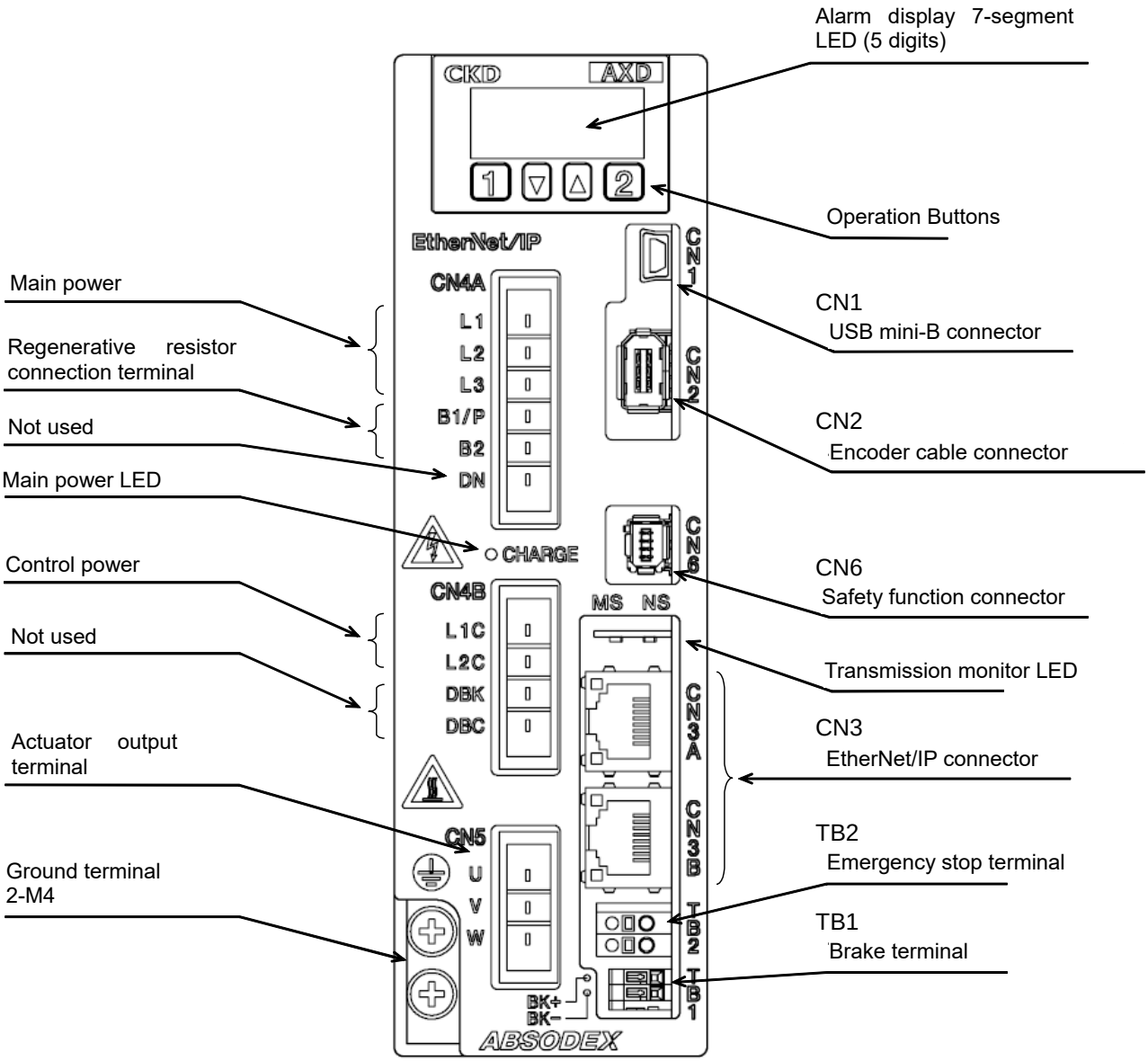
DO NOT TOUCH the heat dissipation fin of the driver during operation and even after power is disconnected until it is cooled down.

- To prevent burn injury, do not touch the hot surface.

■ EtherNet/IP specifications

<AXD-S Type Driver Panel>

AXD-S AXD-H



⚠ CAUTION

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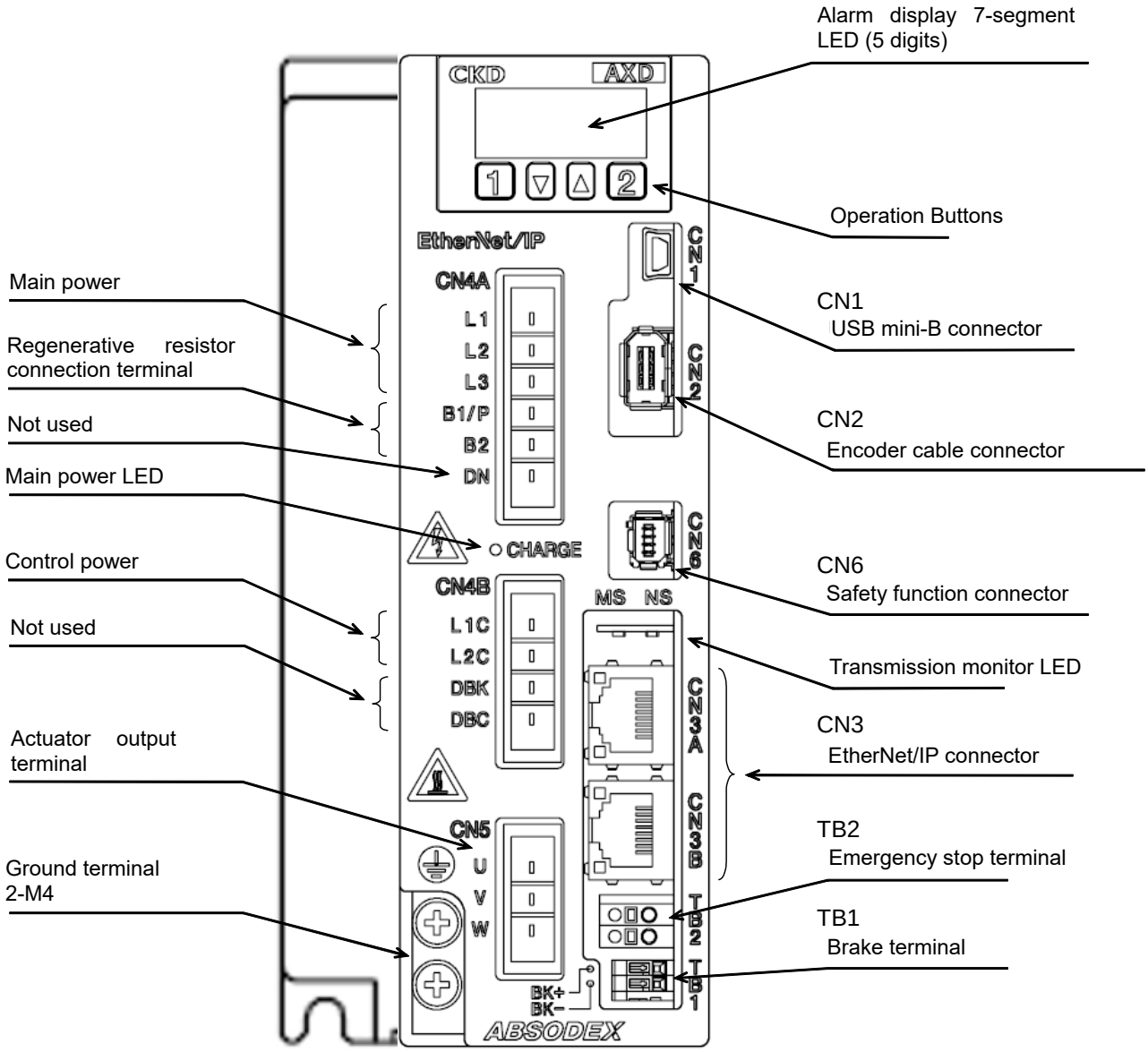
<AXD-H Type Driver Panel>



CAUTION

The main power LED (CHARGE) indicates the charging state of the main circuit.

- Keep away from the power terminals and actuator output terminals when the LED is lit.
- Keep away from these terminals for five minutes after the power is turned off, without relations to the lighting condition.

DO NOT TOUCH the heat dissipation fin of the driver during operation and even after power is disconnected until it is cooled down.

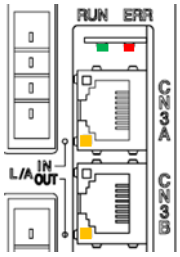
- To prevent burn injury, do not touch the hot surface.

2.6.2. LED Display

■ EtherCAT specifications

LED display shows the states of this product and network. For LED display, refer to the following table.

<LED Name>



<List of LED Specifications>

LED name	Color	Display contents
RUN	Green	Indicates the slave state.
ERR	Red	Indicates the communications state.
L/A IN	Orange	Indicates the link state of the IN side of CN3 connector.
L/A OUT	Orange	Indicates the link state of the OUT side of CN3 connector.

<LED State List>

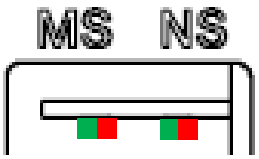
LED name	LED state	Behavior
RUN	●	INIT state
	◎	PRE-OPERATIONAL state
	◎ **(Flash)**	SAFE-OPERATIONAL state
	◎ **(Flickering)**	BOOTSTRAP state
	○	OPERATIONAL state
ERR	●	Normal communications
	◎ **(Double flash)**	Communications failure (WD timeout)
	◎	Communications failure
L/A IN	●	NO LINK, NO ACTIVITY
	○	LINK, NO ACTIVITY
	◎ **(Flickering)**	LINK, ACTIVITY
L/A OUT	●	NO LINK, NO ACTIVITY
	○	LINK, NO ACTIVITY
	◎ **(Flickering)**	LINK, ACTIVITY

○: On, ●: Off, ◎: Flashing

■ EtherNet/IP specifications

LED display shows the states of this product and network. For LED display, refer to the following table.

<LED Name>



<List of LED Specifications>

LED name	Color	Display contents
MS	Green/Red	LED display shows the states of the network module of this product.
NS	Green/Red	LED display shows the states of the network.

<LED State List>

LED name	LED state	Behavior
MS	●	Power OFF
	○ **Green**	Normal operation
	◎ **Green**	Waiting for connection establishment from the master
	◎ **Red**	Recoverable error occurred
	○ **Red**	Unrecoverable error occurred
NS	●	Power OFF, or unconfigured IP address
	◎ **Green**	Unestablished connection
	○ **Green**	Normal communications
	◎ **Red**	Error (timeout)
	○ **Red**	Error (duplicated IP address)

○: On, ●: Off, ◎: Flashing

3. INSTALLATION

DANGER

Do not attach or remove connectors with the power on.

- A malfunction, failure or electric shock may be caused.

Do not operate in explosive or fire atmosphere.

WARNING

Do not remove devices until the safety is confirmed.

The brake built-in actuator series do not completely clamp the output axis in all cases.

- In the case of maintenance of the application, in which the output axis may rotate by unbalanced load, or when the machine is stopped for an extended period of time, be sure to set a balanced status or mechanical lock mechanism.
- The built-in brake only is not enough to secure safety.

Be sure to ground the protective earth terminal of the driver to avoid electric shock.

CAUTION

When carrying the actuator, do not hold the connector, connector mount or draw-out cable.

- The connector part may be damaged or disconnected.

Actuators and the drivers are not water-proof type.

- For using them where water or oil may be splashed, provide a protective means for the actuator and the driver.

As for cables between the actuator and driver, be sure to use and install dedicated ones.

- Changing the length or the material of the dedicated cable should not be done as performance function may be lost or malfunction may be caused. Do not scratch and strongly pull cables.

Observe the following when installing the actuator, driver, and cables.

◎ When using ABSODEX in a place where there is high frequency, high voltage, strong electric field, strong magnetic field, discharge, or radiation, take measures such as installing noise filters or shields to prevent malfunction or damage to the equipment.

◎ Take measures to prevent the effects of induction noise on the encoder cable, I/O cable, CC-Link cable, and power cable.
(Example) Attach a noise suppression component such as a noise filter, ferrite core, or surge protector to each cable, and ground the shielded wire of the cable using an FG clamp or the like.
When wiring, shield the cables from the noise source by keeping a sufficient distance from the noise source or routing the cables in grounded metal ducts.

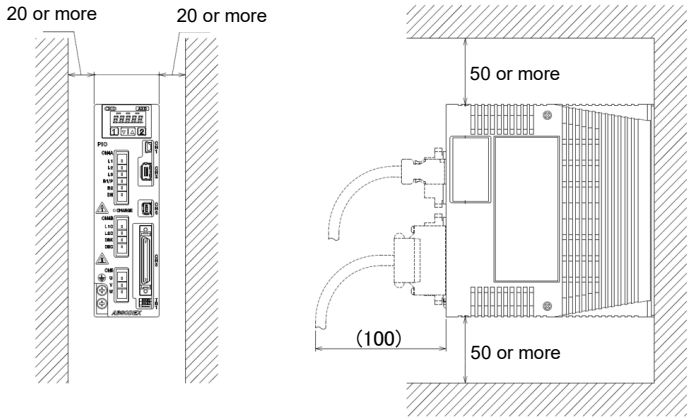
3.1. Driver Installation

3.1.1. Precautions for Installation of Driver

The ABSODEX driver is not designed for dust-tight and water-proof construction.
Make sure that appropriate protection is provided for the driver so that dust, water, and oil will not ingress the driver.

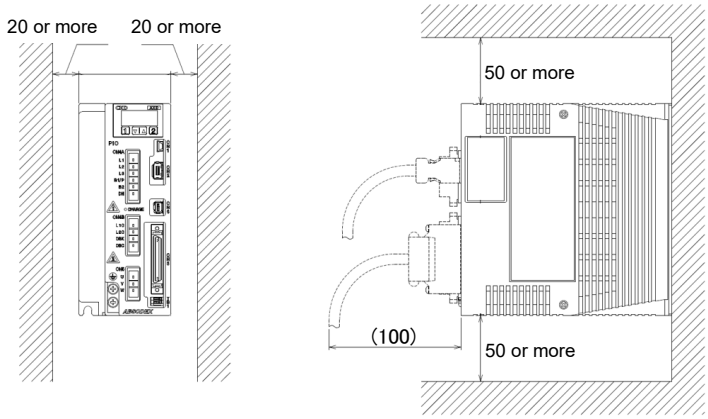
When installing the ABSODEX driver, make a space of 50 mm or more on an upper surface and lower surface, and 20 mm or more on a side surface from a structural object such as an adjacent driver, another device and wall. If heat is generated from another driver or device, the ambient temperature should not exceed 55ºC.

<AXD-S Type Driver Installation Interval>



AXD-S | AXD-H

<AXD-H Type Driver Installation Interval>



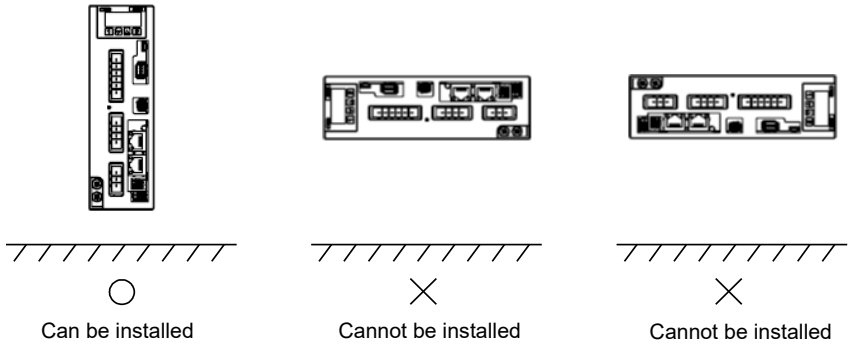
AXD-S | AXD-H

* Determine the dimension including a margin according to the cables to be used.

■ Driver Installation Direction

If the driver is installed horizontally, air stays inside the driver to deteriorate heat radiation and raise the internal temperature, possibly causing failure of the driver. Install the driver in the erected state without fail.

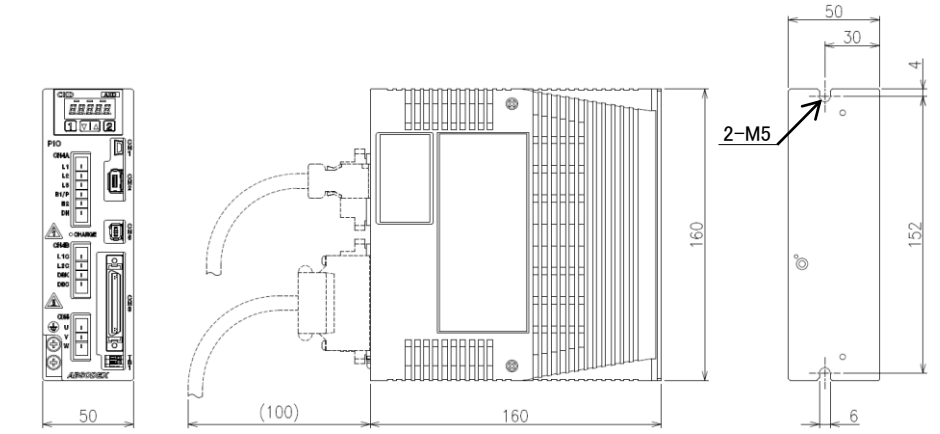
<Driver Installation Direction>



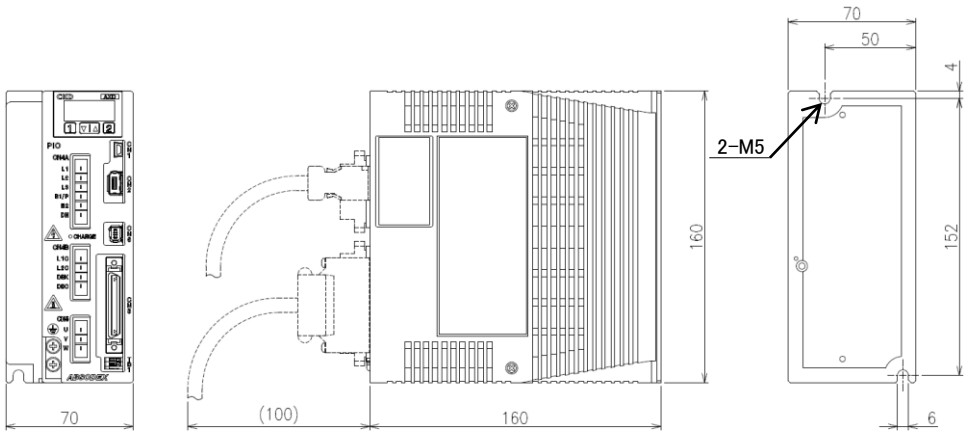
■ Dimensional Drawing and Installation Dimension of ABSODEX Driver

<Dimensions of Driver (Figure above: AXD-S Type Driver, Figure below: AXD-H Type Driver)>

AXD-S AXD-H



AXD-S AXD-H



3.2. About Cable

Use the dedicated cable (optionally available) without fail for the wiring between the actuator and driver. Avoid excessive forces or scratches on wiring in the installed state.

CAUTION

Do not remodel the power cable or the encoder cable (optionally available). A remodeled cable will cause malfunction and failure.

Route the power cables such as the power cable and power supply cable separately from the signal cables such as the encoder cable and I/O cable.

- Do not tie the cables belonging to different groups or do not route them in the same conduit.

Fix the cable sheath near the connector of the actuator unit for applications where the cable is susceptible to repetitive bending operations.

The cable extension of the AX2R series and AX4R-009 is not a movable cable.

- Fix it at the connector without fail so that it does not move.
- Do not hold the cable extension when lifting the unit. Do not exert an excessive force. Otherwise a broken wire will be caused.

3.3. Unpacking

3.3.1. Product Model

Check that the product model is the ordered one.
The product model is stated in the nameplate on the driver side panel.

3.3.2. Product Configuration

This product consists of the items specified in the table below.
Check that all items are delivered when unpacking for the first time.

<Product Configuration>

Name			Quantity
1. Driver Unit			1
2. Handling Precautions			1
3. Accessories			
Main power supply connector	**06JFAT-SBXGF-I or 06JFAT-SBXGGKS-A**	**[J.S.T.MFG.CO.,LTD.]**	1
Control power connector	**04JFAT-SBXGF-I or 04JFAT-SBXGGKS-A**	**[J.S.T.MFG.CO.,LTD.]**	1
Connector for actuator output	**03JFAT-SBYGF-I or 03JFAT-SBYGGKS-A**	**[J.S.T.MFG.CO.,LTD.]**	1
Operating lever for connector	**J-FAT-OT or J-FAT-OT(N)**	**[J.S.T.MFG.CO.,LTD.]**	1
STO shorting plug	**DZ02B008DC1**	**[J.S.T.MFG.CO.,LTD.]**	1

CAUTION

Do not pull cables and connectors.

Fix the cable sheath near the connector of the actuator unit for applications where the cable is susceptible to repetitive bending operations.

3.4. Wiring Method

3.4.1. Connection to Power and Actuator (CN4A, CN4B, CN5)

■ L1, L2, L3 (CN4A), L1C, L2C (CN4B)

Connect to the power supplies using the connectors provided.

To use with 3-phase power supply, connect the 50/60 Hz power cables to the L1, L2, L3, L1C and L2C terminals.
To use with single-phase power supply, connect the 50/60 Hz power cables to the L1, L2, L1C and L2C terminals.

If it is used at single-phase 200 VAC, the calculation of the torque limit area is different from normal one. If you cannot judge whether they can be used, please contact us.
The power cable must be of heat resistant vinyl cladding, and of the conductor cross section area of 2 mm^2.

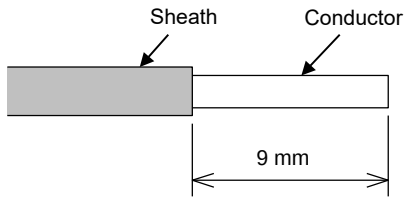
⏚ (Ground terminal)
The ground cable (G) of the power cable and the ground of the main power must be wired to this terminal to avoid an electrical shock.
The cross-sectional area of the wire for the protective earthing conductor shall be larger than or equal to that of the power supply cable (2 mm^2).
Use a crimp terminal for the wiring at this terminal. The size of the screw is M4.
Tighten the screw to 1.2 N·m.

■ U, V, W (CN5)

Connect to the actuator using the connectors provided. Connect the U, V and W cables of the power to the corresponding terminals.

■ Wiring Method for Accessory Connector (CN4A, CN4B, CN5)

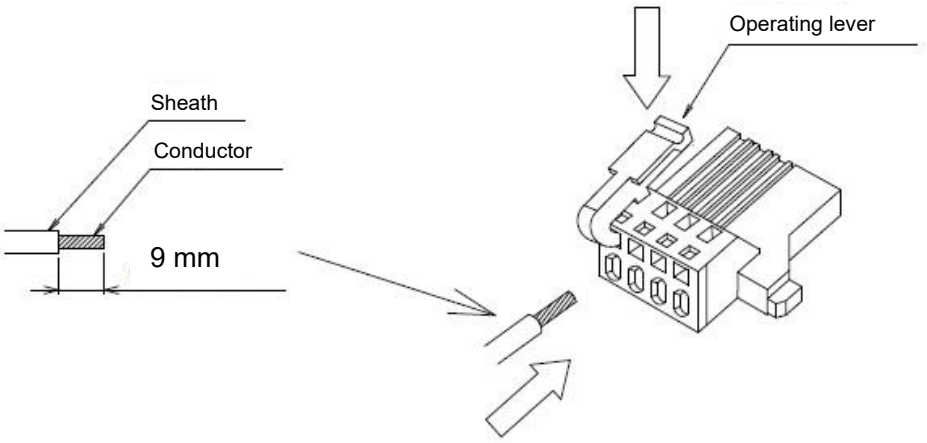
<Cable End Treatment Drawing>



Stranded cable: Peel off the sheath of the cable and twist it to use.
At the time, be careful to avoid a short circuit across the element wire of the conductor and adjacent pole.
Do not solder the conductor; otherwise poor continuity may be caused.

How to Insert the Cable into the Connector

Use the provided operating lever to insert the power supply insertion section of the plug connector.
Remove the plug connector from the equipment before inserting it.



DANGER

The L1, L2, L3, L1C, L2C, U, V and W terminals are charged with high voltages.

- Keep away from the terminals when the power is on.
- In addition, keep them away for five minutes after the power is shut down, because of high-voltage charges accumulated in internal capacitors.

CAUTION

Connecting to the higher voltage than specified may cause the driver to fail.

Route the power cables such as the power cable and power supply cable separately from the signal cables such as the encoder cable and I/O cable.

- Do not tie the cables belonging to different groups or do not route them in the same conduit.

Connect to the specified commercial power source.

- Connecting PWM output type inverter may cause the driver to fail.

■ Power Supply and Circuit Breaker Capacities

<Power Supply and Circuit Breaker Capacities>

Actuator Model	Driver Model	Power Supply Capacity (kVA) Note 1		Breaker Capacity (A)
		Max. value	Rated value	Rated current
AX1R-022	AXD-S	1.0	0.5	10
AX1R-045		1.5	0.5	
AX1R-075		2.0	0.8	
AX2R-006		0.8	0.5	
AX2R-012		1.0	0.5	
AX2R-018		1.0	0.5	
AX4R-009		1.0	0.5	
AX4R-022		1.0	0.5	
AX4R-045		1.5	0.5	
AX4R-075		2.0	0.8	
AX1R-150	AXD-H	3.0	0.8	20
AX1R-210		4.0	1.5	
AX4R-150		3.0	0.8	
AX4R-300		4.0	1.5	
AX4R-500		4.0	2.0	
AX4R-10W		4.0	2.0	

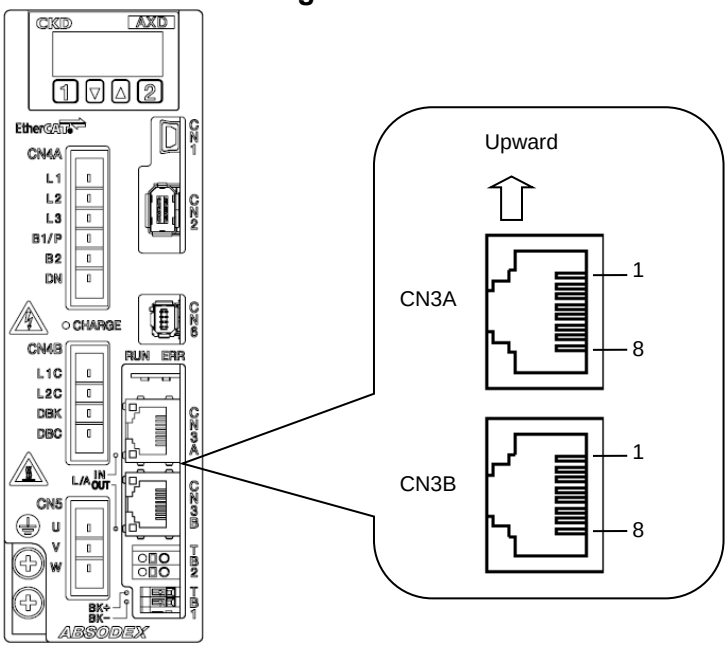
Note 1: The power supply capacity is determined by the actuator to be connected.

3.4.2. Communications Connector

■ EtherCAT specifications

The pin alignment of EtherCAT communications connectors (CN3A, CN3B) are shown below:

<Communications Connectors - Pin Alignment>



<CN3 Pin Alignment>

Connector	Pin	Signal Name	Function	Explanation
CN3A/CN3B	1	TD+	Transmits data plus	Connect TD+ line.
	2	TD-	Transmits data minus	Connect TD- line.
	3	RD+	Receives data plus	Connect RD+ line.
	4	-	Not used	-
	5	-	Not used	-
	6	RD-	Receives data minus	Connect RD- line.
	7	-	Not used	-
	8	-	Not used	-

- It is recommended to use cables and connectors that are compliant with the EtherCAT specifications.

<Example of cables>

PNET/B	Industrial shielded cable (double shield) Ethernet cable	Made by JMACS

<Example of connectors>

3R104-1110-000 AM	Industrial RJ45 modular plug	Made by 3M

CAUTION

For signal cables, use dedicated cables compliant with EtherCAT specifications.

When performing the work, insert/remove a connector straight to avoid excessive force.

Make sure that the communication cable has a sufficient bend radius and do not bend it forcefully.

Keep a sufficient distance between the communication cable and the power cable (power cable).

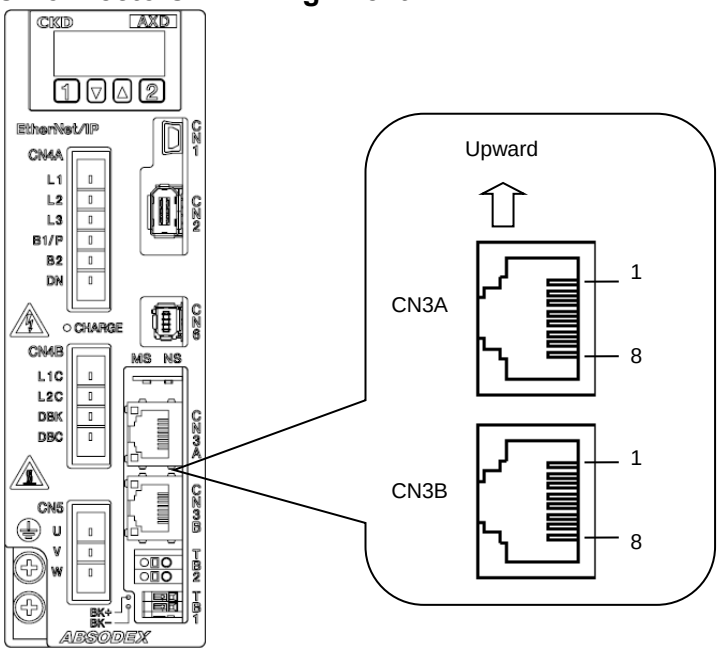
When the communication cable and the power cable are approximated or bundled together, communications become unstable due to noise, which causes a communications error.

For the installation of the communication cables, refer to EtherCAT installation manual, etc.

■ EtherNet/IP specifications

The pin alignment of EtherNet/IP communications connectors (CN3A, CN3B) is shown below:

<Communications Connectors - Pin Alignment>



<CN3 Pin Alignment>

Connector	Pin	Signal Name	Function	Explanation
CN3A/CN3B	1	TD+	Transmits data plus	Connect TD+ line.
	2	TD-	Transmits data minus	Connect TD- line.
	3	RD+	Receives data plus	Connect RD+ line.
	4	-	Not used	-
	5	-	Not used	-
	6	RD-	Receives data minus	Connect RD- line.
	7	-	Not used	-
	8	-	Not used	-

- It is recommended to use cables and connectors that are compliant with the EtherNet/IP specifications.

<Example of cables>

PNET/B	Industrial shielded cable (double shield) Ethernet cable	Made by JMACS

<Example of connectors>

3R104-1110-000 AM	Industrial RJ45 modular plug	Made by 3M

CAUTION

For signal cables, use dedicated cables compliant with EtherNet/IP specifications.

When performing the work, insert/remove a connector straight to avoid excessive force.

Make sure that the communication cable has a sufficient bend radius and do not bend it forcefully.

Keep a sufficient distance between the communication cable and the power cable (power cable).

When the communication cable and the power cable are approximated or bundled together, communications become unstable due to noise, which causes a communications error.

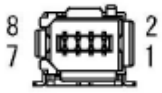
For the installation of the communication cables, refer to EtherNet/IP installation manual, etc.

3.4.3. Wiring for Safety Function

CN6: Safety function Connect to a safety relay or the like.

The safety function employed in this product, STO: Safe Torque Off, is such that the power that can cause rotation of actuator is not applied.
To use the safety function, purchase an optional STO cable.
The ready return input and servo-on input (I/O functions) are necessary for restarting the PDS after the STO activation.
For the safety function sequence, refer to “4.7.5.Sequence of Safety Function.”

<CN6 Pin Alignment>



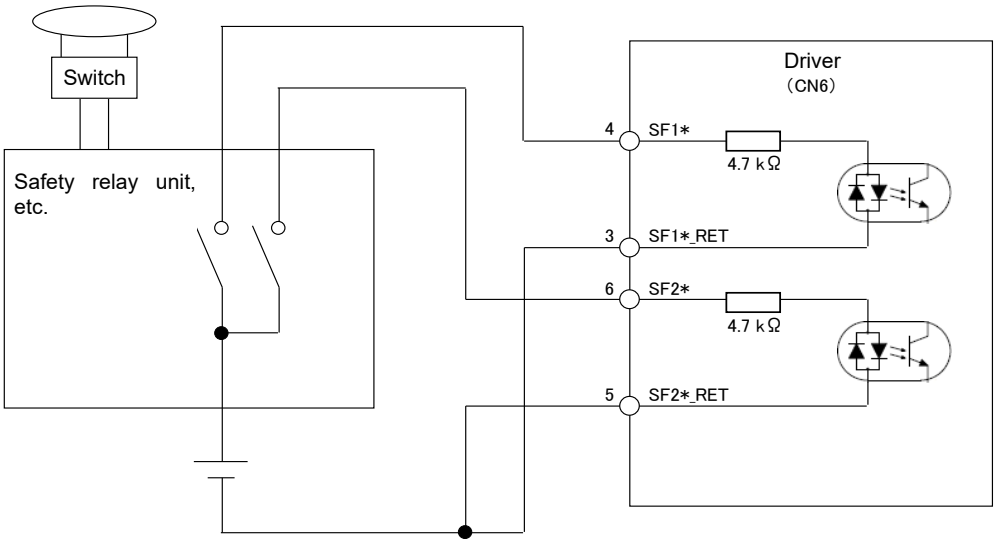
Number	Signal Code	Signal Name
1	NC	Not Connected (Reserved)
2	NC	Not Connected (Reserved)
3	SF1*_RET	Safety input signal 1 (Return)
4	SF1*	Safety input signal 1
5	SF2*_RET	Safety input signal 2 (Return)
6	SF2*	Safety input signal 2
7	EDM -	For monitor output signals (Return)
8	EDM +	For monitor output signals

<STO Cable (AXP-CBLST1-□□, Optionally Available)>

Number	Signal Code	Signal Name	STO Cable Wiring Color
1	NC	Not Connected (Reserved)	-
2	NC	Not Connected (Reserved)	-
3	SF1*_RET	Safety input signal 1 (Return)	Blue
4	SF1*	Safety input signal 1	White/Blue
5	SF2*_RET	Safety input signal 2 (Return)	Yellow
6	SF2*	Safety input signal 2	White/Yellow
7	EDM -	For monitor output signals (Return)	Green
8	EDM +	For monitor output signals	White/Green
-	-	-	Green (0.3SQ) _ for FG

<Wiring Example of Safety Input Signal>

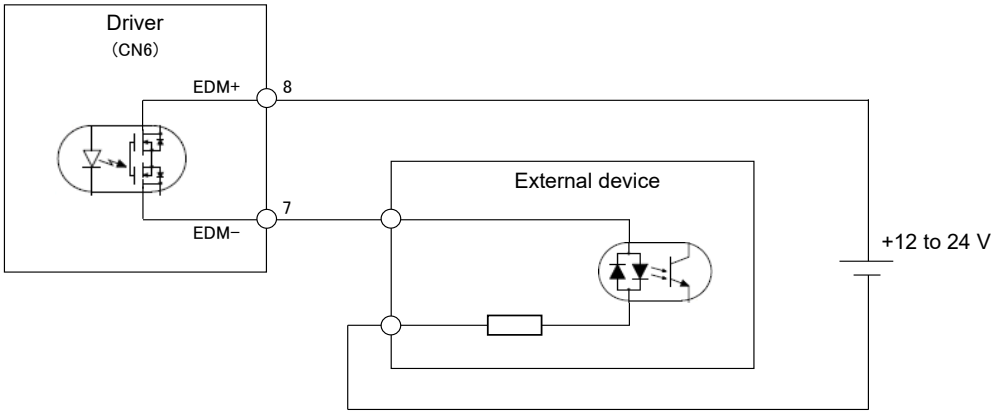
Use a micro current switching relays or an open collector output transistor for a contact.
Turn on when a contact is closed, and turn off when the contact is open.



Item	Description
Insulation method	Photocoupler insulation
Working voltage range	10.2 to 26.4 VDC
Ripple rate	Within 5%
Input full load current	12 VDC: Approx. 2.5 mA
	24 VDC: Approx. 5.0 mA
Input resistance	Approx. 4.7 kΩ

<Wiring Example of Monitor Output Signals>

Turn on when it is electrically conducted between the terminals, and turn off when it is released between the terminals.



Item	Description
Insulation method	MOSFET relay
Maximum load voltage	30 VDC
Maximum load current	50 mA/1 point
Leak current	0.1 mA
Saturation voltage	1.0 V or lower

CAUTION

Monitor output signals are for non-safety related parts, which is not covered by safety standards.

WARNING

The optional electromagnetic brake is for retention only and cannot be used for braking.

Brake outputs (BK+, BK-) and other inputs and outputs (other than CN6) are not safety-related.

- Do not design a safety system using these functions.

Power module failure may cause the actuator to move in a range equivalent to approximately 18° in output axis.

Before using the safety function, make sure to conduct a comprehensive risk assessment of the final application.

- System design shall comply with applicable safety standards so that there are no malfunctions.

When using the safety function, only equipment's that comply with applicable safety standards shall be connected.

The safety function involved is a function that cuts off power supply to the actuator and is not a function to stop it from rotating.

- If this function is used when there is torque applied on the device due to gravity, torque will cause the actuator to rotate. In addition, using this function when the actuator is still rotating will cause the actuator to rotate through inertia. Operate the actuator in the balanced condition so that rotational force is not applied for these operations after all safety aspects are confirmed.

Within 5 ms after interrupting the safety circuit, the power to rotate the actuator is removed.

- Above amount of time must be considered when demonstrating safety in design.

The safety function cuts off power to the actuator but does not cut off power to the driver and does not provide electrical insulation.

- Before performing maintenance on the driver, power to the driver must be cut off in an appropriate manner.

While the safety function is in operation, the 7-segment LEDs display “_ _” (under-scores).

- If the 7-segment LED indications do not change, equipment failure and loose wiring are the possible causes.
- Periodically check that the indications are working properly and perform maintenance as necessary.

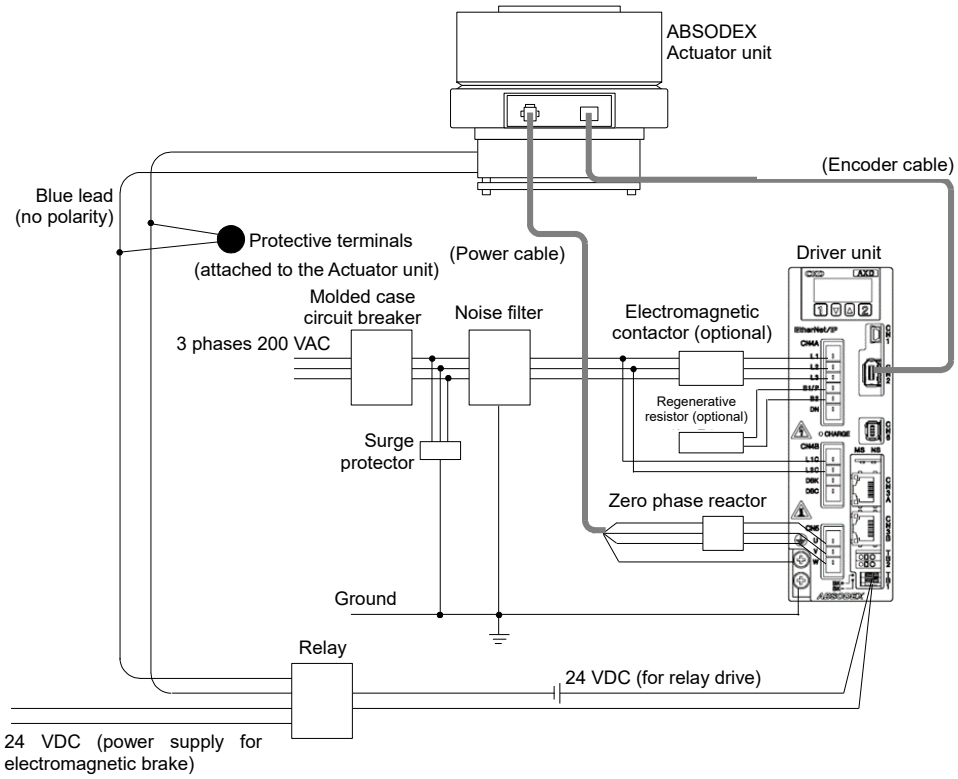
3.4.4. About Electromagnetic Brake

TB1: Brake output Connect an electromagnetic brake.
In a system equipped with an optional electromagnetic brake or with an electromagnetic brake installed outside the ABSODEX by the user and controlled by the ABSODEX program, take care of the following points.

■ Wiring the Electromagnetic Brake

To use an electromagnetic brake, supply 24 VDC as shown in the figure below.

<Wiring the Electromagnetic Brake>



The strip length of wires must be 9 to 10 mm.
The applicable cable is AWG22 to 24 (solid conductor) or AWG22 to 24 (stranded conductor).

CAUTION

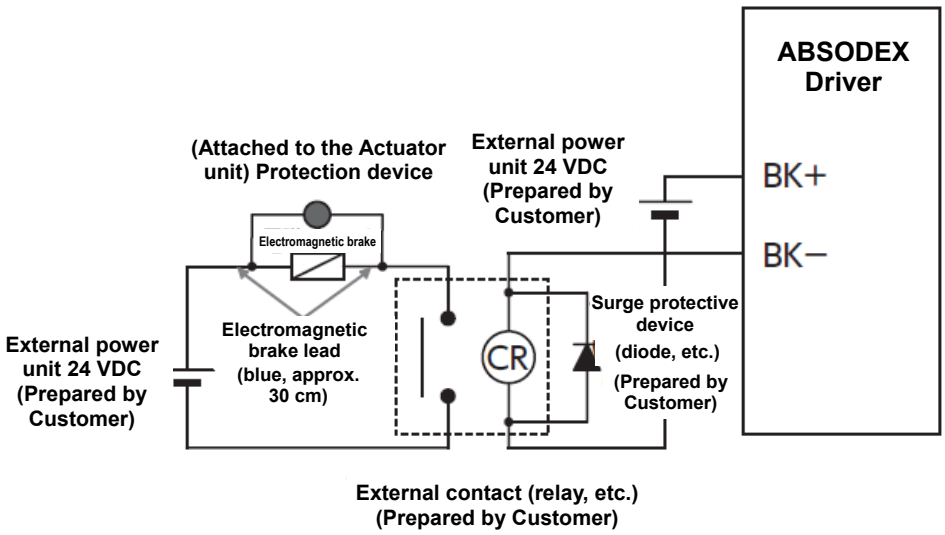
Do not use the electromagnetic brake to decelerate or stop the rotating output axis.

- Noise may cause malfunction of the equipment.

Do not press the button forcibly when inserting or disconnecting cables into/from the terminal block.

■ Recommended Circuit for Electromagnetic Brake

<Recommended Circuit 1 for Electromagnetic Brake>



The BK+ and BK- terminals are for brake (rated current: 150 mA).
To use an electromagnetic brake, an external 24 VDC power supply is necessary.
When an inductive load such as a relay mentioned above is connected as an external contact, the rated coil voltage must be 24 VDC and the rated current must be within 100 mA, and take measures against surge.

Connect the electromagnetic brake so that the brake is released when the circuit across BK+ and BK- is closed and it is applied when the circuit is open.

Because the life of the contact of the contact relay is generally short, use a solid state relay (SSR) as an external contact if the electromagnetic brake is operated (turned on or off) frequently.
<Recommended Product> Model: G3NA-D210B DC5-24
Manufacturer: OMRON Corporation
When using one, carefully read the instruction manual that comes with the SSR.

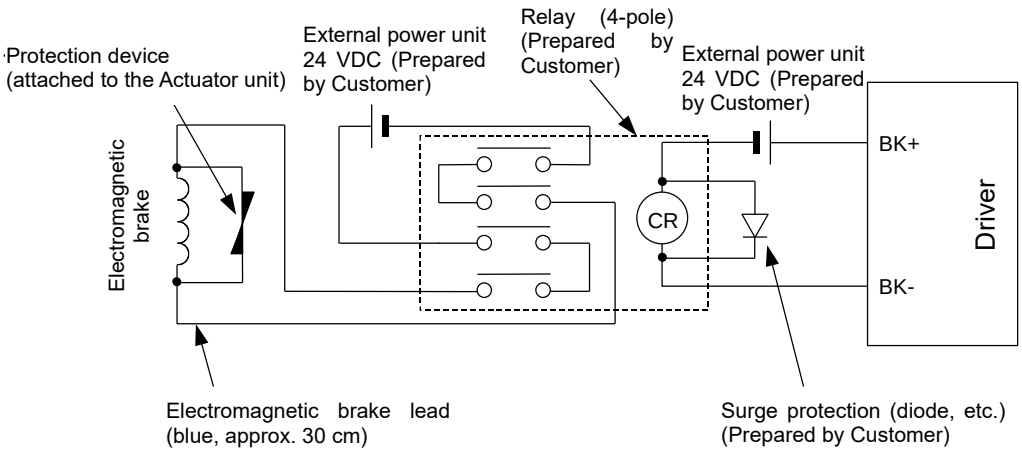
CAUTION

The driver will be damaged if the BK+ and BK- terminals of the driver are connected directly with the electromagnetic brake.

If the polarity of the BK+ and BK- terminals of the driver is wrong, the driver may be broken.

- Be careful when wiring the external power supply.

<Recommended Circuit 2 for Electromagnetic Brake>



When using a contact relay, use a relay having a contact capacity 10 times or larger than the rated current.
If the contact capacity is smaller, use a 4-pole relay and connect as shown in the above figure. The contact life of the relay will be extended.

CAUTION

The driver will be damaged if the BK+ and BK- terminals of the driver are connected directly with the electromagnetic brake.

If the polarity of the BK+ and BK- terminals of the driver is wrong, the driver may be broken.

- Be careful when wiring the external power supply.

■ How to Activate the Electromagnetic Brake

Execute NC code M68 or M69 in the NC program or supply a brake release input (Input signal 1 - bit 13 / input data byte 1 - bit 5) to open or close across the BK+ and BK- terminals of the ABSODEX driver, thereby controlling the operation under an external power supply voltage of 24 VDC.

<Controlling with NC Code "M68"/"M69">

Execute an "M68" code to disconnect across BK+ and BK- (to apply the brake), or execute an "M69" code to connect across BK+ and BK- (to release the brake).

<Controlling with Brake Release Input (Input signal 1 - bit 13 / input data byte 1 - bit 5)>

Supply a brake release input in a state with the applied brake to connect across BK+ and BK- (to release the brake).

■ Manually Releasing the Electromagnetic Brake

Prepare three manually releasing bolts. Insert the bolts into tapped holes for the electromagnetic brake located on the bottom panel of the actuator, and tighten them alternately to release the brake. Be sure to tighten the three bolts alternately.
If not, deformation will be caused in the side plate or the like, reducing the torque.
After finishing work with the brake released, be sure to remove three bolts without delay, and check that the brake is applied.

<Bolt for Electromagnetic Brake>

Model	Bolt Size	Length	Quantity
AX4R-022, AX4R-045	M5	20 mm or over	3
AX4R-075, AX4R-150 AX4R-300	M8	30 mm or over	3

In the travel after the brake is released, enter a larger value in PRM27 (delay after brake output) if the response time after the electromagnetic brake is released is too long.
For details, refer to "5.PARAMETER SETTING."

CAUTION

Note that the magnetic force of the electromagnetic brake may cause stuck iron powder or effects on measuring instruments, sensors or other devices.

If a stand or the like is located below, draw a preliminary design with a space reserved to accept the wrench handle length.

To pass a shaft through the hollow hole of the model equipped with an electromagnetic brake, use a non-magnetic material (such as SUS303).

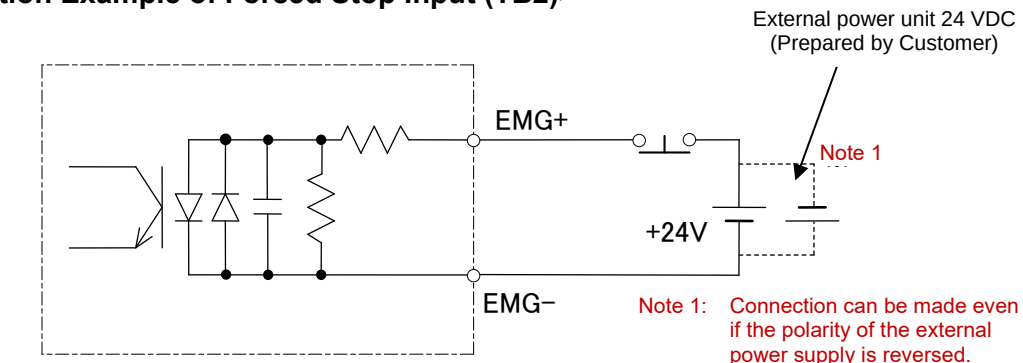
- If a magnetic material (such as S45C) is used, the shaft will be magnetized, causing stuck iron powder on the equipment or giving magnetic effects on peripheral devices.

Due to the timing issue of the brake, position deviation may result.

- Apply the brake after the output axis is stopped completely.

3.4.5. Wiring of Forced Stop Input (TB2)

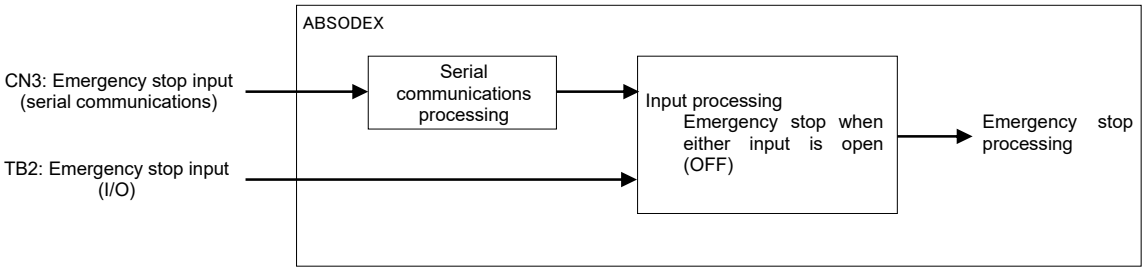
<Connection Example of Forced Stop Input (TB2)>



Rated voltage: 24 V ±10%, rated current 5 mA or less

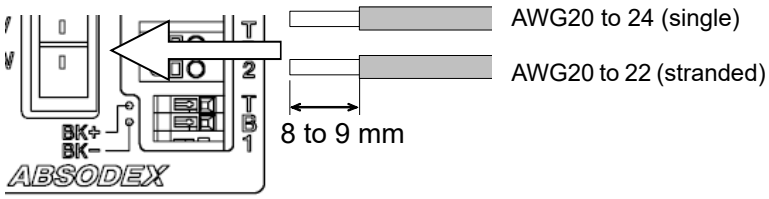
- Forced stop input is effective when the product is shipped. For the forced stop setting, refer to “5.PARAMETER SETTING.”
- The forced stop is b-contact input, and becomes effective when the forced stop input (TB2) is open. The forced stop via serial communications becomes effective when the input data is OFF.

<Specifications of Forced Stop Input>



- There are two inputs for the forced stop input: input terminal of TB2 and serial communications of CN3. When either input is open (or OFF), it is considered forced stop. Therefore, input to TB2 is required to cancel the forced stop.

<Applicable Wires to TB2 and Peeling Length>

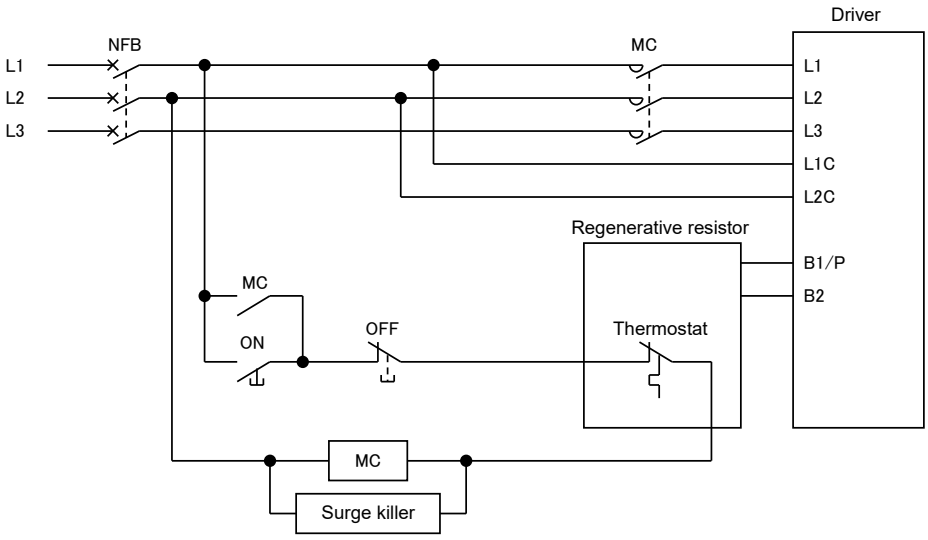


- The strip length of wires must be 8 to 9 mm.
- The applicable cable is AWG20 to 24 (solid conductor) or AWG20 to 22 (stranded conductor).

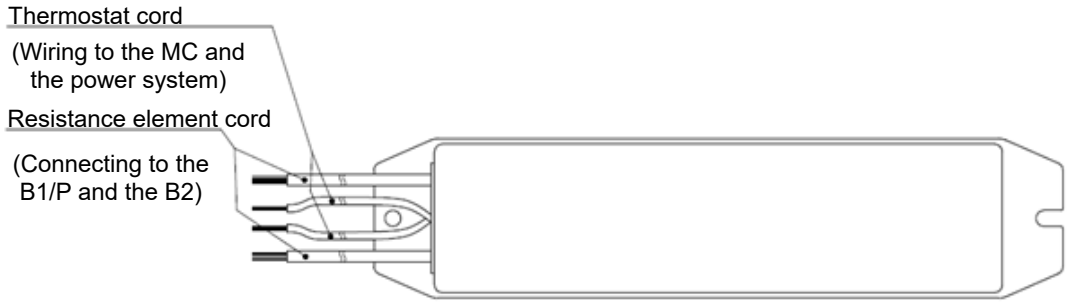
3.4.6. Wiring of Regenerative Resistor

When wiring a regenerative resistor, connect it to B1/P, B2 terminal. As the contact of the thermostat will be activated (opened) when the regenerative resistance overheats, make wiring to shut off the main power supply at that timing. The contact specification of the thermostat is contact current 5 A at 125 VAC, and contact current 3.5 A at 250 VAC.
Install the unit in a way that it does not affect other devices since the regenerative energy generates heat.
To enable the regenerative resistor function, PRM107 (regeneration capacity) needs to be set.
Load factor of the regenerative resistor is calculated within the driver. Load factor is a hot start.

<Wiring Example of Regenerative Resistor>



Refer to the figure below for wiring the regenerative resistor.



CAUTION

The regenerative resistor becomes hot during energization and for a while after power is disconnected.

- To prevent burn injury, do not touch the hot surface.

If an abnormal current flows through the regenerative resistor, it becomes hot in a short time, which is very dangerous.

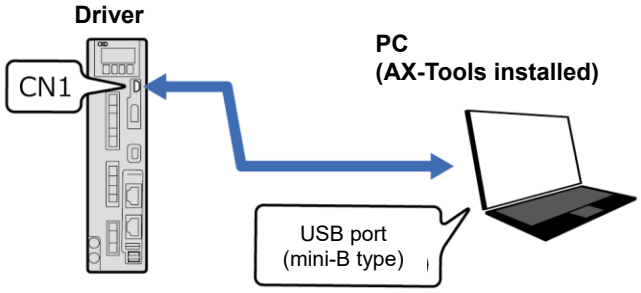
- Configure a circuit that shuts off the main power supply at the contact of the thermostat without fail.

A temperature of the regenerative resistor can be as high as 100ºC or higher.

3.4.7. Connection to Other Terminal Blocks

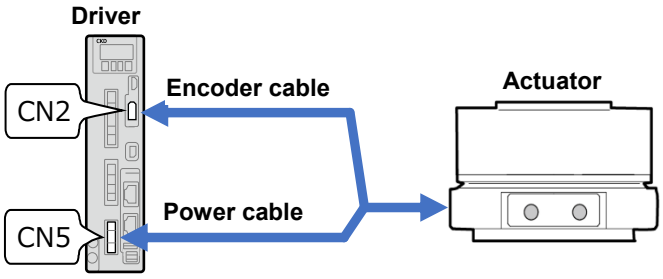
■ CN1 (USB-miniB)

This port is a serial port, which interfaces with a personal computer etc.
For the communication method via USB-miniB, refer to “7.COMMUNICATION FUNCTIONS (CN1: USB).”



■ CN2 (Resolver)

This port is for position detector (resolver) built in the actuator.
The dedicated encoder (optionally available) cable should be used to connect to the actuator.



CAUTION

Do not press the button forcibly when inserting or disconnecting cables into/from the terminal block.

Route the signal cables separately from power cables or other high voltage cables.

- Do not tie the cables belonging to different groups or do not route them in the same conduit.
- Noise may cause malfunction of the equipment.

4. HOW TO USE

WARNING

Servo off (including safety function, forced stop and alarm), brake release, and system reset (including resetting via network) with the output axis being rotated due to an unbalanced load, etc. may cause the actuator to rotate.

- Perform these operations in the balanced condition or after all safety aspects are con-firmed.

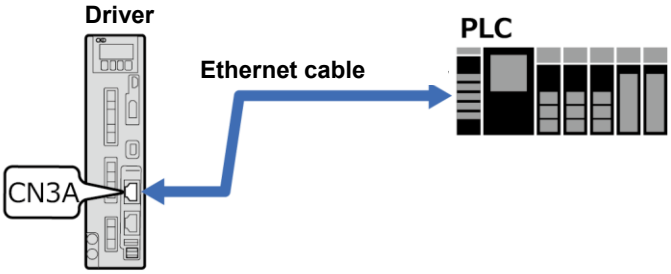
If the main power is turned on while there is position deviation, the actuator will rotate due to the function to clear the position deviation caused.

- If the main power and control power are turned on separately, make sure that ABSODEX is in servo-off state before turning on power.

CAUTION

The output axis may move from the holding position even without an external force if the power or servo is turned off (including safety function, forced stop and alarm) or the torque limit setting is decreased from the servo-on state (retention state).

This chapter describes the specifications and usage of I/O signals exchanged at the connector (CN3) connected mainly with a programmable logic controller.



4.1. Communication Specifications

■ EtherCAT communications specifications

<Communications Specifications>

Item	Specification
Communication protocol	EtherCAT
Communications speed	100Mbps (Fast Ethernet, full-duplex)
Process data	Fixed PDO mapping
Maximum PDO data length	RxPDO: 40 bytes / TxPDO: 40 bytes
Station alias	0 to 65535 (set from the master)
Connection cable	EtherCAT compliant cable (CAT5e or higher twisted-pair cables (double shield with aluminum tape and braid) are recommended)
Node address	Automatically assigned by the master

■ EtherNet/IP communications specifications

<Communications Specifications>

Item	Specification
Communication protocol	EtherNet/IP
Communications speed	Automatic setting (100 Mbps/10 Mbps, full-duplex/half-duplex)
Occupied bytes	Input: 32 bytes / Output: 32 bytes
IP address	0.0.0.0 to 255.255.255.255 (set by parameter)
Subnet mask	0.0.0.0 to 255.255.255.255 (set by parameter)
Default gateway	0.0.0.0 to 255.255.255.255 (set by parameter)
RPI **(packet interval)**	2 msec to 10000 msec
Connection cable	EtherNet/IP compliant cable (CAT5 or higher twisted-pair cables (double shield with aluminum tape and braid) are recommended)

To connect with a programmable logic controller, it is necessary to register the EDS file of ABSODEX in the setting software of programmable logic controller. EDS file is available from our website.

4.2. Register Setting

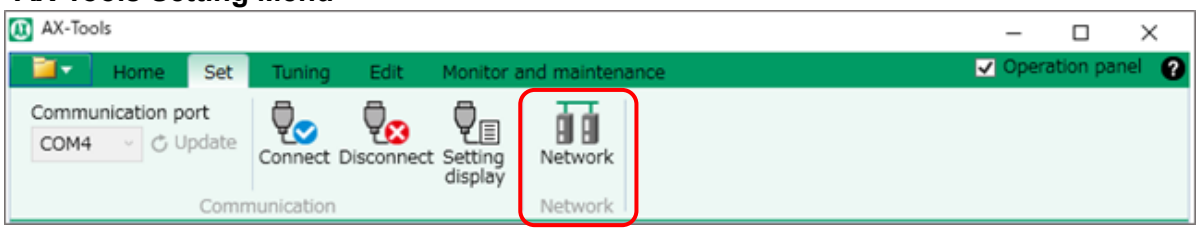
■ EtherNet/IP specifications

With AX-Tools Ver. 3 or later, set an IP address, subnet mask, and default gateway.

• EtherNet/IP setting screen

From the menu of AX-Tools, select “Setting” – “Network” to show “EtherNet/IP Setting Register” screen.

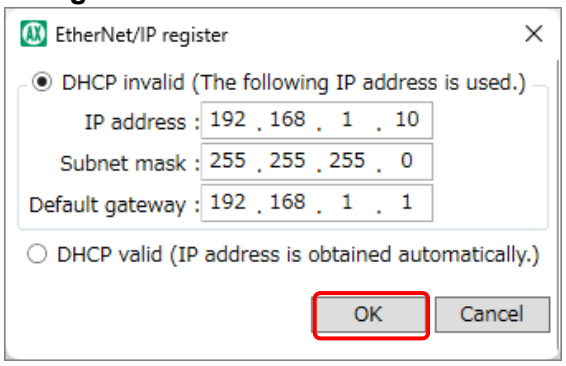
<AX-Tools Setting Menu>



• EtherNet/IP Setting Register

Check that a value is displayed in the EtherNet/IP register setting value, and select “OK.”

<EtherNet/IP Register Setting Screen>



<IP Address>

The current setting value of IP address is displayed. Set the IP address in the range of 0.0.0.0 to 255.255.255.255.

<Subnet Mask>

The current setting value of subnet mask is displayed. Set the subnet mask in the range of 0.0.0.0 to 255.255.255.255.

<Default Gateway>

The current setting value of default gateway is displayed. Set the default gateway in the range of 0.0.0.0 to 255.255.255.255.

<DHCP server>
Select “disable” or “enable.” When “enable” is selected, the IP address, subnet mask, and default gateway are automatically assigned from the DHCP server.

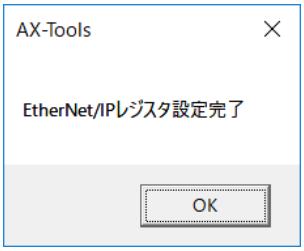
<OK>
Clicking this button transfers data to the register of ABSODEX.

<Cancel>
Clicking this button closes the screen.

- Completion of setting

When the setting is completed successfully, the completion screen appears.
After completing the setting, turn on the power again.
The settings of IP address, subnet mask, and default gateway are enabled by turning the power off then on again.

<Screen of Setting Completion>



When the system is initialized, the setting of EtherNet/IP register is also restored to its initial state.
After initializing the system, set EtherNet/IP register again.

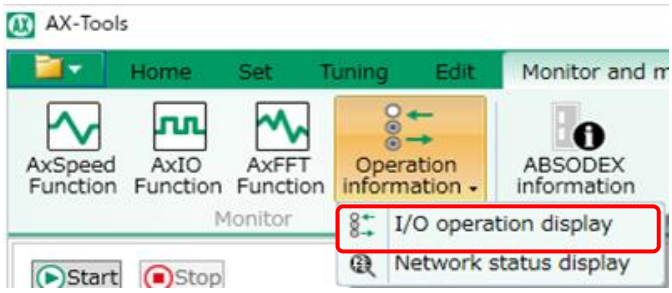
4.3. Communication Status Monitor

Use AX-Tools Ver. 3 or later to monitor the I/O status after establishing the communications.

■ I/O display

From the menu of AX-Tools, select “Monitor & Maintenance” – “Operation Information” – “I/O Operation Display” to display “I/O Display.”

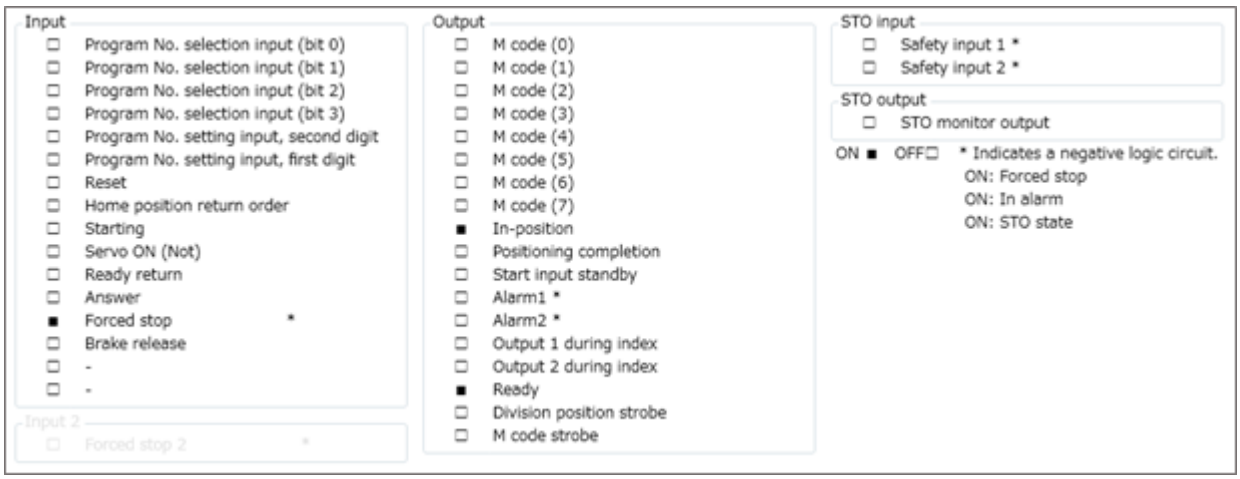
<AX-Tools Monitor Menu>



■ Check I/O

Monitor the I/O status after establishing the communications.
I/O display is ON during the open state since “*” is a negative logic symbol.

<Example of I/O Display Screen>



4.4. Input/Output

■ EtherCAT specifications

- PDO mapping

<RxPDO>

Index	Sub Index	Display Name	Description
0x1600	0x00	The number of PDO objects	10
	0x01	Output signal 1	0x2000-0x01
	0x02	Output signal 2	0x2000-0x02
	0x03	Output data 1	0x2001-0x01
	0x04	Output data 2	0x2001-0x02
	0x05	Output data 3	0x2001-0x03
	0x06	Output data 4	0x2001-0x04
	0x07	Output data 5	0x2001-0x05
	0x08	Output command 1	0x2002-0x01
	0x09	Output command 2	0x2002-0x02
	0x0A	Output command 3	0x2002-0x03

<TxPDO>

Index	Sub Index	Display Name	Description
0x1A00	0x00	The number of PDO objects	10
	0x01	Input signal 1	0x3000-0x01
	0x02	Input signal 2	0x3000-0x02
	0x03	Input data 1	0x3001-0x01
	0x04	Input data 2	0x3001-0x02
	0x05	Input data 3	0x3001-0x03
	0x06	Input data 4	0x3001-0x04
	0x07	Input data 5	0x3001-0x05
	0x08	Input command 1	0x3002-0x01
	0x09	Input command 2	0x3002-0x02
	0x0A	Input command 3	0x3002-0x03

• Input/Output signals

<Input Signal List (EtherCAT Specifications) (1/2)>

PLC → AX (Input)

Index	Sub Index	Display Name	bit	Description	Logic	Judgment
0x2000	0x01	Output signal 1	0	Program No. selection input (bit 0)	Positive	Level
			1	Program No. selection input (bit 1)	Positive	Level
			2	Program No. selection input (bit 2)	Positive	Level
			3	Program No. selection input (bit 3)	Positive	Level
			4	Program No. setting input, 2nd digit / Program No. selection input (bit 4)	Positive	Edge level
			5	Program No. setting input, 1st digit / Program No. selection input (bit 5)	Positive	Edge level
			6	Reset input	Positive	Edge
			7	Home positioning instruction input	Positive	Edge
			8	Start input	Positive	Edge
			9	Servo-on input / Program stop input	Positive	Level edge
			10	Ready return input / Continuous rotation stop input	Positive	Edge
			11	Answer input / Position deviation counter reset input	Positive	Edge level
			12	Forced stop input	Negative	Level
			13	Brake release input	Positive	Level
			14	Jog operation input (CW direction) Note 1	Positive	Level
			15	Jog operation input (CCW direction) Note 1	Positive	Level
			16	Unavailable Note 2/ Travel unit selection input (bit 0) Note 3	Positive	Level
			17	Unavailable Note 2/ Travel unit selection input (bit 1) Note 3	Positive	Level
			18	Unavailable Note 2/ Travel speed unit selection input Note 3	Positive	Level
			19	Table operation, data input operation switching input	Positive	Level
			20 to 31	Unavailable		

Note 1: Available only in the network operation mode.
Note 2: This is selected when the table operation is (Output signal 1 - bit 19 = OFF).
Note 3: This is selected when the data input operation is (Output signal 1 - bit 19 = ON).

<Input Signal List (EtherCAT specifications) (2/2)>

PLC → AX (Input)

Index	Sub Index	Display Name	bit	Description	Logic	Judgment
0x2000	**0x02**	Output signal 2	0	Monitor output execution request	Positive	Level
			1	Instruction code execution request	Positive	Edge
			2 to 31	Unavailable		
0x2001	**0x01**	Output data 1	-	Monitor code 1		
	0x02	Output data 2	-	Monitor code 2		
	0x03	Output data 3	-	Monitor code 3		
	0x04	Output data 4	-	Monitor code 4		
	0x05	Output data 5	-	Monitor code 5		
0x2002	**0x01**	Output command 1	-	Instruction code		
	0x02	Output command 2	-	Write data Note 1 / A code or P code Note 2		
	0x03	Output command 3	-	Data specification Note 1/ F code Note 2		

Note 1: This is selected when the table operation is (Output signal 1 - bit 19 = OFF).
Note 2: This is selected when the data input operation is (Output signal 1 - bit 19 = ON).

- Turn on or off the input signal at least for 20 msec.
- “Edge” in the table indicates “rising edge detection,” which indicates recognition of the OFF-to-ON input signal change.
- “Level” in the table indicates “level detection,” which indicates recognition of the input signal state in the scanning cycle.

<Output Signal List (EtherCAT Specifications) (1/2)>

AX (Output) → PLC

Index	Sub Index	Display Name	bit	Description	Logic
0x3000	0x01	Input signal 1	0	M code output (bit 0)	Positive
			1	M code output (bit 1)	Positive
			2	M code output (bit 2)	Positive
			3	M code output (bit 3)	Positive
			4	M code output (bit 4)	Positive
			5	M code output (bit 5)	Positive
			6	M code output (bit 6)	Positive
			7	M code output (bit 7)	Positive
			8	In-position output	Positive
			9	Positioning completion output	Positive
			10	Start input wait output	Positive
			11	Alarm output 1	Negative
			12	Alarm output 2	Negative
			13	Output 1 during indexing / Home position output	Positive
			14	Output 2 during indexing / Servo state output	Positive
			15	Ready output	Positive
			16	Segment position strobe output	Positive
			17	M code strobe output	Positive
			18 to 31	Unavailable	
	0x02	Input signal 2	0	Monitoring	Positive
			1	Instruction code execution completion	Positive
			2 to 31	Unavailable	
0x3001	0x01	Input data 1	-	Monitor data 1	
	0x02	Input data 2	-	Monitor data 2	
	0x03	Input data 3	-	Monitor data 3	
	0x04	Input data 4	-	Monitor data 4	
	0x05	Input data 5	-	Monitor data 5	

<Output Signal List (EtherCAT Specifications) (2/2)>

AX (Output) → PLC

Index	Sub Index	Display Name	bit	Description	Logic
0x3002	**0x01**	Input command 1	-	Response code	
	0x02	Input command 2	-	Read data	
	0x03	Input command 3	-	Unavailable	

■ EtherNet/IP specifications

<Input Data List (EtherNet/IP Specifications) (1/2)>

PLC → AX (Input)

Byte	bit	Description	Logic	Judgment
0	0	Program No. selection input (bit 0)	Positive	Level
	1	Program No. selection input (bit 1)	Positive	Level
	2	Program No. selection input (bit 2)	Positive	Level
	3	Program No. selection input (bit 3)	Positive	Level
	4	Program No. setting input, 2nd digit / Program No. selection input (bit 4)	Positive	Edge level
	5	Program No. setting input, 1st digit / Program No. selection input (bit 5)	Positive	Edge level
	6	Reset input	Positive	Edge
	7	Home positioning instruction input	Positive	Edge
1	0	Start input	Positive	Edge
	1	Servo-on input / Program stop input	Positive	Level edge
	2	Ready return input / Continuous rotation stop input	Positive	Edge
	3	Answer input / Position deviation counter reset input	Positive	Edge level
	4	Forced stop input	Negative	Level
	5	Brake release input	Positive	Level
	6	Jog operation input (CW direction) Note 1	Positive	Level
	7	Jog operation input (CCW direction) Note 1	Positive	Level
2	0	Unavailable Note 2/ Travel unit selection input (bit 0) Note 3	Positive	Level
	1	Unavailable Note 2/ Travel unit selection input (bit 1) Note 3	Positive	Level
	2	Unavailable Note 2/ Travel speed unit selection input Note 3	Positive	Level
	3	Table operation, data input operation switching input	Positive	Level
	4 to 7	Unavailable		
3	-	Unavailable		
4	0	Monitor output execution request	Positive	Level
	1	Instruction code execution request	Positive	Edge
	2 to 7	Unavailable		

Note 1: Available only in the network operation mode.
Note 2: This is selected when the table operation is (Input data byte 2 - bit 3 = OFF).
Note 3: This is selected when the data input operation is (Input data byte 2 - bit 3 = ON).

<Input Data List (EtherNet/IP Specifications) (2/2)>

PLC → AX (Input)

Byte	bit	Description	Logic	Judgment
5	-	Unavailable		
6	-	Unavailable		
7	-	Unavailable		
8	-	Monitor code 1 Note 1		
9	-			
10	-			
11	-			
12	-	Monitor code 2 Note 1		
13	-			
14	-			
15	-			
16	-	Monitor code 3 Note 1		
17	-			
18	-			
19	-			
20	-	Instruction code Note 1		
21	-			
22	-			
23	-			
24	-	Write data Note 1, Note 2/ A code or P code Note 1, Note 3		
25	-			
26	-			
27	-			
28	-	Data specification Note 1, Note 2 / F code Note 1, Note 3		
29	-			
30	-			
31	-			

Note 1: A total of 4 bytes is handled as one piece of data.
The sequence of each byte data is little endian.
Note 2: This is selected when the table operation is (Input data byte 2 - bit 3 = OFF).
Note 3: This is selected when the data input operation is (Input data byte 2 - bit 3 = ON).

- Turn on or off the input signal at least for 20 msec.
- “Edge” in the table indicates “rising edge detection,” which indicates recognition of the OFF-to-ON input signal change.
- “Level” in the table indicates “level detection,” which indicates recognition of the input signal state in the scanning cycle.

<Output Data List (EtherNet/IP Specifications) (1/2)>

AX (Output) → PLC

Byte	bit	Description	Logic
0	0	M code output (bit 0)	Positive
	1	M code output (bit 1)	Positive
	2	M code output (bit 2)	Positive
	3	M code output (bit 3)	Positive
	4	M code output (bit 4)	Positive
	5	M code output (bit 5)	Positive
	6	M code output (bit 6)	Positive
	7	M code output (bit 7)	Positive
1	0	In-position output	Positive
	1	Positioning completion output	Positive
	2	Start input wait output	Positive
	3	Alarm output 1	Negative
	4	Alarm output 2	Negative
	5	Output 1 during indexing / Home position output	Positive
	6	Output 2 during indexing / Servo state output	Positive
	7	Ready output	Positive
2	0	Segment position strobe output	Positive
	1	M code strobe output	Positive
	2 to 7	Unavailable	
3	-	Unavailable	
4	0	Monitoring	Positive
	1	Instruction code execution completion	Positive
	2 to 7	Unavailable	
5	-	Unavailable	
6	-	Unavailable	
7	-	Unavailable	
8	-	Monitor data 1 Note 1	
9	-		
10	-		
11	-		

Note 1: A total of 4 bytes is handled as one piece of data.
The sequence of each byte data is little endian.

<Output Data List (EtherNet/IP Specifications) (2/2)>

AX (Output) → PLC

Byte	bit	Description	Logic
12	-	Monitor data 2 Note 1	
13	-		
14	-		
15	-		
16	-	Monitor data 3 Note 1	
17	-		
18	-		
19	-		
20	-	Response code Note 1	
21	-		
22	-		
23	-		
24	-	Read data Note 1	
25	-		
26	-		
27	-		
28	-	Unavailable	
29	-		
30	-		
31	-		

Note 1: A total of 4 bytes is handled as one piece of data.
The sequence of each byte data is little endian.

■ I/O Output State at Power-on

After the in-position output is turned on and ABSODEX is ready to receive a start input, the start input wait output is turned on.
Turn the servo state output on or off according to the outputting conditions.
Other outputs are turned off.
However, if there is an alarm, an alarm output is turned on.
(Alarm outputs are negative logic.)
Before alarm outputs are turned off, other I/O outputs may become unstable.
Build an AND circuit with alarm outputs or take other measures when necessary.
Turn the ready output on or off according to the outputting conditions after the alarm output is established.

■ I/O Output State Upon Emergency Stop Input

The state of CN3 output signals shown in “Output Signal List (EtherCAT Specifications) “ and “Output Data List (EtherNet/IP Specifications) “ of “4.4.Input/Output” after a forced stop input is supplied is shown in table below.

<Output Signal State at Forced Stop Input>

Type	State of Output Signal
A	When answer input is unnecessary: OFF upon forced stop input When answer input is necessary: OFF at reset input
B	ON or OFF according to output condition without relations to forced stop input ON at reset input
C	OFF at forced stop input, ON at reset input
D	ON or OFF according to output condition after reset input
E	OFF at reset input

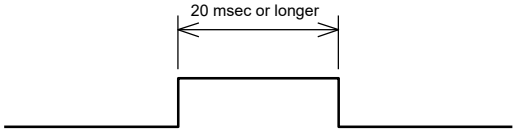
- In “Input Signal List (EtherCAT Specifications) ” and “Input Data List (EtherNet/IP Specifications) ” of “4.4.Input/Output” of this instruction manual, the input signal activated when the value is 1 is called a positive logic input, and the input signal activated when the value is 0 is called a negative logic input.
  As well, in “Output Signal List (EtherCAT Specifications) ” and “Output Data List (EtherNet/IP Specifications) ” of “4.4.Input/Output,” the signal whose value becomes 1 upon an active (ON) output is called a positive logic output, and the signal causing the current to flow in the load upon an inactive (OFF) output is called a negative logic output.

4.5. How to Use General EtherCAT and EtherNet/IP Input/Output

This section explains general EtherCAT and EtherNet/IP I/O signals and how to use them. Some of general EtherCAT and EtherNet/IP I/O signals vary in using method depending on the parameter setting. “5.PARAMETER SETTING” should be read together.

- The start input, program stop input, continuous rotation stop input, answer input, home return command input, reset input, ready return input, and program number setting inputs (first and second digits) are inputs supplied upon detection of the rising edge.
- The input signal is not accepted securely if it remains turned on for 20 msec.
  The timer function of some programmable logic controllers includes variations and may cause trouble.
  Check the specification of the programmable logic controller to assure 20 msec or a longer activation interval.

<Input Signal ON-time>



4.5.1. Program No. Selection Method

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- Program No. selection input bit 0 to 3 (Input signal 1 - bit 0 to 3 / input data byte 0 - bit 0 to 3)
- Program setting input second digit / Program No. selection input bit 4 (Input signal 1 - bit 4 / input data byte 0 - bit 4)
- Program setting input first digit / Program No. selection input bit 5 (Input signal 1 - bit 5 / input data byte 0 - bit 5)
- Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)

■ When PRM36 is set to 1, 2, or 3

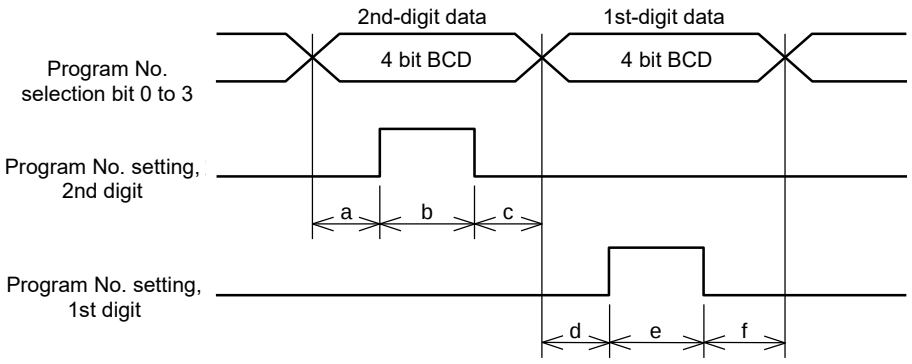
After program number setting is made, selected programs are executed one by one from the first one after the start signal is supplied next time.
If the same program number as that of the already set program is set again, the program is executed in the same way from the top.
One of the following methods can be selected with the setting of PRM36 (I/O program number selection method switching).

<4 bit BCD double selection (PRM36=1: default setting)>

Bit 0 to 3 (Input signal 1 - bit 0 to 3 / input data byte 0 - bit 0 to 3) for program No. selection input enables to set the second (10 digit) and first digit (units digit) data in this order.
The number data is specified by 4 bit BCD (binary coded decimal).
Consequently, the selectable numbers of programs are 0 to 99 (100).

* Enter a bit signal (0: 0000 to 9: 1001) by BCD (binary coded decimal).
If a bit signal outside the above range is entered, an unexpected program No. is selected and malfunction may be caused.

<Timing of Program Number Setting>



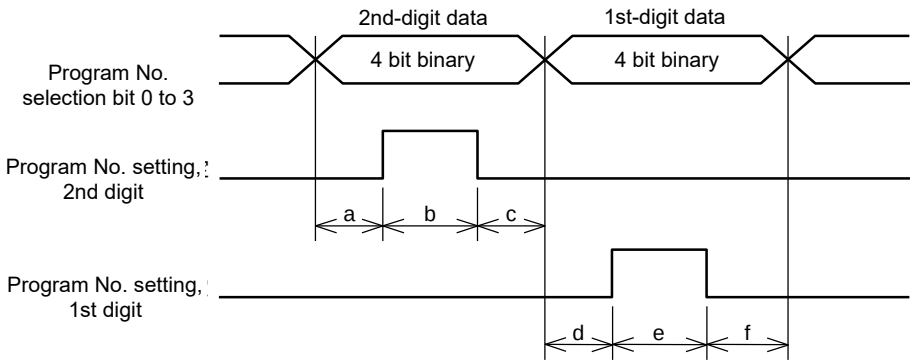
a,b,d,e = 20 msec or larger c,f = 0 msec or larger

- “PRM” indicates the parameter in this manual.

<4 bit binary double selection (PRM36=2)>

Same as in <4 bit BCD double selection (PRM36=1: default setting)>, Bit 0 to 3 (Input signal 1 - bit 0 to 3 / input data byte 0 - bit 0 to 3) for program selection input enables to set the second and first digit data in this order. The number data is specified by 4 bit BCD.
Consequently, the selectable numbers of programs are 0 to 255 (FF).

<Timing of Program Number Setting>

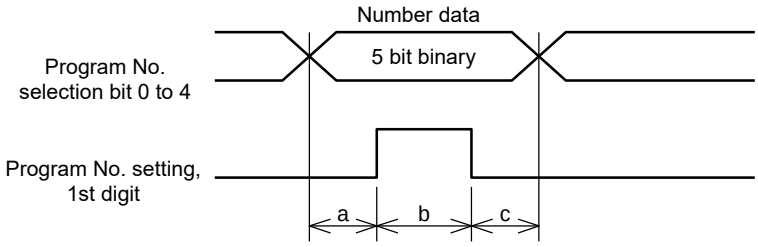


a,b,d,e = 20 msec or larger c,f = 0 msec or larger

<5 bit binary single selection (PRM36=3)>

The second digit in the program setting input (Input signal 1 - bit 4 / input data byte 0 - bit 4) is used as 4 bit of program number selection input.
Using 5 bit of the bit 0 to 4 for the number selection input and first digit in the program setting input (Input signal 1 - bit 5 / input data byte 0 - bit 5) enables to select program numbers 0 to 31 (1F).
After 5 bit binary data output, turn on the first digit of the program setting input.

<Timing of Program Number Setting>



a, b = 20 msec or larger c = 0 msec or larger

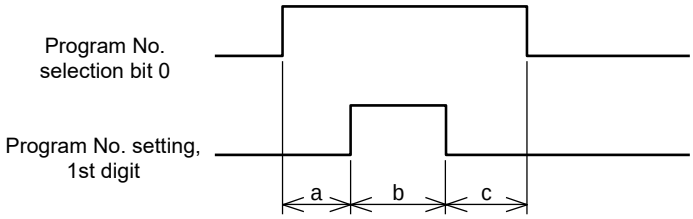
- Program number cannot be set in the following conditions:
  During program execution (start input standby output (Output signal 1 - bit 10 / output data byte 1 - bit 2) = OFF)
  When the safety circuit is in operation and ready return has not been done.
  When alarm 1, 2, 4, 5, 6, 8, 9, E, F or L occurs

- After a program number is entered, the setting remains valid until another number is entered or the control power is shut down. Note that “tens digit” and “units digit” described in <4 bit BCD double selection (PRM36=1: default setting)> and <4 bit binary double selection (PRM36=2)> are independent of each other.

<Example> To enter program number “1” in method “4 bit BCD double selection“ of “4.5.1.Program No. Selection Method” when the program number setting is already “26.”

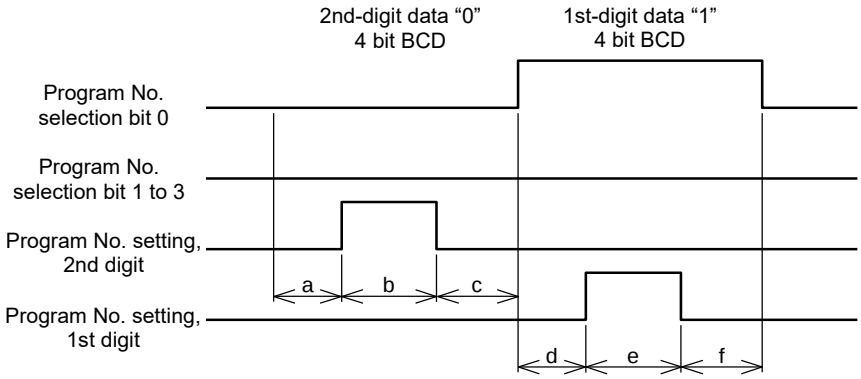
If only the units digit program number signal enters “1,” “2” at the tens digit remains valid and program number “21” is assumed. (Refer to the top part of the following figure)
In this case, enter “0” with the tens digit program number setting signal and enter “1” with the units digit program number setting signal. (Refer to the bottom part of the following figure)

<Timing of Program Number Setting>



a, b = 20 msec or larger c = 0 msec or larger

<Timing of Program Number Setting>



a, b, d, e = 20 msec or larger c, f = 0 msec or larger

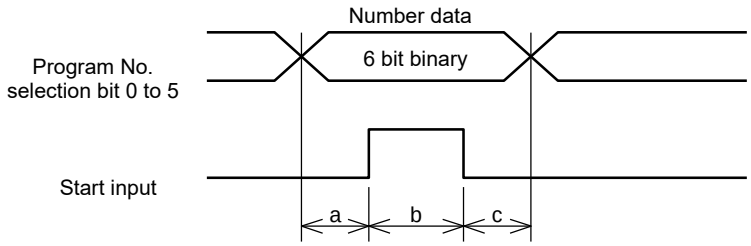
■ When PRM36 is Set to 4 or 5

After the start input is supplied, selected programs are executed one by one from the first one. How the actuator moves after a forced stop differs by the setting of PRM36 (Selection switching of I/O program numbers).

<6 bit binary selection with start (PRM36=4, program number is not set after forced stop)>

The second program setting input digit (Input signal 1 - bit 4/Input data byte 0 - bit 4) is used as bit 4 of the program number selection input, and the first program setting input digit (Input signal 1 - bit 5/Input data byte 0 - bit 5) is used as bit 5 of the program number selection input.
Select a program number between 0 and 63 (3F).
After forced stop, the first start input causes restoration action which is described in “4.7.3.Restoration Action Procedure after Forced Stop.” At this time, neither program number selection nor program start is conducted.
After restoration action is completed, the program number is selected and the program is started with the next start input.

<Timing of Program Number Setting>



a = 10 msec or longer b = 20 msec or longer c = 0 msec or longer

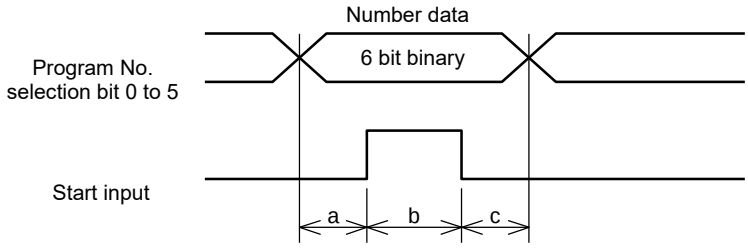
- With the continuous rotation program (G7A**), priority is given to the operation for stopping continuous rotation to stop continuous rotation even if the next program is selected and the start input is supplied.
  At this time, neither program number selection nor program start is conducted.
  After continuous rotation is stopped, select a number to execute it when the next start input is supplied.
- To stop continuous rotation by entering “start input,” “program stop input” or “continuous rotation stop input” during continuous rotation, wait until the actuator is stopped before supplying the next start input.
  A start input supplied during deceleration of the actuator may cause malfunction.
- When this function is selected, the program is executed from the first step without fail.
  For this reason, this function cannot be used in programs where the program stop (M0) code is used
- Program number cannot be set or started in the following conditions:
  When the mode is other than automatic operation mode (M1) or single block mode (M2).
  When the safety circuit is in operation and ready return has not been done.
  When there is an alarm other than 0, 3, or 7.
- Program number selection input is invalid when the control power is turned off and when the ABSODEX is in servo-off state.
  With the control power turned on and the ABSODEX in servo-on state, input the program number selection input again.
- If the start input is input through I/O after the program number has been set using the L16 communication command, the program selected with the program number selection bit is set and started.

- If a program is started using the S1 communication command after the program number has been set using the L16 communication command, the program set with L16 is started. (Status of the I/O program number selection bit is ignored.)
- If a forced stop input is input, the restoration action following the forced stop is carried out with the next start input that is input after the alarm is reset. At this time, neither program number selection nor program start is conducted.
  After restoration action is completed, the program number is selected and the program is started with the next start input.

<6 bit binary selection with start (PRM36=5, program number is set after forced stop)>

The second program setting input digit (Input signal 1 - bit 4/Input data byte 0 - bit 4) is used as bit 4 of the program number selection input, and the first program setting input digit (Input signal 1 - bit 5/Input data byte 0 - bit 5) is used as bit 5 of the program number selection input.
Select a program number between 0 and 63 (3F).
Restoration action is not carried out even after a forced stop. The selected program is set and started.

<Timing of Program Number Setting>



a = 10 msec or longer b = 20 msec or longer c = 0 msec or longer

- With the continuous rotation program (G7A**), priority is given to the operation for stopping continuous rotation to stop continuous rotation even if the next program is selected and the start input is supplied.
  At this time, neither program number selection nor program start is conducted.
  After continuous rotation is stopped, select a number to execute it when the next start input is supplied.
- To stop continuous rotation by entering “start input,” “program stop input” or “continuous rotation stop input” during continuous rotation, wait until the actuator is stopped before supplying the next start input.
  A start input supplied during deceleration of the actuator may cause malfunction.
- When this function is selected, the program is executed from the first step without fail.
  For this reason, this function cannot be used in programs where the program stop (M0) code is used
- Program number cannot be set or started in the following conditions:
  When the mode is other than automatic operation mode (M1) or single block mode (M2).
  When the safety circuit is in operation and ready return has not been done.
  When there is an alarm other than 0, 3, or 7.
- Program number selection input and program setting input are invalid when the control power is turned off and when the ABSODEX is in servo-off state.
  With the control power turned on and the ABSODEX in servo-on state, input the program number selection input and the program setting input again.

- If the start input is input through I/O after the program number has been set using the L16 communication command, the program selected with the program number selection bit is set and started.
- If a program is started using the S1 communication command after the program number has been set using the L16 communication command, the program set with L16 is started.
  (Status of the I/O program number selection bit is ignored.)
- If a forced stop input is input, the program number is set with the next start input that is input after the alarm is reset and the selected program is executed. The restoration action following the forced stop is not carried out.

- If the distance from the forced stop position to the target position is short, Alarm 1 due to an increase in acceleration can be triggered by the rotation speed designation program.
  If the rotation speed designation program is to be used, the device shall be operated by a separate program intended for restoration action.
- After cancelling the forced stop input and resetting the alarm, if a program is started using the S1 communication command, the restoration action following the forced stop is carried out (i.e., the actuator moves to the rotation termination position).

Following table compares the functions of EtherCAT and EtherNet/IP I/O (CN3) and communication command (CN1) that are involved in program number selection.

<Comparison of Functions between EtherCAT, EtherNet/IP I/O and Communications Commands>

<table>
<tr><th colspan="2" rowspan="2">Interface</th><th colspan="3">Range of functions</th></tr>
<tr><th>Program No. selection function</th><th>Program No. setting function</th><th>Start</th></tr>
<tr><td rowspan="3">EtherCAT/
EtherNet/
IP I/O
(CN3)</td><td>4bit BCD (PRM36=1)
4bit BIN (PRM36=2)</td><td>Program No. selection bit 0 to 3 (Input signal 1 - bit 0 to 3 / input data byte 0 - bit 0 to 3)</td><td>Program No. setting 2nd, 1st digit (Input signal 1 - bit 4 and 5 / input data byte 0 - bit 4 and 5)</td><td>Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)</td></tr>
<tr><td>5bit BIN (PRM36=3)</td><td>Program No. selection bit 0 to 4 (Input signal 1 - bit 0 = 4 / input data byte 0 - bit 0 to 4)</td><td>Program No. setting 1st digit (Input signal 1 - bit 5 / input data byte 0 - bit 5)</td><td>Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)</td></tr>
<tr><td>6bit BIN (PRM36=4)
6bit BIN (PRM36=5)</td><td>Program No. selection bit 0 to 5 (Input signal 1 - bit 0 to 5 / input data byte 0 - bit 0 to 5)</td><td colspan="2">Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)</td></tr>
<tr><td colspan="2">Communication Commands (CN1)</td><td colspan="2">L16 (Designation of program number)</td><td>S1 (Start input)</td></tr>
</table>

<When PRM36=1 or 2>

・”Program No. selection bit 0 to 3 (Input signal 1 - bit 0 to 3 / input data byte 0 - bit 0 to 3)” is used to set program numbers.

・”Program No. setting input, 2nd digit and 1st digit (Input signal 1 - bit 4 and 5 / input data byte 0 - bit 4 and 5)” is used to set program numbers.

・”Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)” is used to execute programs.

<When PRM36=3>

・”Program No. selection bit 0 to 4 (Input signal 1 - bit 0 to 4 / input data byte 0 - bit 0 to 4)” is used to select program numbers.

・”Program No. setting input, 1st digit (Input signal 1 - bit 5 / input data byte 0 - bit 5)” is used to set program numbers.

・”Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)” is used to execute programs.

<When PRM36=4 or 5>

・”Program No. selection bit 0 to 5 (Input signal 1 - bit 0 to 5 / input data byte 0 - bit 0 to 5)” is used to select program numbers.

・”Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)” is used to set program numbers and start.

<When Communication Commands are Used>

・”L16” is used to select and set program numbers.

・”S1” is used to start programs.

4.5.2. NC Program Execution Method

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)
- Start input wait output (Output signal 1 - bit 10 / output data byte 1 - bit 2)
- Program stop input (Input signal 1 - bit 9 / input data byte 1 - bit 1)

<PRM to be Used>

- PRM52=1: Function selection for I/O input signal CN3-14 (bit 9)
  * If the program stop input is used

Turn on start input (Input signal 1 - bit 8 / input data byte 1 - bit 0) after program number setting. In the automatic operation mode (refer to “6.PROGRAM“), NC program continues to be executed, and for the single block mode, one block of NC program is executed to stop.

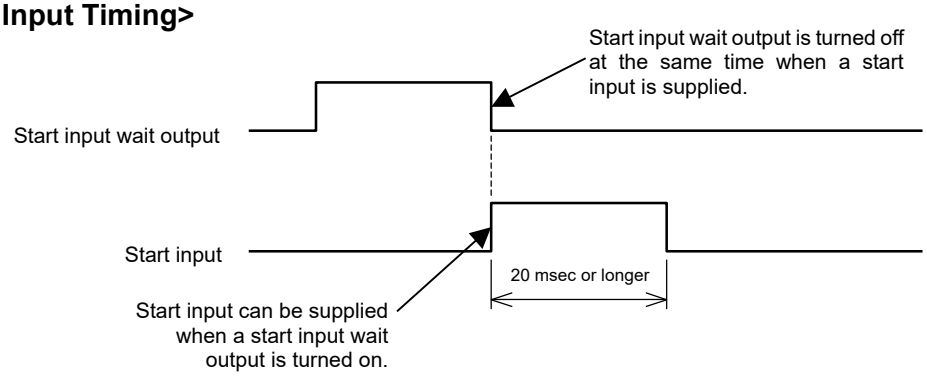
Under automatic mode, turning ON the program stop input (Input signal 1 - bit 9 / input data byte 1 - bit 1) during program execution will cause the program to stop after the motion in that block is completed.
In addition to the program stop input, the programs can be stopped executing a block in NC code M0 and M30.
When an external device requires program stop, NC code M0 will provide surer method than using the program stop input in respect of variations in input timing.

Turning on the start input (Input signal 1 - bit 8 / input data byte 1 - bit 0) again will cause the program next to the one which has stopped to be executed.
(When stopped with M30, the program will be executed from the head.)

When start input is acceptable, start input standby output (Output signal 1 - bit 10 / output data byte 1 - bit 2) is output.
Input the start input when this output is turned ON.

Communication codes (S1 and S2) having functions similar to start input and program stop input are provided. For details, refer to “7.COMMUNICATION FUNCTIONS (CN1: USB).”

<Start Input Timing>



4.5.3. Home Positioning Instruction Input

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- Home Positioning Instruction Input (Input signal 1 - bit 7 / input data byte 0 - bit 7)

The built-in absolute type position detector in ABSODEX does not necessarily require home positioning upon power-on start. If equipment system configuration requires home positioning, it can be achieved by home positioning instruction input (Input signal 1 - bit 7 / input data byte 0 - bit 7).
The input is valid in the pulse string input mode (M6), while it is invalid after pulse string input code G72 is executed in the NC program.
The home positioning operation has the following related parameters.
For details, refer to “5.PARAMETER SETTING.”

PRM3 Home position offset amount
PRM4 Home positioning direction
PRM5 Home positioning speed
PRM6 Home positioning acceleration and deceleration time
PRM7 Home positioning stop

In addition, the communication code S4, and NC code G28 enables the same motions as the above home positioning instruction inputs.

- Entry of the forced stop input during home positioning or interruption of home positioning due to an alarm clears the home position offset amount (PRM3) setting.
  After invalidating the forced stop input or resetting the alarm, if the start input is entered, as is, to begin positioning, ABSODEX may not position properly.
  Always perform one of the following operations after invalidating the forced stop input or resetting the alarm: home positioning, execution of NC code G92.1A0, or turning the power off and back on again.

4.5.4. Forced Stop Input

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- Forced stop input (Input signal 1 - bit 12 / input data byte 1 - bit 4)
- Reset input (Input signal 1 - bit 6 / input data byte 0 - bit 6)

This is a negative logic input signal and it is valid when PRM23 (forced stop input) is “1” or “3” (default setting: 3; servo OFF after stop).
When this signal is turned on, program execution is stopped.

■ During Rotation

Deceleration and stop are caused according to the deceleration rate specified in PRM21.

■ In Stop

The forced stop state is caused in the position.

■ State After Forced Stop

If PRM23 is “1,” the servo is turned on. If PRM23 is “3,” the servo is turned off after the time set at PRM22 (forced stop servo-off delay).
With models equipped with a brake, the brake is applied.
After this signal is supplied, alarm 9 is caused and alarm output 2 is turned on.
For other output states, refer to “I/O Output State Upon Emergency Stop Input” of “4.4.Input/Output.”

- The forced stop input is a negative logic input signal. If PRM23 is set at “1” or “3” when 24 VDC is not supplied at CN3, a forced stop is caused.
- The forced stop input judges the input signal state with the level.
  To reset from the forced stop, keep the signal always off before turning on the reset input.

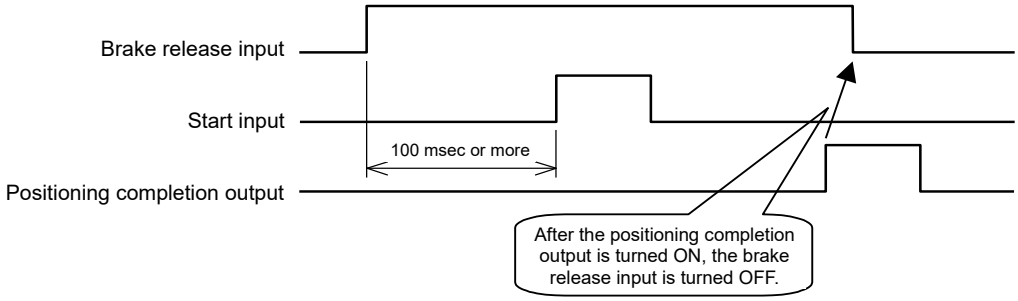
4.5.5. Brake Release Input

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- Brake Release Input (Input signal 1 - bit 13 / input data byte 1 - bit 5)
- Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)
- Positioning completion output (Output signal 1 - bit 9 / output data byte 1 - bit 1)

The brake is released while this signal is turned on even if the brake is applied.
If a forced stop is supplied when the brake is applied, the brake remains applied even after the equipment is reset.
To input a start signal without setting a new program number, reset and supply a brake release input to release the brake, then supply the first start signal.

<Timing of Brake Release Input>



- The above signal is necessary if M68 (apply brake) is used in the program even if models without a brake are used.

4.5.6. Servo State Output

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- Servo state output (Output signal 1 - bit 14 / output data byte 1 - bit 6)

<PRM to be Used>

- PRM57=1: Function selection for I/O output signal CN3-47 (bit 14)

The signal indicating the current servo state is issued from Output signal 1 - bit 14 / output data byte 1 - bit 6. The signal is output in the servo-on mode.
It is not output in an alarm causing servo-off or in the servo-off (M5) mode.
In case of a forced stop, the servo state signal is turned off after a delay specified in PRM22 (forced stop servo-off delay).
The servo and the servo state signal are turned off immediately only in the M3 mode.

This function is an alternative to “output in indexing 2.”

4.5.7. Servo-on Input

<EtherCAT and EtherNet/IP I/O Signals to be Used>

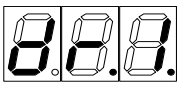
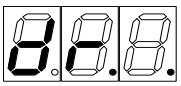
- Servo-on input (Input signal 1-bit 9 / input data byte 1-bit 1)
- Start input (Input signal 1 - bit 8 / input data byte 1 - bit 0)
- Start input wait output (Output signal 1 - bit 10 / output data byte 1 - bit 2)
- Servo state output (Output signal 1 - bit 14 / output data byte 1 - bit 6)

<PRM to be Used>

- PRM52=0: Function selection for I/O input signal CN3-14 (bit 9)

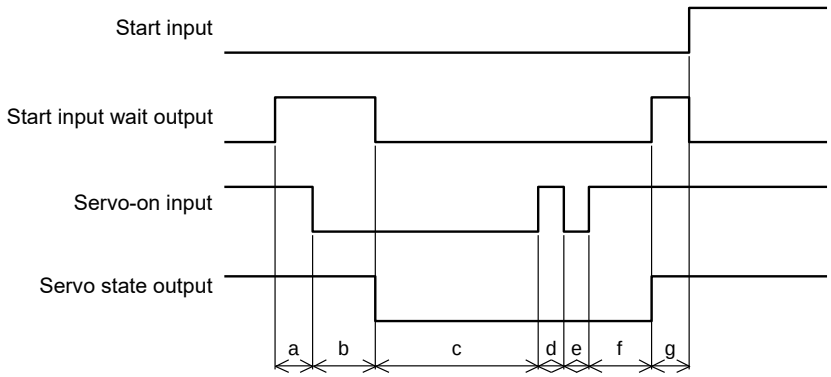
This function makes it possible to turn the servo on/off with a EtherCAT and EtherNet/IP I/O signal.
If this signal is active, the servo is turned on. If this signal is inactive, the servo is turned off.
This function is applicable to all modes except for the servo-off (M5) mode.
When the servo is turned on with this signal from the servo-off state, the operation mode having been effective before the servo is turned off starts. The displayed operation mode is “M5 mode” if the servo is turned off with this signal.
The 7-segment LED shows the following when this function is used.

<Servo-on Input and 7-segment LED Indication Example>

	Servo-on Input	
	ON (servo-on)	OFF (servo-off)
7-segment LED (3rd to 1st digit from the right)		

The timing chart of I/O signals related to this function and servo state output described in “4.5.6.Servo State Output” is shown below.
This example is in the M1 (automatic operation) mode.

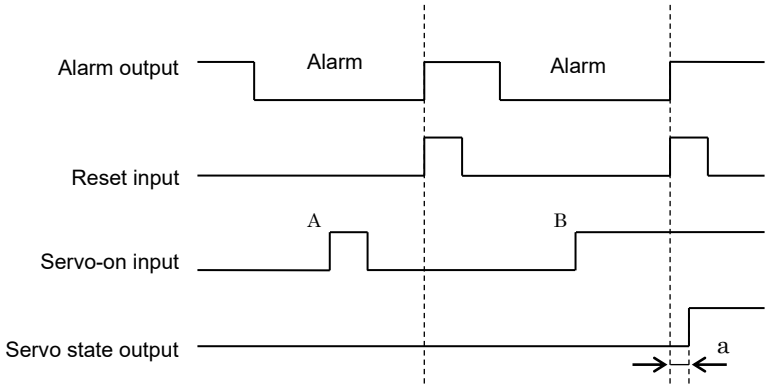
<Timing Chart of Servo-on Input>



a, g = 20 msec or longer c = 100 msec or longer
b, d, e, f = Shorter than 100 msec

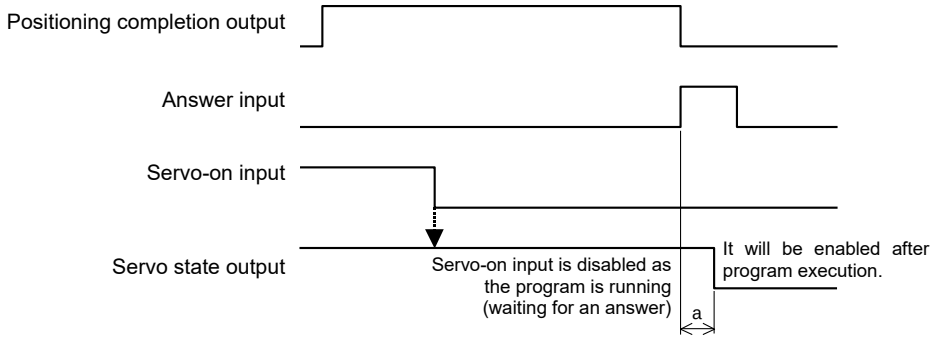
- This function is an alternative to “program stop input.”
- The servo state output is issued after about 100 msec since the servo-on input changes.
- Leave at least 100 msec for the servo-on/off switching timing to avoid malfunctioning. No input is accepted in intervals d or e shown in “Timing Chart of Servo-on Input” of “4.5.7.Servo-on Input.”
- Program number selection input is invalid when the ABSODEX is in servo-off state. With the ABSODEX in servo-on state, input the program number selection input again.
- To perform auto tuning, this signal must be in ON-state (servo-on).
- If this signal is set to OFF (servo-off) while the program is running (rotating, waiting for an answer on position completion, etc.), ABSODEX will go into servo-off state after the program is completed. (The top part of the following figure)
- The brake outputs (BK+, BK-) do not change at this signal.
- Upon a start input after servo-on, the program is executed from the beginning.
- The servo is not turned off and controlled stop keeps going on in the “alarm controlled stop” mode, which is an additional function, even if the servo is turned off with this signal. After controlled stop is finished, remove the cause of the alarm and reset to validate this function.
- (A) The servo-on input is invalid in an alarm and in a forced stop input.
  (B) In an alarm and in a forced stop input, with the servo-on input on, after an alarm reset (or forced stop release), a servo-on state is set. (Refer to the bottom part of the following figure)

<Servo-on Input When an Alarm is Triggered>



a = Shorter than 100 msec

<Servo-on Input When Program is Running>



a = Shorter than 100 msec

4.5.8. Confirmation Method of Positioning Completion

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- Positioning completion output (Output signal 1 - bit 9 / output data byte 1 - bit 1)
- Answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3)

<PRM to be Used>

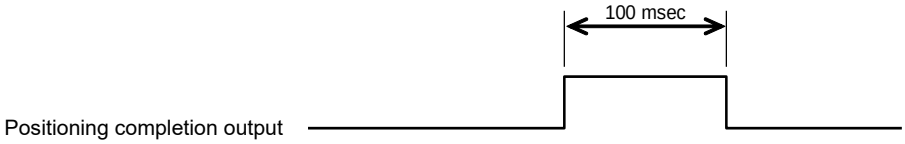
- PRM13: Answer input after completion of positioning and home return
- PRM47: Positioning completion output time
- PRM54=0: Function selection for I/O input signal CN3-16 (bit 11)

Completion of home positioning and positioning will turn on positioning completion output (Output signal 1 - bit 9 / output data byte 1 - bit 1).
(For output conditions, refer to “5.6.Judgment of Positioning Completion.”)
Specify PRM13 (answer input to positioning and home positioning completion) to select whether the answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is necessary or unnecessary.

<When answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is not required (PRM13=2: default setting)>

Positioning completion output (Output signal 1 - bit 9 / output data byte 1 - bit 1) is ON for 100 msec.

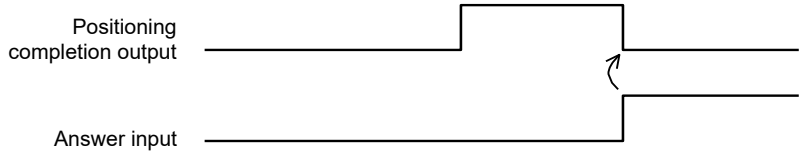
<Positioning Completion Output Timing>



<When answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is required (PRM13=1)>

Positioning completion output (Output signal 1 - bit 9 / output data byte 1 - bit 1) is ON until the answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is ON.
The alarm H will be caused if there is no answer input longer than the time set by the PRM11 (no answer time).

<Positioning Completion Output Timing>



<To Use the Positioning Completion Output Time (PRM13=2: Shipment Setting)>

You can use PRM47 to enter the positioning completion time between “0 and 1,000 msec.”

- If PRM47=0, no positioning completion output is issued.
- If PRM47 is changed to “0,” no positioning completion output is issued and the answer input becomes unnecessary even if PRM13 (answer input after completion of positioning and home return) is “1: Required.”

4.5.9. M Code Output Timing

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- M code output bit 0 to 7 (Output signal 1 - bit 0 to 7 / output data byte 0 - bit 0 to 7)
- M code strobe output (Output signal 1 - bit 17 / output data byte 2 - bit 1)
- Answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3)

<PRM to be Used>

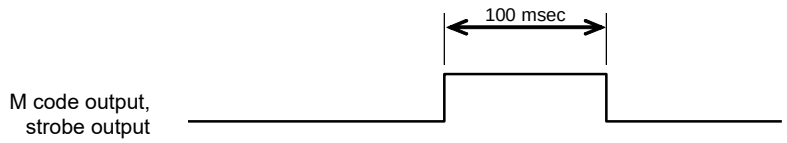
- PRM54=0: Function selection for I/O input signal CN3-16 (bit 11)

Executing M20 to 27 of NC code will turn on the corresponding M code output bit 0 to 7 (Output signal 1 - bit 0 to 7 / output data byte 0 - bit 0 to 7). To discriminate this output from the segment positioning output M70, M code strobe output (Output signal 1 - bit 17 / output data byte 2 - bit 1) is simultaneously made.
Specify PRM12 (M answer necessary/unnecessary) to select whether the answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is necessary or unnecessary.

When answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is not required (PRM12=2: default setting)

M code output is ON for 100 msec.

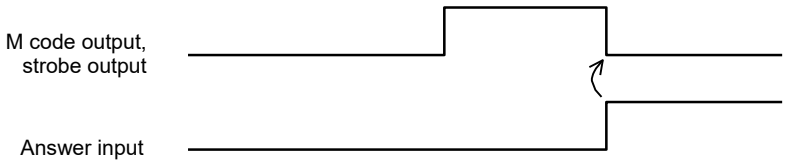
<M Code Output Timing>



When answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is required (PRM12=1)

M code output is made until the answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is ON.
The alarm H will be caused if there is no answer input longer than the time set by the PRM11 (no answer time).

<M Code Output Timing>



4.5.10. Segment Position Output Timing

<EtherCAT and EtherNet/IP I/O Signals to be Used>

- M code output bit 0 to 7 (Output signal 1 - bit 0 to 7 / output data byte 0 - bit 0 to 7)
- Segment position strobe output (Output signal 1 - bit 16 / output data byte 2 - bit 0)
- Answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3)

<PRM to be Used>

- PRM54=0: Function selection for I/O input signal CN3-16 (bit 11)

Executing M70 of NC code (segment position output), when segment number is designated using NC code G101, will output the current segment position in binary in the M code output bit 0 to 7 (Output signal 1 - bit 0 to 7 / output data byte 0 - bit 0 to 7).
For details, refer to “5.8.3.Motion of M70.”
To discriminate this output from the M code output M20 to M27, Segment position strobe output (Output signal 1 - bit 16 / output data byte 2 - bit 0) is simultaneously made.

Specify PRM12 (M answer necessary/unnecessary) to select whether the answer input (Input signal 1 - bit 11 / input data byte 1 - bit 3) is necessary or unnecessary.
Each timing is same as that of M-code output.

4.5.11. Other EtherCAT and EtherNet/IP I/O Signals

■ Reset input (Input signal 1 - bit 6 / input data byte 0 - bit 6)

Release the alarm. Effective only for alarm.
For detail of alarms, refer to “12.ALARMS.”

■ Ready return input (Input signal 1 - bit 10 / input data byte 1 - bit 2)

Use in the return process of the safety function. This function is an alternative to the “continuous rotation stop input.” Enter “0” to PRM53 to validate this function.

■ Continuous rotation stop input (Input signal 1 - bit 10 / input data byte 1 - bit 2)

This is the input to stop continuous rotation with NC code G7.
This input will cause continuous rotation to stop, and then to execute the next block in the NC program.
Program stop input (Input signal 1 - bit 9 / input data byte 1 - bit 1) during continuous rotation will cause the rotation and program execution to stop. This function is an alternative to the “ready return input.”
Enter “1” to PRM53 to validate this function.

■ Position deviation counter reset input (Input signal 1 - bit 11 / input data byte 1 - bit 3)

This function resets the position deviation generating in the pulse string input (M6) mode.
When this signal is active, the position deviation is reset. The function is effective only in the pulse string input (M6) mode. This function is an alternative to the “answer input.”
Enter “1” to PRM54 to validate this function.

- While the position deviation counter reset signal is supplied, slight rotation may be caused due to the drift of the speed loop.

■ In-position output (Output signal 1 - bit 8 / output data byte 1 - bit 0)

This output is made when the servo position deviation is within the tolerance. The same will apply for pulse string inputs.
If PRM51=0 (default value), the signal is output even during rotation.
If PRM51=1, the signal is not output during rotation.
For PRM51, refer to “5.12.In-position Signal Output Mode.”
For judgment of in-position, refer to “5.5.Judgment of In-position.”

■ Alarm output 1 and 2 (Output signal 1 - bit 11 and 12 / output data byte 1 - bit 3 and 4)

This output (negative logic output) turns ON, when an alarm condition exists in ABSODEX.
Depending on the level of alarms, Output 1, Output 2, and both are made.
For the detail of alarms, refer to “12.ALARMS.”

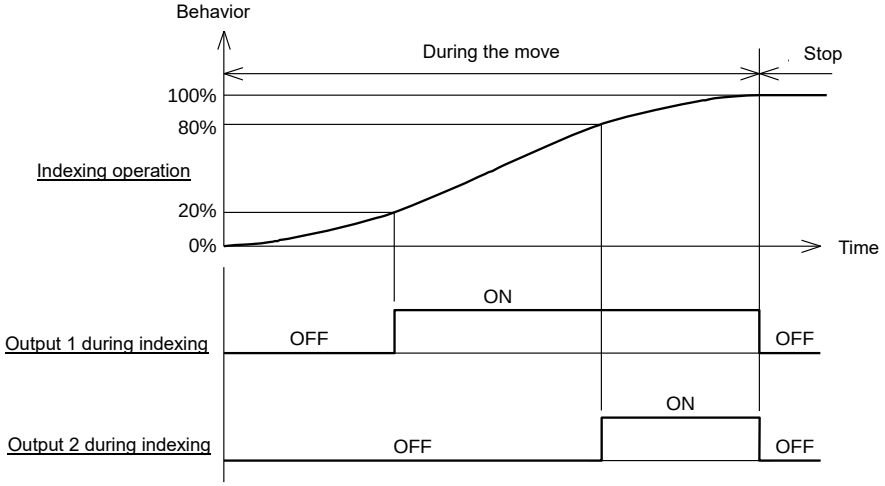
■ Ready output (Output signal 1 - bit 15 / output data byte 1 - bit 7)

The ready output is issued in the ready state where the module is ready to accept input signals. The output is turned off in an alarm (other than 0, 3 and 7) and during activation of the safety circuit.

■ Output 1 and 2 during indexing (Output signal 1 - bit 13 and 14 / output data byte 1 - bit 5 and 6)

These are the output that is made during motion.
According to the settings of PRM33 (output 1 during indexing) and PRM34 (output 2 during indexing) with 0 selected for PRM56 (output 1 during indexing) or PRM57 (output 2 during indexing), the output is turned on, and it is turned off when the positioning completion signal is issued.
The PRM33 and 34 are specified by the percentage of the moving angle.

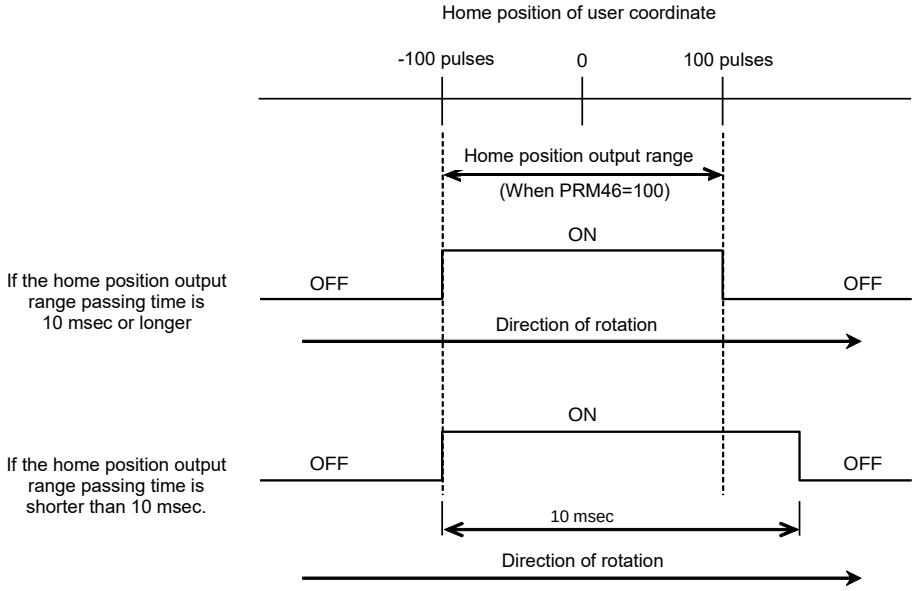
<Intermediate Index Output Example (When PRM33=20 and PRM34=80)>



■ Home position output (Output signal 1 - bit 13/ output data byte 1 - bit 5)

If PRM56 is set at “1” (home position output), home position output “Output signal 1 - bit 13/ output data byte 1 - bit 5” is issued each time the user coordinate origin is passed.

<Home Position Output Timing>



<If the Parameter Setting Range Passing Time is 10 msec or Longer>

If PRM46 is set at “100,” the home position output is issued in the range from -100 to +100 pulses, and it is turned off at the +101 pulse position.

<If the Parameter Setting Range Passing Time is Shorter Than 10 msec>

The home position is passed at the high speed and the pulse output time is 10 msec.

4.6. Monitor Code / Instruction Code

<Monitor Code List>

Code No. Note 1	Items to monitor		Data length	Unit	Display range
1h	Within a full revolution, current position (angle)		32 bit	×1,000 [degree]	0 to 359,999
3h	Within a full revolution, current position (Pulse)	**Resolution setting 540,672 P/rev**	32 bit	[Pulse]	0 to 540,671
		Resolution setting 2,097,152 P/rev			0 to 2,097,151
5h	Position deviation amount		32 bit	[Pulse]	-2,147,483,648 to 2,147,483,647
7h	Program No.		16 bit	[No.]	0 to 999
8h	Load factor		16 bit	×100 [%]	0 to 65,535
9h	Rotation speed		16 bit	[rpm]	-32,768 to 32,767
Ah	Point table number		16 bit	[No.]	0 to 63
Bh	Torque load factor		16 bit	[%]	0 to 110
Ch	Angular acceleration		16 bit	[rad/s^2]	-32,768 to 32,767

Note 1: If there is a lowercase h following a number or letter of a code number, such as "**h," the code number is a hexadecimal number.

<Response Code List> **Note 2**

Code No.	Description	Details
0	Normal	Instruction code is executed normally
1	Code error	Code that is not listed was executed
2	Parameter selection error	Parameter number that cannot be read or set was specified
3	Write range error	Value outside the setting range was executed
4	Timing error	Write instruction code was executed during the processing of CN1 communications function

Note 2: Response codes are common to the monitor, the read instruction, and the write instruction.

<Read Instruction Code List>

Code No. Note 1	Item/Function	Read data		Data specification
10h	Current alarm read	EtherCAT Specification	0 to 7 bit: Alarm read 1 8 to 15 bit: Alarm read 2 16 to 23 bit: Alarm read 3 24 to 31 bit: Alarm read 4	-
		EtherNet/IP specifications	Byte 24: Alarm read 1 Byte 25: Alarm read 2 Byte 26: Alarm read 3 Byte 27: Alarm read 4	
20h	Operation mode read	Current operation mode No.		-
23h	Parameter read (RAM data)	Parameter setting value		Parameter number
25h	Parameter read	Parameter setting value		Parameter number

Note 1: If there is a lowercase h following a number or letter of a code number, such as "**h," the code number is a hexadecimal number.

■ Current alarm read (10h)

This reads the currently occurring alarm number.
It is set to the read data and represents one type by one byte, which can be set up to four.
Alarm display is similar to the 7-segment LED. The first digit represents the alarm detail and the second digit represents the alarm number. Alarms that cannot be represented by 0 to F are as follows:

Alarm H → "d"
Alarm L → "b"
Alarm P, U, others → "8"

Alarms are set in the order of priority from "F" to "0."
In the "NO ALARM" condition, set "00."

■ Operation mode read (20h)

This reads a current operation mode.
The number of operation mode is set to the read data.

<Readable Operation Mode List>

Operation mode	Read data setting value
Automatic mode	1
Single block mode	2
MDI (Manual data input) mode	3
Jog mode	4
Servo-off mode	5
Pulse string input mode	6
Network operation mode	7

■ Parameter read (23h, 25h)

This reads the parameter setting value in integer which is specified with the data specification.
If a parameter has a fractional value, it reads the value multiplied by 100 or 10,000.
For details, refer to “Unit of parameter setting value in instruction code” of “4.6.Monitor Code / Instruction Code.”

<Write Instruction Code List>

Code No. Note 1	Item/Function	Write data	Data specification
21h	Operation mode switching	Operation mode number	-
27h	Parameter setting (RAM data only)	Parameter setting value	Parameter number
29h	Parameter setting	Parameter setting value	Parameter number
30h	Points table initialization	Table number to initialize	-
31h	Parameter initialization	999	-

Note 1: If there is a lowercase h following a number or letter of a code number, such as “**h,” the code number is a hexadecimal number.

■ Operation mode switching (21h)

This switches an operation mode to the operation mode specified with data.
Switchable modes and setting values are as follows:

<Switchable Operation Mode List>

Operation mode	Write data setting value
Automatic mode	1
Single block mode	2
Servo-off mode	5
Network operation mode	7

■ Parameter settings (27h, 29h)

This rewrites the parameter setting value specified with the data specification to the value of write data.
Write data accepts integer values only.
If a parameter has a fractional value, set the value multiplied by 100 or 10,000.
For details, refer to “Unit of parameter setting value in instruction code” of “4.6.Monitor Code / Instruction Code.”
With the instruction code of parameter settings (RAM data only,) only data on RAM is rewritten.

■ Point table initialization (30h)

This initializes the point table specified with write data.
When write data is 999, it initializes all point tables including the common table.
The values after initialization are as follows:

<Point Table after Initialization>

Type	Command	Travel unit	Travel speed unit	A code / P code	F code
Common table	Absolute	×1,000 [degree]	×1,000 [rpm]	-	-
Table No. 0 to 63	Common table	Common table	Common table	0	2,000

■ Parameter initialization (31h)

This initializes the setting values of all parameters.
However, parameter 61 (station number, baud rate setting), parameter 103 (IP address), parameter 104 (subnet mask), and parameter 105 (default gateway) are not initialized.

■ Unit of parameter setting value in instruction code

For each parameter function, refer to “5.1.Parameters and Contents.”

<Parameter List (1/5)>

PRM No.	Description		Setting Range	Initial Value	Unit
1	Cam curve		1 to 5	1	-
2	Acceleration and deceleration time of MC 2 curve		1 to 5,000	100	×100 [sec]
3	Home position offset amount	**Resolution setting 540,672P/rev**	-540,672 to 540,671	0	[Pulse]
		Resolution setting 2,097,152P/rev	-1,048,576 to ～1,048,575		
4	Home positioning direction		1 to 3	1	-
5	Home positioning speed		100 to 2,000	200	×100 [rpm]
6	Acceleration and deceleration time for home positioning		10 to 200	100	×100 [sec]
7	Home return stop		1 to 2	2	-
8	Software limit coordinate A (+ direction)		-99,999,998 to 99,999,999	99,999,999	[Pulse]
9	Software limit coordinate B (- direction)		-99,999,999 to 99,999,998	-99,999,999	[Pulse]
10	Software limit effective or not effective		1 to 2	2	-
11	No answer time		1 to 100 999	999	[sec]
12	M answer setting		1 to 2	2	-
13	Answer input for positioning and home position return		1 to 2	2	-
14	Jog speed		1 to 10,000	200	×100 [rpm]
15	Jog acceleration and deceleration times		10 to 200	100	×100 [sec]
16	In-position range	**Resolution setting 540,672P/rev**	1 to 10,000	2,000	[Pulse]
		Resolution setting 2,097,152P/rev	1 to 40,000	8,000	
17	In-position sampling times		1 to 2,000	1	[Time]
18	Position deviation amount		Setting not feasible	-	[Pulse]
19	Upper limit for position deviation amount	**Resolution setting 540,672P/rev**	1 to 540,672	4,000	[Pulse]
		Resolution setting 2,097,152P/rev	1 to 2,097,152	16,000	

<Parameter List (2/5)>

PRM No.	Description			Setting Range	Initial Value	Unit
20	Speed over limit	**Resolution setting 540,672P/rev**	AX2R-006 AX2R-012 AX2R-018	1 to 5,947	5,947	[Pulse]
			AX1R-022 AX1R-045 AX4R-009 AX4R-022 AX4R-045	1 to 4,866	4,866	
			AX1R-075 AX4R-075	1 to 2,883	2,883	
			AX1R-150 AX1R-210	1 to 2,552	2,522	
			AX4R-150 AX4R-300	1 to 1,982	1,982	
			AX4R-500	1 to 1,441	1,441	
			AX4R-10W	1 to 630	630	
		Resolution setting 2,097,152P/rev	AX2R-006 AX2R-012 AX2R-018 AX1R-022 AX1R-045 AX1R-075 AX4R-009 AX4R-022 AX4R-045 AX4R-075	1 to 11,184	11,184	
			AX1R-150 AX1R-210	1 to 9,786	9,786	
			AX4R-150 AX4R-300	1 to 7,689	7,689	
			AX4R-500	1 to 5,592	5,592	
			AX4R-10W	1 to 2,446	2,446	

<Parameter List (3/5)>

PRM No.	Description		Setting Range	Initial Value	Unit
21	Deceleration rate for forced stop	**Resolution setting 540,672P/rev**	1 to 180 999	999	[Pulse/msec^2]
		Resolution setting 2,097,152P/rev	1 to 698 999		
22	Delay time for forced stop servo-off		0 to 2,000	1,000	[msec]
23	Forced stop input		1 to 3	3	-
24	Load factor		Setting not feasible	-	×100 [%]
25	Upper limit of load factor		Setting not feasible	10000	×100 [%]
27	Delay time after brake output	AX1R Series AX2R Series AX4R-009 AX4R-022 AX4R-045	0 to 1,000	100	[msec]
		AX4R-075 AX4R-150 AX4R-300 AX4R-500 AX4R-10W		250	
28	Brake initial status		1 to 2	2	-
29	Mode setting for power-on		1, 2, 6, 7	1	-
33	Output 1 during indexing		0 to 99	0	[%]
34	Output 2 during indexing		0 to 99	0	[%]

<Parameter List (4/5)>

PRM No.	Description		Setting Range	Initial Value	Unit
36	Selection switching of I/O program numbers		1 to 5	1	-
37	Segment position range width for equal segment designation	**Resolution setting 540,672P/rev**	1 to 270,336	1,500	[Pulse]
		Resolution setting 2,097,152P/rev	1 to 1,048,576	6,000	
38	Rotation direction for equal segment designation		1 to 4	3	-
39	Torque limit		1 to 100	100	[%]
45	Power-on coordinate recognition range	**Resolution setting 540,672P/rev**	0 to 540,671	270,335	[Pulse]
		Resolution setting 2,097,152P/rev	0 to 2,097,151	1,048,575	
46	Home position output range	**Resolution setting 540,672P/rev**	0 to 10,000	2,000	[Pulse]
		Resolution setting 2,097,152P/rev	0 to 40,000	8,000	
47	Positioning completion output time		0 to 1,000	100	[msec]
48	Controlled stop upon alarm		1 to 2	2	-
51	In-position signal output mode		0 to 1	0	-
52	Function selection of I/O input signal CN3-14 (bit 9)		0 to 1	0	-
53	Function selection of I/O input signal CN3-15 (bit 10)		0 to 1	0	-
54	Function selection of I/O input signal CN3-16 (bit 11)		0 to 1	0	-
56	Function selection of I/O input signal CN3-46 (bit 13)		0 to 1	0	-
57	Function selection of I/O input signal CN3-47 (bit 14)		0 to 1	0	-
62	Cut-off frequency for low pass filter 1	AX1R Series AX2R Series AX4R-009 AX4R-022 AX4R-045	1,000 to 100,000	20,000	×100 [Hz]
		AX4R-075 AX4R-150 AX4R-300 AX4R-500 AX4R-10W		10,000	

<Parameter List (5/5)>

PRM No.	Description		Setting Range	Initial Value	Unit
63	Cut-off frequency for low pass filter 2		1,000 to 100,000	50,000	×100 [Hz]
64	Cut-off frequency for notch filter 1		1,000 to 100,000	50,000	×100 [Hz]
65	Cut-off frequency for notch filter 2		1,000 to 100,000	50,000	×100 [Hz]
66	Filter switch		0 to 15	1	-
70	Q value of notch filter 1		10 to 990	100	×100 [-]
71	Q value of notch filter 2		10 to 990	100	×100 [-]
80	Integral gain		0 to 655,360,000	0	×10,000 [-]
81	Proportional gain		0 to 655,360,000	0	×10,000 [-]
82	Differential gain		0 to 655,360,000	0	×10,000 [-]
83	Auto tuning command		0 to 1	0	[-]
87	Auto tuning torque		0 to 8,192	1,000	[-]
89	Auto tuning measurement termination speed	**Resolution setting 540,672P/rev**	0 to 1,000	700	[Pulse/ms]
		Resolution setting 2,097,152P/rev	0 to 4,000	2,800	
106	Regenerative resistor value		10 to 100,000	4,000	×100 [-]
107	Regeneration capacity		0 to 100,000	0	×100 [-]
120	Entering of inertia value		0 to 204,800	0	×100 [kg・m^2]

4.7. Application Examples of EtherCAT and EtherNet/IP Input/Output Signals

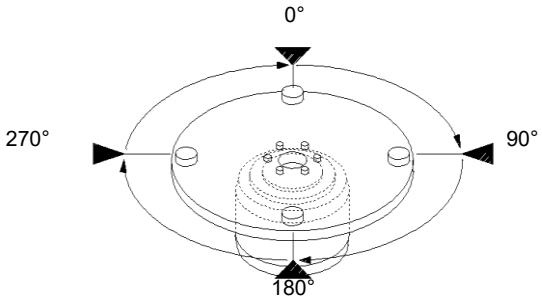
4.7.1. Basic EtherCAT and EtherNet/IP Input/Output Signals Flow

In this section, the basic EtherCAT and EtherNet/IP I/O signal flow starting at program number selection followed by starting and stopping is described.

<Motion Example>

Four-segment indexing
(Direction of rotation: clockwise)

<Motion Example>



<Program Example>

Use only one program with number 1 for this application.

<Program No. 1>

G11;	Change the unit of F to the time (seconds).
G101A4;	Segment a full revolution into four.
G91.1;	Full revolution incremental
A0F1;	Move to the nearest indexing position in 1 sec.
M0;	Start input wait
N1A1F0.5;	Block No. 1; index clockwise in 0.5 sec.
M0;	Start input wait
J1;	Jump to “N1” block.
M30;	End of program

<Parameter Setting Example>

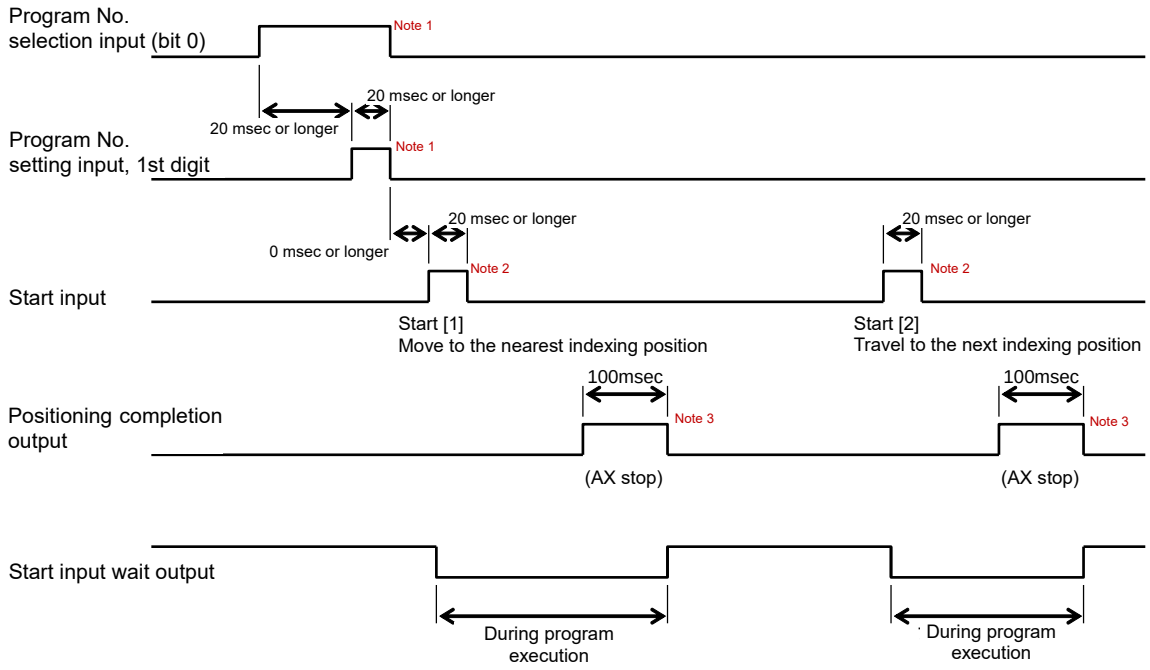
Set PRM36 (I/O program number selection method switching) at “3” (5-bit binary) for the present application.

4.7.2. Key Point to Program Number Selection

- If the number of programs is 32 or fewer, set PRM36 (I/O program number selection method switching) at “3” (5-bit binary) to finish program number entry in one cycle.
- After the power is turned on, program number “0” is automatically selected.
  If the number of programs is one, leave program number “0” to omit number selection operation (and the program runs immediately after a start signal is supplied).
  However, to execute the program from the first step after a forced stop, the “units digit program number setting” signal is necessary.
- The program number selection and start signal input are not accepted unless the “start input wait output” signal is turned on.
  Load or save the program with the AX-Tools when the “start input wait output” signal is ON.

■ Timing Chart Starting at Program Number Selection

<Timing Chart 1>

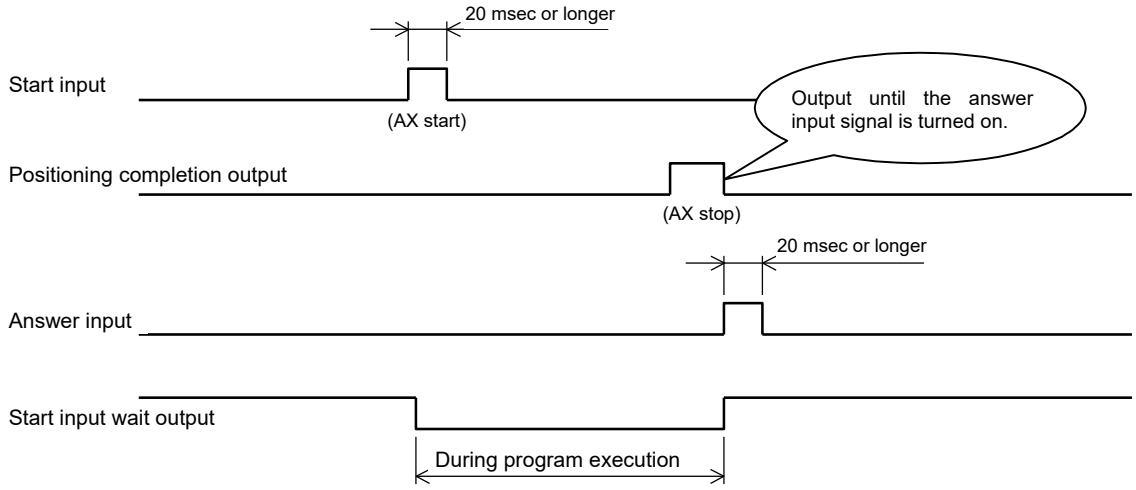


Note 1: Supply the program number selection, setting and start input signals after checking that the start input wait output signal is ON.

Note 2: Turn the start input signal off after checking that the start input signal is supplied and the start input wait output is turned off.
To turn the signal off with a timer or the like, specify the setting so that the signal remains turned on without fail for at least 20 msec.

Note 3: The positioning completion output signal is turned on after the indexing action is finished, and it remains issued for 100 msec before it is turned off.
Because the start input wait output signal is turned off while the positioning completion signal is issued, the start input signal is not accepted.
To turn the start input wait output signal on quickly, use the answer input signal to turn off the positioning completion output signal.
To use the answer input, be sure to specify “1” (necessary) for PRM13 (answer input to positioning and home positioning completion).

<Timing Chart 2>



4.7.3. Restoration Action Procedure after Forced Stop

There are several restoration patterns. The pattern varies according to the action to be taken after the forced stop.

■ Key Point to Restoration Action After Forced Stop

<When PRM36 is Set to 1, 2, or 3>

a) After supplying the reset signal, supply a home positioning instruction signal.
→ Home positioning follows the direction of rotation specified in PRM4 (home positioning direction).

b) After supplying a reset signal, select the new program number and supply the start signal.
→ The selected program runs from the first step.

c) After supplying a reset signal, supply the start signal.
→ If a forced stop signal is supplied while the equipment is stopped, supply a reset signal followed by a start signal, to move to the stopped position, and issue a positioning completion signal.
→ If a forced stop signal is supplied during rotation, supply a reset signal followed by a start signal, to move to the rotation termination position, and issue a positioning completion signal. If the start signal is supplied once more, the NC program is executed from the next block. At this time, the unexecuted NC code in the block having been executed at the time of forced stop is canceled.
(The action varies according to the description of NC codes.)

<When PRM36 is Set to 4 or 5 (Actions Performed Differ by the Parameter Set Value)>

a) After supplying the reset signal, supply a home positioning instruction signal.
→ Home positioning follows the direction of rotation specified in PRM4 (home positioning direction).

b) After supplying a reset signal, supply the start signal. (PRM36=5: Program number is set after forced stop)>
→ The selecting program runs from the first step.

c) After supplying a reset signal, supply the start signal. (PRM36=4: Program number is not set after forced stop)>
→ If a forced stop signal is supplied while the equipment is stopped, supply a reset signal followed by a start signal, to move to the stopped position, and issue a positioning completion signal.
→ If a forced stop signal is supplied during rotation, supply a reset signal followed by a start signal, to move to the rotation termination position, and issue a positioning completion signal.
At this time, the unexecuted NC code in the block having been executed at the time of forced stop is canceled.
If the start signal is input one more time in addition to the above, the NC program selected by the program selection bit is executed from the top.

The forced stop input is valid if PRM23 is set at “1” or “3.”

- With restoration action c), travel to the target position before the forced stop input occurs. Therefore if manual rotation is made after the servo is turned off, rotation opposite to the indexing direction or multiple rotations may occur.
  If interference with equipment may occur, use restoration action b).
- If forced stop is supplied when the brake is applied (with execution of M68), the brake remains applied even after the equipment is reset.
  To supply a start signal without selecting a new program number, reset and issue a brake release input to release the brake before supplying the first start signal.
  (Alarm A lights up if a start signal is supplied with the brake being applied.)

■ Timing Chart of Restoration Action After Forced Stop (When PRM36 is Set to 1, 2 or 3)

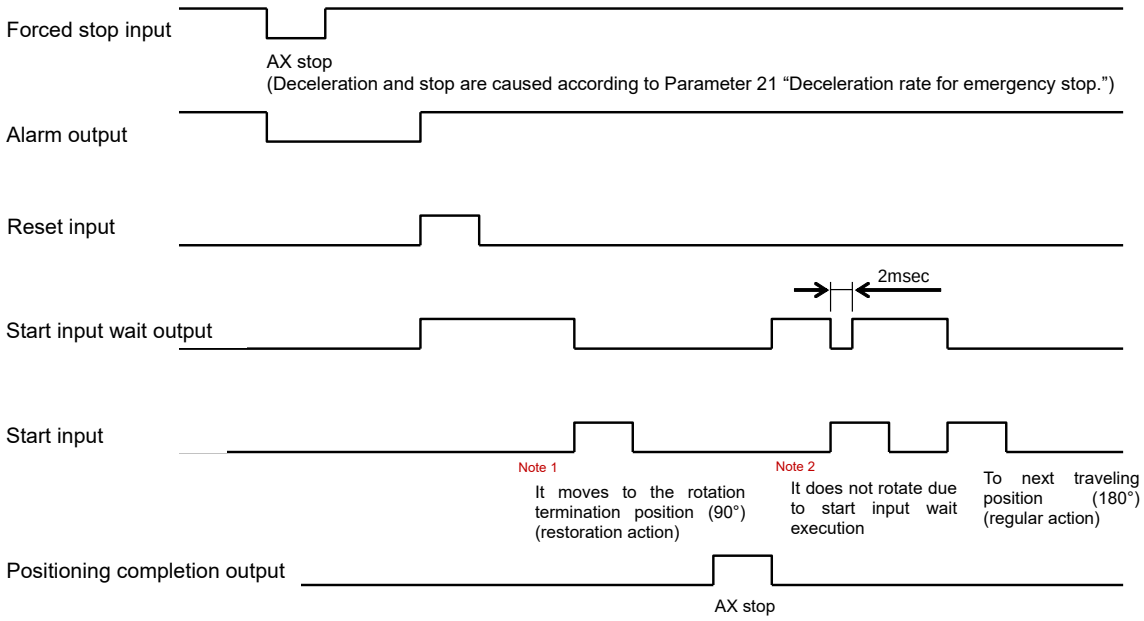
a) If the travel instruction and M0 (start input wait) are described in separate blocks, after supplying a reset signal, supply a start input three times to restore to the indexing action.

<Program No. 1>

G11;	Change the unit of F to the time (seconds).
G101A4;	Segment a full revolution into four.
G91.1;	Full revolution incremental
A0F1;	Move to the nearest indexing position in 1 sec.
M0;	Start input wait
N1A1F0.5;	Block No. 1; index clockwise in 0.5 sec.
M0;	Start input wait
J1;	Jump to “N1” block.
M30;	End of program

<Timing Chart After Forced Stop During Rotation (From 0° to 90° Position) Caused by Program Example 1>

<Timing Chart 3>

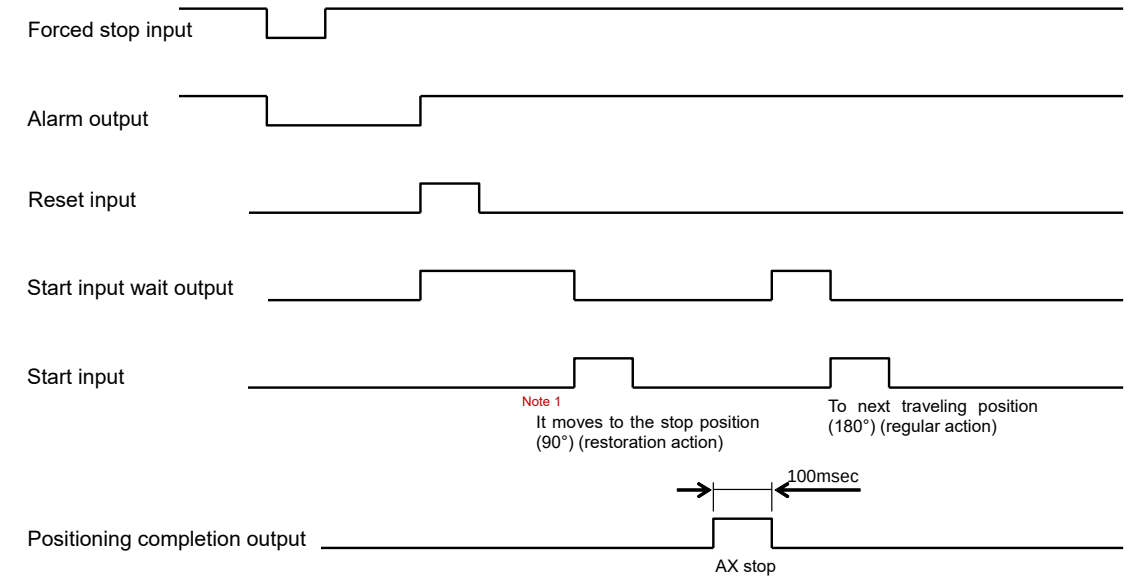


Note 1: The restoration action from the forced stop position causes an action to the last indexing position in the instruction time valid at the time.
(In the example, travel occurs from the forced stop position to the 90° position in 0.5 sec.)

Note 2: Because the M0 command is executed, no rotation occurs.

<Timing Chart After Forced Stop at the 90° Position During Execution of Program Example 1>

<Timing Chart 4>



Note 1: If the setting of PRM23 (forced stop input) is “3” (servo-off after stop), the actuator travels to the stopping position according to the action instruction time specified immediately before the stop.
If the setting of PRM23 (forced stop input) is “1” (stop in servo-on state after stop), a positioning completion signal is issued immediately after the start signal is supplied.

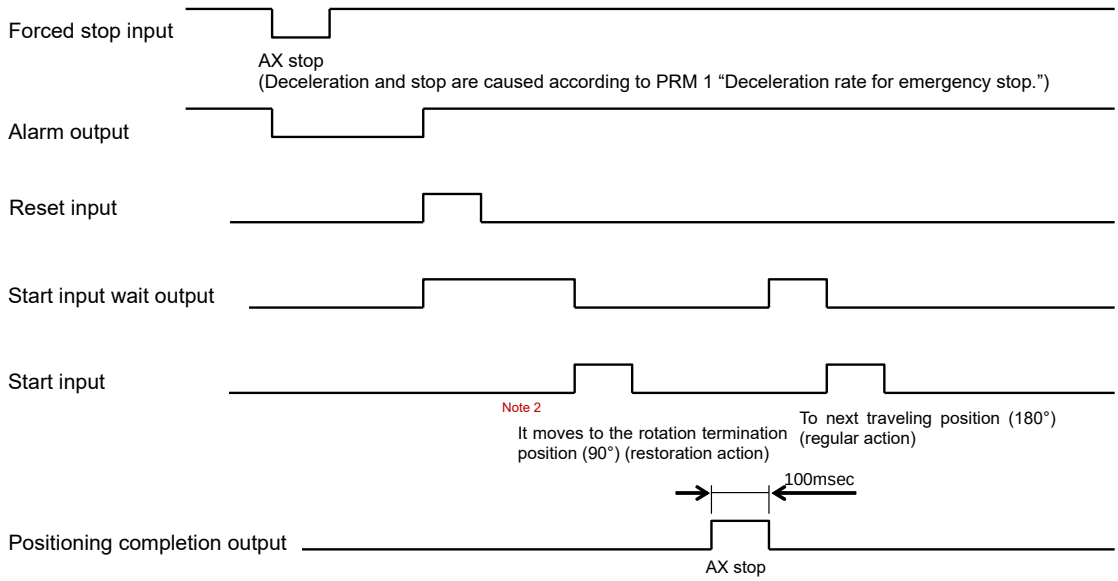
b) If the travel instruction and M0 (start input wait) are described in the same block, after supplying a reset signal[*1], supply a start input second time to restore to the indexing action.

<Program No. 2>

G11;	Change the unit of F to the time (seconds).
G101A4;	Segment a full revolution into four.
G91.1;	Full revolution incremental
A0F1M0;	Travel to the nearest indexing position in 1 sec. Start input wait
N1A1F0.5M0;	Block No. 1. Travel clockwise to index in 0.5 sec. Start input wait
J1;	Jump to “N1” block.
M30;	End of program

<Timing Chart After Forced Stop During Rotation (From 0° to 90° Position) Caused by Program Example 2>

<Timing Chart 5>



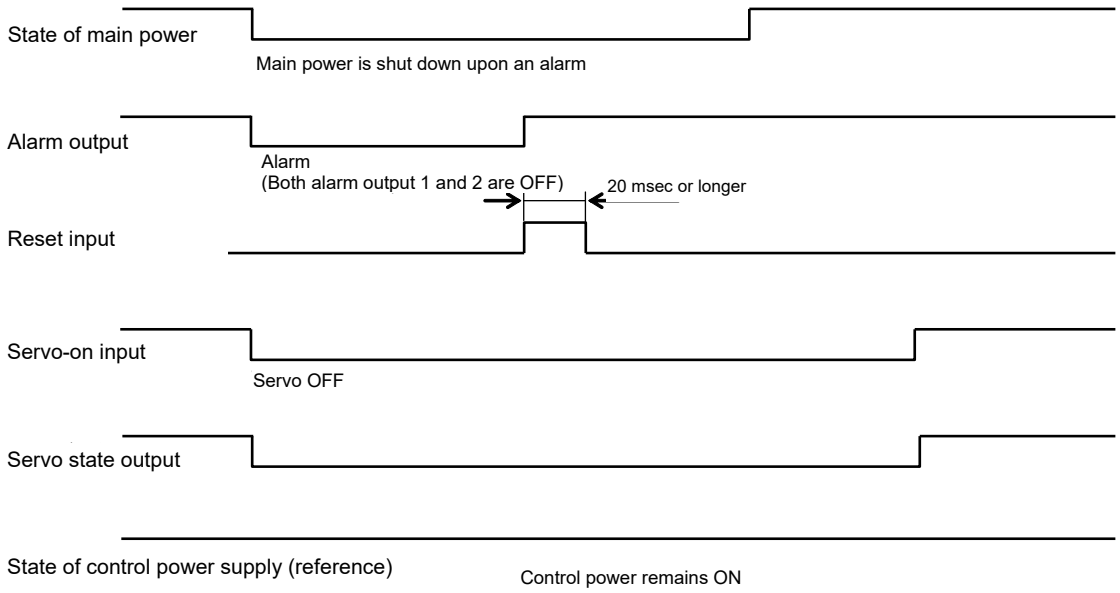
Note 1: If the setting of PRM23 (forced stop input) is “3” (servo-off after stop (default value)), and if the output axis is rotated manually with the servo turned off due to the forced stop in above pattern b), several rotations may occur at the maximum rotation speed according to the amount of rotation.

Note 2: The restoration action from the forced stop position causes an action to the last indexing position in the instruction time valid at the time.
(In the example, travel occurs from the forced stop position to the 90° position in 0.5 sec.)

4.7.4. Main Power Supply Sequence

The main power and control power are separated from each other with this product.
When a serious alarm (where both alarm outputs 1 and 2 are issued) occurs, you can use an electromagnetic contactor or the like to shut down only the main power in trouble.

<Timing Chart>



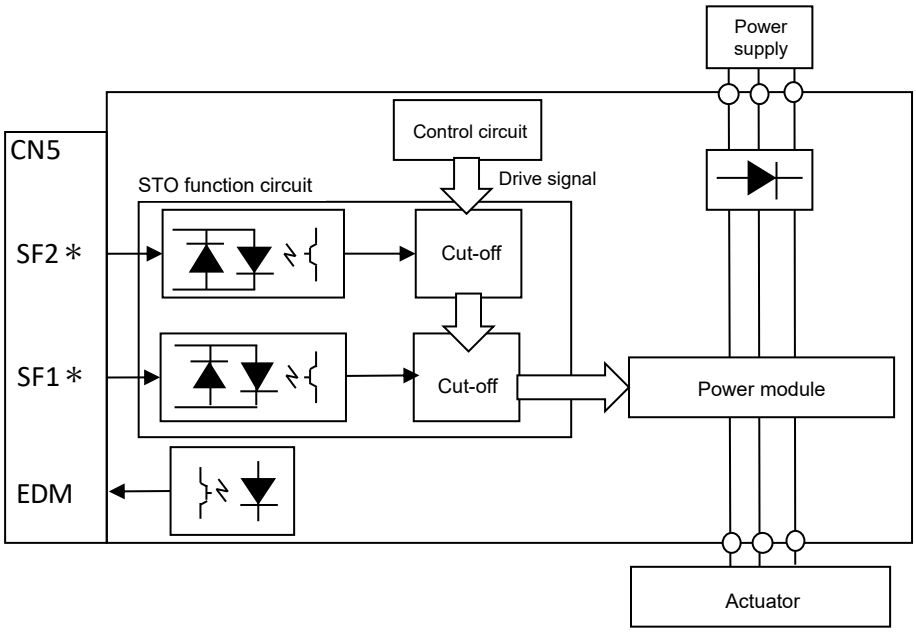
- If the main power is turned on with the servo-on input being active, the actuator may turn by the position deviation at the time.
  To avoid this, turn the main power on with the servo state output is in OFF-state (servo-off) if it must be turned on with the control power turned on.
- If the controlled stop function in an alarm is valid, shutdown of the main power in an alarm causes the motor to coast to stop.
- If the main power is turned off under a torque exerted due to gravity or the like, the torque causes the actuator to rotate. Operate the actuator in the balanced condition so that rotational force is not applied for these operations after all safety aspects are confirmed.

4.7.5. Sequence of Safety Function

The safety function employed in this product, STO: Safe Torque Off, is such that the power that can cause rotation of actuator is not applied.
The above function is activated upon the input contacts of external devices such as the safety relay unit are opened.

<Safety Input Signal (SF1*/SF2*) (CN6)>

Shut off motion of drive signal by safety input signal
The STO motion interrupts the transmission of drive signals to the power module by a safety input signal, and prevents the actuator from receiving power.
It is intended to be used when the motor is stopped to prevent accidents caused by accidental starting.



When the safety input signal status is “OFF,” the drive signal will be cut off.
The drive signal will be cut off if either the safety input signal 1 or the safety input signal 2 is turned OFF. However, design it so that both safety inputs are turned OFF.
If this function is not used, a dedicated short-circuit plug is required.

Status of Safety Input Signal 1/2		State of Drive Signal Transmission to the Power Module
SF1*	**SF2***	
ON	**ON**	**Normal**
OFF	**OFF**	**Cut-off**
ON	**ON**	**Cut-off**
OFF	**OFF**	**Cut-off**

Be sure to turn off the safety input signal for at least 5 ms.
The test pulse input to the safety input signal should be 1 ms or less.

The sequence for using the safety function is shown below.
<Example>

1. **After stopping the actuator, set the servo-on input (Input signal 1 - bit 9 / input data byte 1 - bit 1) to OFF.**
2. **Make sure the servo state output (Output signal 1 - bit 14 / output data byte 1 - bit 6) is OFF, and open the contacts on external devices (i.e., request to enable the safety function).**
3. **The safety function is enabled, and the ready output (Output signal 1 - bit 15 / output data byte 1 - bit 7) becomes OFF.**
4. **After any work that requires functional safety is completed, close the contacts on external devices (i.e., disable the STO function).**
5. **With the servo-on input still in OFF-state, set the ready return input (Input signal 1 - bit 10 / input data byte 1 - bit 2) to ON.**
6. **Set the servo-on input to ON and resume normal operation.**

<Monitor Output Signal (EDM)>

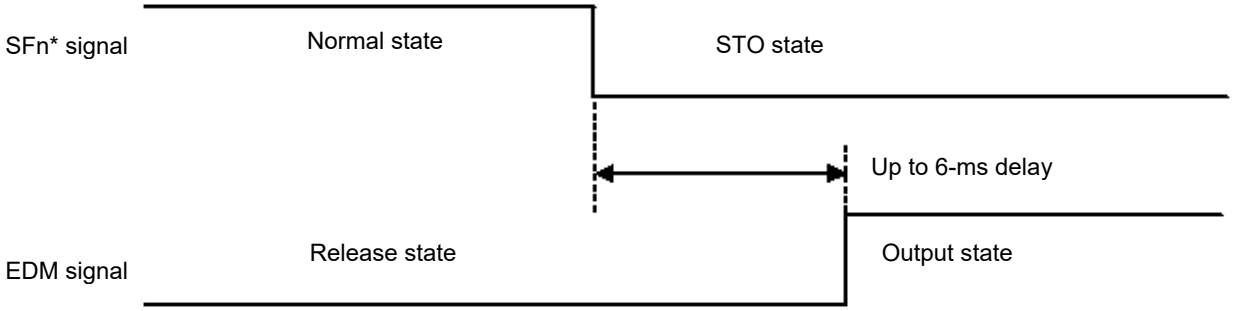
A monitor output signal (EDM) is an output signal used for detecting error of safety input. This signal is monitored by external detection, and abnormality such as disconnection is detected by changing the safety input signal.

When both safety input signals 1 and 2 are turned OFF, the monitor output signal turns ON.

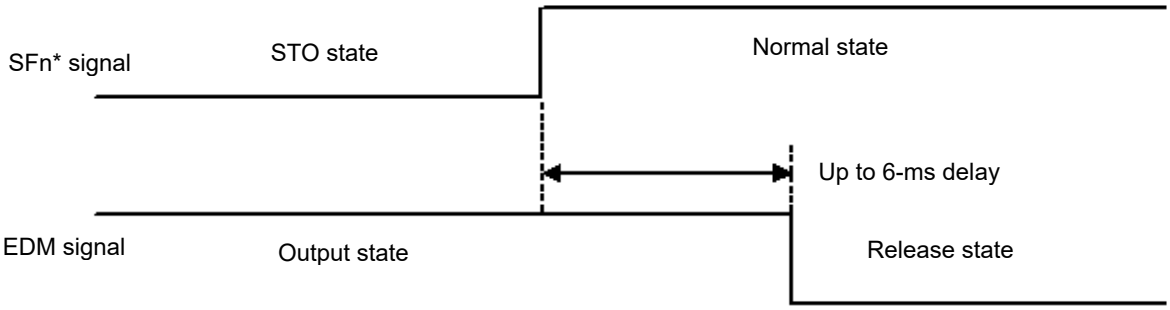
There is a delay of up to 6 ms before the monitor output signal changes due to a change in the safety input signal 1 and 2.

Signal	State			
SF1*	ON	OFF	ON	OFF
SF2*	ON	ON	OFF	OFF
EDM	OFF	OFF	OFF	ON

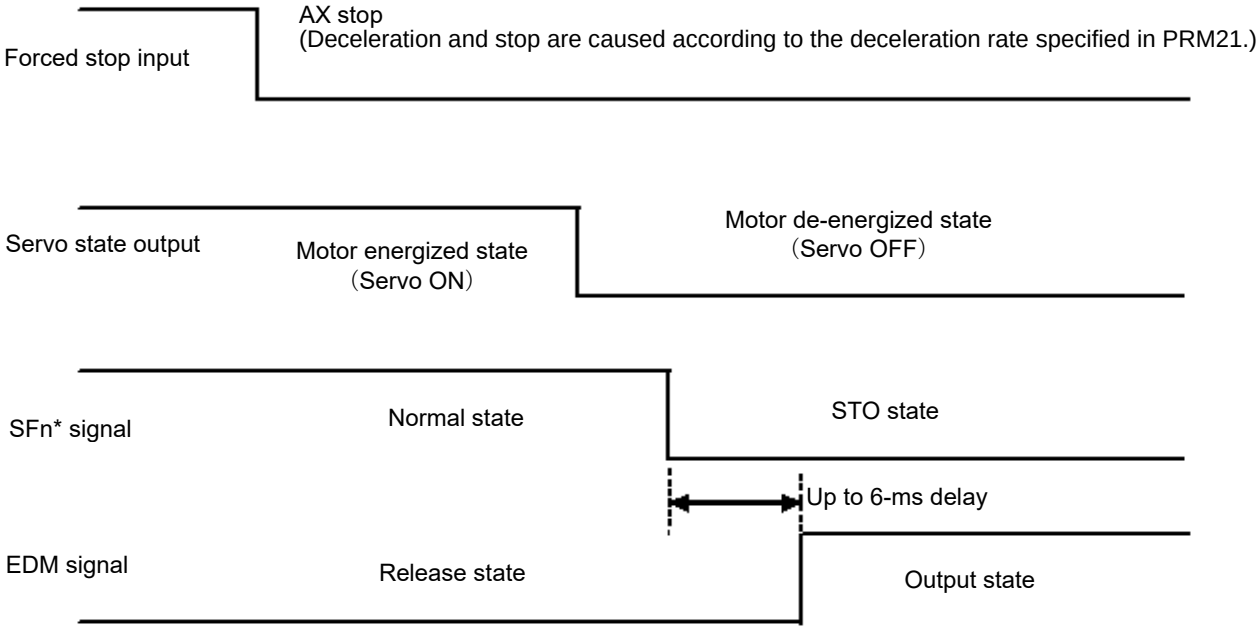
The timing chart of the monitor output signal (EDM) when activating the STO function is as follows.
When SF1* or SF2* is OFF, the STO function is activated and the STO state is entered.



The timing chart of the monitor output signal (EDM) when recovering from the STO state is as follows.
When both the SF1* and SF2* are ON, the STO state is released and the normal state is recovered.



<Instructions for Use>
The basic usage of this function is to interrupt the power supply's path to the motor by inputting a forced stop signal to the driver and turning OFF the SFn* signal while the motor is de-energized.
(1) Turn ON the driver's forced stop signal.
(2) The motor stops.
(3) After stopping, the servo state output of the driver is turned OFF.
(4) After the servo state output signal is turned OFF, turn OFF the SF1* and SF2* signals.

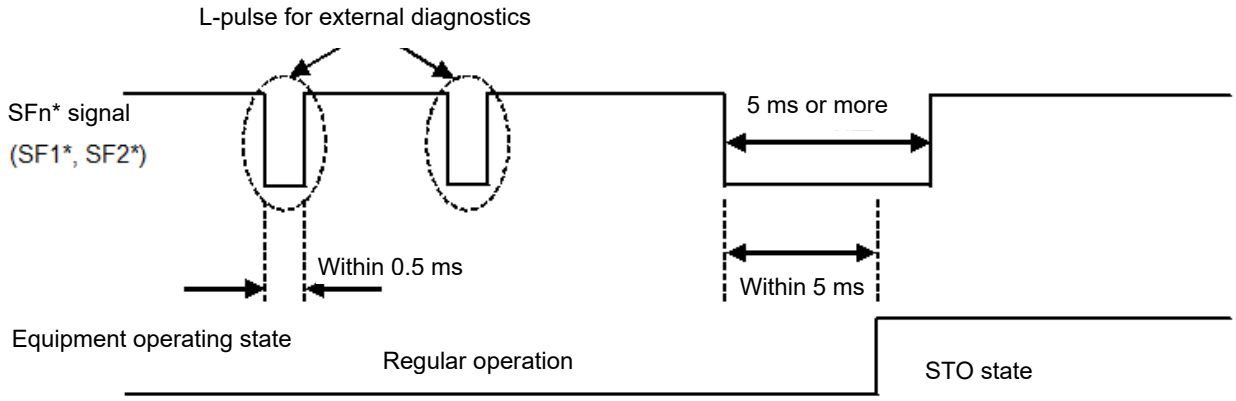


<L-pulse for External Diagnostics of Safety Equipment>

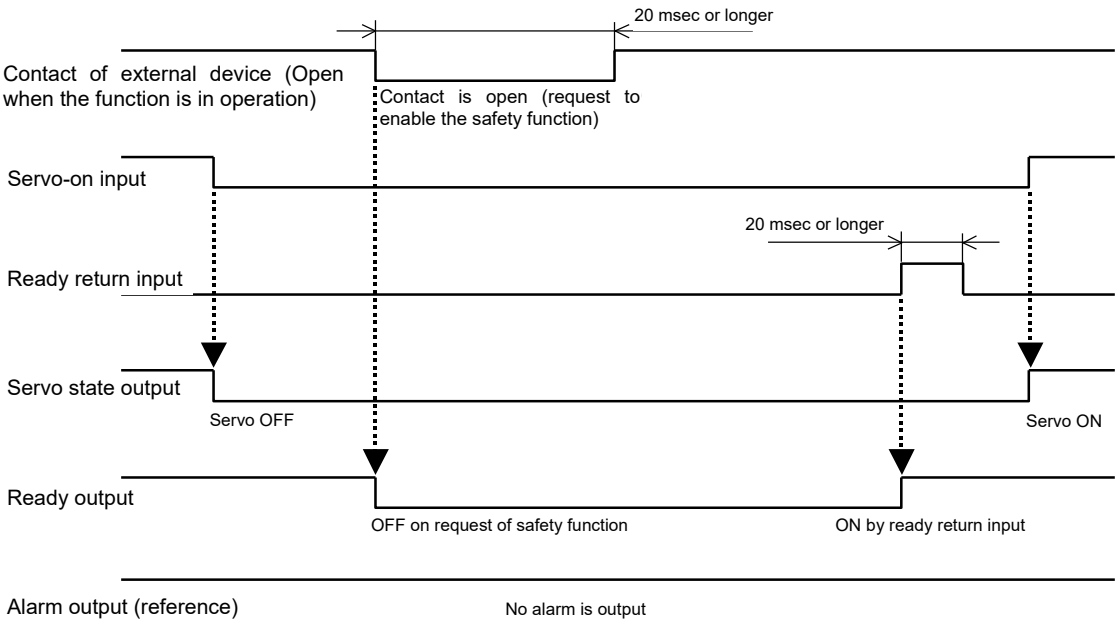
When connecting safety equipment such as safety controllers and safety sensors, the safety output signals from these higher-level equipment may contain L-pulses for external diagnostics.

To prevent a malfunction caused by the L-pulse for external diagnostics, the STO function circuit contains a filter that rejects the L-pulse for external diagnostics.

If the OFF time of the STO input signal (SFn* signal) is less than 0.5 ms, the STO function circuit will not recognize it as OFF. The safety input signal must remain OFF for at least 5 ms in order to ensure that the OFF signal is recognized.



<Timing Chart>



- If the safety function is operated while the servo state output is OFF.
  To return from the safety function, it is necessary to input the ready return signal while the servo-on input is OFF.
- If the safety function is operated while the servo state output is ON, chattering of the safety relay may generate an alarm or cause the driver to malfunction.
- Allow more than 20 msec between inputs of the safety function (opening and closing of the external contacts).
  Otherwise, the restoration action will not perform normally.
- The brake outputs (BK+, BK-) do not change when the safety function is in operation.
- For the wiring of the safety function, refer to “3.4.3.Wiring for Safety Function.”

WARNING

Brake outputs (BK+, BK-) and other inputs and outputs (other than TB1) are not safety-related.

- Do not design a safety system using these functions.

Power module failure may cause the actuator to move in a range equivalent to approximately 18° in output axis.

Before using the safety function, make sure to conduct a comprehensive risk assessment of the final application.

- System design shall comply with applicable safety standards so that there are no malfunctions.

When using the safety function, only equipment's that comply with applicable safety standards shall be connected.

The safety function involved is a function that cuts off power supply to the actuator and is not a function to stop it from rotating.

- If this function is used when there is torque applied on the device due to gravity, torque will cause the actuator to rotate. In addition, using this function when the actuator is still rotating will cause the actuator to rotate through inertia. Operate the actuator in the balanced condition so that rotational force is not applied for these operations after all safety aspects are confirmed.

Within 5 ms after interrupting the safety circuit, the power to rotate the actuator is removed.

- Above amount of time must be considered when demonstrating safety in design.

The safety function cuts off power to the actuator but does not cut off power to the driver and does not provide electrical insulation.

- Before performing maintenance on the driver, power to the driver must be cut off in an appropriate manner.

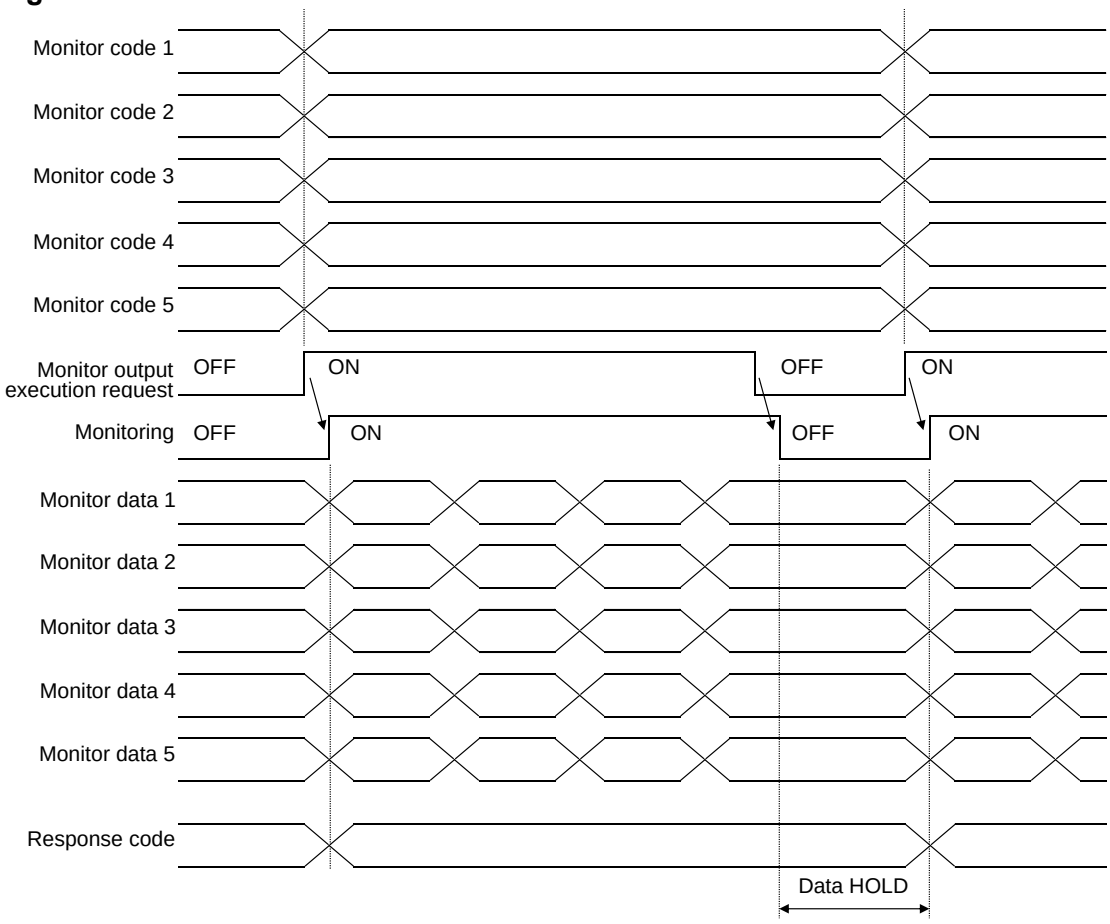
While the safety function is in operation, the 7-segment LEDs display “_ _” (under-scores).

- Input to S1 terminal changes the second digit of 7-segment LED indication from the right, and input to S2 terminal changes the first digit of 7-segment LED indication from the right. If the 7-segment LED indications do not change even though inputs are made, equipment failure and loose wiring are the possible causes.
- Periodically check that the indications are working properly and perform maintenance as necessary.

The monitor output signals (CN6-7, CN6-8) are not covered by the safety standards.

4.7.6. Monitor Code

<Timing Chart for Monitor Code Execution>



Set the monitor code to the monitor code 1 to 5, and set the monitor output execution request to ON.
Set the obtained data to the monitor data.
All data is in hexadecimal. This is when the monitoring becomes ON at the same time.

Monitor data 1 : Data requested by the monitor code 1
Monitor data 2 : Data requested by the monitor code 2
Monitor data 3 : Data requested by the monitor code 3
Monitor data 4 : Data requested by the monitor code 4
Monitor data 5 : Data requested by the monitor code 5

A monitor data is constantly updated while monitoring is ON.
When monitoring is OFF, data set to monitor data 1 to 5 is retained.
If any one of the monitor code 1 to 5 is a monitor code that is not included in the specification, an error code (□□□□□□□1) is set to the response code.

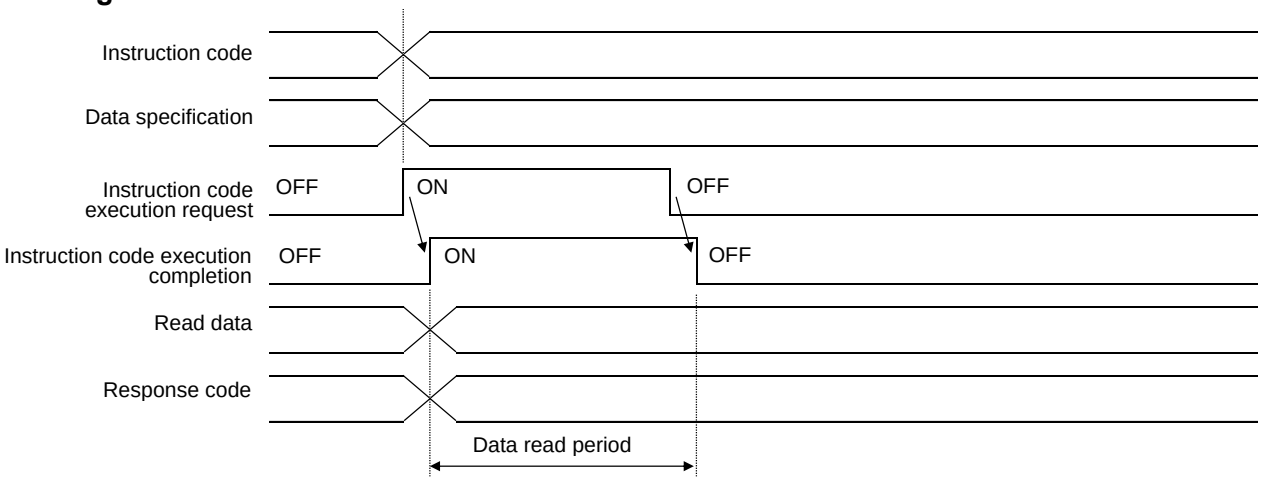
<Assignment List of I/O Data to be Used for Monitor Code Execution>

Input/Output	Signal Name	EtherCAT specifications	EtherNet/IP specifications
Input (PLC → AX)	Monitor code 1	Output data 1	Input data byte 8 to 11
	Monitor code 2	Output data 2	Input data byte 12 to 15
	Monitor code 3	Output data 3	Input data byte 16 to 19
	Monitor code 4	Output data 4	-
	Monitor code 5	Output data 5	-
	Monitor output execution request	Output signal 2 - bit 0	Input data byte 4 - bit 0
Output (AX → PLC)	Monitoring	Input signal 2 - bit 0	Output data byte 4 - bit 0
	Monitor data 1	Input data 1	Output data byte 8 to 11
	Monitor data 2	Input data 2	Output data byte 12 to 15
	Monitor data 3	Input data 3	Output data byte 16 to 19
	Monitor data 4	Input data 4	-
	Monitor data 5	Input data 5	-
	Response code	Input command 1	Output data byte 20 to 23

4.7.7. Instruction Code

■ Read instruction code

<Timing Chart for Read Instruction Code Execution>



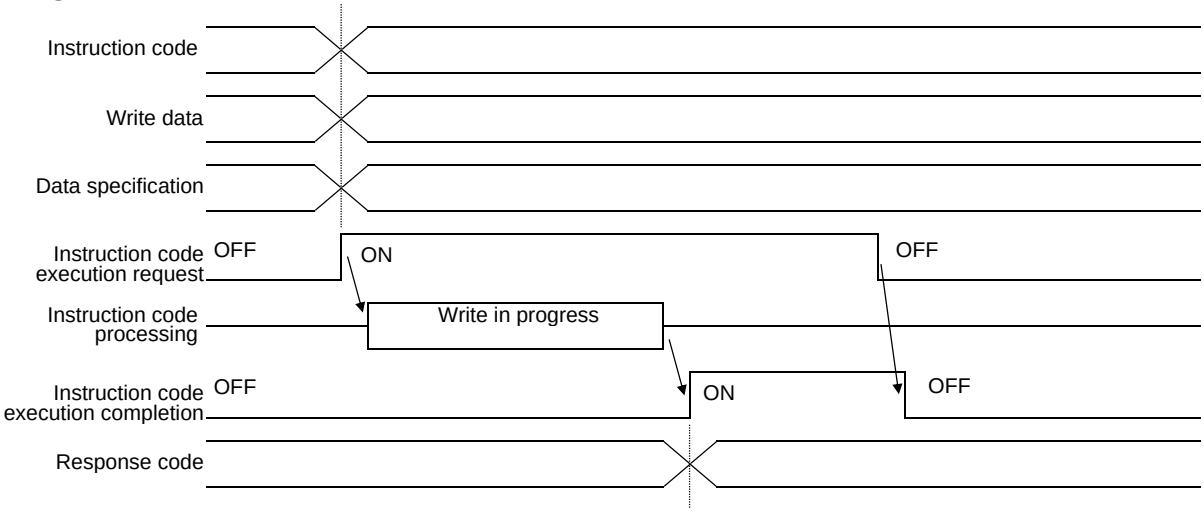
When the read instruction code is set to the instruction code and as necessary, to the data specification, and the instruction code execution request is ON, data corresponding to the set read code is set to the read data.
All data is in hexadecimal. This is when the instruction code execution completion becomes ON at the same time.
Read the data set to the read data while the instruction code execution request is ON.
The data is retained until the next read instruction code is set and the instruction code execution request is ON.
When an instruction code that is not included in the specification is set to the instruction code, the error code (□□□□□□1□) is set to the response code. When an unavailable parameter is read, the error code (□□□□□□2□) is set.
Set the instruction code execution request to OFF after data has been read.

<Assignment List of I/O Data to be Used for Instruction Code Execution>

Input/Output	Signal Name	EtherCAT specifications	EtherNet/IP specifications
Input (PLC → AX)	Instruction code	Output command 1	Input data byte 20 to 23
	Write data	Output command 2	Input data byte 24 to 27
	Data specification	Output command 3	Input data byte 28 to 31
	Instruction code execution request	Output signal 2 - bit 1	Input data byte 4 - bit 1
Output (AX → PLC)	Instruction code execution completion	Input signal 2 - bit 1	Output data byte 4 - bit 1
	Read data	Input command 2	Output data byte 24 to 27
	Response code	Input command 1	Output data byte 20 to 23

■ Write instruction code

<Timing Chart for Write Instruction Code Execution>

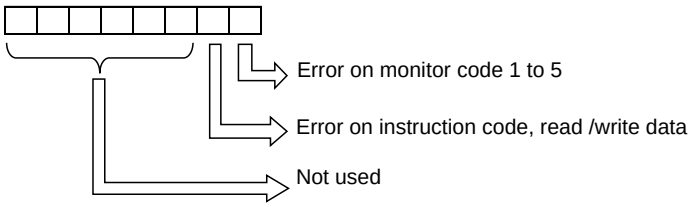


Set the write instruction code to the instruction code, and set data to write to the write data and as necessary, to the data specification.
Then, the data specified with the instruction code is written when the instruction code execution request is ON.
All data is in hexadecimal. This is when the instruction code execution completion becomes ON after data has been written.
When an instruction code that is not included in the specification is set to the instruction code, the error code (□□□□□□1□) is set to the response code. If data is attempted to be written in a parameter that cannot be set in the parameter setting, the error code (□□□□□□2□) is set. The error code (□□□□□□3□) is also set if a value outside the setting range is attempted to be written. In addition, the error code (□□□□□□4□) is set if the write instruction code is executed during the processing of a communications command input in CN1.
Turn OFF the instruction code execution request after the instruction code execution completion has been ON.

4.7.8. Response Code

If the monitor code or the instruction code is outside the setting range, an error code is set to the response code.
If it is normal, “00” is set.

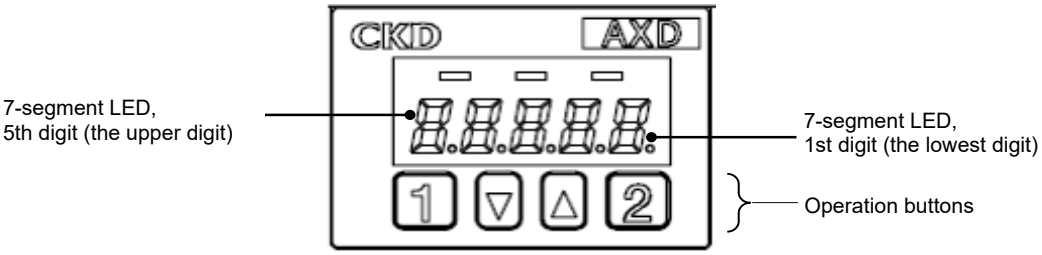
<Descriptions of Response Code Error>



4.8. Operation panel

Use the operation panel to display the driver status and adjust the gain.

<Appearance of Operation Panel>



4.8.1. 7-Segment LED

<Display List>

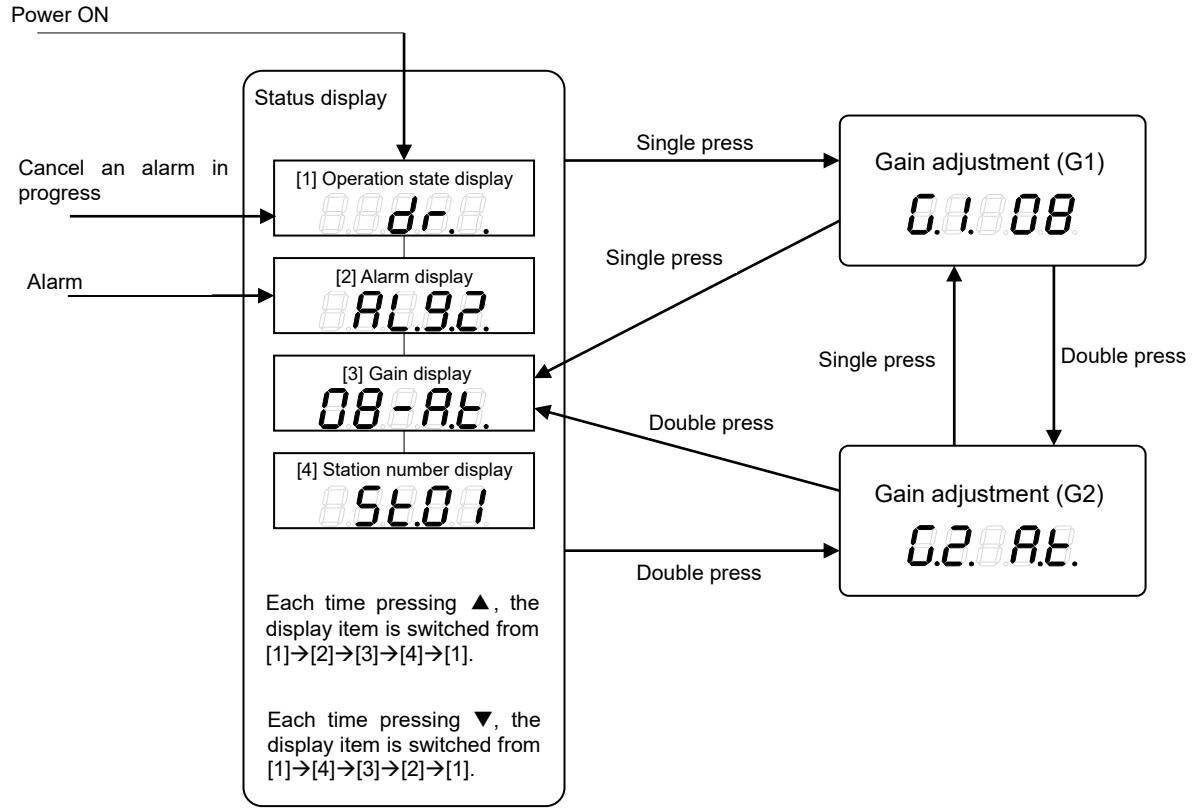
Operation mode	Display item	Display contents	Display example
Status display	Operation state indication	The operation mode is indicated by “dr.” and a number (dotted). When servo is OFF, it shows “dr...”	dr.1. dr...
	Alarm display	Alarm in progress is indicated by “AL.” and numbers (with dots). When an alarm is not generated, it is indicated by “AL....”	AL.92. AL....
	Gain display	Gain G1 and G2 are indicated by “-” and numbers (without dots). When the value of G2 is -1, it is indicated by “A.t..”	08-00 08-A.t.
	Station number display	A station number and an IP address are indicated by “St.” and numbers (without dots).	St.01
Gain adjustment (G1)	G1	The value of G1 is indicated by “G.1.” and numbers (without dots).	G.1.08
Gain adjustment (G2)	G2	The value of G2 is indicated by “G.2.” and numbers (without dots). When the value of G2 is -1, it is indicated by “A.t..”	G.2.A.t.

4.8.2. Operation Buttons

<Function List>

Button	Operation mode	Description
▲	**Status display**	Displays the next item
	Gain adjustment (G1)	Writes the value of G1 (PRM121) plus 1
	Gain adjustment (G2)	Writes the value of G2 (PRM122) plus 1
▼	**Status display**	Displays the previous item
	Gain adjustment (G1)	Writes the value of G1 (PRM121) minus 1.
	Gain adjustment (G2)	Writes the value of G2 (PRM122) minus 1.
1	**Status display**	Shifts to the operation mode of Gain Adjustment (G1)
	Gain adjustment (G1)	Shifts to the gain display of status display.
	Gain adjustment (G2)	Shifts to the operation mode of Gain Adjustment (G1)
2	**Status display**	Shifts to the operation mode of Gain Adjustment (G2)
	Gain adjustment (G1)	Shifts to the operation mode of Gain Adjustment (G2)
	Gain adjustment (G2)	Shifts to the gain display of status display.

<Transition of Display Status>

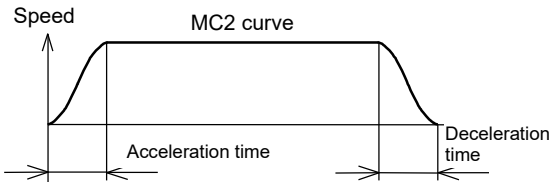


5. PARAMETER SETTING

Various parameters are available for ABSODEX to set motion conditions.
* Before executing [Parameter Setting], be sure to execute the [Load (ABSODEX)] command to load parameters saved in the driver into the editing work.

5.1. Parameters and Contents

<Parameter List (1/13)>

<table>
<tr><th>PRM No.</th><th colspan="2">Description</th><th>Setting Range</th><th>Initial Value</th><th>Unit</th><th>G79 Setting</th></tr>
<tr><td rowspan="2">1</td><td colspan="2">Cam curve</td><td>1 to 5</td><td>1</td><td>-</td><td>Feasible</td></tr>
<tr><td colspan="6">Selects a cam curve.
1 to 5 corresponds to the following curves.
1:MS,2:MC,3:MT,4:TR,5:MC2
For details, refer to “5.2.Types and Characteristics of Cam Curve.”</td></tr>
<tr><td rowspan="2">2</td><td colspan="2">Acceleration and deceleration time of MC 2 curve</td><td>0.01 to 50.0</td><td>1.0</td><td>sec</td><td>Feasible</td></tr>
<tr><td colspan="6">Sets acceleration and deceleration times of MC2 curve.
 

Acceleration and deceleration zones will form the characteristics of MS curve.
Acceleration and deceleration times cannot be set separately.
For details, refer to “5.2.Types and Characteristics of Cam Curve.”</td></tr>
<tr><td rowspan="3">3</td><td rowspan="2">Home position offset amount</td><td>Resolution setting 540,672 P/rev</td><td>-540,672 to 540,671</td><td>0</td><td>Pulse</td><td>Not feasible</td></tr>
<tr><td>Resolution setting 2,097,152 P/rev</td><td>-1,048,576 to ～1,048,575</td><td>0</td><td>Pulse</td><td>Not feasible</td></tr>
<tr><td colspan="6">Shift the user coordinate system home position when the power is turned on for the actuator home position.
After entering, turn the power off then on again or execute home positioning to validate the setting.
For details, refer to “5.3.Amount of Home Position Offset and Home Positioning Motion.”</td></tr>
<tr><td rowspan="2">4</td><td colspan="2">Home positioning direction</td><td>1 to 3</td><td>1</td><td>-</td><td>Feasible</td></tr>
<tr><td colspan="6">Selects the direction of rotation of the home positioning action.
1: CW, 2: CCW, 3: Shortest route</td></tr>
<tr><td rowspan="2">5</td><td colspan="2">Home positioning speed</td><td>1 to 20</td><td>2.0</td><td>rpm</td><td>Feasible</td></tr>
<tr><td colspan="6">Sets the maximum home positioning speed.
Communication code “S4,” home positioning instruction input, and NC code “G28” will enable home positioning.</td></tr>
</table>

<Parameter List (2/13)>

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
6	Acceleration and deceleration time for home positioning	0.1 to 2.0	1.0	sec	Feasible
	Sets acceleration and deceleration times for home positioning. Acceleration and deceleration take place in accordance with the curve.				
7	Home return stop	1 to 2	2	-	Feasible
	Determines if the home return is to be made by “stop” input. 1: Stop, 2: Invalid Select “1: Stop” to stop the action according to communication code “S2” or “S20” or the program stop input or continuous rotation stop input signal. The user coordinate after the stop is corrected to between -180° and 179.999°. No positioning completion output (CN3-42) is issued after the stop.				
8	Software limit coordinate A (+ direction)	-99,999,998 to 99,999,999	99,999,999	Pulse	Not feasible
	Sets the motion range in the (+) direction. For details, refer to “5.4.Precautions for Software Limit.”				
9	Software limit coordinate B (- direction)	-99,999,999 to 99,999,998	-99,999,999	Pulse	Not feasible
	Sets the motion range in the (-) direction. For details, refer to “5.4.Precautions for Software Limit.”				
10	Software limit effective or not effective	1 to 2	2	-	Feasible
	1: Effective, 2: Not effective Even with 2: Not effective, alarm will be given if the range -99,999,999 to +99,999,999 (pulse) is exceeded. When the resolution setting is 540,672 P/rev, (pulse) range: ±184 revolutions When the resolution setting is 2,097,152 P/rev, (pulse) range:±47 revolutions For details, refer to “5.4.Precautions for Software Limit.”				
11	No answer time	1 to 100 999	999	sec	Feasible
	Sets the answer input waiting time. Alarm is given, if there is no answer for the set time. Effective only when PRM12 and 13 are set to 1: Required. When 999 is set, waiting is infinite.				
12	M answer setting	1 to 2	2	-	Feasible
	1: Required: Answer input will turn M code output OFF. 2: Not Required: M code output is made at 100 msec.				

<Parameter List (3/13)>

PRM No.	Description		Setting Range	Initial Value	Unit	G79 Setting
13	Answer input for positioning and home position return		1 to 2	2	-	Feasible
	1: Required: Answer input will turn positioning completion output OFF. 2: Not required: Positioning completion output is made at 100 msec. The output time can be changed with PRM47 (output time of positioning completion signal).					
14	Jog speed		0.01 to 100	2.0	rpm	Not feasible
	Sets the maximum jog motion speed.					
15	Jog acceleration and deceleration times		0.1 to 2.0	1.0	sec	Not feasible
	Sets acceleration and deceleration times.					
16	In-position range	**Resolution setting 540,672 P/rev**	1 to 10,000	2,000 (1.332°)	Pulse	Feasible
		Resolution setting 2,097,152 P/rev	1 to 40,000	8,000 (1.373°)	Pulse	Feasible
	Sets allowable accuracy of positioning. For details, refer to “5.5.Judgment of In-position,” “5.6.Judgment of Positioning Completion,” and “5.7.Correct Setting Of PRM16 (In-Position Range).”					
17	In-position sampling times		1 to 2,000	1	Time	Feasible
	Sets numbers of confirmation times when at in-position. Confirming in-position for specified sampling times will output positioning completion and in-position signals. Whether within the range or not can be confirmed at every 1 msec. This is also used to judge positioning completion output (CN3-42). For details, refer to “5.5.Judgment of In-position,” “5.6.Judgment of Positioning Completion,” and “5.7.Correct Setting Of PRM16 (In-Position Range).”					
18	Position deviation amount		Setting not feasible	-	Pulse	Not feasible
	Indicates the current position deviation amount.					
19 Note 1	Upper limit for position deviation amount	**Resolution setting 540,672 P/rev**	1 to 540,672	4,000 (2.664°)	Pulse	Feasible
		Resolution setting 2,097,152 P/rev	1 to 2,097,152	16,000 (2.747°)	Pulse	Feasible
	PRM18 exceeding this value will cause Alarm 1.					

Note 1: If the setting of PRM19, 20 or 39 is too small, alarm 1 may be caused and the actuator may not be activated.

<Parameter List (4/13)><Parameter List (4/13)>

PRM No.	Description			Setting Range	Initial Value	Unit	G79 Setting
20 **Note 1** **Note 2**	Speed over limit	**Resolution setting** **540,672 P/rev**	AX2R-006 AX2R-012 AX2R-018	1~5,947	5,947 Note) (about 330 rpm)	Pulse	Not feasible
			AX1R-022 AX1R-045 AX4R-009 AX4R-022 AX4R-045	1 to 4,886	4,866 Note) (about 270 rpm)		
			AX1R-075 AX4R-075	1 to 2,883	2,883 Note) (about 160 rpm)		
			AX1R-150 AX1R-210	1~2,552	2,522 Note) (about 140 rpm)		
			AX4R-150 AX4R-300	1 to 1,982	1,982 Note) (about 110 rpm)		
			AX4R-500	1 to 1,441	1,441 Note) (about 80 rpm)		
			AX4R-10W	1 to 630	630 Note) (about 35 rpm)		
		Resolution setting **2,097,152 P/rev**	AX2R-006 AX2R-012 AX2R-018 AX1R-022 AX1R-045 AX1R-075 AX4R-009 AX4R-022 AX4R-045 AX4R-075	1 to 11,184	11,184 Note) (about 160 rpm)		
			AX1R-150 AX1R-210	1~9,786	9,786 Note) (about 140 rpm)		
			AX4R-150 AX4R-300	1 to 7,689	7,689 Note) (about 110 rpm)		
			AX4R-500	1 to 5,592	5,592 Note) (about 80 rpm)		
			AX4R-10W	1 to 2,446	2,446 Note) (about 35 rpm)		

	When the resolution setting is 540,672 P/rev 540,672 : 1 full revolution pulse When the resolution setting is 2,097,152 P/rev 2,097,152 : 1 full revolution pulse The motion amount [pulse] exceeding the set value for every 2 msec will cause Alarm 1. Note 1 The rotation speed N [rpm] with the per-2 msec motion amount P [pulses] is: N = per-1 msec motion amount (pulses) / 1 full revolution pulse =30,000P/2,097,152 ≈ 0.0143P [rpm] ... Note) Initial value for Speed over limit indicates the RAM set value the driver refers to during operation. If the set value stored in the parameter (flash memory) is one of the initial values of the actuators, the initial value of the actuator connected to the driver becomes the RAM set value when the power is turned on. If the driver is initialized after connecting the actuator, the initial value that corresponds to that actuator is stored in the flash memory. If the set value stored in the parameter (flash memory) is not one of the initial values of the actuators, the driver will operate with the set parameter regardless of the connected actuator. Whenever a different actuator is connected, always initialize the driver.

Note 1: If the setting of PRM19, 20 or 39 is too small, alarm 1 may be caused and the actuator may not be activated.

Note 2: If parameter settings are edited without loading them, parameter settings are reset to the default values held in the AX-Tools. Be sure to load parameters before editing parameter settings.

<Parameter List (5/13)>

<table>
<tr><th>PRM No.</th><th colspan="2">Description</th><th>Setting Range</th><th>Initial Value</th><th>Unit</th><th>G79 Setting</th></tr>
<tr><td rowspan="3">21
Note 1</td><td rowspan="2">Deceleration rate for forced stop</td><td>Resolution setting
540,672 P/rev</td><td>1 to 180
999</td><td>999</td><td>Pulse/msec^2</td><td>Feasible</td></tr>
<tr><td>Resolution setting
2,097,152 P/rev</td><td>1 to 698
999</td><td>999</td><td>Pulse/msec^2</td><td>Feasible</td></tr>
<tr><td colspan="6">When the resolution setting is 540,672 P/rev
Speed deceleration will take place for every 1 msec for a forced stop.
The time t until rotation stops by a forced stop while rotating at N rpm can be calculated by the following formula:
t = 1 * 540,672 / 60 / 1,000 * N / PRM21
≈ 9.0112 * N / PRM21 [msec].
The inertia torque Ti with inertia moment J [kg·m^2] can be calculated by the following formula:
Ti = 2π * 10^6 / 540,672 / 1 * J * PRM21
≈ 11.62 * J * PRM21 [N·m].
Enter PRM21 so that Ti does not exceed the maximum torque limit of the actuator.

When the resolution setting is 2,097,152 P/rev
Speed deceleration will take place for every 1 msec for a forced stop.
The time t until rotation stops by a forced stop while rotating at N rpm can be calculated by the following formula:
t = 1 * 2,097,152 / 60 / 1,000 * N / PRM21
≈ 34.953 * N / PRM21 [msec].
The inertia torque Ti with inertia moment J [kg·m^2] can be calculated by the following formula:
Ti = 2π * 10^6 / 2,097,152 / 1 * J * PRM21
≈ 2.996 * J * PRM21 [N·m].
Enter PRM21 so that Ti does not exceed the maximum torque limit of the actuator.

If the initial value (999) is used, the actuator decelerates by applying its own maximum torque.
To set an arbitrary time for “t” (the time it takes to stop rotating), change this parameter.</td></tr>
</table>

Note 1: If parameter settings are edited without loading them, parameter settings are reset to the default values held in the AX-Tools. Be sure to load parameters before editing parameter settings.

<Parameter List (6/13)>

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
22	Delay time for forced stop servo-off	0 to 2,000	1,000	msec	Feasible
	Sets delay time for servo-off by forced stop (CN3-17) input causing deceleration and stop when PRM23 is set to 3 (servo-off after stop).				
23 Note 2	Forced stop input	1 to 3	3	-	Not feasible
	1: Maintain servo-on state after stop 2: Not effective 3: Servo-off after stop				
24 Note 1	Load factor	Setting not feasible	-	%	Not feasible
	Load factor calculated by the driver.				
25 Note 1	Upper limit of load factor	Setting not feasible	100	%	Not feasible
	PRM24 exceeding the set temperature will cause the alarm 4.				
27 Note 2	Delay time after brake output	0 to 1,000	100	msec	Feasible
	Motion to be delayed when motion instruction after brake release is specified by M69.	AX1R Series AX2R Series AX4R-009 AX4R-022 AX4R-045	100		
		AX4R-075 AX4R-150 AX4R-300 AX4R-500 AX4R-10W	250		
28	Brake initial status				
	Sets whether or not the brake is released upon power-on. 1: Brake on, 2: Release	1 to 2	2	-	Not feasible
29	Mode setting for power-on				
	1: Auto run mode 2: Single block mode 6: Pulse string input mode 7: Network operation mode The network operation mode is enabled only for a driver that supports the serial communications option.	1,2,6,7	1	-	Not feasible

Note 1: For monitoring only in the parameter mode. Parameter setting cannot be done.
Note 2: If parameter settings are edited without loading them, parameter settings are reset to the default values held in the AX-Tools. Be sure to load parameters before editing parameter settings.

<Parameter List (7/13)>

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
33	Output 1 during indexing	0 to 99	0	%	Feasible
	Enables to set the output 1 (CN3-46) to be made at what percentage of motion during positioning motion. 0% setting for no output. The output is not issued upon entry of home return (CN3-12) or NC code G28.				
34	Output 2 during indexing	0 to 99	0	%	Feasible
	Enables to set the output 2 (CN3-46) to be made at what percentage of motion during positioning motion. 0% setting for no output. The output is not issued upon entry of home return (CN3-12) or NC code G28.				
35	Pulse rate change	1 to 5	1	-	Feasible
	Enables to set multiplier of pulses in the G72 and M6 pulse string input modes. 1: 1 time, 2: 2 times, 3: 4 times, 4: 8 times, 5: 16 times The setting enables to determine pulses of actuator movement for 1 pulse of pulse string input.				
36	Selection switching of I/O program numbers	1 to 5	1	-	Feasible
	Enables to select program numbers: 1: 4 bit 2 times (BCD) Note 1 (No. range 0 to 99) 2: 4 bit 2 times (Binary) (No. range 0 to 255) 3: 5 bit 1 time (Binary) (No. range 0 to 31) 4: 6 bit Selection with Start (binary, program number is not set after forced stop) (No. range 0 to 63) 5: 6 bit Selection with Start (binary, program number is set after forced stop) (No. range 0 to 63)				
37	Segment position range width for equal segment designation — **Resolution setting 540,672 P/rev**	1 to 270,336	1,500 (about 1.0°)	Pulse	Feasible
	Segment position range width for equal segment designation — **Resolution setting 2,097,152 P/rev**	1 to 1,048,576	6,000 (about 1.0°)	Pulse	Feasible
	Sets the vicinity of segment position of equal segment (G101). For details, refer to “5.8.G101 (Equal Segment Designation) and Parameter.”				
38	Rotation direction for equal segment designation	1 to 4	3	-	Feasible
	Specifies rotation direction for G91A0F□□ of equal segment designation (G101). 1:CW 2:CCW 3: Nearer head direction 4: Alarm C outside the vicinity of equal segment position For details, refer to “5.8.G101 (Equal Segment Designation) and Parameter.”				
39 Note 2	Torque limit	1 to 100	100	%	Feasible
	Enables to set the upper limit of torque output by percentage against the maximum torque.				

Note 1: When 1: 4 bit BCD (binary coded decimal) is selected, enter a bit signal (0: 0000 to 9: 1001). If a bit signal outside the above range is entered, an unexpected program No. is selected and malfunction may be caused.

Note 2: If the setting of PRM19, 20 or 39 is too small, alarm 1 may be caused and the actuator may not be activated.

<Parameter List (8/13)>

PRM No.	Description		Setting Range	Initial Value	Unit	G79 Setting
42	Pulse string input		1 to 4	1	-	Not feasible
	1: Pulse/Direction 2: Forward rotation/Reverse rotation 3: A/B phase 4 times 4: A/B phase 2 times					
45 **Note 1**	Power-on coordinate recognition range	**Resolution setting 540,672 P/rev**	0 to 540,671	270,335	Pulse	Not feasible
		Resolution setting 2,097,152 P/rev	0 to 2,097,151	1,048,575	Pulse	Not feasible
	Specify the power-on coordinate recognition range. The output axis at power-on is supposed to be located in the range of when the resolution setting is 540,672 P/rev (the setting - 540,671 to the setting), or when the resolution setting is 2,097,152 P/rev (the setting - 2,097,151 to the setting).					
46	Home position output range	**Resolution setting 540,672 P/rev**	0 to 10,000	2,000	Pulse	Not feasible
		Resolution setting 2,097,152 P/rev	0 to 40,000	8,000	Pulse	Not feasible
	Enter the output range of the home position output When the resolution setting is 540,672 P/rev With default value 2,000, the home position output ±2,000 pulses before and after the user home position remains turned on. Enter “0” to turn on the home position output at exactly 0 pulse in the user coordinate. When the resolution setting is 2,097,152 P/rev With default value 8,000, the home position output ±8,000 pulses before and after the user home position remains turned on. Enter “0” to turn on the home position output at exactly 0 pulse in the user coordinate.					
47	Positioning completion output time		0 to 1,000	100	msec	Not feasible
	Specify the interval in which the positioning completion output is issued.					
48	Controlled stop upon alarm		1 to 2	2	-	Not feasible
	Select whether the controlled stop function is validated or invalidated upon an alarm. 1: Effective, 2: Not effective					

Note 1: Avoid using the parameter together with G07, G90.1, G90.2, G90.3, G91.1, G92, G92.1 or other codes that resets the coordinate system.
For details, refer to “10.APPLICATION EXAMPLES.”

<Parameter List (9/13)>

PRM No.	Description		Setting Range	Initial Value	Unit	G79 Setting
50 **Note 1**	Encoder output resolution	**Resolution setting 540,672 P/rev**	0 to 135,168	135,168	pulse/rev	Not feasible
		Resolution setting 2,097,152 P/rev	0 to 524,288	524,288	pulse/rev	Not feasible
	Specify the resolution of encoder output. Enter the number of output pulses of the pulse string output signal. When the resolution setting is 540,672 P/rev The A-/B-phase output pulse of the driver counted in four multiples is 4 to 540,672 pulses/rev. When the resolution setting is 2,097,152 P/rev The A-/B-phase output pulse of the driver counted in four multiples is 4 to 2,097,152 pulses/rev. After entering, turn the power off then on again to validate the setting.					
51 **Note 1**	In-position signal output mode		0 to 1	0	-	Not feasible
	Select the in-position signal output mode. 0: Output even during rotation (Output if the position deviation is within the in-position range.) 1: Do not output during rotation (Output if the position deviation is within the in-position range and if the position command is “0.”) After entering, turn the power off then on again to validate the setting.					

Note 1: Avoid using the parameter together with G07, G90.1, G90.2, G90.3, G91.1, G92, G92.1 or other codes that resets the coordinate system.
For details, refer to “10.APPLICATION EXAMPLES.”

<Parameter List (10/13)>

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
52	Function selection of I/O input signal CN3-14 (bit 9)	0 to 1	0	-	Not feasible
	DI_9 0: Servo-on input 1: Program stop input After entering, turn the power off then on again to validate the setting.				
53	Function selection of I/O input signal CN3-15 (bit 10)	0 to 1	0	-	Not feasible
	DI_10 0: Ready return input 1: Continuous rotation stop input After entering, turn the power off then on again to validate the setting.				
54	Function selection of I/O input signal CN3-16 (bit 11)	0 to 1	0	-	Not feasible
	DO_11 0: Answer input 1: Position deviation counter reset input After entering, turn the power off then on again to validate the setting.				
56	Function selection of I/O output signal CN3-46 (bit 13)	0 to 1	0	-	Not feasible
	DO_13 0: Output 1 during indexing 1: Home position output After entering, turn the power off then on again to validate the setting.				
57	Function selection of I/O output signal CN3-47 (bit 14)	0 to 1	0	-	Not feasible
	DO_14 0: Output 2 during indexing 1: Servo state output After entering, turn the power off then on again to validate the setting.				

<Parameter List (11/13)>

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
62 Note 1	Cut-off frequency for low pass filter 1	10 to 1,000	200	Hz	Feasible
		AX1R Series AX2R Series AX4R-009 AX4R-022 AX4R-045			
		AX4R-075 AX4R-150 AX4R-300 AX4R-500 AX4R-10W	100		
63 Note 1	Cut-off frequency for low pass filter 2	10 to 1,000	500	Hz	Feasible
64 Note 1	Cut-off frequency for notch filter 1	10 to 1,000	500	Hz	Feasible
65 Note 1	Cut-off frequency for notch filter 2	10 to 1,000	500	Hz	Feasible
66 Note 1	Filter switch	0 to 15	1	-	Feasible
	Switches to determine if filters are used. For details, refer to “5.9.Using Filters.”				
70 Note 1	Q value of notch filter 1	0.1 to 9.9	1	-	Feasible
	Sets the band width of notch filter 1.				
71 Note 1	Q value of notch filter 2	0.1 to 9.9	1	-	Feasible
	Sets the band width of notch filter 2.				

Note 1: Cannot be set in the parameter mode of the AX-Tools.
Use the “anti-vibration filter adjustment function” to enter this parameter.

<Parameter List (12/13)>

PRM No.	Description		Setting Range	Initial Value	Unit	G79 Setting
80 **Note 1**	Integral gain		0.0 to 65,536.0	0.0	-	Not feasible
	The integral gain of the result of auto tuning is stored.					
81 **Note 1**	Proportional gain		0.0 to 65,536.0	0.0	-	Not feasible
	The proportional gain of the result of auto tuning is stored.					
82 **Note 1**	Differential gain		0.0 to 65,536.0	0.0	-	Not feasible
	The differential gain of the result of auto tuning is stored.					
83 **Note 1**	Auto tuning command		0 to 1	0	-	Not feasible
	In the servo-off mode, write “1” in this parameter to execute auto tuning. Default value “0” indicates no execution of auto tuning.					
87 **Note 1**	Auto tuning torque		0 to 8,192	1,000	-	Not feasible
	Designate the torque of auto tuning action. If the friction load is too large to cause alarm U, increase the parameter in 100 increments.					
88 **Note 1**	Auto tuning measurement starting speed	**Resolution setting 540,672 P/rev**	0 to 1,000	100 (About 11 rpm)	Pulse/ms	Not feasible
		Resolution setting 2,097,152 P/rev	0 to 4,000	400 (About 11 rpm)	Pulse/ms	Not feasible
	Auto tuning data collection starting speed. Do not change the setting in regular cases.					
89 **Note 1**	Auto tuning measurement termination speed	**Resolution setting 540,672 P/rev**	0 to 1,000	700 (about 80 rpm)	Pulse/ms	Not feasible
		Resolution setting 2,097,152 P/rev	0 to 4,000	2,800 (about 80 rpm)	Pulse/ms	Not feasible
	Auto tuning data collection termination speed. Do not change the setting in regular cases. When the resolution is set to 540,672 P/rev, do not set it to 200 or less. When the resolution is set to 2,097,152 P/rev, do not set it to 800 or less.					

Note 1: Cannot be set in the parameter mode of the AX-Tools.
Use the “gain adjustment function” to enter or monitor this parameter.
Record PRM80 to 82 because they may become necessary if the equipment is assembled but auto tuning fails due to interference of jigs or presence of a stopper. They are helpful if parameters are lost due to an error in the NC program or initialization of parameters.
Before writing PRM80 to 82, turn the servo off (M5).

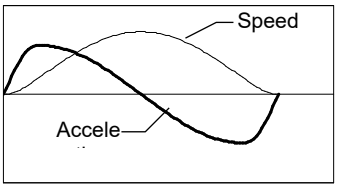
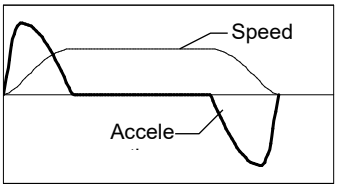
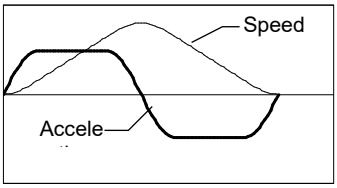
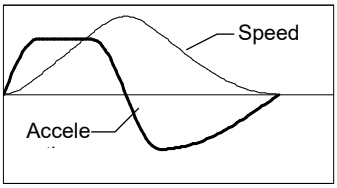
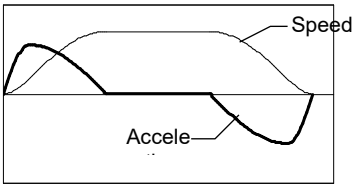
<Parameter List (13/13)>

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
106	Regenerative resistor value	0.1 to 1,000.0	40.0	-	Not feasible
	Set a resistance value [Ω] of the regenerative resistor. Set it to 40 when an optional regenerative resistor is used.				
107	Regeneration capacity	0.0 to 1,000.0	0.0	-	Not feasible
	Set a resistor capacity [W] of the regenerative resistor. Set it to 0, in case of no regenerative resistor. Set it to 120 when an optional regenerative resistor is used.				
120	Entering of inertia value	0.0 to 2,048.0	0.0	kg/m^2	Feasible
	Set an inertia load for the actuator. When the auto tuning runs, the estimated result of load inertia is stored in this parameter. It is enabled only when PRM122 is set to -1.				
121	G1 gain (responsiveness)	0 to 31	8	-	Feasible
	This gain adjusts convergence time.				
122	G2 gain (load inertia moment)	-1 to 15	-1	-	Feasible
	This gain is adjusted in accordance with the load.				
123	Integral limiter	0.001~1.000	1.000	-	Feasible
	Integral limiter in the controller. A value smaller than 1 reduces the undershoot immediately before stoppage and shorten the settling time. The best integration limiter setting varies according to gain adjustment. For details, refer to “5.14. Integral Limiter.”				

5.2. Types and Characteristics of Cam Curve

With ABSODEX, an arbitrary cam curve can be selected with the setting of PRM1.

<Cam Curve List>

Name	Explanation	Acceleration and Speed Curves
MS	Modified sine curve (MS) The modified sine curve is a cycloid curve (sine curve) with the acceleration peak shifted forth or back (modified). It is widely used because each motion characteristic is relatively small and it is well balanced. We use this curve as a standard curve.	
MC	Modified constant velocity (MC) The modified constant velocity curve has a constant speed part in the middle of the travel. While the motion characteristic is inferior to that of the MS curve, this curve is frequently used to transfer the workpiece in the middle of a travel or if a constant-velocity travel of the workpiece is needed. We call this curve “MC curve” while it is generally called MCV50 curve. The number (“50”) in “MCV50” indicates the ratio of the time of travel of the output axis at the constant speed, and “MCV50” indicates that 50 percent of the total traveling time is the constant velocity movement.	
MT	Modified trapezoid curve (MT) The modified trapezoid curve has a smaller maximum acceleration and it is suitable for high speeds. However, characteristics values other than the acceleration are not good, and the balance of the curve is inferior to that of the MC curve in total view, so that the MT curve is hardly used unless for special purposes.	
TR	Trapecloid curve (TR) This curve is used to reduce the remaining vibration in the settling cycle. Though vibration is small enough with other curves, vibration may become a large problem at high speeds or under severe conditions. In such a case, this curve can suppress the remaining vibration because the vibration absorbing force is large. However, the acceleration is larger and a larger torque becomes necessary.	
MC2	Modified constant velocity 2 (MC2) With this curve, the acceleration/deceleration of the MC curve can be arbitrarily entered.	

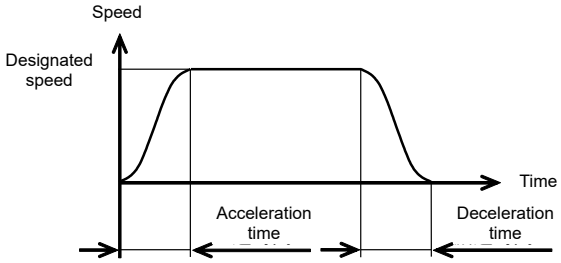
While various other cam curves have been considered, the MS curve is most widely used now. This is because the requirement for general purpose indexing applications is a well-balanced curve in the first place because it is used for every purpose.
Accordingly the MS curve, which features a good balance, is adopted as a standard curve by most indexing unit manufacturers.
For this reason, the standard MS curve is expected to cause the least problem in most cases when a cam curve is selected.

■ Speed Pattern of Cam Curve MC2

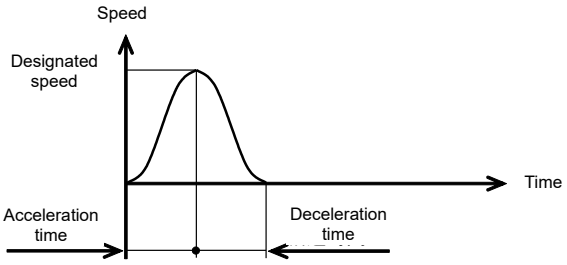
If the rotation speed is designated as a unit of “F” in the NC program, using G10, the speed pattern changes according to the angle of travel as shown below.

<Speed Pattern of MC2>

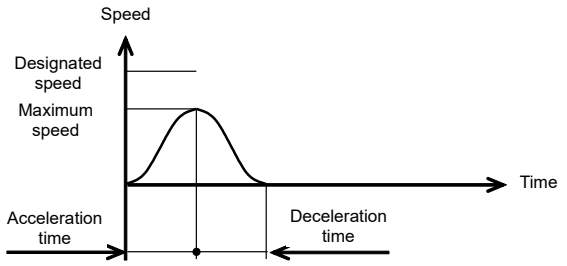
If the traveling time determined by the angle of travel and designated speed is longer than the sum of the acceleration time and deceleration time, a constant velocity interval is added in the speed pattern.



If the traveling time determined by the angle of travel and designated speed is equal to the sum of the acceleration time and deceleration time, the constant velocity interval is eliminated.
This curve is equivalent to the MS curve where the designated speed is the maximum speed.



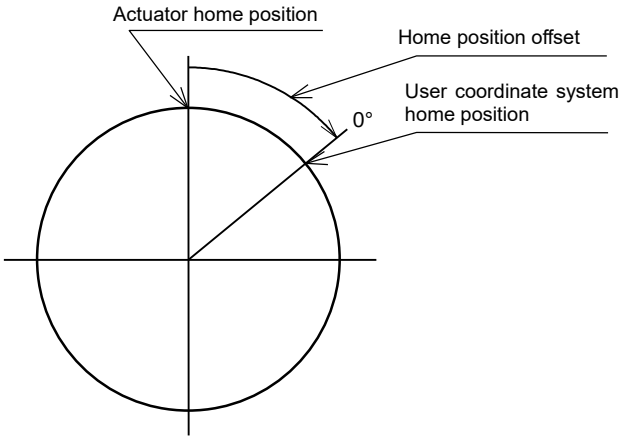
Further, if the traveling time is shorter than the sum of the acceleration time and deceleration time, the traveling time is corrected to the sum of the acceleration time and deceleration time, and the maximum speed is reduced.
The acceleration time and deceleration time are specified in PRM2.



5.3. Amount of Home Position Offset and Home Positioning Motion

ABSODEX with an absolute type position detector has one home position in one rotation, which is called an actuator home position.
The home position of the coordinate system which NC programs refers to is called the user coordinate system home position.
The amount of shifts to the user coordinate system from the actuator home position home position is PRM3 (home position offset amount).

<Amount of Home Position Offset & Coordinate System Home Position>



Executing NC code like G92 enables to move the home position of the user coordinate system. For home positioning, the actuator rotates to the point (actuator home position + home position offset amount) in one direction to stop clearing the home position of the user coordinate system.
(The point after home positioning is home position of the user coordinate system.)

Home positioning can be done by either one of the following three methods, which all moves in the same manner:

1. Instruction through S4 USB port

2. Instruction during G28 NC programming

3. Instruction from an I/O port (Input signal 1 - bit 7 / input data byte 0 - bit 7) programmable logic controller

5.4. Precautions for Software Limit

Using PRM8 (software limit coordinate A), PRM9 (software limit coordinate B), and PRM10 (software limit effective/not effective), software limit can be set.
The following precautions should be taken for using software limit.

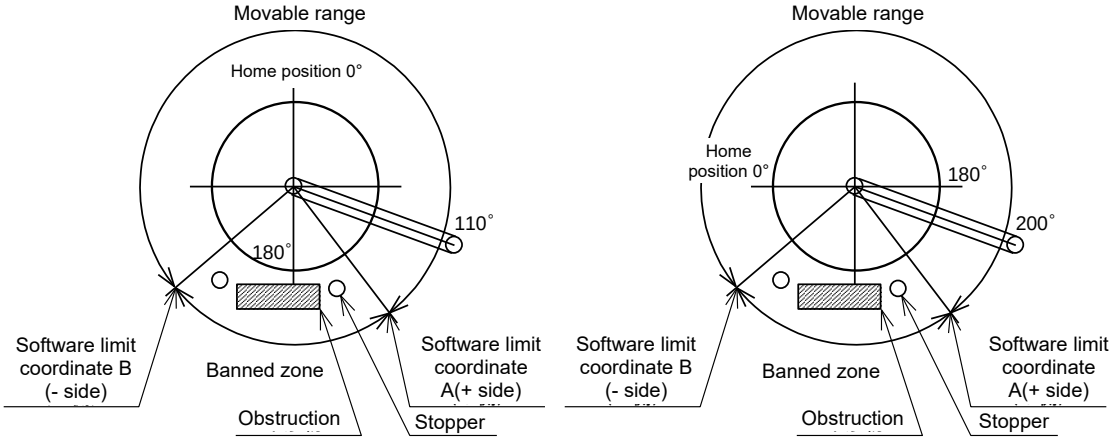
- The home positioning explained in “5.3.Amount of Home Position Offset and Home Positioning Motion” is made without referring to software limit. Consequently, even if the software limit specifies the motion banned zone, home positioning may be made through the banned zone.
  If software limit is to be set, when there is an obstruction within one rotation range, move the actuator directly by executing the program without giving home positioning command.

<Example>

O1G90A0F1M0;	moves to the home position in the coordinate system
N1A30F0.5M0;	moves to 30° position in 0.5 seconds
N2A-60F1M0;	moves to -60° position in 1 second
:	
J1;	jumps No. 1 block of sequence number.
M30;	End of program

- Upon power-on, ABSODEX assumes that the output axis is located in the range of -180.000° to +179.999°. (If the power is supplied in the 190° position, the -170° position is recognized.) Consequently, when there is an obstruction within one rotation range, set the software limit so that the 180° position is included in the motion banned zone.
  (The user coordinate system of G92 can be changed by the PRM3.)

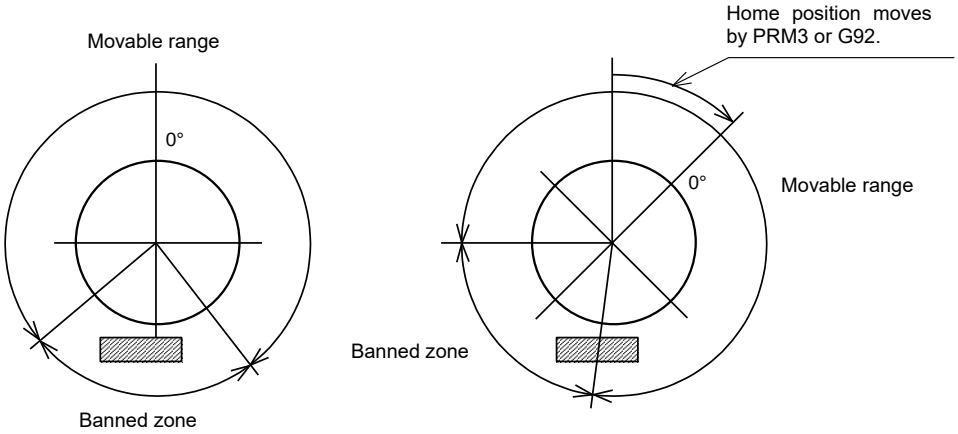
<Home Position & Software Limit>



The current position is recognized as at 110° upon re-power-on for the above figure (a), and as at -160° for the above figure (b). The motion to 0° in case of the above figure (a) causes counterclockwise rotation in home positioning, and the clockwise rotation passing the software limit banned zone and colliding with an obstruction in case of the above figure (b).

- Alarm will not occur even if the output axis angle of the ABSODEX is within the motion banned range at the time of power-on start. If the first motion instruction in such condition is to the permitted range, ABSODEX will operate normally.
  For (a) in “Home Position & Software Limit” of “5.4.Precautions for Software Limit,” if the power is turned on at the position where the arm is at the stopper, the first program to be executed, for example motion of “0” degrees, will allow the driver to operate the actuator without an alarm.
- Software limit is the coordinate of the G92 user coordinate system.
  Resetting the coordinate system with G92, software limit becomes effective to cause the absolute position in the motion banned range to be relocated.

<G92 & Software Limit>

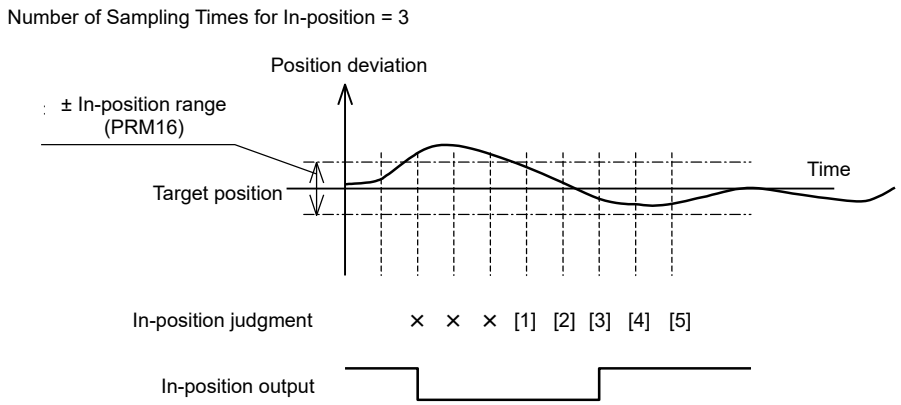


If G90.1, G90.2 or G90.3 is used, the software limit becomes invalid.

5.5. Judgment of In-position

When position deviation within ± in-position range is continuously confirmed after the specified number of sampling times, in-position output signal is output.
Judgment and output will be made during both moving and stop.
The signal may be always issued in some cases.
The following example is for the PRM17 (number of sampling times for in-position) = 3.

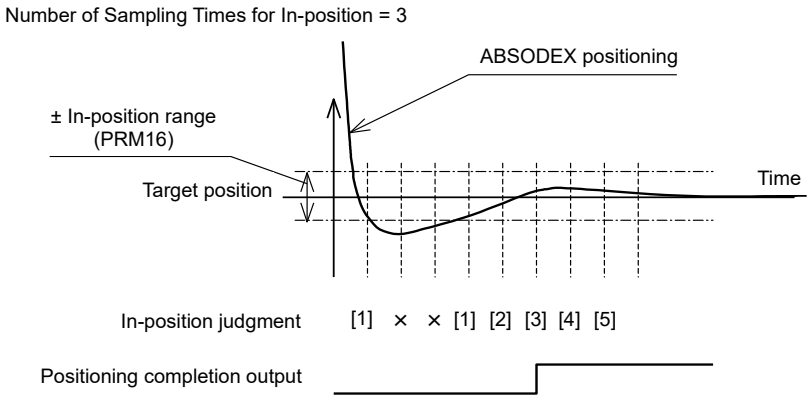
<In-position Output>



5.6. Judgment of Positioning Completion

This function enables judgment similar to that for in-position judgment, but only when the motion is completed.
Once motion is judged to be completed, judgment will not be made until the next motion instruction is completed.
The following example is for the PRM17=3.

<Positioning Completion Output>

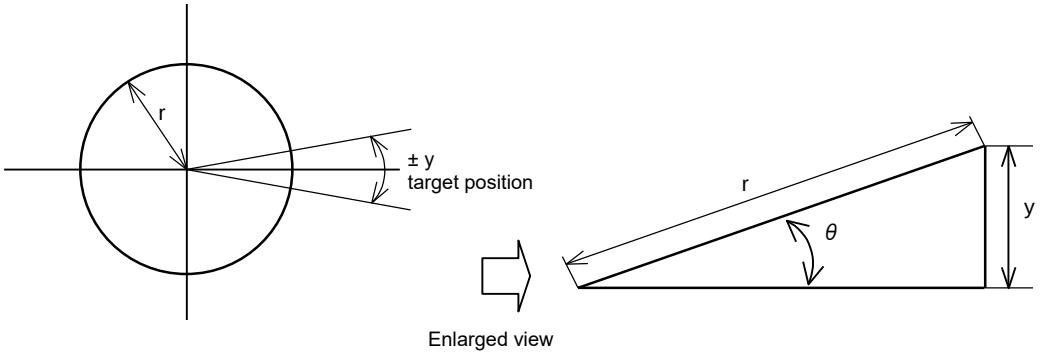


When the PRM13 (answer input for positioning and home positioning completion) is set to 1: Required, the output will be continued until answer signal (Input signal 1 - bit 11 / input data byte 1 - bit 3) is input.
The default setting for the PRM16 (in-position range) is 2,000 (pulses) when the resolution is set to 540,672 P/rev, and 8,000 (pulses) when the resolution is set to 2,097,152 P/rev. Change this setting as required.

5.7. Correct Setting Of PRM16 (In-Position Range)

The correct in-position range varies according to the positioning accuracy requirement.
The method for calculating the correct range is described below.

<Correct In-position Range>



- If a table having radius r is installed on the output axis of ABSODEX, the setting of in-position range P (pulses) for issuing the positioning completion signal in the ± y (mm) range to the target position on the circumference is:

  When the resolution setting is 540,672 P/rev

  θ: angle (rad). If the resolution of ABSODEX is 540,672 (pulses), arc y is small enough to be considered to be a line;

  therefore, $\sin\theta = y/r$ .....[1]

  Because θ is very small, the following equation is assumed:

  $\sin\theta \approx \theta$. .....[2]

  From [1],

  $\theta = y / r$ *.....[3]*

  Conversion of θ into pulse P leads to:

  $P = 540{,}672\,\theta / 2\pi$ .....[4]

  From [3] and [4],

  $P = 54{,}0672\,y / 2\pi r$ .....[5]

  $= 270{,}336\,y / \pi r$

  $\approx 86{,}051\,y / r$

When the resolution setting is 2,097,152 P/rev

θ: angle (rad). If the resolution of ABSODEX is 2,097,152 (pulses), arc y is small enough to be considered to be a line;

$\sin \theta = y / r$ ..... [1]

Because θ is very small, the following equation is assumed:

$\sin \theta \approx \theta$. ..... [2]

From [1] and [2],

$\theta = y / r$ ..... [3]

Conversion of θ into pulse P leads to:

$P = 2{,}097{,}152\ \theta / 2\pi$ ..... [4]

From [3] and [4],

$P = 2{,}097{,}152\ y / 2\pi r$ ..... [5]

$= 1{,}048{,}576\ y / \pi r$

$\approx 333{,}772\ y / r$

Hence, as shown in equation [5], deviation ±y (mm) on the circumference ($2\pi r$) is almost equal to deviation ±P (pulses) with ABSODEX.

- PRM17 (in-position sampling frequency) should be generally “3” at the most if the in-position range is set to 200 to 300 when the resolution setting is 540,672 P/rev, or 800 to 1,200 when the resolution setting is 2,097,152 P/rev.
  Because a sampling cycle is 1 msec, too many counts will cause a delay in the issuance of the positioning completion signal.
- Conversion between angle□(°) and pulse

  When the resolution setting is 540,672 P/rev
  a) To convert P (pulses) into α (°),
     $\alpha = 360P / 540{,}672$
  b) To convert α (°) into P (pulses),
     $P = 540{,}672\ \alpha / 360$

  When the resolution setting is 2,097,152 P/rev
  a) To convert P (pulses) into α (°),
     $\alpha = 360P / 2{,}097{,}152$
  b) To convert α (°) into P (pulses),
     $P = 2{,}097{,}152\ \alpha / 360$

5.8. G101 (Equal Segment Designation) and Parameter

Setting PRM37 (segment position range width for designation of equal segment) and PRM38 (rotation direction for designation of equal segment) for the equal segment designation (G101) program allows to specify rotation direction of the actuator at power-on start and motions after forced stop.
The following is the motion example for four segments (G101A4).

5.8.1. Motion of G91A0F□□ (in Case of A0 for Incremental Instruction)

■ PRM38=1 (CW direction)

When within [1] range for (a), “Equal Segment Designation (G101) & Parameter” of “5.8.G101 (Equal Segment Designation) and Parameter,” executing G101A4;G91A0F□□ will cause the actuator to move to 1H position.
(□□ is any value for specifying motion time or speed.)

■ PRM38=2 (CCW direction)

When within [2] range for (a), “Equal Segment Designation (G101) & Parameter” of “5.8.G101 (Equal Segment Designation) and Parameter,” executing G101A4;G91A0F□□ will cause the actuator to move to 1H position.

■ PRM38=3 (Nearer direction)

When within [3] range for the figure (b) below, executing G101A4;G91A0F□□ will cause the actuator to move to 1H position (nearest position). PRM37 will not influence motions.

■ If PRM38=4 (Alarm C is caused outside the vicinity of segment position)

If G101A4;G91A0F□□ is executed in the range specified [4] in the figure (a) below, a travel to position 3H occurs.
If the command is executed in range [5], alarm C is caused when G101A4 is executed.

5.8.2. Motion of G91A-1F□□ and G91A1F□□

■ PRM38=1 (CW direction), or 2 (CCW direction)

When within [1] range for the figure (a) below, executing G101A4;G91A-1F□□ will cause the actuator to move to 4H position.
When within [2] range, executing G101A4;G91A1F□□ will cause the actuator to move to 2H position.

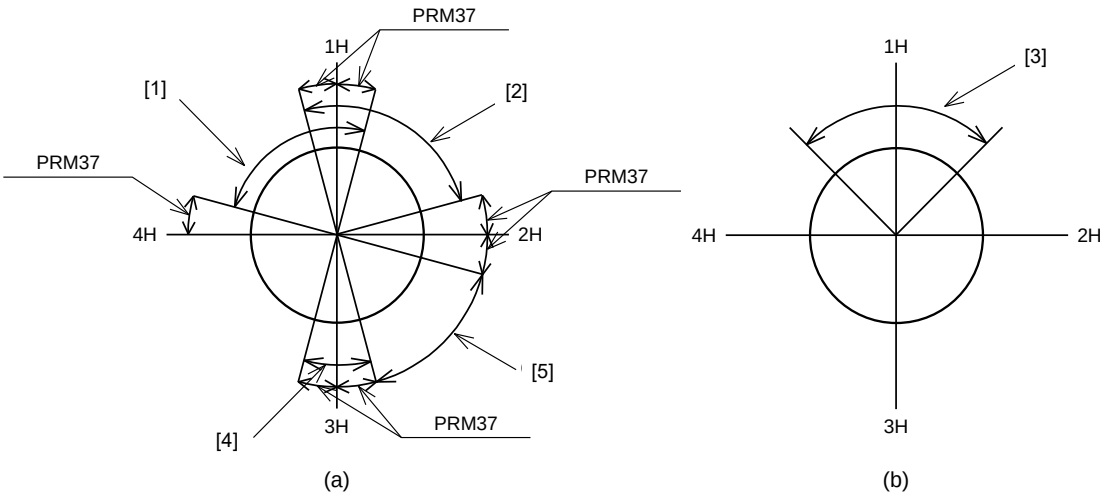
■ PRM38=3 (Nearer direction)

In this case, the actuator moves based upon the nearest indexing position from the current position.
When within [3] range for the figure (b) below, executing G101A4;G91A1F□□ will cause the actuator to move to 2H position and G101A4;G9A-1F□□ will cause the actuator to move to 4H position.

■ If PRM38=4 (Alarm C is caused outside the vicinity of segment position)

If G101A4;G91A-1F□□ is executed in the range specified [4] in the figure (a) below, a travel to position 2H occurs.
If G101A4;G91A1F□□ is executed in range [4], a travel to position 4H occurs.
If the command is executed in range [5], alarm C is caused when G101A4 is executed.

<Equal Segment Designation (G101) & Parameter>



5.8.3. Motion of M70

■ PRM38=1 (CW direction), or 2 (CCW direction)

Within the range [4] in (a), “Equal Segment Designation (G101) & Parameter” of “5.8.G101 (Equal Segment Designation) and Parameter,” executing G101A4;M70; will cause CN3 M code to output the current segment position (segment position 3 .. bit 0 and 1 in the Figure).
Outside the range (range [5]) of the PRM37, one previous segment position (segment position 2 .. bit 1 in the Figure) is output and in-position output turns off while this signal is output.
Segment positions are determined with the first head at the coordinate home position to CW direction followed by 2, 3, 4....

■ PRM38=3 (Nearer direction)

Executing G101A4;M70; will cause CN3 M code to output the nearest head segment position from the current position.
Within the range [3] in (b), “Equal Segment Designation (G101) & Parameter” of “5.8.G101 (Equal Segment Designation) and Parameter” segment position 1 (bit 0) is output.

■ If PRM38=4 (Alarm C is caused outside the vicinity of segment position)

If G101A4;M70; is executed in the range [4] specified in (a), “Equal Segment Designation (G101) & Parameter” of “5.8.G101 (Equal Segment Designation) and Parameter,” the current segment position (segment position 3 in the figure ... bit 0 and bit 1) is issued from the M code output pins of CN3.
If the command is outside the PRM37 range (in range [5]), alarm C is caused when G101A4 is executed.
The in-position output remains turned on.

- For the timing of the segment position output, refer to “4.5.10.Segment Position Output Timing.”

<M Code Output and In-position Output Upon Execution of M70>

M Code Output (bit) / Segment Position	7	6	5	4	3	2	1	0	Binary Display	In-position output
1H (in PRM37 setting range)	○	○	○	○	○	○	○	●	B'00000001 (=D'01)	●
2H (in PRM37 setting range)	○	○	○	○	○	○	●	○	B'00000010 (=D'02)	●
3H (in PRM37 setting range)	○	○	○	○	○	○	●	●	B'00000011 (=D'03)	●
4H (in PRM37 setting range)	○	○	○	○	○	●	○	○	B'00000100 (=D'04)	●
5H (in PRM37 setting range)	○	○	○	○	○	●	○	●	B'00000101 (=D'05)	●
6H (in PRM37 setting range)	○	○	○	○	○	●	●	○	B'00000110 (=D'06)	●
⋮				⋮					⋮	

Between 2H and 3H Range [5] in (a), "Filter Characteristics" of "5.9.Using Filters" (When PRM38 is 1)	○	○	○	○	○	○	●	○	B'00000010 (=D'02)	○
1H Range [3] in (b), "Filter Characteristics" of "5.9.Using Filters" (When PRM38 is 3)	○	○	○	○	○	○	○	●	B'00000001 (=D'01)	●

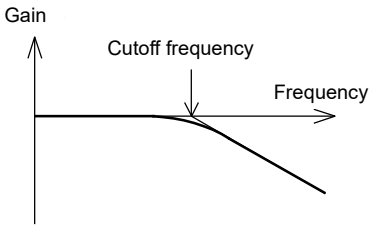
5.9. Using Filters

ABSODEX fitted to a low rigidity load equipment may resonate with the equipment.
For such application, the built-in digital filters (low pass and notch filters) will help reduce resonance to some extent.
PRM62 to 66, 70, 71 are for filters.
For details, refer to “Parameter List” of “5.PARAMETER SETTING.”

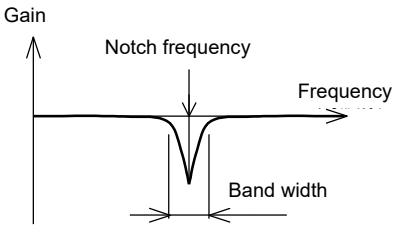
5.9.1. Filter Characteristics

The low pass filter helps attenuate signals in high frequency band, while notch filter helps attenuate signals in a specific frequency.
Using these characteristics enables to attenuate signals of a specific frequency to control resonance.
The diagram in the following figure illustrates the frequency characteristics.

<Filter Characteristics>



Characteristics of Low Pass Filter

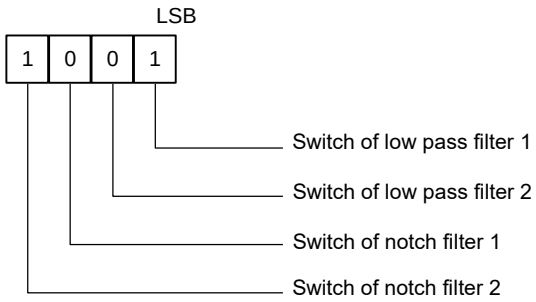


Characteristics of Notch Filter

5.9.2. Filter Switch

PRM66 (filter switch) is used to set whether or not the four filters take effect.
Each bit of the switches corresponds to respective filters, and the bit value “1” is for “effective” and “0” for “not effective.”

<Filter Switch>



<Switch Setting Example>

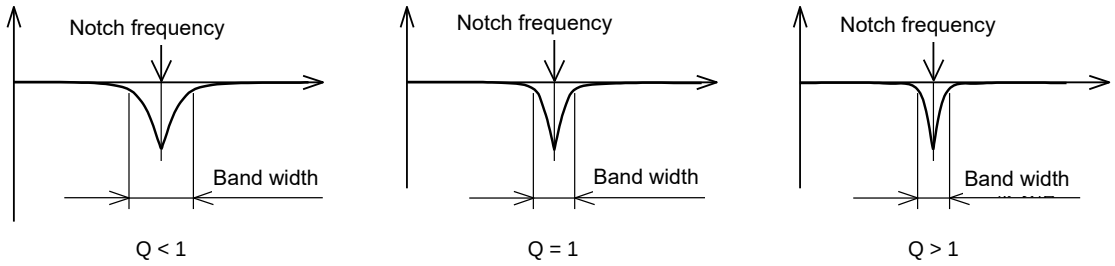
PRM66=9 (=1001): To use both low pass filter 1 and notch filter 2
PRM66=3 (=0011): To use both low pass filters 1 and 2

- Filters should be limited to three (3), if they are used simultaneously.

5.9.3. Q Value of Notch Filter

The band width “Q” of notch filter can be set using PRM70 and 71.
The larger the Q value is, the narrower the band width is. On the contrary, the smaller the Q value is, the larger the band width is.
Default value is Q = 1.
In most cases, there is no need to change “Q” value.

<Q Value of Notch Filter and Band Width>



5.9.4. Example of Filter Setting Using Communication Codes

First, set the low pass filter 1 to 100 Hz and the notch filter 1 to 200 Hz.
Communication code (_denotes space.)

L7_62_100	Set PRM62 to 100.
L7_64_200	Set PRM64 to 200.
L7_66_5	Set PRM66 to 5 (B'0101)

Use the communication code L9 to confirm if the written data is correct or not.
For details, refer to “7.COMMUNICATION FUNCTIONS (CN1: USB).”

5.9.5. Precaution for Use

When ABSODEX resonates with a load equipment, installation of a dummy inertia plate and mechanical measures are fundamentally required to increase rigidity of the equipment.
Then, the use of filters should be considered.
The setting range of frequencies is from 10 to 1,000 Hz. Setting a smaller value will not assure stable motions.
It is recommended that frequencies be set above 80 Hz (desirably over 100 Hz).

5.10. Positioning Completion Signal Outputting Time

You can enter the positioning completion output outputting time to PRM47 (positioning completion signal outputting time). With this function, the outputting time can be specified between “0 and 1,000 msec.”

If PRM47=0, no positioning completion output is issued.
If PRM47=0, no positioning completion output is issued and answer input is unnecessary even if PRM13 (answer input at positioning or home return completion) is set at “1: Required.”

5.11. Controlled Stop upon Alarm Valid/Invalid

Controlled stop is conducted upon an alarm during rotation to avoid coasting to stop, similarly to forced stop.
Change PRM48 to “1” to validate this function.

■ Applicable Alarms

Alarms related to this function are listed below.

<Alarms Applicable to Controlled Stop Upon Alarm>

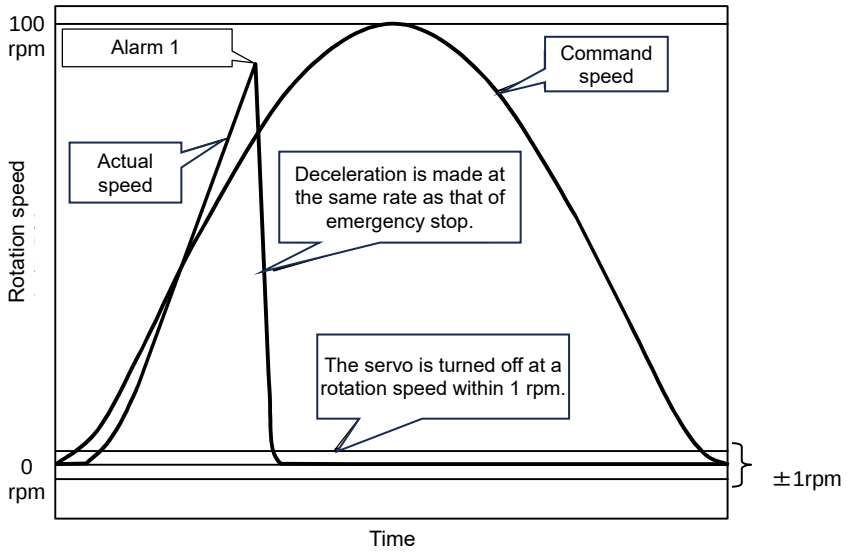
Alarm No.	Name of Alarm
1	Position deviation over, speed over, encoder output max. frequency over
2	Overheated regenerative resistor
4	Overloaded actuator

■ Operation at Alarm

Deceleration is made according to PRM21 (forced stop deceleration rate), similarly to forced stop.
However, if the original command time would be exceeded with the current deceleration rate, the deceleration rate automatically changes so as to make the load stop at or before the target position.

The servo is turned off to coast to a stop if the rotation speed is reduced to within 1 rpm.
If the speed command at the time of occurrence of an alarm is higher than the actual speed, the speed command is substituted with the actual speed before deceleration begins.

<Example of Speed Curve at Alarm>



5.12. In-position Signal Output Mode

This function turns the in-position output off while ABSODEX rotates.
The in-position output is turned on if the position is within the setting of PRM16 (in-position range) after the operation is finished.
Enter “1” to PRM51 to turn in-position output during rotation off.
This function can be used in all operation modes except for the servo-off mode (M5).

After entering the value, turn the power off then on again to validate the parameter setting. This is for prevention of malfunction. The in-position output may be issued at low speeds even if this function is valid.
In that case,

- Enter a smaller setting to PRM16 (in-position range).
- Enter a larger setting to PRM17 (in-position sampling frequency).

By performing the above etc., set the in-position judgment conditions strict.

5.13. Mode Selection of EtherCAT and EtherNet/IP I/O Signal

Change parameters to switch functions of some EtherCAT, EtherNet/IP I/O.
For the applicable EtherCAT, or EtherNet/IP I/O signals and settings, refer to PRM52 to PRM57 in “Parameter List” of “5.PARAMETER SETTING.”

Function switching is valid after the power is turned off then on again; this is for prevention of malfunction

5.14. Integral Limiter

The integral limiter is related to integral control of the control system inside the controller and it can be entered with PRM123 (integral limiter).
A value smaller than 1 reduces the undershoot immediately before stoppage and shorten the settling time. The correct value changes through gain adjustment, too.

Reducing an integral limiter value may increase the overshoot in the stopping cycle.
This also could cause remaining deviation in the stopping cycle.

6. PROGRAM

6.1. General Description

ABSODEX driver with the controller system will enable free setting of actuator rotation angle, moving time, and timer setting with NC programs. Also M code output enables communication with a programmable logic controller.

■ NC Program Capacity

The driver can store up to 256 NC programs, which can be selected through external I/O ports. The capacity of program memory is limited to 16 KB, and a long program may limit the number of programs to be stored.

■ Direction of Rotation of Actuator

Clockwise rotation when viewed from the top of the output axis is called positive direction (+), and counterclockwise rotation is called reverse direction (-).

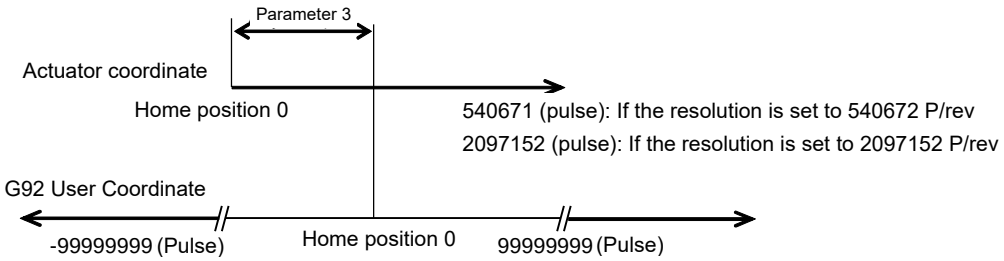
■ Coordinate System

a) G92 user coordinate system
G92 user coordinate system has the range of -99,999,999 to +99,999,999 pulses.
Positioning is done with this coordinate system.
When the resolution setting is 540,672 P/rev: -99,999,999 to +99,999,999 pulses (Approx. ±184 revolutions)
When the resolution setting is 2,097,152 P/rev: -99,999,999 to +99,999,999 pulses (Approx. ±47 revolutions)

b) Actuator coordinate
Pulse range of 0 to □ shows one rotation of the actuator.
When the resolution setting is 540,672 P/rev, □ = Range from 0 to 540,671 pulses
When the resolution setting is 2,097,152, □ = Range from 0 to 2,097,151 pulses

c) Relationship between G92 User Coordinate and Actuator Coordinate Systems
The position at the distance from the actuator coordinate “0” point only by the angle set by PRM3 is the home position of G92 user coordinate system.

<ABSODEX Coordinate System>



- **Operation mode can be selected from the seven (7) modes of automatic, single block, MDI (manual data input), jog, servo-off, pulse string input, and network operation.**

6.2. Operation Mode

The ABSODEX driver has the six (6) operation modes listed in the table below.
For use with a PLC, use the driver in the automatic mode.
Under pulse string input mode, the driver can be interfaced with a pulse string output controller.
The automatic mode also enables pulse string inputs using NC code G72.

Communication codes of M1 through M7 enables switching of the operation modes.
For details, refer to “7.COMMUNICATION FUNCTIONS (CN1: USB).”
Also, operation mode for power-on can be changed by a parameter.
For details, refer to “5.PARAMETER SETTING.”

<Operation Mode>

Operation mode	Description	Communication Codes
Automatic mode Note 1	Enables to execute programs continuously. Default setting is automatic mode for power-on.	M1
Single block mode Note 1	Enables to execute one block of a program to stop for each start input.	M2
MDI (Manual data input) mode	Enables to instantaneously execute NC code input through USB port.	M3
Jog mode	Enables jog motions using communication codes S5, and S6.	M4
Servo-off mode	Enables to release servo-ON.	M5
Pulse string input mode	Enables operation with pulse string output controller. Motions with NC programs and parameters change and so on are not available.	M6
Network operation mode	This operation mode can be used for the reduced wiring specification, -CL, -EC, -EN, (CC-Link, EtherCAT, EtherNet/IP).	M7

Note 1: When the ABSODEX driver is used under automatic and single block modes, NC programs should be stored in the driver.
For setting NC programs and parameters, use the AX-Tools.

6.3. NC Program Format

6.3.1. Format

NC program starts with “O” at the head of the program, which is followed by the program number.
(In the case of the AX-Tools, this block is input automatically.)
N is followed by sequence number, NC code, data and the semi-colon (;) at the last.
The section separated by the semi-colon (;) is called a block, and the sequence number is sometimes called the block number.

O□□; (In the case of the AX Tools, it is not necessary to input this block.)
N□□G□□P□□A□□F□□M□□L□□J□□;
N□□G□□P□□A□□F□□M□□L□□J□□;
.
.
.
N□□M30; (□□ denotes numeral data.)

6.3.2. Notes

- One block can contain plural G codes or M codes in the different group.
  However, one block cannot contain plural NC codes in the same group.
  Refer to “G Code List” of “6.4.Code List” and “M Code List” of “6.4.Code List” for NC code groups.
- When executing M codes in the group D (M20 to M27), CN 3 outputs M code output signals and M code strobe signals in the bit corresponding to the number in the first digit (0 to 7).
  When plural M codes (maximum 3) of the group A are specified in the same block, M code output signals are output simultaneously.
  The M code in Group D cannot be used together with that of other group in the same block.
- When plural M codes of a different group (except for the group D) are in one block, M codes will be executed in the order of the entry except for M30, which will be executed last.
  The segment position output M70 will be in advance output.
- G101 in the group C only cannot be simultaneously used with the G codes in the group A in the same block.
- The end of the program code (M30) is required at the end of the programs.

- Sequence number N□□ is not necessarily required.
  Programs can be executed from the head without relating to the sequence number.
  However, the sequence number is required, when specifying the place to jump to with J code.
- When A code (movement amount) only is written in one block, F value (moving time or velocity) is the value set in the previous block.
  When not set in the previous block, an error will be given for the NC program.
- Input of Angles

  G105A123 denotes 123 degrees.
  G105A123. denotes 123 degrees.
  G105A.123 denotes 0.123 degrees.
  G105A0.123 denotes 0.123 degrees.
- When the rotation speed that is determined by the moving amount specified by A and moving time specified by F exceed the maximum rotation speed of ABSODEX, moving time will be automatically extended to maintain the speed under the maximum rotation speed.
- When moving and jump commands are in the same block, operation program may not be changed.
  In such case, the two commands must be placed in the separate blocks.

G91A180F0.4J1; → G91A180F0.4;J1;

- G92 coordinate system setting and M auxiliary function must be in the separate blocks.
  If in the same block, M code output signal will not be output.
- The program length that can be entered is 3,970 with each of the alphabetic letters, “;” (semi-colon), and numbers are counted as well as the number of entered NC programs.

<NC Program Counting Example>

NC Program	O	1	;	G	101	A	7	;	G	91.1	A	1	F	0.5	;	M	30
Count	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

The sum (= 18) of the above count and “1” for the number of programs make the NC program length.

- If no G code in the C/D/E group is specified in the program, the previously executed G code is valid.
  If the G code is specified in some programs, specify the G code in each program.

6.4. Code List

<NC code list>

<table>
<tr><th>Code</th><th colspan="2">Function</th><th colspan="2">Data Range</th><th>Remarks</th></tr>
<tr><td>O</td><td colspan="2">Program No.</td><td colspan="2">0 to 999</td><td>0 to 255 can be selected from I/O.
o is automatically added.</td></tr>
<tr><td>N</td><td colspan="2">Sequence number</td><td colspan="2">0 to 999</td><td>Can be omitted.</td></tr>
<tr><td>G</td><td colspan="2">Preparation function</td><td colspan="2">0 to 999</td><td>Refer to “G Code List” of “6.4.Code List.”</td></tr>
<tr><td rowspan="11">A</td><td rowspan="8">Instruction to move coordinate axis</td><td rowspan="4">G90,
G91,
G91.1</td><td>Resolution setting
540,672 P/rev</td><td>Resolution setting
2,097,152 P/rev</td><td></td></tr>
<tr><td>±99,999,999</td><td>±99,999,999</td><td>Unit: pulse</td></tr>
<tr><td>±66,583.806</td><td>±17,166.137</td><td>Unit: angle</td></tr>
<tr><td>±47,163</td><td>±12,159</td><td>Unit: number of indexes</td></tr>
<tr><td rowspan="4">G90.1,
G90.2,
G90.3</td><td>Resolution setting
540,672 P/rev</td><td>Resolution setting
2,097,152 P/rev</td><td></td></tr>
<tr><td>±540,672</td><td>±2,097,152</td><td>Unit: pulse</td></tr>
<tr><td>±360.000</td><td>←</td><td>Unit: angle</td></tr>
<tr><td>1 to Designated number of segments</td><td>←</td><td>Unit: number of indexes</td></tr>
<tr><td colspan="2">Designation of segment numbers</td><td colspan="2">1 to 255</td><td></td></tr>
<tr><td colspan="2">Continuous rotation speed</td><td colspan="2">±80.00</td><td>Unit: rpm</td></tr>
<tr><td rowspan="2">F</td><td colspan="2" rowspan="2">Designation of speed</td><td colspan="2">0.01 to 300.00 Note 1</td><td>Unit: rpm</td></tr>
<tr><td colspan="2">0.01 to 100.00</td><td>Unit: sec</td></tr>
<tr><td>M</td><td colspan="2">Auxiliary function</td><td colspan="2">0 to 99</td><td>Refer to “M Code List” of “6.4.Code List.”</td></tr>
<tr><td rowspan="5">P</td><td colspan="2">Dwell</td><td colspan="2">0.01 to 99.99</td><td>Unit: sec G4P□□.□□</td></tr>
<tr><td colspan="2">Designation of sub-program number</td><td colspan="2">0 to 999</td><td>Program No. M98P□□□</td></tr>
<tr><td colspan="2">Gain magnification</td><td colspan="2">0,50 to 200</td><td>Unit: % G12P□□□
0% input will set servo-off.</td></tr>
<tr><td colspan="2">Acceleration and deceleration for continuous rotation</td><td colspan="2">0.01 to 50</td><td>Unit: sec G8P□□□
G9P□□□</td></tr>
<tr><td colspan="2">Parameter data setting</td><td colspan="2">Range defined by parameters</td><td>Unit: the unit defined by each parameter;
G79S□□P□□□</td></tr>
<tr><td>L</td><td colspan="2">Numbers of repetition</td><td colspan="2">1 to 999</td><td>Repeats the block as specified.</td></tr>
<tr><td>J</td><td colspan="2">Jump</td><td colspan="2">0 to 999</td><td>J0 causes a return to the top of the program.</td></tr>
<tr><td>S</td><td colspan="2">Parameter data setting</td><td colspan="2">1 to 99</td><td>Setting parameter No.;
G79S□□P□□□</td></tr>
</table>

Note 1: The minimum rotation speed of the actuator is 0.01 rpm. The rotation speed varies according to the model.

<G Code List (1/3)>

Group	G Code	Function	Description
A	**G1 (G01)**	Positioning	To position at A with speed F <Input Method> G1A□□F□□; A□□F□□; G1 (G01) can be omitted.
	G7 Note 1 (G07)	Continuous Rotation	Under continuous rotation at the speed A. If a program stop input is supplied during continuous rotation, deceleration and stop are caused, followed by stoppage of program execution. If a continuous rotation stop input is supplied, deceleration and stop as well as program execution stop are caused. However, if the next NC code is continuous rotation, the next NC program is executed after deceleration and stop. If a start input is supplied, deceleration and stop are caused, followed by execution of the next NC program. However, when the next NC code is for continuous rotation, start input will cause rotation at the newly set speed without stopping. In this instance, the time for speed change is the time set by G8 (G08). (DO NOT USE this for reverse rotation.) The user coordinate after the stop is revised to -180° to 179.999°. <Input Method> G7A±□□; Unit of A: rpm + rotates CW, and - rotates CCW. Acceleration and deceleration times are set by G8 (G08) and G9 (G09). If omitted, the times previously set are applied. If no previous setting, acceleration and deceleration time will be 1 sec.
	G28 Note 2	Home positioning	Enable home positioning
	G72	Pulse string input	Motion with accordance with the pulse string input by CN3. The program stop input or start input will terminate the execution of G72. Start input will execute the next block without stopping the program.
	G92	Setting of coordinate system	Enables setting or changing coordinate system. Like G92A0, with the code A suffixed to G code, the coordinate system is set so that the current position is the value to follow A. When used with G105, the value of A is interpreted as angle, and with G104 or G106, or G101 as a pulse.
	G92.1	Setting of coordinate system	To set the home position of G92 user coordinate (refer to “ABSODEX Coordinate System” of “6.1.General Description“) at power-on is the value which follows A. When used with G105, the value of A is interpreted as angle, and with G104 or G106, or G101 as a pulse.

Note 1: Select less than 80 rpm for G7 (G07) continuous rotation.
Note 2: Entry of the forced stop input during home positioning or interruption of home positioning due to an alarm clears the home position offset amount (PRM3) setting.
After invalidating the forced stop input or resetting the alarm, if the start input is entered, as is, to begin positioning, ABSODEX may not position properly.
Always perform one of the following operations after invalidating the forced stop input or resetting the alarm: home positioning, execution of NC code G92.1A0, or turning the power off and back on again.

<G Code List (2/3)>

Group	G Code	Function	Description
B	**G4 (G04)**	Dwell	Delay to shift to the next block. <Input Method> G4P□□.□□;
	G8 (G08)	Acceleration time for continuous rotation	Acceleration takes place for the time specified by “P” for continuous rotation. <Input Method> G8P0.5; acceleration time 0.5 sec.
	G9 (G09)	Deceleration time for continuous rotation	Deceleration takes place for the time specified by “P” for continuous rotation. <Input Method> G9P0.5; deceleration time 0.5 sec.
	G12	Change of gain magnification rate	Gain magnification rate determined by Switch Gain 1, 2 <Input Method> G12P100; 100% G12P0; cause servo-off at 0%. Note 1
	G79 Note 2	Parameter data setting	Substitute the parameter number with “S” for the value of “P.” <Input Method> G79S1P2; To substitute the PRM1 for “2.” The RAM data is temporarily stored, and turning off the power will erase all the set data.
C *	**G101 Note 3**	Designation of segment numbers	One rotation is equally segmented to set “A” unit to index number “G106.” <Input Method> G101A10; One rotation = 10 segments A1F1; Unit of “A” is index number
	G104	Designation of pulses	Unit of “A” is pulse.
	G105	Designation of angles	Unit of “A” is angle.
	G106	Designation of index	Unit of “A” is numbers of index. If not set by “G101,” program error will occur.

The asterisk (*) indicates the power-on setting.
Note 1: If positioning (A□F□), continuous rotation (G7P□) or home positioning (G28) is executed with the servo turned off, alarm 0 is caused.
Note 2: Some parameters cannot be set using G79 code. Refer to “Parameter List” of “5.PARAMETER SETTING.”
Note 3: G101 cannot be used simultaneously in the same block with group A.

<G Code List (3/3)>

Group	G Code	Function	Description
D *	G10 Note 1	Designation of rotation number	Unit of “F” is rpm. Moving speed is specified by the maximum rotation number.
	G11	Time designation	Unit of “F” is second. Moving time is specified.
E *	G90	Absolute dimension	The value of “A” to be made absolute value from the home position of coordinates.
	G90.1	A full revolution Absolute dimension	The actuator moves to the nearer direction with the value “A” as the one (1) rotation absolute value from the coordinate home position. The user coordinate after completion of positioning is adjusted within -180° to 179.999°. The specified range of “A” is within ±360°. Specifying 180° will cause the actuator to rotate CCW.
	G90.2 Note 2	CW direction revolution Absolute dimension	The actuator moves to the CW direction with the value “A” as the one (1) rotation absolute value from the coordinate home position. The user coordinate after completion of positioning is adjusted within -180° to 179.999°. The specified range of “A” is within ±360°. (The actuator motions between 0 to 360° in the CW direction.)
	G90.3 Note 2	CCW direction revolution Absolute dimension	The actuator moves to the CCW direction with the value “A” as the one (1) rotation absolute value from the coordinate home position. The user coordinate after completion of positioning is adjusted within -180° to 179.999°. The specified range of “A” is within ±360°. (The actuator motions between 0 to 360° in the CCW direction.)
	G91	Incremental dimension	The value of “A” to be made incremental value from the current position. Designate the direction of rotation, using the sign attached to the value following “A.” A positive value (without a sign) indicates clockwise rotation, while a negative value (-) indicates counterclockwise rotation.
	G91.1	A full revolution Incremental dimension	The value of “A” to be made incremental value from the current position. Designate the direction of rotation, using the sign attached to the value following “A.” A positive value (without a sign) indicates clockwise rotation, while a negative value (-) indicates counterclockwise rotation. The user coordinate after completion of positioning is adjusted within -180° to 179.999°.

The asterisk (*) indicates the power-on setting.

Note 1: If the rotation speed is fast and the traveling angle is small, the acceleration may become too large to cause alarm 1 (position deviation over).
If this happens, change the setting of PRM1 (cam curve) to “5” (MC2) to fix the acceleration to the setting of PRM2 (acceleration/deceleration time of MC2 curve).
For details, refer to “5.PARAMETER SETTING.”
As well, if the rotation speed is low and the traveling angle is large and the calculated traveling time exceeds 100 sec, alarm 0 (NC program error) is caused.

Note 2: Use G90.2 and G90.3 for positioning in the same rotation direction.

■ When an angle is specified with (G105)

The driver will convert the angle to pulse for processing.
When the set angle cannot be accurately converted to pulses, the angle will be converted to the nearest pulse.
Consequently, the program that will specify an angle repeatedly using incremental dimension (G91) will cause cumulative error depending on the set angle.
In such case, use the absolute dimension (G90) or the full revolution absolute dimension (G90.1,) or change the program which uses indexing number (G101).
When incremental dimension (G91) using indexing number (G101) will not cause cumulative error, even if the index angle is not correctly converted into pulses.
(One indexing will cause deviation of less than one pulse.)

■ When set angle cannot be accurately converted to the pulses for the specified angle and indexing

The coordinate system setting (G92) may cause deviations to be accumulated.
Execute “G92” at the position only which enables the accurate angle conversion to the pulse, for example, home position for each rotation, or implement programming (such as one rotation incremental dimension (G91.1)) without using “G92” code.

■ When specifying a small amount of movement with rotation designation (G10) of NC code

The specified moving time will be automatically extended to 2 msec, if internal calculation results in less than 2 msec.

■ When, for continuous rotation, stop signal is input during acceleration

The acceleration will continue to the specified level before deceleration takes place to stop.

■ When segment numbers by (G101) are specified before execution of continuous rotation (G7(G07))

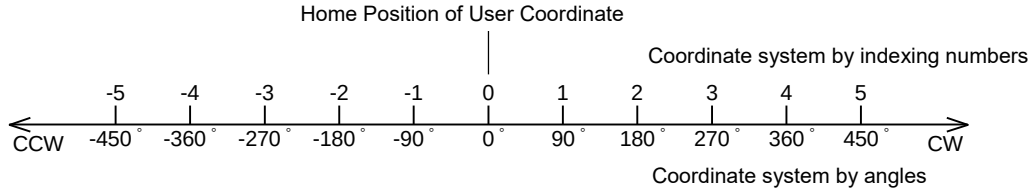
Stop signal will enable the stop at the next segment in which deceleration can take place to stop.
When the angle unit or the pulse unit is designated, deceleration and stop start after the stop signal is supplied.

■ Using segment number designation (G101)

The position of indexing numbers can be specified.
“Coordinate System of Segment Number Designation” of “6.4.Code List” shows the relationship between the position of the specified index number and its angle, when 4 segments are specified.

<For G101A4>

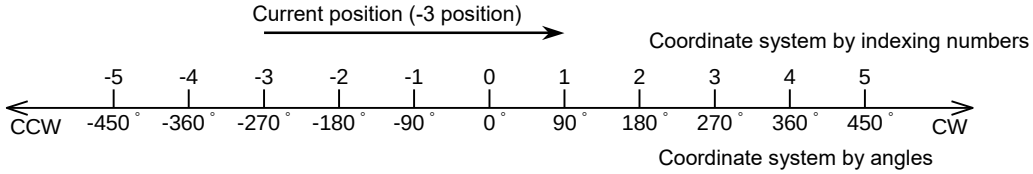
<Coordinate System of Segment Number Designation>



The following describes the examples of NC codes and transfer motions.

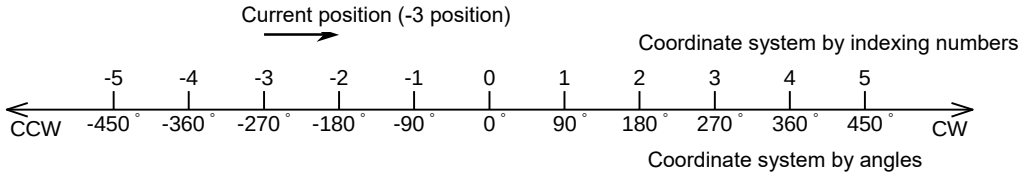
G90A1: enables transfer to the index 1 (90°) regardless of the current position.
(Absolute action instruction)

<Motion Example 1>



G91A1: enables transfer to the index 1 (90°) to the CW (clockwise) direction.
(Incremental action instruction)

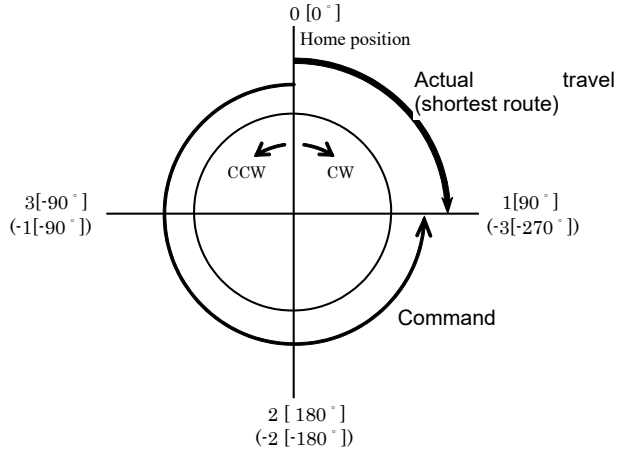
<Motion Example 2>



G90.1A-3: enables transfer to the index 1H in the shortest route within the half round from the current position.
(Shortest route absolute action instruction)

If “G90.1A-3” is executed, a counterclockwise 3-index (-270°) position is designated in the command, while the actual travel is clockwise 1-index position (90°) rotation.
Angle recognition after the travel is corrected to the range from -180.000° to +179.999°.
If the travelling amount is 180°, the travel is in the counterclockwise direction.

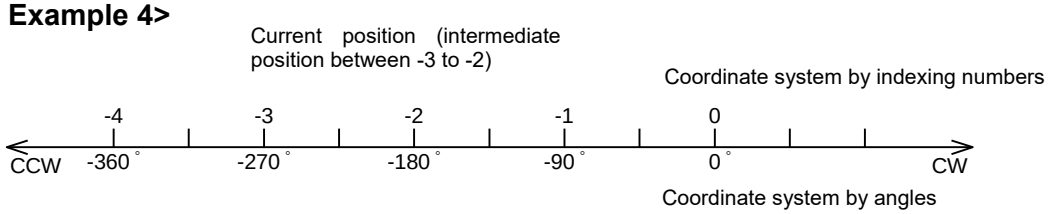
<Motion Example 3>



The upper stage indicates the actual travelling indexing number [angle], and the lower stage indicates the designated indexing number [angle] in the command.

G91A0: Travel to the nearest indexing position.
(Incremental action instruction)

<Motion Example 4>



- If an incremental action instruction (“G91” or “G91.1”) is given for the power-on travel or a travel after a forced stop in the program using equal segment position designation (G101), the action varies according to the settings of PRM37 and 38.
  For details, refer to “5.8.G101 (Equal Segment Designation) and Parameter.”

<M Code List>

Group	M Code	Function	Description
A	**M0 (M00)**	Program Stop	After completion of the current block, the program stops. When the start input is turned ON, program execution starts with the next block.
	M30	End of program	The program terminates to return the head block of the program.
B	**M98**	Sub-program call	Executes sub-program. <Input Method> M98P□□□ ← sub-program number Nest is feasible up to four times.
	M99	End of sub-program	Indicates the end of sub-program. After executing the block containing “M99,” the main program is resumed.
C	**M68**	Braking motion	Does not make servo system integral control. Turn off across the BK+ and BK- terminals of the driver. If there is an optional electromagnetic brake, it will be a brake operation state.
	M69	Release of brake	Makes servo system integral control. Turn on across the BK+ and BK- terminals of the driver(24 VDC). If there is an optional electromagnetic brake, it will be in a brake release state.
D	**M20 to M27**	I/O output	M code output (bits 0 to 7) in bit corresponding to the first digit and M code strobe output are output to CN3 simultaneously. Three (3) M codes can be written in the same block, and can be output simultaneously.
E	**M70**	Segment position output	When “G101” is used, the M code output (bits 0 to 7: binary format) corresponding to the indexing position and the segment position strobe output are simultaneously output at CN3. The segment position for n segmentation is expressed 1 to n.

6.5. ABSODEX Status at Power-on Start

■ Program No.

Upon power-on startup, the program number “0” is selected.
For starting other program, the program number selection is required before the start signal input.

■ Dimensions

Upon power-on start, the following dimensions are set.

Angle designation (G105)
Time designation (G11)
Absolute (G90)

■ Home Position of G92 User Coordinate

The home position is reset at power-on start.
(Resetting will locate the home position at the pulses away specified by PRM3 from the home point of the actuator.)

■ Coordinate Position of Output Axis

The output axis is located within the range of -180,000 to 179,999° in the G92 user coordinate system.

■ Operation Mode

PRM29 (mode upon power-on start) will enable to set either one of automatic operation, single block, pulse string input mode, and network operation mode.

■ Braking

PRM28 (brake initialization) will set brake-on or brake-off.

■ EtherCAT, EtherNet/IP output

After the in-position output is turned on and ABSODEX is ready to receive a start input, the start input wait output is turned on. Turn the servo state output on or off according to the outputting conditions.
Other outputs are turned off.
However, if there is an alarm, an alarm output is turned on.
(Alarm outputs are negative logic.)
Under conditions without alarm, the alarm output turns ON for 0.3 to 0.5 sec upon power-on, and then turns OFF.
Before alarm outputs are turned off, other EtherCAT or EtherNet/IP output may become unstable.
Build an AND circuit with alarm outputs or take other measures when necessary.
Turn the ready output on or off according to the outputting conditions after the alarm output is established.

■ Driver Panel

Under normal condition (without alarm),  (dr and dot) will light on the 7 segment LED (3rd and 2nd digits from the right).
The 7-segment LED (1st digit from the right) shows the operation mode. In this case, ABSODEX is operable.
For details, refer to “7.2.1.Operation Mode Switching.”

CAUTION

The coordinates of the actuator position are recognized when the power is turned on. Be careful to avoid moving the output axis for several seconds after the power is turned on.

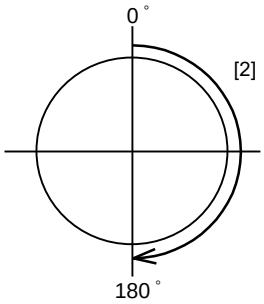
- If there is an external mechanical retention mechanism such as the brake, stagger the retention mechanism resetting timing from the power-on timing.
- If the output axis moves when the power is turned on, alarm F may be caused.

6.6. NC Program Example

The following explains NC program examples.
Unless otherwise noted, the coordinates have returned to 0° position prior to start of the program.

■ Absolute dimension (G90), angle designation (G105) and time designation (G11)

Create an indexing program, using angle and time units at the absolute user coordinate position defined with a home position offset amount (PRM3).

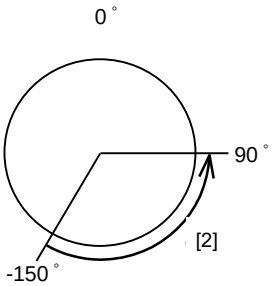


<Program>

N1G90G105G11;	[1]	Absolute, angle, time
N2A180F1.5;	[2]	Travel to the 180° position in 1.5 sec.
N3M30;	[3]	End of program

■ Full revolution absolute dimension (G90.1)

Do not rotate beyond 180°. (shortest route travel)

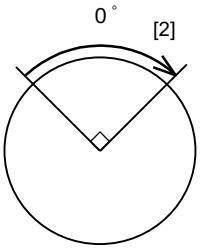


<Program>

N1G90.1G105G11;	[1]	Full revolution absolute, angle, time
N2A90F1.5;	[2]	Travel to the 90° absolute coordinate position in 1.5 sec. on the shortest route.
N3M30;	[3]	End of program

■ Full revolution incremental dimension (G91.1)

Travel from the current position by an angle.

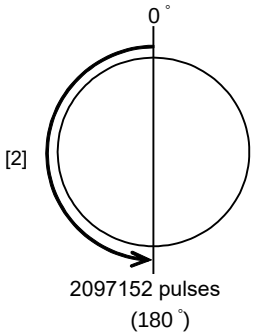


<Program>

N1G91.1G105G11;	[1]	Full revolution incremental, angle, time
N2A90F1;	[2]	Travel from the current position clockwise to the 90° position in 1 sec.
N3M30;	[3]	End of program

■ Pulse designation (G104)

Designate the traveling amount in pulses.



<Program>

When the resolution setting is 540,672 P/rev

[1] N1G90.1G104G11;
[2] N2A270336F2;
[3] N3M30;

[1] Full revolution absolute, pulse designation, time
[2] Travel to the 270,336-pulse (180°) position in 2 sec.
[3] End of program

When the resolution setting is 2,097,152 P/rev

[1] N1G90.1G104G11;
[2] N2A1048576F2;
[3] N3M30;

[1] Full revolution absolute, pulse designation, time
[2] Travel to the 1,048,576-pulse (180°) position in 2 sec.
[3] End of program

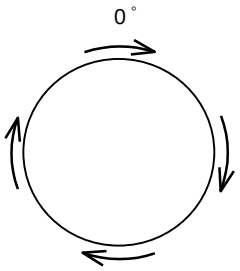
- The 180° travel with G90.1 (shortest route) causes counterclockwise rotation.

■ Continuous rotation (G07), continuous rotation acceleration time (G08), continuous rotation deceleration time (G09)

After supplying a start signal, rotate at the rotation speed specified with G07.
The acceleration/deceleration time at the time follows the settings of G08 and G09.

<Program>

N1G08P1; [1] Acceleration in 1 sec.
N2G09P0.5; [2] Deceleration in 0.5 sec.
N3G07A10; [3] Continuous rotation 10 rpm
N4M30; [4] End of program

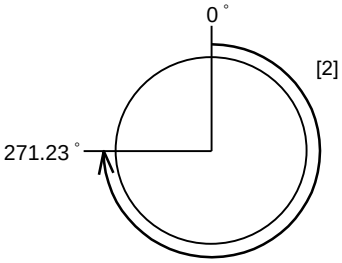


■ Rotation speed designation (G10)

Specify the unit of F at the maximum rotation speed.

<Program>

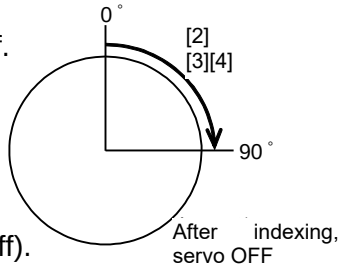
N1G90G105G10; [1] Absolute, angle, rotation speed
N2A271.23F30; [2] Travel to the 271.23° position at 30 rpm.
N3M30; [3] End of program



- If the rotation speed is high and the traveling amount is smaller, the acceleration may become too large to cause alarm 1 (position deviation over).
  If this happens, use MC2 cam curve.

■ Gain multiplication change (G12), dwell (G04)

Use the gain multiplication change function to index and turn the servo off.



<Program>

N1G90.1G105G11;	[1]	Full revolution absolute, angle, time
N2A90F1;	[2]	Travel to the 90° position in 1 sec.
N3G04P0.2;	[3]	Dwell 0.2 sec.
N4G12P0;	[4]	Change the gain multiplication to 0% (servo-off).
N5M30;	[5]	End of program

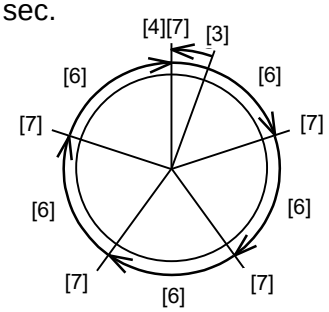
- In the program executed after the servo is turned off, a gain multiplication change command such as “G12P100” is necessary before the travel instruction so that servo-off is reset.

■ Segment number designation (G101), segment position output (M70), start input wait (M0) and jump (J)

After indexing into equal segments, use a segment position output to output the current position to an external programmable logic controller in a binary format.

<Program>

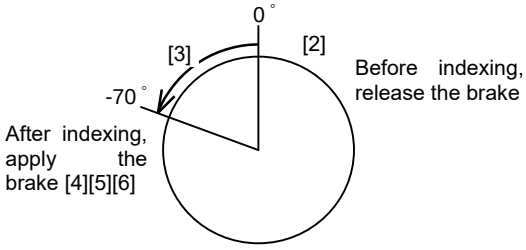
N1G101A5;	[1]	Segment number designation, 5 segments
N2G11;	[2]	Time designation
N3G91A0F1;	[3]	Move to the nearest indexing position in 1 sec.
N4M70;	[4]	Segment position output
N5M0;	[5]	Start input wait
N6G91.1A1F1;	[6]	Travel clockwise by a segment in 1 sec.
N7M70;	[7]	Segment position output
N8M0;	[8]	Start input wait
N9J6;	[9]	Jump to sequence No. 6
N10M30;	[10]	End of program



■ Brake application (M68), brake release (M69) and M code output

Control the brake of ABSODEX equipped with a brake.
Issue an M code after an action to notify the external programmable logic controller of completion of the action.
<Program>

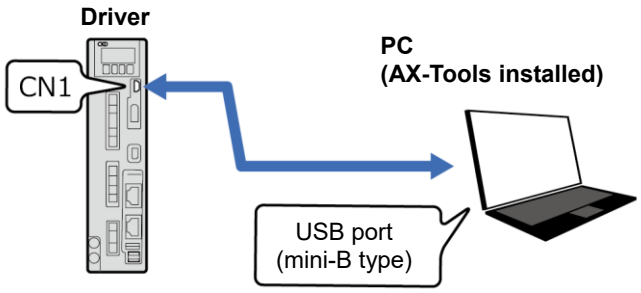
N1G90.1G105G11;	[1]	Full revolution absolute, angle, time
N2M69;	[2]	Release the brake
N3A-70F0.5;	[3]	Travel to the -70° position in 0.5 sec.
N4G04P0.1;	[4]	Dwell 0.1 sec.
N5M68;	[5]	Braking motion
N6M20;	[6]	Output M code bit 0.
N7M30;	[7]	End of program



- The dwell after the indexing cycle is added to settle at the target position.
  The settling time is about 0.05 to 0.2 sec. though it varies according to the operation conditions.
  When the brake is used, position deviation may result due to a timing issue of brake application.
  The positioning completion signal is issued after the in-position range and sampling frequency conditions specified in parameters are satisfied.

7. COMMUNICATION FUNCTIONS (CN1: USB)

Through USB port (CN1), operation mode switching and data setting can be done with a personal computer etc.



7.1. Communication Codes

7.1.1. Kinds of Code

Communication codes are classified into three code groups starting with M, S, and L, each having the functions as described below.

<Kinds of Communication Codes and Return Value>

Code Group	Function	Return Value (Normal)	Return Value (Abnormal)
M1 to M6	Operation Mode Switching	0	*(2AH)
S1 to S7 **S10, S20**	Motion Instructions	0	*(2AH)
L1 to L21	Data I/O	Value defined by each code “Data Input and Output Code” of “7.2.3.Data Input and Output“	*(2AH)

7.1.2. Communication Codes and Data

Communication codes are sequentially transmitted in ASCII codes, and with CR (carriage return code 0DH) added at the end.
When data are required for communication code (L7, and L9), insert space (20H) between a code and data, or between data.
The driver after having received the communication code will return the following return value, listed in the above table, and CR, and LF (line feed code 0AH).
<Example 1>

Parameter setting...to set 3 for PRM1

Data sent to the driver	Data returned by the driver (return value)
L7_1_3 CR	0 CR LF

(_ denotes space.)

<Example 2>

To switch to MDI (manual data input) mode.

Data sent to the driver	Data returned by the driver
M3 CR	0 CR LF

Return values for non-defined code or data is * (2AH), which causes alarm 7.

7.1.3. Parameter Setting Method

To enter a parameter, use communication code “L7” (parameter data input) and key-in “L7_parameter number_setting ↲. (“_” indicates a space and ↲ indicates a Enter key.)
When the unit of set value is a pulse, the prefix of “A” to the setting value enables setting with an angle unit.
Like “L 7M _ Parameter Number _ Set Value↲,” the suffix “M” to L7 enables to overwrite only temporary data in RAM.
(The driver refers to the data stored in RAM to operate.)

<Example>
For setting 3 for PRM1 ...L7_1_3↲
For setting 135, 168 pulses for PRM8 ...L7_8_135168↲
For setting 90° for PRM8 ...L7_8_A90↲
(The value to be actually set is the one converted to the pulses from 90°.)
For changing the data on RAM on PRM8 to 90° ...L7M_8_A90↲
(The data stored in RAM is lost when the power is turned off.)

To refer to a parameter, use communication code “L9” (parameter data output) and key-in “L9_parameter number ↲. This will normally enable to read the contents of EEPROM.
When the unit of set value is pulse, suffix “A” to the parameter number enables reading with the angle unit.
Like “L9M _ Parameter Number□,” the suffix “M” to L9 enables to load temporary data in RAM.

<Example>
To read PRM8 ...L9_8↲
To read PRM8 in angle unit ...L9_8A↲
To read the data on RAM of PRM8 in angle unit ...L9M_8A↲

7.1.4. NC Program Input (L11) and its Return Value

Inputting NC program to the ABSODEX driver will send out NC program following L11.
The return value is “0” for normal, and if there is a problem with the sent NC program, the block number in question and the error content number are returned.
Return value
[Block Number] _ [Error Number] CR LF
Block number is assigned serially with 1 for the head block.

Error Number:
0. Not defined
1. No program number or M30
2. The codes of the same group that cannot be written together exist in the same block.
3. Out of data setting range or the program memory is full.
4. Speed designation has not been made.
5. Non-defined code
6. Program number already registered has been specified.
7. 0 code is duplicated in the same program number.
8. Incorrect use of P code
9. No data to follow the code or data only without code

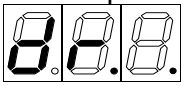
7.2. Communication Code List

7.2.1. Operation Mode Switching

<Operation Mode Switching Code>

Code	Description	Input Data Type	Remarks
M1	Automatic mode	M1[CR]	Mode setting for power-on Note 1 Enables to execute programs continuously.
M2	Single block mode	M2[CR]	Mode in which programs are executed block by block.
M3	MDI (Manual data input) mode	M3[CR]	Enables to instantaneously execute NC code input through USB port.
M4	Jog mode	M4[CR]	Communication codes S5 and S6 enable jog motion.
M5	Servo-off mode	M5[CR]	Selecting M1 to M4 and M6 will turn the servo ON.
M6	Pulse string input mode	M6[CR]	In this mode, operation proceeds according to pulse string input signals. Motions with NC programs and parameters change and so on are not available. To change, switch to M1 to M5.
M7	Network operation mode	M7[CR]	This operation mode can be used for the reduced wiring specification, -CL, -EC, -EN, (CC-Link, EtherCAT, EtherNet/IP).

Note 1: Setting PRM29 (power-on mode) allows to change the operation mode at power-on to M2, M6, or M7.

"CR" denotes carriage return code (0DH).
Under servo-off status, output axis can be manually rotated as the actuator loses its restriction torque.
Under these conditions, communications enable to refer to the current position helping find machine standard reference position. (For brake built-in models, brake releasing is required.)
When switching the operation mode, do not rotate the output axis.
To mechanically hold the output axis in the servo-off mode (after M5 is executed), do not execute mode switching between the servo-off (M5) and automatic operation (M1) modes, and output axis retention resetting simultaneously, but stagger between the two timings.
Switching servo-off mode to other operation modes (M1 to M4) will cause an alarm to be ON, and then the alarm will be cleared, if there is no abnormality.
Use under MDI mode will not permit an input, unless the program capacity is less than 95%. If this 95% is exceeded, delete a part of NC program.
Under servo-off status,  (dr and a dot) is displayed on the driver panel LED.

7.2.2. Motion Instructions

<Motion Instruction Codes>

Code	Description	Input Data Type	Remarks
S1	Start	S1[CR]	Same function as CN3 program start input (Auto run, single block)
S2	Program stop	S2[CR]	Same function as CN3 program stop input
S3	MDI & execution	S3_[NC data][CR] <Example> S3_A100F0.5[CR]	One block of NC code is input and executed.
S4	Home positioning	S4[CR]	Same function as CN3 home return instruction input
S5	Jog (CW)	S5[CR]	Rotation continues in accordance with PRM14 and 15 until CN3 program stop input or continuous rotation stop or S2 and S20 communication code is input.
S6	Jog (CCW)	S6[CR]	
S7	Alarm reset	S7[CR]	Effective only for alarm Same function as CN3 reset input
S10	Answer response	S10[CR]	Valid only when an answer is waited for. Same function as that of CN3 answer input
S20	Continuous rotation stop	S20[CR]	Continuous rotation G7 jog operation stop Same function as CN3 continuous rotation stop input

“CR” denotes carriage return code (0DH), and “_” denotes blank space code (20H).
For MDI data, motion instruction value “A” must be input together with Speed Instruction Value “F.”

7.2.3. Data Input and Output

<Data Input and Output Code (1/3)>

Code	Description	Input Data Type	Output Data Type
L1	Alarm number output	L1[CR]	[Alarm Number] [CR] [LF] <Example> ALM1_ALM2 ••• [CR] [LF] NO ALARM [CR] [LF]
L2	Not to be used		
L3	Current position output Unit: pulse Coordinate: Actuator coordinate	L3[CR]	[Position Data] [CR] [LF] 7 digit maximum (0 to 2,097,151) <Example> 1234 [CR] [LF]
L4	Current position output Unit: Degree Coordinate: Actuator coordinate	L4[CR]	[Position Data] [CR] [LF] 7 digit maximum (0 to 359.999) <Example> 180.001[CR] [LF]
L5	Current position output Unit: pulse Coordinate: G92 coordinate	L5[CR]	[Position Data] [CR] [LF] 9 digit maximum (-99,999,999 to +9,999,999) <Example> 4321[CR] [LF]
L6	Current position output Unit: Degree Coordinate: G92 coordinate	L6[CR]	[Position Data] [CR] [LF] 10 digit maximum (-66,583.806 to +66,583.806)
L7	Parameter data input	L7_[Parameter Number]_[Data] [CR] <Example> L7_1_3[CR] Set PRM1 to 3.	0[CR] [LF]
L8	Not to be used		
L9	Parameter data output	L9_[Parameter Number] [CR] <Example> L9_1 [CR]	[Data] [CR] [LF] <Example> 3[CR] [LF]
L10	Program number output	L10[CR]	[Currently set program number] [CR] [LF]

“CR” denotes carriage return code (0DH), “LF” denotes line feed code (0AH) and “_” denotes blank space code (20H).
Use parameter data input (L7) only in the automatic operation or single block mode during program stop.
DO NOT turn off the Main power for 2 seconds after setting the data.

<Data Input and Output Code (2/3)>

Code	Description	Input Data Type	Output Data Type
L11	NC program input	L11_[NC Program] [CR] <Example> L11_o100N1A90F1; N2G91A45; N3G90A45;N4J1;M30; [CR]	0 [CR] [LF]
L12	NC program output	L12_[NC Program Number] [CR] <Example> L12_200[CR]	[NC Data] [CR] [LF] <Example> o200N1G90A0F2M1;M30; [CR][LF]
L13	NC program number and directory output	L13[CR]	[Using Memory Capacity] [NC Program Number] [CR] [LF] <Example> 2[%]1 2 5 10 ••• CR] [LF]
L14	Not to be used		
L15	Not to be used		
L16	Designation of program number	L16_[Program Number] [CR] <Example> L16_100[CR]	0[CR] [LF]
L17	Delete of program number	L17_[Program Number] [CR] Setting program number to “9999” will delete all programs. Program number “12345” will initialize the system. If an initialize command is sent, leave at least two seconds, and then turn the power off then on again.	0[CR] [LF]
L18	Change of program number	L18_[Current Program Number] _[New Program Number] [CR] <Example> L18_100_200[CR] O100 changed to O200.	0[CR] [LF]
L19	Output of the next block of program to be executed	L19[CR]	[NC Program] [CR] [LF]
L20	Not to be used		

“CR” denotes carriage return code (0DH), “LF” denotes line feed code (0AH) and “_” denotes blank space code (20H).
Use the communication codes, L11, L17 and L18 only when the program is not executed in Automatic mode or Single block mode.
DO NOT turn off the Main power for 2 seconds after setting the data with these communication codes.

<Data Input and Output Code (3/3)>

Code	Description	Input Data Type	Output Data Type
L21	Mode output	L21[CR]	[Mode] [CR] [LF] <Example> M1 [CR] [LF]
L22~L88	Not to be used		
L89	Serial actuator number output	L89[CR]	[Serial number] [CR] [LF] <Example> Ser.1234567 [CR] [LF]

The L89 communication code will not function with AX-Tools that has a function to automatically display the serial number.
The L89 communication code cannot be used without connection with the actuator.

7.3. Communication Methods

Writing data into and reading from ABSODEX driver using communication codes requires a personal computer etc.

7.3.1. Communication Examples

The following are the examples of control method of ABSODEX using the communications. Connect a PC and communicate.
(_ denotes space, and ↲ denotes the Enter key.)

■ MDI (Manual Data Input) Mode ••• Execution immediately after data input.

<Key in>	<Description>
M3↲	Mode setting
S3_A90F1↲	Motion instruction (90°, 1 second)

S3 and motion data are sent in the same manner.

■ Auto Run Mode

<Key in>	<Description>
M1↲	Mode setting
L11_O100N1G91A90F1;J1;↲	Program input
L16_100↲	Program No. selection function
S1↲	Start
S2↲	Stop

When making a communication program on a PC, make sure that return values processing for the communication codes are made.

8. GAIN ADJUSTMENT

WARNING

Keep hands away from the rotating part as sudden motion may take place during gain adjustments or trial run.

- Make sure of the safety in the full revolution of the actuator. Turn on the power and adjust.
- Care should be taken when the operation is done from a position where the actuator cannot be seen.

Your hand and body should not contact the actuator and driver during an operation and immediately after a stop.

- You may get burned.

CAUTION

The full performance is not achieved in the shipment state.

- Adjust the gain without fail.

8.1. What is Gain Adjustment?

Gain adjustment indicates adjustment of the servo gain suitable for the installed load to achieve operation of the ABSODEX at the best performance.
G1 and G2 are adjusted with the push buttons on the front panel, or by changing PRM121 and PRM122.
ABSODEX uses PID servo system, which provides three gain parameters, P (proportional), I (integration), and D (differentiation).
Gain should be adjusted by determining the combinations of the three gains setting G1 and G2 rather than by adjusting them individually.
Each element of P, I and D has the following characteristics.

P (proportional): The torque proportional to the deviation between the target position and current position is controlled and output.

This coefficient functions to reduce deviation.

I (integration): The torque is controlled and output so that it is the time integral of the deviation between the target position and current position.

This coefficient functions to eliminate the deviation quickly.

D (differentiation): The torque is controlled and output according to the time differentiation of the target or current position.

This coefficient controls and outputs the torque instantaneously in response to the time variation caused by instructions or external disturbance.

■ G1 (Gain 1)

Gain 1 adjusts convergence time.
Larger the setting becomes, greater the gain becomes while I (integration gain) increases and D (differentiation gain) decreases.
An increase in G1 reduces the convergence time, while the stability of the control system becomes less stable and may allow oscillation to occur more likely.
When the load equipment does not have sufficient rigidity, adjust G1 in lower range.

■ G2 (Gain 2)

Gain 2 is adjusted in accordance with the load on the actuator.
The larger the setting becomes, the greater the P (proportional gain), I (integration gain) and D (differentiation gain) becomes.
An increase in G2 reduces the overshoot in the positioning cycles.
For a larger load, increase the setting value.

■ Preparation for Gain Adjustments

Before starting the gain adjustments, ABSODEX unit must be firmly fixed to the machine, and have a load installed such as a table to the output axis.
Make sure that there is no interference to the rotating part.
Gain adjustments require a personal computer which has an USB port.
For communication using a personal computer, refer to “7.COMMUNICATION FUNCTIONS (CN1: USB).”

WARNING

KEEP HANDS OFF from the rotating part as sudden motion may take place during gain adjustments.

- Make sure of the safety for the full revolution of the actuator before turning it on.

Make sure that the safety is assured to operate the actuator in case the unit is operated from the place unable to confirm the motion.

G1 and G2 should be switched while the actuator is not in motion.

- DO NOT switch the DIP switches while the actuator is in motion.

Unless the actuator or load table is fixed firmly, fierce vibration may occur.

- Make sure these are firmly fixed, and make adjustments with the actual using load condition or very close to such condition.

CAUTION

If the load is changed, the gain must be adjusted again.

8.2. Gain Adjustment Method

There are two methods for gain adjustment: auto tuning and manual tuning.

8.2.1. Auto Tuning Function

While oscillating with the load installed, and the P, I and D gain parameters are automatically obtained through calculation of the load according to the acceleration and output torque at the time.

■ Preparation Before Auto Tuning

Set G2 to “-1” ("At" in 7-segment LED display).
After “-1” (At) is set, auto tuning is ready.

■ Auto Tuning Parameters

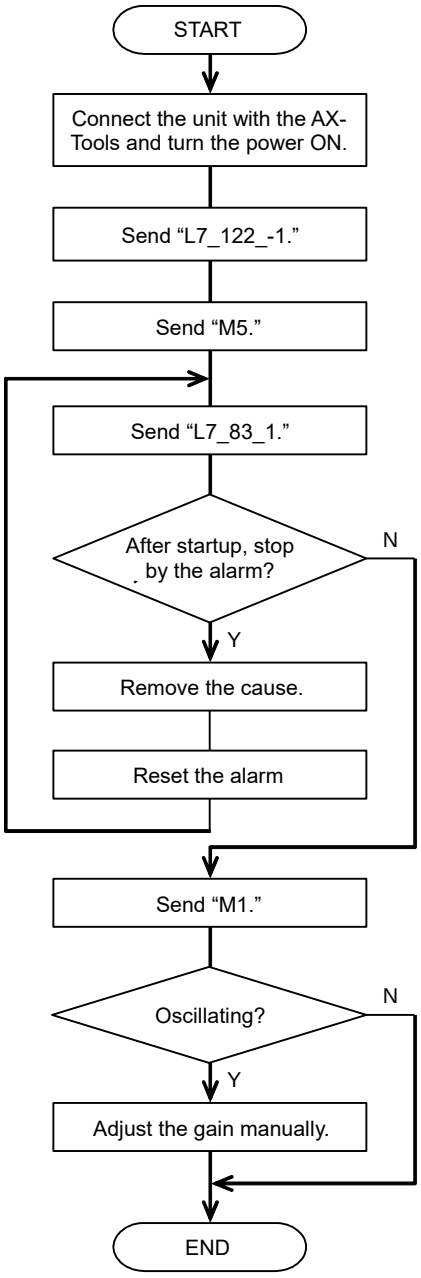
Auto tuning of ABSODEX is related with various parameters for defining the operation conditions and other features.
For details, refer to “5.PARAMETER SETTING.”
PRM83: Auto tuning command
PRM87: Auto tuning torque
PRM89: Auto tuning measurement termination speed
PRM120: Entering of inertia value

After initialization of the NC program and parameters (send “L17_12345”), the results of auto tuning are lost, and gain adjustment becomes necessary.
To prepare for the failure for auto tuning after the equipment is assembled (due to interference of jigs or stopper), record the value of PRM120.
Before writing PRM120, turn the servo off (M5).
If the combination of the actuator is changed after values are written in PRM120, the action refers to preset gains, possibly causing vibration.
If this happens, execute auto tuning again.
After conducting auto tuning, change the G2 setting back to “-1” (At) to continue operation.
By using the AX-Tools, the auto tuning function can be used more easily.
For details, refer to the “AX-Tools instruction manual.”

■ Auto Tuning Procedures

The flowchart of auto tuning is shown below.

<Auto Tuning Flowchart>



Auto Tuning

If L7_83_1 is sent in the servo-off state, swinging begins and normal auto tuning is conducted.

■ Auto Tuning with Limitation in the Rotation Range of ABSODEX (Such as a Stopper or Piping or Wiring in the Hollow Shaft)

1. **According to the auto tuning procedure document, turn the ABSODEX servo off.**

2. **Oscillation of the auto tuning action begins at clockwise rotation. Turn the output axis of the actuator counterclockwise by hand.**

3. **When the resolution is set to 540,672 P/rev, if ABSODEX interferes with a stopper or rotation is blocked by piping or wiring in the middle of auto tuning to cause “alarm U1,” reduce the setting of “PRM89” in 100 increments.**

   Do not reduce the PRM89 setting down below 200.

   When the resolution is set to 2,097,152 P/rev, if ABSODEX interferes with a stopper or rotation is blocked by piping or wiring in the middle of auto tuning to cause “alarm U1,” reduce the setting of “PRM89” in 400 increments.

   Do not reduce the PRM89 setting down below 800.

   Refer to “<Parameter List (12/13)” of “5.PARAMETER SETTING.”

4. If auto tuning fails during operation described in *3.*, an excessive friction load is probable. Increase the auto tuning torque (PRM87) in 100 increments.

In this case, note that the force exerted on the stopper, piping and wiring increases.

5. If auto tuning fails in operation *4.*, perform manual adjustment.

For details, refer to “8.2.2.Manual Tuning.”

■ Conversion from Auto Tuning to Manual Setting

How to replace the result of auto tuning with manual setting is described here.

1. **Read the inertia value entering (PRM120) of the auto tuning result.**
   Let the readout value in response to communications code “L9_120” be “X.”

2. **Read the inertia value entering of the manual gain.**
   Let the readout value in response to communications code “L9M_120” be “Y.”

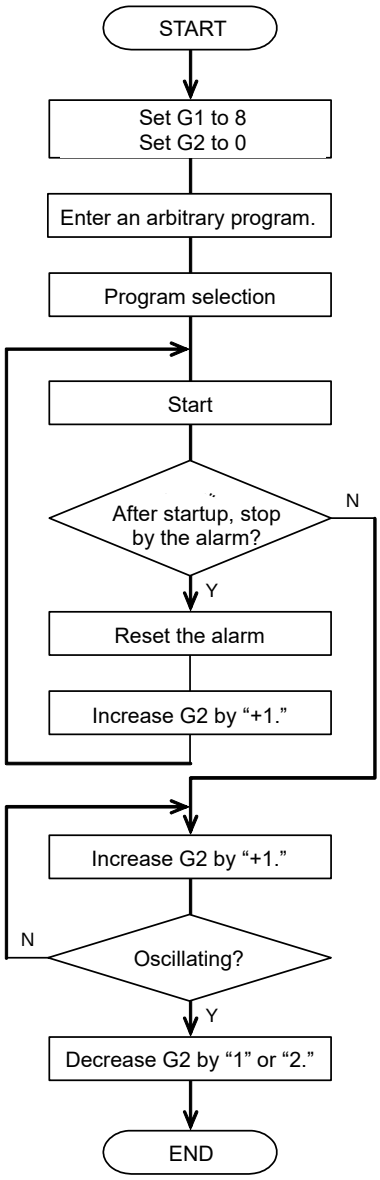
3. **While increasing “G2” in “1” increments, read the inertia value entering setting of the manual gain, using the communications code specified in paragraph *2.***

4. **The setting value of “G2” with which “X” and “Y” is the most similar is the setting value of the manual setting. Send the communication code “L7_122-G2.”**

8.2.2. Manual Tuning

The manual gain adjustment flowchart is shown below.

<Flowchart of Gain Adjustment>



Set it with the push buttons on the driver panel or via AX-Tools.
The shipment settings are “8” (G1) and “-1” (G2.)

For the entry, selection and starting procedures of the program, refer to “AX-Tools Instruction Manual.” (2.OPERATION FLOW)

Repeat similar adjustment while changing the G1 setting, to adjust the gain more accurately.
If the rigidity of the equipment is sufficiently high, increase the G1 setting even with a smaller G2 setting after the above adjustment to improve the action state further.
For G1 and G2, refer to “8.1.What is Gain Adjustment?“
If the G1 or G2 setting is changed, the G1 setting and G2 setting are displayed on the left and right side 7-segment LEDs for about two seconds.

8.2.3. Parameter Setting and References

Setting of parameters and references is done by communication codes using a personal computer.

■ Parameter reference and setting by start-up adjustment supporting tool “AX-Tools”

Select “Edit > Read > Parameter” to load the parameter set value of the ABSODEX driver into the AX-Tools.
There are limitations in the entry of some parameters.
To enter or monitor these parameters, select the “terminal mode.”
Before executing “Parameter,” be sure to execute the Load command to load parameters saved in the driver into the editing work.
Select “Edit > Parameter” and open the parameter setting dialog box to monitor parameter settings of the ABSODEX driver.
To change the parameter setting, select the desired parameter setting and enter the new setting, or, use the arrow key to move the value up or down.
After editing, select “Edit > Write > Parameter” to save the new parameter settings to the ABSODEX driver.

■ Monitoring or entering the parameter with communication code

The set values of parameters can be referred to and edited using communication codes.
In the case of a change by communication codes, parameter items not displayed in the parameter setting mode can be edited.
If using communication codes, use the terminal mode of the start-up adjustment supporting tool “AX-Tools.”

9. Network Operation Mode

Network operation mode is a mode that can be used for the reduced wiring specification - EC (EtherCAT) and -EN (EtherNet/IP).

9.1. Point Table Operation

The point table operation runs with the point table data within ABSODEX driver.
The point table data can be referred to/set via the programmable logic controller.

9.1.1. How to Operate

1. Set the point table

Set with AX-Tools Ver. 3 or later, or instruction codes.

2. Switch the operation mode

Switch the operation mode to “Network Operation Mode.”
The operation mode can be switched by one of the following:

- Send the communication command “M7”
- With PRM29 (mode at power-on) = 7, turn the control power back on.
- Switch with the instruction code (21h)

3. Switch to table operation

Set the table operation and the data input operation switching input to OFF.

OFF: Table operation	Select which table number to operate
ON: Data input operation	Operate it after setting command data

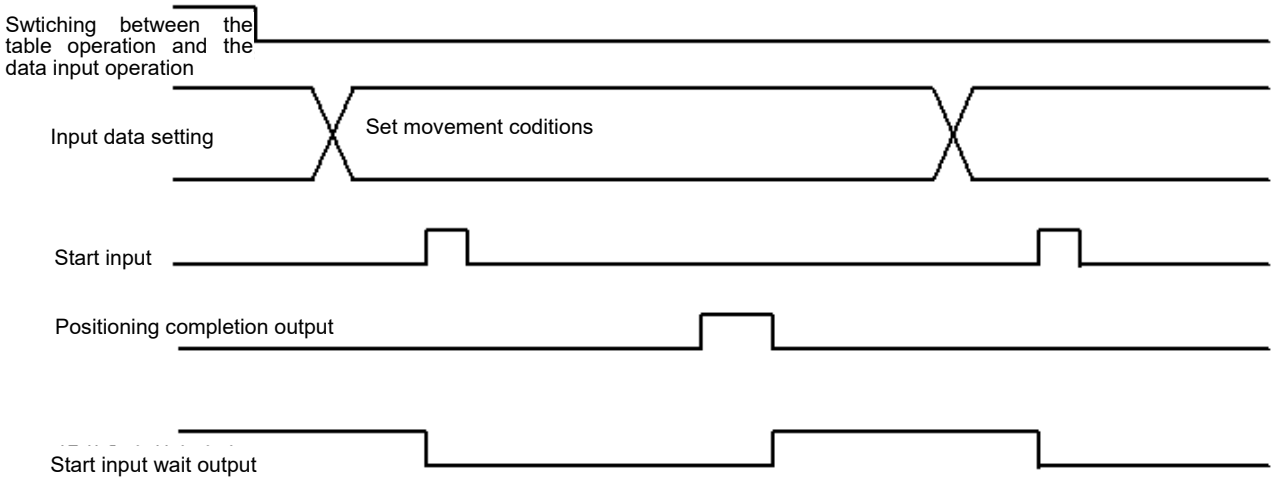
4. Select a point table

To select a point table, use the program No. selection function.
The selection method is a method set to PRM36 (selection switching of I/O program numbers). The selection range of point table is 0 to 63.

5. Start the point table

Execute the selected point table by turning the start input ON.

<Timing Chart for Point Table Operation >



- When the table number is selected and the specified positioning operation is completed, the positioning completion output is generated. (For output conditions, please refer to "5.6. Judgment of Positioning Completion.")
- After the positioning completion output is generated, the start input wait output is generated.
- The start input wait output can be used with driver of software version 8.02.01 or later.

9.1.2. Point Table Data

The point table has a common table and table 0 to 63 data.
As with parameters, read and write the value of each data communications codes, or instruction codes from programmable logic code.

<Point Table Data List (1/2)>

Table No.	Corresponding PRM No.	Description	Setting Range	Initial Value
-	197	Common table command	1 to 6	1
		1: Absolute dimension (G90) 2: Full revolution absolute dimension (G90.1) 3: CW direction absolute dimension (G90.2) 4: CCW direction absolute dimension (G90.3) 5: Incremental dimension (G91) 6: Full revolution incremental dimension (G91.1)		
-	198	Travel unit of common table	1 to 3	1
		1: Angle unit (G105) 2: Pulse unit (G104) 3: Index unit (G106)		
-	199	Travel speed unit of common table	1 to 2	1
		1: Rotation speed (G10) 2: Time (G11)		
0	200	Command	0 to 11	0
		0: Command set to the common table 1: Absolute dimension (G90) 2: Full revolution absolute dimension (G90.1) 3: CW direction absolute dimension (G90.2) 4: CCW direction absolute dimension (G90.3) 5: Incremental dimension (G91) 6: Full revolution incremental dimension (G91.1) 7: Home positioning (G28) 8: Designation of segment numbers (G101) 9: Change of gain magnification rate (G12) 10: Braking motion (M68) 11. Brake release (M69)		
	201	Travel unit	0 to 3	0
		0: Travel unit set to the common table 1: Angle unit (G105) 2: Pulse unit (G104) 3: Index unit (G106)		

<Point Table Data List (2/2)>

<table>
<tr><th>Table No.</th><th>Corresponding PRM No.</th><th colspan="2">Description</th><th>Setting Range</th><th>Initial Value</th></tr>
<tr><td rowspan="6">0</td><td rowspan="2">202</td><td colspan="2">Travel speed unit</td><td>0 to 2</td><td>0</td></tr>
<tr><td colspan="4">0: Travel speed unit set to the common table
1: Rotation speed (G10)
2: Time (G11)</td></tr>
<tr><td rowspan="3">203</td><td rowspan="2">A code / P code</td><td>Resolution setting
540,672 P/rev</td><td>-540,672 to 540,672</td><td>0</td></tr>
<tr><td>Resolution setting
2,097,152 P/rev</td><td>-2,097,152 to 2,097,152</td><td>0</td></tr>
<tr><td colspan="4">According to the contents of the command and the travel unit, set the setting value (value equivalent to A code or P code of NC program) such as an angle within the following range:
Angle : -360,000 to 360,000 ×1,000 [degree]
PulseWhen the resolution setting is 540,672 P/rev
: -540,672 to 540,672 [Pulse]
When the resolution setting is 2,097,152 P/rev
: -2,097,152 to 2,097,152 [Pulse]
Indexing/segment numbers
: 1 to 255 [Indexing, segment numbers]
Gain magnification : 0, 50 to 200 [%]</td></tr>
<tr><td rowspan="2">204</td><td colspan="2">F code Note 1</td><td>10 to 300,000</td><td>2,000</td></tr>
<tr><td colspan="4">According to the contents of the command and the travel speed unit, set the setting value (value equivalent to F code of NC program) such as rotation speed within the following range:
Rotation speed : 110 to 300,000 ×1,000[rpm]
Time : 10 to 100,000 ×1,000 [sec]</td></tr>
<tr><td rowspan="8">n
(1 to 63)</td><td rowspan="2">200 + 5×n</td><td colspan="2">Command</td><td>0 to 11</td><td>0</td></tr>
<tr><td colspan="4">Refer to the description of table 0 command.</td></tr>
<tr><td rowspan="2">201 + 5×n</td><td colspan="2">Travel unit</td><td>0 to 3</td><td>0</td></tr>
<tr><td colspan="4">Refer to the description of table 0 travel unit.</td></tr>
<tr><td rowspan="2">202 + 5×n</td><td colspan="2">Travel speed unit</td><td>0 to 2</td><td>0</td></tr>
<tr><td colspan="4">Refer to the description of table 0 travel speed unit</td></tr>
<tr><td rowspan="3">203 + 5×n</td><td rowspan="2">A code / P code</td><td>Resolution setting
540,672 P/rev</td><td>-540,672 to 540,672</td><td>0</td></tr>
<tr><td>Resolution setting
2,097,152 P/rev</td><td>-2,097,152 to 2,097,152</td><td>0</td></tr>
<tr><td colspan="4">Refer to the description of A code /P code of table 0.</td></tr>
<tr><td rowspan="2">204 + 5×n</td><td colspan="2">F code</td><td>10 to 300,000</td><td>2,000</td></tr>
<tr><td colspan="4">Refer to the description of F code of table 0.</td></tr>
</table>

Note 1: In NC program, the default value of the travel speed unit is traveling time [sec], but in the point table, the default value is rotation speed [rpm].

A table consists of five items: “Command,” “Travel Unit,” “Travel Speed Unit,” “A code / P code,” and “F code.” The required items vary depending on the contents of command.

<List of Network Operation Mode Command Combination>

Command	Travel unit	Travel speed unit	A code / P code	F code
Absolute (G90)	○	○	○	○
Full revolution absolute (G90.1)	○	○	○	○
CW direction absolute (G90.2)	○	○	○	○
CCW direction absolute (G90.3)	○	○	○	○
Incremental (G91)	○	○	○	○
Full revolution incremental (G91.1)	○	○	○	○
Home positioning (G28)	×	×	×	×
Designation of segment numbers (G101)	×	×	○	×
Change of gain magnification rate (G12)	×	×	○	×
Braking motion (M68)	×	×	×	×
Brake release (M69)	×	×	×	×

9.1.3. Setting Examples

■ Rotation operation with the common table

<Operation Command Equivalent to NC Program G90G105G11A90F3>

Table	Description	Setting value	Behavior
Common table	Command	1	Absolute dimension
	Travel unit	1	Angle unit
	Travel speed unit	2	Time
n	Command	0	Travel to the 90-degree position of absolute coordinate in 3 sec. (The absolute, the angle unit, and the speed unit set in the common table are used)
	Travel unit	0	
	Travel speed unit	0	
	A code / P code	90,000	
	F code	3,000	

The setting values set in the common table are used when the setting values of command, travel unit, travel speed unit in the table 0 to 63 are 0 (initial value). In this case, simply changing a setting value of the common table changes the operation of table 0 to 63.
To operate differently from the common table, set the setting values of command, travel unit, and travel speed unit in the table 0 to 63 to a value other than 0.

■ Operation without the common table

<Operation Command Equivalent to NC program G91G104G11A-50, 000F1>

Table	Description	Setting value	Behavior
Common table	Command	1	Absolute dimension
	Travel unit	1	Angle unit
	Travel speed unit	1	Rotation speed
n	Command	5	Travel from the current position to the position of -50,000 pulse in 1 sec (The command, the travel unit, and the speed unit different from the common table are used)
	Travel unit	2	
	Travel speed unit	2	
	A code / P code	-50,000	
	F code	1,000	

■ Home positioning

<Operation Command Equivalent to NC Program G28>

Table	Description	Setting value	Behavior
n	Command	7	Home positioning
	Travel unit	-	Ignores the setting value Hereinafter, described as "－"
	Travel speed unit	-	
	A code / P code	-	
	F code	-	

■ Designation of segment numbers

<Operation Command Equivalent to NC Program G101A4>

Table	Description	Setting value	Behavior
n	Command	8	Designation of segment numbers
	Travel unit	-	-
	Travel speed unit	-	
	A code / P code	4	4 segments
	F code	-	-

■ Change of gain magnification rate

<Operation Command Equivalent to NC Program G12P0>

Table	Description	Setting value	Behavior
n	Command	9	Change of gain magnification rate
	Travel unit	-	-
	Travel speed unit	-	
	A code / P code	0	0%
	F code	-	-

■ Braking motion

<Operation Command Equivalent to NC Program M68>

Table	Description	Setting value	Behavior
n	Command	10	Braking motion
	Travel unit	-	-
	Travel speed unit	-	
	A code / P code	-	
	F code	-	

■ Release of brake

<Operation Command Equivalent to NC Program M69>

Table	Description	Setting value	Behavior
n	Command	11	Release of brake
	Travel unit	-	-
	Travel speed unit	-	
	A code / P code	-	
	F code	-	

9.2. Data Input Operation

The data input operation uses data received from the programable logic controller to operate ABSODEX.
This allows to change the operation contents of ABSODEX only by changing the communication data from the programable logic controller.

9.2.1. How to Operate

1. Switch the operation mode

Switch the operation mode to “Network Operation Mode.”
The operation mode can be switched by one of the following:

- Send the communication command “M7”
- With PRM29 (mode at power-on) = 7, turn the control power back on.
- Switch with the instruction code (21h)

2. Switch to the data input operation

Set the table operation and the data input operation switching input to ON.

OFF: Table operation	Select which table number to operate
ON: Data input operation	Operate it after setting command data

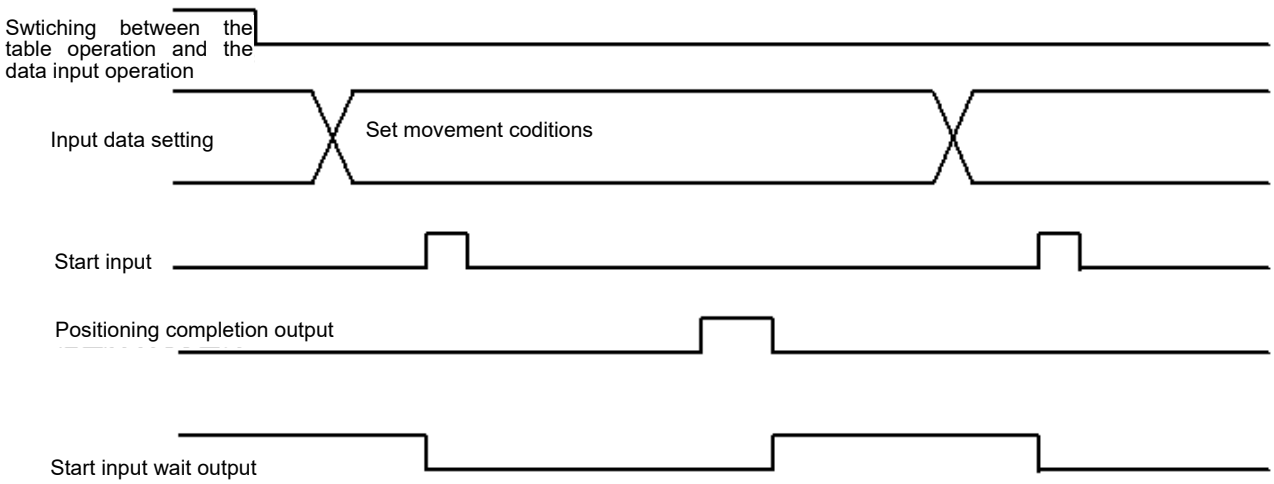
3. Set the operation contents

Set the command, the travel unit, and the travel speed unit.
Then, set a numeric value equivalent to A code /P code and F code.

4. Start with data input operation

By setting the start input to ON, execute the operation contents set above.

<Timing Chart for Data Input Operation>



- When the input data is set and the specified positioning operation is completed, the positioning completion output is generated. (For output conditions, please refer to "5.6. Judgment of Positioning Completion.")
- After the positioning completion output is generated, the start input wait output is generated.
- The start input wait output can be used with driver of software version 8.02.01 or later.

9.2.2. Input Data

<Command List>

Setting value				Description
Program No. selection input				
bit3	bit2	bit1	bit0	
0	0	0	0	Absolute dimension (G90)
0	0	0	1	Full revolution absolute dimension (G90.1)
0	0	1	0	CW direction absolute dimension (G90.2)
0	0	1	1	CCW direction absolute dimension (G90.3)
0	1	0	0	Incremental dimension (G91)
0	1	0	1	Full revolution incremental dimension (G91.1)
0	1	1	0	Home positioning (G28)
0	1	1	1	Designation of segment numbers (G101)
1	0	0	0	Change of gain magnification rate (G12)
1	0	0	1	Braking motion (M68)
1	0	1	0	Brake release (M69)

<Travel Unit List>

Setting value		Description
Travel unit selection input		
bit1	bit0	
0	0	Angle unit (G105)
0	1	Pulse unit (G104)
1	0	Index unit (G106)

<Travel Speed Unit>

Setting value	Description
Travel speed unit selection input	
0	Rotation speed (G10)
1	Time (G11)

<A Code /P Code List>

Setting value A code / P code	Description		
32bit	Angle	: -360,000 to 360,000	×1,000 [degree]
	Pulse	When the resolution setting is 540,672 P/rev : -540,672 to 540,672 [Pulse]	
		When the resolution setting is 2,097,152 P/rev : -2,097,152 to 2,097,152 [Pulse]	
	Indexing/segment numbers	: 1 to 255	[Indexing/segment numbers]
	Gain magnification	: 0, 50 to 200	[%]

<F Code List>

Setting value F code	Description		
32bit	Rotation speed	: 11 to 30,000	×100[rpm]
	Time	: 10 to 30,000	×1,000 [sec]

Input data used for data input operation consists of five items: “Command,” “Travel Unit,” “Travel Speed Unit,” “A code /P code,” and “F code.”
The items of required input data vary depending on the contents of command. For details, refer to “List of Network Operation Mode Command Combination” of “9.1.2.Point Table Data.”

<Assignment List of Input Data to be Used for Data Input Operation Execution>

Input/Output	Signal Name	EtherCAT specifications	EtherNet/IP specifications
Input (PLC → AX)	Program No. selection input (bit 0)	Output signal 1 - bit 0	Input data byte 0 - bit 0
	Program No. selection input (bit 1)	Output signal 1 - bit 1	Input data byte 0 - bit 1
	Program No. selection input (bit 2)	Output signal 1 - bit 2	Input data byte 0 - bit 2
	Program No. selection input (bit 3)	Output signal 1 - bit 3	Input data byte 0 - bit 3
	Travel unit selection input (bit 0)	Output signal 1 - bit 16	Input data byte 2 - bit 0
	Travel unit selection input (bit 1)	Output signal 1 - bit 17	Input data byte 2 - bit 1
	Travel speed unit selection input	Output signal 1 - bit 18	Input data byte 2 - bit 2
	A code / P code	Output command 2	Input data byte 24 to 27
	F code	Output command 3	Input data byte 28 to 31
	Table operation, data input operation switching input	Output signal 1 - bit 19	Input data byte 2 - bit 3
	Start input	Output signal 1 - bit 8	Input data byte 1 - bit 0

9.2.3. Input Data Setting Example

■ Travel from the current position clockwise to the 90° position in 1 sec.

<Operation Command Equivalent to NC Program G91.1G105G11A90F1>

Display Name	bit	Setting value Note 1	Description
Program No. selection input	0	1	Full revolution incremental dimension (G91.1)
	1	0	
	2	1	
	3	0	
Travel unit selection input	0	0	Angle unit (G105)
	1	0	
Travel speed unit selection input	-	1	Time (G11)
A code / P code	-	1 5F90h	1 5F90h = 90,000 (unit: ×1,000 [degree]) = 90°
F code	-	3E8h	3E8h = 1,000 (unit: × 1,000 [sec]) = 1 sec.

Note 1: If there is a lowercase h following a number or letter of a code number, such as “**h,” the code number is a hexadecimal number.

■ Change gain magnification to 100

<Operation Command Equivalent to NC Program G12P100>

Display Name	bit	Setting value Note 1	Description
Program No. selection input	0	0	Change of gain magnification rate (G12)
	1	0	
	2	0	
	3	1	
Travel unit selection input	0	-	-
	1	-	
Travel speed unit selection input	-	-	
A code / P code	-	64h	64h = 100%
F code	-	-	-

10.APPLICATION EXAMPLES

<List of Application Examples>

Item	Action Specification	Point
10.1. Product Type Change	Workpiece change without setup change	Change the program according to the workpiece type.
10.2. Shortest Route Indexing	Random indexing	Change the program according to the stopping position. Shortest route is used for the direction of rotation.
10.3. Crimping	Crimping process at stop	Program for mechanically restricting the output axis in the stopping cycle like a crimping process or a positioning pin insertion process. The brake command is used.
10.4. Pick and Place (Oscillation)	180° oscillation (Do not turn beyond a full turn.)	Be careful of the direction of rotation so that the pipe or cable installed on the actuator will not twist. Coordinate system determination method
10.5 Indexing Table	Continuation of previous day work from intermediate position	Even if the table is moved after the power is shut off to cause the table to be shifted from the power-off position, work can be continued from the power-off position. Use the M code.
10.6. Continuous Rotation	After continuous rotation, stop at the designated position.	During continuous rotation, issue a stop input to stop at the designated position. Use NC code “G101 (segment number designation).”

10.1. Product Type Change

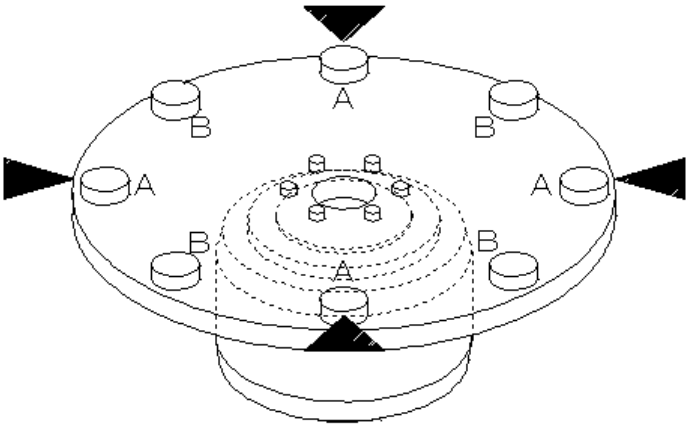
■ Application

Indexing action requiring product type change

■ Application example

Perform four-segment indexing.
Jigs for workpieces A and B are placed at 45° intervals as shown in the figure below.
When workpiece A is supplied, stop the turntable in the position shown in the figure and, when workpiece B is supplied, stop the turntable at a position shifted by 45°.

<Product Type Change>

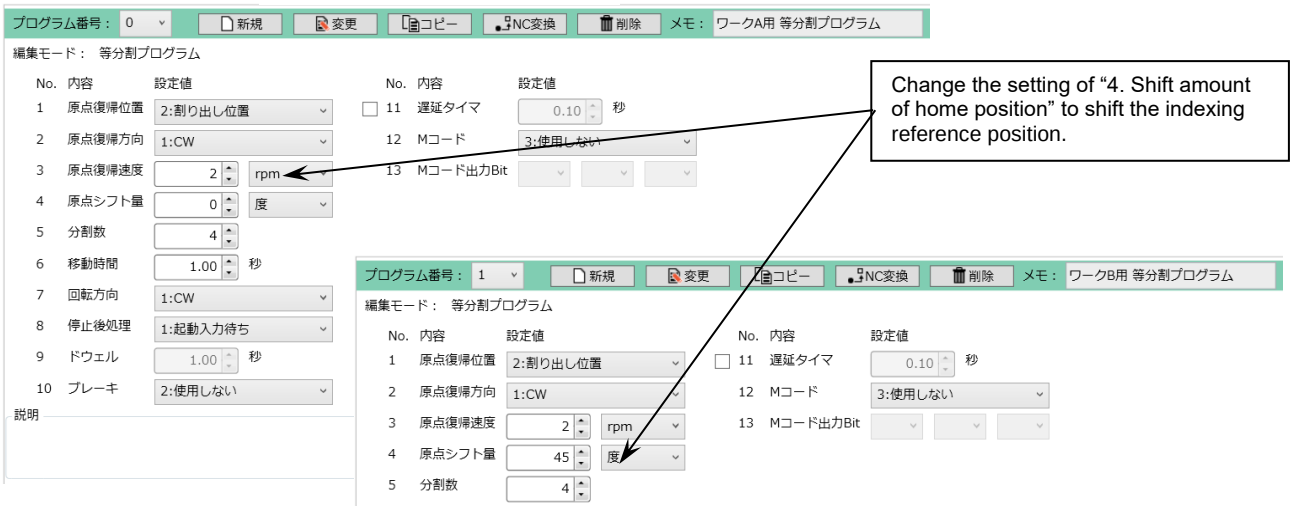


■ Program key point

(Creation example of AX-Tools)

<Editing Equal Segment Program>

Program No. 0, for workpiece A



Program No. 1, for workpiece B

When using an NC program together, be careful of the shift amount of home position.
The entered shift amount remains valid even after the program is changed if an instruction to reset the shift amount of home position to zero is missing.

After a home positioning instruction input signal is supplied or NC code G28 (home positioning) is executed, a travel to the home position specified with PRM3 (home position offset amount) occurs without relations to “4 Shift amount of home position” shown in the above figure.
With the program shown in the above figure, positioning to either one of the four stock positions occurs in a clockwise rotation upon the first start input since power-on.
The stop position before the start input decides it to position to either the nearest stock position or the next stock position.
For details of the action, refer to “PRM38=3 (Nearer direction)” of “5.8.2.Motion of G91A-1F□□ and G91A1F□□.”
The action is the same as running “G101A4; G91A1F□□;” as referred.

10.2. Shortest Route Indexing

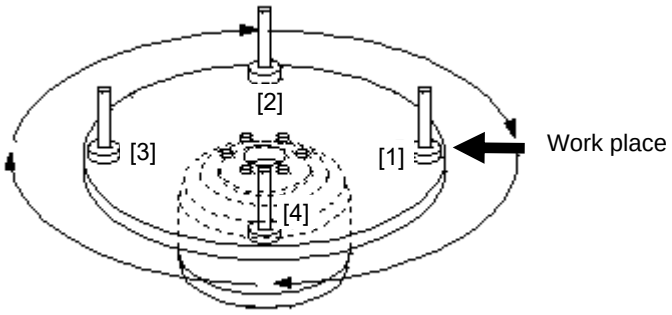
■ Application

Workpiece stocker

■ Application example

Designate from a programmable logic controller one of four stocker positions to position there. Rotation follows the shortest route.
(Rotation at larger than 180° does not occur.)

<Workpiece Stocker>



■ Program key point

Retrieve the workpiece on the shortest route.
→ Use G90.1.

Index [1] to [4] randomly.
→ Prepare four programs. From the programmable logic controller, select the program randomly to control the motion.

<Program Example 1> Designation of segment position

<Program No. 1>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A0F0.5;	Shortest route in absolute, stocker (1) travels to the work position in 0.5 sec.
M30;	End of program

<Program No. 2>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A1F0.5;	Shortest route absolute, stocker (2) travel to workplace in 0.5 sec.
M30;	End of program

<Program No. 3>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A2F0.5;	Shortest route absolute, stocker (3) travel to workplace in 0.5 sec.
M30;	End of program

<Program No. 4>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A3F0.5;	Shortest route absolute, stocker (4) travel to workplace in 0.5 sec.
M30;	End of program

“G101” equal segment designation segments in reference to the home position (0°).
If a full revolution is segmented into four as shown above, the home position becomes the “position at segment 0” and the clockwise 90° position from the home position is the “position at segment 1.”
The above description assumes that the home position means the position where “stocker (1)” is located at the work place.

In the above programs, time designation “G11” is used. The traveling time remains the same even if the traveling angle changes.
Accordingly, the rotation speed with a short traveling angle is low and that with a long traveling angle is high, possibly causing problems in the appearance (too fast rotation is dangerous) or torque shortage.
If this is the case, change the cam curve to “MC2” and use the rotation speed instruction (“G10”).

Because G90.1 is used in the above programs, the shortest route (with indexing angle within 180°) is used during operation. Use G90.2 (clockwise direction) or G90.3 (counterclockwise direction) to designate the direction of rotation.

<Program Example 2> In case of angle designation

<Program No. 1>

G105G11;	Change the unit of A to the angle (°) and unit of F to the time (sec).
G90.1A0F0.5;	Shortest route absolute, stocker (1) travels to 0° in 0.5 sec.
M30;	End of program

<Program No. 2>

G105G11;	Change the unit of A to the angle (°) and unit of F to the time (sec).
G90.1A90F0.5;	Shortest route absolute, stocker (2) travels to 90° in 0.5 sec.
M30;	End of program

<Program No. 3>

G105G11;	Change the unit of A to the angle (°) and unit of F to the time (sec).
G90.1A180F0.5;	Shortest route absolute, stocker (3) travels to 180° in 0.5 sec.
M30;	End of program

<Program No. 4>

G105G11;	Change the unit of A to the angle (°) and unit of F to the time (sec).
G90.1A270F0.5;	Shortest route absolute, stocker (4) travels to 270° in 0.5 sec.
M30;	End of program

10.3. Crimping

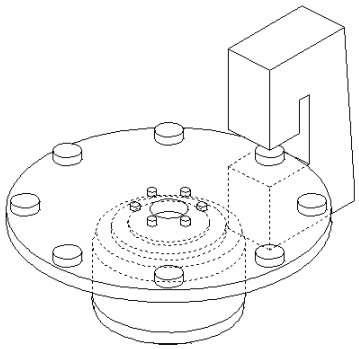
■ Application

Indexing table having a crimping process (or positioning pin insertion mechanism)

■ Application example

Eight-segment indexing table including the crimping process.
The crimping process restricts the output axis.
(The output axis is restricted, too, when the positioning pin is inserted.)
The ABSODEX used here is the type equipped with no brake.

<Crimping Process>



■ Program key point

<Use of Brake Command “M68”>

If the output axis of ABSODEX is restricted by a press or the like, an overload alarm (alarm 4) may be caused.
To avoid this, use brake command “M68” together.
For the operation method, refer to “Program Example 3” of “10.3.Crimping.”

<Brake Command>

If an optional electromagnetic brake is attached, brake command “M68” has a function not only to set a brake operation state but also to stop the integral calculation of the servo system.
With the models without a brake, it activates only the function to stop the integral calculation of the control system, resulting in the overload alarm being suppressed when the output axis is constrained with an external force.
IT DOES NOT generate a braking force in ABSODEX to constrain the output axis.
“M68” activates and “M69” deactivates the brake.
For details, refer to “M Code List” of “6.4.Code List.”

<Dwell Setting>

If a brake is used, and if the friction force is large or rotation is slow, there may be position deviation.
Braking may start before full settlement is obtained.
In this case, use a dwell instruction (G4P□) to add a delay before the brake is applied, reduce the setting of PRM16 (in-position range), or take other measures.
If the dwell instruction is used, prepare a program using NC codes.
Insert “G4P□” between the “travel instruction” block and “brake action” block.

<State at Forced Stop>

If a forced stop is supplied when the brake is applied, the brake remains applied even after the equipment is reset.
To supply a start signal without selecting a new program number, reset and supply a “brake release input” signal of EtherCAT or EtherNet/IP I/O to release the brake, then supply the first start signal.
Because the “brake release input” is a level judgment signal, turn it off after positioning completion output is issued.

<G91.1>

“G91.1” is incremental rotation dimension designation.
It automatically corrects the user coordinate to a position between -180.000° and 179.999° after a positioning completion action.

<Designation of Direction of Rotation>

In the incremental instruction, a positive value following “A” indicates clockwise rotation, and a negative value indicates counterclockwise rotation.

<Servo Off>

Use of “G12” to turn the servo off and suppress an overload alarm is also effective instead of the brake command.
(Replace “M68” with “G12P0” and “M69” with “G12P100” respectively in Program Example 3.)
“G12” changes the gain multiplication power.
“G12P0” turns the servo off and “G12P100” turns the servo on.
(For details, refer to “G Code List (2/3)” of “6.4.Code List.”)

<Program Example 3>

G11;	Change the unit of F to the time (sec)
G101A8;	Segment the full revolution into eight.
G91.1;	Full revolution incremental
M69;	Release of brake
A0F0.5;	Travel to the nearest station in 0.5 sec.
N1M68;	Block No. 1, apply brake.
M0;	Start input wait
M69;	Release of brake
A1F0.5;	Travel by an indexing segment in 0.5 sec (rotate clockwise).
J1;	Jump to block No. 1.
M30;	End of program

10.4. Pick and Place (Oscillation)

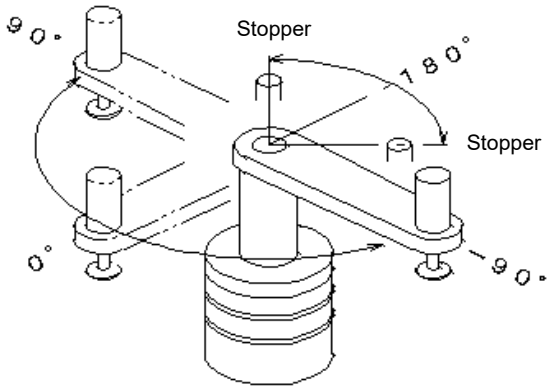
■ Application

Pick-and-place unit where each rotation is within a full revolution.

■ Application example

180° oscillation
To avoid the twist in the piping or wiring, rotation must be within a full revolution.
A mechanical stopper is provided to stop moving beyond the operation range.

<Pick-and-place>



■ Program key point

- Consider the coordinate system.
  Determine the origin of the coordinate system so that the 180° position is in the banned zone.
  Though the 0° position shown in the figure is not a stopping position, the 180° position is between stoppers.
  (The oscillation operation is from 90° to -90°.)

<Program Example 4>

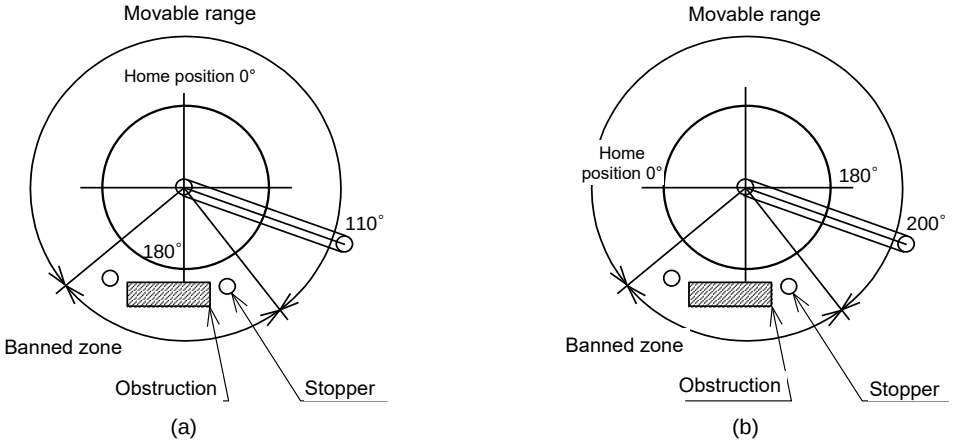
G105G11;	Change the unit of A into the angle and the unit of F into the second.
G90;	Absolute
N1A90F1;	Block No. 1; travel to the 90-degree position in 1 sec.
M0;	Start input wait
A-90F1;	Travel to the -90-degree position in 1 sec.
M0;	Start input wait
J1;	Jump to block No. 1.
M30;	End of program

To perform a home positioning, do not use the home positioning instruction having a fixed direction of rotation, but build a program using the absolute coordinate system (G90).

Upon power-on, ABSODEX assumes that the output axis is located in the range of -180.000° to +179.999°. (If the power is supplied in the 190° position, the -170° position is recognized.)

Accordingly define the 180° position in the banned zone if there are interfering matters in the full revolution.
(The coordinate mentioned here is in the G92 user coordinate system; it can be changed, using PRM3 (home position offset amount).
Refer to “5.PARAMETER SETTING.”)

<Coordinate System Setting>



The current position is recognized as at 110° upon re-power-on for the above figure (a), and as at -160° for the above figure (b).
If a travel to the 0° position is caused in this state, the case in the above figure (a) causes counterclockwise rotation up to the home position while the case in the above figure (b) causes clockwise rotation, resulting in intrusion of the banned zone.

- Use PRM45 (power-on coordinate recognition range).
  In the default parameter state, the power-on coordinate system is between -180.000° and 179.999° as mentioned in [1]. You can change PRM45 to change the power-on coordinate system arbitrarily.
  If this function is used to place the border of the coordinate system in the banned zone, there is no need to determine the home position so that the 180° position is in the banned zone.

When the resolution setting is 540,672 P/rev
PRM45
Initial Value :270,335
Setting Range : 0 to 540,671
Unit : Pulse
Effect : The power-on coordinate system is between (setting - 540,671) and setting.
<Example>
To prohibit entry into the banned zone shown in (b), “Coordinate System Setting” of “10.4.Pick and Place (Oscillation)” determine the coordinate system between -90.000° and 269.999° positions.
Convert 269.999° into pulses.
269.999÷360×540,672=405,502
Hence write “405,502” in PRM45.

When the resolution setting is 2,097,152 P/rev
PRM45
Initial Value :1,048,575
Setting Range : 0 to 2,097,151
Unit : Pulse
Effect The power-on coordinate system is between (setting - 2,097,151) and setting.
<Example>
To prohibit entry into the banned zone shown in (b), “Coordinate System Setting” of “10.4.Pick and Place (Oscillation)” determine the coordinate system between -90.000° and 269.999° positions.
Convert 269.999° into pulses.
269.999÷360×2,097,151=1,572,858
Hence write “1,572,858” in PRM45.

→ After this setting is entered, the 200° position shown in (b), “Coordinate System Setting” of “10.4.Pick and Place (Oscillation)” is recognized to be the 200° position after the power is turned on.

This function becomes valid when it is used together with the oscillation action using G90 and G91.
Do not use this function with G90.1, G90.2, G90.3, G91.1, G92, G92.1 or other codes causing determination of the coordinate system.

10.5. Indexing Table

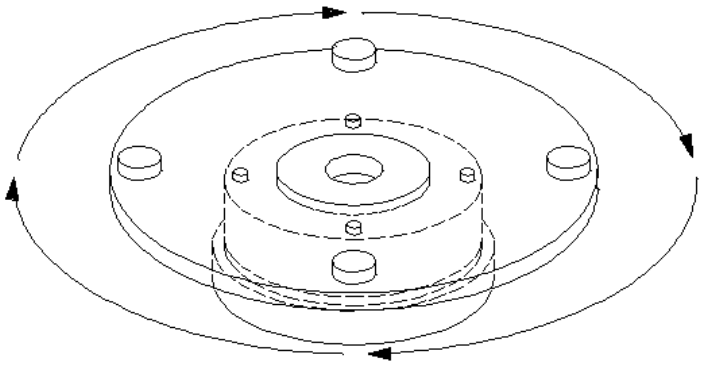
■ Application

Return to the power-off indexing position and start to index.

■ Application example

Use a four-segment indexing table and rotate clockwise.
When work is started, return to the last indexing position of the previous day.

<Indexing Table>



■ Program key point

- Use the memory of the programmable logic controller.

  → From ABSODEX, issue an M code equal to the program number and save it in the programmable logic controller.
- When the power is turned on, execute the program having the same number as the M code saved last.
- At the programmable logic controller, select programs 1 to 4 in the indexing order and execute them.
- Use segment position output “M70.”
  Use “M70” together with “G101” to output the number (binary format) corresponding to the indexing position, from the “M code output” pins of CN3 to the programmable logic controller. (A0→1, A1→2, ••• A3→4 output)

- Direction of rotation
  “G90.1” causes the shortest route travel. After the power is turned on, a travel occurs to the designated indexing position on the shortest route even if the table has been manually moved.
  Execution of the number immediately after the saved one causes indexing to the position following the one indexed last time.
  If “G90.1” in the program is replaced with “G90.2,” clockwise rotation is caused. If it is replaced with “G90.3,” counterclockwise rotation is caused.

<Program Example 5>

<Program No. 1>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A0F0.5;	Shortest route absolute; travel to indexing position 0 (home position) in 0.5 sec.
M70;	Segment position output (“1” is output.)
M30;	End of program

<Program No. 2>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A1F0.5;	Shortest route absolute; travel to indexing position 1 in 0.5 sec.
M70;	Segment position output (“2” is output.)
M30;	End of program

<Program No. 3>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A2F0.5;	Shortest route absolute; travel to indexing position 2 in 0.5 sec.
M70;	Segment position output (“3” is output.)
M30;	End of program

<Program No. 4>

G11;	Change the unit of F to the time (sec)
G101A4;	Segment the full revolution into four.
G90.1A3F0.5;	Shortest route absolute; travel to indexing position 3 in 0.5 sec.
M70;	Segment position output (“4” is output.)
M30;	End of program

10.6. Continuous Rotation

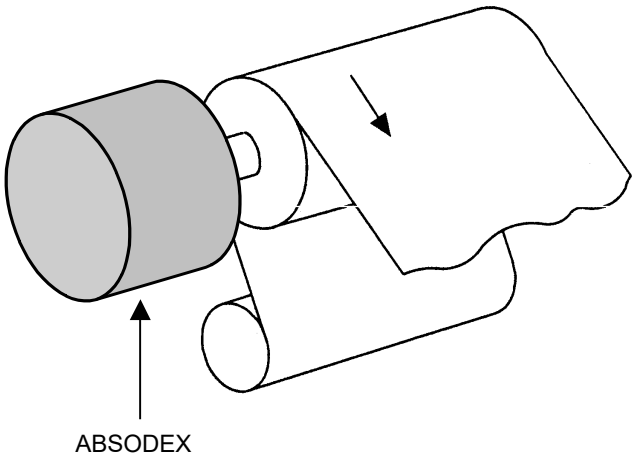
■ Application

Stop the shaft, which keeps rotating during regular operation, at the designated position upon a stop input.

■ Application example

Roll feeder

<Roll Feeder>



■ Program key point

<Continuous Rotation “G07”>

Add a hyphen “-” before the rotation speed value for counterclockwise rotation like “G07A-10.”
Enter the G08 (acceleration time of continuous rotation) and G09 (deceleration time of continuous rotation) settings.
The default value of both settings is 1 sec.
For details, refer to “G Code List” of “6.4.Code List.”

<Equal Segment Designation “G101”>

If the segment number is designated with “G101” before continuous rotation “G07” is executed, the position stopping upon a “program stop input,” “continuous rotation stop input” or “start input” becomes an indexing position.
For example, if “G101A36” is executed, a full revolution is equally segmented into 36.
The stopping position is one of the 36 positions.
For details, refer to “G Code List” of “6.4.Code List.”

<After Stop Input>

After the stop input is issued, deceleration occurs according to the “G09” setting, followed by stoppage at the next indexing position.
According to some timing of the stop input and the rotation speed and deceleration time, the stopping position may be a farther indexing position.

<Program Example 6>

<Program No. 1>

G11;	Change the unit of F to the time (sec)
G101A36;	Segment the full revolution into 36.
G08P0.5;	Set the continuous rotation acceleration time at 0.5 sec.
G09P0.5;	Set the continuous rotation deceleration time at 0.5 sec.
G07A-20;	Set the continuous rotation speed at 20 rpm and the counterclockwise rotation.
M30;	End of program

If the equipment configuration is the one shown in “Roll Feeder” of “10.6.Continuous Rotation,” deviation of alignment between the equipment and actuator will cause an alarm or breakage of the actuator.
In addition, shaft extension causes deterioration in the rigidity of the machine and resonance. Install a dummy inertia at a position nearest to the actuator.
If a work torque (force that rotates the output axis) always acts on the output axis of the actuator, use a model equipped with a brake.
If “G101A36;” is omitted in the above program, deceleration begins immediately after the stop input is supplied, to stop after 0.5 sec.
To stop continuous rotation, supply one of the “program stop input,” “continuous rotation stop input” and “start input.”
The action varies according to the supplied signal.
For details, refer to “G Code List (1/3)” of “6.4.Code List.”

11. MAINTENANCE AND TROUBLESHOOTING

DANGER

TURN OFF POWER when making maintenance inspection or changing switches in the driver with the side cover removed as electrical shock due to high voltage can occur.

Do not attach or remove connectors with the power on.

- A malfunction, failure or electric shock may be caused.

The voltages of the driver's whole surface panel terminals and connectors are high. Do not touch them when power is supplied to the product.

- Risk of electric shock due to hazardous voltage presents inside the driver. Do not touch them when product is energized, otherwise you may get an electric shock. A high voltage is applied into the capacitor at least for 5 minutes after the power is turned off.

WARNING

Do not rotate the actuator output axis at 30 rpm or more with the power off.

- There is a risk of a failure of the driver or electric shock due to the power generation action of the actuator.

On a moving part such as the actuator or a rotary table installed on the actuator, do not perform maintenance work.

Do not remove devices until the safety is confirmed.

For a while after turning off the main power, electrical charge accumulated in the capacitor inside the driver can supply power to the actuator and cause it to rotate.

- Confirm safety before carrying on working.

CAUTION

Do not overhaul the actuator unit as original functions and accuracy may not be restored.

- In particular, overhauling of the rotation position detection part may lead to a malfunction or accuracy deterioration.

Frequent repetition of power-on and -off causes deterioration of elements inside the driver due to in-rush current.

- Excessive repetition of power-on and -off will shorten the service life of the driver.

The product is supplied for use by the persons who have proper expertise in electrical or mechanical engineering.

- CKD will not be liable for bodily injuries or accident caused by the use by the people who has no or little knowledge in electrical and mechanical fields, and by the people who is not thoroughly trained for using ABSODEX.

The coordinates of the actuator position are recognized when the power is turned on. Be careful to avoid moving the output axis for several seconds since the power is turned on.

- If there is an external mechanical retention mechanism such as the brake, stagger the retention mechanism resetting timing from the power-on timing.
- If the output axis of the actuator moves when the power is turned on, alarm F may be caused.

If a small angle is designated and the operation is done, perform a rotation operation of 1 rotation or more periodically to prevent damage to the bearing part due to fretting etc.

To perform a dielectric voltage test to mechanical equipment equipped with ABSODEX, disconnect the power cables (L1, L2, L3, L1C and L2C) from the ABSODEX driver so that the test voltage is not added to the driver itself. Otherwise failure may be caused.

If power is to be turned back on after turning it off, wait for more than 10 seconds after turning off power (and also make sure actuator output axis has completely stopped) before turning it back on.

11.1. Maintenance Inspection

■ Periodical Inspection

For using ABSODEX a long time, make a periodical inspection (once or twice a year).
Turn off power for inspection except for the items 3 and 5 which require to be inspected with power ON.

<Periodical Inspection>

No.	Inspection Item	Inspection Method	Countermeasures
1	**External appearance (Any dust or dirt on the surface)**	Inspect visually.	Remove any dust or dirt found.
2	**Loose screw and connectors**	Check for looseness.	Re-tighten screws and connectors.
3	**Abnormal noise from actuator**	Confirm by hearing.	Request CKD to repair.
4	**Cuts and crack in cables**	Inspect visually.	Replace faulty cable.
5	**Power voltage**	Confirm the supply voltage with a tester.	Check the power supply system to supply power within the specified voltage range.
6	**Normal operation of fan**	Check visually and audibly.	Replace parts.
7	**Dust clogged in the fan section**	Inspect visually.	Remove any dust or dirt found.

* The product may not be accepted for repair depending on its condition.
* Do not disassemble or modify the product, as this can result in product failure or malfunction.

■ Electrolytic Capacitors Inside the Driver

The capacitors used for the driver are an electrolysis type, which deteriorates with time. Deterioration speed depends on the ambient temperature and using condition. If the product is used in an ordinary room that is air conditioned, replace the driver after 10 years (operated 8 hours per day) of use.
When solution leak or open pressure relief valve are found, replace the driver immediately.

11.2. Troubleshooting

<Troubleshooting (1/4)>

Symptom	Probable Cause	Countermeasures
Power does not turn on.	・Voltage is not measured (confirmed by a tester). ・Fuse inside the driver is blown.	・Check the power system. ・Replace or repair the driver.
Output axis rotates when power is turned ON.	・Gain adjustments are not made. ・Cable between the actuator and driver is broken or the connectors are loose. ・Wrong UVW connection ・The main power is turned on when there is position deviation.	・Adjust gain (Refer to 8). ・Check the cable connector. ・Change the wring connection of the cable. ・Turn the main power on in the servo-off state.
Alarm F will light when power is turned on.	・The encoder cable between the actuator and driver is broken or the connectors are loose. ・Excessive moment and lateral loads are applied to the actuator. ・When the power is turned on, abnormal coordinate recognition occurs.	・Check the cable connector. ・Check the equipment alignment. ・Remove excessive load. ・Check that the output axis does not rotate during power-on.
No communication with a personal computer.	・USB cable is broken or connectors are loose. ・COM ports of the PC are not correct.	・Check the cable connector. ・Check the COM port numbers.
Load table vibrates	・Gain adjustments are not sufficient. ・Load is not fixed tight. ・Load does not have enough rigidity. ・Friction load is large. ・Loose connection of actuator	・Adjust gain (Refer to 8). ・Tighten bolts. ・Increase load rigidity by reinforcement and to adjust gain smaller. ・Install dummy inertia. ・Use anti-vibration filter. ・Reduce friction load. ・Tighten bolts.
Not positioned to target position (position deviation occurs)	・Gain adjustments are not sufficient.	・Adjust gain (Refer to 8).
The 7-segment LED shows “-” (hyphen) or “_” (underscore).	・The safety function is activated.	・Refer to “3.4.3.Wiring for Safety Function.”
Alarm 0 turns on.	・NC program error ・Program number setting input has been made while writing a program. ・An unknown program number is selected and started. ・Started in servo-off mode (G12P0)	・Review the NC program. ・DO NOT turn on number setting while writing a program. ・Change the program number. Or enter the program. ・Turn the servo on (G12P100) before a rotation code.

<Troubleshooting (2/4)>

Symptom	Probable Cause	Countermeasures
Alarm 1 lights.	・The actuator is loosely tightened.	・Tighten bolts. Retighten without fail.
	・Load is excessive.	・Reduce speed.
	・Connection of the drive to actuator is not right.	・Check the cable connectors. (Refer to “System Configuration” of “1.1.1.System Configuration Example.”)
	・Output axis is restricted by machine clamp mechanism.	・Apply or release the brake in the program (Refer to 10.3).
	・Load is not fixed tight.	・Tighten bolts.
	・Gain adjustment has not been performed at G2:-1.	・Adjust gain (Refer to 8).
	・Gain adjustments are not sufficient.	・Adjust gain (Refer to 8).
	・DC power (24 V) is not supplied for brake built-in series.	・Supply 24 VDC (Refer to 0).
Alarm 2 lights.	・Acceleration/deceleration cycles are large.	・Set stop time longer (Take time for heat reduction to re-start.)
Alarm 4 lights.	・Acceleration/deceleration cycles are large.	・Set stop time longer (Take time for heat reduction to re-start.)
	・Moving time is short.	・Revise the program.
	・Load equipment resonates.	・Install dummy inertia.
		・Use anti-vibration filter (Refer to 5.9).
	・Output axis is restricted by machine clamp mechanism.	・Apply or release the brake in the program (Refer to 10.3).
	・Rotation and friction torque of load equipment is large.	・Reduce the load. Increase the size of ABSODEX.
Alarm 5 lights.	・Failure or faulty insulation of actuator Check of connector damage and deformation, foreign matter (metal chips, chips, dust, etc.) catching and entrance	・Foreign matter removal ・Actuator repair and replacement
	・Faulty insulation of power cable Power cable breakage and damage and core short circuit and disconnection check	・Check around wiring ・Replacement of cable
	・Driver failure and insulation defect Foreign matter (metal chips, chips, dust, etc.) entrance	・Foreign matter removal ・Driver repair and replacement
	・Others Noise filter selection mistake	・Connect the ferrite core to the power cable (the noise filter for power supply 3SUP-EF10-ER-6, etc. cannot be used).
	Wrong wiring and installation environment	・Check the cable connectors, and installed environment. ・Cable connection check ・Decrease the ambient temperature.

<Troubleshooting (3/4)>

Symptom	Probable Cause	Countermeasures
Alarm 6 lights.	・Power voltage is low. ・Instantaneous power failure has occurred. ・Power resumed immediately after power off. ・The regenerative energy caused an over-voltage error.	・Check the power system. ・Check the power system. ・Turn off power, and turn it on after a few seconds. ・Reduce the traveling speed.
Alarm 9 lights.	・Forced stop is input. ・24 VDC is not supplied.	・Check I/O signal. Confirm the PRM23. ・Supply 24 VDC.
Alarm A lights.	・An attempt was made to rotate with brake-on. The brake is applied in a travel. ・PRM28 is set for motion.	・Review the program. ・Parameter correction Review the program.
Alarm H lights.	・Answer input is not made for M code, and positioning completion. ・No answer input is supplied. ・Parameter was changed by mistake. ・A start input or home positioning input is supplied in the state waiting for an answer input.	・Check I/O signal. Confirm the PRM11, 12 and 13. ・Confirm program and timing of programmable logic controller. ・Confirm the PRM12 and 13. ・Check I/O signal.
Alarm C lights.	・Internal coordinate system has overflowed (G92 user coordinate system). ・Parameter was changed by mistake.	・Review the program (reset the G92 coordinate system). ・Confirm the PRM8, 9 and 10.
Alarm F lights.	・There is a fault in power-on coordinate recognition. ・The actuator vibrates during operation, causing an error in coordinate recognition.	・Check the encoder cable wiring. ・Check if the output axis rotates during power-on. ・Refer to the trouble “Load table vibrates.”
Alarm P lights.	・The driver is faulty.	・Replace or repair the driver.
Alarm L lights.	・There is a communication error between the actuator and driver. ・Mismatch between actuator and driver	・Check the cable wiring. ・Check the combination between the actuator and driver.
Alarm 3 lights.	・There is a combination error.	・Check the combination between the actuator and driver. ・Enter the program and parameters again.

<Troubleshooting (4/4)>

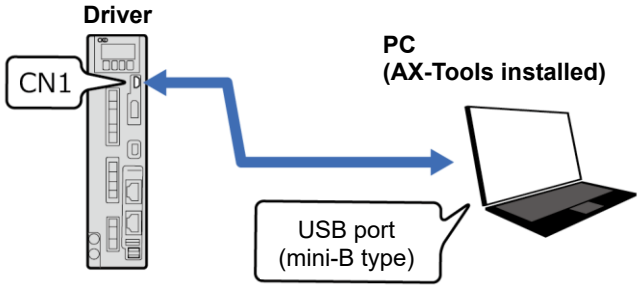
Symptom	Probable Cause	Countermeasures
When the program is stored, alarm 7 lights up and the program is not stored.	・The program area is full. ・Program data is broken. ・Write protection state The program being executed is not completed.	・Delete unnecessary programs. ・Clear the program memory area and enter again. (L17_9999) ・Check the start input wait output. The program can be stored during start input wait output state. ・Change the pulse string input mode to the automatic operation mode. ・Check of I/O signal (start input wait output and answer output) Adjust gain (Refer to 8).
Start signal input will not cause motion to be made.	・Program is not input. ・Brake is applied. ・24 VDC I/O power is not supplied. ・Input signal is shorter than 20 msec. ・No automatic operation. ・The servo-on input is not supplied. ・The safety function is activated. ・The program being executed is not completed.	・Input motion programs. ・Release of brake ・Check the power system. ・Set longer input signal time (Refer to 4.5). ・Set to auto mode. Confirm the PRM29. ・Supply the servo-on input. ・Change PRM52 to “2” and do not use the servo-on input. ・Refer to “3.4.3.Wiring for Safety Function.” ・Adjust gain (Refer to 8).
The start signal supplied after recovery from a forced stop does not cause a start.	・Position in the program where start input wait (M0) is written	・Change the position of “M0.”
The electromagnetic brake does not release.	・24 VDC I/O power is not supplied. ・24 VDC is not supplied to the electromagnetic brake.	・Check the power supply and wiring. ・Check the power supply, wiring and relay. (Refer to 0)
Repetitive five-segment (72-degree) indexing operations cause deviation.	・Accumulated error due to incremental dimension	・Use the equal segment program (G101).
Parameters are not stored.	・Pulse string input (M6) operation mode ・The program being executed is not completed.	・Change to the automatic operation (M1) or single block (M2) operation mode and store. ・Check of I/O signal (start input wait output and answer output) ・Adjust gain (Refer to 8).
Alarm U lights up.	・Friction load is large. ・Brake is applied. ・Interference of rotating parts with jigs or equipment	・Increase PRM87 setting. ・Release the brake. ・Remove peripheral devices.
Oscillation after auto tuning	・No gain adjustment at panel ・The rigidity of the equipment is too small.	・Set to G2:-1. ・Install a dummy inertia and perform auto tuning. ・Adjust the gain manually. (Refer to 8.)

When the output axis of the actuator is manually rotated without power-on with the driver and actuator connected, torque pulsation may be felt, but this is not abnormal condition.
When the above countermeasures will not help troubleshooting, contact CKD.
The product may not be accepted for repair depending on its condition.
Do not disassemble or modify the product, as this can result in product failure or malfunction.

11.3. System Initializing

System initializing means to clear all NC programs, and set parameters to the default values.
For this, a personal computer (AX-Tools) is required.
<Procedure>

1. Connect a PC to CN1.



2. In the terminal mode of AX-Tools, enter L17_12345↵.

3. Turn off power, and turn it on again.

The above procedure will erase all the programs and parameters in the driver.
Make sure backup of these are made before starting the procedure.
The gain adjustment result is also deleted.
After initializing the system, make gain adjustment again.
For details, refer to “8. Gain Adjustment Method.”

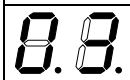
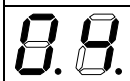
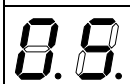
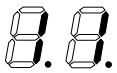
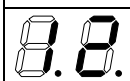
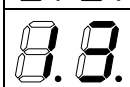
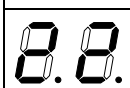
12.ALARMS

An error to ABSODEX will display an alarm number in the 7-segment LED on the front of the driver.
The second digit and the first digit from the right of 7-segment LEDs show the alarm number and details of the alarm, respectively.
At the same time, alarm outputs of EtherCAT and EtherNet/IP I/O (Output signal 1 - bit 11 and 12 / output data byte 1 - bit 3 and 4) will also be ON. (Alarm outputs are negative logic.)

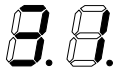
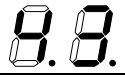
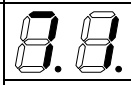
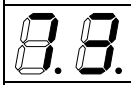
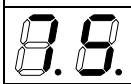
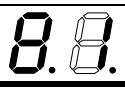
12.1. Alarm Display and Description

The table below lists alarm displays and their description.
For alarms, refer to “11.MAINTENANCE AND TROUBLESHOOTING.”

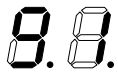
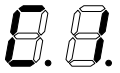
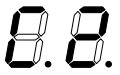
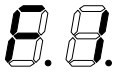
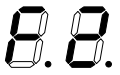
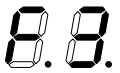
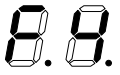
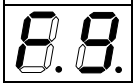
<Alarm List (1/4)>

Alarm No.	Description	Alarm output	7-segment LED	Remarks
0	NC program error	Alarm 1		Program data error (M1 mode)
				Program selection error
				Program data error (M3 mode)
				S4 is input when the program cannot be executed.
				Answer input command S10 is executed while no answer is waited for.
				Time exceeded during pulse travel
				Other program errors
				
1	Position deviation over	Alarm 1 Alarm 2		Setting of PRM19 (upper limit of position deviation amount) is exceeded.
	Speed limit over			Setting of PRM20 (speed over limit) is exceeded.
	Encoder output max. frequency over			The maximum encoder output frequency is exceeded.
2	Overheated regenerative resistor	Alarm 1 Alarm 2		The power is turned on in a regenerative resistor overheat error.
				A regenerative resistor overheat error is caused during operation.
				A regenerative resistor overcurrent error is caused during operation.

<Alarm List (2/4)>

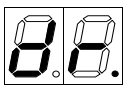
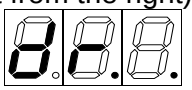
Alarm No.	Description	Alarm output	7-segment LED	Remarks
3	Actuator/Driver combination abnormal	Alarm 1		An actuator different from the previous one is connected (model error)
				An actuator different from the previous one is connected (serial number error in same model).
4	Overloaded actuator	Alarm 1 Alarm 2		Error caused by load factor calculation
				Error caused by load factor calculation (The load factor is 120% or higher.)
				The power module protective function is activated.
5	Power module abnormal	Alarm 1 Alarm 2		The power is turned on in the presence of an over-current or a fault signal sent from the power module.
				An over-current or a fault signal from the power module is sent during operation.
				The power is turned on in the presence of an overheat or a fault signal sent from the power module.
				An overheat or a fault signal from the power module is sent during operation.
6	Main power abnormal	Alarm 1 Alarm 2		A travel command is generated in the low-voltage error state. A low-voltage error is caused during travel.
				The power is turned on in a state with an over-voltage error.
				An over-voltage error is caused during operation.
7	Communication error	Alarm 1		Data input error
				A user tries to write into a parameter into which writing is impossible.
				An M-code is sent during operation.
				The parameter number is not specified in the parameter loading/writing cycle.
				Other communication errors
				
8	Control PCB abnormal	(Indefinite)		Hardware of CPU in the driver may be faulty.

<Alarm List (3/4)>

Alarm No.	Description	Alarm output	7-segment LED	Remarks
9	Forced stop input has been made	Alarm 2		A forced stop input has been supplied when the servo-on-after-stop parameter (PRM23) is set at “1.”
				A forced stop input is supplied when the servo-on-after-stop parameter (PRM23) is set at “1.”
				A forced stop input has been supplied when the servo-off-after-stop parameter (PRM23) is set at “3.”
				A forced stop input is supplied when the servo-off-after-stop parameter (PRM23) is set at “3.”
A	Brake abnormal	Alarm 2		A travel command is generated after a brake command (M68) is executed.
				A travel command is generated under brake application with the I/O brake release input turned off.
C	Software limit over	Alarm 2		PRM10=2: If the software limit is not effective: The user coordinate exceeds the PRM8 set range upper limit value or PRM9 set range lower limit value. PRM10=1: If the software limit is effective: The user coordinate exceeds PRM8 or PRM9 set value.
				Segment range error with PRM38 (direction of rotation at equal segment designation) being “4”
F	Position detector abnormal	Alarm 1 Alarm 2		The position data has suddenly changed during indexing operation.
				The position data has suddenly changed during other than above operation (such as during continuous rotation and while inputting pulse).
				An error generates in the electric angle during indexing operation.
				An error generates during other than above operation (such as during continuous rotation and while inputting pulse).
				Signals from two position detectors (resolvers) are not consistent with each other.
				When the power is turned on or mode is changed, the position data are not stabilized.
				The position detector is abnormal.
				The position detectors (resolvers) are abnormal.
				

<Alarm List (4/4)>

Alarm No.	Description	Alarm output	7-segment LED	Remarks
H	No answer error	Alarm 2	H.8.	The no-answer time after an M-code output exceeds the PRM11 setting.
			H.A.	The no-answer time at positioning completion output exceeds the PRM11 setting.
			H.9.	A start input is supplied while an answer is waited for.
			H.9.	A home return input is supplied while an answer is waited for.
L	Actuator communication abnormal	Alarm 1 Alarm 2	L.8.	Actuator data reception error
			L.A.	Connection of inapplicable actuator (error in connection between small and large types)
			L.9.	Actuator data reception error (Abnormality is detected on the actuator side.)
			L.9.	Actuator data reception error (position detector data reception error)
	Drive PCB abnormal		L.A.	A hardware failure in the drive PCB is probable.
P	Memory abnormal	Alarm 2	P.8.	Data writing error to internal memory
			P.A.	Driver information has an error.
U	Auto tuning abnormal	Alarm 1 Alarm 2	U.8.	Acceleration is impossible up to the auto tuning end speed.
			U.A.	An error generates in auto tuning operation.
				A load factor error occurred during auto tuning.
- (Hyphen)	Activation of safety function		-.-	Wait for ready return input after activation of safety function
_ (Under-score)			_..	During activation of safety function

The 7-segment LED shows  (a dr and a dot) at the third digit and the second digit from the right without an alarm.
The 7-segment LED (1st digit from the right) shows the operation mode.
For servo off (M5 executed),  (dr and two dots) will be displayed.

■ Alarm 3

Alarm 3 is displayed when the power is turned on with a wrong combination between the actuator and driver to urge the operator to check the connection.
Alarm 3 is temporarily removed upon resetting, but it is displayed again after the power is turned off then on again.
Check that the actuator connected with the driver is correct, enter the program or parameters and reset so that alarm 3 is not caused upon power-on.
<Supplementary description>
After the driver is connected with the actuator and the program or parameters are entered, the data about the connected actuator is stored in the driver and the combination between the driver and actuator is determined.
If an actuator different from the one stored in the driver is connected, alarm 3 is caused. After the above operation, the data about the actuator stored in the driver is updated. Combination can be changed arbitrarily.
The data about the actuator stored in the driver is initialized and alarm 3 is not caused with any combination in the following cases.

- Shipment state
- After initialization
- If a program or parameter is entered without an actuator

■ Alarm 6

Low-voltage error alarm 6 is caused only if there is a travel command to be executed in the low main power supply voltage state. Alarm 6 does not notify of a low main power supply voltage directly.

CAUTION

DO NOT restart the actuator until it cools down if alarm 4 (overloaded actuator: load factor) is caused.

- The following may be causes for alarm 4. Remove the causes before restarting operation.
  1. Resonance or vibration → Secure sufficient rigidity for the installation.
  2. Cycle time or speed → Elongate the traveling time and stopping time.

Even if alarm 3 is caused, program execution can be made. However, to avoid unexpected operation caused by wrong combination, check the program and parameters without fail before executing the program.

Structured to constrain the output axis → Add M68 and M69 command.

- Refer to “10.3.Crimping.”

12.2. Servo Status for Alarms

Alarm	1, 2, 4, 5, 6, 9 (PRM23=3), A, F and L	→	Servo OFF
Alarm	0, 3, 7, 9 (PRM23=1), C, E, H, P and U	→	Servo ON

When an alarm occurs while an NC program is executed, the program execution will be terminated to turn into the servo conditions as described above.
However, for the alarm 7 (communication error) or alarm 3 (combination error), the program execution will be continued with alarm output and displayed.
Reset signal input after eliminating the cause of alarms will cause the servo-off alarm to turn to servo-on. Alarms 9 (PRM23=1) and E will cause the servo-off and then servo-on.
For the safety function restoration process, refer to “4.7.5.Sequence of Safety Function.”

CAUTION

For an alarm, make sure that the cause of the alarm is eliminated prior to resetting.

- For alarms, refer to “11.MAINTENANCE AND TROUBLESHOOTING.”

13.SUPPORT FOR UL STANDARD

If this product is used as UL-compliant product, be sure to read this section before use.
A product on which a UL mark is attached is a UL-compliant product. A product on which no mark is attached is not a UL-compliant product.

Operation of this equipment requires detailed installation and operation instructions provided in the instruction manual intended for use with this product.
This manual should be retained with this device at all times.

Manufacture's name: CKD Corporation

<Applicable Standards>

Item	UL File No.	UL Standard	Description
Driver	E325064	UL61800-5-1	Adjustable Speed Electrical Power Drive Systems

13.1. Precautions for Using the Driver

13.1.1. Installation Location and Installation Environment

■ Pollution degree

<Pollution degree>

Pollution degree
2

Install device in pollution degree 2 environments.
If this product is being used in a pollution degree 3 environment, install the driver within a control panel having a construction that is free of water, oil, carbon, metallic powder, dust, etc. (IP54)

■ Maximum surrounding air temperature

<Maximum surrounding air temperature>

Maximum surrounding air temperature	
AXD-SA2	55ºC
AXD-HA2	55ºC

13.1.2. Connection to Power and Actuator (CN4A, CN4B, CN5)

■ L1, L2, L3 (CN4A), L1C, L2C (CN4B)

Connect to the power supplies using the connectors provided.
To use with 3-phase power supply, connect the 50/60 Hz power cables to the L1, L2, L3, L1C and L2C terminals.
To use with single-phase power supply, connect the 50/60 Hz power cables to the L1, L2, L1C and L2C terminals.

* If it is used at single-phase 200 VAC, the calculation of the torque limit area is different from normal one. If you cannot judge whether they can be used, please contact us.
* The power cable must be of heat resistant vinyl wire having the temperature limit of 75ºC.
* For wiring of L1, L2, and L3, use voltage-resistant wire of 600 V or higher.

■ ⏚ Ground terminal

The ground cable (G) of the power cable and the ground of the main power must be wired to this terminal to avoid an electrical shock.
The cross-sectional area of the wire for the protective grounding conductor shall be larger than or equal to that of the power supply cable.
Use a crimp terminal for the wiring at this terminal. The size of the screw is M4.
Tighten the screw to 1.2 N·m.

■ U, V, W (CN5)

Connect to the actuator using the connectors provided.
Connect the U, V and W cables of the power to the corresponding terminals.

■ Wiring method for accessory connector (CN4A, CN4B, CN5)

Applicable cable

Refer to the following table for the wire diameter to be wired to the connector.

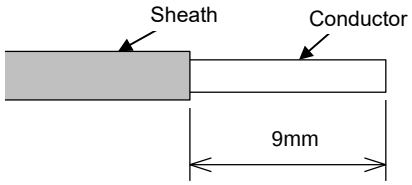
Model	Input L1C, L2C	Input L1, L2, L3	Output U, V, W
AXD-SA2	AWG18(0.8 mm^2) to AWG14(2.0 mm^2) (Strand wire)	AWG14(2.0mm^2) (Strand wire)	AWG14(2.0mm^2) (Strand wire)
AXD-HA2			

* The wire diameter can be selected based on the rated current of the actuator.
The values in the table indicate the wire diameters based on the rated output of the driver.

Cable End Treatment

Stranded cable: Peel off the sheath of the cable and twist it to use.
At the time, be careful to avoid a short circuit across the element wire of the conductor and adjacent pole.
Do not solder the conductor; otherwise poor continuity may be caused.

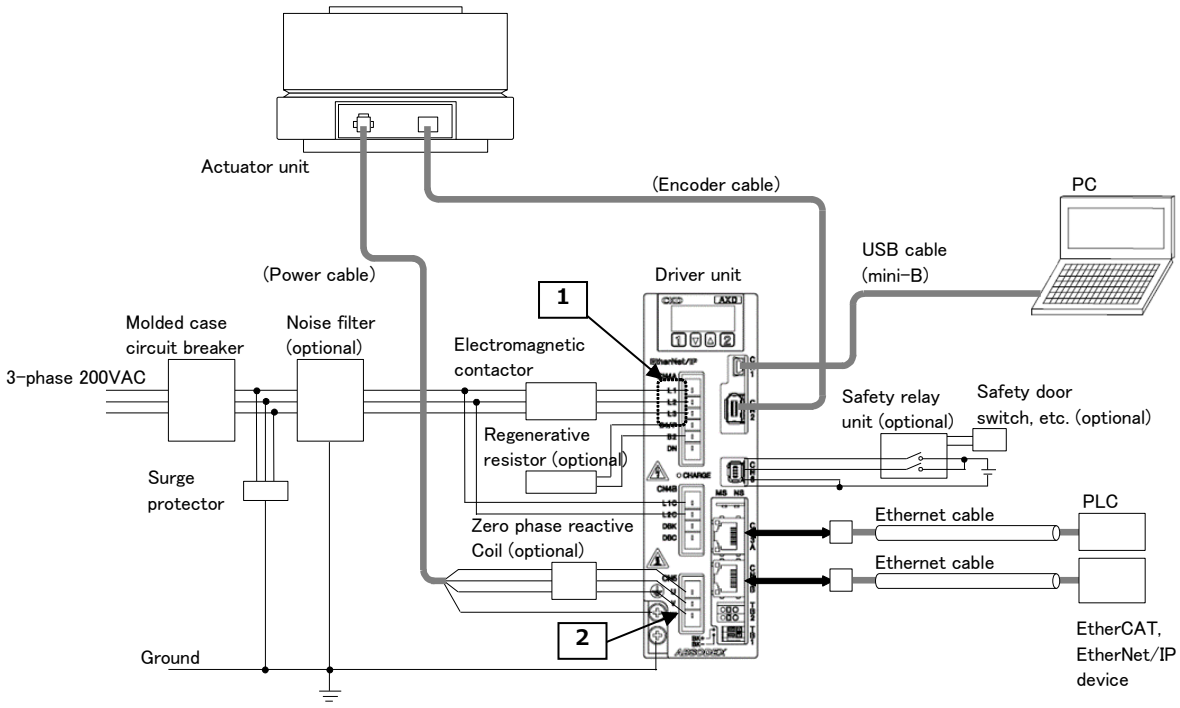
<End Treatment Drawing>



How to Insert the Cable into the Connector

Use the provided operating lever to insert the power supply insertion section of the plug connector.
Remove the plug connector from the equipment before inserting it.
A poorly tightened cable can cause poor continuity, resulting in a heat generating from the cable or connector.

13.1.3. System Configuration Example



<Applicable Cable>

Item	Wire Range (AWG)
1 2	14 (75ºC, Cu Wire Only)

Wiring terminal: Terminal must be wired according to the description given in “1.PRODUCT CONFIGURATION.”

13.1.4. Rating of the Driver

<Rating of the Driver>

Item		AXD-SA2	AXD-HA2
Power Input	Voltage	AC200-240V	AC200-240V
	Rated current	5.5A/3.2A	9.0A/5.2A
	Number of phase	1-Phase/3-Phase	1-Phase/3-Phase
	Frequency	50/60Hz	50/60Hz
Control Input	Voltage	AC200-240V	AC200-240V
	Rated current	0.12A	0.12A
	Number of phase	1-Phase	1-Phase
	1-Phase	50/60Hz	50/60Hz
Power Output	Voltage	0-230V	0-230V
	Rated current	3.5A	6.8A
	Number of phase	3-Phase	3-Phase
	Base Frequency and Frequency Range	0-50Hz	0-50Hz
Maximum Surrounding Air Temperature		55ºC	
Enclosure		Open Type	
SCCR (Short Circuit Current Rating)		5kA	

13.1.5. Degree of Protection Level

Solid state motor overload protection is provided in each model.
Solid State motor overload protection reacts with max. 100 % of FLA.
* FLA (Full Load Ampere): Rated Output Current

13.1.6. Short Circuit Current Rating

Suitable for use on a circuit capable of delivering not more than 5 kA rms Symmetrical Amperes, 240 Volts Maximum.

MODEL: AXD-SA2,AXD-HA2
SCCR: 5kA
When protected by CC, G, J or R class fuses, or when protected by a circuit breaker having an interrupting rating not less than 5 kA rms Symmetrical Amperes, 240 Volts Maximum.
*Suitable for use on a circuit capable of delivering not more than 5 kA rms Symmetrical Amperes, 240 Volts Maximum.

Integral solid state short circuit protection does not provide branch circuit protection.
For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes" or equivalent.
For installation in Canada, branch circuit protection must be provided, in accordance with the Canada Electrical Code, Part 1 or the equivalent.
Use UL/CSA-certified wiring circuit breakers and fuses.
・For wiring of the main circuit input power supply, use voltage-resistant wire of 600 V or higher.
・When bundling the wires to insert them into rigid vinyl pipes or metal ducts, consider the decrease rate of the allowable current of the wires.
For current capacity, refer to the following table.

Main circuit input power supply	Driver Model		Current capacity of wiring circuit breakers and fuses (Arms) Note 1, Note 2	
	Capacity (kW)	**AXD**		
AXD-S	0.4	SA2-	10 A	Note 3
AXD-H	0.8	HA2-	20 A	Note 3

Note 1: Those are net values at rated road. In selecting an actual fuse, determine a capacity considering the required derating.
Note 2: Breaking characteristics (25ºC) 200%, 2s or more, 700% 0.01s or more
Note 3: UL certification tests were conducted using a wiring circuit breaker with 240 VAC and 15 A.

13.1.7. External Power

External 24 VDC of CN3 and TB1 must be supplied from Class 2 power unit.

13.1.8. Overheating Protection

This product is not provided with the motor overheating protection specified in UL61800-5-1.
If your system in which this product is to be used requires motor overheating protection, take appropriate measures, such as implementing a motor overheating detection.

WARNING

CAUTION - Risk of Electric Shock, Capacitor discharge time is at least 5 min. Danger of electric shock from high voltage generated on the connectors and inside the driver.

- Do not touch them when power is supplied to the product.
- Do not touch the connectors and inside the driver for at least 5 minutes after power is disconnected.
- Moreover, the capacitor contains high electrical energy that may lead to the electric shock.

14.SUPPORT FOR EUROPEAN STANDARDS

If this product is used as EN-compliant application, be sure to read this section before use.
A product on which a CE and a UKCA marks are attached is compliant with European Standards. A product on which no marks are attached is not compliant with European Standards.
In addition, refer to “1.PRODUCT CONFIGURATION.”

14.1. EU Directive / European Standards

■ Low Voltage Directives

IEC/EN 61800-5-1

■ EMC Directive

IEC/EN 61800-3

■ Safety Function (Safe Torque Off)

IEC/EN 61800-5-2
EN ISO/ISO 13849-1
IEC/EN 61508-1,2

14.2. Precautions on Operation in EU Member Countries and U. K.

14.2.1. Installation Conditions

Be sure to observe the following installation conditions to operate our product safely.
Over voltage category: III
Pollution degree: 2

14.2.2. Protection Against Electric Shock

The product is designed to comply with the protective class I structure.
The power supply circuit, primary control circuit and secondary low voltage signal control circuit (inputs/outputs of CN1, CN2, CN3, CN6, and TB1) are separated by reinforced isolation.
The driver is also designed to provide IP2X protection by its enclosure.
To avoid direct contact with hazardous voltages or damage from external forces, install drivers in the following locations:

14.2.3. Environment

Operate our product in pollution degree 2 or better environment.
If the product needs to be used in pollution degree 3 or 4, install the driver in an enclosure (e.g. control cabinet) of IP54 or higher where entry of water, oil, carbon, metallic powder, dust and others is prevented.

14.2.4. Protective Earthing

Be sure to ground the protective earth terminal of the driver to avoid electric shock.
Even if an earth leakage breaker is used, be sure to ground the driver.
Connection of only one protective earth wire to one terminal is permitted. Do not connect two or more wires at a single terminal.
The cross-sectional area of the wire for the protective earthing conductor shall be larger than or equal to that of the power supply cable (2 mm^2).
The touch current exceeds 3.5 mAAC when the driver is used with the following models.
Ground it using the protective earthing terminal of the actuator.
(AX1R-150, AX1R-210, AX4R-300, AX4R-500, AX4R-10W)
The minimum size of the protective earth conductor shall comply with the local safety regulations.

14.2.5. Test Operation

Perform test operation in the final installation state.

14.2.6. Provision of External Overcurrent/Short-Circuit Protective Device

Install a circuit-breaker (IEC/EN 60947-2) to the line side of each driver.
The rated current of the breaker is as shown in “Circuit Breaker Capacity” table below. A reference model is also shown in “Reference Model” table below.

<Circuit Breaker Capacity>

Driver Model	Rated current
AXD-S	10A
AXD-H	20A

14.2.7. Residual Current Protection

Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection, only an RCD or RCM of Type B is allowed on the supply side of product.
Otherwise, protective measures, such as isolating the driver with double insulation or reinforced insulation or isolating the input from the power supply using an isolation transformer, will be necessary.

14.2.8. Overload Protection

Solid state motor overload protection is provided in this product.
Solid State motor overload protection reacts with max. 100 % of FLA.
* FLA (Full Load Ampere): Rated Output Current

14.2.9. SCCR (Short Circuit Current Rating)

The value of SCCR is 5 kA.

14.2.10. Compatible Actuators

The driver models and their compatible actuators that can be used in combination are as indicated in the table below.

Driver Type and Compatible Actuator

Driver Model	Compatible Actuator	
AXD-S*	AX1R Series	AX1R-022
		AX1R-045
		AX1R-075
	AX2R Series	AX2R-006
		AX2R-012
		AX2R-018
	AX4R Series	AX4R-009
		AX4R-022
		AX4R-045
		AX4R-075
AXD-H*	AX1R Series	AX1R-150
		AX1R-210
	AX4R Series	AX4R-150
		AX4R-300
		AX4R-500
		AX4R-10W

14.2.11. Forced Stop

The category of the forced stop function using EtherCAT or EtherNet/IP I/O (Input signal 1 - bit 12 / input data byte 1 -bit 4) provides category 2 stop in accordance with IEC/EN 60204-1.
When this function is used, assess if this stop category 2 is adequate for the actual application.
For the forced stop function using EtherCAT or EtherNet/IP I/O (Input signal 1-bit 12 / input data byte 1 - bit 4), refer to “4.HOW TO USE .”

Description of term

Category 2: Controlled stop; the mechanical operating device remains supplied with electric power.

(Description is given in “8.2.2.Manual Tuning” of IEC/EN 60204-1.)

14.2.12. Safety Function (CN6)

The safety function employed in this product, STO: Safe Torque Off, is such that the power that can cause rotation of actuator is not applied by opening the contact connected to CN6.
Within 5 ms after interrupting the safety circuit, the power to rotate the actuator is removed.
If the safety function is used, make sure to conduct a comprehensive risk assessment of the final application and check if the STO function detailed in “Safety Function Parameters” table below satisfies the required performance level / safety integrity level of the application.
In addition, reference models for the safety relay unit are indicated in “Reference Model” table below.

<Safety Function Parameters>

Item	Specification
Safety function	STO (IEC/EN61800-5-2)
Safety performance	EN ISO13849-1 Cat3 PL e Note 1 EN61508 SIL3
Diagnostic coverage (DC)	90%
Probability of failure on demand per hour (PFH)	1.00×10^{-8} to 1.00×10^{-7}
Probability of failure on demand (PFD)	1.00×10^{-4} to 1.00×10^{-3}

<Reference Model>

Manufacturer	Series Name	Remarks
Omron Corporation	G9SX-BC202	Safety relay unit (semiconductor contact output)

- See “3.4.3.Wiring for Safety Function” and “4.7.5.Sequence of Safety Function” if the safety function is used.

14.2.13. Operating Environment

<Driver>

Condition	Temperature	Humidity	Atmospheric Pressure
During operation	0 to 55ºC	90%RH or lower, no condensation allowed	86 kPa to 106 kPa
During storage	-20 to 65ºC	90%RH or lower, no condensation allowed	70 kPa to 106 kPa
During transportation	-20 to 65ºC	90%RH or lower, no condensation allowed	70 kPa to 106 kPa

WARNING

Electric shock – Risk of electric shock due to hazardous voltage present at the connectors and inside the driver. Do not touch them when power is supplied to the product.

- A high voltage is applied into the capacitor at least for 5 minutes after the power is turned off.
- Do not touch the connectors and inside the driver for at least 5 minutes after power is disconnected.

Hot surface – Heat sink becomes hot when the driver is energized and even after power is disconnected until it is cooled down.

- To prevent burn injury, do not touch the hot surface.

This product can cause a direct current in the protective earth conductor in earth fault event.

- Where a residual current-operated protective (RCD) or monitoring (RCM) device is used for protection, only an RCD or RCM of Type B is allowed on the supply side of product.
  Otherwise, protective measures, such as isolating the driver with double insulation or reinforced insulation or isolating the input from the power supply using an isolation transformer, will be necessary.

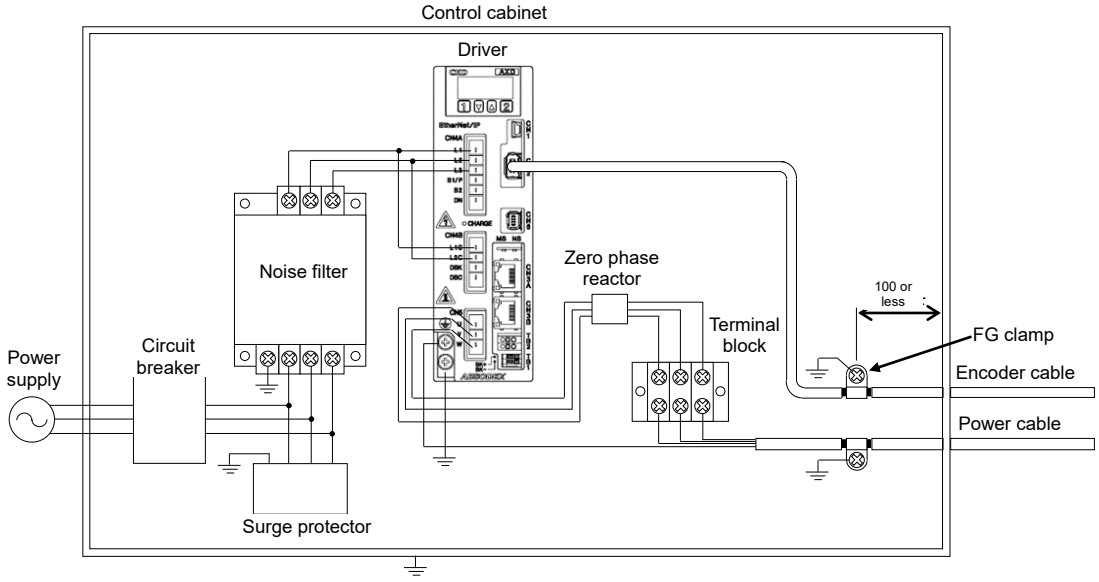
Be sure to ground the protective earth terminal of the driver to avoid electric shock.

- Even if an earth leakage breaker is used, be sure to ground the driver.

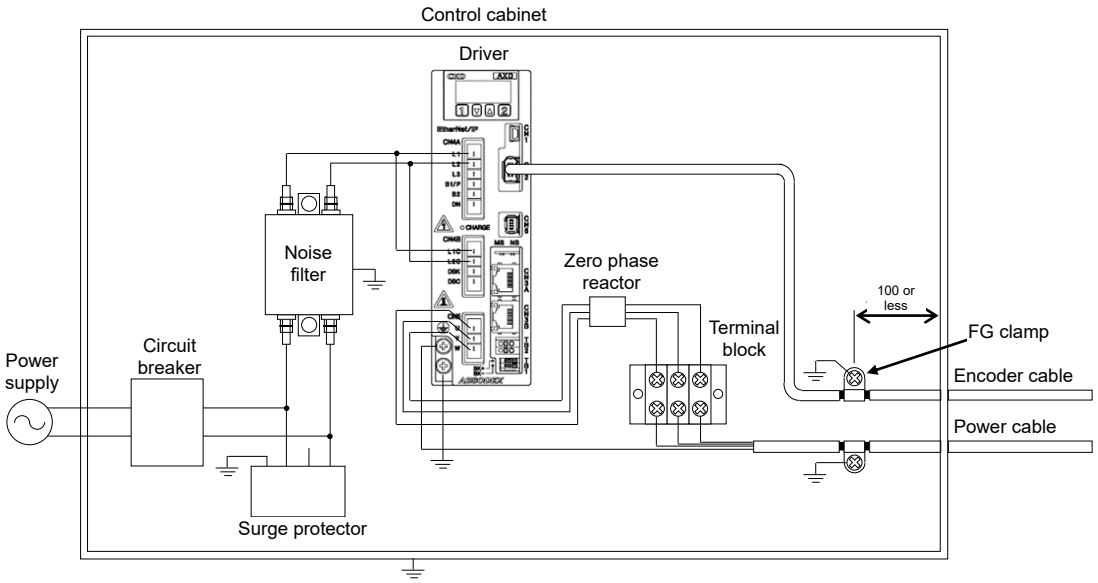
14.3. Installation Method

Installation methods are shown in “Installation of Driver (in case of 3 phases)” table below and “Installation of Driver (in case of single phase)” table below.
Install the designated noise filter and zero-phase reactor in the inputs and outputs of the driver and build in a conductive enclosure.
Strip the power and encoder cables sheath and use a grounding (FG) clamp or alike to make the shield contact with the conductive enclosure connected to the ground.
Ground the actuator as shown in “Grounding Example on Actuator Side” of “14.3.Installation Method.”
Parts used for installation are shown in “Parts to be Used” of “14.3.Installation Method.”
Moreover, implement additional EMC countermeasures (for example, route wire through duct) as necessary.

<Installation of Driver (in case of 3 phases)>



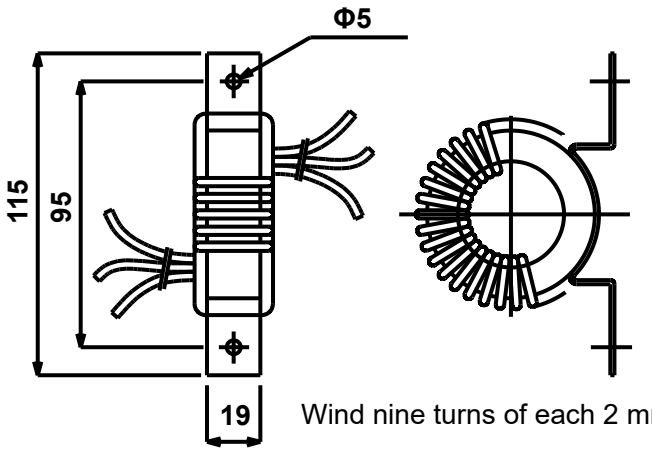
<Installation of Driver (in case of single phase)>



<Parts to be Used>

Part Name	Application	Model	Manufacturer
Input filter	3 phases	3SUP-EF10-ER-6	OKAYA ELECTRIC INDUSTRIES CO., LTD.
		NF3010A-VZ	SOSHIN ELECTRIC CO., LTD.
	Single phase	NF2015A-OD NF2016A-UP NF2016A-UPF	SOSHIN ELECTRIC CO., LTD.
Zero phase reactor	Single phase 3 phases	RC5060ZZ	SOSHIN ELECTRIC CO., LTD.
Surge protector		RSPD-250-U4	OKAYA ELECTRIC INDUSTRIES CO., LTD.
		LT-CS32G801WS LT-C32G801WS	SOSHIN ELECTRIC CO., LTD.
FG clamp		FGC-5, FGC-8	KITAGAWA INDUSTRIES CO., LTD.

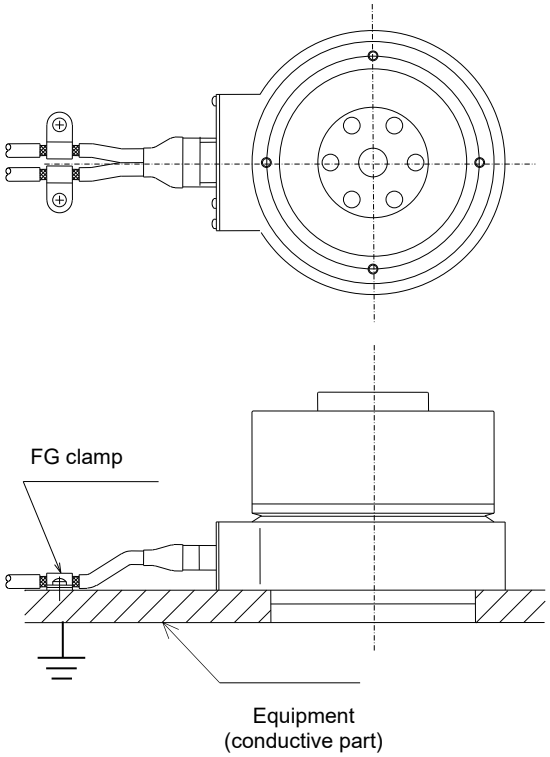
<Number of Turns of Zero-phase Reactor>



Wind nine turns of each 2 mm^2 UVW wire.

On the actuator side, strip the power and encoder cables sheaths as close to the actuator as possible, and ground the shield. (See the figure below.)

<Grounding Example on Actuator Side>



15.TERMS OF WARRANTY

■ Period

The warranty period of this product is one year since the date of delivery to your designated place.

■ Scope

If failure is caused in the above warranty period obviously due to poor workmanship of our product, we will provide a replacement for this product or necessary replacement parts, or repair the product at our factory, without charge.
However, the scope of warranty shall not cover the following cases.

(1) Operation and use under the conditions or in the environment other than those specified in catalogs, specifications, or instruction manuals
(2) Failure due to exceeded durability (number of times, distance, time, etc.), or consumables-related reasons
(3) Failure caused by other than this product
(4) Failure caused by operation derailing from the purposes for which the product is designed
(5) Failure caused by modification or repair done without our involvement
(6) Failure caused by reason that is unforeseeable with technology put into practical use at the time of delivery
(7) Failure caused by reason not attributable to our company, such as natural catastrophes or disasters

The scope of warranty shall cover the delivered product only, and shall not cover losses induced by a defect of the delivered product.

■ Confirmation of compatibility

Customers are responsible for confirming the compatibility of the CKD product with their system, machine, and device.

16.REFERENCE INFORMATION

16.1. Driver Specifications

16.1.1. Specifications of AXD-S Type Driver, AXD-H Type Driver

<General Specifications of AXD-S Type Driver / AXD-H Type Driver>

Item			Description
1. Rated output		AXD-S	400W
		AXD-H	800W
2. Main circuit input power supply Note 1	Rated voltage		1-Phase or 3-Phase 200 to 240 VAC
	Frequency		50/60Hz
	Allowable voltage fluctuation		170 to 264 VAC
	Rated current	AXD-S	5.5A(1-Phase)/3.2A(3-Phase)
		AXD-H	9.0A(1-Phase)/5.2A(3-Phase)
3. Control circuit input power supply Note 1	Rated voltage		1-Phase 200 to 240 VAC
	Frequency		50/60Hz
	Allowable voltage fluctuation		170 to 264 VAC
	Rated current		0.12A
	Power consumption		15W
4. Continuous output current		AXD-S	3.5A
		AXD-H	6.8A
5. Instantaneous output current		AXD-S	9.9A
		AXD-H	17.0A
6. Structure (protection structure)		AXD-S	Natural cooling
		AXD-H	Forced cooling
7. Operating ambient temperature			0 to 55ºC
8. Storage ambient temperature			-20 to 65ºC

Note 1: As for the main circuit input power supply and the control circuit input power supply, power should be supplied from the same power supply. Power whose voltage and phase are different should not be supplied.
Malfunction or breakage will be caused.

Item		Description
9. Use/storage ambient humidity		90%RH or lower, no condensation allowed
10. Atmosphere		Free from corrosive gases, and dust
11. Anti-vibration		5.9 m/s^2
12. Mass	**AXD-S**	About 1.0 kg
	AXD-H	About 1.5 kg
13. Dimension	**AXD-S**	W50*H160*D160
	AXD-H	W70*H160*D160
14. Elevation		Altitude within 1000 m
15. Protection		IP20

- If using as products supporting for the UL Standard, check “13.SUPPORT FOR UL STANDARD” and if using as products supporting for the European Standards, check “14.SUPPORT FOR EUROPEAN STANDARDS.”

<Performance Specifications of AXD-S Type Driver / AXD-H Type Driver>

Item		Description
1. Number of Controlled Axes		1 axis, 540,672 pulses/rotation (2,097,152 pulses/rotation)
2. Angle Setting Unit		° (degree), pulse, and number of indexes
3. Angle Setting Minimum Unit		0.001°, 1 pulse (= About 2.4 seconds [0.00067 degrees]
4. Speed Setting Unit		sec, rpm
5. Speed Setting Range		0.01 to 100 sec/0.01 to 300 rpm Note 1
6. Number of Equal Segments		1 to 255
7. Maximum Instruction Value		8 digit input ± 99,999,999
8. Timer		0.01 to 99.99 sec
9. Programming Language		NC language
10. Programming Method		Data setting through USB port using PC, etc.
11. Operation Mode		Auto, single block, MDI, jog, servo off, pulse string input mode
12. Coordinate		Absolute and incremental
13. Acceleration Curve (Five types)		Modified sine (MS), Modified constant velocity (MC, MC2), Modified trapezoid (MT), Trapecloid (TR)
14. Status Display		LED display, CHAR GE: Main power
15. Alarm Display		7-segment LED (5 digits)
16. Communication Interface		USB 2.0 standard-compliant (FULL Speed) mini-B for PC (AX-Tools installed) and driver connections
17. I/O Signal	**Input**	Home positioning instruction, reset, start, stop, continuous rotation stop, forced stop, answer, position deviation counter reset, program number selection, brake release, servo-on , program number setting, ready return
	Pulse string input	Entering method: Select the pulse or direction, up or down, and A- or B-phase through switching.
	Output	Alarm 1 and 2, positioning completion, in-position, standby for start input, M code 8 points, output during indexing 1/2, home position output, servo state, M code strobe, segment position strobe, ready output
	Encoder output	Output method: A-/B- and Z-phase line driver output Resolution: Max. 135,168 pulses/rev (540,672 pulses/rev after multiplication by four) Max. frequency: 4 MHz
18. Program Capacity		About 6,000 characters (256 pcs.)
19. Load factor		Protects the actuator from being overheated.

Note 1: The speed setting range varies with the actuator to be used.
If models having a maximum torque of 75 N·m or more are used at single-phase 200 VAC, the calculation of the torque limit area is different from normal one. If you cannot judge whether they can be used, please contact us.
For external, and installation dimensions, refer to the equipment brochure.
The NC program is stored in intermediate codes and the number of characters that can be entered is not constant.
For details, refer to “6.PROGRAM.”

16.1.2. Specifications of EtherCAT and EtherNet/IP I/O signals

For the I/O data and signal names of the connector (CN3) connected with the programmable logic controller, refer to “4.HOW TO USE .” For the connection method, refer to “1.PRODUCT CONFIGURATION.”