CKD

SMB-75A

INSTRUCTION MANUAL

ABSODEX

AX SERIES

MU TYPE

- 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.

3nd Edition
CKD Corporation

For safety operation of product

Read before starting operation.

When designing or manufacturing equipment incorporating ABSODEX, check that the mechanism of the equipment and the electric control for controlling the mechanism assure the safety of the system, to manufacture safe equipment.

To operate our product safely, selection, operation and handling of the product as well as adequate maintenance procedures are important.

Be sure to observe the description given under DANGER, WARNING and CAUTION to assure safety of the equipment.

In addition, any information described in relevant international standards (ISO/IEC), Japanese Industrial Standards (JIS), and other safety regulations (such as industrial safety and health laws), must be fully understood beforehand so that designs are in compliance with them.

⚠ DANGER: **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING: **Indicates a potentially hazardous situation, if not avoided, could result in death or serious injury.**

⚠ CAUTION: **Indicates a potentially hazardous situation, if not avoided, may result in minor or moderate injury or ABSODEX and its peripheral equipment damage.**

The word or words that designate a degree or level of safety alerting.

SIGNAL WORD used in this manual is classified into the following three levels in accordance with the degree of injury or equipment damage.

Utmost care is required for higher degree of SIGNAL WORD.

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

The product specification of a custom product may differ from the description given in this instruction manual.

Check the specification drawing or the like for each product.

DANGER:

- TURN OFF POWER before mounting or dismounting connectors as equipment malfunction, damage, and electrical shock can be caused.
- Do not operate in explosive or fire atmosphere.

WARNING:

- DO NOT TURN the output axis of the actuator exceeding the speed of 30 rpm as power generation of the actuator may damage the driver or may cause electrical shock.
- Power off, servo off (including emergency stop and alarm) with rotational force being applied e.g. by gravity may cause the actuator to rotate.
  Also, if the power is turned off or if servo-off is executed while the actuator is still rotating, it will not stop rotating instantly due to inertia.
  Operate the actuator in the balanced condition so that rotational force is not applied for these operations after all safety aspects are confirmed.
- 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.
- DO NOT TOUCH the actuator and 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.
- Do not step on the actuator or a rotary table or other moving parts installed on the actuator, during maintenance work.
- Do not remove devices until the safety is confirmed.
- If the main power is turned on while there is position deviation, the actuator will rotate according to the accumulated position deviation.
  If the main power and control power are turned on separately, make sure that ABSODEX is in servo-off state before turning on power.
- 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.
- Be sure to ground the FG terminal of the driver to avoid malfunction.

⚠ CAUTION:

- 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.
- Do not overhaul the actuator unit as original functions and accuracy may not be restored. This is especially so with the resolver leading to fatal damage.
- Do not hit the output axis with a hammer or assemble the actuator with excessive power to maintain the designed accuracy and performance.
- 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.
- Use the furnished cable only for connecting the driver to the actuator. Install the cable so that no excessive stresses are applied or no physically damage is made to the cable. Changing the length or the material of the furnished cable should not be done as performance function may be lost or malfunction may be caused.
- The full performance is not achieved in the shipment state. Adjust the gain without fail.
- 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.
- To operate with designation of fine angles, periodically turn at least a full turn to avoid bearing breakage caused by fretting, etc.
- To perform a dielectric voltage test to mechanical equipment equipped with ABSODEX, disconnect the power cables from the ABSODEX driver so that the voltage is not added to the driver itself. Otherwise failure may be caused.
- When carrying the actuator, do not hold the cable extension.
- The output axis may move from the holding position even without an external force if the power or servo is turned off (including emergency stop and alarm) or the torque limit setting is decreased from the servo-on state (retention state).
- 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.
- 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.

Terms of warranty

The warranty period and the scope of warranty are described below.

1) Period
   The warranty period of the product is one year since the date of delivery.
   (However, the period assumes eight hours of operation per day. As well, if the durability limit is reached within one year, the period to the durability limit is the warranty period.)

2) Scope
   If failure is caused in the above warranty period due to poor workmanship of our product, we will repair the product without charge without delay.
   However, the scope of warranty shall not cover the following cases.
   ① Operation under the conditions or in the environment derailing from those specified in the product specifications
   ② Failure caused by lack of attention or erroneous control
   ③ Failure caused by other than the delivered product
   ④ Failure caused by operation derailing from the purposes for which the product is designed
   ⑤ Failure caused by modification in the structure, performance, specification or other features made by other than us after delivery, or failure caused by repairs done by other than our designated contractor
   ⑥ Loss in our product assembled to your machine or equipment, which would be avoided if your machine or equipment were provided with general functions, structures or other features common in the industry
   ⑦ Failure caused by reason that is unforeseeable with technology put into practical use at the time of delivery
   ⑧ Failure caused by fire, earthquake, flood, lightning, or other acts of God, earth shock, pollution, salt hazard, gas intoxication, excessive voltage, or other external causes

   The warranty mentioned here covers the discrete delivered product. Only the scope of warranty shall not cover losses induced by the failure of the delivered product.

3) Warranty of product exported outside Japan
   ① We will repair the product sent back to our factory or company or factory designated by us. Work and cost necessary for transportation shall not be compensated for.
   ② The repaired product will be packed according to the domestic packing specification and delivered to a designated site inside Japan.

4) Confirmation of compatibility
   Customers are responsible for confirming the compatibility of the CKD product with their system, machine, and device.
5) Others
   This warranty terms describe basic items. Priority will be given to specification drawings and specification sheets if warranty description given on such specification drawings or specification sheets is different from the warranty terms given herein.

CONTENTS

ABSODEX

AX SERIES [MU TYPE]

INSTRUCTION MANUAL No. SMB-75A

Created on August 19, 2013
Revised on May 21, 2014

—- MEMO —-

INTRODUCTION

Thank you for choosing 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 AX Series MU type driver. It is inapplicable to other types.
Use a start-up adjustment support tool “AX Tools” for programming and other purposes.
Before starting operation of our product, read through this instruction manual to keep the initial performance and operate without failures.

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

—- **MEMO** —-

1. UNPACKING

1.1 Product Model

Check that the delivered product is what you have ordered.

The model number of the product is specified in nameplates on the actuator unit and on the side panel of the driver.

1.2 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.

Table 1.1 Product Configuration

Name			Quantity
1. Actuator unit			1
2. Driver unit			1
3. Resolver cable *1, *2			1
4. Motor cable *1, *2			1
5. Instruction manual CD-ROM	SMB-46		1
6. Handling Precautions	SMB-47		1
7. Driver accessories			
Power supply connector	04JFAT-SBXGF-I	[J.S.T. Mfg. Co., Ltd.]	1
Open tool for power connector	J-FAT-OT	[J.S.T. Mfg. Co., Ltd.]	1
I/O signal connector (plug)	10150-3000PE	[Sumitomo 3M Limited]	1
I/O signal connector (shell)	10350-52A0-008	[Sumitomo 3M Limited]	1

Note *1: The accessory cable is a special cable for the driver.

*2: The cable type (standard/movable) and length are the ones selected optionally.

- **Cable length (2 to 10m) can be changed by purchasing individual cables.**

⚠ CAUTION:

- **Do not add tension to cables and connectors.**
- **The standard cable may not be used for applications accompanying repetitive bending motions. Use the optional movable cable for such purposes.**
- **To use a movable cable, fix the cable sheath near the connector of the actuator unit.**
- **The cable extension of the AX6000M Series 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.**

—- **MEMO** —-

2. INSTALLATION

2.1 Actuator Installation

1) The machine for which ABSODEX is installed should have the maximum rigidity, so that ABSODEX will perform as designed. This rigidity requirement bases on that relatively low number of mechanical natural frequency (approximately 200 to 300Hz) of a load machine, and deck will cause ABSODEX to resonate with the machine and its deck. Make sure that all fixing bolts of a turntable and the actuator are completely tight to maintain sufficient rigidity.

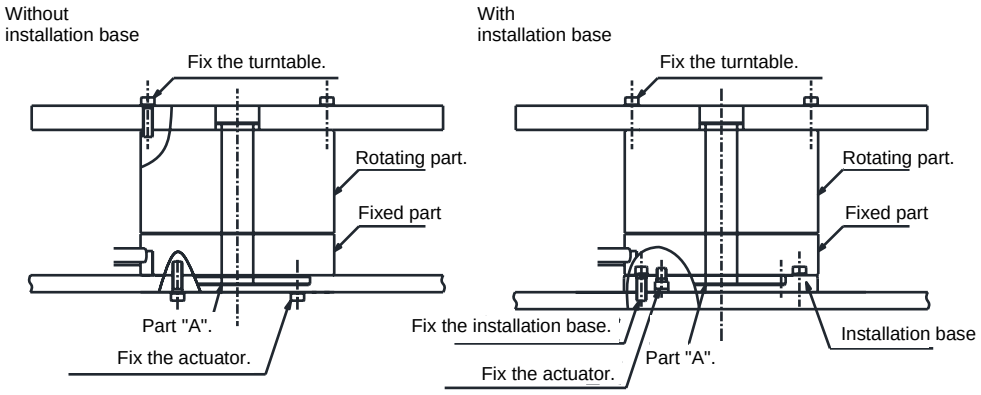


Fig. 2.1 Actuator Installation

⚠ WARNING:

- **The part "A" in Fig. 2.1 contains the precision part (resolver).**
  DO NOT LOOSEN the bolts in the part "A."
  Also do not install parts or apply excessive force on this part as designed accuracy and function may be ruined.
- **ABSODEX is precision equipment.**
  DO NOT GIVE SHOCK to the unit and output axis, or do not assemble with excessive force as designed accuracy and function may be ruined.
- **Make sure that the components are securely installed before restarting the equipment.**

2) When ABSODEX can not be directly mounted on a machine, it should be mounted on the deck of high rigidity.

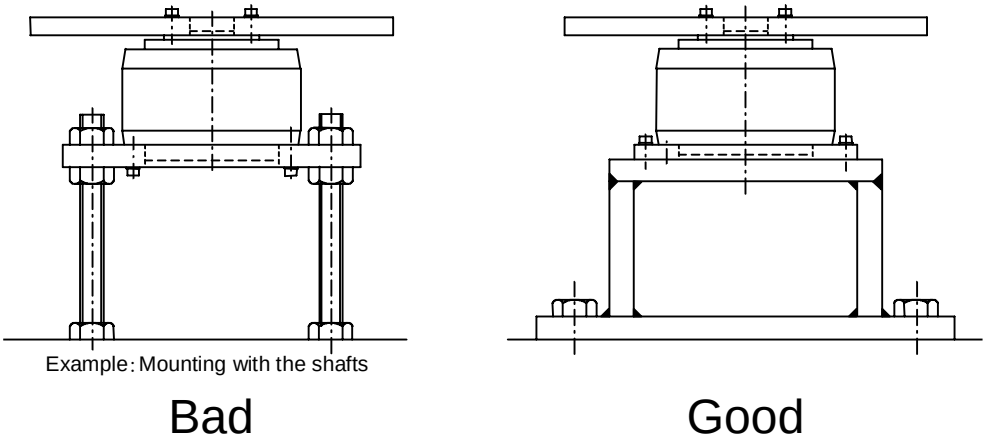


Fig. 2.2 Actuator Installation Method

3) Anti-vibration Using Dummy Inertia Plate

When sufficient rigidity is not available for a machine, a dummy inertia plate at the nearest position to the actuator will help reduce resonance with the machine. The following explains the installation of a dummy inertia plate.

Guideline for the magnitude of a dummy inertia is: Load inertia x (0.2 to 1).

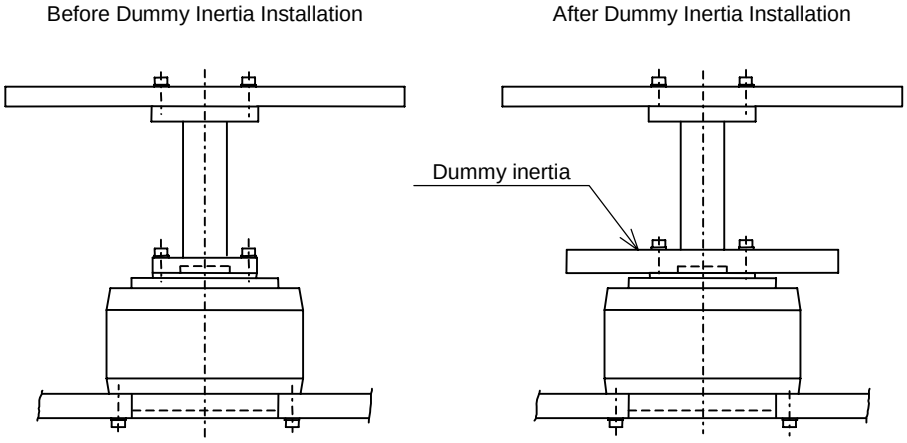


Fig. 2.3 Dummy Inertia Installation 1

When extending the output shaft, refer to Table 2.1 "The guideline for the diameter of the extension shaft."

Table 2.1 The guideline for the diameter of the extension shaft

Maximum output torque [N･m]	The length of the extension [mm]	
	50	100
1.2	Φ35	Φ40
3	Φ35	Φ40

Connections by belts, a gear, a spline, and a key will cause machine rigidity to be reduced. In such instance, dummy inertia should be assumed to be load inertia x (0.5 to 2). When speed is reduced using belts or gear, load inertia should be the value converted by the actuator output axis, and dummy inertia plate should be installed at the actuator side.

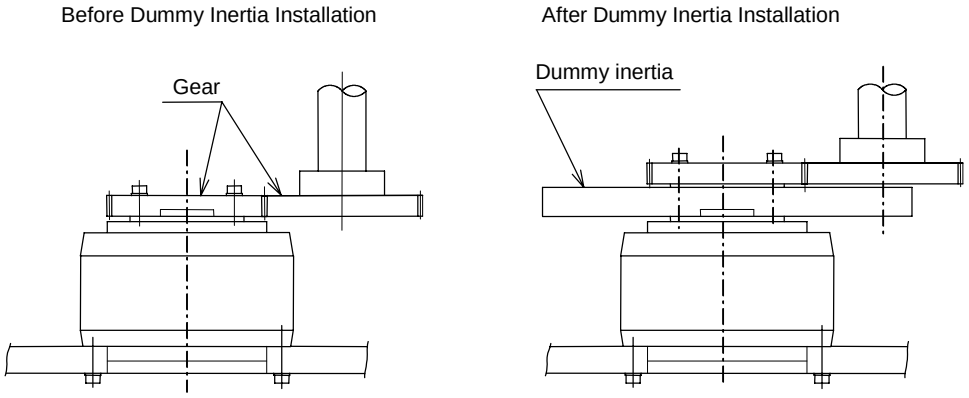


Fig. 2.4 Dummy Inertia Installation 2

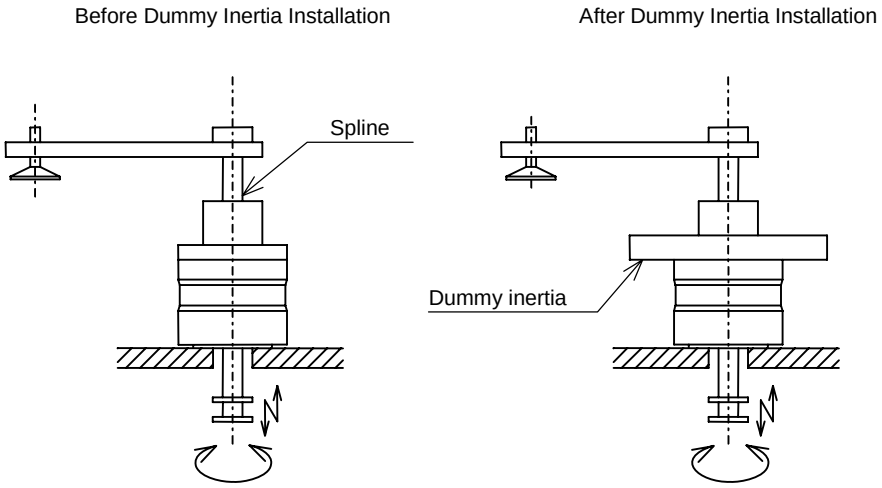
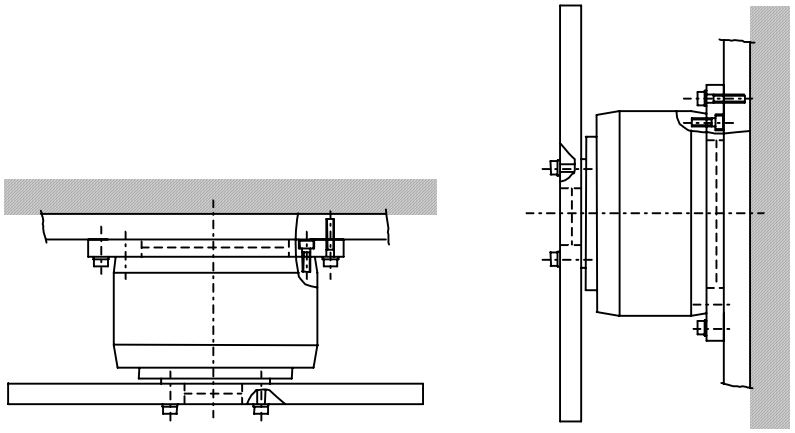


Fig. 2.5 Dummy Inertia Installation 3

- **Dummy inertia plate shall be as large as possible within the capacity of the actuator.**

4) The actuator can be installed horizontally (on the floor or on the ceiling) or vertically



Good Good

Fig. 2.6 Direction of Installation of Actuator

WARNING:

- **Servo off including emergency stop and alarm, and brake release with rotational force being applied e.g. by gravity may cause 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.**

2.1.1 Installation Environment

1) Use the actuator indoors at a place free from corrosive or explosive gases.

2) Use in the environment of ambient temperatures between 0 and 40°C. For details, refer to **Chapter 13. "ACTUATOR SPECIFICATIONS."**

⚠ CAUTION:

- **No waterproof treatment is made to the actuator and drivers. Take waterproof measures when using the product in an environment prone to water and oil splashes.**
- **Chips and dust gathered on the actuator or driver will cause earth leakage and failures. Take measures to block such obstacles.**

2.1.2 Operating Conditions

The allowable moment load and allowable axial load of the actuator vary according to the Series and size of the actuator. Check these particulars of your operating environment. For the allowable load, refer to **Chapter 13. "ACTUATOR SPECIFICATIONS."**

⚠ CAUTION:

- **Excessive eccentric loads and excessive loads will cause permanent deformation of the rotor or bearing faults. Avoid giving impacts or external interference on the actuator.**
- **When passing parts or piping through a hollow hole, be sure to allow a clearance. Never press-fit into the hollow hole or add a force on it.**
- **Do not approach a strong magnetic field such as that caused by rare earth magnets. Otherwise the proper accuracy may not be achieved.**
- **The actuator unit may become hot according to some operating conditions. Install a cover or the like to keep off.**
- **Do not drill or cut the actuator unit. If such fabrication is necessary, contact us.**

2.2 Driver Installation

1) 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.

2) When the ABSODEX driver is to be housed in a control box, the arrangement should be made so that the temperature inside the box does not exceed 50°C with the space around the driver as shown in the figure below.

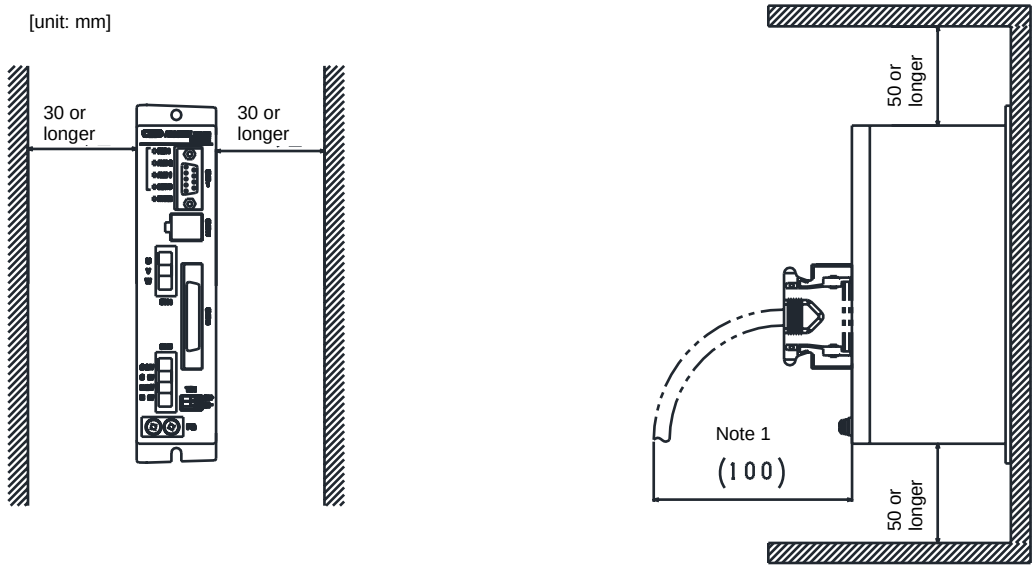


Fig. 2.7 MU Driver Installation

Note *1: Determine the dimension including a margin according to the cables to be used.

3) The orientation of the driver is shown in figures below.
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.

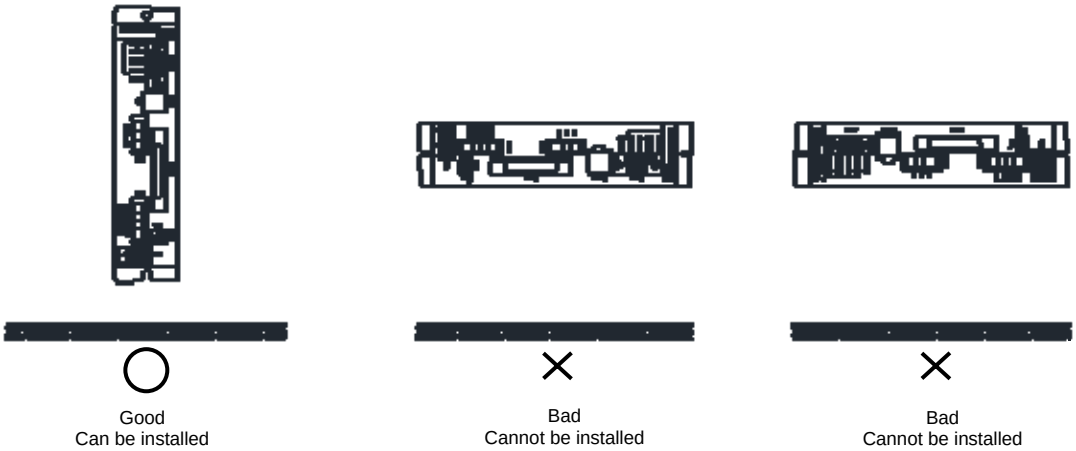


Fig. 2.8 Orientation of Drivers

4) Dimensions drawings of driver are shown below.

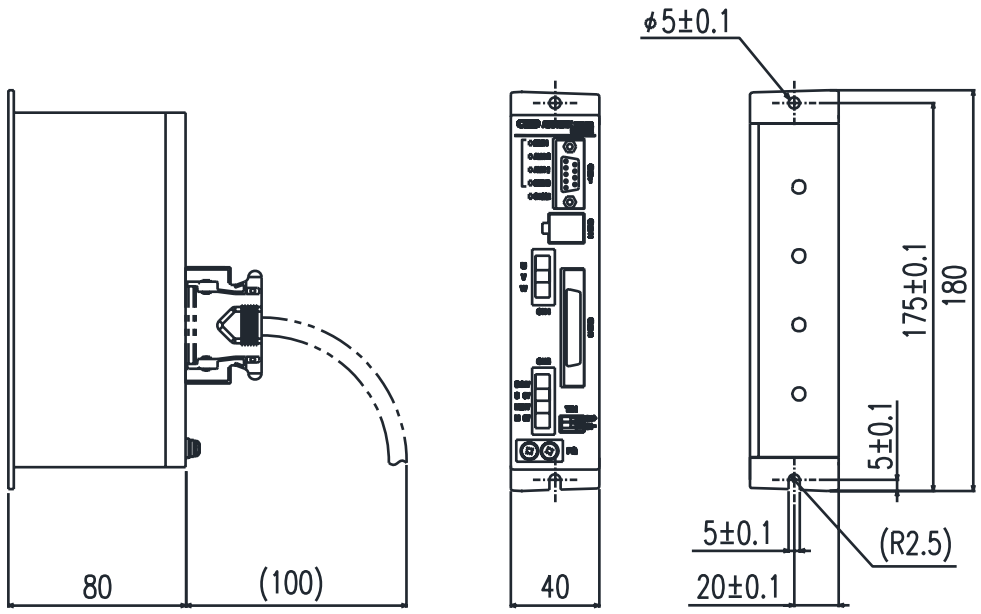


Fig. 2.9 Dimensions of Driver

2.3 About Cable

1) Use the attached cable without fail for the wiring between the actuator and driver. Avoid excessive forces or scratches on wiring in the installed state.

2) To change the length of the cable, order the cable separately.

⚠ CAUTION:

- **Do not remodel the accessory cable. A remodeled cable will cause malfunction and failure.**
- **Route the power cables such as the motor cable and power cable separately from the signal cables such as the resolver cable and I/O cable. Do not tie the cables belonging to different groups or do not route them in the same conduit.**
- **The standard cable may not be used for applications accompanying repetitive bending motions.**
  Use the optional movable cable for such purposes.
- **To use a movable cable, fix the cable sheath near the connector of the actuator unit.**
- **The cable extension of the AX6000M Series 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.

2.4 About Brake

1) For a System Equipped with an External Braking Mechanism

To use an external brake or to forcibly restrict the output axis of the actuator, use an M code ("M68": Brake application, "M69": Brake release) in the NC program.

If the brake is applied (M68) after the movement is stopped, the integral control of the servo system is stopped, thereby preventing the actuator from being overloaded.

Build the NC program to release the brake (M69) before executing movement NC codes.

As well, oscillation may be caused if the external brake is not rigid enough. Use a rigid brake.

For details, refer to **Chapter 3. "SYSTEM CONFIGURATION AND WIRING"** and **Chapter 8. "APPLICATION EXAMPLES."**

3. SYSTEM CONFIGURATION AND WIRING

3.1 System Configuration

BASIC SETTING ITEMS

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

BASIC DRIVE METHODS

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

3.1.1 System Configuration Example

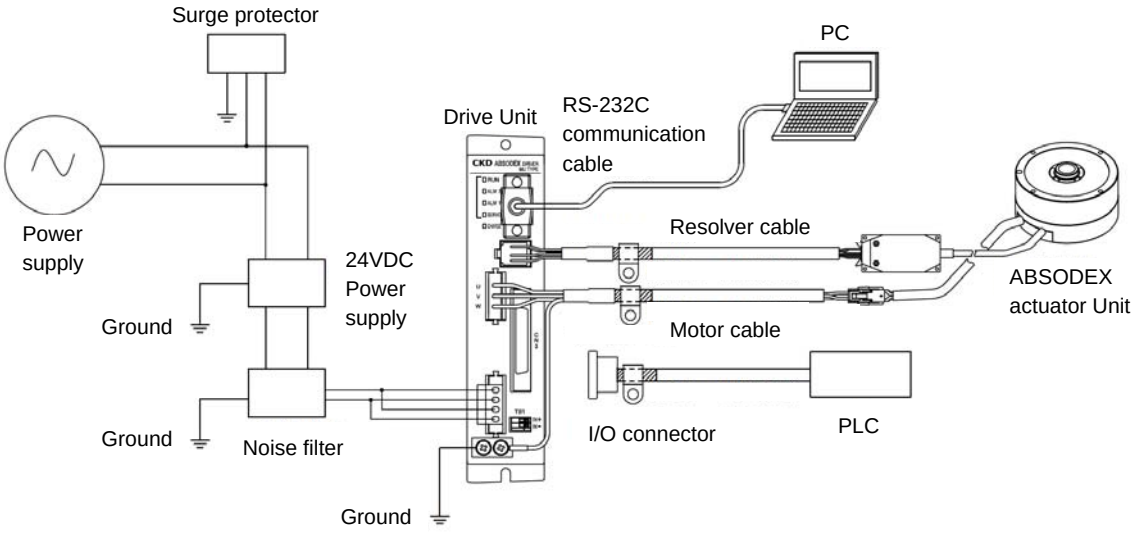


Fig. 3.1 System Configuration

- **Do not connect the CN1 connector unless for programming, parameter entry or test operation.**

⚠ CAUTION:

- **Route the power cables such as the motor cable and power cable separately from the signal cables such as the resolver 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 Chapter 10. "ALARMS".
- **If other than the compatible driver is connected, the actuator may be burned.**
- **If the main power is turned on in position deviation, the actuator starts due to the accumulated position deviation.**
  If the main power and control power are turned on separately, be sure to turn the main power on with the servo turned off.
  Moreover, do not turn on and off only the control power. Doing so may result in product malfunction.
- **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, control power and I/O power (CN3-24VDC).**
- **When using a circuit breaker, select one that has high frequency counter measures for inverter use.**
- **To avoid malfunction or the like caused by noise, keep consistency in the electric potential between the driver casing and the casing of the 24VDC power supply.**

3.1.2 List of Peripheral Devices

1) Communications Software for PC
   Part name: AX Tools Windows Version
   (For Windows ®7, Windows® Vista, Windows® XP SP3)
   Manufacturer: CKD Corporation
   • **The software may not run in some environments.**

2) RS-232C Communications Cable

Table 3.2 Communications Cable

Communication cable	Model	Manufacturer
D-sub 9-pin (2m)	AX-RS232C-9P	CKD Corporation

3.2 Wiring

3.2.1 Driver Panel Description

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

Figs. 3.2 shows the front panel configuration.

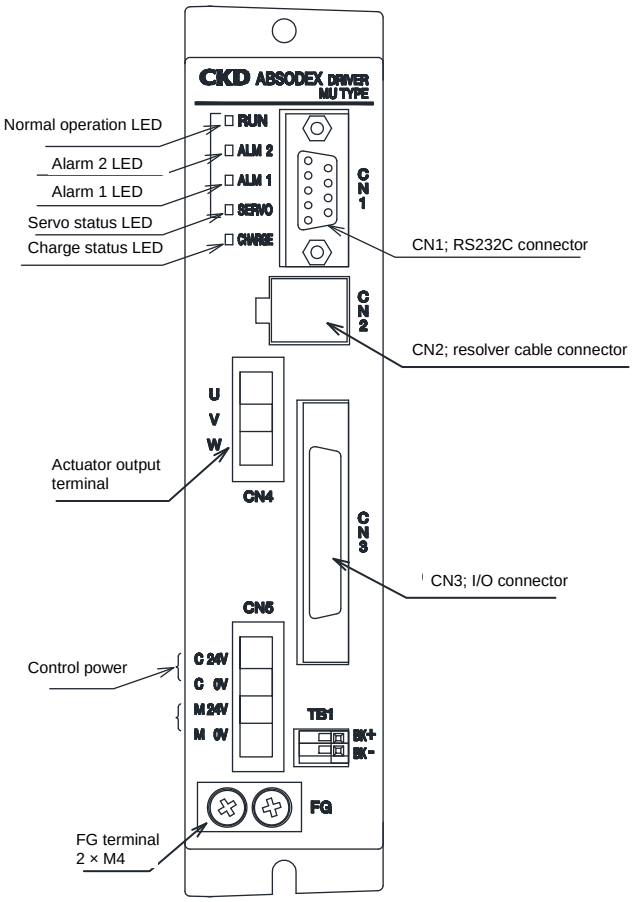


Fig. 3.2 MU Type Driver Panel

⚠ CAUTION:

- **The heat sink of the driver 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.

3.2.2 Connection to Power and Actuator (CN4, CN5)

1) M24V, M0V, C24V and C0V (CN5)
   Connect to the power supplies using the connectors provided.

   - **The power cable must be of heat resistant vinyl cladding, and of the conductor cross section area of 1.25mm^2 to 2.0mm^2.**

2) FG terminal
   The ground cable (G) of the motor cable and ground of the power supply must be wired to the FG terminal of the driver to avoid malfunction.
   Use a crimp terminal for the wiring at this terminal. The size of the screw is M4.
   Tighten the screw to 1.2N· m.

3) U, V, W (CN4)
   Connect to the actuator using the cable provided.

4) Wiring method for accessory connector (CN5)

a) Cable end treatment

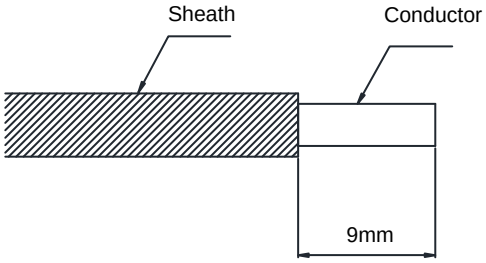


Fig. 3.3 End Treatment Drawing

b) How to insert the cable into the connector

1. Install the accessory open tool to the connector.
2. Push down the open tool to open the spring.
3. While maintaining the open state, insert the stripped cable.
4. Release the open tool to lock the cable.
5. Check that the cable is securely locked and that the cable sheath is caught in the spring.

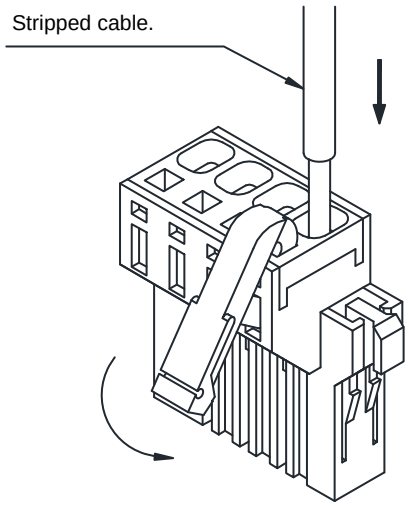


Fig. 3.4 Cable Insertion Method

CAUTION:

- **Route the power cables such as the motor cable and power supply cable separately from signal cables such as the resolver cable and I/O cable. Do not tie cables belonging to the different groups or do not route them in the same conduit.**
- **Connecting to the higher voltage than specified may cause the driver to fail.**

5) Power Supply Capacity

Table 3.3 Power Supply Capacity

Actuator Model	Driver Model	Power Supply Voltage	Rated Input Current	Max. Input Current
AX6001M, AX6003M	AX9000MU	24VDC±10%	3.3A	10A

3.2.3 Connection to Other Terminal Blocks

1) CN1 (RS-232C)
This port is a serial port, which interfaces with a personal computer. For RS-232C communication method, refer to **Chapter 13. "COMMUNICATION FUNCTIONS"**.

Cable side Connector
Model: XM2A-0901 (plug)
XM2S-0911 (hood)
Maker: OMRON Corporation

2) CN2 (Resolver)
This port is for position detector (resolver) built in the actuator.
The dedicated resolver cable should be used to connect to the actuator.

3) CN3 (I/O)
This port is mainly used for connecting to a PLC for I/O signals.

Cable side Connector
Model: 10150-3000PE (plug)
10350-52A0-008 (shell)
Maker: Sumitomo 3M Limited

・This connector is supplied as accessory for driver.

4) TB1 (brake output)
This terminal is not used.

⚠ CAUTION:

- **Route the signal cables separately from power cables or other high voltage cables. Do not tie them or do not route them in the same conduit. Noise may cause malfunction of the equipment.**
- **Do not press the button forcibly when inserting or disconnecting cables into/from the terminal block.**

3.2.4 Connecting CN3 (I/O signal)

1) Connecting General I/O

There is no need to connect all I/O signals. Examine necessary signals and connect with a programmable logic controller or the like.

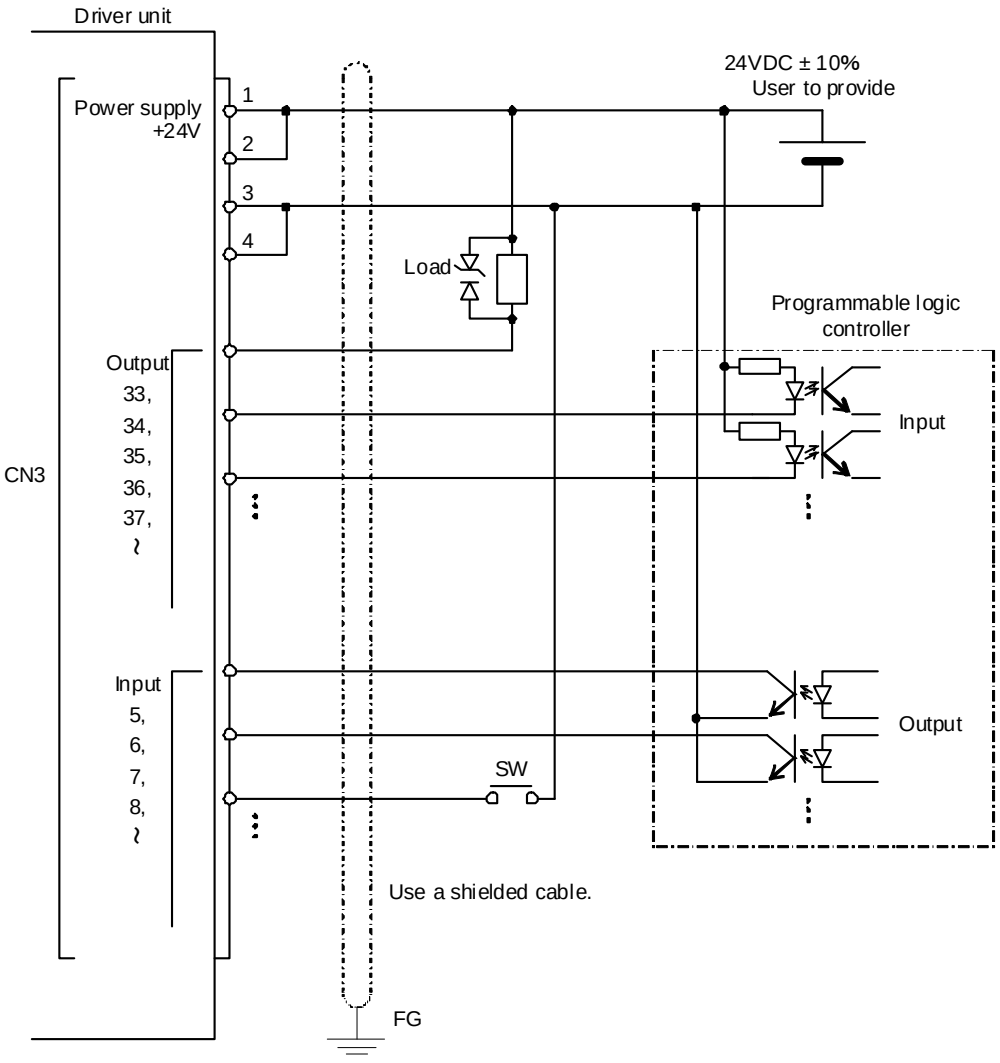
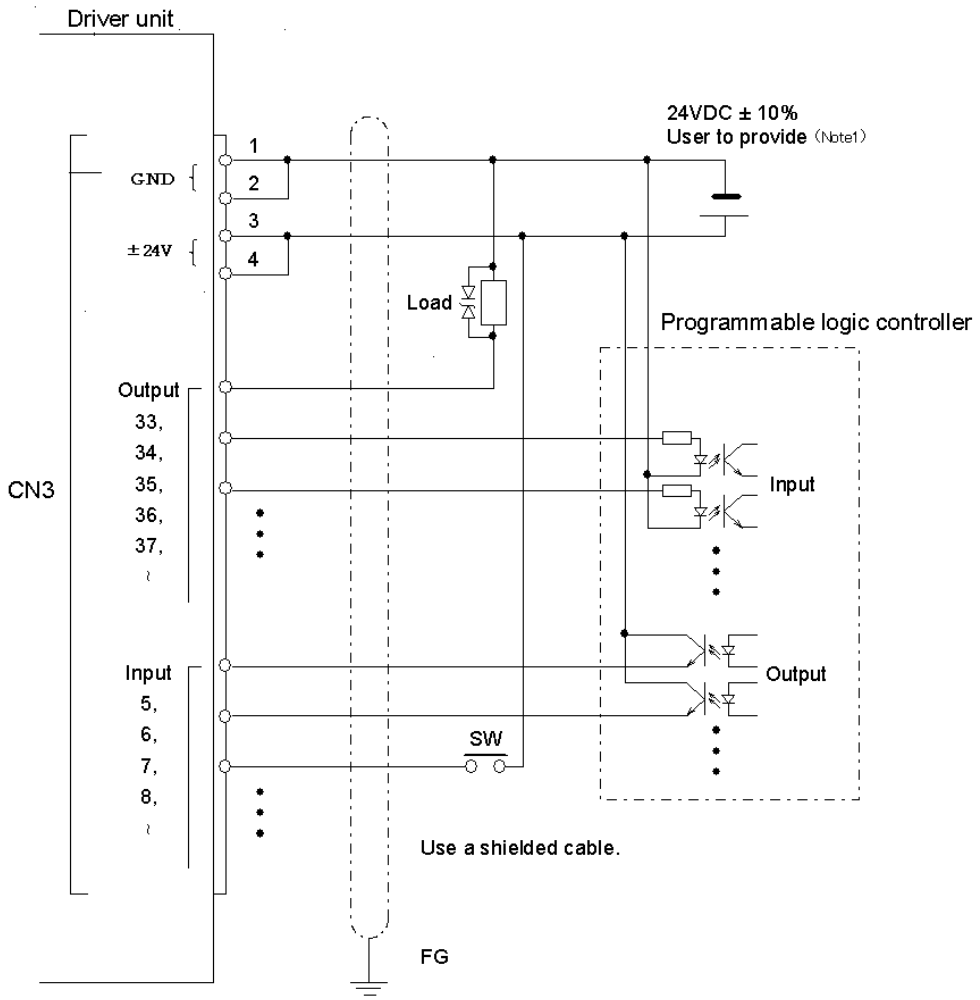


Fig. 3.5 Connection Example NPN specification



(Note1) The wiring is opposite from AX9000MU with NPN specification.

Fig. 3.6 Connection Example PNP specification

CAUTION:

- **When connecting an inductive load such as the relay and solenoid in the output, add a surge absorber in parallel to the load to protect the output port. Be careful of the polarity when connecting. The reverse polarity may cause the output circuit to be damaged.**
  <Recommended product>
  Model: ZD018
  Manufacturer: Ishizuka Electronics Corporation

2) Connecting a Pulse String Input

An example of connection with a host pulse generator is shown below. When connecting one actually, check the specifications of the pulse generator to be used.

Use twisted pair shielded cables to avoid malfunctions caused by noise. The cable must be within 1m long.

The logic with an active photocoupler ('PC' in **Figs. 3.6** and **3.7**) of the pulse input circuit is "TRUE" while the logic with an inactive photocoupler is "FALSE". In case of an open collector output, the logic with active Tr in **Fig. 3.6** is "TRUE" while the logic with inactive Tr is "FALSE".

<Connection example 1> In case of open collector output (pulse and direction)

With an open collector output, the maximum input pulse frequency is 250Kpps. To use the circuit with +5V or larger Vcc, connect a limiting resistor so that input current i is contained within the range specified below. However, the resistor is unnecessary in case of +5V.

Input current i = 7 to 12mA

Limiting resistor R1 (example)

If Vcc is +12V, R1 = 680Ω

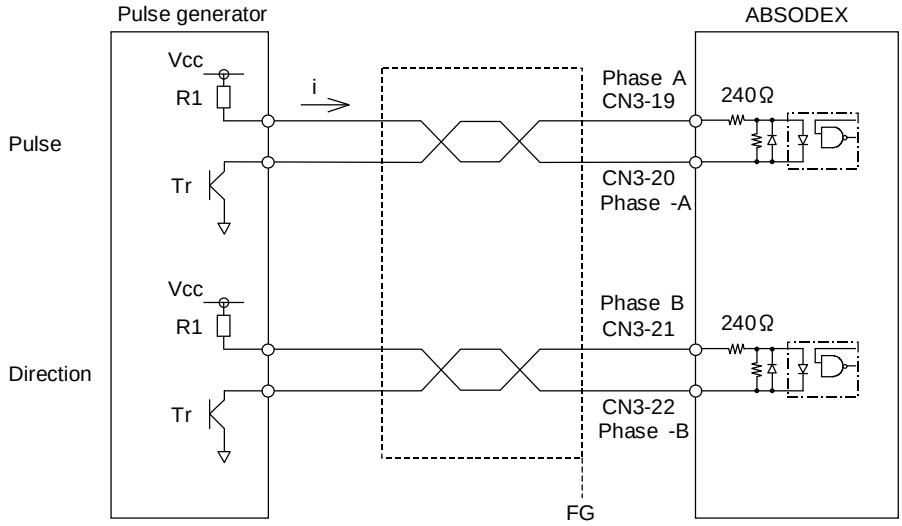


Fig. 3.7 Connection Example 1

<Connection example 2> In case of line driver output

The line driver can be used for the pulse input circuit of the ABSODEX while it supports open collector outputs.

The maximum input pulse frequency of the line driver output is 1Mpps.

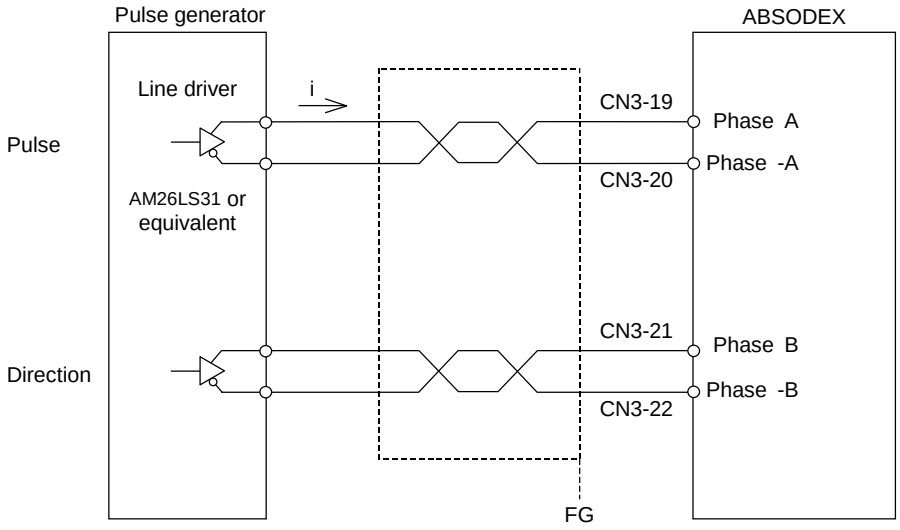


Fig. 3.8 Connection Example 2

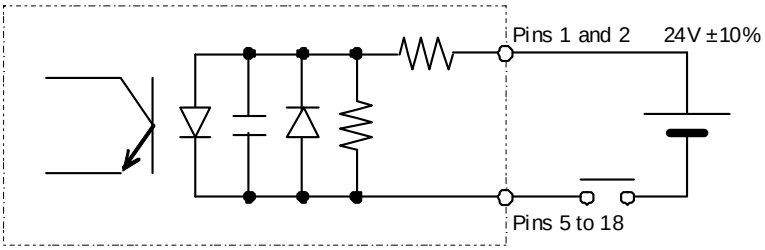
⚠ CAUTION:

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

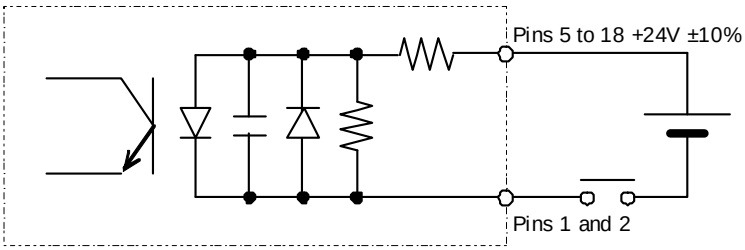
3.2.5 CN3 (I/O signal) Interface Specification

1) General I/O Input Specification

1-1)NPN



1-2)PNP

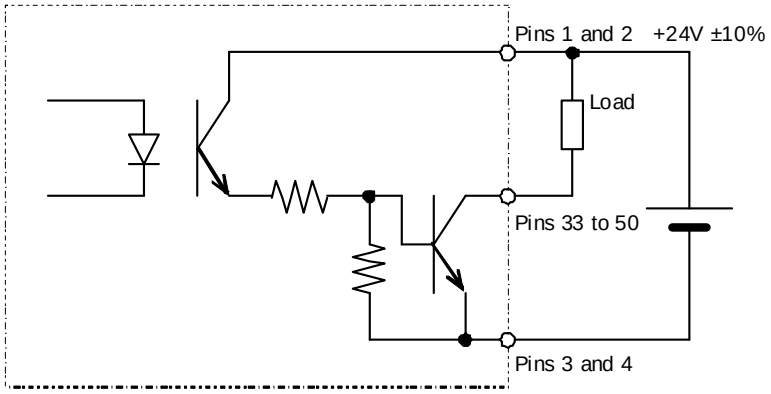


Rated voltage: 24V ±10% (including ripple)
Rated current: 4mA (at 24VDC)

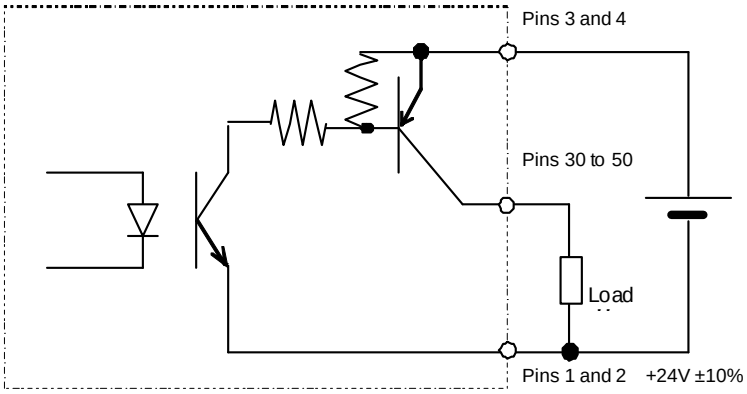
Fig. 3.9 Input Circuit

2) General I/O Output Specification

2-1)NPN



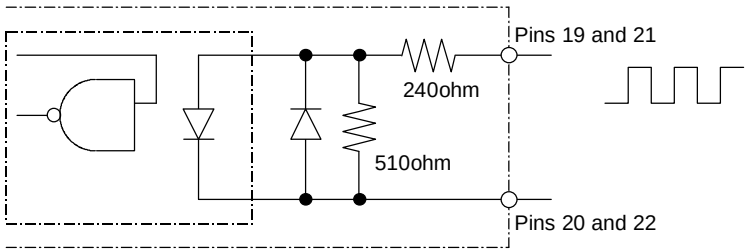
2-2)PNP



Rated voltage: 24V ±10% (including ripple)
Rated maximum current: 30mA (Max.)

Fig. 3.10 Output Circuit

3) Pulse String Input Specification

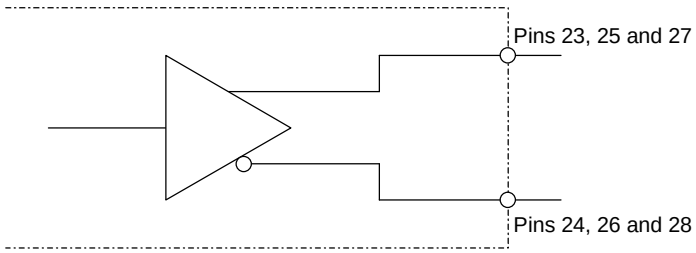


Rated voltage: 5V ±10%
Max. input frequency
Line driver: 1Mpps
Open collector: 250Kpps

Fig. 3.11 Pulse String Input Circuit

- **The logic with the active photocoupler of the pulse string input circuit is "TRUE" while the logic with the inactive photocoupler is "FALSE".**
  For the pulse specification, refer to Chapter 5. "HOW TO USE I/O".

4) Encoder Output (Pulse String) Specification



Output type: Line driver
Line driver to be used: DS26C31
Recommended line receiver: DS26C32 or equivalent

Fig. 3.12 Encoder Output Circuit

3.2.6 Wiring Example

1) Wiring a System Operating with Pulse String Inputs

Shown below is a wiring example in relation to the programmable logic controller for activating ABSODEX in the pulse string input mode.

Table 3.4 PLC to Be Used

Manufacturer of PLC	Name of Unit	Model
Mitsubishi Electric	CPU unit	Q02CPU
	Power unit	Q62P
	Positioning unit	QD75D1

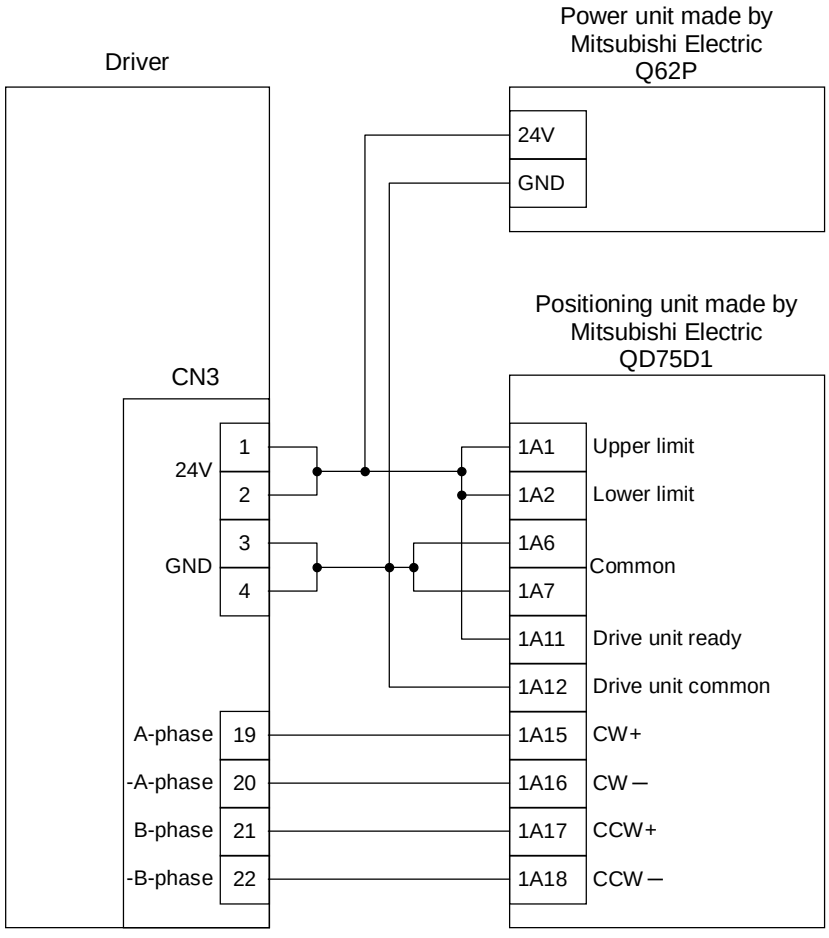


Fig. 3.13 Wiring Example of System Operating with Pulse String Inputs

2) Wiring a System Operating with Encoder Outputs
Shown below is a wiring example of a system in which the encoder output is counted with the counter unit of the programmable logic controller.

Table 3.5 PLC to Be Used

Manufacturer of PLC	Name of Unit	Model
OMRON	CPU unit	CS1G-CPU42H
	Power unit	PA204S
	Positioning unit	CT021

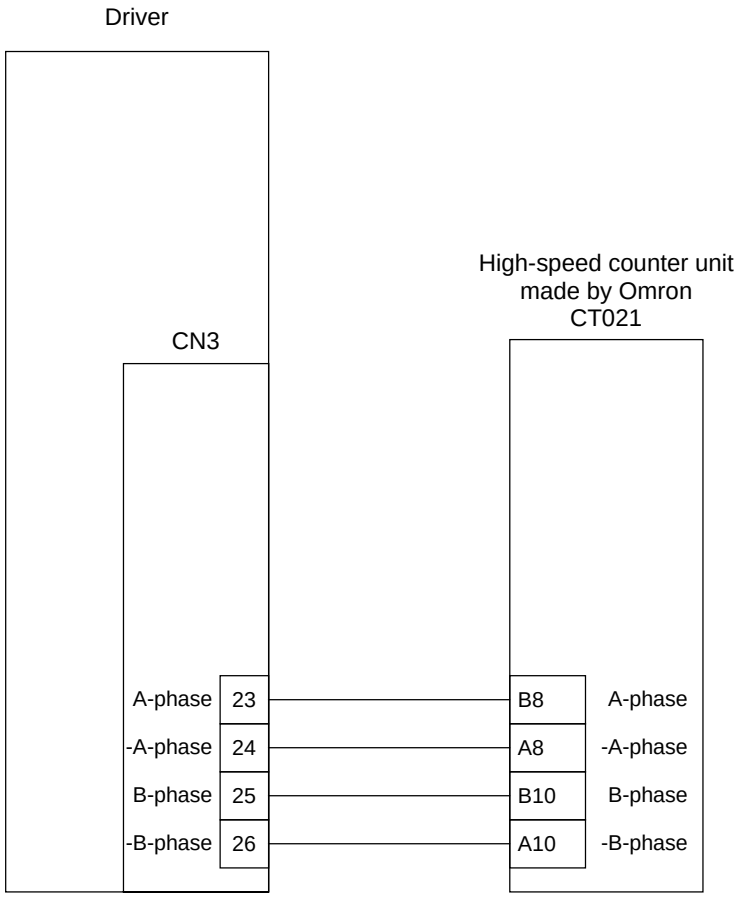


Fig. 3.14 Wiring Example of System Operating with Encoder Outputs

—- **MEMO** —-

4. TEST OPERATION

In this chapter, operate ABSODEX. Follow the procedure below to operate in four steps.

Functions are configured in the following way when the product is shipped from the factory.

Emergency stop input (CN3-17): Valid (I/O signal necessary; in case of no input, servo-off)
Servo-on input (CN3-14): Valid

When test operation is conducted without I/O cables connected, functions can be invalidated temporarily, using the following communication commands. ("_" indicates a space.)

To invalidate the emergency 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 emergency 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 emergency 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 emergency stop input temporarily, send the above-mentioned communication command (L7M_23_2) and then perform alarm reset (send "S7") or turn the control power off.**
- **Turn the control power off then on again to switch the servo-on input function.**
  After the function is switched, CN3-14 is assigned to program stop input.

- **When no alarm is issued, Alarm 1 LED (ALM1) and Alarm 2 LED (ALM2) are unlit and the normal operation LED (RUN) is lit.**
- **In the servo-on state, the servo status LED (SERVO) is lit.**

4.1 Test Operation of MU Type Driver (auto tuning)

Follow the procedure below to perform test operation.

> The following description is related to test operation method equal segment using the auto tuning function.
> The ABSODEX rotates in the same direction depending upon an operation program. Take care to avoid entanglement of cables.

Step 1
Installation and connection check

Check if the ABSODEX is installed and connected correctly.

↓

Step 2
Gain adjustment (auto tuning)

Use the auto tuning function to adjust to the gain matching the load.

↓

Step 3
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.)

↓

Step 4
Creation of test operation program and test operation

Use AX Tools to build a program easily.
Supply a motion command mode start input to start operation.

↓

End

Follow the above procedure to perform test operation.

Step 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 **Chapter 2. "INSTALLATION."**

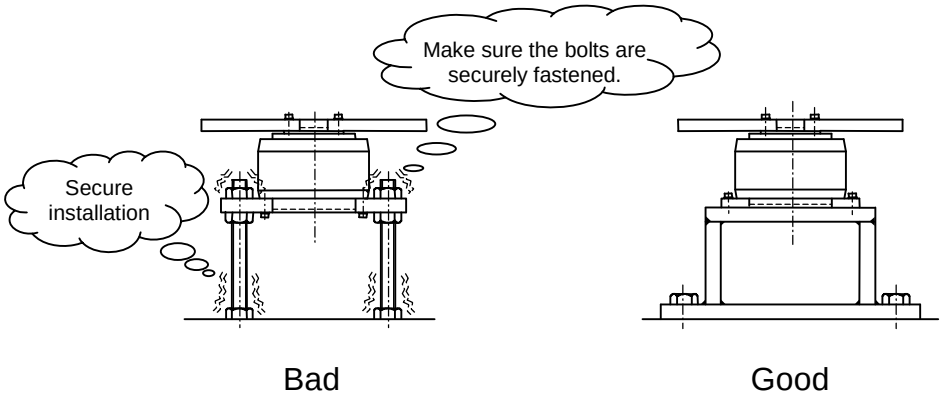


Fig. 4.1 Unit Installation Example

Next, connect all of the actuator, driver and power supply as well as peripheral devices.
For details, refer to **Chapter 3. "SYSTEM CONFIGURATION AND WIRING."**

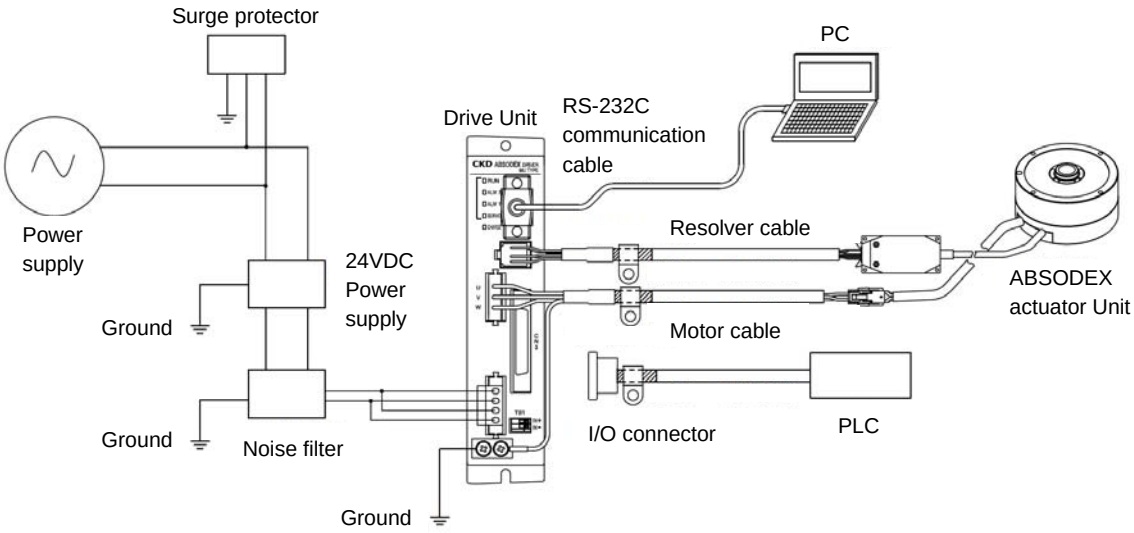


Fig. 4.2 Connection Example

Step 2 Gain adjustment (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.

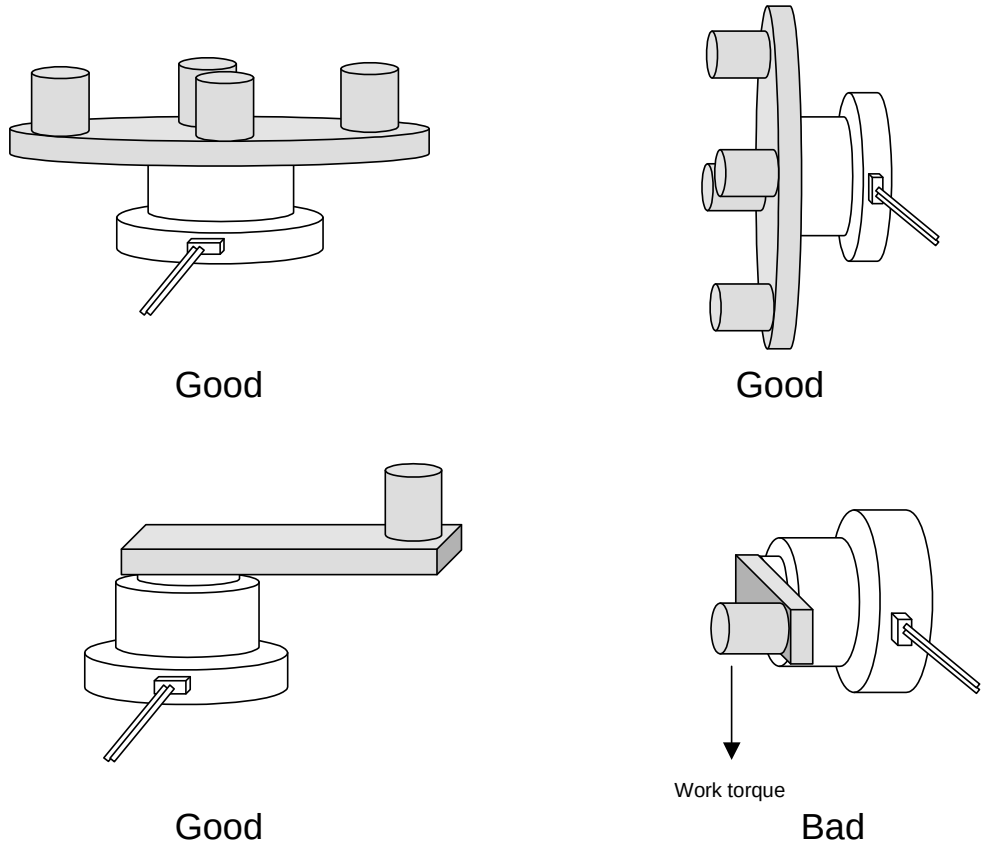


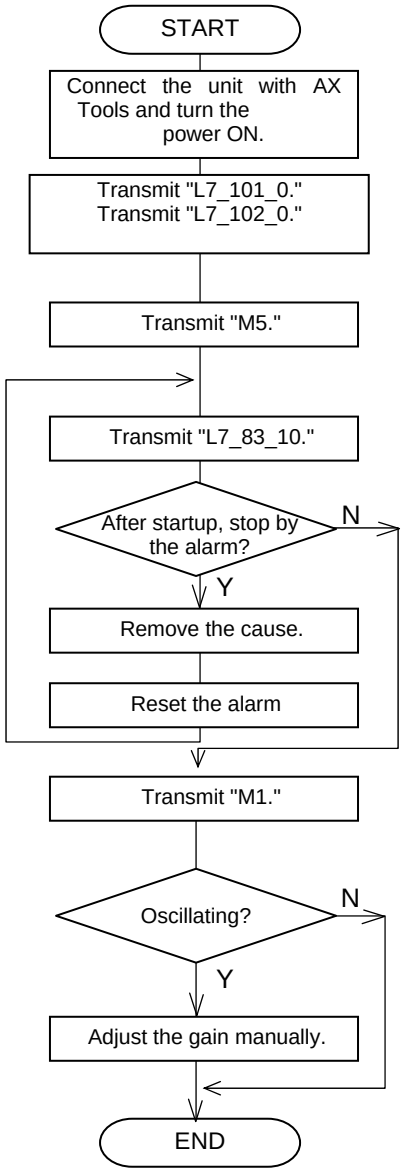
Fig. 4.3 Action of Work Torque

⚠ 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, perform manual tuning to adjust the gain.**
  For the manual adjustment method, refer to Chapter 9. "GAIN ADJUSTMENTS."
- **If a work torque (external force to rotate the output axis of the actuator) acts as shown in the above figure, auto tuning is impossible. Use manual tuning, too, in this case, to adjust the gain.**

Step 2-1 Auto Tuning Method

The flowchart of auto tuning is shown below.



Change the gain setting parameter in the terminal mode. Auto tuning becomes valid.

Turn the servo off.

Auto tuning oscillation starts.

Turn the servo on.

Enter the actual program to start operation.

For manual adjustment, refer to **Chapter 9. "GAIN ADJUSTMENTS**."

Fig. 4.4 Auto Tuning Flowchart

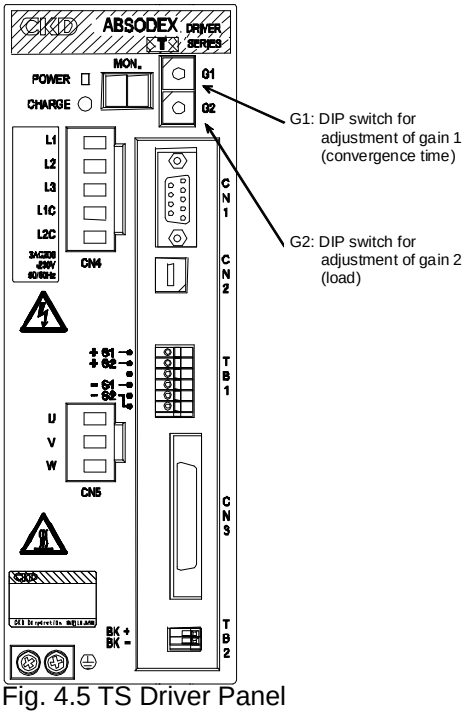


Fig. 4.5 TS Driver Panel

Step 2-2 Auto Tuning Procedures

1) Turn the power on.
After checking that there is no interfering matter when ABSODEX, 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.

2) In the terminal mode of AX Tools, enter commands necessary for auto tuning.

The key-in method of the AX Tools terminal mode is described below. Skip to the next section and enter commands on the actual entry screen if you want.

3) Change gain setting parameters PRM101 and PRM102 to "0."
The auto tuning mode starts.

4) Select the terminal mode of AX Tools. Enter necessary commands in the terminal mode.

5) Follow the flowchart shown in Fig. 4.4 to perform auto tuning.

① Turn the servo off. (Send "M5.")

② Start auto tuning. (Send "L7_83_10.")

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.

③ After the actuator has stopped oscillating, tuning is finished.
(The cycle may take several tens of seconds according to the load.)

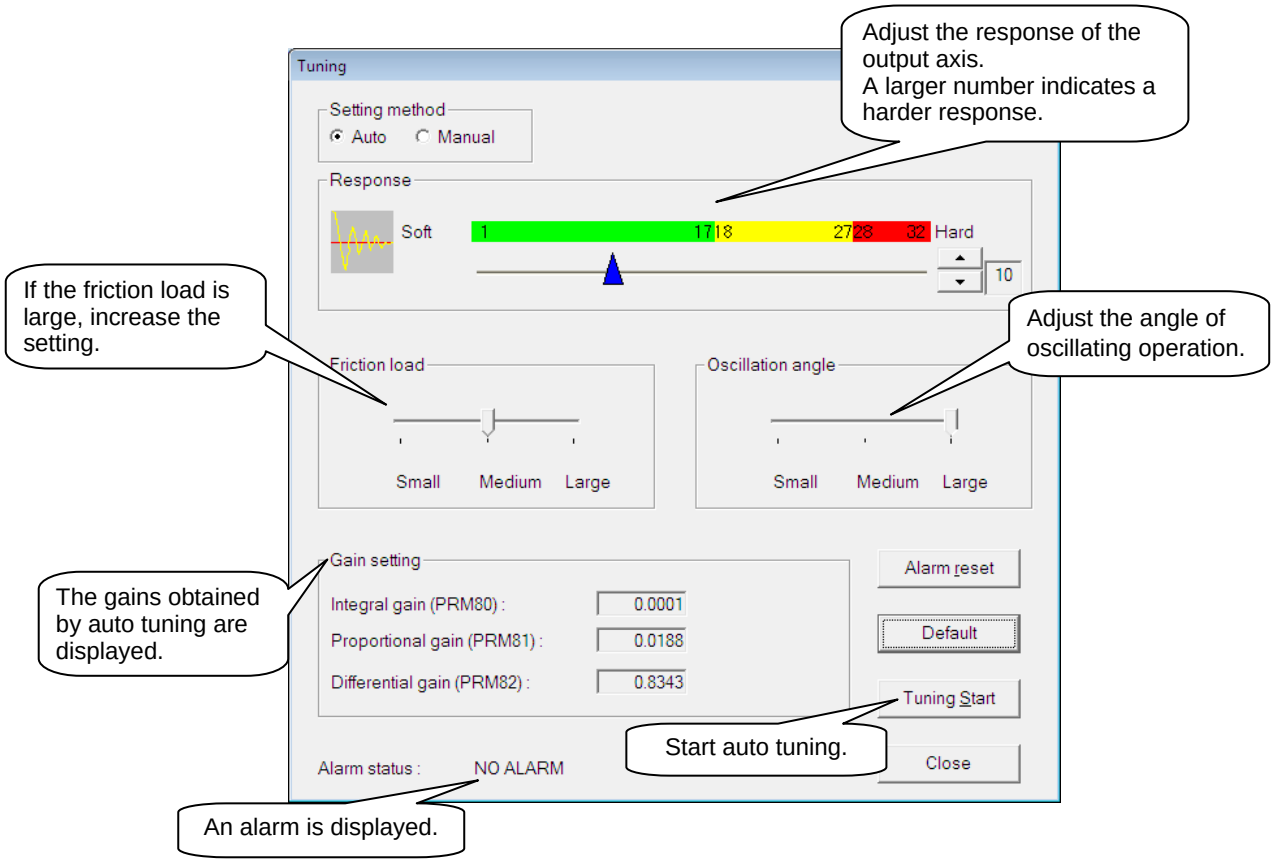
④ Turn the servo on. (Send "M1.")

If the ABSODEX oscillates in this state, manual gain adjustment is necessary.
Refer to Chapter 9. "GAIN ADJUSTMENTS."

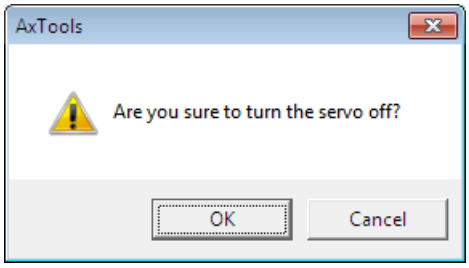
- **If a wrong code is transmitted and "*" is received to cause alarm 7, reset from the alarm (send S7) and enter the correct code and send it again.**

(Reference)
Use AX Tools "Tuning Function" to perform auto tuning more easily.
The method for performing steps 3), 4) and 5) with AX Tools is described here.

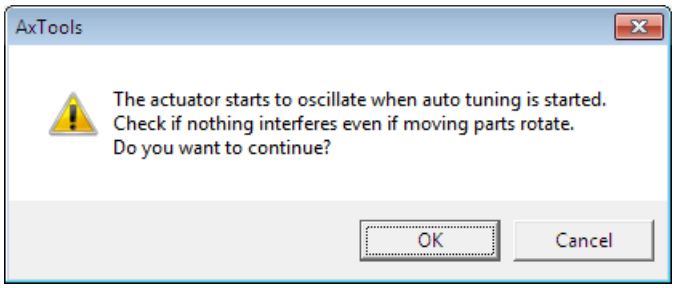
① Launch AX Tools and open the auto tuning dialog box.
To start auto tuning, select "Auto" at the "Setting method" menu and press the "Tuning Start" button.



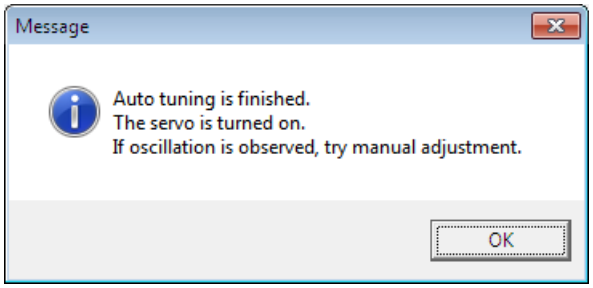
② A servo-off check is requested for.
To continue, press "OK."



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



④ After the actuator has stopped oscillating, auto tuning is finished.
(It takes several seconds to several tens of seconds according to the load.)



- **For details, refer to the "AX Tools instruction manual."**

You can use the "semi-auto tuning function" to perform fine adjustments.
For the operation method and other details, refer to Chapter 9. "GAIN ADJUSTMENTS."

Step 3 Home position determination (Unnecessary for test operation)

Use the home position offset adjustment function of AX Tools to determine the home position in an arbitrary position.

- **For details, refer to the "AX Tools instruction manual."**

Step 4 Creation of test operation program and test operation

Use AX Tools to build a program for test operation.

- **For details, refer to the "AX Tools instruction manual."**

⚠ 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.**

5. HOW TO USE I/O

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

Table 5.1. CN3 I/O Input Specification

Pin No.	Signal Name	NPN Specication (-U0)	PNP Specication (-U1)
1 2	External power input	+24V	GND(0V)
3 4	External power input	GND(0V)	+24V

Table 5.2. CN3 Input Signal

Pin No.	Signal Name	Logic	Judg-ment	Remarks	Reference Section
5	Program No. selection input (bit 0)	Positive	Level	Select or enter the program number to be executed.	5.2.1
6	Program No. selection input (bit 1)	Positive	Level		
7	Program No. selection input (bit 2)	Positive	Level		
8	Program No. selection input (bit 3)	Positive	Level		
9	Program No. setting input, 2nd digit	Positive	Edge		
	Program No. selection input (bit 4)		Level		
10	Program No. setting input, 1st digit	Positive	Edge		
	Program No. selection input (bit 5)		Level		
11	Reset input	Positive	Edge	Alarm reset	5.2.4 5.2.11 1)
12	Home positioning instruction input	Positive	Edge	Home positioning execution	5.2.3
13	Start input	Positive	Edge	Program execution	5.2.2 5.2.5 5.2.7
14	Servo-on input	Positive	Level	Servo input	5.2.7
	Program stop input		Edge	Program stop	5.2.2
15	Continuous rotation stop input	Positive	Edge	Stop of continuous rotation G07	5.2.11 2)
16	Answer input	Positive	Edge	Answer input to positioning completion output and M code output	5.2.8 5.2.9 5.2.10
	Position deviation counter reset input		Level	Input for resetting position deviation in the pulse string input mode	5.2.11 3)
17	Emergency stop input	Nega-tive	Level	Emergency stop	5.2.4
18	Brake release input	Positive	Level	Brake release	5.2.5

- **Turn on or off the input signal at least for 20msec.**
- **"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.**

Table 5.3 CN3 Output Signal

Pin No.	Signal Name	Logic	Emergency Stop	Remarks	Reference Section
33	M code output (bit 0)	Positive	A	・ The M code corresponding to the number bits of the first digit of M20 to M27 NC codes is output. The M code strobe output is issued simultaneously. ・ When NC code M70 is executed, the current segment position is output in a binary. The number of segments must be designated in advance with G101. The segment position strobe output is issued simultaneously.	5.3.9 5.3.10
34	M code output (bit 1)	Positive			
35	M code output (bit 2)	Positive			
36	M code output (bit 3)	Positive			
37	M code output (bit 4)	Positive			
38	M code output (bit 5)	Positive			
39	M code output (bit 6)	Positive			
40	M code output (bit 7)	Positive			
41	In-position output	Positive	B	The signal is output if the servo position deviation is within the allowable limit.	5.3.11 5)
42	Positioning completion output	Positive	A	The signal is issued upon completion of an action.	5.3.5 5.3.8
43	Start input wait output	Positive	C	The signal is output when the ABSODEX is ready to accept a start input.	5.3.2 5.3.7
44	Alarm output 1	Negative	D	Alarm signals are issued in three steps according to the seriousness of the alarm: output 1, output 2, and outputs 1 and 2.	5.3.11 6)
45	Alarm output 2	Negative			
46	Output 1 during indexing	Positive	E	These signals are issued in the middle of a traveling stroke according to the value of PRM 33.	5.3.11 8)
	Home position output			The home position output is issued according to the value of PRM46.	5.3.11 9)
47	Output 2 during indexing	Positive	E	These signals are issued in the middle of a traveling stroke according to the value of PRM 34.	5.3.11 8)
	Servo state output			The current servo state is output.	5.3.6 5.3.7
48	Ready output	Positive	C	The signal is issued if the module is ready for regular operation.	5.3.11 7)
49	Segment position strobe output	Positive	A	The signal is issued when segment position output (M70) is executed.	5.3.10
50	M code strobe output	Positive	A	The signal is output when M codes (M20 to M27) are executed.	5.3.9

1) 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.

2) I/O output state upon emergency stop input

The state of CN3 output signals shown in **Table 5.3** after an emergency stop input is supplied is shown in **Table 5.4**.

Table 5.4 Output Signal State at Emergency Stop Input

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

- **In this instruction manual, the input signal activated upon a closed contact shown in "Fig. 3.13 Input Circuit" is called a positive logic input, and the input signal activated upon an open contact is called a negative logic input. As well, the signal causing the current to flow in the load upon an active (ON) output shown in "Fig. 3.14" Output Circuit 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.**

Table 5.5 CN3 Pulse String Input Signal

Pin No.	Signal Name	Remarks
19	PULSE/UP/phase A	One of the following input modes can be selected with the setting of PRM 42: ・Pulse/direction input ・Up/down input ・Phase A/B input The shipment setting is pulse/direction input.
20	-PULSE/-UP/-phase A	
21	DIR/DOWN/phase B	
22	-DIR/-DOWN/-phase B	

- **The I/O signal scanning interval is 10msec. If two or more signals are supplied within 10msec, either simultaneous inputs or separate inputs are judged according to the scanning timing. ABSODEX may operate differently according to the judgment result. (For example, if a program stop input signal is supplied within 10msec after a start input signal is supplied, the program may or may not be executed.) Take this feature into consideration when designing the timing of input/output signals.**

- **Do not supply unnecessary input signals as far as possible. Among all, do not supply the start input, answer input, home positioning instruction input and servo ON input at 100Hz or higher frequencies.**

Table 5.6 CN3 Encoder Output Signal (Pulse String)

Pin No.	Signal Name	Remarks
23	A-phase (differential, line driver)	The output resolution can be changed with the PRM50 setting.
24	-A-phase (differential, line driver)	
25	B-phase (differential, line driver)	
26	-B-phase (differential, line driver)	
27	Z-phase (differential, line driver)	A single pulse is output in the home position.
28	-Z-phase (differential, line driver)	

5.2 I/O Conversion Table

Shown below are tables of correspondence for converting the CN3 connector of a GS type driver to that of the TS/TH type driver.

You can use MR-50LK2+ (HONDA TSUSHIN KOGYO) to relay CN3-MR50 of a GS type.

- **An error in wiring can cause breakage to the driver. Take sufficient care when conducting wiring.**
- **Leave pins marked with a circle (○) unconnected.**
- **The enlarged view shows the front view obtained with a connector connected.**

GS Type Driver

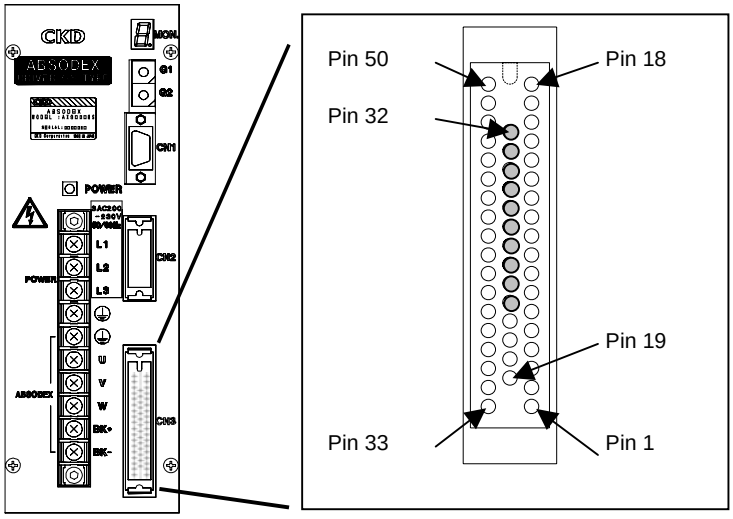


Fig. 5.1 CN3 Connector (GS Type Driver)

TS/TH Type Driver

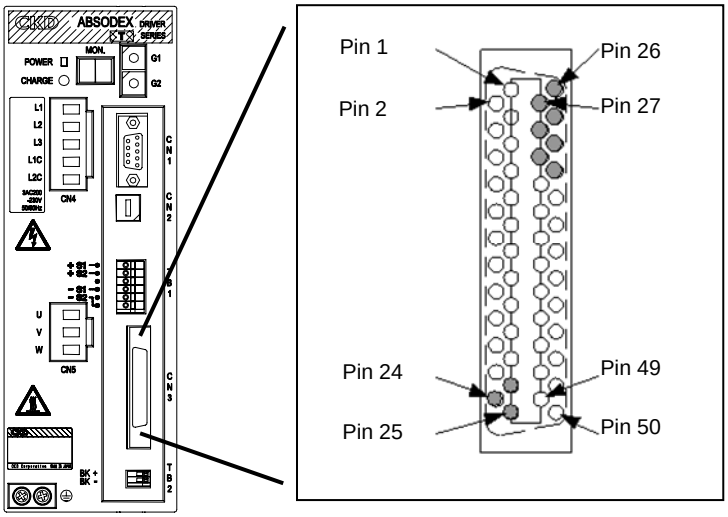


Fig. 5.2 CN3 Connector (TS/TH Type Driver)

Table 5.6 CN3 Connector Correspondence Table

GS Type Driver MR-50LK2+ (Relaying connector hood) MR-50F (Female connector)		TS/TH Type Driver MDR50 (Half pitch)	
Signal Name	Pin No.	Pin No.	Signal Name
External power supply input +24V±10%	1	1	External power supply input +24V±10%
External power supply input +24V±10%	2	2	External power supply input +24V±10%
External power supply input GND	3	3	External power supply input GND
External power supply input GND	4	4	External power supply input GND
Program number selection input (bit 0)	5	5	Program number selection input (bit 0)
Program number selection input (bit 1)	6	6	Program number selection input (bit 1)
Program number selection input (bit 2)	7	7	Program number selection input (bit 2)
Program number selection input (bit 3)	8	8	Program number selection input (bit 3)
Program number setting input, second digit/ Program number selection input (bit 4)	9	9	Program number setting input, second digit/ Program number selection input (bit 4)
Program number setting input, first digit	10	10	Program number setting input, first digit/ Program number selection input (bit 5)
Reset input	11	11	Reset input
Home return command input	12	12	Home return command input
Start input	13	13	Start input
Program stop input	14	14	Servo-on input / Program stop input
Continuous rotation stop input	15	15	Ready return input / Continuous rotation stop input
Answer input	16	16	Answer input / Position deviation counter reset input
Emergency stop input	17	17	Emergency stop input
Brake release input	18	18	Brake release input
A-phase input	19	19	A-phase input
-A-phase input	20	20	-A-phase input
B-phase input	21	21	B-phase input
-B-phase input	22	22	-B-phase input
Leave unconnected.	23	23	Leave unconnected.
	24	24	
	25	25	
	26	26	
	27	27	
	28	28	
	29	29	
	30	30	
	31	31	
	32	32	
M code output (bit 0)	33	33	M code output (bit 0)
M code output (bit 1)	34	34	M code output (bit 1)
M code output (bit 2)	35	35	M code output (bit 2)
M code output (bit 3)	36	36	M code output (bit 3)
M code output (bit 4)	37	37	M code output (bit 4)
M code output (bit 5)	38	38	M code output (bit 5)
M code output (bit 6)	39	39	M code output (bit 6)
M code output (bit 7)	40	40	M code output (bit 7)
In-position output	41	41	In-position output
Positioning completion output	42	42	Positioning completion output
Start input wait output	43	43	Start input wait output
Alarm output 1	44	44	Alarm output 1
Alarm output 2	45	45	Alarm output 2
Output in indexing 1 / Home position output	46	46	Output in indexing 1 / Home position output
Output in indexing 2	47	47	Output in indexing 2 / Servo state output
Timing output	48	48	Ready output
Divided position strobe output	49	49	Divided position strobe output
M code strobe output	50	50	M code strobe output

5.3 How to Use General I/O Signals

This section explains general I/O signals, the contents and use.
Some of general I/O signals vary in using method depending on the parameter setting.
Chapter 7. "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 20msec.**
  The timer function of some programmable logic controllers includes variations and may cause trouble.
  Check the specification of the programmable logic controller to assure 20msec or a longer activation interval.

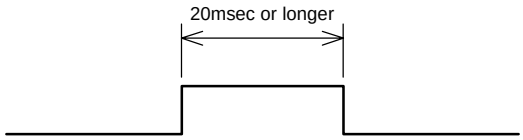


Fig. 5.3 Input Signal ON-time

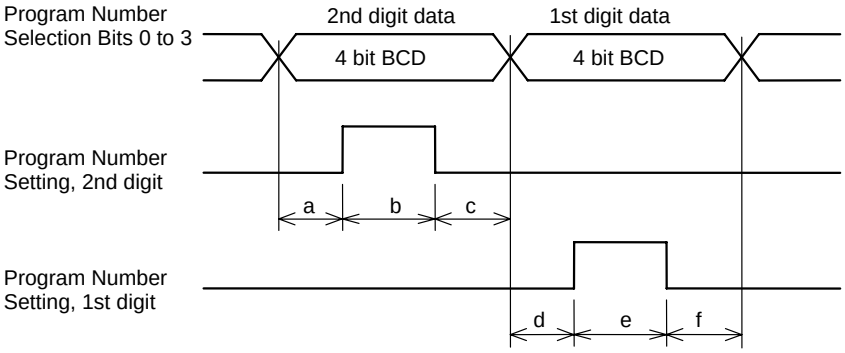
5.3.1 Program No. Selection Method

I/O Signals to be Used:	**・Program No. selection input bit 0 to 3 (CN3-5 to 8)** **・Program setting input second digit / Program No. selection input bit 4 (CN3-9)** **・Program setting input first digit / Program No. selection input bit 5 (CN3-10)** **・Start input (CN3-13)**

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 PRM 36 (I/O program number selection method switching).

1) 4 bit BCD Double Selection (PRM36=1: default setting)
Bit 0 to 3 (CN3-5 to 8) for program No. selection input enables to set the second (tens 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).

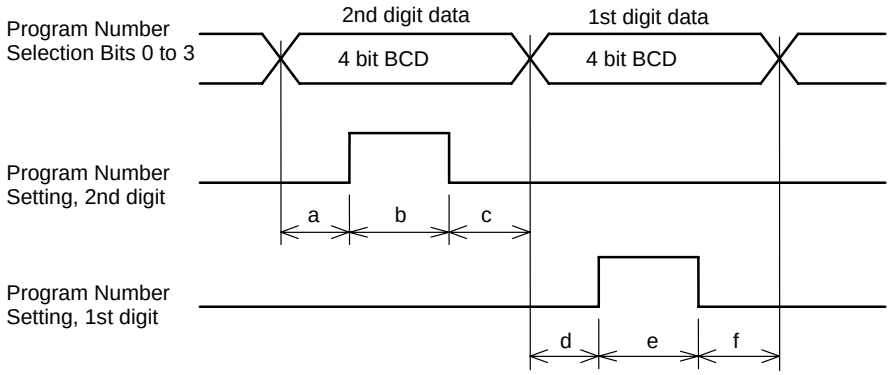


a,b,d,e = 20msec or larger c,f = 0msec or larger

Fig. 5.4 Timing for Program Number Input

- **"PRM" indicates the parameter in this manual.**

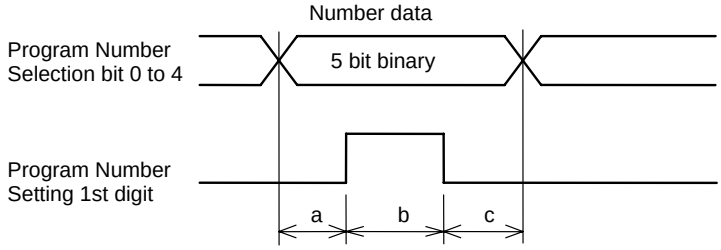
2) 4 bit Binary Double Selection (PRM36=2)
Same as in 1), Bit 0 to 3 (CN3-5 to 8) for program selection input enables to set the second and first digit data in this order. The number data is specified by 4 bit BCD. Consequently, the selectable numbers of programs are 0 to 255 (FF).



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

Fig. 5.5 Timing for Program Number Input

3) 5 bit Binary Single Selection (PRM 36=3)
The second digit in the program setting input (CN3-9) is used as 4 bit of program number selection. Using 5 bit of the bit 0 to 4 for the number selection input and first digit in the program setting input (CN3-10) 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.



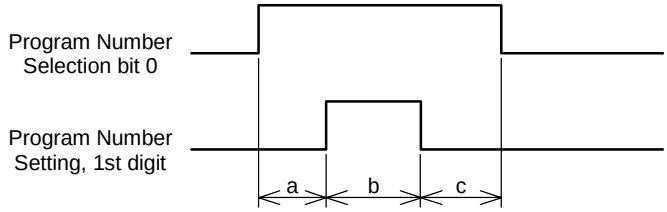
a,b = 20msec or larger c = 0msec or larger

Fig. 5.6 Timing of Program Number Input

- **Program number setting cannot be done during program execution (state where the start input wait output (CN3-43) is turned off) or when alarm No. 1, 2, 4, 5, 6, 8, 9, E, F or L is displayed.**

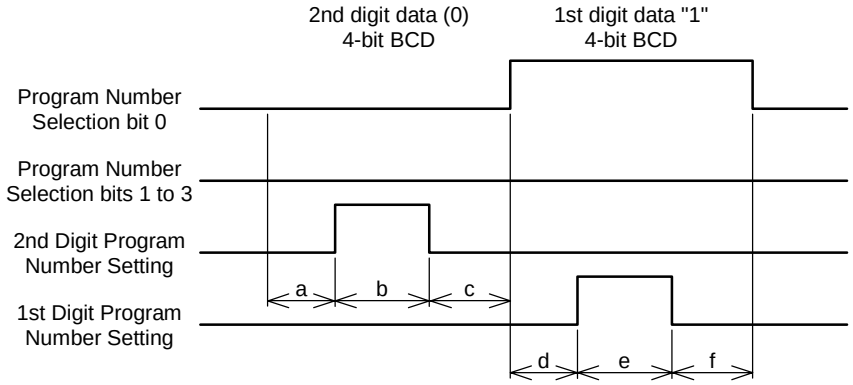
- **After a program number is entered, the setting remains valid until another number is entered or the control power is shut down.**
  Note that "tens digit" and "units digit" described in 1) and 2) are independent of each other.

  <Example> To enter program number "1" in method "1) selection of 4-bit BCD twice" when the program number setting is "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 Fig. 5.7.)
  In this case, enter "0" with the tens digit program number signal and enter "1" with the units digit program number signal. (Refer to Fig. 5.8.)



a, b: 20msec or longer c: 0msec or longer

Fig. 5.7 Program Number Setting Timing



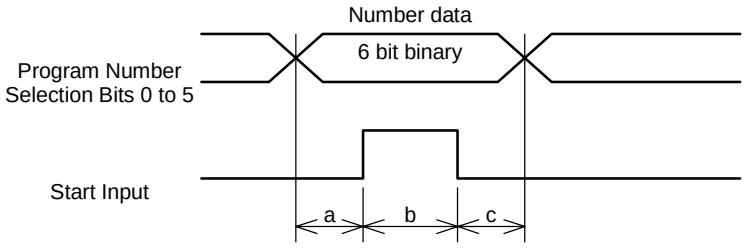
a, b, d, e: 20msec or longer c, f: 0msec or longer

Fig. 5.8 Program Number Setting Timing

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 an emergency stop differs by the setting of PRM36 (Selection switching of I/O program numbers).

4) 6 bit Binary Selection with Start (PRM36=4, program number is not set after emergency stop)
The second digit (CN3-9) in the program setting input is used for bit 4 of the program number selection input, and the first digit (CN3-10) in the program setting input is used for bit 5 of the program number selection input. Select a program number between 0 and 63 (3F). After emergency stop, the first start input causes restoration action which is described in "5.6.3 Restoration Action Procedure after Emergency 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.

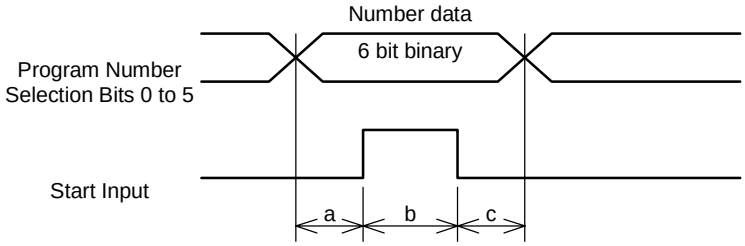


a = 10msec or longer b = 20msec or longer c = 0msec or longer

Fig. 5.9 Program Number Setting Timing

- **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 an emergency stop input is input, the restoration action following the emergency stop is carried out with the next start input that is input after the alarm is reset. The program number is not set and the program is not started at this time. After the restoration action is completed, the program number is selected and the program is started with the next start input.**

5) 6 bit Binary Selection with Start (PRM36=5, program number is set after emergency stop)
The second digit (CN3-9) in the program setting input is used for bit 4 of the program number selection input, and the first digit (CN3-10) in the program setting input is used for 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 an emergency stop. The selected program is set and started.



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

Fig. 5.10 Program Number Setting Timing

- **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 an emergency 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 emergency stop is not carried out.**
- **If the distance from the emergency 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 emergency stop input and resetting the alarm, if a program is started using the S1 communication command, the restoration action following the emergency stop is carried out (i.e., the actuator moves to the rotation termination position).**

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

Table 5.7 Comparison of functions between I/O and communication command

Interface		Range of functions		
		Program No. selection function	Program No. setting function	Start function
I/O (CN3)	4bit BCD (PRM36=1) 4bit BIN (PRM36=2)	Program No. selection bit 0～3 (CN3-5～8)	Program No. setting input 2nd, 1st digit (CN3-9, 10)	Start input (CN3-13)
	5bit BIN (PRM36=3)	Program No. selection bit 0～4 (CN3-5～9)	Program No. setting input 1st digit (CN3-10)	Start input (CN3-13)
	6bit BIN (PRM36=4) 6bit BIN (PRM36=5)	Program No. selection bit 0～5 (CN3-5～10)	Start input (CN3-13)	
Communication Codes (CN1)		L16 (Designation of Program Number)		S1 (Start)

(1) When PRM36=1 or 2
"Program No. selection bits 0 to 3 (CN3-5 to 8)" are used to select program numbers.
"Program No. setting input, 2nd digit (CN3-9) and 1st digit (CN3-10)" are used to set program numbers.
"Start input (CN3-13)" is used to execute programs.

(2) When PRM36=3
"Program No. selection bits 0 to 4 (CN3-5 to 9)" are used to select program numbers.
"Program No. setting input, 1st digit (CN3-10)" is used to set program numbers.
"Start input (CN3-13)" is used to execute programs.

(3) When PRM36=4 or 5
"Program No. selection bits 0 to 5 (CN3-5 to 10)" are used to select program numbers.
"Start input (CN3-13)" is used to set program numbers and to start programs.

(4) When communication commands are used
"L16" is used to select and set program numbers.
"S1" is used to start programs.

5.3.2 NC Program Execution Method

I/O Signals to be Used:	**・Start input (CN3-13)** **・Start input standby output (CN3-43)** **・Program stop input (CN3-14)**
PRM to be Used:	**・Function selection for I/O input signal CN3-14 (bit 9)** *** If the program stop input is used**

Turn on start input (CN3-13) 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 (CN3-14) 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 (CN3-13) 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 (CN3-43) 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. These communication codes can be used at the dialog terminal to execute or stop the program. For details, refer to **Chapter 12. "COMMUNICATION FUNCTIONS**."

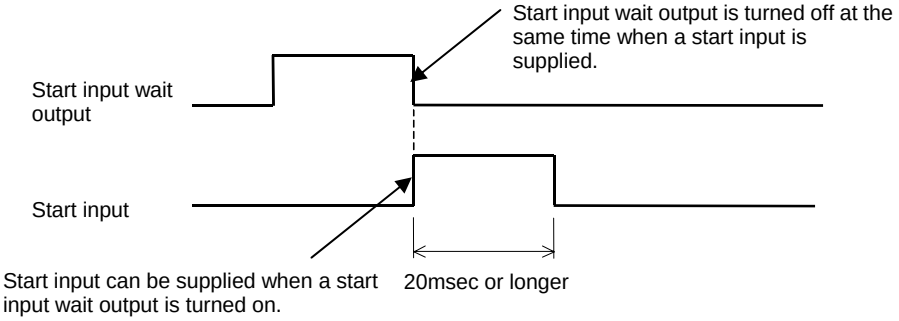


Fig. 5.11 Start Input Timing

5.3.3 Home Positioning Instruction Input

I/O Signals to be Used:	**・Home positioning instruction input (CN3-12)**

The built-in absolute resolver 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 (CN3-12).
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 following are the related parameters for home positioning, which should be referred to in **Chapter 7. "PARAMETER SETTING."**

PRM 3 Home position offset amount
PRM 4 Home positioning direction
PRM 5 Home positioning speed
PRM 6 Home positioning acceleration and deceleration time
PRM 7 Home positioning stop

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

Note *1 Entry of the emergency 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 emergency 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 emergency stop input or resetting the alarm: home positioning, execution of NC code G92.1A0, or turning the power off and back on again.

5.3.4 Emergency Stop Input

I/O Signals to be Used:	• **Emergency stop input (CN3-17)** • **Reset input (CN3-11)**

This is a negative logic input signal and it is valid when PRM 23 (emergency stop input) is "1" or "3" (default setting: 3; servo OFF after stop). When this signal is turned on, program execution is stopped.

1) During rotation
   Deceleration and stop are caused according to the deceleration rate specified in PRM 21.

2) In stop
   The emergency stop state is caused in the position.

3) State after emergency stop
   If PRM 23 is "1", the servo is turned on. If PRM 23 is "3", the servo is turned off after the time set at PRM 22 (emergency 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 **5.1 2) " I/O output state upon emergency stop input."**

- **The emergency stop input is a negative logic input signal. If PRM 23 is set at "1" or "3" when 24VDC is not supplied at CN3, an emergency stop is caused.**

- **The emergency stop input judges the input signal state with the level. To reset from the emergency stop, keep the signal always off before turning on the reset input.**

- **When the EMERGENCY STOP button is pressed at the dialog terminal, "stop followed by servo-on" is caused, following by alarm E without relations to the setting of PRM 23.**

5.3.5 Brake Release Input

I/O Signals to be Used:	• **Brake release input (CN3-18)** • **Start input (CN3-13)** • **Positioning completion output (CN3-42)**

The brake is released while this signal is turned on even if the brake is applied.
If an emergency 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.

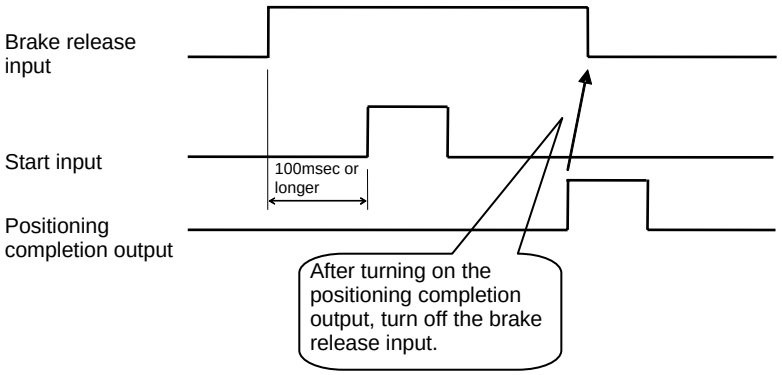


Fig. 5.12 Timing of Brake Release Input

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

5.3.6 Servo State Output

I/O Signals to be Used:	**・Servo state output (CN3-47)**
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 CN3-47.
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 an emergency stop, the servo state signal is turned off after a delay specified in PRM22 (emergency stop servo-off delay).
However, the servo and the servo state signal are turned off immediately in the M3 mode.

- **This function is an alternative to "output in indexing 2."**

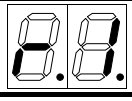
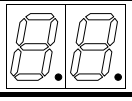
5.3.7 Servo-on Input

I/O Signals to be Used:	**・Servo-on input (CN3-14)** **・Start input (CN3-13)** **・Start input wait output (CN3-43)** **・Servo state output (CN3-47)**
PRM to be Used:	**・PRM52=0: Function selection for I/O input signal CN3-14 (bit 9)**

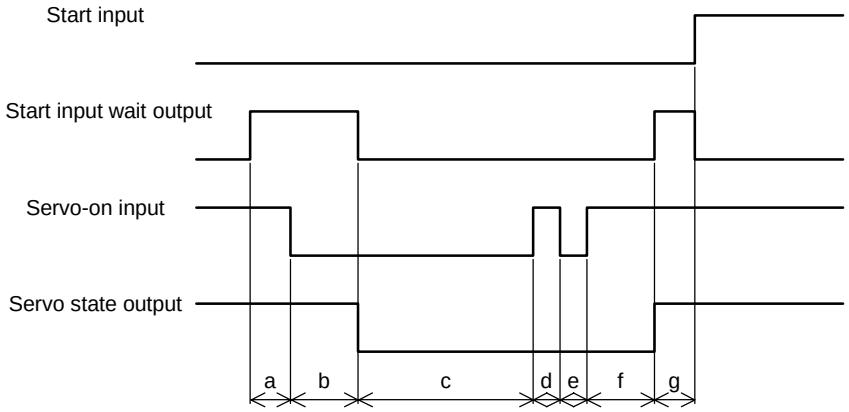
This function makes it possible to turn the servo on/off with an I/O signal.
If this signal is active, the servo is turned on. If this signal is inactive, the servo is turned off.
This function is applicable to all modes except for the servo-off (M5) mode.
When the servo is turned on with this signal 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.

Table 5.8 Servo-on Input and 7-segment LED Indication Example

	Servo-on Input	
	ON (servo-on)	OFF (servo-off)
7-segment LED		

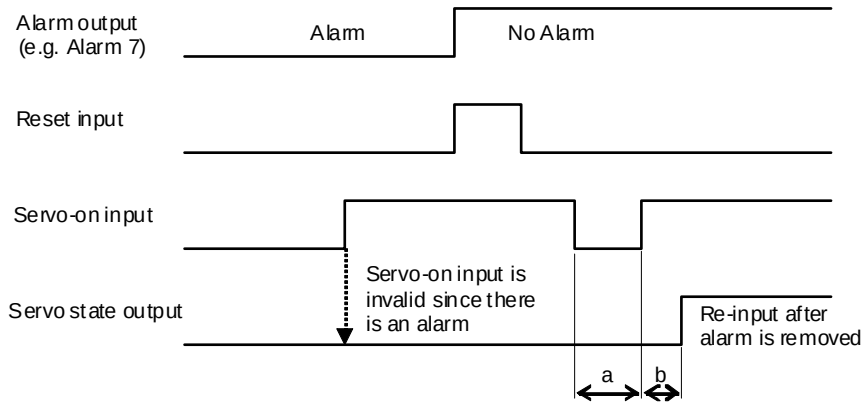
The timing chart of I/O signals related to this function and servo state output described in Section 5.3.6 is shown below.
This example is in the M1 (automatic operation) mode.



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

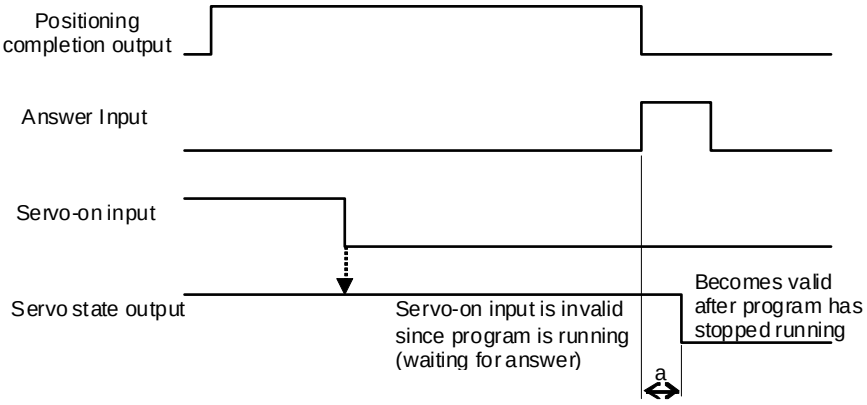
Fig. 5.13 Timing Chart of Servo-on Input

- **This function is an alternative to "program stop input."**
- **The servo state output is issued after about 100msec since the servo-on input changes.**
- **Leave at least 100msec for the servo-on/off switching timing to avoid malfunctioning. No input is accepted in intervals d or e shown in Fig. 5.13.**
- **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.**
- **This function is invalid in an alarm or in an emergency stop input. (Fig. 5.14) Remove the cause of the alarm and reset to validate. After the alarm is removed, set the function again to ON or OFF.**
- **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. (Fig. 5.14)**
- **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 = 20msec or longer b = Shorter than 100msec

Fig. 5.14 Servo-on input when an alarm is triggered



a = Shorter than 100msec

Fig. 5.15 Servo-on input when program is running

5.3.8 Confirmation Method of Positioning Completion

I/O Signals to be Used:	• **Positioning completion output (CN3-42)** • **Answer input (CN3-16)**
PRM to be Used:	• **Answer input after completion of positioning and home return** • **Positioning completion output time** • **Function selection for I/O input signal CN3-16 (bit 11)**

Completion of home positioning and positioning will turn on positioning completion output (CN3-42).
(For output conditions, refer to **Section 7. 7 "Judgment of Positioning Completion**."
Specify PRM 13 (answer input to positioning and home positioning completion) to select whether the answer input (CN3-16) is necessary or unnecessary.

1) When answer input (CN3-16) is not required (PRM 13=2: default setting)
Positioning completion output (CN3-42) is ON for 100 msec.

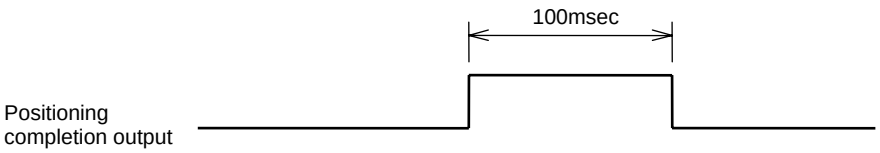


Fig. 5.16 Positioning Completion Output Timing

2) When answer input (CN3-16) is required (PRM 13=1)
Positioning completion output (CN3-42) is ON until the answer input (CN3-16) is ON.
The alarm H will be caused if there is no answer input longer than the time set by the PRM 11 (no answer time).

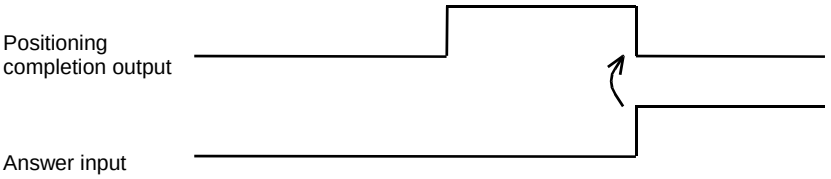


Fig. 5.17 Positioning Completion Output Timing

3) To use the positioning completion output time (PRM13 = 2: shipment setting)
You can use PRM47 to enter the positioning completion time between "0 and 1000msec."

- **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."**

5.3.9 M Code Output Timing

I/O Signals to be Used:	• **M code output bit 0 to 7(CN3-33 to 40)** • **M code output bit 0 to 7(CN3-50)** • **M code strobe output (CN3-50)** • **Answer input (CN3-16)**
PRM to be Used:	• **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 (CN3-33 to 40).
To discriminate this output from the segment positioning output M70, M code strobe output (CN3-50) is simultaneously made.

Specify PRM 12 (M answer necessary/unnecessary) to select whether the answer input (CN3-16) is necessary or unnecessary.

1) When answer input (CN3-16) is not required (PRM 12=2: default setting)
M code output is ON for 100 msec.

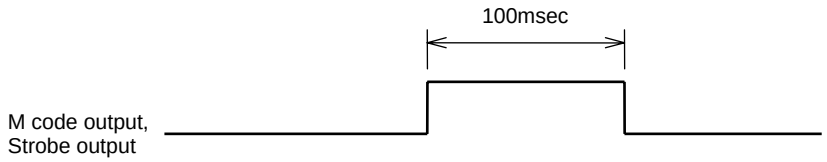


Fig. 5.18 M Code Output Timing

2) When answer input (CN3-16) is required (PRM 12=1)
M code output is made until the answer input (CN3-16) is ON. The alarm H will be caused if there is no answer input longer than time set by the PRM 11 (no answer time).

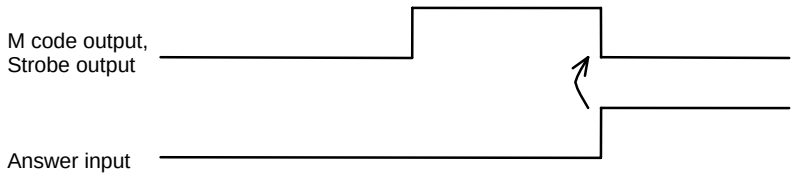


Fig. 5.19 M Code Output Timing

5.3.10 Segment Position Output Timing

I/O Signals to be Used:	• **M code output bit 0 to 7 (CN3-33 to 40)** • **Segment position strobe output (CN3-49)** • **Answer input (CN3-16)**
PRM to be Used:	• **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 (CN3-33 to 40).
For details, refer to **7.9.3 Motion of M70**.
To discriminate this output from the M code output M20 to M27, Segment position strobe output (CN3-49) is simultaneously made.

Setting the PRM 12 (whether or not M answer is required) enables to select whether or not the answer input (CN3-16) is required.
Each timing is same as that of M-code output.

5.3.11 Other I/O Signals

1) Reset Input (CN3-11)
   This is used to reset an alarm, and is effective only when the alarm exists.
   For detail of alarms, refer to **Chapter 10. "ALARMS."**

2) Ready Return Input (CN3-15)
   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.

3) Continuous Rotation Stop Input (CN3-15)
   This is the input to stop continuous rotation with NC code G07.
   This input will cause continuous rotation to stop, and then to execute the next block in the NC program. Program stop input (CN3-14) 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.

4) Position Deviation Counter Reset Input (CN3-16)
   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.**

5) In-position Output (CN3-41)
   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 **Section 7.15 "In-position Signal Output Mode."**
   For judgment of in-position, refer to **Section 7.6 "Judgment of In-position."**

6) Alarm Output 1, 2 (CN3-44 and 45)
   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 **Chapter 10. "ALARMS."**

7) Ready Output (CN3-48)
   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.

8) Output 1 and 2 during Indexing (CN3-46 and 47)
These are the output that is made during motion.
According to the settings of PRM 33 (output 1 during indexing) and PRM 34 (output 2 during indexing) with 0 selected for PRM 56 (output 1 during indexing) or PRM 57 (output 2 during indexing), the output is turned on, and it is turned off when the positioning completion signal is issued. The PRM 33 and 34 are specified by the percentage of the moving angle.

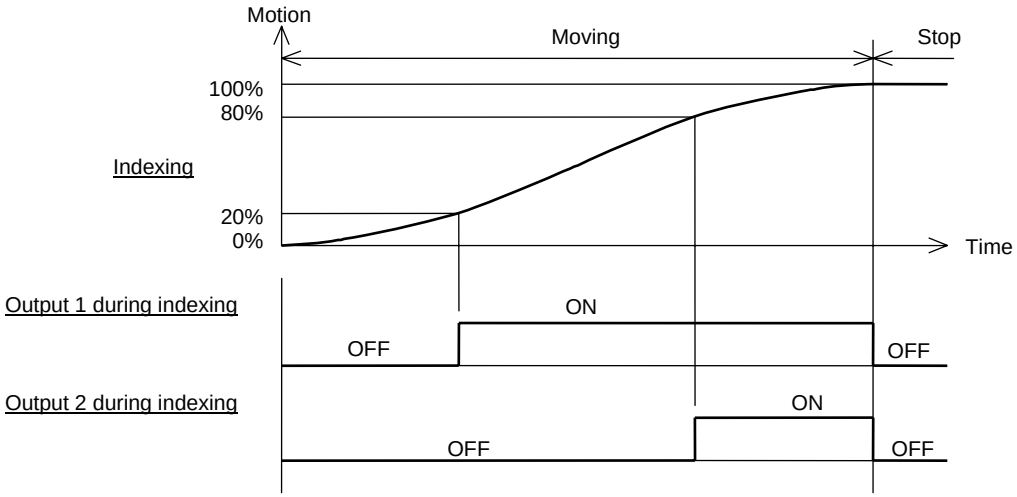


Fig. 5.20 Example of Output During Indexing
(In case of PRM33 = 20, PRM34 = 80)

9) Home Position Output (CN3-46)

If PRM56 is set at "1" (home position output), home position output CN3-46 is issued each time the user coordinate origin is passed.

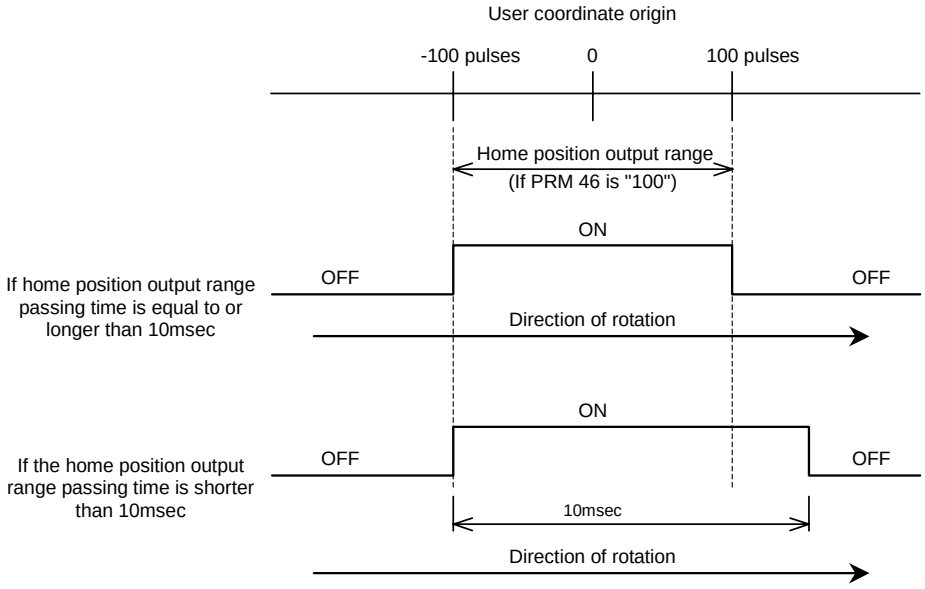


Fig. 5.21 Home Position Output Timing

a) If the parameter setting range passing time is 10msec or longer

If PRM 46 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.

b) If the parameter setting range passing time is shorter than 10msec.

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

5.4 Pulse String Input Signals

5.4.1 Using Pulse String Input Signals

I/O Signals to be Used:	• **PULSE/UP/A Phase (CN3-19)** • **PULSE/-UP/-A Phase (CN3-20)** • **DIR/DOWN/B Phase (CN3-21)** • **DIR/-DOWN/-B Phase (CN3-22)**

The following two methods can be used to drive an actuator in the pulse string input mode.

1) Executing NC code G72 in the NC program
   Executing NC code G72 will make pulse string input effective. It will become ineffective stopping execution of G72, when there is no pulse string input for more than 2 msec after start input or program stop input is turned on. For start input, NC program execution continues to execute the next block in the program.

2) Turning Operation Mode to M6 (Pulse String Input Mode)
   Sending the communication code M6 from a dialog terminal enables switching to pulse string input mode. Setting PRM 29 (power-on mode) to 6 will turn on pulse string input mode upon power-on.

- **M6 (pulse string input mode) disables actions according to NC programs, program or parameter changes. To change, switch to one among M1 to M5.**

5.4.2 Kinds of Pulse String Input Signals

This function provides pulse string inputs for pulse and direction, up and down, and A and B phases (90° phase difference).

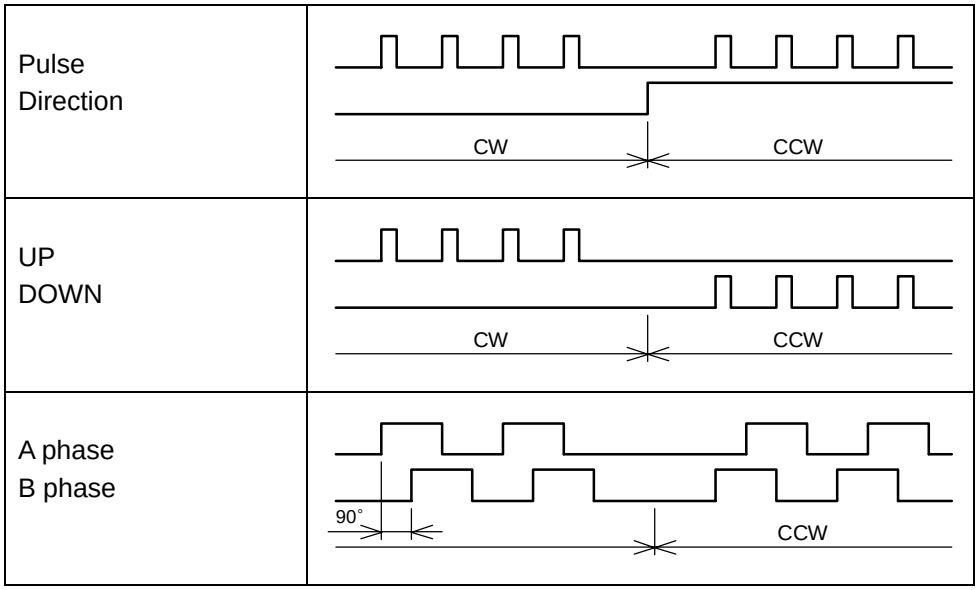


Fig. 5.22 Kind of Pulse String Input

The driver is set for pulse and direction inputs at default.
To change this setting, change PRM 42 (pulse string input).

Table 5.9 Pulse String Input Mode

PRM 42 setting	Mode	Input terminal	
		CN3-19/20	CN3-21/22
1	Pulse, Direction	Pulse	H: CCW L: CW
2	Up/Down	Up	Down
3	A/B Phase, 4 times	A phase	B phase
4	A/B Phase, 2 times	A phase	B phase

- **The multiplication setting at the entry of the A or B phase and the pulse rate setting specified in PRM 35 can be entered independently.**
  Accordingly the multiplication at the entry of the A or B phase is the product of the multiplication setting at the entry of the A or B phase and the PRM 35 setting.

5.4.3 Instruction Pulse Specifications

The pulse width input should be made to satisfy the following conditions.

<Conditions>
t1 ≧ 1.25 μsec
t2 ≧ 5 μsec
t1/t3 ≦ 50%

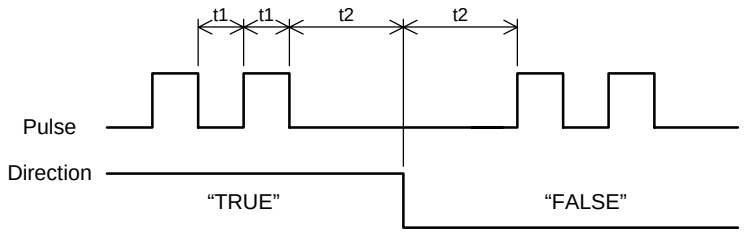


Fig. 5.23 Pulse & Direction Inputs

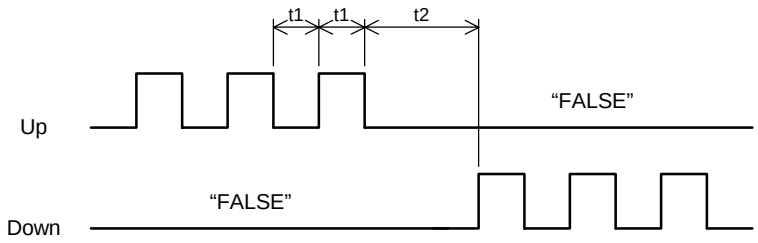


Fig. 5.24 Up & Down Inputs

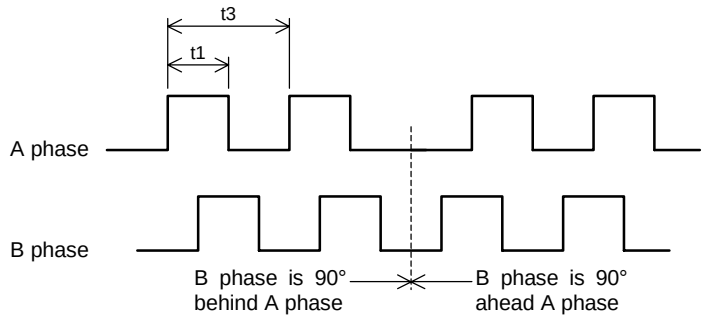


Fig. 5.25 A & B Phase Inputs

- **In case of up and down inputs, input the logic "FALSE" for the side to which pulses are not input.**

5.4.4 Pulse Rate and Rotation Numbers

1) Inputs for Pulse/ Direction and Up and Down
Pulse rate can be changed using PRM 35 (pulse rate change).
The actuator can be set in motion with the multiplications of the rotation and movement set by the parameter.

Number of motion pulses = Input pulse × Multiplication of PRM 35
Number of motion pulse frequency = Input pulse frequency × Multiplication of PRM 35

<Example> Input pulse = 100,000 pulses, Input pulse frequency (max.) = 150 Kpps
PRM 35 set value = 3 (4 times):

Motion pulses = 100,000 pulses × 4 times = 400,000 pulses
Motion pulse frequency = 150 Kpps × 4 times = 600 Kpps
Actuator rotation (max.)
= 150 Kpps × 4 times × 60 sec/540672 pulses (equal to 1 rotation)
= 66.6 rpm

2) Inputs for A & B Phase
Pulse rate can be changed using PRM 35 (pulse rate change) or by multiplication setting of PRM 42 (pulse string input), or both of them.

Number of motion pulses = Input pulse × Multiplication of PRM 35 × Multiplication
Number of motion pulse frequency = Input pulse frequency × Multiplication of PRM 35 × multiplication

<Example> Input pulse = 100,000 pulses, Input pulse frequency (max.) = 150 Kpps
PRM 35 set value = 2 (2 times), PRM 42 set value = 4 (Double multiplication):

Motion pulses = 100,000 pulses × 2 times × Double multiplication = 400,000 pulses
Motion pulse frequency= 150 Kpps× 2 times × Double multiplication = 600 Kpps
Actuator rotation (max.)
= 150 Kpps x 2 times × Double multiplication × 60 sec/540672 pulses
(equal to 1 rotation)
= 66.6 rpm

- **PRM 35 and multiplication shall be set so that an actuator speed will not exceed the max. speed. Exceeding the limit will cause an alarm or malfunction.**
The maximum rotation speed varies according to the model.

5.5 Encoder Output Function

I/O Signals to be Used:	•	A-phase	(CN3-23)
	•	-A-phase	(CN3-24)
	•	B-phase	(CN3-25)
	•	-B-phase	(CN3-26)
	•	Z-phase	(CN3-27)
	•	-Z-phase	(CN3-28)

The output is a pulse string output in the line driver type A-/B- and Z-phases.
The encoder output is effective in all operation modes.
Use PRM50 to specify the resolution of the A-/B-phase output.

The parameter used with this function is shown below.

Table 5.10 Resolution of Encoder Output

PRM50 Setting	(Pulse Count after Multiplication by Four)	Max. Rotation Speed [rpm]
0	0 [P/rev]	300
1 to 8448	4 to 33792 [P/rev]	
16896	67584 [P/rev]	
33792	135168 [P/rev]	
67584	270336 [P/rev]	50

- **After entering the parameter, turn the power off then on again to validate. This is for the prevention of malfunction.**
- **Note that the maximum rotation speed is limited according to the specified resolution.**
- **If the maximum output frequency is exceeded, "alarm 1" is caused.**

The maximum output pulse frequency is 170 [kHz].
The output is the A-/B-phase outputs deviating by 90°.
The Z-phase output is issued between phase switching points around the point changing to the 0° position.

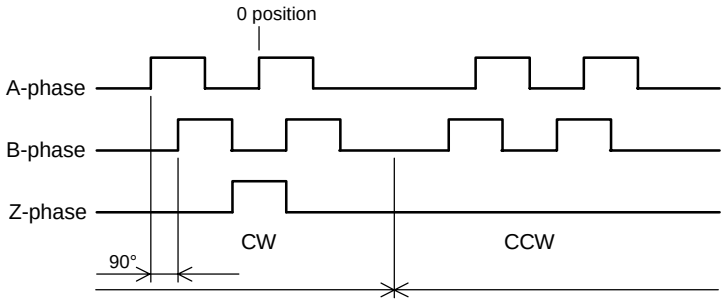


Fig. 5.26 Output Pulse

5.6 Application Example of I/O Signal

5.6.1 Basic flow of I/O signals

In this section, the basic 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)

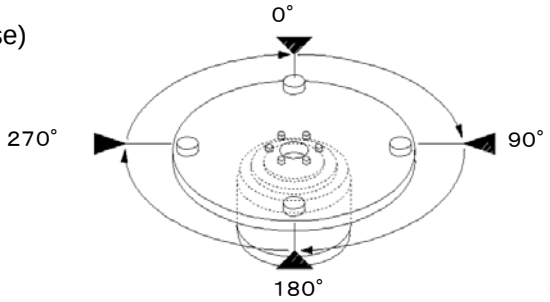


Fig. 5.27 Motion Example

<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 PRM 36 (I/O program number selection method switching) at "3" (5-bit binary) for the present application.

5.6.2 Key point to program number selection

1) If the number of programs is 32 or fewer, set PRM 36 (I/O program number selection method switching) at "3" (5-bit binary) to finish program number entry in one cycle.

2) 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 an emergency stop, the "units digit program number setting" signal is necessary.

3) 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 dialog terminal or Teaching Note when the "start input wait output" signal is ON.

Timing chart starting at program number selection

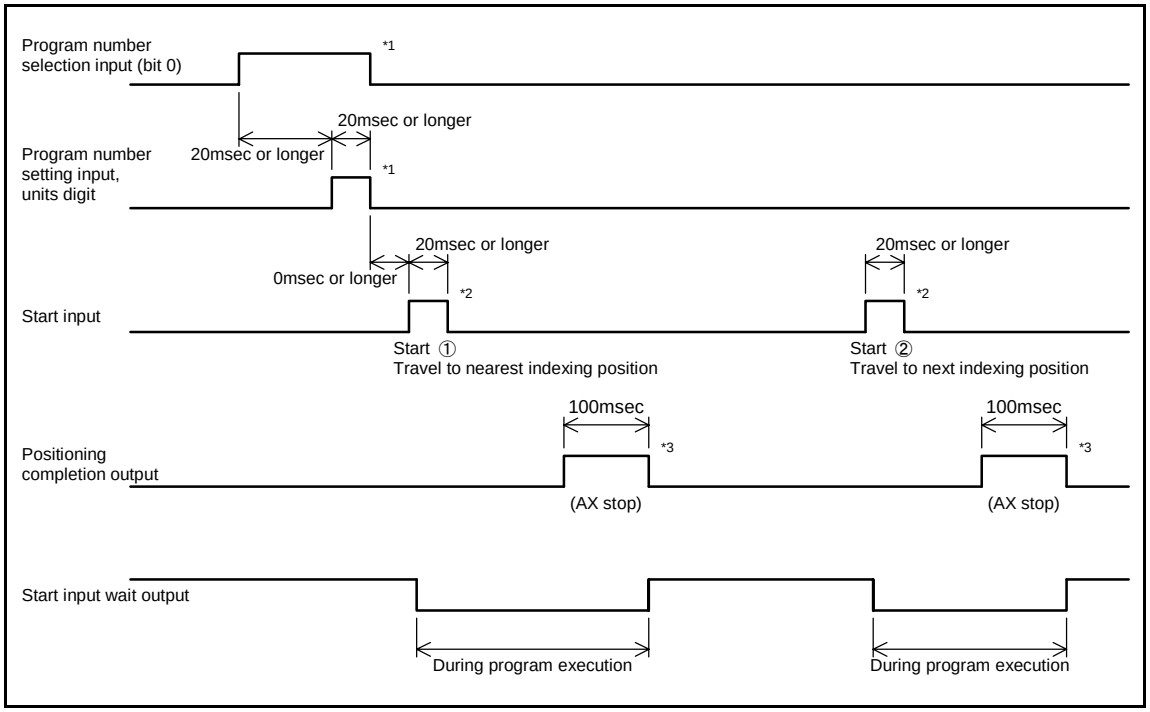


Fig. 5.28 Timing Chart 1

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

***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 20msec.

***3: The positioning completion output signal is turned on after the indexing action is finished, and it remains issued for 100msec 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 PRM 13 (answer input to positioning and home positioning completion).

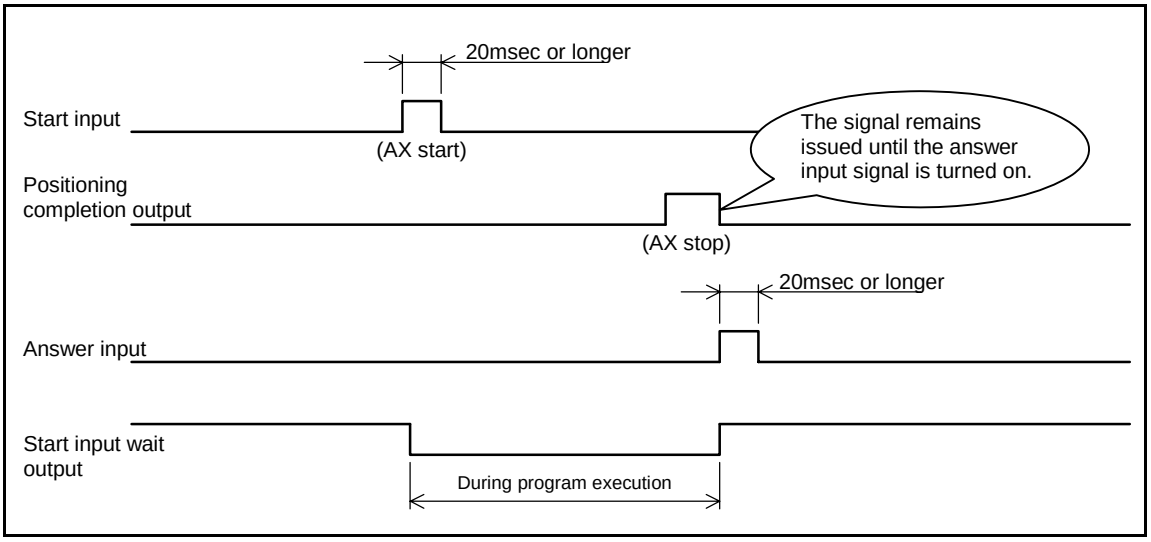


Fig. 5.29 Timing Chart 2

5.6.3 Restoration Action Procedure after Emergency Stop

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

1) Key point to restoration action after emergency 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 PRM 4 (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 an emergency stop signal is supplied while the equipment is stopped, supply a reset signal followed by a start signal, to move to the stopped position. A positioning completion signal is issued.
→ If an emergency 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 emergency 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 PRM 4 (home positioning direction).

b) After supplying a reset signal, supply the start signal. (If PRM is set at "5")
→ The selecting program runs from the first step.

c) After supplying a reset signal, supply the start signal. (If PRM is set at "4")
→ If an emergency stop signal is supplied while the equipment is stopped, supply a reset signal followed by a start signal, to move to the stopped position. A positioning completion signal is issued.
→ If an emergency 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 emergency 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 emergency stop input is valid if PRM 23 is set at "1" or "3."**
- **With restoration action c), travel to the target position before the emergency 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 emergency 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.)

2) Timing chart of restoration action after emergency 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 Example 1

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

Timing chart after emergency stop during rotation (from 0° to 90° position) caused by execution of program example 1

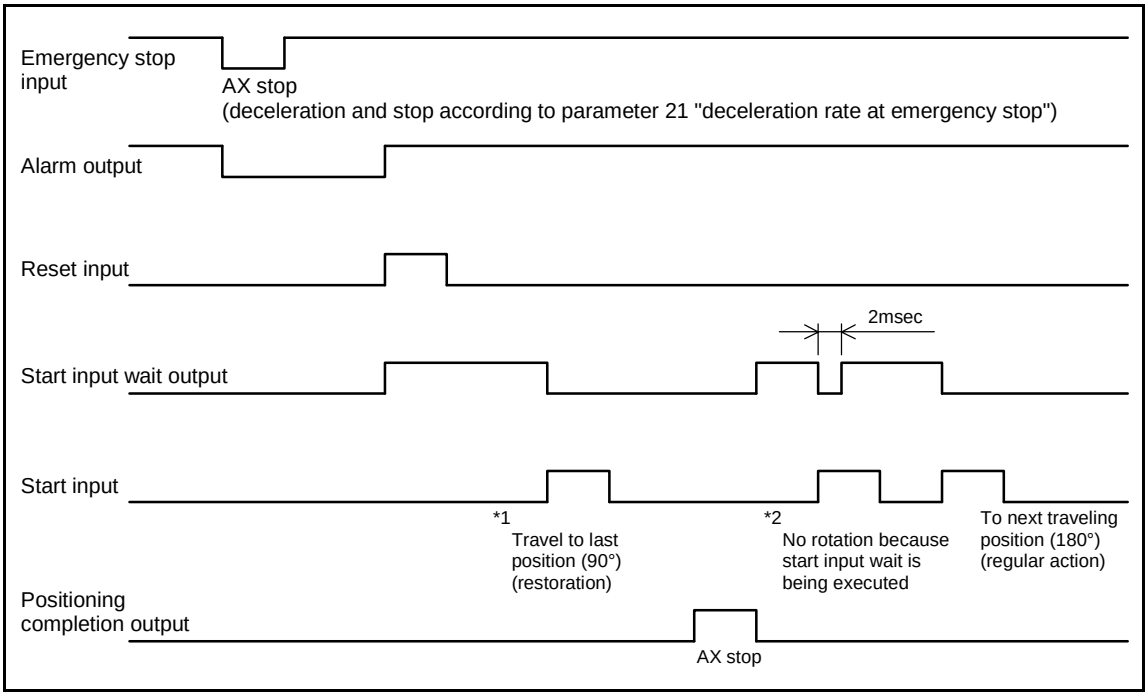


Fig. 5.30 Timing Chart 3

Note *1: The restoration action from the emergency 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 emergency stop position to the 90° position in 0.5 sec.)

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

Timing chart after emergency stop at the 90° position during execution of program example 1

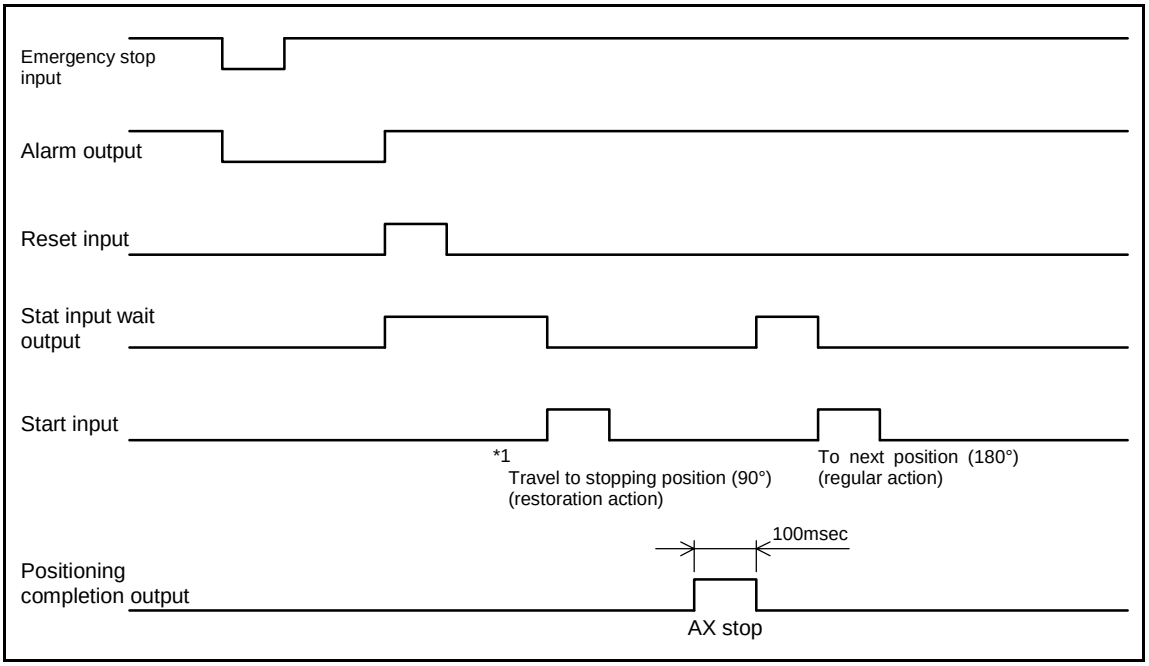


Fig. 5.31 Timing Chart 4

Note *1: If the setting of PRM 23 (emergency 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 PRM 23 (emergency 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 [*1]
After the reset signal is supplied, the second start input causes restoration to the indexing action.

Program Example 2

G11;	Change the unit of F to the time (second).
G101A4;	Segment the full revolution into four.
G91.1;	Full revolution incremental
A0F1MO;	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 block "N1".
M30;	End of program

Timing chart after emergency stop during rotation (from 0° to 90° position) caused by program example 2

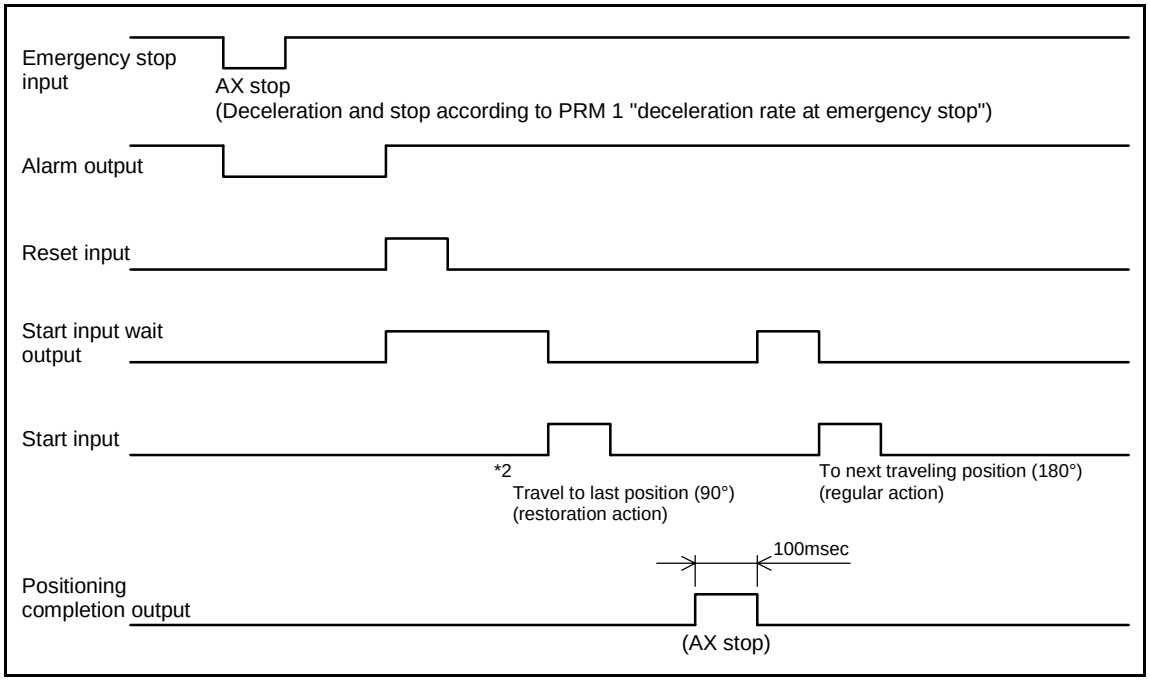


Fig. 5.32 Timing Chart 5

Note *1: If the setting of PRM 23 (emergency 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 emergency stop in above pattern b), several rotations may occur at the maximum rotation speed according to the amount of rotation.

***2: The restoration action from the emergency stop position follows the instruction time, which is valid at the time, to travel to the last indexing position. (In the example, the actuator travels from the emergency stop position to the 90° position in 0.5 sec.)**

5.6.4 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.

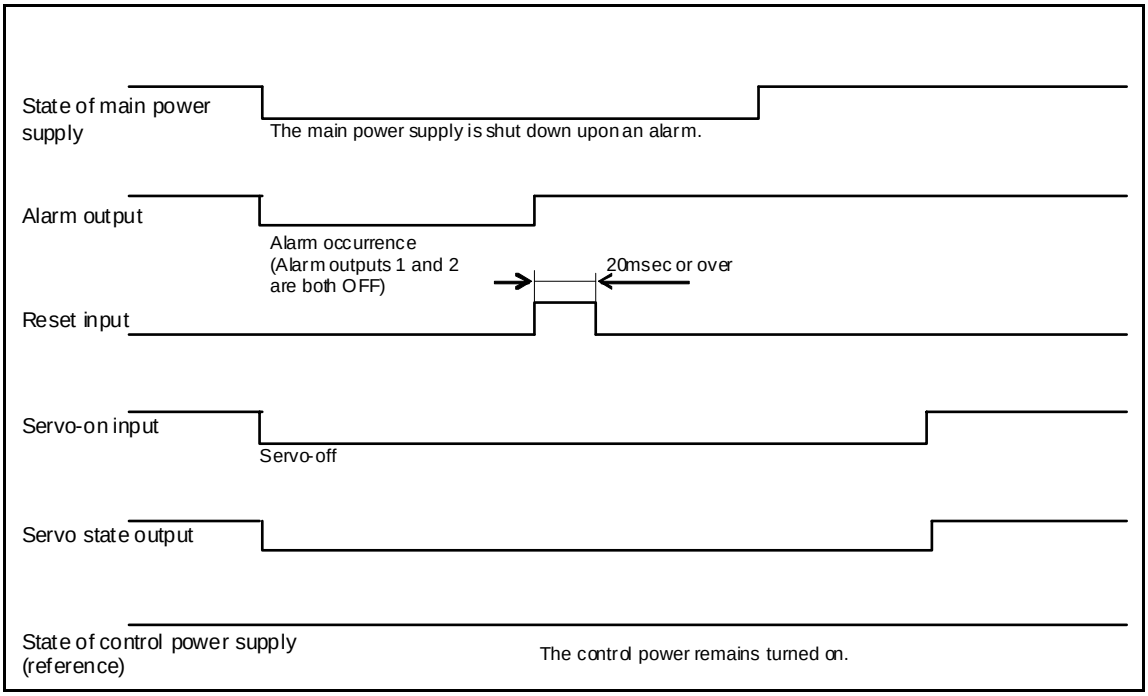


Fig. 5.33 Timing Chart

- **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.**
  Create an equilibrium where no torque is exerted, or check for safety when conducting such operations.

5.6.5 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. The sequence for using the safety function is shown below.

<Example>

1. After stopping the actuator, set the servo-on input (CN3-14) to OFF.
2. Make sure the servo state output (CN3-47) 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 (CN3-48) 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 (CN3-15) to ON.
6. Set the servo-on input to ON and resume normal operation.

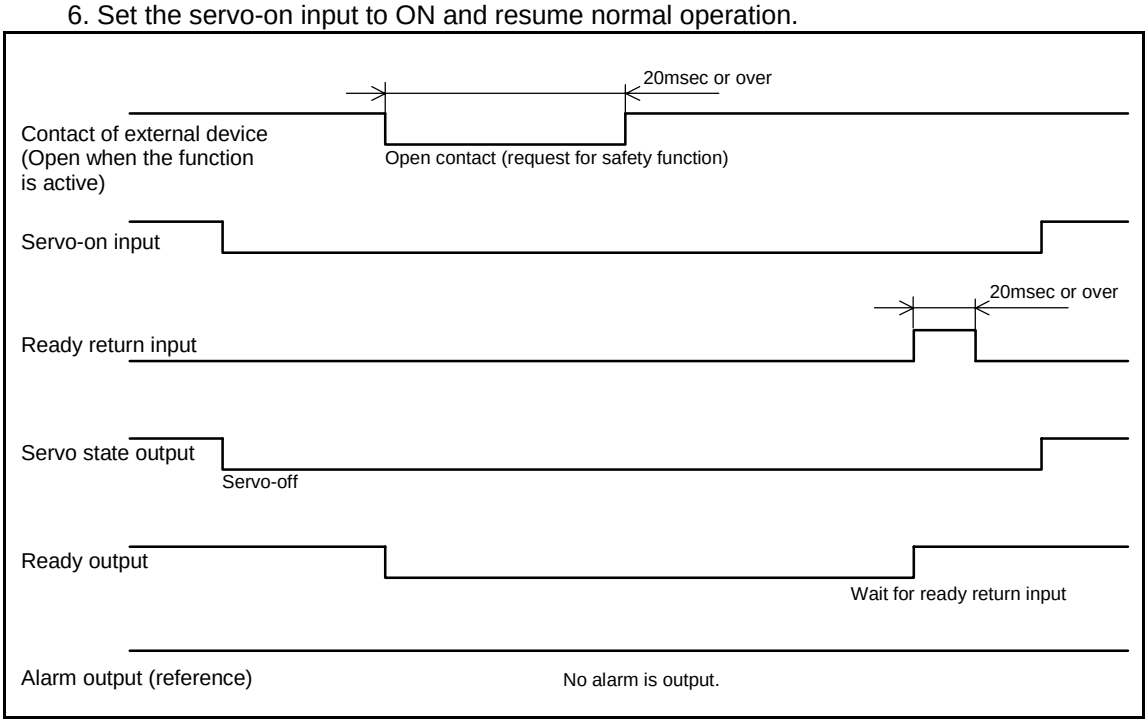


Fig. 5.34 Timing Chart

- **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 20msec 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 "3.2.8 Wiring for Safety Function."**

WARNING:

- **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 equipments that comply with applicable safety standards shall be connected.**
- **Short-circuits between the cores/conductor of the cables connecting the safety input device to the safety inputs will not be detected, may lead to the loss of safety function and must be prevented in the final installation. Suitable installation methods are:**
  (a) Physically separate the single core cables of the safety input circuit when routing them
  (b) Mechanically protect cables of the safety input circuit by e.g. storing them in an electrical enclosure
  (c) Use of cables whose core is individually shielded with earth connection
  Refer to EN ISO/ISO 13849-2 for details.
- **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. These operations shall be performed in a balanced state so that no torque gets applied or after having confirmed safety.
- **Power module failure may cause the actuator to move by an electrical angle range of at most 180 degrees (equivalent to 1/20 rotation in output axis).**
- **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.**

⚠ 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 TB1) are not safety-related. Do not design a safety system using these functions.**
- **The brake outputs (BK+, BK-) do not change when the safety function is in operation.**
- **While the safety function is in operation, the 7-segment LEDs display "_ _" (under-scores).**
  Input to S1 terminal changes the left side 7-segment LED indication, and input to S2 terminal changes the right side 7-segment LED indication.
  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.

—- **MEMO** —-

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. Also M code output enables communication with a programmable logic controller.

1) 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.

2) 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 (-).

3) Coordinate System
   a) G92 User Coordinate System
      G92 user coordinate system has the range of -9999999 to +9999999 pulses (about ±18 rotations). Positioning is done with this coordinate system.

   b) Actuator Coordinate System
      Pulse range of 0 to 540671 shows one rotation of the actuator.

   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 PRM 3 is the home position of G92 user coordinate system.

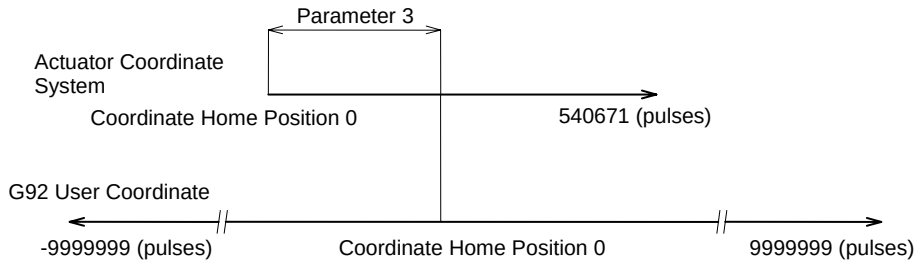


Fig. 6.1 ABSODEX Coordinate System

4) Operation mode can be selected from the six (6) modes of automatic, single block, MDI (manual data input), jog, servo-off, and pulse string input.

- **Programs and parameters are re-writable up to 100,000 times.**

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 M6 enables switching of the operation modes. For detail, refer to **Chapter 12. "COMMUNICATION FUNCTIONS."** Also, operation mode for power-on can be changed by a parameter. For detail, refer to **Chapter 7. "PARAMETER SETTING."**

Table 6.1 Operation Mode

Operation Mode	Description	Communication Code
Automatic mode *1	Enables to execute programs continuously. Default setting is automatic mode for power-on.	M1
Single block mode *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 the input NC codes at the serial input.	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	Enables operation with pulse string output controller. Motions with NC programs and parameters change and so on are not available.	M6

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 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.
(This block is automatically entered when AX Tools is used.)
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□□; (Entry of this block is Automatic if AX Tools is used.)
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

1) One block can contain plural G codes or M codes in the different group.
However, one block can not contain plural NC codes in the same group.
Refer to **Table 6.3 G Code List** and **Table 6.4 M Code List** for NC code groups.

2) 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) 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.

3) 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.

4) G101 in the group C only cannot be simultaneously used with the G codes in the group A in the same block.

5) The end of the program code (M30) is required at the end of the programs.

6) 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.

7) 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.

8) Input of Angles

G105A123	denotes 123 degrees.
G105A123.	denotes 123 degrees.
G105A.123	denotes 0.123 degrees.
G105A0.123	denotes 0.123 degrees.

9) 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.

10) 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.
For example:
G91A180F0.4J1; ⟶ G91A180F0.4;J1;

11) 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.

12) The program length that can be entered is 3970 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>

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.

13) 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

Table 6.2 NC Code List

Code	Function		Data Range	Remarks
O	Program number		0 to 999	0 to 255 can be selected from I/O. "o" is automatically added.
N	Sequence number		0 to 999	Can be omitted.
G	Preparation function		0 to 999	Refer to "Table 6.3 G Code List."
A	Instruction to move coordinate axis	G90, G91, G91. 1	±9999999	Unit: pulse
			±6658.380	Unit: angle
			±4716	Unit: number of indexes
		G90. 1, G90. 2, G90. 3	±540672	Unit: pulse
			±360.000	Unit: angle
			1 to Designated number of segments	Unit: number of indexes
	Designation of segment numbers		1 to 255	
	Continuous rotation speed		±80.00 *1	Unit: rpm
F	Designation of speed		0.11 to 300.00 *1	Unit: rpm
			0.01 to 100.00	Unit: sec
M	Auxiliary function		0 to 99	Refer to "Table 6.4 M Code List."
P	Dwell		0.01 to 99.99	Unit: sec. G4P□□.□□
	Designation of sub-program number		0 to 999	Program No.: M98P□□□
	Gain magnification		0, 50 to 200	Unit: % G12P□□□
				0% input will set servo-off.
	Acceleration and deceleration for continuous rotation		0.01 to 50	Unit: sec G8P□□□ G9P□□□
	Parameter data setting		Range defined by parameters	Unit: the unit defined by each parameter; G79S□□P□□□
L	Numbers of repetition		1 to 999	Repeats the block as specified.
J	Jump		0 to 999	"J0" causes a return to the top of the program.
S	Parameter data setting		1 to 99	Setting parameter No.; G79S□□P□□□

Note *1: The minimum rotation speed of the actuator is 0.11rpm.
The rotation speed varies according to the model.
For details, refer to Chapter 13. "ACTUATOR SPECIFICATIONS."

Table 6.3 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 *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°~ 179.999° . <Input Method> G7A±□□; Unit of A: rpm "+" indicates clockwise rotation, while "-" indicates counterclockwise rotation. 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	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 Fig. 6.1) 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 emergency stop input during home positioning or interruption of home positioning due to an alarm clears the home position offset amount (PRM3) setting. After 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 resetting the alarm: home positioning, execution of NC code G92.1A0, or turning the power off and back on again.

Table 6.3 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 0.5sec.
	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 0.5sec.
	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%. *1
	G79 *2	Parameter data setting	Substitute the parameter number with "S" for the value of "P." <Input Method> G79S1P2; To substitute the PRM 1 for "2." The RAM data is temporarily stored, and turning off the power will erase all the set data.
C *	G101 *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.

***2: Some parameters cannot be set using G79 code.**
Refer to Parameter data setting of G79 in Table 7.1.

***3: "G101" cannot be used simultaneously in the same block with group A.**

Table 6.3 G Code List (3/3)

Group	G Code	Function	Description
D *	G10 *1	Designation of rotation number	Unit of "F" is rpm. Moving speed is specified by the maximum rotation number.
	G11	Designation of time	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	One rotation 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 *2	CW direction 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 *2	CCW direction 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. Same as G90.2 except for the rotation direction changes to CCW. 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	One rotation incremental dimension	The value of "A" is the 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 PRM 1 (cam curve) to "5" (MC2) to fix the acceleration to the setting of PRM 2 (acceleration/deceleration time of MC2 curve). For details, refer to Chapter 7. "PARAMETER SETTING."

As well, if the rotation speed is low and the traveling angle is large and the calculated traveling time exceeds 100sec, alarm 0 (NC program error) is caused.

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

1) 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 pulses. 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 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.)

2) When set angle cannot be accurately converted to the pulses for the specified angle and indexing number
   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)) rather than using "G92" code.

3) 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.

4) When, for continuous rotation, stop signal is input during acceleration
   The acceleration will continue to the specified level before deceleration takes place to stop.

5) 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.

6) Using segment number designation (G101)
The position of indexing numbers can be specified.
The following diagram shows the relationship between the position of the specified index number and its angle, when 4 segments are specified.

<For G101A4>

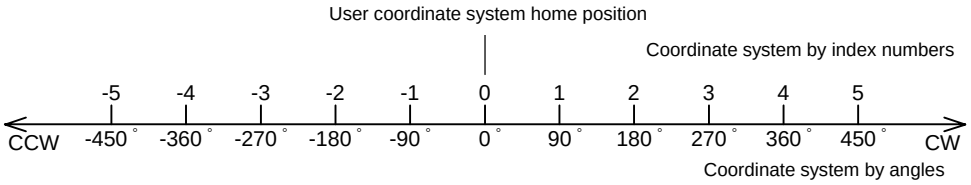


Fig. 6.2 Coordinate System of Segment Number Designation

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

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

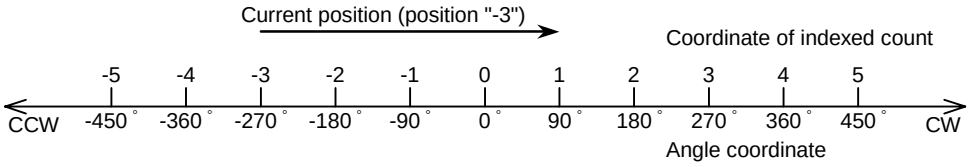


Fig. 6.3 Action Example 1

② G91A1: enables transfer to the index 1 (90°) to the CW (clockwise) direction. (Incremental action instruction)

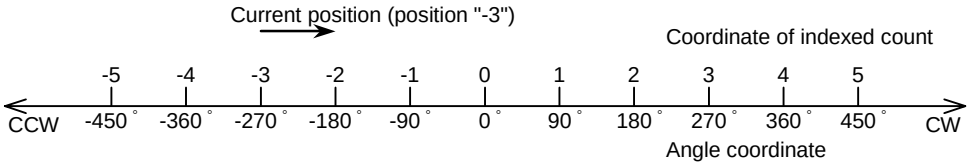
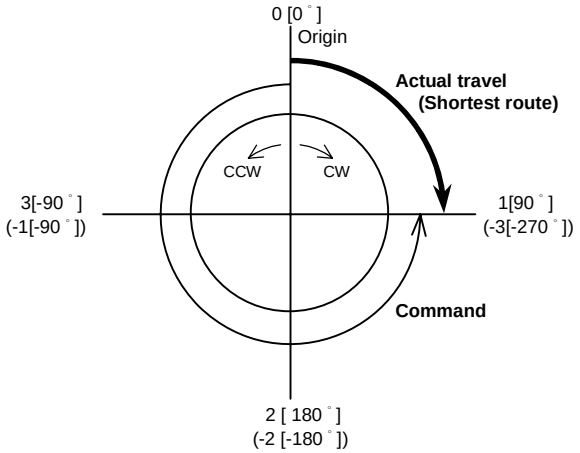


Fig. 6.4 Action Example 2

③ 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° to +179.999°.
If the traveling amount is 180°, the travel is in the counterclockwise direction.



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

Fig. 6.5 Action Example 3

④ G91A0: Travel to the nearest indexing position.
(Incremental action instruction)

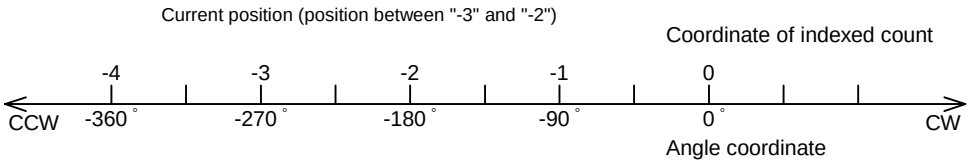


Fig. 6.6 Action Example 4

- **If an incremental action instruction ("G91" or "G91.1") is given for the power-on travel or a travel after an emergency stop in the program using equal segment position designation (G101), the action varies according to the settings of PRM 37 and 38.**
  For details, refer to "7. 9 Designation of Equal Segment (G101) and Parameters."

Table 6.4 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> M98 P□□□ ←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	De-energize the valve for the brake and dose not make servo system integral control. Turn off across the BK+ and BK- terminals of the driver.
	M69	Brake Releasing	Energize the valve for the brake and makes servo system integral control. Turn on (24VDC) across the BK+ and BK- terminals of the driver.
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

1) Program Number
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.

2) Dimensions
Upon power-on start, the following dimensions are set.
Angle designation (G105)
Time designation (G11)
Absolute (G90)

3) 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 PRM 3 from the home point of the actuator.)

4) 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.

5) Operation Mode
PRM 29 (mode upon power-on start) will enable to set either one of automatic operation, single block, and pulse string input mode.

6) Braking
PRM 28 (brake initialization) will set brake-on or brake-off.

7) I/O Output
In-position output turns ON, and when start input is accepted, start input wait output will turn on.
The servo state output is turned on or off according to output conditions.
However, other outputs turn OFF.
(The alarm output is the negative logic output.)
Under conditions without alarm, the alarm output turns ON for 0.3 to 0.5 sec upon power-on, and then turns OFF. Other I/O outputs may be unstable until the alarm output turns OFF completely. As required, provide AND logic for the alarm output.
Turn the ready output on or off according to output conditions after the alarm output has settled.

8) Driver Panel
Under normal condition without alarm, alarm 1 LED (ALM1) and alarm 2 LED (ALM2) will be unlit. In the servo-on state, the servo status LED (SERVO) is lit. In this case, ABSODEX is operable.
For details, refer to Section 12.2.1 "Operation Mode Switching. "

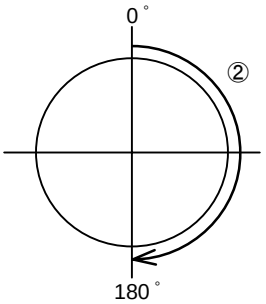
CAUTION:

- **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 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.

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.

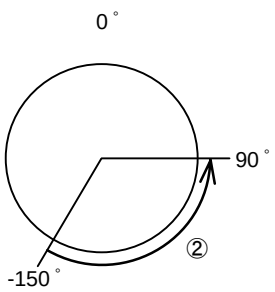
1) Absolute dimension (G90), angle designation (G105) and time designation (G11)
Create an indexing program, using angle and time units at the absolute user coordinate position defined with a home position offset amount (PRM 3).



<Program>

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

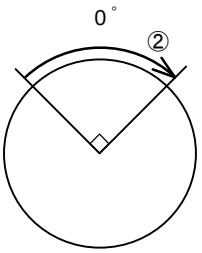
2) Full revolution absolute dimension (G90.1)
Do not rotate beyond 180° (shortest route travel).



<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

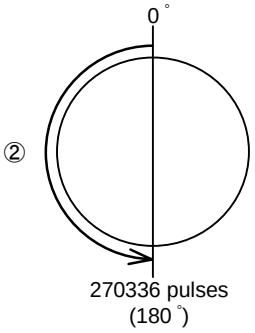
3) Full revolution incremental dimension (G91.1)
Travel from the current position by an angle.



<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

4) Pulse designation (G104)
Designate the traveling amount in pulses.

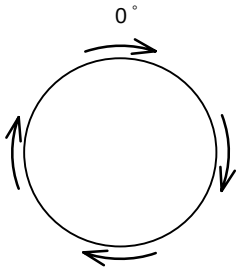


<Program>

N1G90. 1G104G11;	① Full revolution absolute, pulse designation, time
N2A270336F2;	② Travel to the 270336-pulse (180°) position in 2 sec.
N3M30;	③ End of program

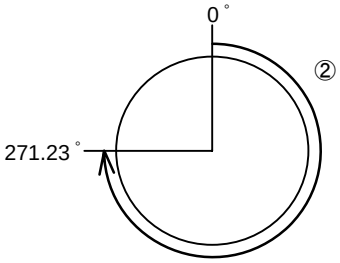
- **The 180° travel with G90.1 (shortest route) causes counterclockwise rotation.**

5) 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 10rpm
N4M30; ④ End of program

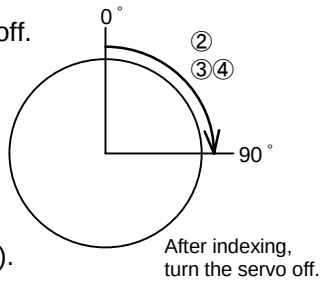
6) Rotation speed designation (G10)
Specify the unit of F at the maximum rotation speed.



<Program>
N1G90G105G10;① Absolute, angle, rotation speed
N2A271. 23F30; ② Travel to the 271.23° position at 30rpm.
N3M30; ③ Deceleration in 0.5 sec.

- **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.**

7) Gain multiplication change (G12), dwell (G04)
Use the gain multiplication change function to index and turn the servo off.



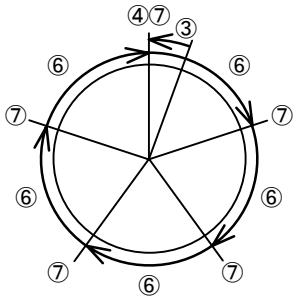
<Program>
N1G90. 1G105G11; ① Full revolution absolute, angle, time
N2A90F1; ② Travel to the 90° position in 1 sec.
N3G04P0. 2; ③ Dwell 0.2 sec.
N4G12P0; ④ Change the gain multiplication to 0% (servo-off).
N5M30; ⑤ End of program

- **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.**

8) 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>

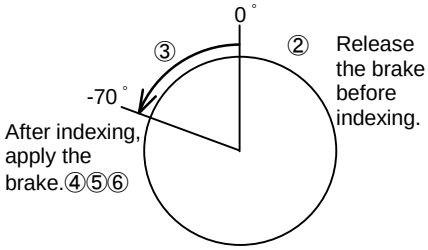
N1G101A5;	① Segment number designation, 5 segments
N2G11;	② Time designation
N3G91A0F1;	③ Travel to the nearest indexing position in 1 sec.
N4M70;	④ Segment position output
N5M0;	⑤ Start input wait
N6G91. 1A1F1;	⑥ Travel clockwise by a segment in 1 sec.
N7M70;	⑦ Segment position output
N8M0;	⑧ Start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



9) 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 Apply the brake.
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.

—- **MEMO** —-

7. PARAMETER SETTING

Various parameters are available for ABSODEX to set motion conditions.

7.1 Parameters and Contents

Table 7.1 Parameters (1/10)

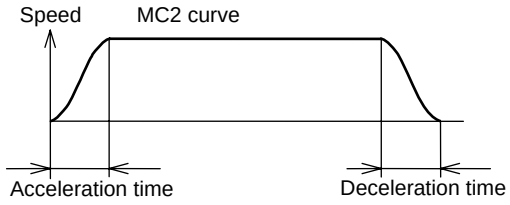
PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
1	Cam curve	1 to 5	1	-	Feasible
	Selects a cam curve. 1 to 5 corresponds to the following curves. 1: MS, 2: MC, 3: MT, 4: TR, 5: MC2 For details, refer to **Section 7.3 "Types and Characteristics of Cam Curve**. "				
2	Acceleration and deceleration time of MC 2 curve	0.01 to 50.0	1.0	sec	Feasible
	Sets acceleration and deceleration times of MC 2 curve.  Acceleration and deceleration zones will form the characteristics of MS curve. Acceleration and deceleration times cannot be set separately. For details, refer to **Section 7.3 "Types and Characteristics of Cam Curve. "**				
3	Home position offset amount	-270336 to 270335	0	Pulse	Not feasible
	The home position of the user coordinate system at power-on shifts to the actuator home position, and becomes effective upon re-power on or home return. For detail, refer to **Section 7.4 "Amount of Home Position Offset and Home Positioning Motion. "**				
4	Home positioning direction	1 to 3	1	—	Feasible
	Selects the direction of rotation of the home positioning action. 1: CW, 2: CCW, 3: Shortest route				
5	Home Positioning speed	1 to 20	2.0	rpm	Feasible
	Sets the maximum home positioning speed. Communication code "S4", home positioning instruction input, and NC code "G28" will enable home positioning.				
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.				

Table 7.1 Parameters (2/10)

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
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)	-9999998 to 9999999	9999999 (6658.380°)	Pulse	Not feasible
	Sets the motion range in the (+) direction. For details, refer to **Section 7.5 "Precautions for Software Limit**. "				
9	Software limit coordinate B (- direction)	-9999999 to 9999998	9999999 (-6658.380°)	Pulse	Not feasible
	Sets the motion range in the (-) direction. For details, refer to **Section 7.5 "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 -9999999 to +9999999 (pulse) (±18 rotations) is exceeded. For details, refer to **Section 7.5 "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 PRM 12 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 100msec.				
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 100msec. The output time can be changed with PRM47 (output time of positioning completion signal).				

Table 7.1 Parameters (3/10)

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
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	1 to 10000	2000 (1.332°)	Pulse	Feasible
	Sets allowable accuracy of positioning. For details, refer to **Section 7.6 "Judgment of In-position, " Section 7.7 "Judgment of Positioning Completion" and Section 7.8 "PRM 16 Correct In-position Range**."				
17	In-position sampling times	1 to 2000	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 2msec. This is also used to judge positioning completion output (CN3-42). For details, refer to **Section 7.6 "Judgment of In-position," Section 7.7 "Judgment of Positioning Completion" and Section 7.8 "PRM 16 Correct In-position Range**."				
18 *1	Position deviation amount	Setting not feasible	–	Pulse	Not feasible
	Indicates the current position deviation amount.				
19 *2	Upper limit for position deviation amount	1 to 540672	4000 (2.664°)	Pulse	Feasible
	PRM 18 exceeding this value will cause Alarm 1.				

Note *1: For monitoring only; no parameter entry can be made.
***2: If the setting of PRM 19, 20 or 39 is too small, alarm 1 may be caused and the actuator may not be activated.**

Table 7.1 Parameters (4/10)

PRM No.	Description		Setting Range	Initial Value	Unit	G79 Setting
20 *1	Speed over limit	AX6001MU AX6003MU	1 to 4866	4866 (about 270rpm)	Pulse	Not feasible
	The motion amount [pulse] exceeding the set value for every 2msec will cause Alarm 1. *1 The rotation speed N [rpm] with the per-2msec motion amount P [pulses] is: N = Motion amount (pulses) per min / one-revolution pulses =30000P/540672 ≒0.0555P [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 (5947, 4866, 2883, 2552, 1982, 1441, or 630), 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.					
21*2	Deceleration rate for emergency stop		1 to 180 999	999	Pulse/ 2ms^2	Feasible
	Speed deceleration will take place for every 2msec for an emergency stop. The time t until rotation stops by an emergency stop while rotating at N rpm can be calculated by the following formula: t=2×540672/60/1000×N/PRM21 ≒18.0224×N/PRM21［msec］ The inertia torque Ti with inertia moment J[kg·m^2] can be calculated by the following formula: Ti=2 π ×10^6/540672/2×J×PRM21 ≒5.81×J×PRM21［N･m］ Enter PRM 21 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.					

Note *1: If the setting of PRM 19, 20 or 39 is too small, alarm 1 may be caused and the actuator may not be activated.

Table 7.1 Parameters (5/10)

PRM No.	Description		Setting Range	Initial Value	Unit	G79 Setting
22	Delay time for emergency stop servo-off		0 to 2000	1000	msec	Feasible
	Sets delay time for servo-off by emergency stop (CN3-17) input causing deceleration and stop when PRM 23 is set to 3 (servo-off after stop).					
23 *1,3	Emergency stop input		1 to 3	3	-	Not feasible
	1: Maintain servo-on state after stop 2: Not effective 3: Servo-off after stop					
24 *2	Actuator temperature rise		Setting not feasible	-	°C	Not feasible
	Temperature rise of the actuator calculated by electronic thermal					
25 *2	Upper limit of actuator temperature rise		Setting not feasible	40	°C	Not feasible
	PRM 24 exceeding the set temperature will cause the alarm 4. 1: No output, 2: Output					
27 *3	Delay time after brake output	AX6001MU AX6003MU	0 to 1000	100	msec	Feasible
	Motion to be delayed when motion instruction after brake release is specified by M69.					
28	Brake initial status		1 to 2	2	-	Not feasible
	Sets whether or not the brake is released upon power-on. 1: Brake on, 2: Release					
29	Mode setting for power-on		1, 2, 6	1	-	Not feasible
	1: Auto run 2: Single block 6: Pulse string input					

Note *1: If the emergency stop button of the Dialogue Terminal is pressed, "servo-on after stop" is selected without relations to the PRM23 setting.

***2: Reference only is possible. No parameters can be entered.**

***3: If parameter settings are edited without loading them**
Parameter settings are reset to the default values held in AX Tools. Be sure to load parameters before editing parameter settings.

Table 7.1 Parameters (6/10)

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 (CN3-47) 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: 16times 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 4	1	-	Feasible
	Enables to select program numbers: 1: 4 bit 2 times (BCD) (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 with start (Binary, Program number is not set after emergency stop.) (No. range 0 to 63) 5: 6-bit with start (Binary, Program number is set after emergency stop.) (No. range 0 to 63)				
37	Segment position range width for equal segment designation	1 to 270336	1500 (about 1.0°)	Pulse	Feasible
	Sets the vicinity of segment position of equal segment (G101). For details, refer to **Section 7.9 "Designation of Equal Segment (G101) and Parameters**."				
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 **Section 7.9 "Designation of Equal Segment (G101) and Parameters**."				
39 *1	Torque limit	1 to 100	100	%	Feasible
	Enables to set the upper limit of torque output by percentage against the maximum torque.				

Note *1: If the setting of PRM 19, 20 or 39 is too small, alarm 1 may be caused and the actuator may not be activated.

Table 7.1 Parameters (7/10)

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
42	Pulse string input	1 to 4	1	-	Feasible
	1: Pulse/Direction 2: Forward rotation/Reverse rotation 3: A/B phase 4 times 4: A/B phase 2 times				
45 *1	Power-on coordinate recognition range	0 to 540671	270335	Pulse	Not feasible
	Specify the power-on coordinate recognition range. The output axis is supposed to be located at a position between "setting - 540671" and setting when the power is turned on.				
46	Home position output range	0 to 10000	2000	Pulse	Not feasible
	Enter the output range of the home position output (pulse string mode only). With default value 2000, the home position output ±2000 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 1000	100	msec	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: Valid. 2: Invalid				
50	Encoder output resolution	0 to 8448 16896 33792 67584	33792	pulse/ rev	Not feasible
	Specify the resolution of encoder output. Enter the number of output pulses of the pulse string output signal. The A-/B-phase output pulse of the driver counted in four multiples is 4 to 270336 pulses/rev. If PRM50 = 67584, the maximum rotation speed is limited at 50rpm. After entering, turn the power off then on again to validate the setting.				
51	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 setting, 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 Chapter 8. "APPLICATION EXAMPLES."

Table 7.1 Parameters (8/10)

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
	0: Servo-on input 1: Program stop input After setting, 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
	0: Answer input 1: Position deviation counter reset input After setting, turn the power off then on again to validate the setting.				
56	Function selection of I/O input signal CN3-46 (bit 13)	0 to 1	0	-	Not feasible
	0: Output during indexing 1 1: Home position output After setting, turn the power off then on again to validate the setting.				
57	Function selection of I/O input signal CN3-47 (bit 14)	0 to 1	0	-	Not feasible
	0: Output during indexing 2 1: Servo state output After setting, turn the power off then on again to validate the setting.				

Table 7.1 Parameters (9/10)

PRM No.	Description		Setting Range	Initial Value	Unit	G79 Setting
62	Cut-off frequency for low pass filter 1	AX6001MU AX6003MU	10 to 1000	200	Hz	Feasible
63	Cut-off frequency for low pass filter 2		10 to 1000	500	Hz	Feasible
64	Cut-off frequency for notch filter 1		10 to 1000	500	Hz	Feasible
65	Cut-off frequency for notch filter 2		10 to 1000	500	Hz	Feasible
66	Filter switch		0 to 15	1	-	Feasible
	Switches to determine if filters are used. For details, refer to **Section 7.10 "Using Filters**."					
67	Integral limiter		1 to 540672	100000	Pulse	Feasible
	Integral limiter in the controller. A smaller value reduces the overshoot immediately before stoppage and improves stability of a system with a large inertia moment load. The best integration limiter setting varies according to gain adjustment. For details, refer to **Section 7.11 "Integral Limiter**."					
70	Q value of notch filter 1		0.1 to 9.9	1	-	Feasible
	Sets the band width of notch filter 1.					
71	Q value of notch filter 2		0.1 to 9.9	1	-	Feasible
	Sets the band width of notch filter 2.					
72	Integral gain multiplier	AX6001MU AX6003MU	0.1 to 10.0	1.0	-	Feasible
	The multiplier of the integral gain can be changed. A smaller value improves stability for large inertia loads and/or less rigid loads. A larger value shorten the convergence time, it deteriorates the stability of the control system. For details, refer to **Section 7.12 "Multiplier of Integral Gain**."					

Table 7.1 Parameters (10/10)

PRM No.	Description	Setting Range	Initial Value	Unit	G79 Setting
80	Integral gain	0.0 to 32.0	0.0	-	Not feasible
	The integral gain of the result of auto tuning is stored.				
81	Proportional gain	0.0 to 512.0	0.0	-	Not feasible
	The proportional gain of the result of auto tuning is stored.				
82	Differential gain	0.0 to 2048.0	0.0	-	Not feasible
	The differential gain of the result of auto tuning is stored.				
83	Auto tuning command	1 to 32	0	-	Not feasible
	In the servo-off mode, write a number between "1" and "32" in this parameter to execute auto tuning. Write "10" in regular cases. Default value "0" indicates no execution of auto tuning.				
87	Auto tuning torque	0 to 8192	500・1000	-	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	Auto tuning measurement starting speed	0 to 1000	100 (About 11 rpm)	Pulse /ms	Not feasible
	Auto tuning data collection starting speed. Do not change the setting in regular cases.				
89	Auto tuning measurement termination speed	0 to 1000	700 (About 80 rpm)	Pulse /ms	Not feasible
	Auto tuning data collection termination speed. Do not change the setting in regular cases. Do not enter 200 or a smaller setting.				
101	G1 gain (response)	0 to 15	8	-	Not feasible
	Gain for adjusting the convergence time. For details, refer to **9.1 What Is Gain Adjustment?**.				
102	G2 gain (load inertia moment)	0 to 15	0	-	Not feasible
	Gain for adjusting according to the load. For details, refer to **9.1 What Is Gain Adjustment?**.				

- **Record PRM 80 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 PRM 80 to 82, turn the servo off (M5).**

7.2 Parameter Setting and References

Setting of parameters and references is done by communication codes using a personal computer.

1) Monitoring or entering the parameter at AX Tools (PC communication software)

Select Reading(ABSODEX) from the "Edit mode" in the menu bar displayed in the AX Tools (Teaching Note), and select "Program and Parameter" to load parameter settings from the ABSODEX driver to AX Tools.

- **There are limitations in the entry of some parameters.**
  To enter or monitor these parameters, select the "terminal mode."
- **If parameter settings are edited without loading them in advance, initial values stored in AX Tools are overwritten on unchanged parameters. To avoid this, be sure to execute Reading (ABSODEX) before editing them.**

Select "Parameter setting" from the "Edit mode" of the menu bar 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 and press the [Finish] button located at the bottom of the dialog box to finish editing work.

You can select "Storage(ABSODEX)" from the "Edit mode" in the menu bar and select "Program and Parameter" to save the new parameter settings to the ABSODEX driver.

2) Monitoring or entering the parameter with communication code

To enter a parameter, to which editing is not allowed, at AX Tools (PC communication software), use communication codes in the terminal mode to monitor or enter parameter settings of the driver.

In addition, you can use communication codes and RS-232C PC communication software such as HyperTerminal to monitor or change parameter settings.

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.
Also like

L 7M _ Parameter Number _ Set Valve↵

The suffix "M" to L7 enables to overwrite temporary data in RAM. (The driver refers to the data stored in RAM to operate.)

<Example>

For setting 3 for PRM 1 . . . L7_1_3↵
For setting 135168 pulses for PRM 8 . . . L7_8_135168↵
For setting 90° for PRM 8 . . . 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 PRM 8 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.

Also like,

L9M _ Parameter Number↵

suffix "M" to L9 will enable to read temporary data on RAM.

<Example>

To read PRM 8 . . . L9_8↵
To read PRM 8 in angle unit . . . L9_8A↵
To read the data on RAM of PRM 8 in angle unit . . . L9M_8A↵

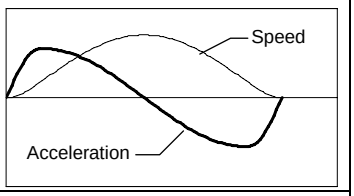
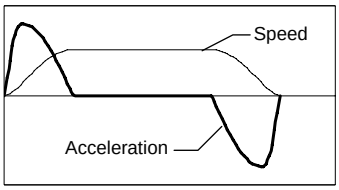
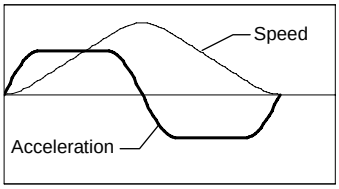
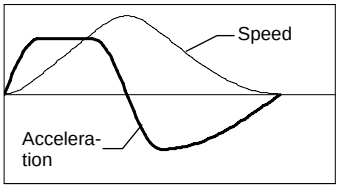
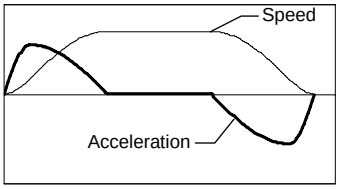
For detail of the communication codes, refer to **Chapter 12. "COMMUNICATION FUNCTIONS. "**

- **Programs and parameters are re-writable up to 100,000 times.**

7.3 Types and Characteristics of Cam Curve

With ABSODEX, an arbitrary cam curve can be selected with the setting of PRM 1.

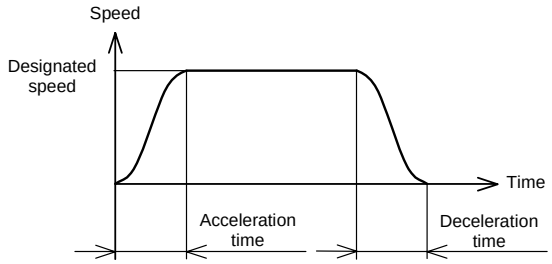
Table 7.2 Cam Curve List

Name	Description	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 curve (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.	

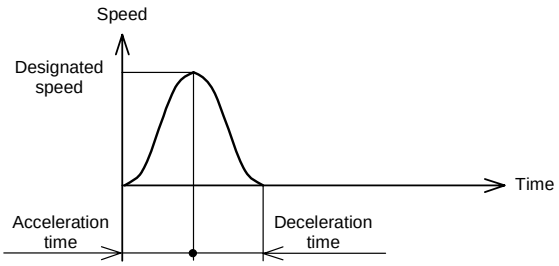
- **While various other cam curves have been considered, the MS curve is most widely used now. This is because the requirement for general purpose indexing applications is a well-balanced curve in the first place because it is used for every purpose. Accordingly the MS curve, which features a good balance, 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.

1) 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.

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 MC 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 PRM 2.

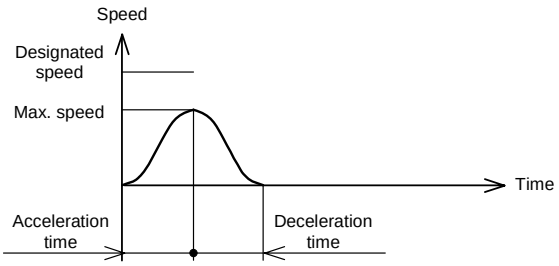


Fig. 7.1 Speed Pattern of MC2

7.4 Amount of Home Position Offset and Home Positioning Motion

ABSODEX using an absolute resolver 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 PRM 3 (home position offset amount).

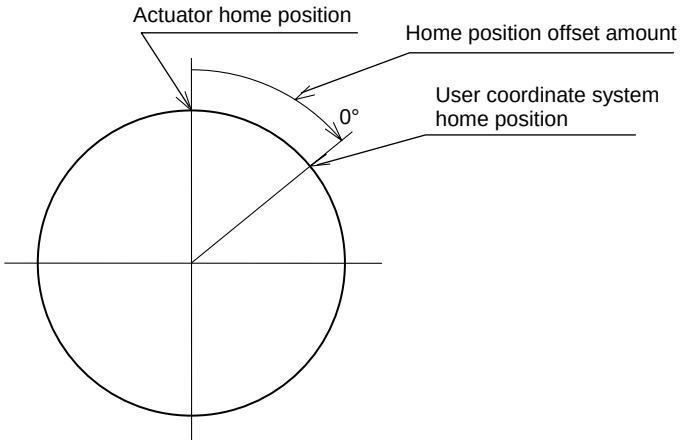


Fig. 7.2 Amount of Home Position Offset & Coordinate System Home Position

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 S4 Instruction through RS-232C port
② G28 Instruction during NC programming
③ I/O port (CN3-12) Instruction from a Programmable logic controller

7.5 Precautions for Software Limit

Using PRM 8 (software limit coordinate A), PRM 9 (software limit coordinate B), and PRM 10 (software limit effective/not effective), software limit can be set. The following precautions should be taken for using software limit.

1) The home positioning explained in **7.4 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

2) Upon power-on, ABSODEX assumes that the output axis is located in the range of -180.000° to +179.999° (when power is turned on again at the position of 190°, the output axis is assumed to be at -170°). 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 PRM 3).

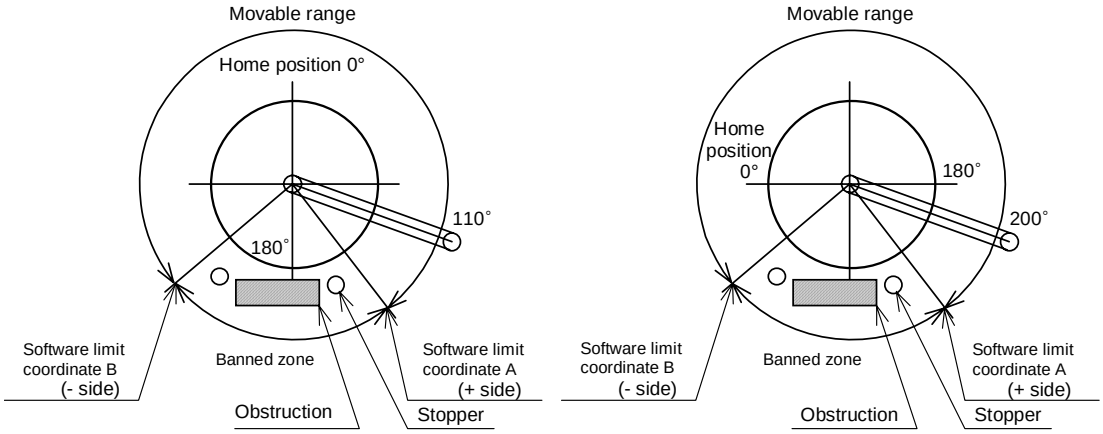


Fig. 7.3 Home Position & Software Limit

The current position is recognized as at 110° upon re-power-on for **Fig. 7.3 (a)**, and as at -160° for **Fig. 7.3 (b)**.
The motion to 0° in case of **Fig. 7.3 (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 **Fig. 7.3 (b)**.

3) 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 **Fig. 7.3 (a)**, 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.

4) 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.

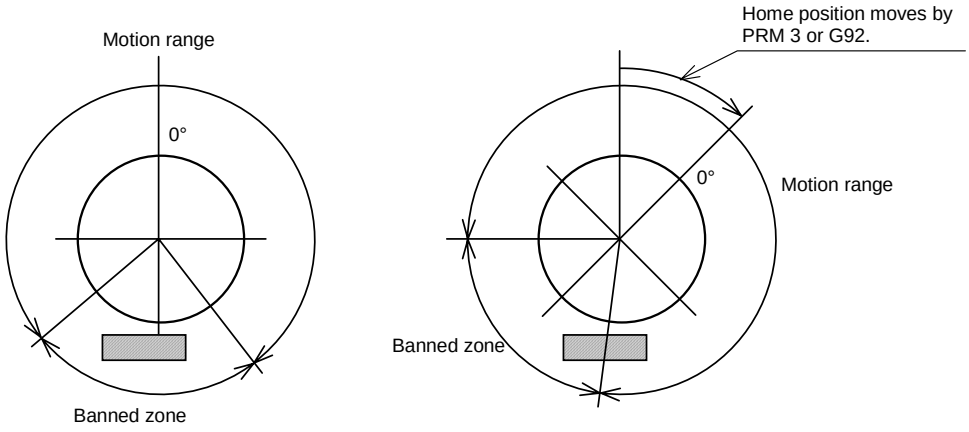


Fig. 7.4 G92 & Software Limit

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

7.6 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 PRM 17 (number of sampling times for in-position) = 3.

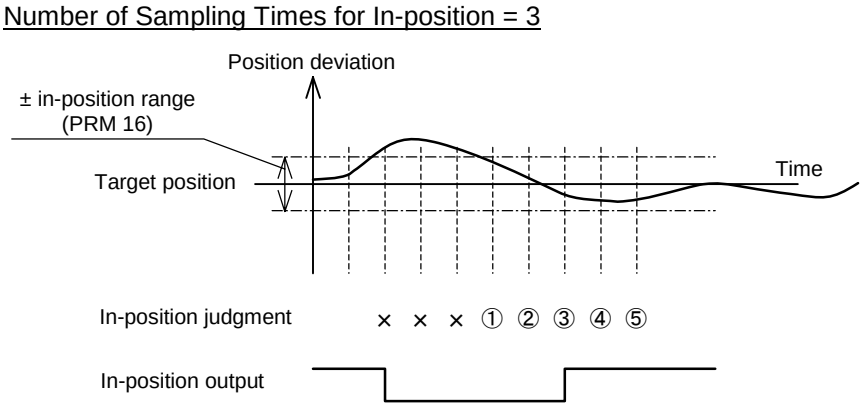


Fig. 7.5 In-position Output

7.7 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 PRM 17 = 3.

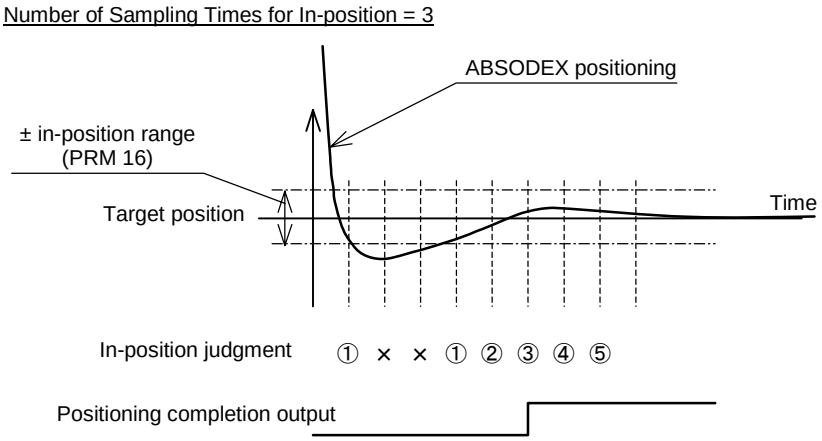


Fig. 7.6 Position Completion Output

When the PRM 13 (Answer input for positioning and home positioning completion) is set to 1: Required, the output will be continued until answer signal (CN3-16) is input.

The default setting for the PRM 16 (in-position range) is 2000 (pulses). Change this setting as required.

7.8 Correct Setting of PRM 16 (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.

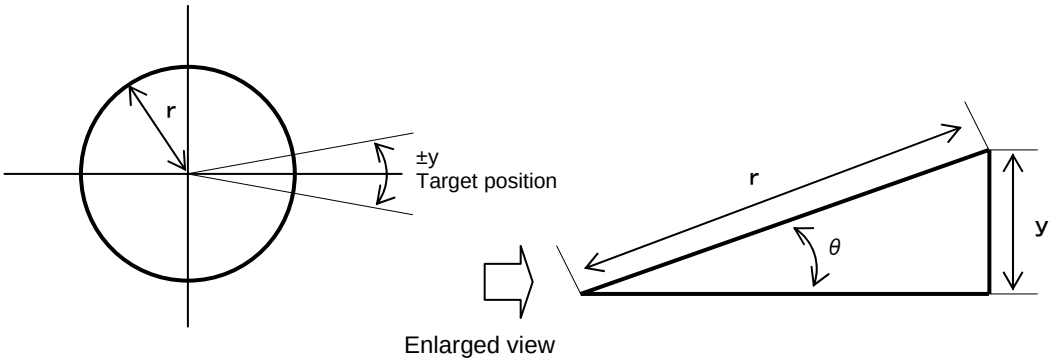


Fig. 7.7 Correct In-position Range

1) 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:

θ: angle (rad). If the resolution of ABSODEX is 540672 (pulses), arc y is small enough to be considered to be a line.

$\sin\theta = y/r \quad \cdots ①$

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

$\sin\theta \fallingdotseq \theta \quad \cdots ②$

From ① and ②,

$\theta = y/r \quad \cdots ③$

Conversion of θ into pulse P leads to:

$P = 540672\,\theta/2\pi \quad \cdots ④$

From ③ and ④,

$P = 540672y/2\pi r \quad \cdots ⑤$

$=270336y/\pi r$

$\fallingdotseq 86051y / r$

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

2) PRM 17 (in-position sampling frequency) should be generally "3" at the most if the in-position range is set at 200 to 300. Because a sampling cycle is 2msec, too many counts will cause a delay in the issuance of the positioning completion signal.

3) Conversion between angle α (°) and pulse

a) To convert P (pulses) into α (°),
$\alpha = 360P / 540672$

b) To convert α (°) into P (pulses),
$P = 540672 \alpha / 360$

7.9 G101 (Designation of Equal Segment) and Parameters

Setting PRM 37 (segment position range width for designation of equal segment) and PRM 38 (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 emergency stop.
The following is the motion example for four segments (G101A4).

7.9.1 Motion of G91A0F□□ (in case of A0 for incremental instruction)

1) PRM 38 = 1 (CW direction)
When within ① range for (a), **Fig. 7.8 (a)**, executing G101A4;G91A0F□□ will cause the actuator to move to 1H position.
(□□ is any value for specifying motion time or speed.)

2) PRM 38 = 2 (CCW direction)
When within ② range for (a), **Fig. 7.8 (a)**, executing G101A4;G91A0F□□ will cause the actuator to move to 1H position.

3) PRM 38 = 3 (Nearer direction)
When within ③ range for (b), **Fig. 7.8 (b)**, executing G101A4;G91A0F□□ will cause the actuator to move to 1H position (nearest position). PRM 37 will not influence motions.

4) If PRM 38 = 4 (alarm C is caused outside the vicinity of segment position)
If G101A4;G91A0F□□ is executed in the range specified ④ in **Fig. 7.8 (a)**, a travel to position 3H occurs.
If the command is executed in range ⑤, alarm C is caused when G101A4 is executed.

7.9.2 Motion of G91A-1F□□ and G91A1F□□

1) PRM 38 = 1 (CW direction), or 2 (CCW direction)
When within ① range for **Fig. 7.8 (a)**, 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.

2) PRM 38 = 3 (Nearer direction)
In this case, the actuator moves based upon the nearest indexing position from the current position. When within ③ range for **Fig. 7.8 (b)**, executing G101A4;G91A1F□□ will cause the actuator to move to 2H position and G101A4;G91A-1F□□ will cause the actuator to move to 4H position.

3) If PRM 38 = 4 (alarm C is caused outside the vicinity of segment position)
If G101A4;G91A-1F□□ is executed in the range specified ④ in **Fig. 7.8 (a)**, 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.

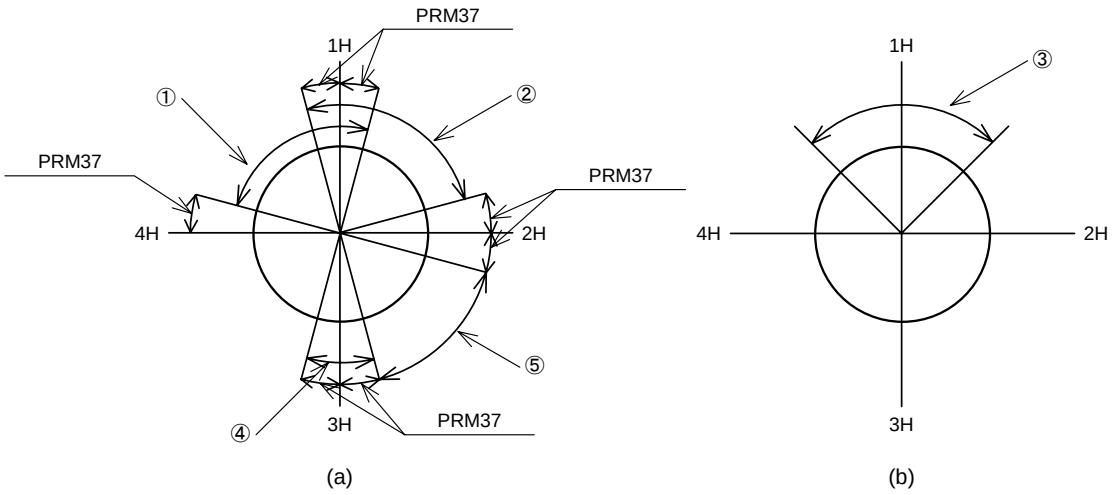


Fig. 7.8 Equal Segment Designation (G101) & Parameter

7.9.3 Motion of M 70

1) For PRM 38 = 1 (CW direction) or 2 (CCW direction)
Within the range ④ in the Fig. 7.8 (a), 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 PRM 37, 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....

2) PRM 38 = 3 (Nearest head)
Executing G101A4;M70; will cause CN3 M code to output the nearest head segment position from the current position.
Within the range ③ in the Fig. 7.8 (b), segment position 1 (bit 0) is output.

3) If PRM 38 = 4 (alarm C is caused outside the vicinity of segment position)
If G101A4;M70; is executed in the range specified ④ in Fig. 7.8 (a), 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 PRM 37 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 **Section 5.3.10 "Segment Position Output Timing. "**

Table 7.3 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 Fig. 7.8 (a) (When PRM38 is 1)	○	○	○	○	○	○	●	○	B'00000010 (=D'02)	○
1H Range ③ in Fig. 7.8 (b) (When PRM38 is 3)	○	○	○	○	○	○	○	●	B'00000001 (=D'01)	●

7.10 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.

- **PRM 62 to 71 are for filters.**
  For detail, refer to Table 7.1 Parameters.

7.10.1 Characteristics of Filters

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.

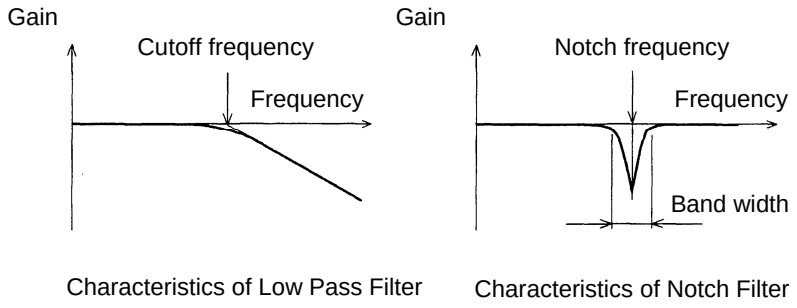


Fig. 7.9 Filter Characteristics

7.10.2 Filter Switch

PRM 66 (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".

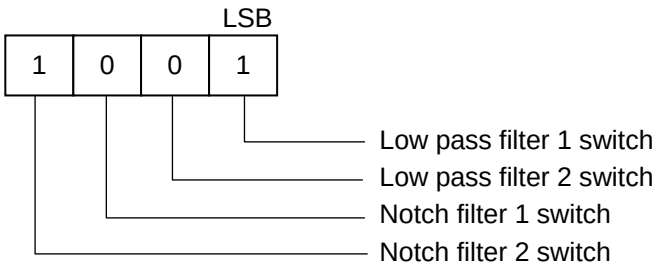


Fig. 7.10 Filter Switch

< Switch Setting Example >
PRM 66 = 9 (= 1001): To use both low pass filter 1 and notch filter 2
PRM 66 = 3 (= 0011) : To use both low pass filters 1 and 2

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

7.10.3 Q Value of Notch Filter

The band width "Q" of notch filter can be set using PRM 70 and 71. The larger the Q value is, and the narrower the band width is. On the contrary, the smaller the Q value is, larger the band width is. Default value is Q = 1.
In most cases, there is no need to change "Q" value.

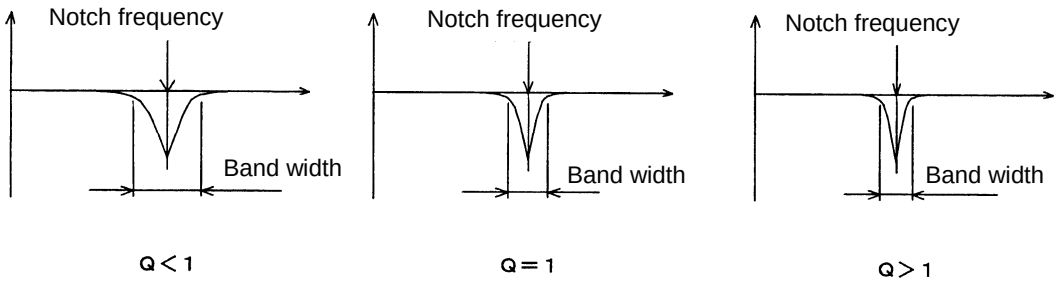


Fig. 7.11 Q Value of Notch Filter and Band Width

7.10.4 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 PRM 62 to 100.
L7_64_200	Set PRM 64 to 200.
L7_66_5	Set PRM 66 to 5 (B'0101)

Use the communication code L9 to confirm if the written data is correct or not.
For detail, refer to **Chapter 12. "COMMUNICATION FUNCTIONS**. "

7.10.5 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 500 Hz. Smaller value of setting will not assure of stable motions. It is recommended that frequencies be set above 80 Hz (desirably over 100 Hz).

7.11 Integral Limiter

The integral limiter is related to integral control of the control system inside the controller and it can be entered with PRM 67 (integral limiter).

If a load causing to exceed the allowable moment of inertia of the actuator with a larger margin is installed, the control system sometimes becomes unstable to disable settling. In such a case, reduce this value to a setting that does not cause position deviation in the stopping cycle, to suppress stopping overshoot and improve stability of loads having a large moment of inertia. The correct value changes through gain adjustment, too.

- **If the integral limiter setting is too small, sufficient torque is not output in the constant state, possibly causing remaining deviation in the stopping cycle. If the indexing accuracy is required, do not change the integral limiter setting from the default value.**

7.12 Multiplier for Integral Gain

A multiplier for integral gain in the control system of the driver can be set to PRM 72 (integral gain multiplier).

A smaller value serves similar to PRM 67 (integral limiter).

A larger value makes the convergence time shorter while the stability of the control system may become less stable.

- **If the large-inertia load is to be used, do not use the continuous rotation function and the auto tuning function. Doing so may trigger an alarm or damage the driver.**

7.13 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 1000msec."

- **No positioning completion output is issued if PRM47 = 0.**
- **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."**

7.14 Controlled Stop upon Alarm Valid/Invalid

Controlled stop is conducted upon an alarm during rotation to avoid coasting to stop, similarly to emergency stop.

Change PRM48 to "1" to validate this function.

1) Applicable alarms

Alarms related to this function are listed below.

Table 7.4 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

2) Operation at alarm

Deceleration is made according to PRM21 (emergency stop deceleration rate), similarly to emergency 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 stop if the rotation speed is reduced to within 1rpm.**
- **If the speed command at the time of occurrence of an alarm is smaller than the actual speed, the speed command is substituted with the actual speed before deceleration begins.**

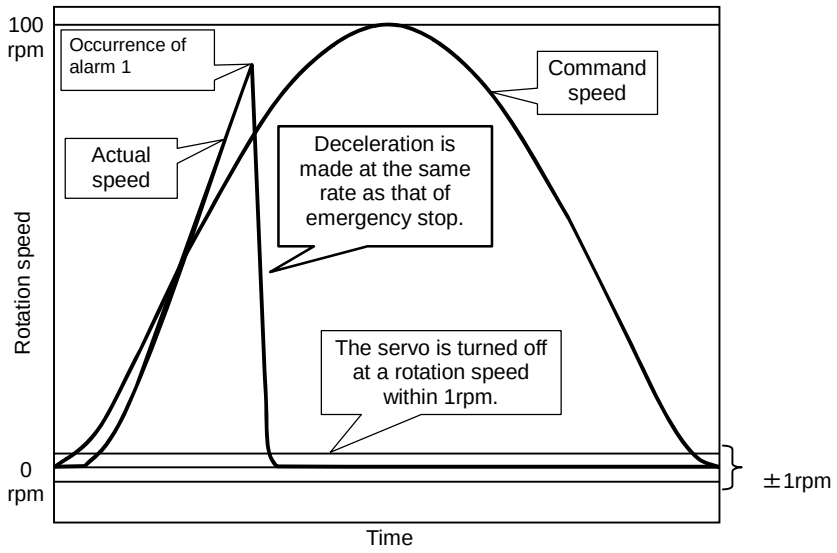


Fig. 7.12 Example of Speed Curve at Alarm

7.15 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. If this happens, follow the procedures below to set stricter in-position judgment conditions.**

  ① Enter a smaller setting to PRM16 (in-position range).

  ② Enter a larger setting to PRM17 (in-position sampling frequency).

7.16 Mode Selection of I/O Signal

Change parameters to switch functions of some I/Os.
For the applicable I/O signals and settings, refer to PRM52 to PRM57 in "Table 7.1 Parameters."

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

8. APPLICATION EXAMPLES

Table 8.1 List of Application Examples

Item	Action Specification	Point
8.1 Product type change	Workpiece change without setup change	Change the program according to the workpiece type.
8.2 Shortest route indexing	Random indexing	Change the program according to the stopping position. @^Shortest route is used for the direction of rotation.
8.3 Caulking	Caulking process at stop	Program for mechanically restricting the output axis in the stopping cycle like a caulking process or a positioning pin insertion process. The brake command is used.
8.4 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
8.5 Indexing table	Continuation of previous day work from intermediate position	Even if the table is manually 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.
8.6 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). "

8.1 Product Type Change

1) Application
   Indexing action requiring product type change

2) 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°.

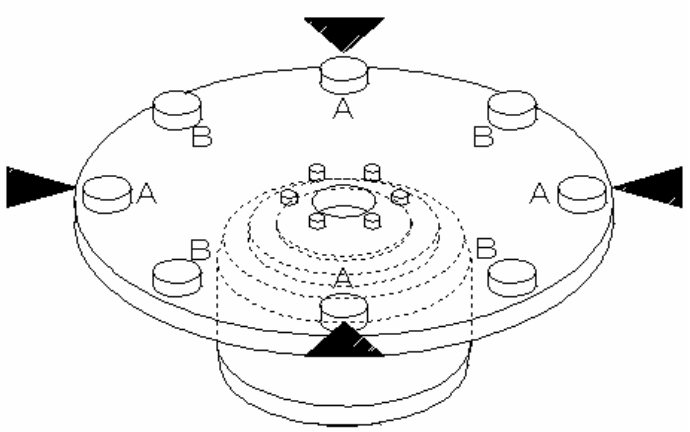
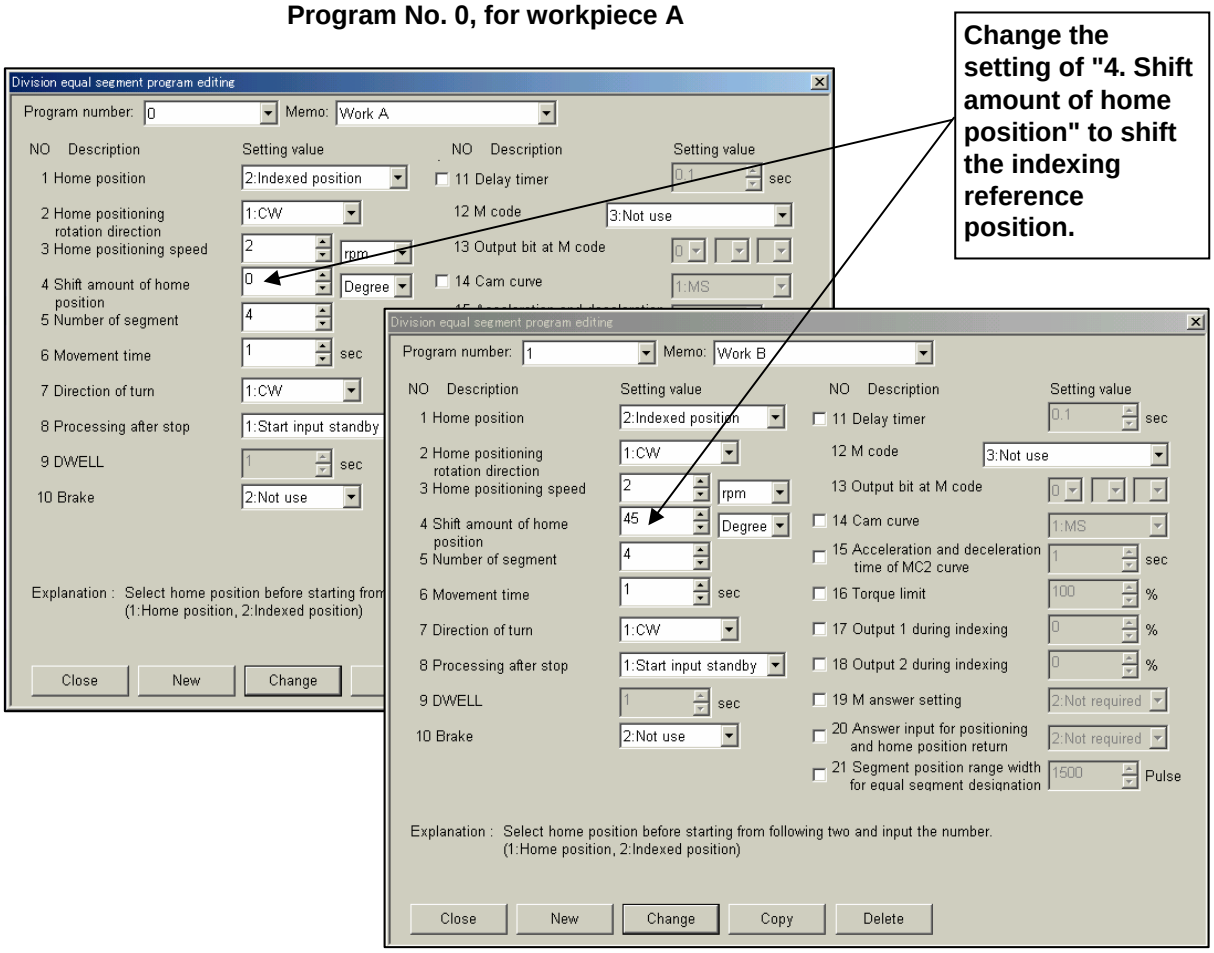


Fig. 8.1 Product Type Change

3) Program key point
(Creation example using AX Tools)

Program No. 0, for workpiece A



Program No. 1, for workpiece B

Fig. 8.2 Editing Equal Segment Program

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 PRM 3 (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 four stock positions occurs in 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 Section 7.9.2 2) PRM 38 = 3 (Shortest Route). The action is the same as running "G101A4; G91A1F□□;" as referred.

8.2 Shortest Route Indexing

1) Application
   Workpiece stocker

2) 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.)

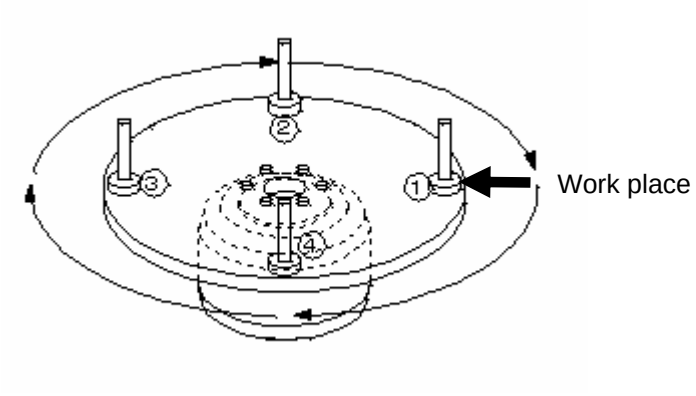


Fig. 8.3 Workpiece Stocker

3) 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

8.3 Caulking

1) Application

Indexing table having a caulking process (or positioning pin insertion mechanism)

2) Application example

Eight-segment indexing table including the caulking process.
The caulking 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.

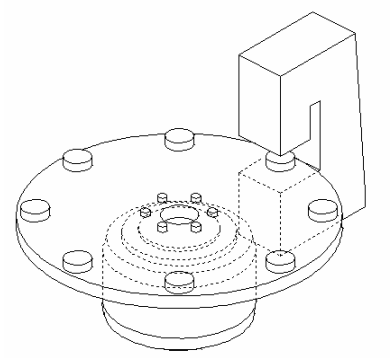


Fig. 8.4 Caulking Process

3) Program key point

① 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>.

② Brake command

Brake command "M68" not only activates the built-in air brake or an optional electromagnetic brake but also stops the integral calculation of the control 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 **Table 6.4 "M Code List"**.

③ 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 PRM 16 (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.

④ State at emergency stop

If an emergency stop input 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 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.

⑤ About 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.

⑥ Designation of direction of rotation

In the incremental instruction, a positive value following "A" indicates clockwise rotation, and a negative value indicates counterclockwise rotation.

⑦ 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 **Table 6.3 "G Code List (2/3)**".)

<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 the brake.
A0F0. 5;	Travel to the nearest station in 0.5 sec.
N1M68;	Block No. 1, apply brake.
M0;	Start input wait
M69;	Release the brake.
A1F0. 5;	Travel by an indexing segment in 0.5 sec (rotate clockwise).
J1;	Jump to block No. 1.
M30;	End of program

8.4 Pick and Place (oscillation)

1) Application

Pick-and-place unit where each rotation is within a full revolution.

2) 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.

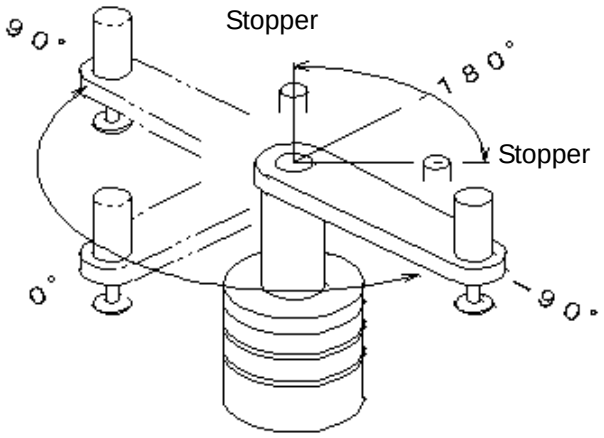


Fig. 8.5 Pick-and-place

3) Program key point

① 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).**

After the power is turned on, ABSODEX assumes that the output axis is in a position between -180.000° and +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 is interfering matters in the full revolution.
(The coordinate mentioned here is in the G92 user coordinate system; it can be changed, using PRM 3 (home position offset amount). Refer to **Chapter 7. "PARAMETER SETTING. "**)

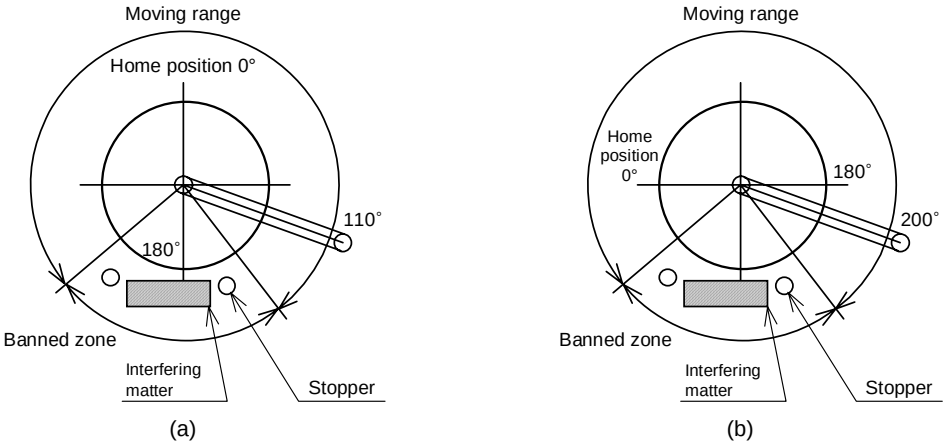


Fig. 8.6 Coordinate System Setting

In **Fig. 8.6 (a)**, ABSODEX recognizes the current position to be at 110° after the power is turned on. In **Fig. 8.6 (b)**, it recognizes the current position to be at -160° after the power is turned on.
If a travel to the 0° position is caused in this state, the case in **Fig. 8.6 (a)** causes counterclockwise rotation up to the home position while the case in **Fig. 8.6 (b)** causes clockwise rotation, resulting in intrusion of the banned zone.

② Use PRM 45 (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.

PRM45
Default value: 270335
Setting range: 0 to 540671
Unit: pulses
Effect: The power-on coordinate system is between (setting - 540671) and setting.

<Example>
To prohibit entry into the banned zone shown in Fig. 8.6 (b), determine the coordinate system between -90.000° and 269.999° positions.
Convert 269.999° into pulses.
269.999/360 × 540672 = 405502
Hence write "405502" in PRM45.
→ After this setting is entered, the 200° position shown in Fig. 8.6 (b) 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.

8.5 Indexing table

1) Application

Return to the power-off indexing position and start to index.

2) 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.

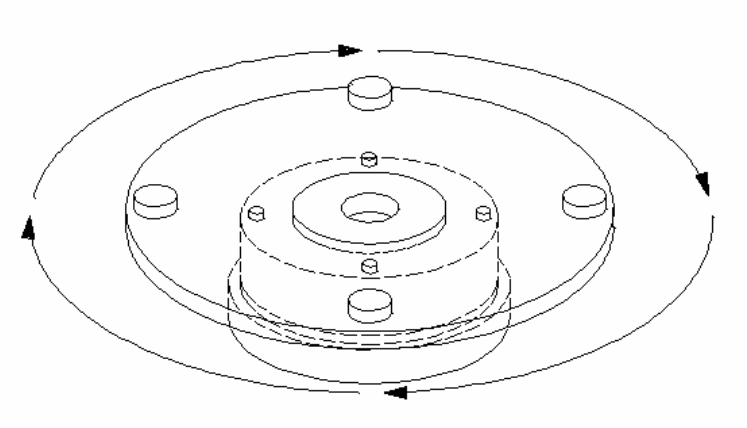


Fig. 8.7 Indexing Table

3) Program key point

① 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.

② When the power is turned on, execute the program having the same number as the M code saved last.

③ At the programmable logic controller, select programs 1 to 4 in the indexing order and execute them.

④ 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)

⑤ 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 a 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 a 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 a 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 a 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

8.6 Continuous Rotation

1) Application
   Stop the shaft, which keeps rotating during regular operation, at the designated position upon a stop input.

2) Application example
   Roll feeder

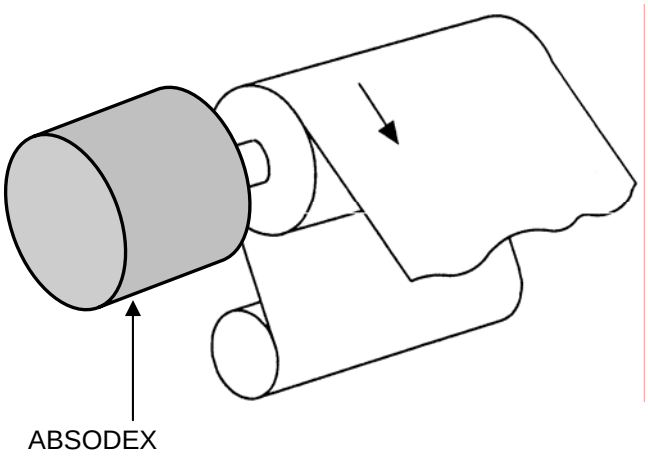


Fig. 8.8 Roll Feeder

3) Program key point
   ① 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 the both settings is 1 sec.
   For details, refer to **Table 6.3 "G Code List."**

   ② 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 **Table 6.3 "G Code List."**

   ③ 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 20rpm and the counterclockwise rotation.
M30;	End of program

- **If the equipment configuration is the one shown in Fig. 8.8, 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 Table 6.3 "G Code List (1/3). "

9. GAIN ADJUSTMENTS

9.1 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.

Change PRM101 and 102 to adjust gain 1 (response) and gain 2 (load inertia moment).

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 PRM101 and 102 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.

1) PRM101 (Gain 1, response)

PRM101 adjusts convergence time.

Larger the setting becomes, greater the gain becomes while I (integration gain) increases and D (differentiation gain) decreases.

An increase in PRM101 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 PRM101 in lower range.

2) PRM102 (Gain 2, load inertia moment)

PRM102 is adjusted in accordance with the load on the actuator.

Larger the setting becomes, greater the P (proportional gain), I (integration gain) and D (differentiation gain) becomes.

An increase in PRM102 reduces the overshoot in the positioning cycles. For a larger load, increase the setting value.

3) Preparation for Gain Adjustments

Before starting gain adjustments, ABSODEX unit must be firmly fixed to the machine, and install load 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 RS-232C port.

For communication using a personal computer, refer to Chapter 12. "COMMUNICATION FUNCTIONS. "

⚠ 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 actuator rotation will not cause a danger before starting, when the actuator cannot be seen.**
- **PRM101 and 102 should be switched while the actuator is not in motion. (DO NOT switch them 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.**

9.2 Gain Adjustment Method

There are two methods for the gain adjustment of MU type driver: auto tuning and manual adjustment.

9.2.1 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.

1) Preparation before auto tuning
   Set both PRM101 and 102 settings at "0."
   After "0" is set, auto tuning becomes ready.

2) Auto tuning parameters
   Auto tuning of ABSODEX is related with various parameters for defining the operation conditions and other features.
   For details, refer to **Chapter 7. "PARAMETER SETTING**."

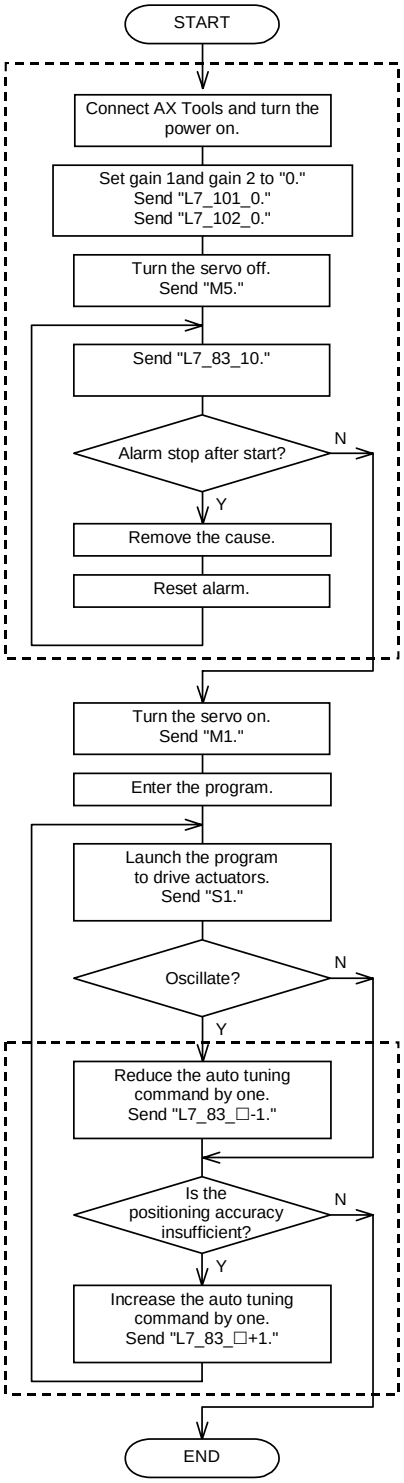
   PRM 80: Integral gain
   PRM 81: Proportional gain
   PRM 82: Differential gain
   PRM 83: Auto tuning command
   PRM 87: Auto tuning torque
   PRM 88: Auto tuning measurement starting speed
   PRM 89: Auto tuning measurement termination speed

- **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 PRM 80 to 82 settings.
- **To write PRM 80 to 82, turn the servo mode off ("M5").**
- **If the combination of the actuator is changed after values are written in PRM 80 to 82, the action refers to preset gains, possibly causing vibration.**
  If this is the case, turn the power on with the motor cable disconnected, and initialize the NC program and parameters (send L17_12345) according to the description given in "11.3 System Initializing."
- **After conducting auto tuning, change both PRM101 and 102 settings back to "0" to continue operation.**
- **By using AX Tools, the auto tuning function can be used more easily.**
  Refer to "AX Tools Instruction Manual" for details.

3) Adjustment of result of auto tuning (semi-auto tuning function)
After conducting auto tuning, calculate and enter PID gain parameters without swinging.
To adjust the response (rigidity) of ABSODEX after auto tuning, change 10 of L7_83_10 of the auto tuning command.
Change the setting from 1 to 10 to 32 to increase the rigidity.

- **ABSODEX can cause oscillation or cause "alarm 1" during rotation with some pieces of equipment according to the rigidity.**
- **If L7_83_☐ is sent in the servo-off mode (M5 mode), swinging starts to calculate the load size again.**
- **Gain setting is not given even if semi-auto tuning is executed without executing auto tuning.**
- **By using AX Tools, the semi-auto tuning function can be used more easily.**
  Refer to "AX Tools Instruction Manual" for details.

4) Auto Tuning Procedures
The following is the auto tuning flowchart.



Auto tuning
Swinging begins to conduct regular auto tuning if L7_83_□□ is sent in the servo-off state.

Semi-auto tuning
If L7_83_□□ is sent in the servo-on state, swinging does not begin and semi-auto tuning is conducted.

Fig. 9.1 Auto Tuning Flowchart

5) 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 If ABSODEX interferes with a stopper or rotation is blocked by piping or wiring in the middle of auto tuning to cause "alarm U," reduce the setting of "PRM 89" in 100 increments.

- **Do not reduce the PRM 89 setting down below 200.**
  Refer to Table 7.1 Parameter (11/11) in Section 7.1.

④ If auto tuning fails during operation described in ③, an excessive friction load is probable. Increase the auto tuning torque (PRM 87) 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 **Section 9.2.2 "Manual Adjustment**."

6) Conversion from auto tuning to manual setting
How to replace the result of auto tuning with manual setting (PRM101 and PRM102) is described here.

① The setting ("1" to "32") in the auto tuning command corresponds to the manual setting (PRM101) as shown in the table below.

Table 9.1 Correspondence between Auto Tuning Command and PRM101

Auto tuning command	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PRM101		1		2		3		4		5		6		7	

Auto tuning command	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
PRM101	8		9		A		B		C		D		E		F		

② Enter the value corresponding to the auto tuning command setting, to PRM101.

③ Read the differential gain (PRM 82) of the result of auto tuning.
Let the readout value in response to communications code "L9_82" be "X."

④ Read the differential gain setting of the manual gain.
Let the readout value in response to communications code "L9M_82" be "Y."

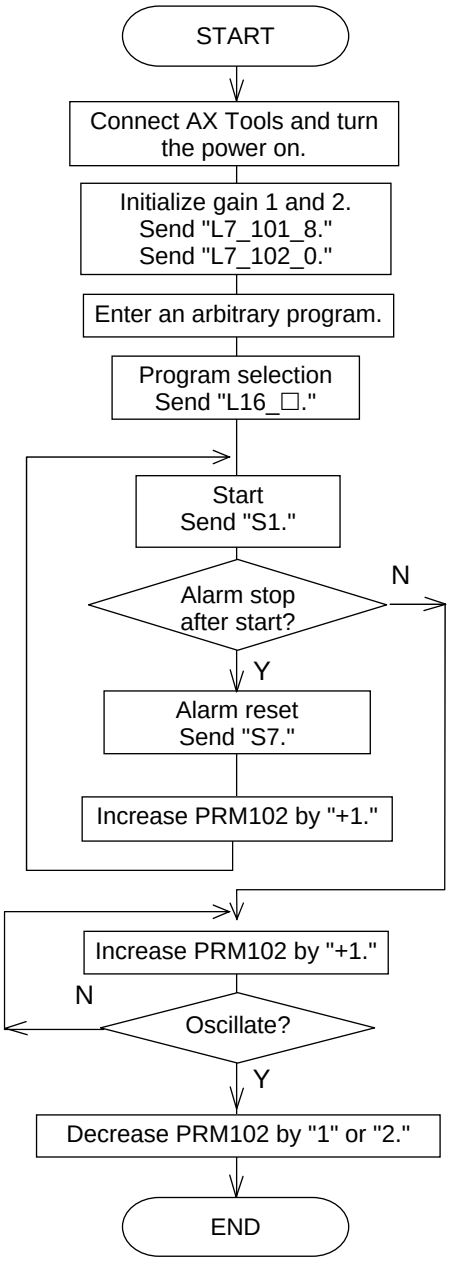
⑤ While increasing the setting of PRM102 in "1" increments, read the differential gain setting of the manual gain, using the communications code specified in paragraph ④.

⑥ The setting of PRM102 with which "X" and "Y" is the most similar is the manual setting (PRM102).

- **Enter the setting of PRM101 at paragraph ②. before reading the differential gain.**

9.2.2 Manual Adjustment (manual tuning)

The manual gain adjustment flowchart is shown below.



Change the PRM101 and 102 values to the initial ones.
PRM101: 8
PRM102: 0

For the entry, selection and starting procedures of the program, refer to **Chapter 4 "TEST OPERATION."**

Fig. 9.2 Flowchart of Gain Adjustment

Repeat similar adjustment while changing PRM101 setting, to adjust the gain more accurately.
If the rigidity of the equipment is sufficiently high, increase the PRM101 setting even with a smaller PRM102 setting after the above adjustment to improve the action state further.
For PRM101 and 102, refer to **Section 9.1 "What is Gain Adjustment**?"

- To read PRM101 and 102, use communication codes "L9_101" and "L9_102."

10. ALARMS

When there is an alarm in the ABSODEX, an LED on the front panel of the driver is lit.
ALM1 indicates the alarm 1 output state and ALM2 indicates the alarm 2 output state.
At the same time, alarm outputs of I/O (CN3-44 and 45) will also be ON. (Alarm output is made with the negative logic.)
When an alarm is issued, connect AX Tools and refer to the ABSODEX data in the help menu to check information about the current alarm.

10.1 Alarm Display and Description

The table below lists alarm displays and their description.
Refer to **Chapter 11. "MAINTENANCE AND TROUBLESHOOTING"** for troubleshooting of the alarms.

Table 10.1 Alarm (1/4)

Alarm No.	Description	Alarm Output	Alarm data (3-digit number)	Remarks
0	NC program error	Alarm 1	01X	Program data error (M1 mode)
			02X	Program selection error
			03X	Program data error (M3 mode)
			04X	The I/O number is entered while the program is stored.
			05X	Answer input command S10 is executed while no answer is waited for.
			06X	Time expiration in pulse travel mode
			09X	Other program errors
1	Position deviation over	Alarm 1 Alarm 2	11X	Setting of PRM 19 (upper limit of position deviation amount) is exceeded.
	Speed limit over		12X	Setting of PRM 20 (speed over limit) is exceeded.
	Encoder output max. frequency over		13X	The maximum encoder output frequency is exceeded.
2	Regenerative resistor overheat	Alarm 1 Alarm 2	21X	The power is turned on in a regenerative resistor overheat error.
			22X	A regenerative resistor overheat error is caused during operation.
3	Actuator/Driver combination abnormal	Alarm 1	31X	An actuator different from the previous one is connected (model error).
			32X	An actuator different from the previous one is connected (serial number error in same model).

* The third place (X) of the alarm data is an arbitrary number between 0 and 9.

Table 10.1 Alarm (2/4)

Alarm No.	Description	Alarm Output	Alarm data (3-digit number)	Remarks
4	Actuator overload	Alarm 1 Alarm 2	41X	Error caused by electronic thermal overload calculation
			42X	Error caused by electronic thermal overload calculation (The electronic thermal value is 110°C or over.)
			43X	The power module protective function is activated.
5	Power module abnormal	Alarm 1 Alarm 2	51X	The power is turned on in the presence of an over-current or a fault signal sent from the power module.
			52X	An over-current or a fault signal from the power module is sent during operation.
6	Main power abnormal	Alarm 1 Alarm 2	61X	A travel command is generated in the low-voltage error state. A low-voltage error is caused during travel.
			62X	The power is turned on in a state with an over-voltage error.
			63X	An over-voltage error is caused during operation.
7	Communication error	Alarm 1	71X	Data input error
			72X	Settings are not written in the parameter writing cycle.
			73X	An M-code is sent during operation.
			74X	The parameter number is not specified in the parameter loading/writing cycle.
			75X	Other communication errors
			76X	
8	Control PCB abnormal	(Indefinite)	81X	Hardware of CPU in the driver may be faulty.

Table 10.1 Alarm (3/4)

Alarm No.	Description	Alarm Output	Alarm data (3-digit number)	Remarks
9	An emergency stop input has been made.	Alarm 2	91X	An emergency stop input has been supplied when the servo-on-after-stop parameter (PRM23) is set at "1."
				An emergency stop input is supplied when the servo-on-after-stop parameter (PRM23) is set at "1."
			92X	An emergency stop input has been supplied when the servo-off-after-stop parameter (PRM23) is set at "3."
				An emergency stop input is supplied when the servo-off-after-stop parameter (PRM23) is set at "3."
A	Brake abnormal	Alarm 2	A1X	A travel command is generated after a brake command (M68) is executed.
			A2X	A travel command is generated under brake application with the I/O brake release input turned off.
C	Software limit over	Alarm 2	C1X	PRM 8 and 9 settings are exceeded. Or ±18 revolutions are exceeded.
			C2X	Segment range error with PRM38 (direction of rotation at equal segment designation) being "4"
E	Emergency stop by dialog terminal	Alarm 2	E1X	An emergency stop is supplied from the dialogue terminal.
F	Resolver abnormal	Alarm 1 Alarm 2	F1X	The resolver data has suddenly changed during indexing operation.
			F2X	The resolver data has suddenly changed during other than above operation (such as during continuous rotation and while inputting pulse).
			F3X	An error generates in the electric angle during indexing operation.
			F4X	An error generates during other than above operation (such as during continuous rotation and while inputting pulse).
			F5X	There is no consistency between signals sent from two resolvers.
			F7X	The resolver data is instable at power-on.
			F8X	Other resolver errors
			F9X	
			FAX	

Table 10.1 Alarm (4/4)

Alarm No.	Description	Alarm Output	Alarm data (3-digit number)	Remarks
H	No answer error	Alarm 2	H1X	The no-answer time after an M-code output exceeds the PRM11 setting.
			H2X	The no-answer time at positioning completion output exceeds the PRM11 setting.
			H3X	A start input is supplied while an answer is waited for.
			H4X	A home return input is supplied while an answer is waited for.
L	Actuator communication abnormal	Alarm 1 Alarm 2	L1X	Actuator data reception error
			L2X	Connection of inapplicable actuator (error in connection between small and large types)
	Drive PCB abnormal		LFX	A hardware failure in the drive PCB is probable.
P	Memory abnormal	Alarm 2	P1X	Data writing error to internal memory
U	Auto tuning abnormal	Alarm 1 Alarm 2	U1X	Acceleration is impossible up to the auto tuning end speed.
				An error generates in auto tuning operation.
				An electronic thermal error generates in auto tuning.

- **When there is no alarm, Alarm 1 LED (ALM1) and Alarm 2 LED (ALM2) are unlit and the normal operation LED (RUN) is lit.**
- **In the servo-on state, the servo status LED (SERVO) is lit.**

- **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.

  ① Shipment state
  ② After initialization
  ③ 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:

- **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.**
- **DO NOT restart the actuator until it cools down if alarm 4 (overloaded actuator: electronic thermal) is caused.**
  The following may be causes for alarm 4.
  Remove the causes before restarting operation.
  - **Resonance or vibration → Secure sufficient rigidity for the installation.**
  - **Cycle time or speed → Elongate the traveling time and stopping time.**
  - **Structured to constrain the output axis → Add M68 and M69 command. (Refer to Section 8.3 Caulking.)**

10.2 Servo Status for Alarms

Alarm: 1, 2, 4, 5, 6, 9 (PRM 23 = 3), A, F and L → Servo OFF
Alarm: 0, 3, 7, 9 (PRM 23 = 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 (PRM 23 = 1) and E will cause the servo-off and then servo-on.

⚠ CAUTION:

- **For an alarm, make sure that the cause of the alarm is eliminated prior to resetting. For alarms, refer to Chapter 11. "MAINTENANCE AND TROUBLESHOOTING."**

11. MAINTENANCE AND TROUBLESHOOTING

11.1 Maintenance Inspection

1) Periodical Inspection

For using ABSODEX 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.

Table 11.1 Periodical Inspection

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 screws and connectors	Check that the screws and connectors are not loose.	Re-tighten screws and connectors.
3. Abnormal noise from actuator.	Confirm by hearing.	Request CKD to repair.
4. Cuts and crack in cable.	Check the cable 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.

※ 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.

2) 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

Table 11.2 Troubleshooting (1/4)

Symptom	Probable Cause	Countermeasures
1. 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.
2. 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. ◆ The main power is turned on when there is position deviation.	→ Adjust gain (Refer to **Chapter 9**). → Check the cable connector. → Turn the main power on in the servo-off state.
3. Alarm F will occur when power is turned on.	◆ The resolver cable between the actuator and driver may be broken or the connectors may be loose. ◆ Excessive moment and lateral loads are applied to the actuator. ◆ There is a fault in power-on coordinate recognition.	→ Check the cable connectors. → Check the equipment alignment. → Remove excessive load. → Check the resolver cable wiring. → Check that the output shaft does not rotate when the power is turned on.
4. No communication with a personal computer.	◆ Communication cable is broken or connectors are loose. ◆ Baud rate of a personal computer does not match that of the driver. ◆ Communication cable wiring is not correct.	→ Check the cable connectors. → Confirm communication specifications such as baud rate and parity. → Correct the wring connection of the cable.
5. 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 **Chapter 9**.). → Tighten bolts. → Increase load rigidity by reinforcement and to adjust gain smaller. → Install dummy inertia. → Use anti-vibration filter. → Reduce friction load. → Retighten the bolts.
6. Failure to position in the target position (Position deviation)	◆ Poor gain adjustment	→ Adjust the gain. (Refer to **Chapter 9**.)
7. Alarm 0 occurs.	◆ 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 write a program. → Turn the servo on (G12P100) before a rotation code.

Table 11.2 Troubleshooting (2/4)

Symptom	Probable Cause	Countermeasures
8. Alarm 1 occurs.	◆ The actuator is loosely tightened.	→ Retighten the bolts. Retighten without fail.
	◆ Load is excessive.	→ Reduce speed.
	◆ Connection of the drive to actuator is not right.	→ Check the cable connectors. (Refer to **Fig. 3-1**.)
	◆ Output axis is restricted by machine clamp mechanism.	→ Apply or release the brake in the program (Refer to **8.3**).
	◆ Load is not fixed tight.	→ Tighten bolts.
	◆ Gain adjustments are not made sufficiently.	→ Adjust gain (Refer to **Chapter 9.**).
9. Alarm 2 occurs.	◆ Acceleration/deceleration cycles are large.	→ Set stop time longer (Take time for heat reduction to re-start).
10. Alarm 4 occurs.	◆ 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 (Refer to **2.1**).
		→ Use anti-vibration filter (Refer to **7.10**).
	◆ Output axis is restricted by machine clamp mechanism.	→ Perform brake-on/off in the program (Refer to **8.3**).
	◆ Rotation and friction torque of load equipment is large.	→ Reduce the load. Increase the size of ABSODEX.
11. Alarm 5 occurs.	◆ Insulation of the actuator is faulty.	→ Check the cable connectors, and installed environment.
	◆ Ambient temperature around the driver is high.	→ Ventilate to reduce ambient temperature.
12. Alarm 6 occurs.	◆ Power voltage is low.	→ Check the power system.
	◆ Instantaneous power failure has occurred.	→ Check the power system.
	◆ Power resumed immediately after power off.	→ Turn off power, and turn it on after a few seconds.
	◆ The regenerative energy caused an over-voltage error.	→ Reduce the traveling speed.

Table 11.2 Troubleshooting (3/4)

Symptom	Probable Cause	Countermeasures
13. Alarm 9 occurs.	◆ Emergency stop is input. ◆ 24VDC is not supplied.	→ Check I/O signal. Confirm the PRM 23. → Supply 24VDC.
14. Alarm A occurs.	◆ An attempt was made to rotate with brake-on. The brake is applied in a travel. ◆ PRM 28 is set for motion.	→ Review the program. → Revise the parameter and review the program.
15. Alarm H occurs.	◆ 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 PRM 11,12 and 13. → Confirm program and timing of programmable logic controller. → Confirm the PRM 12 and 13. → Check I/O signal.
16.Alarm C occurs.	◆ Internal coordinate system has overflowed (G92 user coordinate system). ◆ Parameter was changed by mistake.	→ Review the program (reset the G92 coordinate system). → Revise the PRM 8, 9 and 10.
17. Alarm E occurs.	◆ Dialog terminal is faulty. ◆ RS-232C cable is shortcircuited.	→ Replace or repair the terminal. → Check the cable.
18. Alarm F occurs.	◆ The actuator vibrates during operation, causing an error in coordinate recognition.	→ Refer to Trouble 5 (Load table vibrates.).
19. Alarm P occurs.	◆ The driver is faulty.	→ Replace or repair the driver.
20. Alarm L occurs.	◆ There is a communication error between the actuator and driver. ◆ The communication board is not provided. ◆ Mismatch between actuator and driver	→ Check the cable wiring. → Check the communication board. → Check the combination between the actuator and driver.
21. Alarm 3 occurs.	◆ There is a combination error.	→ Check the combination between the actuator and driver. → Enter the program and parameters again.
22. When the program is stored, alarm 7 occurs and the program is not stored.	◆ The program area is full. ◆ Program data is broken. ◆ Write protection state ◆ The running program is not finished.	→ 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 I/O signals (startup input wait output, answer output). → Adjust the gain. (Refer to Chapter 9.)

Table 11.2 Troubleshooting (4/4)

Symptom	Probable Cause	Countermeasures
23. Start signal input will not cause motion to be made.	◆ Program is not input. ◆ Brake is applied. ◆ 24VDC I/O power is not supplied. ◆ Input signal is shorter than 20m sec. ◆ No automatic operation. ◆ The servo-on input is not supplied. ◆ The running program is not finished.	→ Input motion programs. → Release the brake. → Check power source (Refer to **3.2.5**). → Set longer input signal time (Refer to **5.2**). → Set to auto mode. Confirm the PRM 29. → Supply the servo-on input. → Change PRM52 to "2" and do not use the servo-on input. → Check the startup input wait output. Adjust the gain. (Refer to Chapter **9**.)
24. The start signal supplied after recovery from an emergency stop does not cause a start.	◆ Position in the program where start input wait (M0) is written	→ Change the position of "M0".
25. Repetitive five-segment (72-degree) indexing operations cause deviation.	◆ Accumulated error due to incremental dimension	→ Use the equal segment program (G101).
26. Parameters are not stored.	◆ Pulse string input (M6) operation mode ◆ The running program is not finished.	→ Change to the automatic operation (M1) or single block (M2) operation mode and store. → Check I/O signals (startup input wait output, answer output). → Adjust the gain. (Refer to Chapter **9**.)
27. Alarm U occurs.	◆ Too large friction load ◆ The brake is applied. ◆ Interference of rotating parts with jigs or equipment	→ Increase PRM 87 setting. → Release the brake. → Remove peripheral devices.
28. Oscillation after auto tuning	◆ The rigidity of the equipment is too small.	→ Install a dummy inertia and perform auto tuning. → Adjust the gain manually. (Refer to **Chapter 9**.)

- **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, dialog terminal or a personal computer is required.

<Procedure>

① Connect the personal computer to CN1.
② Select terminal mode on AX Tools, and input L17_12345 ↵.
③ Turn off power, and turn it on again.

For system software version-up, make sure system initializing is done.

- **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 result of auto tuning is also deleted.**
  After initializing the system, execute auto tuning again.

12. COMMUNICATION FUNCTIONS

Through RS-232C port (CN1), operation mode switching and data setting can be done with a personal computer.

12.1 Communication Codes

12.1.1 Kinds of Code

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

Table 12.1 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 instruction	0	*(2AH)
L1 to L21	Data I/O	Value defined by each code (Table 12.4)	*(2AH)

12.1.2 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 PRM 1

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.

12.1.3 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 be made.
5	Non-defined code
6	Program number already registered has been specified.
7	O 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

- **Programs and parameters can be re-written 100, 000 times.**

12.2 Communication Code List

12.2.1 Operation Mode Switching

Table 12.2 Operation Mode Switching Code

Code	Description	Input Data Type	Remarks
M1	Automatic mode	M1 [CR]	Power-on mode. *1 Mode in which programs are run continuously.
M2	Single block mode	M2 [CR]	Mode in which programs are executed block by block.
M3	MDI (Manual Data Input) mode	M3 [CR]	Mode in which NC code input through RS232C port is instantaneously executed.
M4	Jog mode	M4 [CR]	Communication codes S5 and S6 enable job 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. Disable motions by using the NC program, and changing parameters. To change, switch to M1 to M5.

Note *1: Change PRM 29 (power-on mode) to change the power-on operation mode to M2 or M6.

- **"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.**
- **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.**
- **In the servo-on state, the servo status LED (SERVO) is lit.**

12.2.2 Motion Instructions

Table 12.3 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 return	S4 [CR]	Same function as home return instruction input
S5	Jog (CW)	S5 [CR]	Rotation continues in accordance with PRM 14 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".**

12.2.3 Data Input and Output

Table 12.4 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]
L3	Current Position Output Unit: Pulse Coordinate: Actuator coordinate	L3 [CR]	[Position Data] [CR] [LF] 6 digit maximum (0 to 540671) <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] 8 digit maximum (-9999999 to +9999999) <Example> 4321 [CR] [LF]
L6	Current Position Output Unit: Degree Coordinate: G92 coordinate	L6 [CR]	[Position Data] [CR] [LF] 9 digit maximum (-6658.380 to +6658.380)
L7	Parameter Data Input	L7_[Parameter Number]_[Data] [CR] <Example> L7_1_3 [CR] To set 3 to PRM 1.	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.

Table 12.4 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/Directory Output	L13 [CR]	[Using Memory Capacity] [NC Program Number] [CR] [LF] <Example> 2[%]1 2 3 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.

Table 12.4 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 to 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.**

12.3 Baud Rate

Baud rate is fixed to 9600. It can't be changed.
The default setting of the baud rate is 9600 baud. To change, contact us.
The baud rate of Dialog Terminal is set at 9600 baud.
For details of communication specifications, refer to **Chapter 14. "DRIVER SPECIFICATIONS**. **"**

12.4 Communication Methods

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

12.4.1 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.)

1) 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.

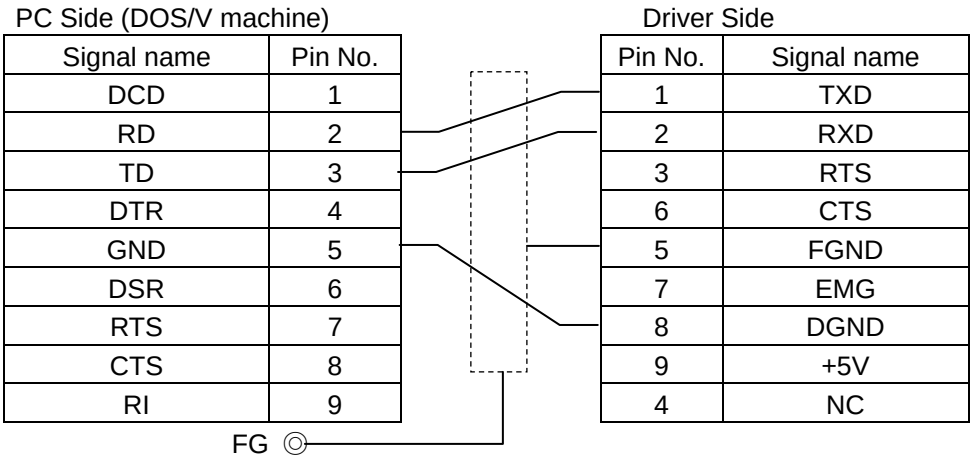
2) Auto Run Mode

< Key in>	< Description>
M1↵	Mode setting
L11_O100N1G91A90F1;J1; ↵	Program input
L16_100↵	Program number selection
S1↵	Start
S2↵	Stop

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

12.4.2 Example of RS-232C Interface Cable Connection Diagram

1) PC side Dsub 9-pin (DOS/V machine)

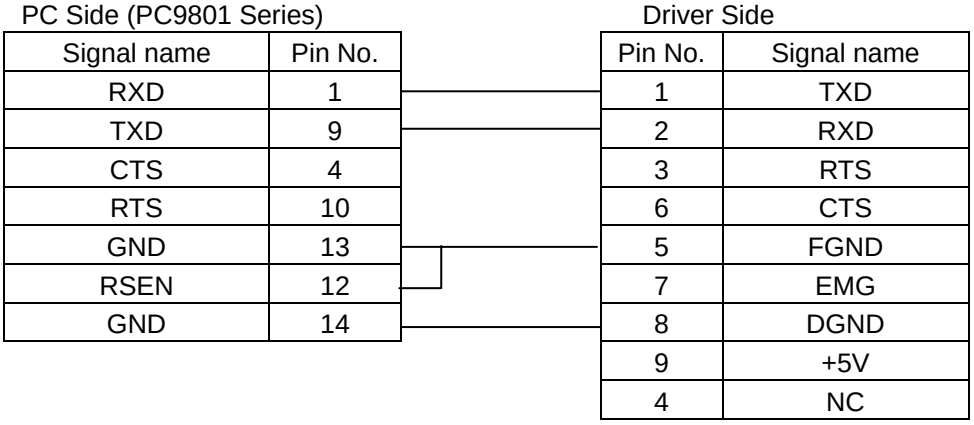


Connector: D-sub 9-pin
Plug: XM2D-0901 (Omron)
Hood: XM2S-0913 (Omron)

Connector: D-sub 9-pin
Plug: XM2A-0901 (Omron)
Hood: XM2S-0911 (Omron)

Fig. 12.1 RS-232C Cable Connection Diagram (Dsub 9-pin)
Our product model: AX-RS232C-9P

2) PC side half pitch 14-pin (old PC9801 series)



Connector: Half pitch 14-pin
Plug: 10114-3000VE (Sumitomo 3M)
Hood: 10314-42F0-008 (Sumitomo 3M)

Connector: D-sub 9-pin
Plug: XM2A-0901 (Omron)
Hood: XM2S-0911 (Omron)

Fig. 12.2 RS-232C Cable Connection Diagram (half pitch 14-pin)

3) PC side Dsub 25-pin (old PC9801 series)

PC Side (PC9801 Series)

Signal name	Pin No.
GND	1
TXD	2
RXD	3
RTS	4
CTS	5
GND	7

Driver Side

Pin No.	Signal name
5	FGND
1	TXD
2	RXD
3	RTS
6	CTS
8	DGND
7	EMG
9	+5V
4	NC

Connector: Dsub 25-pin
Plug: XM2A-2501 (Omron)
Hood: XM2S-2511 (Omron)

Connector: D-sub 9-pin
Plug: XM2A-0901 (Omron)
Hood: XM2S-0911 (Omron)

Fig. 12.3 RS-232C Cable Connection Diagram (Dsub 25-pin)

CAUTION:

- **Do not use the general-purpose cross or straight type RS-232C cable. The internal connection is different.**
- **N0. 7 and 9 pins of CN1 are designed for use with a dedicated dialog terminal. When connecting other than this to CN1, do not connect to No. 7 and 9 pins so that the driver will not be damaged by incorrect wiring.**
- **For Dsub 25 and 9 pins on the PC side, the fitting screw may vary depending on the PC makers. Make sure of the screw type with the manufacturer.**
  The hood model numbers are different depending on the size of the screws;
  M2.6 (Metric)
  Hood: XM2S-□□11 (Omron)
  M3 (Metric):
  Hood: XM2S-□□12 (Omron)
  #4-40UNC (Inch):
  Hood: XM2S-□□13 (Omron)
  (□□ denotes 25 or 09.)

13. ACTUATOR SPECIFICATIONS

13.1 AX6000M Series

Table 13.1 Actuator Specifications

Item		AX6001M	AX6003M
1. Maximum Output Torque	N·m	1.2	3.0
2. Continuous Output Torque	N·m	0.4	1.0
3. Maximum Rotation Speed	rpm	240 *1	
4. Allowable Axial load	N	600	
5. Allowable Moment Load	N·m	5	
6. Output Axis Inertia Moment	$kg \cdot m^2$	0.00034	0.00059
7. Allowable Load Inertia Moment	$kg \cdot m^2$	0.034	0.059
8. Indexing Accuracy	sec	±90	
9. Repeating Accuracy	sec	±10	
10. Output Axis Friction Torque	N·m	0.13	0.22
11. Resolution	P/rev	540672	
12. Motor Insulation Class		A	
13. Dielectric Strength of Motor		550VAC for 1 minute	
14. Motor Insulation Resistance		10MΩ minimum, 500VDC	
15. Operating Ambient Temperature		0 to 40°C	
16. Operating Relative Humidity		20 to 85%RH No condensation allowed	
17. Storage Ambient Temperature		–10 to 65°C	
18. Storage Relative Humidity		20 to 90%RH No condensation allowed	
19. Atmosphere		Free from corrosive and explosive gases and dust	
20. Mass	kg	1.2	1.8
21. Output Axis Run-out	mm	0.03	
22. Output Axis Side Run-out	mm	0.05	
23. Degree of Protection		IP20	

Note *1: Operate at 80rpm or smaller speeds during continuous rotation operation.

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14. DRIVER SPECIFICATIONS

14.1 General Specifications

Table 14.1 MU Driver Specifications

Item		Description
1. Power	Motor power	24VDC±10%
	Control power	24VDC±10%
2. Configuration		Open modular type (driver, and controller)
3. Operating Ambient Temperature		0 to 50°C
4. Operating Relative Humidity		20 to 90% RH No condensation allowed
5. Storage Ambient Temperature		-10 to 65°C
6. Storage Relative Humidity		20 to 90% RH No condensation allowed
7. Atmosphere		Free from corrosive gases, and dust
8. Anti-noise		1000V (P-P), pulse width 1μsec, startup 1nsec
9. Anti-vibration		4.9 m/s^2
10. Mass		About 0.5kg
11. Dimension		W75*H220*D160
12. Elevation		Altitude within 1000m
13. Degree of protection		IP2X

14.2 Performance Specifications

Table 14.3 Driver Performance Specifications

Item		Description
1. Number of Controlled Axes		1 axis, 540672 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 100sec/0.01 to 240rpm
6. Number of Equal Segments		1 to 255
7. Maximum Instruction Value		7 digit input ±9999999
8. Timer		0.01 to 99.99sec
9. Programming Language		NC language
10. Programming Method		Data setting through RS-232C port using PC
11. Operation Mode		Auto, single block, MDI, jog, servo off, pulse string input
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		RUN: Normal operation state ALM2: Alarm 2 state ALM1: Alarm 1 state SERVO: Servo state CHARGE: Charge state
15. Communication Interface		Meets RS-232C specification
16. I/O Signal	Input	Home positioning instruction, reset, start, stop, continuous rotation stop, emergency 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. 67,584 pulses/rev (270,336 pulses/rev after multiplication by four) Max. frequency: 170kHz (The resolution sets limitation on the maximum rotation speed.)
17. Program Capacity		About 6000 characters (256 pcs.)
18. Electronic Thermal		Protects the actuator from being overheated.

- **Programs and parameters are re-writable up to 100,000 times.**
- **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 Chapter 6. "PROGRAM. "**

14.3 I/O Signal Specifications

For the layout and signal name of the I/O pins of the connector (CN3) connected with the programmable logic controller, refer to **Chapter 5. "HOW TO USE I/O. "** For the connection method, refer to **Chapter 3. "SYSTEM CONFIGURATION AND WIRING. "**

14.4 RS -232C Signal Specifications

1) Communication Specifications

Table 14.4 RS-232C Signal Specifications

Item	Specification
1. Baud rate	9600 (Fixed)
2. Character length	7 bits
3. Parity	ODD
4. Stop bit	1 bit
5. X parameter	XON

2) CN1 Layout

Table 14.5 Dsub 9-pin Layout

Pin#	Signal name
1	TXD
2	RXD
3	NC
4	NC
5	FGND
6	NC
7	EMG
8	DGND
9	+5V

—- **MEMO** —-

15. SUPPORT FOR EUROPEAN STANDARDS

If this product is used as EN-compliant application, be sure to read this section before use.
Please note that products bearing the “CE” marking conform to following EU directives; while products not bearing the “CE” marking do not.
In addition, refer to Chapter 3. "SYSTEN CONFIGURATION AND WIRING" for precautions on wiring.

1) EU directives / European standards

(1) Electromagnetic compatibility directive

Driver : IEC/EN 61800-3

2) Precautions on Operation in Europe (EU member country)

(1) Test operation
Perform test operation in the final installation state.

(2) 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 circuit-breaker shall be as specified in Table 15.1.shows reference models.

Table 15.1 Circuit Breaker Capacity

Driver Model	Rated Current
AX9000TS-**	10A to 20A
AX9000TH-**	20A

(3) Compatible Actuators

The driver models and their compatible actuators that can be used in combination are as indicated in Table 15.2.

Table 15.2 Driver Type and Compatible Actuator

Driver Model	Compatible Actuator	
AX9000MU-**	AX6000M Series	AX6001M
		AX6003M

(4) Stop function (CN3-17)
The category of the stop function using I/O (CN3-17) provides category 2 stop in accordance with IEC/EN 60204-1. When this function is used, assess if this stop category is adequate for the actual application.
For the stop function using I/O (CN3-17), refer to **Chapter 5. " HOW TO USE I/O."**

Description of term

Category 2: Controlled stop; the mechanical operating device remains supplied with electric power. (Description is given in Section 9.2.2 of IEC/EN 60204-1.)

(5) Operating environment

Table 15.3 Actuator

Condition	Temperature	Humidity	Atmospheric Pressure
During operation	0 to 40°C	20 to 85%RH, no condensation	86kPa to 106kPa
During storage	-10 to 65°C	20 to 90%RH, no condensation	86kPa to 106kPa
During transportation	-10 to 65°C	20 to 90%RH, no condensation	86kPa to 106kPa

Table 15.4 Driver

Condition	Temperature	Humidity	Atmospheric Pressure
During operation	0 to 40°C	20 to 90%RH, no condensation	86kPa to 106kPa
During storage	-10 to 65°C	20 to 90%RH, no condensation	70kPa to 106kPa
During transportation	-10 to 65°C	20 to 90%RH, no condensation	70kPa to 106kPa

⚠ WARNING :

- **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.
- **To prevent electric shock, connect the protective FG conductor to the protective earth terminal.**
  This is also required even residual current circuit breaker (earth leakage breaker) is used.

3) Installation Method

Figs. 15.1 indicate installation methods.

Install the designated filter in the inputs and outputs of the driver and build in a conductive enclosure. Strip the motor and resolver and I/O connector 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 **Figs. 15.2**. Parts used for installation are shown in **Figs. 15.3**. Moreover, implement additional EMC countermeasures (for example, route wire through duct) as necessary.

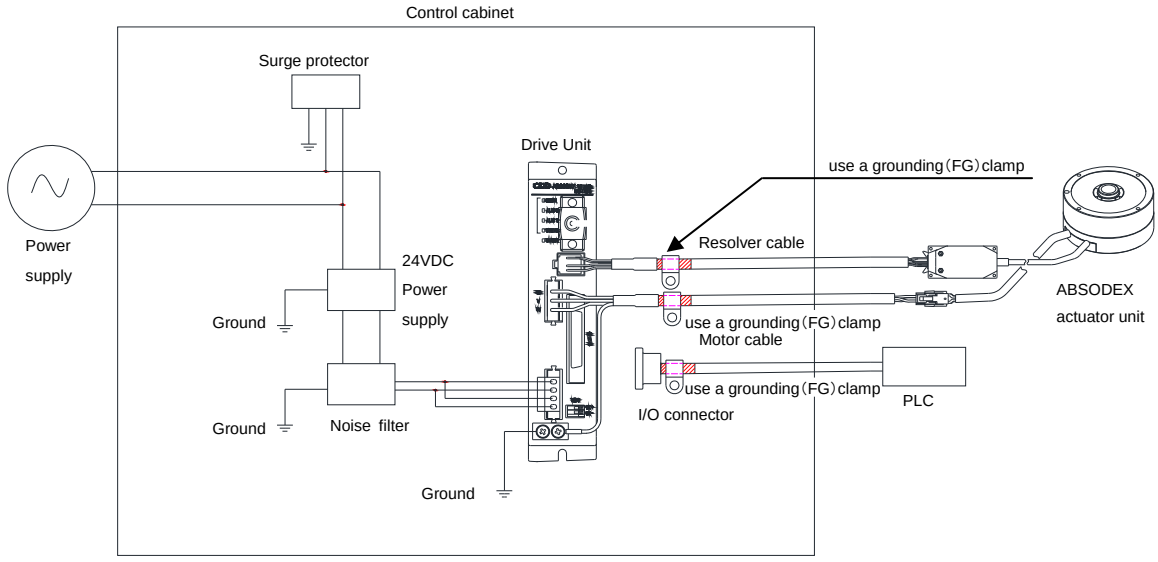

Fig. 15.1 Installation of Driver (in case of 3 phases)

Table 15.4 Parts to be Used

Specification Parts	Model	Manufacturer
Noise filter	NF2015A-OD	SOSHIN ELECTRIC CO., LTD.
Surge protector	RAV-781BXZ-4 RAV-781BWZ-4 RSPD-250-Q4 RSPD-250-U4	OKAYA ELECTRIC INDUSTRIES CO., LTD.

- On the actuator side, strip the motor and resolver cables of the sheath as close to the actuator as possible, and ground the shield. (Refer to Fig. 2.)

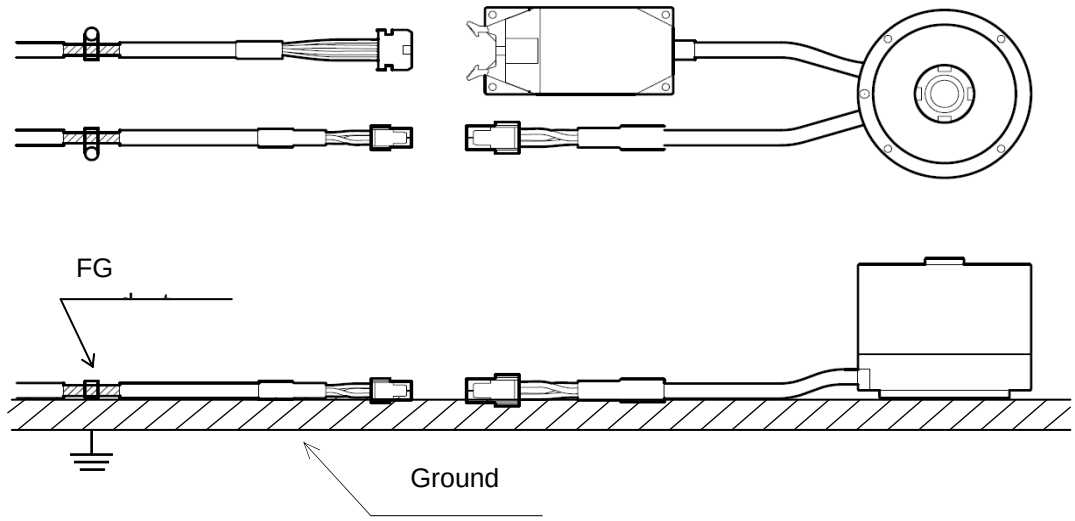

Fig.15.2 Grounding Example on Actuator Side

—- **MEMO** —-

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August 2013	—	—	First edition is issued.
October 2013	Rev. 2	Chapter 2	Drawing is modified.
		Chapter 4	Description is reviewed.
		Chapter 5	Cautionary item on home return is added.
		Chapter 6	Cautionary item on home return is added.