Discontinue

CKD

SMB-14E

INSTRUCTION MANUAL

ABSODEX

AX SERIES

H TYPE

GH 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.

Ver. 16
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.

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:

- DO NOT TOUCH the terminal strip in the front panel of the driver, as it is charged with high voltage, when power is ON. Also do not touch the terminal for about 5 minutes after power is turned off until the internal condenser discharges high voltage.
- TURN OFF POWER when making maintenance inspection or changing switches in the driver with the side cover removed as electrical shock can occur.
- 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.
- Servo off including emergency stop and alarm and brake off with rotational force is 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.
- 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.
- The brake built-in actuator series do not completely clamp the output axis in all cases. Maintenance of the application, in which the output axis may rotate by unbalanced load, or when the machine is stopped for an extended period of time, the built-in brake only is not enough to secure safety. Make sure equipment is maintained balanced or provide a mechanical locking means.
- DO NOT TOUCH the actuator and the driver during operation or just after stopped. There is a risk to get burned. Keep away from actuators and drivers during operation or immediately after operation is stopped. Otherwise you may suffer from burns.
- 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.

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 except for AX8000 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.
- Standard accessory cable is not designed for use under repeated bending. For applications accompanying repetitive bending actions, use optional moving cables.
- The full performance is not achieved in the shipment state. Adjust the gain without fail.
- With a non-compatible type (H type), the actuator and the driver must be marked with the same serial number. With different combination of the actuator and driver, malfunction and failure may be caused.
- To perform a dielectric voltage test to mechanical equipment equipped with ABSODEX, disconnect the main power cables (R, S and T or, for GH type and CE, L1, L2 and L3) 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 connector or connector mount.
- The output axis may move from the holding position even without an external force if the power or servo is turned off or the torque limit setting is decreased from the servo-on state (retention state).

Discontinue

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.)

Durability

10,000,000 cycles of operation for brake, piston packing and valve of ABSODEX equipped with air brake (condition: room temperature, room humidity, rated voltage, and rated air pressure)

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) 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

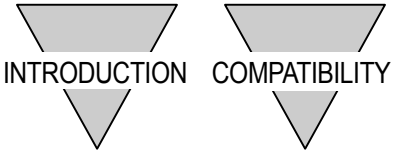
ABSODEX

AX SERIES [H TYPE/GH TYPE]

INSTRUCTION MANUAL No. SMB-14E

Discontinue

—- 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 H type driver and GH type driver. It is inapplicable to other types.
Use a dialog terminal for programming and other purposes. The dialog terminal is common for the H and GH type drivers.
Before starting operation of our product, read through operation precautions and maintenance and inspection items described below to keep the initial performance and operate without failures.

COMPATIBILITY

1) Compatible type [GH]
   With the "GH type," compatibility among the actuator and driver sets is provided.
   Therefore it can be used in combination with actuators, drivers or cables marked with different serial numbers.

   Description for only the "compatible" type is marked with [GH] in this instruction manual.

2) Incompatible type [H]
   With the "H type," compatibility among the actuator and driver sets is not provided.
   Therefore use the actuator, driver and cable of the same serial number in combination.
   If an actuator and a driver having different serial numbers are used or the length or type of the cable is changed, the performance described in specifications is not satisfied. Be careful.

   Description for only the "incompatible type" is marked with [H] in this instruction manual.

3) No mark is given to the description common for the "compatible" and "incompatible" types in this instruction manual.

⚠ CAUTION:

- **The same cable connector is used for the "compatible" and "incompatible" types.**
  If the "compatible type" is connected with the "incompatible type," breakage may be caused.

—- **MEMO** —-

1. UNPACKING

1) Product Model
Check that the delivered product is what you have ordered.

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

	Product Description	Quantity
1	Actuator unit	1
2	Driver unit	1
3	Resolver cable Standard cable 4m (Note 1)	1
4	Actuator cable Standard cable 4m (Note 1)	1
5	Instruction manual	1
6	Accessories	
	Plug MR-50M (HONDA TSUSHIN KOGYO CO., LTD.)	1
	Hood MR-50L (HONDA TSUSHIN KOGYO CO., LTD.)	1
	Fuse Standard model: FGBO (10A, 250V) (FUJI TERMINAL) Models complying with EU directives: 19195 (10A, 250VAC) (WICKMAN)	3 (Note2)
	Mounting kit	2

Note 1: If the option is selected, the cable will be either a standard cable (-D□□) or a moving cable (-DM□□), whose length is 2 to 30m long (H) or 2 to 20m long (GH).

[H] Type of the cable and length can not be changed after system delivery due to required adjustment at the time of assembling process.

[GH] Type of the cable (standard or moving) and length (2 to 20m) can be changed by purchasing individual cables.

Note 2: In case of the optional driver for 100VAC, two fuses are attached.

⚠ CAUTION:

- **The standard cable is not for applications where repetitive bending actions are added. For such applications, use the optional moving cable.**
- **Do not add an excessive tension to cables and connectors.**

3) Consistency of Serial Number
After unpacking, check that the serial number is uniform among the actuator, driver and cable.

The serial number label as shown below is put on the actuator unit and on the front panel of the driver.

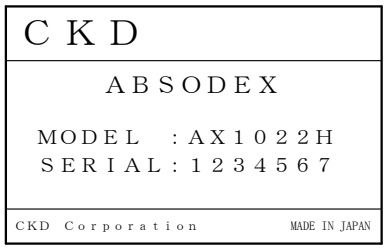


Fig. 1.1 ABSODEX Serial Number Label

[H] CAUTION:

- **The serial number of the actuator unit must be the same as that of the driver.**
  If two or more units of ABSODEX are used, be careful to keep consistency in the combination.
  If the actuator and driver are operated in a different combination, malfunction and failure may be caused.

2. INSTALLATION

1) Actuator Installation Method

(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.

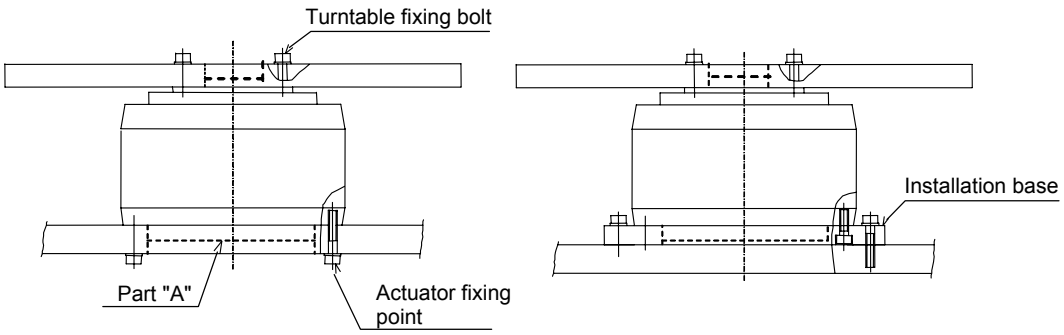


Fig. 2.1 Actuator Installation

⚠ 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.

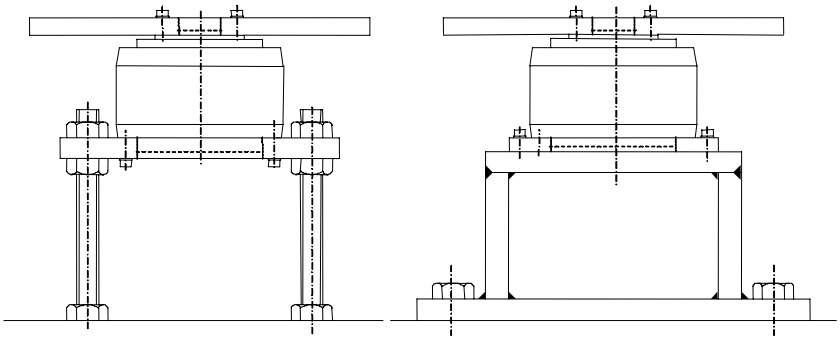
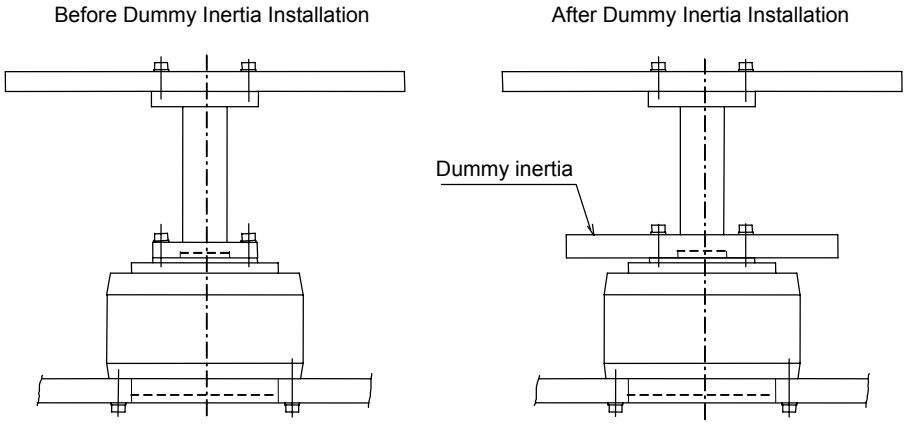


Fig. 2.2 Actuator Installation Method

(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. The diameter of the extension shaft should be Ø60mm or over for models with 45N-m or larger maximum output torques, Ø90mm or over for 70 to 300N-m models, or Ø150mm or over for 500N-m models.



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

Fig. 2.3 Dummy Inertia Installation 1

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.

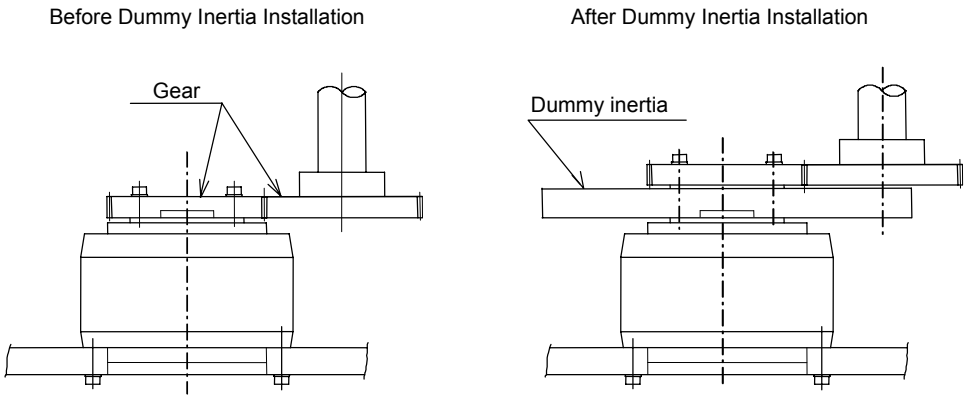


Fig. 2.4 Dummy Inertia Installation 2

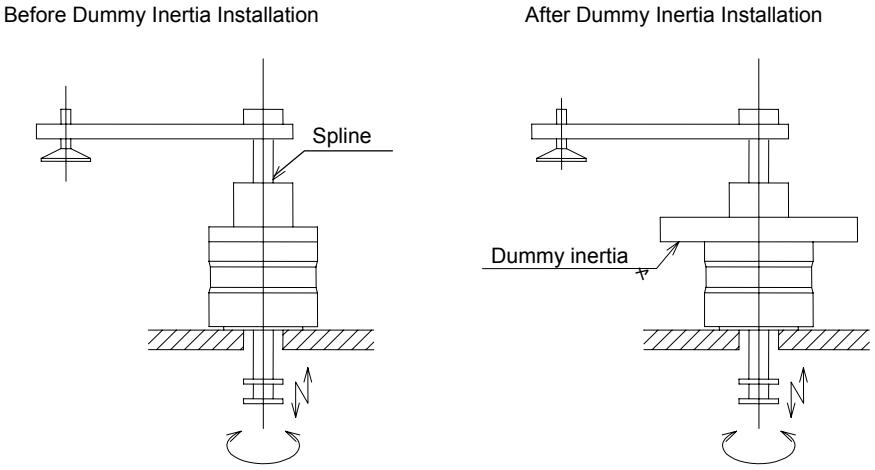


Fig. 2.5 Dummy Inertia Installation 3

- **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.

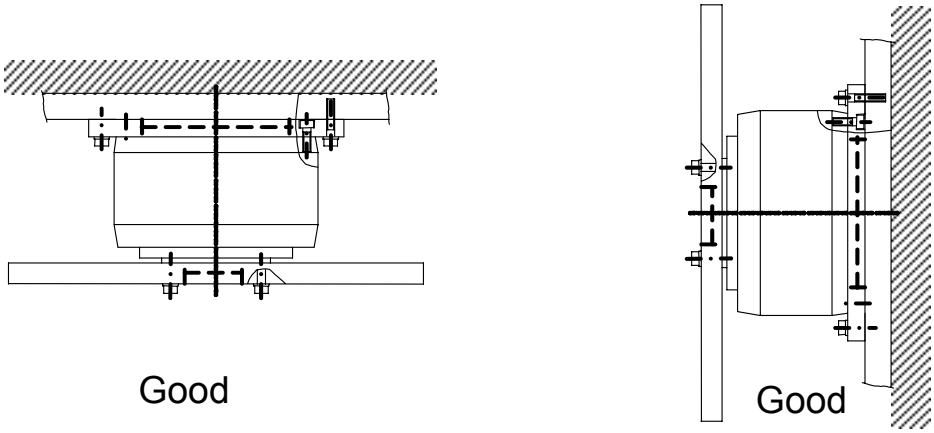


Fig. 2.6 Direction of Installation of Actuator

⚠ WARNING:

- Servo off including emergency stop and alarm, and brake release with rotational force is 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.
- The brake system of the brake built-in actuator does not perfectly hold the output axis in all cases. It will not be safe to hold the load with only the built-in brake in case of maintenance service when the output axis rotates under unbalanced load conditions, or the system is not operated for an extended period of time. Please make the load balanced or provide an external mechanical locking system.

2) Installation Site of Actuator

(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 45°C. For details, refer to **Chapter 14. "ACTUATOR SPECIFICATIONS."**

⚠ CAUTION:

- No waterproof treatment is made to the actuator (except for AX8000 Series) and drivers. Take waterproof measures when using the product in an environment prone to water and oil splashes.

[H]

- Nitric rubber is used in the sealing part of AX8000 Series (waterproof type with a built-in brake). Do not use coolant or the like to cause swelling.

- Chips and dust gathered on the actuator or driver will cause earth leakage and failures. Take measures to block such obstacles.

3) Operating Conditions

(1) 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 14. "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.

4) Driver Installation

(1) 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 **Fig. 2.7**.
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.

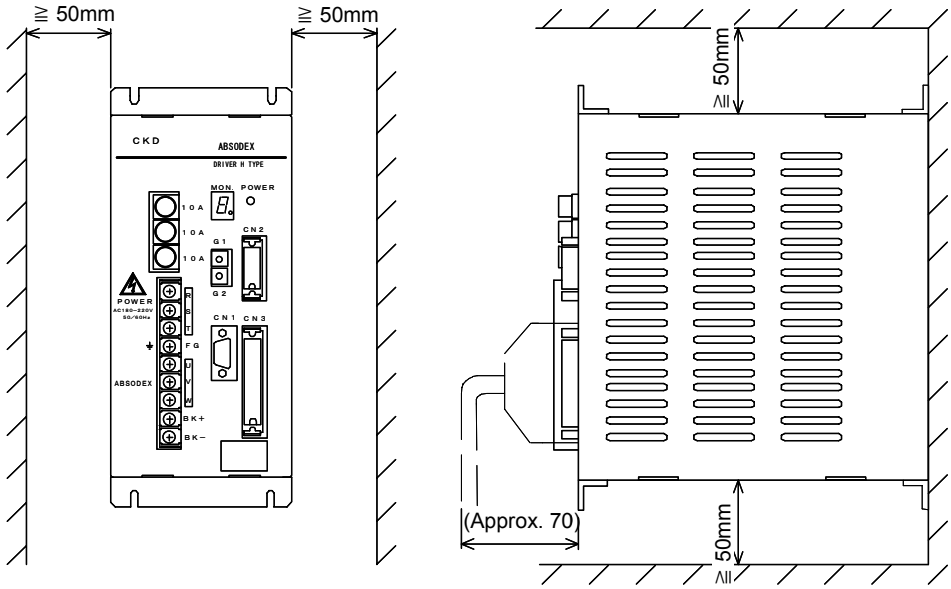


Fig. 2.7 Driver Installation

5) 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.

[H] (2) The length and type of the cable cannot be changed after shipment. Do not change, or deterioration or malfunction will be caused.
If it is inevitable to change the length or type of the cable, return the driver and actuator to our factory. Adjustment is necessary.

[GH] (3) To change the length and type of the cable, order the cable separately.

(4) The standard accessory cable is not for applications accompanying repetitive bending operations. For applications accompanying repetitive bending of the cable, use the optional movable cable. To use a movable cable with AX2000, AX3000 or AX4000 Series, fix the cable sheath near the actuator unit.
For AX2006, AX2012, AX2018 and AX4009, fix the lead wire so that it is not bent repetitively.

⚠ CAUTION:

- Do not remodel the accessory cable. A remodeled cable will cause malfunction and failure.

6) About Brake

[H] (1) About Built-in Pneumatic Brake

① The AX5000 and AX8000 series with built-in brake are provided with air clamp type brake and a built-in air valve. Braking requires supply of clean compressed air to the supply connector at the pressure of 0.5MPa. (Do not supply the pressure exceeding 0.7MPa.) The air valve requires power supply of 24V DC±10% to CN3. The valve control shares power with I/O power.

NC codes (M68 and M69) are used in the NC program to apply or release the brake. For details, refer to **Chapter 3. "SYSTEM CONFIGURATION AND WIRING**."

Fig 2.8 shows the recommended air circuit. (Make sure that no lubrication is introduced using a lubricator.)

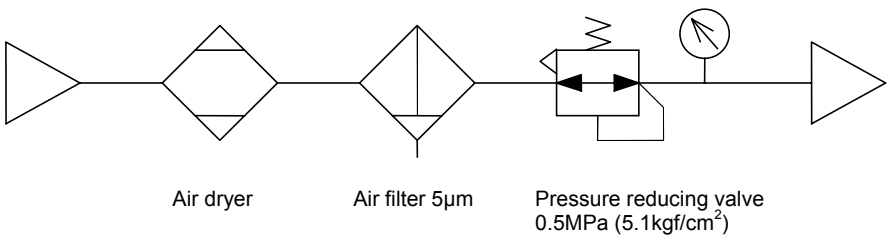


Fig. 2.8 Recommended Air Circuit

② The built-in pneumatic brake clamps the output axis if compressed air is supplied with the power turned off. The retention force of the output axis is the brake torque (air pressure: 0.5MPa) specified in **Tables 14.6 and 14.7**. If a larger torque is added, slippage is caused at the brake, causing the output axis to rotate. As well, if the air pressure drops or supply of compressed air is stopped, a sufficient retention force is not maintained. To fix the output axis securely due to maintenance or the like, do not rely on merely the built-in brake but take other measures to mechanically fix the output axis.

③ The built-in air brake requires a response time between about 100 and 150msec. (Refer to **Tables 14.6 and 14.7**.)
Moving time to arrive at the target position requires 50 to 200 msec for settling in addition to the time in the program. For study of machine timing, these time element should be considered as well.

④ If AX8000 Series is used as a circular table (to machine the workpiece mounted on the output axis), be sure to apply the brake during machining operation. As well, ABSODEX cannot be used for applications where it rotates during workpiece machining operation.

⚠ CAUTION:

- The brake for the brake built-in series is for reinforcing the retaining power while the output axis is stopped. Do not use the brake for braking or stopping the output axis while the actuator is rotating.
- Due to the timing issue of the brake, position deviation may result. Apply the brake after the output axis is completely stopped.

(2) Use of Optional Electromagnetic Brake

① The optional electromagnetic brake of AX4000 Series requires a response time between about 150 and 250msec. (Refer to **Table 14.6**.)
The traveling time requires a settling time between 50 and 200msec for settling at the target position in addition to the programmed traveling time. Take these times into consideration when examining the mechanical timing.
For the recommended circuit with an electromagnetic brake, refer to **Chapter 3. "SYSTEM CONFIGURATION AND WIRING**."

⚠ CAUTION:

- The optional electromagnetic brake is to increase the retention force of the stopped output axis. Do not use it to decelerate or stop a rotating output axis.
- To pass a shaft through the hollow hole of the model equipped with an electromagnetic brake, use a non-magnetic material (such as SUS303).
If a magnetic material (such as S45C) is used, the shaft will be magnetized, causing stuck iron powder on the equipment or giving magnetic effects on peripheral devices.
- Note that the magnetic force of the electromagnetic brake may cause stuck iron powder or effects on measuring instruments, sensors or other devices.
- Due to the timing issue of the brake, position deviation may result. Apply the brake after the output axis is stopped completely.

(3) 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 NC code ("M68": Brake application, "M69": Brake release) in the NC program in the stopped state (execute "M68" in the stopped state, or execute "M69" before start of a travel). These NC codes turn on or off the integral loop of the servo system besides brake control, and they avoid overloads of the actuator. 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

1) System Configuration

BASIC SETTING ITEMS

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

BASIC DRIVE METHODS

④ A program to be executed is selected at the sequencer (PLC).
⑤ Start signal is input at the sequencer (PLC).

(1) System Configuration Example (in case of 3-phase 200VAC)

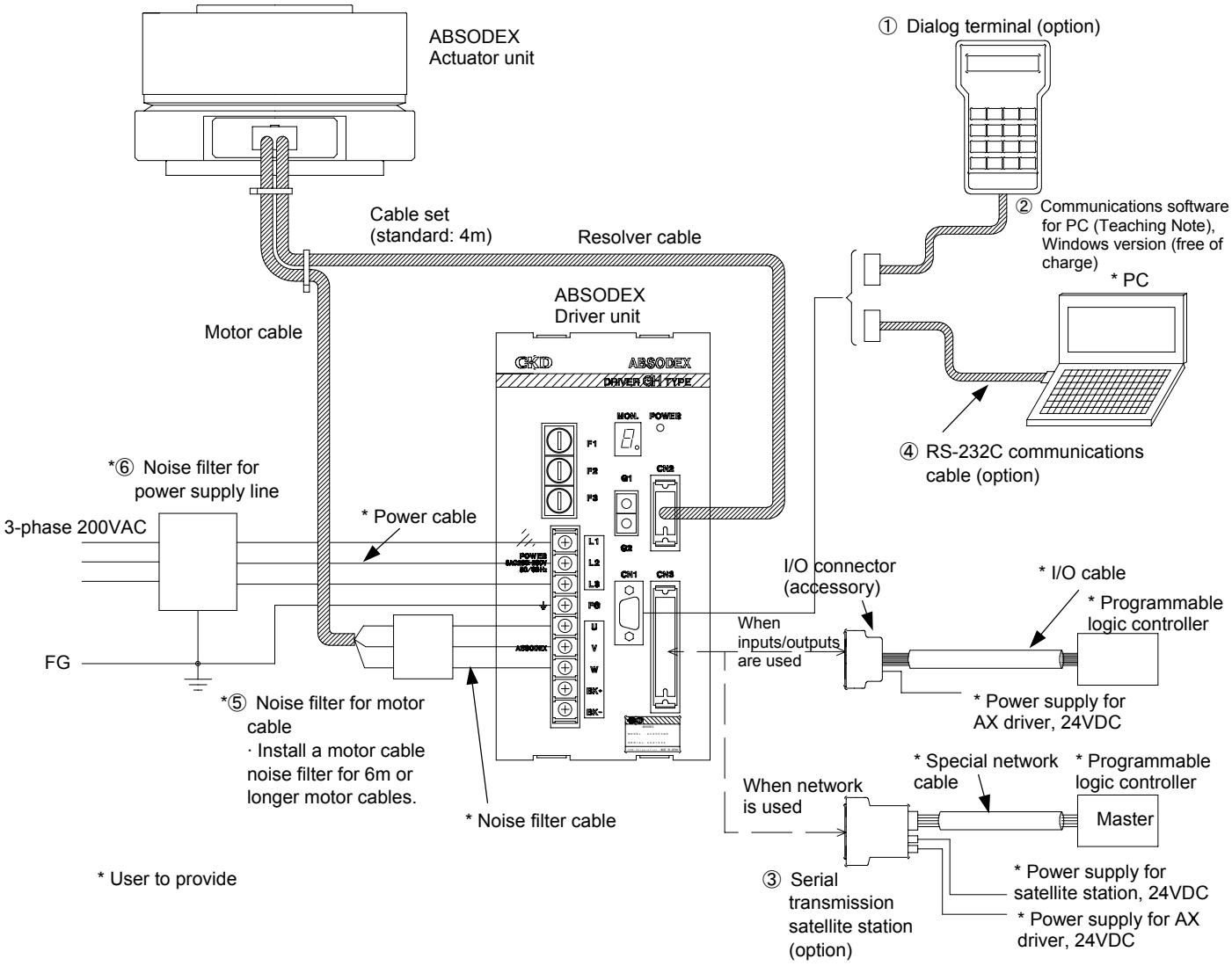


Fig. 3.1 System Configuration

[SMB-14E]

- Do not connect the dialog terminal unless for programming, parameter entry or test operation.

- For 6m or a longer cable length, install a motor cable noise filter in the U, V and W cables of the motor. Connect the IN terminal of the noise filter with the driver and install as close to the driver as possible. (Refer to Fig. 3.1.)
  The motor cable noise filter is unnecessary for a 4m cable.

⚠ CAUTION:

- **Do not use the power line noise filter as a motor cable noise filter.**

- **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.**

[GH]

- **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."

(2) List of Peripheral Devices

① Dialog Terminal

Table 3.1 Dialog Terminal

Dialog Terminal	Model	Manufacturer
Standard (Japanese language version)	AX0170H	CKD Corporation
English language version	AX0170H-E	CKD Corporation

② Communications Software for PC

Part name: Teaching Note Windows Version

(For Windows 95, 98, NT 3.51, 4.0, ME, 2000 and XP)

Note: The software may not run in some environments.

Manufacturer: CKD Corporation

③ Serial Transmission Slave Unit

Table 3.2 Serial Transmission Slave Unit

Applicable Network	Model	Manufacturer
CC-LINK	AX-OPX-7G	CKD Corporation
DeviceNet	AX-OPX-7D	CKD Corporation

④ RS-232C Communications Cable

Table 3.3 Communications Cable

	Model	Manufacturer
D-sub 25-pin (2m)	AX-RS232C-25P	CKD Corporation
D-sub 9-pin (2m)	AX-RS232C-9P	CKD Corporation
Half pitch 14-pin (2m)	AX-RS232C-14P	CKD Corporation

⑤ Recommended Motor Cable Noise Filter

Table 3.4 Noise filter for motor cable

Actuator	Model	Manufacturer	Remarks
Models with 150N-m or larger max. torques (Note 1) AX□150, AX□210 AX□300, AX□500	LF-320KA	NEC TOKIN CORPORATION	3-phase, 20A
All models other than above	LF-310KA	NEC TOKIN CORPORATION	3-phase, 10A

Note 1: The noise filter is applicable to models with smaller maximum torques.

CAUTION:
- **Do not use the power supply line noise filter as a motor cable noise filter.**

⑥ Recommended Power Supply Line Noise Filter

Table 3.5 Power Supply Line Noise Filter

Source Voltage	Actuator	Model	Manufacturer	Remarks
200VAC 230VAC	Models with 150N-m or larger max. torques (Note 2) (Note 3) AX□150, AX□210 AX□300, AX□500	LF-315	NEC TOKIN Corporation	3-phase, 15A
	All models other than above	LF-310	NEC TOKIN Corporation	3-phase, 10A
100VAC	All models (100VAC models)	LF-210	NEC TOKIN Corporation	Single-phase, 10A
		NF2015A-OD	SOSHIN ELECTRIC CO., LTD.	Single-phase, 15A

Note 2: The noise filter is applicable to models with smaller maximum torques.

Note 3: To insert a noise filter in the power supply line, use one having 10A or larger current capacities (15A or larger current capacities with 150N-m or larger maximum torques).

2) Wiring

(1) Driver Panel Description

A terminal strip and connectors, etc. are located on the front panel of the driver. Figs. 3.2, 3.3 and 3.4 show the front panel configuration.

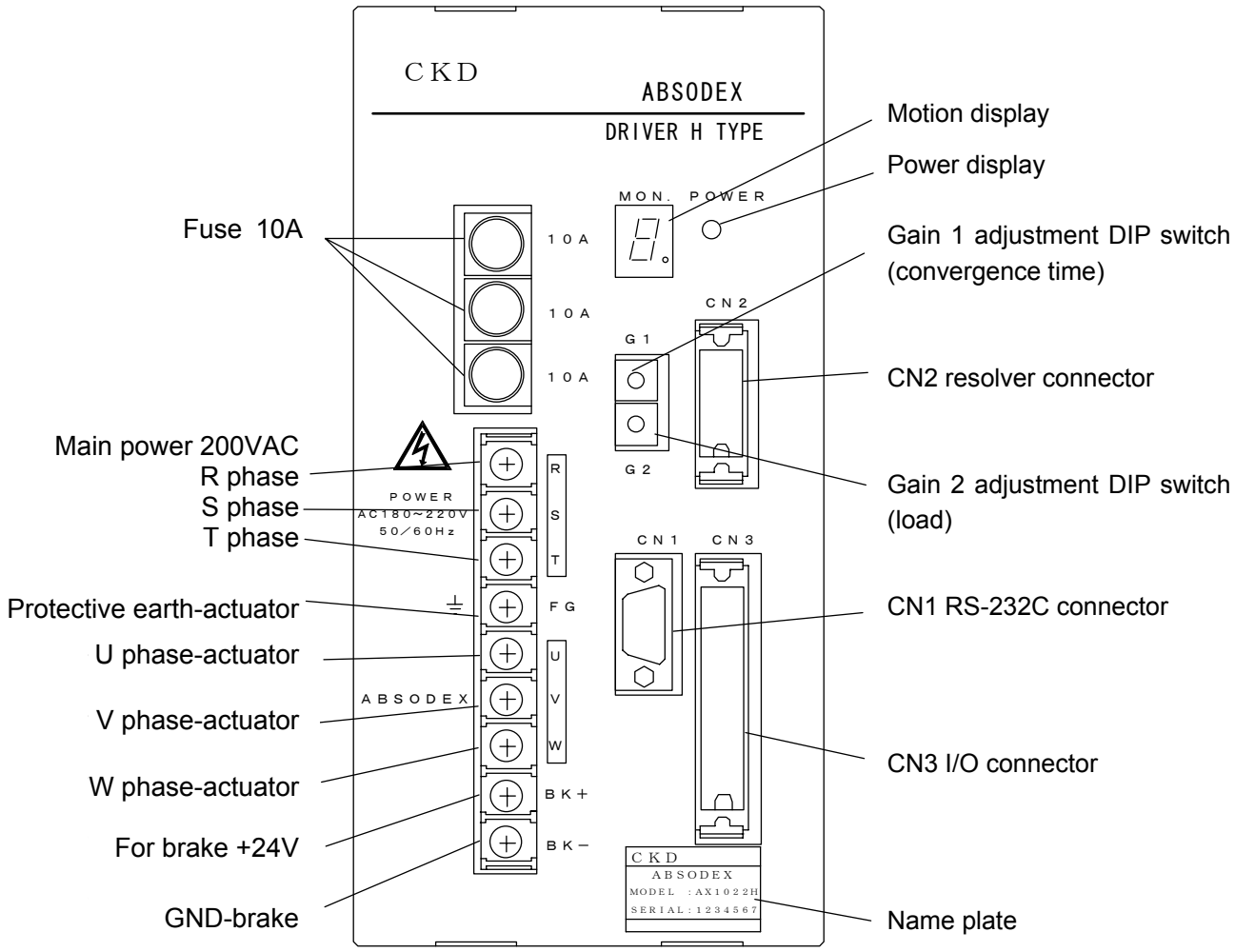


Fig. 3.2 H Type Driver Panel
In case of 200VAC specification (standard)

Note: Power lamp (POWER) will light by internal control power (5V), and is not designated for detecting main power.

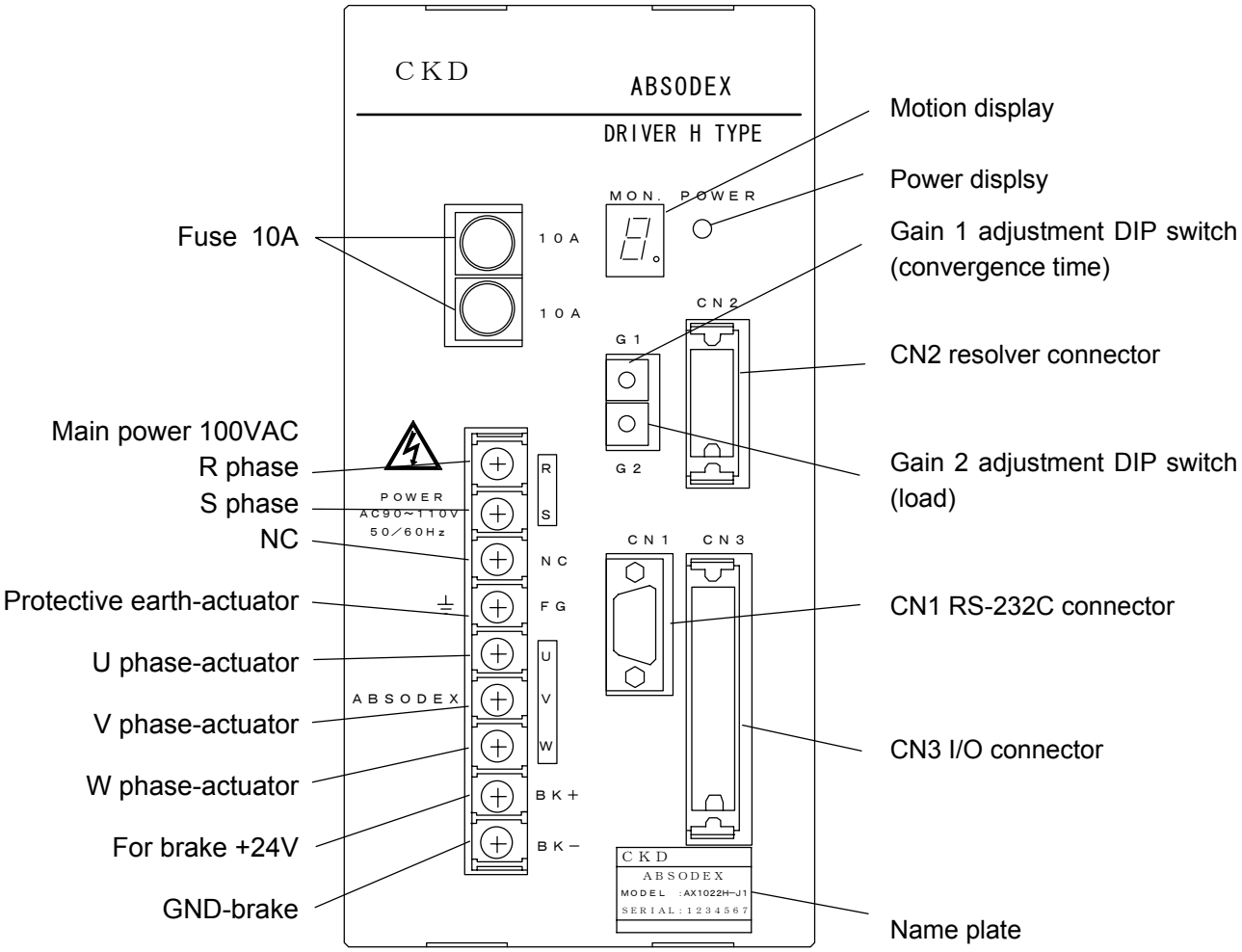


Fig. 3.3 H Type Driver Panel
In case of 100VAC specification (optional)

Note: Power lamp (POWER) will light by internal control power (5V), and is not designated for detecting main power.

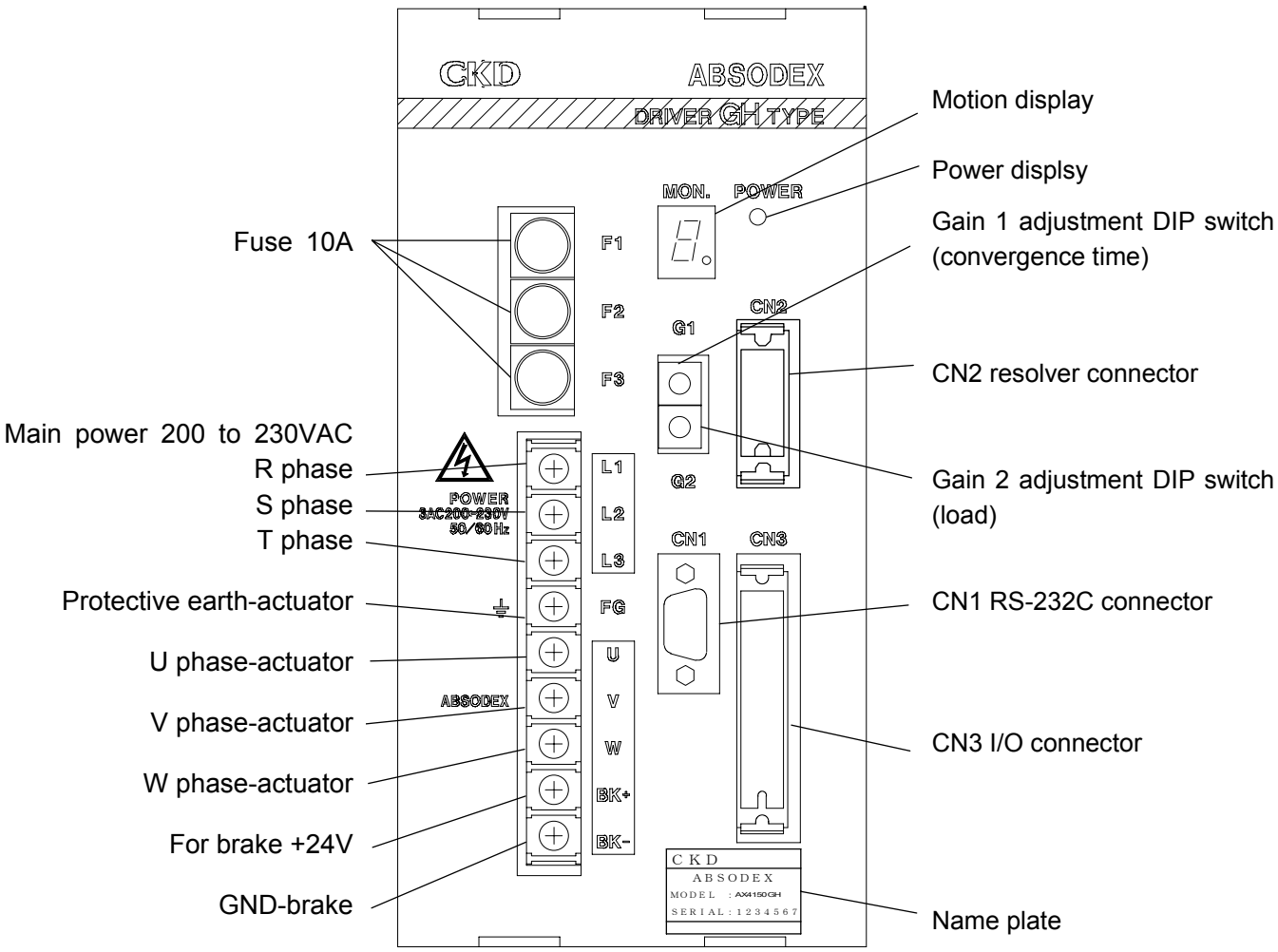


Fig. 3.4 GH Type Driver Panel
In case of 200 to 230VAC specification (standard)

Note: Power lamp (POWER) will light by internal control power (5V), and is not designated for detecting main power.

(2) Connection to Terminal Strip

① R, S, T, FG (L1, L2, L3, FG for GH type)

- In case of 200VAC, 230VAC driver
  To use with 3-phase power supply, connect the 50/60Hz power cables to the R, S, T or L1, L2 and L3 terminals. (Refer to Fig. 3.1.)
  To use with single-phase power supply, connect the 50/60Hz power cables to the R and S terminals.

[H] • In case of 100VAC driver
100VAC should be wired to R, and S terminals. The voltages shall be 50/60 Hz. NC terminal should be left unconnected.

Note: The single-phase, 200V power supply is to be used only for the models with the maximum torque of less than 50N·m.

Note: The power cable must be of heat resistant vinyl cladding, and of the conductor cross section area of not less than 2mm^2.

②  (Protective earth)
Protective earth of the motor cable and protective earth of the main power must be wired to this terminal. (Refer to Fig. 3.1.)

③ U, V, W, BK+, BK-
These terminals must be wired to the actuator using motor cable supplied as accessories. (Refer to Fig. 3.1.)

Note: To use an electromagnetic brake, refer to Section 3. 2). (4) "Wiring the Electromagnetic Brake."

DANGER:

- **The R, S, T, L1, L2, L3, NC, U, V and W terminals are charged with high voltages. Keep away from the terminals when the power is on. In addition, keep them away for five minutes after the power is shut down, because of high-voltage charges accumulated in internal capacitors.**

CAUTION:

- **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.**
- **Connect to the specified commercial power source. Connecting PWM output type inverter may cause the driver to fail.**
- **Connecting to the higher voltage than specified may cause the driver to fail.**

Note: BK+ and BK- terminals are for 24V DC output with output current of 200mA MAX. For using brake system, external 24V DC power supply is required. Nos. 1 & 2, and 3 & 4 pins of CN3 of I/O port should be connected to +24V DC±10%, and GND. This power source is shared by I/O.

Note: The air valve for braking for the brake built-in actuator series consumes 75mA. When the valve is de-energized, air pressure will clamp the brake, and when the valve is energized, the brake is released.

④ Power Supply Capacity

Table 3.6 Power Supply Capacity

Actuator Model	Power Supply Capacity (kVA)
AX2006	0.8
AX4009	1
AX2012	
AX2021	
AX1022, AX3022 AX4022, AX5022	
AX2042	1.5
AX1045, AX3045 AX4045, AX5045, AX8045	
AX8070	2
AX1075, AX3075 AX4075, AX5075	
AX1150, AX4150 AX4150G, AX5150	3
AX1210, AX5210	4
AX4300, AX4300G	
AX4500, AX4500G	

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

(3) Connection of Connector

① CN1 (RS-232C)

This port is a serial port, which interfaces with Dialog terminal, and a personal computer. For RS-232C communication method, refer to **12. COMMUNICATION FUNCTIONS**.

Cable side Connector

Maker: Omron

Connector Model: XM2A-0901 (plug), XM2S-0911 (hood)

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 sequencer (PLC) for I/O signals.

Cable side Connector

Maker: HONDA TSUSHIN KOGYO CO., LTD.

Connector Model: MR-50M (plug), MR-50L (hood)

This connector is supplied as accessory.

⚠ CAUTION:

- **Route the CN1 and CN3 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.

(4) Wiring the Electromagnetic Brake

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

(Note) Wiring the Electromagnetic Brake

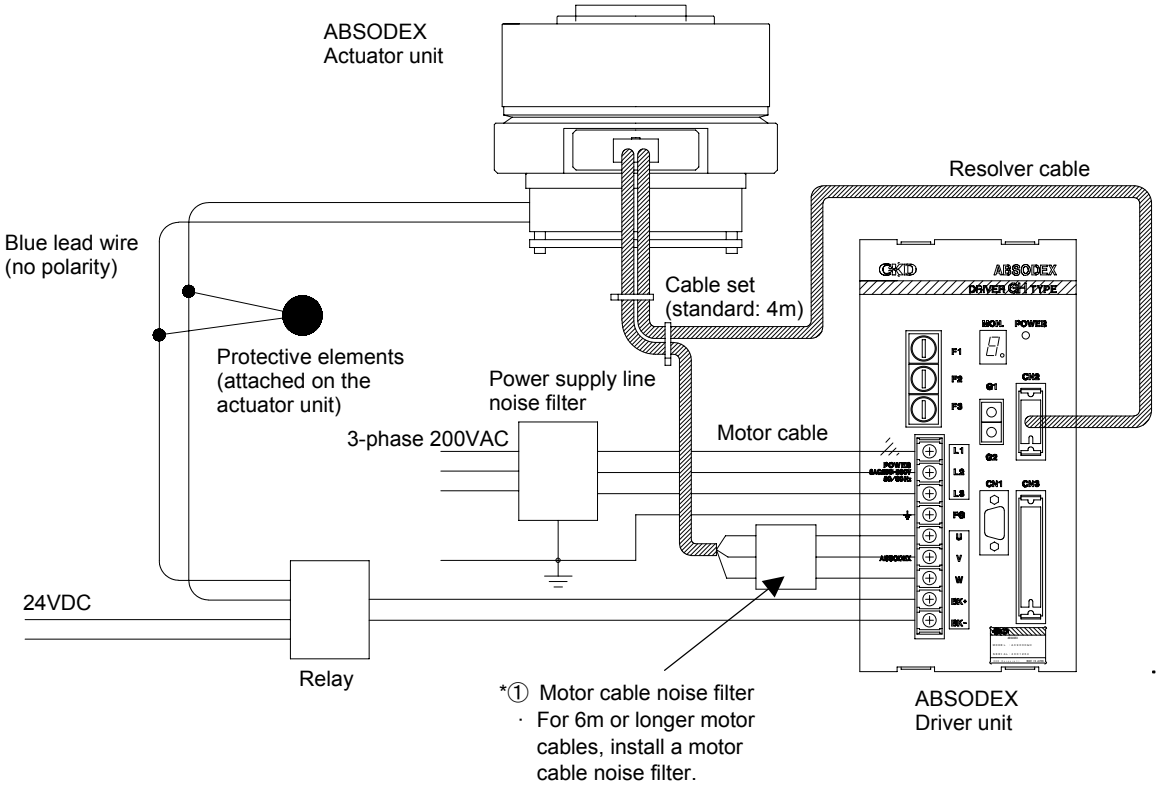


Fig. 3.5 Wiring the Electromagnetic Brake

To use an electromagnetic brake, supply 24VDC to the external input terminals (pin 1, 2-3, 4) of the I/O connector (CN3).

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

② Recommended Circuit for Electromagnetic Brake

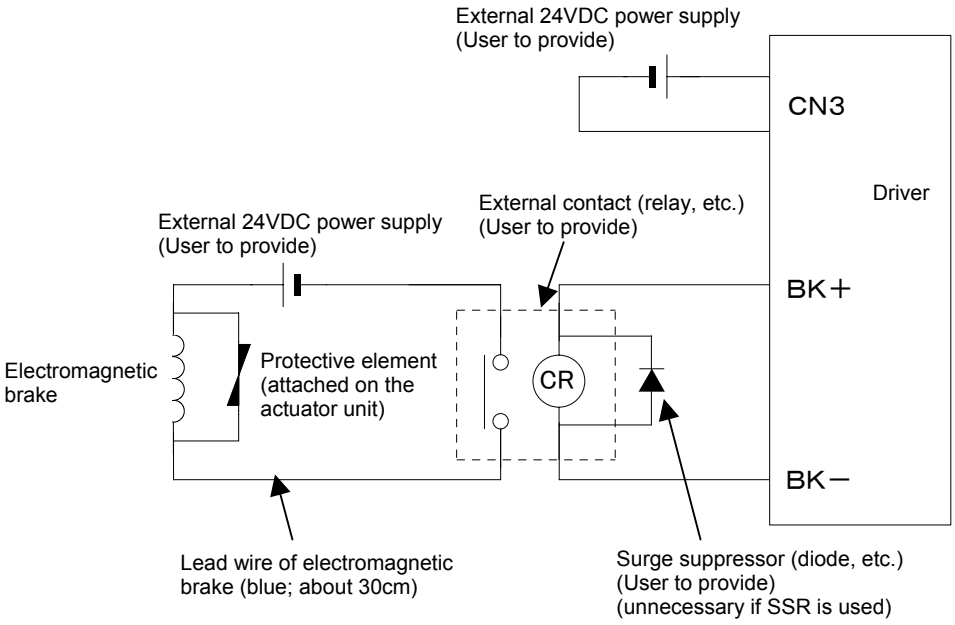


Fig. 3.6 Recommended Circuit for Electromagnetic Brake

CAUTION:

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

- **The BK+ and BK- terminals are for 24V outputs (output current: max. 200mA) for the brake control signal. To use an electromagnetic brake, an external 24VDC power supply is necessary. Connect +24V ±10% and GND to pins 1 and 2 or 3 and 4 of the I/O connector (CN3). This power supply is also used as an I/O power supply.**

- **When an inductive load such as a relay mentioned above is connected as an external contact, the rated coil voltage must be 24VDC and the rated current must be within 100mA, and take measures against surge.**

- **Connect wiring of the electromagnetic brake so that the brake is released when the voltage across BK+ and BK- is 24V and the brake is applied when the voltage is 0V without relations to negative or positive actuation.**

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

- **Use a relay having a contact capacity 10 times or larger than the rated current. If the contact capacity is smaller, use a 4-pole relay and connect as shown in Fig. 3.7. The contact life of the relay will be extended.**

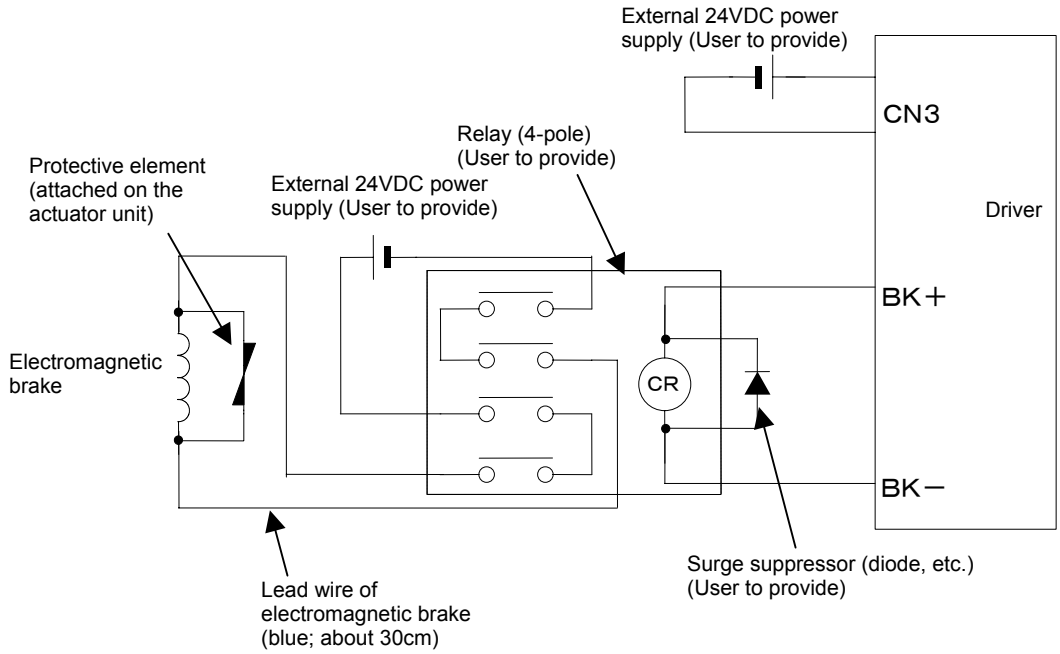


Fig. 3.7 Recommended Circuit 2 for Electromagnetic Brake

CAUTION:

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

③ How to Activate the Electromagnetic Brake

Execute an NC code "M68" or "M69" code in the NC program or supply a brake release input (CN3-18) to control the action of the electromagnetic brake with the 24VDC voltage supplied to the BK+ and BK- terminals of the ABSODEX driver.

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

b. Controlling with brake release input (CN3-18)
Supply a brake release input in a state with the applied brake to connect across BK+ and BK- (to release the brake).

- **In the travel after the brake is released, enter a larger value in parameter 27 (delay after brake output) if the response time after the electromagnetic brake is released is too long.**
For details, refer to Section 7. "PARAMETER SETTING."

⚠ CAUTION:

- **To pass a shaft through the hollow hole of the model equipped with an electromagnetic brake, use a non-magnetic material (such as SUS303).**
If a magnetic material (such as S45C) is used, the shaft will be magnetized, causing stuck iron powder on the equipment or giving magnetic effects on peripheral devices.

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

- **Due to the timing issue of the brake, position deviation may result. Apply the brake after the output axis is stopped completely.**

(5) 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.

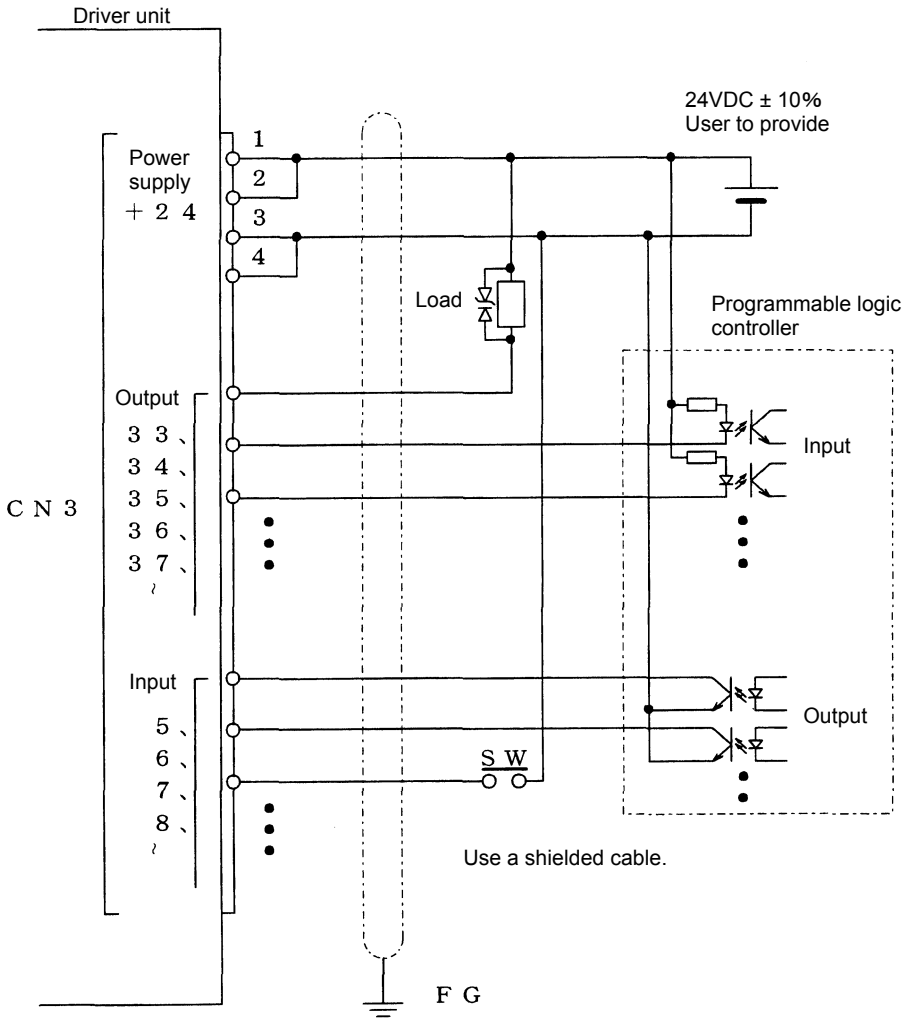


Fig. 3.8 Connection Example

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> Manufacturer: Ishizuka Electronics Corporation, model ZD018

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. 3.9 and 3.10) 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. 3.9 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. The resistor is unnecessary in case of +5V.

Input current i = 7 to 15mA

Limiting resistor R1 (example)

If Vcc is +12V, R1 = 680Ω

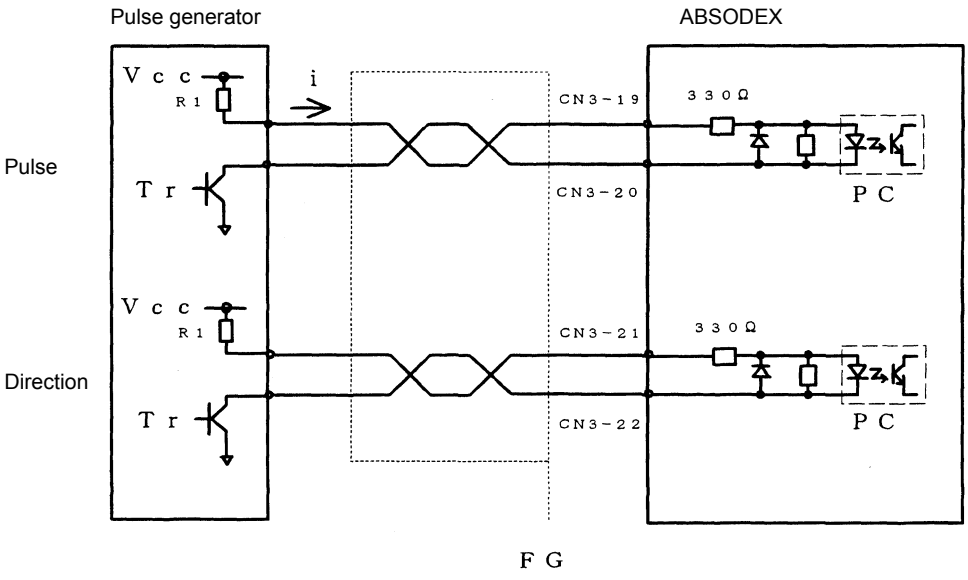


Fig. 3.9 Connection Example 1

<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 400Kpps.

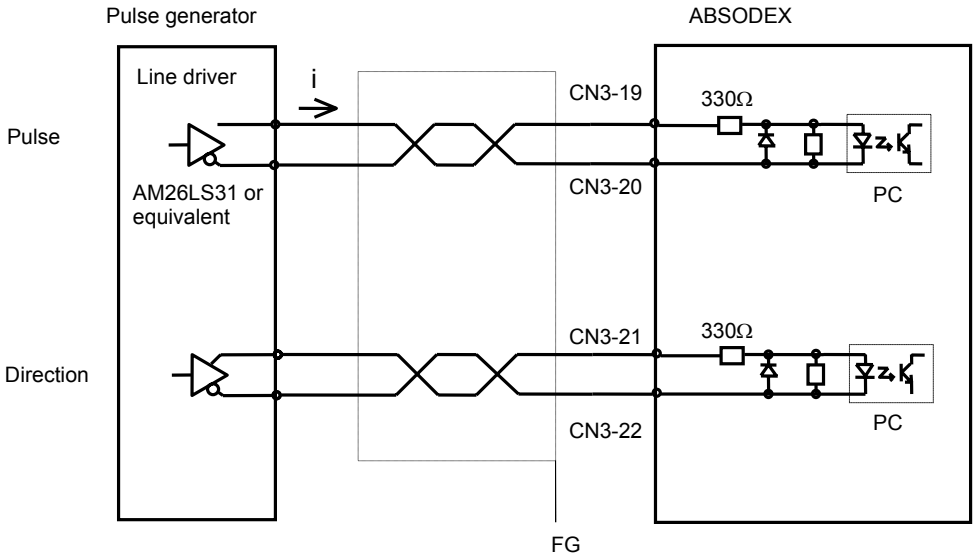


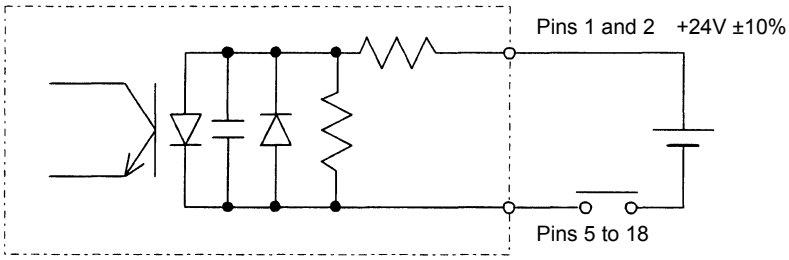
Fig. 3.10 Connection Example 2

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.**

(6) CN3 (I/O signal) Interface Specification

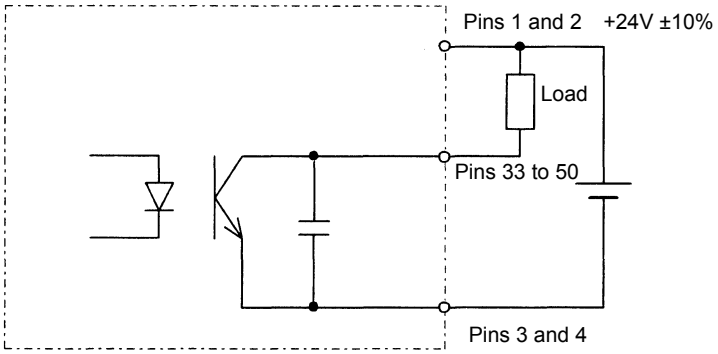
① General I/O Input Specification



Rated voltage 24V ±10%, rated current 7.5mA
Time constant About 5msec

Fig. 3.11 Input Circuit

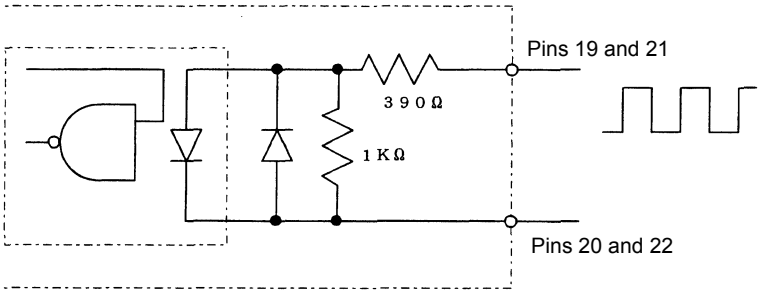
② General I/O Output Specification



Rated voltage 24V ±10%, rated maximum current 150mA

Fig. 3.12 Output Circuit

③ Pulse String Input Specification



Rated voltage 5V ±10%
Fig. 3.13 Pulse String Input Circuit

Note: The logic with the active photocoupler of the pulse string input circuit shown in Fig. 3.13 is "TRUE" while the logic with the inactive photocoupler is "FALSE."
For the pulse specification, refer to Section 5. "HOW TO USE I/O."

4. TEST OPERATION

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

* The following description of test operation is related to equal segment. The ABSODEX rotates in the same direction. Take care to avoid entanglement of cables.

STEP1

Installation and connection check	Check if the ABSODEX is installed and connected correctly.

↓

STEP2

Gain adjustment and creation of test operation program	Use the dialog terminal to build a program easily.

↓

STEP3

Gain adjustment	Adjust to the gain matching the load.

↓

STEP4

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.)

↓

End	Supply a start input from the dialog terminal to start operation.

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.

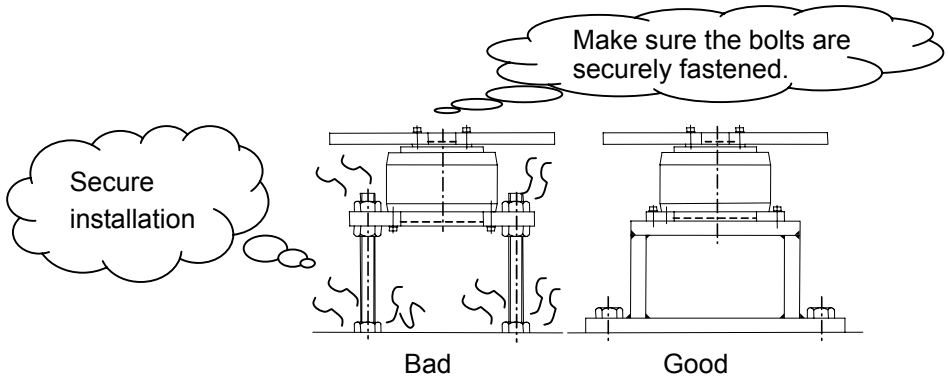


Fig. 4.1

* For details, refer to **Chapter 2. "INSTALLATION."**

Next, connect all of the actuator, driver and power supply as well as peripheral devices.

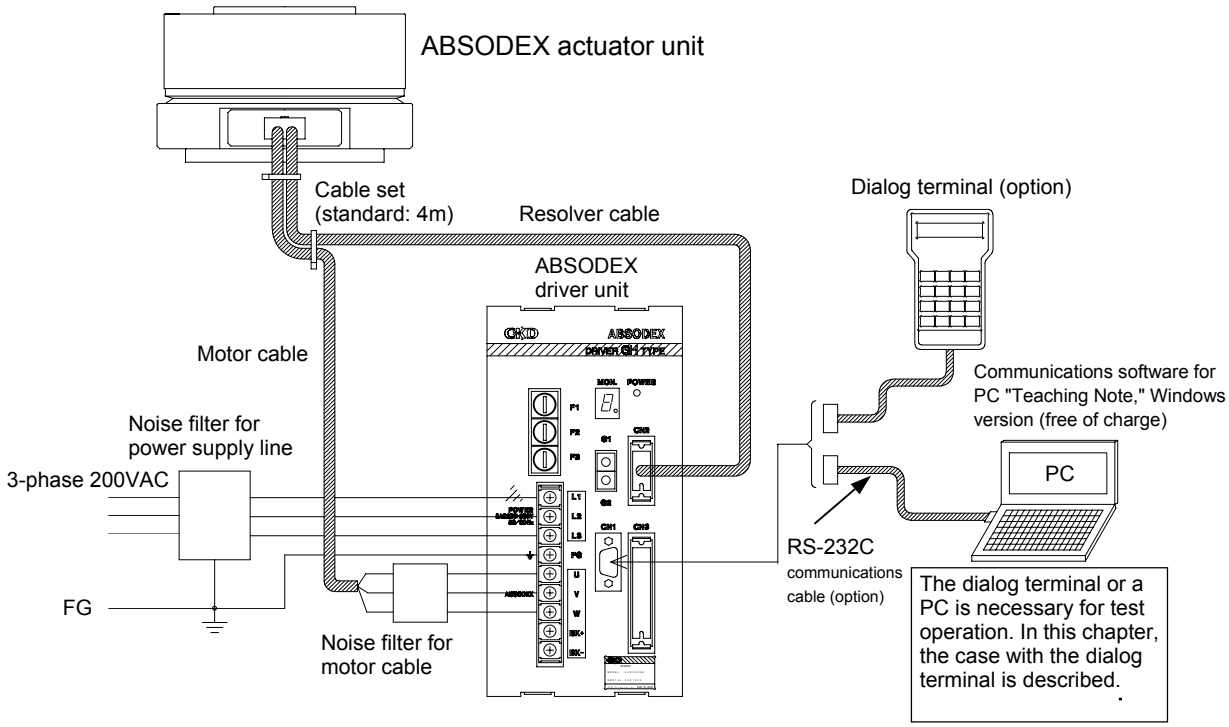


Fig. 4.2 Connection Example (in case with 3-phase 200VAC power supply)

* For details, refer to **Chapter 3. "SYSTEM CONFIGURATION AND WIRING."**

Step 2. Gain adjustment and creation of test operation program

Gain adjustment is necessary for the operation of ABSODEX. Gain adjustment is made for each load so that ABSODEX operates in the best state.
The method for creating gain adjustment and test operation programs with the dialog terminal is described here.

Use the dialog terminal to create a four-division program.
This program indexes clockwise 90° in a moving time of 1sec each time a start input is supplied.

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) Operate the dialog terminal.

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

① Name of key

- [↵]: Enter key
  Use the enter key to determine the menu or command or to execute a process.

- [SP ;]: Space/Semi-colon key
  The key functions as a space in the MDI motion mode or terminal mode or it functions as a semi-colon in the editing mode of the NC unit. In other cases, the key is invalid.

- [MODE DEL]: Reset/Mode key
  The character at the cursor is deleted. If there is no character at the cursor, the character immediately before the cursor is deleted. (The space is handled as a character.)

  While holding down the [SHIFT] key, press this key to use it as a mode key.
  Use the mode key to cancel a process in each mode.
  Each time this key is pressed, the previous menu screen is displayed.

- [↑ ←] [↓ →]: Cursor move key (left/right arrow), scroll key (up/down arrow)
  Use the key to move the cursor in the direction of the arrow.

  While holding down the [SHIFT] key, press this key to scroll the screen.
  A block of data scrolls in the direction of the arrow.

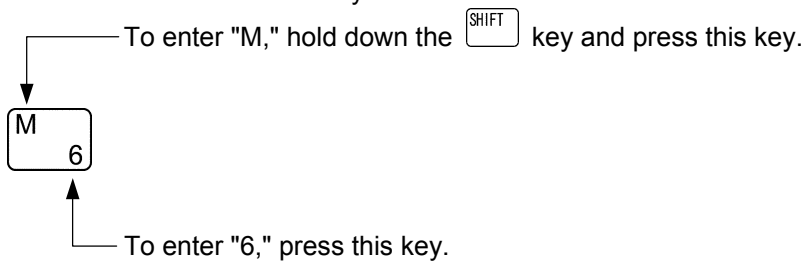
- [SHIFT]: Shift key
  Use the SHIFT key to enter an alphabet, [↑ ←] (up arrow), [↓ →] (down arrow), [MODE DEL] (mode), [− 0] (-), or [• SP ;] (a decimal point). While holding down the [SHIFT] key, press the corresponding key.

  Hereinafter, the entering method with the [SHIFT] key held down is specified in the following way: [SHIFT] [M 6] (entering 'M').

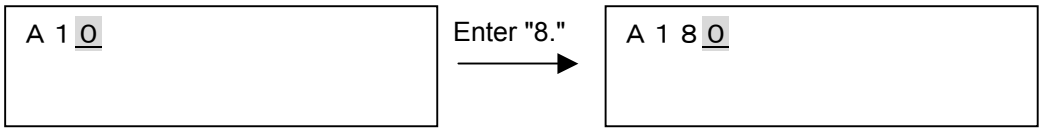
- [EMERGENCY STOP]: Emergency stop key

  Use this key to stop program execution and stop the actuator immediately. The servo is turned off immediately in the auto tuning mode.
  (Alarm E is caused.)

② How to enter a character or symbol



Note: Characters and symbols are entered in the insert mode; the character/symbol is inserted immediately before the cursor position.



Note:
If there is an error in key entry, press MODE DEL to delete and enter again.
If a wrong code is transmitted to cause alarm 7, enter the correct code and send it again.

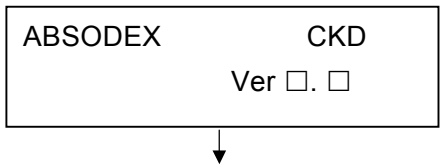
Note:
To exit from the terminal mode and motion mode and return to mode selection, enter SHIFT MODE DEL and SHIFT MODE DEL.

Note:
If a wrong code is transmitted and "*" is received to cause alarm 7, reset from the alarm (send SHIFT S 3, A 7, and ↵ ("S7") to display "0") and enter the correct code and send it again.

For details, refer to the dialog terminal instruction manual.

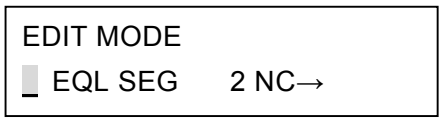
3) Enter the program at the dialog terminal.

① Turn the ABSODEX on.
Following the opening screen, the mode selection screen appears.



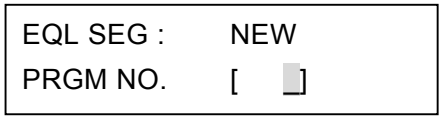
② Select the edit mode.
Press the ↵ key.

③ From the edit mode menu, select "1 EQL SEG."
Press the ↵ key.

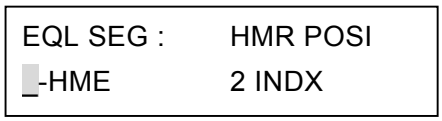


④ Program numbers stored in the ABSODEX driver are displayed. If no program has been stored, the screen looks like this. After confirming, press the ↵ key.

⑤ Enter the desired program number to be created.
Enter "1" for the present purpose and press the ↵ key.

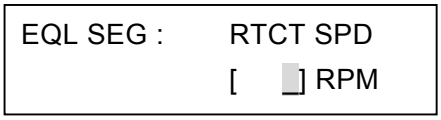


⑥ Select the pre-launch home position.
Select the full revolution home position for the present purpose.
Press the ↵ key.
* The hyphen "-" after the number indicates the currently selected option.



⑦ Select the home positioning direction.
Select clockwise for the present purpose.
Press the ↵ key.

⑧ Enter the home positioning speed.
Press the ↵ key.
(If the ↵ key is pressed without entering a number, the action follows the setting of **parameter 5 "home positioning speed"**). The default value is 2rpm.)



⑨ Enter the number of segments.

Enter "4" for the present purpose.

Enter "4" and press the ↵ key.

```
EQL SEG :    SEG NO.
             [  4]
```

⑩ Enter the movement time for a single indexing cycle.

Enter "1sec" for the present purpose.

Enter "1" and press the ↵ key.

```
EQL SEG :    MOV'G
             [  1] SEC
```

⑪ Select the direction of rotation of the actuator.

Select clockwise for the present purpose.

Enter "1" and press the ↵ key.

```
EQL SEG :    ROT'N DIR
1 CW         2-CCW
```

⑫ Select the stopping process after completion of positioning.

Select indexing at each start for the present purpose.

Press the ↵ key.

```
EQL SEG :    STOP
1-STNBY      2 DWEL
```

⑬ Select whether the brake is used or not.

The brake is not used for the present purpose.

Select "2 UNUSED" and press the ↵ key.

```
EQL SEG :    BRK
1-USED       2 UNUSED
```

⑭ Select the M code process.

The M code is not used for the present purpose.

Enter "3" and press the ↵ key.

```
EQL SEG :    M CODE
1～3         [3] M CODE
```

⑮ Select whether or not to enter the parameter setting.

Parameter setting is not entered for the present purpose.

Press the ↵ key.

```
EQL SEG :    PARA SET
  ?          [Y / N]
```

⑯ The editing process is finished. Go to "5 STORE" in the editing mode.

Press the ↵ key.

```
EDIT MODE
←4 CNT       5 STORE→
```

⑰ The following screen is displayed. Press the ↵ key.

```
EQL SEG                01
STORE?              [Y / N]
```

⑱ The following screen is displayed. Press the ↵ key.

EQL SEG : PRGM TO EXE? [_ / N]

⑲ The following message is displayed and the motion mode screen is displayed.

(End of preparation of test operation)
Enter "1" to start home positioning. (If the current position is the home position, no motion occurs.)
Enter "1" again to start a four-segment cycle. Each time "1" is entered, the actuator moves 90°.

PRGM NO. [1] SELECTED

1 START	2 STOP
3 NO.	4 RESET

While operating, perform gain adjustment described in Step 3.

* If an alarm is caused, press "4" (RESET).

Note: The shipment gain setting is for operation with almost no load. If the moment of inertia of the load is large and the gain setting is too small, the actuator may swing or an alarm is caused to coast to stop due to inertial force when a start input is supplied. If the rigidity of the equipment is small, strong vibration may be caused. Check for safety before operating.

⚠ 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 safety is assured to operate the actuator when operating it from the place unable to confirm the motion.**

(Reference)

To start a stored program, select the program number.

1) Select "3 NO." in the motion mode. (Enter "3.")

1 START	2 STOP
3 NO.	4 RESET

2) Enter the desired program number and press the ↵ key.

NO. SELECT
PRGM NO. [ ]

3) The following message is displayed and the menu is displayed again.

(The example shows the case where program number 1 has been selected.)

PRGM NO. [1]
SELECTED

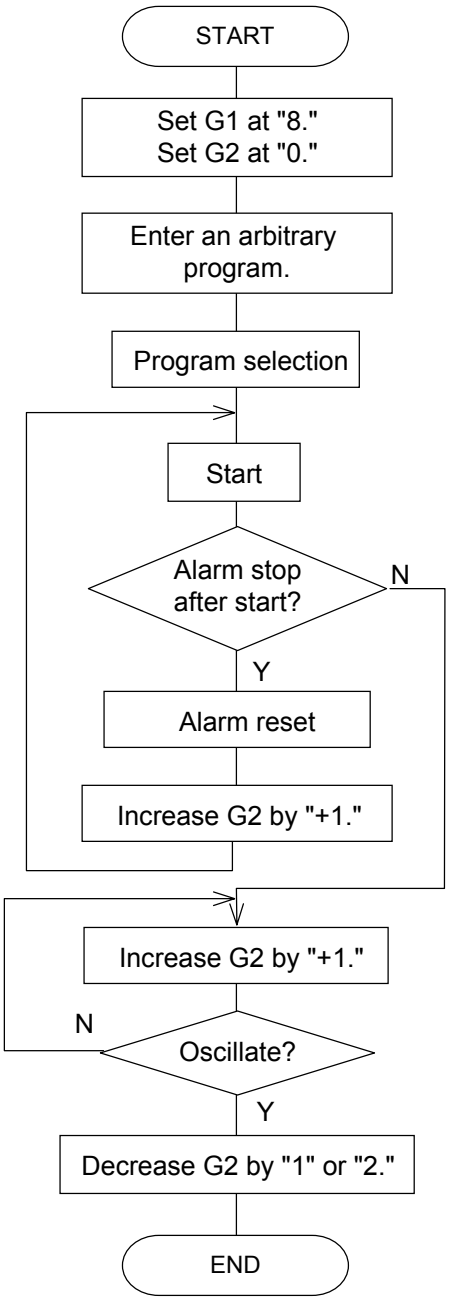
4) Select "1 START."

(Enter "1.")
The program currently selected at the ABSODEX driver automatically starts.
If the program is the same as the previously selected one, a home positioning cycle is performed. Since then, **the actuator turns 90° each time "1" is entered**.

1 START	2 STOP
3 NO.	4 RESET

Step 3. Gain adjustment

The gain adjustment flowchart is shown below.



Use a regular screwdriver or the like to change the DIP switch setting on the driver panel. The shipment settings are "8" (G1) and "0" (G2).
This setting assumes operation with almost no load.
The G2 setting is determined in principle according to the magnitude of the moment of inertia of the load.

For the entry, selection and starting procedures of the program, refer to **Step 2. Gain adjustment and creation of test operation program."**

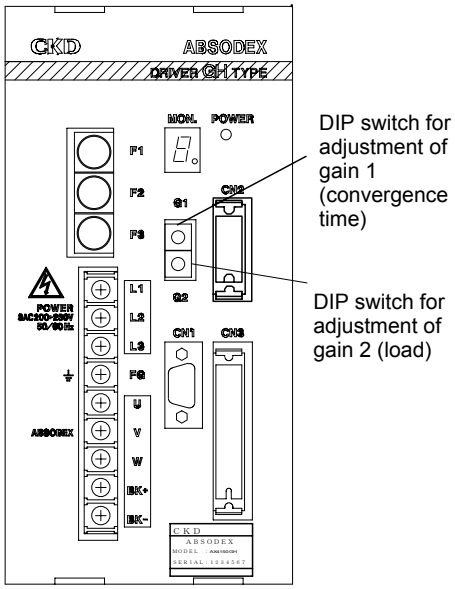


Fig. 4.4 Driver Panel

Note: If the moment of inertia of the load is large and the gain setting is too small, the actuator may swing or an alarm is caused to coast to stop due to inertial force when a start input is supplied.

Note: If the rigidity of the equipment is not large, vibration may be caused. If this is the case, reduce G1 and perform similar adjustment.

Note: If gain adjustment is unsuccessful, perform similar adjustment with a longer indexing time and a smaller rotation speed. Then gradually reduce the indexing time while observing the result.

Fig. 4.3 Flowchart of Gain Adjustment

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

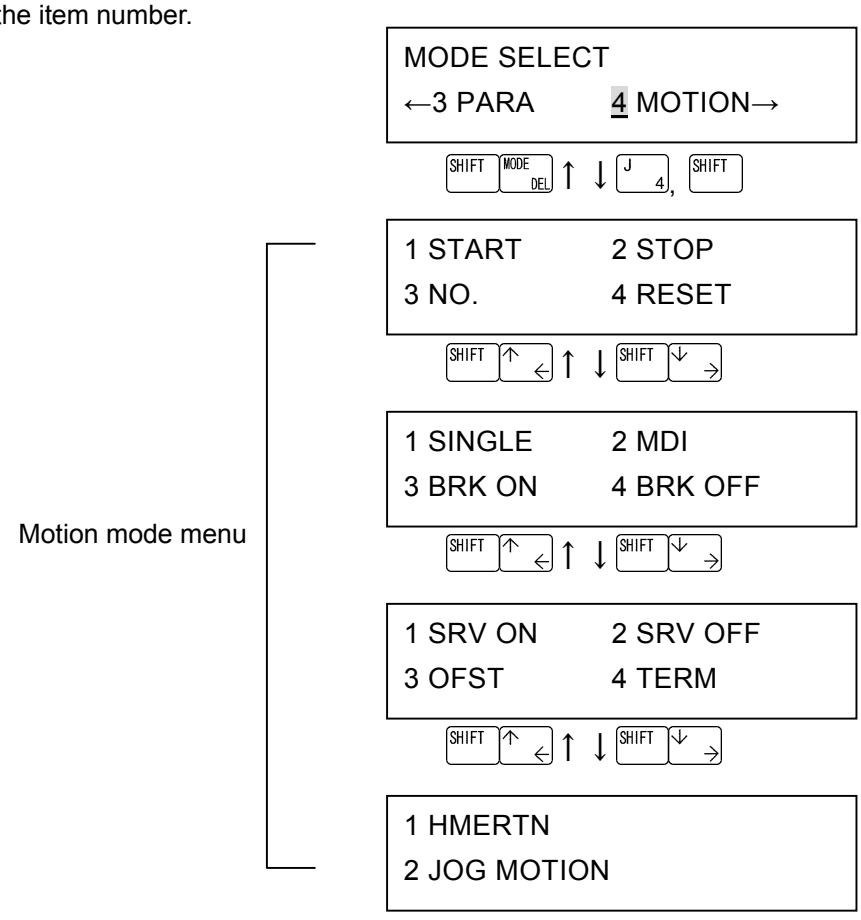
Step 4. Home position determination (Unnecessary for test operation)

Use the home position offset of the dialog terminal to determine the home position in an arbitrary position.
Select the motion mode on the mode selection screen.

- Mode selection procedure
  - ① Move the cursor to the desired mode number. Perform one of the following two methods.
    - a. Key-in the desired mode number directly.
    - b. Enter the ↑ or ↓ key to move the cursor.
  - ② Press the ↵ key. The selected mode starts.

- Motion mode

The motion mode includes 13 menu items. To scroll the menu, press the SHIFT ↓ or SHIFT ↑ keys. To execute the desired item, scroll to the screen where the desired item is displayed, and key-in the item number.



Home position offset amount setting procedure

1) Go to the menu screen where "**2 SRV OFF**" is displayed.

1 SRV ON	2 SRV OFF
3 OFST	4 TERM

2) Press the P 2 key. The servo is turned off.

The cursor blinks in position 2 twice.

SRV ON

Note: The following message is displayed if "START," "STOP," "SINGLE," "MDI," "BRK ON," "BRK OFF," or "HMERTN" is selected in the servo-off state. To execute these functions, turn the servo on.

Note: If the servo is turned off with the actuator installed sideward, the output axis may rotate due to the weight of the load. If this is the case, do not use this procedure but use the MDI or other functions to position with the servo turned on.

3) Turn the output axis of the actuator manually to align the home position of the machine with the assumed home position of the output axis of the actuator.

4) Go to the menu screen where "**3 OFST**" is displayed.

1 SRV ON	2 SRV OFF
3 OFST	4 TERM

5) Press the S 3 key. The following screen is displayed.

(This example shows the case where the home position offset amount before data entry is "0.")

PARA SET	[Y / N]
	0 PLS

Home position offset amount preset in the parameter

6) Move the cursor to "Y" and press the ↵ key. The new home position offset amount is entered.

* The new home position offset amount becomes valid after the power is turned off then on again.

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 safety is assured to operate the actuator when operating it from the place unable to confirm the motion.**

— MEMO —

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.

1) Pin Arrangement and Signal Name

Table 5.1. CN3 Input Signal

Pin No.	Signal Name	Logic	Judg-ment	Bit	Remarks	Reference Section
1 2	External power input, +24V ±10%				Connect the external 24V power.	
3 4	External power input, ground					
5	Program No. selection input (bit 0)	Positive	Level	0	Select or enter the program number to be executed.	5.2). (1)
6	Program No. selection input (bit 1)	Positive	Level	1		
7	Program No. selection input (bit 2)	Positive	Level	2		
8	Program No. selection input (bit 3)	Positive	Level	3		
9	Program No. selection input (bit 4) /Program No. setting input, tens digit	Positive	Level Edge	4		
10	Program No. setting input, units digit	Positive	Edge	5		
11	Reset input	Positive	Edge	6	Alarm reset	5.2). (4) 5.2). (9) .①
12	Home positioning instruction input	Positive	Edge	7	Home positioning execution	5.2). (3)
13	Start input	Positive	Edge	8	Program execution	5.2). (2)
14	Program stop input	Positive	Edge	9	Program stop	5.2). (2)
15	Continuous rotation stop input	Positive	Edge	10	Stop of continuous rotation G07	5.2). (9).②
16	Answer input	Positive	Edge	11	Answer input to positioning completion output and M code output	5.2). (6) 5.2). (7) 5.2). (8)
17	Emergency stop input	Nega-tive	Level	12	Emergency stop	5.2). (4)
18	Brake release input	Positive	Level	13	Brake release	5.2). (5)

- **Each signal is mapped at internal I/O address E080008.**

- **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 5.2 CN3 Output Signal

Pin No.	Signal Name	Logic	Address/Bit	Emer-gency Stop	Remarks	Reference Section
33	M code output (bit 0)	Positive	E080004・ 0	A	① 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. ② 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.	5.2). (7) 5.2). (8)
34	M code output (bit 1)	Positive	E080004・ 1			
35	M code output (bit 2)	Positive	E080004・ 2			
36	M code output (bit 3)	Positive	E080004・ 3			
37	M code output (bit 4)	Positive	E080004・ 4			
38	M code output (bit 5)	Positive	E080004・ 5			
39	M code output (bit 6)	Positive	E080004・ 6			
40	M code output (bit 7)	Positive	E080004・ 7			
41	In-position output	Positive	E080004・ 8	B	The signal is output if the servo position deviation is within the allowable limit.	5.2). (9).③
42	Positioning completion output	Positive	E080004・ 9	A	The signal is issued upon completion of an action.	5.2). (6)
43	Start input wait output	Positive	E080004・10	C	The signal is output when the ABSODEX is ready to accept a start input.	5.2). (2)
44	Alarm output 1	Nega-tive	E080004・11	D	Alarm signals are issued in three steps according to the seriousness of the alarm: output 1, output 2, and outputs 1 and 2.	5.2). (9).④
45	Alarm output 2	Nega-tive	E080004・12			
46	Output 1 during indexing	Positive	E080004・13	E	These signals are issued in the middle of a traveling stroke according to parameters 33 and 34.	5.2). (9).⑤
47	Output 2 during indexing	Positive	E080004・14			
48	Timing output	Positive	E080004・15	F	The signal is issued each time the equal segment position is passed after continuous rotation G07 is executed.	5.2). (9).⑥
49	Segment position strobe output	Positive	5FFFFC0・13	A	The signal is issued when segment position output (M70) is executed.	5.2). (8)
50	M code strobe output	Positive	5FFFFC0・14	A	The signal is output when M codes (M20 to M27) are executed.	5.2). (7)

- 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. Other outputs are turned off. However, if there is an alarm, an **alarm output** is turned on. (**Alarm outputs** are negative logic.)
  If there is no alarm, **alarm outputs** are turned on for 0.3 to 0.5 seconds after the power is turned on, then they are turned off. 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.

- I/O output state upon emergency stop input
  The state of CN3 output signals shown in Table 5.2 after an emergency stop input is supplied is shown in Table 5.3.

Table 5.3 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
F	OFF at emergency stop input

- **In this instruction manual, the input signal activated upon a closed contact shown in Fig. 3.11 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. 3.12 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 5.4 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 DIP switch on the I/O circuit board: pulse/direction input, up/down input and 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 and home positioning instruction input at 100Hz or higher frequencies.**

2) How to Use General I/O Signals

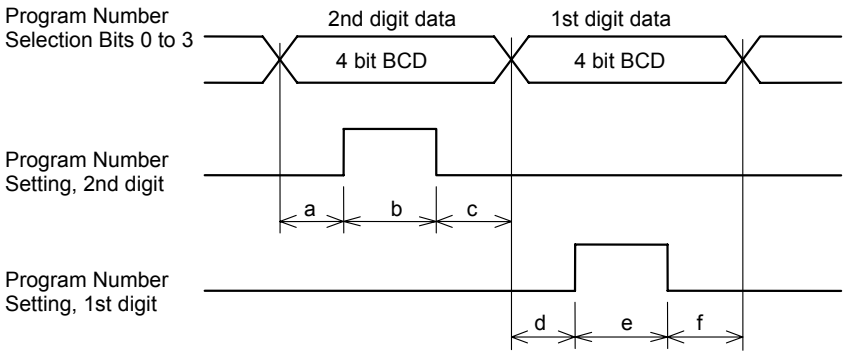
This section explains general I/O signals, the contents and use. Some of general I/O signals vary in using method depending on the parameter setting. **Chapter 7. PARAMETER SETTING** should be read together.
The input signal is not accepted securely if it remains turned on for 20msec. The timer function 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.

(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 first digit (CN3-10)** **• Program setting input second digit (CN3-9)**

After program number selection is made, selected programs are executed one by one from the first one after the start signal is supplied next time. A similar phenomenon occurs if the same number as that of the selected program is selected again.
One of the following three methods can be selected with the setting of parameter 36 (I/O program number selection method switching).

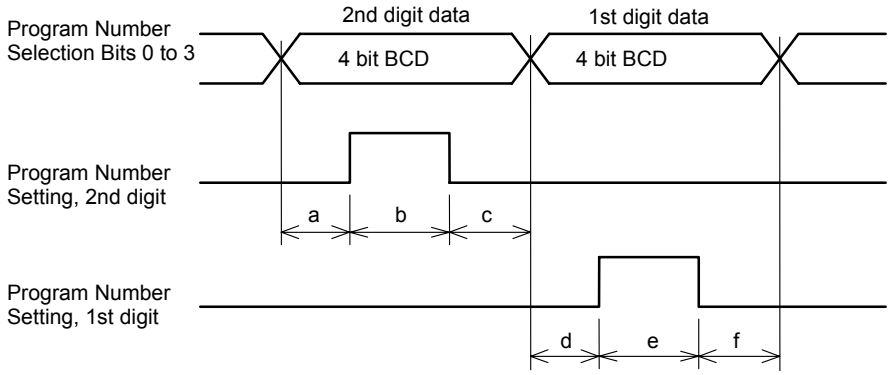
① 4 bit BCD Double Selection (PRM36=1: default setting) (Note1)
Bit 0 to 3 (CN3-5 to 8) for program No. selection input enables to set the second (tens digit) and first digit (units digit) data in this order. The number data is specified by 4 bit BCD (binary coded decimal). Consequently, the selectable numbers of programs are 0 to 99 (100).



a,b,d,e = 20msec or larger c,f = 0msec or larger
Fig. 5.1 Timing for Program Number Input

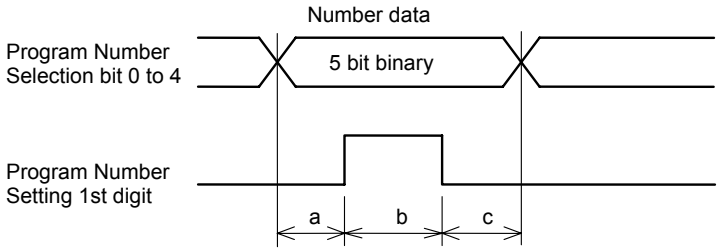
Note 1: "PRM" indicates the parameter in this manual.

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. 5.2 Timing for Program Number Input

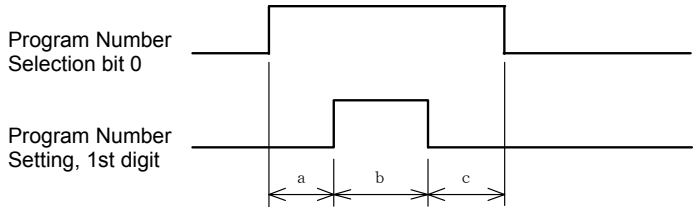
③ 5 bit Binary Single Selection (PRM 36=3)
The second digit in the program setting input (CN3-9) is used as 4 bit of program number selection. Using 5 bit of the bit 0 to 4 for the number selection input and first digit in the program setting input (CN3-10) enables to select program numbers 0 to 31 (1F). 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. 5.3 Timing of Program Number Input

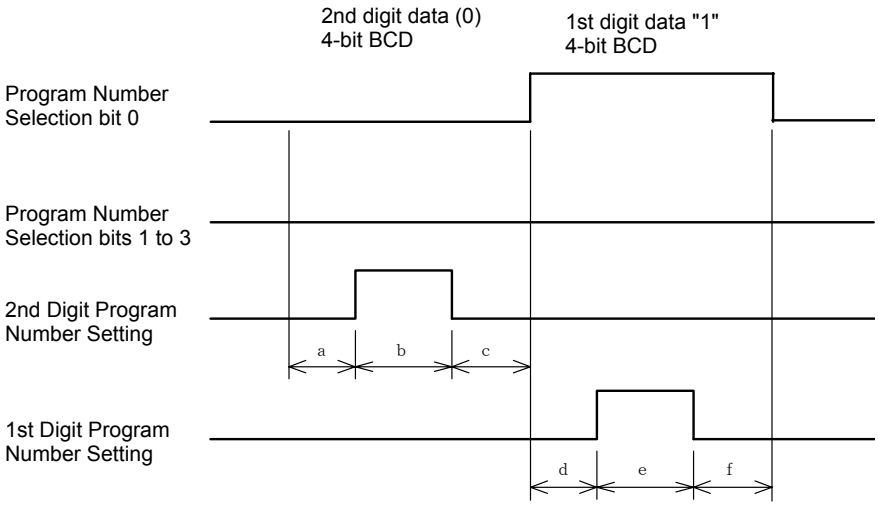
- **Program number selection cannot be done during program execution (state where the start input wait output (CN3-43) is turned off)) or when alarm No. 1, 2, 4, 5, 6, 9, E, F or L is displayed.**

- **After a program number is entered, the setting remains valid until another number is entered or the 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. 5.4.)
  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. 5.5.)



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

Fig. 5.4 Program Number Setting Timing



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

Fig. 5.5 Program Number Setting Timing

(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)**

Turn on start input (CN3-13) after program number selection. 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**."

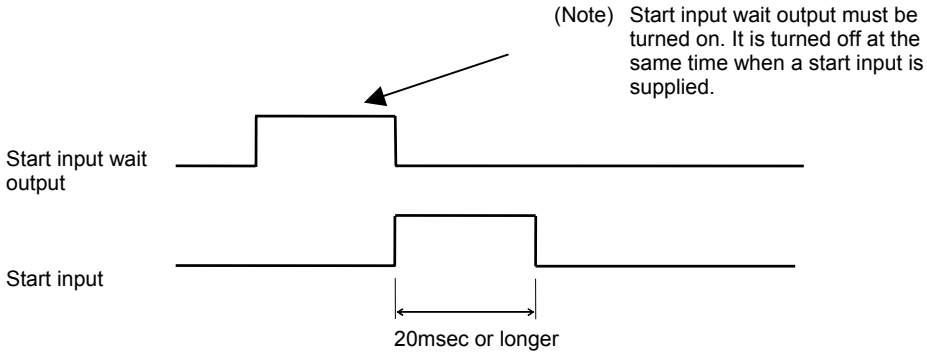


Fig. 5.6 Start Input Timing

(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.

(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 parameter 23 (emergency stop input) is "1" or "3" (default setting: 2; invalid). 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 parameter 21.

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

③ State after emergency stop
If parameter 23 is "1," the servo is turned on. If parameter 23 is "3," the servo is turned off after the time set at parameter 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. Other output states do not change.

- **The emergency stop input is a negative logic input signal. If parameter 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 without relations to the setting of parameter 23.**

(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 selecting a new program number, reset and supply a brake release input to release the brake, then supply the first start signal.

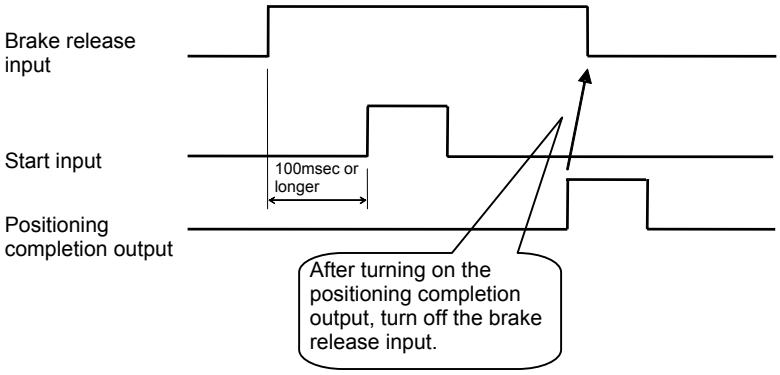


Fig. 5.7 Timing of Brake Release Input

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

(6) Confirmation Method of Positioning Completion

I/O Signals to be Used:	• **Positioning completion output (CN3-42)** • **Answer input (CN3-16)**

Completion of home positioning and positioning will turn on positioning completion output (CN3-42). (For output conditions, refer to **Chapter 7. 7) Judgment of Positioning Completion**.

Specify parameter 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.

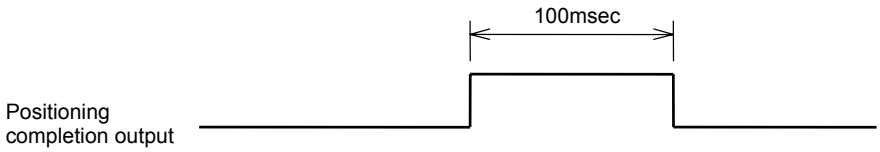


Fig. 5.8 Positioning Completion Output Timing

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 parameter 11 (no answer time).

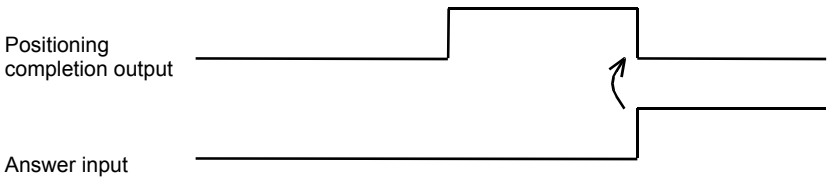


Fig. 5.9 Positioning Completion Output Timing

(7) M Code Output Timing

I/O Signals to be Used:	• **M code output bit 0 to 7(CN3-33 to 40)** • **M code strobe output (CN3-50)** • **Answer input (CN3-16)**

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 parameter 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.

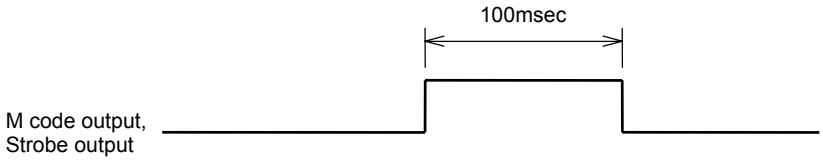


Fig. 5.10 M Code Output Timing

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 parameter 11 (no answer time).

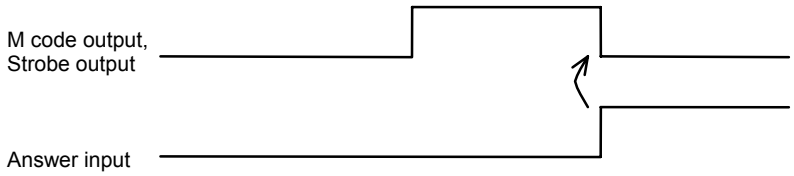


Fig. 5.11 M Code Output Timing

(8) 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)**

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 parameter 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.

(9) 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 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.

③ In-position Output (CN3-41)

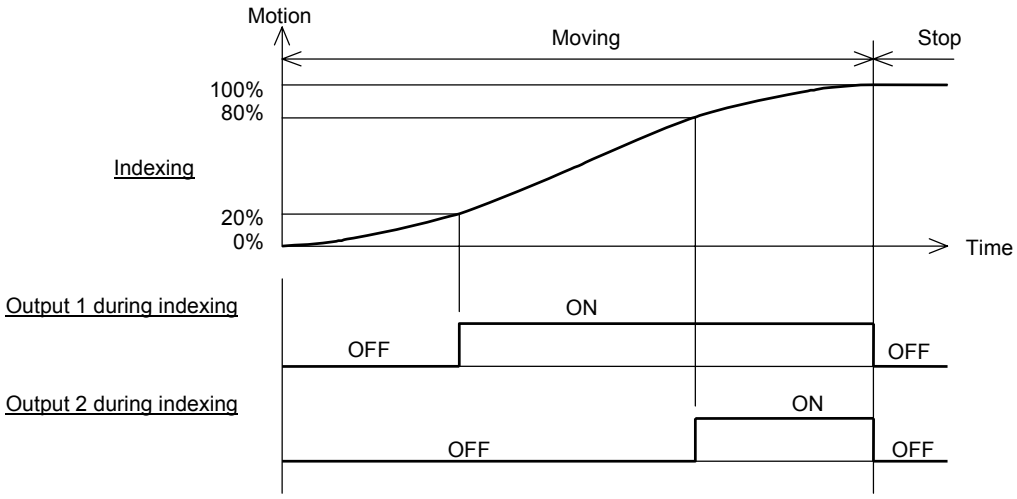
This output is made when the servo position deviation is within the tolerance. The same will apply for pulse string inputs. For judgment of in-position, refer to **Section 7. 6) Judgment of In-position.**

④ 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**.

⑤ Output 1 and 2 during Indexing (CN3-46 and 47)

These are the output that is made during motion. According to the settings of parameter 33 (output 1 during indexing) and parameter 34 (output 2 during indexing), the output is turned on, and it is turned off when the positioning completion signal is issued. The parameters 33 and 34 are specified by the percentage of the moving angle.



PRM33 = 20, PRM34 = 80

Fig. 5.12 Example of Output During Indexing

⑥ Timing Output (CN3-48)

Specifying segment numbers with NC code G101, and executing continuous rotation with G07 will cause timing output to turn ON every time a segment is passed. The following are the related parameters:

PRM30 Output for timing advance (%)
PRM31 Timing output width (msec)
PRM32 Timing output (Effective or Not effective)

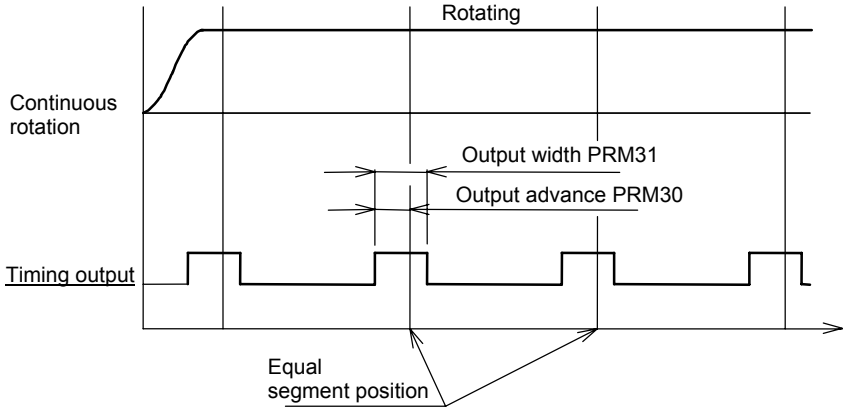


Fig. 5.13 Example of Timing Output

- **Inputs for start, program stop, continuous rotation stop, answer, home positioning instruction, rest, and 1st and 2nd digits of program number are the inputs to check the startup edge.**
- **Input signals should be ON for more than 20 msec to be accepted. Sequencers may vary in their timer function causing troubles.**
- **Make sure to check the sequencer specifications to set ON timer not shorter than 20 msec.**

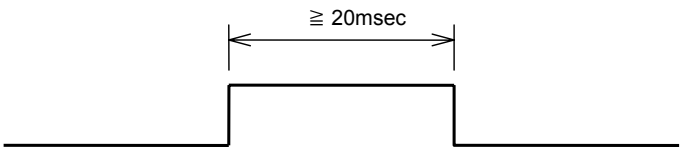


Fig. 5.14 Input Signal ON Time

3) Using Pulse String Input Signals

(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 the parameter 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 or parameter changes. To change, switch to one among M1 to M5.**

(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).

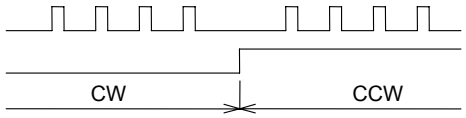
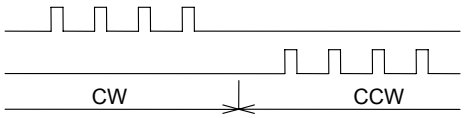
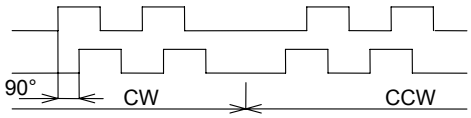
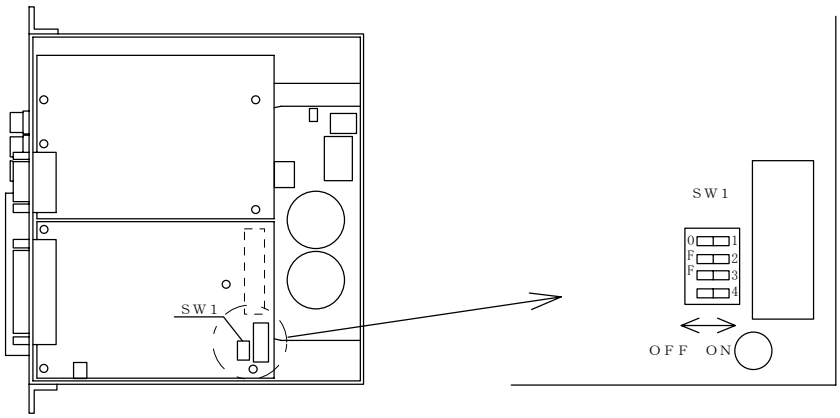
Pulse Direction	
UP DOWN	
A phase B phase	

Fig. 5.15 Kind of Pulse String Input

The driver is set for pulse and direction inputs at default. To change this setting, change the DIP switch SW1 shown in Fig. 5.16.



① Remove the right side cover of the driver.

② Set SW1.

Fig. 5.16 Changing the Pulse String Input Setting

Table 5.5 Pulse String Input Mode

DIP switch SW1 setting			Mode	Input terminal	
1	2	3		CN3-19/20	CN3-21/22
on	off	off	Pulse, Direction	Pulse	H: CCW L: CW
off	on	off	Up/Down	Up	Down
on	on	off	A/B Phase, 1 time	A phase	B phase
off	off	on	A/B Phase, 2 times	A phase	B phase
on	off	on	A/B Phase, 4 times	A phase	B phase

- **Multiplication in the phase A/B input is determined by hardware. The pulse rate changed with parameter 35 is determined by software. The two methods are independent of each other.**

(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%

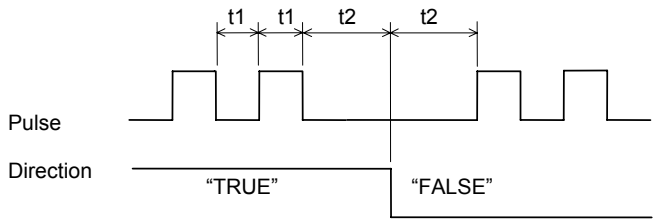


Fig. 5.17 Pulse & Direction Inputs

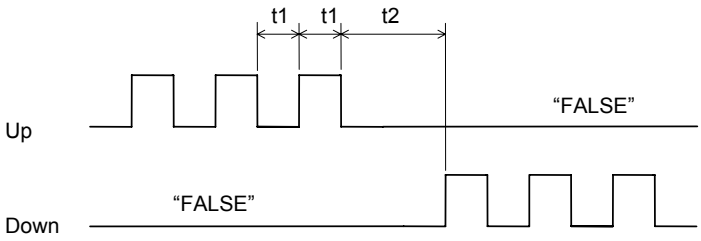


Fig. 5.18 Up & Down Inputs

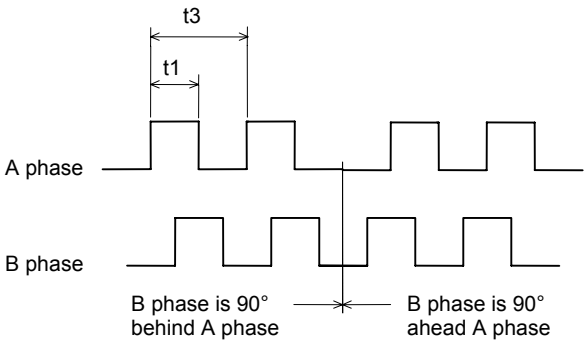


Fig. 5.19 A & B Phase Inputs

- **In case of up and down inputs, input the logic "FALSE" for the side to which pulses are not input. When the photocoupler in pulse input circuit (Fig. 3.9, and Fig. 3.10 on PC) turns on, the logic is "TRUE," and when it turns off, the logic is "FALSE."**

(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 the DIP switch SW1 for A & B phase inputs.

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), DIP switch SW1 setting = 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

- **The parameter 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.**

4) Application Example of I/O Signal

(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)

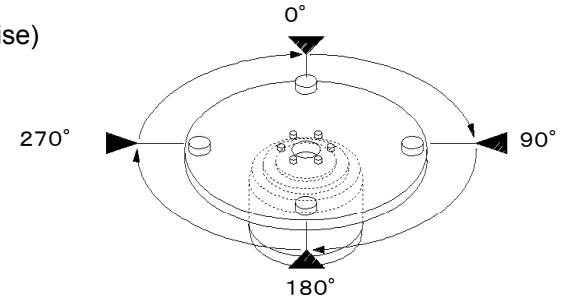


Fig. 5.20 Motion Example

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

① Key point to program number selection

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

b. 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.

c. 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.

① Timing chart starting at program number selection

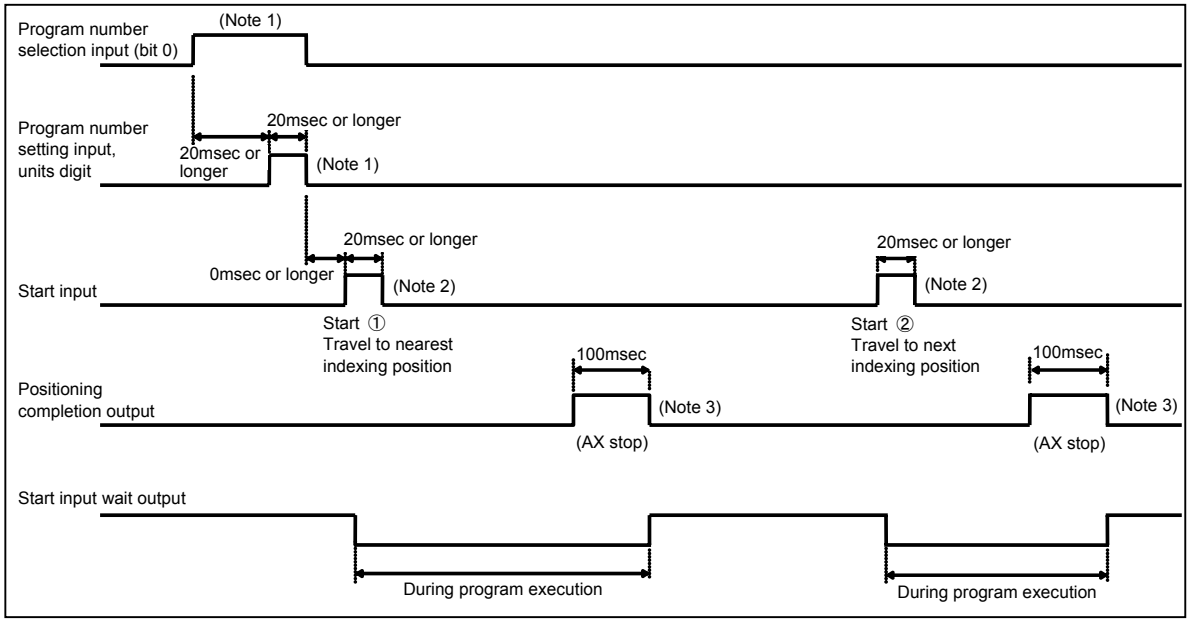


Fig. 5.21 Timing Chart 1

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

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

Note 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 parameter 13 (answer input to positioning and home positioning completion).

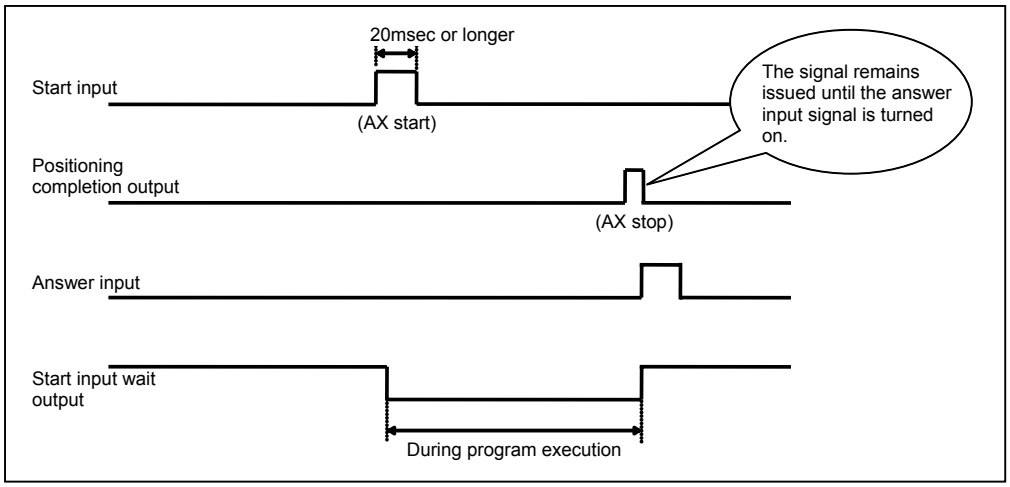


Fig. 5.22 Timing Chart 2

(2) 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

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

- **The emergency stop input is valid if parameter 23 (emergency stop input) 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

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

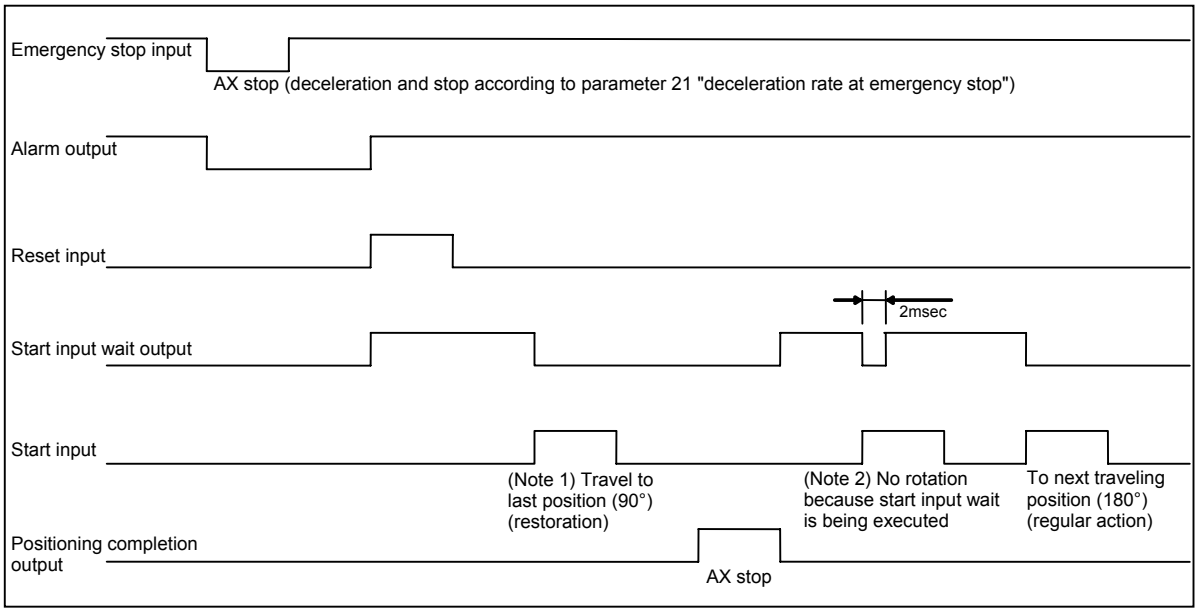


Fig. 5.23 Timing Chart 3

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.)

Note 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

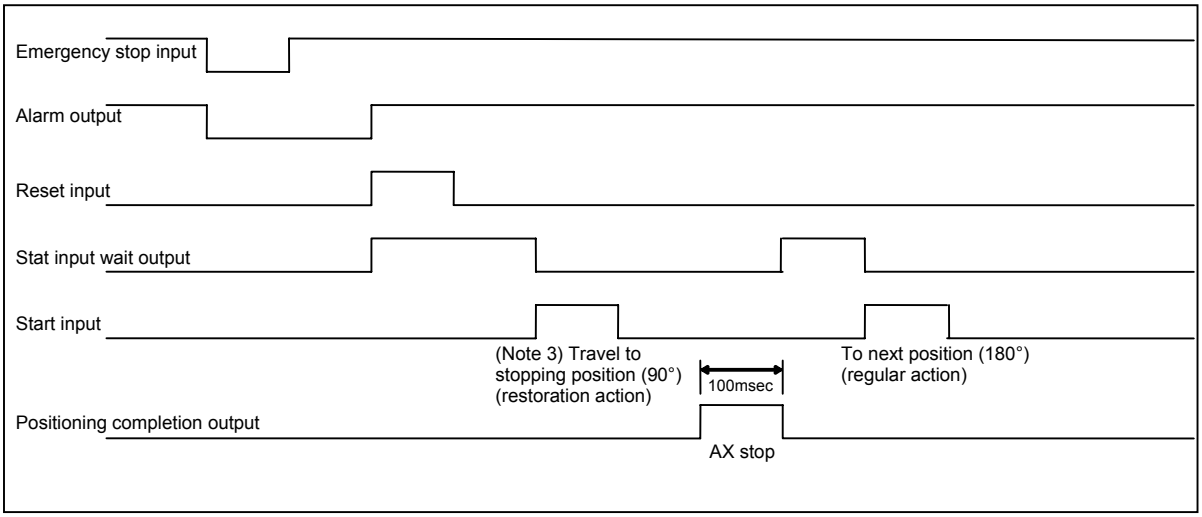


Fig. 5.24 Timing Chart 4

Note 3: If the setting of parameter 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 parameter 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 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

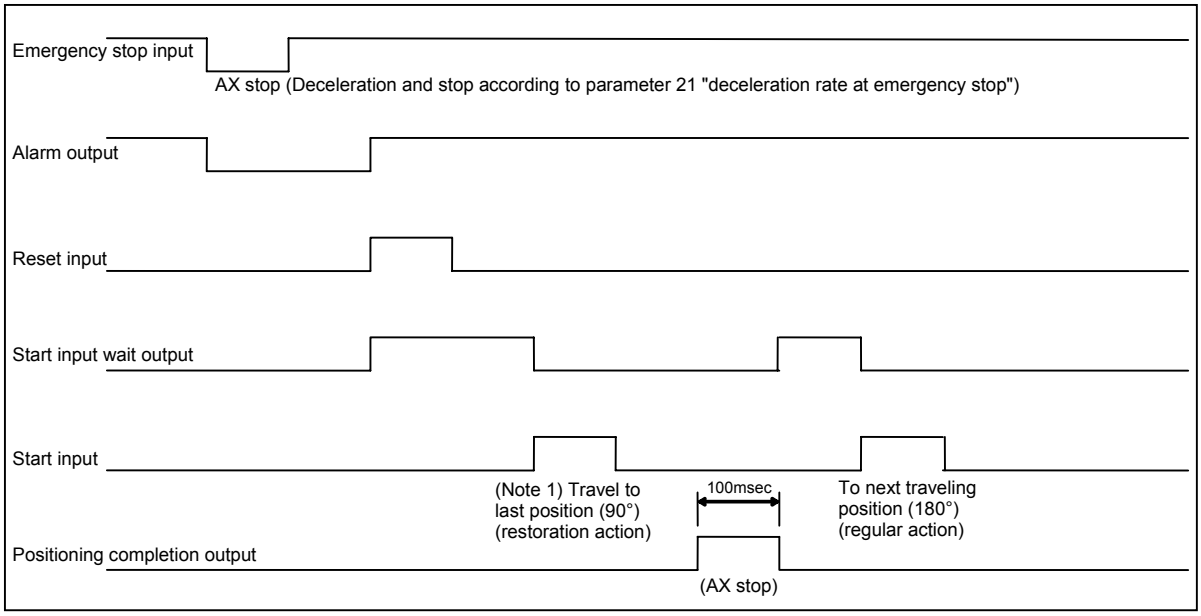


Fig. 5.25 Timing Chart 5

Note 1: 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.)

Note 2: If the setting of parameter 23 (emergency stop input) is "3" (servo-off after stop), 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.

— MEMO —

6. PROGRAM

1) General Description

(1) 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 external sequencer (PLC).

(2) 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.

(3) 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 (-).

(4) Coordinate System

① 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.

② Actuator Coordinate System
Pulse range of 0 to 540671 shows one rotation of the actuator.

③ 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 the parameter "3" is the home position of G92 user coordinate system.

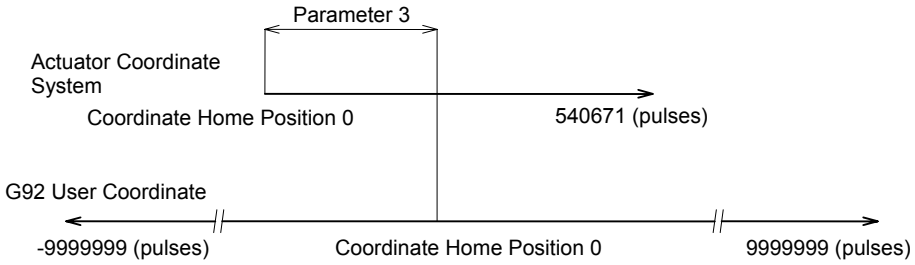


Fig. 6.1 ABSODEX Coordinate System

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.

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

2) Operation Mode

The ABSODEX driver has the six (6) operation modes listed in the Table 6.1 below. For use with a sequencer (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	Enables to execute programs continuously. Default setting is automatic mode for power-on.	M1
Single block mode	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: When the ABSODEX driver is used under automatic and single block modes, NC programs should be stored in the driver. For setting NC programs and parameters, use the dialog terminal or PC.

3) NC Program Format

(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 the dialog terminal or Teaching Note 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 the dialog terminal or Teaching Note is used.)
N□□G□□P□□A□□F□□M□□L□□J□□;
N□□G□□P□□A□□F□□M□□L□□J□□;
•
•
•
N□□M30; (□□ denotes numeral data.)

(2) Notes

① One block can not contain plural NC codes in the same group except for M codes in Group D. Refer to **Table 6.2 NC 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 in the bit corresponding to the number in the first digit (0 to 7). Simultaneously, M code strobe signal is output. 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 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.

④ 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 alarm will be given for the program.

⑤ 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.

⑥ Input of Angles

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

⑦ 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.

⑧ 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;

⑨ 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.

⑩ G101 in the group C only cannot be simultaneously used with the G codes in the group A in the same block.

⑪ The end of the program code (M30) is required at the end of the programs.

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	6	;	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.

4) NC 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.
N	Sequence number	0 to 999	Can be omitted.
G	Preparation function	0 to 999	Refer to G code list.
A	Instruction to move coordinate axis	±9999999	Unit: pulse
		±6658.380	Unit: angle
		±4716	Unit: number of indexes
	Designation of segment numbers	1 to 255	
	Continuous rotation speed	±100	Unit: rpm (Note 1)
F	Designation of speed	0.01 to 100	Unit: rpm (Note 1)
		0.01 to 100	Unit: sec
M	Auxiliary function	0 to 99	Refer to M code list.
P	Dwell	0.01 to 99.99	Unit: sec. G04P□□.□□
	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 G08P□□□ G09P□□□
	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 rotation speed varies according to the model. For details, refer to Chapter 14. "ACTUATOR SPECIFICATIONS."

G Code List

Table 6.3 G Code List (1/3)

Group	G Code	Function	Description
A	G01	Positioning	To position at A with speed F <Input Method> G01 A□□ F□□; **Note:** **A□□ command can make positioning without G01.**
	G07	Continuous rotation (Note 1)	Under continuous rotation at the speed A (rpm). 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 G08. (DO NOT USE this for reverse rotation.) The user coordinate after the stop is revised to -180°~ 179.999° . <Input Method> G07 A±□□; Unit of A: rpm "+" indicates clockwise rotation, while "-" indicates counterclockwise rotation. Acceleration and deceleration times are set by G08 and 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.

Note 1: Select less than 80 rpm for G07 continuous rotation.

Table 6.3 G Code List (2/3)

Group	G Code	Function	Description
A	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.
B	G04	Dwell	Delay to shift to the next block. <Input Method> G04 P□□.□□;
	G08	Acceleration time for continuous rotation	Acceleration takes place for the time specified by P for continuous rotation. <Input Method> G08 P0.5; acceleration time 0.5sec.
	G09	Deceleration time for continuous rotation	Deceleration takes place for the time specified by P for continuous rotation. <Input Method> G09 P0.5; deceleration time 0.5sec.
	G12	Change of Gain Magnification Rate	Gain magnification rate determined by Switch Gain 1, 2 <Input Method> G12 P100; (100%) G12 P0; cause servo-off at 0%. (Note 3)
	G79 (Note 1)	Parameter data setting	Substitute the parameter number with "S" for the value of P. <Input Method> G79S1P2; To substitute the parameter 1 for 2. The RAM data is temporarily stored, and turning off the power will erase all the set data.
C	G101 (Note 2)	Designation of Segment Numbers	One rotation is equally segmented to set A unit to index number G106. <Input Method> G101A10; ←One rotation = 10 segments G01A1; ←Unit of A is index number

Note 1: Some parameters cannot be set using G79 code. Refer to Parameter data setting of G79 in Table 7.1.

Note 2: G101 cannot be used simultaneously in the same block with the G codes in group A.

Note 3: If positioning (A□F□), continuous rotation (G7P□) or home positioning (G28) is executed with the servo turned off, alarm 0 is caused.

Table 6.3 G Code List (3/3)

Group	G Code	Function	Description
C	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.
D	G10	Designation of rotation number (Note 1)	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 ± one (1) rotation. Specifying 180° will cause the actuator to rotate CCW.
	G90.2	CW direction absolute dimension (Note 2)	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 ± one (1) rotation. (The actuator motions between 0 to 360° in the CW direction.
	G90.3	CCW direction absolute dimension (Note 2)	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.
	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.

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

- When an angle is specified with G105, the driver will convert the angle to pulse for processing. When the set angle cannot be accurately converted to pulses, the angle will be converted to the nearest 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.)

- 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.

- 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.

- For continuous rotation, stop input signal during acceleration will cause the acceleration to continue to the specified level before deceleration takes place to stop.

- When segment numbers by G101 are specified before execution of continuous rotation (G07), stop input signal will enable the stop at the next segment in which deceleration can take place to stop. When the angle unit or the pulse unit is designated, deceleration and stop start after the stop signal is supplied.

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

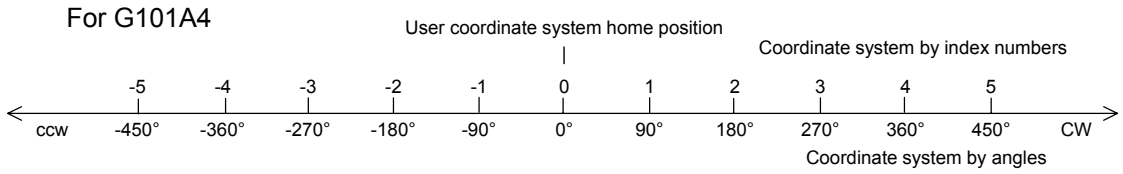


Fig. 6.2 Coordinate System of Segment Number Designation

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)

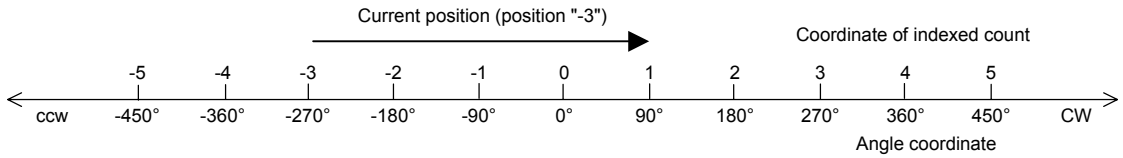


Fig. 6.3 Action Example 1

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

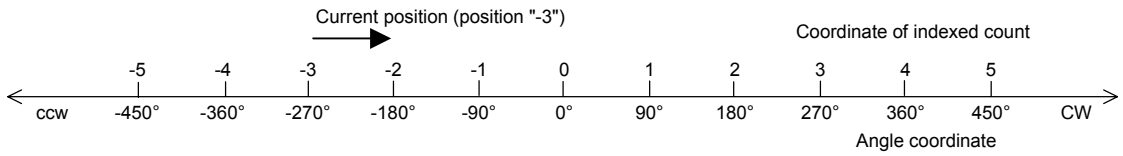


Fig. 6.4 Action Example 2

③ G90.1A1: enables transfer to the index 1 in the shortest route within the half round from the current position. When the coordinate system after transfer is not at 90° (e.g. 450°), it is corrected to the current position to be at 90°. This will avoid the overflow in the coordinate system when G90.1 is repeatedly executed.
(Shortest route absolute action instruction)

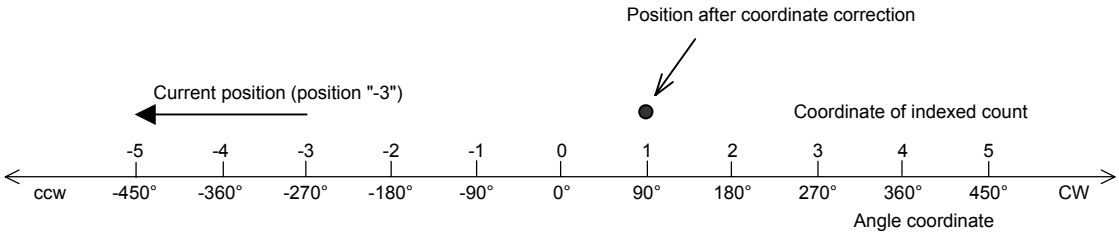


Fig. 6.5 Action Example 3

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

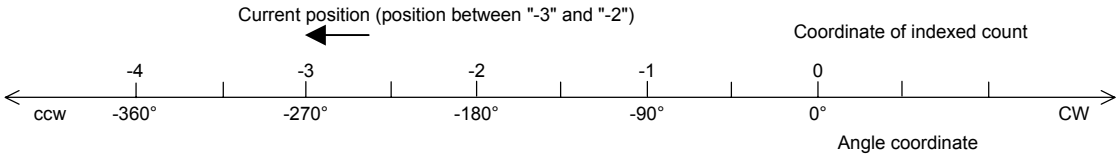


Fig. 6.6 Action Example 4

Note: 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 parameters 37 and 38. For details, refer to 7. 9) Designation of Equal Segment (G101) and Parameters.

M Code List

Table 6.4 M Code List

Group	M Code	Function	Description
A	M00	Program Stop	After completion of the current block, the program stops. When the start signal is input again, 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. 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 signal in bit corresponding to the first digit is output to CN3, and M code strobe output will turn ON simultaneously. Three (3) M codes can be written in the same block, and can be output simultaneously.
E	M70	Segment position output	The current segment position is output to CN3 in binary form. The segment position for n segmentation is expressed 1 to n. To separate the segment position output from M code output, segment position strobe output terns ON simultaneously.

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

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

(7) I/O Output
In-position output turns ON, when start input is accepted, start input wait output will turn on. While other outputs turn OFF except for the alarm condition when the alarm output turns ON. (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.

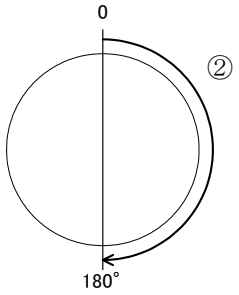
(8) Driver Panel

Under normal condition without alarm,  will light on the 7 segment LED on the monitor. With this on the monitor, ABSODEX is operable.

6) NC Program Example

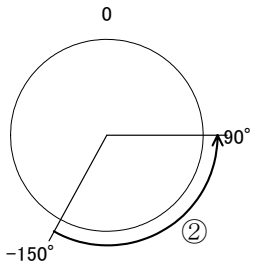
The following explains NC program examples.
Unless otherwise noted, the coordinates have returned to 0° position prior to start of the program.

(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 (parameter 3).



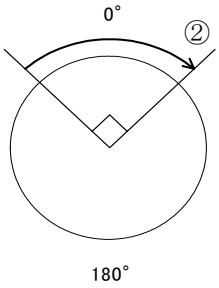
Program
N1G90G105G11; ① Absolute, angle, time
N2A180F1. 5; ② Travel to the 180° position in 1.5 sec.
N3M30; ③ End of program

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



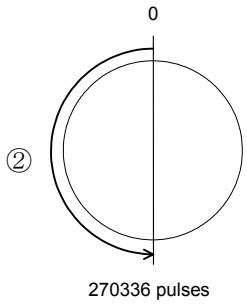
Program
N1G90. 1G105G11; ① Full revolution absolute, angle, time
N2A90F1. 5; ② Travel to the 90° absolute coordinate position in 1.5 sec. on the shortest route.
N3M30; ③ End of program

(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.

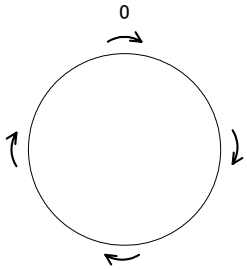


Program
N1G90. 1G104G11; ① Full revolution absolute, pulse designation, time
N2A270336F2; ② Travel to the 270336-pulse (180°) position in 2 sec.
N3M30; ③ End of program

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

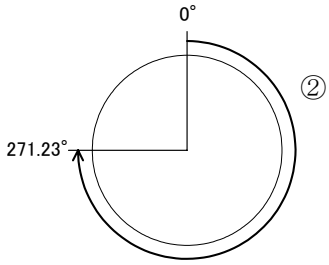
(5) Continuous rotation (G07), continuous rotation acceleration time (G08), continuous rotation deceleration time (G09)
After supplying a start signal, rotate at the rotation speed specified with G07. The acceleration/deceleration time at the time follows the settings of G08 and G09.

Program
N1G105; ① Angle designation
N2G08P1; ② Acceleration in 1 sec.
N3G09P0. 5; ③ Deceleration in 0.5 sec.
N4G07A10; ④ Continuous rotation 10rpm
N5M30; ⑤ End of program



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

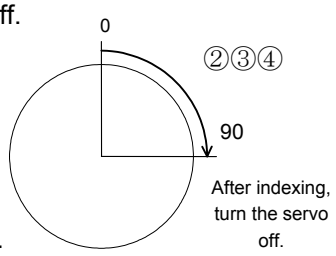
Program
N1G90G105G10;① Absolute, angle, rotation speed
N2A271. 23F30; ② Travel to the 271.23° position at 30rpm.
N3M30; ③ Deceleration in 0.5 sec.



- **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



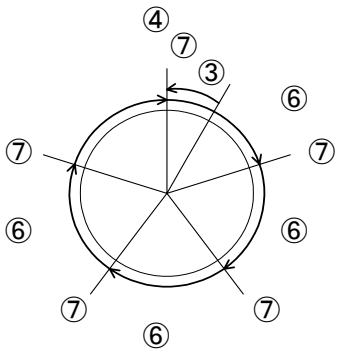
- **In the program executed after the servo is turned off, a gain multiplication change command such as "G12P100" is necessary before the travel instruction so that servo-off is reset.**

(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

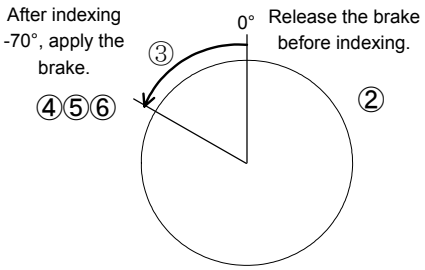


(9) Brake application (M68), brake release (M69) and M code output

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. (Note)
N5M68;	⑤ Apply the brake.
N6M20;	⑥ Output M code bit 0.
N7M30;	⑦ End of program



Note: 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.

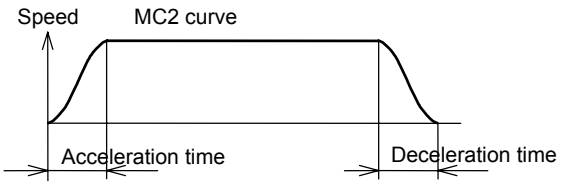
— MEMO —

7. PARAMETER SETTING

Various parameters are available for ABSODEX to set motion conditions.
The values set by the parameters should be recorded in **the parameters list in the Appendix-2** with the model and serial numbers.

1) Parameters and Contents

Table 7.1 Parameters (1/7)

Parameter 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	-540672 to 540671	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 **Chapter 7. 4) Amount of Home Position Offset and Home Positioning Motion.**				
4	Home positioning direction	1 to 2	1	—	Feasible
	1: CW, 2: CCW				
5	Home Positioning speed	1 to 100	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	[H] 0.1 to 1.0	0.1	sec	Feasible
		[GH] 0.1 to 2.0	1.0 (Note)		
	Sets acceleration and deceleration times for home positioning. Acceleration and deceleration take place in accordance with the curve.				

Brief memo
Pulse/Angle unit conversion formula
1° = 540672/360≒1502 pulses

Note: Load the parameters in advance to edit them when using the dialog terminal or Teaching Note (PC communications software).
Failing to do so will result in overwriting the parameters with 0.1, default value of the dialog terminal or Teaching Note.

Table 7.1 Parameters (2/7)

Parameter 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 (about 6667°)	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 (about -6667°)	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 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	60	sec	Feasible
	Sets the answer input waiting time. Alarm is given, if there is no answer for the set time. Effective only when parameters 12 and 13 are set to require an answer. 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.				

Table 7.1 Parameters (3/7)

Parameter 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 1.0	1.0	sec	Not feasible
	Sets acceleration and deceleration times.				
16	In-position range	1 to 10000	2000 (About 1.34°)	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) "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) "Correct In-position Range**."				
18	Position deviation amount	Setting not feasible		Pulse	Not feasible
	Indicates the current position deviation amount.				
19	Upper limit for position deviation amount	1 to 540672	10000 (about 6.7°)	Pulse	Feasible
	Parameter 18 exceeding this value will cause Alarm 1. (Note 1)				
20	Speed over limit	1 to 3064	1982 (about 110rpm) [H] 3604 (about 200rpm) (Note 2)	Pulse	Not feasible
	The motion amount [pulse] exceeding the set value for every 2msec will cause Alarm 1. (Note 1) In case of 180rpm specification, the default value is 3604. (Note 2) 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 1: If the setting of parameter 19, 20 or 39 is too small, alarm 1 may be caused and the actuator may not be activated.

[H] **Note 2: For the models supporting 180rpm, refer to Chapter 14. "ACTUATOR SPECIFICATIONS."**

Table 7.1 Parameters (4/7)

Parameter No.	Description	Setting Range	Initial Value	Unit	G79 Setting
21	Deceleration rate for emergency stop	1 to 180	2	Pulse/ms^2	Feasible
	Speed deceleration will take place for every 1msec 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 = 18.0224 × N/(PRM21) [msec] The inertia torque Ti with inertia moment J[kg·m^2] can be calculated by the following formula: Ti = 5.81x J x (PRM21) [N·m] Enter parameter 21 so that Ti does not exceed the maximum torque limit of the actuator. When Ti exceeds the maximum torque limit of the actuator, alarm 1 may be caused and allow the actuator to coast. [GH] When inertia torque Ti exceeds the maximum torque limit of the actuator during deceleration, alarm 1 does not occur and the maximum torque is continuously output until the actuator decelerates and is stopped. In this case, time t taken to emergency stop becomes longer than that specified above.				
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	Emergency stop input (Note 1)	1 to 3	2	-	Not feasible
	Emergency stop input enables the following settings: 1: Maintain servo-on state after stop. 2: Not effective 3: Servo-off after stop				
24	Actuator temperature rise	Setting not feasible		°C	Not feasible
	Temperature rise of the actuator calculated by electronic thermal				
25	Upper limit of actuator temperature rise	Setting not feasible	70	°C	Not feasible
	Parameter 24 exceeding the set temperature will cause the alarm 4.				
26	NC program output during auto run	1 to 2	1	-	Feasible
	1: No output, 2: Output (Note 2)				
27	Delay time after brake output	0 to 1000	250 (Note 3) AX4075 AX4150 AX4300 AX4500 100	msec	Feasible
	Motion to be delayed when motion instruction after brake release is specified by M69.				

Note 1: **If the EMERGENCY STOP button is pressed at the dialog terminal, "servo-on after stop" is caused without relations to the setting of parameter 23.**

Note 2: **Dialog terminal, and PC, etc. are not designed to effectively use this function. Make sure that this parameter is always set to 1: No output.**

Note 3: **Load the parameters in advance to edit them when using the dialog terminal or Teaching Note (PC communications software).**
Failing to do so will result in overwriting the parameters with “100”, default value of the dialog terminal or Teaching Note.
Avoid this for the systems equipped with an electromagnetic brake.

Table 7.1 Parameters (5/7)

Parameter No.	Description	Setting Range	Initial Value	Unit	G79 Setting
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				
30	Advance in timing output	0 to 99	0	%	Feasible
	Enables to output timing output in advance of the segment position. Setting is made by the percentage of the angle of the segment to output timing at the angle corresponding to the percentage.				
31	Timing output width	1 to 200	20	msec	Feasible
	Enables to set pulse width for timing output.				
32	Timing output	1 to 2	1	-	Feasible
	Enables to set timing output when continuous and equal segment rotations are both specified. 1: To output, 2: Not to output				
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.				
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.				

Table 7.1 Parameters (6/7)

Parameter No.	Description	Setting Range	Initial Value	Unit	G79 Setting
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 3	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)				
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	Torque limit	1 to 100	100	%	Feasible
	Enables to set the upper limit of torque output by percentage against the maximum torque. (Note 1)				

Note 1: When the set values of parameters 19, 20, and 39 are too small, the alarm 1 is generated and the actuator may not operate.

Table 7.1 Parameters (7/7)

Parameter No.	Description	Setting Range	Initial Value	Unit	G79 Setting
62	Cut-off frequency for low pass filter 1	10 to 500	[H] 200 [GH] 100 (Note 1)	Hz	Feasible
63	Cut-off frequency for low pass filter 2	10 to 500	500	Hz	Feasible
64	Cut-off frequency for notch filter 1	10 to 500	500	Hz	Feasible
65	Cut-off frequency for notch filter 2	10 to 500	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. Setting this value in the range that will not cause position deviation when the actuator has stopped will control overshooting immediately before stop and will improve stability for loads having large inertia moment. Adjusting gain will cause appropriate values to be changed. For details, refer to **Section 7. 11) "Integral Limiter**."				
68	PI output limiter	1 to 1000	800	-	Feasible
	Do not set this parameter.				
69	Random gain	1 to 2000	500	-	Feasible
	Do not set this parameter.				
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.				
[GH] 72 (Note 2)	Integral gain multiplier	0.1 to 10.0	0.3	-	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. The new setting becomes effective after the power is turned off and then turned on again. The default value is applicable to large inertia loads. For details, refer to **Section 7.12) "Multiplier of Integral Gain**."				

Note 1: **Load the parameters in advance to edit them when using the dialog terminal or Teaching Note (PC communications software).**
Failing to do so will result in overwriting the parameters with “100”, default value of the dialog terminal or Teaching Note.

[GH] **Note 2:** **Parameter 72 cannot be entered or monitored with the parameter mode of the dialog terminal or Teaching Note (PC communications software).**
Use the "terminal mode" to enter or monitor this parameter. For details, refer to Section 7.2) "Parameter Setting and References."

2) Parameter Setting and References

Setting of parameters and references is done by communication codes using a personal computer or dialogue terminal.
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 Parameter 1 . . . L7_1_3↵
For setting 135168 pulses for Parameter 8 . . . L7_8_135168↵
For setting 90° for Parameter 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 Parameter 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 Parameter 8 . . . L9_8↵
To read Parameter 8 in angle unit . . . L9_8A↵
To read the data on RAM of Parameter 8 in angle unit . . . L9M_8A↵

For detail of the communication codes, refer to **Chapter 12. COMMUNICATION FUNCTIONS.**
The dialog terminal has the convenient parameter mode for settings and references. For detail, refer to the instruction manual for dialog terminal.

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

3) Types and Characteristics of Cam Curve

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

(1) 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.

(2) 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.

(3) 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.

(4) 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.

(5) Modified constant velocity 2 (MC2)

With this curve, the acceleration/deceleration of the MC curve can be arbitrarily entered. 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 in Fig. 7.1.

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 with parameter 2.

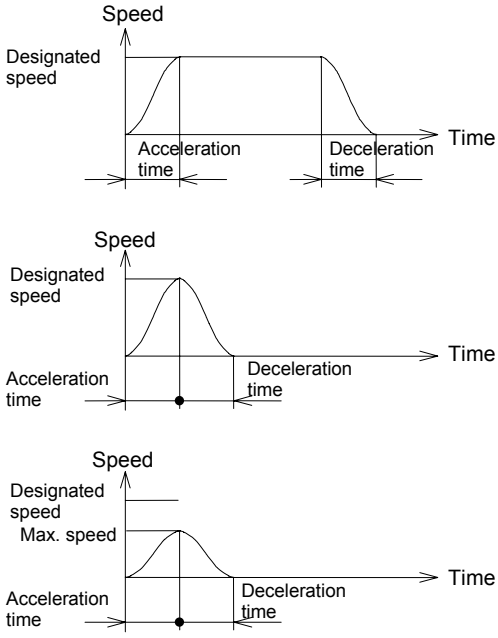
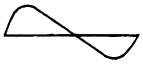
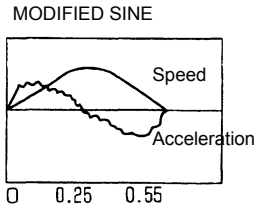
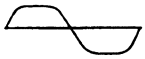
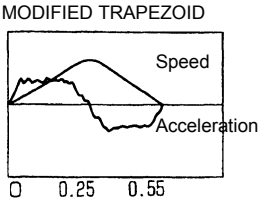
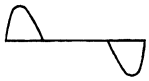
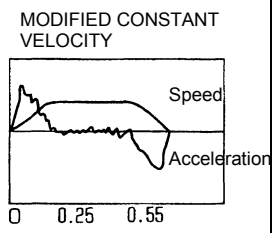
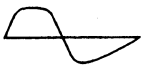
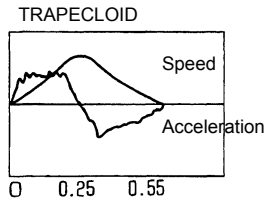


Fig. 7.1 Speed Pattern of MC2

- **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.

Characteristics of Cam Curve and Measurement Examples

Name	Acceleration Curve	Vm	Am	Jm	Measurement Example
MODIFIED SINE (MS)		1.76	±5.53	+69.5 -23.2	
MODIFIED TRAPEZOID (MT)		2.00	±4.89	±61.4	
MODIFIED CONSTANT VELOCITY (MC)		1.28	±8.01	+201.4 -67.1	
TRAPECLOID (TR)		2.18	±6.17	±77.5	

Operating Conditions of Measurement Examples

Model AX1045

Operating conditions

Indexing angle 90°

Indexing time 0.5 sec.

Load inertia moment $1.67 \times 10^{-2} kg \cdot m^2$

Fig. 7.2 Characteristics of Cam Curve

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 the home position offset amount (parameter 3).

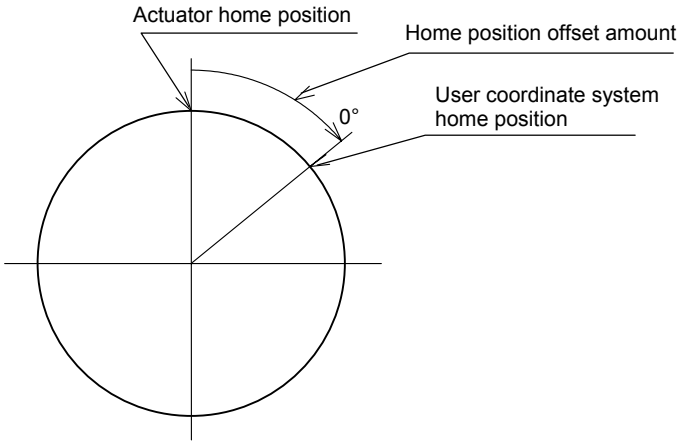


Fig. 7.3 Amount of Home Position Offset & Coordinate System Home Position

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 sequencer

5) Precautions for Software Limit

Using parameters 8 (software limit coordinate A), 9 (software limit coordinate B), and 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 parameter 3).

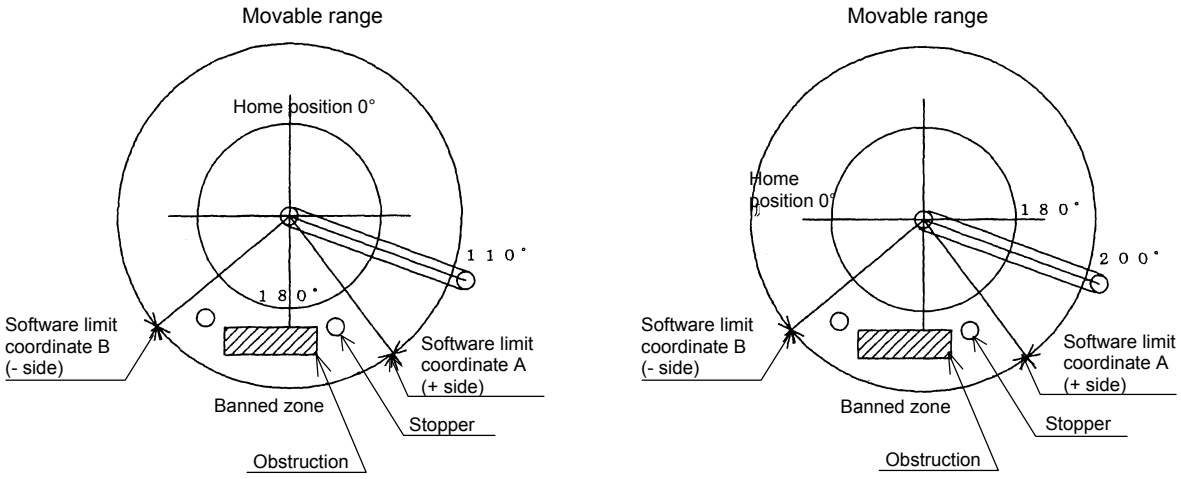


Fig. 7.4 Home Position & Software Limit

The current position is recognized as at 110° upon re-power-on for Fig. 7.4 (a), and as at -160° for Fig. 7.4 (b).
The motion to 0° in case of Fig. 7.4 (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. 7.4 (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. 7.4 (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.

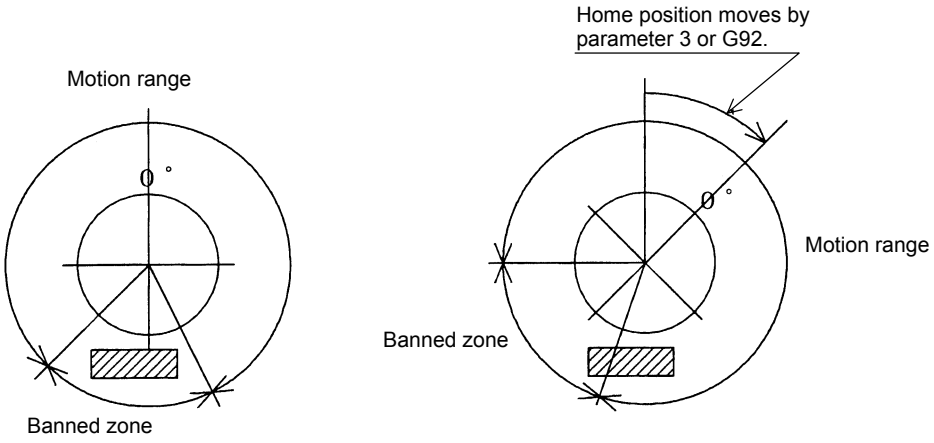


Fig. 7.5 G92 & Software Limit

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

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

Number of Sampling Times for In-position = 3

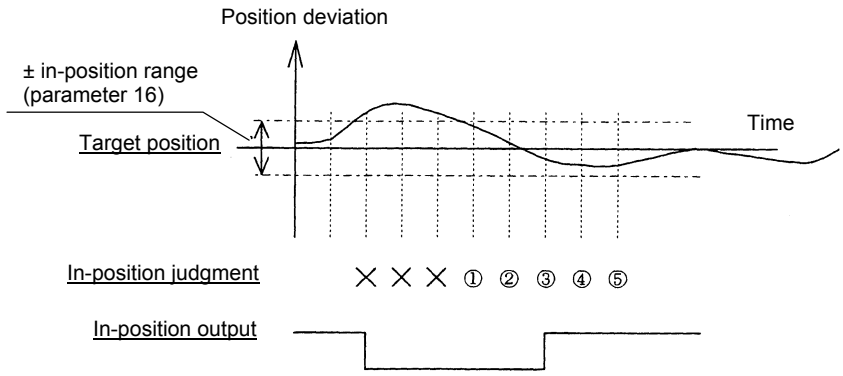


Fig. 7.6 In-position Output

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 parameter 17 = 3.

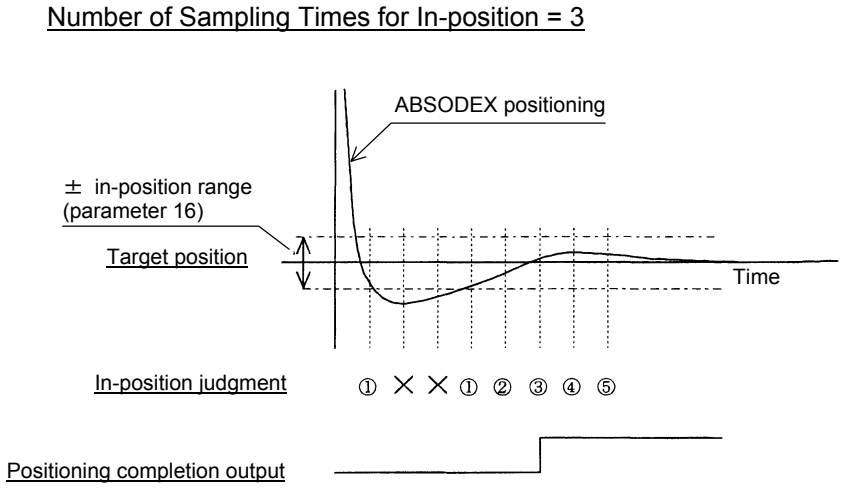


Fig. 7.7 Position Completion Output

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

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

8) Correct In-position Range (parameter 16)

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

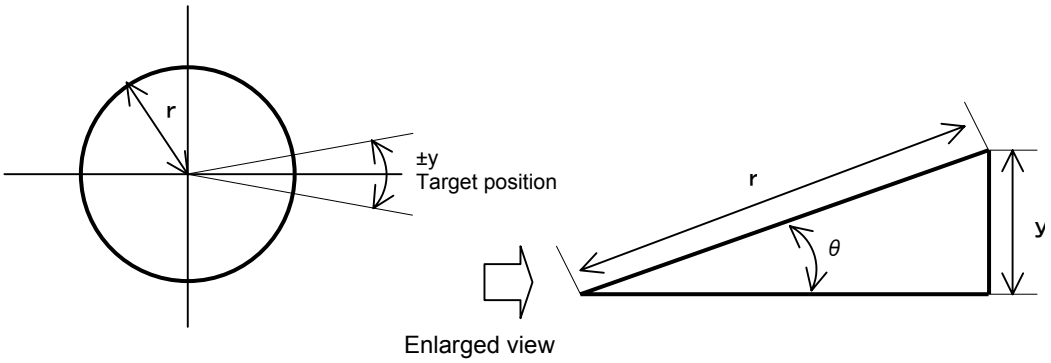


Fig. 7.8 Correct In-position Range

(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.
$\sin\theta = y/r$ ··· ①
Because θ is very small, the following equation is assumed.
$\sin\theta \fallingdotseq \theta$ ··· ②
From ① and ②,
$\theta = y/r$ ··· ③
Conversion of θ into pulse P leads to:
$P = 540672\,\theta/2\pi$ ···④
From ③ and ④,
$P = 540672y/2\pi r$ ···⑤
$=270336y/\pi r$
$\fallingdotseq 86051y / r$
Hence, as shown in equation ⑤, deviation ±y (mm) on the circumference (2πr) is almost equal to deviation ±P (pulses) with ABSODEX.

(2) The in-position sampling frequency (parameter 17) 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
① To convert P (pulses) into α (°),
$\alpha = 360P / 540672$
② To convert α (°) into P (pulses),
$P = 540672 \alpha / 360$

9) Designation of Equal Segment (G101) and Parameters

Setting the parameters 37 (segment position range width for designation of equal segment) and 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).

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

① Parameter 38 = 1 (CW direction)
When within ① range for (a), Fig. 7.9, executing G101A4;G91A0F□□ will cause the actuator to move to 1H position. (□□ is any value for specifying motion time or speed.)

② Parameter 38 = 2 (CCW direction)
When within ② range for (a), Fig. 7.9, executing G101A4;G91A0F□□ will cause the actuator to move to 1H position.

③ Parameter 38 = 3 (Nearer direction)
When within ③ range for (b), Fig. 7.9, executing G101A4;G91A0F□□ will cause the actuator to move to 1H position (nearest position). The parameter 33 will not influence motions.

④ If parameter 38 = 4 (alarm C is caused outside the vicinity of segment position)
If G101A4;G91A0F□□ is executed in the range specified ④ in Fig. 7.9 (a), a travel to position 3H occurs.
If the command is executed in range ⑤, alarm C is caused when G101A4 is executed.

(2) Motion of G91A-1F□□ and G91A1F□□

① Parameter 38 = 1 (CW direction), or 2 (CCW direction)

When within ① range for (a), Fig. 7.9, 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 Parameter 38 = 3 (Nearer direction)

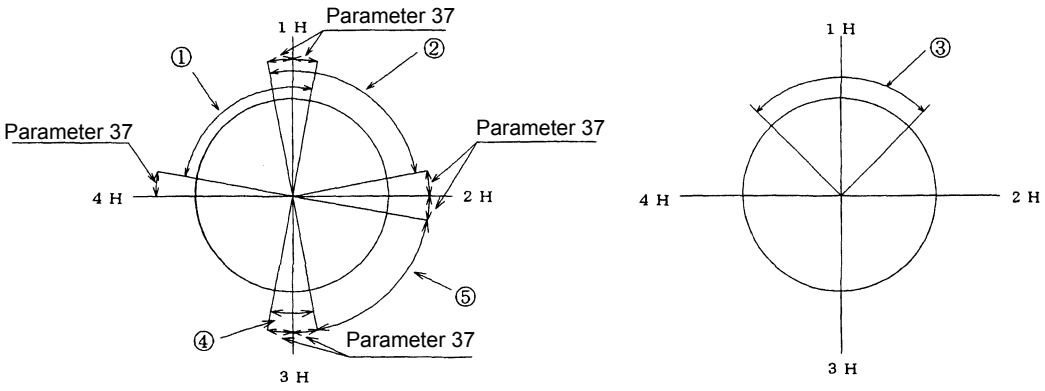
In this case, the actuator moves based upon the nearest indexing position from the current position. When within ③ range for (b), Fig. 7.9, executing G101A4;G91A1F□□ will cause the actuator to move to 2H position and G101A4;G91A-1F□□ will cause the actuator to move to 4H position.

③ If parameter 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. 7.9 (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.



(a) (b)

Fig. 7.9 Equal Segment Designation (G101) & Parameter

(3) Motion of M 70

① For Parameter 38 = 1 (CW direction) or 2 (CCW direction)
Within the range ④ in the Fig. 7.9 (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 parameter 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 Parameter 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. 7.9 (b), segment position 1 (bit 0) is output.

③ If parameter 38 = 4 (alarm C is caused outside the vicinity of segment position)
If G101A4;M70; is executed in the range specified ④ in Fig. 7.9 (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 parameter 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. 2) (8) "Segment Position Output Timing."**

Table 7.2 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. 7.9 (a) (When PRM38 is 1)	○	○	○	○	○	○	●	○	B'00000010 (=D'02)	○
1H Range ③ in Fig. 7.9 (b) (When PRM38 is 3)	○	○	○	○	○	○	○	●	B'00000001 (=D'01)	●

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.

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

(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 Fig. 7.10 illustrates the frequency characteristics.

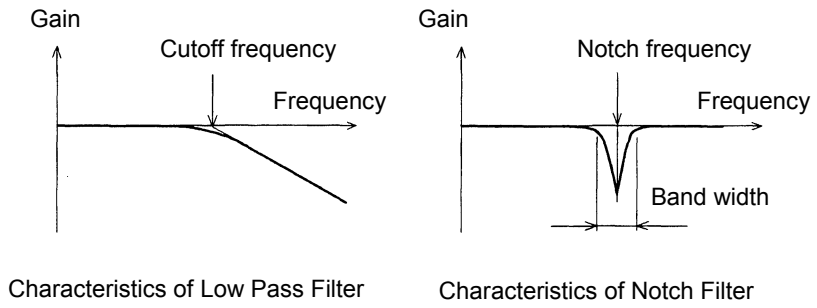


Fig. 7.10 Filter Characteristics

(2) Filter Switch

Parameter 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."

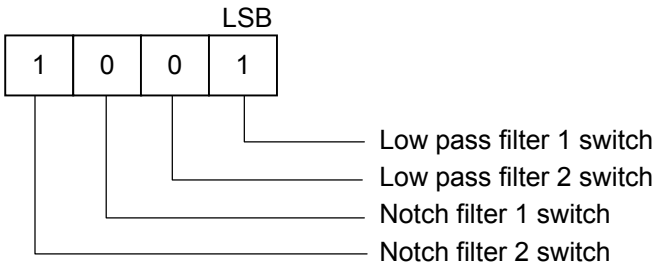


Fig. 7.11 Filter Switch

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

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

(3) Q Value of Notch Filter

The band width "Q" of notch filter can be set using the parameters 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.

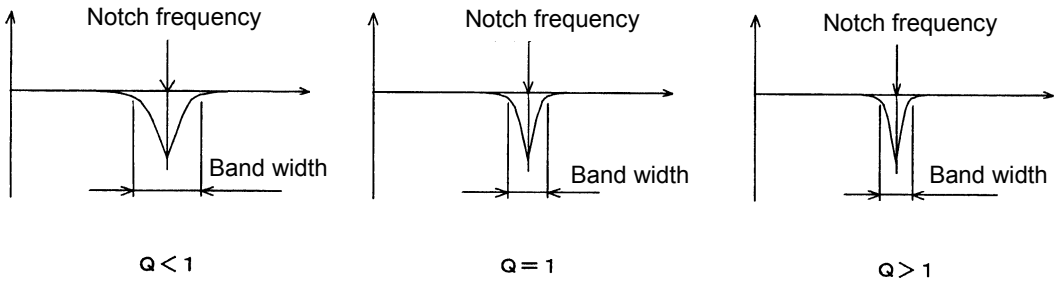


Fig. 7.12 Q Value of Notch Filter and Band Width

(4) Setting Example

The following is an 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 the parameter 62 to 100.
L7_64_200 ↵ Set the parameter 64 to 200.
L7_66_5 ↵ Set the parameter 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**.

(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).

11) Integral Limiter

The integral limiter is related to integral control of the control system inside the controller and it can be entered with parameter 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.**

[GH] 12) Multiplier for Integral Gain

A multiplier for integral gain in the control system of the driver can be set to parameter 72 (integral gain multiplier).
A smaller value serves similar to parameter 67 (integral limiter). A larger value makes the convergence time shorter while the stability of the control system may become less stable.
A smaller value is set as factory setting for stable operation with a large inertia load. A larger value not causing vibration may be set to drive a small inertia load for high speed with brief cycles.

WARNING
Vibration or oscillation may occur with a larger value set to parameter 72 than the factory setting for a load of about one tenth or larger of the allowable load inertia moment.
TO AVOID DANGER, gradually change the setting from the factory setting while observing the result.
When parameter 72 is set to 1.0, it functions equivalent to that of the H-type driver.

8. APPLICATION EXAMPLES

List of Application Examples

Table 8.1 List of Application Examples

	Item	Action Specification	Point
1)	Product type change	Workpiece change without setup change	Change the program according to the workpiece type.
2)	Shortest route indexing	Random indexing	Change the program according to the stopping position. Shortest route is used for the direction of rotation.
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.
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
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.
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 APPLICATION EXAMPLES

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 Fig. 8.1.
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°.

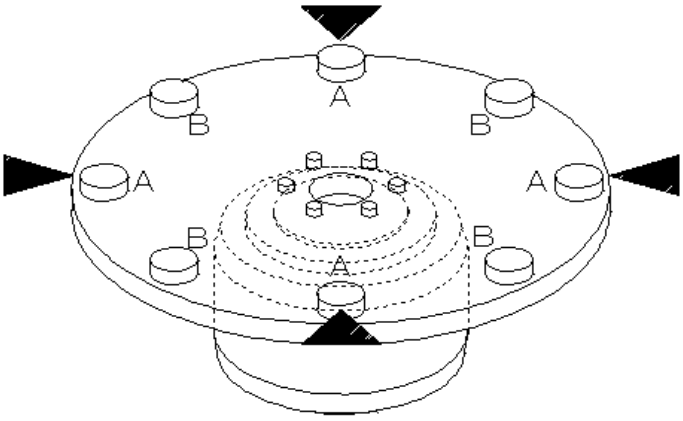
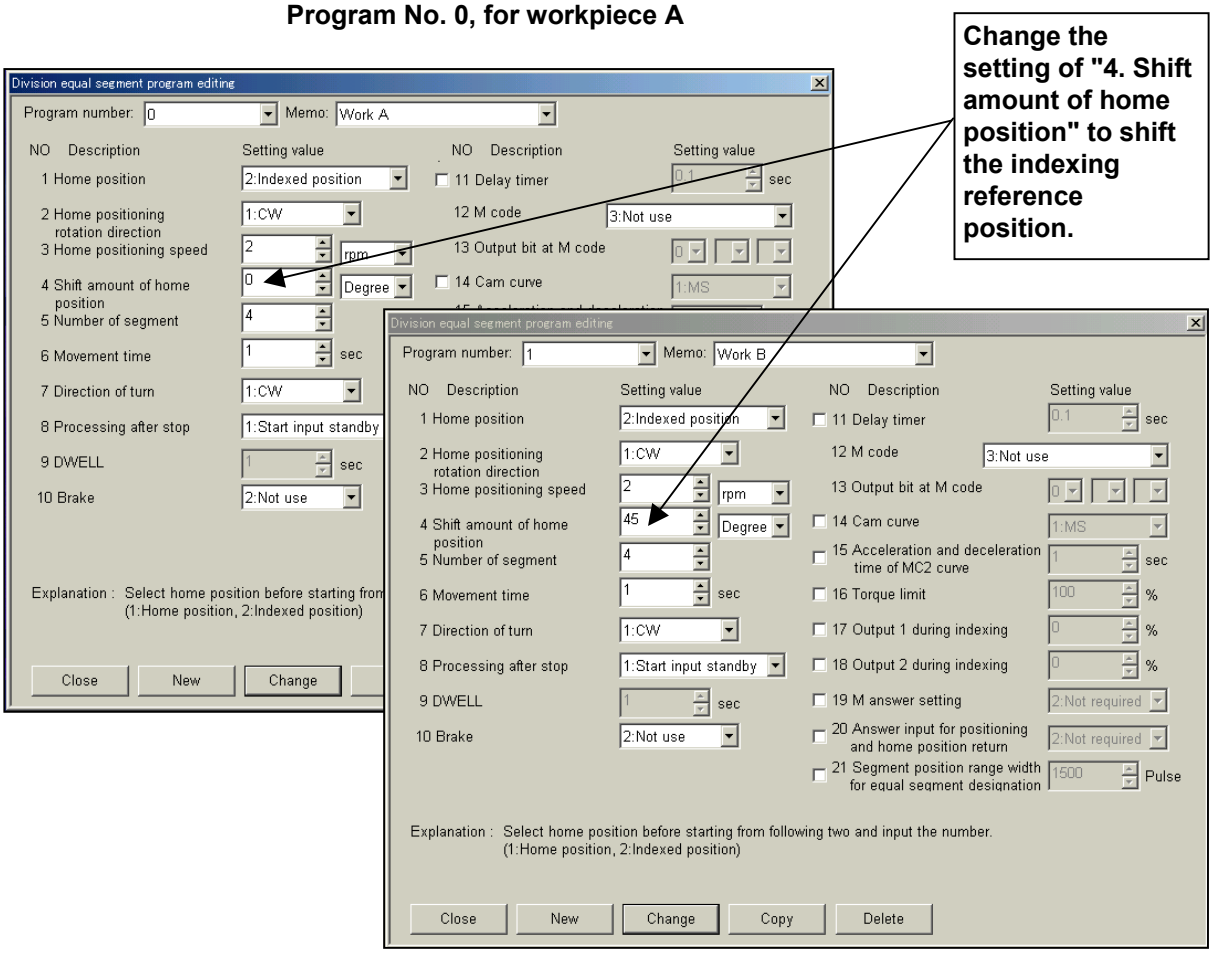


Fig. 8.1 Product Type Change

(3) Program key point (Creation example using Teaching Note)

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.

Note 1: 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 parameter 3 (home position offset amount) occurs without relations to "4. Shift amount of home position" shown in Fig. 8.2.

Note 2: With the program shown in Fig. 8.2, 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 Parameter 38 = 3 (Shortest Route)**.
The action is the same as running "G101A4; G91A1F□□;" as referred.

2) Shortest Route Indexing

(1) Application
Workpiece stocker

(2) Application example
Designate one of four stocker positions to position there.
Rotation follows the shortest route.
(Rotation at larger than 180° does not occur.)

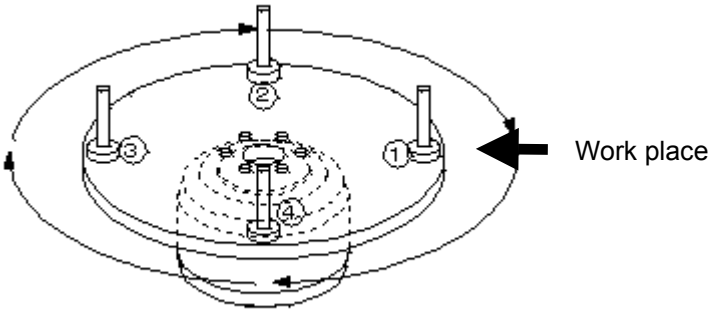


Fig. 8.3 Workpiece Stocker

(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, travel to 0° in 0.5 sec. (Stocker ①)
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, travel to 90° in 0.5 sec. (Stocker ②)
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, travel to 180° in 0.5 sec. (Stocker ③)
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, travel to 270° in 0.5 sec. (Stocker ④)
M30	End of program

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.

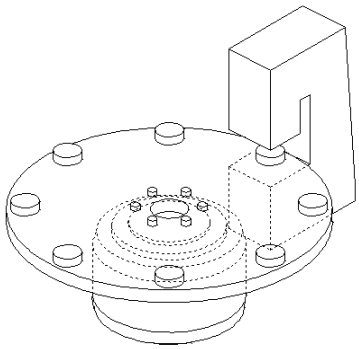


Fig. 8.4 Caulking Process

(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 parameter 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

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.

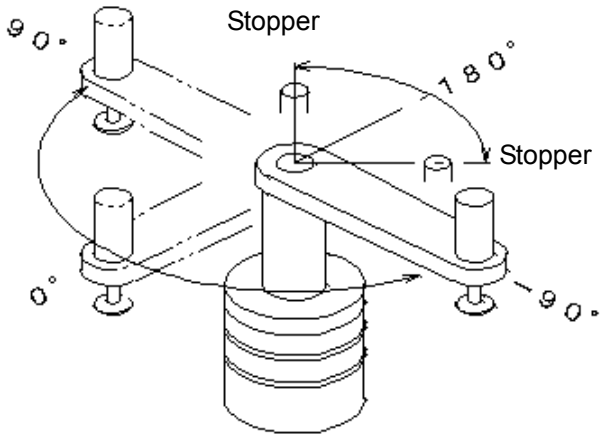


Fig. 8.5 Pick-and-place

(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

Note: 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 parameter 3 (home position offset amount). Refer to **Chapter 7. "PARAMETER SETTING."**)

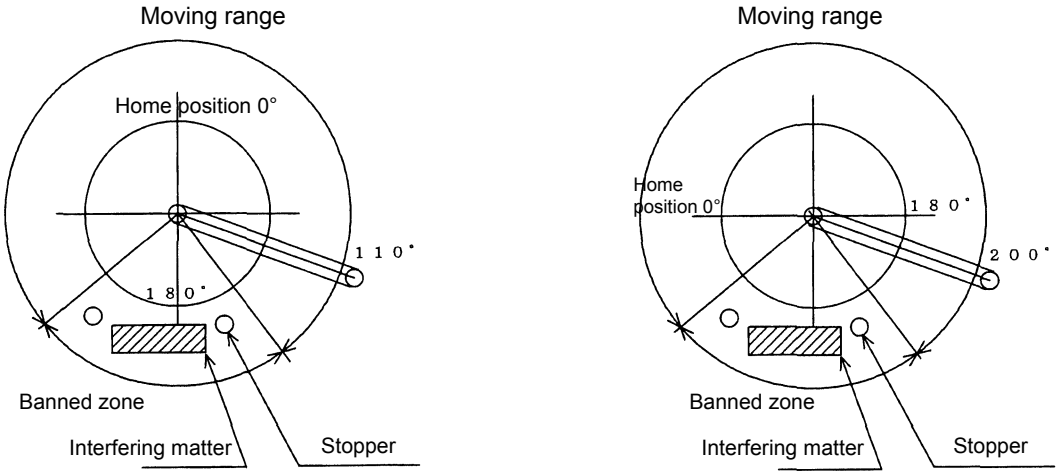


Fig. 8.6 Coordinate System Setting

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.

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.

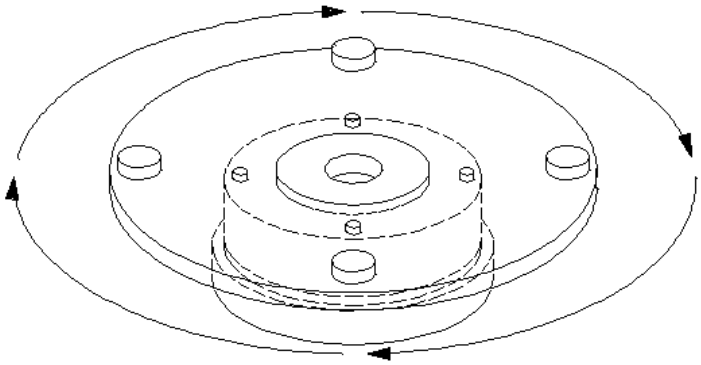


Fig. 8.7 Indexing Table

(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

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

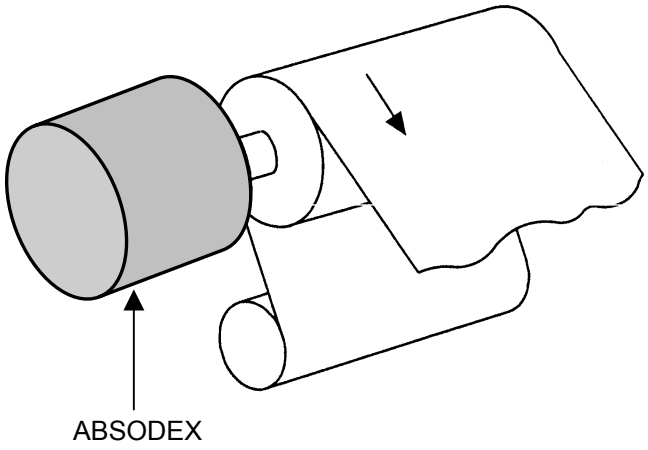


Fig. 8.8 Roll Feeder

(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.

④ Timing output (CN3-48)
If "G101A□;G07;" is executed, the timing output is turned on each time the segment position is passed. (For details, refer to Chapter 5. "HOW TO USE I/O.")

(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

Note 1: 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.

Note 2: 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.

Note 3: If "G101A36;" is omitted in the above program, deceleration begins immediately after the stop input is supplied, to stop after 0.5 sec.

Note 4: 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)."

— MEMO —

9. GAIN ADJUSTMENTS

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. Gain adjustments are made by the DIP switches, G1 and G2 on the front panel. 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 the G1 and G2 DIP switches 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) G1 (Gain 1)
Gain 1 adjusts convergence time. Larger the setting becomes, greater the gain becomes while I (integration gain) increases and D (differentiation gain) decreases. An increase in G1 reduces the convergence time, while the stability of the control system becomes less stable and may allow oscillation to occur more likely. When the load equipment does not have sufficient rigidity, adjust G1 in lower range.

(2) G2 (Gain 2)
Gain 2 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 G2 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 or a dialog terminal which has RS-232C port. For communication using a personal computer, refer to **Chapter 12. COMMUNICATION FUNCTIONS**.

ABSODEX with the brake system should be adjusted using the program which dose not apply brake.

⚠ WARNING:

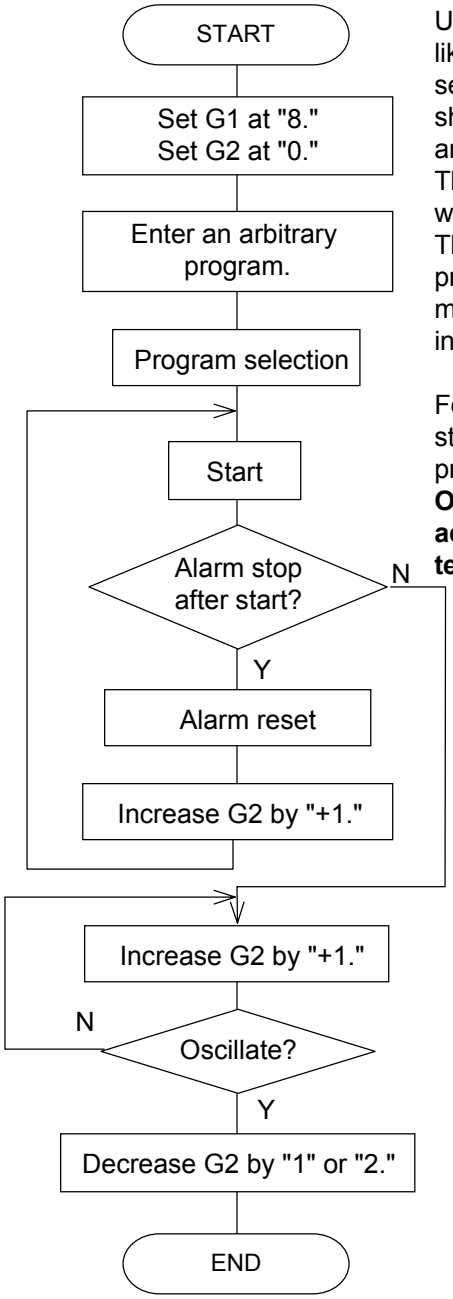
- **KEEP HANDS OFF from the rotating part as sudden motion may take place during gain adjustments. Make sure of the safety for the full revolution of the actuator before turning it on.**
- **MAKE SURE actuator rotation will not cause a danger before starting, when the actuator cannot be seen.**
- **DIP switches G1 and G2 should be positively switched step by step with a minus (-) screw driver while the actuator is not in motion. DO NOT switch 0 → F, or F → 0. (DO NOT switch the DIP switches while the actuator is in motion.)**
- **Unless the actuator or load table is fixed firmly, fierce vibration may occur. Make sure these are firmly fixed, and make adjustments with the actual using load condition or very close to such condition.**

⚠ CAUTION:

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

2) Gain Adjustment Method

Use DIP switches G1 and G2 on the front panel to adjust the gain.
The gain adjustment flowchart is shown below.



Use a regular screwdriver or the like to change the DIP switch setting on the driver panel. The shipment settings are "8" (G1) and "0" (G2).
This setting assumes operation with almost no load.
The G2 setting is determined in principle according to the magnitude of the moment of inertia of the load.

For the entry, selection and starting procedures of the program, refer to **4. TEST OPERATION Step 2. Gain adjustment and creation of test operation program."**

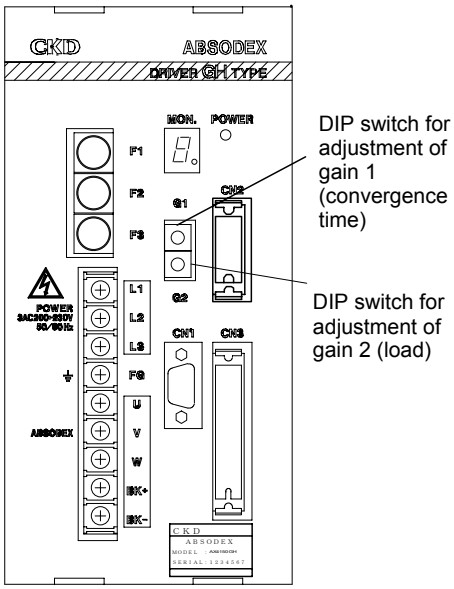


Fig. 9.2 Driver Panel

(Note) If the moment of inertia of the load is large and the gain setting is too small, the actuator may swing or an alarm is caused to coast to stop due to inertial force when a start input is supplied.

(Note) If the rigidity of the equipment is not large, vibration may be caused. If this is the case, reduce G1 and perform similar adjustment.

(Note) If gain adjustment is unsuccessful, perform similar adjustment with a longer indexing time and a smaller rotation speed. Then gradually reduce the indexing time while observing the result.

Fig. 9.1 Flowchart of Gain Adjustment

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

[GH] 3) Approximate Gain Setting

An approximate G2 setting for the GH Series with G1 setting at "8" is shown.

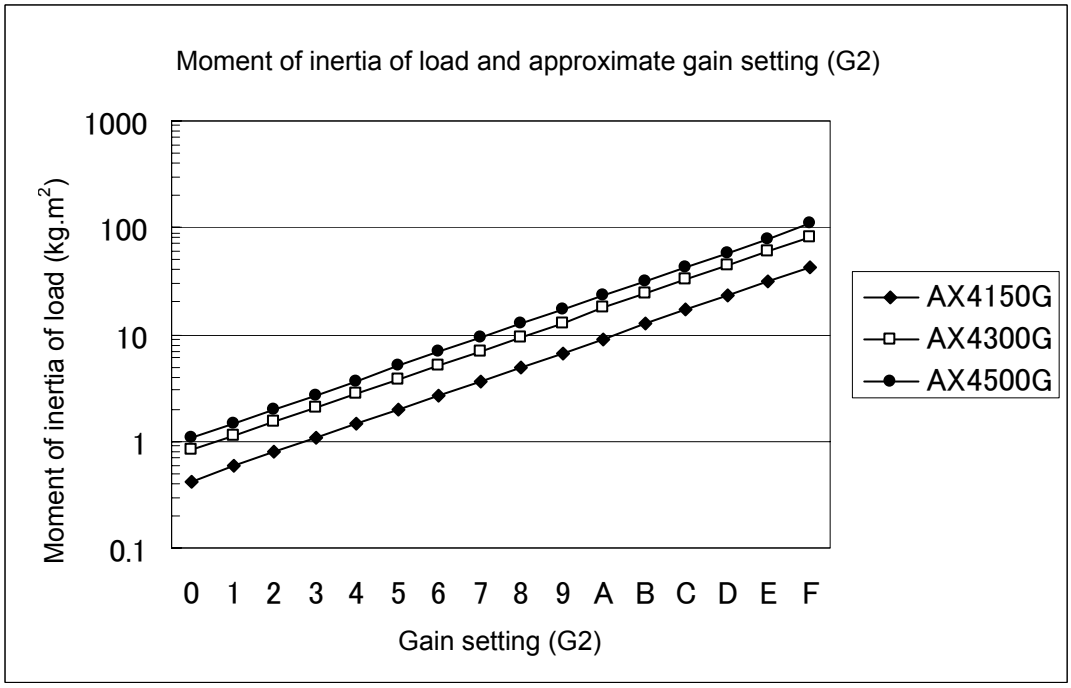


Fig. 9.3 Approximate gain setting for AX4000GH Series

Note: For an inertia moment load exceeding that shown in the chart, the approximate G2 setting should be "F."

Note: The best G2 setting varies according to the rigidity of the equipment, G1 setting and other conditions. Refer to the chart shown above and adjust the gain suitably for the equipment conditions.

10. ALARMS

An error to ABSODEX will display an alarm number in the 7 segment LED on the front of the driver. 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.)

1) Alarm Display and Description

The table 10.1 lists alarm displays and their description. Additional alarms for the GH type are shown in Table 10.2. Refer to **Chapter 11. MAINTENANCE AND TROUBLESHOOTING** for troubleshooting of the alarms.

Table 10.1 Alarm (1/2)

LED Display	Alarm No.	Description	Alarm Output	Remarks
	0	NC program error	Alarm 1	Program selection error Program data error
	1	Position deviation over or speed over	Alarm 1 Alarm 2	Settings of parameters 19 and 20 are exceeded.
	2	Regenerative resistor overheat	Alarm 1 Alarm 2	
	4	Actuator overload (electronic thermal)	Alarm 1 Alarm 2	
	5	Power module abnormal	Alarm 1 Alarm 2	Overcurrent, Module overheat
	6	Main power abnormal	Alarm 1 Alarm 2	
	7	Communication error (data input error)	Alarm 1	
	8	CPU error	(Indefinite)	Hardware of CPU in the driver may be faulty.
	9	An emergency stop input has been made.	Alarm 2	
	A	Brake abnormal	Alarm 2	An attempt was made to move while the brake is on. The brake is applied during a travel.

Table 10.1 Alarm (2/2)

LED Display	Alarm No.	Description	Alarm Output	Remarks
	C	Software limit over	Alarm 2	Parameters 8 and 9 settings are exceeded. Or ±18 revolutions are exceeded.
	E	Emergency stop by dialog terminal	Alarm 2	
	F	Resolver abnormal	Alarm 1 Alarm 2	Error in position detector
	H	No M answer No positioning answer	Alarm 2	Parameter 11 setting is exceeded.
	P	Memory abnormal	Alarm 2	Data writing error to internal memory.

- **With no alarm displayed,**  **(r and dot) will be displayed on LED.**

- **For servo off (M5 executed),**  **(dot only) will be displayed on LED.**

⚠ CAUTION:

- **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.)**

[GH] Table 10.2 Additional Alarms for GH Type

LED Display	Alarm No.	Description	Alarm Output	Remarks
	3	Actuator and driver combination error	Alarm 1	The combination between the actuator and driver is incorrect.
	L	Actuator communication error	Alarm 1 Alarm 2	Failure to receive actuator data

- **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

⚠ 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.**

2) Servo Status for Alarms

Alarm: 1, 2, 4, 5, 6, 9 (parameter 23 = 3), A, F and L
Servo OFF

Alarm: 0, 3, 7, 9 (parameter 23 = 1), C, E, H and P
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 (parameter 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

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 4, 6 and 8 which require to be inspected with power ON.

Table 11.1 Periodical Inspection

Inspection Item	Inspection Method	Countermeasures
1. Dust inside the driver	Inspect internal visually.	Clean internal of the driver.
2. Loose terminal screw and connectors	Check that the screws and connectors are not loose.	Re-tighten screws and connectors.
3. Discoloration by heat, and damage, and liquid leak from the capacitor	Visually inspect internal.	Replace parts or request CKD to repair.
4. Check if the fan operates correctly.	Check the fan visually or by hearing.	Replace the faulty part.
5. Clogging in the fan exhaust vent.	Check the exhaust vent visually.	Clean.
6. Abnormal noise from actuator and brake part.	Confirm by hearing.	Replace parts or request CKD to repair.
7. Cuts and crack in cable.	Check the cable visually.	Replace faulty cable.
8. Power voltage	Confirm the supply voltage with a tester.	Check the power supply system to supply power within the specified voltage range.
9. Compressed air pressure for brake (with pneumatic brake)	Check the air pressure gauge.	Adjust the regulator. (0.5MPa)
10. Fouled air filter for compressed air (with pneumatic brake)	Inspect the filter visually.	Follow the air equipment maintenance manual.
11. Brake condition (with brake)	Inspect the brake manually.	Replace brake parts or request CKD to repair.
12. Blown fuse.	Check the fuse visually.	Replace the faulty part.

(2) Maintenance Parts List

Table 11.2 Maintenance Parts List

Parts Name	Model	Maker	Remarks
1. Fuse	FGBO (10A, 250VAC)	FUJI TERMINAL	Standard model
	19195 (10A, 250VAC)	WICKMAN	Models complying with EU directives (-K)
2. SELEX valve	AX-0002	CKD	
3. Cooling fan	AX-0003 (Note) (2408NL-04W-B20)	NMB	

Note: The AX-0003 is the NMB made fan with the connector added by CKD.

(3) Parts Replacement Intervals and Replacing Method

① Fuse

Replacement Timing:

There is no need for periodic replacement. Replace the fuse if it is blown.

Check the wiring without fail if the fuse is blown as leakage or a short circuit may be causes.

How To Replace:

Remove the cap of the fuse holder on the front panel of the driver and replace the fuse.

② SELEX valve (for pneumatic brake) AX5000, AX8000 series

Replacement Timing:

The valve has an estimated life cycle of 10,000,000 times of motion using clean compressed air (at 0.5MPa).

Replacing Method:

SELEX valve for brake is located in the connector base on the side of the actuator.

Loosen the hex cap screws to remove the connector base, and remove the screws fixing the valve for replacing the valve.

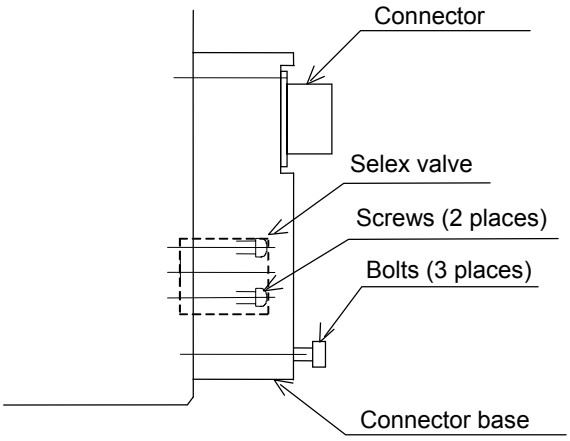


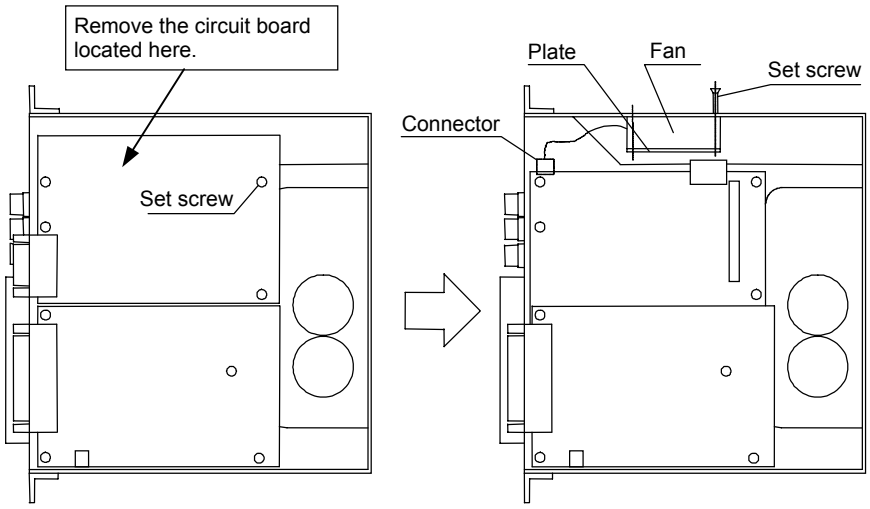
Fig. 11.1 Replacement of Valve

- **An O-ring is installed between the connector base and the unit. For re-assembly, make sure this O-ring is correctly mounted. Selex valve (AX-0002) is provided with a gasket, which should be correctly mounted for assembly of the valve.**

- **With AX5022 to AX5150, AX8045 and AX8070, one Selex valve is used, while two Selex valves are used with AX5210.**

④ Cooling fan (for driver)
Replacement Timing:
Replace about every 20000 hours.

How To Replace:
Remove the right side cover and the front cover of the driver and remove the circuit board located at the top.
(This is the resolver board for the H type drivers or the communications board for the GH type drivers).
Disconnect the cooling fan cable connector, remove four set screws, and replace with the new cooling fan.
Install the cooling fan so that the air flows upward.



① Remove four set screws and remove the circuit board.

② Disconnect the connector and remove the fan.

Fig. 11.2 Replacing the Cooling Fan

(4) Replacing Electrolytic Capacitor
The capacitors used for the driver are an electrolysis type, which deteriorates with time. Deterioration speed depends on the ambient temperature and using condition. When used in an air conditioned space, the condensers will last about ten years under daily operation for 8 hours. Request CKD to replace it with a new one.
When solution leak or open pressure relief valve are found in the periodical inspection, immediately request CKD to repair.

2) Troubleshooting

Table 11.3 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. → Repair the driver. (Refer to (11.1). (3). ①.)
2. Output axis rotates when power is turned ON to cause alarm lamp to light.	◆ Gain adjustments are not made. ◆ Actuator and driver have different serial numbers. [H] ◆ Cable between the actuator and driver is broken or the connectors are loose. ◆ Wrong UVW connection	→ Adjust gain (Refer to **Chapter 9. GAIN ADJUSTMENTS**). → Use the driver and actuator having the same serial number. [H] → Check the cable connector. → Change the wring connection of the cable.
3. Alarm F will light when power is turned on.	◆ The resolver cable between the actuator and driver may be broken or the connectors may be loose. ◆ Actuator and driver have different serial numbers. [H] ◆ Excessive moment and lateral loads are applied to the actuator.	→ Check the cable connectors. → Use the driver and actuator having the same serial number. [H] → Check the equipment alignment. Remove excessive load.
4. No communication with a personal computer or a dialog terminal.	◆ 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. GAIN ADJUSTMENTS**). → Tighten bolts. → Increase load rigidity by reinforcement and to adjust gain smaller. Install dummy inertia, and use anti-vibration filter → Reduce friction load. → Retighten the bolts.
6. Alarm 0 turns on.	◆ NC program error ◆ Program number setting input has been made while writing a program. ◆ An unknown program number is selected and started. ◆ Started in servo-off mode (G12P0)	→ Review the NC program. → DO NOT turn on number setting while writing a program. → Change the program number or write a program. → Turn the servo on (G12P100) before a rotation code.

Table 11.3 Troubleshooting (2/4)

Symptom	Probable Cause	Countermeasures
7. Alarm 1 lights.	◆ The actuator is loosely tightened.	→ Retighten the bolts. Retighten without fail.
	◆ Load is excessive.	→ Reduce speed.
	◆ DC power (24V) is not supplied for brake built-in series.	→ Supply 24VDC (Refer to 3. 2). (4).).
	◆ Valve for pneumatic brake is faulty.	→ Replace the valve (Refer to Fig. 11-1.).
	◆ Actuator and driver have different serial numbers. [H]	→ Use the driver and actuator having the same serial number. [H]
	◆ 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.
	◆ Load is not fixed tight.	→ Tighten bolts.
	◆ Gain adjustments are not made sufficiently.	→ Adjust gain (Refer to **Chapter 9. GAIN ADJUSTMENTS.**).
8. Alarm 2 lights.	◆ Acceleration/deceleration cycles are large.	→ Set stop time longer (Take time for heat reduction to re-start).
9. Alarm 4 lights.	◆ Acceleration/ deceleration cycles are large.	→ Set stop time longer (take time for heat reduction to re-start).
	◆ Moving time is short.	→ Revise the program.
	◆ Load equipment resonates.	→ Install dummy inertia (Refer to 2. 1). (3)), and 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.
10. Alarm 5 lights.	◆ Insulation of the actuator is faulty.	→ Check the cable connectors, and installed environment.
	◆ Connection of the actuator and driver is not correct.	→ Check the cable connection (Refer to 3. 2). (2).).
	◆ Ambient temperature around the driver is high.	→ Ventilate to reduce ambient temperature.

Table 11.3 Troubleshooting (3/4)

Symptom	Probable Cause	Countermeasures
11. Alarm 6 lights.	◆ Power voltage is low. ◆ Instantaneous power failure has occurred. ◆ Power resumed immediately after power off.	→ Check the power system. → Check the power system. → Turn off power, and turn it on after a few seconds.
12. Alarm 9 lights.	◆ Emergency stop is input. ◆ 24VDC is not supplied.	→ Check I/O signal. Confirm the parameter 23. → Supply 24VDC.
13. Alarm A lights.	◆ An attempt was made to rotate with brake-on. The brake is applied in a travel. ◆ Parameter 28 is set for motion.	→ Review the program. → Revise the parameter and review the program.
14. Alarm H lights.	◆ Answer input is not made for M code, and positioning completion. ◆ No answer input is supplied. ◆ Parameter was changed by mistake. ◆ A start input or home positioning input is supplied in the state waiting for an answer input.	→ Check I/O signal. Confirm the parameters 11,12 and 13. → Confirm program and timing of sequencer (PLC). → Confirm the parameters 12 and 13. → Check I/O signal.
15.Alarm C lights.	◆ Internal coordinate system has overflowed (G92 user coordinate system). ◆ Parameter was changed by mistake.	→ Review the program (reset the G92 coordinate system). → Revise the parameters 8, 9 and 10.
16. Alarm E lights.	◆ Dialog terminal is faulty. ◆ RS-232C cable is shortcircuited.	→ Repair the terminal. → Check the cable.
17. Alarm P lights.	◆ The driver is faulty.	→ Repair the driver.
18. Alarm L lights. [GH]	◆ There is a communication error between the actuator and driver.	→ Check the cable wiring.
19. Alarm 3 lights. [GH]	◆ There is a combination error.	→ Check the combination between the actuator and driver. → Enter the program and parameters again.

Table 11.3 Troubleshooting (4/4)

Symptom	Probable Cause	Countermeasures
20. When the program is stored, alarm 7 lights up and the program is not stored.	◆ The program area is full. ◆ Program data is broken. ◆ Write protection state ◆ No answer input is supplied in response to an M code or positioning completion output.	→ 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. → Check I/O signals. Check parameters 11, 12 and 13.
21. 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.	→ 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 parameter 29.
22. Pneumatic brake does not release.	◆ 24VDC I/O power is not supplied. ◆ Valve is faulty.	→ Check power source (Refer to 3. 2). (5).). → Replace the valve (Refer to Fig. 11-1.).
23. The electromagnetic brake does not release.	◆ 24VDC I/O power is not supplied. ◆ 24VDC is not supplied to the electromagnetic brake.	→ Check the power supply and wiring. (Refer to Section 3.2 (4).) → Check the power supply, wiring and the relay. (Refer to Section 3.2 (4).)
24. Alarm 7 lights when connected to the dialog terminal.	◆ Parameter 26 is changed.	→ Check the parameter 26.
25. 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."
26. Repetitive five-segment (72-degree) indexing operations cause deviation.	◆ Accumulated error due to incremental dimension	→ Use the equal segment program (G101).
27. Parameters are not stored.	◆ Pulse string input (M6) operation mode ◆ No answer input is supplied in response to an M code or positioning completion output.	→ Change to the automatic operation (M1) or single block (M2) operation mode and store. → Check I/O signals. Check parameters 11, 12 and 13.

- **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.**

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 dialog terminal to CN1.
② Select terminal mode on the dialog terminal, 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.**

12. COMMUNICATION FUNCTIONS

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

1) Communication Codes

(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, S20	Motion instruction	0	*(2AH)
L1 to L21	Data I/O	Value defined by each code (Table 12.4)	*(2AH)

(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 Table 12.1, and CR, and LF (line feed code 0AH).

(Example 1) Parameter setting.....to set 3 for parameter 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.

(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.**

2) Communication Code List

(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. (Note) 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	Disable motions by using the NC program, and changing parameters. To change, switch to M1 to M5.

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

- **CR denotes carriage return code (0DH).**
- **Under servo-off mode, output axis can be manually rotated as the actuator loses its restriction torque. Under these conditions, communications enable to refer to the current position helping find machine standard reference position. (For brake built-in models, brake releasing is required.)**
- **Switching servo-off mode to other operation modes 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.**
- **Servo-off status, when M5 is executed, LED**  **(dot only) is displayed on the driver panel.**

(2) Motion Instructions

Table 12.3 Motion Instruction Codes

Code	Description	Input Data Type	Remarks
S1	Start	S1 CR	Auto run, single block Same function as CN3 program start input
S2	Program operation 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 the parameters 14 and 15 until S2 (program stop input) or S20 (continuous rotation stop) is input.
S6	Jog (CCW)	S6 CR	
S7	Alarm reset	S7 CR	Effective only for alarm Same function as CN3 reset input
S20	Continuous rotation stop	S20 CR	Continuous rotation stop G7 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."**

(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
L2	I/O Status Output	L2_[IO Address] CR 4 digit, HEX display (Example) L2_E080008 CR	[IO Data] CR LF (Note) 4 digit, HEX display (Example) FFFF CR LF
L3	Current Position Output Unit: Pulse Coordinate: Actuator coordinate	L3 CR	[Position Data]CR LF 6 digit maximum (0 to 540671)
L4	Current Position Output Unit: Degree Coordinate: Actuator coordinate	L4 CR	[Position Data] CR LF 7 digit maximum (0 to 359.999)
L5	Current Position Output Unit: Pulse Coordinate: G92 coordinate	L5 CR	[Position Data] CR LF
L6	Current Position Output Unit: Degree Coordinate: G92 coordinate	L6 CR	[Position Data] CR LF
L7	Parameter Data Input	L7_[Parameter Number]_[Data]CR (Example) L7_8_135168 CR (Pulse unit) L7_8_A90 CR (Angle unit) L7M_8_A90 CR (Angle unit) To set 135168 to the parameter 8.	0 CR LF

- **I/O address is an internal I/O address which is detailed in 5. HOW TO USE I/O. Each bit of the data expressed with HEX corresponds with each I/O signal.**

Table 12.4 Data Input and Output Code (2/3)

Code	Description	Input Data Type	Output Data Type
L8	Not to be used		
L9	Parameter Data Output	L9_[Parameter Number]CR (Example) L9_8 CR (EEPROM data output) L9_8A CR (EEPROM data output) L9M_8A CR (RAM data output)	[Data]CR LF (Example) 135168 CR LF (Pulse unit) 90 CR LF (Angle unit) 90 CR LF (Angle unit)
L10	Output of Currently Set Program Number	L10 CR	[Data]CR LF
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.	0 CR LF

Table 12.4 Data Input and Output Code (3/3)

Code	Description	Input Data Type	Output Data Type
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		
L21	Mode Output	L21 CR	[Mode] CR LF (Example) M1 CR LF
L22 or more	Not to be used		
L89	Serial actuator number output	L89 CR	[Serial number] CR LF (Example) Ser.1234567 CR LF

- **CR denotes carriage return code (0DH), LF denotes line feed code (0AH) and _ denotes blank space code (20H).**

- **Use the communication codes, L7, 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 by these communication codes.

- **The L89 communication code will not function with Teaching Note that has a function to automatically display the serial number.**

[GH] ● **The L89 communication code will not function for the GH type drivers without connection with the actuator.**

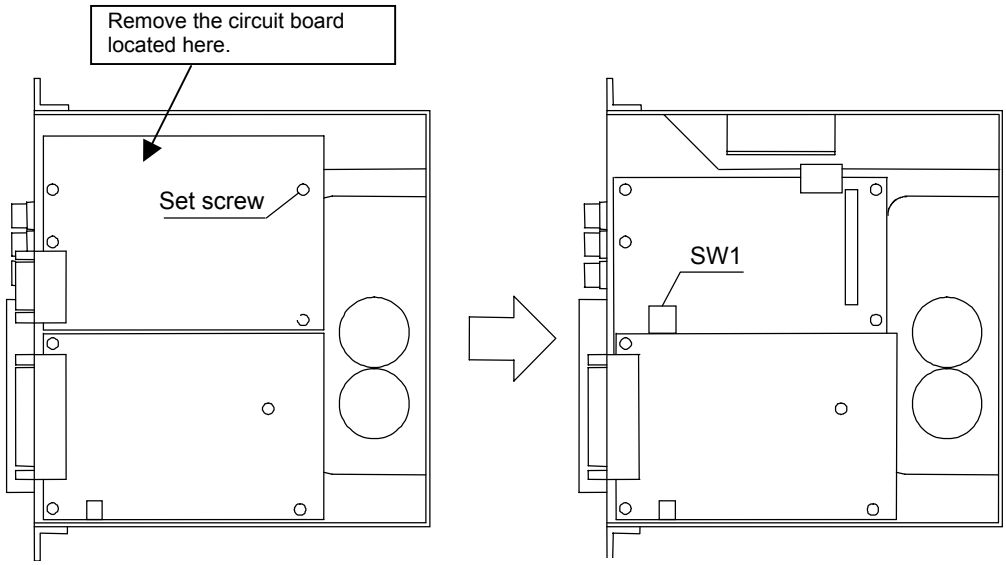
3) Changing the Baud Rate

The default setting of the baud rate is 9600 baud. To change, turn the rotary switch (SW1) inside the driver in the desired position.
For details, refer to **Chapter 15. DRIVER SPECIFICATIONS**.

Table 12.5 Changing the Baud Rate

Setting	Baud rate
0	1200
1	2400
2	4800
3	9600 [Default Setting]

Changing method:
Remove the right side cover and the front panel of the driver, then remove the circuit board located at the top.
(This will be the resolver board (H type) or the communications board (GH type).)
Turn SW1 to the desired baud rate.



① Remove the four set screws and remove the circuit board.

② Turn SW1 to the desired baud rate.

Fig. 12.1 Changing the Baud Rate

Note: **To use the dialog terminal (AX0170H), adjust to 9600 baud [default setting].**

Note: **Do not touch the other switches except for SW1.**

⚠ CAUTION:

- **Make sure to disconnect the power before changing the switch setting to avoid possible electric shock. Even after disconnecting the power, keep away for approximately five minutes until the electric charge accumulated in capacitors are discharged.**

4) Communication Methods

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

(1) Communication Examples

The following are the examples of control method of ABSODEX using the communications.

Connect the dialog terminal or a PC and communicate.

(_ denotes blank 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.

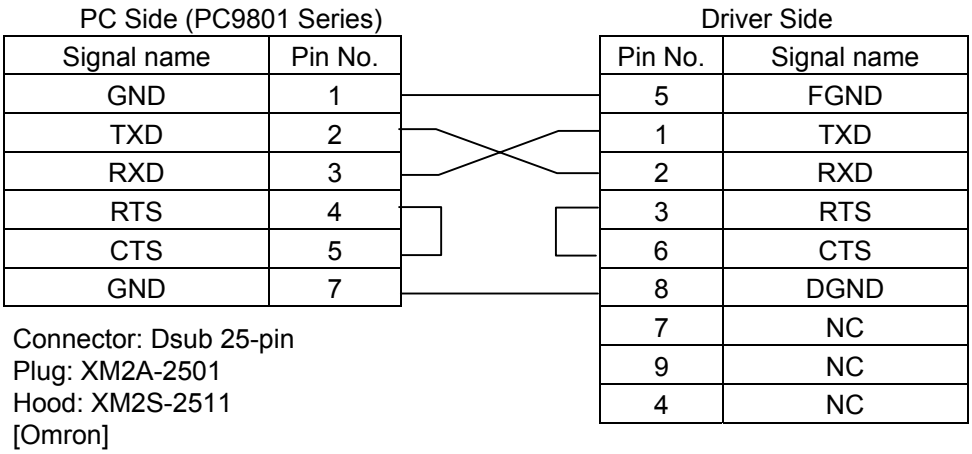
② Auto Run Mode

< 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.**

(2) Example of RS-232C Interface Cable Connection

① PC side Dsub 25-pin



PC Side (PC9801 Series)

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

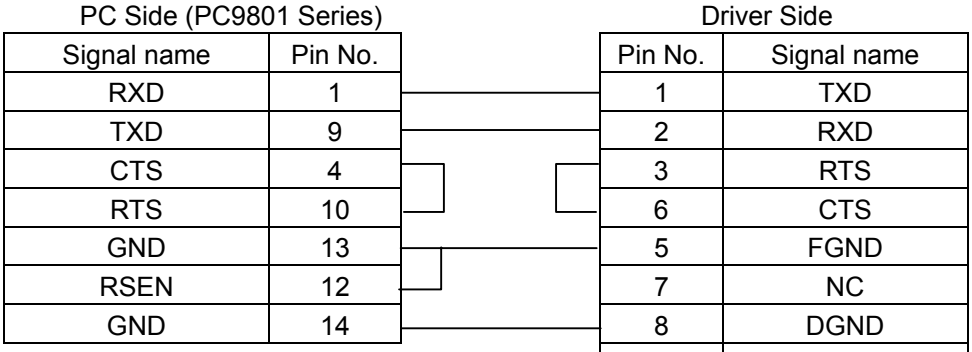
Driver Side

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

Connector: Dsub 25-pin
Plug: XM2A-2501
Hood: XM2S-2511
[Omron]

Fig. 12.2 Example of RS-232C Cable Connection (Dsub 25-pin)

② PC side half pitch 14-pin



PC Side (PC9801 Series)

Signal name	Pin No.
RXD	1
TXD	9
CTS	4
RTS	10
GND	13
RSEN	12
GND	14

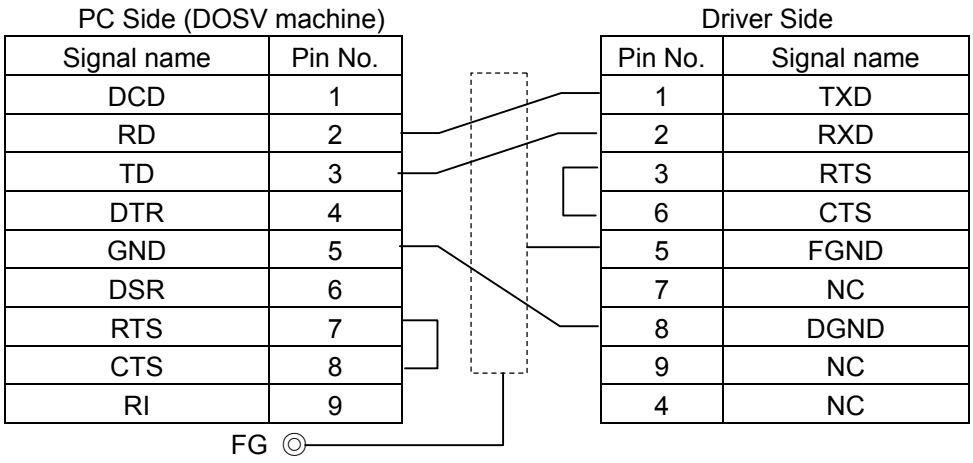
Driver Side

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

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

Fig. 12.3 Example of RS-232C Cable Connection (half pitch 14-pin)

③ PC side Dsub 9-pin (DOSV machine)



Connector: D-sub 9-pin
Plug: XM2D-0901 [Omron]
Hood: XM2S-0913 [Omron]

Fig. 12.4 Example of RS-232C Cable Connection (Dsub 9-pin)

CAUTION:

- **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.**

- **The connector model numbers of the driver side RS-232C cable are as follows:**
  Plug: XM2A-0901 (Omron)
  Hood: XM2S-0911 (Omron)

- **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.)

— MEMO —

13. SUPPORT FOR EUROPEAN STANDARD [H]

The following models of ABSODEX are certified to EN standards by Tuf Lineland.
(The support is provided with optional models.)

1) Models Certified to European Standards

[H] Table 13.1 List of Models Certified to European Standards

Series	Model		
	Actuator	Driver	Source Voltage
AX1000	AX1022H-K	AX9022H-K	3-phase or single-phase 200VAC, 3-phase or single-phase 200 to 230VAC, single-phase 100VAC
	AX1045H-K	AX9045H-K	
	AX1075H-K	AX9075H-K	3-phase 200VAC, 3-phase 200 to 230VAC
	AX1150H-K	AX9150H-K	
	AX1210H-K	AX9210H-K	
AX2000	AX2006H-K	AX9006H-K	3-phase or single-phase 200VAC, 3-phase or single-phase 200 to 230VAC, single-phase 100VAC
	AX2012H-K	AX9012H-K	
	AX2021H-K	AX9021H-K	
	AX2042H-K	AX9042H-K	
AX3000	AX3022H-K	AX9022H-K	3-phase or single-phase 200VAC, 3-phase or single-phase 200 to 230VAC, single-phase 100VAC
	AX3045H-K	AX9045H-K	
	AX3075H-K	AX9075H-K	3-phase 200VAC, 3-phase 200 to 230VAC
AX4000	AX4009H-K	AX9009H-K	3-phase or single-phase 200VAC, 3-phase or single-phase 200 to 230VAC, single-phase 100VAC
	AX4022H-K	AX9022H-K	
	AX4045H-K	AX9045H-K	
	AX4075H-K	AX9075H-K	3-phase 200VAC, 3-phase 200 to 230VAC
	AX4150H-K	AX9150H-K	
	AX4300H-K	AX9300H-K	
	AX4500H-K	AX9500H-K	
AX5000	AX5022H-K	AX9022H-K	3-phase or single-phase 200VAC, 3-phase or single-phase 200 to 230VAC, single-phase 100VAC
	AX5045H-K	AX9045H-K	
	AX5075H-K	AX9075H-K	3-phase 200VAC, 3-phase 200 to 230VAC
	AX5150H-K	AX9150H-K	
	AX5210H-K	AX9210H-K	

- **The 3-phase 200VAC or 200 to 230VAC specification driver can be used for the single phase if the maximum output torque of the model is within 50N-m.**
  In this case, connect the rated single-phase power across L1 and L2.

2) Applicable Standards

(1) Low voltage directives
Driver: EN50178
Actuator: EN60034-1, EN60034-5

(2) Electromagnetic compatibility directive
Driver: EN55011, EN61800-3

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

(1) Installation condition

Be sure to observe the following installation conditions to operate our product safely.
Installation category: Category II
Pollution degree: Class 2

(2) Protection against electric shock

The product is designed to comply with class I, where only basic isolation is provided.
The power supply circuit, primary control circuit and secondary control circuit (inputs/outputs of CN1, CN2 and CN3) are isolated from each other only with basic isolation.
Provide the final assembly, in which ABSODEX is installed, with auxiliary isolation complying with EN50178 and EN60664-1 so that the dangerous primary voltage circuit is separated from the external low-voltage operation circuit.

Use CN1 exclusively for the dialog terminal. Do not connect it to a computer. Connect the dialog terminal only when entering or changing data. Disconnect it in other cases.

(3) Environment

Operate our product in pollution degree class 2 or cleaner environment. To use it in pollution class 3, install the driver in a control cabinet (IP54) where entry of water, oil, carbon, metallic powder, dust and others is blocked.

(4) Power supply

Operate under conditions of installation category II. To achieve the purpose, use a reinforced isolation transformer at the power supply input section and use varistor (TVS) or the like to block 1500V or higher impulse voltages.

(5) Grounding

Be sure to ground the protective grounding terminal of the driver to avoid electric shock.
Even if an earth leakage breaker is used, be sure to ground the protective grounding terminal of the driver to avoid electric shock.
Connect only one cable when connecting a grounding cable to the protective grounding terminal. Do not tighten two or more cables at a single terminal.

(6) Dialog terminal
Check if the dialog terminal complies with the standard applied to the final product in which ABSODEX is installed. For the judgment of danger, refer to EN1050. For robots, refer to EN775, ANSI/RIA R15.06 and ISO 10218.

(7) Test operation
Perform test operation in the final installation state according to the description given in EN50178 (insulation resistance 9.4.5.4, visual inspection 9.4.1, and operation test 9.4.7).

(8) Wiring precautions
Be careful to avoid contact between the primary and secondary cables at the terminal block. Use crimp terminal equipped with insulating tube for the wiring at the terminal block.

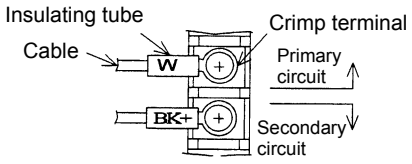


Fig. 13.1 Wiring at Terminal Block

(9) Connection of circuit breaker
To connect the main power supply, connect a circuit breaker having a rated current matching the model, for each driver. For the rated current of the circuit breaker, refer to Table 13.5.

(10) Earth leakage breaker
When using RCD (residual-current-operated protective device; protective device such as the earth leakage breaker), use type B, which operates even on the direct current, on the main power supply side of the electronic device (EE; ABSODEX driver).
Otherwise double isolation, separation of EE with reinforced isolation, or an isolating transformer is necessary to isolate from the power supply.

(11) Emergency stop

The category of the stopping function of the equipment in which ABSODEX is installed depends on the danger degree. Category 2 is insufficient for the emergency stop in most cases. Use an electromagnetic switch or other electric parts to shut off from the main power supply or take similar measures.

Note that, if the power supply is shut off during rotation of the output axis of the actuator, the output axis may keep rotating due to inertia force.

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 EN60204: 1997.)
The emergency stop function of the inside of ABSODEX belongs to category 2.

(12) Operating environment

[H] Table 13.2 Actuator

Condition	Temperature	Humidity	Atmospheric Pressure
During operation	0 to 45°C	20 to 85%RH, no condensation	86kPa to 106kPa
During storage	-20 to 85°C	20 to 90%RH, no condensation	86kPa to 106kPa
During transportation	-20 to 85°C	20 to 90%RH, no condensation	86kPa to 106kPa

[H] Table 13.3 Driver

Condition	Temperature	Humidity	Atmospheric Pressure
During operation	0 to 50°C	20 to 90%RH, no condensation	86kPa to 106kPa
During storage	-20 to 80°C	20 to 90%RH, no condensation	70kPa to 106kPa
During transportation	-20 to 80°C	20 to 90%RH, no condensation	70kPa to 106kPa

4) Installation Method

Figs. 13.2 and 13.3 indicate installation methods. Install the designated filter and ferrite core in the inputs and outputs of the driver and build in a conductive enclosure. Strip the motor and resolver cables of sheath and use a grounding (FG) clamp or the like to make the shield into contact with the enclosure. Ground the actuator as shown in Fig. 13.5. Parts used for installation are shown in Table 13.4.

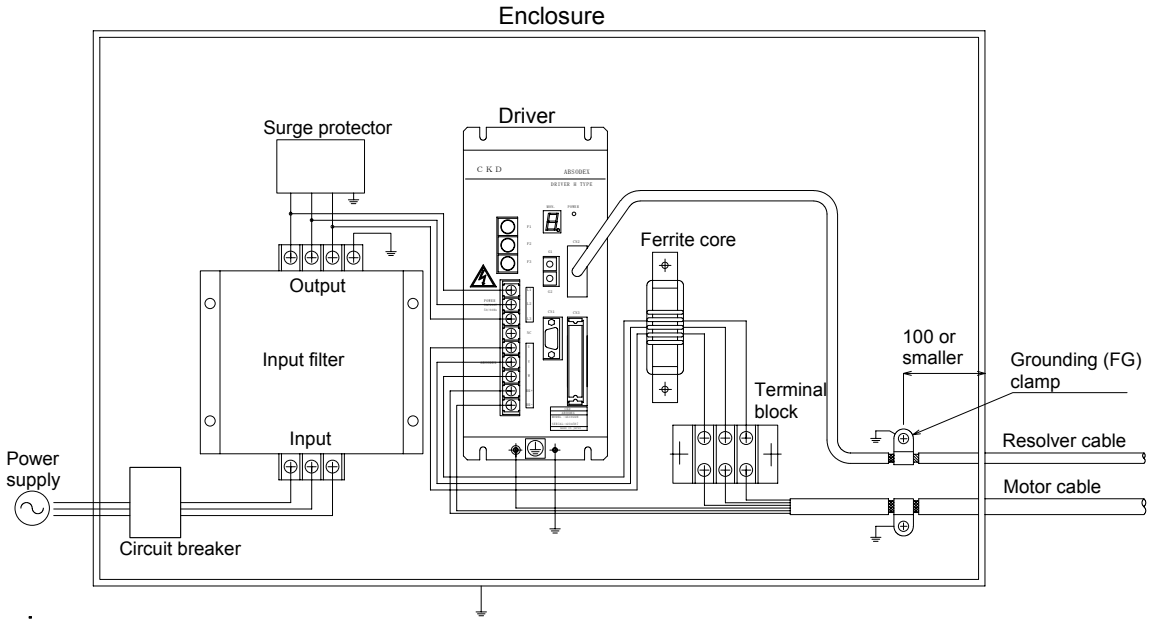


Fig. 13.2 Installation of Driver (in case of 3 phases)

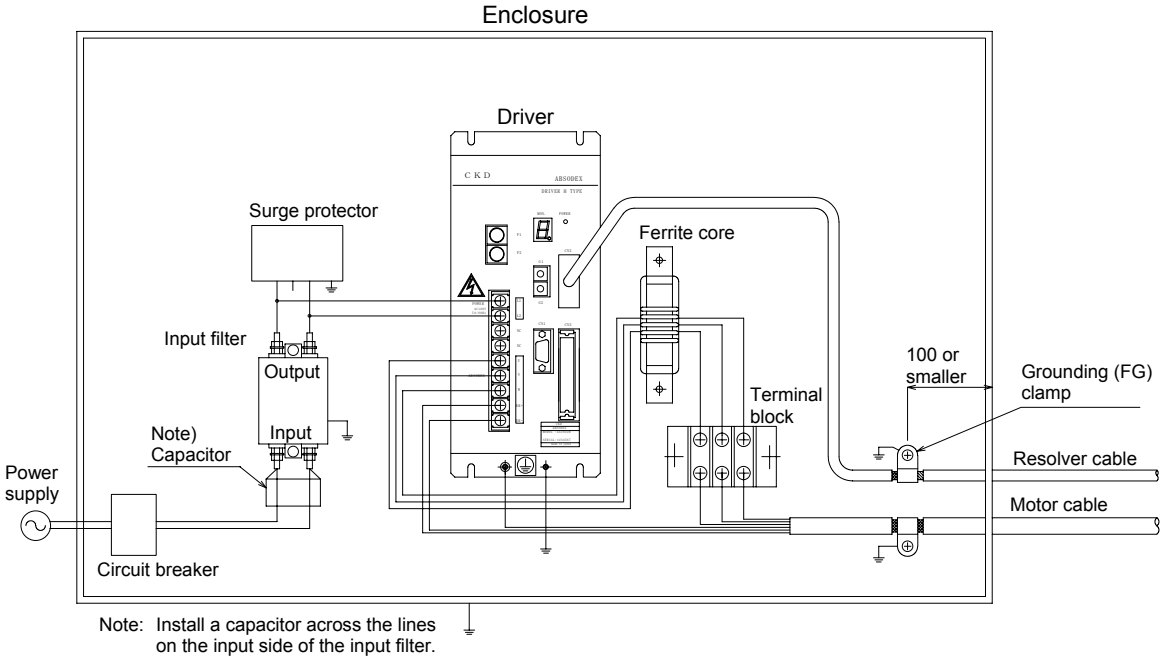


Fig. 13.3 Installation of Driver (in case of single phase)

Note: In case the single-phase power supply is used, connect a capacitor on the input side of the input filter to comply with EN standards EN55011.

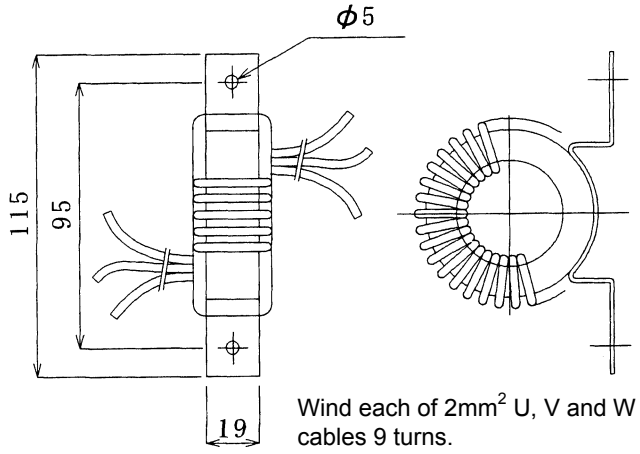


Fig. 13.4 Ferrite Core 1

[H] Table 13.4 Parts to be Used

Specification Parts	Applicable to	Model	Manufacturer
Input filter	3 phases	HF3020C-TOA	SOSHIN ELECTRIC CO., LTD.
	Single phase	NF2015A-OD	SOSHIN ELECTRIC CO., LTD.
Ferrite core	Common	RC5060	SOSHIN ELECTRIC CO., LTD.
Capacitor	Single phase	PA105-L	OKAYA ELECTRIC INDUSTRIES CO., LTD.
Grounding (FG) clamp	Common	FGC-8	KITAGAWA INDUSTRIES CO., LTD.
Surge protector	Common	R·A·V-781BXZ-4	OKAYA ELECTRIC INDUSTRIES CO., LTD.

[H] Table 13.5 Rated Input Current of Driver and Rated Current of Circuit Breaker

Driver Model	Rated Voltage	Rated Input Current (A)	Rated Current of Circuit Breaker (A)
AX9006H	Single-phase 100 to 115VAC, 50/60Hz	3.5	10
	3-phase 200 to 230VAC, 50/60Hz	1.0	
	Single-phase 200 to 230VAC, 50/60Hz	1.7	
AX9009H AX9012H	Single-phase 100 to 115VAC, 50/60Hz	5.9	
	3-phase 200 to 230VAC, 50/60Hz	1.7	
	Single-phase 200 to 230VAC, 50/60Hz	3.0	
AX9021H AX9022H	Single-phase 100 to 115VAC, 50/60Hz	6.3	
	3-phase 200 to 230VAC, 50/60Hz	1.8	
	Single-phase 200 to 230VAC, 50/60Hz	3.1	
AX9042H AX9045H	Single-phase 100 to 115VAC, 50/60Hz	9.0	
	3-phase 200 to 230VAC, 50/60Hz	2.6	
	Single-phase 200 to 230VAC, 50/60Hz	4.5	
AX9075H	3-phase 200 to 230VAC, 50/60Hz	2.6	
AX9150H	3-phase 200 to 230VAC, 50/60Hz	4.2	20
AX9210H	3-phase 200 to 230VAC, 50/60Hz	6.1	
AX9300H	3-phase 200 to 230VAC, 50/60Hz	6.1	
AX9500H	3-phase 200 to 230VAC, 50/60Hz	6.1	

- **Table 13.5 indicates the rated input current of the driver. Use 2.0mm^2 or 2.5mm^2 polyvinyl chloride (PVC) cables or cables with isolated sheath having equivalent or better allowable current for the cable connected to the L1, L2, L3 and ⏚ terminals.**

- **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. 13.5.)**

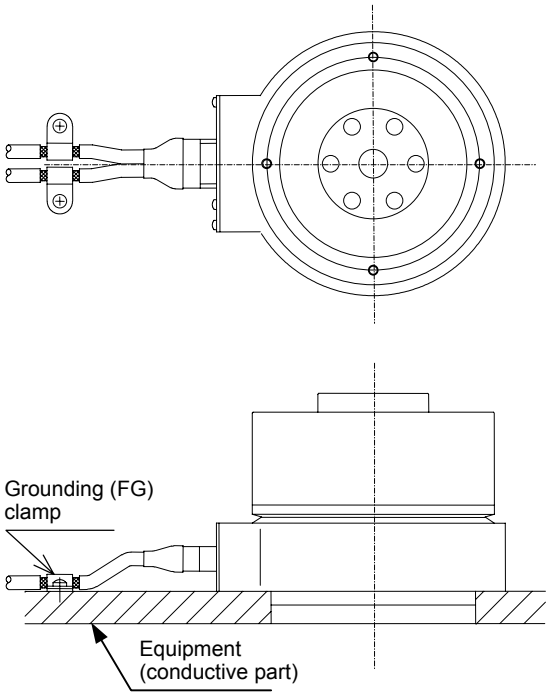


Fig. 13.5 Grounding Example on Actuator Side

- **Connect the grounding cable to the protective grounding terminal of the accessory bracket of the ABSODEX driver to assure safety. (One of two brackets is provided with protective grounding terminals.)**
  Leave part A (NC terminal) unconnected.
  Refer to Figs. 13.6 and 13.7.

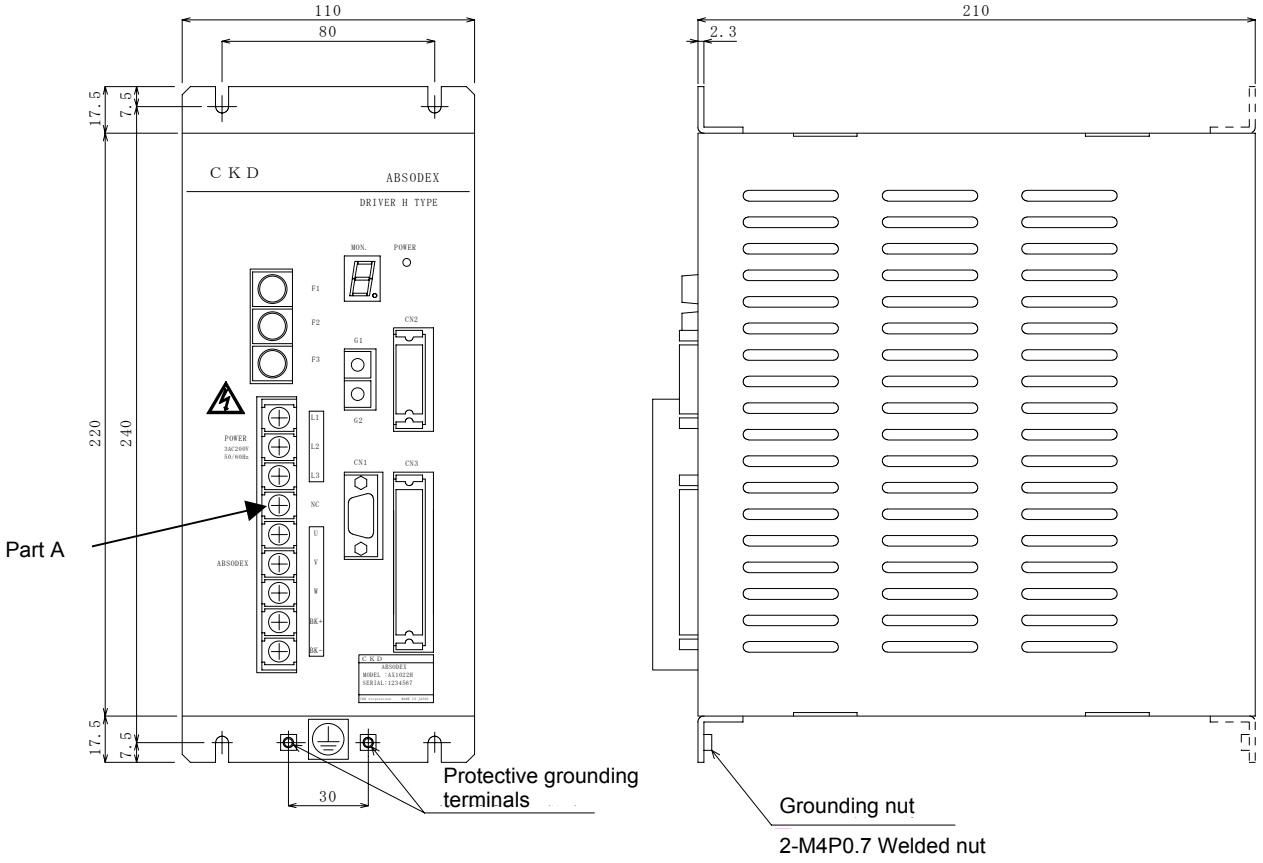


Fig. 13.6 Dimensioned Drawing of Driver

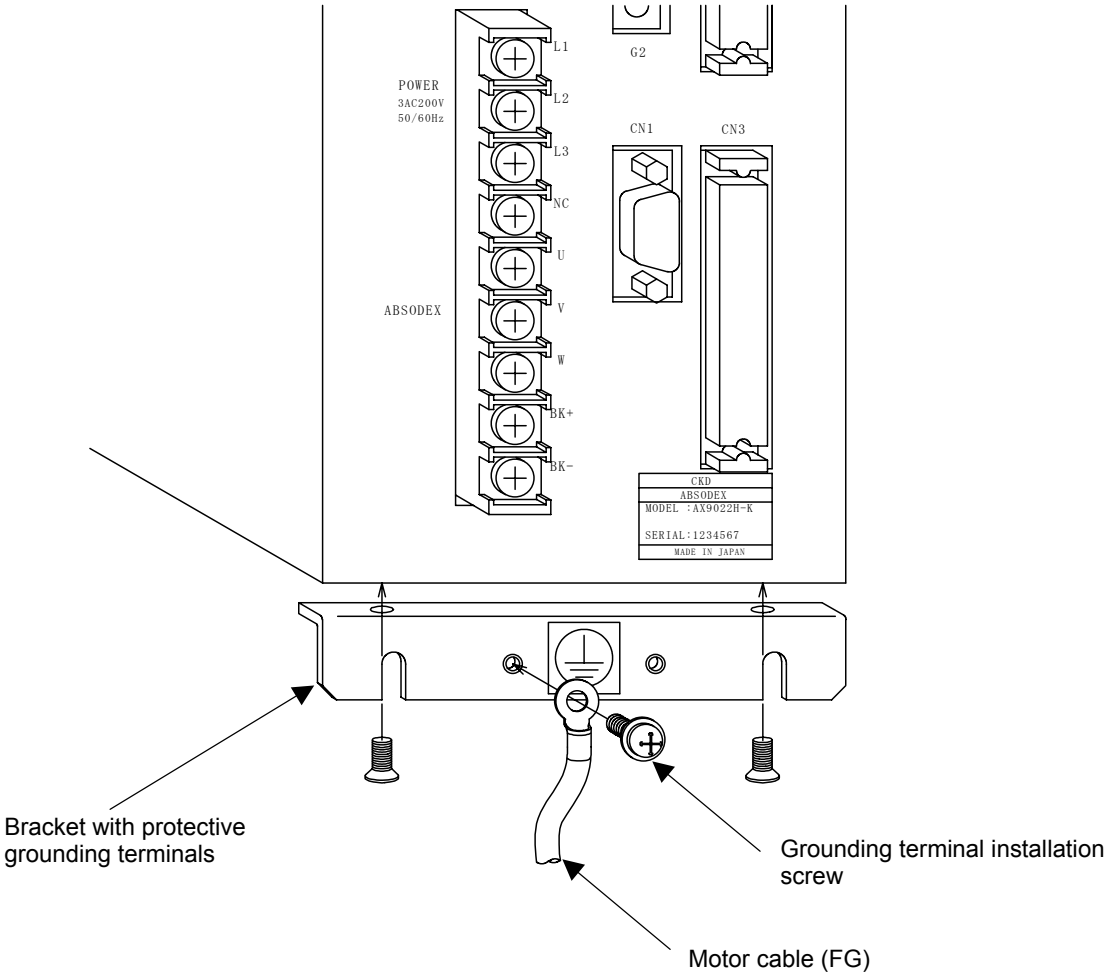


Fig. 13.7 Connection of Protective Ground for Product Complying with EN standards

- **Fig. 13.8 indicates the installation method of the driver. The driver can be installed on either the front or back side.**
  Fix in the correct position, using bolts.

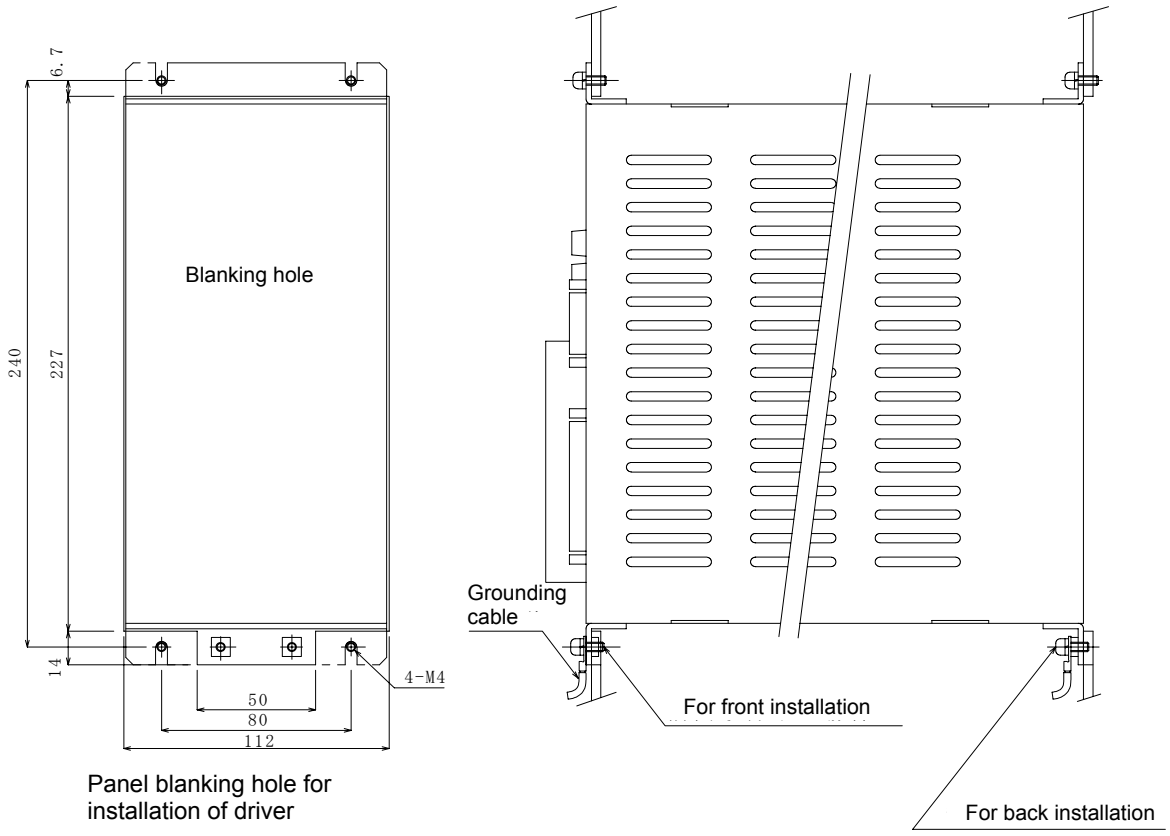
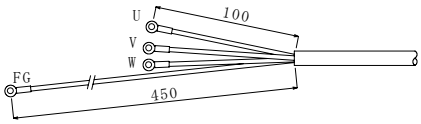
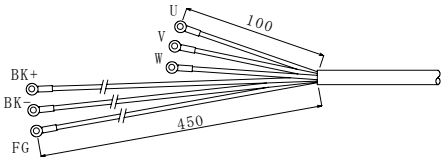


Fig. 13.8 How to Install the Driver

- **The end of the accessory motor cable is shown in Fig. 13.9. The cable to be connected with the ferrite core is shorter by 350mm than the FG, BK+ and BK- cables.**



In case of 4-conductor cable



In case of 6-conductor cable

Fig. 13.9 End of Accessory Motor Cable

WARNING:

- **When inserting a fuse in the U, V or W phase motor power cable, provide a cover on the fuse together with the fuse holder to avoid electric shock.**

14. ACTUATOR SPECIFICATIONS

1) AX1000 Series [H]

Series with high precision (indexing accuracy, output axis runout accuracy, etc.)

[H] Table 14.1 Actuator Specifications

Item	AX1022	AX1045	AX1075	AX1150	AX1210
1. Continuous Output Torque (N·m)	7	15	25	50	70
2. Maximum Output Torque (N·m)	22	45	75	150	210
3. Maximum Rotation Speed (rpm)	100 (180) (Note 1)		100		
4. Allowable Axial load (N)	600		2200		
5. Allowable Radial Load (N)	1000		4000		
6. Allowable Moment Load (N·m)	19	38	70	140	170
7. Output Axis Inertia Moment ($kg \cdot m^2$)	0.00505	0.00790	0.03660	0.05820	0.09280
8. Allowable Load Inertia Moment ($kg \cdot m^2$)	0.6	0.9	4.0	6.0	10.0
9. Output Axis Run-out (mm)	0.01				
10. Output Axis Side Run-out (mm)	0.01				
11. Output Axis Friction Torque (N·m)	2.0		8.0		
12. Mass (kg)	8.9	12.0	23.0	32.0	44.0
13. Resolver Revolution (P/rev)	540672				
14. Indexing Accuracy (sec)	±15				
15. Repeating Accuracy (sec)	±5				
16. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)				
17. Ambient Temperature and Humidity	While used: 0 to 45°C, 20 to 85%RH, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation				
18. Degree of Protection	IP20				

Note 1: The model for 180rpm max. is available on order.

2) AX2000 Series [H]

Small diameter series convenient for cable wiring and piping; compact models (AX2006 and AX2012) and models with a hollow fixed shaft (AX2021 and AX2042) are provided.

[S] Table 14.2 Actuator Specifications

Item	AX2006	AX2012	AX2021	AX2042
1. Continuous Output Torque (N·m)	2	4	7	14
2. Maximum Output Torque (N·m)	6	12	21	42
3. Maximum Rotation Speed (rpm)	100 (180) (Note 1)			
4. Allowable Axial load (N)	1000		2000	
5. Allowable Moment Load (N·m)	40		60	
6. Output Axis Inertia Moment ($kg·m^2$)	0.00575	0.00695	0.03450	0.04830
7. Allowable Load Inertia Moment ($kg·m^2$)	0.3	0.4	0.6	0.9
8. Output Axis Run-out (mm)	0.03			
9. Output Axis Side Run-out (mm)	0.03			
10. Output Axis Friction Torque (N·m)	0.4		3	
11. Mass (kg)	4.7	5.8	13.0	17.0
12. Resolver Revolution (P/rev)	540672			
13. Indexing Accuracy (sec)	±15			
14. Repeating Accuracy (sec)	±5			
15. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)			
16. Ambient Temperature and Humidity	While used: 0 to 45°C, 20 to 85%RH, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation			
17. Degree of Protection	IP20			

Note 1: The model for 180rpm max. is available on order.

3) AX3000 Series [H]

Compact and space saving design series

[H] Table 14.3 Actuator Specifications

Item	AX3022	AX3045	AX3075
1. Continuous Output Torque (N·m)	7	15	25
2. Maximum Output Torque (N·m)	22	45	75
3. Maximum Rotation Speed (rpm)	100 (180) (Note 1)		100
4. Allowable Axial load (N)	600		2200
5. Allowable Radial Load (N)	1000		4000
6. Allowable Moment Load (N·m)	19	38	70
7. Output Axis Inertia Moment ($kg·m^2$)	0.0110	0.0170	0.0700
8. Allowable Load Inertia Moment ($kg·m^2$)	0.6	0.9	4.0
9. Output Axis Run-out (mm)	0.03		
10. Output Axis Side Run-out (mm)	0.05		
11. Output Axis Friction Torque (N·m)	2.5		10.0
12. Mass (kg)	12.0	16.0	30.0
13. Resolver Revolution (P/rev)	540672		
14. Indexing Accuracy (sec)	±30		
15. Repeating Accuracy (sec)	±5		
16. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)		
17. Ambient Temperature and Humidity	While used: 0 to 45°C, 20 to 85%RH, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation		
18. Degree of Protection	IP20		

Note 1: The model for 180rpm max. is available on order.

4) AX4000 Series [H]

Large hollow hole diameter convenient for cable wiring and piping
Series with many models and options

[H] Table 14.4 Actuator Specifications

Item	AX4009	AX4022	AX4045	AX4075
1. Continuous Output Torque (N·m)	3	7	15	25
2. Maximum Output Torque (N·m)	9	22	45	75
3. Maximum Rotation Speed (rpm)	100 (180) (Note 1)			100
4. Allowable Axial load (N)	800	3700		20000
5. Allowable Moment Load (N·m)	40	60	80	200
6. Output Axis Inertia Moment ($kg·m^2$)	0.0090	0.0206	0.0268	0.1490
7. Allowable Load Inertia Moment ($kg·m^2$)	0.35	0.6	0.9	5.0
8. Output Axis Run-out (mm)	0.03			
9. Output Axis Side Run-out (mm)	0.05			
10. Output Axis Friction Torque (N·m)	0.8	3.5		10.0
11. Mass (kg)	5.5	12.3	15.0	36.0
12. Total mass including assembled brake (kg)	-	16.4	19.3	54.0
13. Resolver Revolution (P/rev)	540672			
14. Indexing Accuracy (sec)	±30			
15. Repeating Accuracy (sec)	±5			
16. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)			
17. Ambient Temperature and Humidity	While used: 0 to 45°C, 20 to 85%RH, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation			
18. Degree of Protection	IP20			

Note 1: The model for 180rpm max. is available on order.

[H] Table 14.5 Actuator Specifications

Item	AX4150	AX4300	AX4500
1. Continuous Output Torque (N·m)	50	100	160
2. Maximum Output Torque (N·m)	150	300	500
3. Maximum Rotation Speed (rpm)	100		70
4. Allowable Axial load (N)	20000		
5. Allowable Moment Load (N·m)	300	400	500
6. Output Axis Inertia Moment ($kg·m^2$)	0.2120	0.3260	0.7210
7. Allowable Load Inertia Moment ($kg·m^2$)	7.50	18.00	30.00
8. Output Axis Run-out (mm)	0.03		
9. Output Axis Side Run-out (mm)	0.05		
10. Output Axis Friction Torque (N·m)	10.0		15.0
11. Mass (kg)	44.0	66.0	115.0
12. Total mass including assembled brake (kg)	63.0	86.0	-
13. Resolver Revolution (P/rev)	540672		
14. Indexing Accuracy (sec)	±30		
15. Repeating Accuracy (sec)	±5		
16. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)		
17. Ambient Temperature and Humidity	While used: 0 to 45°C, 20 to 85%RH, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation		
18. Degree of Protection	IP20		

[H] Table 14.6 Specifications of Electromagnetic Brake (option)

Applicable Model	AX4022 AX4045	AX4075 AX4150 AX4300
1. Type	Non-backlash dry off-brake	
2. Rated voltage	24VDC	
3. Power supply capacity	30W	55W
4. Rated current	1.25A	2.30A
5. Static friction torque	35N·m	200N·m
6. Armature release time (brake-on)	Within 50msec	Within 50msec
7. Armature attraction time (brake-off)	Within 150msec	Within 250msec
8. Retention accuracy	Within 45 min.	
9. Max. operating frequency	60 cycles/min.	40 cycles/min.

CAUTION:

- **Friction noise may generate between rotation of the output axis during the disk of the electromagnetic brake and the fixed part.**
- **The armature makes contact with the fixed part of the electromagnetic brake during operation of the electromagnetic brake, causing noise to be generated.**
- **The delay time parameter must be changed according to the above armature attraction time for the travel occurring after the brake is released.**
- **Though the brake is of a non-backlash type, the position may deviate if a load is added in the circumferential direction.**
- **The optional electromagnetic brake is provided to increase the rigidity to hold the stopped output axis. Do not use it to decelerate or stop the rotating output axis.**

For other cautions, refer to 3. 2). (4).

5) AX5000 Series [H]

Series with built-in pneumatic brake; best for post-stop load application work because the output axis is clamped when it is stopped

[H] Table 14.7 Actuator Specifications

Item	AX5022	AX5045	AX5075	AX5150	AX5210
1. Continuous Output Torque (N·m)	7	15	25	50	70
2. Maximum Output Torque (N·m)	22	45	75	150	210
3. Maximum Rotation Speed (rpm)	100 (180) (Note 1)		100		
4. Allowable Axial load (N)	600		2200		
5. Allowable Radial Load (N)	1000		4000		
6. Allowable Moment Load (N·m)	19	38	70	140	170
7. Output Axis Inertia Moment ($kg \cdot m^2$)	0.0056	0.0085	0.0403	0.0619	0.0987
8. Allowable Load Inertia Moment ($kg \cdot m^2$)	0.6	0.9	4.0	6.0	10.0
9. Output Axis Run-out (mm)	0.01				
10. Output Axis Side Run-out (mm)	0.01				
11. Output Axis Friction Torque (N·m)	2.0		8.0		
12. Brake Torque (N·m)	45		150		210
13. Brake Response Time (sec)	0.1		0.15		0.18
14. Mass (kg)	16.0	20.0	40.0	50.0	65.0
15. Resolver Revolution (P/rev)	540672				
16. Indexing Accuracy (sec)	±15				
17. Repeating Accuracy (sec)	±5				
18. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)				
19. Ambient Temperature and Humidity	While used: 0 to 45°C, 20 to 85%RH, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation				
20. Degree of Protection	IP20				

Note 1: The model for 180rpm max. is available on order.

CAUTION:

- **The brake torque indicates the value at a pneumatic pressure of 0.5MPa.**
  The brake is applied with a pneumatic pressure and released with a spring force.
- **Do not use it to decelerate or stop the rotating output axis. The built-in brake is provided to increase the rigidity to hold the stopped output axis.**

For other cautions, refer to 2. 6).

6) AX8000 Series [H]

Series best for rotation positioning in environment prone to water splashes or much dust

[H] Table 14.8 Actuator Specifications

Item	AX8045	AX8070
1. Continuous Output Torque (N·m)	15	23
2. Maximum Output Torque (N·m)	45	70
3. Maximum Rotation Speed (rpm)	100 (180) (Note 1)	100
4. Allowable Axial load (N)	1200	2200
5. Allowable Radial Load (N)	1700	4000
6. Allowable Moment Load (N·m)	38	73
7. Output Axis Inertia Moment ($kg \cdot m^2$)	0.0330	0.1540
8. Allowable Load Inertia Moment ($kg \cdot m^2$)	0.9	4.0
9. Output Axis Friction Torque (mm)	3.0	10.0
10. Brake Torque (N·m)	80	210
11. Brake Response Time (sec)	0.13	0.20
12. Mass (kg)	35.0	80.0
13. Resolver Revolution (P/rev)	540672	
14. Indexing Accuracy (sec)	±15	
15. Repeating Accuracy (sec)	±5	
16. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)	
17. Ambient Temperature and Humidity	While used: 0 to 45°C, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation	
18. Degree of Protection	IP65 (IEC60529), IP55 (IEC60034-5)	

Note 1: The model for 180rpm max. is available on order.

[H] Table 14.9 Actuator Test Specifications

Item	AX8045	AX8070
1. Table Top Verticality (mm)	0.015	
2. Side Run-out on Table Top (mm)	0.015	
3. Degree of Parallel Between Table Top and Housing Bottom (mm)	0.02	
4. Degree of Right Angle Between Table Top and Housing Side (mm)	0.02	
5 Run-out of the Table Shaft Hole (mm)	0.015	

CAUTION:

- **The braking torque is based on the compressed air pressure of 0.5MPa. Brake mechanism is that brake is applied by air pressure and is released by a spring.**
- **For enhanced water-proofing, supply compressed air same as that for braking (0.05MPa or lower) through the air purge connector on the unit body. Abnormal noise may occur due to the air flow leaking outside. If the noise causes problems, reduce the air pressure.**
- **The performance and life of the seal may be substantially deteriorated according to liquid types because NBR (nitrile rubber) is adopted as the material of the seal.**
  The actuator is made of steel (output axis) and cast iron (housing) without anticorrosive treatment.
- **To use AX8000 Series as a circular table, apply the brake during machining operation without fail. Do not use it in applications where the workpiece is machined during rotation.**
- **Do not use it to decelerate or stop the rotating output axis. The built-in brake is provided to increase the rigidity of the stopped output axis.**
- **The actuator is designed for minor cutting operation. If heavy duty cutting accompanying large cutting resistance is performed, vibration may be caused.**
- **No water proof treatment is provided with the driver and dialog terminal. To operate them in the environment susceptible to water and oil splashes, take water proof measures.**

7) AX2000 Series [GH]

Series featuring easy maintenance due to compatibility between actuator and driver

[GH] Table 14.10 Actuator Specifications

Item	AX4150G	AX4300G	AX4500G
1. Continuous Output Torque (N·m)	50	100	160
2. Maximum Output Torque (N·m)	150	300	500
3. Maximum Rotation Speed (rpm)	100		70
4. Allowable Axial load (N)	20000		
5. Allowable Moment Load (N·m)	300	400	500
6. Output Axis Inertia Moment ($kg·m^2$)	0.2120	0.3260	0.7210
7. Allowable Load Inertia Moment ($kg·m^2$)	75.00 (Note 1)	180.00 (Note 1)	300.00 (Note 1)
8. Output Axis Run-out (mm)	0.03		
9. Output Axis Side Run-out (mm)	0.05		
10. Output Axis Friction Torque (N·m)	10.0		15.0
11. Mass (kg)	44.0	66.0	115.0
12. Total mass including assembled brake (kg)	63.0	86.0	-
13. Resolver Revolution (P/rev)	540672		
14. Indexing Accuracy (sec)	±30		
15. Repeating Accuracy (sec)	±5		
16. Electrical Insulation	Class: F Withstand voltage: 1500VAC, 1 minute Insulation resistance: >10MΩ (500VDC)		
17. Ambient Temperature and Humidity	While used: 0 to 45°C, 20 to 85%RH, No condensation While stored: -20 to 80°C, 20 to 90%RH, No condensation		
18. Degree of Protection	IP20		

Note 1: Different from H type

[GH] Table 14.11 Specifications of Electromagnetic Brake (option)

Applicable Model	AX4150G/AX4300G
1. Type	Non-backlash dry off-brake
2. Rated voltage	24VDC
3. Power supply capacity	55W
4. Rated current	2.3A
5. Static friction torque	200N·m
6. Armature release time (brake-on)	Within 50msec
7. Armature attraction time (brake-off)	Within 250msec
8. Retention accuracy	Within 45 min.
9. Max. operating frequency	40 cycles/min.

⚠ CAUTION:

- **Friction noise may generate during rotation of the output axis between the disk of the electromagnetic brake and the fixed part.**
- **The armature makes contact with the fixed part of the electromagnetic brake during operation of the electromagnetic brake, causing noise to be generated.**
- **The delay time parameter must be changed according to the above armature attraction time for the travel occurring after the brake is released.**
- **Though the brake is of a non-backlash type, the position may deviate if a load is added in the circumferential direction.**
- **The optional electromagnetic brake is provided to increase the rigidity to hold the stopped output axis. Do not use it to decelerate or stop the rotating output axis.**

For other cautions, refer to 3. 2). (4).

Note 1: For the dimensions and mounting dimensions of the actuator, refer to the catalogue.

15. DRIVER SPECIFICATIONS

1) General Specifications

[H] Table 15.1 H Type Driver Specifications

Item	Description
1. Power	① 200VAC±10%, 3 phase (standard) (Note 1) ② 100VAC±10%, single phase (optional code J1) ③ 220VAC-10% to 230VAC +10%, 3 phase (J2 option) (Note 1) (Note 2)
2. Power frequency	50/60Hz
3. Configuration	Open modular type (driver, and controller)
4. Ambient temperature and humidity	When used: 0 to 50℃, Humidity: 20 to 90%RH, No condensation When stored: -20 to 80℃, 20 to 90% RH, No condensation
5. Atmosphere	Free from corrosive gases, and dust
6. Anti-noise	1000V (P-P), pulse width 1μsec, startup 1nsec
7. Anti-vibration	4.9m/s^2
8. Elevation	Less than 1000m for operation, Less than 3265m for transport
9. Mass	About 4kg
10. Degree of Protection	IP00

Note 1: Models with 50N-m or smaller maximum output torques operate even with single-phase power supply.

Note 2: The source voltage range of the J2 option specification complying with EU directives is 200VAC -10% to 230VAC +10%.

[GH] Table 15.2 GH Type Driver Specifications

Item	Description
1. Power	200VAC-10% to 230VAC +10%, 3 phase
2. Power frequency	50/60Hz
3. Configuration	Open modular type (driver, and controller)
4. Ambient temperature and humidity	When used: 0 to 50℃, Humidity: 20 to 90%RH, No condensation When stored: -20 to 80℃, 20 to 90% RH, No condensation
5. Atmosphere	Free from corrosive gases, and dust
6. Anti-noise	1000V (P-P), pulse width 1μsec, startup 1nsec
7. Anti-vibration	$4.9m/s^2$
8. Elevation	Less than 1000m for operation, Less than 3265m for transport
9. Mass	About 4kg
10. Degree of Protection	IP00

2) Performance Specifications

[H] Table 15.3 H Type Driver Performance Specifications

Item	Description
1. Number of Controlled Axes	1 axis, 540672 pulses/rotation (Name: Axis "A")
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 100rpm (Note)
6. Number of Indexes	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 dialog terminal or PC
11. Operation Mode	Auto, MDI, jog, single block, 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	LED power lamp display
15. Alarm Display	7-segment LED
16. Communication Interface	Meets RS-232C specification
17. I/O	Input Home positioning instruction, reset, start, stop, continuous rotation stop, emergency stop, answer, program number selection, brake release, program number setting, pulse string input Output Alarm 1 and 2, positioning completion, in-position, standby for start input, M code 8 points, Timing, M code strobe, segment position strobe, output during indexing 1, 2
18. Program Capacity	About 6000 characters (256 pcs.)
19. Electronic Thermal	Estimates actuator temperature.

Note: The speed setting range of the actuator varies with the actuator. Refer to Chapter 14. "ACTUATOR SPECIFICATIONS."

[GH] Table 15.4 GH Type Driver Performance Specifications

Item	Description
1. Number of Controlled Axes	1 axis, 540672 pulses/rotation (Name: Axis "A")
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 100rpm (Note)
6. Number of Indexes	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 dialog terminal or PC
11. Operation Mode	Auto, MDI, jog, single block, 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	LED power lamp display
15. Alarm Display	7-segment LED
16. Communication Interface	Meets RS-232C specification
17. I/O	Input Home positioning instruction, reset, start, stop, continuous rotation stop, emergency stop, answer, program number selection, brake release, program number setting Output Alarm 1 and 2, positioning completion, in-position, standby for start input, M code 8 points, Timing, M code strobe, segment position strobe, output during indexing 1, 2
18. Program Capacity	About 6000 characters (256 pcs.)
19. Electronic Thermal	Estimates actuator temperature.

Note: The speed setting range of the actuator varies according to the actuator. Refer to Chapter 14. "ACTUATOR SPECIFICATIONS."

- Analog, digital, and frame ground (Protective earth) are short circuited within the driver.
- 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."**

3) I/O Signal Specification

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."**

4) RS -232C Signal Specifications

(1) Communication Specifications

Table 15.5 RS-232C Signal Specifications

Item	Specification
① Baud rate	9600 (Changeable with a switch) (Note)
② Character length	7 bits
③ Parity	ODD
④ Stop bit	1 bit
⑤ X parameter	XON

Note: For baud rate change, refer to Chapter 12. "COMMUNICATION FUNCTIONS."

(2) CN1 Layout

Table 15.6 CN1 Pin Layout

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

Dsub 9-pin

APPENDIX 1 PROGRAM CHART

(/)

Machine Name: Model: AX

System Name: Serial No.

Program No.	Block No.	NC Code	Remarks

APPENDIX 2 PARAMETER RECORD TABLE (1/3)

Machine Name: Model: AX

System Name: Serial No.

Parameter No.	Description	Setting Range	Initial Value	Copy of Setting Value	Unit
1	Cam Curve 1:MS, 2:MC, 3:MT, 4:TR, 5:MC2	1 to 5	1		
2	Acceleration and deceleration time of MC 2 curve	0.01 to 50.0	1.0		sec
3	Home position offset amount	-540672 to 540671			Pulse
4	Home positioning direction 1:CW, 2:CCW	1 to 2	1		
5	Home positioning speed	1 to 100	2.0		RPM
6	Acceleration and deceleration time for home positioning [H] [GH]	0.1 to 1.0 0.1 to 2.0	0.1 1.0		sec
7	Home positioning stop 1: Stop, 2: Invalid	1 to 2	2		
8	Software limit coordinate A (+ direction)	-9999998 to 9999999	9999999		Pulse
9	Software limit coordinate B (- direction)	-9999999 to 9999998	-9999999		Pulse
10	Software limit setting 1: Effective, 2: Not Effective	1 to 2	2		
11	No answer time setting	1 to 100, 999	60		sec
12	M answer setting 1: Required, 2:Not required	1 to 2	2		
13	Answer input for positioning and home positioning completion 1: Required, 2: Not required	1 to 2	2		
14	Jog speed	0.01 to 100	2.0		RPM
15	Jog acceleration and deceleration time	0.1 to 1.0	1.0		sec
16	In-position range	1 to 10000	2000		Pulse

APPENDIX 2 PARAMETER RECORD TABLE (2/3)

Machine Name: Model: AX

System Name: Serial No.

Parameter No.	Description	Setting Range	Initial Value	Copy of Setting Value	Unit
17	In-position sampling times	1 to 2000	1		Times
19	Upper limit for the amount of position deviation	1 to 540672	10000		Pulse
20	Speed over limit	1 to 3064	1982 3604 (Note)		Pulse
21	Deceleration rate for emergency stop	1 to 180	2		p/ms^2
22	Delay time for emergency stop servo-off	0 to 2000	1000		msec
23	Emergency stop input 1: Servo-on state maintained after stop 2: Invalid 3: Servo-off after stop	1 to 3	2		
26	NC program output (auto run) 1: Not to output, 2: To output	1 to 2	1		
27	Delay time after brake output	0 to 1000	250 (AX4075 AX4150 AX4300 AX4500) 100 (Other)		msec
28	Brake initial status 1: Brake-on, 2: Release	1 to 2	2		
29	Mode setting for power-on 1: Auto run mode 2: Single block mode 6: Pulse string input mode	1, 2, 6	1		
30	Output for timing advance	0 to 99	0		%
31	Timing output width	1 to 200	20		msec
32	Timing output 1: To output, 2: Not to output	1 to 2	1		
33	Output 1 during indexing	0 to 99	0		%
34	Output 2 during indexing	0 to 99	0		%

Note: For models supporting 180rpm, refer to Chapter 14. "ACTUATOR SPECIFICATIONS."

APPENDIX 2 PARAMETER RECORD TABLE (3/3)

Machine Name: Model: AX

System Name: Serial No.

Parameter No.	Description	Setting Range	Initial Value	Copy of Setting Value	Unit
35	Pulse rate change 1:1 time, 2: 2 times, 3: 4 times, 4: 8 times, 5:16 times	1 to 5	1		
36	I/O program number selection method switching 1: 4 bits 2 times (BCD) 2: 4 bits 2 times (binary) 3: 5 bits 1 time (binary)	1 to 3	1		
37	Segment position range width for equal segment designation	1 to 270336	1500		Pulse
38	Rotation direction for equal segment designation 1: CW, 2: CCW, 3: Nearer head 4: Alarm C outside segment position vicinity range	1 to 4	3		
39	Torque limit	1 to 100	100		%
62	Cut-off frequency for low pass filter 1	10 to 500	[H] 200 [GH] 100		Hz
63	Cut-off frequency for low pass filter 2	10 to 500	500		Hz
64	Cut-off frequency for notch filter 1	10 to 500	500		Hz
65	Cut-off frequency for notch filter 2	10 to 500	500		Hz
66	Filter switch	0 to 15	1		
67	Integral limiter	1 to 540672	100000		Pulse
70	Q value of notch filter 1	0.1 to 9.9	1		
71	Q value of notch filter 2	0.1 to 9.9	1		
72	Integral gain multiplication	0.1 to 10.0	0.3		—