Vigo Servo AR Series

Instruction Manual

- Applied models -

Servo actuator : AR15/30/60/135/H7/H17/H24/10H

Servo amplifier : ARN15-A/30-A/60-A/135-A

Software version (See page7-5 for details) : From 01.10

Before attempting to operate this product, you should thoroughly read and fully understand all the contents of this manual. Specifications are subject to change without notice.

Carefully note the precautions on pages 1-4,5,6,7 before turning on the power supply.

TS Corporation

TMF00007E 01/Oct.'03

For your safety

- To prevent accidents, strictly follow the procedures and cautions noted in this manual.
  Safety information for the prevention of danger is given in "1. ON SAFETY" in this manual.
  From Chapter 2, safety information is given for any task or operation that is potentially dangerous and each of these messages is prefaced with the appropriate signal word.

- A warning label marked  (electrical shock) is affixed to the servo amplifier front panel.
  Be careful to avoid injury from shock, as electrical circuits are incorporated in the area near this label. (See pages 5-1,3)

- This manual provides general guidelines, precautions and warnings for the safe operation of this machine.

  If this machine is used in ways other than those described in this manual, unforeseen problems or accidents may occur, and we shall bear no liability or responsibility for the consequences.

- This manual contains important information you must know about the AR series servo system, which consists of a servo actuator and a servo amplifier, its safety features, and necessary operating precautions. Be sure to read it thoroughly before attempting to transport, install, wire, operate, service or inspect the servo system.

- Please be sure to deliver this instruction manual to all administrators and operators charged with the operation of this machine.
  They must carefully read this manual and fully understand its contents, and should not let anyone who is not familiar with the contents of this manual operate or inspect this machine.
  Keep this manual available near the equipment at all times so that it can be immediately referred to whenever necessary.

- Look up the name, address and phone number of our nearest dealer or branch office listed on the back page of this manual, and post the information prominently for quick reference.

WARNING

All machine operators must read "1. ON SAFETY" in this manual carefully and thoroughly.

Do not turn on the machine's power supply until all the noted precautions have been studied and understood.

Very serious accidents may occur if this instruction is not observed.

Contents

CAUTION

To comply UL and/or CUL standard,
please keep in mind the following points.

This equipment is to be installed in an enclosure that provides a pollution degree 2 (controlled) environment (Normally, only nonconductive pollution.
However, temporary conductivity caused by condensation may be expected. .

These devices are suitable for factory wiring using Nos.2..1. AWG copper wire.
Use 60.75 . wire or the equivalent for ARN15 and ARN30.
Use 75 . wire or the equivalent for ARN60 and ARN135.
Tighten field wiring terminal (TB1.TB3) to 4.4 lb-in for ARN15 and ARN30.
Tighten field wiring terminal (TB1) to 11.0 lb-in for ARN60 and ARN135.
Tighten field wiring terminal (TB3) to 4.4 lb-in for ARN60 and ARN135.

.....Suitable for use on a circuit capable of delivering not more than
5000 rms symmetrical amperes, 240 volts maximum,
when protected by circuit breaker having an interrupting rating
not less than 15 rms symmetrical amperes, 240 volts maximum.

.....Suitable for use on a circuit capable of delivering not more than
5000 rms symmetrical amperes, 240 volts maximum,
when protected by circuit breaker having an interrupting rating
not less than 20 rms symmetrical amperes, 240 volts maximum.

.....Suitable for use on a circuit capable of delivering not more than
5000 rms symmetrical amperes, 240 volts maximum,
when protected by circuit breaker having an interrupting rating
not less than 30 rms symmetrical amperes, 240 volts maximum.

Preface

1. Purpose

Teijin Seiki's "AR servo actuator and ARN servo amplifier" (hereafter simply termed "servo system") has been developed for use with servo systems for general industrial equipment.

When the power supply to the industrial equipment is turned on, the servo system operates in accordance with the program set in the machine sequencer.

This program should be designated by the industrial equipment engineer.
The end user can operate the servo system by executing the program.

Operation of the servo actuator is controlled by the parameters set for the servo amplifier.

The servo amplifier is activated by the signals input to and output from the industrial equipment sequencer.

For example, the servo system is used for driving a machine tool ATC magazine, transfer unit arm, index table, conveyor, press or other device into position.

Therefore, please keep in mind the following points.

(1) The servo system cannot be used with any devices that affect people's bodies or health, such as medical appliances.
(2) The servo system must not be used with any devices that could adversely affect the environment or public safety, such as railway vehicles, aircraft, toys and passenger elevators.
(3) The servo system cannot be used in environments, which are subject to strong vibrations, such as in automotive vehicles, marine vessels, etc.
(4) The servo system cannot be used in certain special environments, i.e., nuclear environments with ambient radiation, high vacuum space environments, etc.
(5) You must not modify the servo amplifier or the servo actuator.
If this servo system is to be used for any purpose or in any environment mentioned in (1) to (4) above, please consult with us before proceeding any further.

2. Intended readers

. This manual is intended for use by engineers in the development of industrial equipment.

It describes information and procedures for choosing suitable specifications for the incorporation of the servo system into the industrial equipment, its installation, settings and equipment operation.

3. Requests to industrial equipment manufacturers

. To prevent injuries or harm to any person using machines, which incorporate our servo system (hereafter referred to as "end user"), each industrial equipment manufacturer should reprint the instructions and precautions noted in "1. ON SAFETY" in their own machine instruction manuals for the end user.

We therefore hereby authorize each manufacturer to copy, reprint, or reproduce the contents of this manual for these purposes only.

. When incorporating the servo system into its machines, each industrial equipment manufacturer must carefully observe all the procedures and cautionary notes included in this manual to prevent injuries or accidents caused by its improper installation or operation.

4. Exporting the servo system

. International transfer of this machine, any of its parts, components and/or software must be carried out in compliance with the relevant laws and ordinances of the country of export and the country of equipment end-use.

. We do not assume any responsibility or liability for equipment transferred without regard to proper export/import regulations or procedures.

5. Product warranty

. The term of warranty on the servo system is either one year from installation or 2000 running hours after incorporation into the equipment, whichever is shorter, under condition that proper setup and wiring have been carried out in accordance with the ratings we stipulate.
However, we will not bear incidental costs, such as man-hours required to remove from and/or install to the equipment, transportation costs, taxes, warehouse charges, etc.
We shall also not compensate losses resulting from the stoppage of any equipment that incorporates the servo system due to problems caused by the servo system.

. If we make financial compensation for the product, the maximum amount of the compensation shall not exceed the sales price of the applicable product.

6. Usage liability

· Please note that machine specifications are subject to change without notice for updates and improvements. This may cause inconsistencies between the contents of this manual and the machine you currently possess.

. We shall bear absolutely no liability or responsibility for the consequences if this machine is utilized for purposes other than those described in this manual.

· We shall not be held responsible for any damage caused by conditions beyond our control such as customer modifications, disassembly or misuse of our products, or their use in a defective or deficient environment.

. We assume no responsibility or liability for any damage or consequential and/or indirect losses resulting from any accident or malfunction that might occur during the operation of this machine.

· The data noted in this manual is only offered as sample reference data for normal usage of this machine.

We shall not bear any legal responsibility for its suitability for each customer's particular uses nor shall we be held liable for any incidental or indirect damages caused by usage of the machine itself.

7. Copyright

1. ON SAFETY

This chapter contains precautions on using this machine, which must be observed to ensure operator safety.

1-1 Alert Symbol

This manual marks important safety information with two alert symbols, "WARNING" and "CAUTION", corresponding to the level of potential danger involved.
Please understand the meanings of both symbols and strictly follow their instructions.

⚠ WARNING	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate personal injury or damage to the machine.

- This machine has not been designed or manufactured for use with any device or system that may affect people's lives.
- For use with facilities, which may affect people's lives or may cause serious damage to the machine resulting from machine fault, be sure to install safety devices appropriate to the facilities.
- Please consult us before using this machine in specialized environments.

1-2 ⚠ WARNING

⚠ To prevent electrical shock, be sure to turn off the power supply before beginning installation, removal or wiring of the machine.
Only skilled technicians should perform these tasks.
Attempts by nonqualified personnel could lead to electrical shock, injury, or fire.

⚠ The PE ⏚ terminals of both servo actuator and servo amplifier must be grounded to prevent electrical shock.

⚠ Make the ground cable 2 to 3 cm longer than L1, L2, and L3 and U,V, and W so that it will be the last to disconnect if either the main power cable or servo actuator power line is forcibly disconnected.

Ignoring this instruction could lead to electrical shock. (See page 5-11.)

⚠ Stay away from the rotating section of the servo actuator while the power is supplied.
Ignoring this instruction could lead to serious injury.

⚠ Do not expose the machine to gases that may cause the machine to corrode or an explosion to occur.

⚠ Hang the servo actuator with a hanger bolt when installing, removing or transferring the servo actuator so that it will not drop.
Use the hanger bolt with the nominal diameter specified in "11. EXTERNAL DIMENSIONS".
Use of another size bolt could lead to serious injury.

⚠ The type of machine to which the servo actuator is installed, its setup environment, and the mass and torque of the servo actuator must be carefully considered when designating the dimensions and materials for the section to which the servo actuator is installed and the installation method.
If this instruction is ignored, the servo actuator can drop and may cause serious personal injury.

⚠ Observe the following preventive measures to avoid hazards that could result from servo system rotation.

Ignoring these instructions could lead to serious injury.

⚠ The servo actuator can keep rotating due to load or inertia even when the power supply is turned off.

Therefore, never touch the rotating section unless it is completely stopped.
Ignoring this instruction could lead to serious injury.

⚠ Although the power supply is turned off, the servo amplifier will have been charging with high voltage for a while.
Do not start wiring until the Charge LED on the front panel of the servo amplifier goes out.
Ignoring this instruction could lead to electrical shock.

⚠ A battery is used for the absolute encoder type servo system. Keep in mind the following precautions when handling the battery.

- Do not heat the battery to 100 °C or above (Do not incinerate the battery).
  Ignoring this instruction could lead to ignition, combustion and explosion.
- Do not disassemble the battery. Contact of the eyes with battery contents could lead to loss of eyesight.
- Do not re-charge the battery. Ignoring this instruction could lead to explosion or leakage.
  Contact of the eyes with battery contents could lead to loss of eyesight.

⚠ In case of an emergency stop, turn off the main power supplies (L1, L2 and L3) to the servo amplifier to stop the servo actuator safely. Ignoring this instruction could lead to serious injury from unexpected servo actuator rotation.

1-3 ⚠CAUTION

⚠ Use the servo actuator and the servo amplifier in accordance with the combinations stated in the "Table of Specifications" on pages 2-2,3,4,5. If they are used with any other combinations, fire, burns or electrical shock could occur.

⚠ Do not connect the commercial power supply to the output terminals (U, V and W) of the servo amplifier or to the input terminals (U, V and W) of the servo actuator. Ignoring this instruction could lead to electrical shock, burns or fire.

⚠ The servo system may reach high temperatures during operation. To prevent burns, do not touch the servo system immediately after the power supply is turned off, but wait for the system to cool.

⚠ If an error has occurred in the servo system, do not operate it until the appropriate remedy has been applied. Ignoring this instruction could lead to serious injury or electrical shock.

⚠ Securely tighten all the fixing bolts for the servo system. If any bolts are loose, the servo system may shift or drop, and damage to the other parts of the equipment or personal injury could result.

⚠ Do not perform an high voltage insulation resistance test of the servo system.
Ignoring this instruction could lead to damage to the servo system or electrical shock.

⚠ Do not jar the servo actuator.
Ignoring this instruction could damage the encoder inside of the servo actuator.

⚠ Keep excess water and oil away from the servo actuator. Also, do not allow water and oil to enter the connectors along the cables. Ignoring these instructions could lead to damage to the servo system or electrical shock.

1-4 Precautions for Initial Turning-on of the Power Supply

When the main power and the control power are first turned on, follow the procedures below. Before beginning each procedure, carry out wiring according to the instructions in "5. WIRING" on page 5-1.

For absolute encoder type specifications

↓

Follow the "5.WIRING" and connect the servo amplifier and servo actuator to the peripheral devices.

↓

Select and define the alarms to be used. In order to avoid any signals that might disturb the smooth start-up of the machine, leave the CN2 connector (for control I/O signals, page5-1,5-3) disconnected.

↓

- In all cases, except when using external regenerative resistance, short the RGEN and DCC pins on connector TB2(ARN15,30) or TB1(ARN60,135) for motor power cable/external regenerative resistance, using a conductor whose cross-sectional area is not less than 1.25 mm², according to the description on pages 5-12,13.

  If these pins are not shorted, an overvoltage alarm (AL-4, page 9-2) may occur during regenerative operation.

↓

- Make sure that the encoder selector switch has been set to ABS(absolute) as noted on pages 5-2,3.
  If not , Following the instruction on these page, alter the setting to ABS.

↓

- Do not connect the battery (p5-19) for the absolute encoder.
  If it is first connected, excessive current could be supplied from the battery to the capacitor in the encoder, which may cause the battery to deteriorate.

↓

- Turn on the main and control power supplies. (See pages 5-10,13)
  When the power is turned on, the front panel of the main unit shows"HELLO Arn** AbS".
  Alarm(p9-1) appears on the front panel after "HELLO Arn** AbS".

↓

- Wait approximately five minutes in this state, to charge the capacitor inside of the encoder.

↓

- Turn off the main and control power supplies.
  Turn on the main and control power supplies again.

↓

- Since the information concerning the absolute encoder has been lost, "AL-13" (Encoder system down, page 9-3) is displayed.

↓

- When a servo actuator incorporating a brake function (p2-1) is used , if the power for brake has not been supplied, a brake power supply disconnection alarm (AL-10) will occur (p9-3) as soon as an "Operation ready command (p6-9)" is issued.
  Supply the power to the brake. (See page 5-14)

↓

- When a servo actuator without a brake function is used, since control parameter 7 (CP-7) (p7-15) has been set to 1 (available) by default for brake available/unavailable selection, a brake power supply disconnection alarm (AL-10) will occur when an “Operation ready command” is issued.

  When a servo actuator without a brake function is used, change the setting of control parameter 7 to “2” (unavailable) according to the description on page 7-7.

  |

- Perform an origin setting from the panel switches following the instructions on page 6-7.
  (Since the servo actuator cannot operate in this state, the output shaft position cannot be set to the mechanical origin. Therefore, designate the current output shaft position as the origin.)

  |

- Turn off the main and control power supplies.

  |

- Connect the battery to the battery connector. (See page 5-19)

  |

- Turn on the main and control power supplies again. The machine can now operate.

For **incremental** encoder type specifications (other than AR10H)

Follow the "5.WIRING" and connect the servo amplifier and servo actuator to the peripheral devices.

Select and define the alarms to be used. In order to avoid any signals that might disturb the smooth start-up of the machine, leave the CN2 connector (for control I/O signals, page5-1,5-3) disconnected.

- Battery (p5-19) connection is not required.

- In all cases, except when using external regenerative resistance, short the RGEN and DCC pins on connector TB2(ARN15,30) or TB1(ARN60,135) for motor power cable/external regenerative resistance, using a conductor whose cross-sectional area is not less than 1.25 mm², according to the description on pages 5-12,13.

  If these pins are not shorted, an overvoltage alarm (AL-4, page 9-2) may occur during regenerative operation.

- The encoder selector switch has been set to ABS (absolute) as noted on pages 5-2,3.
  Following the instruction on these pages, alter the setting to INC (incremental).
  Failure to do so results in the display of “AL-11”(Encoder Trouble) or “AL-14”(Encoder type mismatch)(See page 9-3).

- Holding down the UP ? and DOWN ? buttons at the front of the servo amplifier, turn on the main and control power supplies (p5-10,13). (See page 7-35)
  The setting of control parameter 1 (CP-1) for choosing the encoder type (p7-13) will be changed from "1" (absolute AR) to "2" (incremental AR).
  When the power is turned on, the front panel of the main unit shows"InIt.I HELLO Arn** InC"

- When a servo actuator incorporating a brake function (p2-1) is used , if the power for brake has not been supplied, a brake power supply disconnection alarm (AL-10) will occur (p9-3) as soon as an "Operation ready command (p6-9)" is issued.
  Supply the power to the brake. (See page 5-14)

- When a servo actuator without a brake function is used, since control parameter 7 (CP-7) (p7-15) has been set to 1 (available) by default for brake available/unavailable selection, a brake power supply disconnection alarm (AL-10) will occur when an “Operation ready command” is issued.
  When a servo actuator without a brake function is used, change the setting of control parameter 7 to “2” (unavailable) according to the description on page 7-7.

- Turn off the main and control power supplies.

- Turn on the main and control power supplies again. The machine can now operate.

For AR10H (incremental encoder type specifications)

Make sure that model code of servo amplifier is ARN30

Follow the "5.WIRING" and connect the servo amplifier and servo actuator to the peripheral devices.

Select and define the alarms to be used. In order to avoid any signals that might disturb the smooth start-up of the machine, leave the CN2 connector (for control I/O signals, page5-1,5-3) disconnected.

- Battery connection is not required.
- In all cases, except when using external regenerative resistance, short the RGEN and DCC pins on connector TB2 for motor power cable/external regenerative resistance, using a conductor whose cross-sectional area is not less than 1.25 mm², according to the description on pages 5-12.

  If these pins are not shorted, an overvoltage alarm (AL-4, page 9-2) may occur during regenerative operation.
- The encoder selector switch has been set to ABS (absolute) as noted on pages 5-2.
  Following the instruction on that page, alter the setting to INC (incremental).
  Failure to do so results in the display of “AL-11”(Encoder Trouble) or “AL-14”(Encoder type mismatch)(See page 9-3).
- Holding down the MODE and UP ? buttons at the front of the servo amplifier, turn on the main and control power supplies (p5-10). (See page 7-35)
  The setting of control parameter 1 (CP-1) for choosing the encoder type (p7-13) will be changed from "1"(absolute AR) to "3" (incremental AR10H).
  And internal motor contorol parameters will be changed for AR10H.
  If do not execute this, ARN30 can not be used for AR10H.
  When the power is turned on, the front panel of the main unit shows"InIt.H HELLO Arn30 10H"
- When a servo actuator incorporating a brake function (p2-1) is used , if the power for brake has not been supplied, a brake power supply disconnection alarm (AL-10) will occur (p9-3) as soon as an "Operation ready command (p6-9)" is issued.
  Supply the power to the brake. (See page 5-14)
- When a servo actuator without a brake function is used, since control parameter 7 (CP-7) (p7-15) has been set to 1 (available) by default for brake available/unavailable selection, a brake power supply disconnection alarm (AL-10) will occur when an “Operation ready command” is issued.
  When a servo actuator without a brake function is used, change the setting of control parameter 7 to “2” (unavailable) according to the description on page 7-7.
- Turn off the main and control power supplies.
- Turn on the main and control power supplies again. The machine can now operate.

2. SPECIFICATIONS

2-1 Definitions of Model Codes

(1) Servo actuator

AR **135** **A** **128** - **B** **A** **0**

- AR: Series name (AR/ARH)
- 135: Frame No.
- A: Type indication (A,B,C,F,S,H)
- 128: Reduction gear ratio
- B: Availability of brake
- A: Type of encoder
- 0: Option

Availability of brake	
B	Available
0	Unavailable

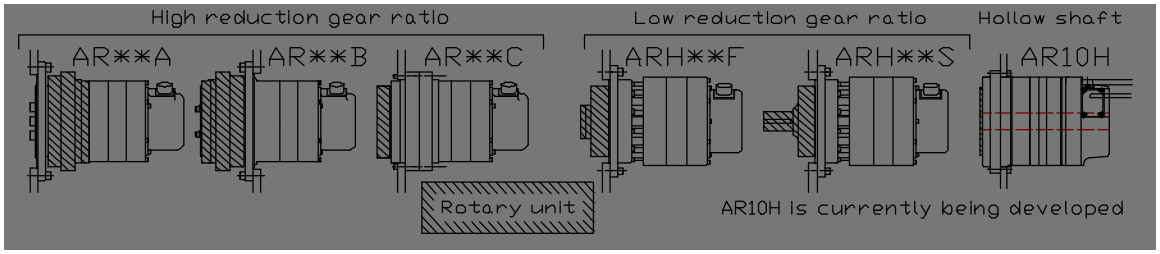
Type of encoder	
I	Incremental (INC)
A	Absolute (ABS)

Option	
0	Standard specification
T	UL, EN standards supported

. Regulation numbers of UL and EN to which AR series are supported are shown below.

	UL standards	CUL standards	European safety standards
Servo amplifier	UL508C	CSA C22.2 No.14	EN50178
Servo actuator	UL1004	CSA C22.2 No.100-95	

Type indication of each actuator model



(2) Servo amplifier

ARN **135** - **A** **B**

- ARN: Series name
- 135: Frame No.
- B: Option

	ARN15,30	ARN60,135
B	TB1 (p5-10),TB2 (p5-12),TB3 (p5-14) connector and battery (p5-18) attached	TB3 (p5-14) connector and battery (p5-18) attached
----	Unavailable	Unavailable

(3) Battery (p5-18) **21EP002** Required when an absolute encoder is used. (-AB : battery is attached)

2-2 Table of Specifications

	Frame No.		..15					..30				
	RV/GH reduction gear frame no.	-	RV15A2					RV40E				
	Motor output	kW	0.4					0.8				
	Moment of inertia of motor	$kg.cm^2(GD^2/4)$	3.3					9.8				
	Reduction gear ratio; types A, B	-	56	80	104	120	140	56	80	104	120	152
	Reduction gear ratio; types C	-	57	81	105	121	141	57	81	105	121	153
	Rated output torque	N.m	66	94	122	141	167	132	188	245	282	363
		kgf.m	6.7	9.6	12	14	17	13	19	25	29	37
	Maximum torque	N.m	263	274	274	274	274	461	659	856	988	1029
		kgf.m	27	28	28	28	28	47	67	87	101	105
	Rated rotation speed	rpm	45	31	24	21	18	45	31	24	21	16
	Maximum output rotation speed	rpm	54	38	29	25	21	54	38	29	25	20
Servo actuator	Backlash	arc min	1									
	Lost motion	arc min	1									
	Spring constant	N.m/arc min	34					108				
		kgf.m/arc min	3.5					11				
	Allowable load moment of inertia	$kg.m^2(GD^2/4)$	5.2	11	18	24	32	15	31	53	71	113
	Allowable thrust load	N	1960					5194				
		kgf	200					530				
	Allowable moment	N.m	608					1666				
		kgf.m	62					170				
	Moment rigidity	N.m/arc min	274					931				
		kgf.m/arc min	28					95				
	Brakes Torque	N.m	86	115	143	162	186	212	282	353	400	494
		kgf.m	8.8	12	15	17	19	22	29	36	41	50
	Brakes Voltage	V	.....±...									
	Brakes Current	A	0.3					0.4				
	Speed/position detector	-	Absolute type: 2048 p/rev; incremental type: 2000 p/rev									
	Weight	kg	12.5					27				
Servo amplifier	Frame No.	-	ARN15					ARN30				
	Control system	-	Transistor PWM control									
	Power supply Voltage, frequency	V , Hz	3-phase AC 200V to 230V +10%/-15%, 50/60 Hz									
	Power supply Capacity	kVA	1.0					1.5				
	Continuous output current	Arms	2.7					4.5				
	Maximum output current	Arms	9					16				
	Positioning functions	-	Equal division and optional division , max. 255 addresses , absolute encoder infinite feed supported , etc									
	Input signals	-	Address number, mode, servo ON, interlock, reset, pulse train, etc.									
	Output signals	-	Positioning completion, home position, alarm detection, etc.									
	Protective functions	-	Overload, excessive speed, overvoltage, overheating of the motor, etc.									
	Weight	kg	2.4					2.4				

· The power supply capacity indicated above is based on the rated output torque. At the maximum torque, power supplied three times the noted value is required.

Servo actuator	Frame No.			..60					..135				
	RV/GH reduction gear frame no.		-	RV80E					RV160E				
	Motor output		kW	1.5					2.5				
	Moment of inertia of motor		kg.cm^2(GD^2/4)	24					79				
	Reduction gear ratio; types A, B		-	65	80	100	120	152	80	100	128	144	170
	Reduction gear ratio; types C		-	66	81	101	121	153	81	101	129	145	171
	Rated output torque		N.m	304	376	470	564	715	753	941	1204	1352	1599
			kgf.m	31	38	48	58	73	77	96	123	138	163
	Maximum torque		N.m	1019	1254	1568	1882	1960	2258	2822	3613	3920	3920
			kgf.m	104	128	160	192	200	230	288	369	400	400
	Rated rotation speed		rpm	38	31	25	21	16	25	20	16	14	12
	Maximum output rotation speed		rpm	46	38	30	25	20	31	25	20	17	15
	Backlash		arc min	1									
	Lost motion		arc min	1									
	Spring constant		N.m/arc min	196					392				
			kgf.m/arc min	20					40				
	Allowable load moment of inertia		kg.m^2(GD^2/4)	51	77	120	173	277	253	395	647	819	1142
	Allowable thrust load		N	7840					14700				
			kgf	800					1500				
	Allowable moment		N.m	1735					3920				
			kgf.m	177					400				
	Moment rigidity		N.m/arc min	1176					2940				
			kgf.m/arc min	120					300				
	Brakes	Torque	N.m	451	539	657	774	962	1051	1286	1615	1803	2109
			kgf.m	46	55	67	79	98	107	131	165	184	215
		Voltage	V	.....±...									
		Current	A	0.5					0.8				
	Speed/position detector		-	Absolute type: 2048 p/rev; incremental type: 2000 p/rev									
	Weight		kg	37.5					73.5				
Servo amplifier	Frame No.		-	ARN60					ARN135				
	Control system		-	Transistor PWM control									
	Power supply	Voltage, frequency	V , Hz	3-phase AC 200V to 230V +10%/-15%, 50/60 Hz									
		Capacity	kVA	3.0					4.5				
	Continuous output current		Arms	8.3					15				
	Maximum output current		Arms	29					44				
	Positioning functions		-	Equal division and optional division , max. 255 addresses , absolute encoder infinite feed supported , etc									
	Input signals		-	Address number, mode, servo ON, interlock, reset, pulse train, etc.									
	Output signals		-	Positioning completion, home position, alarm detection, etc.									
	Protective functions		-	Overload, excessive speed, overvoltage, overheating of the motor, etc.									
	Weight		kg	6.0					6.0				

· The power supply capacity indicated above is based on the rated output torque. At the maximum torque, power supplied three times the noted value is required.

Servo actuator	Frame No.		....			.....			.....			
	RV/GH reduction gear frame no.	-	GH7			GH17			GH24			
	Motor output	kW	0.8			1.5			2.5			
	Moment of inertia of motor	kg.cm^2(GD^2/4)	9.8			24			79			
	Reduction gear ratio	-	461/41	21	153/5	11	21	31	11	21	31	
	Rated output torque	N.m	26	49	73	52	99	146	103	198	292	
		kgf.m	2.6	5.0	7.4	5.3	10	15	11	20	30	
	Maximum torque	N.m	91	173	206	172	329	486	310	593	696	
		kgf.m	9.2	18	21	18	34	50	32	60	71	
	Rated rotation speed	rpm	150	119	81	150	119	81	150	95	65	
	Maximum output rotation speed	rpm	250	143	97	250	143	97	227	119	81	
	Backlash	arc min	6									
	Lost motion	arc min	6									
	Spring constant	N.m/arc min	15			29			44			
		kgf.m/arc min	1.5			3.0			4.5			
	Allowable load moment of inertia	kg.m^2(GD^2/4)	0.59	2.2	4.7	1.5	5.3	12	4.8	17	38	
	Allowable thrust load	N	1470			1960			2940			
		kgf	150			200			300			
	Allowable moment	N.m	461			804			843			
		kgf.m	47			82			86			
	Moment rigidity	N.m/arc min	-			-			-			
		kgf.m/arc min	-			-			-			
	Brakes Torque	N.m	60	89	119	81	157	225	167	314	461	
		kgf.m	6.1	9.1	12	8.3	16	23	17	32	47	
	Brakes Voltage	V	.....±...									
	Brakes Current	A	0.4			0.5			0.8			
	Speed/position detector	-	Absolute type: 2048 p/rev; incremental type: 2000 p/rev									
	Weight	kg	19			33			51			
Servo amplifier	Frame No.	-	ARN30			ARN60			ARN135			
	Control system	-	Transistor PWM control									
	Power supply Voltage, frequency	V , Hz	3-phase AC 200V to 230V +10%/-15%, 50/60 Hz									
	Power supply Capacity	kVA	1.5			3.0			4.5			
	Continuous output current	Arms	4.5			8.3			15			
	Maximum output current	Arms	16			29			44			
	Positioning functions	-	Equal division and optional division , max. 255 addresses , absolute encoder infinite feed supported , etc									
	Input signals	-	Address number, mode, servo ON, interlock, reset, pulse train, etc.									
	Output signals	-	Positioning completion, home position, alarm detection, etc.									
	Protective functions	-	Overload, excessive speed, overvoltage, overheating of the motor, etc.									
	Weight	kg	2.4			6.0			6.0			

· The power supply capacity indicated above is based on the rated output torque. At the maximum torque, power supplied three times the noted value is required.

Servo actuator	Frame No.			AR10H (currently being developed)
	RV/GH reduction gear frame no.		-	RV10C
	Motor output		kW	0.5
	Moment of inertia of motor		$kg.cm^2(GD^2/4)$	9.5
	Reduction gear ratio		-	45
	Rated output torque		N.m	72
			kgf.m	7
	Maximum torque		N.m	245
			kgf.m	25
	Rated rotation speed		rpm	56
	Maximum output rotation speed		rpm	67
	Backlash		arc min	1
	Lost motion		arc min	1
	Spring constant		N.m/arc min	47
			kgf.m/arc min	4.8
	Allowable load moment of inertia		$kg.m^2(GD^2/4)$	9.6
	Allowable thrust load		N	5880
			kgf	600
	Allowable moment		N.m	686
			kgf.m	70
	Moment rigidity		N.m/arc min	421
			kgf.m/arc min	43
	Brakes	Torque	N.m	245
			kgf.m	25
		Voltage	V	.....±...
		Current	A	0.5
	Speed/position detector		-	Incremental type: 1000 p/rev
	Weight		kg	16
Servo amplifier	Frame No.		-	ARN30 (Initialization necessary refer p7-35)
	Control system		-	Transistor PWM control
	Power supply	Voltage, frequency	V , Hz	3-phase AC 200V to 230V +10%/-15%, 50/60 Hz
		Capacity	kVA	1.5
	Continuous output current		Arms	4.5
	Maximum output current		Arms	16
	Positioning functions		-	Equal division and optional division , max. 255 addresses , etc
	Input signals		-	Address number, mode, servo ON, interlock, reset, pulse train, etc.
	Output signals		-	Positioning completion, home position, alarm detection, etc.
	Protective functions		-	Overload, excessive speed, overvoltage, overheating of the motor, etc.
	Weight		kg	2.4

· The power supply capacity indicated above is based on the rated output torque. At the maximum torque, power supplied three times the noted value is required.

2-3 Ambient Conditions for Use

Use of the AR series in ambient conditions outside the range of these specifications can cause failures or malfunctioning.
Be absolutely sure to use the AR series in the operating ambient conditions set forth below.

(1) Operating ambient conditions

	Servo actuator	Servo amplifier
Temperature	0 - +40°C	0 - +55°C
Humidity	Maximum 80% room humidity (no condensation)	
Atmosphere	Indoors free from corrosive or explosive gases No metal powder or dust No sources of vibration nearby No strong electrical or magnetic fields	
Water- and oil-proof characteristics	No exposure to large numbers of drops of water or oil No exposure of connectors to drops of water or oil	No exposure to drops of water or oil
Power supply	Overvoltage category II as specified by IEC664	
Degree of contamination	-	Environment with degree of contamination 2 or above as specified by IEC664

(2) Storage ambient conditions

	Servo actuator	Servo amplifier
Temperature	-20 ~ +80°C	-20 ~ +65°C

⚠ Do not expose the machine to gases that may cause the machine to corrode or an explosion to occur.

⚠ Keep excess water and oil away from the servo actuator. Also, do not allow water and oil to enter the connectors along the cables. Ignoring these instructions could lead to damage to the servo system or electrical shock.

3. Overview

3-1 Equipment Features

The AR series is a digital AC servo actuator system combining a servo actuator with a servo amplifier.

The actuator integrates a high-rigidity and high-accuracy reduction gear and servo motor into a single unit while the amplifier incorporates a controller.

(1) Compact integrated design

The servo actuator integrates the reduction gear, motor, holding electromagnetic brake and encoder into a single unit which is both flat and compact.
Similarly, the servo amplifier integrates the servo driver and controller into a single unit.
This design significantly contributes to making the machine equipment more compact and reducing the number of design processes.

(2) Full choice offered by variations

Four types of motors with a capacity ranging from 0.4 kW to 2.5 kW as well as 8 different reduction gears are available.
Selection of the output shaft formats can be made from a wide range.

All in all, this broad spectrum of variations meets the many and different requirements of the customers.

(3) Built-in high-rigidity, high-accuracy reduction gears

The reduction gear featured in the servo actuator is the high-rigidity, high-accuracy RV or GH reduction gear which is used in industrial robots and which has received high critical acclaim.

(4) Multi-functional operation modes

The operation method can be selected from 12 operation modes, including the main modes (equal parts division system or any number of parts division system) and sub modes (I/O jog and step operation), to support various kinds of positioning applications.

(5) Self-contained electronic gear

The electronic gear function enables the positioning data to be set easily without the need to consider the reduction gear ratio of the machine system.

(6) UL and EN standards supported

The AR series line-up consists of products, which comply with UL standards, CUL standards and European safety standards. (See p2-1 for details)

(7) Infinite-length positioning enabled

Infinite-length positioning is possible even when the absolute encoder is employed.
Even in this case, there is no cumulative error.

(8) Absolute and incremental encoders supported

Both absolute and incremental encoders are supported by the same servo amplifier.

(9) Built-in brake control function

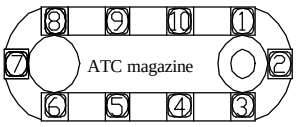
The holding brake built into the servo actuator is automatically controlled in synchronization with the servo ON/OFF operations.

3-2 Basic Command Methods

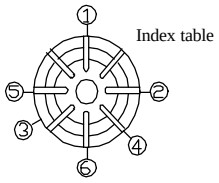
(1) Introduction The operation method can be selected from operation modes <1> to <12> below.

Main operation modes

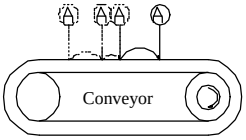
- <1> Equal pitch multi-rotation coordinates (p3-6)
  - Enables equal division and indexing.
  - Infinite feed is possible using the absolute encoder.
  - Short-cut operation is also possible.



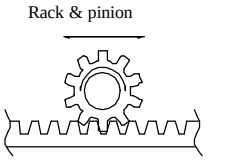
- <2> Optional division 360° coordinates (p3-7)
  - Enables positioning to any (= optional) position.
  - Infinite feed is possible using the absolute encoder.
  - Coordinate axes: 0 to 360°.



- <3> Infinite linear coordinates (p3-8)
  - Enables feed operations by specifying the increment.
  - Infinite feed is possible.
  - The coordinates are reset with every positioning.

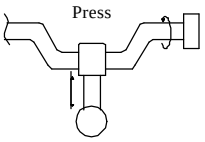


- <4> Finite linear coordinates (p3-9)
  - Enables positioning to any (= optional) position.
  - Restrictions apply to the operating range.
  - Coordinate axes: linear coordinates.



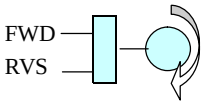
- <5> Pulse train operation (p3-10)
  - Supply the pulses from the sequencer.
  - Rotation corresponds to the pulse amount supplied.
  - There are 2 pulse formats to choose from.

- <6> Speed command operation (p3-11)
  - Initiates rotation by speed control.
  - The operation speed is set in a parameter.
  - There are 6 speed and 3 acceleration/deceleration time constants to choose from.

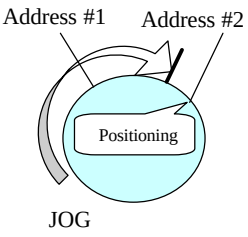


Sub operation modes

- <7> I/O jog operation (p3-12)
  - Initiates jog operation when the rotation command is used by FWD or RVS.
  - A speed and an acceleration/deceleration time constant inconsistent with those in the main operation mode can be set.



- <8> Step operation (p3-13)
  - Initiates positioning at the nearest address after the jog operation.
  - Used for manually replacing the tools in the ATC magazine.
  - Can also be used for checking the positioning position.

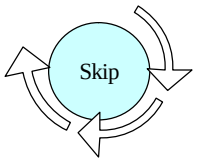


<9> Machine origin return (p3-14)

The return origin of the absolute encoder can be set with the panel switch when the power is first turned ON, the incremental encoder is operated using external limit switches, etc.

<10> I/O skip operation (p3-15)

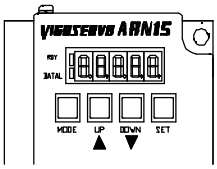
Initiate rotation by skip operation.
Rotation in one fixed angle increment is initiated by ON edge of FWD or RVS.



Manual operation modes

<11> Manual jog operation (p3-16)

Enables jog operation while no control signals are input.
Operation is initiated by the panel switch at the front of the servo amplifier.
Rotation is executed only while the switch is held down.

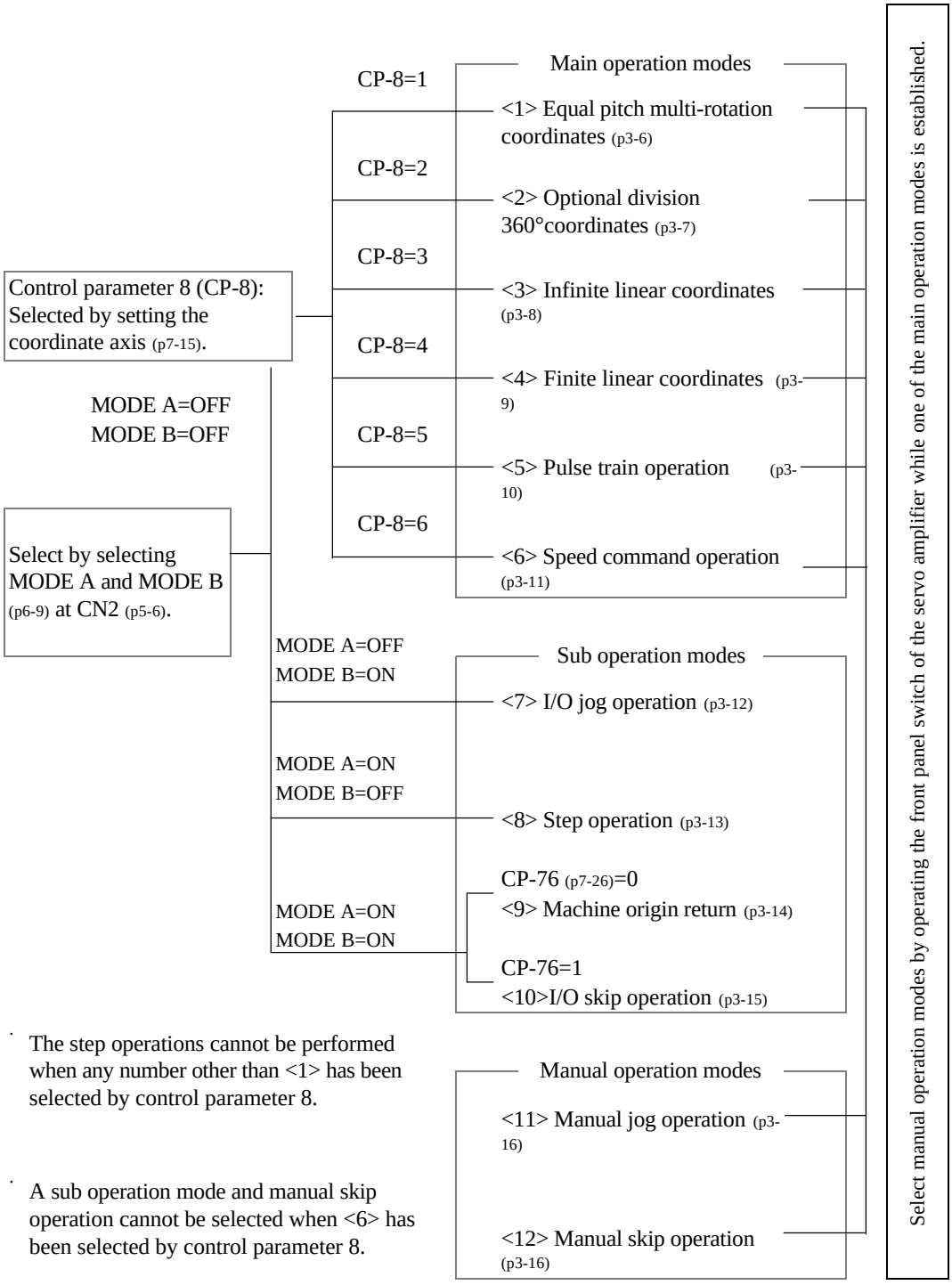


<12> Manual skip operation (p3-16)

Enables skip operation while no control signals are input.
Operation is initiated by the panel switch at the front of the servo amplifier.
Rotation in one fixed angle increment is initiated by pushing the switch once.

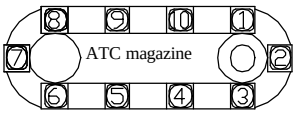
(2) How to select the operation mode

- One of the main or sub operation modes is selected by switching MODE A and MODE B (p6-9).
- While a main operation mode is established, an operation mode is selected by setting control parameter 8 (p7-15).
- A manual operation mode is executed by operating the front panel switches of the servo amplifier while one of the main operation modes is established. (p6-5)



- The step operations cannot be performed when any number other than <1> has been selected by control parameter 8.
- A sub operation mode and manual skip operation cannot be selected when <6> has been selected by control parameter 8.

(3) Detailed description of operation modes



<1> Equal pitch multi-rotation coordinates

- This mode is used for equal division and indexing to drive the ATC magazine, etc.
- Equal division and indexing are enabled simply by setting the total number of addresses, reduction gear ratio, etc.
- Use of the absolute encoder (p2-1) obviates the need for machine origin return despite the fact that infinite feed is enabled.

Servo amplifier

Servo actuator : short-cut control enabled

Both absolute and incremental systems supported

Sequencer outputs

Mode A (OFF) Main operation modes (p3-5) are selected
Mode B (OFF) by mode A and mode B (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

AD0 Address numbers (p6-11) : Positioning addresses are each designated by a binary number.
AD7

B1,B2 brake control

The brake is automatically controlled in synchronization with the servo ON/OFF operations. (p5-14)

Power save timer: When CP-39 (p7-21) is set, the servo lock is automatically switched over to brake hold after the time set in the parameter has elapsed.

Start (p6-10): Positioning is executed when start is input.

Speed selection (p6-12):Two kinds of speeds and acceleration/deceleration time constants used for positioning can be set and selected. If the speed selections have not been allocated to controls 1 through 14 (p6-10), speed 1 for equal division and acceleration/deceleration time constant 1 will be selected.

- Speed 1 for equal division: SP-7 (p7-10): Selected when the speed selection has been set to OFF.
- Speed 2 for equal division: SP-8 (p7-10): Selected when the speed selection has been set to ON.
- Acceleration/deceleration time constant 1: SP-9 (p7-11): Selected when the speed selection has been set to OFF.
- Acceleration/deceleration time constant 2: SP-10 (p7-11): Selected when the speed selection has been set to ON.

Sequencer inputs

Positioning completion (p6-19)

OUT-AD0
OUT-AD7

The address nearest the current position is output as a binary number. (p6-20)

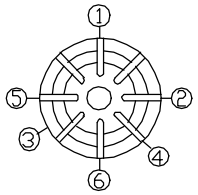
Home position (p6-23): This is set ON each time the positioning address is passed through.

<2> Optional division 360° coordinates

. This mode is used for positioning to any position using an index table, etc.

. Using the electronic gear, the position can be input using an angle ranging from 0 to 359.99···° without the need to take the reduction gear ratio into consideration. (p7-14,33)

. Use of the absolute encoder (p2-1) obviates the need for machine origin return (p3-14) despite the fact that infinite feed is enabled.



Servo amplifier

Servo actuator : short-cut control enabled

Sequencer outputs

Mode A (OFF)
Mode B (OFF)
Main operation modes (p3-5) are selected by mode A and mode B (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

AD0 | AD7
Address numbers (p6-11): Positioning addresses from #1 to #255 are each designated by a binary number.

Both absolute and incremental systems supported

B1, B2 brake control

The brake is automatically controlled in synchronization with the servo ON/OFF operations. (p5-14)

Start (p6-10): Positioning is executed when start is input.

Torque limiting enable (p6-12): Controls the torque that enables the motor to be forcibly stopped by an external stopper.

External failure input (p6-12): Causes the servo actuator to immediately stop, while maintaining its power.

Acceleration/deceleration time constant selection (p6-13): Two kinds of acceleration/deceleration time constants for positioning can be set and selected. If this signal does not select the acceleration/deceleration time constant, acceleration/deceleration time constant 1 will be selected.

- Acceleration/deceleration time constant 1: SP-9 (p7-11)
- Acceleration/deceleration time constant 2: SP-10 (p7-11)

Positioning data (p7-33)

This can be set from address #1 up to address #255 in the 0 to 359.99···° range. Input the motor rotational speed and position for each data.

Address #1	Position
	Motor rotation speed
Address #2	Position
	Motor rotation speed

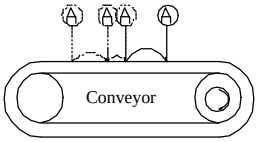
Sequencer inputs

Positioning completion (p6-19)

OUT-AD0 | OUT-AD7
The target address is output as a binary number. (p6-20)

Fixed point/through point 1, 2 (p6-21)
This signal is set ON when the servo actuator is at the position which has been set.

<3> Infinite linear coordinates



- This mode is used for positioning by designating the feed amount of a conveyor, etc.
- Positioning data (p7-33): Positioning position - current position = increment
- The coordinates enable infinite feed.
- The coordinates are reset with each positioning.
- If the feed amount converted into the encoder pulse has a fraction, the deviation may accumulate.

  Example: When the reduction gear ratio equals 121 and the encoder equals the absolute value (8192 (2048x4)pulse/rev), a conversion of the feed amount per single degree of servo actuator's output shaft into the encoder pulse can be calculated as follows: 121 x 8192/360 = 2753.422… ".422…" is the fraction. In this case feeding single degree will accumulate the daviation.

Servo amplifier

Servo actuator

Both absolute and incremental systems supported

Sequencer outputs

Mode A (OFF)
Mode B (OFF) Main operation modes (p3-5) are selected by mode A and mode B (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

AD0 … AD7 Address numbers (p6-11): Positioning addresses from #1 to #255 are each designated by a binary number.

Start (p6-10): Positioning is executed when start is input.

B1, B2 brake control

The brake is automatically controlled in synchronization with the servo ON/OFF operations. (p5-14)

Torque limiting enable (p6-12): Controls the torque that enables the motor to be forcibly stopped by an external stopper.

External failure input (p6-12): Causes the servo actuator to immediately stop, while maintaining its power.

Acceleration/deceleration time constant selection (p6-13): Two kinds of acceleration/deceleration time constants for positioning can be set and selected. If this signal does not select the acceleration/deceleration time constant, acceleration/deceleration time constant 1 will be selected.

- Acceleration/deceleration time constant 1: SP-9 (p7-11)
- Acceleration/deceleration time constant 2: SP-10 (p7-11)

Positioning completion (p6-19)

OUT-AD0 … OUT-AD7 The target address is output as a binary number. (p6-20)

Fixed point/through point 1, 2 (p6-21): The signal turns on when the servo actuator is at the fixed point.

Positioning data (p7-33)

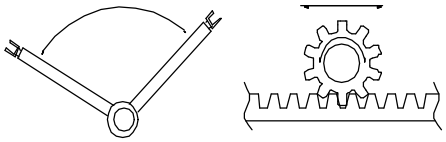
This can be set from address #1 up to address #255.

Input the motor rotational speed and position for each data.

Address #1	Position (Incremental) Motor rotation speed
Address #2	Position (Incremental) Motor rotation speed

<4> Finite linear coordinates

- This mode is used for optional positioning operations within the restricted ranges of the robot arm, rack & pinion, etc.
- It enables positioning at any position.
- Restrictions apply to the operation range. (p3-17)
- The coordinate axes are linear coordinates.



Servo actuator

Servo amplifier

Sequencer outputs

Mode A (OFF)
Mode B (OFF)
Main operation modes (p3-5) are selected by mode A and mode B (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

AD0 | AD7
Address numbers (p6-11): Positioning addresses from #1to #255 are each designated by a binary number.

Start (p6-10): Positioning is executed when start is input.

Torque limiting enable (p6-12): Controls the torque that enables the motor to be forcibly stopped by an external stopper.

External failure input (p6-12): Causes the servo actuator to immediately stop, while maintaining its power.

Acceleration/deceleration time constant selection (p6-13): Two kinds of acceleration/deceleration time constants for positioning can be set and selected.

If this signal does not select the acceleration/deceleration time constant, acceleration/deceleration time constant 1 will be selected.

- Acceleration/deceleration time constant 1: SP-9 (p7-11)
- Acceleration/deceleration time constant 2: SP-10 (p7-11)

Sequencer inputs

Positioning completion (p6-19)

OUT-AD0 | OUT-AD7
The target address is output as a binary number. (p6-20)

Fixed point/through point 1, 2 (p6-21)
This signal is set ON when the servo actuator is at the set position.

Rotational restrictions apply to both the absolute and incremental encoders.

Both absolute and incremental systems supported

B1, B2 brake control

The brake is automatically controlled in synchronization with the servo ON/OFF operations.(p5-14)

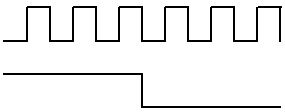
Positioning data (p7-33)

This can be set from address #1 up to address #255.

Input the motor rotational speed and position for each data.

Address #1	Position
	Motor rotation speed
Address #2	Position
	Motor rotation speed

<5> Pulse train operation



. Supply the pulses from the sequencer. (p5-9)
. Rotation corresponds to the amount of pulses supplied. There are 2 pulse formats to choose from. (p7-18)
. The encoder signals can be output to the sequencer. (p5-9)
. The current position can be sent to the sequencer by RS-232C communication. (p5-8,8-1)

Servo actuator

Servo amplifier

Rotational restrictions apply to both the absolute and incremental encoders.

Both absolute and incremental systems supported

Sequencer outputs

Mode A (OFF)
Mode B (OFF)
Main operation modes (p3-5) are selected by mode A and mode B (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

5V
A-IN
*A-IN
B-IN
*B-IN
0V
Inputs pulses from the sequencer. (p5-9) There are 2 pulse formats to choose from. (p7-18)

Motor rotation amount [Pulse] = No. of pulses input x Electronic gear α (p7-14) / Electronic gear β (p7-14)

B1, B2 brake control (p5-14)

The brake is automatically controlled in synchronization with the servo ON/OFF operations.(p5-14)

Torque limiting enable (p6-12) :
Controls the torque that enables the motor to be forcibly stopped by an external stopper.

External failure input (p6-12) :
Causes the servo actuator to immediately stop, while maintaining its power.

Sequencer inputs

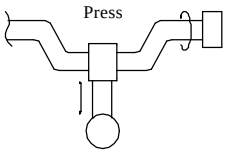
Positioning completion (p6-19)

A-OUT
B-OUT
Z-OUT
0V
The A-, B- and Z-phase source signals of the encoder can be output to the sequencer. (p5-9)

RS-232C The current position can be sent in real-time to the sequencer. (p5-8,8-1)

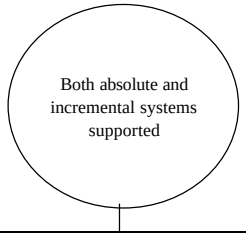
<6> Speed command operation

- This mode is used when controlling the speed of a press, etc.
- The operation speed is set in a parameter, and it is selected by a control input (p6-10).
- There are 6 speeds and 3 acceleration/deceleration time constants to choose from. (p6-17)



Servo actuator

Rotational restrictions apply to both the absolute and incremental encoders.



B1, B2 brake control

The brake is automatically controlled in synchronization with the servo ON/OFF operations.(p5-14)

Servo amplifier

Sequencer outputs

Mode A (OFF)
Mode B (OFF)
Main operation modes (p3-5) are selected by mode A and mode B (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

FWD
RVS
The servo actuator rotates. (p6-15)

CONT1-14 allocation (p6-16) → Servo parameter SP (p7-11)

Speed command speed selection 1	Speed command speed 1
Speed command speed selection 2	Speed command speed 2
Speed command speed selection 3	Speed command speed 3
Speed command speed selection 4	Speed command speed 4
Speed command speed selection 5	Speed command speed 5
Speed command speed selection 6	Speed command speed 6

- Up to 6 motor rotation speeds can be set.
- Speeds are selected by speed command speed selection 1 through 6.
- Speed command speed 1 is automatically selected when speed command speed selections 1 through 6 have not been allocated to control 1 through 14.

- Up to 3 motor acceleration/ deceleration time constants can be set.

(p6-17) → (p7-12)

Speed command acceleration/ deceleration selection 1	Speed command acceleration/deceleration 1
Speed command acceleration/ deceleration selection 2	Speed command acceleration/deceleration 2
Speed command acceleration/ deceleration selection 3	Speed command acceleration/deceleration 3

- The acceleration/ deceleration time constant is selected by speed command acceleration/ deceleration selection 1, 2 or 3.

External failure input (p6-12): Causes the servo actuator to be shut down immediately.

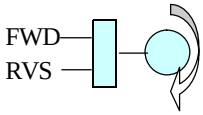
RS-232C (p5-8): Enables the command speed to be changed using the communication function.

- Speed command acceleration/ deceleration 1 is automatically selected when speed command acceleration/ deceleration selections 1 through 3 have not been allocated to control 1 through 14.

Sequencer inputs

Speed arrival (p6-23): This signal is set ON when the motor rotation speed exceeds the speed arrival identification speed CP-26 (p7-19) setting.

<7> I/O jog operation



. The main operation mode is switched to the I/O jog operation by switching mode A and mode B(p6-9).

. Jog operation at a constant rotation speed can be performed using the control I/O signals (p5-6).

. The I/O jog mode is used as an auxiliary function (sub-operation mode) of the main operation modes (p3-3).

. The I/O jog operations are controlled by position control. (p3-17)

Servo actuator

Servo amplifier

Rotational restrictions apply to both the absolute and incremental encoders.

Sequencer outputs

Mode A (OFF) I/O jog operation is selected by mode A and mode B
Mode B (ON) (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

FWD
RVS } The servo actuator rotates. (p6-15)

Both absolute and incremental systems supported

B1, B2 brake control (p5-14)

The brake is automatically controlled in synchronization with the servo ON/OFF operations. (p5-14)

The motor speed is set in the SP-4 manual feedrate (p7-10) parameter.

The motor acceleration/deceleration time constant is set in the SP-5 manual feed acceleration/deceleration time constant (p7-10) parameter.

External failure input (p6-12): Causes the servo actuator to immediately stop, while maintaining its power.

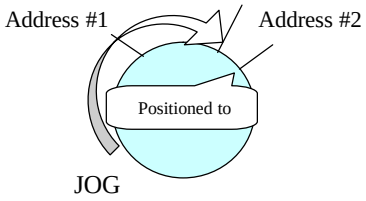
RS-232C (p5-8,8-1): Enables the command speed to be changed using the communication function.

Sequencer inputs

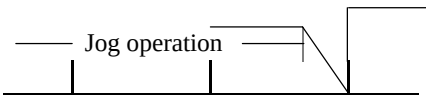
Positioning completion (p6-19): Invalid when CP-8 (Coordinate axis) has been set to “1” (equal pitch multi-rotation coordinates.)

Speed arrival (p6-23): This signal is set ON when the motor rotation speed exceeds the speed arrival identification speed CP-26 (p7-19) setting.

<8> Step operation



- This mode provides positioning to the nearest address after a jog operation.
- It is used for manually replacing the tools in the ATC magazine.
- It can also be used for checking the positioning position.
- It is used as an auxiliary function (sub-operation mode) of the equal pitch multi-rotation coordinates (p3-6).
- Step operations cannot be performed at any coordinate axis other than at the equal pitch multi-rotation coordinates.
- The main operation mode (p3-5) is switched to the step operation by switching between mode A and mode B (p6-9).



Positioned to the address that comes next to where jog operation goes OFF

(If the motor cannot stop at the above address because of the long deceleration time, it will stop at the address next to the predetermined one.)

Servo amplifier

Servo actuator

Mode A (ON) Step operation is selected by
Mode B (OFF) mode A and mode B (p6-9).

Operation ready command (p6-9): Supplies power to the main power supply.

Servo ON (p6-9): Supplies power to the servo actuator.

Both absolute and incremental systems supported

FWD
RVS
The servo actuator rotates. (p6-15)

B1, B2 brake control

The brake is automatically controlled in synchronization with the servo ON/OFF operations. (p5-14)

Sequencer outputs

The motor speed is set in the SP-4 manual feedrate (p7-10) parameter.

The motor acceleration/deceleration time constant is set in the SP-5 manual feed acceleration/deceleration time constant (p7-10) parameter.

External failure input (p6-12): Causes the servo actuator to immediately stop, while maintaining its power.

Sequencer inputs

Positioning completion (p6-19)

<9> Machine origin return

- When using an incremental encoder, an origin return is necessary whenever the power supply is turned ON.
- The main operation mode (P3-5) is switched to origin return by switching between mode A and mode B (p6-9).
- Origin return is executed when ORG (p6-14) is set ON.
- The rotation direction of origin return is set by origin return direction CP-18 (p7-19).
- When an origin return is performed, the current coordinates are changed to the value in CP-22 "Origin return position setting" (p7-19).

Servo amplifier

Sequencer outputs

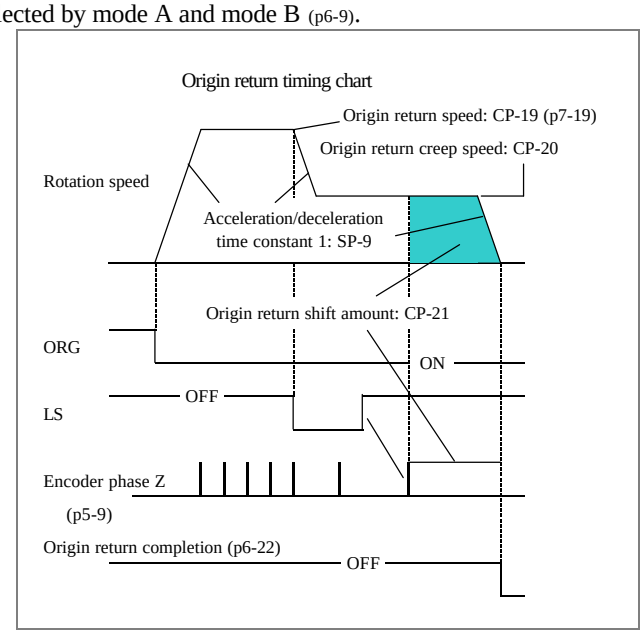
Mode A (ON)
Mode B (ON)
Origin return is selected by mode A and mode B (p6-9).

Operation ready command (p6-9):Supplies power to the main power supply.

Servo ON (p6-9):Supplies power to the servo actuator.

ORG (p6-14):The origin return operation is started at the ON edge of this signal.

LS (p6-14):Input of the origin return limit switch.



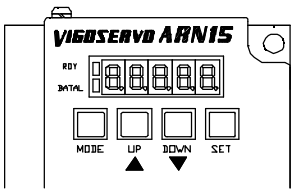
Sequencer inputs

Positioning completion (p6-19)
(Invalid when CP-8 (Coordinate axis) has been set to “1”(equal pitch multi-rotation coordinates.))

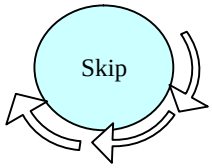
Origin return completion (p6-22)

- The above describes the origin return procedure using the mode A, mode B, and control input signals.

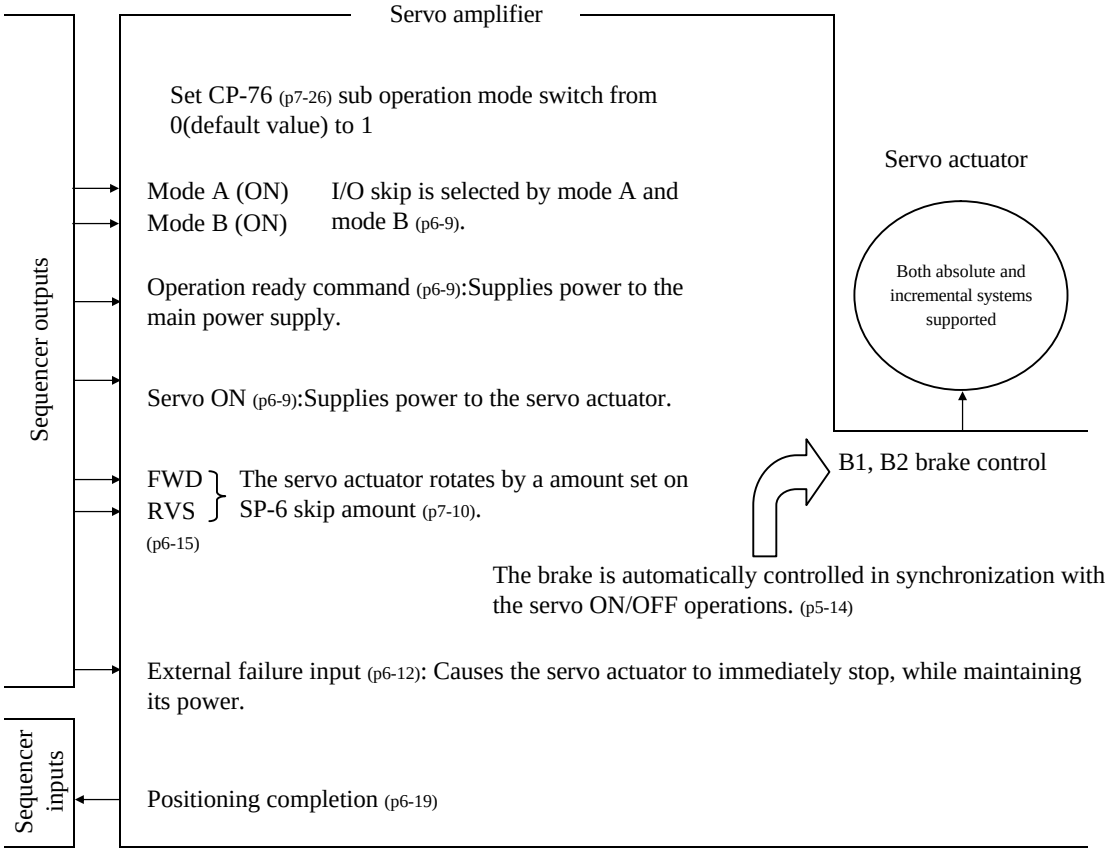
  You can also use the panel switches in the main operation mode (p3-5).
- When using an absolute encoder (p2-1), as long as an origin setting is performed during the initial turning on of the power supply, origin return operation will no longer be required. Using the panel switches, perform an origin setting as follows.
- Proceed with machine origin return using the manual jog operation (p3-16), etc.
- Use the panel switches to set the origin. (p6-7)
  When the origin is set, the following operations are performed inside the system.
  - The multi-rotation counter of the absolute encoder is reset.
  - The current position on the coordinate axes is changed to the origin return position setting CP-22 (p7-19).
  - In the case of equal pitch multi-rotation coordinates (p3-6) (coordinate axis: CP-8=1 (p7-15)), the positions of all the positioning addresses are shifted by an amount equivalent to the origin return position setting (p7-19).



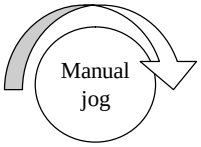
<10> I/O Skip operation



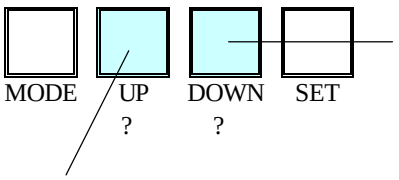
- Set CP-76 (p7-26) sub operation mode switch from 0(default value) to 1, sub operation mode when MODE A,B=ON is changed from machine origin return to I/O skip operation (p3-5).
- The servo actuator rotates by a fixed amount to the current position incrementing direction when FWD (p6-15) is ON.
- The servo actuator rotates by a fixed amount to the current position decrementing direction when RVS (p6-15) is ON.
- The motor speed is set in the SP-4 manual feedrate (p7-10) parameter.
- The motor acceleration/deceleration time constant is set in the SP-5 manual feed acceleration/deceleration time constant (p7-10) parameter.
- The servo motor rotation amount is set in the SP-6 skip amount parameter (unit = encoder pulses) (p7-10).
- This operation mode is used for adjustment of machine origin.
- This operation is invalid when CP-8 (Coordinate axis) has been set to “6” speed command operation.



<11> Manual jog operation

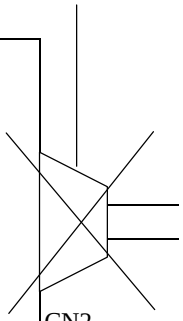


- Jog operations are possible while no input signals (p6-9) are input.
- Operation is initiated by the panel switch. (p6-5)
- Rotation is executed only while the switch is held down.
- Operation is possible even without connecting the CN2 control I/O signal connector (p5-6).



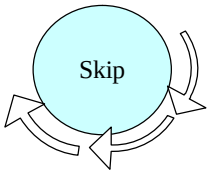
Servo actuator rotates to the current position decrementing direction while DOWN switch is held down.

Servo actuator rotates to the current position incrementing direction while UP switch is held down.

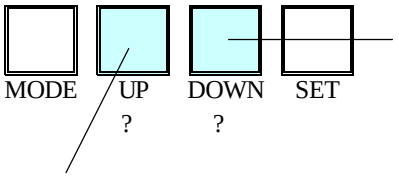


- The motor rotates at the SP-4 manual feedrate (p7-10) setting.
- The motor accelerates and decelerates according to the setting of the SP-5 manual feed acceleration/deceleration time constant (p7-10).
- For details on the rotational direction of the actuator output axis, refer to the section on the" input signals, parameters and servo actuator rotation directions (p3-26)".

<12> Manual skip operation

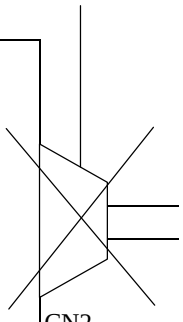


- Skip operations are possible while no input signals (p6-9) are input.
- Operation is initiated by the panel switch. (p6-6)
- Rotation by a prescribed angle is executed only by pressing the switch once.
- Operation is possible even without connecting the CN2 control I/O signal connector (p5-6).



The servo actuator rotates by a fixed amount to the current position decrementing direction.

The servo actuator rotates by a fixed amount to the current position incrementing direction.



- The servo motor rotation amount is set in the SP-6 skip amount parameter (unit = encoder pulses) (p7-10).
- The motor rotates at the SP-4 manual feedrate (p7-10) setting.
- The motor accelerates and decelerates according to the setting of the SP-5 manual feed acceleration/deceleration time constant (p7-10).
- For details on the rotational direction of the actuator output axis, refer to the section on the "input signals, parameters and servo actuator rotational directions (p3-26)".

(4) Main operation modes, and selectable sub operation modes and manual operation modes

? Operations marked with the black dot can be performed.

Example: Pulse train operation is set as the main operation mode when "5" is selected as the coordinate axis CP-8 (p7-15) setting.

When both modes A and B (p6-9) are set OFF, pulse train operation (p3-10) can be performed in the main operation mode (p3-5).

When mode A is set OFF and mode B is set ON in this state, I/O jog operation (p3-12) is performed.

Step operation (p3-13) cannot be performed when the main operation mode has been set to pulse train operation.

				Input statuses of modes A, B		CP-76	Main operation mode (p3-5)					
				MODE A	MODE B		Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation
				OFF	OFF	*2 *4	Position control					Speed control
Functional restrictions	Sub operation mode	Position control	I/O jog operation	OFF	ON	-	?	?	?	?	?	-
			Step operation	ON	OFF	-	?	-	-	-	-	-
			Machine origin return	ON	ON	0	?	?	?	?	?	-
			I/O skip			1	?	?	?	?	?	
	Manual operation mode		Manual jog operation			-	?	?	?	?	?	?
			Manual skip operation			-	?	?	?	?	?	-
	Encoder type						Absolute / Incremental					
	Unidirectional infinite rotation						?	?	?	-	-	?
	Short-cut control						?	?	-	-	-	-
	Absolute encoder limit stop (*1)						-	-	-	?	?	? *3
	Incremental encoder limit stop (*1)						-	-	-	?	?	-
Coordinate axis: CP-8 (*2) (p7-15)							1	2	3	4	5	6
Position data type							-	Abso-lute	Incre-mental	Absol-ute	-	-

*1: In any mode marked with a white dot ?, the servo actuator is stopped by the alarm detection (of an overflow) when the motor shaft has rotated through ±32767 rotations or more centering on the origin.

*2: CP = Control parameter (p7-13)

*3: The “AL-15” (overflow) (p9-3) is displayed when the power is turned ON again.

*4: Sub operation mode when MODE A,B are both ON is selected from machine origin return or I/O skip operation by CP-76 (p7-26).

(5) Correlation between operation modes and control input signals

Signal	Symbol	CN2 pin number. (p5-6)	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
				Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog operation	Manual skip operation
Operation ready command	PRDY	36	6-9	?	?	?	?	?	?	?	?	?	?	-	-
Servo ON	SVON	35		?	?	?	?	?	?	?	?	?	?	-	-
Mode A	MODE A	24		?	?	?	?	?	?	?	?	?	?	-	-
Mode B	MODE B	25		?	?	?	?	?	?	?	?	?	?	-	-
Start	START	22	6-10	?	?	?	?	-	-	-	-	-		-	-
Reset	RESET	40		?	?	?	?	?	?	?	?	?	?	-	-
Control 1-14	CONT1-14	*		?	?	?	?	?	?	?	?	?	?	-	-

(6) Correlation between operation modes and control output signals

?: The signal is not output in the equal pitch multi-rotation coordinates mode.

Positioning completion	INP	31	6-19	?	?	?	?	?	-	?	?	?	?	-	-
Output 1-15	OUT1-15	*		?	?	?	?	?	?	?	?	?	?	-	-
Battery alarm	BAT ALM	46	6-24	?	?	?	?	?	?	?	?	?	?	?	?

* : See p5-6

(7) Correlation between operation modes and servo parameters

No.	Servo parameter	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
			Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog	Manual skip
1	Speed loop proportional gain	7-9	?	?	?	?	?	?	?	?	?	?	?	?
2	Speed loop integral gain		?	?	?	?	?	?	?	?	?	?	?	?
3	Position loop gain		?	?	?	?	?	-	?	?	?	?	?	?
4	Manual feedrate	7-10	-	-	-	-	-	-	?	?	-	?	?	?
5	Manual feed acceleration/deceleration time constant		-	-	-	-	-	-	?	?	-	?	?	?
6	Skip amount		-	-	-	-	-	-	-	-	-	?	-	?
7	Speed 1 for equal division		?	-	-	-	-	-	-	-	-	-	-	-
8	Speed 2 for equal division		?	-	-	-	-	-	-	-	-	-	-	-
9	Acceleration/deceleration time constant 1	7-11	?	?	?	?	-	-	-	-	?	-	-	-
10	Acceleration/deceleration time constant 2		?	?	?	?	-	-	-	-	-	-	-	-
11	Speed command speed 1		-	-	-	-	-	?	-	-	-	-	-	-
12	Speed command speed 2		-	-	-	-	-	?	-	-	-	-	-	-
13	Speed command speed 3		-	-	-	-	-	?	-	-	-	-	-	-
14	Speed command speed 4		-	-	-	-	-	?	-	-	-	-	-	-
15	Speed command speed 5		-	-	-	-	-	?	-	-	-	-	-	-
16	Speed command speed 6		-	-	-	-	-	?	-	-	-	-	-	-
17	Speed command acceleration/deceleration 1	7-12	-	-	-	-	-	?	-	-	-	-	-	-
18	Speed command acceleration/deceleration 2		-	-	-	-	-	?	-	-	-	-	-	-
19	Speed command acceleration/deceleration 3		-	-	-	-	-	?	-	-	-	-	-	-

(8) Correlation between operation modes and control parameters

No.	Control parameter	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
			Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog	Manual skip
1	Encoder type	7-13	?	?	?	?	?	?	?	?	?	?	?	?
2	Reduction gear ratio numerator		?	?	-	-	-	-	-	-	-	-	-	-
3	Reduction gear ratio denominator		?	?	-	-	-	-	-	-	-	-	-	-
4	Electronic gear a	7-14	-	?	?	?	?	-	-	-	-	-	-	-
5	Electronic gear ß		-	?	?	?	?	-	-	-	-	-	-	-
6	Unit amount		-	?	?	?	-	-	-	-	-	-	-	-
7	Brake available / unavailable	7-15	?	?	?	?	?	?	?	?	?	?	?	?
8	Coordinate axis		?	?	?	?	?	?	?	?	?	?	?	?
9	Number of divisions		?	-	-	-	-	-	-	?	-	-	-	-
10	Total number of addresses		?	-	-	-	-	-	-	?	-	-	-	-
11	Optional division short-cut control		-	?	-	-	-	-	-	-	-	-	-	-
12	Indexing number incrementing direction	7-16	?	-	-	-	-	-	-	-	-	-	-	-
13	MF/FIN available / unavailable		?	-	-	-	-	-	-	-	-	-	-	-
14	Short-cut/unidirectional selection		?	-	-	-	-	-	-	-	-	-	-	-
15	2-position indexing direction selection	7-17	?	-	-	-	-	-	-	-	-	-	-	-
16	Input pulse system	7-18	-	-	-	-	?	-	-	-	-	-	-	-

? : Valid only for the equal pitch multi-rotation coordinates.

.: Invalid during the pulse train and speed command operations.

? : Valid only for the finite linear coordinates and the pulse train operation.

? : Invalid during the equal pitch multi-rotation operations.

.: Invalid during the finite linear operations.

No.	Control parameter	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
			Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog	Manual skip
17	Pulse train operation rotation direction	7-18	-	-	-	-	?	-	-	-	-	-	-	-
18	Origin return direction	7-19	-	-	-	-	-	-	-	-	?	-	-	-
19	Origin return speed		-	-	-	-	-	-	-	-	?	-	-	-
20	Origin return creep speed		-	-	-	-	-	-	-	-	?	-	-	-
21	Origin return shift amount		?	?	?	?	?	-	-	-	?	-	-	-
22	Origin return position setting		?	?	?	?	?	-	-	-	?	-	-	-
23	Origin detection range		?	?	?	?	?	-	-	-	-	.	-	-
24	Positioning completion width		?	?	?	?	?	-	?	?	?	?	-	-
25	Excessive deviation width		?	?	?	?	?	-	?	?	?	?	?	?
26	Speed arrival identification speed		?	?	?	?	?	?	?	?	?	?	-	-
27	Fixed point/through point detection pattern		-	?	?	?	-	-	-	-	-	-	-	-
28	Fixed point/through point detection position 1		-	?	?	?	-	-	-	-	-	-	-	-
29	Fixed point/through point detection position 2		-	?	?	?	-	-	-	-	-	-	-	-
30	Fixed point detection range		-	?	?	?	-	-	-	-	-	-	-	-
31	Soft + over-travel detection position	7-20	-	-	-	?	?	-	-	-	?	-	-	-
32	Soft - over-travel detection position		-	-	-	?	?	-	-	-	?	-	-	-
33	Speed limit value		?	?	?	?	-	?	?	?	?	?	?	?
34	Torque limit value		?	?	?	?	?	?	?	?	?	?	-	-
35	Brake forcible release		?	?	?	?	?	?	?	?	?	?	-	-

? : Valid only for the equal pitch multi-rotation coordinates.

.: Invalid during the pulse train and speed command operations.

?: Valid only for the finite linear coordinates and the pulse train operation.

?: Invalid during the equal pitch multi-rotation operations.

.: Invalid during the finite linear operations.

No.	Control parameter	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
			Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog	Manual skip
36	Home position detection range	7-21	?	-	-	-	-	-	-	-	-	-	-	-
37	Backlash compensation amount		?	-	-	-	-	-	-	-	-	-	-	-
38	Backlash compensation direction		?	-	-	-	-	-	-	-	-	-	-	-
39	Power save timer available/unavailable		?	-	-	-	-	-	-	-	-	-	-	-
40	Power save timer time		?	-	-	-	-	-	-	-	-	-	-	-
41	Overshoot amount	7-22	?	-	-	-	-	-	-	-	-	-	-	-
42	Number of follow-up pulses		?	-	-	-	-	-	-	-	-	-	-	-
43	Interlock logic		?	?	?	?	-	-	.	?	-	-	-	-
44	Rewriting prohibited	7-23	?	?	?	?	?	?	?	?	?	?	?	?
45	Monitor selection		?	?	?	?	?	?	?	?	?	?	?	?
46	Display contents when power is turned ON	7-24	?	?	?	?	?	?	?	?	?	?	?	?
47-60	Control / no function designated	7-25	?	?	?	?	?	?	?	?	?	?	-	-
	Control/AD0		?	?	?	?	-	-	-	-	-	-	-	-
	Control/AD1		?	?	?	?	-	-	-	-	-	-	-	-
	Control/AD2		?	?	?	?	-	-	-	-	-	-	-	-
	Control/AD3		?	?	?	?	-	-	-	-	-	-	-	-
	Control/AD4		?	?	?	?	-	-	-	-	-	-	-	-
	Control/AD5		?	?	?	?	-	-	-	-	-	-	-	-
	Control/AD6		?	?	?	?	-	-	-	-	-	-	-	-

? : Valid only for the equal pitch multi-rotation coordinates.

.: Invalid during the pulse train and speed command operations.

? : Valid only for the finite linear coordinates and the pulse train operation.

? : Invalid during the equal pitch multi-rotation operations.

.: Invalid during the finite linear operations.

No.	Control parameter	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
			Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog	Manual skip
47-60	Control/AD7	7-25	?	?	?	?	-	-	-	-	-	-	-	-
	Control / P operation		?	?	?	?	?	?	?	?	?	?	-	-
	Control/ torque limiting enable		?	?	?	?	?	?	?	?	?	?	-	-
	Control/ external failure input		?	?	?	?	?	?	?	?	?	?	-	-
	Control/ speed selection		?	-	-	-	-	-	-	-	-	-	-	-
	Control/ acceleration/ deceleration time constant selection		-	?	?	?	-	-	-	-	-	-	-	-
	Control / + over-travel		?	?	?	?	?	?	?	?	?	?	-	-
	Control / - over-travel		?	?	?	?	?	?	?	?	?	?	-	-
	Control/ORG		-	-	-	-	-	-	-	-	?	-	-	-
	Control/LS		-	-	-	-	-	-	-	-	?	-	-	-
	Control/FWD		-	-	-	-	-	?	?	?	-	?	-	-
	Control/RVS		-	-	-	-	-	?	?	?	-	?	-	-
	Control/ speed command speed selection 1		-	-	-	-	-	?	-	-	-	-	-	-
	Control/ speed command speed selection 2		-	-	-	-	-	?	-	-	-	-	-	-
	Control/ speed command speed selection 3		-	-	-	-	-	?	-	-	-	-	-	-
	Control/ speed command speed selection 4		-	-	-	-	-	?	-	-	-	-	-	-
	Control/ speed command speed selection 5		-	-	-	-	-	?	-	-	-	-	-	-

? : Valid only for the equal pitch multi-rotation coordinates.

.: Invalid during the pulse train and speed command operations.

? : Valid only for the finite linear coordinates and the pulse train operation.

? : Invalid during the equal pitch multi-rotation operations.

.: Invalid during the finite linear operations.

No.	Control parameter	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
			Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog	Manual skip
47-60	Control/ speed command speed selection 6	7-25	-	-	-	-	-	?	-	-	-	-	-	-
	Control/ speed command acceleration/deceleration selection 1		-	-	-	-	-	?	-	-	-	-	-	-
	Control/ speed command acceleration/deceleration selection 2		-	-	-	-	-	?	-	-	-	-	-	-
	Control/ speed command acceleration/deceleration selection 3		-	-	-	-	-	?	-	-	-	-	-	-
	Control/interlock		?	?	?	?	-	-	.	?	-	-	-	-
61-75	Out/ no function designated	7-26	?	?	?	?	?	?	?	?	?	?	-	-
	Out/OUT-AD0		?	?	?	?	-	-	?	?	-	?	-	-
	Out/OUT-AD1		?	?	?	?	-	-	?	?	-	?	-	-
	Out/OUT-AD2		?	?	?	?	-	-	?	?	-	?	-	-
	Out/OUT-AD3		?	?	?	?	-	-	?	?	-	?	-	-
	Out/OUT-AD4		?	?	?	?	-	-	?	?	-	?	-	-
	Out/OUT-AD5		?	?	?	?	-	-	?	?	-	?	-	-
	Out/OUT-AD6		?	?	?	?	-	-	?	?	-	?	-	-
	Out/OUT-AD7		?	?	?	?	-	-	?	?	-	?	-	-
	Out/ operation ready completion		?	?	?	?	?	?	?	?	?	?	-	-
	Out/servo ON/OUT		?	?	?	?	?	?	?	?	?	?	-	-
	Out/operation underway		?	-	-	-	-	-	?	?	-	?	-	-

? : Valid only for the equal pitch multi-rotation coordinates.

.: Invalid during the pulse train and speed command operations.

?: Valid only for the finite linear coordinates and the pulse train operation.

?: Invalid during the equal pitch multi-rotation operations.

.: Invalid during the finite linear operations.

No.	Control parameter	Reference page	Main operation mode						Sub operation mode				Manual operation mode	
			Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation	I/O jog operation	Step operation	Machine origin return	I/O skip operation	Manual jog	Manual skip
61-75	Out/ fixed point/ through point 1	7-26	-	?	?	?	-	-	-	-	-	-	-	-
	Out/ fixed point/ through point 2		-	?	?	?	-	-	-	-	-	-	-	-
	Out/ over-travel detection		?	?	?	?	?	?	?	?	?	?	-	-
	Out/ origin return completion		?	?	-	?	?	-	.	?	.	.	-	-
	Out/ alarm detection		?	?	?	?	?	?	?	?	?	?	-	-
	Out/ speed arrival		?	?	?	?	?	?	?	?	?	?	-	-
	Out/ home position		?	-	-	-	-	-	?	?	-	?	-	-
	Out/torque limiting underway		?	?	?	?	?	?	?	?	?	?	-	-
	Out/ positioning completion		?	?	?	?	?	-	?	?	?	?	-	-
76	Sub operation mode switch		?	?	?	?	?	-	-	-	?	?	-	-
77	Factory use (not for users)		-	-	-	-	-	-	-	-	-	-	-	-
78	Position defect alarm available / unavailable	7-27	?	-	-	-	-	-	?	?	?	?	-	-
79	Position defect alarm width		?	-	-	-	-	-	?	?	?	?	-	-

? : Valid only for the equal pitch multi-rotation coordinates.

.: Invalid during the pulse train and speed command operations.

?: Valid only for the finite linear coordinates and the pulse train operation.

?: Invalid during the equal pitch multi-rotation operations.

.: Invalid during the finite linear operations.

(9) Input signals, parameters and servo actuator rotation directions

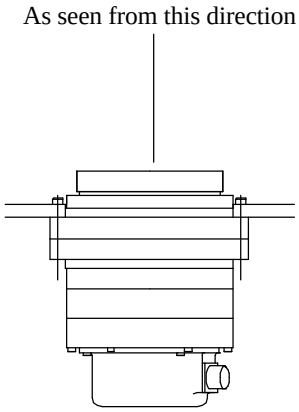
Input signal / parameter \ Servo actuator type indication (p2-1)				A , B	C , S , F , H
Name	Control parameter No.	Reference page	Setting, operation		
FWD	47-60	6-15	-	CCW	CW
RVS			-	CW	CCW
+ over-travel		6-13	-	Install in CCW direction.	Install in CW direction.
- over-travel			-	Install in CW direction.	Install in CCW direction.
Pulse train operation	-	7-18	*1	CCW	CW
Manual jog operation	-	6-5	?	CCW	CW
			?	CW	CCW
Manual skip operation	-	6-6	?	CCW	CW
			?	CW	CCW
Indexing number incrementing direction	12	7-16	1 (default value)	CCW	CW
			2	CW	CCW
Short-cut/unidirectional selection	14		1 (default value)	-	-
			2	CCW	CW
			3	CW	CCW
2-position indexing direction selection	15	7-17	1 (default value)	Address #1 CCW Address #2 CW Address #1	Address #1 CW Address #2 CCW Address #1
			2	Address #1 CW Address #2 CCW Address #1	Address #1 CCW Address #2 CW Address #1
Origin return direction	18	7-19	1 (default value)	CCW	CW
			2	CW	CCW
Origin return position setting	22		Positive value	Coordinate axis zero point moves in CW direction.	Coordinate axis zero point moves in CCW direction.
			Negative value	Coordinate axis zero point moves in CCW direction.	Coordinate axis zero point moves in CW direction.
Soft +overtravel detection position	31	7-20	-	Set the position in the CCW direction.	Set the position in the CW direction.
Soft -overtravel detection position	32		-	Set the position in the CW direction.	Set the position in the CCW direction.
Backlash compensation direction	37	7-21	1 (default value)	CCW	CW
			2	CW	CCW
Position data	-	7-33	-	CCW direction is the increment direction.	CW direction is the increment direction.

*1 The rotation direction for the pulse train input signals is the rotation direction when the "current position incrementing direction pulses" shown in the figure provided for the "input pulse system" on page 7-18 have been input.

For this reason, the "input pulse system CP-16" and "pulse train operation rotation direction CP-17" are interrelated. (refer to page 7-18)

. The motor rotation direction is the same for servo actuator type displays C, S, F and H.
(Rotating direction of motor installed in a servo actuator and output shaft of a servo actuator is not always the same.)

. The specifications in this section apply when the servo actuator and motor are seen from the direction shown in the figure below.



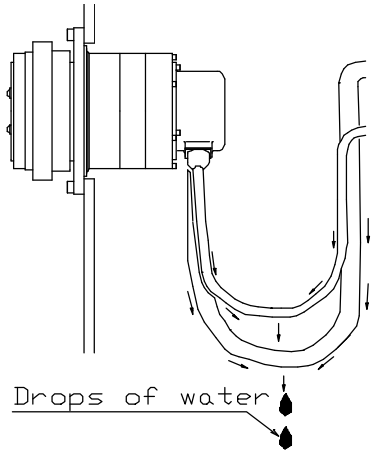
4. INSTALLATION

4-1 Servo Actuator

⚠ WARNING: Hang the servo actuator with a hanger bolt when installing, removing or transferring the servo actuator so that it will not drop.
Use the hanger bolt with the nominal diameter specified in "11. EXTERNAL DIMENSIONS".
Use of another size bolt could lead to serious injury.

⚠ WARNING: The type of machine to which the servo actuator is installed, its setup environment, and the mass and torque of the servo actuator must be carefully considered when designating the dimensions and materials for the section to which the servo actuator is installed and the installation method. If this instruction is ignored, the servo actuator can drop and may cause serious personal injury.

⚠ CAUTION: Keep excess water and oil away from the servo actuator. Also, do not allow water and oil to enter the connectors along the cables. Ignoring these instructions could lead to damage to the servo system or electrical shock.



Connect the wires from below in such a way that water or oil will not run along them and find its way inside the connectors.

(1) Servo actuator mounting direction

The servo actuator can be mounted either horizontally or perpendicularly.

(2) Tightening torque and allowable transmission torque for mounting bolts

<1> Use hexagon socket head bolts for installation.
<2> Tighten the mounting bolts with the tightening torque values shown on the following page.

The table on the following page is applicable in cases where the other side is made of steel or cast iron.

When using aluminum or other materials, re-examine the tightening torque and transmission torque carefully.

Specifications of bolts used JIS: Japanese Industrial Standards

Hexagon socket head bolt	Class of strength	Screw
JISB 1176	JISB 1051 12.9	JIS B 0205 6g or class 2

Model	Connecting part	No. of bolts/size		Tightening torque top : N.m bottom : kgf.m		Allowable transmission torque top : N.m bottom : kgf.m	
	Types	A, B, F	C, S	A, B, F	C, S	A, B, F	C, S
AR15	Rotary part	8-M6	4-M10	15.7±0.8 1.6±0.08	73.5±3.7 7.5±0.35	1070 109	1030 105
	Fixed part	6-M8	8-M6	37.3±1.9 3.8±0.19	15.7±0.8 1.6±0.08	1730 176	1070 109
AR30	Rotary part	8-M8	6-M12	37.3±1.9 3.8±0.19	128±6.4 13.1±0.65	2510 256	2730 278
	Fixed part	6-M10	8-M8	73.5±3.7 7.5±0.35	37.3±1.9 3.8±0.19	3600 367	2520 257
AR60	Rotary part	12-M8	9-M12	37.3±1.9 3.8±0.19	128±6.4 13.1±0.65	4440 453	5210 531
	Fixed part	8-M10	12-M8	73.5±3.7 7.5±0.35	37.3±1.9 3.8±0.19	5480 559	4440 453
AR135	Rotary part	12-M12	9-M16	128±6.4 13.1±0.65	319±16 32.5±1.62	12900 1315	11900 1211
	Fixed part	12-M12	12-M12	128±6.4 13.1±0.65	128±6.4 13.1±0.65	14900 1518	12900 1316
ARH7	Rotary part	6-M10	-	73.5±3.7 7.5±0.35	- -	686 70	- -
	Fixed part	4-M8	4-M8	37.3±1.9 3.8±0.19	37.3±1.9 3.8±0.19	1290 132	1290 132
ARH17	Rotary part	8-M12	-	128±6.4 13.1±0.65	- -	1820 186	- -
	Fixed part	4-M10	4-M10	73.5±3.7 7.5±0.35	73.5±3.7 7.5±0.35	2450 250	2450 250
ARH24	Rotary part	8-M12	-	128±6.4 13.1±0.65	- -	2380 243	- -
	Fixed part	4-M10	4-M10	73.5±3.7 7.5±0.35	73.5±3.7 7.5±0.35	3090 315	3090 315
AR10H	Rotary part	6-M8		37.3±1.9 3.8±0.19		884 90	
	Fixed part	12-M6		15.7±0.8 1.6±0.08		1880 191	

Refer to page 2-1 for "Types A, B, C, F, S".

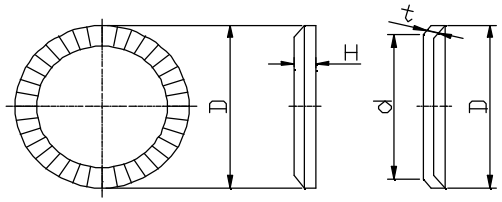
(3) Centering

The servo actuator is provided with a bearing for external load support.
When the output shaft has an external support function, set the centering accuracy level to 30 µm to 50 µm.

Improper centering may cause damage to the bearing, output shaft, etc. inside the reduction gear.

(4) Conical spring washer

Use conical spring washers for use with hexagon socket heads to prevent looseness in the hexagon socket head bolts and protect the bolt seat surfaces from being marked.



Name : Conical spring washer
Denomination : Conical SW-2H-nominal
Material : S50CM - S65CM
Hardness : HRC40 - 48
Manufacturer : Heiwa Hatsujo Co., Ltd. (Japanese company)

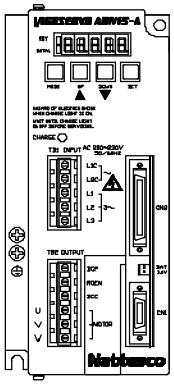
Nominal	Conical spring inside & outside diameters		t	H
	d	D		
5	5.25	8.5	0.6	0.85
6	6.4	10	1.0	1.25
8	8.4	13	1.2	1.55
10	10.6	16	1.5	1.9
12	12.6	18	1.8	2.2
14	14.6	21	2.0	2.5
16	16.9	24	2.3	2.8

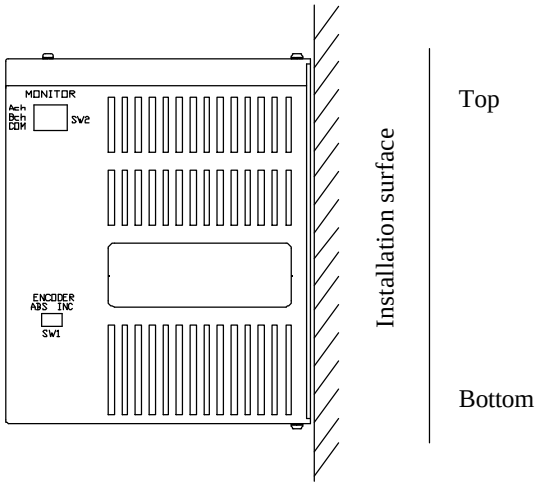
[mm]

4-2 Servo Amplifier

⚠ WARNING: To prevent electrical shock, be sure to turn off the power supply before beginning installation, removal or wiring of the machine.
Only skilled technicians should perform these tasks.
Attempts by nonqualified personnel could lead to electrical shock, injury, or fire.

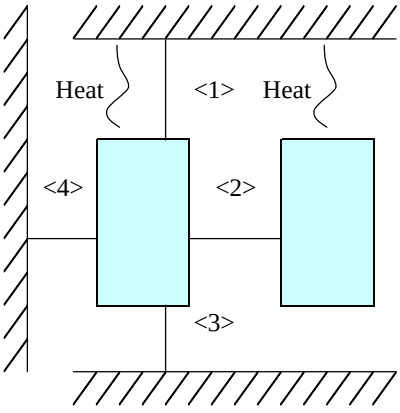
(1) Install the servo amplifier vertically to the ground so that the 7-segment LED display on the front panel is positioning horizontally.





(2) Installation space

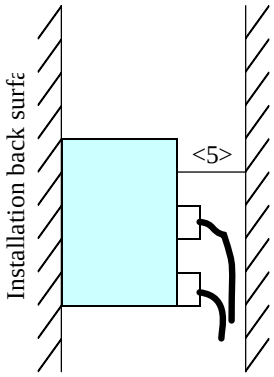
Provide the clearances shown below to enable the heat to dissipate.
Do not block the vents of the servo amplifier.



	Clearance dimensions [mm]
<1>	100
<2>	30
<3>	100
<4>	30
<5>	80

Above dimensions are common to all frame numbers.

Provide the clearances shown below to enable the cables and connectors to be connected and routed.



The minimum volume of the power board required for heat dissipation is as below.

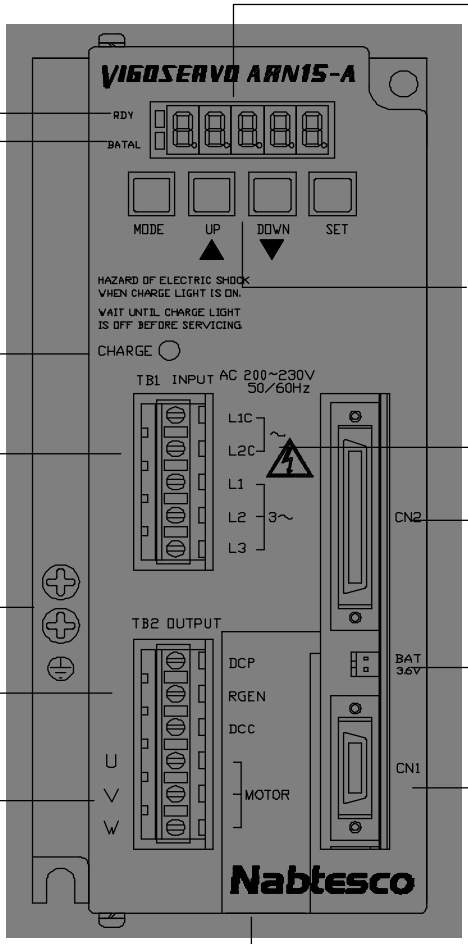
Minimum volume of power board required

Frame No.	Volume [cm³]
ARN15	50,000
ARN30	100,000
ARN60	250,000
ARN135	450,000

5. WIRING

5-1 Names of Parts

(1) ARN15,30



7-segment LED display

Control power ready completion LED (p6-3)

Battery voltage drop warning LED (p6-3)

Panel switches for settings

Charge LED

TB1 (p5-10)
Main/control power supply input connectors 3-phase, 200V

WARNING label

CN2 (p5-6)
Connector for control I/O signals

PE ⏚ terminals

CN-BAT (p5-19)
Connector for battery

TB2 (p5-12)
Connectors for external regenerative resistance

Connectors for motor power cable

CN1(p5-4)
Connector for encoder

Battery compartment

The servo amplifier incorporates a regenerative resistance. (p10-11)
Consult with us if an external regenerative resistance is to be used because the capacity of the internal regenerative resistance is insufficient or for other reasons. (p5-12)

⚠ WARNING: To prevent electrical shock, be sure to turn off the power supply before beginning installation, removal or wiring of the machine.
Only skilled technicians should perform these tasks.
Attempts by nonqualified personnel could lead to electrical shock, injury, or fire.

⚠ WARNING: Although the power supply is turned off, the servo amplifier will have been charging with high voltage for a while. Do not start wiring until the Charge LED on the front panel of the servo amplifier goes out. Ignoring this instruction could lead to electrical shock.

⚠ WARNING: The PE ⏚erminals of both servo actuator and servo amplifier must be grounded to prevent electrical shock.

Side panel

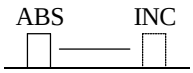
Monitor connector
• Ach: Motor rotation speed monitor • Bch: Torque monitor • COM: Common

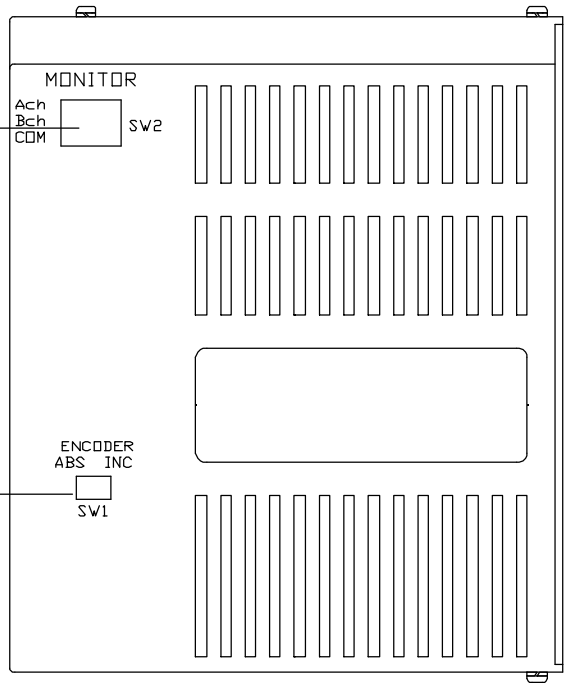
For details, refer to page 7-23.

Encoder selector switch

Absolute (ABS) encoder is the factory setting.

Set the switch to INC if the incremental encoder or AR10H is to be used. (p1-6,7)

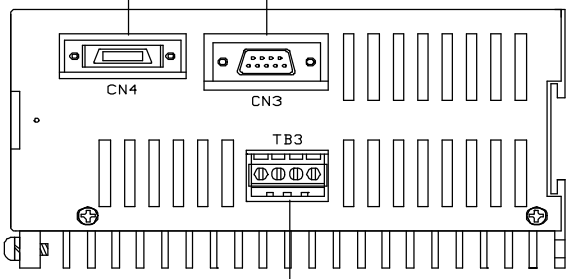




Bottom panel

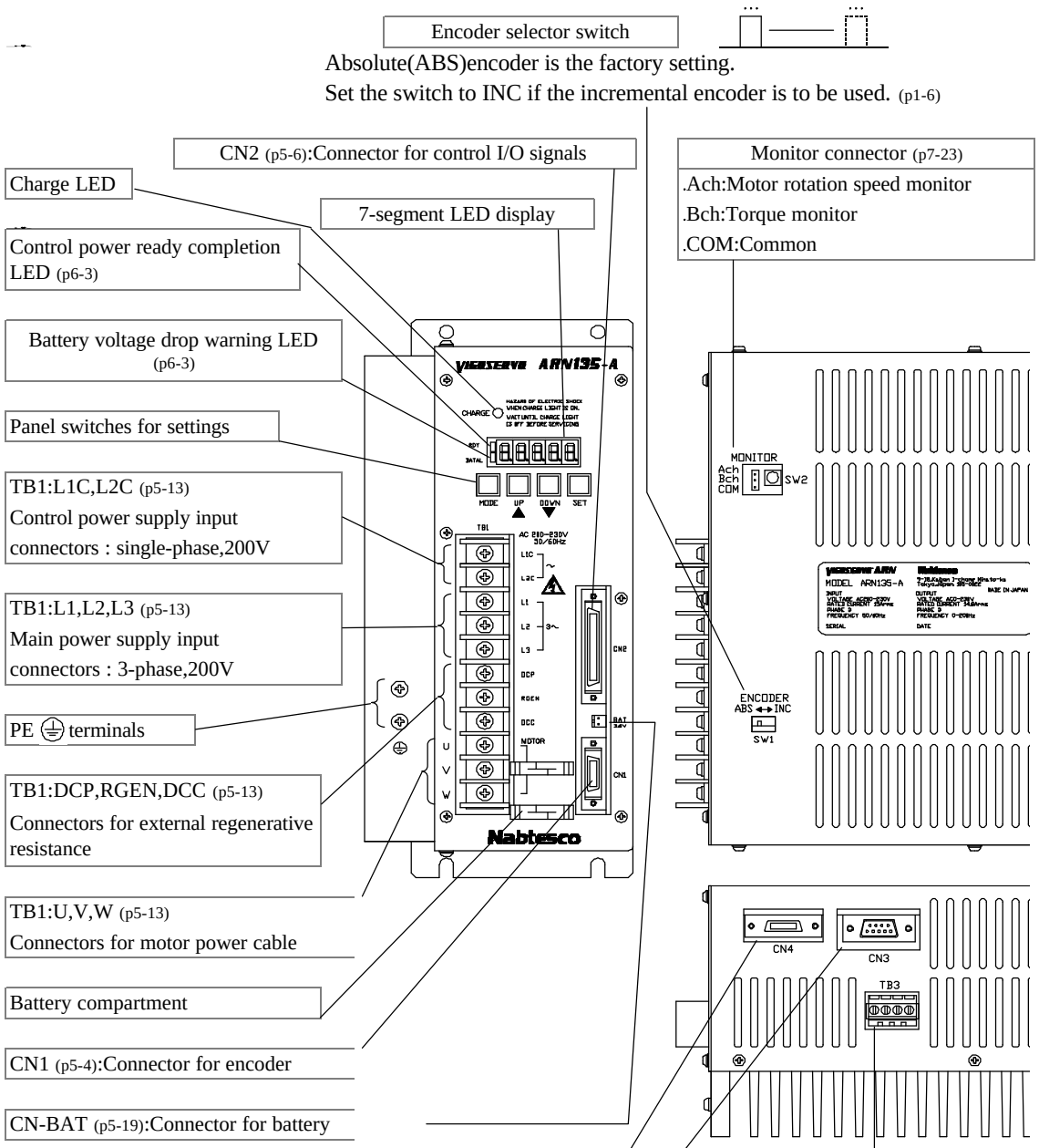
CN4 (p5-9)
Connector for pulse train I/O signals

CN3 (p5-8)
RS-232C connector



TB3 (p5-14)
Connector for brake

...ARN60,135



The servo amplifier incorporates a regenerative resistance. (p10-11)

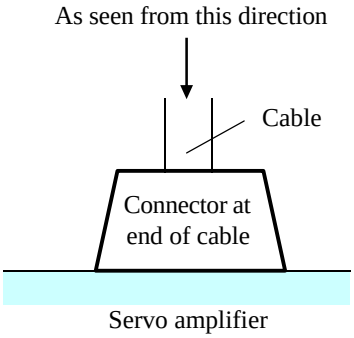
Consult with us if an external regenerative resistance is to be used because the capacity of the internal regenerative resistance is insufficient or for other reasons. (p5-12,13)

⚠ WARNING:

Although the power supply is turned off, the servo amplifier will have been charging with high voltage for a while. Do not start wiring until the Charge LED on the front panel of the servo amplifier goes out. Ignoring this instruction could lead to electrical shock.

5-2 Connector Pin Layout and Connections

All the pin layout diagrams show the connectors at the ends of the cables as seen from the cable end.



(1) Servo amplifier

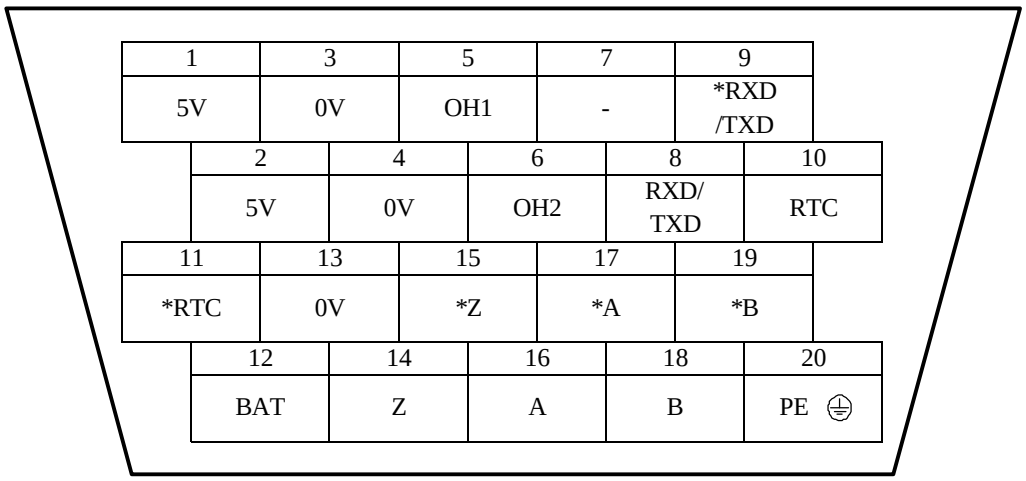
<1> CN1: Connector for encoder

Compatible plug type (made by Honda Tsushin Kogyo Co., Ltd.)

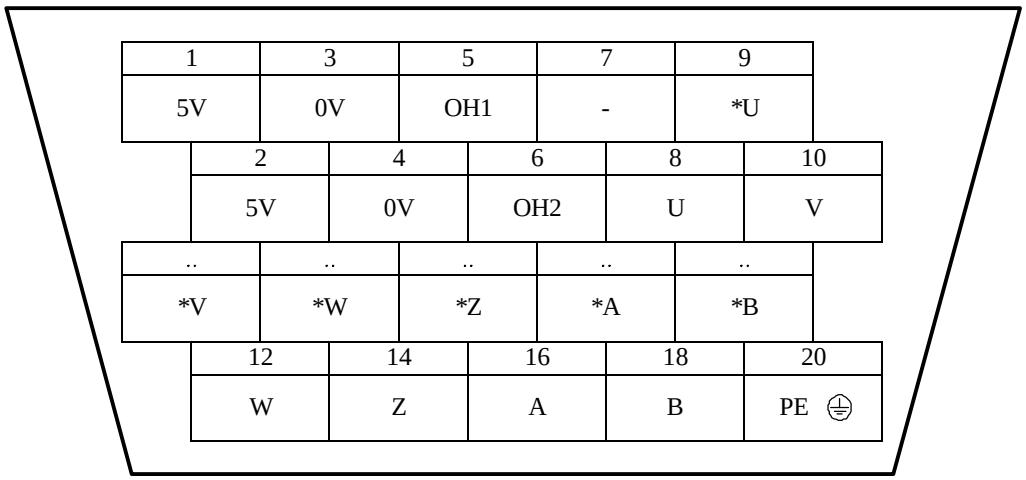
Plug: PCR-S20FS

Case: PCR-LS20LA1

Absolute encoder



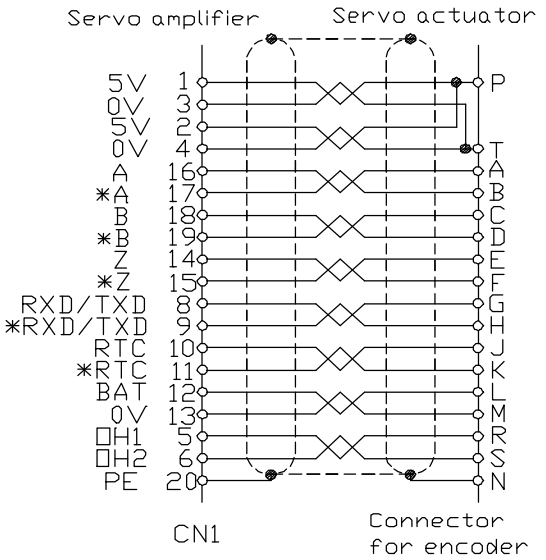
Incremental encoder and AR10H



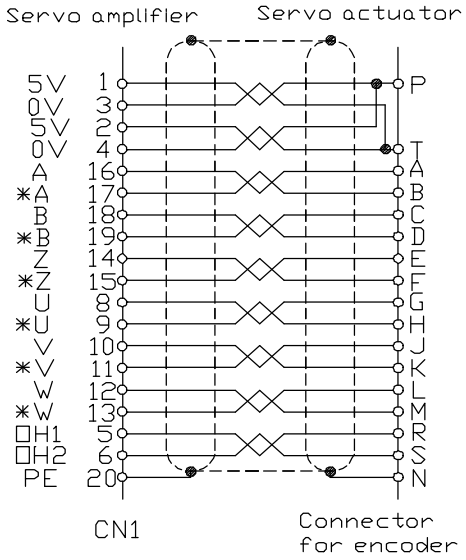
Note: Do not connect a pin marked with "-".
These pins may already be connected to the circuitry inside the servo amplifier.

Connection diagrams

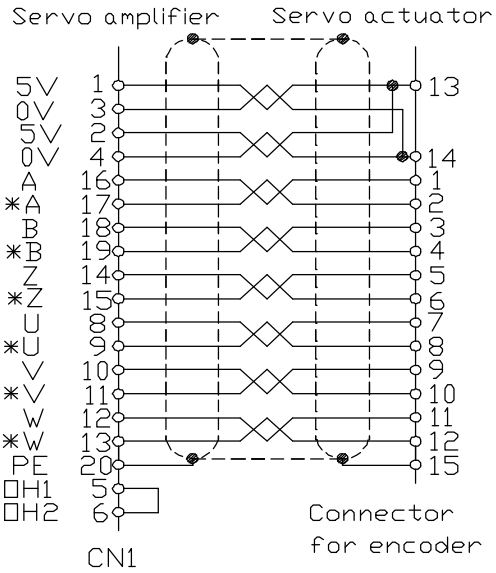
Absolute encoder



Incremental encoder (other than AR10H)



AR10H (incremental encoder)



AR10H do not have thermo switch in the motor.

Connect OH1,OH2 pin5,6 CN1 at inside of CN1.

If not , AL-2(Overheating of motor) (p9-1) may occur at power on.

See wiring diagram on the left.

Perform the connections in accordance with the following specifications.

Wire : Twisted pair, multiple-wire shielded cable, .0.3 mm² cross-sectional area

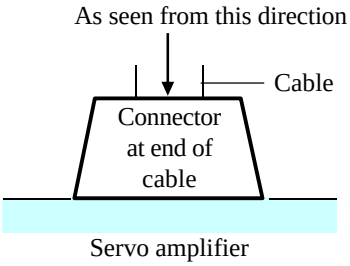
Length : . 20 m (contact us for a length of over 20 m)

5 V, 0 V wiring: Connect two wires in parallel as shown in the above figure to prevent voltage drops.

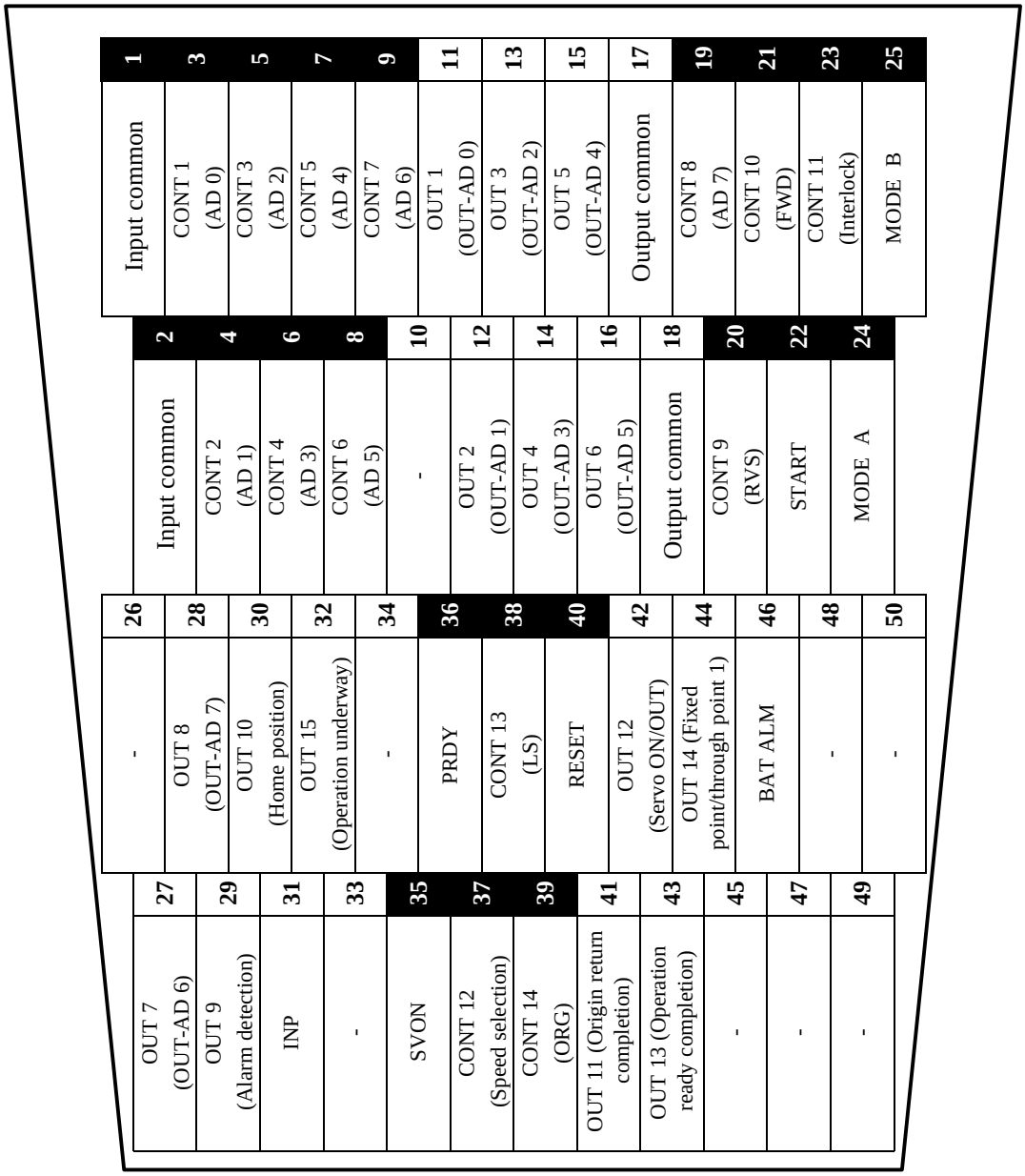
<2> CN2: Connector for control I/O signals

Compatible plug type (made by Honda Tsushin Kogyo Co., Ltd.)

Plug: PCR-S50FS Case: PCR-LS50LA

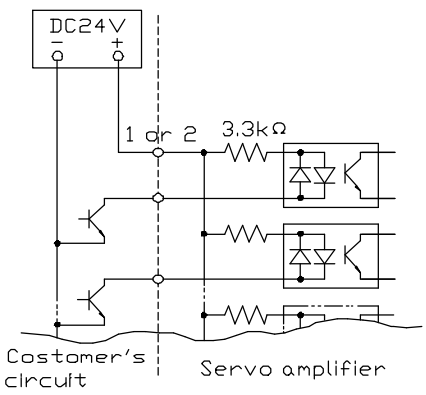


The terminals with white pin numbers like pin 1 are the control input terminals.
The default setting (.7-25) is written in parentheses.

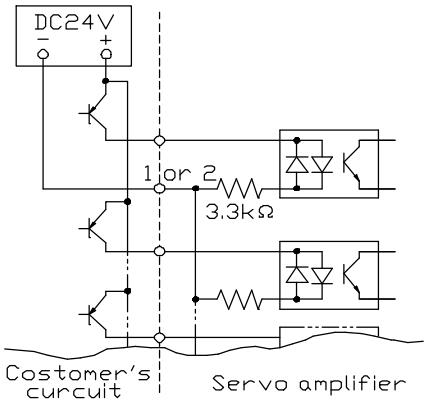


Note: Do not connect a pin marked with "-".
These pins may already be connected to the circuitry inside the servo amplifier.

. Input circuits Compatible with both plus common and minus common; all circuits insulated with photocouplers.



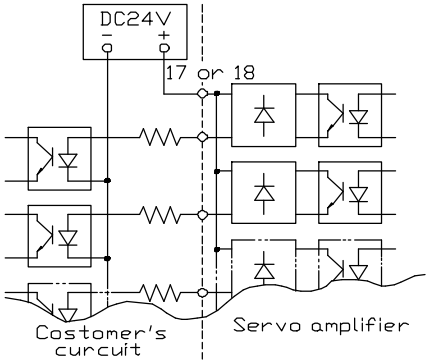
With plus common



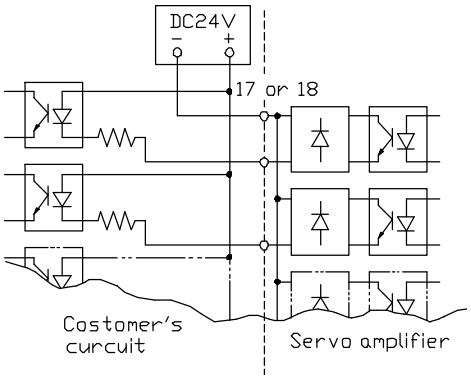
With minus common

. Input circuit specifications Max. applied voltage : 26 V
Supply current : 7 mA (at 24 V)

. Output circuits Compatible with both plus common and minus common; all circuits insulated with photocouplers.



With plus common

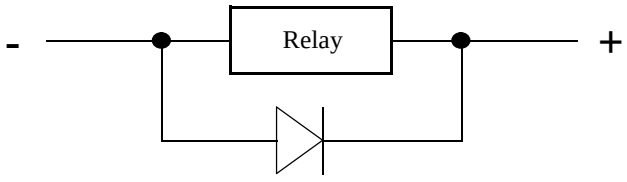


With minus common

. Output circuit specifications Max. applied voltage : 30 V
Max. supply current : 50 mA

Note: In the case of an inductive load (relay, etc.), a diode (with 240 V dielectric withstanding voltage or higher, 100 mA current or higher) must always be connected in parallel with the load.

Note: Take care not to connect the polarities in reverse since this will damage the servo amplifier.



. Power supply for I/O circuits

The power supply for the I/O circuits is to be provided by the customer.

DC 24 V ±10% , 1.2 A or higher

Note: Ground the PE terminal of the power supply.

Note: Keep the power supply for the control I/O signals separate from the power supply for the brake (p5-14).

Using one power supply for both purposes may give rise to malfunctioning.

Note: If certification under the European safety standards (p2-1) is to be obtained for the products, use power supplies (SELV : Safety extra low voltage) complying with the standards.

<3> CN3: RS-232C connector

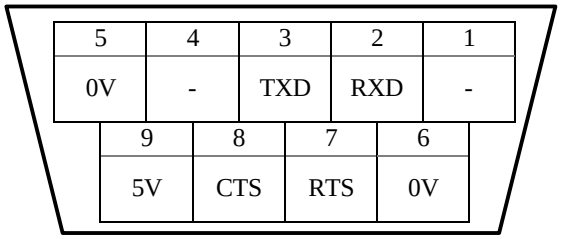
Compatible plug type (made by Hirose Electric Co., Ltd.)

Plug: HDEB-9P Case: HDE-CTH

The types of communication listed below are possible using the RS-232C connector.

For more details on the communications specifications, refer to Section 8 communications (p8-1).

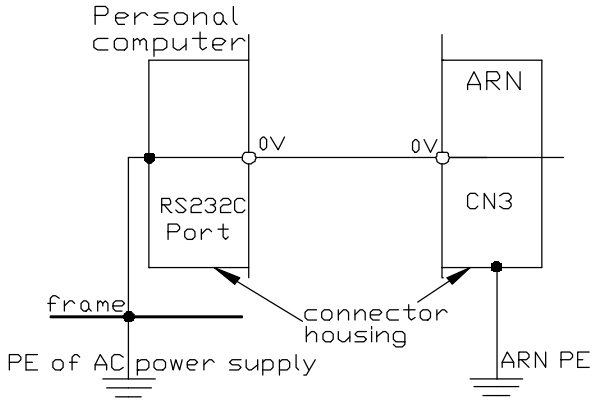
. Servo parameter reading
. Servo parameter writing
. Control parameter reading
. Control parameter writing
. Positioning data reading
. Positioning data writing
. Display data reading
. Initialization



Note: CN3 is not isolated with the control circuit inside the servo amplifier. 0V terminal of equipment like personal computer may be connencted to the connector housing, frame, and PE terminal of AC power supply plug.

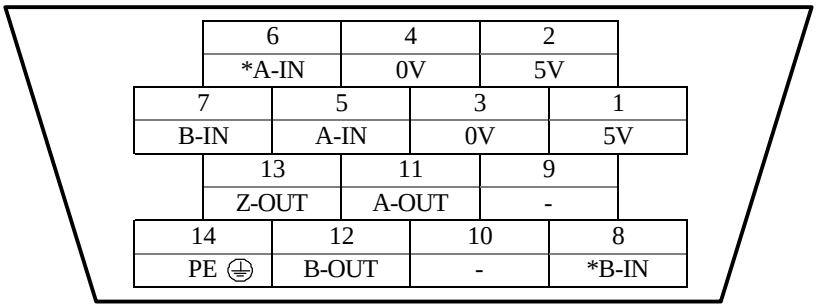
If servo amplifier is connected to an equipment like this, Surge voltage between PE of equipment and PE of servo apmlifier may rush into the control circuit of servo amplifire and damage it.

In this case, disconnect the PE termainal of the equipments or consult us.



<4> CN4: Connector for pulse train I/O signals

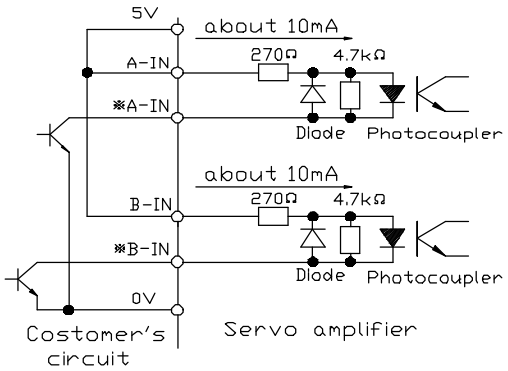
Compatible plug type (made by Sumitomo 3M Co., Ltd.)
Plug: 10114-3000VE Case: 10314-52A0



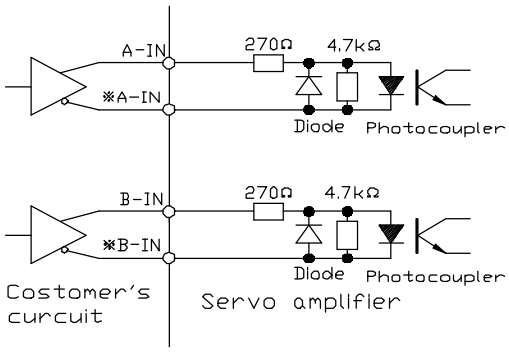
Input pin	Signal name	Description
1	5 V	This pin outputs a +5 V voltage. Maximum output current: 500 mA
2		
3	0 V	5 V common
4		
5	A-IN	These are the pulse train input signal pins. Input signals to these pins to execute pulse train operations (p3-10). Interfacing with open collector and line driver is possible.
6	*A-IN	
7	B-IN	
8	*B-IN	
11	A-OUT	These pins output the A-, B- and Z-phase pulse of the encoder. A, B: encorder pulse (p7-14) / motor one revolution 90°phase difference Z: 1 pulse / motor one revolution They are used for feedback to the sequencer. Interface with an open collector output format. Maximum output current: 45 mA, maximum applied voltage: 30 V
12	B-OUT	
13	Z-OUT	
14	PE⏚	This pin is connected inside the servo amplifier to the PE terminal (p5-1,3) of the chassis. Use it as the shielded ground of the signal cables.

Pulse train input circuit

With an open collector

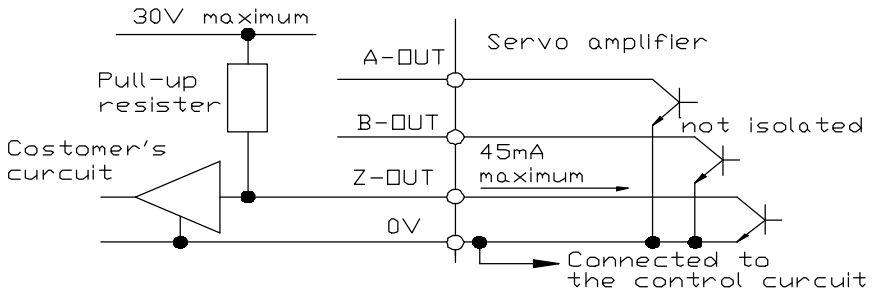


With a line driver



Note : 5v, 0v are connected to the control circuit inside the servo amplifier, take care on the interface circuit so as not to rush in the serge current to the control cuicuit.

Encoder A-, B- and Z-phase pulse output circuit



Note : 0v and open collector transistors are connected to the control circuit inside the servo amplifier, take care on the interface circuit so as not to rush in the serge current to the control cuicuit.

<5> TB1(ARN15,30) : Connector for main/control power supply input

Compatible plug BLZ7.62/5/90 (made by Weidmüller)
Terminal tightening torque 5.1kg.cm
For information on the compatible solderless terminal, see the following page.

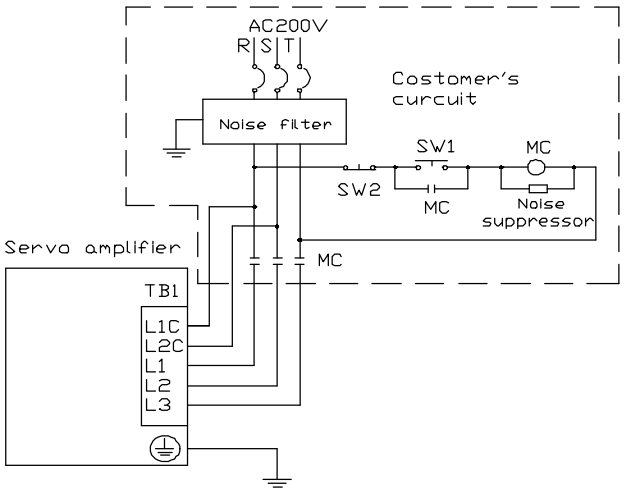
1	2	3	4	5
L1C	L2C	L1	L2	L3

Input pin	Signal name	Description
1	L1C	Single-phase 200-230 VAC for control power supply input +10% -15%
2	L2C	
3	L1	3-phase 200-230 VAC for main power supply input +10% -15%
4	L2	
5	L3	

Since the main power and control power are supplied separately, the main power can be turned off in a state in which the current operation information has been stored.

⚠ WARNING: To prevent electrical shock, be sure to turn off the power supply before beginning installation, removal or wiring of the machine.
Only skilled technicians should perform these tasks.
Attempts by nonqualified personnel could lead to electrical shock, injury, or fire.

The figure on the right shows an example of the power supply connections.



. A circuit breaker or fuse must be installed where the main power is led in.

. Do not use quick-break fuses since they may melt when the power is turned on.

. If the European safety standards (p2-1) are to be met, use parts which satisfy the EN60947-2 and EN60934 EN standards.

Capacity of circuit breaker, MCC, or fuse for main power supply

Type	Capacity [A]
ARN15	10
ARN30	15

. Cross-sectional area of conductors in cables used

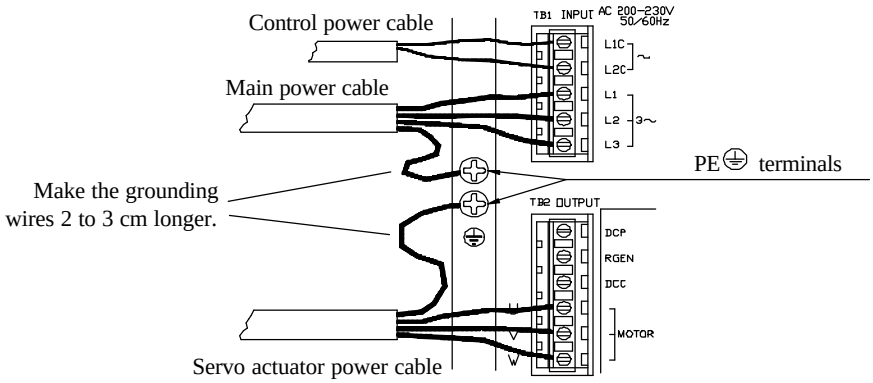
Type	Main power cable L1, L2, L3 [mm²]	Grounding wire [mm²]	Compatible solderless terminal main power cable and grounding wire	Control power cable [mm²]
ARN15	Min. 0.75	Min. 0.75	H0.75/14 (made by Weidmuller)	Min. 0.75
ARN30	Min. 1.25	Min. 1.25	H1.5/14 (made by Weidmuller)	

The H0.75/14 solderless terminal made by Weidmüller is compatible with control power cable when cross-section area of conductors in cables are 0.75mm^2.

. Grounding

⚠ WARNING: The PE ⏚ erminals of both servo actuator and servo amplifier must be grounded to prevent electrical shock.

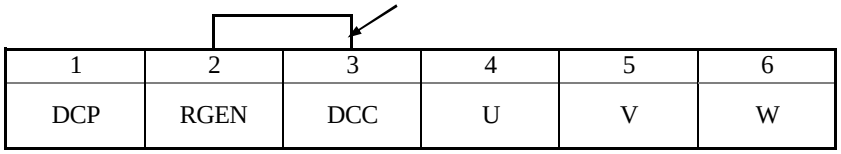
⚠ WARNING: Make the ground cable 2 to 3 cm longer than L1, L2, and L3 and U,V, and W so that it will be the last to disconnect if either the main power cable or servo actuator power line is forcibly disconnected. Ignoring this instruction could lead to electrical shock.



<6> TB2(ARN15,30) : Connector for motor power cable/external regenerative resistance

Compatible plug type: BLZ7.62/6/90 (made by Weidmüller)
Terminal tightening torque 5.1kg.cm

Pins 2 and 3 are shorted under normal circumstances (when an internal regenerative resistance is used) using a conductor whose cross-sectional area is not less than 1.25 mm².

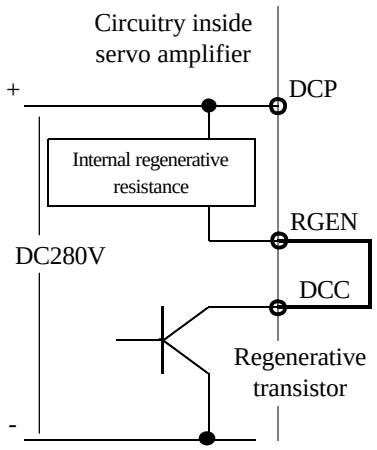


1	2	3	4	5	6
DCP	RGEN	DCC	U	V	W

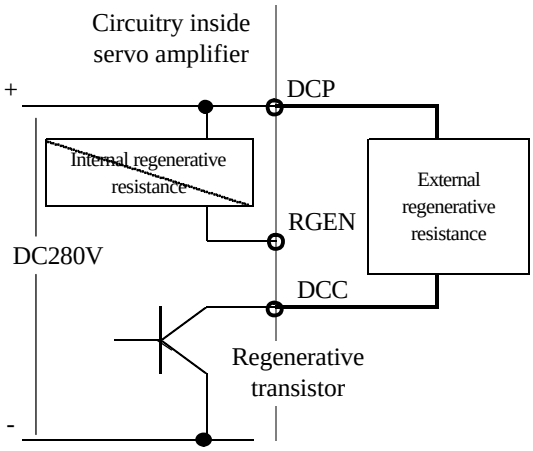
Figure out the regeneration capacity (refer to page 10-11). When the regenerative power is greater than the allowable value of the servo amplifier, an external regenerative resistance is required. In such cases, please consult with us.

Input pin	Signal name	Description
1	DCP	For an external regenerative resistance.
2	RGEN	Short pins 2 and 3 under normal circumstances (when using an internal regenerative resistance).
3	DCC	
4	U	For motor power cable; connect this with the U, V and W pins on the servo actuator.
5	V	
6	W	

Normal circumstances
(Use internal regenerative resistance)



Use external regenerative resistance

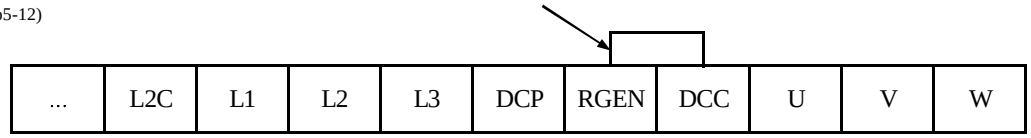


Cross-sectional areas of motor power cable U, V, W and PE conductors
and compatible solderless terminal.

Type	Cross-sectional area [mm²]	Compatible solderless terminal
ARN15	Min 0.75	H0.75/14(made by Weidmuller)
ARN30	Min 1.25	H1.5/14(made by Weidmuller)

<7> TB1(ARN60,135) : Connector for motor power cable/external regenerative resistance
Terminal tightening torque 12.7kg.cm

DCP and RGEN must be shorted under normal circumstances (when an internal regenerative resistance is used) using a conductor whose cross-sectional area is not less than 1.25 mm². (refer p5-12)



Signal name	Description
.1.	Single-phase 200-230 VAC for control power supply input +10% -15%
...	
..	3-phase 200-230 VAC for main power supply input +10% -15%
..	
..	
DCP	For an external regenerative resistance. Short RGEN and DCC under normal circumstances (when using an internal regenerative resistance).
RGEN	
DCC	
U	For motor power cable; connect this with the U, V and W pins on the servo actuator.
V	
W	

. Since the main power and control power are supplied separately, the main power can be turned off in a state in which the current operation information has been stored.

. A circuit breaker for the wiring or fuse must be installed where the main power is led in.

Capacity of circuit breaker, MCC, or fuse for main power supply

Type	Capacity [A]
ARN60	20
ARN135	30

. Cross-sectional area [mm^2] of conductors in cables used

Type	Main power cable R/S/T [mm²]	Grounding wire [mm²]	Compatible solderless terminal main power cable and grounding	Control power cable [mm²]
ARN60	Min. 2.0	Min. 2.0	TMEV2-4(made by Nichifu)	Min. 0.75
ARN135	Min. 3.5	Min. 3.5	TMEV3.5-4(made by Nichifu)	

. Figure out the regeneration capacity (refer to page 10-11). When the regenerative power is greater than the allowable value of the servo amplifier, an external regenerative resistance is required. In such cases, please consult with us.

. Cross-sectional areas of motor power cable U, V, W and PE conductors and compatible solderless terminal.

Type	Cross-sectional area [mm²]	Compatible solderless terminal
ARN60	Min 2.0	TMEV2-4(made by Nichifu)
ARN135	Min 3.5	TMEV3.5-4(made by Nichifu)

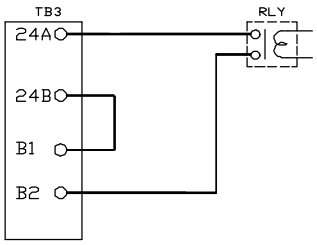
<8> TB3: Connector for brake

The power supply (DC 24 V) for the brake is to be provided by the customer. For details on the current capacity, refer to Section 2-2 with the Table of Specifications (p2-2).

Compatible plug type: BLZ5.08/4/90 (made by Weidmüller)
Terminal tightening torque 5.1kg.cm

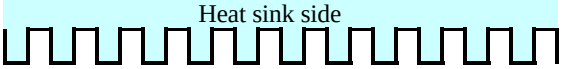
Compatible solderless terminal type: H0.75/14 made by Weidmüller, for 0.75 mm² cross-sectional area.

Circuit incorporated in servo amplifier



1	2	3	4
24A	24B	B1	B2

Heat sink side



Input pins 24A and 24B are nonpolar.

Input pin	Signal name	Description
1	24A	Input of power supply for holding electromagnetic brake
2	24B	
3	B1	Output of power supply for holding electromagnetic brake
4	B2	

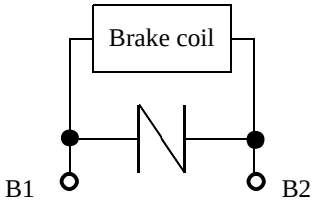
. The brake incorporated in the servo actuator is exclusively for holding purposes.
Do not use it to stop the motor while it is running.

. The brake power must be released while the servo actuator is stopped.

Turning OFF the 24 V power for the brake or turning OFF the servo ON signal while the servo actuator is still running will engage the holding brake, possibly wearing or damaging the brake's contact areas.

. Switching noise from the motor power cable may be induced in the brake wiring, possibly giving rise to a high voltage.

. A surge absorber is wired inside the servo actuator in parallel with the brake in order to prevent surges when the brake is turned ON or OFF.



. If certification under the European safety standards (p2-1) is to be obtained for the products, use power supplies (SELV : Safety extra low votage) complying with the standards.

. The brake is engaged when an alarm (p9-1) occurs.

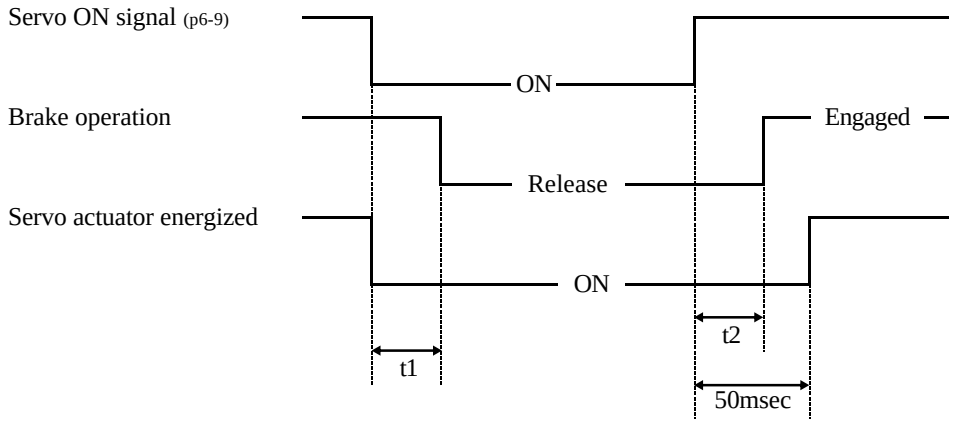
. Provide a separate brake power supply, and do not use it as power supply for the control I/O signals (p5-7). Motor switching noise carried along the brake wiring may cause the control I/O signals to malfunction.

. Use a power supply with stable DC output for the brake power supply.

. The brake timing is shown below.

The servo amplifier is controlled at the timing below. Therefore, positional skew will not occur even when the servo ON signal (p6-9) is turned ON or OFF with a load applied.

However, positional skew equivalent to the amount of play between the brake and motor shaft will occur. (Refer to number of follow-up pulses CP-42 (p7-22).)



Type	Attraction time t1	Release time t2
AR15	70	10
AR30,ARH7	80	30
AR60,ARH17	90	30
AR135,ARH24	90	30
AR10H	90	30

[msec]

Attraction time : Time elapsing after brake has been energized until it is released.

Release time : Time elapsing after power to the brake is stopped until brake is operated (engaged).

Note:
Brake is released when current flows to the brake coil.
Brake will be damaged soon if motor is rotated with no current flow to the brake coil.

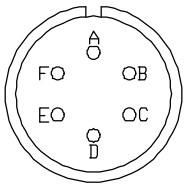
(2) Servo actuator standard specifications (other than AR10H)

<1> Connector for servo actuator power cable

Compatible plug type Made by JAE Electronics, Inc.

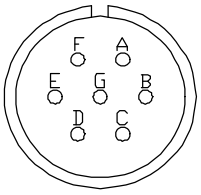
	L-type plug	Straight plug	Cable clamp
AR15	MS3108B14S-6S	MS3106B14S-6S	MS3057-6A
AR30, ARH7	MS3108B16S-1S	MS3106B16S-1S	MS3057-8A
AR60, ARH17	MS3108B20-15S	MS3106B20-15S	MS3057-12A
AR135, ARH24	MS3108B24-10S	MS3106B24-10S	MS3057-16A

For AR15



	Signal name
A	U
B	V
C	W
D	PE ⏚
E	B1 (brake)
F	B2 (brake)

AR30-135, ARH7-24



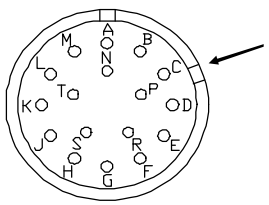
	Signal name
A	U
B	V
C	W
D	PE ⏚
E	B1 (brake)
F	B2 (brake)
G	-

<2> Connector for servo actuator encoder

Compatible plug type Made by JAE Electronics, Inc.

	L-type plug	Straight plug	Cable clamp
Absolute type	MS3108B20-29SZ	MS3106B20-29SZ	MS3057-12A
Incremental type	MS3108B20-29S	MS3106B20-29S	

Incremental encoder guide key position



Absolute encoder guide key position

	Absolute type Signal name	Incremental type Signal name
A	A	A
B	*A	*A
C	B	B
D	*B	*B
E	Z	Z
F	*Z	*Z
G	RXD/TXD	U
H	*RXD/TXD	*U
J	RTC	V
K	*RTC	*V
L	BAT	W
M	0 V	*W
N	PE ⏚	PE ⏚
P	5 V	5 V
R	OH1	OH1
S	OH2	OH2
T	0 V	0 V

(3) Servo actuator specifications for meeting UL and EN standards (other than AR10H)

In the case of specifications for meeting UL and EN standards, separate connectors--one for the U, V, W and PE signals and one for the B1 and B2 signals--are used.

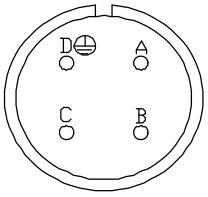
The connector for the encoder is the same one as for the standard specifications.

(Refer to Section 11 on external dimensions in page 11-1.)

<1> Connector for servo actuator power cable

Compatible plug type Made by JAE Electronics, Inc.

	L-type plug	Straight plug	Cable clamp
AR15 AR30, ARH7	JL04V-8A18-10SE-EB	JL04V-6A18-10SE-EB	JL04-18CK(13)
AR60, ARH17 AR135, ARH24	JL04V-8A22-22SE-EB	JL04V-6A22-22SE-EB	JL04-2022CK(14)

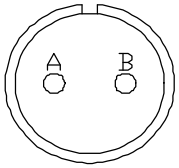


	Signal name
A	U
B	V
C	W
D	PE ⏚

<2> Connector for servo actuator brake

Compatible plug type Made by HIROSE Electric Inc.

	L-type plug	Straight plug	Cable clamp
Common to all types	H/MS3108B10SL-4S	H/M3106A10SL-4S	H/MS3057-4A



	Signal name
A	B1 (brake)
B	B2 (brake)

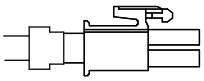
... AR10H

<1> Compatible plug type Made by AMP

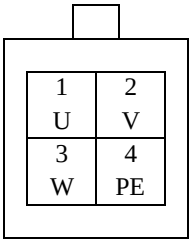
	Servo actuator side		Cable side	
	Plug	Pin	Cap	Socket
Power cable	172167-1	170360-1	172159-1	170362-1
Encoder cable	172171-1	170359-1	172163-1	170361-1
Brake cable	172165-1	170360-1	172157-1	170362-1

<2> Pin assignment

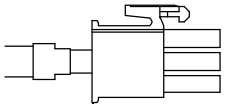
. Power cable



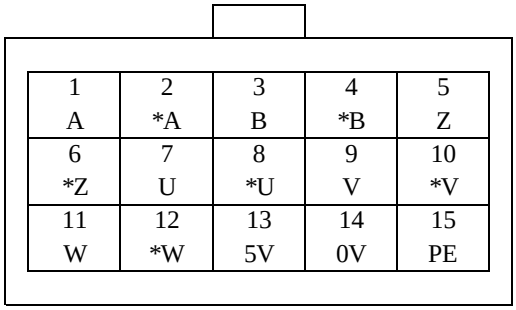
? As seen from this direction



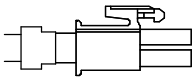
. Encoder cable



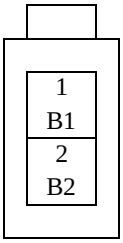
? As seen from this direction



. Brake cable



? As seen from this direction



5-3 Battery

A lithium battery is used to back up the data of the absolute encoder.

When the servo amplifier is to be used in combination with the absolute servo actuator, the battery must be connected to the CN-BAT (p5-1,3) servo amplifier battery connector in accordance with the precautions to be observed when initial turning-on of the power supply. (p1-4)

(1) Recommended battery and connector type

The following battery is recommended.

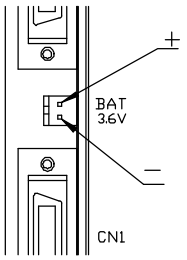
Name: Lithium battery (made by Toshiba Denchi Co., Ltd.)

Type: ER17500V C (with connector)

Ratings: 3.6 V, 2700 mAh

Connector specifications
Housing: IL-2S-S3(N)
Contact: IL-C2-1
Made by JAE Electronics, Inc.

CN-BAT polarities



No battery is required if an incremental encoder (p1-6,1-7,2-1) is used for the servo actuator.

(2) Concerning replacement of the battery

<1> When the battery voltage has dropped, the battery voltage drop warning LED (p5-1,5-3,6-3) on the front panel of the servo amplifier lights, and the battery alarm (p6-24) is turned ON.

<2> The data is retained for about one week after the battery voltage drop warning LED has lighted. Replace the battery as soon as possible since the current position data will be lost if more than one week is allowed to elapse.

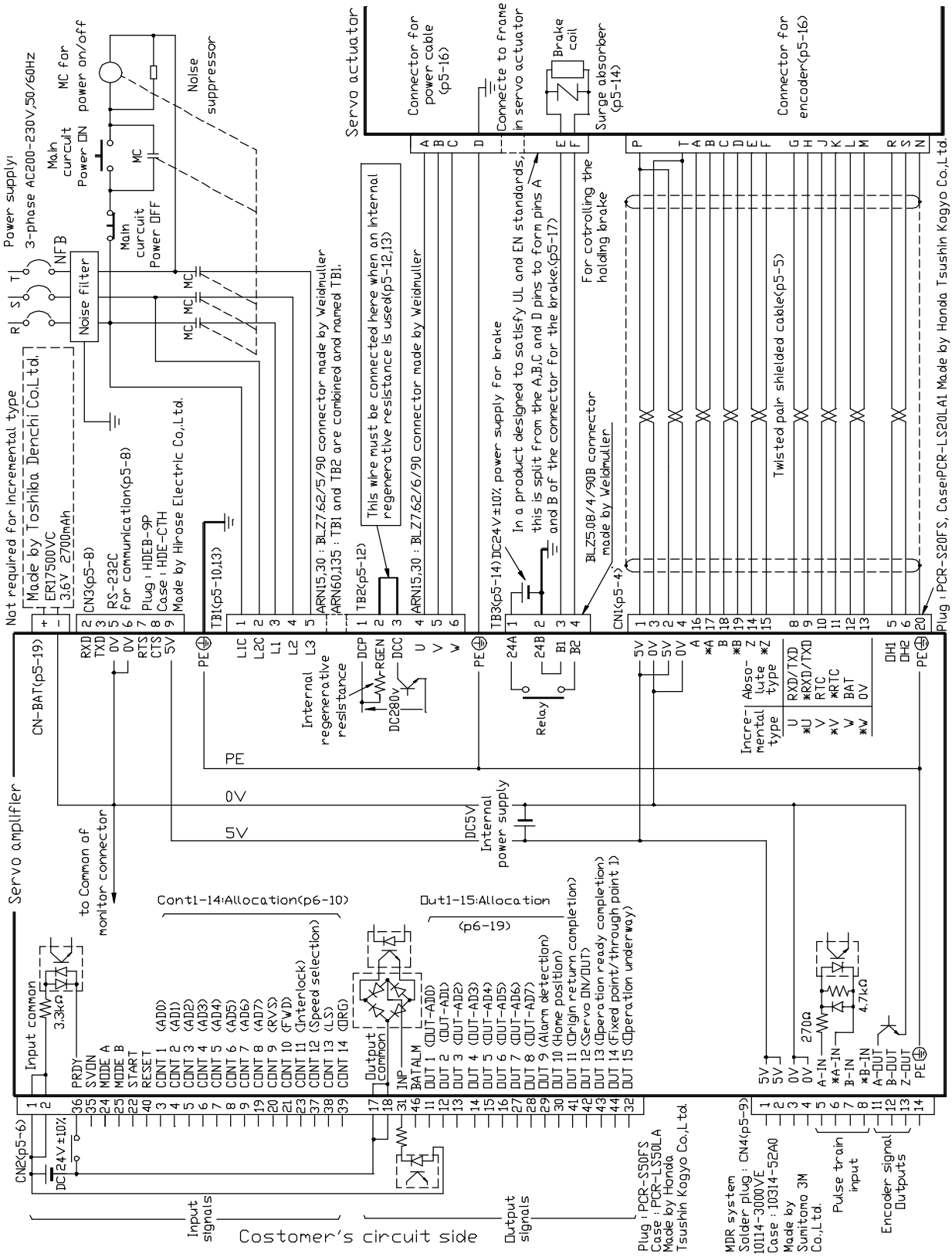
<3> Replace the battery when two years or the cumulative power failure duration totals approximately 12,000 hours have elapsed after the battery was connected.

<4> Replace the battery quickly.
The data is retained only about 30 minute with control power off and battery not connected.

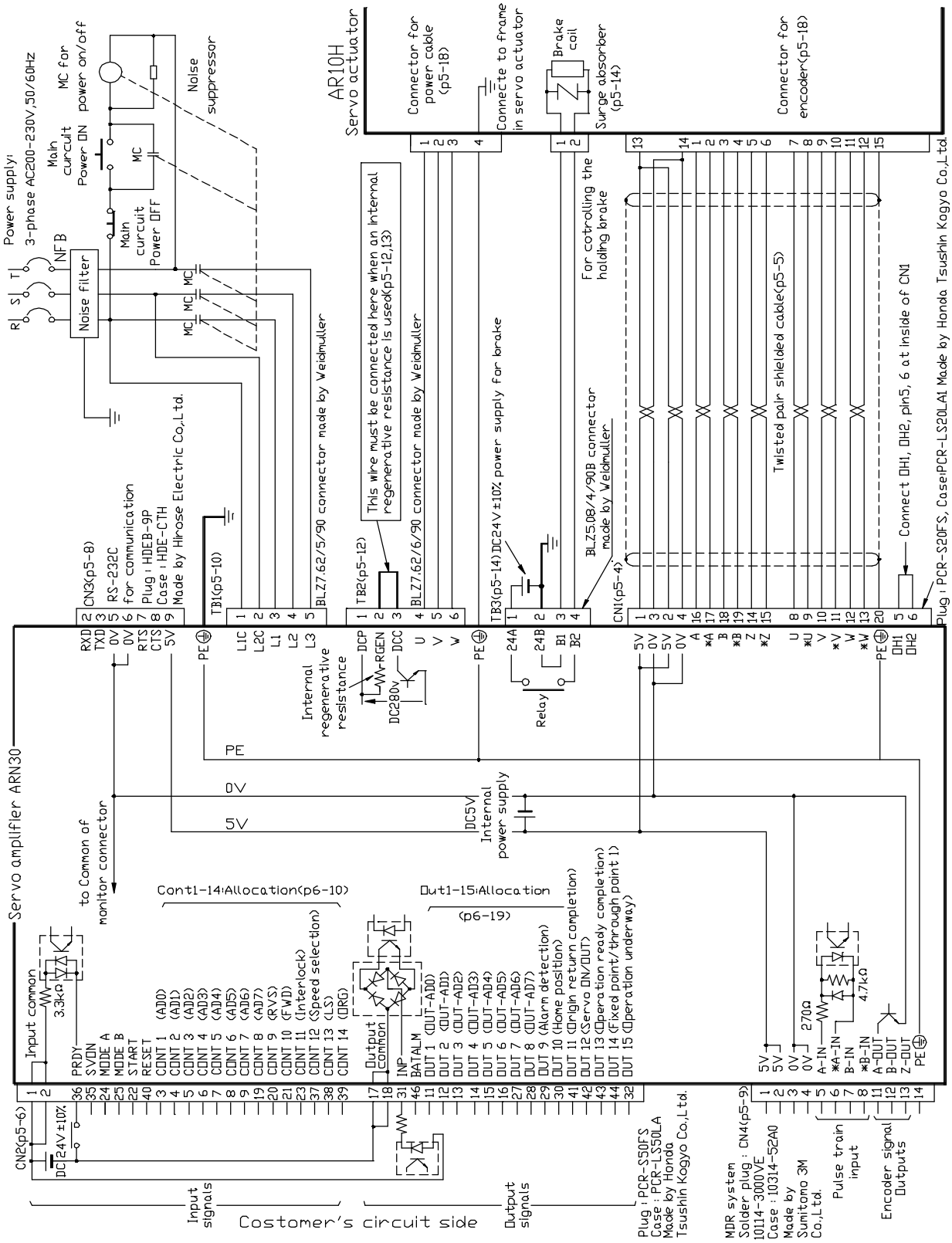
⚠ WARNING: A battery is used for the absolute encoder type servo system. Keep in mind the following precautions when handling the battery.

- Do not heat the battery to 100 °C or above (Do not incinerate the battery).
  Ignoring this instruction could lead to ignition, combustion and explosion.
- Do not disassemble the battery. Contact of the eyes with battery contents could lead to loss of eyesight.
- Do not re-charge the battery.
  Ignoring this instruction could lead to explosion or leakage.
  Contact of the eyes with battery contents could lead to loss of eyesight.

5-4 Wiring Diagram (1) Other than AR10H



(2) AR10H (currently being developed)



6. RUN

6-1 Run Sequence

Listed below are the steps taken to run the actuator.

Item	Description	Related page
1. Verification of specifications	• Verify that combination of the servo amplifier and servo actuator is correct.	2-1 2-2
2. Installation	• Install the servo amplifier and servo actuator.	4-1
3. Wiring	• Connect the servo amplifier and servo actuator to the peripheral devices.	5-1
	• Connect the power supply for the brake as well if the servo actuator is equipped with a brake.	5-14
4. Power ON	• Turn on the power in accordance with the "precautions for initial tuning-on of the power supply".	1-4
	• Following the directions in the power ON section, check that the 7-segment LED display of the servo amplifier is trouble-free.	6-3
	• Following the directions in the power ON section, check that the green and red LED displays of the servo amplifier are trouble-free.	6-3
5. Trial run	• Proceed with a trial run.	6-5
6. Parameter settings	• Set the parameters as the specifications dictate.	7-9, 7-7
7. Positioning data setting	• Set the positioning data.	7-33
8. Run	• Run the actuator using the control I/O signals.	5-6

⚠ WARNING: Stay away from the rotating section of the servo actuator while the power is supplied.

Ignoring this instruction could lead to serious injury.

⚠ WARNING: Observe the following preventive measures to avoid hazards that could result from servo system rotation.

Ignoring these instructions could lead to serious injury.

⚠ WARNING: The servo actuator can keep rotating due to load or inertia even when the power supply is turned off.

Therefore, never touch the rotating section unless it is completely stopped.

Ignoring this instruction could lead to serious injury.

⚠ WARNING: Although the power supply is turned off, the servo amplifier will have been charging with high voltage for a while. Do not start wiring until the Charge LED on the front panel of the servo amplifier goes out. Ignoring this instruction could lead to electrical shock.

⚠ WARNING: In case of an emergency stop, turn off the main power supplies (L1, L2 and L3) to the servo amplifier to stop the servo actuator safely. Ignoring this instruction could lead to serious injury from unexpected servo actuator rotation.

⚠ CAUTION: Use the servo actuator and the servo amplifier in accordance with the combinations stated in the "Table of Specifications" on pages 2-2,3,4,5. If they are used with any other combinations, fire, burns or electrical shock could occur.

⚠ CAUTION: The servo system may reach high temperatures during operation. To prevent burns, do not touch the servo system immediately after the power supply is turned off, but wait for the system to cool.

⚠ CAUTION: If an error has occurred in the servo system, do not operate it until the appropriate remedy has been applied. Ignoring this instruction could lead to serious injury or electrical shock.

6-2 Power ON

(1) Preparations and inspections

<1> Check that the main power and control power have been connected properly. (p5-10,13)
<2> Check that 3-phase 200V is the supply voltage.
<3> To ensure safety, keep the servo actuator unconnected (no-load status) to the machine system.
<4> Connect the motor's power cable (p5-12,13) and encoder cable (p5-4).
<5> Connect the power supply for the brake when using a servo actuator equipped with a brake. (p5-14)

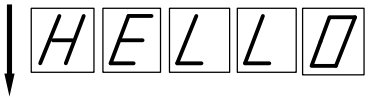
(2) Power ON

When the power is turned on, the front panel of the main unit shows the following displays.

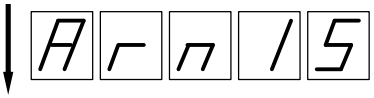
<1> Turn on the power in accordance with the "precautions for initial turning-on of the power supply." (p1-4)

<2> 7-segment LED display

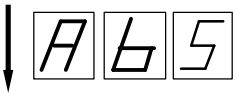
• HELLO display



• Frame number display (for ARN15)



• ABS (absolute) display

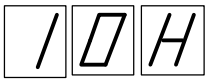


Or

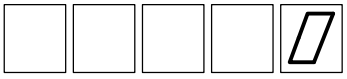
INC (incremental) display

Or

AR10H display



• Display mode 1: Display of rotation speed



<3> Displays on LEDs (at left of 7-segment LED display)

Control power ready complition LED (green)

• This lights when power is supplied to the control power supplies (L1C, L2C) (p5-10,13).

Battery voltage drop warning LED (red)

• This lights when the battery (p5-19) voltage has dropped. Replace the battery when this LED has lighted.
• The battery is not needed if the incremental system is used. The LED will not light when the encoder selector switch (p5-2,3) on the servo amplifier's side panel is set to INC (Incremental).

<4> Charge LED display (in center of main unit) (p5-1,3)

This is the main power LED. It lights (yellowish brown) all the time while the main power L1, L2, L3 (p5-10,13) is on.

⚠ WARNING: Although the power supply is turned off, the servo amplifier will have been charging with high voltage for a while. Do not start wiring until the Charge LED on the front panel of the servo amplifier goes out.
Ignoring this instruction could lead to electrical shock.

6-3 Trial Run

Perform a test run to confirm that both the main power and the control power are supplied and that the connections between the servo actuator and the servo amplifier are correct.
Listed below are the steps taken to execute a trial run.

(1) Trial run (manual operation) without connecting the control I/O signals (p5-6)

The servo actuator can be run without supplying the control input signals (CN2) (p5-6).
It is operated using the panel switches at the front of the servo amplifier.

Manual operation includes manual jog operation where the servo actuator continues to run while the panel switch is held down and manual skip operation where the servo actuator rotates for a fixed amount each time the switch is pressed (p3-16).

In the manual operation mode, if a transfer is made to an operation subsequent to the "JrUn" display, the control input signal (p6-9) supply will be canceled, and all the control output signals (p6-19) will be turned OFF.

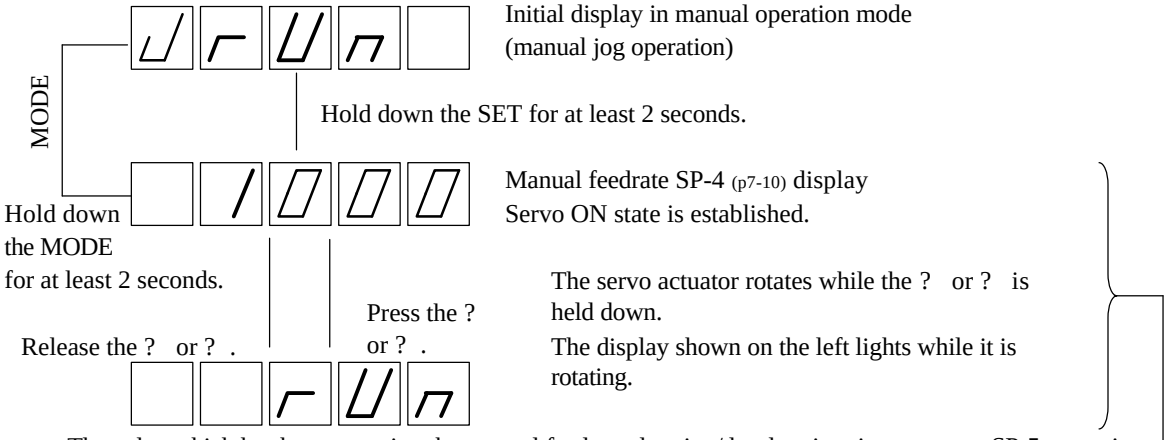
The servo actuator is rotated in the current direction incrementing direction by the ? and in the current direction decrementing direction by the ? .

For details on the direction in which the servo actuator output shaft rotates, refer to the section on the input signals, parameters and the servo actuator rotation directions (p3-26).

The operation methods after the manual mode has been established are shown below.
For information regarding the procedure for switching over to the manual operation mode, refer to Section 7-1 which outlines the setting methods (p7-1).

<1> Manual jog operation

In the manual operation mode, the actuator keeps rotating while the panel switch is held down.

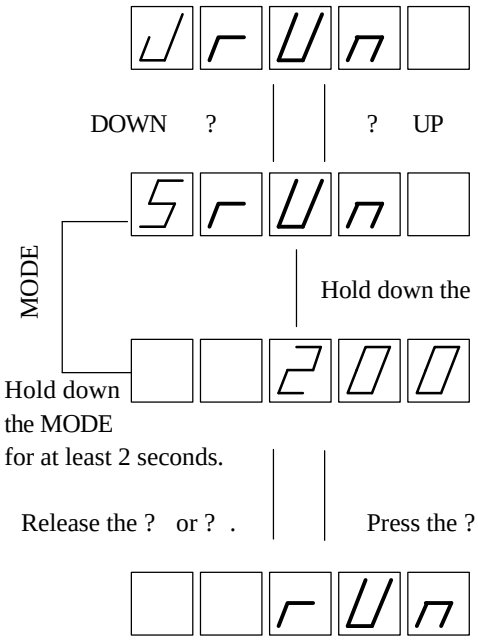


The value which has been set using the manual feed acceleration/deceleration time constant SP-5 (p7-10) is the one used as the acceleration/deceleration time constant value.

The control I/O signal input (p6-9) is canceled, and all the control output signals (p6-19) are turned off.

<2> Manual skip operation

Every time the panel switch is pressed, the servo actuator rotates by an amount equivalent to the skip amount SP-6 (p7-10) value.



Manual operation mode initial display (manual jog operation)

Manual skip operation mode display

Skip amount SP-6 (p7-10)
Shown as the skip amount units are the encoder pulses after they have been multiplied 4 times. The servo ON status is established.

The servo actuator is rotated by the skip amount in the current position incrementing direction by pressing the ? and in the decrementing direction by pressing the ? .
(The display shown on the left lights while the servo actuator is rotating.)

For details on the direction in which the servo actuator output shaft rotates, refer to the section on the input signals, parameters and servo actuator rotation directions (p3-26).

The value which has been set by manual feedrate SP-4 (p7-10) serves as the rotation speed of the motor.

The value which has been set using the manual feed acceleration/deceleration time constant SP-5 (p7-10) is the one used as the acceleration/deceleration time constant value.

There is no need to hold down the ? and ? .
The servo actuator rotates by the skip amount when the ON edge of the ? or ? is detected.

(2) Trial run using control I/O signals (p3-12)

Operations (I/O jog operations) can be performed using the FWD and RVS (p6-15) input signals.

For further details, refer to <7> I/O jog operation (p3-12) in Section 3-2 on the basic command methods.

When the + over-travel, - over-travel (p6-13) and external failure input (p6-12) signals have been allocated to CONT1 to 14 (p6-10), set each of the signals to ON.
The servo actuator will not rotate if these signals are OFF.

6-4 Origin Setting

(1) With the absolute encoder

Use the panel switches at the front of the servo amplifier to set the origin as described below.

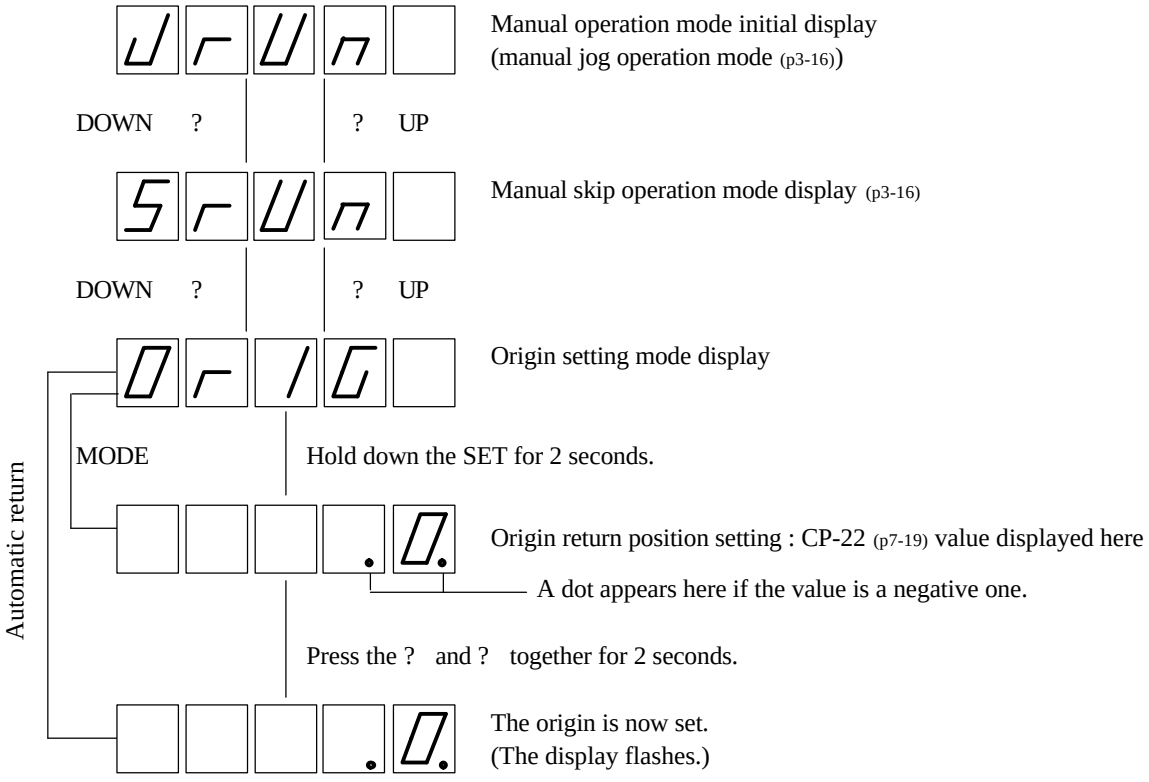
<1> Operate the servo actuator, and locate the machine origin.
When locating the machine origin, the servo actuator can be driven by I/O jog operation (p3-12), manual jog operation (p3-16) or manual skip operation (3-16).

<2> When the machine origin has been located, follow the steps below to set the coordinate origin of the absolute encoder.
When the origin is set, the following operations are performed inside the system.

- The multi-rotation counter of the absolute encoder is reset.
- The current position on the coordinate axes is changed to the origin return position setting CP-22 (p7-19).
- In the case of equal pitch multi-rotation coordinates (p3-6) (coordinate axis: CP-8=1 (p7-15)), the positions of all the positioning addresses are shifted by an amount equivalent to the origin return position setting (p7-19).
- Origin settings are available in any main operation mode (p3-5).

Press the mode switch on the front panel of the servo amplifier to establish the manual operation mode. (p7-1)

Once the manual operation mode has been established, operate as indicated below.



(2) With the incremental encoder

When the incremental encoder is used, set the origin by conducting the origin return operation that employs the LS signal. Refer to p6-14, 3-14 for details.

(Origin return can also be conducted using the panel switches at the front of servo amplifier as with the .absolute encoder.)

6-5 Control Functions

(1) Input signals (CN2) (p5-6)

"ON" and "OFF" in the text below are defined as follows.
ON : The state in which power is supplied to the input circuit LED (p5-7)
OFF : The state in which no power is supplied to the input circuit LED

<table>
<tr><th>Signal name</th><th>Symbol</th><th>Pin no.</th><th>Description</th></tr>
<tr><td>Operation ready command</td><td>PRDY</td><td>36</td><td>. This signal is for preparing for operation.
. When it is turned on, the relay which supplies power to the main circuitry is turned on.
. The low-voltage alarm (p9-2) results if L1, L2, and L3 have not been turned on in the main circuitry when this signal is on.
. The signals from the encoder are counted if the control power has been turned on even when this signal is off.
. Operation is not possible when this signal is off.
. Keep this signal on at all times if two separate power supplies--one for the main power and another one for the control power--are not used.</td></tr>
<tr><td>Servo ON</td><td>SVON</td><td>35</td><td>. When both the operation ready command and this signal are on, the servo actuator is energized and, thus, operable.
. The brake (p5-14) is released when this signal is on; it engages when it is off.
. The signals from the encoder are counted even when this signal is off.</td></tr>
<tr><td>Mode A</td><td>MODE A</td><td>24</td><td rowspan="2">. These signals select the operation mode (p3-3).
<table>
<tr><th>MODE A</th><th>MODE B</th><th colspan="2">Operation mode</th></tr>
<tr><td>OFF</td><td>OFF</td><td colspan="2">Main operation mode (p3-3)</td></tr>
<tr><td>OFF</td><td>ON</td><td>I/O jog operation</td><td rowspan="4">Sub operation mode</td></tr>
<tr><td>ON</td><td>OFF</td><td>Step operation</td></tr>
<tr><td rowspan="2">ON</td><td rowspan="2">ON</td><td>Origin return</td></tr>
<tr><td>I/O skip operation</td></tr>
</table>
. Choice of Origin return and I/Oskip operation is determined by CP-76 sub operation mode switch (p7-26).
. When the step operation is selected by switching between MODE A and B during the operation in the equal pitch multi-rotation coordinates (p3-6), the servo actuator stops at the nearest address and the positioning completion (p6-19) and home position (p6-23) signals turn ON.
. When the mode is switched between A and B during any operation other than those noted above, the servo actuator decelerates until it stops.</td></tr>
<tr><td>Mode B</td><td>MODE B</td><td>25</td></tr>
</table>

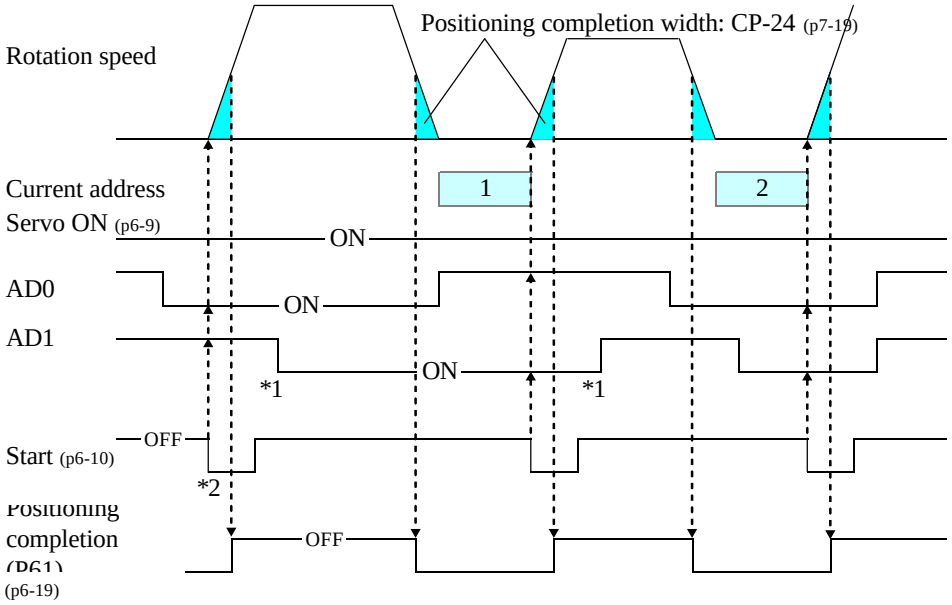
Signal name	Symbol	Pin no.	Description
Start	START	22	. During operation in the equal pitch multi-rotation coordinates (p3-6), optional division 360°coordinates (p3-7), infinite linear coordinates (p3-8) or finite linear coordinates (p3-9) mode, operation is initiated when the servo amplifier reads AD0 to 7 (p6-11) at the ON edge of this signal.
Reset	RESET	40	. Alarms (p9-1) are released at the ON edge of this signal. . Unless the cause of the alarm is removed, the alarm will not be released even when this signal is turned on. . If the nature of the alarm points to a serious failure (p9-1), the alarm will not be released even when this signal is turned on. Turn off the power and turn it back on again.
Control 1 to 14	CONT1 CONT2 CONT3 CONT4 CONT5 CONT6 CONT7 CONT8 CONT9 CONT10 CONT11 CONT12 CONT13 CONT14	3 4 5 6 7 8 9 19 20 21 23 37 38 39	. These signals enable the functions selected among the ones listed below to be allocated. . Up to 14 functions can be allocated to control parameters 47 to 60 (p7-25). . For settings other than "0", if the same setting is specified for two or more symbols from CONT1 through CONT14, the setting for the CONT symbol with the highest number will be in effect. (0) No function designated (1) AD0 (2) AD1 (3) AD2 (4) AD3 (5) AD4 (6) AD5 (7) AD6 (8) AD7 (9) P operation (10) Torque limiting enable (11) External failure input (12) Speed selection (13) Acceleration/deceleration time constant selection (14) + over-tarvel (15) - over-travel (16) ORG (17) LS (18) FWD (19) RVS (20) Speed command speed selection 1 (21) Speed command speed selection 2 (22) Speed command speed selection 3 (23) Speed command speed selection 4 (24) Speed command speed selection 5 (25) Speed command speed selection 6 (26) Speed command acceleration/deceleration selection 1 (27) Speed command acceleration/deceleration selection 2 (28) Speed command acceleration/deceleration selection 3 (29) Interlock

Signal name	Symbol	Pin no.	Description
Control 1 to 14			(1) AD0 to (8) AD7 (address numbers) . These signals are each read at the start signal (p6-10) rise, and the servo actuator starts rotating in the direction of the addresses of the signal concerned. . They take effect in the equal pitch multi-rotation coordinates (p3-6), optional division 360° coordinates (p3-7), infinite linear coordinates (p3-8) and finite linear coordinates (p3-9) modes.

These signals are each recognized by a binary number. Shown below is the correspondence with decimal numbers.

AD7	AD6	AD5	AD4	AD3	AD2	AD1	AD0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

Example: When AD1, 3 and 5 are on, the address is 42 (2+8+32).
Example: When the maximum number of addresses is 7, there is no need to allocate functions to AD3 to 7.



*1 After the start signal has been set on (started), the positioning contents will remain unchanged even if the address numbers (input values of AD0 to 7) are changed.

*2 Rotation is started at the ON edge of the start signal. Operation to the next address is not executed if the signal is permanently on.

<table>
<tr><th>Signal name</th><th>Symbol</th><th>Pin no.</th><th>Description</th></tr>
<tr><td>Control 1 to 14</td><td></td><td></td><td>
(9) P operation

. When this signal is set on, the speed loop control goes from proportional and integral control to proportional control only.
. The signal enables the servo rigidity to be weakened.

(10) Torque limiting enable

. This function limits the output torque of the servo actuator.
. The output torque is limited when this signal is on.
. The limit level is set by the torque limit value CP-34 (p7-20).
. The maximum torque (= maximum torque limit value) when the torque is not limited is as below.

<table>
<tr><th>AR15</th><th>AR30
ARH7</th><th>AR60
ARH17</th><th>AR135
ARH24</th><th>AR10H</th></tr>
<tr><td>350</td><td>350</td><td>350</td><td>300</td><td>350</td></tr>
</table>
[%]
(Rated torque = 100%)

(11) External failure input
. This is used to stop the servo actuator when a failure has occurred in an external device.
. The servo actuator stops immediately when this signal is turned off, while maintaining its power.
. When the servo ON signal (p6-9) is on, the holding torque remains in force even after shutdown.
. Even if this signal is reset, the operation cannot resume unless a signal to direct the operation, such as START (p6-10), FWD (p6-15), etc., is input.
. The rotation commands (including the pulse train commands) which have been input while this signal is off are invalid.

(12) Speed selection

. This selects the motor rotation speed and the motor acceleration/deceleration time constant in the equal pitch multi-rotation coordinates (p3-6) mode.
. The servo amplifier reads the input status at the ON edge of the start signal (p6-10).
. The relation between the ON/OFF statuses and the selected servo parameters is as below.

<table>
<tr><th rowspan="2">Input status of speed selection</th><th colspan="2">Selected servo parameter</th></tr>
<tr><th>Motor rotation speed</th><th>Motor acceleration/deceleration time constants</th></tr>
<tr><td>ON</td><td>SP-8: Speed 2 for equal division</td><td>SP-10: Acceleration/deceleration time constant 2</td></tr>
<tr><td>OFF</td><td>SP-7: Speed 1 for equal division</td><td>SP-9: Acceleration/deceleration time constant 1</td></tr>
</table>
</td></tr>
</table>

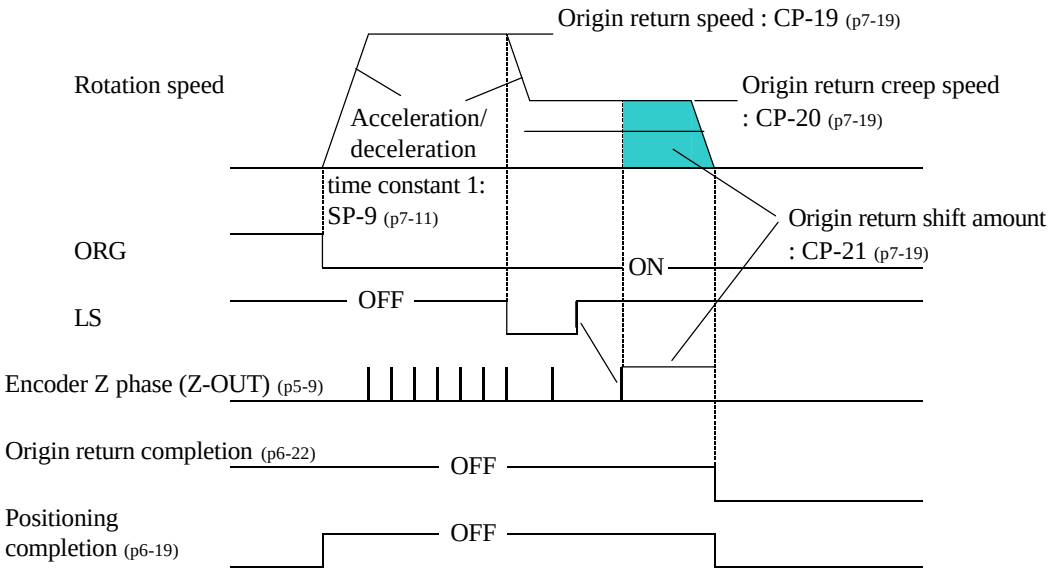
Signal name	Symbol	Pin no.	Description
Control 1 to 14			(13) Acceleration/deceleration time constant selection . This selects the acceleration/deceleration time constant in the optional division 360° coordinates (p3-7), the infinite linear coordinates (p3-8) and the finite linear coordinates (p3-9) modes. . The servo amplifier reads the input status at the ON edge of the start signal (p6-10). . The relation between the ON/OFF statuses and the selected servo parameters is as below.

Input status of acceleration/deceleration time constant selection	Selected servo parameter
ON	SP-10: Acceleration/deceleration time constant 2
OFF	SP-9: Acceleration/deceleration time constant 1

			(14) + over-travel, (15) - over-travel . When these pins are turned off, the rotation command in the detection direction is ignored, and the servo actuator stops immediately, while maintaining its power. . The servo actuator does not stop even when the over-travel signal in the reverse direction of the rotating direction turns OFF. . Even in the over-travel detection status, the servo actuator can be rotated in the direction opposite to the over-travel detection direction.

Signal name	Symbol	Pin no.	Description
Control 1 to 14			(16) ORG The origin return operation is started at the ON edge of this signal.
			(17) LS This is for the origin return limit switch input.

Origin return timing chart



(Invalid if the origin return is executed in the equal pitch multi-rotation coordinates (p3-6).)

<1> When the ORG signal changes to ON from OFF in the timing chart, then the servo actuator is operated at the origin return speed (CP-19 setting, p7-19) in the origin return direction (CP-18 setting, p7-19).

<2> Starting at the moment when the origin LS signal goes from off to on, the servo actuator decelerates at the origin return creep speed (CP-20 setting, p7-19). In this case, the acceleration/deceleration time constant 1 SP-9 setting serves as the acceleration/deceleration time constant.

<3> When the first encoder Z phase signal is detected after the origin LS signal goes from on to off, the servo actuator stops at the position reached after having rotated for the equivalent of the origin return shift amount CP-21 (p7-19) setting (unit: encoder pulses).

(The Z phase signal is output once for each complete rotation of the motor.)

<4> The current position of the coordinate axes is changed to the origin return position CP-22 (p7-19) setting (unit = encoder pulses).

In the case of equal pitch multi-rotation coordinates (coordinate axes: CP-8=1, p7-15), the positioning addresses positions are shifted by an amount equivalent to the origin return position setting.

The origin return completion signal is turned on.

After origin return has been set, the origin return completion signal turns on if the current position of the servo actuator is within the origin detection range CP-23 (p7-19) setting centered on the origin.

When either the + over-travel or the - over-travel signal (p6-13) in the rotating direction is detected during the origin return operation, the servo actuator stops immediately. In this case, step <4> above is not executed.

Signal name	Symbol	Pin no.	Description
Control 1 to 14			(18) FWD (forward) (19) RVS (reverse) . FWD: The servo actuator rotates in the current position incrementing direction while this signal is on. . RVS: The servo actuator rotates in the current position decrementing direction while this signal is on. . These signals take effect with I/O jog operation, step operation and speed command. . For the rotation direction of the servo actuator, refer to input signals, parameters and rotation directions of the servo actuator (p3-26). . The rotation speed is set as follows.

I/O jog operation (p3-12) Step operation (p3-13) I/O skip operation (p3-15)	The manual feedrate (SP-4, p7-10) setting is applied to operations.
Speed command operation (p3-11)	The speed can be selected from speed command speed 1 to 6 (SP-11 to SP-16) (p7-11) by the speed command speed selection 1 to 6 (p6-16).

. In the speed command operation mode (p3-11):

The speed command speed 1 is automatically selected if speed command speed selections 1 to 6 have not been allocated to control 1 to 14 or if all the signals are off even when these selections have been allocated.

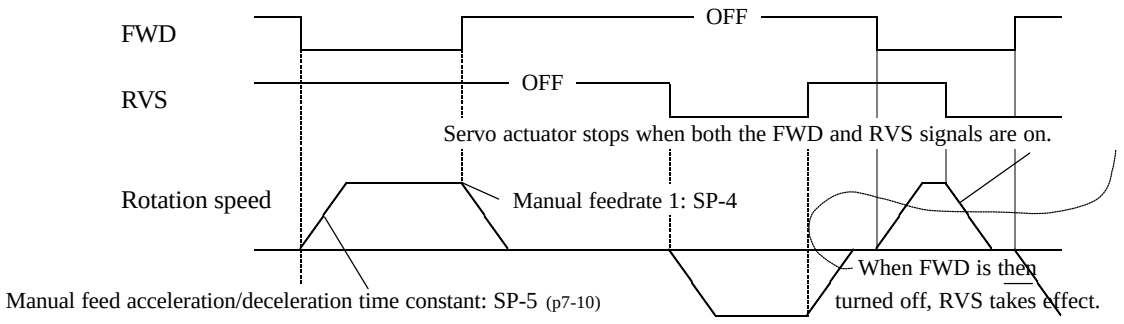
. The acceleration/deceleration time constant is set as follows.

I/O jog operation (p3-12) Step operation (p3-13) I/O skip operation (p3-15)	The manual feed acceleration/deceleration time constant (SP-5, p7-10) setting is applied to these operations.
Speed command operation (p3-11)	The time constant can be selected from speed command acceleration/deceleration 1, 2 or 3 (SP-17, SP-18 or SP-19) (p7-12) by the speed command acceleration/deceleration selection 1, 2 or 3 (p6-17).

. In the speed command operation mode (p3-11):

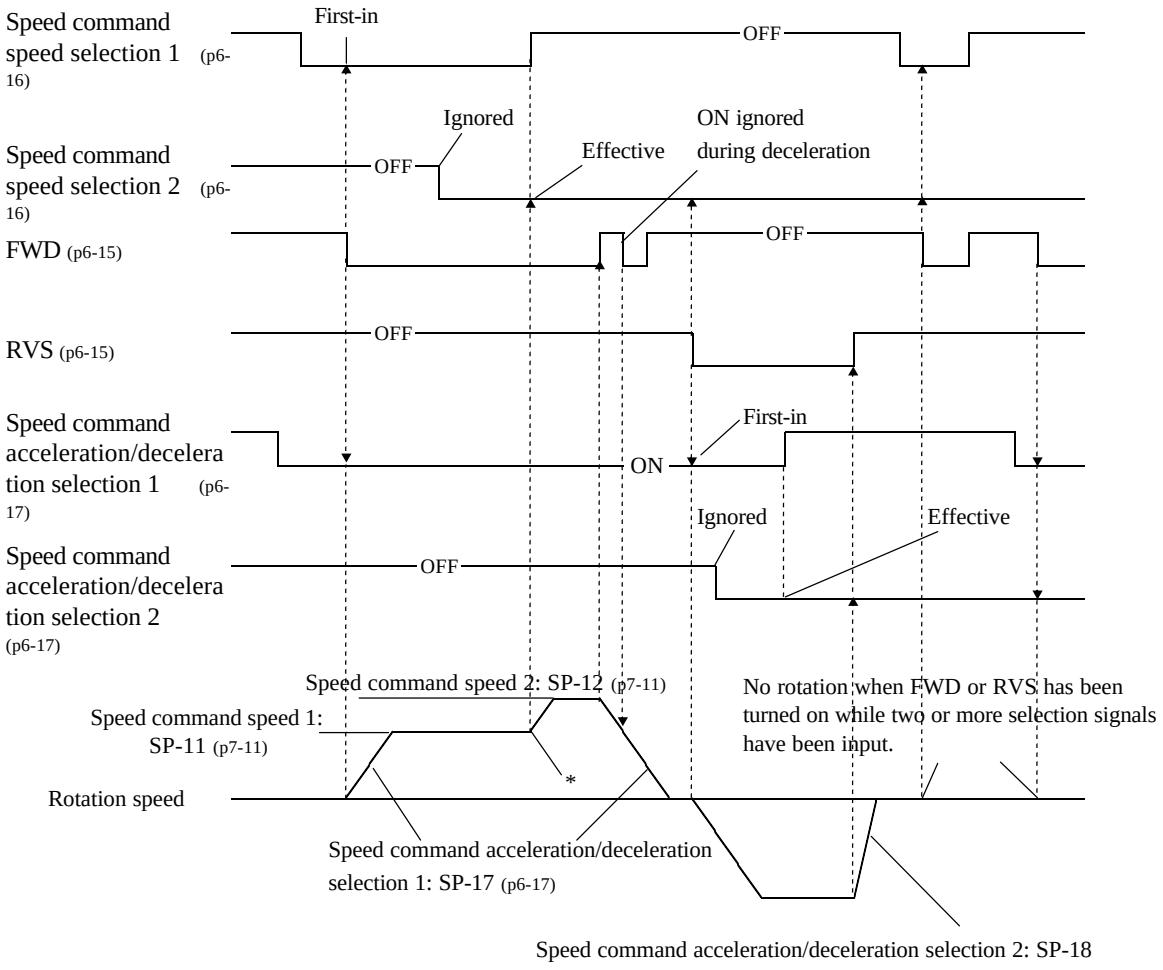
The speed command acceleration/deceleration 1 is automatically selected if speed command acceleration/deceleration selections 1 to 3 have not been allocated to control 1 to 14 or if all the signals are off even when these selections have been allocated.

Timing chart during I/O jog operations (p3-12)



Signal name	Symbol	Pin no.	Description
Control 1 to 14			(20) Speed command speed selection 1 (21) Speed command speed selection 2 (22) Speed command speed selection 3 (23) Speed command speed selection 4 (24) Speed command speed selection 5 (25) Speed command speed selection 6 · The motor rotates at the speed which has been set in speed command speed 1 to 6 (SP-11 to SP-16) (p7-11) by issuing the rotation command (turning on the FWD or RVS signal) after this signal is input. · The rotation direction is determined by the FWD or RVS signal. · For the rotation direction of the servo actuator, refer to input signals, parameters and rotation directions of the servo actuator (p3-26). · This signal has first-in priority during the FWD or RVS signal ON period. · During the FWD or RVS signal ON period, when the ON edges of two or more signals have been detected in 2ms or so, the servo actuator decelerates until it stops. · When the command has been changed during acceleration or deceleration, the speed changes to the post-change speed after the pre-change speed has been reached.

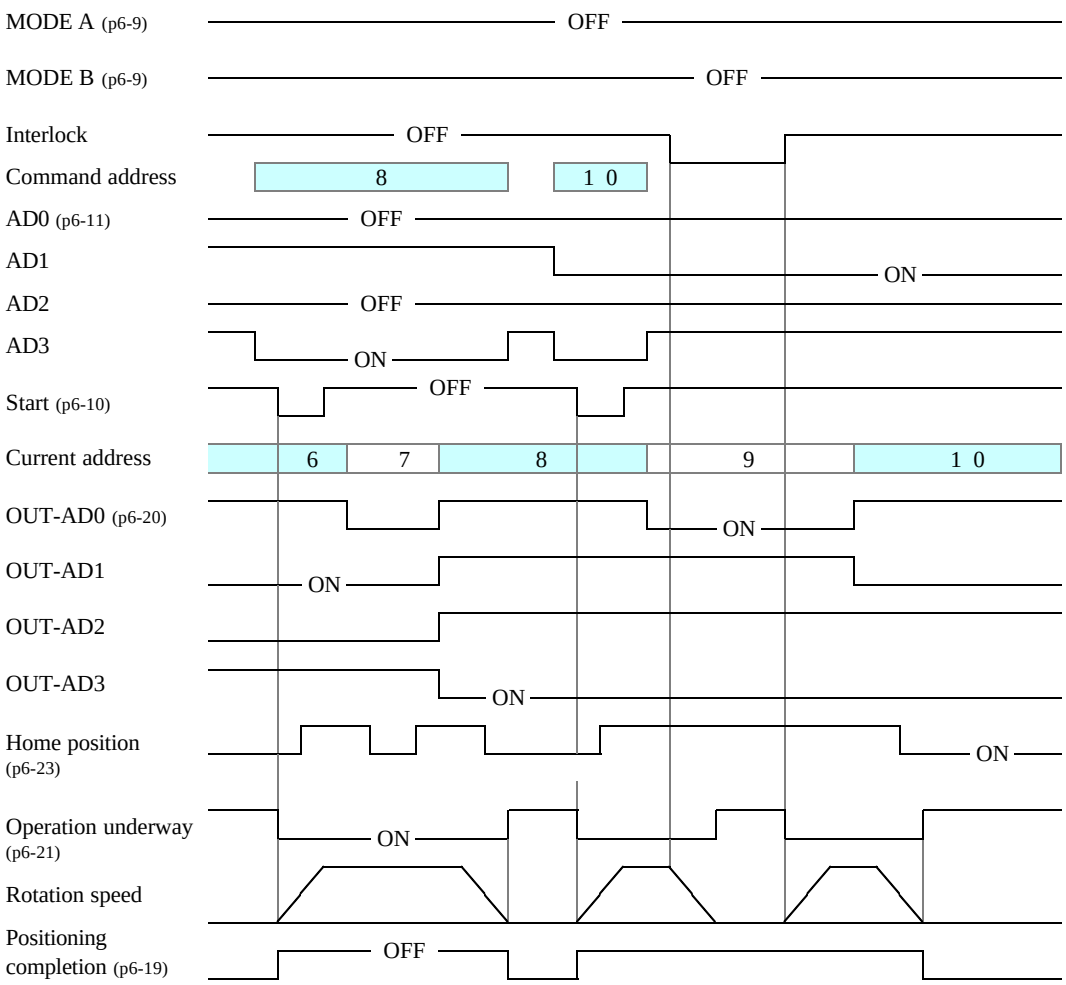
Signal name	Symbol	Pin no.	Description
Control 1 to 14			(26) Speed command acceleration/deceleration selection 1 (27) Speed command acceleration/deceleration selection 2 (28) Speed command acceleration/deceleration selection 3 . This signal selects the acceleration/deceleration time constant to be used when the speed command is issued. . This signal has first-in priority during the FWD or RVS (p6-15) signal ON period. . Upon issuance of a speed change command (* in the following diagram), when two or more signals are ON, the servo actuator decelerates until it stops. . When the command has been changed during acceleration or deceleration, the command is not reflected immediately but starting when the next acceleration/deceleration command has been generated.



Signal name	Symbol	Pin no.	Description
Control 1 to 14			(29) Interlock . Rotation is prohibited while this signal is on. . When this signal turns on, the servo actuator decelerates until it stops. . The servo lock status is established while the servo actuator has stopped. . The remaining operations are executed when this signal turns off. . The above logic and chart below apply when interlock logic CP-43 (p7-22) is 1 (default value). This logic can be reversed using this parameter.

.Example of equal pitch multi-rotation coordinates (p3-6): CP-8=1

In this case, the interlock signal is input around address 9 during operation from address 8 toward address 10, the servo actuator stops, the interlock is then released, and the servo actuator is positioned at address 10.



(2) Output signals (CN2) (p5-6)

"ON" and "OFF" in the text below are defined as follows.

ON : The state in which the output circuit transistors (p5-7) are ON
OFF : The state in which the output circuit transistors are OFF.

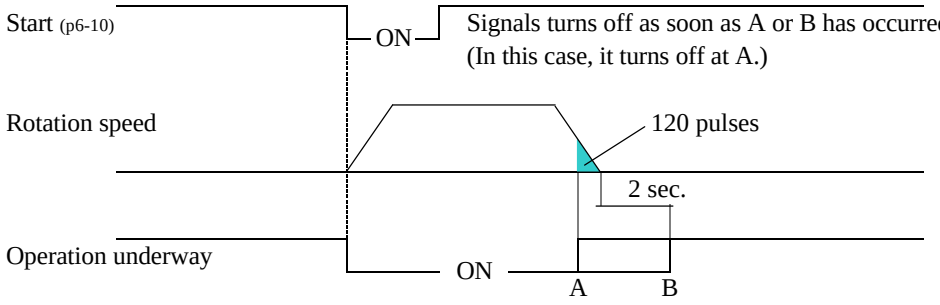
Signal name	Symbol	Pin no.	Description
Positioning completion	INP	31	. This signal turns ON under the following conditions. · For equal pitch multi-rotation coordinates (p3-6) : In the main operation mode (p3-5) or the step operation mode (p3-13), | Target address position – Current position | < Positioning completion width (CP-24, p7-19) · For the optional division 360° coordinates, the infinite linear coordinates, the finite linear coordinates and the pulse train operation : | Command position – Current position | < Positioning completion width (CP-24, p7-19)
Out 1 to 15	OUT1 OUT2 OUT3 OUT4 OUT5 OUT6 OUT7 OUT8 OUT9 OUT10 OUT11 OUT12 OUT13 OUT14 OUT15	11 12 13 14 15 16 27 28 29 30 41 42 43 44 32	. These signals enable the functions selected from among the ones listed below to be allocated. . Up to 15 functions can be allocated to control parameters 61 to 75 (p7-26). . The same function can be set in more than one pin. (0) No function designated (1) OUT-AD0 (2) OUT-AD1 (3) OUT-AD2 (4) OUT-AD3 (5) OUT-AD4 (6) OUT-AD5 (7) OUT-AD6 (8) OUT-AD7 (9) Operation ready completion (10) Servo ON/OUT (11) Operation underway (12) Fixed point/through point 1 (13) Fixed point/through point 2 (14) Over-travel detection (15) Origin return completion (16) Alarm detection (17) Speed arrival (18) Home position (19) Torque limiting underway (20) Positioning completion

Signal name	Symbol	Pin no.	Description
Out 1 to 15			(1) OUT-AD0 to (8) OUT-AD7 . These signals output the current address. . The same binary number output format as for AD0 to 7 (p6-11) of control 1 to 14 is used. . These signals take effect, in the case of an absolute encoder, after the power is turned on, since the previous position has been backed up even when the power is OFF. . However, in the case of an incremental encoder, this signal is output in accordance with the "zero" position that will be recognized when the power is turned ON. . The correlation between the coordinate axes and output logic is as shown below.

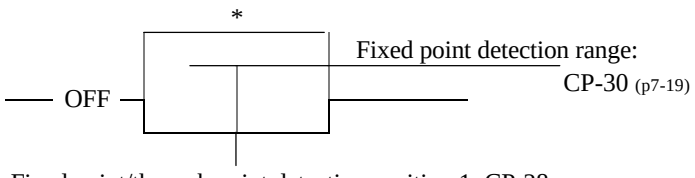
Coordinate axes: CP-8 (p7-15)		Output logic
Equal pitch multi-rotation coordinates (p3-6)	1	Address nearest the current position
Optional division 360° coordinates (p3-7)	2	Target address
Infinite linear coordinates (p3-8)	3	
Finite linear coordinates (p3-9)	4	

			(9) Operation ready completion . This signal turns on when both of the following conditions have been met. Conditions . When operation ready command (p6-9) is ON . When no alarms (p9-1) have occurred . After the operation ready command has turned on, there is a delay of approximately (300ms=ARN15,30 : 600ms=ARN60,135) before this signal is output.
			(10) Servo ON/OUT . This signal turns on when all of the following conditions have been met. . This signal indicates the power is being supplied to the servo motor. Conditions . When operation ready command (p6-9) is ON . When no alarms (p9-1) have occurred . When servo ON (p6-9) is ON . When the power save timer (p7-21) is not active (the brake is not applied) . After the operation ready command has turned on, there is a delay of of approximately (300ms=ARN15,30 : 600ms=ARN60,135) before this signal is output.

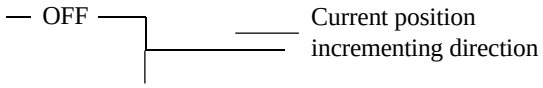
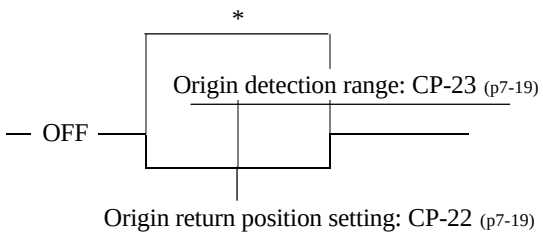
Signal name	Symbol	Pin no.	Description
Out 1 to 15			(11) Operation underway . This signal turns on when the rotation command has been output from the servo amplifier to the servo actuator. . It turns off 2 seconds after the rotation command is output from the servo amplifier to the servo actuator or when the difference between the current position and positioning target position is ±120 pulses, which is equivalent to four times the encoder source signal. . The signal takes effect only when the coordinate axes CP-8 (p7-15) setting is 1 (equal pitch multi-rotation coordinates (p3-6)).

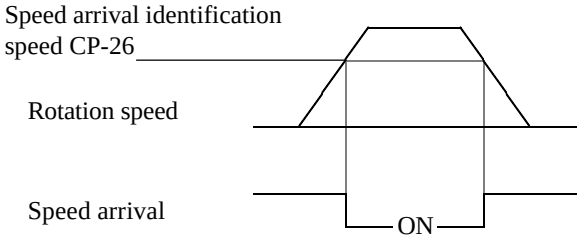
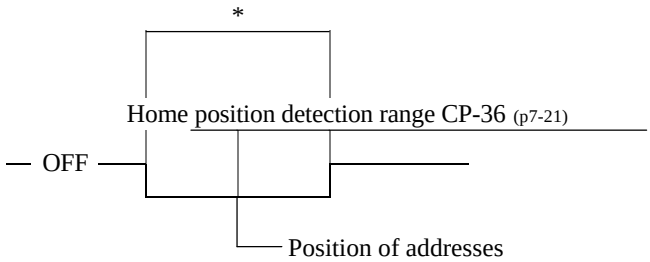


			(12) Fixed point/through point 1 (13) Fixed point/through point 2 . This signal can be turned on or off at the fixed point or through point by setting fixed point/through point detection pattern CP-27 (p7-19). <1> Fixed point (CP-27=1) . The signal turns ON when the current position of the servo actuator comes within the range (two times larger than the fixed point detection range) marked by (*) below.



Fixed point/through point detection position 1: CP-28 (p7-19)
Fixed point/through point detection position 2: CP-29

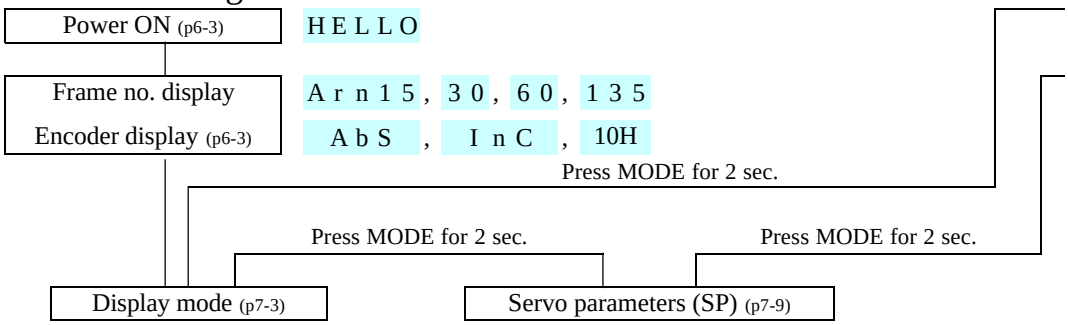
Signal name	Symbol	Pin no.	Description
Out 1 to 15			<2> Through point (CP-27=2) . The signal turns on when the current position of the servo actuator is more than the through point setting position; it turns off if it is less.  Fixed point/through point detection position 1: CP-28 (p7-19) Fixed point/through point detection position 2: CP-29 (14) Over-travel detection . This signal turns on when one of the following conditions has occurred. Conditions . + over-travel signal (p6-13) has gone off. . - over-travel signal (p6-13) has gone off. . Current position is more than soft + over-travel detection position CP-31 (p7-20). . Current position is less than soft - over-travel detection position CP-32 (p7-20). (15) Origin return completion . This signal turns on upon completion of origin return. Subsequently, it turns on when the current position of the servo actuator comes within the range marked with an asterisk (*) shown below (twice of the origin detection range). (See page 3-14) . When a value except zero is input for the CP-22 origin return position setting (p7-19), the origin return completion signal may not turn ON at the position where origin return was executed because the coordinate origin position differs from the position where origin return was executed. . Concerning the equal pitch multi-rotation coordinates (p3-6) and the optional division 360° coordinates (p3-7), the coordinate axis shifts automatically during operation. Therefore, this signal does not necessarily correspond to the mechanical origin point. 

Signal name	Symbol	Pin no.	Description
Out 1 to 15			(16) Alarm detection . This signal turns on when an alarm (p9-1) is detected. . To release the alarm status, remove the cause of the alarm and either turn on the reset signal (p6-10) or turn off the main power and control power and then turn them back on again. . The external failure input (p6-12), + over-travel and - over-travel (p6-13) and interlock (p6-18) are not identified as an alarm status.
			(17) Speed arrival . This signal turns on when the motor rotation speed exceeds the speed arrival identification speed CP-26 (p7-19) setting. 
			(18) Home position . This signal turns on when the current position of the servo actuator has come within the range, marked with an asterisk (*), of each address shown below (This range is twice that of the home position detection range). . The home position detection width is set using home position detection range CP-36 (p7-21). . The signal takes effect only when the coordinate axes CP-8 (p7-15) setting is 1 (equal pitch multi-rotation coordinates (p3-6)). 

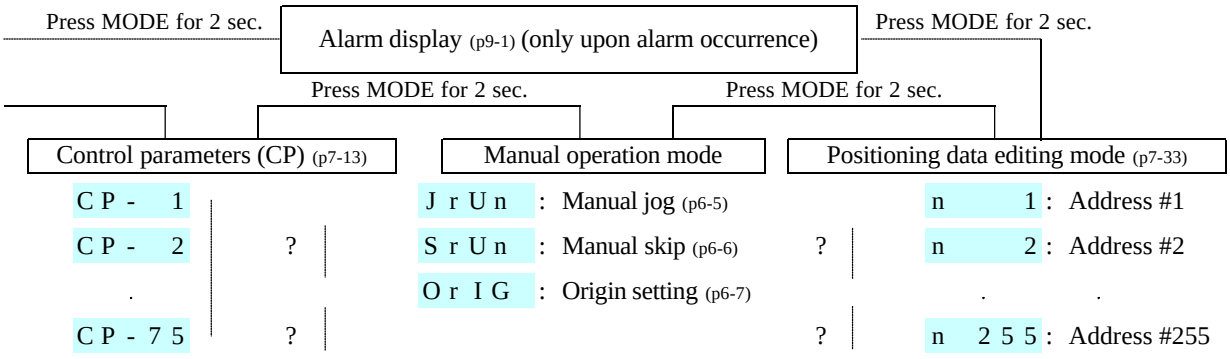
Signal name	Symbol	Pin no.	Description
Out 1 to 15			(19) Torque limiting underway . This signal turns on when the following conditions is met. Conditions: The torque limiting enable signal (p6-12) of control 1 to 14 is turned on, and the motor torque has been limited by the torque limit value CP-34 setting. (20) Positioning completion . The function of this signal is the same as that of INP (positioning completion) noted on page 6-19. . The same function as the positioning completion can be allocated to OUT1 through OUT15.
Battery alarm	BAT ALM	46	. This signal turns on when the voltage of the battery (p5-19) for the absolute encoder has dropped. . It has the same function as the battery voltage drop warning LED (red) (p5-1,3) on the front panel. . When this signal has turned on, replace the battery immediately. (See page 5-19)

7. SETTING METHODS

7-1 Overview of Setting Methods



	1. S P E d	: Motor rotation speed			
	2. P A d d	: Position address number		2 : Speed loop integral gain	p7-9
?	3. P O S	: Current position ??	?	3 : Position loop gain	p7-9
	4. r P O S	: Requested position ??		4 : Manual feedrate	p7-10
	5. P t O r	: Percentage torque		5 : Manual feed acceleration/deceleration time constant	p7-10
?	6. d P U L	: Deviation pulse ??	?	6 : Skip amount	p7-10
	7. F P U L	: Feedback pulse ??		7 : Speed 1 for equal division	p7-10
	8. r P U L	: Requested pulse ??		8 : Speed 2 for equal division	p7-10
	9. A L H I	: Alarm history		9 : Acceleration/deceleration time constant 1	p7-11
	1 0. d I	: Digital input monitor		1 0 : Acceleration/deceleration time constant 2	p7-11
	1 1. d O	: Digital output monitor		1 1 : Speed command speed 1	p7-11
	1 2. v E r	: Software version		1 2 : Speed command speed 2	p7-11
				1 3 : Speed command speed 3	p7-11
	? : There are five or more upper digits.			1 4 : Speed command speed 4	p7-11
	? : Positive or negative value.			1 5 : Speed command speed 5	p7-11
				1 6 : Speed command speed 6	p7-11
				1 7 : Speed command acceleration/deceleration 1	p7-12
				1 8 : Speed command acceleration/deceleration 2	p7-12
				S P - 1 9 : Speed command acceleration/deceleration 3	p7-12



1	Encoder type	40	Power save timer time	76	Sub operation mode switch
2	Reduction gear ratio numerator	41	Overshoot amount	77	Factory use (Not for user)
3	Reduction gear ratio denominator	42	Number of follow-up pulses	78	Position defect alarm available/unavailable
4	Electronic gear a?	43	Interlock logic		
5	Electronic gear ß?	44	Rewriting prohibited	79	Position defect alarm width
6	Unit amount	45	Monitor selection		
7	Brake available/unavailable	46	Display contents when power is turned on		
8	Coordinate axis	47	Control 1		
9	Number of divisions	48	Control 2		
10	Total number of addresses	49	Control 3		
11	Optional division short-cut control	50	Control 4		
12	Indexing number incrementing direction	51	Control 5		
13	MF/FIN available/unavailable	52	Control 6		
14	Short-cut/unidirectional selection	53	Control 7		
15	2-position indexing direction selection	54	Control 8		
16	Input pulse system	55	Control 9		
17	Pulse train operation rotation direction	56	Control 10		
18	Origin return direction	57	Control 11		
19	Origin return speed	58	Control 12		
20	Origin return creep speed	59	Control 13		
21	Origin return shift amount	60	Control 14		
22	Origin return position setting	61	Out 1		
23	Origin detection range	62	Out 2		
24	Positioning completion width	63	Out 3		
25	Excessive deviation width	64	Out 4		
26	Speed arrival identification speed	65	Out 5		
27	Fixed point/through point detection pattern	66	Out 6		
		67	Out 7		
28	Fixed point/through point detection position 1??	68	Out 8		
		69	Out 9		
29	Fixed point/through point detection position 2??	70	Out 10		
		71	Out 11		
30	Fixed point detection range	72	Out 12		
31	Soft + over-travel detection position??	73	Out 13		
32	Soft - over-travel detection position??	74	Out 14		
33	Speed limit value	75	Out 15		
34	Torque limit value				
35	Brake forcible release				
36	Home position detection range				
37	Backlash compensation amount				
38	Backlash compensation direction				
39	Power save timer available/unavailable				

Functions allocated to control 1 to 14 (p6-10)
(0) No function designated
(1) AD0
(2) AD1
(3) AD2
(4) AD3
(5) AD4
(6) AD5
(7) AD6
(8) AD7
(9) P operation
(10) Torque limiting enable
(11) External failure input
(12) Speed selection
(13) Acceleration / deceleration time constant selection
(14) + over-travel
(15) - over-tarvel
(16) ORG
(17) LS
(18) FWD
(19) RVS
(20) Speed command speed selection 1
(21) Speed command speed selection 2
(22) Speed command speed selection 3
(23) Speed command speed selection 4
(24) Speed command speed selection 5
(25) Speed command speed selection 6
(26) Speed command acceleration/deceleration selection 1
(27) Speed command acceleration/deceleration selection 2
(28) Speed command acceleration/deceleration selection 3
(29) Interlock

Functions allocated to out 1 to 15 (p6-19)
(0) No function designated
(1) OUT-AD0
(2) OUT-AD1
(3) OUT-AD2
(4) OUT-AD3
(5) OUT-AD4
(6) OUT-AD5
(7) OUT-AD6
(8) OUT-AD7
(9) Operation ready completion
(10) Servo ON/OUT
(11) Operation underway
(12) Fixed point/through point 1
(13) Fixed point/through point 2
(14) Over-travel detection
(15) Origin return completion
(16) Alarm detection
(17) Speed arrival
(18) Home position
(19) Torque limiting underway
(20) Positioning completion

? : There are five or more upper digits.

? : Positive or negative value.

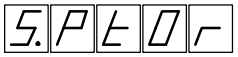
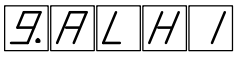
7-2 Detailed Description of Display Modes

. When the power is turned on, the frame number and the encoder are displayed, respectively. (p6-3)

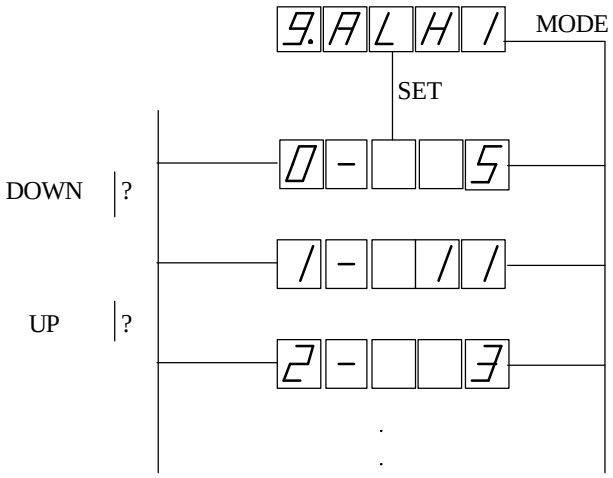
Then, the display mode is indicated. You can select the mode item to be displayed using the ? and ? . (p7-1)

. Which item of the display mode is to be displayed when the power is turned on can be selected using the "display contents when power is turned on" CP-46 (p7-24) setting. This parameter's default is the motor rotation speed.

. ? Items marked with a black dot have high-order digits when their contents are displayed (p7-6).

No.	Item	Display	Remarks
1	Motor rotation **spe**e**d**		. Displays the rotation speed of the motor. [rpm]
2	**P**osition **add**ress number		. Displays the requested address AD0 to 7 (p6-11). [Position address number]
3 ?	Current **Pos**ition		. Displays the current position. . For details, refer to the table on p7-4. [Position address number or unit amount]
4 ?	**R**equested **pos**ition		. Displays the requested address position data. . For details, refer to the table on p7-4. [Unit amount]
5	**P**ercentage **tor**que		. Displays the torque command value. . The rated torque is 100%. [%]
6 ?	**De**viation **pul**se		. Displays the difference between the requested pulse and feedback pulse. . For details, refer to the table on p7-4. [Encoder pulse]
7 ?	**F**eedback **pul**se		. Displays the cumulative number of pulses which have been fed back from the encoder. • For details, refer to the table on p7-4. [Encoder pulse]
8 ?	**R**equested **pul**se		. This is the internal request value. . Displays the number calculated from “(Cumulative total number of pulses which have been input from the external source [Number of ?and ? for CP-16, p7-18]) x Electronic gear a /Electronic gear ß ” during the pulse train operation (p3-10). [Encoder pulse]
9	**Al**arm **hi**story		. Among the alarms which have occurred in the past (p9-1), this displays the alarm which occurred last. . A history of the last 10 alarms is displayed by pressing the button on the front panel. . The alarms are displayed in sequence starting with the most recent one.

The method used to display the alarm history is described below.

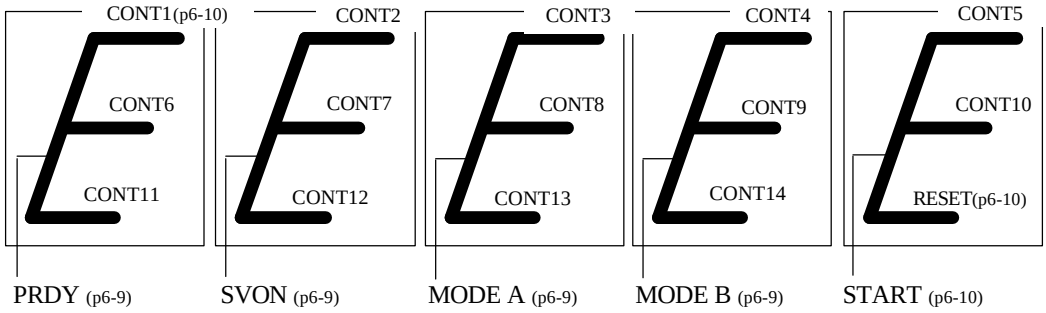


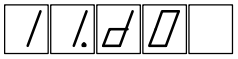
What is displayed for the items below differs according to the operation mode which has been selected.

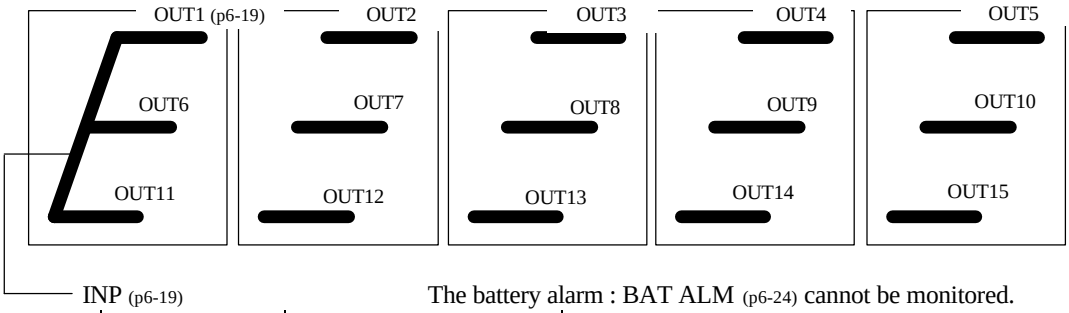
		Main operation modes					
		Equal pitch multi-rotation coordinates	Optional division 360° coordinates	Infinite linear coordinates	Finite linear coordinates	Pulse train operation	Speed command operation
Current position	Zero point	Origin		Start (p6-10) ON position	Origin	-	-
	Unit	Address	Unit amount (p7-14)			-	-
Requested position	Zero point	-	Origin	Start (p6-10) ON position	Origin	-	-
	Unit	-	Unit amount (p7-14)			-	-
Deviation pulse	Zero point	When requested pulse = feedback pulse					-
	Unit	Encoder pulses					-
Feedback pulse	Zero point	Origin					-
	Unit	Encoder pulses					-
Requested pulse	Zero point	Origin					-
	Unit	Encoder pulses					-

- The encoder pulses are the A- and B-phase signals multiplied by 4.
- What is displayed in the sub operation modes is the same as what is selected as the main operation mode.
- When an absolute encoder is used, the current position and feedback pulse are held even when the power is turned off.
- When an absolute encoder is used, the requested pulse has the same value as the feedback pulse when the power is turned on.
- Displayed as the current position of the equal pitch multi-rotation coordinates is the address closest to the current position.
- When the reset signal (p6-10) is turned on and the alarm is released, the requested pulse will have the same value as the feedback pulse.
- When the START signal (p6-10) turns on, both the current and requested positions of the infinite linear coordinates are reset to zero.

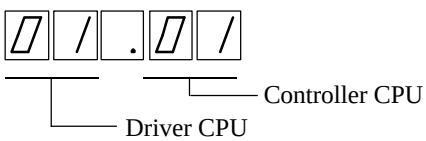
No.	Item	Display	Remarks
10	**D**igital **i**nput monitor		. Displays the status of the input signal of control I/O signal CN2 (p5-6). . Segments illuminated: ON This denotes that power is supplied to the input circuit LED (p5-7). . Segments extinguished: OFF This denotes that power is not supplied to the input circuit LED.



11	**D**igital **o**utput monitor		. Displays the status of the output signal of control I/O signal CN2 (p5-6). . Segments illuminated: ON This denotes that the output circuit transistors (p5-7) have turned on. . Segments extinguished: OFF This denotes that the output circuit transistors have turned off.



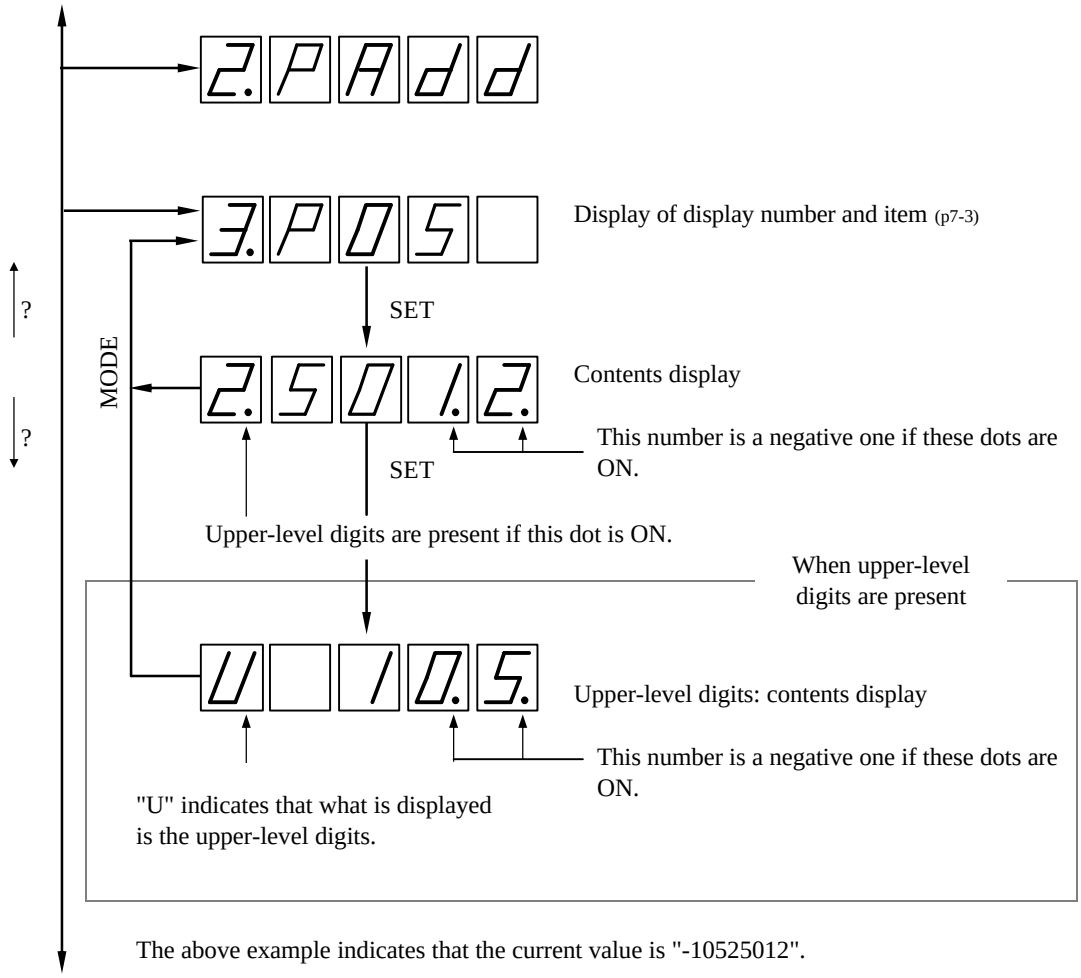
The battery alarm : BAT ALM (p6-24) cannot be monitored.

12	Software **Ver**sion		. Displays the software version. 

7-3 Display Mode Operation Methods

This section describes how to operate the display mode.
The panel switches at the front of the servo amplifier are used for operation.

The "1. SPEd:Motor rotation speed (p7-3)" contents display appears when the power is first turned on.

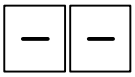


The above example indicates that the current value is "-10525012".

. The current position, requested position, deviation pulse, feedback pulse and requested pulse (p7-3) have upper-level digits.

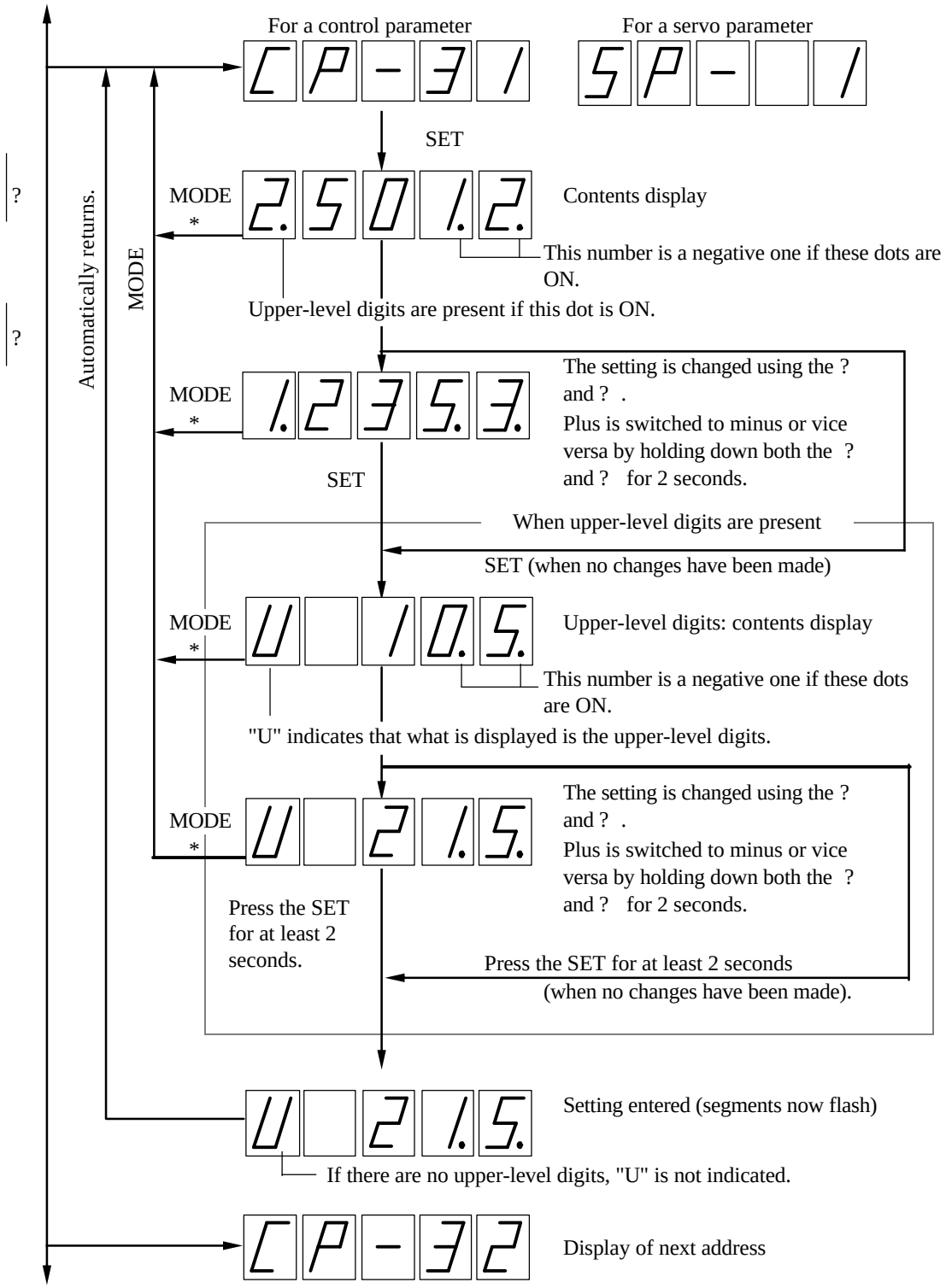
Even if the upper-level digits is zero, the upper-level digit display is still provided, and zero is displayed.

. If the display is invalid (p7-4) such as the "current position" display when the speed command operation (p3-11) has been selected, the contents display will appear as shown on the right.



7-4 Parameter Setting Methods

This section describes how the servo parameters (p7-9) and control parameters (p7-13) are set.
The parameters are set using the panel switches at the front of the servo amplifier.



- In this example, control parameter 31(CP-31) has been changed from "-10525012" to "-21512353".

- Even when the value of the upper-level digits is zero for a parameter in which upper-level digits can be set, the upper-level digit will be displayed (as zero).

- Changes in places with * are not reflected in the parameters.

- Changes made using the ? and ? are not carried down from the upper-level to low-order digits or carried up from the low-order to upper-level digits.

- When zero is input as the value of lower-level digits for electronic gear a(p7-14) (control parameter 4) or ß (control parameter 5), the upper-level digit cannot be set to zero.

7-5 Detailed Description of Parameters

(1) Servo parameters

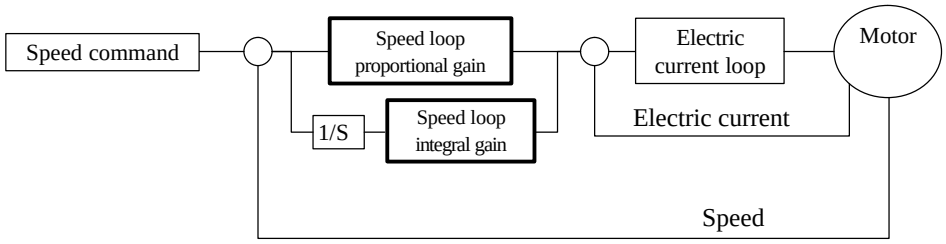
Servo parameters 1, 2, 3 and 11 through 19 can be changed during operation.
Such changes immediately affect the operation.
The other parameters can also be changed during operation.
However, the changes will be made after the parameters are changed and the motor stops.

No.	Parameter	Setting range	Default value				
			ARN15	ARN30		ARN60	ARN135
				Other than AR10H	AR10H		
1	Speed loop proportional gain	1-15000	150	270	1000	280	510
2	Speed loop integral gain	1-15000	930	1800	2000	1800	3300
3	Position loop gain	1500-5000	2000				

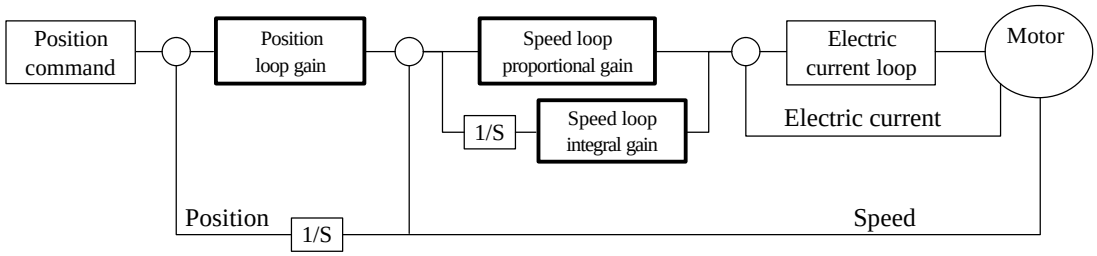
- These parameters are used to adjust the response characteristics of the motor. Increasing their numerical values increases the response characteristics.

- In the equal pitch multi-rotation coordinates (p3-6), the optional division 360° coordinates (p3-7) and the infinite linear coordinates (p3-8) modes, if hunting has occurred on the servo actuator, infinite feed may not be possible. Adjust the gain properly.

For speed command operation (p3-11)



For position control (other than speed command operation)



. To adjust or designate the parameters refer to the following table.

Inertia moment ratio			1	3	5
ARN15		Speed loop proportional gain	150	290	430
		Speed loop integral gain	930	1900	2800
		Position loop gain	2000		
ARN30	Other than AR10H	Speed loop proportional gain	270	550	820
		Speed loop integral gain	1800	3500	5300
		Position loop gain	2000		
	AR10H	Speed loop proportional gain	1000	1500	2000
		Speed loop integral gain	2000	3000	4000
		Position loop gain	2000		
ARN60		Speed loop proportional gain	280	550	840
		Speed loop integral gain	1800	3200	4600
		Position loop gain	2000		
ARN135		Speed loop proportional gain	510	1000	1500
		Speed loop integral gain	3300	4000	4700
		Position loop gain	2000		

$$\text{Inertia moment ratio} = \frac{\text{Load moment of inertia [kg·m}^2\text{]} \times 10000}{\text{Reduction gear ratio}^2 \times \text{Moment of inertia of motor [kg·cm}^2\text{]}}$$

No.	Parameter	Setting range	Default value
4	Manual feedrate	1 - 3000 [rpm] (AR135:2500)	100
5	Manual feed acceleration/deceleration time constant	0 - 30000 [msec]	500

. These parameters are for setting the motor rotation speed and the acceleration/deceleration time constant during the I/O JOG (p3-12), the step operation (p3-13), the I/O skip operation(p3-15), the manual jog operation (p3-16) and the manual skip operation (p3-16).

No.	Parameter	Setting range	Default value
6	Skip amount	1 - 99999 [encoder pulses]	100

. This parameter is for setting the skip amount during manual skip operations (p3-16) and I/O skip operation (p3-15).

. Using the encoder's pulse units, this value indicates the angle of motor rotation, which is equivalent to four times the encoder source signal.

No.	Parameter	Setting range	Default value
7	Speed 1 for equal division	1 - 3000 [rpm] (AR135:2500)	100
8	Speed 2 for equal division	1 - 3000 [rpm] (AR135:2500)	100

. These parameters are for setting the motor rotation speed in the equal pitch multi-rotation coordinates (p3-6) mode.

. The rotation speed can be selected by speed selection (p6-12).

. If the speed selections have not been allocated to control 1 to 14 (p6-10), speed 1 for equal division is automatically selected.

No.	Parameter	Setting range	Default value
9	Acceleration/deceleration time constant 1	0 - 30000 [msec]	500
10	Acceleration/deceleration time constant 2	0 - 30000 [msec]	500

. The following table shows the operation modes, the selected acceleration/deceleration time constants, and the selection function names.

Operation mode	Acceleration/ deceleration time constant 1	Acceleration/ deceleration time constant 2	Selection function name (Control allocation (p6-10))
Equal pitch multi-rotation coordinates (p3-6)	?	?	Speed selection (p6-12)
Optional division 360° coordinates (p3-7)	?	?	Acceleration/deceleration time constant selection (p6-13)
Infinite linear coordinates (p3-8)	?	?	
Finite linear coordinates (p3-9)	?	?	
Machine origin return (p3-14)	?	-	-

. When the speed selection (p6-12) is not allocated to controls 1 to 14 (p6-10) in the equal pitch multi-rotation coordinates mode, acceleration/deceleration time constant 1 is automatically selected.

. When the acceleration/deceleration time constant selection (p6-13) is not allocated to controls 1 to 14 (p6-10) in the optional division 360° coordinates, the infinite linear coordinates or the finite linear coordinates mode, acceleration/deceleration time constant 1 is automatically selected.

. The parameters denote the time taken from 0 to 3000 rpm at motor and vice versa.

No.	Parameter	Setting range	Default value
11	Speed command speed 1	1 - 3000 [rpm] (AR135:2500)	100
12	Speed command speed 2		
13	Speed command speed 3		
14	Speed command speed 4		
15	Speed command speed 5		
16	Speed command speed 6		

. These parameters are for setting the motor rotation speed during speed command operations (p3-11).
. Speed command speed 1 to 6 are selected by speed command speed selections 1 to 6 (p6-16).
. When these parameters are changed during operation, the speed is changed in accordance with the selected speed command acceleration/deceleration 1 to 3.
. If the speed command speed selections 1 to 6 have not been allocated to control 1 to 14 (p6-10) or if all the control signals are OFF even though they have been allocated, speed command speed 1 is automatically selected.

No.	Parameter	Setting range	Default value
17	Speed command acceleration/deceleration 1	0 - 30000 [msec]	500
18	Speed command acceleration/deceleration 2		
19	Speed command acceleration/deceleration 3		

- These parameters are for setting the motor acceleration/deceleration time constants during speed command operations (p3-11).
- Speed command acceleration/deceleration 1 to 3 are selected by speed command acceleration/deceleration selections 1 to 3 (p6-17).
- The parameters denote the time taken from 0 to 3,000 rpm at motor and vice versa.
- If the speed command acceleration/deceleration selections 1 to 3 have not been allocated to control 1 to 14 (p6-10) and if all the control signals are OFF even when they have been allocated, speed command acceleration/deceleration 1 is automatically selected.

(2) Control parameters

Control parameters can be edited during operation but they take effect only when the power is turned off and then turned back on.

No.	Parameter	Setting range	Default value
1	Encoder type	1(Absolute AR) 2(Incremental AR) 3(Incremental AR10H)	1

- This parameter is for setting the encoder type (p2-1) which is incorporated inside the servo actuator.
- Refer to "Precautions for Initial Turning-on of the Power Supply" on pages 1-4,5,6,7.
- Change of this parameter should be done by "Initialization (p7-35)" shown below.
  If it is done by "Parameter setting methods (p7-7)" , motor may not run properly because internal parameters for motor control can not be changed.

Method for initialization (Turn on the control power while pressing panel switches below)	Value to be set on this parameter
MODE and SET	1(Absolute AR)
UP and DOWN	2(Incremental AR)
MODE and UP	3(Incremental AR10H)

- This parameter can not be changed from 1 or 2 to 3 by the method written on "Parameter setting methods (p7-7)".
- This parameter can not be changed from 3 to 1 or 2 by the method written on "Parameter setting methods".

No.	Parameter	Setting range	Default value
2	Reduction gear ratio numerator	1 - 999	1
3	Reduction gear ratio denominator	1 - 999	1

- These parameters are used for setting the deceleration ratios of the RV and GH reduction gears (p2-2), which are built in to the servo actuator.
- These parameters are used for the calculations on whose basis the coordinates are shifted to a position before the encoder's rotational limit to enable infinite feed in the equal pitch multi-rotation coordinates (p3-6) mode or optional division 360° coordinates (p3-7) mode.
- If they are not set correctly, the calculation errors will accumulate, resulting in positional skew.
- Example: Numerator = 120, denominator = 1 for AR15-A120 (p2-2)
- Example: Numerator = 461, denominator = 41 for ARH7-S11(461/41) (p2-4) since they have a fractional reduction gear ratio.

No.	Parameter	Setting range	Default value
4	Electronic gear a	1 - 999999 (6 digits)	1
5	Electronic gear ß	1 - 999999 (6 digits)	1
6	Unit amount	1 , 2 , 3 , 4 , 5	1

- These electronic gear settings are provided to enable the movement amount of the machine output end to be directly assigned using physical quantities (mm, deg, etc.). Setting these parameters makes it possible to input the position data (p7-33) directly as physical quantities.
- In the equation below, the electronic gears a and ß are determined on the basis of the unit amount which is the resolution of the position data and the amount by which the machine output end moves for each motor rotation.

$$\frac{4 \times \text{number of encoder pulses}}{\text{Machine system movement amount per motor rotation}} \times \text{Unit amount} = \frac{\text{Electronic gear a}}{\text{Electronic gear ß}}$$

- The correlation between the settings and the unit amounts (resolution) and their position data setting range is shown below.
  (In the optional division 360° coordinates (p3-7) mode, the "Unit amount × Position data" value is less than 360.)

Setting	Unit amount (resolution)	Position data setting range
1	1	±999999999 (9 digits) [unit amount]
2	0.1	
3	0.01	
4	0.001	
5	0.0001	

Number of encoder pulses (p2-2) (before multiplication by 4)

Encoder type	No. of pulses
Absolute	2048
Incremental (other than AR10H)	2000
AR10H	1000

- Calculation example: Reduction gear ratio = 120, unit amount = 0.01°, overview of machine system = rotary table drive, encoder type = absolute

$$\text{Machine system movement amount per motor rotation} = 360° \times \frac{1}{120} = \frac{360}{120}$$

$$\frac{4 \times \text{number of encoder pulses}}{\text{Machine system movement amount per motor rotation}} \times \text{Unit amount} = \frac{4 \times 2048 \times 120 \times 0.01}{360} = \frac{2048}{\cancel{8192}\ \cancel{300}}\ \begin{matrix} = \text{Electronic gear a} \\ 75 = \text{Electronic gear ß} \end{matrix}$$

  The 123.45° position data in this case yields a setting of 12345. (Positioning position = Position data × unit amount)
- In the case of pulse train operations (p3-10), the motor rotates by an amount equivalent to: Number of input pulses (p7-18) × electronic gear a/electronic gear ß.
- These parameters have no effect in the equal pitch multi-rotation coordinates (p3-6) mode and speed command operation (p3-11) mode.

No.	Parameter	Setting range	Default value
7	Brake available/unavailable	1 (available), 2 (unavailable)	1

. This parameter is for enabling or disabling the brake power (p5-14) supply disconnection alarm (p9-3).
. When "1" is set in the parameter, the brake power supply disconnection alarm AL-10 is output when the brake power fails to be supplied.
. Set "2" (unavailable) when using a servo actuator (p2-1) which is not equipped with a brake.
. The brake power is checked only at the ON edge of the operation ready command (p6-9).

No.	Parameter	Setting range	Default value
8	Coordinate axis	1 , 2 , 3 , 4 , 5 , 6	1

. This parameter is for setting the coordinate axes (p3-5).

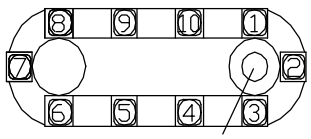
Equal pitch multi-rotation coordinates (p3-6)	:1	Finite linear coordinates (p3-9)	:4
Optional division 360° coordinates (p3-7)	:2	Pulse train operation (p3-10)	:5
Infinite linear coordinates (p3-8)	:3	Speed command operation (p3-11)	:6

No.	Parameter	Setting range	Default value
9	Number of divisions	2 - 255	2

. This parameter is for setting the number of addresses per rotation of the servo actuator.
. It is valid only when the equal pitch multi-rotation coordinates (p3-6) mode has been selected (coordinate axes CP-8=1).
. As in the case of the drawing for control parameter No. 10 below, the number of addresses per rotation of the servo actuator output shaft is 4 (= 360/90) in this parameter because the movement of the output shaft is demarcated by 90-degree increments.

No.	Parameter	Setting range	Default value
10	Total number of addresses	2 - 255	2

. This parameter is for setting the total number of addresses.
. It is valid only when the equal pitch multi-rotation coordinates (p3-6) mode has been selected (coordinate axes CP-8=1).
. In the case of the figure on the right, this parameter's setting is 10.

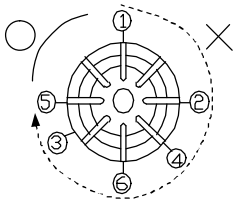


Servo actuator

No.	Parameter	Setting range	Default value
11	Optional division short-cut control	1 (available), 2 (unavailable)	1

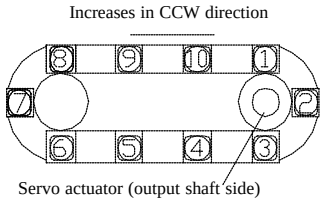
. This parameter is for enabling or disabling short-cut control in the optional division 360° coordinates (p3-7) mode.

. As shown in the figure on your right, when position . is 0 degrees and position . is 270 degrees, if the servo actuator is to be positioned to . from ., route ? uses a short-cut control and route x does not use such a control.



. CP-14 is used to enable or disable short-cut control in the equal pitch multi-rotation coordinates (p3-6) mode.
. Note that setting this parameter to "2" (disabled) rotates the output shaft at the end of the following sequence: Positioning to 0° address ? Servo OFF ? Slight positional shift after the motor power shuts off ? For example, when the output shaft is positioned at 359°. ? Instruction for positioning the output shaft to 0°.? The output shaft rotates one turn.

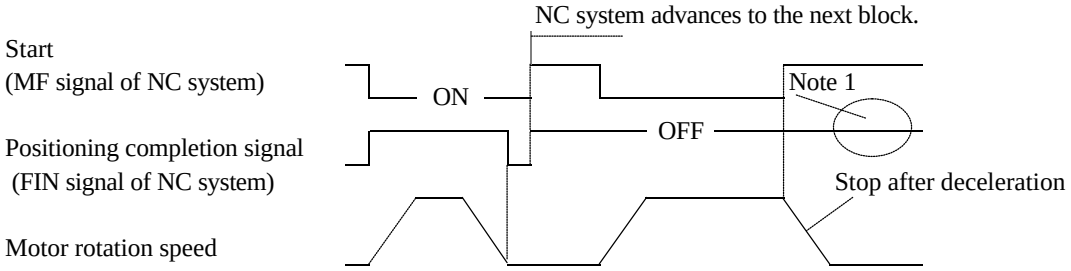
No.	Parameter	Setting range	Default value
12	Indexing number incrementing direction	1 , 2	1



- This parameter is for setting the rotation direction in which the indexing address numbers (p6-11) are incremented.
- It is valid only when the equal pitch multi-rotation coordinates (p3-6) mode has been selected (coordinate axes CP-8=1).
- "1" is set as the current position incrementing direction and "2" as the current position decrementing direction.
- For details on the rotation direction of the servo actuator output shaft, refer to the section on the input signals, parameters and servo actuator rotation directions on p3-26.
- "1" is the setting when the addresses are to be incremented in the direction shown in the figure using AR**A. Refer to p3-26.

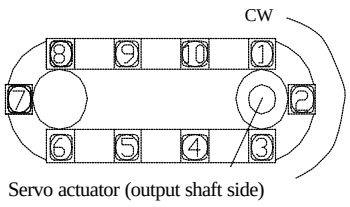
No.	Parameter	Setting range	Default value
13	MF/FIN available/unavailable	1 (available), 2 (unavailable)	2

- When this parameter is set to "1" (available), the positioning completion signal (p6-19) is turned off in synchronization with the turning OFF of the start signal (p6-10).
- This parameter is used for interfacing with the M functions of the NC system, in which case the start signal serves as the MF signal of the NC system and the positioning completion signal serves as the its FIN signal.
- Note 1: If the start signal is turned off before the positioning completion signal is turned on, the motor decelerates and ultimately stops. Therefore, the positioning completion signal will fail to turn on.



No.	Parameter	Setting range	Default value
14	Short-cut/unidirectional selection	1 , 2 , 3	1

- This parameter is for setting the indexing direction with unidirectional indexing in the equal pitch multirotation coordinates (p3-6) mode.
- Set "1" for short cut, "2" for current position incrementing direction, and "3" for current position decrementing direction.
- For details on the settings and rotation direction of the servo actuator output shaft, refer to the section on the input signals, parameters and servo actuator rotation directions on p3-26.
- "3" is the setting when indexing in the direction shown in the figure using AR**A. Refer to p3-26.



No.	Parameter	Setting range	Default value
15	2-position indexing direction selection	1 , 2	1

. This parameter is for setting the indexing direction with 2-position indexing in the equal pitch multi-rotation coordinates (p3-6) mode.

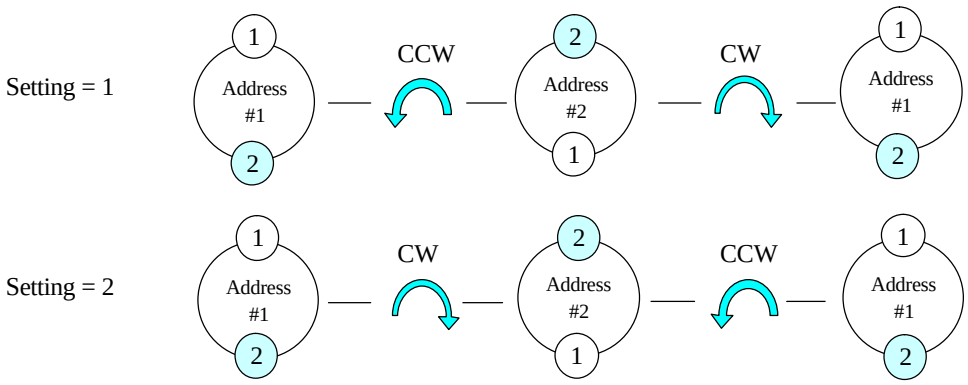
. It takes effect when the number of divisions (CP-9) is set to "2", the total number of addresses (CP-10) is "2" and short-cut/unidirectional selection (CP-14) is "1".

. Setting "1": Address #1 ? rotation in current position incrementing direction ? address #2 ? rotation in current position decrementing direction ? address #1.

. Setting "2": Address #1 ? rotation in current position decrementing direction ? address #2 ? rotation in current position incrementing direction ? address #1.

. For details on the settings and rotation direction of the servo actuator output shaft, refer to the section on the input signals, parameters and servo actuator rotation directions on p3-26.

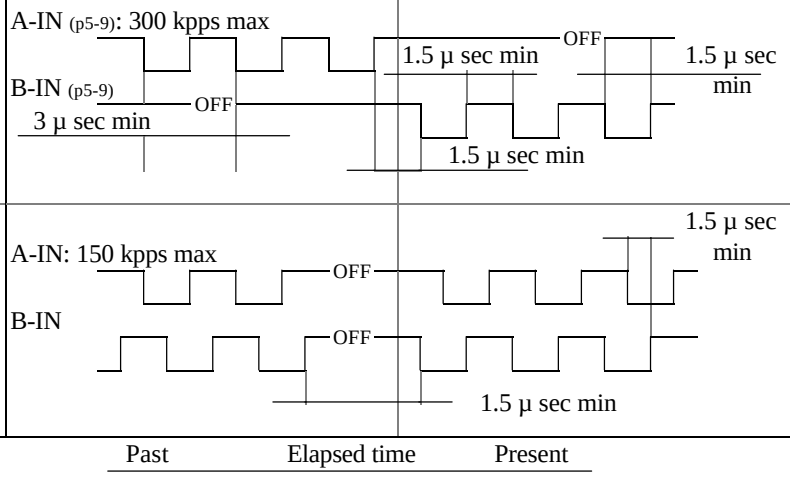
. The setting for indexing using AR**A is shown in the figure below. Refer to p3-26.
In this figure, the servo actuator is seen from the output shaft side.



No.	Parameter	Setting range	Default value
16	Input pulse system	1(Foward pulse reverse pulse) 2(90°phase difference 2 signals)	1

. This parameter is for setting the input pulse format when performing pulse train operations (p3-10).
. The motor rotates by an amount equivalent to the value obtained from: number of input pulses × electronic gear a/electronic gear ß(p7-14).
. For details on the input pulses and rotation direction of the servo actuator output shaft, refer to the section on the input signals, parameters and servo actuator rotation directions on p3-26.
. ON in the table below denotes a state in which power is supplied to the p5-9 pulse train input circuit LED.

Input pulse system		Input pulse count and numbers are input pulse numbers.	
Motor rotation direction	CP17=1	Current position incrementing direction	Current position decrementing direction
	CP17=2	Current position decrementing direction	Current position incrementing direction



No.	Parameter	Setting range	Default value
17	Pulse train operation rotation direction	1 , 2	1

. This parameter is for setting the motor rotation direction during pulse train operations.
Refer to the above figure for the correlation between the setting and rotation direction.

No.	Parameter	Setting range	Default value
18	Origin return direction	1: Current position incrementing direction	1
		2: Current position decrementing direction	
19	Origin return speed	1 - 3000 [rpm] (AR135:2500)	100
20	Origin return creep speed	1 - 3000 [rpm] (AR135:2500)	100
21	Origin return shift amount	0 - 99999 [encoder pulses]	0
22	Origin return position setting	0 - ±99999 [encoder pulses]	0

- These parameters are for setting the origin return operation. For the significance of the signals, refer to p3-14.

No.	Parameter	Setting range	Default value
23	Origin detection range	1 - 9999 [encoder pulses]	10

- This parameter is for setting the output range of the origin return completion signal.
- For details, refer to origin return completion on p6-22.

No.	Parameter	Setting range	Default value
24	Positioning completion width	1 - 9999 [encoder pulses]	10

- This parameter is for setting the output range of the positioning completion signal.
- For the significance of the numerical values, refer to positioning completion on page 6-19.

No.	Parameter	Setting range	Default value
25	Excessive deviation width	1 - 99999 [encoder pulses]	30000

- Alarm AL-8 (excessively high position deviation) results when the difference (deviation amount) between the requested position and servo actuator current position exceeds this setting. (p9-2)
- Used as the unit is the number of encoder pulses after multiplication by 4.

No.	Parameter	Setting range	Default value
26	Speed arrival identification speed	1 - 3000 [rpm] (AR135:2500)	2500

- This parameter is for setting the rotation speed of the motor shaft for the speed arrival signal. For details, refer to page 6-23.

No.	Parameter	Setting range	Default value
27	Fixed point/through point detection pattern	1 (fixed point), 2 (through point)	1
28	Fixed point/through point detection position 1	0 - ±999999999 [Unit amount]	0
29	Fixed point/through point detection position 2	0 - ±999999999 [Unit amount]	0
30	Fixed point detection range	1 - 9999 [encoder pulses]	10

- These parameters are for setting the output format, position and range of the fixed point/through point signals.
- For details, refer to page 6-21.

No.	Parameter	Setting range	Default value
31	Soft + over-travel detection position	0 - ±999999999 [encoder pulses]	+999999999
32	Soft - over-travel detection position	0 - ±999999999 [encoder pulses]	-999999999

- When an attempt is made to feed the servo actuator beyond either of these settings, the servo actuator is stopped immediately at the position of the setting.
- In this case, the control output over-travel detection signal (p6-22) turns on, and then "AL-17" (Soft over-travel detection, p9-4) is displayed.
- These parameters are valid only in the finite linear coordinates (p3-9), pulse train operation (p3-10) and machine origin return (p3-14) modes.
- Even in the over-travel detection status, the servo actuator can be rotated in the direction opposite to the over-travel detection direction.
- Do not set the parameters where the soft + over-travel detection position is less than the soft - over-travel detection position, or else “AL-17” (Soft over-travel detection, p9-4) will occur in the finite linear coordinates mode (p3-9), the pulse train operation (p3-10) and machine origin return (p3-14) modes.

No.	Parameter	Setting range	Default value
33	Speed limit value	1 - 3000 [rpm] (AR135:2500)	3000 (ARN135:2500)

- This parameter is for setting the maximum rotation speed of the motor shaft.

No.	Parameter	Setting range	Default value
34	Torque limit value	AR15: 0 - 350	350
		AR30 , ARH7: 0 - 350	350
		AR60 , ARH17: 0 - 350	350
		AR135 , ARH24: 0 - 300	300
		AR10H	350

- This parameter is for setting the torque limit value of the motor shaft. The rated torque is treated as 100%.
- The parameter is valid during the ON period of the control input signal's torque limiting enable (p6-12) signal.
- The torque limiting underway (p6-24) signal turns on while the torque is being limited by this parameter's setting.

No.	Parameter	Setting range	Default value
35	Brake forcible release	1 (release), 2	2

- When setting "1" is selected, the holding electromagnetic brake (p5-14) is released regardless of whether the servo ON signal (p6-9) is ON or OFF.
- The brake cannot be released while the operation ready command signal (p6-9) is off.
- When “1” (release) is selected, the power save timer function (CP-39) (p7-21) is deactivated.
- When “1” (release) is selected and the operation ready command signal turns ON, the brake is released.

Note that, if an unbalanced load is applied to the output shaft, the servo actuator may be rotated by an external force.

No.	Parameter	Setting range	Default value
36	Home position detection range	1 - 9999 [encoder pulses]	800

. This parameter is used for setting the range wherein the home position signal (p6-23) turns on.
. For details, refer to the home position on page 6-23.
. Used as the unit is the number of encoder pulses after multiplication by 4.

No.	Parameter	Setting range	Default value
37	Backlash compensation amount	0 - 9999 [encoder pulses]	0
38	Backlash compensation direction	1 (current position incrementing direction)	1
		2 (current position decrementing direction)	

. These parameters are used to correct the error resulting from machine system backlash.
. When the servo actuator is to be rotated in the designated direction, it is positioned at the position resulting when the backlash compensation amount is added to the target position.

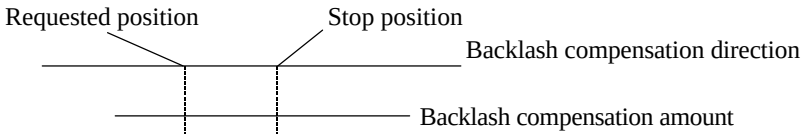
. For details on the backlash compensation direction and rotation direction of the servo actuator output shaft, refer to the section on the input signals, parameters and servo actuator rotation directions on page 3-26.

. The unit used for the backlash compensation amount is the number of encoder pulses after multiplication by 4.

. The amount moved by the output shaft of the servo actuator is calculated using the following formula.

. These parameters are valid only in the equal pitch multi-rotation coordinates (p3-6).

$$\text{Amount compensated by output shaft [°]} = \frac{\text{Backlash compensation amount} \times 360}{\text{Number of encoder pulses} \times \text{reduction gear ratio}}$$



No.	Parameter	Setting range	Default value
39	Power save timer available/unavailable	1 (available), 2 (unavailable)	2
40	Power save timer time	30 - 9999 [sec]	30

. These parameters are for reducing the heat generated by the motor if it is stopped when torque has been applied for a prolonged period of time.
. When the time set by the power save timer parameter is reached after the servo ON status has been established and no position commands are in force, the servo ON (p6-9) signal automatically turns off, and the brake (p5-14) is engaged.
. When the start signal (p6-10) turns on after this, the brake is released, and operation is commenced.

. These parameters are valid only when the coordinate axis (CP-8, p7-15) has been set to “1” and the equal pitch multi-rotation coordinates mode (p3-6) has been selected for the main operation mode (p3-5).

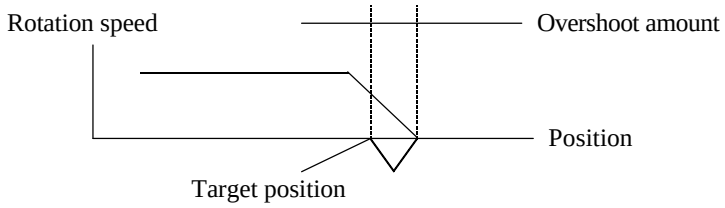
. These parameters are invalid when the brake forcible release (CP-35) has been set to “1” (release).

No.	Parameter	Setting range	Default value
41	Overshoot amount	0 - 9999 [encoder pulses]	0

. The holding torque in the servo lock status may be boosted by distortion in the machine system resulting from a frictional load.

This parameter enables the machine system distortion to be reduced so that the holding torque is lowered.

. During positioning, the servo actuator passes through the target position by an amount equivalent to this parameter's setting, and then it returns to the target position.
. By passing through and returning to the target position, the machine system distortion (hysteresis) is eliminated, and the servo lock torque is reduced.
. Set the overshoot amount to the optimum level while checking the holding torque.
. When a number of pulses other than zero has been set in this parameter, the positioning time is slightly longer than when zero has been set.
. Used as the unit is the number of encoder pulses after multiplication by 4.
. This function is valid only when the equal pitch multi-rotation coordinates (p3-6) mode has been selected (coordinate axes : CP-8=1).



No.	Parameter	Setting range	Default value
42	Number of follow-up pulses	0 - 1000[encoder pulses]	0

. Positional skew equivalent to the amount of play between the brake and motor shaft may occur when the servo ON (p6-9) signal is turned ON, then OFF and back ON again.
This parameter is used to correct this skew.
. The current position is ignored and positioning occurs at the indexing address requested position only when the difference between the indexing address requested position and current position is less than the setting of this parameter.
. This function is executed when the servo ON signal is turned ON, then OFF and back ON again.
. The function is disabled if zero is set for the parameter's setting.
. Used as the unit is the number of encoder pulses after multiplication by 4.
. This function is valid only when the equal pitch multi-rotation coordinates (p3-6) mode has been selected (coordinate axes : CP-8=1).

No.	Parameter	Setting range	Default value
43	Interlock logic	1 , 2	1

. This parameter is for selecting the contact logic of the interlock signal.
. At the "1" setting, rotation is prohibited when the signal is ON; at the "2" setting, rotation is prohibited when the signal is OFF.
. For details on the interlock function, refer to interlock on page 6-18.

No.	Parameter	Setting range	Default value
44	Rewriting prohibited	1 (not prohibited) 2 (prohibited)	1

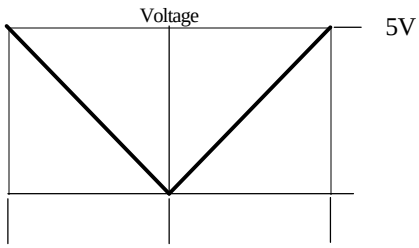
. When "2" has been set, rewriting of the servo parameters (p7-9), control parameters and positioning data (p7-33) is prohibited.
. Even in the rewriting prohibited mode, only this parameter can be rewritten.
. Even in the rewriting prohibited mode, initialization on page 7-35 can be executed.

No.	Parameter	Setting range	Default value
45	Monitor selection	1 , 2 , 3 , 4	1

. This parameter is for selecting the scale of the monitor connector (p5-2,3) on the side panel of the servo amplifier.
. For torque display purposes, the rated torque is treated as 100%.

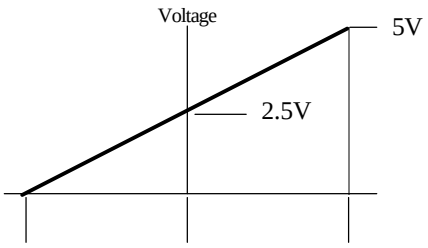
Setting	Motor rotation speed monitor (channel A)	Torque monitor (channel B)
1	Return	Return
2	Return	Linear
3	Linear	Return
4	Linear	Linear

Return



-3000rpm	0	3000rpm	Motor rotation speed
-500%	0	500%	Torque

Linear



-3000rpm	0	3000rpm
-500%	0	500%

No.	Parameter	Setting range	Default value
46	Display contents when power is turned on	1 - 12	1

. Immediately after the power has been turned on, the 7-segment LED is set to the display mode and displays the display contents below. (p7-1)

· This parameter is for selecting what is to be displayed immediately after the power has been turned on.

. The correlation between the settings and display contents is shown below.

Setting	Display content
1	Motor rotation speed
2	Position address number
3	Current position
4	Requested position
5	Percentage torque
6	Deviation pulse
7	Feedback pulse
8	Requested pulse
9	Alarm history
10	Digital input monitor
11	Digital output monitor
12	Software version

...	Parameter	CN2 No.	Default value	Setting range
47	Control 1	3	AD0	0: No function designated
48	Control 2	4	AD1	1: AD0
49	Control 3	5	AD2	2: AD1
50	Control 4	6	AD3	3: AD2
51	Control 5	7	AD4	4: AD3
52	Control 6	8	AD5	5: AD4
53	Control 7	9	AD6	6: AD5
54	Control 8	19	AD7	7: AD6
55	Control 9	20	RVS	8: AD7
56	Control 10	21	FWD	9: P operation
57	Control 11	23	Interlock	10: Torque limiting enable
58	Control 12	37	Speed selection	11: External failure input
59	Control 13	38	LS	12: Speed selection
60	Control 14	39	ORG	13: Acceleration/deceleration time constant selection
				14: + over-travel
				15: - over-travel
				16: ORG
				17: LS
				18: FWD
				19: RVS
				20: Speed command speed selection 1
				21: Speed command speed selection 2
				22: Speed command speed selection 3
				23: Speed command speed selection 4
				24: Speed command speed selection 5
				25: Speed command speed selection 6
				26: Speed command acceleration/deceleration selection 1
				27: Speed command acceleration/deceleration selection 2
				28: Speed command acceleration/deceleration selection 3
				29: Interlock

. These parameters are for setting the functions to be allocated to control 1 to 14 (p6-10).
. For details on the functions, refer to control 1 to 14 on page 6-10.
. For settings other than "0", if the same setting is specified for two or more symbols from CONT1 through CONT14, the setting for the CONT symbol with the highest number will be in effect.

...	Parameter	CN2 No.	Default value	Setting range
61	Out 1	11	OUT-AD0	0: No function designated
62	Out 2	12	OUT-AD1	1: OUT-AD0
63	Out 3	13	OUT-AD2	2: OUT-AD1
64	Out 4	14	OUT-AD3	3: OUT-AD2
65	Out 5	15	OUT-AD4	4: OUT-AD3
66	Out 6	16	OUT-AD5	5: OUT-AD4
67	Out 7	27	OUT-AD6	6: OUT-AD5
68	Out 8	28	OUT-AD7	7: OUT-AD6
69	Out 9	29	Alarm detection	8: OUT-AD7
70	Out 10	30	Home position	9: Operation ready completion
71	Out 11	41	Origin return completion	10: Servo ON/OUT 11: Operation underway
72	Out 12	42	Servo ON/OUT	12: Fixed point/through point 1
73	Out 13	43	Operation ready completion	13: Fixed point/through point 2 14: Over-travel detection
74	Out 14	44	Fixed point /through point 1	15: Origin return completion 16: Alarm detection
75	Out 15	32	Operation underway	17: Speed arrival 18: Home position 19: Torque limiting underway 20: Positioning completion

. These parameters are for setting the functions to be allocated to out 1 to 15 (p6-19).
. For details on the functions, refer to out 1 to 15 on page 6-19.
. Two or more of the same functions can be set.

No.	Parameter	Setting range	Default value
76	Sub operation mode switch	0(Machine origin return) 1(I/O skip operation)	0

. This parameter is for setting the function when MODE A and MODE B is ON.

Setting	Sub operation mode
0	Machine origin return
1	I/O skip operation

. For details, refer to "How to select the operation mode (p3-5)", "I/O skip operation (p3-15)", "Machine origin return (p3-14)", "Main operation modes, and selectable sub operation modes and manual operation modes (p3-17)".

No.	Parameter	Setting range	Default value
77	Factory use (Not for users)	-	-

. This parameter is not for users, but for Teijinseiki co., Ltd. to check this servo amplifier.

No.	Parameter	Setting range	Default value
78	Position defect alarm available/unavailable	1(available) 2(unavailable)	2
79	Position defect alarm width	800~9999[encoder pulses]	9999

. When CP-78 is 1(available), following operation are performed.

Servo amplifier memorizes the position of servo actuator when control power (p5-10) is turned OFF. (This position data is named "Position OFF")

Servo amplifier memorizes the position of servo actuator when control power is turned ON. (This position data is named "Position ON")

Servo amplifier compares "Position ON" and "Position OFF".

If | Position ON - Position OFF | > CP-79 then "AL-19 , Positon defect (p9-5) " is displayed.

. This function is valid only when all of the following conditions are available.
This function is invalid if one of the following conditions is unavailable.

.CP-1 (p7-13) = 1 : Absolute AR
.CP-7(p7-15) = 1 :Brake available
.CP-8 (p7-15) = 1 : Equal pitch multi-rotation coordinates (p3-6).
.Encorder selector switch (p5-2,3) = ABS
.No command to rorate motor is executed when control power (p5-10) is turned OFF.
.Battery (p5-19) is connected to servo amplifier.

. Servo amplifier checks the data in encoder when control power is turned ON, therefor more severe system check is possible with this function.

. AL-19 (p9-5) may be displayed if servo actuator is rotated by external force when control power is OFF and this function is ON.

. Used as the unit of CP-79 is the number of encoder pulses after multiplication by 4.
(8192 pulse/motor revolution : absolute encoder)

7-6 List of Parameters

(1) Servo parameters

No.	Parameter	Setting range	Default value
1	Speed loop proportional gain (p7-9)	1 - 15000	ARN15:150 ARN30:270 ARN60:280 ARN135:510
2	Speed loop integral gain (p7-9)	1 - 15000	ARN15:930 ARN30:1800 ARN60:1800 ARN135:3300
3	Position loop gain (p7-9)	1500 - 5000	2000
4	Manual feedrate (p7-10)	1 - 3000 [rpm] (AR135:2500)	100
5	Manual feed acceleration/deceleration time constant (p7-10)	0 - 30000 [msec]	500
6	Skip amount (p7-10)	1 - 99999 [encoder pulses]	100
7	Speed 1 for equal division (p7-10)	1 - 3000 [rpm] (AR135:2500)	100
8	Speed 2 for equal division (p7-10)		
9	Acceleration/deceleration time constant 1 (p7-11)	0 - 30000 [msec]	500
10	Acceleration/deceleration time constant 2 (p7-11)		
11	Speed command speed 1 (p7-11)	1 - 3000 [rpm] (AR135:2500)	100
12	Speed command speed 2 (p7-11)		
13	Speed command speed 3 (p7-11)		
14	Speed command speed 4 (p7-11)		
15	Speed command speed 5 (p7-11)		
16	Speed command speed 6 (p7-11)		
17	Speed command acceleration/deceleration 1 (p7-12)	0 - 30000 [msec]	500
18	Speed command acceleration/deceleration 2 (p7-12)		
19	Speed command acceleration/deceleration 3 (p7-12)		

(2) Control parameters

No.	Parameter	Setting range	Default value
1	Encoder type (p7-13)	1 (Absolute AR) 2 (Incremental AR) 3 (AR10H)	1
2	Reduction gear ratio numerator (p7-13)	1 - 999	1
3	Reduction gear ratio denominator (p7-13)		
4	Electronic gear a (p7-14)	1 - 999999	1
5	Electronic gear ß (p7-14)		
6	Unit amount (p7-14)	1(1), 2(0.1), 3(0.01), 4(0.001), 5(0.0001)	1
7	Brake available/unavailable (p7-15)	1 (available), 2 (unavailable)	1

No.	Parameter	Setting range	Default value
8	Coordinate axis (p7-15)	1 (equal pitch multi-rotation coordinates) 2 (optional division 360° coordinates) 3 (infinite linear coordinates) 4 (finite linear coordinates) 5 (pulse train operation) 6 (speed command operation)	1
9	Number of divisions (p7-15)	2 - 255	2
10	Total number of addresses (p7-15)		
11	Optional division short-cut control (p7-15)	1 (available), 2 (unavailable)	1
12	Indexing number incrementing direction (p7-16)	1 (current position incrementing direction) 2 (current position decrementing direction)	1
13	MF/FIN available/unavailable (p7-16)	1 (available), 2 (unavailable)	2
14	Short-cut/unidirectional selection (p7-16)	1 (short-cut) 2 (current position incrementing direction) 3 (current position decrementing direction)	1
15	2-position indexing direction selection (p7-17)	1 , 2	1
16	Input pulse system (p7-18)	1 (forward pulse / reverse pulse) 2 (90° phase difference 2 signals)	1
17	Pulse train operation rotation direction (p7-18)	1 , 2	1
18	Origin return direction (p7-19)	1 (current position incrementing direction) 2 (current position decrementing direction)	1
19	Origin return speed (p7-19)	1 - 3000 [rpm] (AR135:2500)	100
20	Origin return creep speed (p7-19)		
21	Origin return shift amount (p7-19)	0 - 99999 [encoder pulses]	0
22	Origin return position setting (p7-19)	0 - ±99999 [encoder pulses]	0
23	Origin detection range (p7-19)	1 - 9999 [encoder pulses]	10
24	Positioning completion width (p7-19)		
25	Excessive deviation width (p7-19)	1 - 99999 [encoder pulses]	30000
26	Speed arrival identification speed (p7-19)	1 - 3000 [rpm] (AR135:2500)	2500
27	Fixed point/through point detection pattern (p7-19)	1 (fixed point), 2 (through point)	1
28	Fixed point/through point detection position 1 (p7-19)	0 - ±999999999 [unit amount]	0
29	Fixed point/through point detection position 2 (p7-19)		

No.	Parameter	Setting range	Default value
30	Fixed point detection range (p7-19)	1 - 9999 [encoder pulses]	10
31	Soft + over-travel detection position (p7-20)	0 - ±999999999 [encoder pulses]	+999999999
32	Soft - over-travel detection position (p7-20)		-999999999
33	Speed limit value (p7-20)	1 - 3000 [rpm] (AR135:2500)	3000
34	Torque limit value (p7-20)	AR15: 0 - 350	350
		AR30, ARH7: 0 - 350	350
		AR60, ARH17: 0 - 350	350
		AR135, ARH24: 0 - 300	300
		AR10H	350
35	Brake forcible release (p7-20)	1 (release) , 2	2
36	Home position detection range (p7-21)	1 - 9999 [encoder pulses]	800
37	Backlash compensation amount (p7-21)	0 - 9999 [encoder pulses]	0
38	Backlash compensation direction (p7-21)	1 (current position incrementing direction) 2 (current position decrementing direction)	1
39	Power save timer available/unavailable (p7-21)	1 (available) , 2 (unavailable)	2
40	Power save timer time (p7-21)	30 - 9999 [sec]	30
41	Overshoot amount (p7-22)	0 - 9999 [encoder pulses]	0
42	Number of follow-up pulses (p7-22)	0 - 1000 [encoder pulses]	0
43	Interlock logic (p7-22)	1 (rotation prohibited when ON) 2 (rotation prohibited when OFF)	1
44	Rewriting prohibited (p7-23)	1 (not prohibited), 2 (prohibited)	1
45	Monitor selection (p7-23)	1 (A=return, B=return) 2 (A=return, B=linear) 3 (A=linear, B=return) 4 (A=linear, B=linear)	1
46	Display contents when power is turned on (p7-24)	1 (motor rotation speed) 2 (position address number) 3 (current position) 4 (requested position) 5 (percentage torque) 6 (deviation pulse) 7 (feedback pulse) 8 (requested pulse) 9 (alarm history) 10 (digital input monitor) 11 (digital output monitor) 12 (software version)	1

No.	Parameter	CN2 No.	Default value	Setting range
47	Control 1 (p6-10)	3	AD0	0: No function designated (p6-10) 1: AD0 (p6-11) 2: AD1 3: AD2 4: AD3 5: AD4 6: AD5 7: AD6 8: AD7 9: P operation (p6-12) 10: Torque limiting enable (p6-12) 11: External failure input (p6-12) 12: Speed selection (p6-12) 13: Acceleration/deceleration time constant selection (p6-13) 14: + over-travel (p6-13) 15: - over-travel 16: ORG (p6-14) 17: LS (p6-14) 18: FWD (p6-15) 19: RVS (p6-15) 20: Speed command speed selection 1 (p6-16) 21: Speed command speed selection 2 22: Speed command speed selection 3 23: Speed command speed selection 4 24: Speed command speed selection 5 25: Speed command speed selection 6 26: Speed command acceleration/deceleration selection 1 (p6-17) 27: Speed command acceleration/deceleration selection 2 28: Speed command acceleration/deceleration selection 3 29: Interlock (p6-18)
48	Control 2	4	AD1	
49	Control 3	5	AD2	
50	Control 4	6	AD3	
51	Control 5	7	AD4	
52	Control 6	8	AD5	
53	Control 7	9	AD6	
54	Control 8	19	AD7	
55	Control 9	20	RVS	
56	Control 10	21	FWD	
57	Control 11	23	Interlock	
58	Control 12	37	Speed selection	
59	Control 13	38	LS	
60	Control 14	39	ORG	

No.	Parameter	CN2 No.	Default value	Setting range
61	Out 1 (p6-19)	11	OUT-AD0	0: No function designated (p6-19)
62	Out 2	12	OUT-AD1	1: OUT-AD0 (p6-20)
63	Out 3	13	OUT-AD2	2: OUT-AD1
64	Out 4	14	OUT-AD3	3: OUT-AD2
65	Out 5	15	OUT-AD4	4: OUT-AD3
66	Out 6	16	OUT-AD5	5: OUT-AD4
67	Out 7	27	OUT-AD6	6: OUT-AD5
68	Out 8	28	OUT-AD7	7: OUT-AD6
69	Out 9	29	Alarm detection	8: OUT-AD7
70	Out 10	30	Home position	9: Operation ready completion (p6-20)
71	Out 11	41	Origin return completion	10: Servo ON/OUT (p6-20) 11: Operation underway (p6-21)
72	Out 12	42	Servo ON/OUT	12: Fixed point/through point 1 (p6-21)
73	Out 13	43	Operation ready completion	13: Fixed point/through point 2 14: Over-travel detection (p6-22)
74	Out 14	44	Fixed point/through point 1	15: Origin return completion (p6-22) 16: Alarm detection (p6-23) 17: Speed arrival (p6-23)
75	Out 15	32	Operation underway	18: Home position (p6-23) 19: Torque limiting underway (p6-24) 20: Positioning completion (p6-24)

No.	Parameter	Setting range	Default value
76	Sub operation mode switch (p7-26)	0 (Machine origin return) 1 (I/O skip operation)	0
77	Factory use (Not for users) (p7-26)	-	-
78	Position defect alarm available/unavailable (p7-27)	1 (available) , 2 (unavailable)	2
79	Position defect alarm width (p7-27)	800 - 9999	9999

7-7 Positioning Data Setting Method

. The positioning data can be edited during operation.The edited data is in effect when the Start input signal (p6-10) turns ON.

. In the case of optional division 360° coordinates (p3-7), infinite linear coordinates (p3-8) and finite linear coordinates (p3-9) operations, the positioning data inside the servo amplifier is used for positioning.

The method used to set this positioning data will be described.

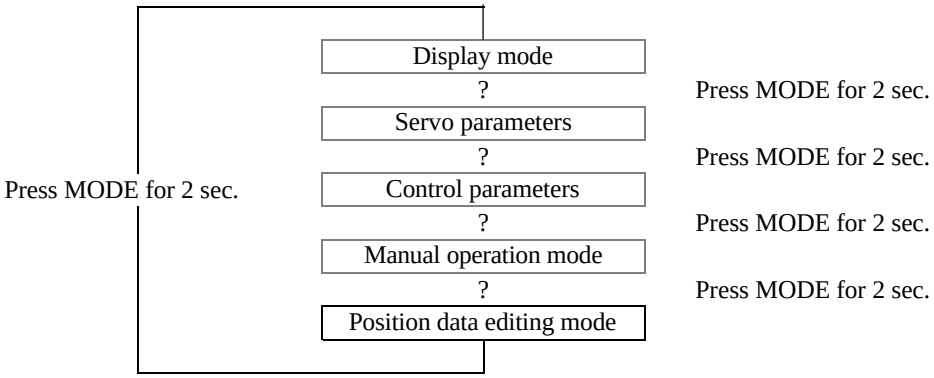
. The positioning data can be set using the panel switches in front of the servo amplifier.

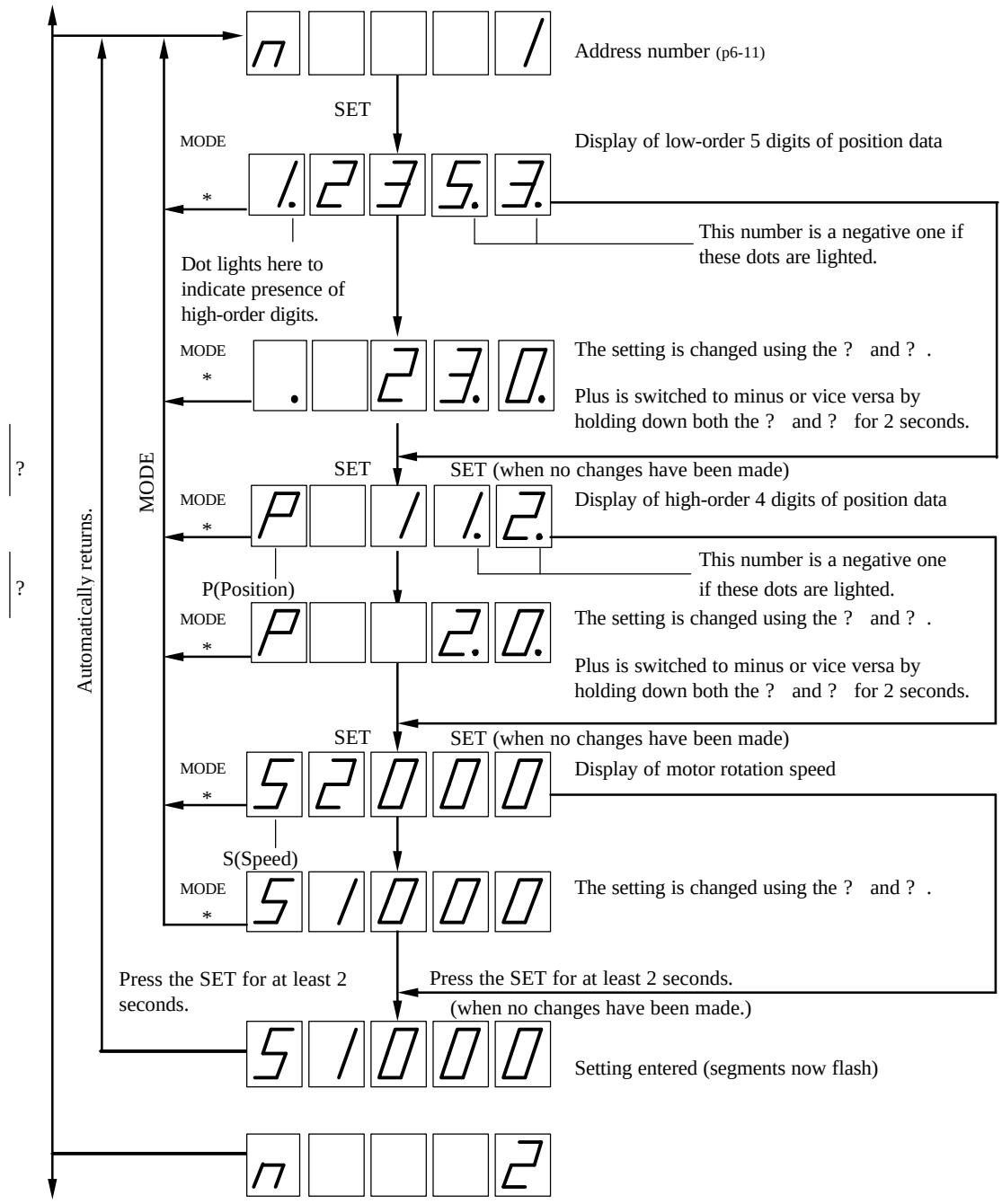
. The positioning data includes the following.

Position data: For setting the target position; unit = [unit amount (p7-14)],
setting range = -999999999 to +999999999 (9 digits).
(In the optional division 360° coordinates mode (p3-7), the “Unit amount x Position data” value is equal to or greater than 0 and is less than 360. If the address of a value less than 0 or equal to or greater than 360 is started, an Address error (AL-16, p9-4) occurs.)

Motor rotation speed: For setting the rotation speed of the motor; unit = [rpm], setting range = 0 to 3000 (AR135: 2500)

. Operate the mode switch on the front panel of the servo amplifier to establish the positioning data editing mode (p7-2).
Refer the figure below.





- Even when the value of the high-order digits is zero for a parameter in which high-order digits can be set, the high-order digit will be displayed (as zero).
- When ? is held down, the displayed figure will reach the maximum value which is then followed by the minimum value.
- When ? is held down, the displayed figure will reach the minimum value which is then followed by the maximum value.
- Changes in places with * are not reflected in the parameters.
- Changes made using the ? and ? are not carried down from the high-order to low-order digits or carried up from the low-order to high-order digits.
- The default values are 0 for the position data and 0 rpm for the motor rotation speed.

7-8 Initialization

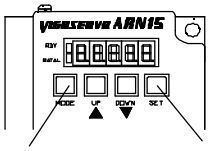
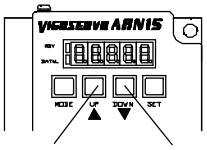
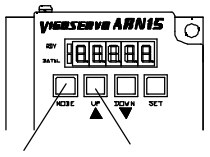
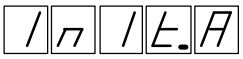
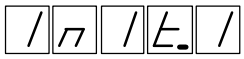
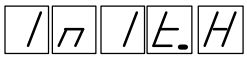
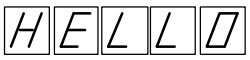
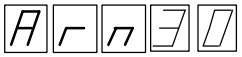
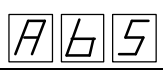
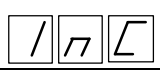
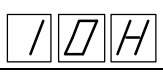
The following will be set to the default value (initialized) when the control power is turned on while the buttons on the front panel of the servo amplifier are held down.

- Servo parameters (p7-9)
- Control parameters (p7-13)
- Positioning data (p7-33)

Depending on the encoder type (absolute or incremental) and AR10H, the initialization can be performed in one of three ways.

Initialization is executed even when "2" (prohibited) has been selected as the control parameter 44 setting (rewriting prohibited (p7-23)).

The current position data stored inside the encoder will not be initialized.

Encoder type / Initialization methods	Absolute	Incremental	AR10H
Turn on the control power while pressing the panel switches shown in the figure on the right.	 MODE SET	 UP DOWN	 MODE UP
Servo parameter values after initialization	Default value		
Control parameter values after initialization	Default value	Encoder type: CP-1=2 (Incremental AR) Otherwise, default values	Encoder type: CP-1=3 (Incremental AR10H) Otherwise, default values
Positioning data values after initialization	Default value		
7-segment LED display while initialization is being performed	Initial.ABS 	Initial.INC 	Initial.H 
7-segment LED display after completion of initialization (Automatically performed)	HELLO display 		
	Frame number display  (with ARN15)		
	Encoder type display 		

Servo amplifier for AR10H is ARN30, Initialization for AR10H is invalid for other amplifier than ARN30.

If initialization for AR10H is executed on ARN30, CP-1 will be set to 3(Incremental AR10H) and change from 3 to 1 or 2 is invalid. (refer to CP-1: Encoder type p7-13)

8. COMMUNICATIONS

Use of the communications facility enables the parameters to be written and statuses to be monitored using a personal computer.

8-1 Specifications

Connection specifications : RS-232C
Transfer rate : 9600 bps

Transmission configuration : 1 start bit
8 data bits
1 parity bit, even parity
1 stop bit

8-2 Communication Contents

Servo parameter (p7-9) reading
Servo parameter writing
Control parameter (p7-13) reading
Control parameter writing
Positioning data (p7-33) reading
Positioning data writing
Display data (p7-3) reading
Initialization (p7-35)

8-3 Transmission Format

(1) Fixed codes

Code	Alarm occurrence	Data	Description
STX (Start Text)	-	51H	Transmission start
ACK (Acknowledge)	No	53H	Acknowledge
	Yes	54H	
NAK (Non Acknowledge)	No	55H	Negative acknowledge
	Yes	56H	

ACK and NAK change as shown above when an alarm has occurred in the servo amplifier.

(2) List of commands (CMD) and sub commands (SCMD)

Description		CMD	SCMD1	SCMD2
Servo parameter reading	Request	01H	00H	01-20H , parameter number (BCD)
	Response	81H		
Servo parameter writing	Request	11H	?	?
	Response	41H		
Control parameter reading	Request	02H	00H	01-79H , parameter number (BCD)
	Response	82H		
Control parameter writing	Request	12H	?	?
	Response	42H		
Positioning data reading	Request	03H	00H or 01H or02H	01-99H
	Response	83H	High-order digits of positioning data number (BCD)	Low-order digits of positioning data number (BCD)
Positioning data writing	Request	13H	?	?
	Response	43H		
Display data reading	Request	04H	00H	01-12H , 50H*
	Response	84H		Display data number (BCD)
Initialization	Request	15H	ABS:00H , INC:01H	00H
	Response	45H		

.There are two kinds of initialization: one (ABS) applies when an absolute encoder is used, and the other (INC) applies when an incremental encoder is used. (p7-35) Initilization for AR10H(p7-35) is invalid by this communication.

.* : 50H is used for Number 5-9 of alarm history display data reading.

(3) Data configuration

The data consists of 5 bytes as shown below, and the numerical values are transferred by BCD (binary coded decimal).

Bit no. —— Low order

Byte no.	8	7	6	5	4	3	2	1
DATA1	Plus/minus sign				10^8 digits			
DATA2	10^7 digits				10^6 digits			
DATA3	10^5 digits				10^4 digits			
DATA4	10^3 digits				10^2 digits			
DATA5	10^1 digits				10^0 digits			

Plus/minus sign: plus = 0H, minus = 1H

Example: "-987654321" in decimal notation is shown below.

Bit no. —— Low order

Byte no.	8	7	6	5	4	3	2	1
DATA1	1H				9H			
DATA2	8H				7H			
DATA3	6H				5H			
DATA4	4H				3H			
DATA5	2H				1H			

The data can be expressed in series as shown below.

19H , 87H , 65H , 43H , 21H

The configuration differs from what is shown above for alarm history, digital input monitor and digital output monitor among the display data reading contents. Refer to page 8-7.

(4) BCC (block check character)

This is the one low-order byte of the value obtained by adding all the data prior to BCC.

In the example shown on the right, BCC is the product of 53H + 81H + 00H + 07H + 00H + 00H + 09H + 87H + 65H which add up to 1D0H, yielding D0H as the low-order byte.

53H	ACK
81H	CMD
00H	SCMD1
07H	SCMD2
00H	DATA1
00H	DATA2
09H	DATA3
87H	DATA4
65H	DATA5
D0H	BCC

Total of these bits

8-4 Detailed Description of Transmission Contents

(1) Servo parameter (p7-9) reading

	PC? ARN	Example
STX	51H	51H
CMD	01H	01H
SCMD1	00H	00H
SCMD2	Parameter number	07H
BCC	Check data	59H

The example applies when servo parameter 7 = 98765.

	Acknowledge ARN?	PC
53H	ACK	53H
81H	CMD	81H
00H	SCMD1	00H
07H	SCMD2	Parameter number
00H	DATA1	Plus or minus sign/data
00H	DATA2	Data
09H	DATA3	Data
87H	DATA4	Data
65H	DATA5	Data
D0H	BCC	Check data

Negative acknowledg ARN?	PC
NAK	55H
BCC	55H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

(2) Servo parameter writing

	PC? ARN	Example
STX	51H	51H
CMD	11H	11H
SCMD1	00H	00H
SCMD2	Parameter number	07H
BCC	Check data	69H

The example applies when servo parameter 7 = 98765.

	Acknowledge ARN?	PC
53H	ACK	53H
41H	CMD	41H
00H	SCMD1	00H
07H	SCMD2	Parameter number
9BH	BCC	Check data

Negative acknowledge ARN?	PC
NAK	55H
BCC	55H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

STX	51H	51H
CMD	11H	11H
SCMD1	00H	00H
SCMD2	Parameter number	07H
DATA1	Plus or minus sign/data	00H
DATA2	Data	00H
DATA3	Data	09H
DATA4	Data	87H
DATA5	Data	65H
BCC	Check data	5EH

	Acknowledge ARN?	PC
53H	ACK	53H
41H	CMD	41H
00H	SCMD1	00H
07H	SCMD2	Parameter number
9BH	BCC	Check data

Negative acknowledge ARN?	PC
NAK	55H
BCC	55H

(3) Control parameter (p7-13) reading

PC? ARN		Example
STX	51H	51H
CMD	02H	02H
SCMD1	00H	00H
SCMD2	Parameter number	31H
BCC	Check data	84H

The example applies when servo parameter 31 = -987654321.

Acknowledge ARN? PC		
53H	ACK	53H
82H	CMD	82H
00H	SCMD1	00H
31H	SCMD2	Parameter number
19H	DATA1	Plus or minus sign/data
87H	DATA2	Data
65H	DATA3	Data
43H	DATA4	Data
21H	DATA5	Data
6FH	BCC	Check data

Negative acknowledge ARN? PC	
NAK	55H
BCC	55H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

(4) Control parameter writing

PC? ARN		Example
STX	51H	51H
CMD	12H	12H
SCMD1	00H	00H
SCMD2	Parameter number	31H
BCC	Check data	94H

The example applies when servo parameter 31 = -987654321.

Acknowledge ARN? PC		
53H	ACK	53H
42H	CMD	42H
00H	SCMD1	00H
31H	SCMD2	Parameter number
C6H	BCC	Check data

Negative acknowledge ARN? PC	
NAK	55H
BCC	55H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

STX	51H	51H
CMD	12H	12H
SCMD1	00H	00H
SCMD2	Parameter number	31H
DATA1	Plus or minus sign/data	19H
DATA2	Data	87H
DATA3	Data	65H
DATA4	Data	43H
DATA5	Data	21H
BCC	Check data	FDH

Acknowledge ARN? PC		
53H	ACK	53H
42H	CMD	42H
00H	SCMD1	00H
31H	SCMD2	Parameter number
C6H	BCC	Check data

Negative acknowledge ARN? PC	
NAK	55H
BCC	55H

- CP-1:Encoder type 3(AR10H) (p7-13) can not be written by this communication.
  Initialization (p7-35) must be executed when you use ARN30 for AR10H servo actuator.
- If control parameter writing with CP-1=3 is executed by communication , ARN will respond "Negative acknowledge".
- If control parameter writing with CP-1=1 or 2 is executed when setting of CP-1=3 by communication , ARN will respond "Negative acknowledge".

(5) Positioning data (p7-33) reading

PC? ARN

		Example
STX	51H	51H
CMD	03H	03H
SCMD1	Positioning data high-order digits	02H
SCMD2	Positioning data low-order digits	34H
BCC	Check data	8AH

The example applies when address number = 234, position data = -123456789 and speed data = 2345.

Acknowledge

ARN? PC

			Example
	ACK	53H	53H
	CMD	83H	83H
	SCMD1	Positioning data high-order digits	02H
	SCMD2	Positioning data low-order digits	34H
Positioning data	DATA1	Plus or minus sign/data	11H
	DATA2	Data	23H
	DATA3	Data	45H
	DATA4	Data	67H
	DATA5	Data	89H
Speed data	DATA1	Plus or minus sign/data	00H
	DATA2	Data	00H
	DATA3	Data	00H
	DATA4	Data	23H
	DATA5	Data	45H
	BCC	Check data	DDH

Negative acknowledge

ARN? PC

NAK	55H
BCC	55H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

(6) Positioning data (p7-33) writing

PC? ARN		Example
STX	51H	51H
CMD	13H	13H
SCMD1	Positioning data high-order digits	02H
SCMD2	Positioning data low-order digits	34H
BCC	Check data	9AH

The example applies when address number = 234, position data = -123456789 and speed data = 2345.

Acknowledge		
ARN?		PC
53H	ACK	53H
43H	CMD	43H
02H	SCMD1	Positioning data high-order digits
34H	SCMD2	Positioning data low-order digits
CCH	BCC	Check data

Negative acknowledge	
ARN?	PC
NAK	55H
BCC	55H

STX	51H	51H
CMD	13H	13H
SCMD1	Positioning data high-order digits	02H
SCMD2	Positioning data low-order digits	34H
DATA1	Plus or minus sign/data	11H
DATA2	Data	23H
DATA3	Data	45H
DATA4	Data	67H
DATA5	Data	89H
DATA1	Plus or minus sign/data	00H
DATA2	Data	00H
DATA3	Data	00H
DATA4	Data	23H
DATA5	Data	45H
BCC	Check data	6BH

Positioning data

Speed data

Acknowledge		
ARN?		PC
53H	ACK	53H
43H	CMD	43H
02H	SCMD1	Positioning data high-order digits
34H	SCMD2	Positioning data low-order digits
CCH	BCC	Check data

Negative acknowledge	
ARN?	PC
NAK	55H
BCC	55H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

(7) Display data (p7-3) reading

PC? ARN		Example
STX	51H	51H
CMD	04H	04H
SCMD1	00H	00H
SCMD2	Display data number	03H
BCC	Check data	58H

The example applies when display data 3 = 123456789.

	Acknowledge ARN? PC	
53H	ACK	53H
84H	CMD	84H
00H	SCMD1	00H
03H	SCMD2	Display data number
01H	DATA1	Plus or minus sign/data
23H	DATA2	Data
45H	DATA3	Data
67H	DATA4	Data
89H	DATA5	Data
33H	BCC	Check data

Negative acknowledge ARN? PC	
NAK	55H
BCC	55H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

. The alarm history data is as shown below.

Byte no.	Bit no. —— Low order							
	8	7	6	5	4	3	2	1
DATA1	0 (latest)high order				0 (latest) low order			
DATA2	1 high order				1 low order			
DATA3	2 high order				2 low order			
DATA4	3 high order				3 low order			
DATA5	4 high order				4 low order			

. Number 0 - 4 correspond to the history numbers on p7-4.

. 0H is the data value when no alarms have occurred.

. ALHI 0-4 (p7-4) is sent from servo amplifier when display data number is 09H , ALHI 5-9 is sent when display number is 50H.

Example: The data is as shown below when the most recent alarm number is 15, number 4 is 1 and the other numbers are 2.

DATA1:15H DATA2:02H DATA3:02H DATA4:02H DATA5:01H

. The digital input monitor (p7-5) data is as shown below. When the input is ON, the data is 1.

Bit no. —— Low order

Byte no.	8	7	6	5	4	3	2	1
DATA1	0	0	0	0	0	0	0	0
DATA2	0	0	0	0	0	0	0	0
DATA3	0	0	0	0	PRDY	SVON	MODE A	MODE B
DATA4	START	RESET	CONT1	CONT2	CONT3	CONT4	CONT5	CONT6
DATA5	CONT7	CONT8	CONT9	CONT10	CONT11	CONT12	CONT13	CONT14

. The digital output monitor (p7-5) data is as shown below. When the output is ON, the data is 1.

Bit no. —— Low order BAT ALM cannot be transferred.

Byte no.	8	7	6	5	4	3	2	1
DATA1	0	0	0	0	0	0	0	0
DATA2	0	0	0	0	0	0	0	0
DATA3	0	0	0	0	0	0	0	0
DATA4	INP	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7
DATA5	OUT8	OUT9	OUT10	OUT11	OUT12	OUT13	OUT14	OUT15

. The data in the software version are: DATA1,2,3 = "0"; DATA4 = Driver CPU; DATA5= Controller CPU.

(8) Initialization (p7-35)

- Bear in mind that the servo parameters, control parameters and positioning data stored in the servo amplifier will be deleted when initialization is performed.
- There are two kinds of initialization: one (ABS) applies when an absolute encoder is used, and the other (INC) applies when an incremental encoder is used. (p7-35)
- Turn servo ON (p6-9) off when performing initialization using the communication facility.
  If initialization is attempted while it is on, it will fail to be performed, and the servo amplifier will return the negative acknowledge (NAK) code.
- It takes about 30 seconds from when PC sends an initialization instruction to the ARN, to perform initialization, until the ARN returns an acknowledge or a negative acknowledge.
  Perform proper settings in the communication software to avoid any communication timeout.
- Performing initialization initializes servo parameters, control parameters, and positioning data stored in the servo amplifier, thereby effecting the initial values. It is, therefore, not necessary to turn the power OFF and then back ON.
- Initialization for AR10H (p7-35) is invalid by this communication.

<1> Initialization when absolute encoder is used

	PC? ARN	Data
STX	51H	51H
CMD	15H	15H
SCMD1	00H	00H
SCMD2	00H	00H
BCC	Check data	66H

	Acknowledge ARN? PC	
53H	ACK	53H
45H	CMD	45H
00H	SCMD1	00H
00H	SCMD2	00H
98H	BCC	Check data

Negative acknowledge ARN? PC	
NAK	55H
BCC	55H

<2> Initialization when incremental encoder is used

	PC? ARN	Data
STX	51H	51H
CMD	15H	15H
SCMD1	01H	01H
SCMD2	00H	00H
BCC	Check data	67H

ACK = 54H and NAK = 56H when an alarm has occurred in the servo amplifier.

	Acknowledge ARN? PC	
53H	ACK	53H
45H	CMD	45H
01H	SCMD1	01H
00H	SCMD2	00H
99H	BCC	Check data

Negative acknowledge ARN? PC	
NAK	55H
BCC	55H

9. ALARMS

. When an error has been detected in the servo system, an alarm appears on the 7-segment LED display of the servo amplifier.
When an alarm has been detected, the servo actuator turns off the servo system, and the alarm number appears on its front panel 7-segment LED display.
In addition, the brake (p5-14) is engaged if the servo actuator is equipped with a brake.

If the "AL-17"alarm is displayed, the servo actuator does not turn off the servo system nor is the brake applied.

"Alarm detection (p6-23)" will turn on when "AL-17" alarm is displayed and will stay on untill current position is between + and -over-travel detection position.

. The alarm status can be released either by turning the power off and then back on or by inputting the reset signal (p6-10) after the cause of the alarm has been removed.
Alarms indicated by a black dot ? (serious failures) cannot be released by the reset signal.
In this case, turn the power off and then back on.

. When the reset signal (p6-10) has been turned on to release the alarm, the requested pulse (p7-3) will have the same value as the feedback pulse.

. Parameters can be changed even in the alarm status. An alarm display mode is inserted between the positioning data edit mode and the display mode. (See page 7-1)

. The BAT ALM (p6-24) battery alarm is not displayed as an alarm.

Display	Trouble/symptom criteria	Probable cause	Remedy
AL-1	**Overload** . An overload was detected in the motor by the electronic thermal protector inside the servo amplifier.	. Load torque constantly exceeds the rated torque.	. Review the machine system. . Review the selection of the frame number.
		· The acceleration/deceleration time is too short; the load torque during acceleration/deceleration is too high.	· Increase the acceleration/deceleration time constant.
		. Hunting.	. Reduce the inertial load. . Re-adjust the gain.
AL-2 ?	**Overheating of motor** · The motor heated up, causing the thermostat inside the motor to trip.	. Load is too high, and the motor overheated.	. Review the machine system. · Review the selection of the frame number. . Cool down the servo actuator using a fan.
		· CN1 (p5-4) OH1 and OH2 were disconnected between the servo amplifier and servo actuator.	· Check the wiring connections and repair the wiring.
		. In case of AR10H, OH1 OH2 at CN1 are not connected.(refer to p5-5)	
		. Ambient temperature is too high.	. Reduce the ambient temperature.

Display	**Trouble**/symptom criteria	Probable cause	Remedy
AL-3	**Overheating of regenerative resistance** . The regenerative resistance (p10-11) heated up, causing the thermostat inside the regenerative resistance to trip.	. Inertial load is too high.	. Reduce the inertial load.
		. Regenerative frequency (p10-11) is too high.	. Review the operating pattern.
		. Servo actuator was rotated by an external force.	. Prevent it from being rotated.
AL-4	**Overvoltage** . Internal DC voltage exceeded the allowable limit.	. Input supply voltage (p5-10,13) is too high.	. Normalize the input supply voltage.
		. No short-circuiting between RGEN/DCC (p5-12,13) of TB.	. Short-circuit.
		. Faulty connection of external regenerative resistance (p5-12).	. Contact us.
AL-5 ?	**Overcurrent** . Output current exceeded the allowable limit. . A power transistor overheated.	. Grounding or short-circuiting of servo actuator's power cable (p5-12,13).	. Connect the cable properly.
		. Excessively high load.	. Review the machine system. . Review the selection of the frame number. . Re-adjust the gain (p7-9).
		. Acceleration/deceleration time is too short.	. Review operating pattern. . Re-adjust the gain (p7-9).
		. Ambient temperature of servo amplifier is too high.	. Reduce the ambient temperature.
AL-6	**Low voltage** . Internal DC voltage is low.	. Input supply voltage (p5-10,13) is too low.	. Set the input supply voltage to the appropriate level.
		. Main power (p5-10,13) is not being input.	. Turn on the main power.
AL-7	**Excessively high speed** . Motor rotation speed has exceeded 3300 rpm (or 2800 rpm for AR135).	. Overshoot of servo actuator.	. Increase the acceleration/deceleration time constant.
		. Hunting in servo actuator.	. Re-adjust the gain (p7-9).
AL-8	**Excessively high position deviation** . Deviation pulse (p7-3) has exceeded excessive deviation width set in control parameter 25 (p7-19).	. Excessive deviation width (p7-19) value is too low.	. Increase the value.
		. Torque limiting enable signal (p6-12) is on.	. Turn off the signal.
		. Excessively high load.	. Review the machine system. . Review the selection of the frame number.
		. Output shaft is locked mechanically.	. Release the lock.
AL-9 ?	**Signal cable disconnection** . Trouble with encoder signals.	. Faulty wiring of encoder signal cable between CN1 (p5-4) and servo actuator.	. Connect the cable properly.
		. Power was turned on while the servo actuator was allowed to rotate.	. Turn on the power while the servo actuator is shut down.

Display	**Trouble**/symptom criteria	Probable cause	Remedy
AL-10	**Brake power supply disconnection** · Brake power is not being supplied.	· Brake power supply (p5-14) is not connected.	· Connect the power supply.
		· A servo actuator without a brake is being used but "1" (available) has been selected as the brake available/unavailable CP-7 (p7-15) setting.	· Set to "2" (unavailable).
AL-11 ?	**Encoder trouble** · Trouble in communication with absolute encoder.	· Faulty wiring of encoder signal cable between CN1 (p5-4) and servo actuator.	· Connect the cable properly.
		· Encoder cable is too long. · Cross-sectional area of encoder cable is too small.	· Correct the encoder cable wiring according to p5-5.
AL-12	**Power cable disconnection** · No current is flowing to power cable.	· Motor power cable (p5-12,13) has been disconnected.	· Connect the cable properly.
AL-13 ?	**Encoder system down** · The data stored in the absolute encoder memory has been lost.	· Voltage of the battery (p5-19) used for the absolute encoder has dropped. · Battery is not connected. · Faulty wiring of encoder signal cable between CN1 (p5-4) and servo actuator.	· Remove the cause and then perform the origin setting by following the instructions on page 6-7. (The origin setting must be carried out in the current position since the servo actuator cannot be operated.)
AL-14 ?	**Encoder type mismatch** · The encoder type CP-1 (p7-13) setting, encoder selector switch (p5-2,3) setting and the actual encoder do not match.	· Faulty setting of CP-1: Encoder type (p7-13) or Encoder selector switch (p5-2,3).	· Follow p1-4,5,6,7 to set the parameters and switches to ensure that they match.
AL-15 ?	**Overflow** · The absolute encoder has exceeded its rotation limit. · Current position has exceeded the limit of the coordinate axes.	· Motor shaft has rotated more than ±32767 rotations from the origin. (p3-17)	· Perform the origin setting by following the instructions on page 6-7. (The origin setting must be carried out in the current position, since the servo actuator cannot be operated.) · In the case of an incremental encoder, the origin setting is not necessary.

Display	**Trouble**/symptom criteria	Probable cause	Remedy
AL-16	**Address error** · In the equal pitch multi-rotation coordinates (p3-6), the 0 address or addresses exceeding CP- 10 "total number of addresses" have been activated. · In the optional division 360°coordinates (p3-7), infinite linear coordinates (p3-8), or finite linear coordinates (p3-9), the 0 address, or the addresses where the motor rotational speed is set to "0", have been activated. · In the optional division 360°coordinates mode, the address of a value less than 0 or equal to or greater than 360 was started. · In either the infinite linear coordinates or the finite linear coordinates mode, positioning with a value more than the limit of the coordinates--±32767 rotations from the origin-- was instructed.	· Faulty setting of address numbers(p6-11) or positioning data(p7-33).	· Specify the address and the positioning data properly.
AL-17	**Soft over-travel detection** · The current position is farther from the origin than the CP-31 soft + over-travel detection position (p7-20). · The current position is farther from the origin than the CP-32 soft - over-travel detection position (p7-20).	· Same as the left.	· Move the servo actuator to the position between the CP-31 and the CP-32 .
	· The CP-31 soft + over-travel detection position set value is less than the CP-32 soft - over-travel detection position set value.	· Faulty setting of CP-31 or CP-32.	· Specify the CP-31 and CP-32 settings properly.

Display	**Trouble**/symptom criteria	Probable cause	Remedy
AL-18 ?	**CPU error** . CPU problem	. CPU operation stopped. . Communication problem between CPUs	. Turn power switch ON again. . Perform initialization (p7-35).
AL-19 ?	**Position defect** . | Position ON - Position OFF | > CP-79 (refer to p7-27)	. Position memory of absolute encoder has problem.	. Replace a servo actuator.
		. Servo actuator is rotated when control power is off.	. Stop the rotation when power off. . Increase the value in CP-79 (p7-27). . Set CP-78 to 2(unvailable) to invalid this alarm. . Remove the cause and then perform the origin setting by following the instructions on page 6-7. (The origin setting must be carried out in the current position since the servo actuator cannot be operated.)

10. SELECTION

10-1 General Selection Method

Follow the steps below to select the servo actuator.

(1) Figuring out the load (p10-2)

Decide on the load and operating pattern.

(2) Figuring out the torque area (p10-2)

Make sure that the torque and rotation speed required by the operating pattern are within the torque range of the servo actuator.

(3) Figuring out the effective torque (p10-4)

Calculate the effective torque from the operating pattern, and check that it is less than the rated torque of the servo actuator.

(4) Figuring out the brake torque (p10-5)

If the servo actuator is to be held by the brake incorporated inside the servo actuator, check that the brake torque satisfies the requirement.

(5) Figuring out the reduction gear's service life (p10-5)

Calculate the anticipated service life of the reduction gear from the operating pattern, and check that it is more than the required service life.

(6) Figuring out the positioning accuracy (p10-7)

Make sure that the backlash, lost motion, angle transmission error and spring constant satisfy the requirements.

(7) Figuring out the bearing capacity (p10-8)

Make sure that the thrust weight and moment applied to the main bearing of the servo actuator are less than the specification values.

(8) Figuring out the moment of inertia of the load (p10-10)

Make sure that the moment of inertia of the load is less than the specification value.

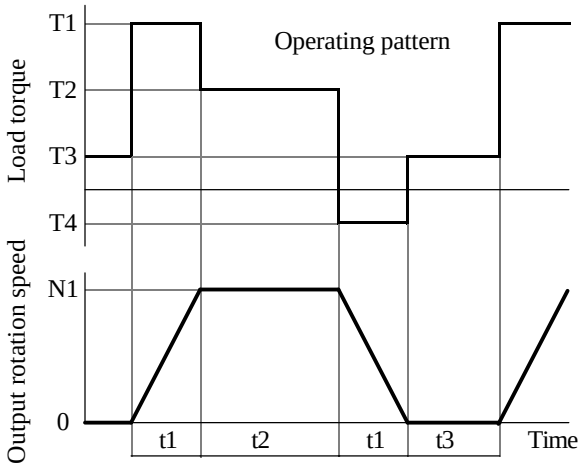
(9) Figuring out the regeneration capacity (p10-11)

When the servo actuator decelerates, the inertial energy is converted into heat by the regenerative resistance inside the servo amplifier.
Make sure that the regenerative power calculated from the operating pattern is within the capacity of the regenerative resistance.

10-2 Details of Selection Methods

(1) Figuring out the load

. Decide on the operating pattern from the load conditions, and plot the load torque versus time and output rotation speed versus time as graphs.



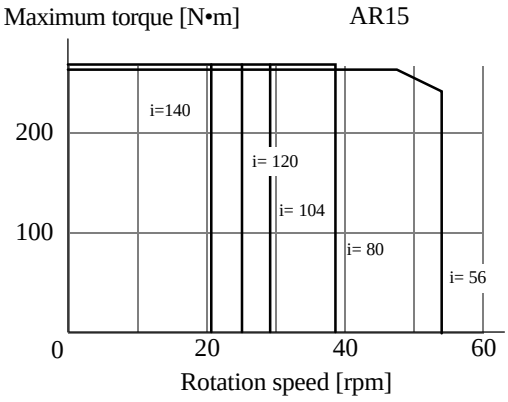
T1	:	Acceleration torque	[N•m]
T2	:	Torque in steady state	[N•m]
T3	:	Torque at shutdown	[N•m]
T4	:	Torque during deceleration	[N•m]
N1	:	Maximum rotation speed	[rpm]
t1	:	Acceleration/deceleration time	[sec]
t2	:	Steady-state operation time	[sec]
t3	:	Shutdown time	[sec]

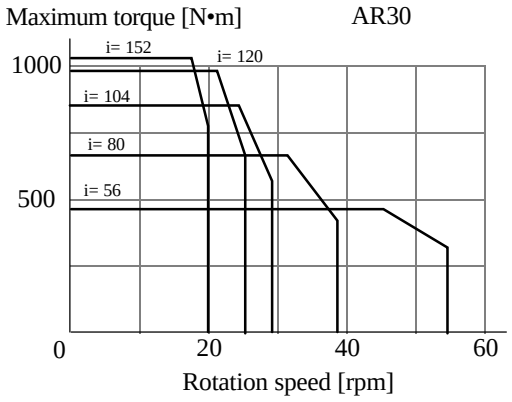
Decide on the operating pattern.

(2) Figuring out the torque area

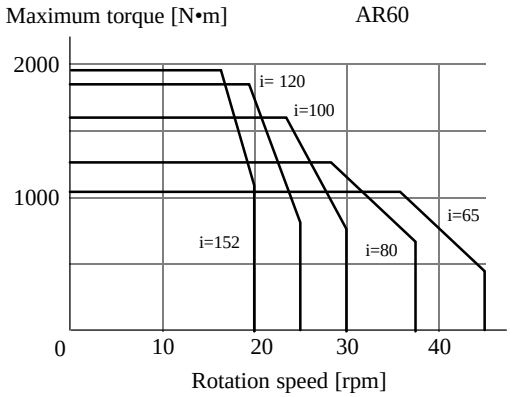
. Make sure that the torque and rotation speed required by the operating pattern are within the maximum torque range of the servo actuator.

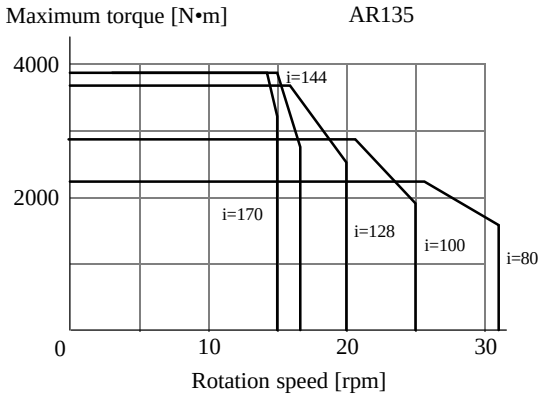
. The maximum torque ranges of the servo actuators are provided below.

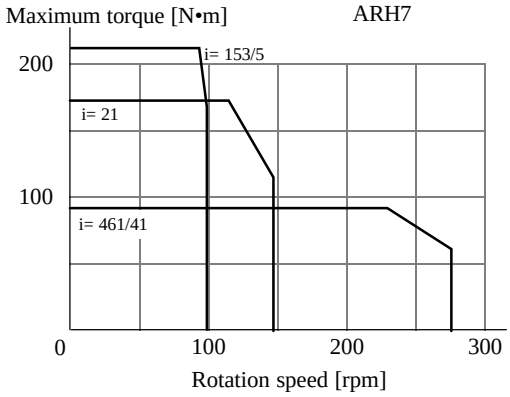


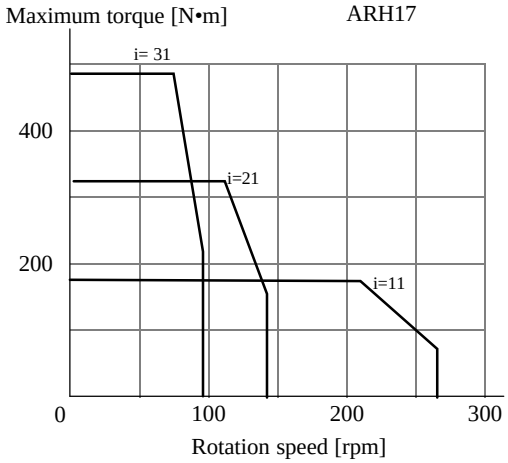


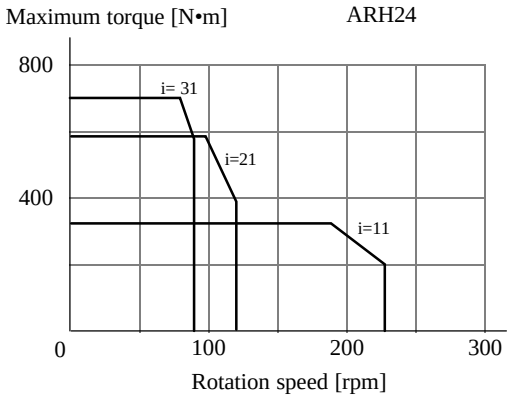
"i" = in the graph, indicates the reduction gear ratio.

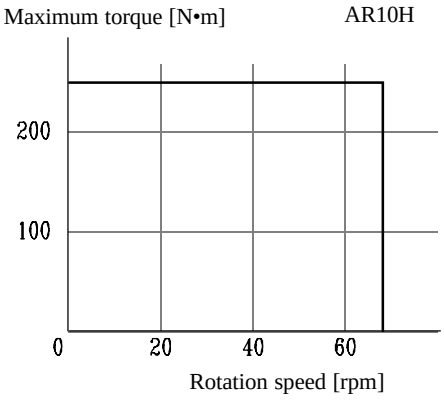












"i" = in the graph, indicates the reduction gear ratio.

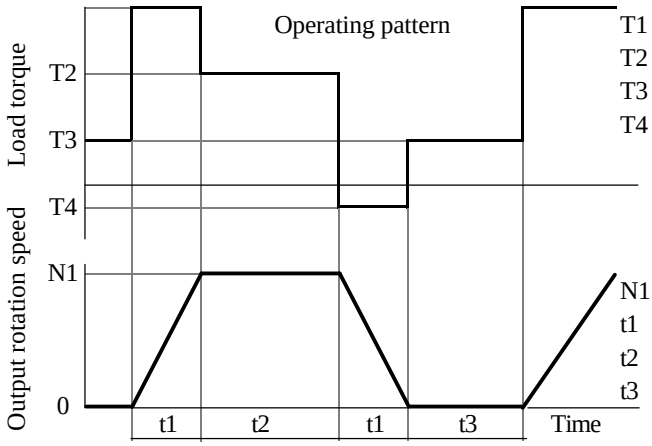
Make sure that the operating pattern is within the maximum torque range of the servo actuator.

(3) Figuring out the effective torque

. Calculate the anticipated effective torque from the operating pattern, and check that it is less than the rated torque of the servo actuator.

. The effective torque is calculated using the following formula for the operating patterns presented below.

$$\text{Effective torque } Trms = \sqrt{\frac{t1\times T1^2 + t2\times T2^2 + t3\times T3^2 + t1\times T4^2}{2\times t1 + t2 + t3}} \quad [N\cdot m]$$



T1 : Acceleration torque [N•m]
T2 : Torque in steady state [N•m]
T3 : Torque at shutdown [N•m]
T4 : Torque during deceleration [N•m]

N1 : Maximum rotation speed [rpm]
t1 : Acceleration/deceleration time [sec]
t2 : Steady-state operation time [sec]
t3 : Shutdown time [sec]

. The rated torques of the servo actuators are shown below.

Frame number	Unit	AR15					AR30				
Reduction gear ratio A, B type	-	56	80	104	120	140	56	80	104	120	152
Reduction gear ratio C type	-	57	81	105	121	141	57	81	105	121	153
Rated torque	N•m	66	94	122	141	167	132	188	245	282	363
	kgf•m	6.7	9.6	12	14	17	13	19	25	29	37

Frame number	Unit	AR60					AR135				
Reduction gear ratio A, B type	-	65	80	100	120	152	80	100	128	144	170
Reduction gear ratio C type	-	66	81	101	121	153	81	101	129	145	171
Rated torque	N•m	304	376	470	564	715	753	941	1204	1352	1599
	kgf•m	31	38	48	58	73	77	96	123	138	163

Frame number	Unit	ARH7			ARH17			ARH24			AR10H
Reduction gear ratio	-	461/41	21	153/5	11	21	31	11	21	31	45
Rated torque	N•m	26	49	73	52	99	146	103	198	292	72
	kgf•m	2.6	5.0	7.4	5.3	10	15	11	20	30	7

Make sure that the effective torque is less than the rated torque of the servo actuator.

Make sure that the servolock torque is 70% or less than the rated torque of the servo actuator.

(4) Figuring out the brake torque

. If the servo actuator is to be held by the brake (p5-14) incorporated inside the servo actuator, check that the brake torque satisfies the requirement.

. The brake torques of the servo actuators are shown below.

Frame number	Unit	AR15					AR30				
Reduction gear ratio A, B type	-	56	80	104	120	140	56	80	104	120	152
Reduction gear ratio C type	-	57	81	105	121	141	57	81	105	121	153
Brake torque	N•m	86	115	143	162	186	212	282	353	400	494
	kgf•m	8.8	12	15	17	19	22	29	36	41	50

Frame number	Unit	AR60					AR135				
Reduction gear ratio A, B type	-	65	80	100	120	152	80	100	128	144	170
Reduction gear ratio C type	-	66	81	101	121	153	81	101	129	145	171
Brake torque	N•m	451	539	657	774	962	1051	1286	1615	1803	2109
	kgf•m	46	55	67	79	98	107	131	165	184	215

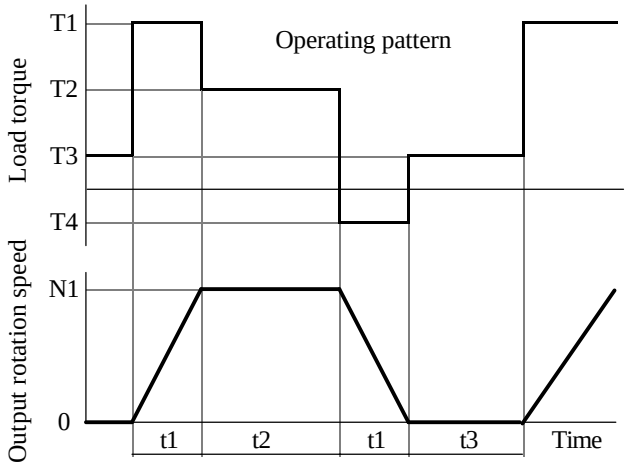
Frame number	Unit	ARH7			ARH17			ARH24			AR10H
Reduction gear ratio	-	461/41	21	153/5	11	21	31	11	21	31	45
Brake torque	N•m	60	89	119	81	157	225	167	314	461	245
	kgf•m	6.1	9.1	12	8.3	16	23	17	32	47	25

Make sure that the brake torque of the servo actuator is higher than the brake torque requirement.

(5) Figuring out the reduction gear's service life

. Calculate the anticipated service life of the reduction gear from the operating pattern, and check that it is more than the required service life.

. How to calculate the service life of the reduction gear is provided for the operating pattern below.



T1 : Acceleration torque [N•m]
T2 : Torque in steady state [N•m]
T3 : Torque at shutdown [N•m]
T4 : Torque during deceleration [N•m]

N1 : Maximum rotation speed [rpm]
t1 : Acceleration/deceleration time [sec]
t2 : Steady-state operation time [sec]
t3 : Shutdown time [sec]

. Calculate the mean load torque (Tm).

$$Tm = \sqrt[10/3]{\frac{t1\times(N1/2)\times T1^{10/3} + t2\times N1\times T2^{10/3} + t1\times(N1/2)\times T4^{10/3}}{2\times t1\times(N1/2) + t2\times N1}} \quad [N\bullet m]$$

Torque at shutdown (T3) and shutdown time (t3) are not used in this calculation.

. Calculate the mean output rotation speed (Nm).

$$Nm = \frac{2\times t1\times(N1/2) + t2\times N1}{2\times t1 + t2} \quad [rpm]$$

. Calculate the service life of the reduction gear in hours (Lh). (Rotation shutdown time t3 is not factored into this calculation.)

$$Lh = 6000 \times \frac{N_0}{Nm} \times \left(\frac{T_0}{Tm}\right)^{10/3} \quad [hour]$$

T_0: Rated torque [N•m] of reduction gear

N_0: Rated rotation speed [rpm] of reduction gear

. Calculate the service life of the reduction gear in years (Ly).
(Rotation shutdown time t3 and the annual operation rate are factored into this calculation.)

$$Ly = \frac{Lh\times(2\times t1 + t2 + t3)\times 100}{(2\times t1 + t2)\times.\times 24\times 365} \quad [year]$$

d : Annual operation rate [%]

. The table below shows the torque and rotation speed ratings of the reduction gears.
. The rated rotation speed resulting from the calculation of the reduction gear's service life differs from the rated output rotation speed of the servo actuator (p2-2).

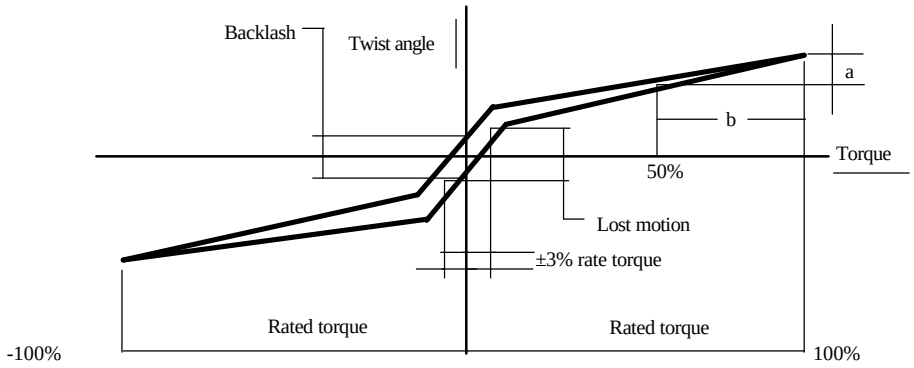
Frame number	Unit	AR15	AR30	AR60	AR135	ARH7	ARH17	ARH24	AR10H
Rated torque T_0	N•m	137	412	784	1568	68.6	167	235	98
	kgf•.	14	42	80	160	7	17	24	10
Rated rotation speed N_0	rpm	15				50			15

Make sure that the service life of the reduction gear is longer than the required service life.

(6) Figuring out the positioning accuracy

- Make sure that the backlash, lost motion, angle transmission error and spring constant satisfy the requirements.
- Calculate the backlash, lost motion, angle transmission error and spring constant as shown below.

When the input shaft of the servo actuator (servo motor shaft) is secured and torque is applied to the output shaft side, twisting corresponding to the torque applied is generated.
The hysteresis curve shown in the figure below expresses this correspondence.
The spring constant, lost motion and backlash are defined in the figure below.



$$\text{Spring constant} = \frac{\text{Rated torque}/2}{\text{Twist angle at rated torque - Twist angle at 50\% of rated torque}} = \frac{b}{a}\ [\text{N•m/arc min}]$$

Lost motion : Twist angle at intermediate point of hysteresis curve width at ±3% of rated torque. [arc min]

Backlash : Twist angle at "zero" torque of hysteresis curve [arc min]

- The following formula is used to calculate the twist angle and twisting amount when the load torque (offset load, etc.) is applied to the servo actuator from one direction.

$$\text{Twist angle} = \frac{\text{Lost motion [arc min]}}{2} + \frac{\text{Load torque [N•m]}}{\text{Spring constant [N•m/arc min]}}\ [\text{arc min}]$$

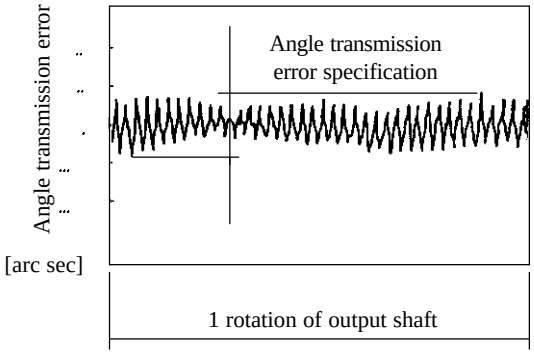
- The total twist angle when the load is applied in one direction and also in its opposite direction is the value obtained by adding the backlash amount to twice the value calculated using the formula above.
- Twist amount = L × tan (twist angle [arc min]/60) .[mm] L : Distance from rotary center of servo actuator to load point [mm]
- The table below shows the spring constants, lost motion and backlash of the servo actuators.

		AR15	AR30	AR60	AR135	ARH7	ARH17	ARH24	AR10H
Spring constant	N•m/arc min	34	108	196	392	15	29	44	47
	kgf•./arc min	3.5	11	20	40	1.5	3.0	4.5	4.8
Lost motion	arc min	1				6			1
Backlash	arc min	1				6			1

. The definition and specification of the angle transmission error are provided below.

The "angle transmission error" is the difference between the theoretical output rotation angle when any rotation angle (?in) is supplied to the servo actuator and the actual output rotation angle (?out).

This accuracy is expressed in terms of angle transmission error (?er).



$$\text{Angle transmission error } (?er) = \frac{?in}{i} - ?out \quad [\text{arc min}]$$

?in : Input angle [arc min]
?out : Output angle [arc min]
i : Reduction gear ratio [-]

. The angle transmission error (? er) of the AR series is not more than 1 arc min.

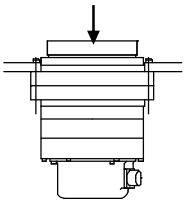
(The angle transmission error of the ARH**F and ARH**S does not stipulate to any particular value.)

Make sure that the positioning accuracy of the servo actuator satisfies the positioning accuracy requirement.

(7) Figuring out the bearing capacity

. Make sure that the thrust weight and moment applied to the main bearing of the servo actuator are less than the specification values.

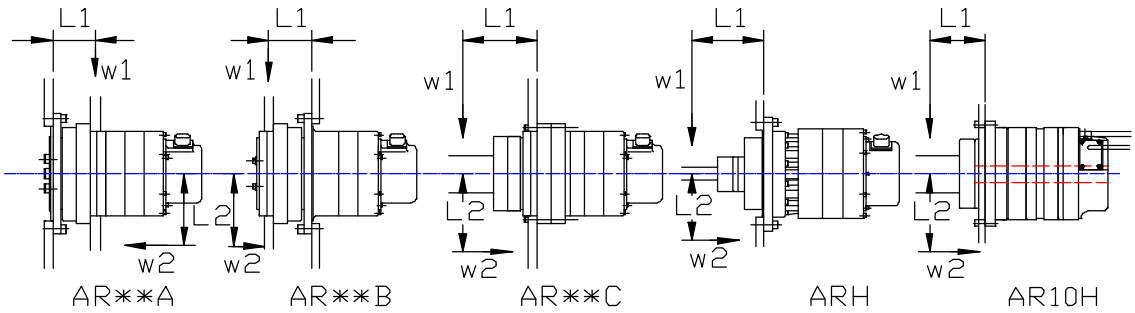
. The "thrust weight" refers to the weight which is applied in the direction shown in the figure below, and its specification is shown in the table on the right.



Frame number	Allowable thrust weight	
	N	kgf
AR15	1960	200
AR30	5194	530
AR60	7840	800
AR135	14700	1500
ARH7	1470	150
ARH17	1960	200
ARH24	2940	300
AR10H	5880	600

Make sure that the thrust weight is less than the value allowed for the servo actuator.

. The "moment" refers to the weight which is applied in the direction shown in the figure below.



. The moment is calculated as follows.

A, B type : Moment [N•m] = W1×(L1-a)+W2×L2

C, F, S type, AR10H : Moment [N•m] = W1×(L1-b)+W2×L2

W1, W2 : Weight [N] from load
L1,L2 : Distance [m] up to weight action point
a,b : Constants [m]

. The table below shows the allowable moment and constants a and b of the servo actuators.

Frame number	Allowable moment		a	b
	N•m	kgf•m	m	
AR15	608	62	0.042	0.005
AR30	1666	170	0.052	0.011
AR60	1735	177	0.057	-0.002
AR135	3920	400	0.071	-0.011
ARH7	461	47	-	0.025
ARH17	804	82	-	0.031
ARH24	843	86	-	0.030
AR10H	686	70	-	0.017

Make sure that the load moment is less than the allowable moment of the servo actuator.

(8) Figuring out the moment of inertia of the load

- Make sure that the moment of inertia of the load is less than the specification value of the servo actuator.

- The table below shows the servo actuators' allowable moments of inertia of the load.

- Example : Calculation for the Load which diameter = D[m], weight = W[kg] and circular shape is shown below.

Moment of inertia of the load [kg.m^2 (GD^2/4)]= $\frac{1}{4} \cdot \frac{1}{2}$ W[kg].D^2[m]

Frame number	Unit	AR15					AR30				
Reduction gear ratio A, B type	-	56	80	104	120	140	56	80	104	120	152
Reduction gear ratio C type	-	57	81	105	121	141	57	81	105	121	153
Allowable moment of inertia of load	kg•m^2 (GD^2/4)	5.2	11	18	24	32	15	31	53	71	113

Frame number	Unit	AR60					AR135				
Reduction gear ratio A, B type	-	65	80	100	120	152	80	100	128	144	170
Reduction gear ratio C type	-	66	81	101	121	153	81	101	129	145	171
Allowable moment of inertia of load	kg•m^2 (GD^2/4)	51	77	120	173	277	253	395	647	819	1142

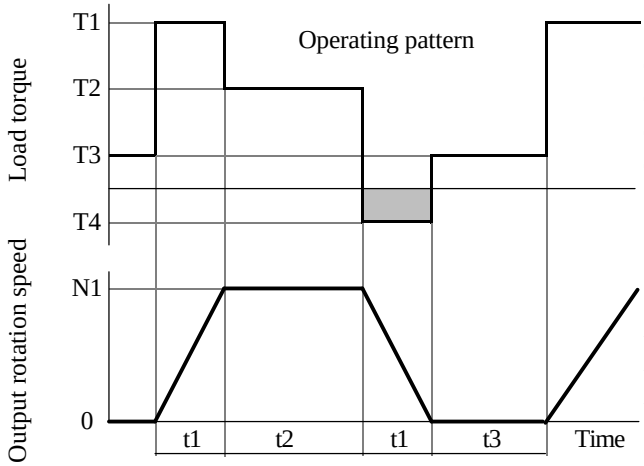
Frame number	Unit	ARH7			ARH17			ARH24			AR10H
Reduction gear ratio	-	461/41	21	153/5	11	21	31	11	21	31	45
Allowable moment of inertia of load	kg•m^2 (GD^2/4)	0.59	2.2	4.7	1.5	5.3	12	5.0	17	38	9.6

Make sure that the moment of inertia of the load is less than the specification value of the servo actuator.

(9) Figuring out the regeneration capacity

. When the servo actuator decelerates, the inertial energy is converted into heat by the regenerative resistance inside the servo amplifier.

. Make sure that the regenerative power calculated from the operating pattern is within the capacity of the regenerative resistance.



T1 : Acceleration torque [N•m]
T2 : Torque in steady state [N•m]
T3 : Torque at shutdown [N•m]
T4 : Torque during deceleration [N•m]

N1 : Maximum rotation speed [rpm]
t1 : Acceleration/deceleration time [sec]
t2 : Steady-state operation time [sec]
t3 : Shutdown time [sec]

. When the inertial load has been positioned in the above operating pattern, the shaded area represents the regeneration range.
The method used to calculate the regenerative power and the allowable values for the servo amplifier are shown below.

$$\text{Regenerative power [W]} = \frac{T4\times(N1/2)\times 0.105\times t1}{2\times t1 + t2 + t3}$$

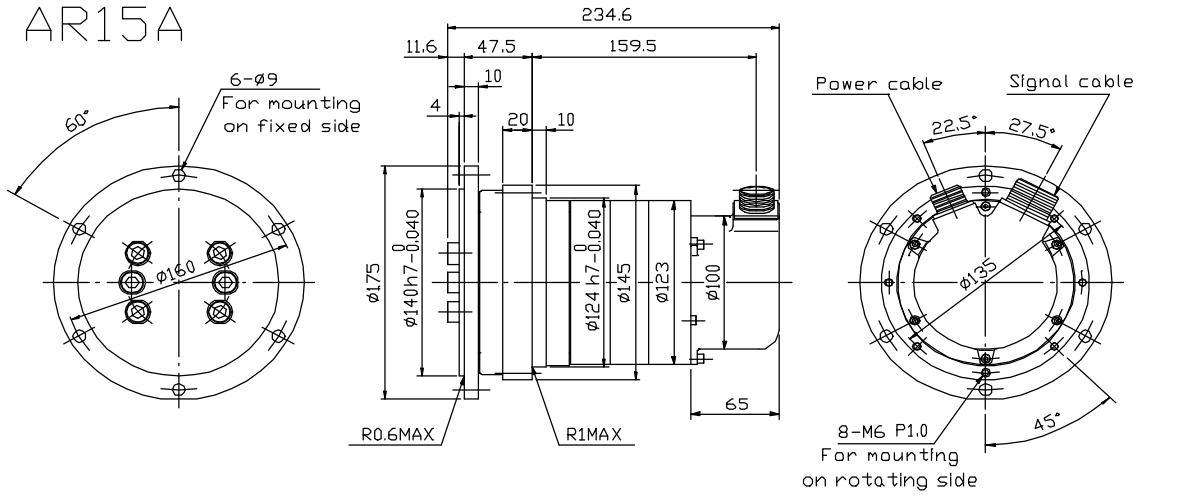
Servo amplifier frame number	Allowable regenerative power [W]
ARN15	20
ARN30	20
ARN60	60
ARN135	60

Make sure that the regenerative power is less than the allowable value of the servo amplifier.

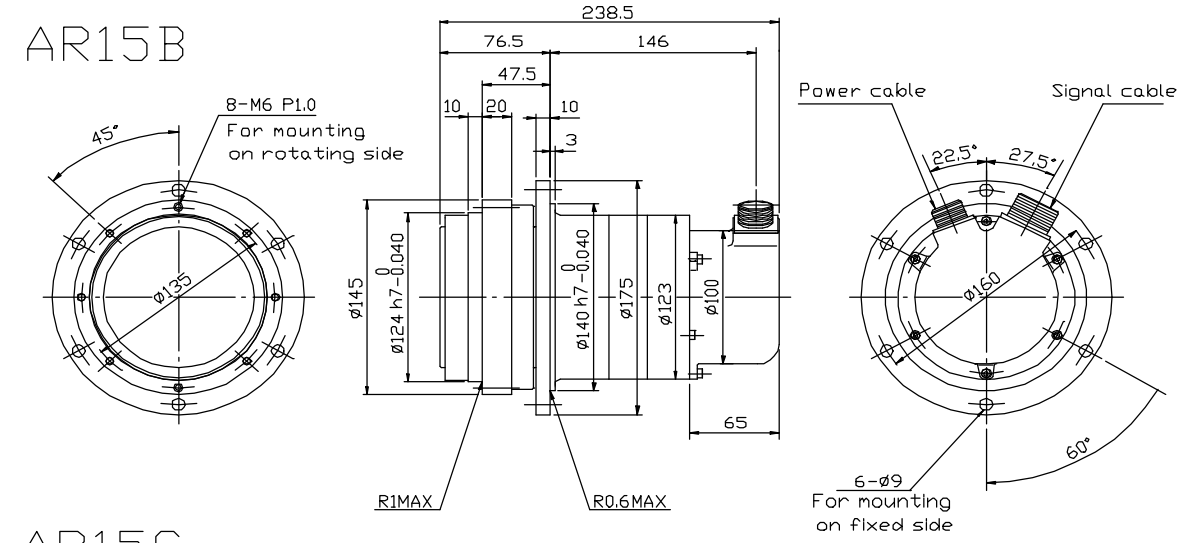
11. EXTERNAL DIMENSIONS

11-1 Servo Actuator

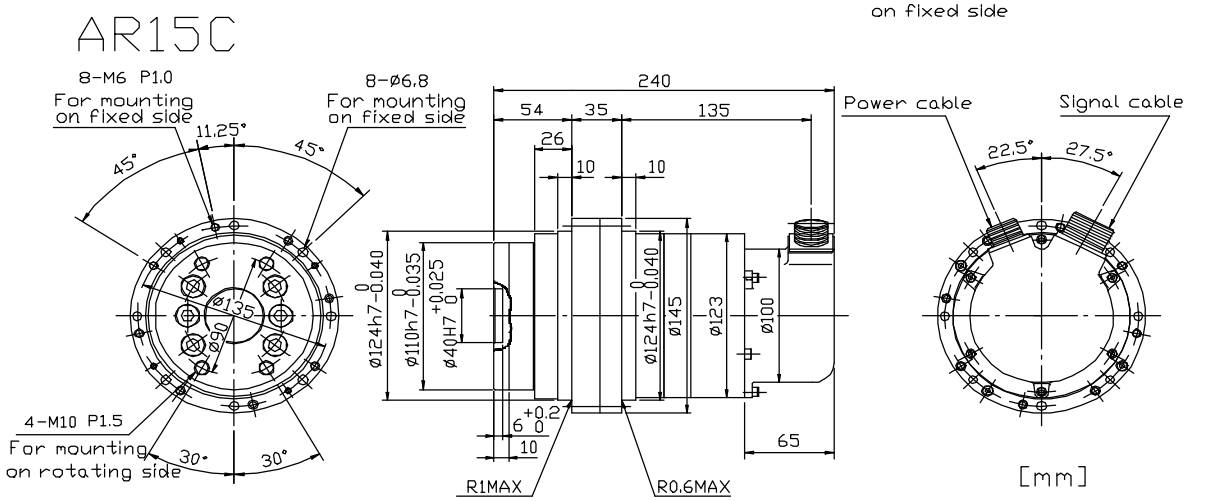
AR15A



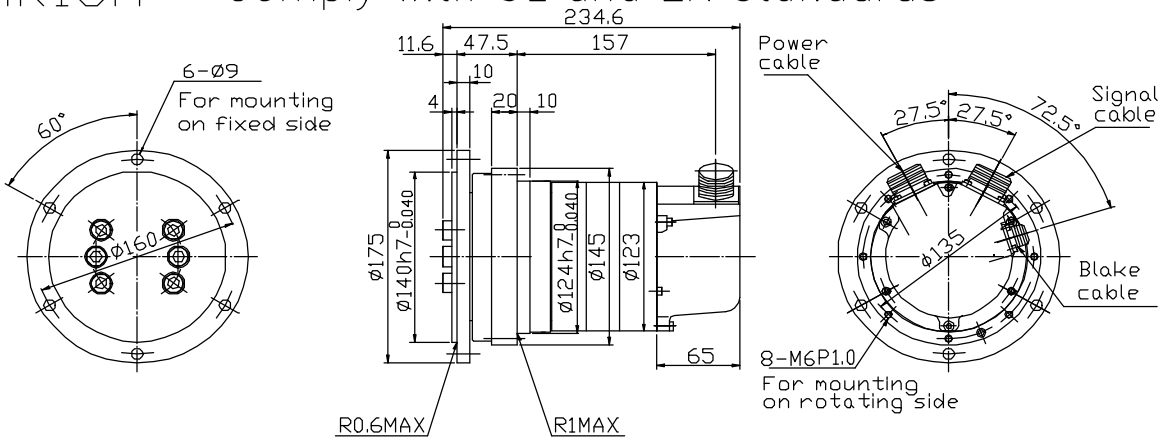
AR15B



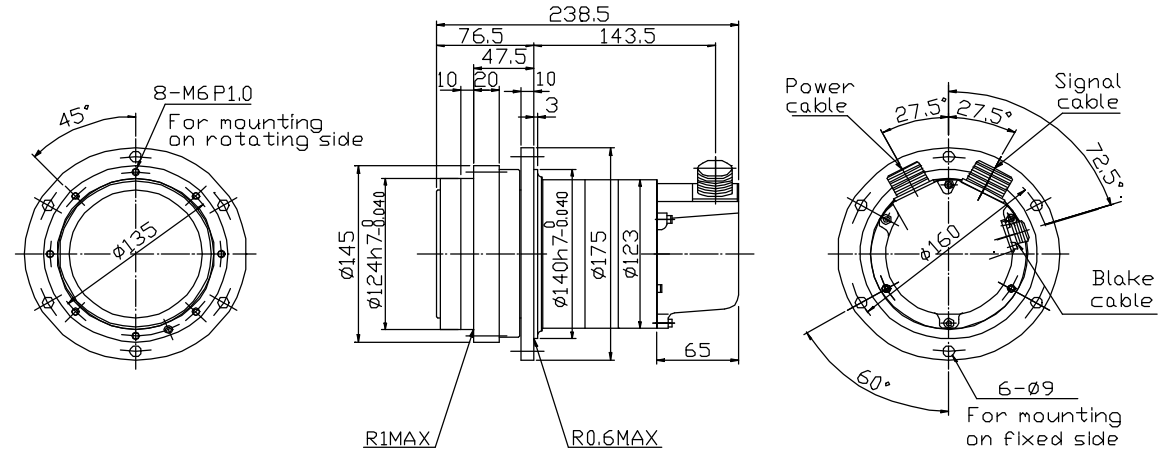
AR15C



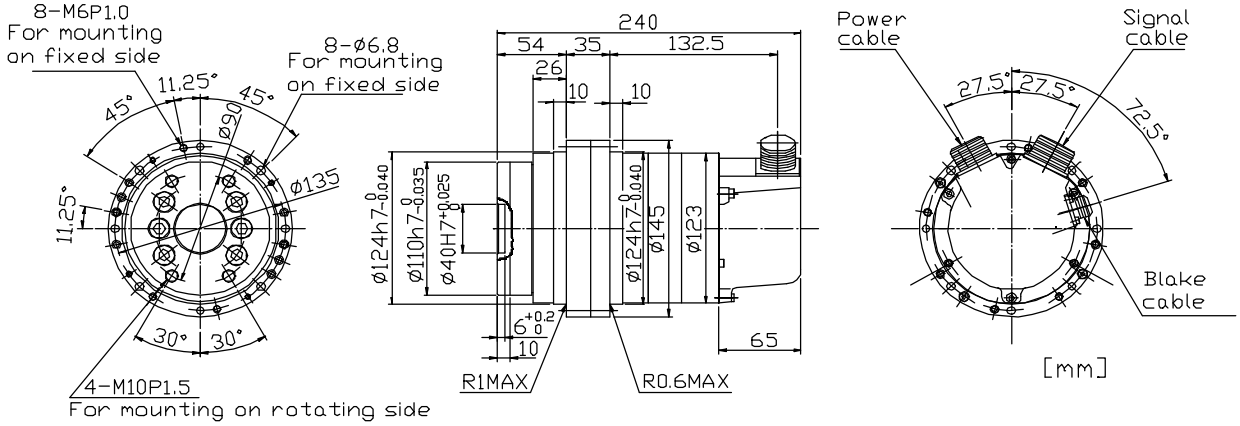
AR15A Comply with UL and EN standards



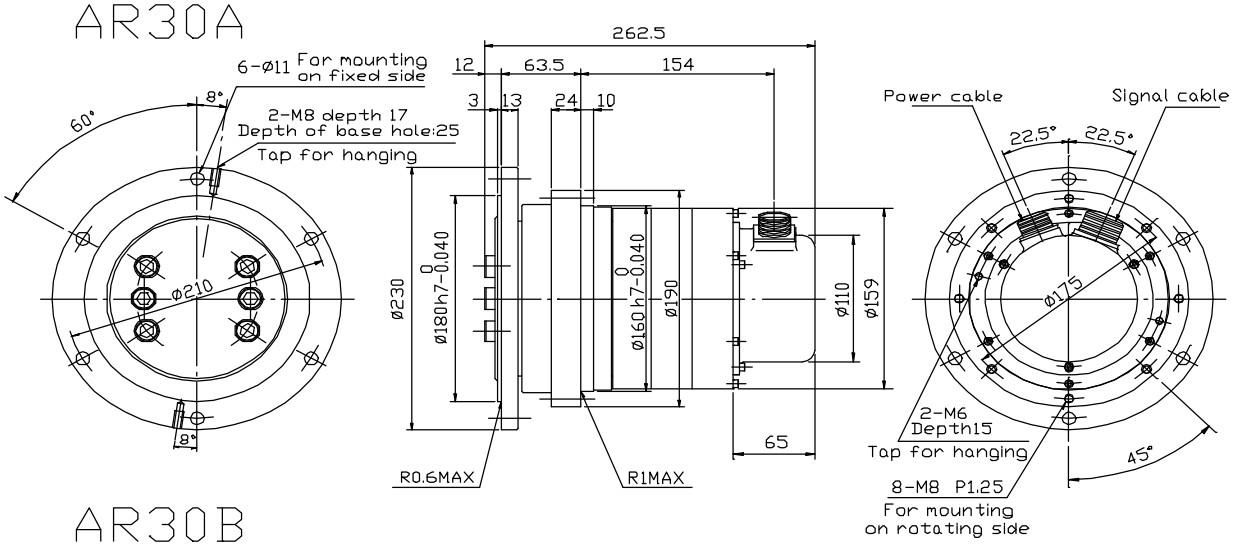
AR15B Comply with UL and EN standards



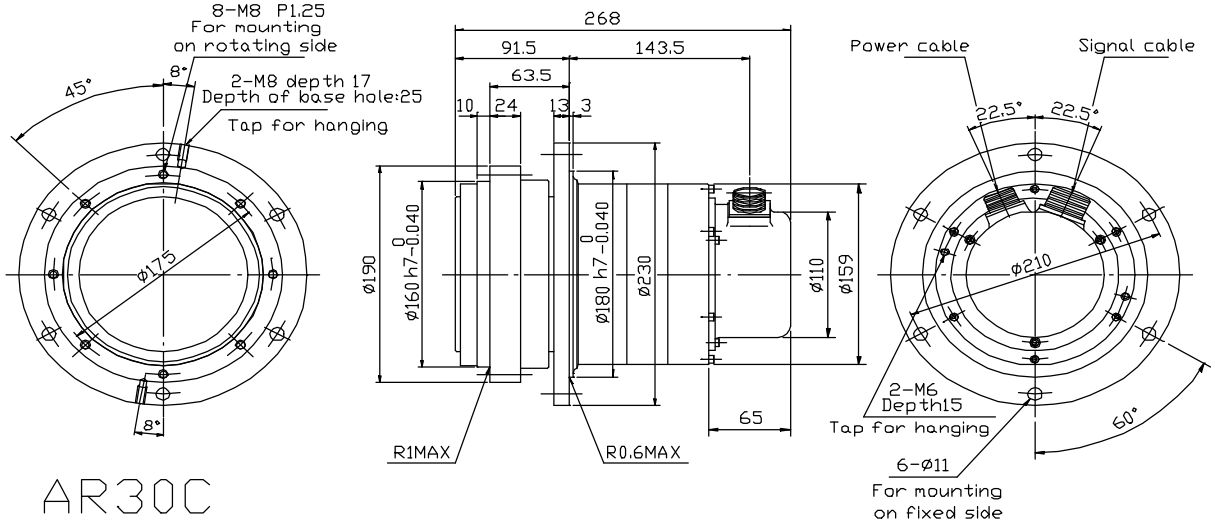
AR15C Comply with UL and EN standards



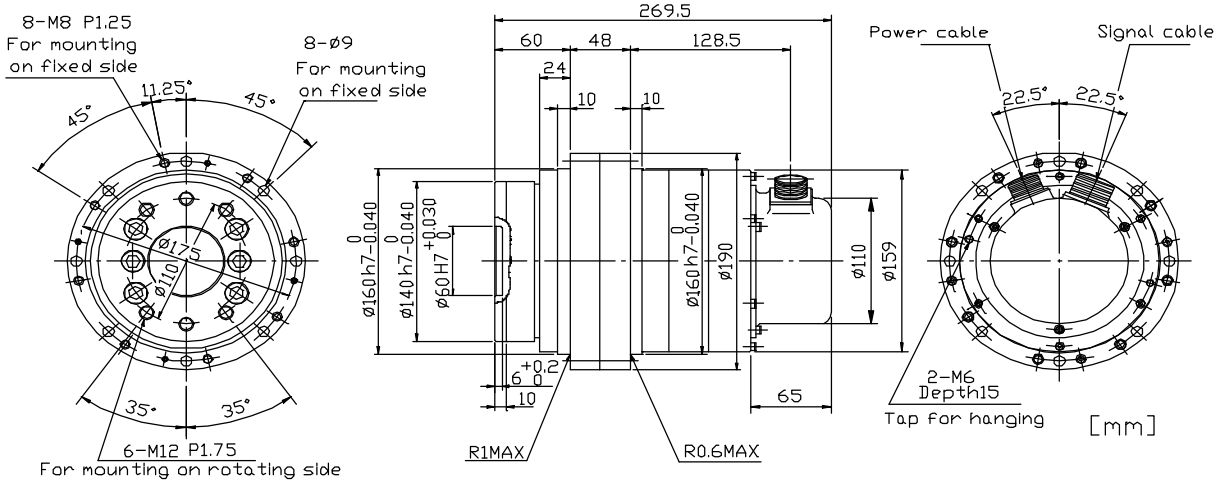
AR30A



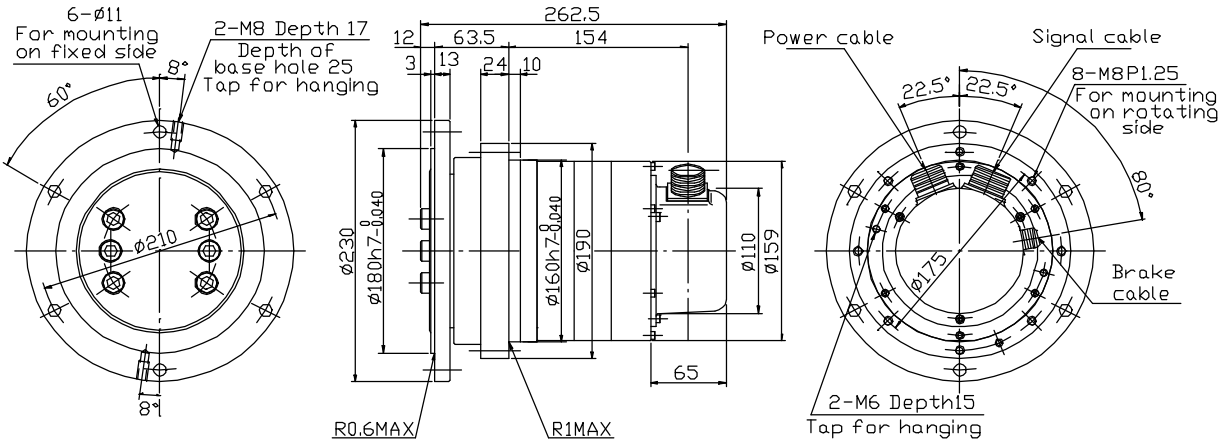
AR30B



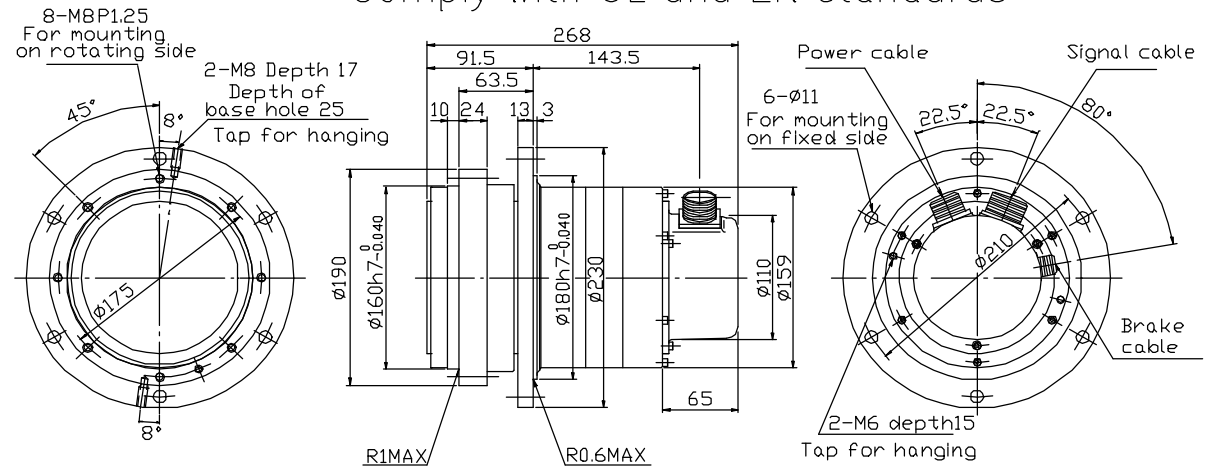
AR30C



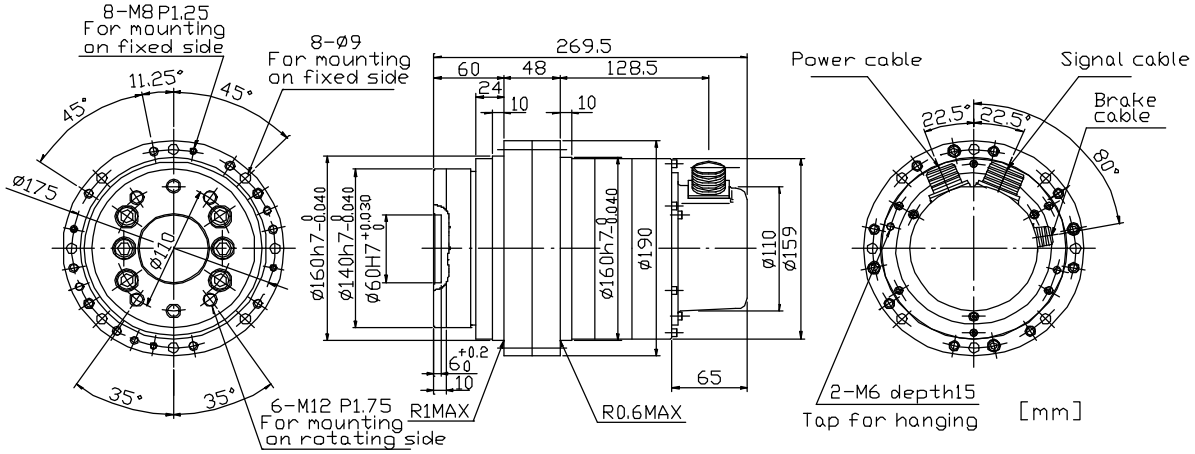
AR30A Comply with UL and EN standards



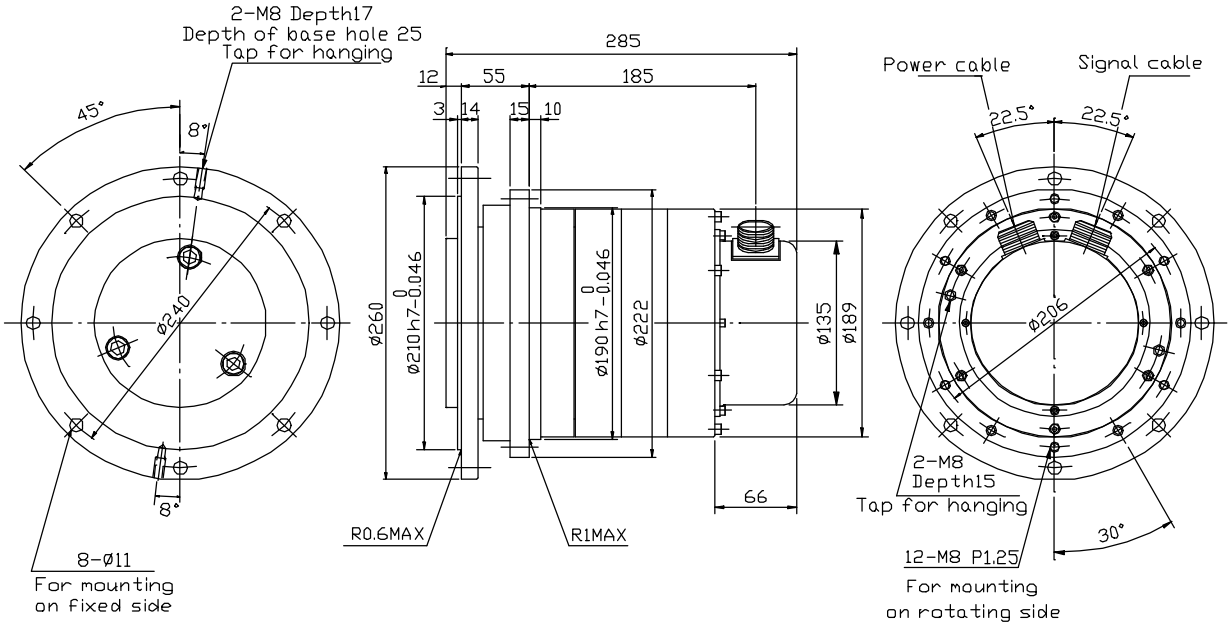
AR30B Comply with UL and EN standards



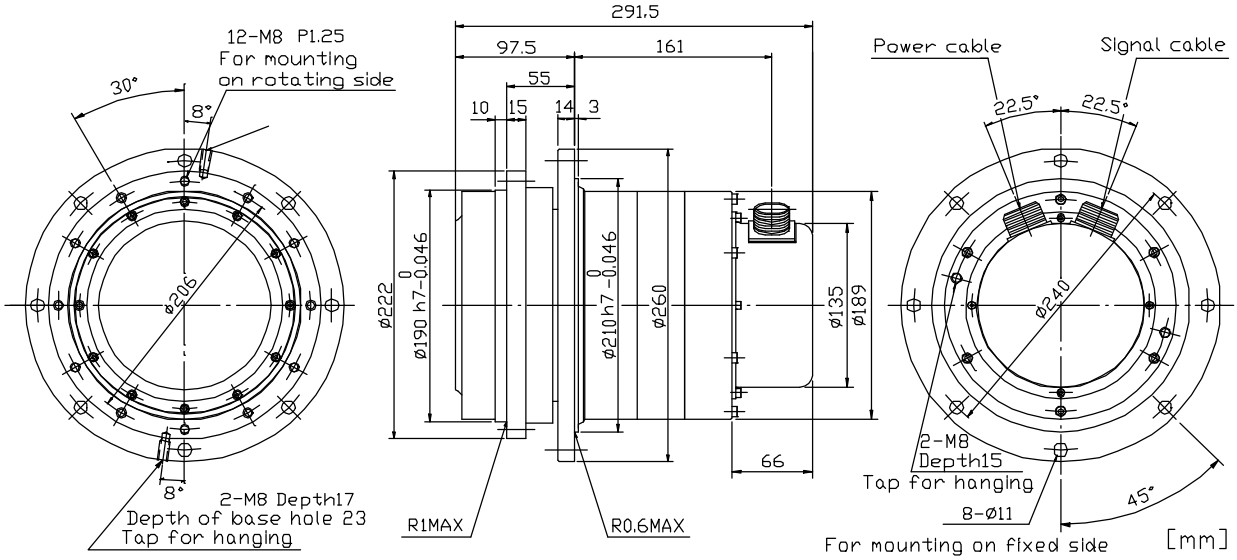
AR30C Comply with UL and EN standards



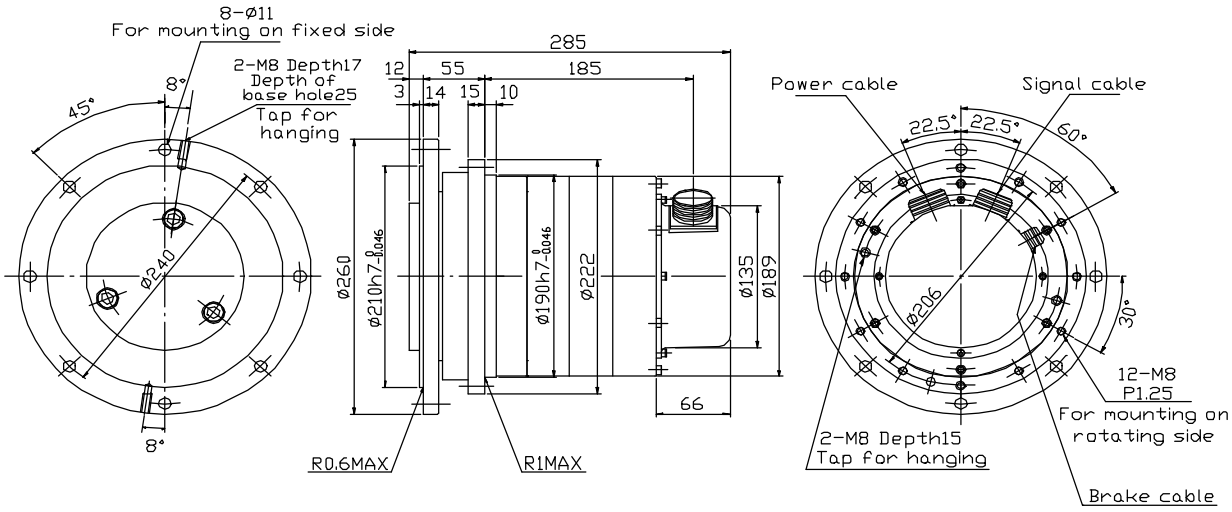
AR60A


2-M8 Depth17
Depth of base hole 25
Tap for hanging
45°
8°
ø240
8°
8-ø11
For mounting
on fixed side
285
12
55
185
3
14
15
10
ø260
ø210h7 0 -0.046
ø190h7 0 -0.046
ø222
ø135
ø189
66
R0.6MAX
R1MAX
Power cable
Signal cable
22.5°
22.5°
ø206
2-M8
Depth15
Tap for hanging
30°
12-M8 P1.25
For mounting
on rotating side

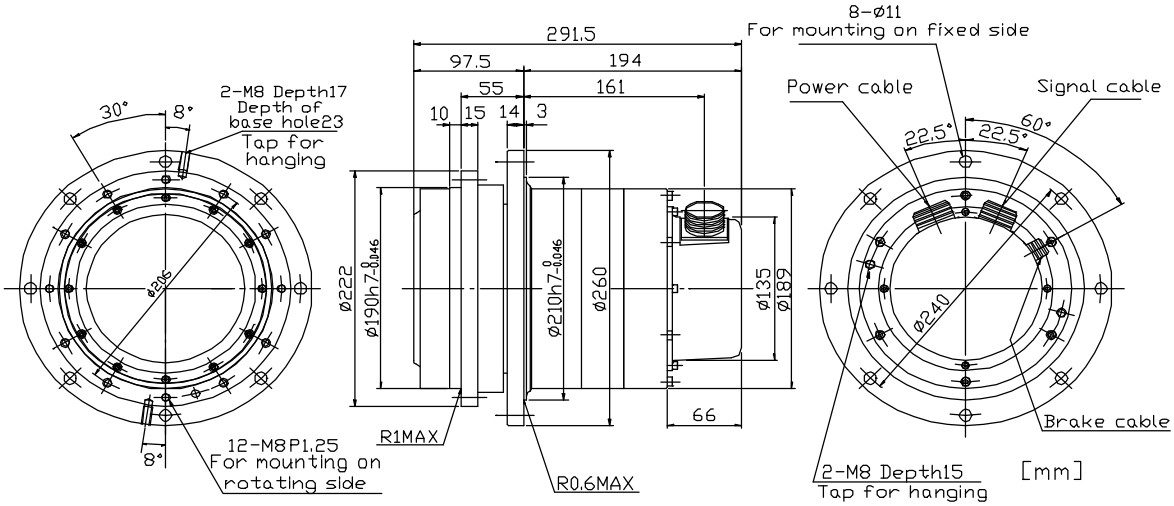
AR60B


12-M8 P1.25
For mounting
on rotating side
30°
8°
ø206
8°
2-M8 Depth17
Depth of base hole 23
Tap for hanging
291.5
97.5
161
55
10
15
14
3
ø222
ø190h7 0 -0.046
ø210h7 0 -0.046
ø260
ø135
ø189
66
R1MAX
R0.6MAX
Power cable
Signal cable
22.5°
22.5°
ø240
2-M8
Depth15
Tap for hanging
8-ø11
45°
For mounting on fixed side
[mm]

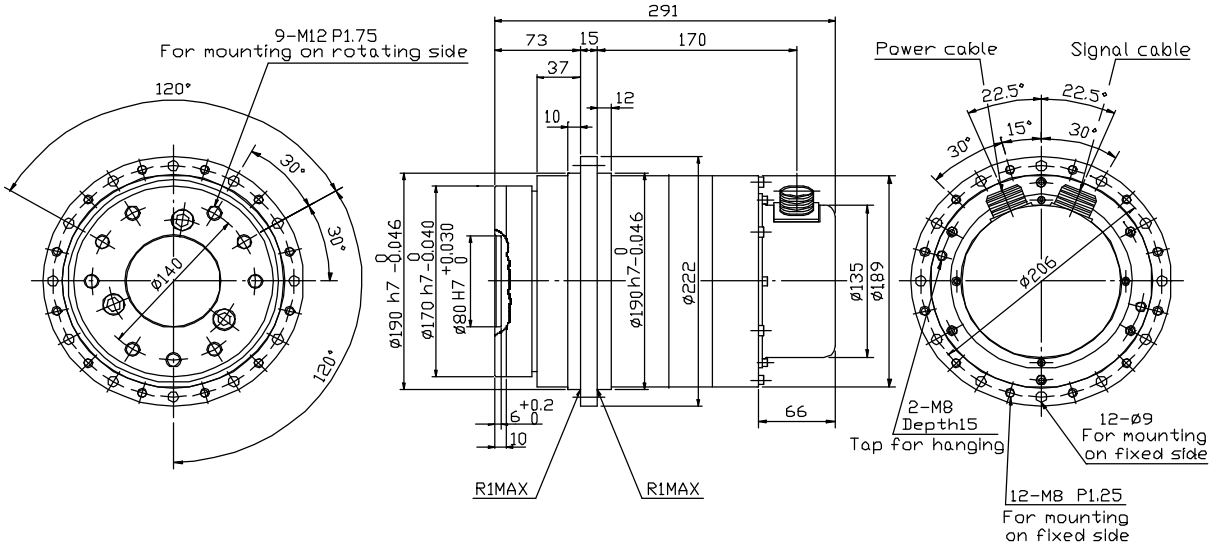
AR60A Comply with UL and EN standards



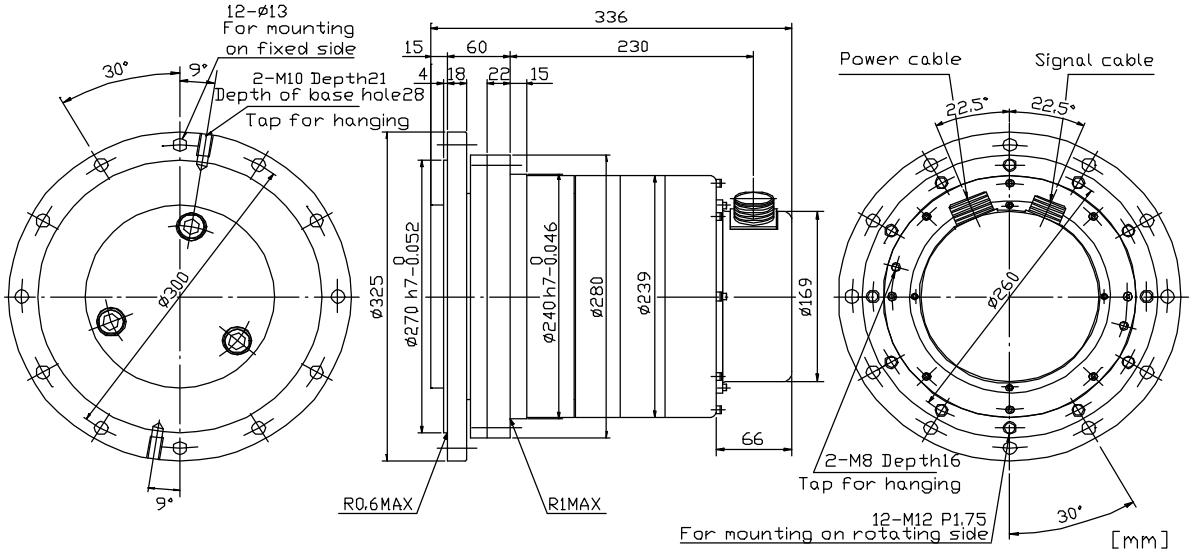
AR60B Comply with UL and EN standards



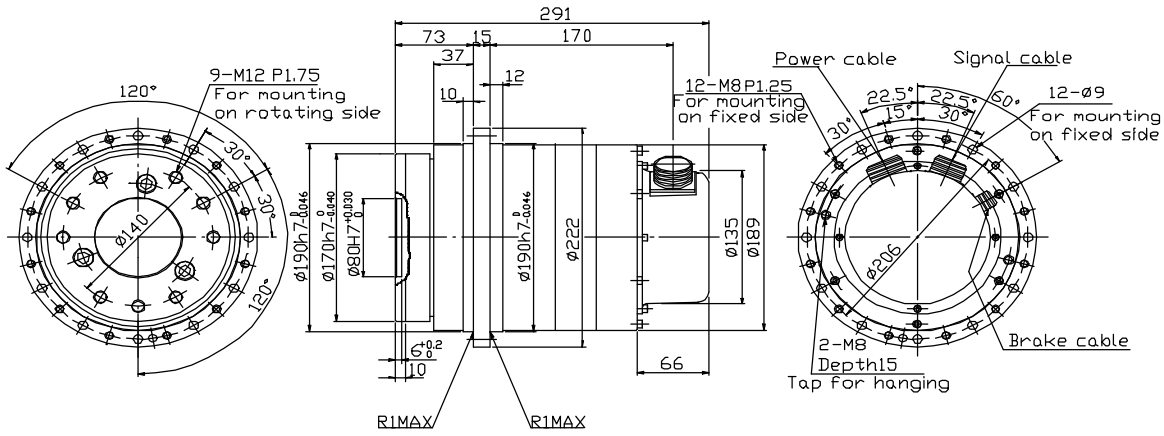
AR60C



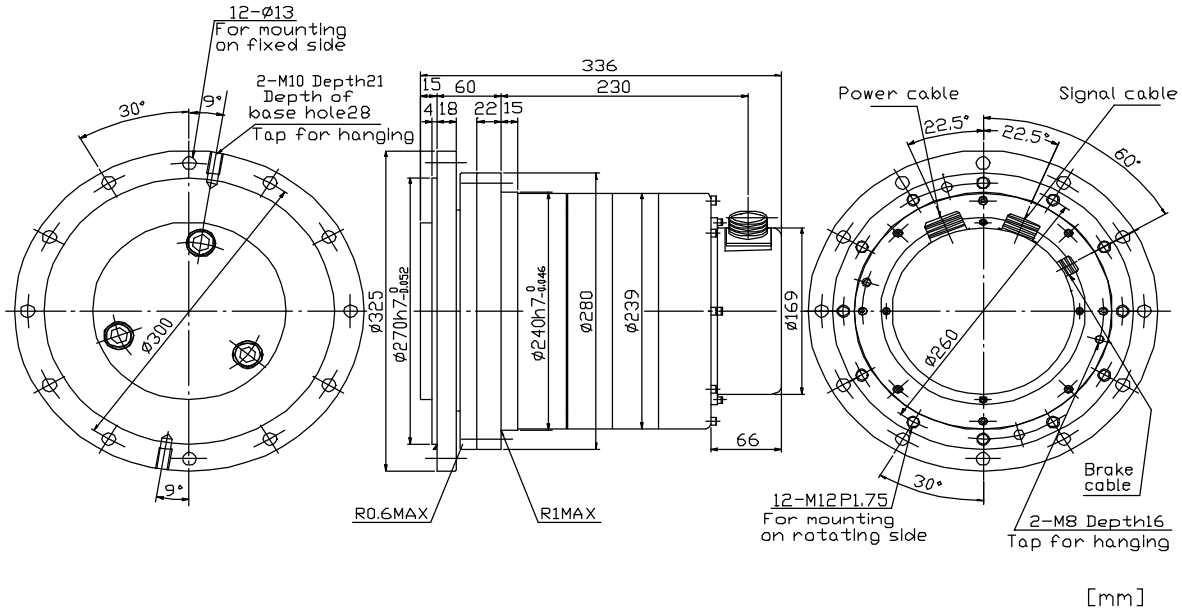
AR135A



AR60C Comply with UL and EN standards

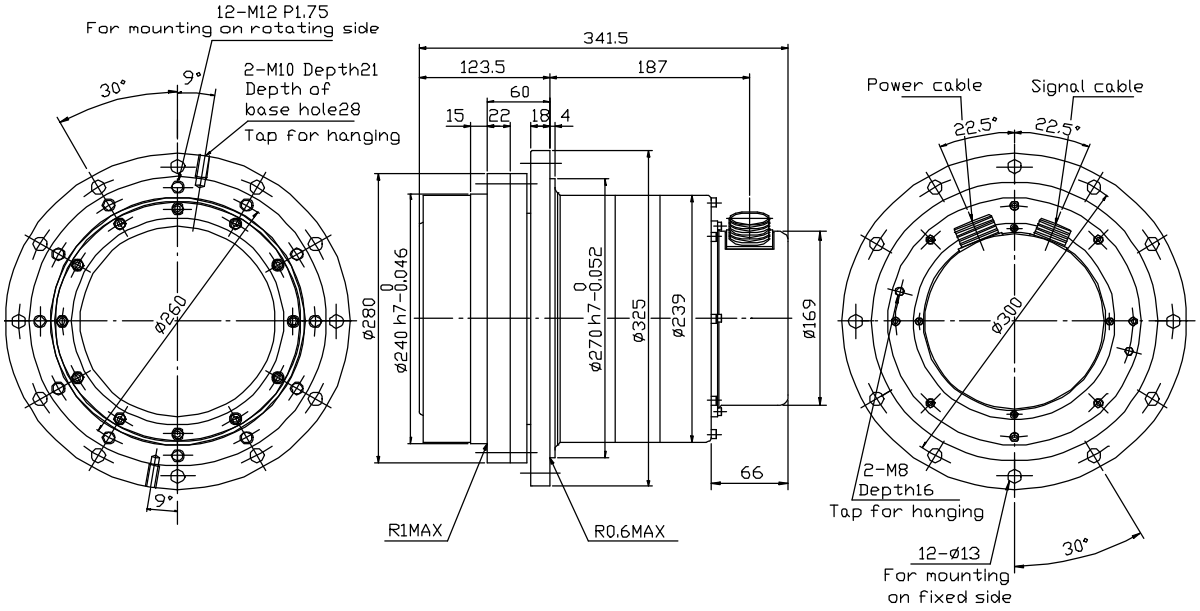


AR135A Comply with UL and EN standards

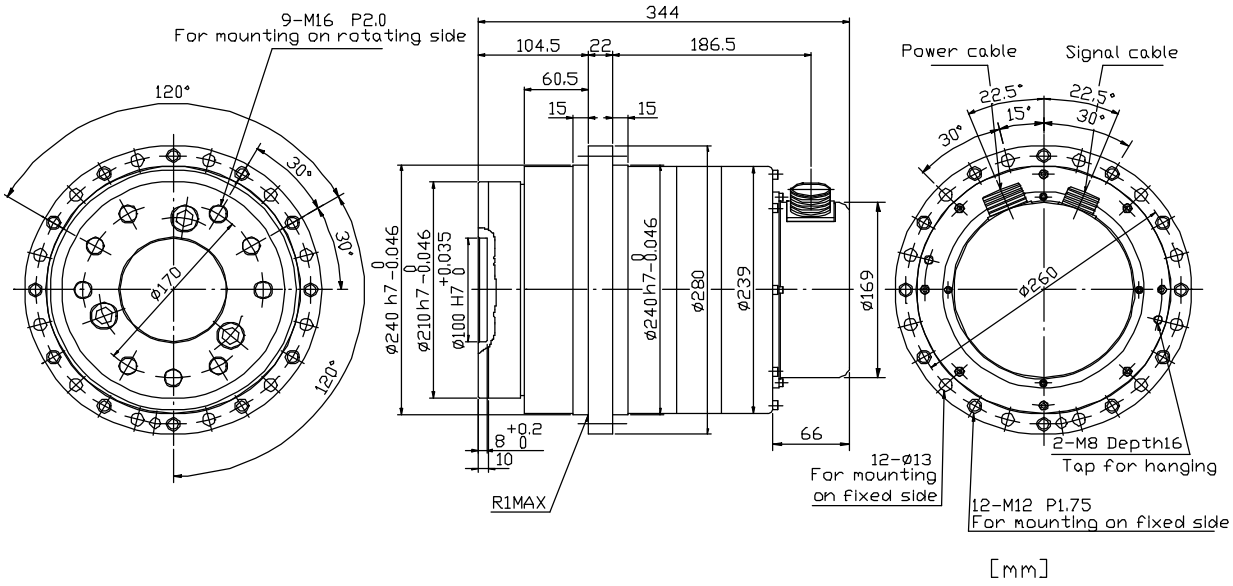


[mm]

AR135B

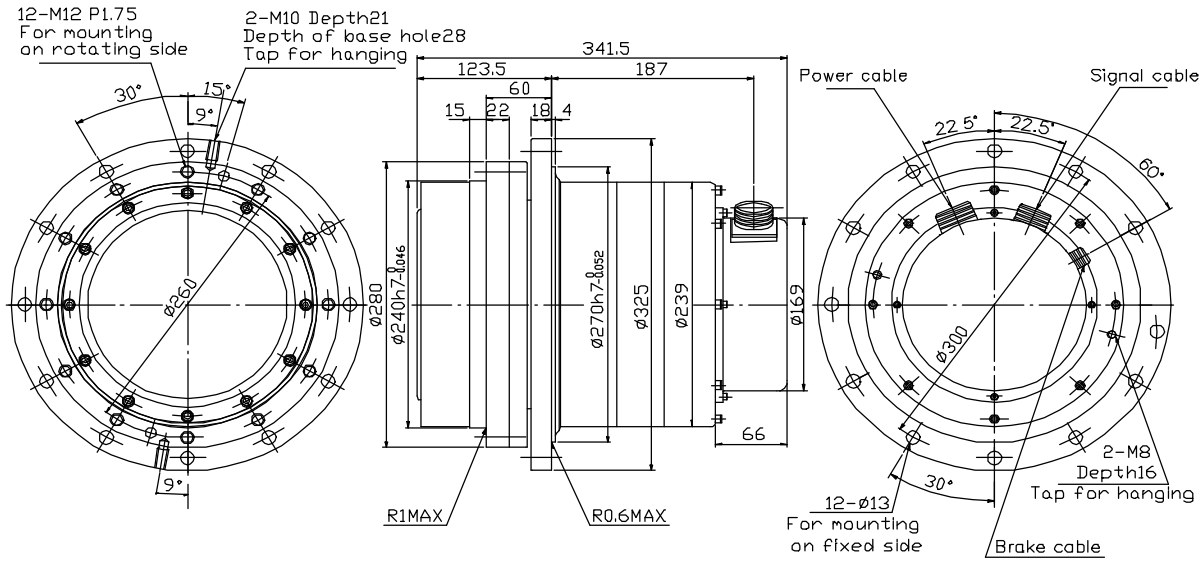


AR135C

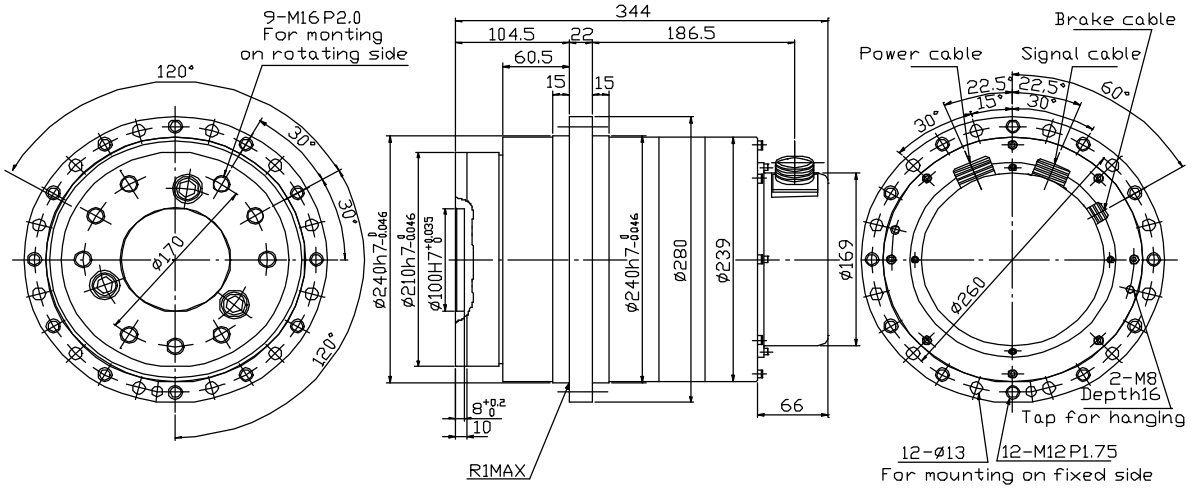


[mm]

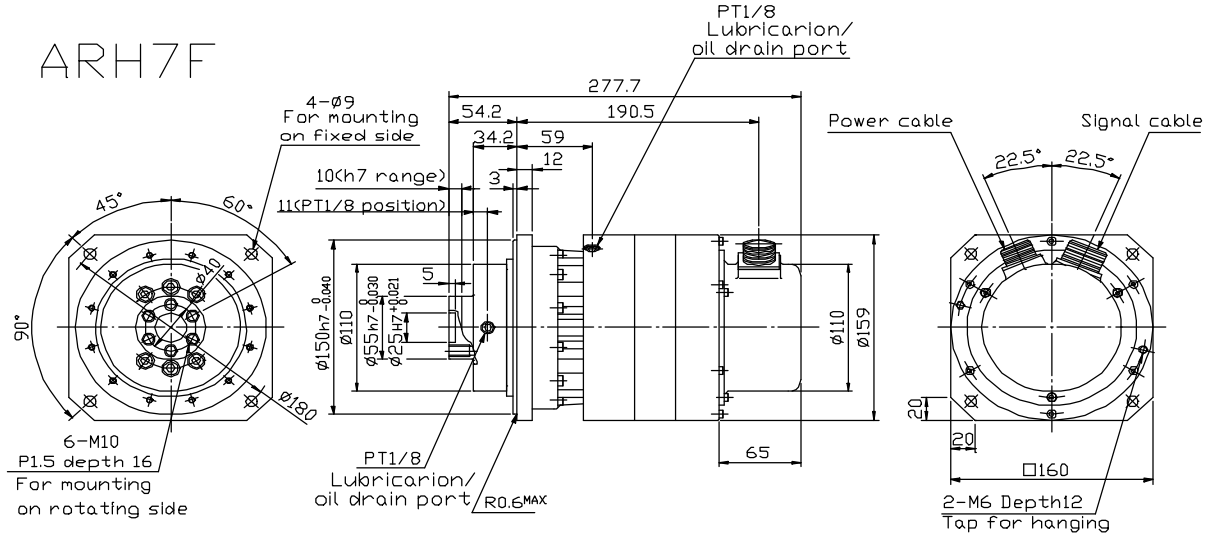
AR135B Comply with UL and EN standards

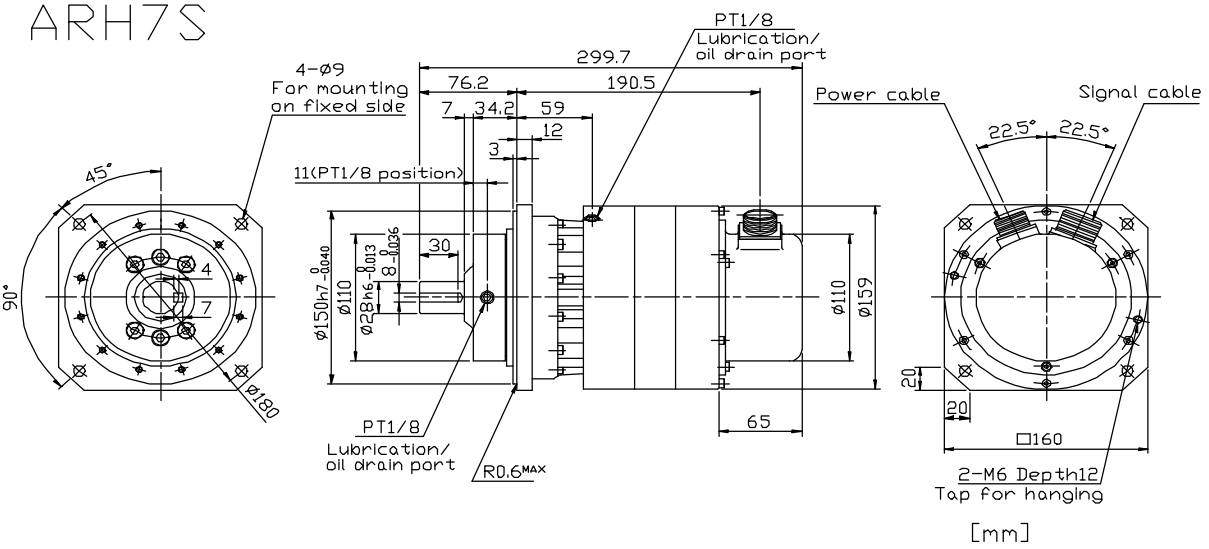


AR135C Comply with UL and EN standards

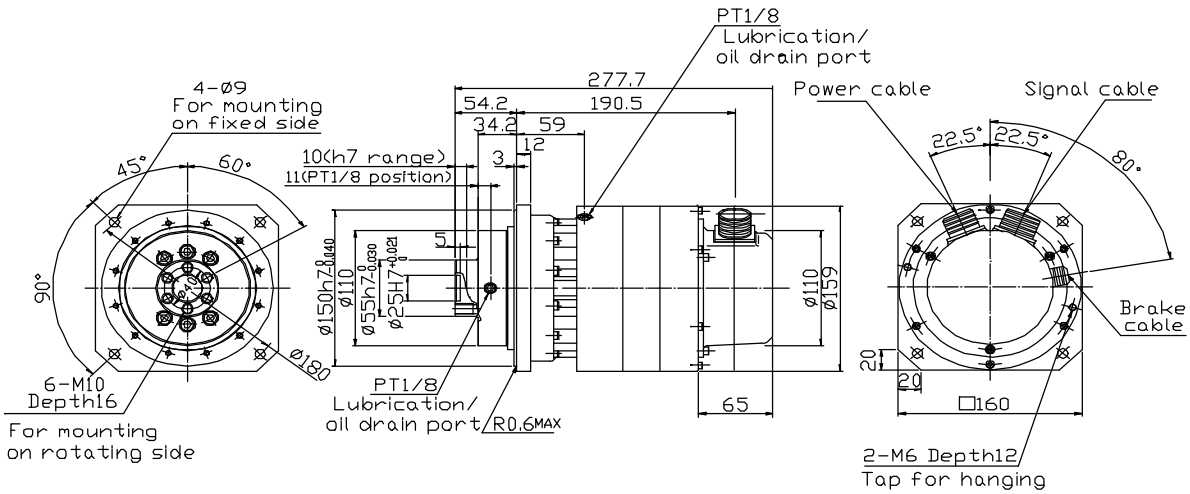


[mm]

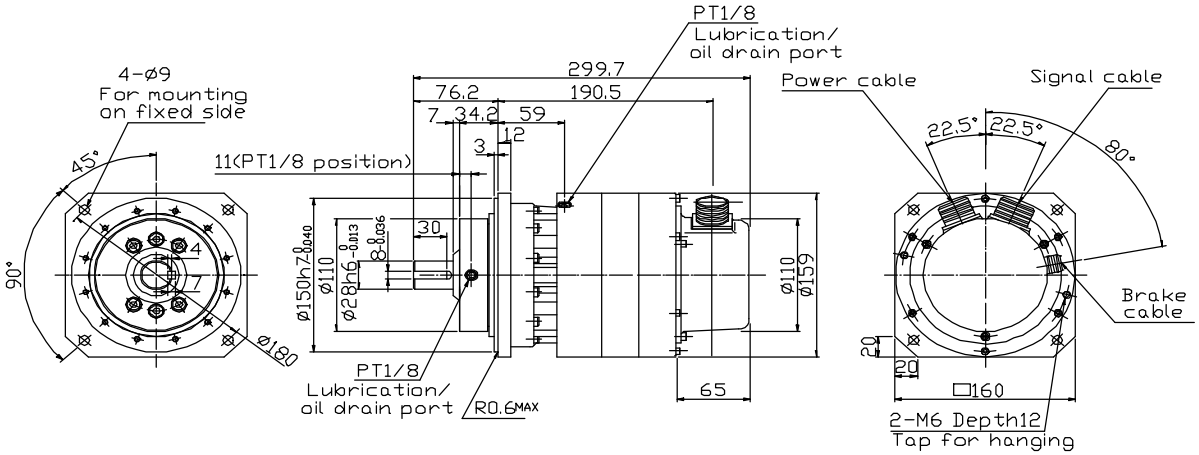

ARH7F
PT1/8
Lubricarion/
oil drain port
277.7
4-ø9
For mounting
on fixed side
54.2
190.5
34.2
59
12
10(h7 range)
3
11(PT1/8 position)
Power cable
Signal cable
22.5°
22.5°
45°
60°
90°
5
ø150h7 -0.040
ø110
ø55h7 -0.030
ø25H7 +0.021
ø110
ø159
ø180
6-M10
P1.5 depth 16
For mounting
on rotating side
PT1/8
Lubricarion/
oil drain port
R0.6MAX
65
20
20
□160
2-M6 Depth12
Tap for hanging


ARH7S
PT1/8
Lubrication/
oil drain port
299.7
4-ø9
For mounting
on fixed side
76.2
190.5
7
34.2
59
12
3
11(PT1/8 position)
Power cable
Signal cable
22.5°
22.5°
45°
90°
30
ø150h7 -0.040
ø110
ø28h6 -0.013
8 -0.036
4
7
ø110
ø159
ø180
PT1/8
Lubrication/
oil drain port
R0.6MAX
65
20
20
□160
2-M6 Depth12
Tap for hanging
[mm]

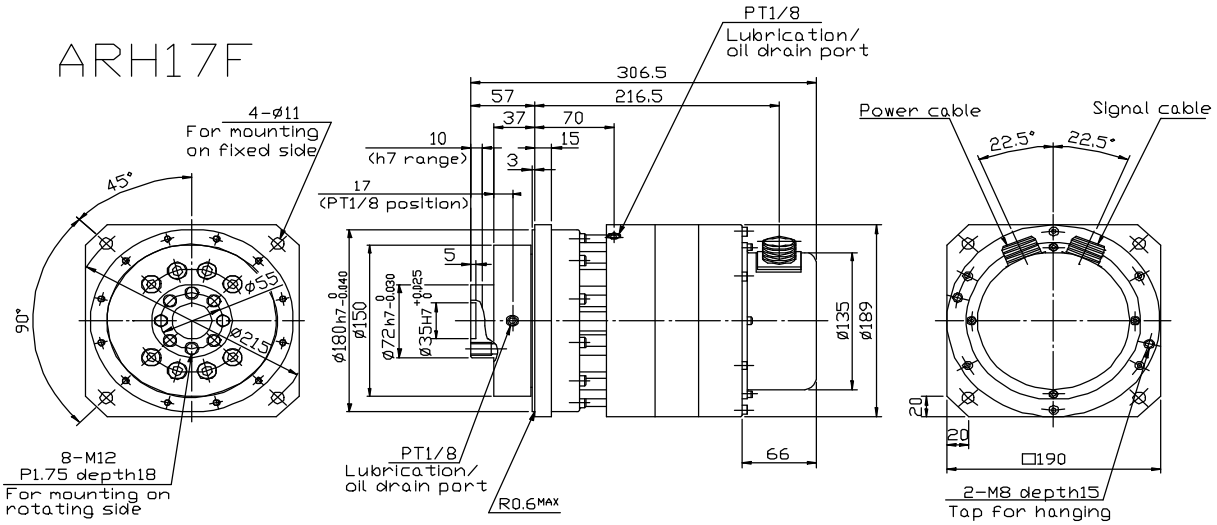
ARH7F Comply with UL and EN standards

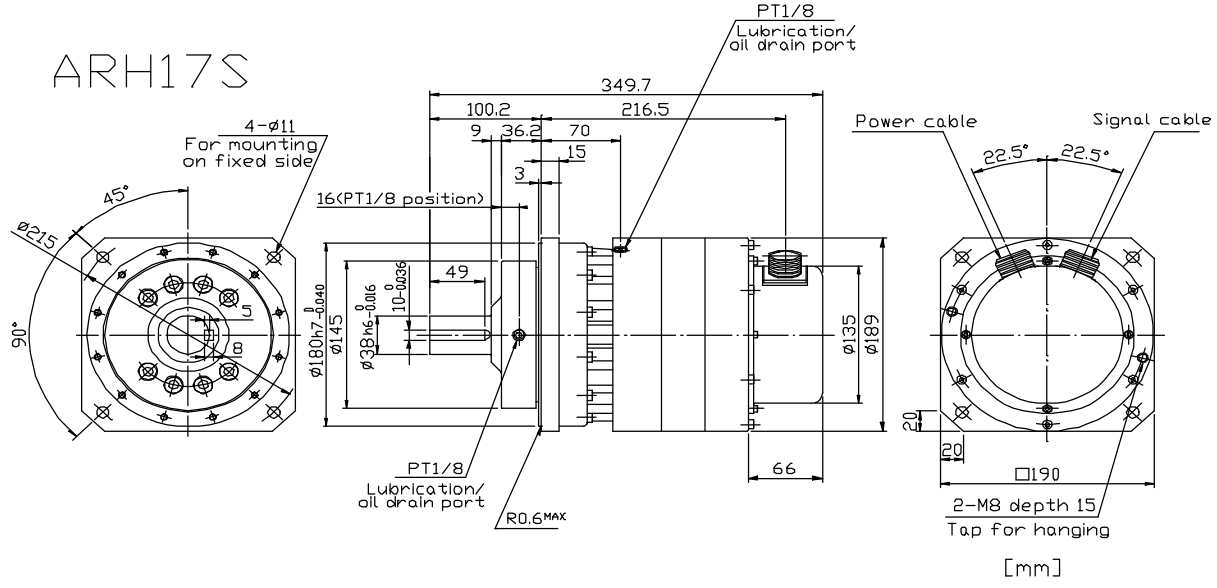


ARH7S Comply with UL and EN standards

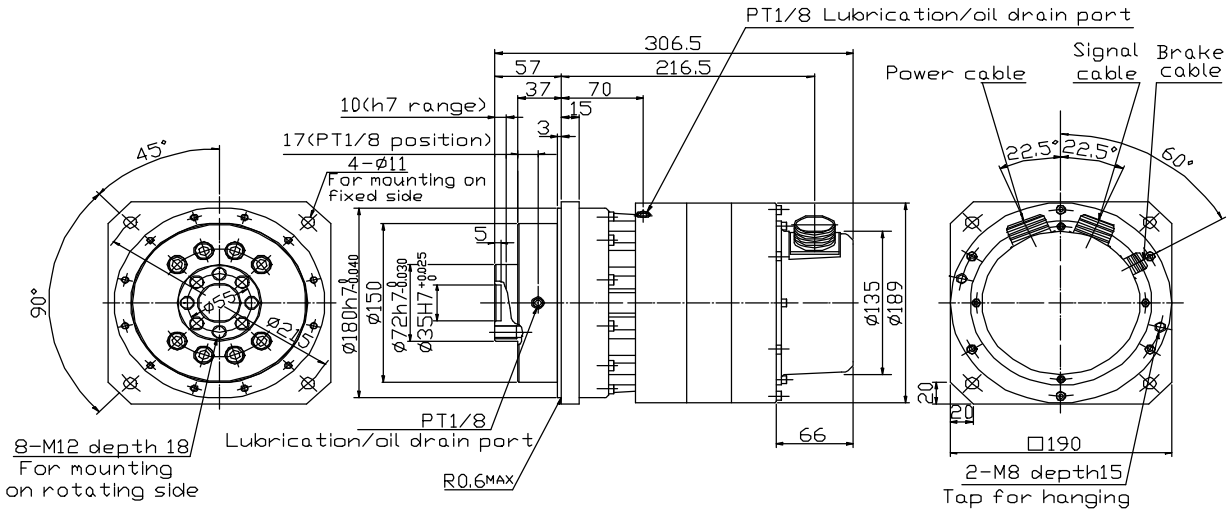


[mm]

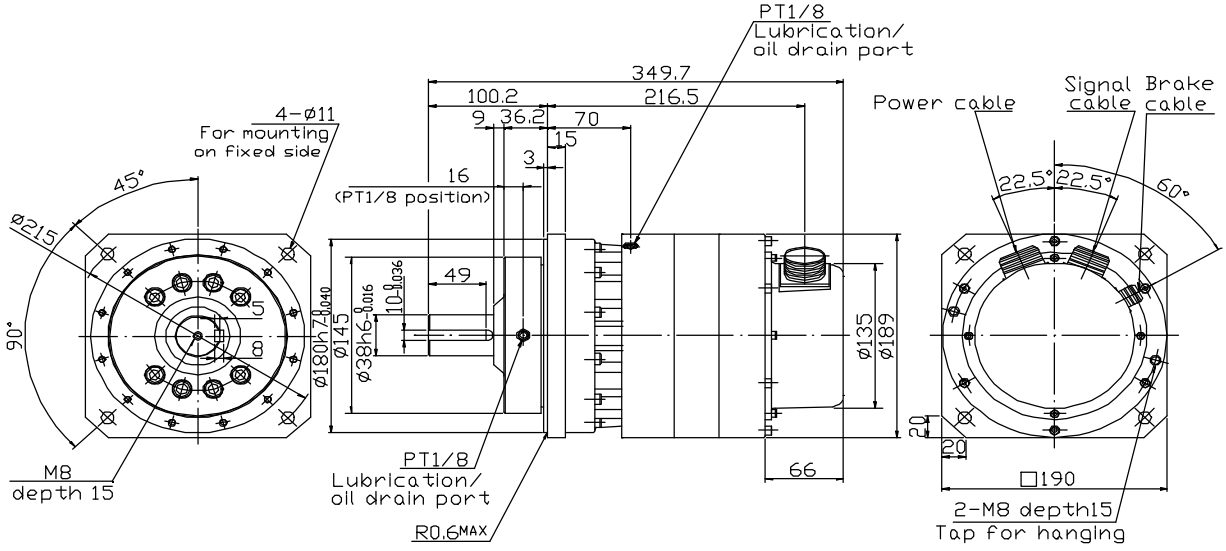

ARH17F
PT1/8
Lubrication/
oil drain port
306.5
57
216.5
37
70
15
3
10
(h7 range)
17
(PT1/8 position)
4-ø11
For mounting
on fixed side
45°
90°
ø55
ø215
5
ø180h7 0 -0.040
ø150
ø72h7 0 -0.030
ø35H7 +0.025 0
8-M12
P1.75 depth18
For mounting on
rotating side
PT1/8
Lubrication/
oil drain port
R0.6MAX
ø135
ø189
66
Power cable
Signal cable
22.5°
22.5°
20
20
□190
2-M8 depth15
Tap for hanging


ARH17S
PT1/8
Lubrication/
oil drain port
349.7
100.2
216.5
9
36.2
70
15
3
16(PT1/8 position)
4-ø11
For mounting
on fixed side
45°
90°
ø215
5
8
49
ø180h7 0 -0.040
ø145
ø38h6 0 -0.016
10 0 -0.036
PT1/8
Lubrication/
oil drain port
R0.6MAX
ø135
ø189
66
Power cable
Signal cable
22.5°
22.5°
20
20
□190
2-M8 depth 15
Tap for hanging
[mm]

ARH17F Comply with UL and EN standards

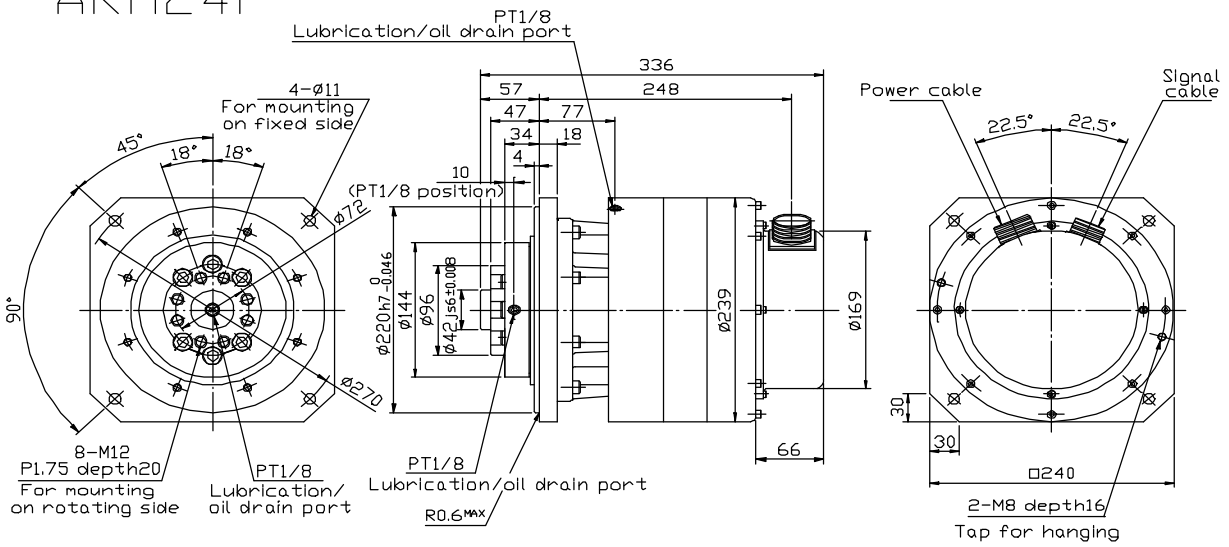


ARH17S Comply with UL and EN standards

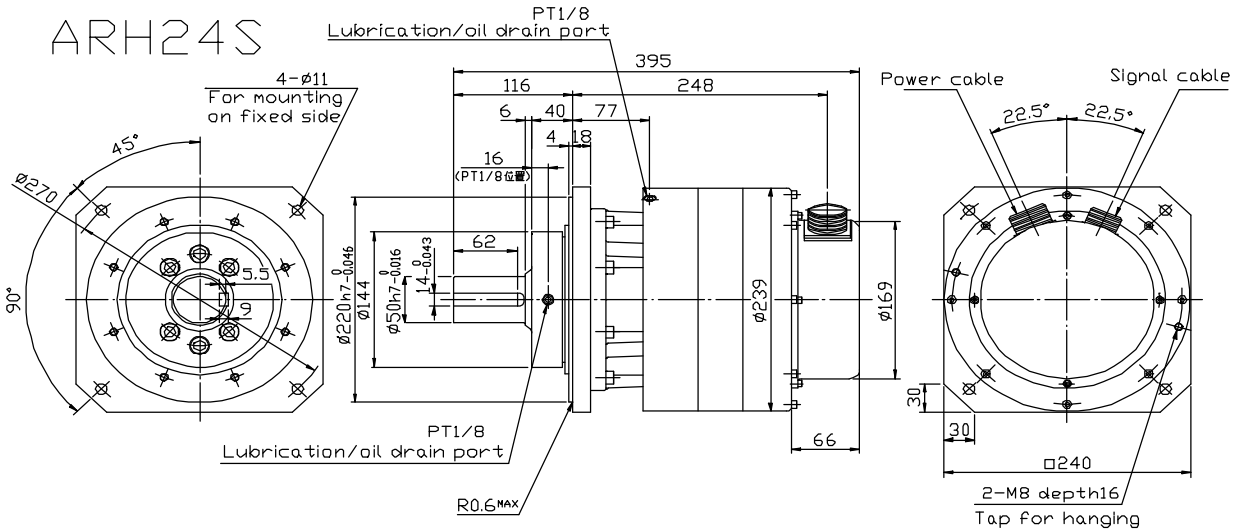


[mm]

ARH24F

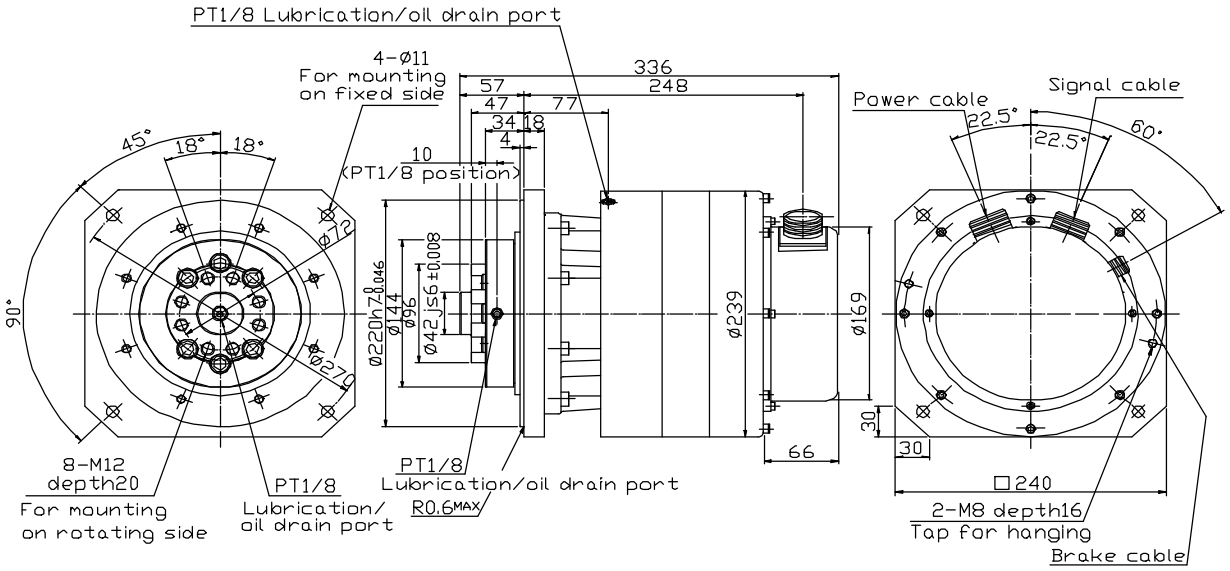


ARH24S

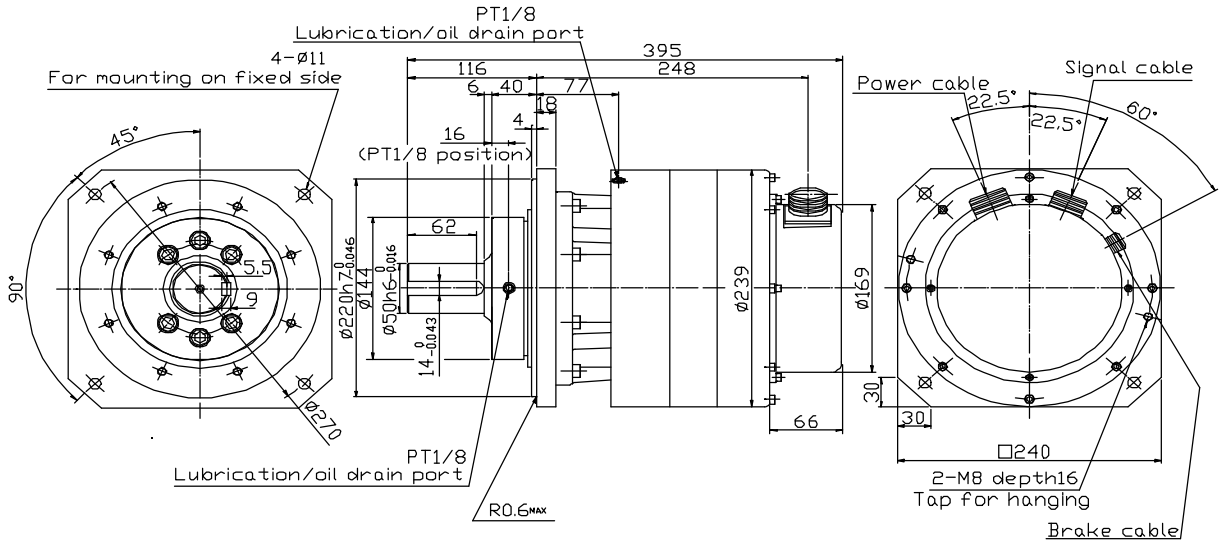


[mm]

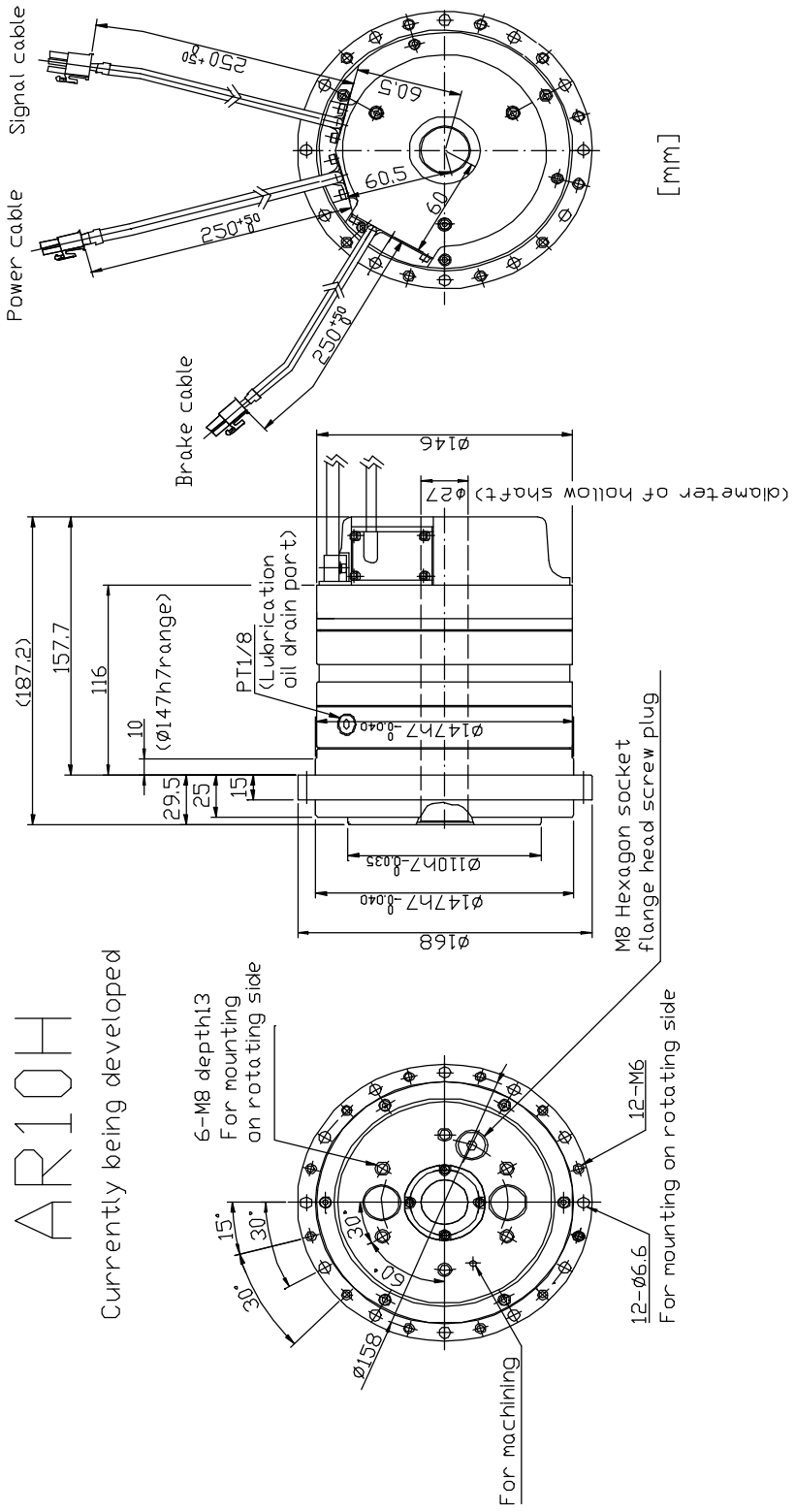
ARH24F Comply with UL and EN standards



ARH24S Comply with UL and EN standards

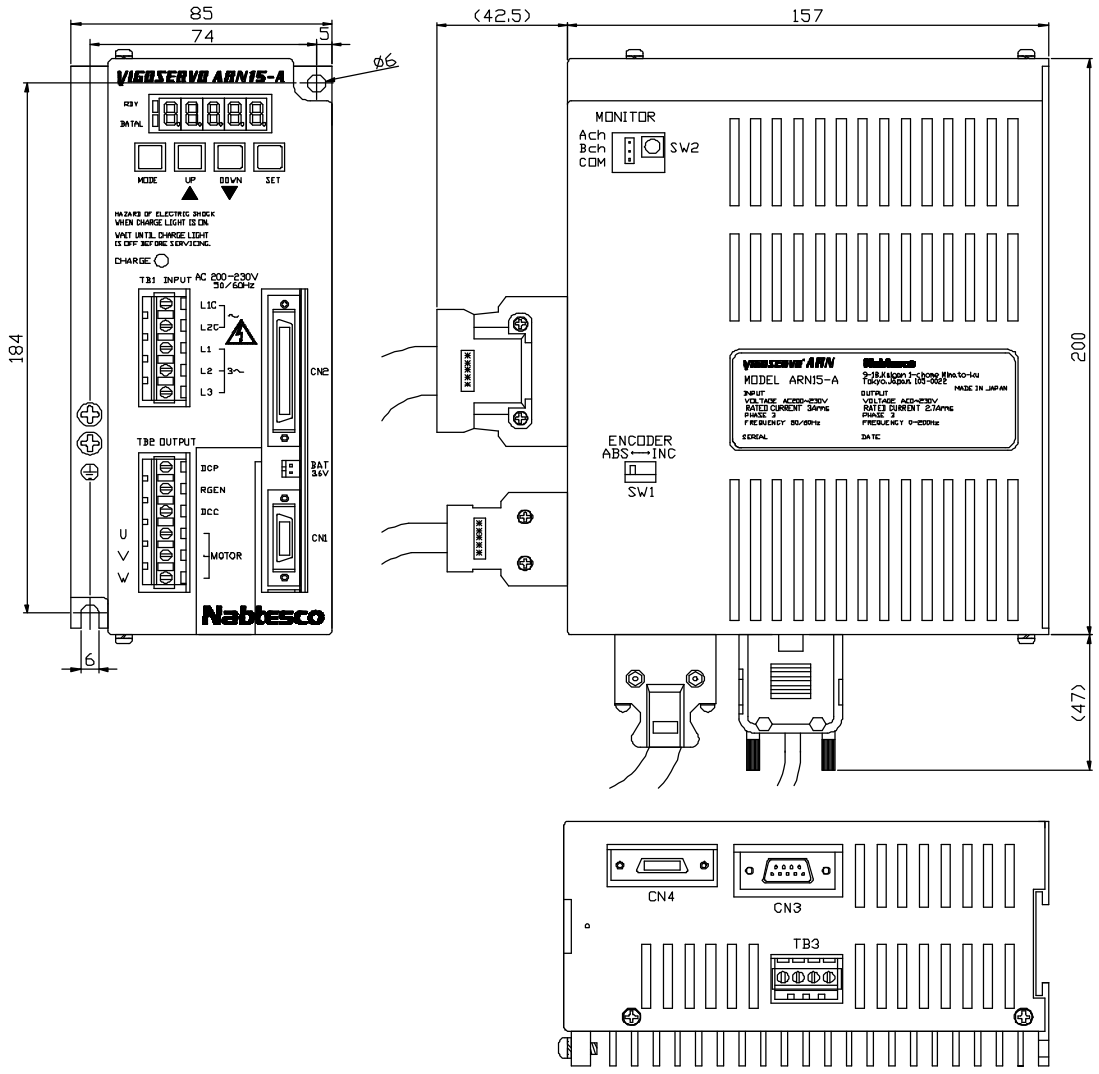


[mm]

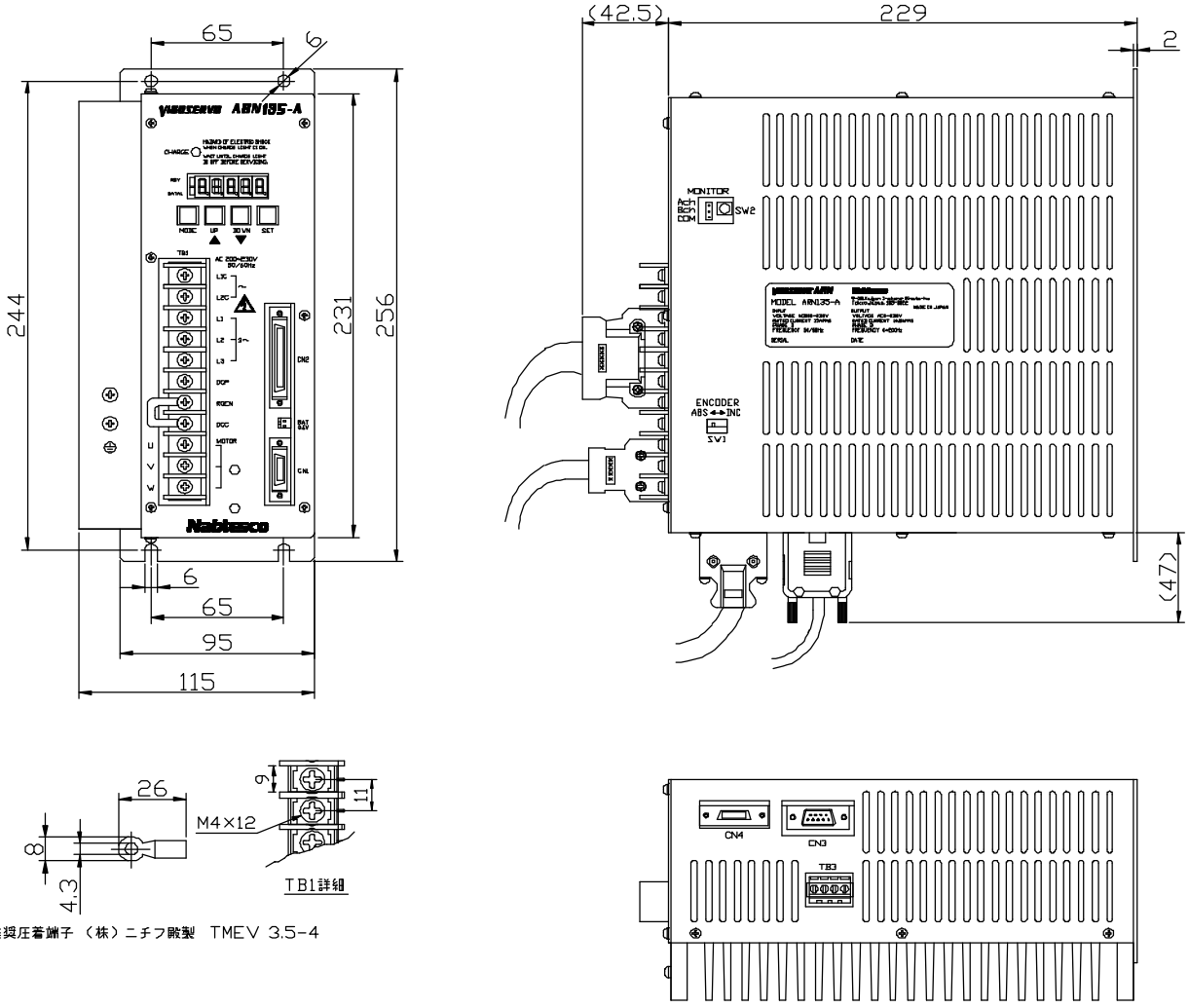

AR10H
Currently being developed
Signal cable
Power cable
Brake cable
250±50
60.5
60
[mm]
ø146
(diameter of hollow shaft) ø27
(187.2)
157.7
116
10
(ø147h7range)
PT1/8
(Lubrication
oil drain port)
ø147h7 +0.040 0
29.5
25
15
ø110h7 -0.035
ø147h7 +0.040 0
ø168
M8 Hexagon socket
flange head screw plug
6-M8 depth13
For mounting
on rotating side
12-M6
12-ø6.6
For mounting on rotating side
15°
30°
30°
30°
60°
ø158
For machining

11-2 Servo Amplifier

(1) ARN15, 30



(2) ARN60, 135



推奨圧着端子（株）ニチフ製造 TMEV 3.5-4

Product disposal

To protect the environment, choose a recycling contractor, if possible, when disposing of the servo system.

If you have any questions concerning the disposal of servo system, consult with the dealership where you purchased the product or contact our sales office.

Service information

When you have any questions concerning the servo system or servicing, please contact us at any of the following addresses.

When you request service, please inform us of the basic information (model and serial numbers) on your servo system's nameplate.

Nabtesco
TS Corporation

.In North and South America
Nabtesco Precision USA Inc
31731 Northwestern Hwy.,Suite 113E, Farmington Hills,Michigan 48334 U.S.A.
Phone : +1-248-538-9165 Fax : +1-248-538-9170
Email : info@nabtesco-precision.com
Home page : www.nabtesco-precision.com

.In Europe and Africa
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