

Maintenance Manual for AR Series VIGO Servo

Publication # CARSMA0010E



Maintenance Manual for AR Series VIGO Servo

Publication # CARSMA0010E

10/2000

CAUTION

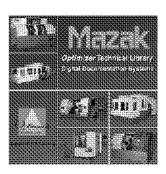
This Manual is published to assist experienced personnel on the operation, maintenance and/or programming of Mazak machine tools.

All Mazak machine tools are engineered with a number of safety devices to protect personnel and equipment from injury or damage. Operators should not, however, rely solely upon these safety devices, but should operate the machine only after fully understanding what special precautions to take by reading the following documentation thoroughly.

Do not attempt to operate or perform maintenance / repair on the machine without a thorough understanding of the actions about to be taken. If any question exists, contact the nearest Mazak service center for assistance.

Certain covers, doors or safety guards may be open or removed to more clearly show machine components. These items must be in place before operating the machine. Failure to comply with this instruction may result in serious personal injury or damage to the machine tool.

This manual was considered complete and accurate at the time of publication, however, due to our desire to constantly improve the quality and specification of all Mazak products, it is subject to change or modification.



Notes:

CONTENTS

1.	Spec	cifications for AR series VIGO SERVO	1-1
	1-1.	Basic Structure	
	1-2.	Indications of Models	1-2
		1-2-1. Servo actuator	
		1-2-2. Servo controller	1-3
	1-3.	Table for the Specifications	1-4
		⚠Using Environment	
	1-5.	Block Diagram of Servo Controller	1-6
_	1	Mation Test Openstics and Adjustics and	
2.		Allation, Test Operation and Adjustments	
	2-1.	Alnstallation of the Servo Actuator	
		2-1-1. Clamping torque of fixing bolts and allowable torque	
		2-1-2. Aligning	
		2-1-3. Conical spring washers	
	2-2.	Installing the Servo Controller	2-2
		2-2-1. Methods of installation	
		2-2-2. Environment of the installing location	
	2-3.	Wiring and Connections	
		2-3-1. Wiring to the servo driver/controller	
		3	2-6
		2-3-3. Specifications of receptacles	
		2-3-4. Specifications of signal line connectors	
	2-4.		
		2-4-1. AConnection of the main circuit power	
		2-4-2. Protection of power supplies	
		2-4-3. Main circuit power supply conditions	
		2-4-4. Applicable wires and sizes	
		2-4-5. A Grounding	2-17
		2-4-6. Wiring of signal lines	
		2-4-7. Noise suppression	
		2-4-8. ACautions on the holding brake	2-18
	2-5.	Trial Operation	2=19
		2-5-1. Alnspections before operation	2-19
		2-5-2. AStarting the operation	2-19
		2-5-3. Sequence after applying the power	2-20
	2-6.	Reference Point Adjustment	2-21
	2-7.	•	2-22
		2-7-1. Alnspections before operation	2-22
			2-22
			2-23
		- · · · · · · · · · · · · · · · · · · ·	

3.	Expl	anations of the Servo Controller	3-1
	3-1.	Specifications	3-1
	3-2.	Drive Mode	3-2
		3-2-1. Timing chart	3-3
	3-3.	Input and Output Signals	3-8
		3-3-1. Input signals (CN2)	
		3-3-2. Output signals (CN2)	3-9
		3-3-3. Anput signal specifications	3-10
		3-3-4. \(\text{\text{Output signal specifications} \) \(\text{} \)	3-12
	3-4.		3-14
			3-14
			3-15
			3-18
			3-20
		3-4-5. Items of parameter setting	3-21
			3-27
		·	3-32
		3-4-8. Servo parameters	
		3-4-9. Alarm history	
	3-5	Driver Section	
	J J.	3-5-1. Driver (CN4) input and output signal	
	3-6	Measurement of Servo Motor Shaft Torque	0 10
	3 0.	and Speed (Revolution)	3-43
		3-6-1. Measuring method	
		3-6-2. Calculating the torque	
		3-6-3. Calculating the speed	3-44
		o o o, containing the speed	V
4.	Trou	ibleshooting	4-1
		Inspection in Trouble	
	,	4-1-1. Inspection in trouble	
		4-1-2. Actions required at occurrence of abnormality	
		4-1-3. In case of improper positioning	
		4-1-4. In case of abnormal sound, vibration or heat generation	
	4-7	Diagnosis and Countermeasures for Abnormality in Control	4-7
		4-2-1. Explanations of control alarm	4-7
		4-2-2. Releasing the alarm state	4-8
		4-2-3. Dynamic braking function	4-8
		4-2-4. Diagnosis and countermeasures for the control alarms	4-10
		4-2-5. Diagnosis and countermeasures for	
		control alarm (Driver)	4-14
		4-2-6. Diagnosis and countermeasures for controller alarm	4-17
	4-3	Abnormalities in the Battery and when to Renew it	4-18
	,	4-3-1. When to renew the battery	4-18
		4-3-2. Cautions when renewing the battery	4-18
		4-3-3 Applicable types of the battery and connector	4-19

5.	AR Series Dimensional Outline Drawings 5	-1
	5-1. Dimensional Outline Drawings for Servo Actuator 5-	-1
	5-2. Dimensional Outline Drawings for Servo Controller 5-	-14
	5-2. Dimensional Outline Drawings for Option 5-	-18
6.	Selecting the Servo Actuator 6	j-1
		5-1
		5-1
	6-1-2. Angle transmission accuracy 6-	-2
	6-2. Selection of the Servo Actuator 6-	-3
	6-2-1. Study of loads 6-	
	6-2-2. Simplified selection method 6-	
		5-6
7.	Operation from Personal Computer 7-	'-1
	7-1. Introduction 7-	-1
	7-2. Specifications 7-	-1
	7-3. Operation	-2
8.	Disassembling Procedures of Servo Actuator 8-	-1
	8-1. APrecautions Concerning Disassembling 8-	3-1
	8-2. ADisassembling Procedures	3-1
	8-3. APrecautions Concerning Re-assembling 8-	-5
	8-4. ARe-assembling Procedures 8-	-5
	8-5. Exploded View of Servo Actuator 8-	J-9
	8-6. List of Jigs and Tools for Disassembling and Assembling 8	-12
	8-7. List of Bolt Clamp Torque	3-12
	8-8. List of Weights of Servo Actuator and Servo Driver/ Controller 8-	-12
	8-9. List of Shapes of Jigs and Tools 8-	3-13
9.	List 9-)-1
	9-1. List of Connectors	J-1
	9-2. Parameters 9	1-6
	9-3 Contents of Control Alarm	1.11

Cautionary Instructions

1-1. Definitions and symbols

1) **WARNING**

This indicates a danger which may cause death or serious injury if not avoided.

2) A CAUTION

This indicates a danger which may cause slight to rather serious injuries if not avoided. And, it also indicates a danger which may cause physical damages.

1-2. WARNING

- 1) Avoid using AR series in a location where corrosive or explosive gas is present.
- 2) When a danger is anticipated from rotating of the servo actuator, proper protective measures must be implemented.
- For preventing electrical shock, power must be cut off during installation, removal or wiring operations.
- 4) For preventing electrical shock and malfunction, protective conductor terminal* on L1, L2 and L3 terminal side on the servo controller front panel terminal board must be grounded at least in Class 3 (100 ohms or less, 1.6 mm diameter minimum) grounding and with single-point grounding.
 - The grounding wire should be 40 mm or more longer than power line of L1, L2 and L3. (Specification for equipment to be certified by TÜV.)
- 5) For preventing electrical shock, grounding terminal of the servo actuator must be connected to the protective conductor terminal on the side of motor power line connecting terminals U, V and W that are installed on the servo controller front panel terminal board.
 - Grounding wire should be 40 mm or more longer than power line of U, V and W. (Specification for equipment to be certified by $T\ddot{U}V$.)
- 6) Installation, disassembly, removal or transportation of the servo actuator should be done in such manner that a danger by its falling off is avoided.
- 7) For preventing electric shock, the terminal board on the servo controller front panel should be used only after terminal board cover is installed to it.
- 8) For preventing electric shock, power for holding brake, input/output power and input/output signal must have reinforced insulation (primary and secondary) (SELV). (Specification for equipment to be certified by TÜV.)

- 9) For certain time after the power is turned off, the controller is charged with high voltage. Make sure CHARGE LED is off before starting a work.
 - Do not touch terminals on the terminal board nor inside of the controller until CHARGE LED goes off.

-3

10) This product uses battery.

Pay attention to handling of the battery.

Improper handling may cause burst, firing or burn. Such handling has a danger of getting the battery contents into your eyes, too.

- ① Do not heat battery up to 100°C or more. Also, avoid throw it into fire. (Such actions could cause a danger of burst, firing or burn.)
- ② Do not try to disassemble. (Battery contents might get into your eyes.)
- 3 Do not charge. (It has a danger of burst or leaked fluid getting into your eyes.)
- 11) At an emergency stop, the servo controller power (terminals L1, L2 and L3) must be cut off so that the servo actuator is securely stopped.

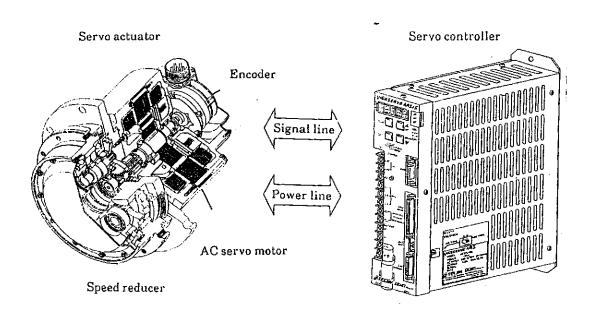
1-3. A CAUTION

- For preventing burn, do not touch servo actuator and servo controller heat sink or regenerative resistor during operation and for certain time after the power has been cut off. When it is needed to touch them, do so after protective measures have been implemented.
- Observe following instructions, otherwise the servo actuator or servo controller might be damaged.
 - ① Do not connect power directly to the servo actuator U, V and W terminals. It may burn the servo actuator.
 - ② Do not give shock to the servo actuator, for example by a hammer. Encoder inside the servo actuator might be damaged.
 - 3 Do not connect power to U, V and W terminals on the servo controller terminal board.
 - When conducting voltage withstand test or megger test, remove all terminals on the servo controller terminal board and connectors before the test so that the test voltage may not be applied to the servo controller.
 - S Avoid using the serve actuator and the serve controller in an improper combination.
 - Make sure the servo actuator is not directly exposed to from oil or water drift.
 Make sure water or oil does not enter into the servo actuator via its lead wire.
 Install the servo actuator such that the connector faces downward. Wiring should be done from lower position.
 - The servo actuator and servo controller must be used only under the specified using environment.

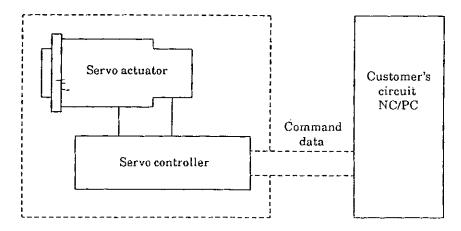
1. Specifications for AR series VIGO SERVO

1-1. Basic-Structure

♦ AR series consists of a servo actuator and servo controller.



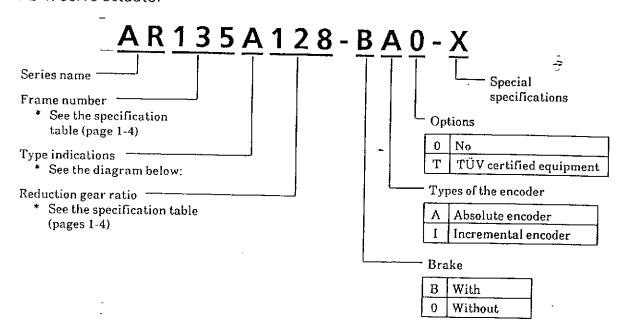
◆ AR series



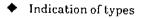
- One servo actuator necessitates one servo driver / controller.
- ullet Select an incremental encoder or an absolute value type encoder as position detector.
- Connection cable for each device is not included in our supplies.

1-2. Indications of Models

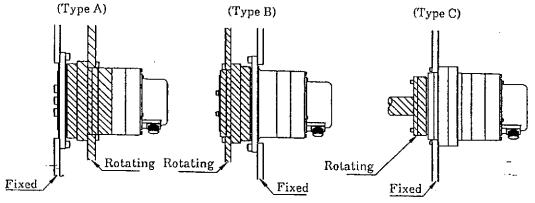
1-2-1. Servo actuator



The seal shown to the right is attached to TÜV certified equipments.

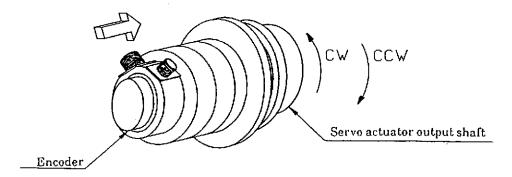


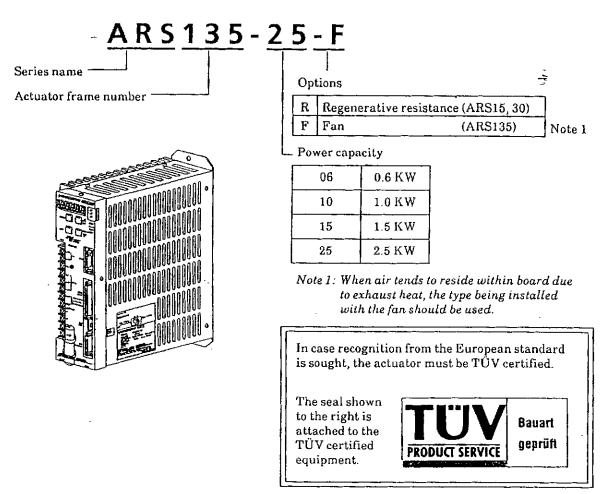




Direction of rotation

Direction of rotation of the servo actuator is when it is seen from the encoder.

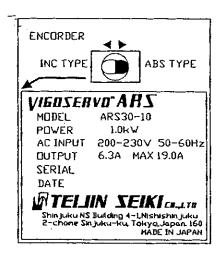




Switching between the absolute and incremental encoders

Switching between the absolute and incremental encoders is done by setting the switches on the servo controller side and by parameter setting.

With the absolute encoder, the switch is on ABS TYPE side and with the incremental encoder it is on INC TYPE side. See page 3-21 for parameter setting.



If the switch is improperly set, the encoder will not be able to back up the coordinate (for the absolute type).

1-3. Table for the Specifications

<u> </u>		Models		1	ΑR	15			AR	30			٨R	60		1	٨R	T35	
Servo actu-	Rated out	put of the servo	kW		0.	4			0.	8	_	1.5				2.5			
ator	Reduction for A and I	gear ratio (R) B types	1:R	56	80	104	120	56	80	104	120	80	100	120	152	80	100	128	170
	Reduction for C type	gear ratio (R)	1:R	57	81	105	121	57	81	105	121	81	101	121	153	81	101	129	171
	Rated out	out torque	N·m kgſ·m	61 6	87 9	115 11	131 13	127 13	186 19	245 25	284 29	372 38	471 48	564 58	637 65	755 77	941 96	1206 123	1324 135
	and decele	acceleration ration torque	N-m kg⊡m	272 28	275 28	275 28	275 28	439 45	627 64	815 83	833 85	1177 120	1471 150	1589 162	1589 162	1881 198	2352 248	3010 317	3305 337
	 	out revolutions	грт	44	31	24	20	44	31	24	20	31	25	20	16	25	20	16	12
	Maximum revolution		rpm	53	37	28	25	50	37	28	25	37	30	25	20	25	25	20	16
	Backlash		ละเขาท่า	L	1			·	1				1				1	l	
	Lost motio	n	arc-min	<u> </u>	ł								1				1		-
	Rigidity	-	N·m/ min kgf·m/ min		34 3.	-			75 8				15 1				35	-	
	Allowable Allowable	load inertia load GD ²	kg·m² kgf·m²	5 20	11 42	18 71	24 95	15 61	31 125	53 211	71 292	76 303	119 474	171 682	274 1095	254 1014	396 1585	649 2596	1115 4580
	Servo lock	allowable	N-m	59	88	108	127	118	167	216	245	333	412	490	628	657	824	1049	1402
	torque	T	kgf·m	6	9	11	13	12	17	22	25	34	42	50	64	67	84	107	143
	Holding brake	Holding brake	N·m kg(·m	98 10	137 14	177 18	206 21	206 21	294 30	382 39	441 45	588 60	735 75	883 90	1118 114	1177 120	1471 150	1883 192	2501 255
i		Voltage	γ							D	C24V	±10%							
	L	Current	Λ	0,25 0.4			l	0.5			<u></u>	0.7							
		position sensor	p/rev	Absolute encoder: 2048 p/rev (However				er, it i	is used				rnally	quade	upled	.)			
	Weight		kg	12.5 27			<u> </u>		37			73.5							
Servo		Control methods		Transistor PWM controls															
con- trol-	Input power	Main circuit an circuit po	ver	Three-phase AC 200 to 230 V + 10%, - 15% 50/60 Hz.															
ler	supply	Power capacity	kVA	0.8			1.2			1.8			3.5						
		s output current	Arms	3.0			4.6		8.0				16						
		output current	Arms		11 17 28					42									
	Positioning functions			For equipartition and indexing, maximum 255 partitions of indexing (8 bit binary code), indexed address instructing method, and parameter setting of operation conditions.									exed						
		Inputsignals		Address command, operation start, mode selection, manual command CW/CCW, operation preparation command, serve on, interlock, reset, zero point LS.															
	Output signals			Present address indication, positioning finish, operation preparation finish, home position, servo actuator in operation, control alarm, controller alarm, driver alarm and battery alarm.															
	Protection functions			IPM alarm, over-voltage, open signal line, low voltage, overload, overheat, open power line, brake power supply failure, controller alarm, battery alarm, positional deviation limit, absolute encoder communication abnormality, excess drift, overflow, unknown zero point, absolute encoder abnormality. (Operation stops at appearance of the above (Upon appearance of the above alarms,															
		·		alarm:	· <u>·</u>							dynan stops.))		appl	ied ar			ation
Weig	ght of the se	rvo controller	kg	L	2.	l .			2.	4			3.	G		L	4.	2	

Note 1: With AR 15, the reduction gear ratio of 140 (141 for C type) is also available other than the ratio given in the above table.

Note 2: With AR 30, the reduction gear ratio of 152 (153 for C type) is also available other than the ratio given in above table.

Note 3: With ΛR 60, the reduction gear ratio of 65 (66 for C type) is also available other than the ratio given in the table above.

Note 4: With AR 135, the reduction gear ratio of 144 (145 for C type) is also available other than ratio one given in the table above. Contact us for further details.

1-4. Using Environment

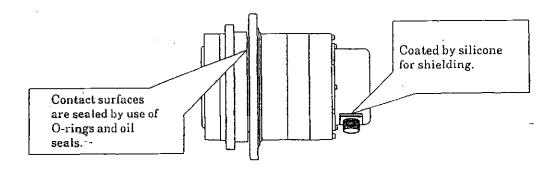
AR series are designed for indoor use.

⚠ CAUTION

Using the equipment under improper environment can cause a trouble. Always use under following environmental conditions.

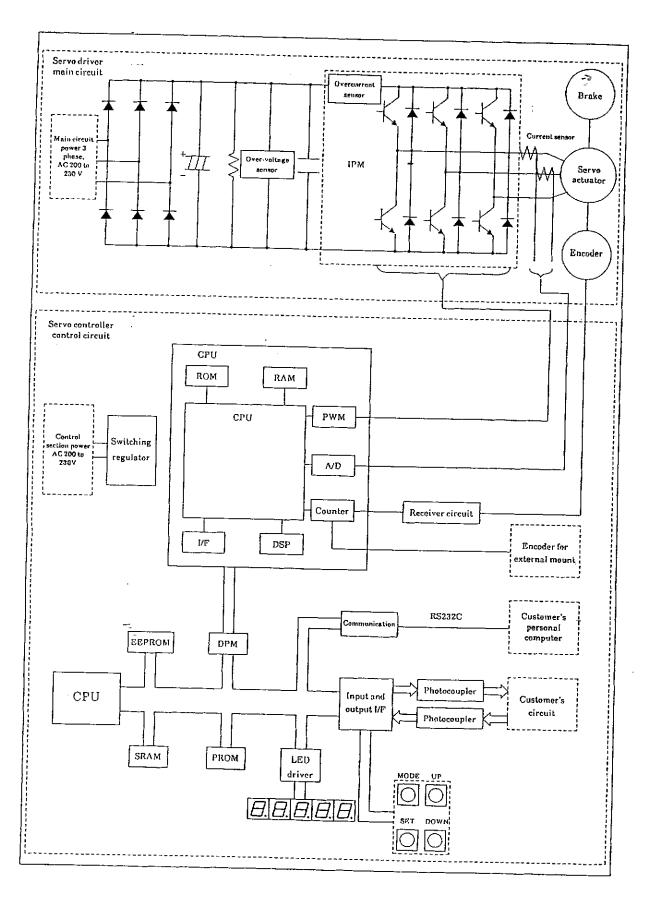
		Servo actuator		Servo controller
٠	Ambient temperature for use:	0 to +40°C	-	0 to +55°C
•	Ambient temperature for storage:	-20 to +80°C		-20 to +65°C
>	Humidity:	80% RH or less		90% RH or less
		(Dew conden	eations she	ould not occur)

- Atmosphere:
 - (1) Indoor location without existence of corrosive gas or explosive gas.
 - (2) Well ventilated location with less iron powder, dust and humidity.
 - (3) A location away from a source of vibrations.
 - * It causes imperfect contacts in the connector, electro-magnetic contactor, and relay.
- Water-proofing and oil-proofing:
 - (1) Servo actuator protection standard IP-43 equivalent.
 - * Provide a cover when substantial amount of water drips or oil drips fall.
 - (2) The input/output connector on the servo actuator is coated by silicone. Face the connector downward when installing.



Note: Refer to the chapter 2 for cautions in assemblies, installations and wiring.

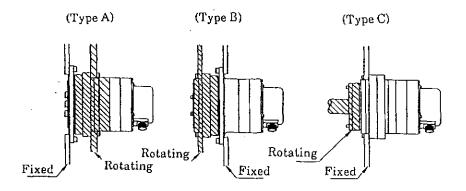
1-5. Block Diagram of Servo Controller



2. Installation, Test Operation and Adjustments

2-1. Installation of the Servo Actuator

- WARNING: When installing the servo actuator, exercise care to avoid a danger caused by its falling off.
- > The serve actuator allows both of horizontal and vertical installations.
- : In the horizontal installation of the servo actuator, install the connector such that it faces downward. And, the wiring should be done from the lower position for both horizontal and vertical installation.



2-1-1. Clamping torque of fixing bolts and allowable torque

- ▶ Use hexagon socket head cap screws (JISB 1176) for installation.
 - Fixing bolts should be clamped at the clamping torque given in the table below.
 - Note: ① Data given below are in case the object for mounting is made of steel or cast iron.
 - ② If using aluminum mating parts, carefully determin the tightening and transfer torque.

(When $\mu = 0.15$)

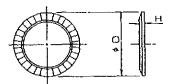
Types	Fastening sections	Bolts Quantities and Sizes	Clamping torque N·m	Allowable transfer torque N·m	Bolts to be used
AR-15	Rotating section	8-M6	15.6±0.78	1068	• Hexagon
	Fixed section	6-M8	37.2±1.86	1724	socket head cap screws
AR-30	Rotating section	8-M8	37.2±1.86	2508	JISB 1176 • Strength
	Fixed section	6-M10	73.5±3.43	3596	JISB 1051 12.9
AR-60	Rotating section	12-M8	37.2±1.86	4439	Threading JISB 0205 6g
	Fixed section	8-M10	73.5 ± 3.43	5478	or Class 2
AR-135	Rotating section	12-M12	128.4±6.37	12887]
	Fixed section	12-M12	128.4±6.37	14876	

2-1-2. Aligning

- > Outer pathload bearing integrated into servo actuator.
- Aligning accuracy should be 30μ to 50μ .

2-1-3. Conical spring washers

Use conical spring washers for hexagon socket head capscrews for installation. If not, loosening
of or scrathes on bolts are caused.



Name:

Conical spring washers

(Manufactured by Heiwa Hatsujo Co., Ltd.)

Abbreviated name:

Sara SW-2H-\(\phi\)D (size of hexagon socket head cap screw)

Material:

S50CM to S65CM

Hardness:

HRC40 to 48

2-2. Installing the Servo Controller

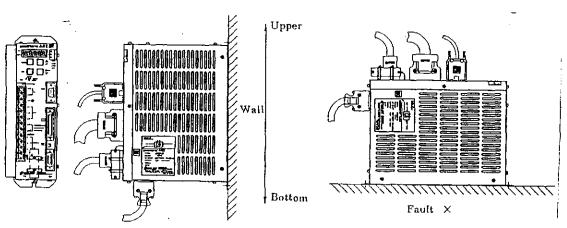
2-2-1. Methods of installation

• **A**WARNING

Before installing or removing the servo controller, power must be cut off to avoid electrical shock.

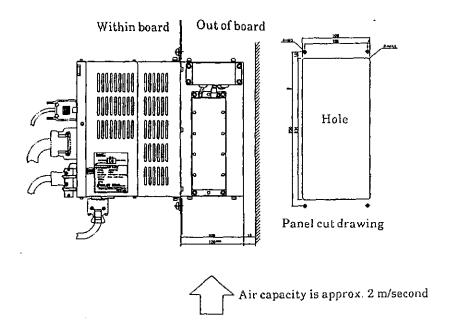
- > 100 mm minimum clearance should be provided to top and bottom of the serve controller.
- > 30 mm minimum clearance should be provided on both sides of the servo controller.
- If exhaust heat within the board restricts air circulation on ARS 135, specify the type being installed with the fan.
- > The servo controller is vertically installed.

Do not try to install it horizontally.



Out-of-board heat radiation (ARS 60 and ARS 135)

The servo controller can be installed in such that exhaust heat is radiated out of the board. With this approach, approximately 70% of heat generated by the servo controller can be radiated out of the board.



2-2-2. Environment of the installing location

▶ Temperature conditions

Ambient temperature over 55°C may cause abnormal operation, resulting in damages on the product. Make sure that the ambient temperature stays less than 55°C.

Use the fan to circulate air entrapped in the closed board. Do not allow air to reside within the board. Do not install heat elements such as regenerative options near to the servo controller.

(Heat generation of servo driver/controller)

Types	Output	Calorific power (Out-of-board heat radiation approach)
AR-15	0.4 kw	60W
AR-30	0.8 kw	100W
AR-60	1.5 kw	140W (50 W)
AR-135	2.5 kw	180W (60 W)

Vibrations

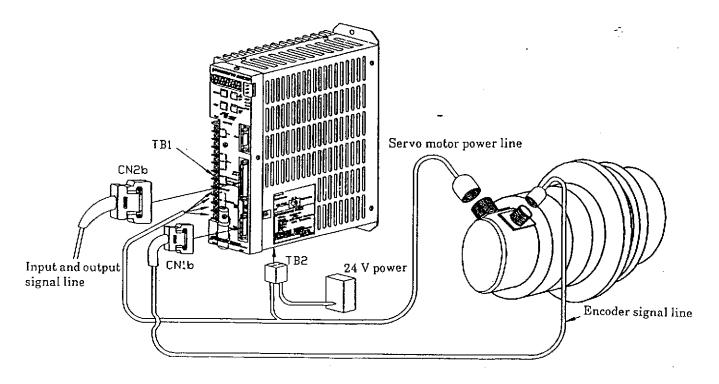
Do not install it near a source of great vibration. If installing it in such a place, provide it with a shock absorber for absorbing vibration.

Atmosphere

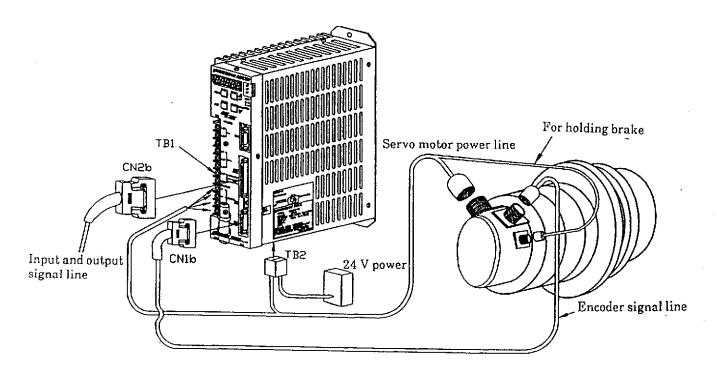
Since imperfect contacts may occur between the connector and contactor, do not use it in a high-temperature, humid, dusty or corrosive gas existing place.

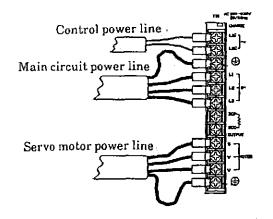
2-3. Wiring and Connections

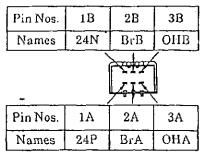
2-3-1. Wiring to the servo driver/controller



Wiring to servo controller (Specification for equipment to be certified by TÜV)





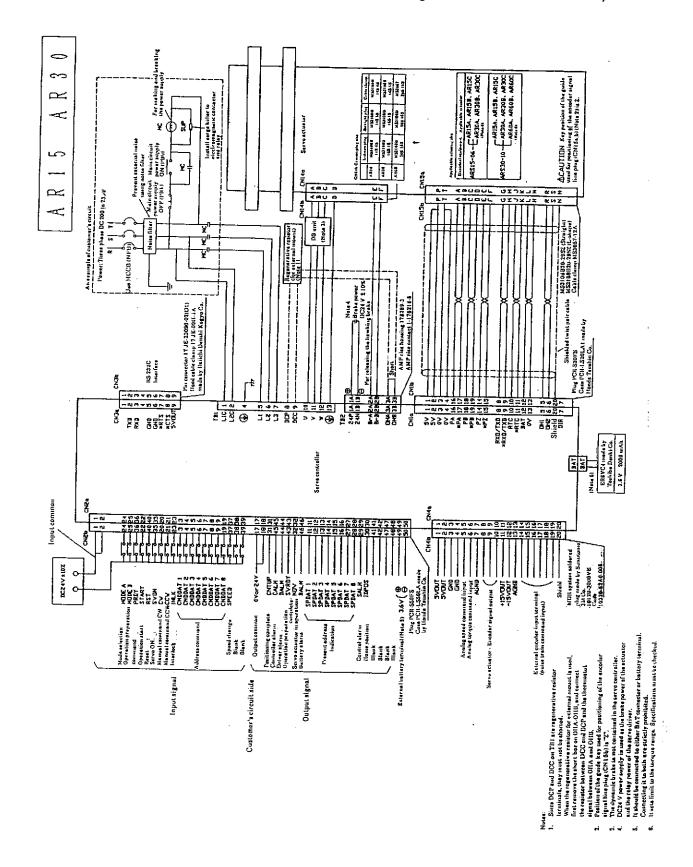


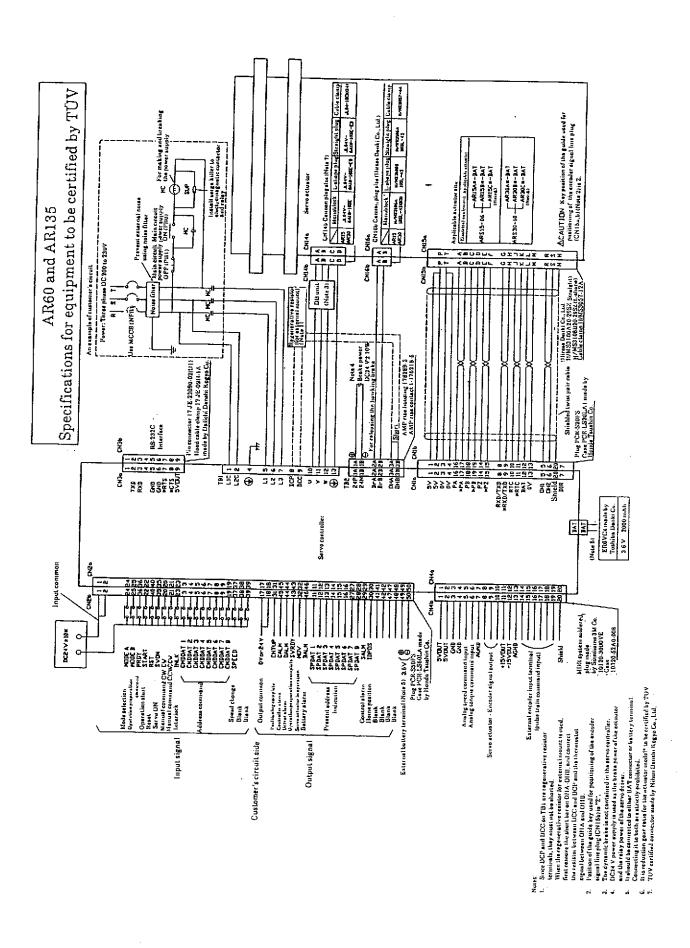
TB2 pin No.s.

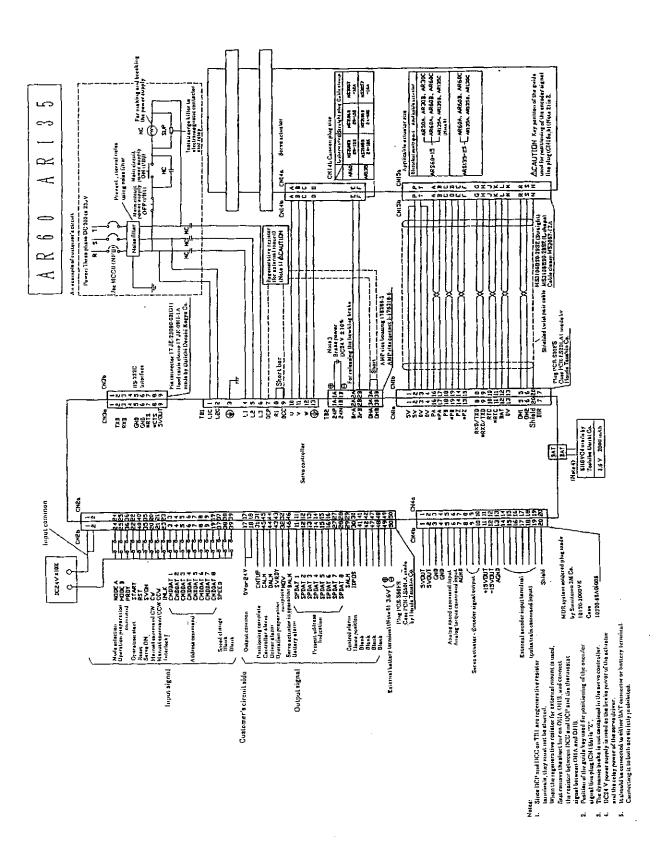
Names of Terminals

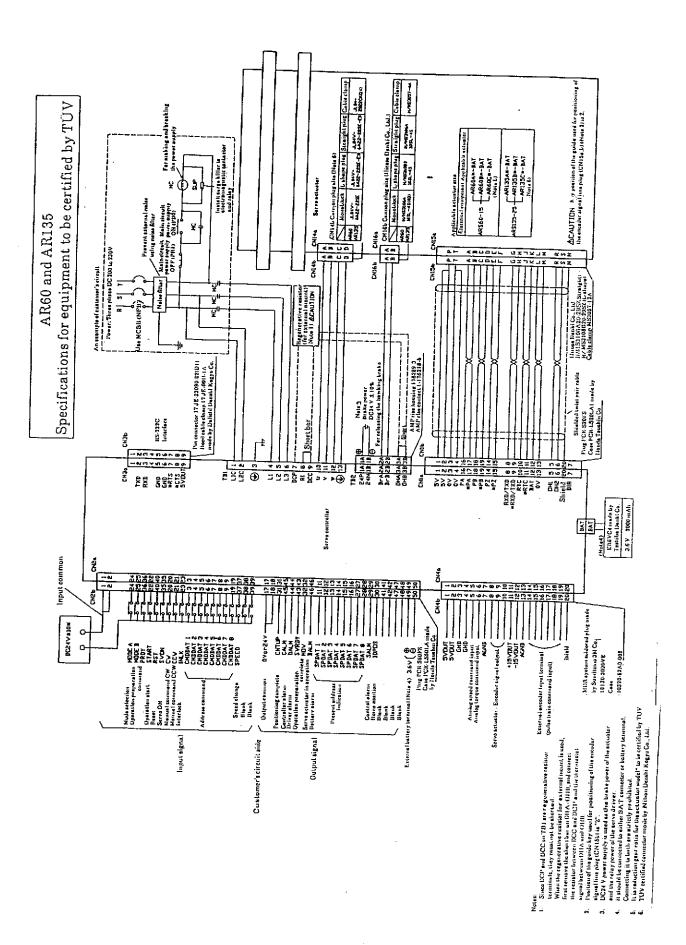
Terminal board Nos	Symbols of terminals		Names	Contents
	L1C L2C	Control pow	er input terminal	Single phase 200 to 230V + 10% - 15% (50/60Hz)
	L1 L2 L3	Main circuit terminal	t power input	Three phase 200 to 230V + 10% - 15% (50/60Hz)
İ	⊕	Grounding t	erminal	Ground for main circuit power
TB-1	DCP DCC	AR15, 30	Regenerative resistance	Terminal for connecting the external regenerative resistance
	DCP DCC RI	AR60, 135	connection terminal	(Do not short DCP and DCC)
	U V W Servo motor power line terminal		U motor A terminal, V motor B terminal and W motor C terminal	
	⊕	Grounding t	erminal	Ground for motor D terminal
ТВ-2	· • • • • • • • • • • • • • • • • • • •		r input terminal	Inputs the brake power DC24V (+:1A,-:1B)
	2A 2B	Brake connection terminal		Connects to the motor brake terminal
	3A 3B	External regenerative resistance thermal		Connects the external regenerative thermal line

2-3-2. Connection diagram when using the absolute encoder (Contact us for connection diagram when using the incremental encoder)







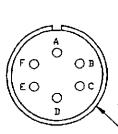


2-3-3. Specifications of receptacles

(1) Specifications of connections

Layouts of pins of the servo actuator receptacles are shown below.

- ◆ For servo motor power line (CN14a)
- ▶ (For AR15)

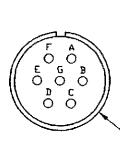


Pin Nos.	Signal names
Λ	U
В	V
c	w
D	⊕(Frame ground)
E	B1 (Holding brake)
F	B2 (Holding brake)

AR15 MS3102A 14S-6P

(Made by Japan Aviation Electronics Ind., Ltd)

• (For AR30 to AR135)



Pin Nos.	Signal names
A	U
В	٧
С	W
D	⊕(Frame ground)
E	B1 (Holding brake)
F	B2 (Holding brake)
G	-

AR30 JAE MS3102A 16S-1P

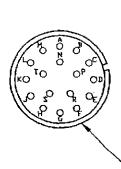
AR60 JAE MS3102A 20-15P

AR135 JAE MS3102A 24-10P

(Made by Japan Aviation Electronics Ind., Ltd)

- ◆ For encoder signal line (CN15a)
- (Absolute encoder)

(Contact us for the incremental encoder.)



Pin Nos.	Signal names	Pin Nos.	Signal names
A	PA	К	* RTC
В	* PA	L	ВАТ
C	PB	М	OV
D	+ PB	N	Shield
E	PZ	P	+5V
F	* PZ	R	OH1
G	RXD/TXD	s	OH2
Н	* RXD/TXD	Т	ov
J	RTC		

H/MS3102A20-29PZ (Made by Hirose Electric Co.)

- (2) Types of receptacles and plugs
- ◆ Servo motor power line (CN14)

	CN14a	CN14b		
	Types of receptacles	L-shape plugs	Straight plugs	Cable clamps
AR15	MS3102A14S-6P	MS3108B14S-6S	MS3106B14S-6S	MS3057-6A
AR30	MS3102A16S-1P	MS3108B16S-1S	MS3106B16S-1S	MS3057-8A
AR60	MS3102A20-15P	MS3108B20-15S	MS3106B20-15S	MS3057-12A
AR135	MS3102A24-10P	MS3108B24-10S	M53106B24-10S	MS3057-16A

◆ Encoder signal line (CN15)

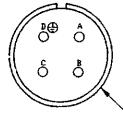
	CN15a	CN		
	Types of receptacles	L-shape plugs	Straight plugs	Cable clamps
Common to all types	H/MS3102A20-29PZ	H/MS3108B20-29SZ	H/MS3106A20-29SZ	H/MS3057-12A

Specifications of receptacles (Specification for equipment to be certified by TÜV)

(1) Specifications of connections

Layouts of pins of the servo actuator receptacles are shown below.

♦ For servo motor power line (CN14a)

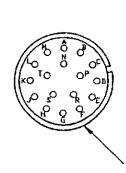


Pin Nos.	Signal names
A	U
В	V
С	w
D	(Frame ground)

AR15, 30 JL04V-2E18-10PE-B AR60, 135 JL04HV-2E22-22PE-B (Made by Japan Aviation Electronic Ind., Ltd)

- ◆ For encoder signal line (CN15a)
- (Absolute encoder)

(Contact us for the incremental encoder.)



Pin Nos.	Signal names	Pin Nos.	Signal names
A	PA	K	* RTC
В	*PA	L	BAT
C	РВ	M	0V
D	* PB	N	Shield
E	PZ	P	+5V
F	* PZ	R	OHI
G	RXD/TXD	S	OH2
Н	* RXD/TXD	T	ov
J	RTC	1	

H/MS3102A20-29PZ (Made by Hirose Electric Co.)

For holding brake (CN16a)



Pin Nos.	Signal names
Λ	B1 (Holding brake)
В	B2 (Holding brake)

H/MS3102A10SL-4P Made by Hirose Electric Co.

(2) Types of receptacles and plugs

◆ Servo motor power line (CN14)

	CN14a	CN	14b	
	Types of receptacles	L-shape plugs	Straight plugs	Cable clamps
AR15	JL04V-2E18	JL04V-8A18	JL04V-6A18	JL04-18CK (13)
AR30	-10PE-B	-10SE-EB	-10SE-EB	
AR60	JL04HV-2E22	JL04V-8A22	JL04V-6A22	JL04-2022CK (14)
AR135	-22PE-B	-22SE-EB	-22SE-EB	

◆ Encoder signal line (CN15)

	CN15a	CN		
	Types of receptacles	L-shape plugs	Straight plugs	Cable clamps
Common to all types	H/MS3102A20-29PZ	H/MS3108B20-29SZ	H/MS3106A20-29SZ	H/MS3057-12A

♦ Holding brake line (CN16)

	CN16a	CN16b		
	Types of receptacles	L-shape plugs	Straight plugs	Cable clamps
Common to all types	H/MS3102A10SL-4P	H/MS3108B10SL-4S	H/MS3106A10SL-4S	H/MS3057-4A

2-3-4. Specifications of signal line connectors

- (1) Encoder signal line (CN1)
- ◆ Layouts of pins of the connector (CN1a)

▶ Absolute encoder

(Contact the company for the incremental encoder.)

L	2	3	4	5	6	7	8	9	10
5V	5∀	0 V	0 V	ОНТ	ОН2	DIR	RXD /TXD	*RXD ÆXD	RTC
11	12	13	14	15	16	17	18	19	20
•RTC	ВАТ	0ν	PZ	*PZ	PA	*PA	PB	*PB	Shield

The encoder uses DC5V as its power supply.

Set the cable length so that voltage drop due to the cable is 0.2 V maximum.

 $0.2 > \frac{0.30 \times R \times 2L}{}$

0.30 : Encoder current consumption (A)

R: Resistance on cable (Ω/m)

L : Cable length (m)

n : Number of cables to be bundled

(Nnumber of cable)

◆ Types of the connector and applicable plugs (CN1)

Types of connectors	Types of applicable plugs (CN1b)						
(CN1a)	Soldered type	Caulked type	Case	Name of the manufacturer			
PCR-E20LMDET-SL Right angle 20P	PCR-S20FS		PCR- LS20LA1	Manufactured by Honda Tsushin Kogyo Co., Ltd.			

- (2) Input and output signal line (CN2)
- ◆ Layouts of pins of the connector (CN2a)

1	2	3	4	_ 5	6	7	8	9	10_	11	12	13
Input common	Input common	CMD DAT1	CMD DAT2	CMD DAT3	CMD DAT4	CMD DAT5	CMD DAT6	CMD DAT7		SP DATI	SP DAT2	SP DAT3
14	15	16_	17	18	19	20	21	22	23	24	25	26
SP DAT4	SP DAT5	SP DAT6	0V or 24V	0V or 24V	CMD DAT8	cw	CCW	START	INLK	MODE A	MODE B	
27	28	29	30	31	32	33	34	35	36	37	38	39
SP DAT7	SP DAT8	SALM	IDPOS	CNTUP	MOV			SVON	PRDY	SPEED	REFLS	AUX1
40	41	42	43	44	45	46	47	48	4	9	5	0
RESET	AUX2	AUX3	SVRDY	DALM	CALM	BALM	AUX4	AUX5	3.6	External SV -	battery 3.61	/ +

Note: When the external battery terminal 49 pin, 50 pin is used, BAT connector should not be connected. Either one of the external battery terminal or BAT connector should be connected.

◆ Types of the connector and applicable plugs (CN2)

Types of connectors	Types of applicable plugs (CN2b)						
(CN2a)	Soldered type	Caulked type	Case	Name of the manufacturer			
PCR-E50LMDET-SL Right angle 50P	PCR-S50FS		PCR-LS50LA	Manufactured by Honda Tsushin Kogyo Co., Ltd.			

(3) Brake power (TB2)

1B	1B 2B 3	
24N	ВгВ	OHB
1 A	2A	3 A
24P	BrA	AHO

Pin Nos.	1B	28	3B	
Names	24N	BrB	ОНВ	
Pin Nos.	1A	2A	3A	
Names	24P	BrA	OHA	

TB2 pin Nos.

◆ Types of the connector and applicable plugs (TB2)

Type of connector	Types of applicable plug (TB2)		
(TB2)			Manufacturer name
178303-5	Rise housing 178289-3	Rise contact 1-175218-5	Made by Nippon AMP CO., Ltd.

2-4. Cautions for Wiring

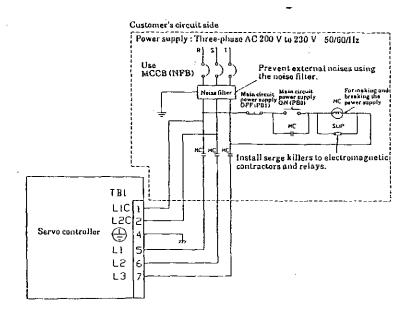
2-4-1. Connection of the main circuit power

• [WARNING : For preventing electrical shock, power must be cut off before wiring.

• MARNING : For preventing electrical shock, the servo controller terminal board

must be used with its cover on.

Make the power connections as shown in the diagram below.



2-4-2. Protection of power supplies

- Be sure to install a molded case circuit breaker (NFB) or a fuse at the intake of the main circuit power.
- Do not use a quick melting fuse as it may melt when the power is turned on.
- When certification from the European Standards is intended, use products designed for the EN Standards EN60947-2 and EN60934.

Servo driver power capacity and NFB or fuse capacity

Types	Servo driver power capacity (KVA)	NFB or fuse capacity (A)	
ARS15	0.8	5	
ARS30	1.2	8	
ARS60	1.8	10	
ARS135	3.5	15	

2-4-3. Main circuit power supply conditions

- The power supply for the AR series is "three-phase 200 to 230V + 10%, -15% 50/60Hz".
- When available power supply voltage differs from the above, install a power transformer to meet the above requirement.
- Making and breaking of the power supply should be done on the primary side of the power transformer.

2-4-4. Applicable wires and sizes

Recommended wires and sizes are given in the table below.

(HIV: Special heat resistant PVC wire JISC 3317)

Types	Main circuit power line R-S-T (mm²)	Motor power line U·V·W (mm²)	Brake power line A ₁ , A ₂ (mm ²)	Encoder signal line: CN1 Input and output signal line: CN2 (mm²)	Grounding line (mm²)
AR15	HIV 0.75 or more	HIV 0.75 or more	HIV 0.75 or more Twisted pair wire or shielde		HIV 2.0 or more
AR30	HIV 1.25 or more	HIV 1.25 or more		twisted pair wire with the core wires of 0.2mm ²	
AR60	HIV 2.0 or more	HIV 2.0 or more		equivalent or more. Tinned annealed copper	
AR135	HIV 3.5 or more	HIV 3.5 or more		twisted wires.	

- Condition is when rated current is passed at environmental temperature of 40°C and with 3 lead wires being bundled.
- (KIV ... Vinyl coated wire) can be wed, too. Size is equivalent with HIV.

2-4-5 Grounding

WARNING

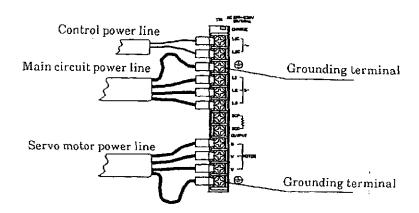
For preventing electrical shock, make sure that D terminal on the motor power line connector is connected to the protective conductor terminal \oplus on the motor power line connecting terminals U, V and W side.

The grounding wire must be 40 mm longer in minimum than the power line on U, V and W.

WARNING

For preventing electrical shock and malfunction, make sure that protective conductor terminal \oplus on the serve controller main circuit power input terminals L1, L2 and L3 side are grounded in at least Class 3 grounding (100 ohms or less, 1.6 mm diameter minimum) with single-point grounding.

Grounding wire must be 40 mm longer in minimum than the power lines on L1, L2 and L3. (Specifications for equipment to be certified TÜV.)



2-4-6. Wiring of signal lines

Types of signal lines

Always use twisted wires or shielded twisted pair wires.

Length of signal lines

Input and output signal lines: Max. 3 m (Analog input for the motor terminal and CN4a)

Encoder signal lines: Max. 20 m

- Connect all signal lines including those which are not in use to connectors (CN1b, CN2b, etc.).
- > The signal conductor is 0.2 to 0.3 mm² in sectional area. A great tensile force applied on the conductor causes disconnection.

2-4-7. Noise suppression

- Do not pass the signal conductor near a high-voltage cable. Otherwise, noise is generated in the conductor, causing malfunction. Install a electromagnetic shielding plate between the conductor and cable.
- Do not use power supplies in common with noise generating sources (such as electric welders and electric discharge machines).
- When there is a noise generating source nearby, install a noise filter.
- Always install surge absorber circuits to coils of relays, electromagnetic contactors and solenoids.
- Install power filters in the power line. If not, radio interference may occur.

2-4-8. Cautions on the holding brake

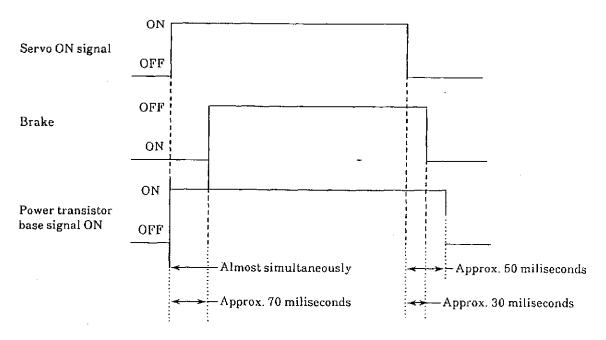
- Handling the holding electromagnetic brake
 - The built-in brake of the servo actuator is for holding exclusively.
 - Do not release the brake power or turn off the servo ON signal during rotation of the servo
 actuator. Otherwise, the contact of the electromagnetic brake will be worn abnormally.
 - If you release the brake power or turn off the servo ON signal during rotation of the servo actuator, electromagnetic brake is activated resulting in excessive wear on its contact.
- Specifications of the holding electromagnetic brakes

Types	Holding torque N-m (Servo motor shaft)	Voltage DC (V) ± 10%	Current (A) at 20°C
AR15	1.37		0.25
AR30	2.94	24	0.4
AR60	5.88		0.5
AR135	11.76]	0.75

Note: WARNING

- For preventing electrical shock, the power supply for the holding brake should have reinforced insulation (primary and secondary) (SELV). (Specifications for equipments to be certified by TÜV.)
- The brake power should be taken from an independent power supply.
- The power must be separate from the input/output signal power.
- The brake power must be fully smoothed.

> Timing of holding brake



2-5. Trial Operation

2-5-1. Inspections before operation

- Check if connections are correct. (See pages 2-1 to 2-19)
- Check if the main circuit voltage is appropriate. (200 to 230V + 10%, -15%)
- Check if an NFB or fuse is installed.
- Make sure the motor connection terminals (U, V & W) and the motor terminals (U, V & W) are matching.
- Make sure the operation preparation command signal OFF.



When rotation of the actuator can cause a danger, appropriate protective measures must be implemented.

2-5-2. Starting the operation

(1) Applying the control power

Set up parameters, after making sure that the control power has been applied.

Compare your specifications with the initialization values (see pages 3-21 to 3-39) to correct differences.

[At initial turn on of the power, an encoder related alarm might be generated (because coordinate of the encoder is not defined). Press the mode button for I second or more to erase the alarm display, and then perform the zero point setting (see page 3-20) to erase the encoder alarm]

- (2) After the parameter setting, turn the control power off once and turn it on again, or enter reset signal. Without this operation, the set parameter is not valid.
- (3) Main circuit power on

Apply main circuit power after turning the operation preparation command signal the servo ON signal off (see page 3-8).

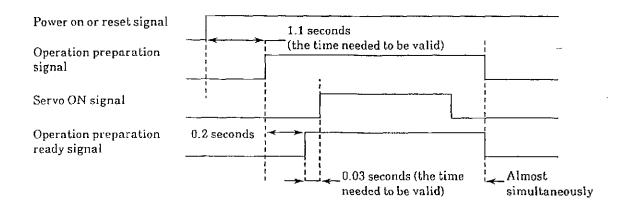
Specify the brake power before entering the operation preparation command signal.

- (4) Enter the operation preparation command signal (PRDY) and servo ON signal (SVON).
- (5) Select manual JOG operation mode (page 3-2) by the mode selection signal to start operation.
- (6) Check following items.
 - ① The servo actuator rotates in the same direction as shown on page 11.
 - ② No vibration occurs.
 - 3 No abnomal sound is heard.
 - 4 The atomospher around the motor of the servo actuator is not so hot.
- (7) When abnormalities are not found, perform zero point adjustment. (see page 2-21)
- (8) When reference point adjustment is completed, start automatic operations.

À WARNING

When rotation of the actuator can cause a danger, appropriate protective measures must be implemented.

2-5-3. Sequence after applying the power



2-6. Reference Point Adjustment

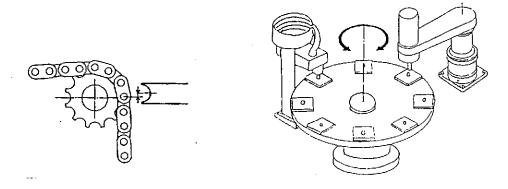
(1) In case of the absolute encoder

Set the reference point.

Set the coordinate zero point of the absolute encoder.

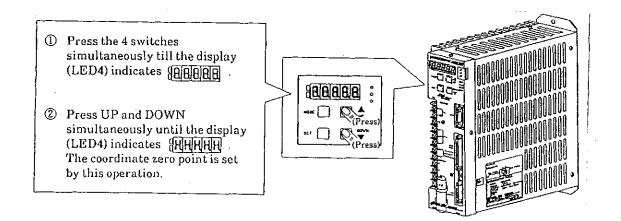
> Set the reference point.

Note: When setting the reference point, set it in the optional step feeding mode (parameter No. P-67, page 3-29) or by minute step operation in the local mode (parameter No. P-69, page 3-31).



When the reference point is set, press the pushbutton switches for absolute encoder on the servo controller.

Note: Make sure the absolute encoder of paramater No. P-13, page 3-23, P-60, page 3-27 before reference point adjustment.



Note: • Machine zero point refers to the state in which positioning has been done to the indexed position being specified as indexing No.1.

• Record the value of Parameter No. P-14 (page 3-23).

2-7. Operation

2-7-1. Inspections before operation

- Check if connections are correct (see pages 2-1 to 2-19).
- Check if main circuit voltage is correct (200V to 230V, +10% and -15%)
- Make sure NFB or fuse is installed.
- Make sure the motor connection terminals (U, V and W) and the motor terminals (U, V and W) matches.
- Make sure the operation preparation command is turned off.



When rotation of the servo can cause a danger appropriate protective measures must be implemented.

2-7-2. Starting the operation

- (1) Applying the control power
- (2) Applying the main circuit power Apply the main circuit power after turning off the operation preparation command signal and the servo ON signal (see page 3-8).
- (3) Input the operation preparation command signal.
 The serve controller will output the operation preparation ready signal.
 Specify the brake power before entering the operation preparation command signal.
- (4) Enter the servo ON signal.
 The signal provides the operation ready state and the servo actuator proceeds to the servo lock.
- (5) Start operation by selecting drive mode (page 3-2) with mode select signal.

2-7-3. Cautions during the operation

- (1) Check the the following points during operation.
 - Abnormal vibration occurs
 - ② Abnormal sound is heard
 - 3 Abrupt temperature rise is recognized
- (2) Following actions during operation will stop the servo actuator.

① Servo off: The servo controller cuts off base signal and stops.

With ARS 60 and ARS 135, the dynamic brake is activated.

② Reset: The servo controller cuts off base signal and stops.

With ARS 60 and ARS135, the dynamic brake is activated.

③ Stroke limit: Gradually decelerates and then stops, thus generating the alarm "E-4".

Alarm: The servo controller cuts off base signal and then stops. Alarm is actuated.

With ARS60 and ARS135, the dynamic brake is activated.

(S) Main circuit power off:

The servo controller cuts off base signal and stops.

With ARS60 and ARS135, the dynamic brake is activated.

3. Explanations of the Servo Controller

3-1. Specifications

Items	Explanations			
Outlines of the functions	 For equipartition indexing by input of the index address (numbers). The maximum 255 partitions of indexing (8 bit binary code). Operating conditions are set up by the parameter. The time constant during acceleration is same as that during deceleration. Lithium battery is built-in to back up the absolute encoder and the parameter. 			
Drive mode	 The drive modes consists of following modes: Selection of each of the drive modes is made by esignals (input signals). Automatic operation mode. (Short-cut operation selected by the parameter.) Manual step operation mode. Manual JOG operation mode. Zero point return mode. 	·		
Input signals	 External input signals needed for operation of the below: Operation preparation command signal Servo ON signal Mode selection signal Address command signal Operation start signal Manual command CW/CCW signal Reset signal Interlock signal Zero point LS (Limit switch) signal 	ne controller are given 1 bit 1 bit 2 bits 8 bits 1 bit 2 bits 1 bit 1 bit 1 bit 1 bit		
Output signals	 Output signals coming out from the controller at Operation preparation finish command signal Servo actuator in operation signal Positioning finish signal Home position signal Present address indication signal Control alarm signal Controller alarm signal Driver alarm signal Battery alarm signal 	re given below: 1 bit 1 bit 1 bit 1 bit 8 bits 1 bit 1 bit 1 bit 1 bit		
Parameter	 The main parameter setting items are given below Reduction gear ratio The number of partitions of indexing The number of gears of the sprocket Operating speed (automatic and manual) Acceleration and deceleration time constant (automatic number of gain Allowable positional deviation The range of in-position The number of encoder pulses Grit shift value Backlash correction value and others 			

3-2. Drive Mode

- The drive mode is elected by inputting the mode select signal from an external source.
- See the input signal section (on page 3-8) for the mode select signal.

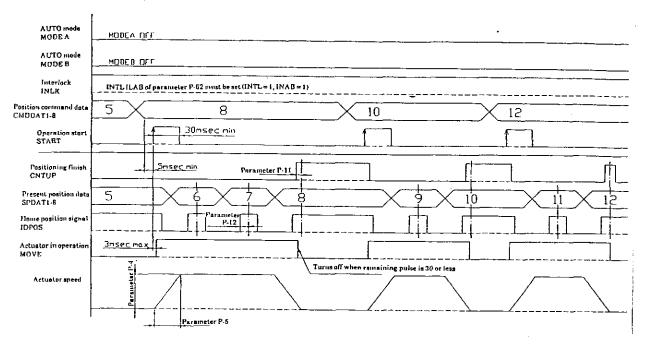
Mode type	Explanations
Automatic operation	 When the operation start signal (see page 3-8) is input, the controller reads the address instructed from the NC/P or the sequencer. The controller drives the servo actuator to position at the instructed indexing position. Upon completion of positioning, the controller outputs the positioning end signal.
Manual step operation mode (see note)	 When the manual CW signal or CCW signal (see page 3-8) is input, the servo actuator rotates clockwise or counterclockwise as long as the signal is input. When the signal input ends, the servo actuator stops after rotating to the nearest address in the rotation direction. Upon completion of the positioning, the servo controller outputs the positioning end signal.
Manual jog operation mode	 When the manual CW signal or CCW signal is input, the servo actuator rotates clockwise or counterclockwise as long as the signal is input. When the signal input ends, the servo actuator decelerates and then stops. The controller does not output the positioning end signal.
Zero point reset mode	 With the incremental encoder (always performed at the main circuit power on) When the operation start signal is input, the servo actuator starts and depresses the zero point limit switch installed near the indexing position. As the zero point limit switch is depressed, the servo actuator is decelerated to the creep speed and stops at the first detected Z phase position in the encoder. This position is the reference point. If the reference point is deviated from the indexing position, correct it by inputting grit shift (see Parameter No. P-15 page 3-23). With the absolute encoder (performed as desired) When the operation start signal is input, the servo actuator rotes and stops at the stored coordinates origin. After the end of operation, the controller outputs the positioning end signal.

Note: Feeding of one time should not exceed 255 addresses in the manual operation. When a feeding beyond 255 addresses is required [alarm E-6 (see page 4-3) occurs], turn the manual command CW or CCW off once and then re-start the operation.

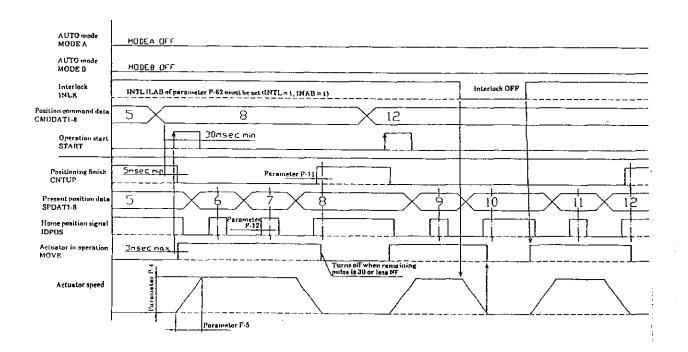
3-2-1. Timing chart

Automatic operation mode (When parameter P-62, MFIN = 0 is set (see page 3-28))

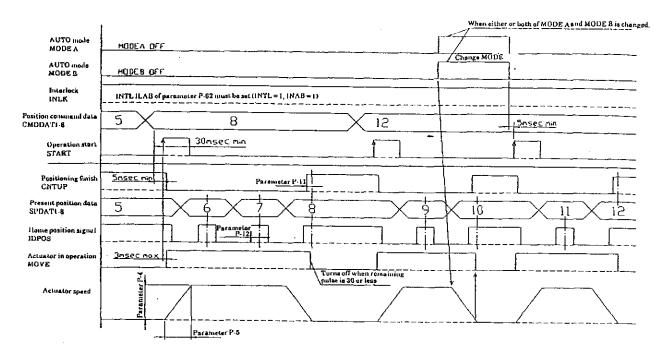
For normal operation



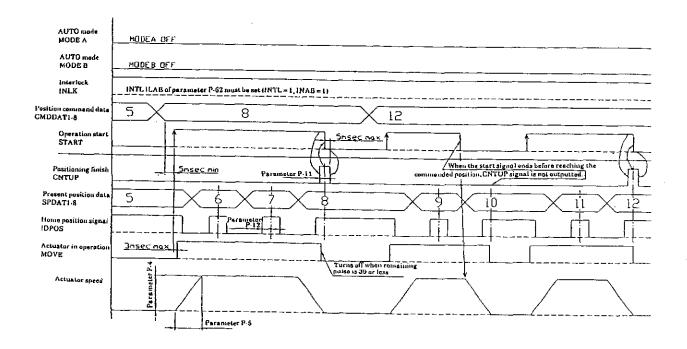
Automatic operation mode (when parameter P-62 MFIN = 0 is set. (see page 3-28))
Interlock ON



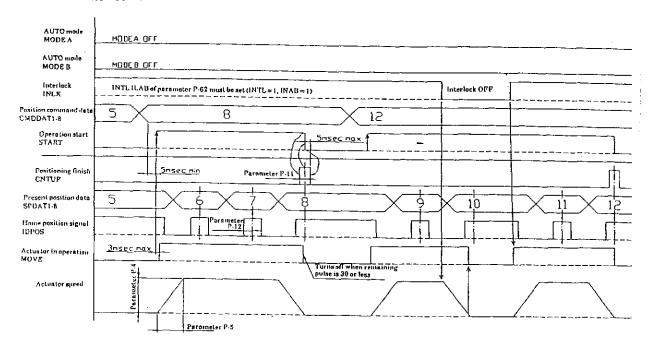
Automatic Operation mode (When parameter p-62, MFIN = 0 is set (see page 3-28)) For switching the drive mode during operation



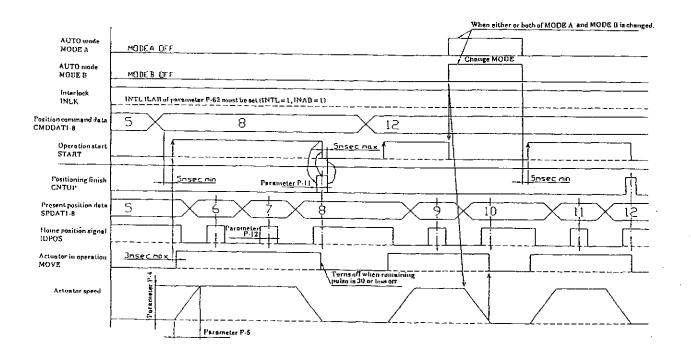
 $\label{eq:automatic operation} Automatic operation mode (When parameter p-62, MFIN = 1 is set (see page 3-28))$ For normal operation



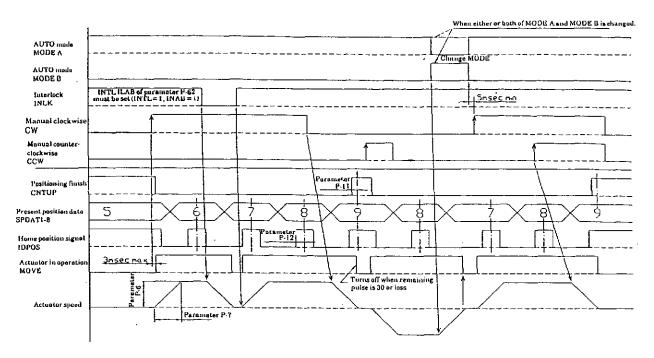
Automatic operation mode (When parameter p-62, MFIN = 1 is set (see page 3-28)) Interlock ON



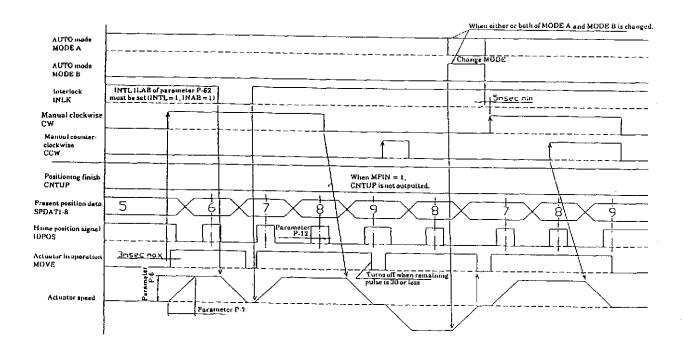
Automatice operation mode (When parameter p-62, MFIN = 1 is set (see page 3-28))
When the drive mode is switched during operation



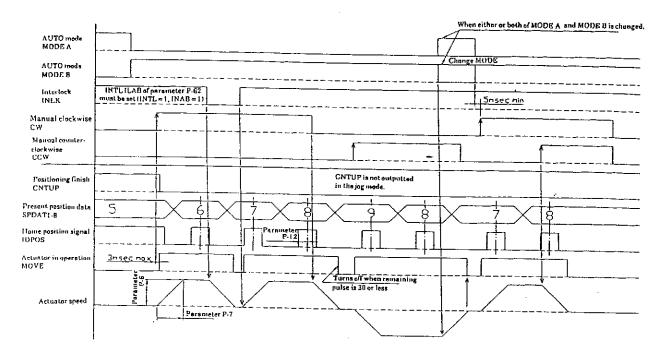
Manual step operation mode (When parameter P-62, MFIN = 0 is set (see page 3-28))



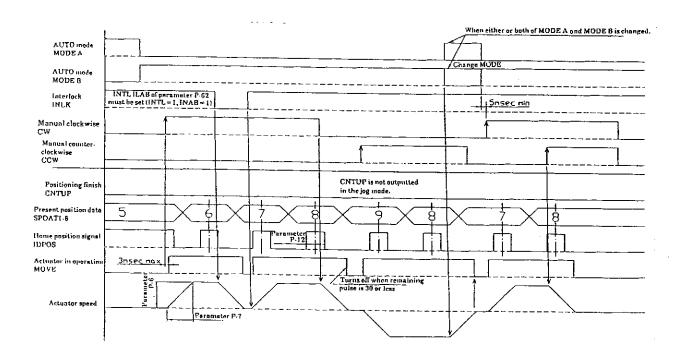
Manual step mode operation (When parameter P-62, MFIN = 1 is set (see page 3-28))



Manual jog mode operation (When parameter P-62, MFIN = 0 is set (see page 3-28))



Manual jog mode operation (When parameter P-62, MFIN = 1 is set (see page 3-28))



3-3. Input and Output Signals

3-3-1. Input signals (CN2)

Signal names	Symbols	Pin No.		Explanations .					
Operation preparation command	PRDY	36	When th:	A signal for preparations of operation. When this signal is entered, the power is supplied to the main circuit of the servo driver.					
Servo ON	SVON	35	this signs state. When this brake wo Signals f	A signal to actuate the control circuit of the servo driver. When this signal is entered, the servo actuator proceeds to the servo lock state. When this signal is interrupted, the holding electromagnetic brake works. Signals from the encoder are kept counted even if this signal is interrupted.					
Mode selection	MODE A MODE B	24 25	A signal	to select the driv	ve mode.				
	: 		Mod	es	Drive	modes]		
			Signals	Automatic	Manual step	Manual JOG	Zero point return		
			MODE	A OFF	ON	OFF	ON		
 -			MODE	OFF	OFF	ОИ	ON		
<u></u>			Selected	by turning on a	nd off the sign	als of Mode A	A and Mode B.		
Address command	CMDDAT	3 to 9, 19	A signalThe inpu	A signal to enter the number of the indexed address. The input style is 1-255 in the binary code (8 bits).					
Operation start	START	22	command The cont	A signal to give timing for the controller to read the address command signal. The controller reads the address command signal during the rising edge of the operation start signal.					
Manual command CW	CW	20	 Signals t modes. () 	Signals to give the operation command during step and JOG modes. (Manual)					
Manual command CCW	ccw	21							
Reset	RST	40	driver alsThis signDuring C	A signal to release the output status of the control alarm and driver alarm. This signal is read during rising time. During CPU initialization, that follows input of the reset signal, LED displays "HELLO".					
Interlock	INLK	23	 When the decelerated disconting Holding 	A signal to tentatively stop the rotation of the servo actuator. When this signal enters during operation, the servo actuator decelerates and then stops. It resumes operation when this signal discontinues. Holding under servo lock status is maintained while the interlock signal is entered.					
Zero point LS	REFLS	38		Used for resetting to the zero point with the incremental encoder. A signal for the zero point limit switch is entered.					
Speed change signal	SPEED	37	automatiIt is read	al enables selection. c operation. in rising edge o at OFF and P-24	f the start sig	nal. P-4 and	P-5 are		

3-3-2. Output signals (CN2)

Signal names	Symbols	Pin No.	Explanations
Operation preparation finish	SVRDY	43	 A signal outputted when operation preparations are finish for both the servo driver and controller. When either of the servo driver and controller is not finish for operation, this signal is not outputted. Also, when an alarm is actuated, this signal will be interrupted.
Servo actuator in operation	MOV	32	Outputted when the servo actuator is in operation.
Positioning finish	CNTUP	31	 A signal outputted when the positioning is finish. The signal is outputted when positioning is finish during automatic operation, manual step operation and zero point return mode. The positioning finish signal turns on when the positioning action is completed, and it turns off when the action starts. With the absolute encoder, this signal is outputted if the stop position is within this set range after the power has been turned on.
Home position	IDPOS	30	 Signals outputted when positioning is being made or each time an address passes the indexed position. Home position signals are provided with each of the addresses. With the absolute encoder, this signal is outputted if the stop position is within this set range after the power has been turned on. The extent of the home position signals is set up by the parameter number P-12 (see page 38).
Present address indication	SPDAT	11 to 16, 27, 28	 A signal to output the present address number for indication of the present address. The output style is 1-255 in binary code (8 bits) With the absolute encoder, present address is displayed starting from the time of application of the power source. With the incremental encoder, the indication is displayed after zero point return.
Control alarm	SALM	29	 A signal outputted when abnormalities occur in controls. The alarm may be released by the reset signal. The content of the alarm is displayed at LED 4 on the controller.
Controller alarm	CALM	45	 A signal outputted when abnormalities occur in the hardware proper of the controller. When this alarm is actuated, the CPUAL on the controller lights. This signal may not be turned off by entering the reset signal.
Driver alarm	DALM	44	 This signal is outputted when a trouble occurs on the driver function. Explanations of the alarm is displayed on LED.
Battery alarm (Battery)	BALM	46	 A signal outputted when the voltage of the back up driver drops. When this alarm is actuated, the BATAL on the controller lights. Generally it should be used as an indication lamp to alert attention of workers.

Note: These signals may momentarily go on at applying the control power.

3-3-3. Input signal specifications

Input signals (DC) mean signals coming from external sources such as signals coming from pushbuttons, limit switches, &c. (All the input signals are insulated by photo-couplers.)

Regardless if the signals are from contacts or not, following conditions must be satisfied:

① Capacity:

DC30V, 16 mA or more

② Leak current during cutoff:

1 mA or less (26.4 V of voltage)

③ Voltage drop when turned on: 1 V or less (approx. 13 mA of current)

Input signal waveform: The chattering time and holding time should be with the following characteristics during operations:

① Input signal allowable chattering time:

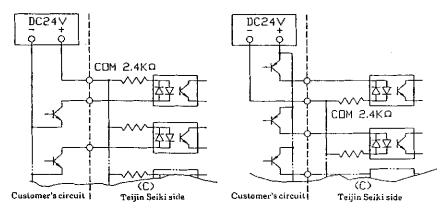
 $T \le 5 \text{ m sec}$

② Input signal holding time:

30 m sec minimum

> Input circuits

The input circuits are shown below:



In case of 24 V common

In case of OV common

Power supply should be prepared by the customer:

DC24V $\pm 10\%$ Approx. 0.4 A (power supply for input and output signals)

Remarks: • The PE (frame ground) of the power supply should be connected to the frame ground of the driver.

 Separate sources of power should be prepared for the input and output signal power and the brake power.



For preventing electrical shock, the power supply for input and output signals should have reinforced insulation (primary and secondary) (SELV).

(Specification for equipment to be certified by $T\ddot{U}V$.)

3-3-4. Output signal specifications

The output signals (DC) are for actuating external relays and light emitting diodes. (All the output signals are insulated by photo-couplers.)

> Ratings of the output transistors should be as follows:

Applied voltage

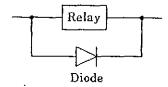
 $(V \text{ max}) \leq 30V$

Conducted current

 $(I max) \leq 60 mA$

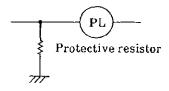
For an inductive load (such as external relays), always connect a diode (with the permissible voltage of 100V or more and current 100mA or more).

Make very sure that the polarity is correct, as otherwise the internal circuit will be damaged.



For a capacitive load (such as lamps), be sure to connect a protective resistor in series with the load to restrict rush current.

Be sure that the max. current including instantaneous cases is restricted within the conductive current range as specified above.



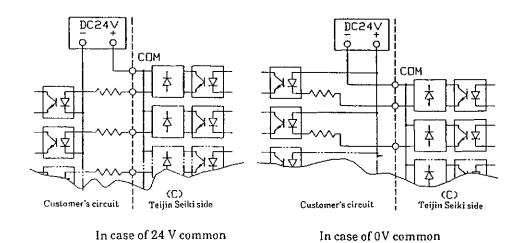
> Output circuits

Output circuits are shown below:

(The DC 24V power supply should be prepared by the customer.) (See page 3-10)



For preventing electrical shock, the power supply for input and output signals should have reinforced insulation (primary and secondary) (SELV). (Specification for equipment to be certified by TÜV.)



Conducted current should always, even momentarily, be below the above indications.

3-4. Explanations and Setting Up of the Parameter

The parameter is used to set up the operating conditions and to check each of the control status during operations.

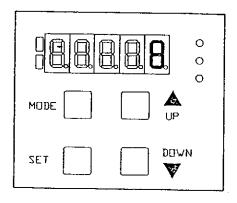
3-4-1. Outline of the parameter

Parame	ter numbers	- Outlines
Control parameter	P-1 to P-29	Items for parameter settings Reduction gear ratio Acceleration and deceleration time constant Number of indexing Operating speed Position loop gain and others
	P-60 to P-69	Items for parameter selections Selection of the encoder Selection of interlock signals Selection between short-cut operation or one-way operation Selection of indexing direction and others
	P-70 to P-79	Indication of the input and output signal status Indication of the absolute encoder alarm status
	P-80 to P-99	 Indication of the contents of the timer and DA converter register Indication of the present coordinate value (pulse) Indication of the error pulse
	m history)) to A-9	Indicates the last 9 alarms.
	parameters) to S-49	 Types of motor connected to the servo controller. Load inertia Servo gain (including speed and current) Servo operation mode

Note: For details of the parameter, refer to page 3-21 and after.

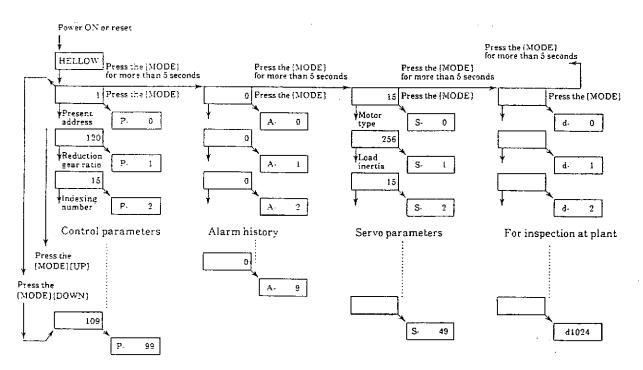
3-4-2. Setting the parameter

- The LED and push button switches in front of the servo controller allow checking and modification of the parameter settings, status display, alarm check and manual operation.
- On the controller front, the LED and switches are provided as shown in the drawing to the right.
- ▶ Normal displays
 - LED indicates present address.

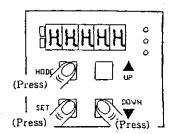


> Transition of display

By pressing the switches, display changes as follow:



- Initialization of the parameter
 - > When operating for the first time after installation, parameters must be initialized.
 - For details of initialization values, refer to the parameter setting section (on page 3-21 and after).
 - When using, the setting values should be modified to meet specifications of the customer.
 - Type of the servo actuator is set to AR15, so perform following servo parameter initialization according to your specifications.



Initialization procedures (1)

① Press four switches simultaneously until the display (LED) indicates 8 8 8 8 8.
② Press the MODE, DOWN and SET switches simultaneously for more than 1 second and the display (LED) indicates H H H H H . (Note)
③ At the time when H H H H H indication appears on the display (LED), the initialization of the parameter is complete.

Initialization procedures (2. Initialization at turn on of the power)
② Turn the power on while pressing the DOWN and SET buttons simultaneously.
The display (LED) displays H H H H H indications. (Note)

Note: The $oxed{H}oxed{H}oxed{H}oxed{H}oxed{H}oxed{H}oxed{H}oxed{H}oxed{H}$ indications appears momentarily.

Initialization of the servo parameter

Set the following values to servo parameter 0 according to the model of your servo actuator and servo controller.

Servo parameters 1 through 49 are automatically set.

Model of servo controller	ARS 15	ARS15	ARS30	ARS30	ARS30	ARS60	ARS60	ARS60	AR\$135	ARS135
Model of servo actuator	AR 15	AR30	AR15	AR30	AR60	AR30	AR60	AR135	AR60	AR135
Settings	15	18	25	30	40	45	60	80	100	135

Notes: • Initialization of the parameters and servo parameters should be done after turning the servo off. Otherwise, alarm E-7 is generated.

- Do not turn the power off during initialization or reloading. If the power is turned off, data might be damaged.
- Reloaded data becomes valid by turning the power on and off, or by entering the reset
 input.

After the loading, turn the power on and off or enter the reset signal.

 Back up of the parameter is done with EEPROM (electrically reloadable ROM). Limit is set to the number of reloading EEPROM can perform (up to 10000 times).

When frequent reloading is required such as for adjustment, setting without EEPROM is also available.

(See parameter No.P-66 on page 3-29.)

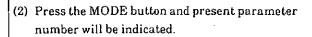
For parameter setting without EEPROM, the set parameter is held by the battery and RAM.

3-4-3. Checking and changing the parameter settings

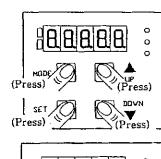
- When checking and changing parameter settings, follow the procedures below:
- When discontinuing operations, release the push-button switch
 The indications in the display (LED) will be automatically reset to the present address indication, 30 minutes later.

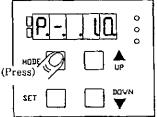
When continuous indications of the parameter settings are needed, operate the parameter No. P-68 (see page 3-30).

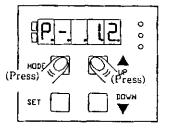
- (1) When changing the parameter setting, press the 4 switches simultaneously will the display (LED) indicates 8 8 8 8 8 8.
 - This operation is not necessary for checking.

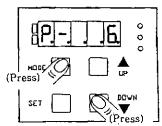


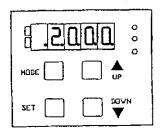
- (3) When raising the parameter number:
 - ① Press the UP button while keeping pressing the MODE button, and the parameter number goes up one by one.
 - ② Keep pressing the MODE and UP buttons simultaneously, and the parameter number goes up continuously.
- (4) When bringing down the parameter number:
 - Press the DOWN button while keeping pressing the MODE button, and the parameter number comes down one by one.
 - Keep pressing the MODE and DOWN buttons simultaneously and the parameter number comes down continuously.
- (5) Indication of the parameter setting
 - When selection of the parameter number is completed, the parameter setting is indicated in 0.5 sec. later

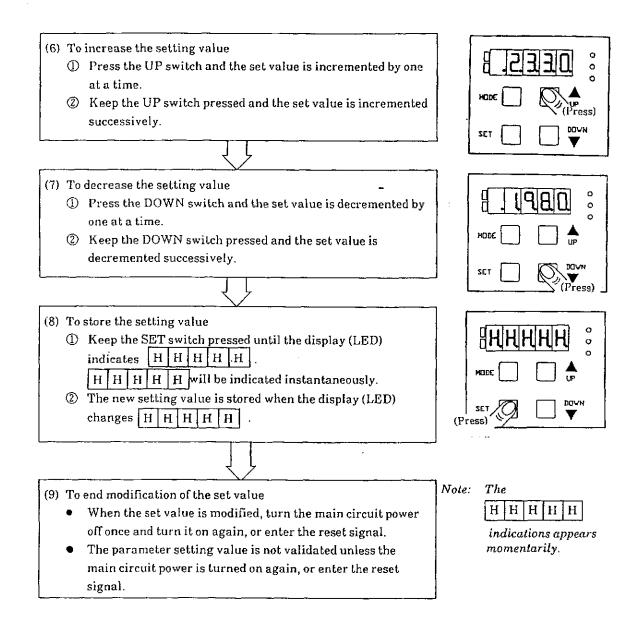












3-4-4. Setting the absolute encoder coordinate zero point

- This operation is for adjusting the zero point of the absolute encoder.
- The reference point is the state where the machine is positioned at index No. 1.
- > Set the coordinate zero point of the absolute encoder after setting the reference point.

Method for setting the coordinate zero point ① Keep the four switches pressed at the same time until the	HHHHH
display (LED) indicates 8 8 8 8 8 8 ② Press the UP and DOWN switches at the same time for 1	MODE DE UP
second or more and the display (LED) changes to H H H H H H to indicate the end of coordinate zero point setting for the absolute encoder.	SET DION

Note) If the parameters are not set in the absolute expression in the operation above, an alarm will result. [See parameters No. P-13 (on page 3-23) and No. P-60 (on page 3-27).]

3-4-5. Items of parameter setting

Para- meter numbers	Contents of the parameter	Setting ranges	Initializa- tion values
P-0	Present address indication		1
P-1	 Reduction gear ratio (R)(1:R) Input the reduction gear ratio of the servo actuator. When reducing the speed of the servo actuator output shaft further, input the overall reduction gear ratio. (Example) 1/120 × 1/2 = 1/240 (Input "240") 	Setting ranges: 2 to 1000 A and B types: Reduction gear ratio (R) by type AR15	120
P-2	Number of indexing ● Input the number of indexing. (Example) - When indexing one turn of the table to 10 equipartitions. Input "10" - In case of 60 units of ATC tool magazine Input "60"	Setting range 2 to 255	15
P-3	 Number of gears of the sprocket Input the number of gears of the sprocket. When the sprocket is not used, input the number of indexing. 	Setting range 2 to 255	15
P-4	Automatic operation speed (r.p.m.) • Input servo motor revolution during automatic operations.	Setting range AR15 to 60 50 to 3000 AR135 50 to 2500	2000
P-5	Acceleration and deceleration time constant during automatic operations (m sec) Input acceleration and deceleration time during automatic operations.	Setting range 50 to 1000 (The acceleration time constant is same as the deceleration time constant.)	500
P-6	 Manual operation speed (r.p.m.) Input the revolution of the servo motor during manual operations. Step, JOG and Zero point return modes. 	Setting range AR15 to 60 50 to 3000 AR135 50 to 2500	1000

Para- meter numbers	Contents of the parameter	Setting ranges	Initializa- tion values
P-7	Acceleration and deceleration time constant during manual operations (m sec) Input acceleration and deceleration time during manual operations.	Setting range 50 to 1000 (The acceleration time constant is same as the deceleration time constant.)	500
P-8	Creep speed during resetting to zero point (r.p.m.) Used for resetting to zero point with the incremental type. This is the rotating speed after stepping on the zero point limit switch.	Setting range 50 to 300	50
P-9	Position loop gain [Kp](sec-1) Select the optimum loop gain. Converted as 0.01 sec-1 = 1	Setting range 1000 to 5000 (10 to 50 sec - 1) Kp = 20 should be inputted as "2000".	2000
P-10	Allowable positional deviation (pulse) Means the max. follow-up errors during rotation. Set to the value obtained from the following equation or more: Used max. revolution of the servo motor Pulse number of the encoder × 1.5 Kp×600 10 pulses are converted as 1	Setting range 1 to 6553 (10 to 65530 pulse)	2000
P-11	 Range of in-position (pulse) Means the range of positionings. The positioning finish signal is outputted when positioned within the range of in-position. 	Setting range (T) 10 to 9999 T Command position	400
	Range of the home position signal (pulse) This signal is outputted at each address. The range of this signal (L) should be wider than the range of inposition, and less than 1/4 pitch. (1 pitch = distance between an address to the next address)	Setting range (L) 10 to 9999 Command position (L>T)	800

Para- meter numbers	Contents of the parameter	Setting ranges	Initializa- tion values
P-13	Number of the encoder pulse (pulse) Input the number of pulse for one rotation of the encoder.	Absolute encoder 8192 (Quadrupled internelly · 2048P/R)	8192
P-14	Deviation from the zero point of the absolute encoder on the one rotation. Indicates deviation from the zero point in one rotation of the encoder. When renewing the printed circuit board and ROM, record the previous parameter No. P-14 figures, and after renewal, set the figures to parameter No. P-14. Renewing may be done without changing the coordinate zero point.	Setting range 0 to 8192	
P-15	Grit shift value (pulse) • Means error adjustment value between zero point of the encoder and the reference point. • Calculate the movement amount (min.) at the output shaft by the following formula: Grit shift value × 360 × 60 Number of × Reduction encoder pulse gear ratio	Setting range 0 to 9999	0
P-16	Backlash correction value (pulse) This is used for correction of errors caused by backlash with either of CW rotation or CCW rotation. Calculate the movement amount (min.) at the servo actuator output shaft by the following formula: Backlash correction value × 360 × 60 Number of × Reduction encoder pulse gear ratio	Setting range 0 to 9999	0

Para- meter numbers	Contents of the parameter	Setting ranges	Initializa- tion values
P-17	Step feeding amount (pulse) This is used in the optional step feeding mode (see page 43) and in the local mode (see page 44). Calculate the movement amount (min.) at the servo actuator output shaft by the following formula: Step feeding amount × 360 × 60 Number of × Reduction encoder pulse gear ratio	Setting range 0 to 9999	200
P-18	 CW rotation side stroke limit This is used when there is a stroke end. 10,000 pulses should be converted to 1. With the absolute encoder, a limit setting value of the stroke limit, in accordance with the operating conditions, will be indicated in the display (LED). Setting should be made to a value equal to or less than this value. 	 Setting range with the incremental encoder 0 to 65535 (10,000 to 665,350,000 pulses) Absolute encoder A maximum value to the set conditions is automatically set. When re-setting, the value must be equal to or less than this this maximum value. Note) 	
P-19	 CCW rotation side stroke limit This is used when there is a stroke end. 10,000 pulses are converted to 1. With the absolute encoder, a limit setting value of the stroke limit, in accordance with the operating conditions, will be indicated in the display (LED). Setting should be made equal to or less than this value. 	 Setting range with the incremental encoder 0 to 66535 (10,000 to 665,350,000 pulses) Absolute encoder A maximum value to the set conditions is automatically set. When re-setting, the value must be equal to or less than this this maximum value. Note) 	

Notes:

- 1. The initialization value is indicated in the display (LED) even if parameter No. P-18 and P-19 are not used, but do not change the initialization value when not using them.
 - ① Incremental encoder : 9999 are indicated in the display (LED).
 - ② Absolute encoder : the limit setting value of the stroke limit is automatically

 $calculated\ and\ indicated\ in\ the\ display\ (LED).$

2. When "0" is set, the stroke limit takes the value of home position signal range (see parameter No.P-12 on page 3-22).

Para- meter numbers	Contents of the parameter	Setting	ranges	Initializa- tion values
P-20	Power save timer (sec) Used to avoid useless heat generation of the motor, when interrupting for long time. When it comes to the setting time in the power save timer, the servo ON signal turns off automatically and the built-in holding electromagnetic brake works. Meanwhile, when the operation start signal enters, the electromagnetic brake is released and the operation is resumed. The servo lock holds during the set time. Select use of the power save timer by parameter No. P-65 (in page 3-28).	Setting range	30 to 9999	30
P-21	 Overshoot (pulse) When the abrasion load is large, the servo lock holding torque may increase or positioning accuracy may deteriorate by mechanical distortions. In such cases, make overshooting. Set up the optimum overshoot checking the holding torque (electric current value). 	Setting range	0 to 9999	0
P-22	Number of follow up pulse (pulse) Corrects minute deviations occurred at the servo on or off. Correction is done at input of the servo on signal. Correction is done only to a deviation below the setting. (Do not set a value to this parameter when a value is set to P-21 (overshoot value).)	Setting range	0 to 400	0
P-24	 Automatic operation speed 2 (rpm) Enter the servo motor revolution in the automatic operation. Operation is done at this speed of this parameter when the speed change signal has been turned on at the time the start signal is entered. 	Setting range AR15 to 60 AR135	50 to 3000 50 to 2500	2000

Para- meter numbers	Contents of the parameter	Setting ranges	Initializa- tion values
P-25	Acceleration and deceleration time constant in the automatic operation 2 (msec) • Enter the acceleration and deceleration time in the automatic operation. • Operation is done at time constant of this parameter when the speed change signal has been turned on at the time the start signal is entered.	Setting range 50 to 1000 (The acceleration time constant and deceleration time constant is identical.)	500

3-4-6. Items of parameter selections

Para- meter numbers	Contents of parameter selections		Initializa- tion values
P-60	 Selection between the absolute encoder and incremental encoder Absolute encoder with the coordinate shifting function By use of the coordinate shifting function, endless indexing may be made without mechanical restrictions of reduction gear ratio, number of indexing and number of gears of sprocket. Absolute encoder without the coordinate shifting function (The coordinate shifting function is used when making positioning with the endless rotation.) Incremental encoder with the reference point return direction in CW rotation. See page 1-2 for the direction of rotation. See page 1-2 for the direction of rotation. 	(LED indication) 0000 0010 0001	0000
P-61	 Selecting the direction in which the number of the indexed address goes up. In case the order of numbering the indexed addresses is counterclockwise (CCW). See page 1-2 for the direction of rotation. In case the order of numbering the indexed addresses is clockwise (CW). See page 1-2 for the direction of rotation. 	(LED indication) 0000	0000

Para- meter numbers	Contents of parameter selections		Initializa- tion values
P-62	Selection of interlock signal. Parameter display (LED)	(LED indication) 0000	0001
	1 should be always indicated		
	Timing chart See (1) (MFIN) See (2)	0	
	Interlock A contact input signal is B contact input	0 1	
	Interlock Used signal is Not used	1 0	
	(1) When bit is 0 (2) When bit is 1		
	START START		
	CMDDAT CMDDAT	· · · · · · · · · · · · · · · · · · ·	
	CNTUP		
	Note: CNTUP is outputted START signal is on the positioning com	and within	
P-63	Selection between short-cut operation and one-way operation Short-cut indexing Finite indexing (when there is a stroke end) One-way indexing (CW rotation) One-way indexing (CCW rotation)	(LED indication) 0000 0001 0010 0011	0000
P-64	 Selection of indexing direction with a 2-position indexing (Address No. 1)→CCW rotation→(Add. No. 2)→CW rotation→(Add. No. 1) (Add. No. 1)→CW rotation→(Add. No. 2)→CCW rotation→(Add. No. 1)→(In case of one-way indexing, make out the setting by use of parameter No. P-63. 	(LED indication) 0000 0001	0000
P-65	Selecting use of the power save timer (Parameter No. P-20, in page 3-25) Not using the power save timer. Using the power save timer.	(LED indication) 0000 0001	0000

Para- meter numbers	Contents of parameter selections	Initializa- tion values
P-66	Using the direction backlash correction, direction of grid shift. S-shape acceleration/deceleration and EEPROM. Selection of the direction of backlash correction and the direction of grid shift. Select the direction of rotation of backlash correction and of grid shift. * Direction of rotation: Refer to page 1-2 Parameter display (LED) Grid shift CW 0 CCW 1 Backlash CW 0 CCW 1 Acceleration/ CCW 1 Acceleration/ Straight 0 deceleration curve S-shape 1 (Note) EEPROM Used 0 Not used 1 Note: When the backlash correction and grid shift are not used, set 0 to parameter numbers P-15 and P-16.	0000
P-67	Selection of the optional step mode If either CW or CCW signal is ON under the following setting, feeding takes places as specified to each parameter [revolution (P-6), acceleration/deceleration time constant (P-7) and minute feeding amount (P-17)]. [MODE A ON	0000

Note: A shock at acceleration or deceleration can be reduced by selecting S-shape acceleration/deceleration curve.

Para- meter numbers	Contents of parameter selections	Initializa- tion values
(Continued from P-67)	* When it is desired to operate the absolute encoder after switching the mode from the minute step to the drive mode. [MODE A → ON	0000
P-68	Selection of the alarm number external output and display duration of the parameter settings. Parameter display (LED) Parameter setting 30-second display 0 Continuous display 1 Alarm number Not outputted 0 (external output) is Outputted 1	0000
	 (1) Selection of parameter settings display duration 30-second display → settings are displayed for 30 seconds upon pressing the button and then display switches to present address. The set value is valid right after the setting is complete. The set value is reset to 0 at re-application of power or input of the reset signal. (2) Selection of the alarm number external output (see page 4-7) 	

Para- meter numbers	Contents of parameter selections	Initializa- tion values
P-69	 Selection of the local mode The local mode is for manual operation by use of push-button switches on the controller. It is used when making adjustments or at the time of test operations. Operations may be carried out skipping the input and output signal lines (CN2). 	0000
·	(LED indication) ① Not using the local mode. ② Selecting the JOG operation of the local mode. ② Selecting the step operation of the local mode. ② Selecting the step operation of the local mode. ② Selecting the minute step operation of the local mode. ② Selecting the minute step operation of the local mode. ② Selecting the minute step operation of the local mode. ③ Selecting the minute step operation of the local mode. ④ Selecting the minute step operation of the local mode. ⑤ Selecting the set-up amount by Parameter No. P-17]	
	 Methods of operation (The set value is valid right after the setting is complete.) ① When UP of the push-button switches is pressed, it rotates clockwise (CW). ② When DOWN of the push-button switches is pressed, it rotates counter-clockwise (CCW). (See page 1-2 for the direction of rotation.) 	
	 Parameter indication During operation, the parameter display (LED) indicates the index address after "L×××". 	
	 Releasing The local mode is released by simultaneously pressing MODE and SET of the push-button switches. 	
:	* The interlock is valid when used in the local mode, too. Check state of the interlock before use.	
		1

3-4-7. Status indications by parameters

When following parameter numbers are designated, status of the input and output signals (CN2) and alarm status of the absolute encoder are indicated in the parameter display (LED).

Para- meter numbers	Contents of indications (LED) Digit 4 Digit 3 Digit 2 Digit 1	Display (LED)
P-70	Input signals	<u> </u>
	CMDDAT4 CMDDAT3 CMDDAT2 CMDDAT1	Input signal
		CMDDAT 1 CMDDAT 2
P-71	Input signals	CMDDAT 3 CMDDAT 4 signals
	CMDDAT8 CMDDAT7 CMDDAT6 CMDDAT5	CMDDAT 5 CMDDAT 6 CMDDAT 7
P-72	Input signals	CMDDAT8
	INLK START CCW CW	CW: Manual command CW signal CCW: Manual command CCW
		signal
P-73	Input signals	START : Operation start signal INLK : Interlock signal
	PRDY SVON MODEB MODEA	MODE A: Mode selection signals MODE B: Mode selection signals SVON: Servo ON signal
P-74	Input signals	PRDY : Operation preparation command signal
	AUX 1 REFLS SPEED	REFLS : Zero point LS signal SPEED : Speed change signal
P-75	Output signals	Output signals
	SPDAT 4 SPDAT 3 SPDAT 2 SPDAT 1	SPDAT 1 SPDAT 2 SPDAT 2
P-76	Output signals	SPDAT 3 SPDAT 4 Present address
	\	SPDAT 5 SPDAT 6 SPDAT 7
	SPDAT 8 SPDAT 7 SPDAT 6 SPDAT 5	SPDAT 8
P-77	Output signals	SALM : Control alarm signal IDPOS : Home position signal
	MOV CNTUP IDPOS SALM	CNTUP: Positioning finish signal MOV: Servo actuator in
P-78	Output signals	operation signal
	AUX 5 AUX 4 AUX 3 AUX 2	
		ENALM: Presence/absence of alarm signal
P-79	Indicates alarm status of the absolute encoder.	BATALM 1: Battery voltage drop BATALM 2: Built-in capacitor voltage drop
	ENALM BATALMI BATALM2 CNTOVF	CNTOVF : Counter overflow

Parameter numbers	Contents	Initial value:
P-30	Value preset by maker	0
P-31	Value preset by maker	0
P-40	Value preset by maker	0
P-41	Monitor output selection	103
P-42	Not used	
P-43	Number of power on/off times	
P-44	Encoder version (Present version: "0", M/C version: "1")	
P-45	Value preset by maker	
P-46	Value preset by maker	
P-47	Value preset by maker	
P-48	Value preset by maker	20
P-49	Value preset by maker	4080
P-50	Drift correction time constant (lower range)	25
P-51	Drift correction time constant (upper range)	5
P-52	Drift correction plus gain	2
P-53	Drift correction minus gain	1
P-54	Value preset by maker	50
P-55	Value preset by maker	400
P-56	Servo lock mode	120
P-57	Permissible position error in servo lock mode	400
P-58	1/10 value of error pulse for excessive position change	
P-59	Number of controller alarm occurred just before	
P-80	Monitor output data (Ch A)	
P-81	Monitor output data (Ch B)	
P-82		
P-83	Indicates contents of timer 3 register (20 msec.)	
P-84	Indicates contents of timer 4 register (1 sec.)	
P-85	Dividing pitch fraction	
P-86	Correction of dividing pitch fraction	
P-87	Number of continuous step feeding times	
P-88	Shift of coordinate in a coordinate shift	
P-89	Operation mode register	
P-90	Speed limit	12000
P-91	Equal-speed command value	30000
P-92	Speed command value in servo lock mode	30000
P-93	Deviation from equal-speed command value	0
P-94	Speed command value	30000
P-95	Error pulse	
P-96	Indicates the coordinate value (of lower range).	
P-97	Indicates the coordinate value (of middle range).	
P-98	Indicates the coordinate value (of higher range).	
P-99	Program version	110

3-4-8. Servo parameters

• Principally, all parameters except S-0 and S-1 should be used at their initialization values.

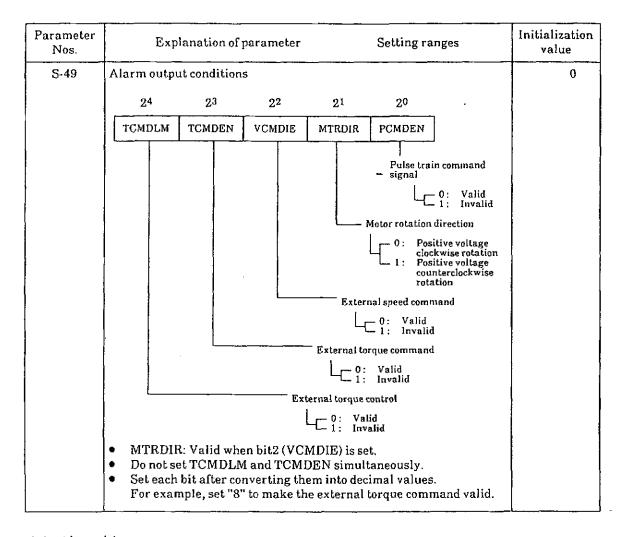
Parameter Nos.	Explanation of parameter	Setting ranges	Initialization value
S-0	Actuator type ROM on the digital servo stores the sta actuator. When the motor parameters below, constants for the speed and curr at the time the power is turned on next	are set according to the table ent loop are automatically set	15
	Servo controller Servo actuato	r Parameter	
	ARS15-06 AR15* AR30*	15 18	
	AR30-10 AR30* AR60*	25 30 40	
	AR30* AR60* AR135*	45 60 80	
	ARS135-25 AR60* AR135*	100 135	
S-1	Load inertia ratio Calculate ratio of the machine load inertia ratio against the motor rotor in expression and set the value.		256
	Load inertia ratio =	chine load inertia × 256 inertia x Reduction gear ratio ²	
S-2	Speed loop proportional gain Use the value that has been automatically set upon setting the mot	Setting ranges: 1 to 16384	71
S-3	Speed loop integral gain Use the value that has been automatically set upon setting the mot	Setting ranges: 1 to 16384	458
S-4	Imperfect integral coefficient This coefficient makes rigidity of the servo finite.	Setting ranges: 1 to 16384 Standard setting: 1 to 16384	16384
S-5	Acceleration feedback gain This stabilizes the servo system when it became unstable because the externa motor inertia. If an excessively large v generate an abnormal sound, therefore level where such sound is avoidable.	value is set, the motor might	0
S-6	PI - IP coefficient Use the value that has been automatically set upon setting the motor type.	Setting ranges: 1 to 16384 Standard setting: 1 to 16384	16384

Parameter Nos.	Explanation of parameter Setting ranges			
S-7	Torque command filter The torque command filter applies low pass filter to the torque command output			
S-8	Speed limit Overspeed alarm "E-111" is generated when the rotation is continued for more t beyond the set value.	han 1 second at a –	revolution	9830
		revolution (rpm)	× 8192	
	Set value =	3000		
S-9	Torque limit Use a value less than the value that has been automatically set upon setting t	Setting ranges:	50 to 2507	2257
S-10	Current loop gain 1 Use the value that has been automatically set upon setting the motor	Setting ranges:		979
S-11	Current loop gain 2 Use the value that has been automatically set upon setting the motor	Setting ranges : type.	50 to 1000	1092
S-12	Current loop proportional gain Use the value that has been automatically set upon setting the motor	Setting ranges:		10985
S-13	Current loop integral gain Use the value that has been automatically set upon setting the motor	Setting ranges : type.	50 to 1000	3373
S-14	Current loop integral limit Use the value that has been automatically set upon setting the motor	Setting ranges : type.		4096
S-15	Rated current parameter Use the value that has been automatically set upon setting the motor	Setting ranges :	50 to 2058	532
S-16	Current dead zone correction Use the value that has been automatically set upon setting the motor	Setting ranges:	0 to 256	0
S-17	Encoder pulse number Settin Set a value equal to 4 times the number of pulse on encoder	granges: 8000) to 10000	8192
S-18	Encoder type Use the value that has been automatically set upon setting the motor	Setting ranges : type.	0 to 6553	0
S-19	External mount encoder pulse number Use the value that has been automatical		0 to 65535	65535

Parameter Nos.	Explanation of parameter	Setting ra	Setting ranges		
S-20	External mount encoder type	Setting ranges :	0 to 15	15	
	Operation mode	Edge sensor	Setting		
	Up/down count mode	Rising edge sensor	5		
		Falling edge sensor	6		
	Phase difference mode Doubled	Both rising/falling edge sensor	11		
	Phase difference count mode Quadrupled		15		
	 Do not set a value other than the In the up/down count mode, PA CN4a are counted. PAI and *P and *PBI inputs control down of the When phase difference exists, up count is performed and if PI performed. The settings are not valid unle 	AI, *PAI, PBI and *PBI PAI inputs control up co count. If PAI and *PAI termin BI and *PBI is earlier d	unt, and PBI al is earlier own count is		
S-21	Overload protection limit Use the value that has been automatically set upon setting the	Setting ranges:	0 to 32767	32000	
S-22	Overload protection coefficient 1 Use the value that has been automatically set upon setting the	Setting ranges:	0 to 32767	16376	
S-23	Overload protection coefficient 2 Use the value that has been autom	Setting ranges : atically set	0 to 32767	2458	
S-24 to S-26	Blank	——————————————————————————————————————		_	
S-27	Brake timing Use the value that has been automatically set.	Setting ranges:	0 to 32767	19200	
S-28	Relay timer Setting ranges: 0 to 3276 Use the value that has been automatically set upon setting the motor type.			65280	
S-29	Current limit Use the value that has been automatically set upon setting the	Setting ranges:	0 to 2407	2257	
S-30	Observer speed loop model Use the value that has been automatically set upon setting the	357			
S-31	Observer motor model Use the value that has been automatically set upon setting the	Setting ranges:	0 to 32767	29569	

Parameter Nos.	Explanation of parameter Setting ranges	Initialization value
S-32	Inertia identification level Setting ranges: 0 to 32767 Use the value that has been automatically set upon setting the motor type.	256
S-33	Speed identification level Setting ranges: 0 to 32767 Use the value that has been automatically set upon setting the motor type.	256
S-34	Observer position loop gain Setting ranges: 1000 to 5000 Use the value that has been automatically set upon setting the motor type.	2000
S-35	Position loop gain Setting ranges: 1000 to 5000 Use the value that has been automatically set upon setting the motor type.	2000
S-36	Imposition range Setting ranges: 0 to 1000 Use the value that has been automatically set. This parameter is not valid unless bit0 of S-49 is set.	100
S-37	Zero speed Setting ranges: 0 to 1000 Use the automatically set value. This parameter is not valid unless bit2 of S-49 is set.	128
S-38	Speed coefficient H Setting ranges: 0 to 2048 Use the automatically set value.	1024
S-39	Speed coefficient L Setting ranges: 0 to 2048 Use the automatically set value.	512
S-40 to S-42	Blank	_
S-43	External torque command offset Setting ranges: 0 to 4095 This sets the offset value for the external torque command (CN4-6). When the voltage calculated from the setting is entered, torque generation goes to zero.	2048
	Offset voltage (V)×2048 Setting value = +2048	
	10	
	This parameter is not valid unless bit3 or bit4 of S-49 is not set.	
S-44	External torque command variable Setting ranges: 0 to 32767 This sets the ratio between the external torque command (CN4-6) and the generated torque. Setting = (0 to 1.9999)×16384 When setting is 16384, the value is max. torque/10 V This parameter is not valid unless bit3 or bit4 of S-49 is not set.	16384
S-45	External speed command offset Setting ranges: 0 to 4095 Sets offset value of the external speed command (CN4-5). The revolution goes to zero when the voltage being calculated from the setting value is input.	2048
	Offset voltage (V)×2048	
	Setting value = 10 + 2048	
	This parameter is not valid if bit2 of S-49 is not set.	

Parameter Nos.	Explanation of parameter				Setting rang	ges	Initialization value
S-46	External speed command variable Setting ranges: 0 to 32767 It sets ratio of the external speed command (CN4-5) to the revolution. Setting value = (0 to 1.9999) × 16384 When the setting value is 16384, the ratio is 3000rpm/10 V. This parameter is not valid if bit2 of S-49 is not set.						16384
S-47	Function se	lection			•		0
	24	23	22	21	20		
	0	0	0	MDLENA	PLPENA		
					Driver sec positional — Model ada	loop	
					control	ptation	
					0: Va 1: Inv		
					imal values. op control is v	valid.	
S-48	Alarm outp	ut condition	s				0
	24	23	22	21	20		•
	0	ROHTHE	монѕтн	монтне	BRKPWR		LE
					 Brake pov	ver	
					— Motor the	rmal	
			L		— Software t	hermal	
		<u> </u>	***	<u> </u>	Regenerat resistor ov		
	:				0: Chec 1: Not		
	brake or • Set each	r when the b bit after co	rake contro nverting th	l is done fro em into dec	r not installed m a separate imal values. is not checke	circuit.	



3-4-9. Alarm history

Parameter Nos.	Explanations	Initial value
A-0	Latest alarm	
A-1	First latest alarm	
_ A-2	2nd latest alarm	
A-3	3rd latest alarm	
Λ-4	4th latest alarm	
A-5	5th latest alarm	
A-6	6th latest alarm	
A-7	7th latest alarm	
A-8	8th latest alarm	
A-9	9th latest alarm	

3-5. Driver Section

3-5-1. Driver (CN4) input and output signal

Signal names	Symbols	Pin numbers	Contents
5 V power	5 V DGND	1, 2 3, 4	Built-in power. + 15V±5%, max. output current 200 mA.
±15 V power	+15 V -15 V AGND	11 12 7,13	Internal power supply for command signal ± 15V ± 5%, max. output current 30 mA.
Speed input command	VCMD	5	Analog command input of the motor rotation speed. It is 0 to ±10 V/0 to ±3000 rpm. However, the motor rotation speed when 10 V is entered can be varied by the servo parameter S-46. Input impedance is approx. 10 k ohms. This input is valid when 4 is set to the servo parameter S-49. Analog input interface Speed command Analog input interface Speed command TCHD Analog input interface Speed command TCHD Analog input interface Speed command TCHD Analog input interface
Torque command input Torque control input	TCMD	6	It is an analog input of the servo controller output current. Actuator (S-9/S-15) input yoltage (V) torque (%) 10.0 V However, the output current when 10V is entered can be varied by the servo parameter S-44. Input impedance is approx. 10 k ohms. This input is valid when 8 or 16 is set to servo parameter S-49. Input voltage range is 0 to 10V during the external torque control. For the input interface, refer to the speed command input.

Signal names	Symbols	Pin numbers	Contents
Pulse train signal input A phase B phase	PAI *PAI PBI *PBI	14 15 16 17	Pulse train command, up to 200 Kpps. High speed photocoupler input. External mount encoder signal input. Set the pull up resistor so that the input current i is within the range of 8mA to 16 mA. LED forward voltage drop f = 1.4 V (a) In case of open collector Open collector method Max. 200 kpps In case of phase difference input ABC D = (P41)±(P48) Set D = (P41)±(P48) Outy ratio ((P21)±(P41))
			(b) In case of line driver Differential receiver method Max. 200 kpps tr. th. In case of phase difference input A Line Transport of the two colors of the color of the col

Signal names	Symbols	Pin numbers	Contents
Positional signal output	AM BM ZM	8 9 10	Signal output of the motor encoder. Open collector output. Limit current equal to or less than 35 mA at 5 to 24 V. Pulse train output interface Pulse train output interface Phase relation During counterclockwise rotation of motor Approx. Jana App
Shield	G	20	Connect the shield signal wire

3-5-2. CN4a input and output signal connector

Connector type (CN4a) (On printed	Appl			
	C-1334	Case (Non-shield shell kit and ground plate are attached)		Manufacturer name
wiring board side)	Soldered type	Jack screw M2.6 type	One touch lock type	
10220-52A2JL Right angle 20P	10120-3000VE	10320-52A0-008	10320-5 2F0 -008	Sumitomo 3M Co. Ltd.

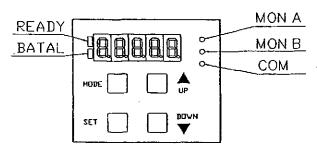
3-6. Measurement of Servo Motor Shaft Torque and Speed (Revolution)

3-6-1. Measuring method

The speed feedback value is output to the monitor terminal A ch and the current feedback value to the monitor terminal B ch.

Measurement is done with an oscilloscope using the motor terminal and COM terminal.

Monitor terminal section



3-6-2. Calculating the torque

Calculating the torque on the servo motor shaft

Calculate the servo motor shaft torque by entering the measured voltage to the following expression.

Servo motor shaft torque \Rightarrow Measured voltage (A/V value \times torque constant $\times 1/\sqrt{2}$) (N·cm) \Rightarrow Measured voltage \times Constant

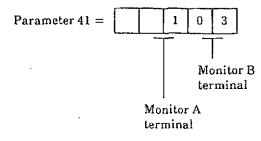
Туре	AR15	AR30	AR60	AR135
A/V value	6.5	9.8	16.3	24.5
Torque constant	54	64	72	78
Constant	248.2	443.5	829.9	1351.3

Servo actuator output shaft torque = Servo motor shaft torque × Reduction gear ratio (R) × (Efficiency)

3-6-3. Calculating the speed

Servo motor shaft rotational speed =
$$\frac{\text{Measured}}{\text{voltage}} \times \frac{3000}{2.5}$$

The monitor output terminal allows output from other monitor terminals. Set following values to parameter 41 and after. However, they are set again to 103 at power on.



For example, set "814" to parameter 41 when the U phase feedback value and the number of motor rotation are to be outputted to monitor A terminal and monitor B terminal, respectively.

0	Speed command	1	Speed feedback value
2	Torque command	3	Torque feedback value
4	Rated current ratio	5	Motor thermal data
6	External speed input value	7	External torque input value
8	U phase feedback value	9	V phase feedback value
10	W phase feedback value	11	U phase current output value
12	V phase current output value	13	W phase current output value
14	Motor rotational speed		

4. Troubleshooting

4-1. Inspection in trouble

4-1-1. Inspection in trouble.

When a trouble occurs, check the following items:

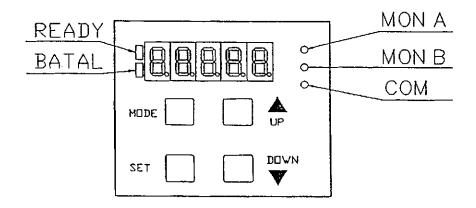
- (1) Kind of trouble in detail
- (2) If any alarm display appears or any alarm signal is output.
- (3) Situations under which a trouble has occurred.

When a trouble occurs, the dynamic brake works, and the servo actuator comes to an emergency stop. At the same time, an alarm display appears on the display of the servo driver/controller, and an alarm signal is output outside.

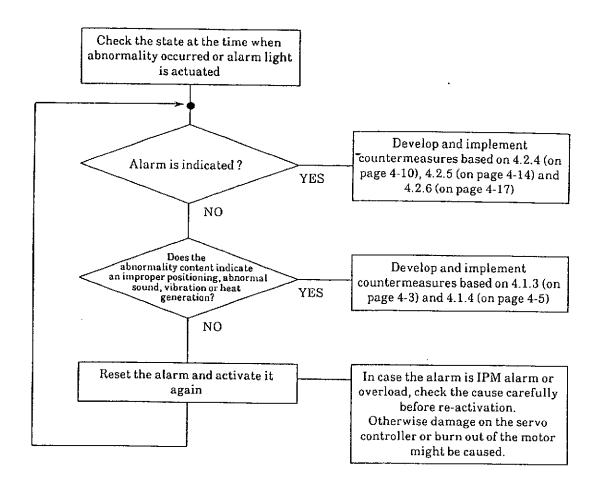
- In the case of control alarms, alarm numbers (Alarm E-2 to 17) appear on the LED, and control alarm signals (CN2-29 pin) are output.
- In case of driver alarms, alarm numbers (Alarm E-101 to E-116) appear on the LED, and driver alarm signals (CN2-44 pin) are output.
- In the case of controller alarms, READY goes on or flickering and controller alarm signals (CN2
 -45 pin) are output.
- In the case of battery alarm BATAL goes on and battery alarm signals (CN2-46 pin) are output.

Note: During CPU initialization with input of reset signal at the time of power on, LED displays "HELLO".

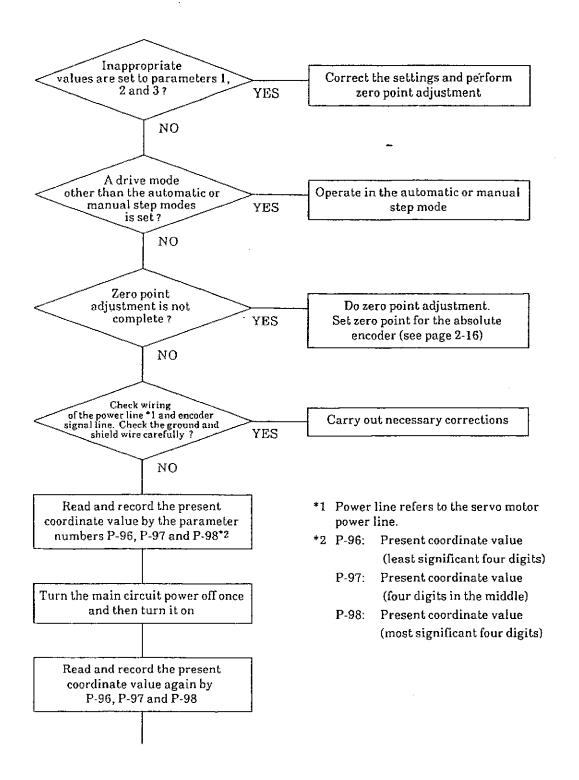
Layouts of Servo Driver/Controller Displays

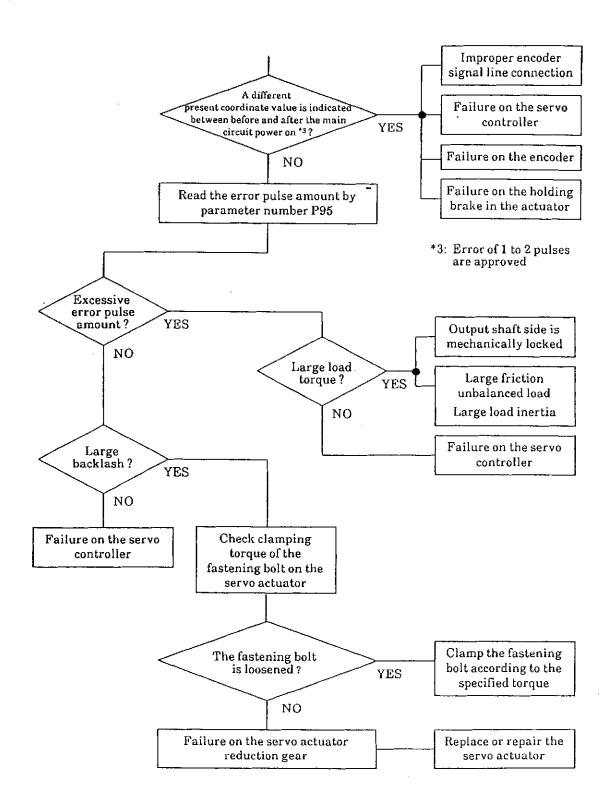


4-1-2. Actions required at occurrence of abnormality

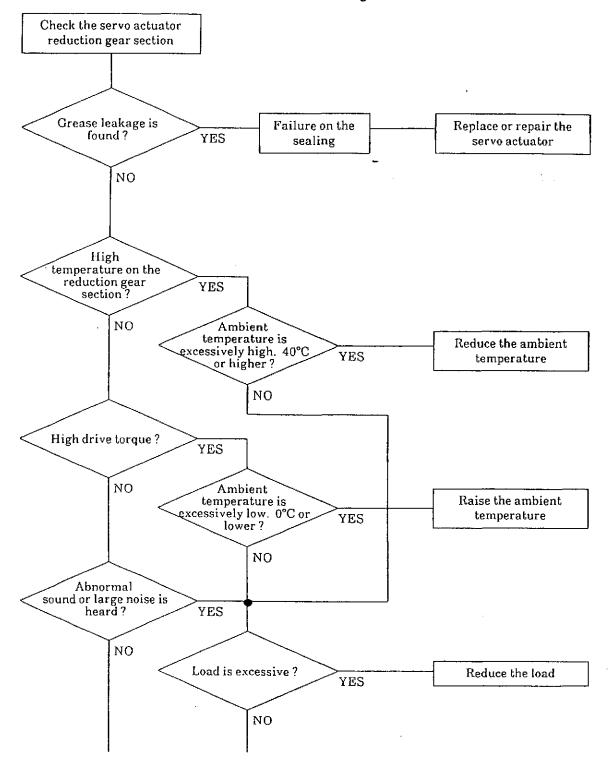


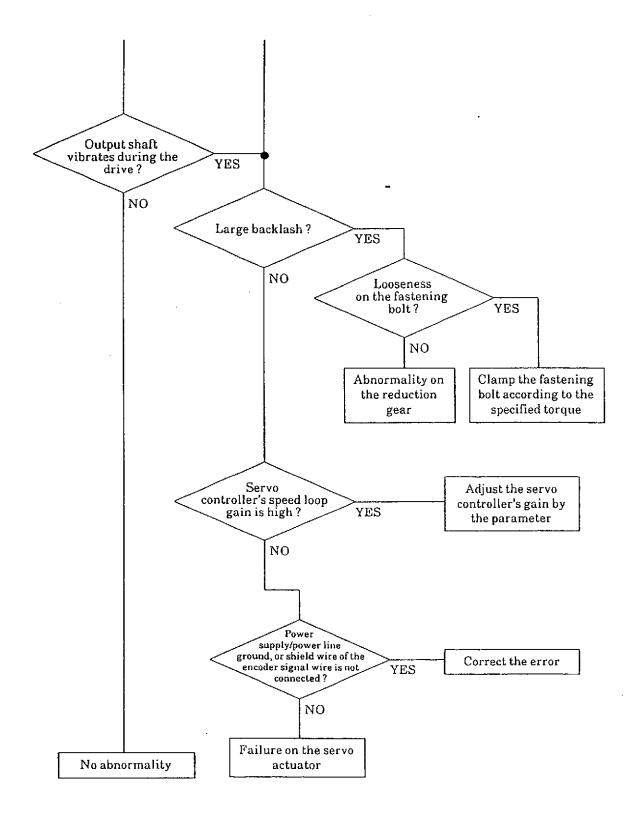
4-1-3. In case of improper positioning





4-1-4. In case of abnormal sound, vibration or heat generation





-

4-2. Diagnosis and Countermeasures for Abnormality in Control

4-2-1. Explanations of control alarm

Alarm number (Indicated on display)	Explanations
E-2	Positional deviation in excess of tolerance
E-3	An address beyond setting range is designated
E-4	Coordinate values exceed the coordinate limit of the control system
E-5	Excess drift
E-6	Operation results overflow
E-7	When data beyond the setting range is set to the parameter
E-8	Zero point is not detected (with the incremental encoder)
E-9	Excessive positional deviation during servo lock
E-10	MAE communication error. In case of data transfer error.
E-11	MAE framing error. In case of data transfer error.
E-12	MAE overrun error. In case of data transfer error.
E-13	MAE parity error. In case of data transfer error.
E-14	Voltage drop in MAE battery.
E-15	When MAE built-in capacitor voltage drops to such level that it can not hold data
E-16	Multiturn section counter of the MAE overflows
E-17	MAE coordinate and coordinate held by the servo controller do not match
E-101	IPM alarm
E-102	Over-voltage
E-103	Open encoder signal line
E-104	Low voltage
E-105	Overload
E-106	Overheat (Servo actuator)
E-107	Undefined
E-108	Servo actuator open power line
E-109	Brake power failure
E-111	Over speed
E-112	Abnormality in the U phase current sensor offset
E-113	Abnormality in the W phase current sensor offset
E-114	Abnormality in AD converter
E-115	Abnormality in regenerative resistor
E-116	Over heating (Regenerative resistor)

Notes: ① MAE -- Abbreviation for Multiturn Absolute Encoder.

3 IPM -- Abbreviation for Intelligent Power Module.

② Alarm numbers E-14 to E-17 output alarms when the abnormality was experienced in the past, even though there is no current problem.

4-2-2. Releasing the alarm state

- Alarms except alarm numbers E-101, E-103, E-106 and E-116 can be released from the mode button on the servo controller.
- Alarm numbers E-2 to E-13 and E-101 to E-103 can be released by entering the reset signal.
- When alarm numbers E-14 to E-17 occur, clear the alarm indication by pressing the mode button for at least 1 second, and then check if the machinery origin is actuated by indexing the indexing No.1 (see page 2-21).
- When the machinery origin is not actuated, perform the zero point adjustment (see page 2-21).
- Control alarm can not be reset by entering reset signal. Turn the power off once and turn it again. If the alarm recurs, the reason may be, ① the reset signal is kept entering, or ② stop of control function. Check the situation and take proper steps.

Note: When alarm appears, check its cause and implement appropriate measures.

If proper steps are not executed, alarm will recur even if alarm state is released.

4-2-3. Dynamic braking function

With ARS 60 and 135 servo controllers, dynamic braking function is provided for stopping operations when abnormalities occur.

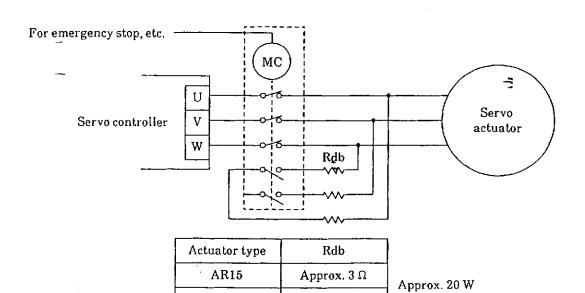
The dynamic brake works under following status:

- When an alarm actuated.
- > When the servo on signal is turned off during operation.
- > When the operation preparation signal is turned off during operation.
- When the main circuit power is turned off during operation.

Note: ARS15-06 and ARS30-10 do not have the built-in dynamic brake. Dynamic braking function can be added to them with the following circuit.

Turn the operation preparation signal off simultaneously with turning off of the electromagnetic contactor MC.

Use an electromagnetic contactor MC on which A contact does not overlap B contact.



Approx. 1 Ω

AR30

4-2-4. Diagnosis and countermeasures for the control alarms

Alarm Nos (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-2 Positional deviation exceeds tolerance (Positional deviation exceeds the value set to P- 10)	At entering the operation start signal	 Improper initialization Imperfect connection of the power line Imperfect connection of the encoder signal line Failure on the servo controller Failure on the servo actuator 		•	•	3
	or deceleration	 Improper setting to parameters P-9 and 10. Excessive load inertia. Acceleration and deceleration time constant is too small. Holding electromagnetic brake is not released. Failure on the servo actuator reduction gear. Failure on the servo actuator. 		•	•	Replace the motor unit if holding torque is not enough at turning the servo off.
When an	address command signal	 Improper setting to parameter P-2. Abnormalities in NC/PC program. Wrong wiring of input signal line. Failure on the servo controller interface. 	•	•		Replace the servo controller.

Alarm Nos. (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-4 (When present coordinate values exceeds the range set to P-18 and P-19)	At power on	 Imperfect connection of the encoder signal line. Errors in reference point setting operation. 		•		Set the reference point.
	During operation	 Errors in setting stroke limit for clockwise and counterclockwise rotation (Parameters P-18 and P-19). The coordinate shift function is not used (Parameter P-60). Operation errors in the manual operation. 		•		Operate so that the stroke limit is not exceeded.
E-5	At entering the servo on signal	 Imperfect connection of the power line. Imperfect adjustment of the servo controller. The power line is thinner and longer than the specified size. Failure on the servo actuator. Imperfect connection of the encoder shield wire. 	•	•	•	
E-6	At entering the servo on signal	 Manual step feeding has been continuously done more than 255 times. Failure on the controller. 	•		•	Number of continuous step feeding is stored on parameter P-87.
E-7		 When data beyond the setting range is set to the parameter. 		•		
E-8	During zero point adjustment of the incremental encoder.	 Failure in the zero point limit switch. Open signal line coming from the zero point limit switch. Errors in the signal input logic of the zero point limit switch. Errors on the servo controller. 		•	•	

Alarm Nos. (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-9 (Positional deviation value at the servo lock is beyond P-57)	At entering the servo on signal	 Imperfect connection of the power line. An excessive external torque has been applied. The power line is thinner and longer than the specified size. 	•	•		ίζα
E-10 to 13		 Imperfect connection of the encoder signal line. In the specifications for the incremental encoder, settings for the absolute encoder are specified to parameters P-13 and P-60. Failure on the encoder. Failure on the servo controller. 		•	•	If power failure occurs or the reset signal is entered while the servo actuator is rotating, E-10 may be outputted. In that case, turn the power on again or enter the reset signal again.
E-14, 15		 Imperfect connection of the encoder signal line. Imperfect setting to the absolute/incremental encoders selector switch. Battery voltage drop. Failure on the servo controller. Failure on the encoder. 		•	•	E-14 will be outputted, if the encoder signal line is not connected at power on.
E-16 —		 Rotation of the servo actuator exceeds the coordinate limit for the absolute encoder due setting errors to parameters P-18 and P-19. Parameter P-60 is not set to have coordinate shift function which is needed for one way indexing in the endless rotation. Failure on the encoder. 		•	•	

Alarm Nos. (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-17 —	At power on	 Coordinate of the encoder and the coordinate held in the servo controller does not match. 				d,

- When alarm numbers E-14 to E-17 are actuated, perform positioning to the indexed position being designated as indexing position No.1 and make sure the machine origin point is actuated. Then set the coordinate zero point by pressing the push button on the servo controller.
- When the machine origin point is not actuated, do the zero point adjustment (see page 2-21).

4-2-5. Diagnosis and countermeasures for control alarm (Driver)

Alarm Nos- (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-101 IPM alarm	At power on	• Failure on the servo controller			•	Replace the servo controller.
	At entering the operation preparation command	• Failure on the servo controller	14		•	Replace the servo controller.
	At entering the servo on signal	• Failure on the servo controller • Imperfect connection of the encoder signal line. • Imperfect connection of the power line. • Imperfect grounding of the power supply and power lines.		•	•	Replace the servo controller.
	operation	 Shield wire of the encoder signal line is not connected. Excessive load. Brake power failed momentarily. Abnormalities in the current limiting circuit. 	•	•		Replace the servo controller.
E-102 Over-voltage (Detected at approx. 400 V)	At power on	 Main circuit capacitor is not discharged. 				Turn the main power off for about 1 minute, then turn it on again.
	At entering the operation preparation command.	Failure on the servo controller.			•	
	At entering the servo on signal.	Input supply voltage is too high.	•	•	ļ.	Input supply voltage is 230 V + 10%.
	operation	Excessive load inertia Acceleration and deceleration time constant is too small. Imperfect connection of the optional regenerative resistor. Abnormalities in the regenerative process circuit.		•	• [Check clamping of DCP and DCN on cerminal board TB1. Replace the servo controller.

Alarm Nos. (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-103 Open signal line	• At power on	 Imperfect connection of the encoder signal line. Failure on the encoder. 		•	•	4
E-104 Low voltage (Detected at approx. 120V)	 At power on. At entering the operation preparation command. At entering the	 Failure on the servo controller. Supply voltage is too low. Power input circuit 	•	•	•	Input supply voltage is 200 V -15%.
	servo on During operation	NFB trips. Imperfect power supply connection (disconnection of phase, loosened terminal, etc.) Failure on the main circuit diode		•	•	Replace the servo controller
E-105 Overload	At power on	• Failure on the servo controller			• .	Replace the servo controller
	At entering the operation preparation command	 Failure on the regenerative circuit 			•	Replace the servo controller
	At entering the servo on signal	 Imperfect connection of the regenerative resistor 	•	•		Check and modify the acceleration/dec eleration time constant and load.
	During operation	 Regeneration frequency is too high 		•		
	During operation	• Excessive load (lock)		•		Electronic thermal is actuated

Alarm Nos. (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-106 — Servo actuator overheat Approx. 120°C (motor thermal)	At power on	 Heat sink on the servo actuator or supply unit, or regenerative resistor is heated too high. 	•			4,1
E-116 Regenerative resistor overheat Approx. 100°C	At entering the servo on signal	 Imperfect connection of the encoder signal line Imperfect connection of TB2, 24 V Imperfect connection of the regenerative resistor thermal line 	-	•		Check polarity, etc.
٠.	During operation	 Excessive load Electromagnetic brake is not released Excessive holding torque at servo lock Ambient temperature is too high 	• • •	•		When frictional load is too large, use parameter 21. Use power save timer (P-20)
E-108 Open power line	At power on. At entering the operation preparation command. At entering the servo on signal.	 Failure on the servo controller. Imperfect connection of the power line. 		•	•	
E-109 Open brake power line	At power on. At entering the operation preparation command or servo signal.	 Failure on the servo controller. Open brake power line or brake line. 		•	•	Connect DC24 V brake line to TB2.
E-111 Over speed	During rotation	Being rotated for 1 second or more beyond the speed limit				- -
E-112 U phase current sensor offset error	At power on	 Failure on the servo controller 			•	
E-113 W phase current sensor offset error	At power on	• Failure on the servo controller			•	

Alarm Nos. (Indicated on- LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
E-114 Abnormality in AD converter	At power on	• Failure on the servo controller			•	i,
E-115 Abnormality in regenerative transistor	At entering the operation preparation command	• Failure on the servo controller	_		•	

4-2-6. Diagnosis and countermeasures for controller alarm

Controller alarms can not be released by entering the reset signal. Turn the power off once and then turn it again. If the alarm still remains after this operation, perform the following measures.

Alarm Nos. (Indicated on LED)	Status when alarm light goes on	Presumes causes	Check	Corre- ction	Repair	Remarks
READY flashes		 Reset signal is being entered. Failure on the servo controller. 	•	•	•	Replace the servo controller.
Indication "HELLO" still remains		 Internal parameter settings disappear. Battery voltage is lost. 	•	•		Check the battery voltage, then initialize it (3-16).

4-3. Abnormalities in the Battery and when to Renew it

Use the lithium battery to back-up parameter settings and absolute encoder data.

4-3-1. When to renew the battery

Ę

- When the battery (lithium battery) voltage drops, the display (BATAL) lights and external output signal [battery alarm (BALM), is outputted.
- Even after the battery alarm appears, the battery may support for about a week.
 Data disappear after a week and renew the battery in an earlier stage for precautions.
 - With the incremental encoder

Renew after 4 years of use.

With the absolute encoder

Renew at the earlier date of either 2 years of use or 12000 hours in total of power failure.

4-3-2. Cautions when renewing the battery

Be careful that the electronic parts in the controller may not be affected by static electricity.

- Ground the body of the person touching the battery.
- Do not touch the conductive sections and electronic parts directly.
- After renewal, check the parameter settings.
- If parameter settings disappear, set them again.
 - (* If parameter settings disappear, LED display keeps on indicating HELLO even after the main circuit has been turned on.)

4-3-3. Applicable types of the battery and connector

> The following battery is used:

Name:

Lithium battery

Type and rating:

ER6VC4 (Made by Toshiba Denchi Co. Ltd.)

-3

3.6 V 2000mAh With connector

Specifications of the connector: Housing IL-2S-S3 (N)

Contact IL-C2-1

Made by Japan Aviation Electronics Industry Ltd.



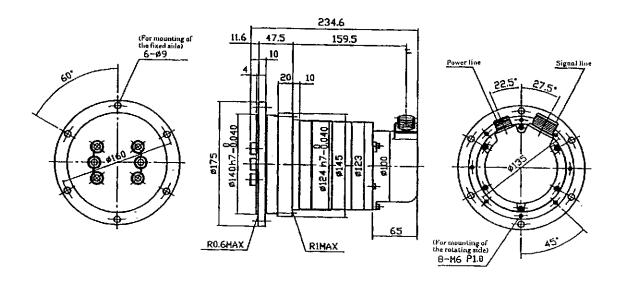
Attention should be paid to the following points when handling the battery. Improper handling could cause explosion, burst, firing or burning. Take care so that your eyes may not be exposed to the battery contents.

- ① Do not heat the battery beyond 100°C nor expose it to fire. Also, do not try to incinerate it. (These could be a cause for burst, firing or burning.)
- ② Do not disassemble. (Battery contents might get into your eyes.)
- 3 Do not try to charge the battery. (This could cause burst. Leakage of battery contents, a danger to your eyes, is also anticipated.)
- ① Disposal of used battery should be done according to the instructions provided by the manufacturer.

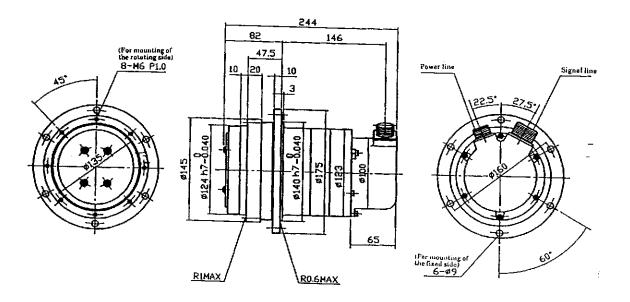
5. AR Series Dimensional Outline Drawings

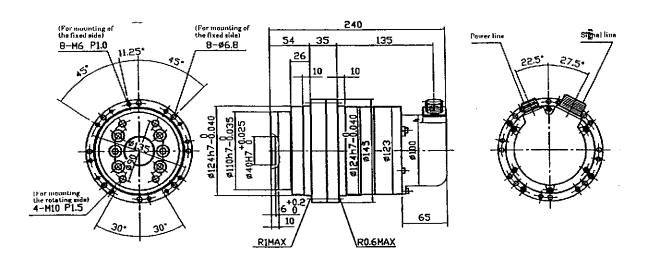
5-1. Dimensional Outline Drawings for Servo Actuator

AR15A

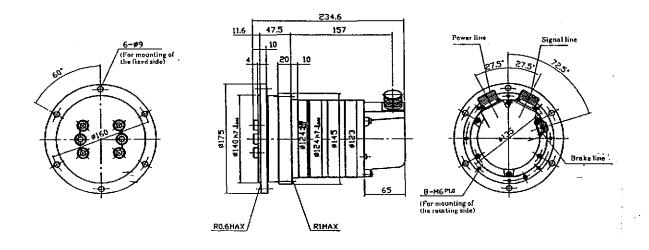


AR15B

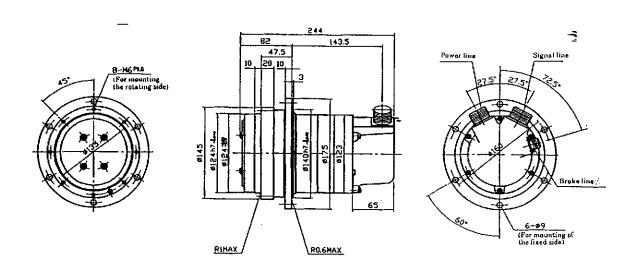




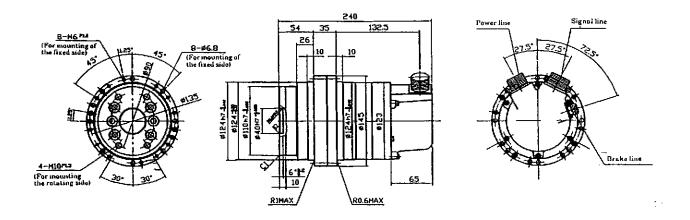
AR15A - TÜV certified equipment

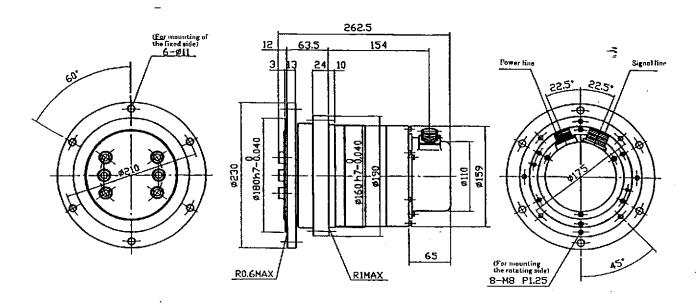


AR15B - TÜV certified equipment

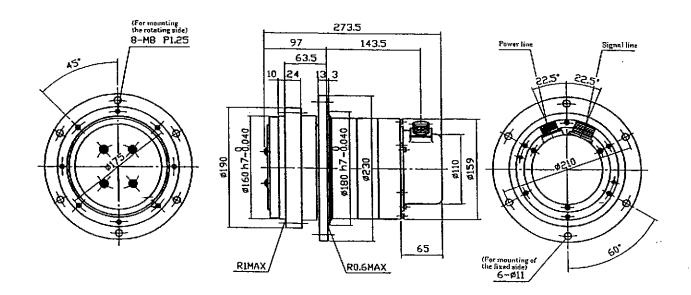


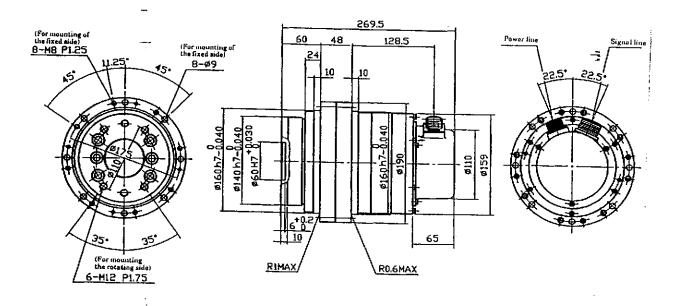
AR15C - TÜV certified equipment



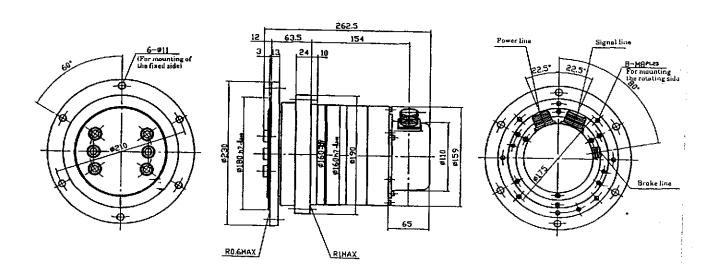


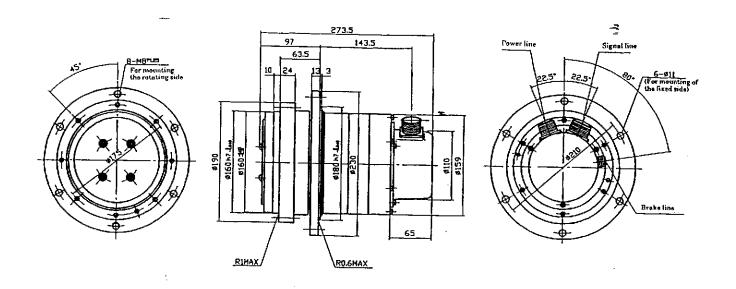
AR30B



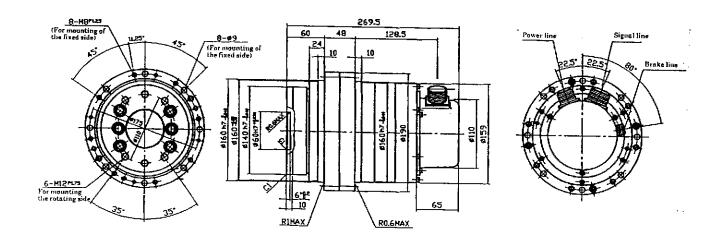


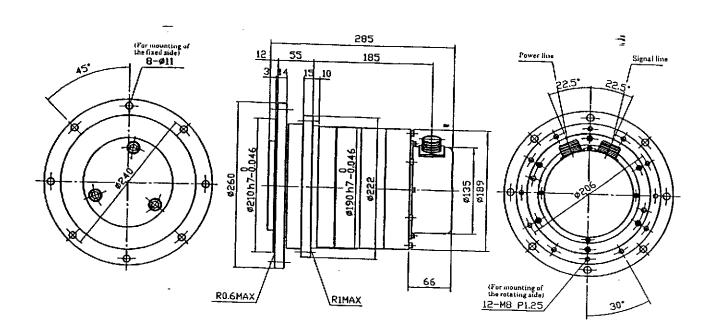
AR30A - TÜV certified equipment



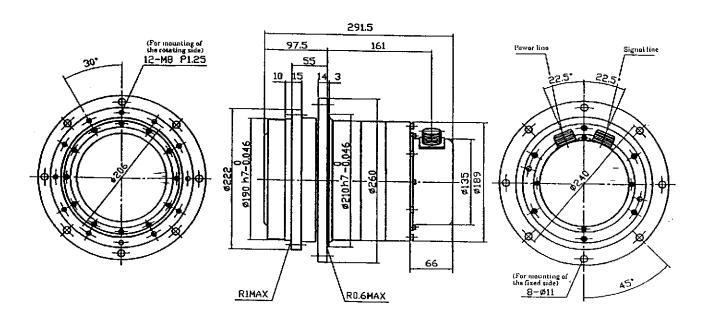


AR30C - $T\ddot{U}V$ certified equipment

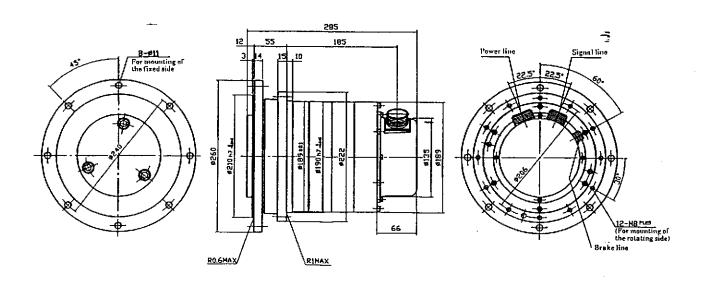




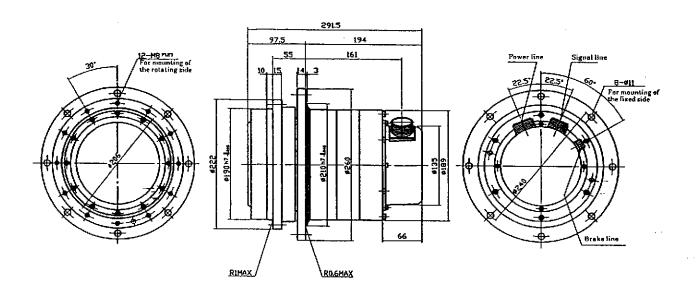
AR60B

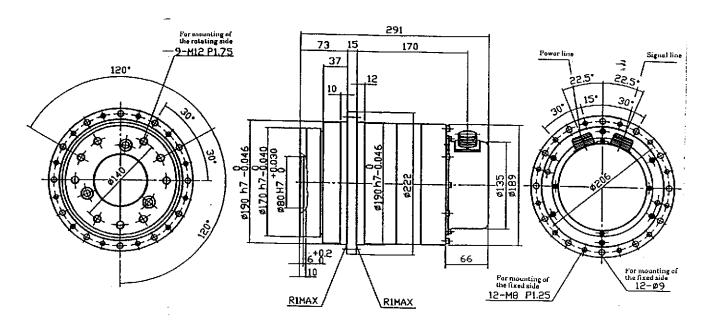


AR60A - TÜV certified equipment

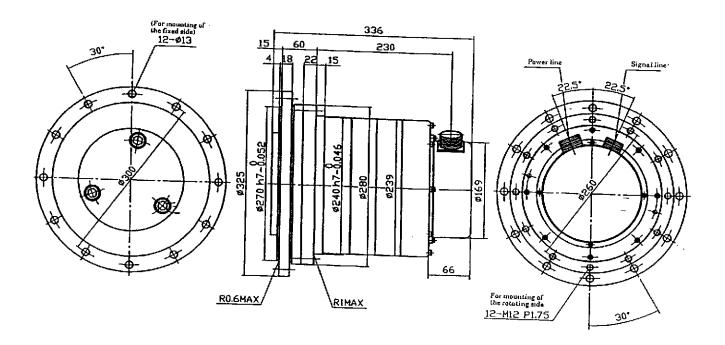


AR60B - TÜV certified equipment

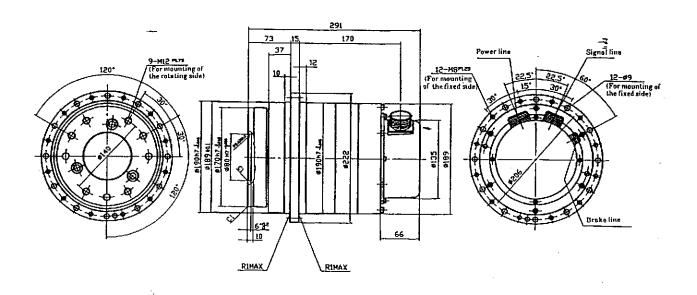




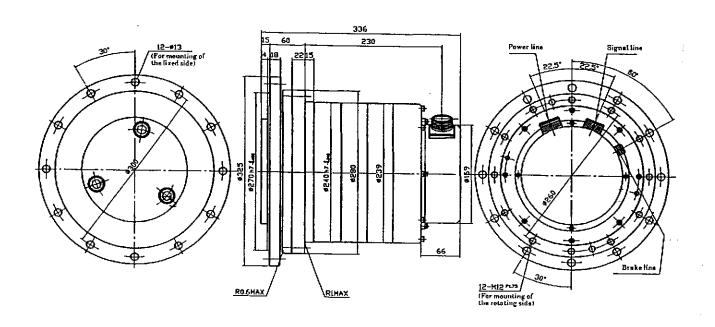
AR135A

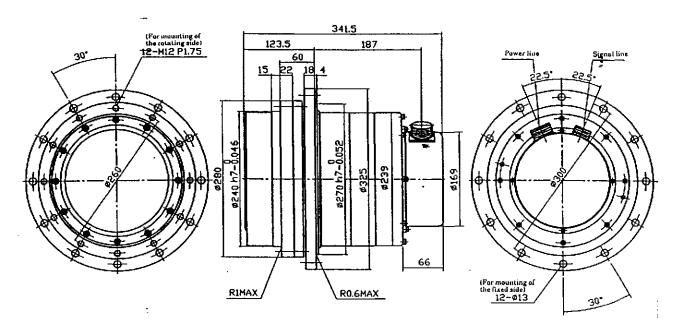


AR60C - TÜV certified equipment

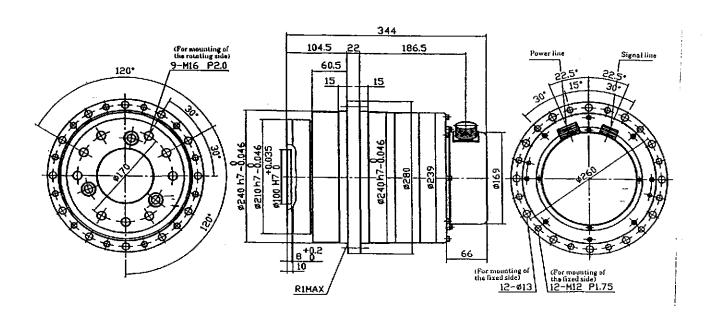


AR135A - $T\bar{U}V$ certified equipment

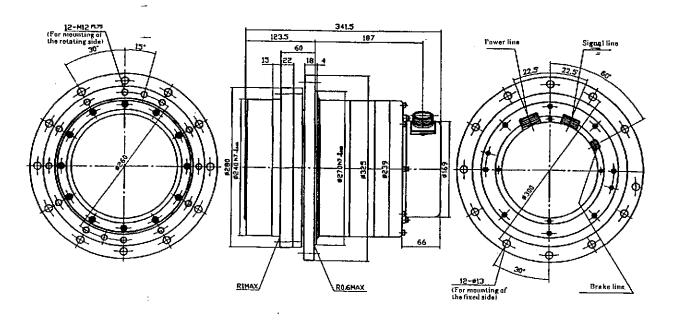




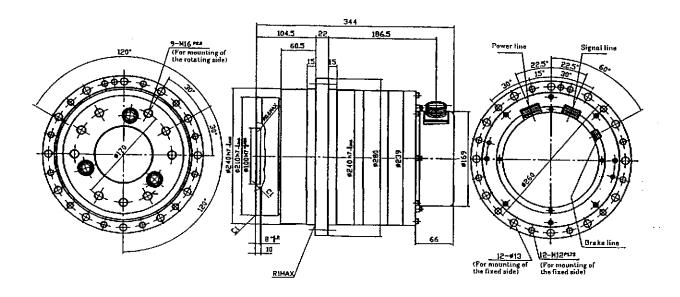
AR135C



AR135B - TÜV certified equipment



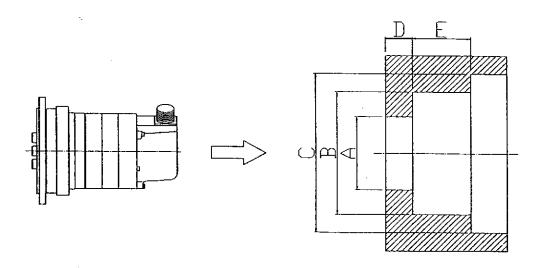
AR135C - TÜV certified equipment



AR15 - Dimensions of inserted members:

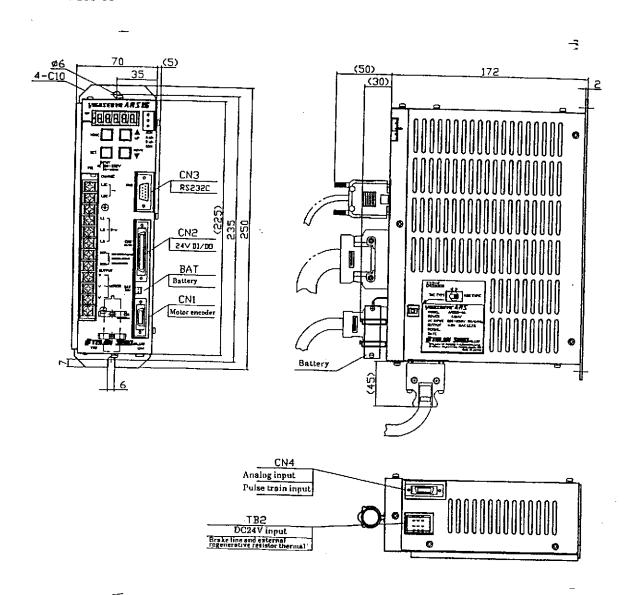
Pay attention to the following dimensions when AR15 actuator is inserted from the direction indicated by the arrow.

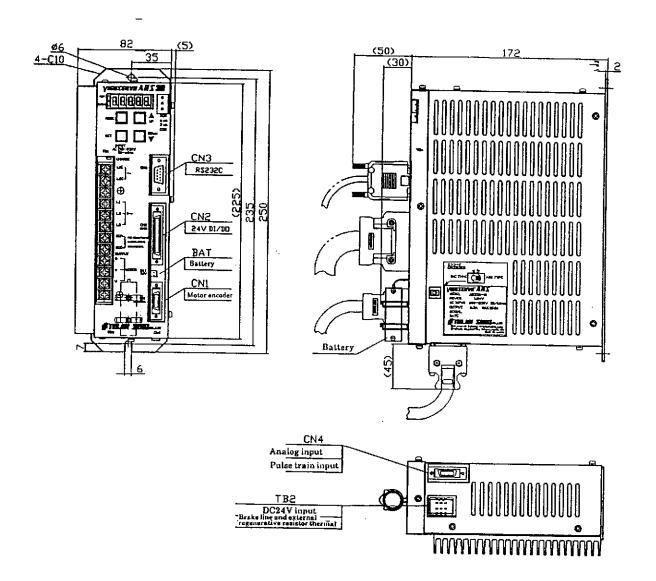
AR15	A	В	C	D	Ē
A type	φ124 H7 + 0.0040 0		Restrictions will be set by dimensions of		MAX 110
B type	\$140 H7 + 0.0040	MIN170	plug _	MAX 20	MAX 95
C type	φ124 H7 0.0040				MAX 85

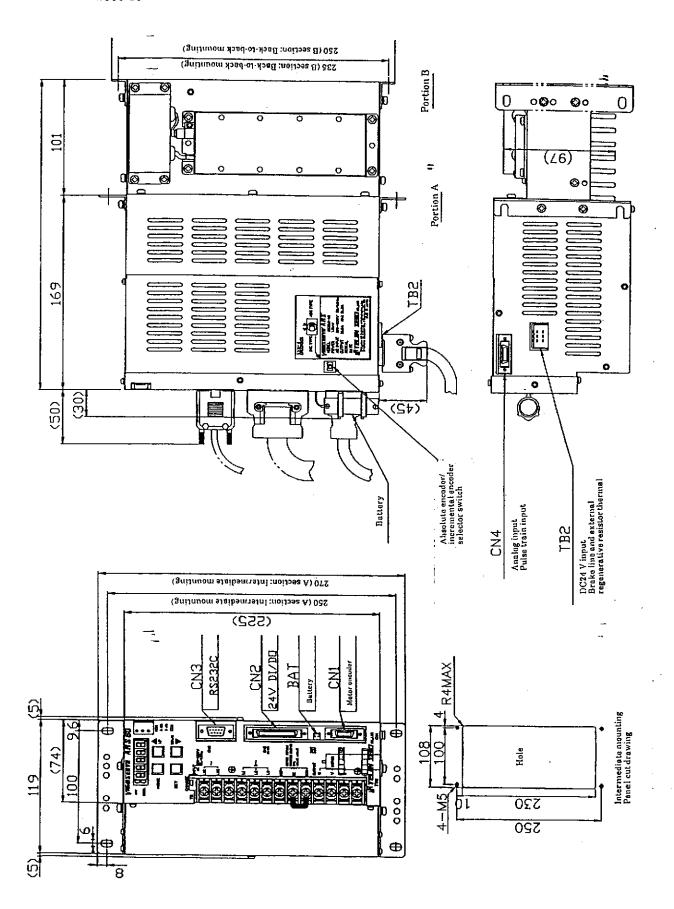


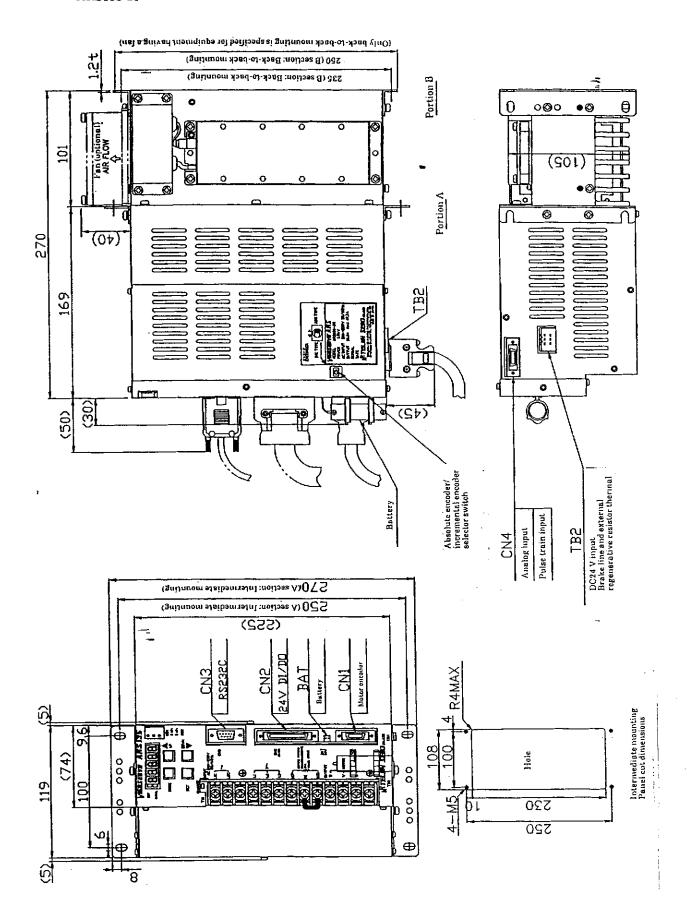
5-2. Dimensional Outline Drawings for Servo Controller

ARS15-06 -

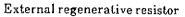


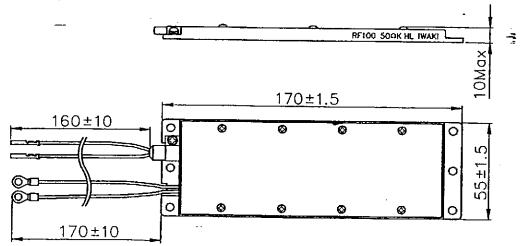




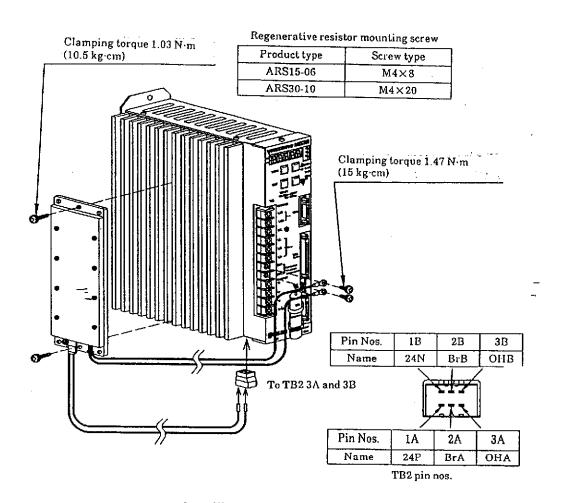


5-2. Dimensional Outline Drawings for Option





 $\label{limination} Dimensional outline of regenerative\ resistor\ ^{\cdot}$



Installing the regenerative resistor

6. Selecting the Servo Actuator

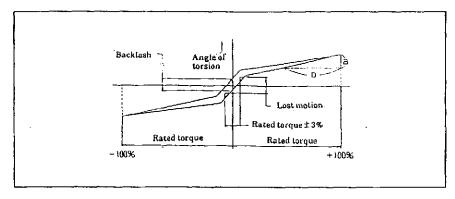
6-1. Mechanical Characteristics

backlash.

6-1-1. Rigidity (spring constant and lost motion) and backlash

When torque is applied to the output shaft with the input shaft side (servo motor shaft of the servo actuator) fixed, torsions corresponding to the torque occur generating the hysteresis curve as shown below. The rigidity of the servo actuator is indicated by the spring constant, lost motion and

--



- Lost motion
 The torsion angles at ±3% of rated torque.
- Backlash
 The torsion angles at when the torque equals zero (0).
- Calculation of the angle of torsion (theta) and the amount of torsion

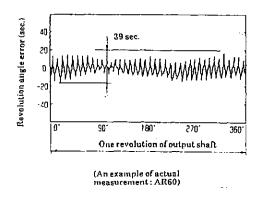
 The angle of torsion and the amount of torsion when a load torque (unbalanced load, &c.) is applied to the servo actuator from a single direction may be obtained by the following equations.

 The overall angle of torsion when loads are applied in forward and reverse, meanwhile, becomes a double of the figure obtained from the following equations plus the backlash.

Items Model	Spring constant (N·m/min.)	Lost motion (min.)	Backlash (min.)
AR15	34		
AR30	78	1	1
AR60	156		
AR135	353		

- Angle of torsion (θ) (min.) = $\frac{\text{Lost motion}}{2}$ + $\frac{\text{Load torque}}{\text{Spring constant}}$
- Amount of torsion (mm) = $\ell \times \tan \left(\frac{\theta}{60} \right)$

6-1-2. Angle transmission accuracy



Angle transmission accuracy refers to a difference between the theoretical output revolution angle and actual revolution angle (θ out) when any revolution angle (θ in) is input, and its accuracy is indicated by ANGLE TRANSMIS-SION ERROR (θ_{er}) expressed with an angle transmission error (θ er). The angle transmission error is found in the following equation.

Angle transmission error $(\theta_{\rm er}) = \frac{\theta_{\rm in}}{R} - \theta_{\rm out}$

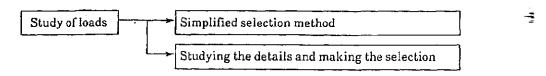
[R: Reduction gear ratio]

-3

• The angle transmission error (θ_{er}) of the AR series is one minute (in angle) or less.

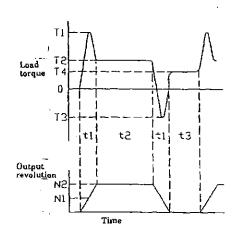
6-2. Selection of the Servo Actuator

For selection of the most appropriate servo actuator



6-2-1. Study of loads

(1) Studying the load cycle



- T₁: Maximum torque during acceleration (N·m)
- T2: Constant speed torque (N·m)
- T₃: Maximum torque during deceleration (N·m)
- T4: Holding torque during stoppage. (N-m)
- t1: Acceleration and deceleration time
- t2: Constant speed operation time
- t₃: Stopping time
- N_1 : Average revolution during acceleration and deceleration (rpm) $N_1 = N_2/2$
- N₂: Revolution during constant speed operation (rpm)

Note: With AR series, the acceleration time equals to the deceleration time and the revolution during acceleration is same as one during deceleration.

(2) Calculation of load torque

 Calculation of the maximum torque during acceleration

$$T_1(N \cdot m) = \frac{I \times N_2}{9.6 \times t_1} + T_2$$

I : Load inertia (kg·m²)

$$I = \frac{GD^2}{4}$$

Calculation of the constant speed torque

 T_2 (N·m) = Friction torque + unbalanced load torque = $(\mu W_1 \ell + W_2 \ell) \times 9.8$

μ : Friction coefficient

W1: Load (kg)

W₂: Unbalanced load (kg) ℓ: Distance between the

center of rotation and the

point of load (m)

 Calculation of the maximum torque during deceleration

$$T_3 (N \cdot m) = T_2 - \frac{I \times N_2}{9.6 \times t_1}$$

=

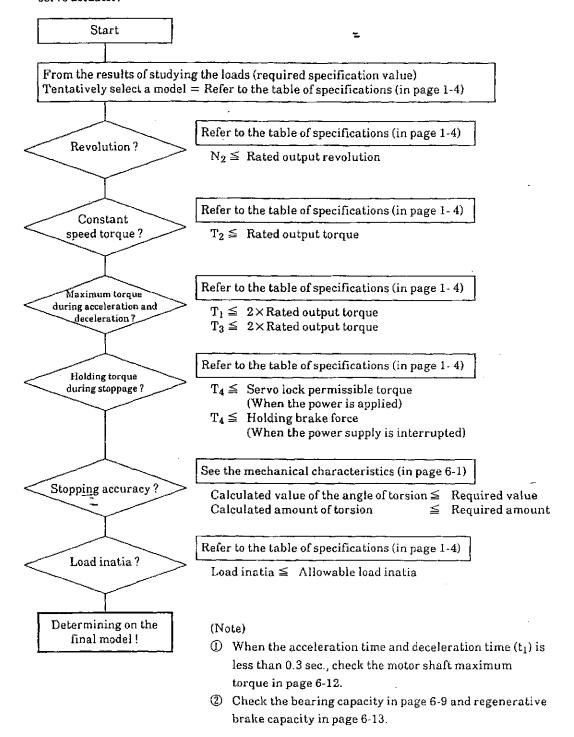
 Calculation of the holding torque during stoppage

$$T_4 (N-m) = Unbalanced load torque$$

= $W_2 \ell \times 9.8$

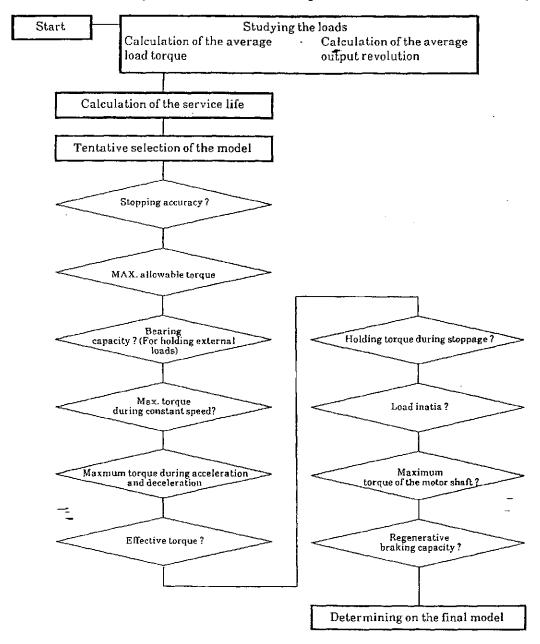
6-2-2. Simplified selection method

- ♦ Select the model of the servo actuator in the following manner.
- ♦ When the required specificaion value exceeds the ratings and tolerances of the model of the tentatively selected serve actuator, shift to a higher grade model or degrade the load conditions, so that the required specification value may stay within the rating and tolerance of the selected serve actuator.



6-2-3. Studying the details and making the selection

- ♦ When studying details and selecting the optimum model of the servo actuator in accordance with the required specification value, follow the procedures below.
- ◆ After studying, when any one item of required specification value exceeds the tolerance of the servo actuator, grade up the model for selection or degrade the conditions such as of load torque.



(1) Studying the loads

The loads applied to the servo actuator are not in a state of continuous steady load but the load torque fluctuate greatly.

Study of the loads should therefore be made after converting these various status of load torque to the average load torque.

> Calculation of the average load torque

$$T_{m} = \frac{\frac{10/3}{t_{1} \cdot N_{1} \cdot T_{1}^{10/3} + t_{2} \cdot N_{2} \cdot T_{2}^{10/3} + t_{3}^{*} \cdot N_{3} \cdot T_{3}^{10/3}}{2 \cdot t_{1} N_{1} + t_{2} N_{2}} (N \cdot m)$$

> Calculation of the average output revolution

$$N_{m} = \frac{2 \cdot t_{1} N_{1} + t_{2} N_{2}}{2 \cdot t_{1} + t_{2}} (rpm)$$

(2) Calculation of the service life

- Calculation of the service life
 - Calculate the service life from the average load torque (T_m) and the average output revolution (N_m).

$$L_{\rm m} = 6000 \times \frac{15}{N_{\rm m}} \times \left[\frac{T_{\rm o}}{T_{\rm m}} \right]^{10/3} (H_{\rm r})$$

Models	Standard torque (T _o)
AR15	137 N·m
AR30	333 N-m
AR60	637 N·m
AR135	1323 N·m

Calculating the needed service life

$$L_{w} = \frac{A \times B \times C \times D}{3600} (H_{r})$$

- How many seconds of actual operation constitute a cycle? (A: sec/cycle)
- For how many cycles a day is it operated?
 (B: cycle/day)
- On how many days in a year actual operations are made? (C: days/year)
- For how many years the actual operations will be continued? (D: years)

Tentative selection of the model

Service life $L_m \ge L_w$ Selection of the model

(3) Checking the stopping accuracy

Calculate the angle of torsion (θ) and the amount of torsion when unbalanced loads are applied referring to the clause for the mechanical characteristics (in page 6-1), and make sure the calculated values are within the extent of the required values.

-

(4) Checking the maximum allowable torque (Emergency stop, etc.)

- When very large torque is applied instantaneously at the time of an emergency stop or by external shocks, the servo actuator may be damaged.
- Make sure these values of very large instantaneous torque may not exceed the maximum allowable torque.

Models	Maximum allowable torque
AR15	686 N·m
AR30	1667 N·m
AR60	3187 N·m
AR135	6619 N·m

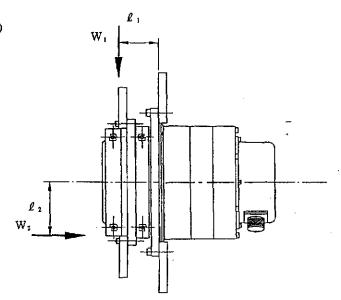
(5) Checking the bearing capacity (For holding external loads)

- ♦ Bearings are provided to support external loads directly.
- ◆ The bearing capacity is indicated by the allowable moment capacity.
- Calculate the moment values and make sure the calculated values are within the limit of the rated moment capacity.
- Contact us in case large thrust loads are expected to be applied or in case torsion of the output shaft causes some problems.

Calculation of moment (MC)

$$MC = (W_1 \cdot \ell_1 + W_2 \cdot \ell_2) \times 9.8$$

MC: Moment (N-m) W_1, W_2 : External loads (kg) ℓ_1, ℓ_2 : Distances (m)



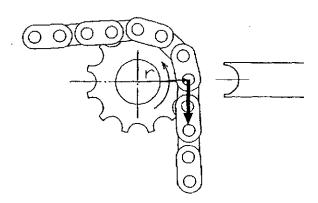
- > A condition for the selection
 - MC≦ Rated moment capacity

Types	Allowable moment capacity	Allowable thrusting force
AR15	608 N·m	1960 N
AR30	1157 N⋅m	2940 N
AR60	1735 N·m	3920 N
AR135	3255 N·m	5880 N

Note:

When the case is as illustrated to the below, calculate the torque reaction force and add the value to the external load.

Torque Maximum torque during reaction force = $\frac{\text{Maximum torque during}}{\text{acceleration and deceleration}} \text{ (N)}$



- (6) Checking the maximum torque during acceleration and deceleration
 - ◆ Make sure the maximum torque values during acceleration and deceleration (T₁, T₃) are
 within the extent of the allowable acceleration and deceleration torque (see page 1-4).

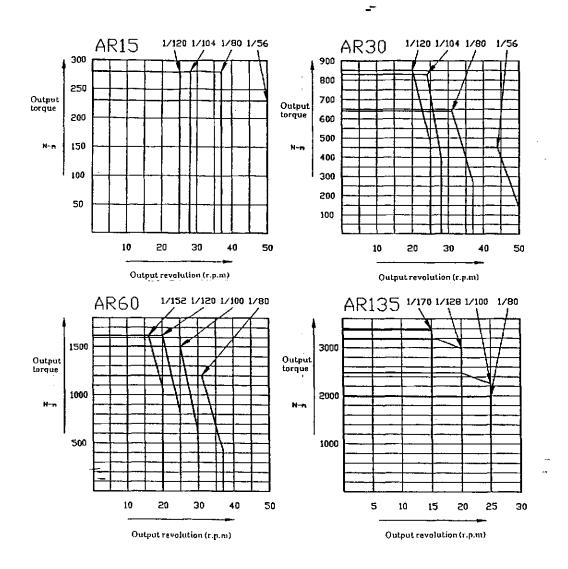
(7) Checking the constant speed torque

◆ Be sure the maximum constant speed torque (T₂) is within the ranges of the maximum torque diagrams.

-3

◆ The output revolutions in this case are the values of N₂.

Maximum torque diagrams



(8) Checking the effective torque

◆ Calculate the effective torque (T) inclusive the period of stoppage and make sure the calculated value is within the extent of the rated output torque (see page 1-4).

$$T = \sqrt{\frac{t_1 \cdot T_1^2 + t_2 \cdot T_2^2 + t_1 \cdot T_3^2 + t_3 \cdot T_4^2}{2 \cdot t_1 + t_2 + t_3}} \quad (N \cdot m)$$

(9) Checking the holding torque

- Torque during the survo locking period
 - When holding by the survo lock, be sure the holding torque during stoppage stays within the extent of the servo lock allowable torque (see page 1-4).
 - When holding for one minute or more with a level of torque exceeding the servo lock allowable torque (see page 1-4), set up the power save timer (Parameter No. P-65: refer to page 3-28) to actuate the holding electromagnetic brake. By servo lock, holding of upto the limits of the allowable acceleration and deceleration torque (see page 1-4) is possible, but overheating occurs when held with high torque.
- ♦ Checking the holding brake capacity

When power supply interruption occurs, the holding electromagnetic brake will be actuated. Make sure the holding torque during power interruption stays within the extent of the holding brake power (see page 1-4).

(10)Checking the load inertia

♦ Make sure that the load inertia is within limits of the allowable load inertia.

Models		AR	.15			AR	30	
Reduction gear ratio (R)1:R	56	80	104	120	56	80	104	120
Allowable load inertia kgm²	5	11	18	24	15	31	53	71
Models	AR60			AR135				
Reduction gear ratio (R)1:R	80	100	120	152	80	100	128	170
Allowable load inertia kgm²	76	119	171	274	254	396	649	1115

(11) Checking the motor shaft maximum torque

- ◆ Calculate max, torque on the servo motor shaft and make sure that the calculated value is within limits of the motor shaft max, torque.
- Calculation of inertia on the servo motor shaft

$$Im (kg \cdot cm^2) = \frac{Load inertia}{(R)^2} + Reduction gear inertia + Rotor inertia$$

-3

Models		AR15	AR30	AR60	AR135
Reduction gear rat	io (R)1:R	0.08	0.25	0.5	1.75
Rotor inertia	kg cm²	3.33	9.8	23.7	79.3

- Calculation of maximum torque on the servo motor shaft
 - ① Max. torque at acceleration (Ta1)

$$Ta_1(N \cdot cm) = \frac{Im^2 \times Nm}{955 \times t_1} + \frac{T_2 \times 10^2}{0.7 \times R}$$

② Max. torque at deceleration (Ta₂)

$$Ta_2(N \cdot cm) = \frac{T_2 \times 10^2}{0.7 \times R} - \frac{Im^2 \times Nm}{955 \times t_1}$$

$$\begin{bmatrix} T_2 : & \text{Steady torque (N·m)} \\ Nm: & \text{Servo motor revolution (r.p.m)} \end{bmatrix}$$

(See page 6-3)

Selection conditions

 $Ta_1 \leq Motor shaft max. torque value$

Ta₂≦ Motor shaft max, torque value

Models	AR15	AR30	AR60	AR135
Max. torque at acceleration (N-cm)	540	980	1960	3038

(12) Checking the regenerative brake capacity

◆ ARS60 and 135 have built-in regenerative resistor. With ARS15 and 30, internal capacitor regeneration is used for that purpose (regenerative resistor is optional).

Regenerative resistor (built-in)

Models	Resistance	Allowable heat generati g n
AR60	50 Ω	120 W
AR135	25 Ω	240 W

- ♦ It is not possible to make continuous operation of the actuator, which is turned from the load side, applying regenerative braking.
- ◆ When the above procedures are needed or when acceleration and deceleration need to be done frequently, it is necessary to install the regenerative resistor externally. Contact us in such cases. Use the following expression as a rule-of-thumb. External regenerative resistor is needed when the following condition is met.

(With ARS15 and 30)

The energy Pc that can be absorved without the regenerative register is 32 [J].

While the energy generated in one regenerative action Pm is;

 $Pm = [mgh\eta + (Im\omega^2)/2] \times 0.8$

When Pm > Pc, the regenerative generator is needed.

When Pm < Pc, the regenerative generator is not needed.

Where, m: Unbalanced load

h: Height

η: Efficiency (approx. 0.8)

 ω : Angle speed

$$\omega = \frac{\text{Nm} \times 2\pi}{60}$$

Nm: Motor speed

Im: Motor axis converted inertia

Conditions for the above expression: Input voltage - 200 V

Load condition - Load with less friction, such as drum type magazine. If input voltage is lower or friction is greater in the above conditions, need for

the regenerative resistor would be reduced.

7. Operation from Personal Computer

7-1. Introduction

ARS can perform serial communication with personal computers available in the market through RS232C. This function allows to initialize, set or modify parameters, and to monitor the ARS operation from the personal computer CRT.

7-2. Specifications

Applicable personal computers
 PC-9801 series made by Nihon Denki Co., Ltd.

(2) Pin layout

Servo controller connector (CN3a)

	5	1	1	;	3	2	2		l
GN	1D	N.	С	ΤΣ	(D	RX	(D	N.	C
	,)		3	-	7	6	3	
	+ 5	5 V	C7	rs	R'	rs	GN	D	

Type of receptacle and applicable connector

	CN3a	CN3b	
	Type of right angle receptacle	Pin connector	Hood cable clamp
Common to all types	FCN-675J009-L/C#UD Fujitsu Co., Ltd.	17JE-23090-02 (D1) Daiichi Denshi Kogyo Co., Ltd.	17JE-09H-1A Daiichi Denshi Kogyo Co., Ltd.

(3) Software

OS (To be prepared by user)

- MS-DOS*1 Ver.3.0 or later version
- Incorporate RS232 control file and printer control file to MS-DOS as the device driver.
- N88BASIC, LIB

ARS communication software

- TARS98
- PARAM.DOC

ARS communication software is available as an option. Contact our sales office.

*1 MS-DOS is the trade mark of Microsoft Co., Ltd. in US. You are advised to pay reasonable care when taking this software out of US since the Re-export regulations of the US Export Control might be applied.

7-3. Operation

(1) Starting

Turn the personal computer power on to start MS-DOS. Prompt "A>" appears on the screen and then set the floppy loaded with "TARS98" to the personal computer and enter

A>TARS98

(2) Command operation

When "TARS98" is started, following menu will be displayed on screen 1.

Screen menu 1

Read all parameters
Write parameter
Write all parameters
Write to EEPROM
Verify
Initialize servo parameter

Initialize parameter
Reset signal input
Parameter printout
Waveform graphic mode
File operation
End program

Select command using III keys or E keys and press return key I.

(3) Read all parameters

When you select this command, following display will appear:

Read all parameters (Space key)
Return to menu screen 1 (ESC key)

Press space key to read contents of all AR parameters the personal computer. Press [1] key to return to menu screen 1.

When the reading is complete, control automatically proceeds to the write parameter operation.

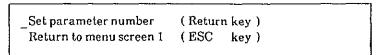
You cannot return to screen 1 during the reading operation. Pressing H key in the reading operation can cause error to the parameter value.

(4) Write parameter

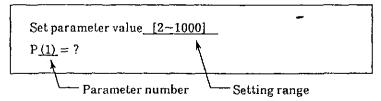
The screen displays 10 parameters at one time.

Nos.	Initialization	Settings	Contents of parameter
P- 0	1	1	Present address indication
Paul	120	120	Reduction gear ratio
P- 2	15	15	Number of indexing
P- 3	15	15	Sprocket gear Nos.
P- 4_	2000	2000	Automatic operation speed 1
P- 5	500	500	Acceleration/deceleration time constant 1 (Automatic operation)
P- 6	1000	1000	Manual operation speed 1
P- 7	500	500	Acceleration/deceleration time constant (Manual operation)
P- 8	50	50	Creep speed at reset to zero point
P- 9	2000	2000	Positional loop gain

Make sure followings are displayed at bottom of the screen:



Select number of the parameter to be modified using 11 keys or eturn key. Press key to return to menu screen 1.



- ① Enter 4 digits in binary to modify parameters from P-60 to P-68.
- ② When A-0 to A-9 is selected, alarm contents are indicated.
- ③ Some parameters do not allow modification.
- When you cancel writing operation after selecting the parameter number, press "Q" followed by return key □.

Modified parameter is valid only after power is turned on again or reset signal is entered.

When EEPROM is used, write the value to EEPROM after the parameter value has been modified.

(5) Write all parameters

Followings are displayed when this command is selected:

```
Write all parameters (Space key)
Return to menu screen 1 (ESC key)
```

Press space key to write all parameter contents on the personal computer to ARS.

Press ESC key to return to the menu screen 1.

You can not return to the menu screen 1 while writing operation is continued. Pressing, [1] key during writing may cause error to the parameter value.

(6) Write to EEPROM

Select this command to write contents of the parameter to EEPROM. Followings are displayed at selection of this command:

```
Writing to EEPROM starts (Space key)
Return to menu screen 1 (ESC key)
```

Press space key to write to EEPROM. Press ESC key to return to menu screen 1.

Before writing to EEPROM, the servo must be turned off Otherwise E-7 occurs.

Approximately 2 seconds maximum will be required for writing to EEPROM. If you press M key during the writing, wrong parameter value might be written.

-

Following messages are displayed when the writing ends:

Press return key I to return to menu screen 1.

(7) Verify

This command compares the parameter values on the personal computer RAM and with that on the ARS. Following display appears when this command is selected:

Verify starts (Space key)
Return to menu screen 1 (ESC key)

Press space key to perform verification. Press ESC key to return to menu screen 1.

You can not return to the menu screen 1 during the verify. Pressing \(\begin{align*} \text{M} \\ \text{key while the verify is } \end{align*} \)
continued can cause error to the parameter value.

1 When there is no error on the parameter, following display appears:

No error Press return key

Press return key to return to menu screen 1.

② If there is error on the parameter, number of errors and the parameter number where error occurred are shown as follows:

Communication error
Do you want printout (Y/N)?

Press "Y" to have printout of the number of errors and the parameter number where error occurred.

Press "N" to return to menu screen 1.

(8) Initialize servo parameter

Initialize the servo parameter after model of the servo actuator and servo controller used has been set. Following display appears when this command is selected.

Select servo actuator model

ARIS AR30 AR60 AR135

Select the servo actuator model using \square keys and then press return key \square .

Press W key to return to menu screen 1.

At selection of the servo actuator model, its model name is displayed in reverse and following display appears:

Select servo actuator model
AR15 AR30 AR60 AR135
Select servo controller model
ARS15 ARS30 ARS60 ARS135

Select servo controller model using \square keys and then press return key \square .

Press backspace key to return to the servo actuator model setting.

Press key to return to menu screen 1.

At selection of the servo controller, its model name is displayed in reverse and following display appears.

Select servo actuator model
AR15 AR30 AR60 AR135
Select servo controller model
ARS15 ARS30 ARS60 ARS135

Are settings right (Y/N)?

Press "N" to start setting again from the servo actuator model.

Press "Y" when the settings are right. If the serve actuator and serve controller are improperly combined, message <u>"There is setting error. OK?"</u> is displayed. Press return key to do setting again from the serve actuator.

When the settings for the the servo actuator and servo controller are finished, following display appears:

Initializes servo parameter (Space key)
Return to menu screen 1 (ESC key)

Press space key to initialize the servo parameter. Press they to return to menu screen 1.

Initialization of the servo parameter must be done after turning the servo off. Otherwise E-7 occurs.

After initialization of the servo parameter, turn the power off or enter reset signal.

(9) Initialization of parameter

3

Following display appears when this command is selected:

```
Initialize parameter

(Absolute encoder => A + Return Key)

(Inremental encoder => I + Return Key)

Return to menu screen I (ESC Key)
```

With the absolute encoder, press "A" + Return key to start initialization.

With the incremental encoder, press "I" + Return key to start the initialization.

Initialization of parameter must be done after turning the servo off. Otherwise E-7 occurs.

You can not return to menu screen 1 during initialization. Pressing Ki key while the initialization is continued can cause error to the parameter value.

After the parameter has been initialized, turn power off or enter the reset signal.

(10)Reset signal input

Following display appears when this command is selected.

Enter reset signal	(Space key)
Returns to menu screen 1	(ESC key)

Press space key to enter the reset signal. Press ESC to return to the menu screen 1.

Input of the reset signal must be done after turning the servo off. Otherwise E-7 occurs.

You can not return to menu screen 1 during the reset signal input. Pressing El key during the reset input can cause error to the parameter value.

(11)Parameter printout

Following display appears when this command is selected:

Print all
Print all
Print salarm history
Print servo parameters
Print part of parameters
Return to menu screen 1

Select parameter to be printed using [1] keys and then press return key [2] to start printing.

· When printing part of parameters

When the following display appears, enter the first and last number of parameters to be printed and press return key .

-3

(Example: 0, 10) ← Parameters with No.0 to 10 are printed.

Enter "0, 0" on this screen to return to menu screen 1.

Print part of parameters

Enter first and last parameters (Start, Stop)?

(12) Waveform graphic mode

Waveform of motor speed and torque can be displayed on CRT in this mode. Following menu screen 2 appears when this command is selected.

Menu screen 2

Torque waveform measurement
Speed waveform measurement
Load waveform data
Save waveform data
Specify drive (Current A: Drive)
Specify directory (Current #)

Return to menu screen 1:

Select the command using [] [] keys and press return key []. You can return to menu screen 1 by pressing ESC key, too.

(Operating procedures for specifying the drive and directly are explained in "(13) File operation".)

① Torque waveform measurement

Time and torque are indicated on horizontal axis and vertical axis, respectively. The screen displays the graph and at the bottom following appears:

Input COMMAND (If you don't know it: HELP key) (ESC key: To menu screen 2)

Enter command for your desired operation.

In case you do not know contents of the command, press help key to display contents of the command.

[F] + [Ret Key]: Save waveform data to file
[C]: Sample data continuously
[S]: Stop sampling next data
[N]: Sample next data
[D]: Change vertical axis scale

[ESC]: Return to original screen

Explanations of command

[F]+[Ret Key]: It saves one screen full waveform data to the file. Data is saved to the

directory and drive being specified in the drive and directory designation

3

operation. Escape character GRP is automatically added.

[C] : Sample data continuously.

[S] : During continuous sampling, stop sampling next data.

[N] : Sample next data.

[D] : Change vertical axis scale.

Torque waveform: Up to 300%, incremented by 25% basis.

Speed waveform: Up to 5000 rpm, incremented by 500 rpm basis.

[ESC] : Returns to original graphic display screen.

② Speed waveform measurement

Time and speed are indicated on horizontal and vertical axes, respectively. Command operations are identical with that for torque waveform measurement.

Torque waveform and speed waveform can not be displayed simultaneously.

3 Load waveform data

This command loads waveform data saved in the file and displays it graphics. Data is loaded from the drive and directory being specified in the drive and directory designation operations.

④ Save_waveform data

This command saves one screen full waveform data to the file. Data is saved to the drive and directory being specified in the drive and directory designation operations.

Escape character ".GRP" is automatically added. Waveform data can be saved from the graphic display screen, too.

Note: In the waveform graphic mode, data is sampled at approx. 20 ms cycle, therefore displayed waveform can be different from actual data.

(13) File operation

Following menu screen 3 is displayed when this command is selected:

Specify drive (Current A : Drive)

Specify directory (Current ¥)

Load parameter

Save parameter

Return to menu screen 1

Select command using [i] L keys and press return key-L. Press ESC key to return to menu screen 1.

-3

① Specify drive

It specifies the drive for saving data. Currently specified drive is indicated to the right. Initialization value is saved to drive A.

② Specify directory

Specify the directory for saving data. Currently specified directory is indicated to the right. There is no directory for initialization value.

3 Load parameter

It loads data saved in the file. Data is loaded from the drive and directory being specified in the drive and directory designation operation.

After loading of data, screen returns to menu screen 1.

Save parameter

This command saves parameters to the file. Data is saved to the drive and directory being specified in the drive and directory designation operation.

Escape character ". PAR" is automatically added.

After data is saved, screen returns to menu screen 1.

(14)End program

Select "End program" on menu screen 1 and press return key. Prompt "A>" is displayed and control returns to MS-DOS.

When you want to start "TARS98" again enter:

A > "TARS98"

8. Disassembling Procedures of Servo Actuator

8-1. Precautions Concerning Disassembling

(1) Be sure to use a workbench for disassembling the servo actuator. For safety's sake, never disassemble the servo actuator when it is set on machinery.

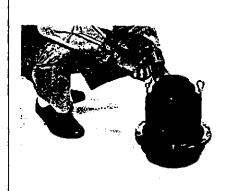
WARNING

It is very dangerous to disassemble the servo actuator when being set on machinery, because it may drop during disassembly.

- (2) Be sure to disassemble the servo actuator according Paragraph 8-2, Disassembling Procedure.
- (3) When disassembling, do not drop and strike the servo actuator and its parts against others.
- (4) When the servo actuator should be left alone after or during disassembly, humidity and dusts cause rust on it. So, be sure to take a proper measure to prevent it from being rusted and to protect it from dusts.
- (5) Disassemble the servo actuator as far as the exploded views, Paragraph 8-5 (See Page 8-9 to 8-11), show.

8-2. Disassembling Procedures

The disassembling procedures are common to Type A, B and C. For the followintg explanation, photos of Type B are used.

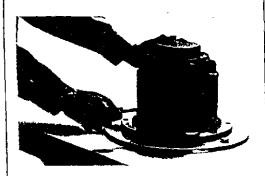


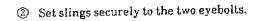
- (1) Setting of Servo Actuator on Workbench
 - Screw two eyebolts in eyebolt holes on the rear of the servo actuator.

For eyebolt sizes, see Paragraph 8-6 (Page 8-12).





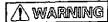






Be sure to secure slings to the servo actuator to prevent it from dropping.

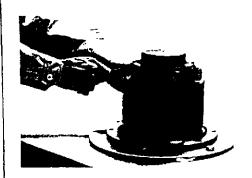
3 Lift the servo actuator with the crane hoist and convey it to the workbench.



Do not approach the servo actuator during the conveyance.

- Set the servo actuator on the workbench to tapped holes.
- ⑤ Tighten two hexagon socket head cap screws with a hexagonal wrench key.

For screw sizes, see Paragraph 8-6 (Page 8-12).



(2) Removal of Motor Unit

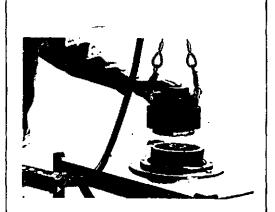
① Remove the hexagon socket head cap screws from the servo-motor with a hexagonal wrench key.

For sizes of hexagonal wrench key, see Paragraph 8-6 (Page 8-12).

② Remove the servo-motor unit from the speed reducer unit.

In the case of AR15

 Wipe out oil on the surface and lift the motor unit straight with both hands to remove it.

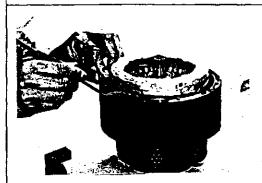




When the surface is oily, the motor unit is in danger of dropping.

In the case of AR30, 60 and 135

- Screw two eyebolts in eyebolt holes on the rear of the servo actuator.
- 2) Set slings to the two eyebolts securely.
- 3) Lift the motor unit straight slowly with the crane hoist to remove it.



(3) Removal of O-ring

① Take out the O-ring with the spatula from the O-ring groove on the motor unit.

Note: Do not use the O-ring taken out.



(4) Removal of Wave Washer

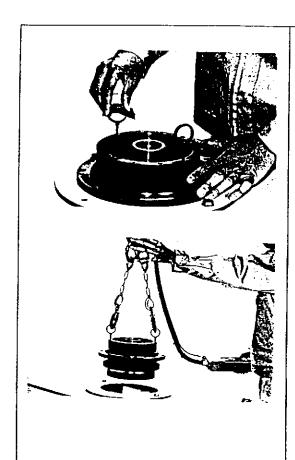
① Take out the wave washer from the speed reducer unit.

Note: Do not use the wave washer taken out:



(5) Removal of Speed Reducer Unit

① Use a hexagonal wrench key and remove the two hexagon socket head cap screws with which the speed reducer unit is fixed on the workbench.



② Screw two eyebolts in tapped holes on the speed reducer unit.

For the sizes of eyebolt, see Paragraph 8-6 (Page 8-12).

3 Set slings to the two eyebolts securely.

A WARNING

Be sure to secure slings to the speed reducer unit, but it will drop.

4 Lift the speed reducer unit straight slowly with the crane hoist to remove it.

Re-assembling Procedures of Servo Actuator

8-3. Precautions Concerning Re-assembling

(1) Be sure to use the workbench for re-assembling.

- -
- (2) Re-assemble the servo actuator according to Paragraph 8-4, Re-assembling Procedures
- (3) Do not drop and strike the servo actuator and its parts to other during re-assembling.
- (4) Replace the O-ring and wave washer with new ones.
- (5) Tighten hexagon socket head cap screws with the torques specified in the List of Clamp Torque. See Paragraph 8-6 (Page 8-12).



Unless tightened with the specified torques, screws may become loose or be broken, and the speed reducer and the servo-motor may be separated.

8-4. Re-assembling Procedures

The re-assembling procedures are common to Type A, B and C. For explanation, photos of Type B are used.

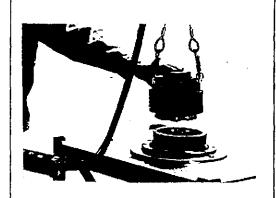


- (1) Setting of Speed Reducer Unit
 - Screw two eyebolts in tapped holes on the speed reducer unit.
 For eyebolt sizes, see Paragraph 8-6 (Page 8-12).
 - ② Set slings securely to the two eyebolts.



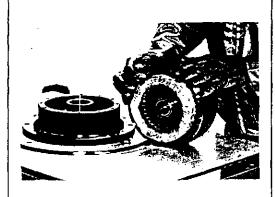
Be sure to secure slings to the speed reducer unit to prevent it from dropping.

③ Carry the speed reducer unit to the workbench with the crane hoist.



- Set the speed reducer unit on the workbench to tapped holes.
- (5) Tighten two hexagon socket head cap screws with a hexagonal wrench key.

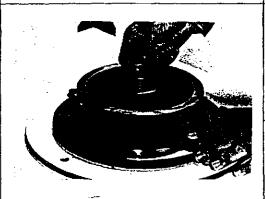
 For screw sizes, see Paragraph 8-6 (Page 8-12).



(2) Fitting of O-ring

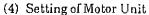
① Fit an O-ring securely in the O-ring groove of the motor unit.

Note: Unless being fitted correctly in the O-ring groove, the O-ring will be broken and become ineffective against leakage of oil or water.

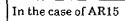


(3) Fitting of Wave Washer

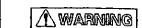
① Fit a wave washer in the bearing housing of the speed reducer unit.



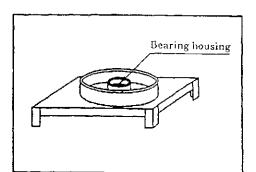
① Bring the motor unit over the workbench.



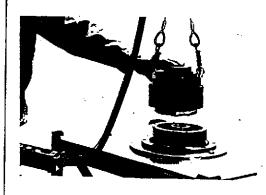
 Wipe out oil on the surface, then carry the motor unit right over the speed reducer with both hands.

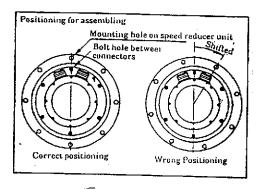


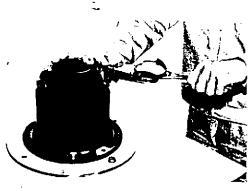
If the surface is oily, the motor unit is in danger of slipping down from both hands.











In the case of AR30, 60 and 135

- Screw two eyebolts in tapped holes on the motor unit.
- 2) Set slings securely to the two eyebolts.

A WARNING

Secure the slings to the motor unit, but the motor unit is in danger of slipping down.

 Carry the motor unit with the crane hoist right over the speed reducer unit.

Note: Use care not to strike the winding of the motor unit to others.

② Let the motor shaft spline get in the spline hole on the speed reducer unit while lowering the motor unit just on it.

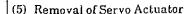
Note: Since motor bearing and speed reducer housing are in the relation of clearance fit, do not force the motor bearing in the housing. When it does not get in smoothly, lift the motor unit again for re-setting. Do not use a hammer to force the motor bearing in the housing.

Note: When assembling, align the bolt holes between connectors of the motor unit with mounting holes on the speed reducer unit.

Tighten hexagon socket head cap screws with specified torques.

For clamp torques, see Paragraph 8-6 (Page 8-12).





Remove the hexagon socket head cap screws with a hexagonal wrench key.

For sizes of the hexagonal wrench keys, see Paragraph 8-6 (Page 8-12).

② Remove the servo actuator from the workbench.

In the case of AR15

 Wipe out oil on the surface first and raise the servo actuator with both hands to remove it from the workbench.



When the surface is oily, the servo actuator is in danger of slipping down.

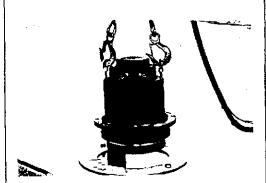
In the case of AR30, 60 and 135

- Screw two eyebolts in the eyebolt holds on the rear of the servo actuator.
- 2) Fit slings securely to the two eyebolts.

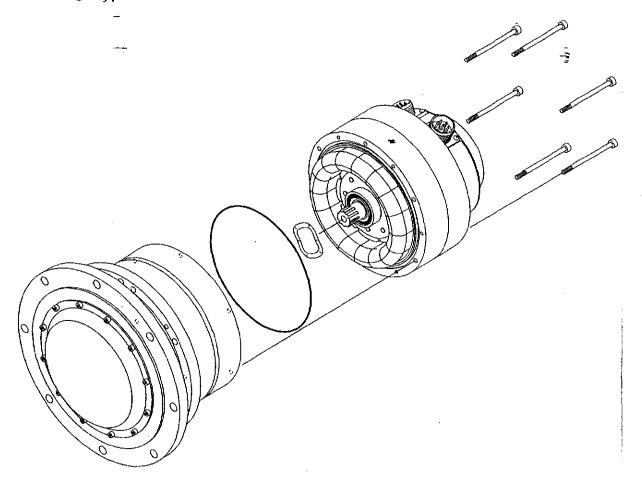


Be sure to secure the slings to the servo actuator, but it will drop.

3) Lift the servo actuator just above slowly with the crane hoist to remove it.



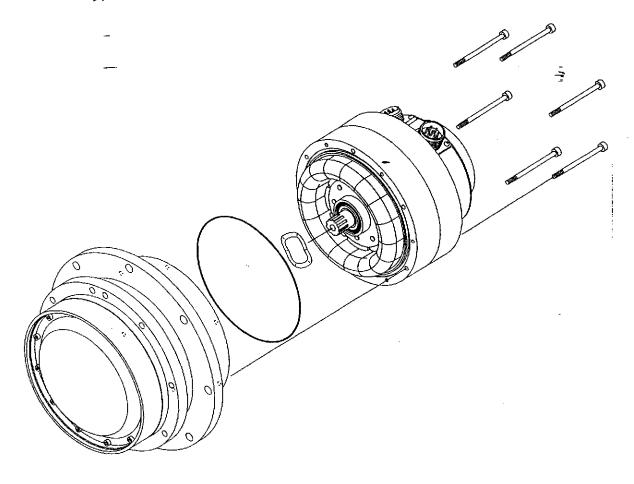
8-5. Exploded View of Servo Actuator ① Type A



Part No.	Part Name	Q'ty
0	Speed_reducer unit	1
②_	Motor unit	1

Part Name	Model/Q'ty				
No.	Farchame	AR15	AR30	AR60	AR135
3	Wave washer	BWW-6200 1 pc. (Ochiai Seisakusho)	BWW-6202 1 pc. (Ochiai Seisakusho)	BWW-6303 1 pc. (Ochiai Seisakusho)	WW-40 2 pcs. (Ochiai Seisakusho)
4	O-ring	AS568-045-70 1 pc.	K-90 1 pc. (Keeper)	AS568-160-70 1 pc.	AS568-171-70 1 pc.
(5)	Hexagon socket head cap screw	M4×60-12.9 6 pcs.	M4×65-12.9 6 pcs.	M5×80-12.9 6 pcs.	M5×90-12.5 8 pcs.

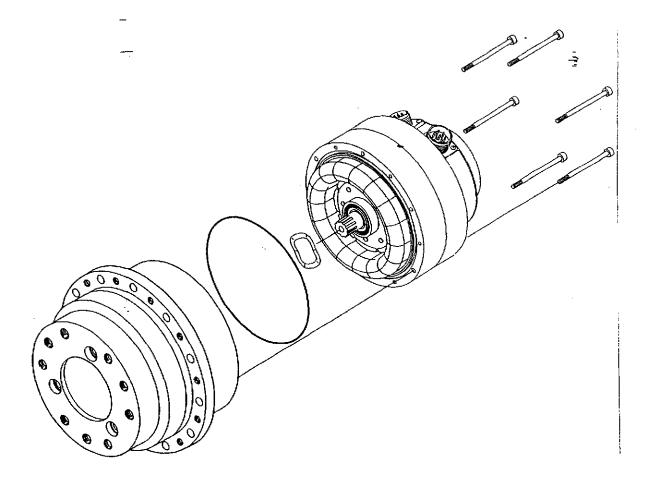
② Type B



Part No.	Part Name	Q'ty
1	Speed reducer unit	1
2	Motorunit	1

Part Name		Model/Q'ty				
No.	rarcivame	AR15	AR30	AR60	AR135	
3	Wave washer	BWW-6200 1 pc. (Ochiai Seisakusho)	BWW-6202 1 pc. (Ochiai Seisakusho)	BWW-6303 1 pc. (Ochiai Seisakusho)	WW-40 2 pcs. (Ochiai Seisakusho)	
4	O-ring	AS568-045-70 1 pc.	K-90 1 pc. (Keeper)	AS568-160-70 1 pc.	AS568-171-70 1 pc.	
(5)	Hexagon socket head cap screw	M4×60-12.9 6 pcs.	M4×65-12.9 6 pcs.	M5×80-12.9 6 pcs.	M5×90-12.5 8 pcs.	

③ Type C



Part No.	Part Name	Q'ty
1	Speed reducer unit	1
2	Motor unit	1

Part Name	Part Nama		Model/Q'ty				
	raitivame	AR15	AR30	AR60	AR135		
3	Wave washer	BWW-6200 1 pc. (Ochiai Seisakusho)	BWW-6202 1 pc. (Ochiai Seisakusho)	BWW-6303 1 pc. (Ochiai Seisakusho)	WW-40 2 pcs. (Ochiai Seisakusho)		
4)	O-ring	AS568-045-70 1 pc.	K-90 1 pc. (Keeper)	AS568-160-70 1 pc.	AS568-171-70 1 pc.		
(\$)	Hexagon socket head cap screw	M4×60-12.9 6 pcs.	M4×65-12.9 6 pcs.	M5×80-12.9 6 pcs.	M5×90-12.5 8 pcs.		

8-6. List of Jigs and Tools for Disassembling and Assembling

	Name	M. 1:1 Ct. 1 1	0,,		Applicat	le Model	
) 	Name	Model, Standard	Q'ty	AR15	AR30	AR60	AR135
Servo Actu-	Crane hoist	Hoisting capacity: 100 kgf min.	1		0	0	0
ator	Sling	JIS B8817 (Hook: No. 1 of JIS B2803)	1		0	0	0
	Workbench	See Page 8-13	1_	0	0	0	0
		M4	1	0	0		
		M5	1			0	0
	Hexagonal wrench key	M8	1	0			
		M10	1		0	0	
		.M12	1				0
i	Torque wrench	100 kgf.cm min.	1	0	0	0	0
		M8	2	0			
	Hexagon socket head cap	M10	2		0	0	
		M12	2				0
		M4	2		0	-	
	Eye bolt	M5	2			0	0
	13ye oo to	M6	2		0		
		М8	2			0	0
	Spatula		1	0	0	0	0

8-7. List of Bolt Clamp Torque

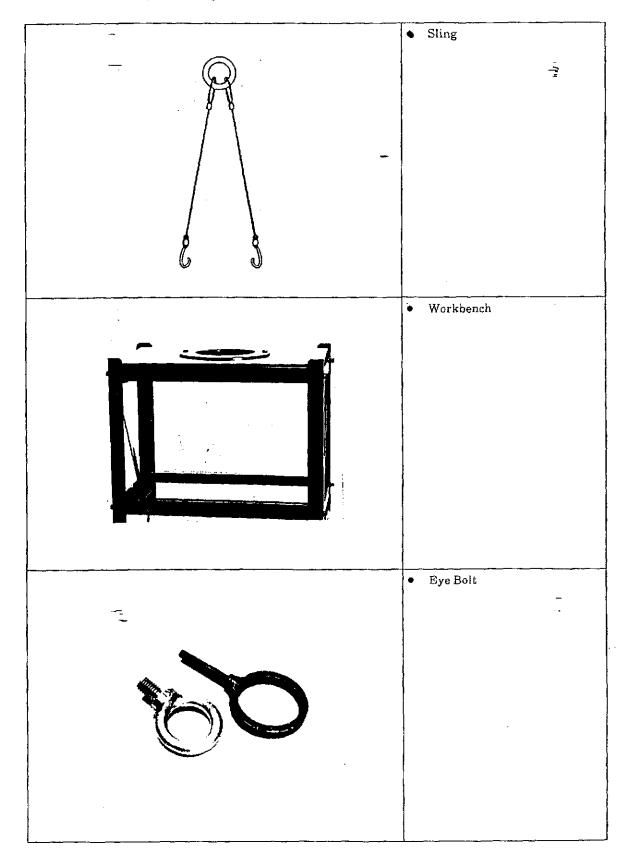
Hexagon socket head cap screw JISB1176	Clamp torque (kgf. cm)
M4	45
M5	95

8-8. List of Weights of Servo Actuator and Servo Controller

Unit: kgw

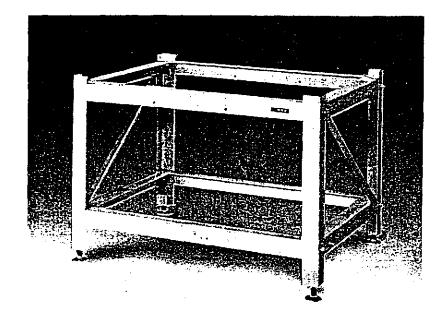
				Circ. ng.,
Model	AR15	AR30	AR60	AR135
Servo Actuator	12.5	27	37	73.5
Speed reducer unit	6.5	16	19	43
Motor unit	6	11	18	30.5
Servo Controller	2.1	2.4	3.6	4.2

8-9. List of Shapes of Jigs and Tools



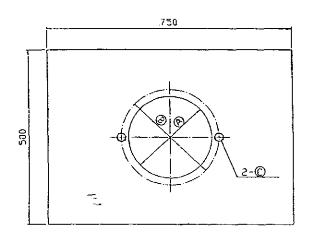
• Hexagonal Wrench Key
Torque Wrench
• Spatula

Recommended Workbench



Sakae, NJS-7550 W755×D505×H809

Special stand for setting working board



Symbol Model	(A)	B	0
AR15	φ147	φ160	M8
AR30	ø193	ø210	M10
AR60	ø225	φ240	M10
AR135	ø283	ø300-	M12

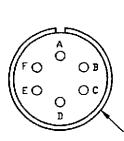
Material : SS41

Working Board

9. List

9-1. List of Connectors

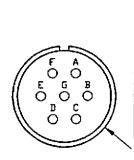
- (1) For servo power line (CN14a)
- ◆ Connector pin layout
- ▶ (For AR15)



Pin Nos.	Signal names	
A	U	
В	v	
С	w	
D	(Frame ground)	
E	B1 (Holding brake)	
F	B2 (Holding brake)	

AR15 MS3102A 14S-6P (Made by Japan Aviation Electronics Ind., Ltd)

(For AR30 to AR135)



Pin Nos.	Signal names
Α	U
В	V
С	w
D	⊕(Frame ground)
E	BI (Holding brake)
F	B2 (Holding brake)
G	_

AR30 MS3102A 16S-1P AR60 MS3102A 20-15P

AR135 MS3102A 24-10P

(Made by Japan Aviation Electronics Ind., Ltd)

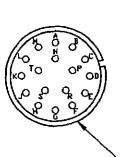
◆ Types of receptacle and applicable plug

	CN14a	CN14b			
	Types of receptacle	L-shape plug	Straight plug	Cable clamp	
AR15	MS3102A14S-6P	MS3108B14S-6S	MS3106B14S-6S	MS3057-6A	
AR30	MS3102A16S-1P	MS3108B16S-1S	MS3106B16S-1S	MS3057-8A	
AR60	MS3102A20-15P	MS3108B20-15S	MS3106B20-15S	MS3057-12A	
AR135	MS3102A24-10P	MS3108B24-10S	MS3106B24-10S	MS3057-16A	

(2) Encoder signal line (CN15a)

• (Absolute encoder) (Contact us for the incremental encoder.)

♦ Connector pin layout



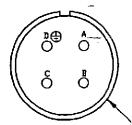
Pin Nos.	Signal names	Pin Nos.	Signal names
A	PΛ	K	* RTC
В	* PA	L	BAT
C	PВ	M	0V
D	+ PB	N	Shield
E	PZ	P	+5V*
F	* PZ	R.	0Н1
G	RXD/TXD	S	OH2
Н	* RXD/TXD	T	ov
J	RTC		

H/MS3102A20-29PZ (Made by Hirose Electric Co.)

◆ Type of receptacle and applicable plug

	CN15a	CN15b			
	Types of receptacle	L-shape plug	Straight plug	Cable clamp	
AR15					
AR30	H/MS3102A20-	H/MS3108B20-	H/MS3106B20-	H/MS3057-12A	
AR60	29PZ	29SZ	29SZ	11/M55057-12A	
AR135		2000	2000		

- (1) For servo motor power line (CN14a) Specification for TÜV certification equipment.
- ◆ Receptacle pin layout



Pin Nos.	Signal names
Α	บ
В	V
C	w_
D	⊕(Frame ground)

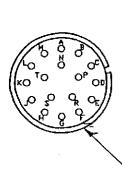
AR15,30 AR60,135 JL04V-2E18-10PE-B JL04HV-2E22-22PE-B

(Made by Japan Aviation Electronics Ind., LTD)

◆ Types of receptacle and applicable plug

	CN14a	CN14b		
	Types of receptacle	L-shape plug	Straight plug	Cable clamp
AR15	JL04V-2E18	JL04V-8A18	JL04V-6A18	JL04-18CK (13)
AR30	-10PE-B	-10SE-EB	-10SE-EB	
AR60	JL04HV-2E22	JL04V-8A22	JL04V-6A22	JL04-2022CK (14)
AR135	-22PE-B	-22SE-EB	-22SE-EB	

- (2) For encoder signal line (CN15a) Specification for TÜV certification equipment
- (Absolute encoder) (Contact us for the incremental encoder.)
- · Receptacle pin layout



Pin Nos.	Signal names	Pin Nos.	Signal names
A	PA	K	* RTC
В	* PA	L	BAT
С	PB	M	07
D	• PB	N	Shield
£	PZ	P	+ 5V
F	* PZ	R	OH1
G	RXD/TXD	s	OH2
Н	* RXD/TXD	Ť	0 V
J	RTC		

H/MS3102A20-29PZ (Made by Hirose Electric Co.)

♦ Type of receptacle and applicable plug

	CN15a	CN15b		
	Types of receptacle	L-shape plug	Straight plug	Cable clamp
Common to all types	H/MS3102A20- 29PZ	H/MS3108B20- 29SZ	H/MS3106A20- 29SZ	H/MS3057-12A

- (3) For holding brake (CN16a) Specification for TÜV certification equipment
- · Receptacle pin layout



Pin Nos.	Signal names
A	B1 (Holding brake)
В	B2 (Holding brake)

H/MS3102A10SL-4P (Made by Hirose Electric Co.)

♦ Type of receptacle and applicable plug

	CN16a	CN16b		
	Types of receptacle	L-shape plug	Straight plug	Cable clamp
Common to all types	H/MS3102A10SL- 4P	H/MS3108B10SL- 4S	H/MS3106A10SL- 4S	H/MS3057-4A

- (1) Encoder signal line (CN1)
- ◆ Connector pin layout (CN1a)
- Absolute encoder

(Contact us for the incremental encoder)

÷

i	2	3	4	5	6	7	8	9	10
5V	5 V	ov	0 V	ОН1	OH2	DIR		*RXD /TXD	RTC
11	12	13	14	15	16	17	18	19	20
*RTC	BAT	07	PZ	*PZ	PA	*PA	PB	*PB	Shield

DC5V is used as the encoder power.

Set the cable length so that voltage drop due to cable length is 0.2 V maximum.

 $0.2 > \frac{0.30 \times R \times 2L}{}$

0.30: Power consumption of encoder (A)

R: Resistance on cable (Ω/m)

L : Cable length (m)
n : Nos. of cables bundled

(Nos. of cables)

◆ Type of receptacle and applicable plug (CN1)

Type of connector	Type of applicable plug (CN1b)					
(CN1a)	Soldered type	Caulked type	Case	Manufacturer name		
PCR-E20LMDET-SL Right angle 20P	PCR-S20FS		PCR- LS20LA1	Manufactured by Honda Tsushin Kogyo Co., Ltd.		

(2) Input/output signal line (CN2)

◆ Connector pin layout (CN2a)

1	2	3	4	5	6	7	8_	9	10	11	12	13
Input common	Input common	CMD DATI	CMD DAT2	CMD DAT3	CMD DAT4	CMD DATS	CMD DAT6	CMD DAT7		SP DAT1	SP DAT2≿	SP DAT3
14	15	16	17	18	19	20	21	22	23	24	25	26
SP DAT4	SP DAT5	SP DAT6	0 V or 24 V	0 V or 24 V	CMD DAT8	CW	ccw	START	INLK	MODE A	MODE B	
27	28	29	30	31	32	33	34	35	36	37	38	39
SP DAT7	SP DAT8	SALM	IDPOS	CNTUP	моч		`	SVON	PRDY	SPEED	REFLS	AUX1
40	41	42	43	44	45	46	47	48	4	9	5	0
RESET	AUX2	AUX3	SVRDY	DALM	CALM	BALM	AUX4	AUX5	Bat 3.6	•	ternal mo 3.6\	

Note: When external battery terminal 49, 50 pin is used, do not connect BAT connector.

Use either one of BAT connector or external battery terminal only.

◆ Type of receptacle and applicable plug (CN2)

Types of connectors	Types of applicable plugs (CN2b)					
(CN2a)	Soldered type	Caulked type	Case	Manufacturer name		
PCR-E50LMDET-SL Right angle 50P	PCR-S50FS		PCR-LS50LA	Manufactured by Honda Tsushin Kogyo Co., Ltd.		

(3) Brake power (TB2)

1B	2B	3B
24N	BrB	ОНВ
1 A	2A	3A
24P	BrA	ОНА

Pin Nos.	1B	2B	3B
Names	24N	BrB	ОНВ
	. `		ζ
		FULL	1
		213	
Pin Nos.	1A	ZIZ ZA	3A

TB2 pin No.s.

◆ Type of receptacle and applicable plug (TB2)

Type of connector	Types of applicable plug (TB2)			
(TB2)			Manufacturer name	
178303-5	Rise housing 178289-3	Rise contact 1-175218-5	Made by Nippon AMP Co., Ltd.	

9-2. Parameters

	meters	<u> </u>	T	ſ
Param- eter Nos	Contents	Setting	Initializa-	User
			tion value	settings
P- 0	Display of current address			
	Reduction ratio	2~1000	120	چ
	Number of divisions	2~255	15	
	Number of sprocket teeth	2~255	15	
P- 4	Automatic driving speed 1	50~3000 (AR15~60) 50~2500 (AR135)	2000	
	Time constant for acceleration or deceleration 1 (Automatic driving)	50~1000 _	500	
	Manual driving speed	50~3000 (AR15~60) 50~2500 (AR135)	1000	
P- 7	Time constant for acceleration or deceleration (manual driving)	50~1000	500	
	Creeping speed at the time of zero return	50~200	50	
	Position loop gain	1000~5000	2000	
P- 10	Permissible position deviation	1~9999	2000	
P- 11	Imposition width	10~9999	400	
	Width of home position signal	10~9999	800	·
}	Number of pulses of encoder	10000 p/r :Incremental 8192 p/r :Absolute	8192	
P- 14	Zero point coordinate value in one rotation of absolute encoder	0~8191	_	
P- 15	Grid shift	0~9999	0	
P- 16	Backlash correction	0~9999	0	
·	Step feed	50~9999	200	
	Stroke limit on CW rotation side	0~40000	Automatic setting	
P- 19	Stroke limit on CCW rotation side	0~40000	Automatic setting	•
P- 20	Power save timer	30~9999	30	
P- 21	Overshoot	0~9999	0	
P- 22	Follow-up range	0~100	0	
	Blank		0	
P- 24	Automatic driving speed 2	50~3000 (AR15~60) 50~2500 (AR135)	2000	
P- 25	Time constant for acceleration or deceleration 2 (Automatic driving)	50~1000	500	_
	Břank		0	
P- 27	Blank		0	
P- 28	Blank		0	
P- 29	Blank	1	0	
P- 30	Manufacture set value		0	
	Manufacture set value		0	
P- 32	Blank		0	
P- 33	Blank		0	<u>-</u>
P- 34	Blank		0	
	Blank		0	
	Blank		0	
	Blank	 	0	
		·		
וו סניתו	Blank		101	

Parameter Nos	Contents	Initializa- tion value
P- 40	Set at parameter back up	0
P- 41	Monitor output selection	<u></u> 103
P- 42	Blank	-
P- 43	Blank	
P- 44	Manufacturer set value	
P- 45	Manufacturer set value	
P- 46	Manufacturer set value	
P- 47	Manufacturer set value	
P- 48	Manufacturer set value	20
P- 49	Manufacturer set value	4080
P- 50	Drift correction time constant (low frequency)	25
P- 51	Drift correction time constant (high frequency)	5
P- 52	Drift correction plus gain	. 2
P- 53	Drift correction minus gain	1
P- 54	Manufacturer set value	50
P- 55	Manufacturer set value	400
P- 56	Servo lock mode	120
P- 57	Allowable positional deviation error at servo lock	400
P- 58	1/10 of value of error pulse at occurrence of excessive positional deviation alarm	
P- 59	No. of immediately preceding control alarm	

Parameter Nos	Contents	Initializa- tion value	User settings
P- 60	Selection between absolute and incremental encoders	0000	
P- 61	Selection in increasing direction of indexed addresses	0000	
P- 62	Selection of interlock signal	0001	
P- 63	Selection between short-cut indexing and one-way indexing	0000	
P- 64	Selection in the two-position indexing	0000	
P- 65	Selection of power save timer	0000	
P- 66	Backlash correction direction, grit shift correction direction, selection of reduction gear, use of EEPROM	0000	
P- 67	Selection of optional step feeding mode	0000	
P- 68	Selection of alarm No. external output and parameter set value display duration	0000	
P- 69	Selection of local mode	0000	

Notes: 1. Check your setting value.

 $2. \quad \textit{Refer to Instruction Manual for details of parameters}.$

Para- meter numbers	Contents of indications (LED) –	
P-70	In p ut signals	Input signal
	CMDDAT4 CMDDAT3 CMDDAT2 CMDDAT1	CMDDAT 1 CMDDAT 3 Address command
P-71	Input signals	CMDDAT 4 Signals CMDDAT 6
	CMDDAT8 CMDDAT7 CMDDAT6 CMDDAT5	EMDDAT7 CMDDAT8
P-72	Input signals	CW: Manual command CW signal
	INLK START CCW CW	CCW: Manual command CCW signal
P-73	Input signals	START : Operation start signal INLK : Interlock signal MODE A : Mode selection signals MODE B : Mode selection signals
,	PRDY SVON MODE B MODE A	SVON : Servo ON signal PRDY : Operation preparation
P-74	Input signals	command signal REFLS: Zero point LS signal SPEED: Speed change signal
	AUX1 REFLS SPEED	
P-75	Output signals	Output signals
1-10		SPDAT 1 SPDAT 2
}	SPDAT 4 SPDAT 3 SPDAT 2 SPDAT 1	SPDAT 3 SPDAT 4 SPDAT 5 Present address
P-76	Output signals	SPDAT 6 indication signals SPDAT 7
	SPDAT 8 SPDAT 7 SPDAT 6 SPDAT 5	SPDAT8
P-77	Output signals	SALM : Control alarm signal IDPOS : Home position signal CNTUP : Positioning finish signal
	MOV CNTUP IDPOS SALM	MOV : Servo actuator in operation signal
P-78	Output signals	-
	AUX 5 AUX 4 AUX 3 AUX 2	ENALM: Presence/absence of alarm signal BATALM 1: Battery voltage drop
P-79	Indicates alarm status of the absolute encoder.	BATALM 1 : Battery voltage drop BATALM 2 : Built-in capacitor voltage drop CNTOVF : Counter overflow
	ENALM BATALM1 BATALM2 CNTOVF	

Parameter Nos	Contents	Initializa- tion value
P- 80	Monitor output data (A channel)	
P-81	Monitor output data (B channel)	- <u>-</u>
P- 82		
P- 83	Indicates contents of timer 3 resistor (20 msec)	
P- 84	Indicates contents of timer 4 resistor (1 sec)	
P- 85	Fraction of indexing pitch	
P- 86	Correction value of fraction of indexing pitch	
P- 87	No. of continuous step feeding	
P- 88	Coordinate shift amount per coordinate shift	
P- 89	Operation mode resistor	
P- 90	Speed limit value	12288
P- 91	Zero speed command value	30000
P- 92	Speed command value at servo lock	30000
P- 93	Deflection from zero speed command value	0
P- 94	Speed command value	30000
P- 95	Error pulse	
P- 96	Indicates coordinate value (4 significant digits)	
P- 97	Indicates coordinate value (4 digits in middle)	
P- 98	Indicates coordinate value (4 least significant digits)	
P- 99	Program version	

Servo parameter

Parameter Nos	Contents	Initializa- tion value	User settings
S- 0	Actuator type	15	
S- 1	Load inertia ratio	256	
S- 2	Speed loop proportional gain		-3
S- 3	Speed loop integrative gain		
S- 4	Incomplete integrative coefficient	1	
S- 5	Acceleration feedback gain	 	
S- 6	PI-IP coefficient	 	
S- 7	Torque command filter		
S- 8	Speed limit	 	
S- 9	Torque limit	 	
S- 10	Current loop gain 1	 	
S- 11	Current loop gain 2		
S- 12	Current loop proportional gain	 	
S- 13	Current loop integrative gain		
S- 14	Current loop integrative limit	 	
S- 15	Rated current parameter		· · · · · · · · · · · · · · · · · · ·
S- 16	Current dead zone correction		
S- 17	Number of encoder pulse	 	
\$- 18	Motor encoder type		
S- 19	Number of external mount encoder pulse		
S- 20	Type of external mount encoder		
S- 21	Overload protection limit		
S- 22	Overload protection coefficient 1		
S- 23	Overload protection coefficient 2		
S-24~26	Blank		
S- 27	Brake timing	-	· · · · · · · · · · · · · · · · · · ·
S- 28	Relay timer		
S- 29	Current limit		
S- 30	Observer speed loop model	 	
S- 31	Observer motor model		
S- 32	Inertia identification level	+	
S- 33	Speed identification level	 	
S- 34	Observer position loop gain	 	
S- 35	Positional loop gain	 	
S- 36	In position width	<u> </u>	
S- 37	Zero speed	†	
S- 38	Speed coefficient H	1	
S- 39	Speed coefficient L	1	
S-40~42	Blank	 	
S- 43	External torque command offset	 	
S- 44	External torque command variable	 	
S- 45	External drive command offset	<u>;</u>	
S- 46	External drive command variable		
S- 47	Function selection	†	
S- 48	Alarm output condition		
S- 49	Selection of command input	1	

Alarm trace back

Parameter Nos	Contents	Initializa- tion value
A-0	Latest alarm	
A-1	Ind latest alarm	
A-2	2rd latest alarm	-
A-3	3th latest alarm	
A-4	4th latest alarm	
A-5	5th latest alarm	
A-6	6th latest alarm	
A-7	7th latest alarm	
A-8	8th latest alarm	
A-9	9th latest alarm	

9-3. Contents of Control Alarm

Alarm No. (Indicated on LED)	Contents			
E-2	When positional deviation goes beyond tolerance			
E-3	When an address beyond the setting range is set			
E-4	When coordinate goes beyond the control system coordinate limit			
E-5	When drift value is too large			
E-6	When operation results overflow			
E-7	When data beyond the setting range is set to parameter			
E-8	When zero point can not be detected (with incremental encoder)			
E-9	Too large Positional deviation at servo lock			
E-10	MAE communication error. In case of data transfer error			
E-11	MAE framing error. In case of data transfer error			
E-12	MAE overrun error. In case of data transfer error			
E-13	MAE parity error. In case of data transfer error			
E-14	Voltage drop on MAE battery			
E-15	When voltage on MAE built-in capacitor drops to the level where data can not be held			
E-16	When multiturn section counter on MAE overflows			
E-17	Coordinate of MAE and coordinate held by the servo controller does not match			
E-101	IPM alarm			
E-102	Over-voltage: Detected when main circuit voltage goes extraordinary high			
E-103	Open signal line			
E-104	Low-voltage			
E-105	Overload			
E-106	Over heating (servo actuator)			
E-108	Open power line			
E-109	Abnormality in brake power			
E-111	Over speed			
E-112	U phase current sensor offset error			
E-113	W phase current sensor offset error			
E-114	Abnormality in AD converter			
E-115	Abnormality in regenerative transistor			
E-116	Over heating (regenerative resistor)			

Notes: 1 MAE stands for Multiturn Absolute Encoder.

- ② Alarm numbers E-14 to E-17 outputs alarm when an abnormality has been experienced in the past even though there is not current problem.
- 3 IPM stands for Intelligent Power Module.