OMRON
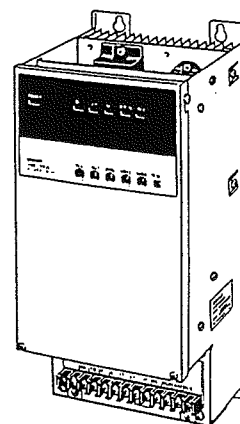
USER'S MANUAL

OMNUC R SERIES

MODEL: R88D-RP05/RP10/RP15/RP20
(PULSE INPUT TYPE)

AC SERVO DRIVER

Notes About Using This Manual

(1) This manual describes in as much detail as possible the functions of the unit and relations with other units. Items not described in this manual should be understood as "unavailable."

(2) Though we have tried to create the manual optimum, do not hesitate to contact our agent if you find anything difficult to understand.

(3) Inside the cover, there are potentially dangerous parts. If you open the cover, serious problems may arise. Never repair or disassemble the unit.

(4) We recommend adding the following precautions to your instruction manuals for unit-installed systems.
   • This unit is high voltage equipment and dangerous to access.
   • Do not touch terminals of the unit after power is switched OFF as voltage remains.

(5) Specifications and functions may change without notice in order to improve performance.

INDEX

1.1 Features and Configuration

This unit is an AC servo driver that performs wide and fine positioning by controlling power to AC servo motor in compliance with pulse train signals.

This series consists of power unit combined AC servo drivers (R88D-RP series), operative 100W to 1,100W motors.

- Compactness, light weight, with a power unit combined.
- Applicable high speed pulse train up to 270 kpps response frequency.
- Shockproof, durable in any environmental condition.
- Electromagnetic encoders are applied for detection.
- AC servo motors are able to rotate up to instant rate 4,000 rpm.
- Smooth and vibrationless rotation by sine wave system.
- Easily applicable outside dynamic brake circuit as dynamic brake sequence is installed internally.
- Extendable distance between the motor and driver up to 30 m.when the standard cable is used.

1. GENERAL

1.2 Outline of Configuration

System configuration example using a unit
is shown below.

Servo driver	Servo motor	Motor output
R88D-RP05	R88M-R10030	100W
R88D-RP10	R88M-R20030	200W
	R88M-R30030	300W
R88D-RP15	R88M-R45030	450W
	R88M-R60030	600W
R88D-RP20	R88M-R82030	820W
	R88M-R1K130	1,100W

R88D-RP series
AC servo driver

Encoder signal
(serial data transfer)

3φAC
200/220V

Dynamic brake unit

R88M-R
AC servo motor

Motor drive signal
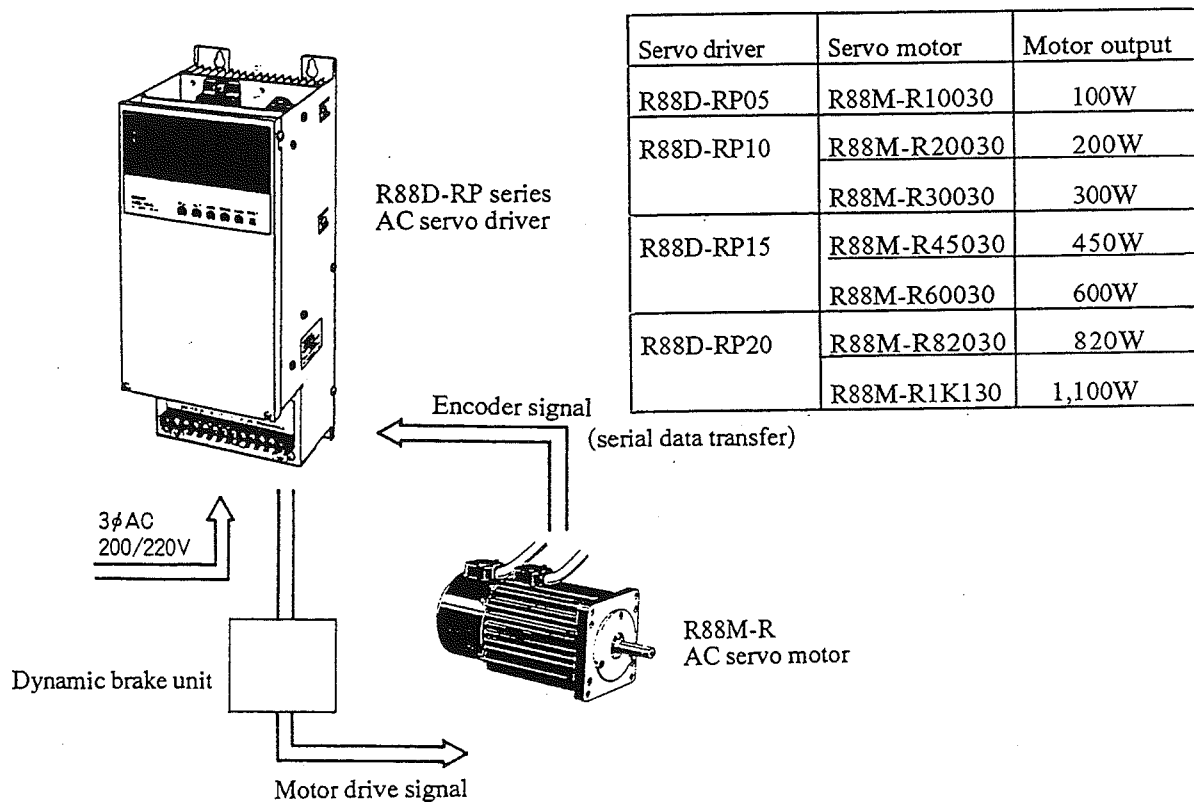
□ **AC servo motor**
  • AC servo motors are available in 7 models: 100 W, 200 W, 300 W, 450 W, 600 W,
    820 W and 1,100 W. Be careful to choose proper servo motor suitable to the AC servo
    driver.

□ **AC servo driver**
  • AC servo drivers of 4 models can control AC servo motors of 100 W to 1,100 W.
    Types of AC servo drivers must be in accordance with each AC servo motor.

❑ Exclusive cable

- Encoder cable for 100 to 450 W motors (R88A-CRR☐☐☐S)

    This is a cable to connect R series AC servo motors (100 to 450 W) with R series AC servo drivers.
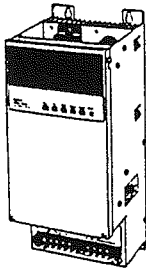
R88D-R
AC servo driver
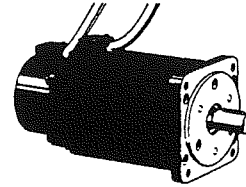
R88M-R
AC servo motor (100 to 450W)

- Encoder cable for 600 to 1,100 W motor (R88A-CRR☐☐☐N)

    This cable is to connect R series AC servo motors (600 to 1,100 W) and R series AC servo drivers.

R88D-R
AC servo driver
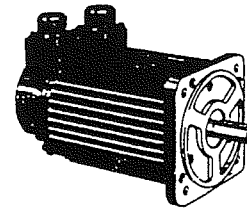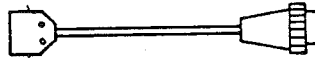
R88M-R
AC servo motor (600 to 1,100W)

- Power cable for 600 to 1,100 W motor (R88A-CAS☐☐☐S)

    This cable is to connect armature connectors of 600 to 1,100 W AC servo motors and R series AC servo drivers.

R88D-R
AC servo driver
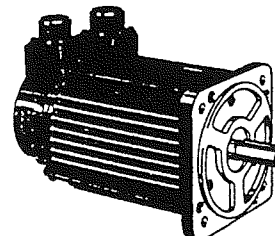
R88M-R
AC servo motor (600 to 1,100W)

• Encoder cable

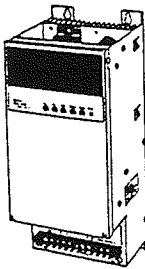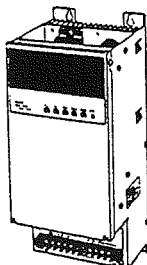| SPECFICATIONS	Length	MODEL
Motor capacity: 100 W,200 W, 300 W,450 W (single-side connector)	3 m	R88A-CRR003S
	5 m	R88A-CRR005S
	10 m	R88A-CRR010S
	15 m	R88A-CRR015S
	20 m	R88A-CRR020S
	30 m	R88A-CRR030S
Motor capacity 600W,820W, 1100W (dual-side connector)	3 m	R88A-CRR003N
	5 m	R88A-CRR005N
	10 m	R88A-CRR010N
	15 m	R88A-CRR015N
	20 m	R88A-CRR020N
	30 m	R88A-CRR030N

• Power cable

SPECFICATIONS		MODEL
Motor capacity 600 W, 820 W, 1,100 W (single-side connector)	3 m	R88A-CAS003S
	5 m	R88A-CAS005S
	10 m	R88A-CAS010S
	15 m	R88A-CAS015S
	20 m	R88A-CAS020S
	30 m	R88A-CAS030S

1.3 Before Reading This Manual

Read this manual carefully before using the unit. In this manual, AC servo motor rotation directions are defined as "Forward" and "Reverse." "Forward" rotation means to rotate motor shaft in an counter-clockwise (CCW) direction. "Reverse" rotation means clockwise (CW) direction looking at the motor from the shaft side.

Forward rotation
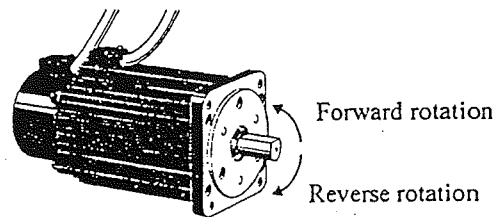
Reverse rotation

AC servo motor

□ Encoder output phase

The encoder output signal from the servo driver is as follows.

• At forward rotation

A phase output

B phase output
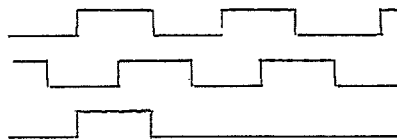
Z phase output

• At reverse rotation

A phase output

B phase output

Zphase output
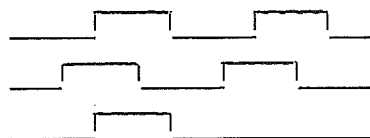
The system consists of an AC servo driver and an AC servo motor.

Specifications of AC servo driver and AC servo motor are shown below.

2.1 General Specifications of Servo Driver

Item	Contents	
Ambient operating temperature	0 to +55°C	
Ambient operating humidity	35 to 85% RH (without dew condensation)	
Storage temperature	-10 to + 75°C	
Ambient condition	Without corrosive gases	
Vibration proof	Less than 2G or the acceleration of 10-150 Hz with half amplitude of 0.15 mm	
Shock proof	Less than 10G in peak acceleration (tested each 3 times in X, Y, Z directions)	
Insulating resistance	Between outside terminals and outside box, more than 5 MΩ at 1,000VDC megger.	
Voltage proof capacity	Between outer terminals and outer box, 1 minute at 1,500 VAC 50/60 Hz	
Structure	Installation inside a box type	
Weight	R88D-RP05/RP10	Approx.4.6 kg
	R88D-RP15/RP20	Approx. 5.0 kg

2. SPECIFICATION

2-2 Performance Specifications
2-2-1 AC servo driver

☐ **Specifications of the error counter and control input/output signals**

Item		Specifications
Max. response pulse frequency		270 kpps
Max. amount of error counter		Selectable between 9, 10, 11, 12 bit
Multiplication figures of position command pulse		1 to 16
Setting on in-position range		± 1 to ± 31 pulse
Input signal of position detector		90° phase difference signal A, B, and Z , 70 kpps max.
Multiplication figures of encoder input signal		× 1, × 2, × 4
Feed forward control		Switchable on the inside
Input signal	Position feedback	A, B, Z phase signal
	Command pulse	TTL line driver input, photo isolation
	Operation ready command	+5V -10 mA, photo isolation
	Zero positioning command	+5V -10 mA, photo isolation
	Pulse prohibition	+5V -10 mA, photo isolation
	Emergency stop	+5V -10 mA, photo isolation
	Error counter reset	+5V -10 mA, photo isolation
	Abnormal reset	+5V -10 mA, photo isolation
	Torque limit	+5V -10 mA, photo isolation
	Gain minimisation	+5V -10 mA, photo isolation
Output signal	Alarm output	Contact output 24 VDC -0.5 A
	Positioning completion output	Open collector output, max. 24V,-10 mA
	Position feedback output	A, B, Z phase (line driver) output. Forward and backward.
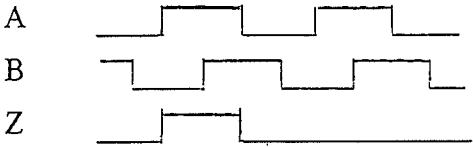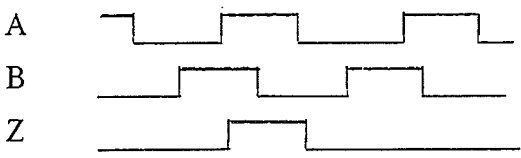
☐ Specifications of servo driver

Item		Unit	Standard			
Power source	Main circuit	V	170VAC - 253VAC, 50/60 Hz, 3-phase			
	Control circuit	V	170VAC - 264VAC, 50/60 Hz, single phase 80 VA.			
Output	Model		R88D-RP05	R88D-RP10	R88D-RP15	R88D-RP20
	Continuous	A0-P	1.7	3.3	5.0	7
	Maximum	AO-P	5.5	10	15	20
Speed feedback			Magnetic encoder 1000 PPR (Pluse Per Revolution)			
Protection functions			Against overcurrent, overload ,overvoltage, and abnormal speed			

Note 1: Prepare main power supply approx. 200% of used motor output capacity. For example, 1.2 kVA main power supply for 600W motor.

Note 2: No regenerative control circuit is installed in R88D-RP05, and R88D-RP10. Only condenser is installed as regenerative function.

☐ Encoder output

Item	Standard
Output pulse	A and B phase: 1000 PPR Z phase: 1 PPR
Output phase	At forward rotation A B Z At reverse rotation A B Z Serial transfer delay of Z phase is 5 to 21 µs.
Output system	EIA-RS-422A or equivalent
Insulation resistance	5 MΩ or up
Durability of sensor	1 minute at 50 VDC between the case and the ground.

Note: Do not practise insulation test on encoders. It may damage the encoder.

2. SPECIFICATION

2-2-2 AC servo motor

□ Specification of AC servo motor (1)

Item	Unit	R88M -R10030	R88M -R20030	R88M -R30030	R88M -R45030
Output power	W	100	200	300	450
Rated torque	kgf·cm	3.25	6.49	9.74	14.6
Rated speed	rpm	3,000	3,000	3,000	3,000
Instantaneous max. speed	rpm	4,000	4,000	4,000	4,000
Instantaneous max. torque	kgf·cm	9.7 or up	24 or up	28 or up	36 or up
Rotor inertia	kgf·cm·s^2	1.89×10^{-4}	5.31×10^{-4}	7.70×10^{-4}	1.60×10^{-3}
Torque constant.	kgf·cm/A	2.02	4.13	3.76	3.32
Induction voltage constant	V/rps	1.25	2.54	2.32	2.04
Power rate	kW/s.	5.48	7.62	11.9	12.8
Mechanical time constant	ms	1.98	1.98	1.6	1.9
Coil resistance	Ω	4.2	6.24	2.9	1.28
Coil inductance	mH	9	18.5	11.5	14.3
Electrical time constant	ms.	2.14	2.96	3.97	11.2
Weight	kg	1.3	2.0	2.6	4.5
Ambient operating conditions	°C, %RH	Temperature: 0 to +40°C, Humidity: 35 to 85 % (without dew condensation)			
Storage condition	°C, %RH	Temperature: -10 to +75°C, Humidity: 35 to 85% RH (without dew condensation)			
Operating atmosphere		Without corrosive gases			
Installation direction		Each direction			
Insulation class		Item B			
Structure		Full-close, self-cooling			
Dustproof structure		IP-52 (in the case of oil seal is applied as option, IP-54)			

Note : See Section 1-3 in Chapter 4 about oil seal.

□ Specification of AC servo motor (2)

Item	Unit	R88M -R60030	R88M -R82030	R88M -R1K130
Output power	W	600	820	1100
Rated torque	kgf·cm	19.5	26.6	35.7
Rated speed	rpm	3,000	3,000	3,000
Instantaneous max. speed	rpm	4,000	4,000	4,000
Instantaneous max. torque	kgf·cm	50 or up	78 or up	88 or up
Rotor inertia	kgf·cm·s^2	2.03x10^{-3}	2.5x10^{-3}	3.66x10^{-3}
Torque constant	kgf·cm/A	5.12	5.34	5.43
Induction voltage constant	V/rps	3.15	3.29	3.34
Power rate	kW/s.	18.4	27.7	34.1
Mechanical time constant	ms	1.54	1.12	0.91
Coil resistance	Ω	1.95	1.25	0.72
Coil inductance	mH	20	16.2	11.1
Electrical time constant	ms	10.3	13	15.4
Weight	kg	5.5	7.1	8.5
Ambient operating conditions	°C, %RH	Temperature: 0 to +40°C, humidity: 35 to 85 % (without dew condensation)		
Storage condition	°C, %RH	Temperature: -10 to +75°C, Humidity: 35 to 85% RH (without dew condensation)		
Operating atmosphere		Without corrosive gases		
Installation direction		Each direction		
Insulation class		Item B		
Structure		Full-close, self-cooling		
Dust proof structure		IP-52 (in the case of oil seal, IP-54)		

Note 1: Servo motor model R88M-R60030 (600W) can be used with the servo driver
model R88D-RP20. In this case, max. torque becomes 60 kfg·cm or over.

Note 2 : See Section 1-3 in Chapter 4 about oil seal.

2. SPECIFICATION

□ **Specifications of built-in brake motor**

Brake release voltage is 24VDC without polarity.

The brake releases when 24VDC is applied to the line.

The purpose for this brake is to hold axis at stop condition, not to stop the axis. Thus, release the brake with the release voltage ON while in operation of the motor. Be careful that the brake inertia should be added to the load inertia.

• Brake circuit

In order to protect the circuit from surge noise at brake excitation OFF, be sure to insert a surge killer. To select surge killer, see the table below:
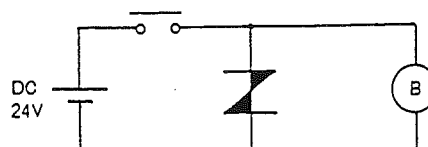
Type	Model	Mfg.	Application
Thyrister	C-5A3	ISHIZUKA ELECTRONICS COPR.	24VDC
Thyrister	V-3	ISHIZUKA ELECTRONICS CORP.	24VDC
Varistor	Z15L470	ISHIZUKA ELECTRONICS CORP.	24 VDC
Varistor	ERZ-C14DK470	MATSUSHITA ELECTRONICS COMPONENTS CO., LTD.	24 VDC
Spark killer	CR50500	OKAYA ELECTRIC INDUSTRIES. CO., LTD.	Compatible AC and DC

□ **Specifications of built-in brake motor (1)**

• Brake specification

Item	Unit	R88M -R10030-B	R88M -R20030-B	R88M -R30030-B	R88M -R45030-B
Brake inertia	kgf·cm·s^2	7.7×10^{-5}	1.0×10^{-4}	1.0×10^{-4}	3.0×10^{-4}
Excitation voltage	V	24 vDC			
Power consumption	W	7.2	10	10	19.5
Static friction torque	kgf·cm	5 or up	10 or up	15 or up	25 or up
Braking time constant	ms	(30)	(40)	(50)	(50)
Release time constant	ms	(20)	(30)	(30)	(100)
Allowable work (1)	kgf·m/time	13	25	25	60
Allowable work (2)	kgf·m/life	1.3×10^4	2.5×10^4	2.5×10^4	5×10^4
Backlash	axis angle	(0.75°)	(0.63°)	(0.63°)	(0.61°)
Rated		Continuous rating			
Insulation class		Item F			

• Weighth

Item	Unit	R88M -R10030-B	R88M -R20030-B	R88M -R30030-B	R88M -R45030-B
Weight (motor + brake)	kg	1.8	2.7	3.4	5.8

Note: Values indicated in parentheses are not guaranteed.

□ Specifications of built-in brake motor (1)

• Brake specification

Item	Unit	R88M -R60030-B	R88M -R82030-B	R88M -R1K130-B
Brake inertia	kgf•cm•s^2	3.0×10^{-4}	3.0×10^{-4}	5.0×10^{-4}
Excitation voltage	V	24 vDC		
Power consumption	W	19.5	19.5	18
Static friction torque	kgf•cm	25 or up	40 or up	55 or up
Braking time constant	ms	(50)	(50)	(50)
Release time constant	ms	(100)	(100)	(100)
Allowable work (1)	kgf•m/time	60	60	60
Allowable work (2)	kgf•m/life	5×10^4	5×10^4	5×10^4
Backlash	axis angle	(0.61°)		
Rated		Continuous rating		
Insulation class		Item F		

• Weight

Item	Unit	R88M -R10030-B	R88M -R20030-B	R88M -R30030-B
Weight (motor + brake)	kg	6.8	8.4	10.5

Note: Values indicated in parentheses are not guaranteed.

2. SPECIFICATION

☐ Characteristic curve (tested with the standard cable 3m)

The characteristic curves below shows operation zones when 200VAC in 3-phase has been input.

R88M-R10030 (100 W)

R88M-R20030 (200 W)

R88M-R30030 (300 W)

R88M-R45030 (450 W)

R88M-R60030 (600 W)

R88M-R82030 (820 W)

R88M-R1K130 (1,100 W)


2-8
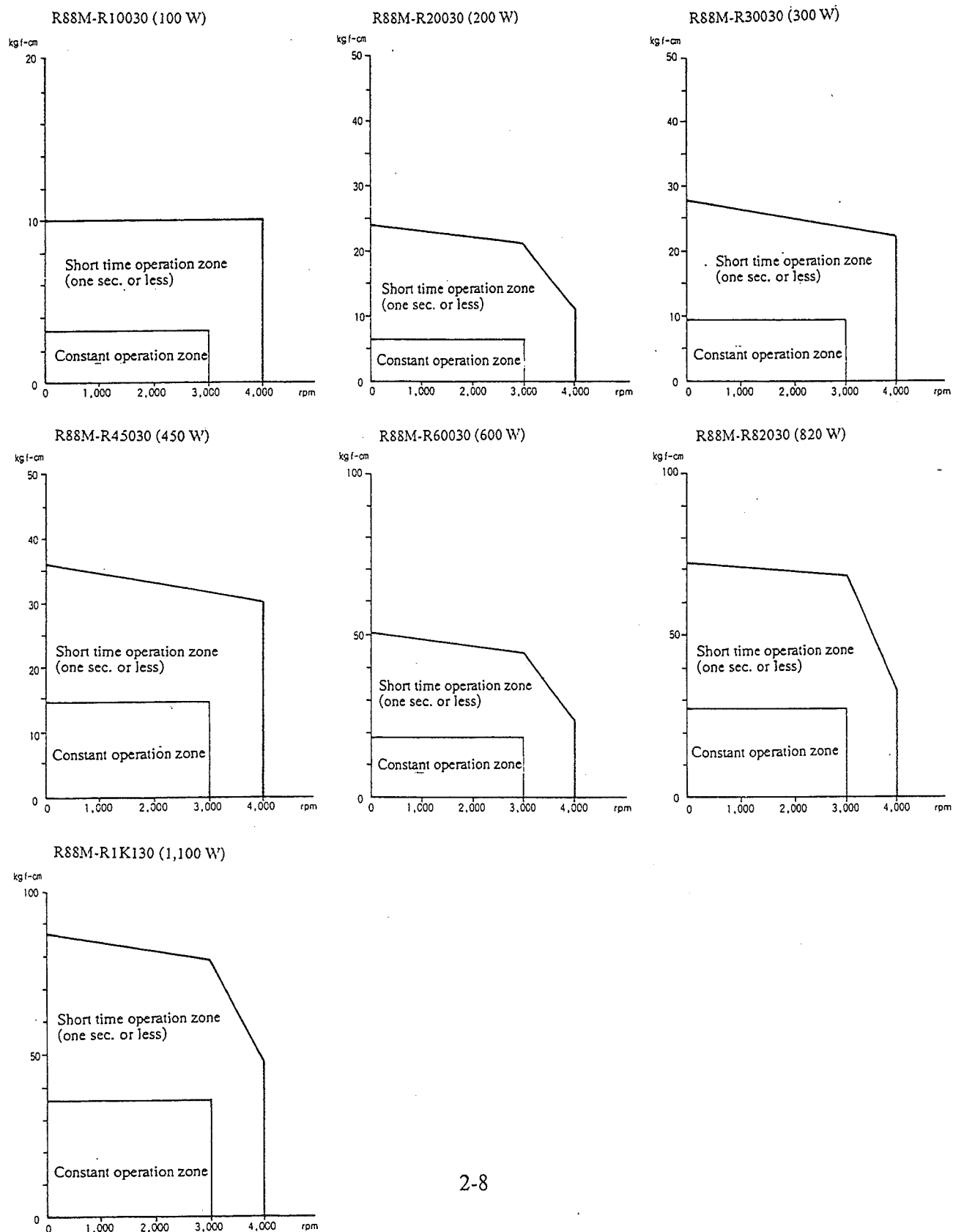
☐ Radiation condition of AC servo motors

In case of continuous operation at the rated torque, the following radiation fins are necessary on the motor flange.

R88M-R20030 Thickness: 6 mm, area: 200mm^2 metal board or equivalent

R88M-R30030 Thickness: 6 mm, area: 250mm^2 metal board or equivalent

R88M-R45030 Thickness: 12 mm, area: 250mm^2 metal board or equivalent

R88M-R60030 Thickness: 12 mm, area: 250mm^2 metal board or equivalent

R88M-R82030 Thickness: 12 mm, area: 250mm^2 metal board or equivalent

R88M-R1K130 Thickness: 12 mm, area: 250mm^2 metal board or equivalent

Note: Above recommendation are at condition of horizontal installation without blockage obstacles around the motor.

☐ Vibration proof characteristics

OMNUC R series AC servo motor allowable against 2G every directions installed in a horizontal axis positions.
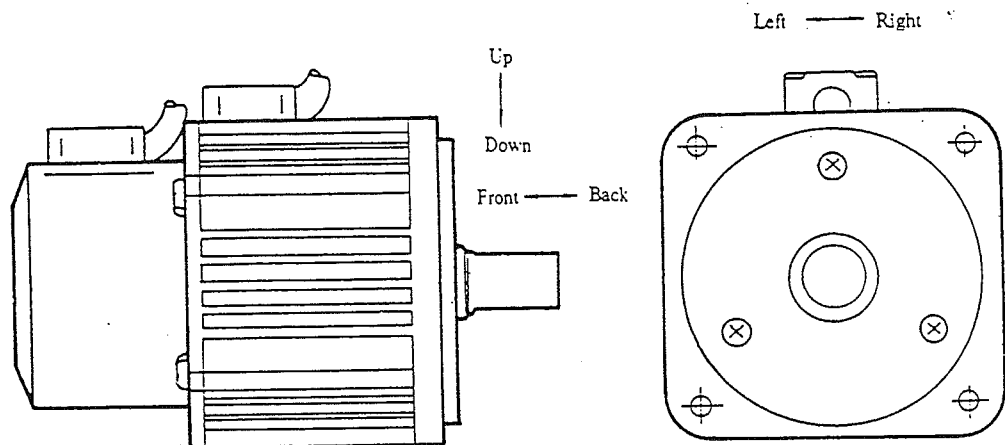
☐ Shockproof characteristics

OMNUC R series AC servo motor can withstand a 50G vertical shock three times when it is installed in a horizontal axis position.

Note : Do not remove the encoder cover nor disassemble the AC servo motor.

2. SPECIFICATION

• Allowable load to motor axis

Allowable radial and thrust load to motor axis are as follows:

(unit : kgf)

Type	Output power	Allowable radial load	Allowable thrust load A	Allowable thrust load B
R88M-R10030	100 W	11.5	3	3
R88M-R20030	200 W	19	8	7.5
R88M-R30030	300 W	20	8	7.5
R88M-R45030	450 W	34	12	11
R88M-R60030	600 W	36	12	11
R88M-R82030	820 W	38	12	11
R88M-R1K130	1,100 W	45	15	13

Note 1: Above allowable radial load are values at the center of the axis (one second of shaft length).

Note 2: Thrust load value differs from load directions.

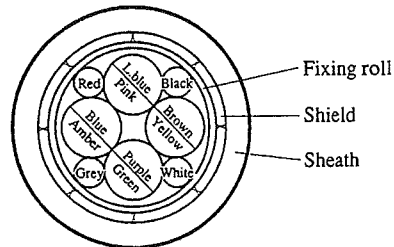Note 3: The above load values are defined according to the target life of 30,000 hours.

Radial load

——— Thrust load

Direction of gravity force

A: Shaft - facing up

B: Shaft - facing down
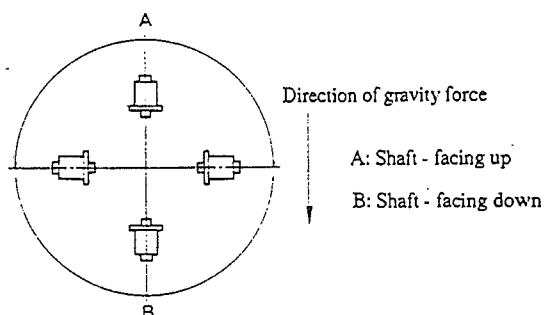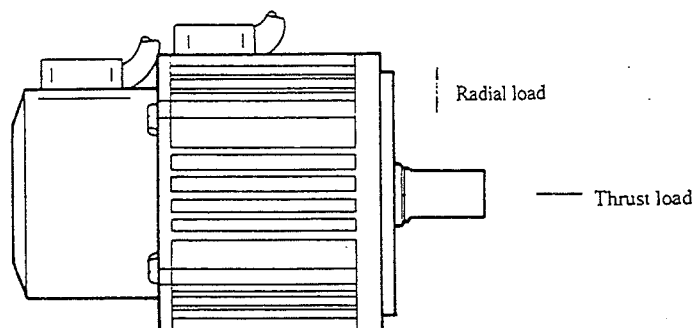
☐ Motor lead wire

• Signal wire (signal and power lines of encoder)

UL2589(105°C,30V) 24AWG x 3P + 22AWG x 3C or equivalent.

Sectional view

Note:Purple, green, and white electric wires are housed inside the sheath.

Item		Specification	
		24AWG	22AWG
Outside diameter	mm	Ø 8 ± 0.2	
Conductor resistance	Ω/km	58.7 or less	42.5 or less
Voltage proof	V/sec.	500	
Insulation resistance	MΩ/km	1.0	
Min. bending radial	mm	30	

• Armature wire (wires to supply power to stator winding of motor and to grounding.)

UL2517 (105°C,300V) 18AWG x 4C or equivalent.

Sectional view
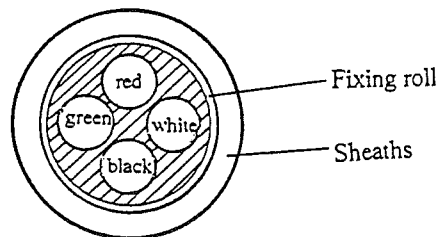
Item		Specification
Outside diameter	mm	Ø 8 ± 0.2
Conductor resistance	Ω/km	24.2 or less
Voltage proof	V/min.	2,000
Insulation resistance	MΩ/km	3.5
Min. bending radial	mm	40

3. MODEL DENOMINATION

□ AC servo driver

Model R88D-R P 05

Output current of nominal value.

Sign	05	10	15	20
Max. output current	5.5A	10A	15A	20A

Means power unit is combined type pulse command input model.

Means "R" series.

Means servo driver.

□ AC servo motor

Model R88M-R 100 30 - □□□□

Special specification

Rated rotation speed is 3,000 rpm

Output
- 100 : 100W
- 200 : 200W
- 300 : 300W
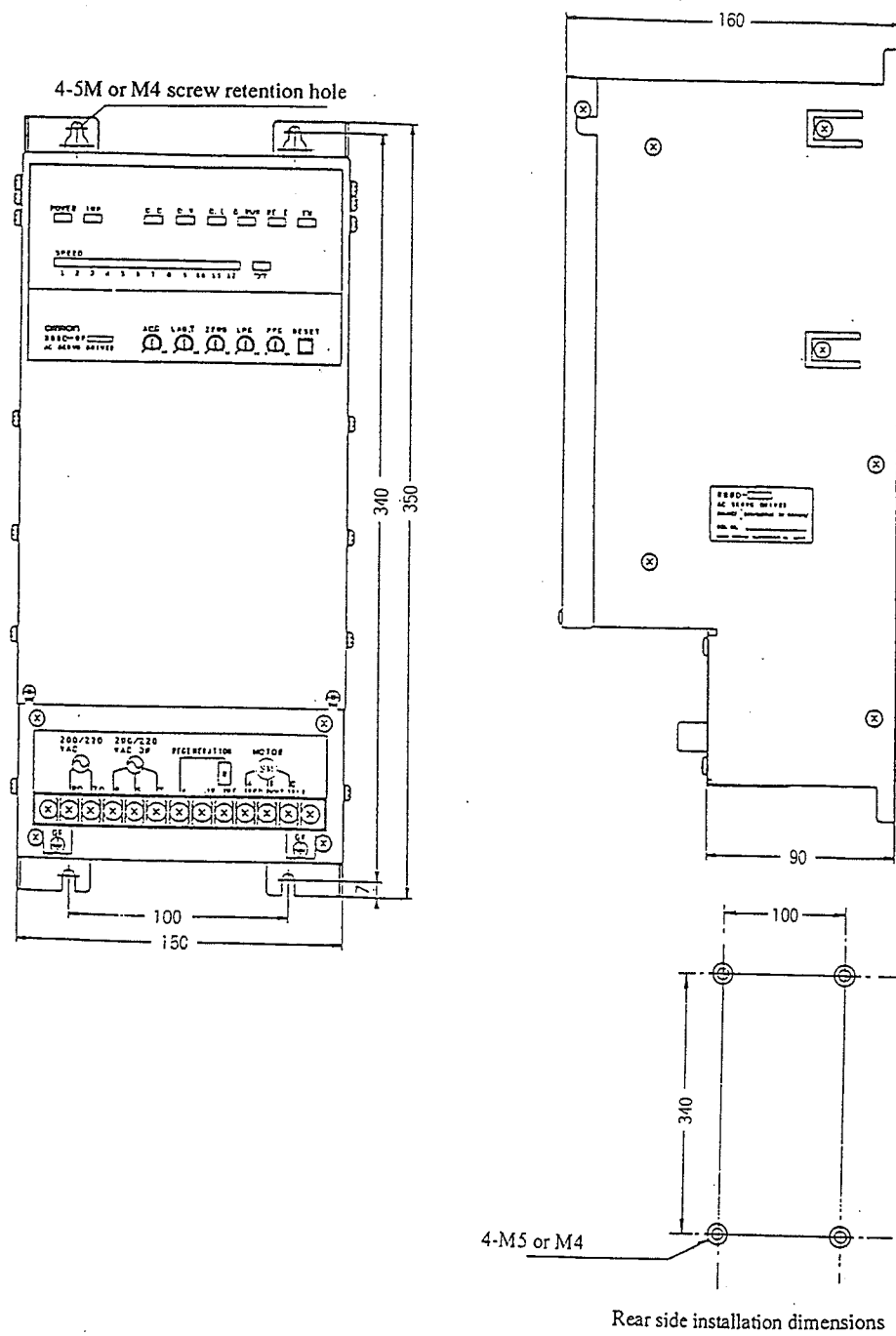- 450 : 450W
- 600 : 600W
- 820 : 820W
- 1K1 : 1100W

Means "R" series.

Means servo motor.

4.1 Installation and Mounting

4.1.1 Outside and installation dimensions of AC servo driver
□ R88D-RP
• **Outside dimensions**

4-5M or M4 screw retention hole

4-M5 or M4

Rear side installation dimensions

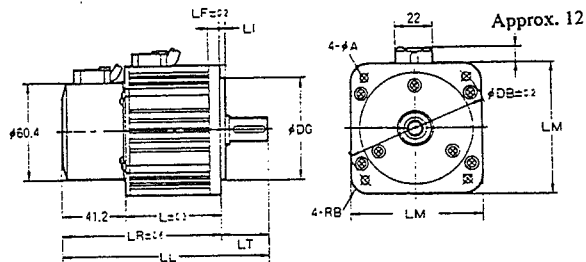# 4. DESIGN

4.1.2 Outside dimensions of AC servo motor
❑ Standard model
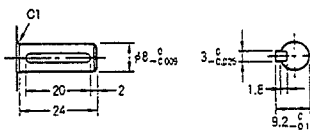• Models R88M-R10030, R88M-R20030, R88M-R30030, and R88M-R45030,
   (100W to 450W)

Type \ Dim. (mm)	LL	LR	L	LF	LI	LT	LM	DB	DG	A	B
R88M-R10030	151.7	122.7	81.5	8	$3.5^{+}_{0.3}$	$29^{+}_{0.5}$	$66^{+}_{0.4}$	80	$50^{0}_{-0.025}$	5	4
R88M-R20030	160.7	131.7	90.5	9	$3.5^{+}_{0.3}$	$29^{+}_{0.5}$	$80^{+}_{0.4}$	90	$70^{0}_{-0.03}$	6	10
R88M-R30030	182.7	153.7	112.5	9	$3.5^{+}_{0.3}$	$29^{+}_{0.5}$	$80^{+}_{0.4}$	90	$70^{0}_{-0.03}$	6	10
R88M-R45030	201.2	161.2	120.0	12	$4.0^{+}_{0.1}$	$40^{+}_{0.5}$	$120^{+}_{1.5}$	130	$110^{0}_{-0.035}$	9	15

Note: Lengths of armature wire and signal wire of standard motor are 500 mm.

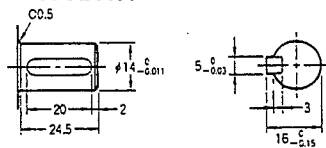   Connectors are not installed at the ends of each cable.
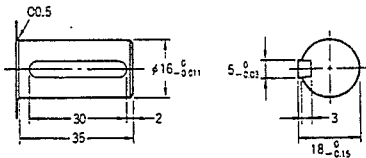

Shaft shape
R88M-R10030

R88M-R20030
R88M-R30030

R88M-R45030

• Models R88M-R60030, R88M-R82030, R88M-R1K130,
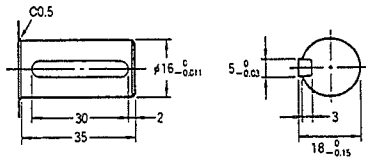   (600W to 1.1 kW)

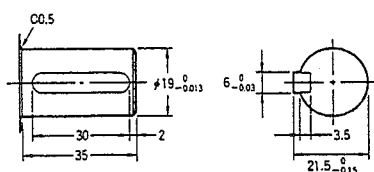| Type \ Dim. (mm)	LL	LR	L
R88M-R60030	242	202	151
R88M-R82030	277	237	186
R88M-R1K130	309	269	218
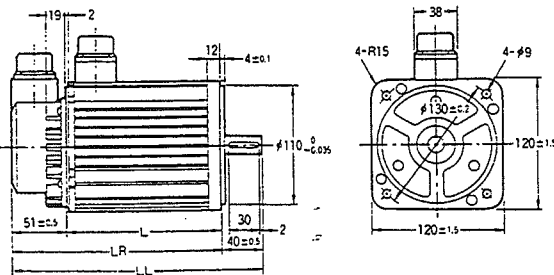
Shaft shape
R88M-R60030
R88M-R82030

R88M-R1K130

❑ Built-in brake model

• Models R88M-R10030-B, R88M-R20030-B, R88M-R30030-B, and R88M-R45030-B (100W to 450W)

Type / Dim. (mm)	LL	LR	L	LF	LI	LT	LM	DB	DG	A	B
R88M-R10030-B	187.7	158.7	117.5	8	$3.5^{+0.3}$	$29^{+0.5}$	$66^{+0.4}$	80	$50_{-0.025}^{0}$	5	4
R88M-R20030-B	192.7	163.7	122.5	9	$3.5^{+0.3}$	$29^{+0.5}$	$80^{+0.4}$	90	$70_{-0.03}^{0}$	6	10
R88M-R30030-B	219.7	190.2	149.0	9	$3.5^{+0.3}$	$29^{+0.5}$	$80^{+0.4}$	90	$70_{-0.03}^{0}$	6	10
R88M-R45030-B	227.2	187.7	146.5	12	$4.0^{+0.1}$	$40^{+0.5}$	$120^{+1.5}$	130	$110_{-0.035}^{0}$	9	15

Note) Lengths of armature wire and brake wire of built-in brake AC servo motors are 500 mm.
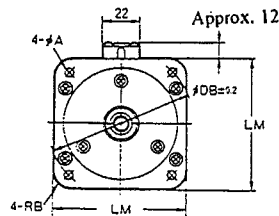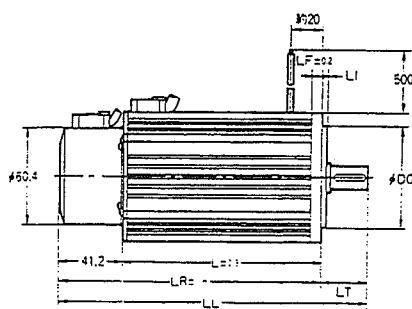
Shaft shape
R88M-R10030-B
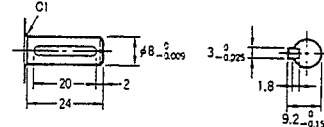
R88M-R20030-B
R88M-R30030-B
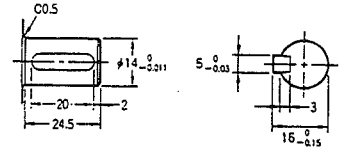
R88M-R45030-B
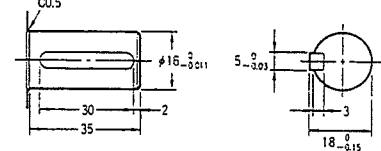
• Models R88M-R60030-B, R88M-R82030-B, R88M-R1K130-B, (600W to 1100 kW)

Type / Dim. (mm)	LL	LR	L
R88M-R60030-B	268.5	228.5	177.5
R88M-R82030-B	306.5	265.5	214.5
R88M-R1K130-B	350.5	310.5	259.5

Shaft shape
R88M-R60030-B
R88M-R82030-B
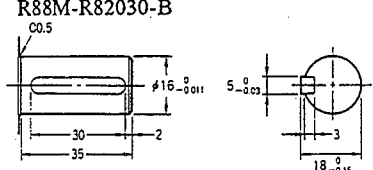
R88M-R1K130-B
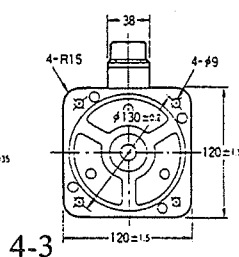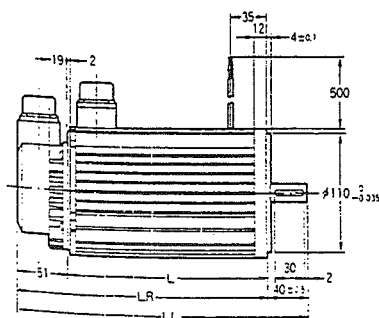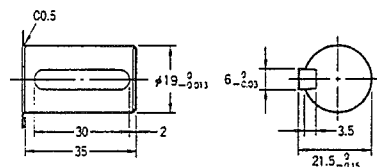
4. DESIGN

4.1.3 Installation conditions

□ AC servo driver

(1) Follow the installation diagram below while installing the unit.

Elevation

Side elevation
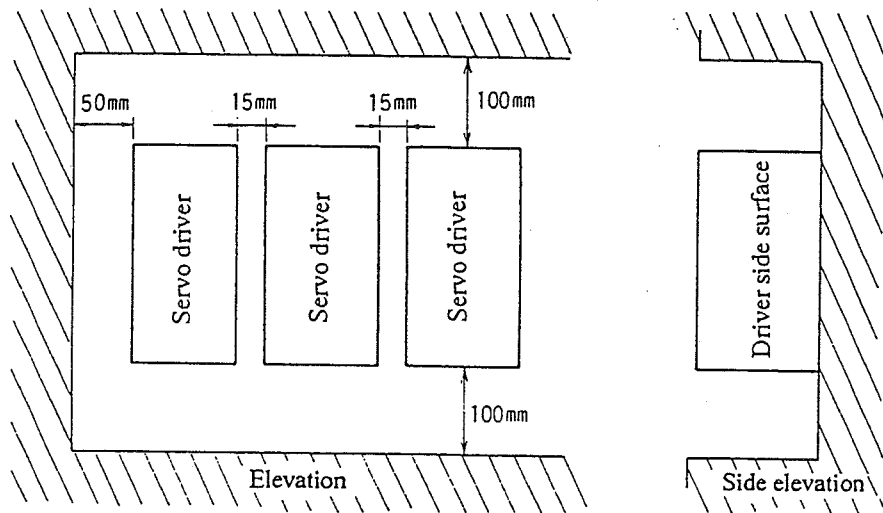
(2) Install the AC servo driver in a vertical direction.

(3) The inside temperature of the unit may increase by approx. 30°C. Therefore, keep away from other equipment and wirings which are thermally affecting.

(4) While installing the servo driver in a box, take measures such as installing forced-cooling fan or air conditioner in order not to increase environmental temperature by more than +55°C.

(5) If noise-producing equipment such as an electro-magnetic contactor, a relay, or a solenoid is placed near the AC servo driver, take measures to protect the unit from these noise.

(6) Operating environmental conditions

Operating environmental temperature : 0 to 55°C

Operating environmental humidity : 35 to 85% RH (without dew condensation)

Storage environmental temperature : -10 to +75°C

Storage environmental humidity : 35 to 85% RH (without dew condensation)

(7) Be careful to install the AC servo driver in the environment without increasing temperature.

(8) Be careful not to let metal powder, oil mist, nor water enter the unit.

(9) Be careful not to let metal powder enter the unit, while installing.

(10) When using model R88D-RP20, be careful that temperature rise of right side should not be more than 20°C by regenerative energy. Reconfirm the amount of regenerative energy.

□ AC servo motor

(1) Do not give any excessive shock to the servo motor while transportation, installation, and removing.

Also, do not hold the encoder section, cable section, and connector sections for loading and unloading the AC servo motor.

(2) When installing a coupling on the motor shaft, do not give shock to the shaft by a hammer. This shock may damage plated part of the shaft and result in problems with the encoder. To remove couplings, be sure to use a special tool, such as pulley remover.

(3) Operating environmental conditions

Operating environmental temperature : 0 to +40°C

Operating environmental humidity : 35 to 85% RH (without dew condensation)

Storage environmental temperature : -10 to +75°C

Storage environmental humidity : 35 to 85% RH (without dew condensation)

(4) Do not cover the servo motor with any materials as the motor temperature rise and a sensor inside the encoder detect "encoder error" (REE).

When this error occurs, decrease load torque and cool the servo motor using a forced cooling fan.

Be sure not to exceed the motor center part temperature by more than 45°C with the rated operation cycle (see Chapter 2: Radiation of AC servo motor).

Do not use the servo motor where much dust, corrosive gas, flammable gas are evident, or outside, in vacuum condition, place higher than 1,000 m.

(5) Conjunction with mechanism

• Be sure to use a flexible coupling to connect the motor shaft and mechanical parts such as ball screws. Plan and process mechanism to keep both shaft center precisely match in the same line. When the motor shaft is connected with high rigidity parts, slight difference of shaft center may give excessive radial load to the motor shaft and damage the motor shaft or the ball bearing.

In case of straight shaft, use "clamp type coupling" Oldam Coupling made by Myty Co., Ltd., "ETP bush" made by Miki Pulley Co., Ltd., Shupan Ring made by Shoda Shoji Co., Ltd.

• Deviation, pitch difference, gear shape differences etc. should be as small as possible to adjust backlash amount to proper level. Make a mechanism to adjust backlash amount. When bevel gear is used, it may give thrust load to the motor shaft. Check this thrust load together with backlash amount.

4. DESIGN

• When a timing belt is used, the motor shaft receives excessive radial load due to tension strength of the timing belt, temperature variation, and aging. This will cause damage to the motor shaft and the ball bearing.

Use the timing belt below the value shown in Chapter 2: Specification, "allowable load of AC servo motor output."

Install the pulley so that it makes the timing belt straight. When the difference arises, a great thrust load may occur. Prior to using the timing belt, see the instruction manual provided by the timing belt manufacturer for proper use.

In some cases, use of the timing belt makes vibration of mechanical part and damage of the shaft due to mechanical resonance point of the belt length and tension.

(6) Drip-proof

As the servo motor is not provide water-proof feature, cutting oil, especially coolant oil, may enter and cause malfunction due to insulation error and short circuit. Thus, prepare measures so as not to drop cutting oil on the servo motor body. Cables of the servo motor are another case of oil entry. Direct the lead wire downward and slacken. When intrusion of oil through the shaft is possible, fix the optional oil seal.

This motor, including its connectors, cannot be used in a location where dripping water and/or oil conditions exist, or in a misty atmosphere.

(7) Oil seal

Our servo motors are designed to connect mechanism by coupling as a whole so that oil seal is not installed. The following oil seals are available instillation. Replace interval of oil seals are approx. 5,000 hours with lubrication.

Model of servo motor	Model no. of oil seal	Mfg.
R88M-R10030	OS10173	
R88M-R20030/R30030	OS15223	IKO Tomson
R88M-R45030/R60030		
R88M-R82030	AC0760AO	NOK
R88M-R1K130	AC1013AO	

(8) OMNIC AC servo motors are synchronous type motors using permanent magnets. They do not rotate even impressed commercial 3-phase power. But it will immediate burn out motor coil.

(9) Though the motor is painted corrosive-preventing oil, put oil or grease on the shaft after installing a coupling.

4.1.4 Wiring

Noiseproof characteristics of the total system are influenced by how it is wired.
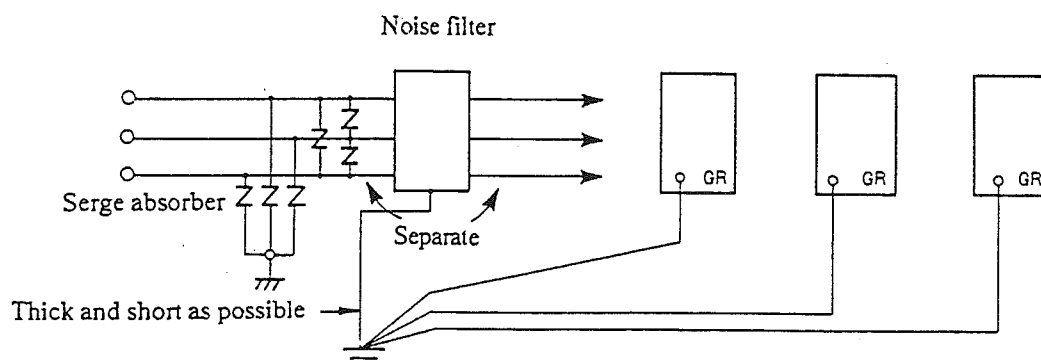
- Apply one-point earthing. Do not insert earthing line into the some ducts of filter output lines, motor power lines, and signal lines.
- In case of wiring in metal conduits and ducts, connect metal body with one point earthing as on the figure above.
- Insert surge absorber and noise filter on the AC lines.

□ Terminal block for power and motor

Terminal block	Contents	Wire diameter	
		R88D-RP05/RP10	R88D-RP15/RP20
Ro, To	Input for servo driver power	0.75 mm^2	0.75 mm^2
R, S, T	Input for input power	1.25 mm^2	1.25 mm^2
A, B, C	Output terminal for motor	0.75 mm^2	1.25 mm^2
GR	Earthing terminal	2 mm^2	2 mm^2

Note : Above values are examples using HIV thermal proof vinyl wire (75°C) at an ambient temperature of 55°C.

□ Connector terminal for control

Use MR series connectors by HONDA TSUSHIN for each connector. Plugs and cases for connectors are supplied together with the unit.

Use shielded twisted-pair cable for control line connector.

Shield wire should be connected to the designated terminal.

4. DESIGN

4.2 Details of Each Section

4.2.1 Front panel, inside the panel

Front panel

Inside the panel

Display section

Model denomination

Adjustment section

Setting section

Load inertia respo' changeover switc.

Torque limit volume

Adjustment section

Connector for motor signals

Connector for control line

Speed, current monitor pin

Optional terminal for programmable controller

Input changeover pin between 5 v and 24 v

Frame ground

Input changeover pin of optional terminal

Terminal block

4.2.2 Display, adjustment, and setting sections
□ Display section

POWER INP O.C O.V O.L O.RUN RE.E EM
▢ ▢ ▢ ▢ ▢ ▢ ▢ ▢

SPEED
▭▭▭▭▭▭▭▭ ▯
1 2 3 4 5 6 7 8 9 10 11 12 −/+
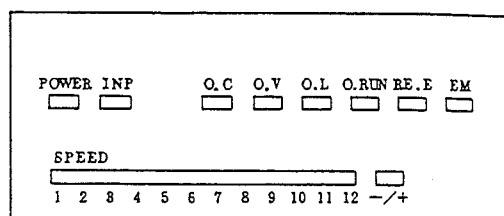
Indication	Function	Lighting conditions
POWER	Indicate that control power is supplied.	Control power is (200VAC) is input.
INP	Indicate completion of positioning.	By positioning command, the motor is within position completion range. This LED lights, in case of RUN command (CN1) is input.
O.C	Indicate overcurrent.	Motor current value exceeds current limit value.
O.V	Indicate overvoltage.	Abnormal increase of main circuit DC voltage.
O.L	Indicate overload.	Load to motor is too heavy.
O.RUN	Indicate error counter over. Indicate overspeed.	The error counter exceeds setting value. Motor speed exceeds the limit value. Abnormal condition of encoder, or disconnection of encoder lines.
RE.E	Indicate encoder error.	Abnormal condition of encoder, or disconnection of encoder lines.
EM	Indicate emergency stop signal is input.	Emergency stop input signal (EM) switched to OFF (open).
SPEED	Indicate value of error counter.	2^{11}(2048 pulse) through 2^0 (1 pulse)
−/+	Indicate sign of error counter.	Light at "-," light OFF at "+."

4. DESIGN

☐ Adjustment section
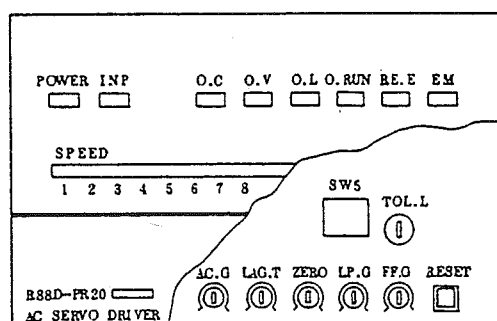
Indication	Volume SW	Function	Set value at factory
AC.G	AC gain	Volume to adjust response characteristics. Adjust in compliance with load inertia.	"0"
LAG.T	Acceleration. correction	Volume to adjust over-shoot and undershoot at start/stop.	"0"
ZERO	Zero balance	Volume to turn the error counter to 0 at balance stoppage of position command pulse.	Already fixed
LP.G	Loop gain	Volume to adjust position loop gain in accordance with mechanical system	Note 2
FF.G	FF gain	Volume to improve acceleration/deceleration characteristics	"5"
RESET	Reset	Button to release from alarm condition.	---
TOL.L	Torque limit	Volume to adjust current limit value using torque limit input.	"5" Approx. 150 % of rated torque

Note 1: For adjustment details, see item 5.3 "Adjustment."

Note 2: AC.G, LAG.T, LP.G, and FF.G are adjusted so as not to vibrate at no load adjustment.

Note 3: Readjustments are required to get optimum value together with AC gain changeover (SW5-1,2).

☐ Setting section

Switch No	Function	Preset value at factory
SW1	• Position command multiplication setting switch. Multiple position command pulse (CN1) is fixed value in this switch | Fixed value	Multiplied value	Fixed value	Multiplied value | |---|---|---|---| | 0 | 1 | 8 | 9 | | 1 | 2 | 9 | 10 | | 2 | 3 | A | 11 | | 3 | 4 | B | 12 | | 4 | 5 | C | 13 | | 5 | 6 | D | 14 | | 6 | 7 | E | 15 | | 7 | 8 | F | 16 | This function determines the number of feed back pulse from the encoder per command pulse. For example: a ball screw of 8 mm lead, and multiplied by 4 for encoder pulse. Then, 1 pulse = 2 μm. In this case, turn this switch to "4" (multiplied by 5) and feed units turns to 10 μm per pulse. Note: Command frequency is a value which is divided by setting value. In above example, 200 k / 5 = 40 kpps.	"0" (Multiplied by 1)

Switch No		Function	Preset value at factory
SW2	No.1	This switch selects one of two functions as follows: "OFF"...Command pulse input is accepted as forward(CCW) command pulse / reverse (CW) command pulse "ON"... Command pulse input is accepted as reverse change over signal / feed command pulse."H" as forward, "L" as reverse.	"OFF"
	No.2 No.3	• Multiplication value setting of encoder feedback pulse. This switch sets multiplication value of position feed back pulse from the encoder. | No.2	No.3	Multiplication value | |---|---|---| | ON | OFF | × 1 | | OFF | ON | × 2 | | ON | ON | × 4 | Note: Never turn both No.2, No.3 OFF as it will prohibit input of command pulse.	No.2 "ON" No.3 "ON" (Multiplied by 4)
	No.4 No.5	Changeover of bit number in the error counter. This switch changes number of bit of the error counter. | No.4	No.5	No. of bit at deflection | |---|---|---| | OFF | OFF | 12 bit (4,096) | | ON | OFF | 11 bit (2,048) | | OFF | ON | 10 bit (1,024) | | ON | ON | 9 bit (512) | Set in accordance with command pulse frequency. In general, refer to the formula below: $$\text{Position loop gain Kp} = \frac{\text{Command pulse frequency}}{\text{Value of error counter}}$$ In case of normal load : Kp<30 In case of lighten load and high response : Kp<50 Ex.: Command pulse frequency : 50 kpps When stored amount of the error counter bit number is 11 bit $$KP = \frac{50000}{2048} \doteqdot 24$$ This equality is conditioned. Then, fix to 11 bit.	No.4 "OFF" No.5 "OFF" (12 bit)

Switch No		Function	Preset value at factory
SW3		• Position completion range setting switch. The unit outputs completion signal when the error counter is less that this fixed value.	"1" ($\pm$ 3)

Fixed value	Completion value (pulse)	Fixed value	Completion value (pulse)
0	$\pm$ 1	8	$\pm$ 17
1	$\pm$ 3	9	$\pm$ 19
2	$\pm$ 5	A	$\pm$ 21
3	$\pm$ 7	B	$\pm$ 23
4	$\pm$ 9	C	$\pm$ 25
5	$\pm$ 11	D	$\pm$ 27
6	$\pm$ 13	E	$\pm$ 29
7	$\pm$ 15	F	$\pm$ 31

Too small completion range takes much time to output completion signal. Fix the range in accordance with feed speed of the system, load condition, or mechanical precision. Too small completion range may not give completion signal.

Switch No		Function	Preset value at factory
SW4	No.1 | No.4	• Feed forward pulse range changeover. This is a pulse range changeover switch of the F/V converter for feed forward control. Set by command pulse frequency.	No.1 - No.4 "OFF"

Frequency of command pulse	No.1	No.2	No.3	No.4
0 to 270k	ON	ON	ON	ON
0 to 150k	ON	ON	ON	OFF
0 to 75k	ON	ON	OFF	OFF
0 to 38k	ON	OFF	OFF	OFF
0 to 20k	OFF	OFF	OFF	OFF

Switch No		Function	Preset value at factory
	No.5	• Feed forward changeover Put "ON" to execute high-speed positioning using feed forward control.	"OFF"

Switch No		Function	Preset value at factory
SW5	No.1 No.2	• AC gain changeover This is a changeover switch to adjust response characteristics. Adjust it as per the table below in compliance with load inertia. | Load inertia	No.1	No.2 | |---|---|---| | 0 to 3 times of motor inertia | OFF | OFF | | 2 to 5 times of motor inertia | ON | OFF | | 4 to 7 times of motor inertia | OFF | ON | | 6 to 10 times of motor inertia | ON | ON | For fine adjustment, use AC gain volume to get the optimum level.	No.1 "OFF" No.2 "OFF"
	No.3	• Proportional control changeover This is a changeover switch to adjust response characteristics. If bit 3 is set to ON, P control is activated instead of PI control, weakening the servo lock P control gain can be controlled with the Torque Limit control.	No.3 OFF

☐ Terminal blocks for power source and motor

Sign	Name	Contents
Ro To	Control power input	Power input terminal for control circuit. Supply commercial source between 170 and 264 VAC.
R S T	Main power input	Input terminal for motor power. Supply power between 170 and 253 VAC, 3-phase.
+	Positive line of main circuit	A terminal for the inverter main circuit. Note 2
JP	Built-in regenerative resistance	A terminal for inside regenerative resistance. Note 1
RE	Regenerative control terminal	A terminal for controlling outside and inside regenerative resistance. Note 1, Note 2
A B C	Output for the motor	Three-phase output terminal to AC servo motor. If three phases are misconnected, the motor cannot rotate. A-red, B-white, C-black

Note 1: • This function does not come with R88D-RP05 and R88D-RP10.
　　　　 • "JP" and "RE" is shorted for R88D-RP15 and R88D-RP20.

Note 2: • When installing outside resistance on R88D-RP15 and R88D-RP20, insert this resistance between "+" and "RE".

Note 3: • Connect "GR" to ground with class 3 or up.

4. DESIGN

4.2.3 Connectors and terminals

☐ **Connector terminal for control**

• Connector terminal for control circuit (CN1)

Connector CN1 has terminals for motor control signals and encoder signals.
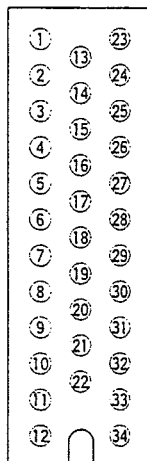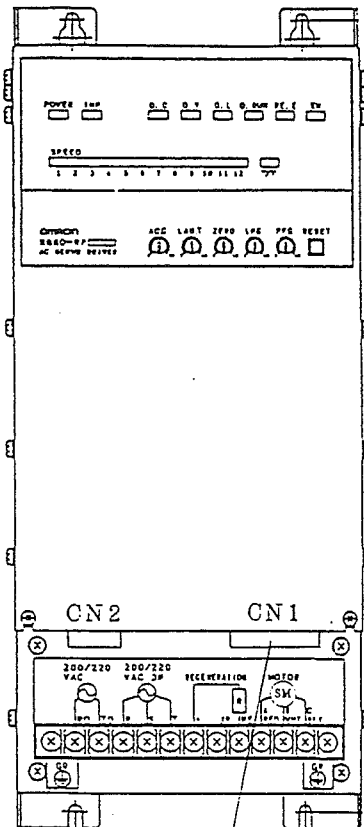
No	Signal	Function
1	+CW	Reverse command pulse input or
2	- CW	feed command pulse input
3	+CCW/+P/M	Forward command pulse input
4	-CCW/-P/M	or forward/reverse changeover signal input.
5	AG	Analog ground
6	AG	
7	+INP	Positioning completion + output
8	-INP	Positioning completion - output
9	SG	Shield ground
10	SG	
11	ALM1	Alarm output
12	ALM2	
13	+5V	+ 5VDC power input
14	+5V	
15	CLIM	Torque limit input
16	MING	Gain minimizing input
17	-	Not used
18	NM	Speed monitor output
19	AM	Current monitor output
20	+A	Encoder A phase + output
21	-B	Encoder B phase - output
22	+Z	Encoder Z phase + output
23	RUN	Operation ready command input
24	EM	Emergency stop input
25	RESET	Alarm reset input
26	IPG	Command pulse prohibition input
27	HRET	Zero positioning command input
28	ECRST	Error counter reset input
29	-	Note 1
30	-	Note 2
31	-A	Encoder A phase - output
32	+B	Encoder B phase + output
33	-Z	Encoder Z phase - output
34	EGND	Encoder signal GND

Note 1: Do not connect any line to Pin No.29 and 30

MR-34M for cable side and
MR-34L as cover
made by HONDA TSUSHIN
KOGYO CO., LTD.

4-16

☐ Connector for motor signal

• Connector for motor signal (CN2)

Connector CN2 has terminals to input encoder and pole sensor signals.
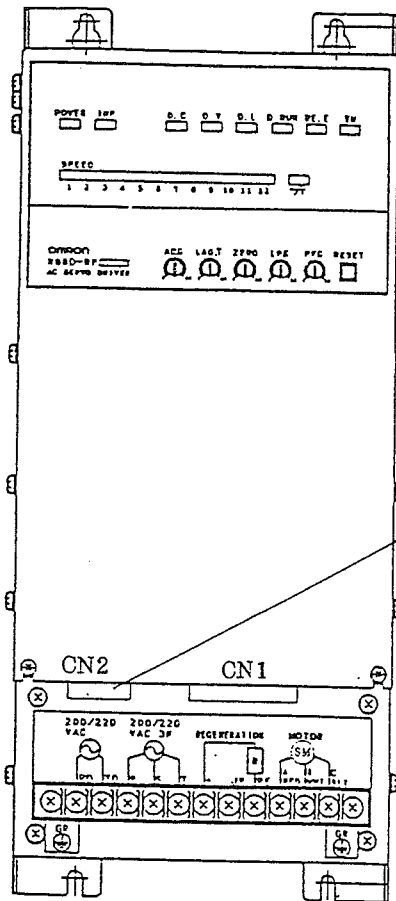
Connector for driver			Cable for motor		
No	Sign	Function	No.	Wire dia.	Wire color
1	+5V	Encoder supply	H	AWG22	Red
2	+5V	power +5VDC			
3	0V	GND terminal of	G	AWG22	Black
4	0V	encoder power			
5	RG	Encoder return ground	A	AWG22	Gray
6	SG	Shield ground		Shield	
7	-	Note 1			
8	-	Note 1			
9	-	Not used			
10	-	Not used			
11	A+	Encoder A phase +	D	AWG24	Blue
12	A-	Encoder A phase -	N	AWG24	Orange
13	B+	Encoder B phase +	M	AWG24	Pink
14	B-	Encoder B phase -	B	AWG24	Light blue
15	S+	Encoder S phase +	L	AWG24	Yellow
16	S-	Encoder S phase -	C	AWG24	Brown

Note 1: Do not connect any line to pin No.7 and 8.
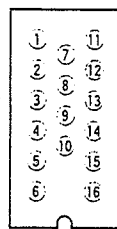
MR-16M for cable side and
MR-16L as cover
made by HONDA TSUSHIN
KOGYO CO., LTD.
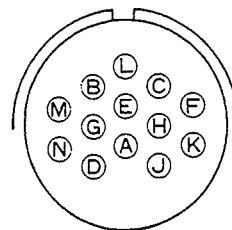
MS3106A20-11S for cable side and
MS3057A-12A as clamp, made by
AMPHENOL

4. DESIGN

4.2.4 Connector of motor
☐ **Connector for 600 - 1,100W motors**

Connector for motor signal	Connector for armature
Made by AMPHENOL	Made by AMPHENOL
MS3106A20-11S	MS3106A20-4S
(Cable side)	(Cable side)
MS3057A-12A	MS3057A-12A
(Cable cramp)	(Cable cramp)
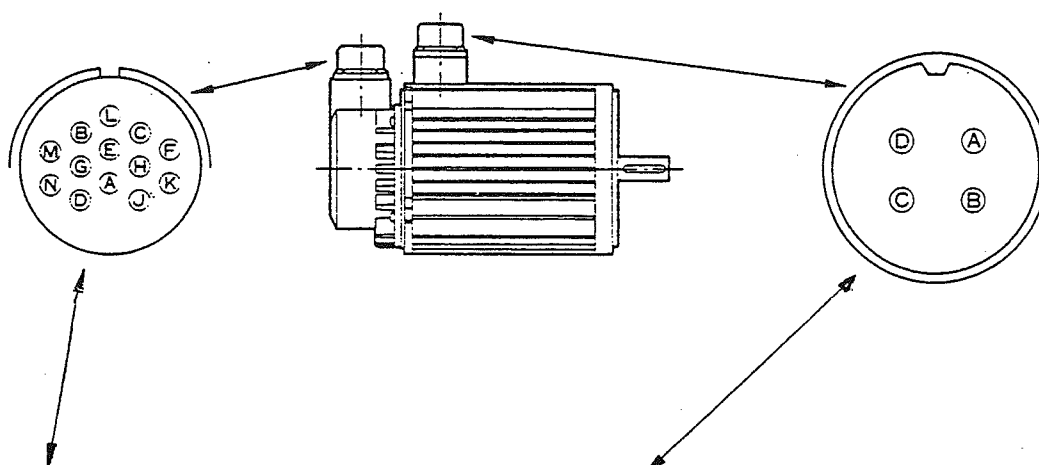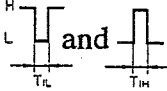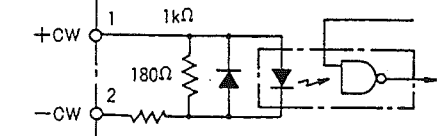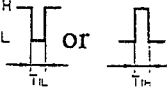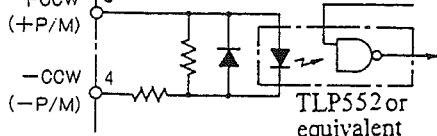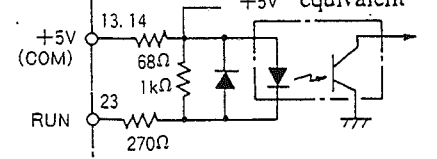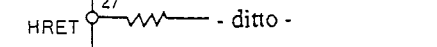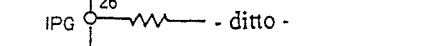
Connec-tor No.	Sign	Function	Cable Wire dia.	Cable Wire color
A	RG	Encoder return ground	AWG22	Gray
B	B-	Encoder B phase -	AWG24	Light blue
C	S-	Encoder S phase -	AWG24	Brown
D	A+	Encoder A phase +	AWG24	Blue
E				
F				
G	0V	Terminal GND of encoder power.	AWG22	Black
H	+5V	Encoder supply power +5VDC	AWG22	Red
J				
K				
L	S+	Encoder S phase +	AWG24	Yellow
M	B+	Encoder B phase +	AWG24	Pink
N	A-	Encoder A phase -	AWG24	Orange

Connec-tor No.	Sign	Function	Cable Wire dia.	Cable Wire color
A	A	Armature A phase input	AWG16 or up	Red
B	B	Armature B phase input	AWG16 or up	White
C	C	Armature C phase input	AWG16 or up	Black
D	D	Motor frame ground	AWG16 or up	Green

4.3 Connection with Support Devices and External Devices

4.3.1 Input/output interface

Note 1: The figure below is for reference. Follow designated time chart of upper master controller. (See section 6-3.)

Note 2: Wait 2 seconds or more after control power and main power being ON, to input RUN operation ready command input.(RUN)

Note 3: Signs in ( ) mean connector signs on R88M-R60030, R82030 and R1K130.

Note 4: Use insulation soldering iron or soldering.

Note 5: Use thermal proof vinyl covered wire (HIV, 75°C or up) for DC power and motor power lines.

Note 6: After switching power OFF, residual voltage remains in a terminal block. Do not touch terminals within 1 minute after power OFF.

"NF" means noise filter
"MC.X" means relay

4. DESIGN

□ Control input interface

Name of signal	Function	Specification	Interface
Reverse command pulse or feed command pulse (+CW) (-CW)	By changeover of CW command pulse inside, this signal turns to feed command pulse.	Input pulse width T_{IL}, $T_{IH} \geqq$ 1.4 μ sec. 19 mA at input voltage 5 V. 7 mA at input voltage 3 V.	
Forward command pulse or forward/ reverse change-over (+CCW/ +P/M) (-CCW/ -P/M)	By changeover of CCW command pulse inside, this signal turns to forward/ reverse changeover signal. Reverse at L (input-signal)	Input pulse width T_{IL}, $T_{IH} \geqq$ 1.4 μ sec. 19 mA at input voltage 5 V. 7 mA at input voltage 3 V.	
Operation ready command (RUN)	ON: This signal turns the unit to operative condition with supplying current to servo motor. OFF: The error counter is cleared and the motor shaft is set free.	10 mA at input signal 5 V.	
Zero posi-tioning command (HRET)	Motor speed is decelerated at the limit switch in front of zero position, and HRET signnal turns ON by turning this L/S signal. Next coming Z phase makes the error counter clear and prohibit input command pulse to the unit simultaneously.	- ditto -	
Pulse Prohibi-tion (IPG)	ON: This signal prohibits input of command pulse.	- ditto -	

Name of signal	Function	Specification	Interface
Error counter reset input (ECRST)	ON: This signal resets the error counter and prohibits input of command pulse.	10 mA at input signal 5 V.	ECRST ○—28—∧∧∧—— - ditto -
Minimizing gain (MING)	ON: This signal is used for minimizing the vibration of servo motor. However, this signal decreases servo lock power	- ditto -	MING ○—16—∧∧∧—— - ditto -
Torque limit (CLIM)	ON: This signal limits supply current to motor to preset value by "TOL.L" volume.	- ditto -	CLIM ○—15—∧∧∧—— - ditto -
Alarm reset (RESET)	This is used to release abnormal condition. Inside reset switch has the same function.	- ditto -	RESET ○—25—∧∧∧—— - ditto -
Emergency stop (EM)	This signal stops the unit at emergency. Make a circuit to close at normal condition.	- ditto -	EM ○—24—∧∧∧—— - ditto -

4. DESIGN

□ Control output interface

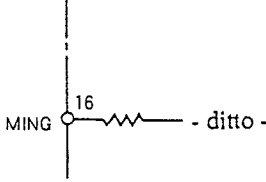| Name of signal	Function	Specification	Interface
Speed monitor output (NM)	This is an output to monitor the speed of servo motor. Voltage output of F/V is supplied on this terminal. The voltage allowance is about ± 10 %.	CCW +7.5 V CW − 7.5 V at 3,000 rpm	CN1 FV, 1kΩ, 18, NM
Current monitor terminal (AM)	An output to monitor supplied current to servo motor. This is output as voltage converting from supply current of servo motor armature line.	±12 V at the instant max.	CN1 Command current, 1kΩ, 19, AM
Encoder feedback output (A, B, Z)	Line driver output after receiving encoder signal from servo motor. For TTL level use, connect EGND and one of lines accordance with polarity.	EIA-RS-422 or equivalent	CN1 20 +A, A, 31 −A, 21 −B, B, 32 ÷B, 22 ÷Z, Z, 33 −Z, 34 EGND
Positioning completion output (INP)	This signal comes when the error counter is within the designated positioning range.	24 VDC 10 mA	CN1 7 +INP, 8 −INP
Alarm output (ALM1) (ALM2)	The contact opens when emergency stop (EM) is input or inside abnormal occurs. For resetting, input alarm reset (RESET) signal or press reset button (RESET). This contact also opens while reset signal is input.	Rated contact load: 24 VDC 0.5 A	CN1 NO 11 ALM1, 12 ALM2

4.3.2 Dynamic brake circuit

Dynamic brake circuit can be provided using optional sequence terminal T1.

The figure below shows connection diagram of the dynamic brake. Be sure to take off short pin SP1 on the control circuit board prior to using the dynamic brake.
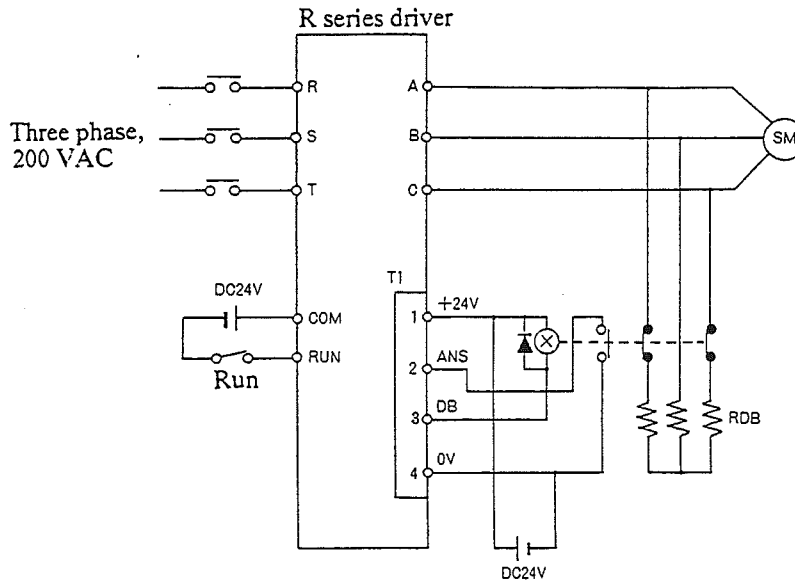
(1) Dynamic brake resistance

Motor model	Armature resistance (Ω)	Brake resistance RDB(Ω) should be greater than below	Counterelectromotive force voltage at 3,000 rpm
R88M-R10030	4.2	0	62.5 Vo-p
R88M-R20030	6.24	0	125 V
R88M-R30030	2.90	0	116 V
R88M-R45030	1.28	6.8 Ω - 20 W	102 V
R88M-R60030	1.95	6.8 Ω - 20 W	157.5 V
R88M-R82030	1.25	5.6 Ω - 20 W	164.5 V
R88M-R1K130	0.75	5.6 Ω - 20 W	167 V

(2) Relay

LY3(OMRON),24 VDC or LY3-D, 24 VDC, or equivalent (Actuating current 60 mA or less, inside resistance 400 Ω or up, rating 24 VDC)

(3) Diode

S5688G (TOSHIBA) or equivalent (400 V withstand voltage)

(4) Dynamic brake unit

A dynamic brake unit, integrated above circuit, is available.

(Model R88A-DB20 for 450 W or up)

4. DESIGN

4.3.3 Voltage changeover of control input interface

Control input voltage is switchable between 5V and 24V using optional sequence terminal.

Inside the driver
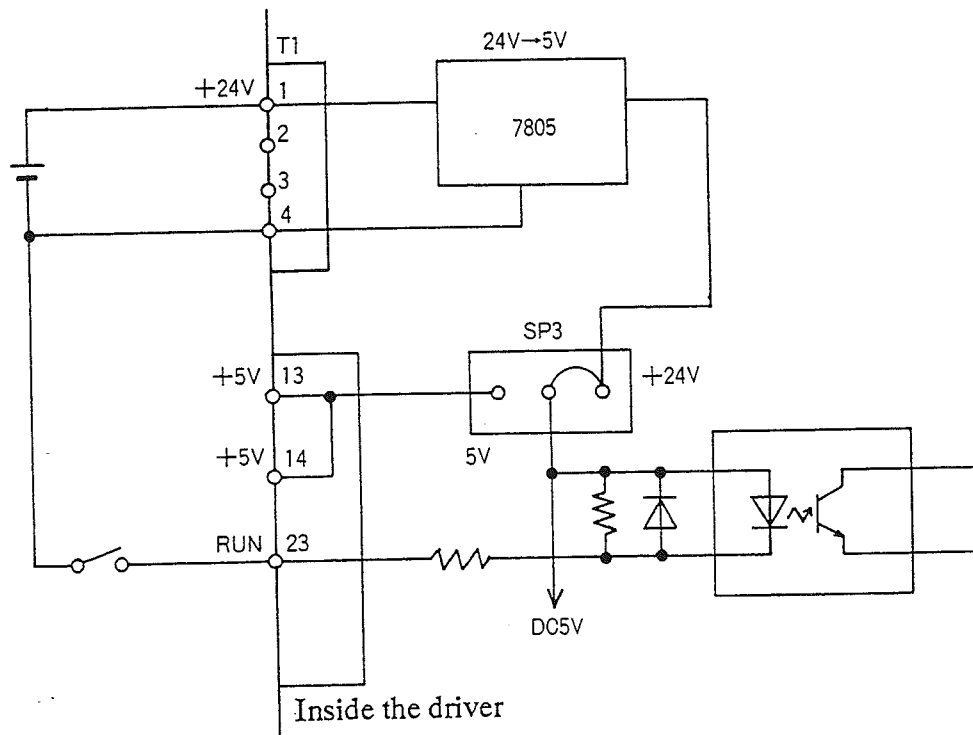
Inner block of the driver is as shown above. In order to change control voltage to 24 V, input +24 V to No.1 terminal, and OV to No.4 terminal on terminal block (T1) of the control circuit board, together with short circuit SP3 jumper to +24 V. There is no need to connect +5 V with pin 13 and 14 of CN1.

Changing CW, and CCW pulse input is not possible. Install outside of the driver 1.2 KΩ, 0.5 W resistance for 24 V input, and 470 Ω, 0.5 W resistance for 12 V input respectively.

4.3.4 Selection example of outer connecting parts

(1) No fuse breaker (NFB)

Use a breaker having applicable current value for your system. Never use one for semiconductor and one having characteristics for immediate response.

Use one with delay characteristics 62 (2.2 to 20 s. at 200% load).

(2) Noise filter (NF)

Phase	Model	Rated	Mfg.
Single phase	GT-205U	5A	TOKIN
	GT-210U	10A	
	ZAC2206-11	6A	TDK
	ZAC2210-11	10A	
	SUP-E3H-EP	3A	OKAYA ELECTRIC IND
	SUP-E5H-EP	5A	
Three phase	LF-315K	15A	TOKIN
	LF-325K	25A	
	LF-305	5A	
	LF-310	10A	
	LF-315	15A	
	LF-320	20A	
	ZCW2205-01	5A	TDK
	ZCW2210-01	10A	
	ZCW2220-01	15A	
	3SUP-A5J-E	5A	OKAYA ELECTRIC IND
	3SUP-A10J-E	10A	
	3SUP-A15J-E	20A	

(3) Magnet relay (MC)

Model	Current	Mfg.
MA415A	15A	
LC1-D173A60	18A	OMRON
LC1-D253A60	26A	

4. DESIGN

(4) Surge absorber (ZNR)

Model	Varistor voltage	Max. voltage	Max. surge	Max. energy	Fuse rating	Type	Mfg.
ERZC10DK471(W)	470V	775V	1.25kA	45J	3~5A	Disc	Matsushita Electric Industrial Co.,Ltd.
ERZC14DK471(W)	470V	775V	2.5kA	80J	3~10A	Disc	
ERZC20DK471(W)	470V	775V	4kA	150J	5~15A		
ERZC20EK471(W)	470V	775V	5kA	150J	——	Block	
ERZC25EK471(Y)	470V	775V	10kA	225J	——	Block	
ERZC32EK471(Y)	470V	775V	20kA	405J	——		
Z10L471	470V	773V	1kA	15W·s	3~5A	Disc	Ishizuka Electronics Co.,Ltd.
Z15L471	470V	738V	1.25kA	20W·s	3~5A	Disc	
Z21L471	470V	733V	3kA	30W·s	5~10A		
Z25M471S	470V	810V	10kA	235J	——	Block	
Z33M471S	470V	810V	20kA	385J	——	Block	

(5) Surge killer

Model	Current	Mfg.
CR-50500	50 Ω - 0.5 μF	OKAYA ELECTRIC IND
S2-A-0	200 Ω - 0.1 μF	
CRE-50500	50 Ω - 0.5 μF	

4.3.5 Calculation of regenerative energy

(1) In case of horizontal axis
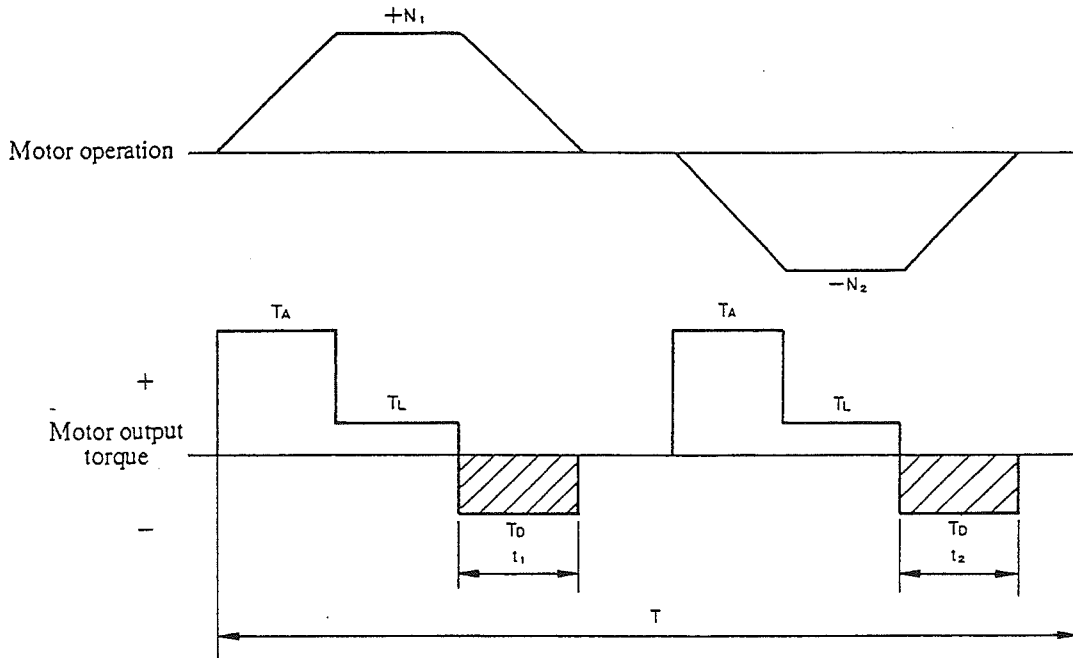
As shown above, regenerative energy occurs when motor output torque becomes negative. Regenerative energy in each section is given in the formula below:

$$Eg_1 \fallingdotseq \frac{1}{2} \times N_1 \times T_D \times t_1 \times 1.027 \times 10^{-2} \ [J]$$

$$Eg_2 \fallingdotseq \frac{1}{2} \times N_2 \times T_D \times t_2 \times 1.027 \times 10^{-2} \ [J]$$

    N   : Number of motor revolutions at triggering deceleration (rpm)

    T_D : Required deceleration torque (kgf•cm)

    t_1, t_2 : Deceleration interval (s)

Average regenerative power is given in the formula below:

$$Eg = \frac{(Eg_1 + Eg_2)}{T} \ (W) \qquad \text{T: operation cycle (s)}$$

Generally, there is energy loss by motor coiling resistance and actual value is approx. 90% of above figure.

4. DESIGN

(2) In case of vertical axis
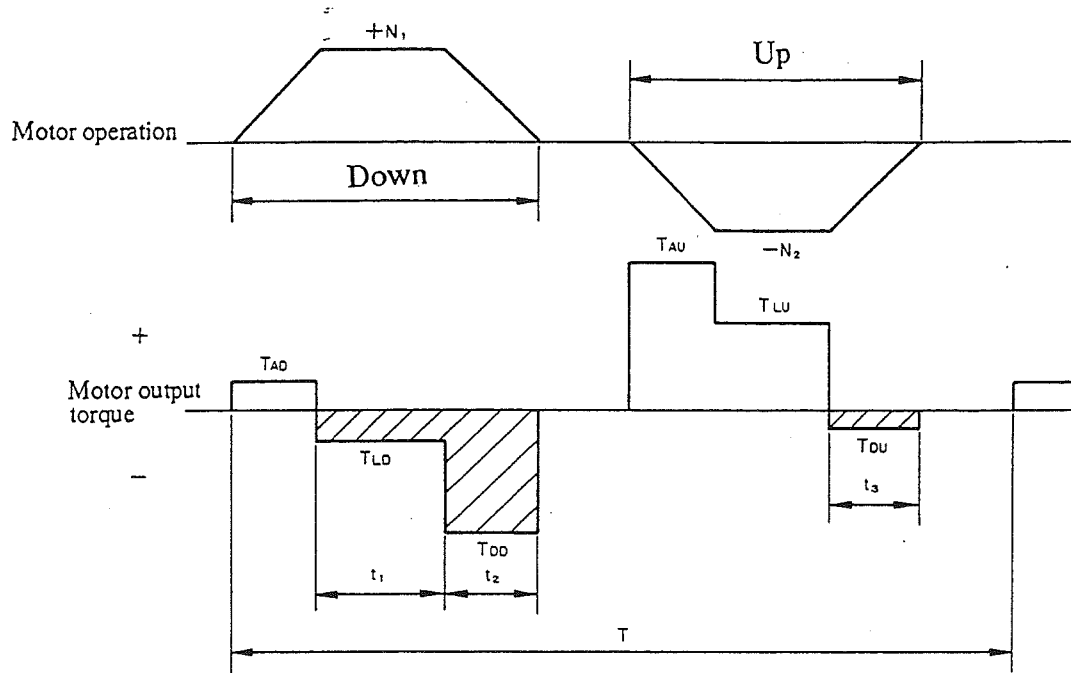
In the above movement, regenerative energy occurs while motor output torque becomes negative. Regenerative energies in each section is given by the formula below:

$$Eg_1 \fallingdotseq N_1 \times T_{LD} \times t_1 \times 1.027 \times 10^{-2} \ [J]$$

$$Eg_2 \fallingdotseq \frac{1}{2} \times N_1 \times T_{DD} \times t_2 \times 1.027 \times 10^{-2} \ [J]$$

$$Eg_3 \fallingdotseq \frac{1}{2} \times N_2 \times T_{DU} \times t_3 \times 1.027 \times 10^{-2} \ [J]$$

N   : Number of motor revolutions at triggering deceleration (rpm)

T_D : Required deceleration torque (kgf·cm)

t_2, t_3 : Deceleration interval (s)

Average regenerative power is given in the formula below:

$$Eg = \frac{(Eg_1 + Eg_2 + Eg_3)}{T} \ (W) \qquad T: \text{operation cycle (s)}$$

Generally, there is energy loss by motor coiling resistance and actual value is approx. 90% of above figure.

4.3.6 Absorption of regenerative energy

The regenerative energy circuit is installed only in R88D-RP15 and R88D-RP20. R88D-RP05 and R88D-RP10 are installed condensers for absorbing energy.

When regenerative energy exceeds the limited values below, install an outer regenerative resistance. For R88D-RP05 and R88D-RP10, use driver model 1 or 2 class up, lower operation speed, or set longer deceleration time to reduce regenerative energy.

Model	Allowable regenerative energy (J) at one regenerative operation	Average regenerative power (W)
R88D-RP05	45J	-
R88D-RP10	45J	-
R88D-RP15	200J	25W
R88D-RP20	200J	25W

Note 1: 1W = 1 J/S   1 cal = 4.2J

Note 2: Thermal produced by regenerative energy increases on right side of the driver. Design not to exceed 20°C at surface temperature of the driver.

For absorption of regenerative energy other than above method, prepare resistance parts at the outside of the driver. For fixing the outer regenerative resistance, take out contact metal from between JP and RE and connect the resistance in chain of "+" and "RE" referring to the figure below:
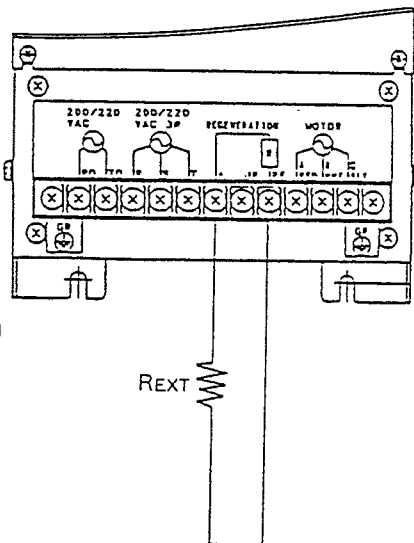
Use 47 Ω coiling resistance for R_{ext} and twist cables. The following resistance are available. Select and order in accordance with regenerative capacity while checking delivery terms.

Model	Mfg.	Nominal capacity	Power at 120°C	Radiation condition
CF220N47ΩK	CHIBA OHM CO., LTD.	220W	60W	T1.0 SPCC 350 X 350
CAS200N47ΩK	CHIBA OHM CO., LTD.	200W	75W	T1.0 SPCC 350 X 350
CAS300N47ΩK	CHIBA OHM CO., LTD.	300W	90W	T1.0 SPCC 350 X 350
CAS400N47ΩK	CHIBA OHM CO., LTD.	400W	120W	T1.0 SPCC 350 X 350
MRS22N470K	MICRON INSTRUMENTS INC.	220W	60W	T1.0 SPCC 350 X 350
MLS20L470K	MICRON INSTRUMENTS INC.	200W	80W	T1.0 SPCC 350 X 350
MLC30L470K	MICRON INSTRUMENTS INC.	300W	110W	T1.0 SPCC 350 X 350
SMR220W47Ω	JAPAN REGISTOR MFG. CO., LTD.	220W	60W	T1.0 SPCC 350 X 350

In order to prevent smoke and fire due to thermal produced by resistance, we recommend to use thermal switch or temperature fuse installed types. Installation of a thermal switch near by the resistance has same function.

Set actuating temperature considering surrounding condition.

5.1 Unpacking

☐ **AC servo driver**

• Check the following items soon after opening the package.

Whether the delivered goods are different from the ordered ones.

Check whether the combination of servo motors and servo drivers are correct by referring to Item 1, 1-1.

Check for possible transportation damage, and check that screws have not been loosened.

Accessories

CN1	connector plug	MR-34M	1 pc.
CN1	connector case	MR-34L	1 pc.
CN2	connector plug	MR-16M	1 pc.
CN2	connector case	MR-16L	1 pc.
Fixing metal			2 pcs.
Fixing screw		M4x6	4 pcs.
Instruction Manual			1 set

☐ **AC servo motor**

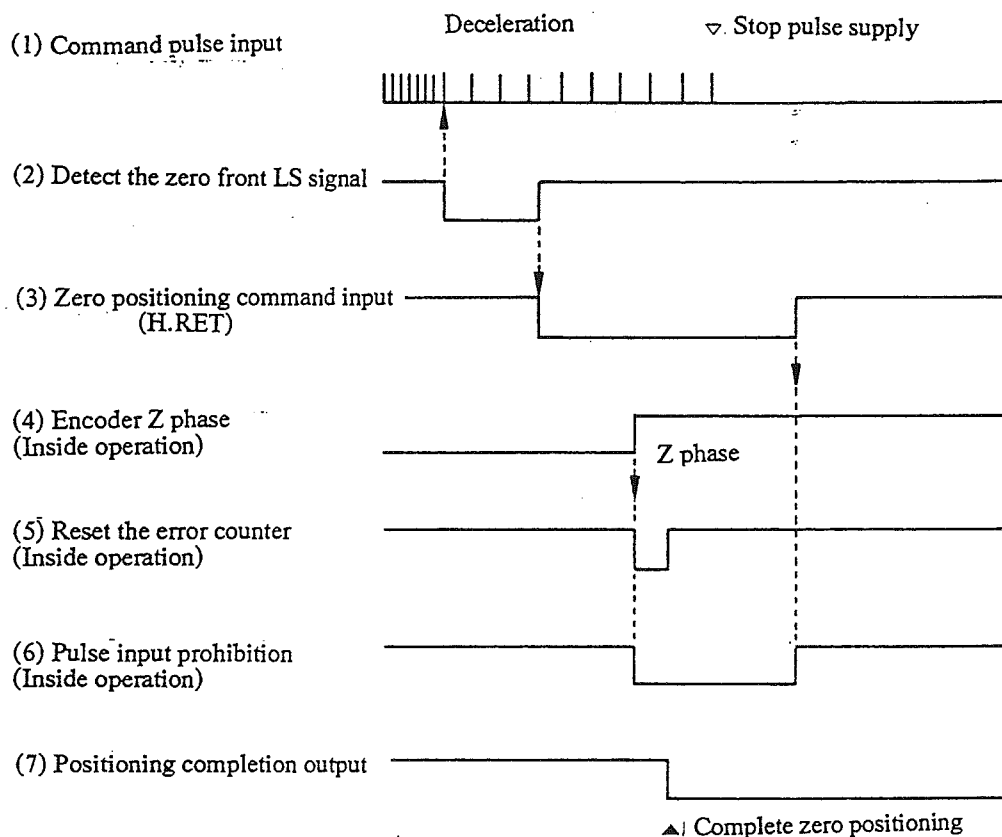|	
Installation Manual	1 set

5.2 Trial Operation

☐ **Check items before operation.**

Confirm the following before start operations

1	Supplied power should be within the specifications.
2	Has a circuit to turn OFF power for main circuit automatically when AC servo driver supplies servo abnormal alarm signals.
3	Remove the motor from machine at trial operation. When it runs at installed condition, be ready to stop the motor anytime. Confirm that there is no person near by the machine.

(1) Check that operation ready signal (RUN) and command pulse are not be input.

Otherwise, the motor rotates soon after power is supplied.

(2) Put ON control power.

(3) Confirm the power indication LED (POWER) is ON. When the LED does not light, check the voltage (170 to 264 VAC) on control power input terminal (Ro.To).

(4) Confirmation of abnormal circuits

Confirm that the system has a circuit to switch OFF main power automatically when abnormal signals are supplied.

(5) Supply main circuit power.

(6) Input RUN (ready for operation) signal two sec. after turn ON main circuit power.

With inputting RUN signal, the motor has holding torque.

Be careful that if command pulse is supplied, motor rotates soon after inputting RUN signal.

Adjust zero balance volume to light OFF all indications of the error counter.

(7) Input command pulse.

Input command pulse and confirm that the motor rotates smoothly. With forward command pulse, the motor should rotate forward direction (CCW) looking at the motor from the shaft side. With reverse command pulse, the motor should rotate reverse direction (CW) looking at the motor from the shaft side.

(8) When there are troubles such as no rotation and rotation without control of the motor, check red LED and see item 6-3, "Troubleshooting."

(9) Confirm zero positioning function.

Input zero positioning command (HRET) in the following sequential process and confirm the function.

(1) Command pulse input

Deceleration   ▽. Stop pulse supply

(2) Detect the zero front LS signal

(3) Zero positioning command input
              (H.RET)

(4) Encoder Z phase
    (Inside operation)

       Z phase

(5) Reset the error counter
    (Inside operation)

(6) Pulse input prohibition
    (Inside operation)

(7) Positioning completion output

▲ι Complete zero positioning

(10) Also confirm the following functions:
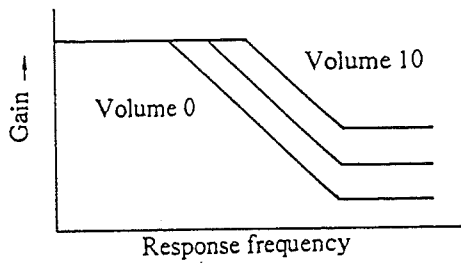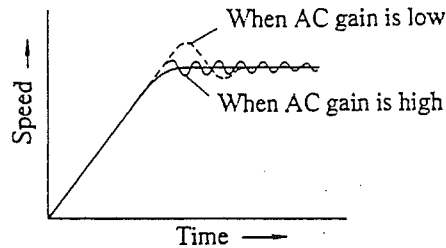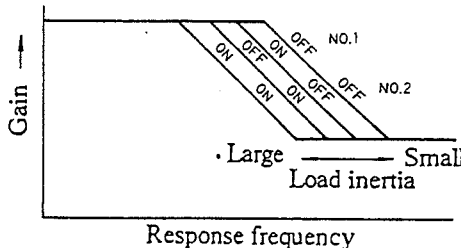
- Emergency stop   The motor stops and alarm indication LED lights.
  (EM)

- Error counter reset   Reset the error counter and light OFF "SPEED" on
  (ECRST)   the display section.

- Pulse prohibition   Prohibit input pulse command and hold the axis
  (OPG)   (servo lock).

- Minimizing gain   Decrease vibration of servo motor.
  (MING)   Decrease servo lock power.

- Torque limit   Turn torque limit adjustment volume (TOL.L) to
  (CLIM)   CCW direction and confirm decrease of motor
      torque.

- Alarm reset   Confirm release from alarm condition by inputting
  (RESET)   RESET after triggered protection circuit.
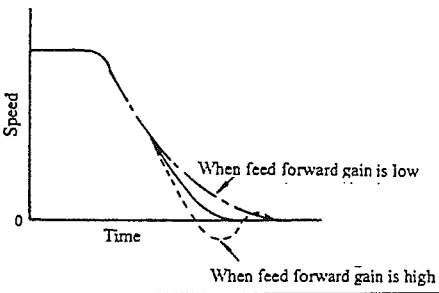
After the completion of confirmations above, operate the system with the required cycle.
Check heat condition of the motor and the driver after 2 to 3 hours of cycle operation.

5.3 Adjustment

The servo driver is adjusted with no load at delivery. Adjust and get the optimum condition by referring to the following chart.

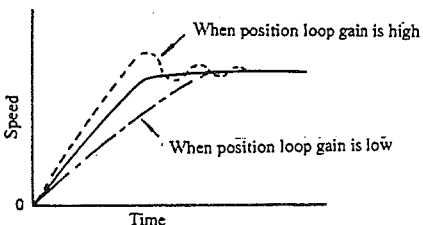| Name of volume SW	Functions	Vibration by adjustment
AC gain (ACG)	Adjustment of AC gain This is used for adjusting response characteristics. Adjust in accordance with load inertia. To monitor response characteristics, check speed monitor signal. Volume 10 Volume 0 Gain ↑ Response frequency	AC gain increase and improves frequency characteristics by turning the volume to clockwise direction. In case of small load inertia, decrease AC gain and vice-versa to minimize overshoot and undershoot. Too much AC gain causes vibration and unstable condition of the motor. When AC gain is low When AC gain is high Speed ↑ Time →

AC gain changeover SW-5
    No.1
    No.2
	This is a switch to adjust response characteristics. Adjust with load inertia. See the table right for reference.
	
	Gain ↑
	NO.1
	NO.2
	• Large ──── Small
	Load inertia
	Response frequency
		<table><tr><td>Load inertia</td><td>No.1</td><td>No.2</td></tr><tr><td>0-3 times of motor inertia</td><td>OFF</td><td>OFF</td></tr><tr><td>2-5 times of motor inertia</td><td>ON</td><td>OFF</td></tr><tr><td>4-7 times of motor inertia</td><td>OFF</td><td>ON</td></tr><tr><td>6-10 times of motor inertia</td><td>ON</td><td>ON</td></tr></table>
		For finer adjustment, use AC gain volume

Zero balance (ZERO)	Zero adjustment Adjust to light OFF all LED of the error counter.	Not balanced condition shows steady lighting ON or OFF "-/+" LED, and the lower bits of the deflection counter light ON.

Name of volume SW	Functions	Vibration by adjustment
Loop gain (LP.G)	Loop gain adjustment This is a volume to adjust acceleration/deceleration response smooth. When overshoot/undershoot is not eliminated, make longer acceleration /deceleration time or minimize feedback multiplication figure.	When position loop gain is high When position loop gain is low
FF gain (FFG)	Feed forward adjustment This turns to effective after turning No.5 of SW4 ON. This volume adjusts feed forward value.	When feed forward gain is low When feed forward gain is high
Torque control (TOL.L)	This torque control turns to effective by CLIM signal, and the maximum current value is limited by this setting value.	Increase setting value by turning the volume CW direction. Maximum setting is instantaneous maximum torque.
Acceleration correction (LAG.T)	Acceleration correction Together with AC gain, adjust acceleration characteristics. It adjust phase and gain at high range.	This volume improves response characteristics by increasing this value when load rigidity is high enough. However, this is not effective when load rigidity is low. Adjust within a range that does not cause vibration during rotation.

6.1 Protective and Check Functions

LED on the display section indicate operation and abnormal conditions of the servo driver.

```
┌─────────────────────────────────────────────────┐
│                                                   │
│   POWER INP     O.C  O.V  O.L  O.RUN RE.E  EM     │
│    ▭    ▭       ▭    ▭    ▭    ▭    ▭    ▭        │
│                                                   │
│   SPEED                                           │
│   ┌──────────────────────────┐ ▭                 │
│   1  2  3  4  5  6  7  8  9 10 11 12  -/+         │
└─────────────────────────────────────────────────┘
```
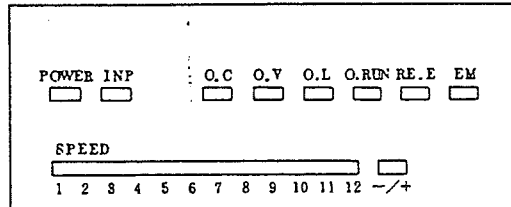
□ **Green LED**

Display	Function	Condition
POWER	Control power	Control power (200 VAC) is input.

□ **Orange LED**

Display	Function	Condition
INP	Completion of positioning	With RUN command input, this LED lights when value of the deflection counter is less than positioning completion range.

□ **Red LED**

Display	Function	Condition
O.C	Overcurrent	Lights when current exceeding instantaneous max. current is coming, armature output is shorted main circuit power is disconnected, or the fuse element is blown.
O.V	Overvoltage	When the main power DC voltage abnormally increases by regenerative control.
O.L	Overload	(1) When the driver is suppling current exceeding the rated value more than 8 sec. (2) When the radiation fin raises its temperature to 85°C or up.
O.RUN	Abnormal speed Counter over	(1) When the motor exceeds the instantaneous max. speed. (2) When the error counter exceeds the designated number of bit, the driver clears the error counter and releases servo lock.
RE.E	Encoder error	(1) When encoder signals are abnormal condition. (2) When RE or PS signal is disconnected. (3) Overheat of the motor (85°C or up inside the encoder)
EM	Emergency stop input	Lights ON when emergency stop signal is input and the motor stops.

6. MAINTENANCE

In order to protect the servo driver and servo motor, the following protective circuits are integrated.

When a protective circuit works, the driver stops operation and supplies servo abnormal signal. At this time, the motor axis turns to free condition. If you need to lock the axis, mechanical brake is required.

☐ Servo driver

Protective function	Indicating LED	Function	Causes
Main circuit fuse	O.C lights	When an overcurrent is supplied to the main circuit, fuse blows and opens circuit connection.	• Short circuit between driver and motor.
Detect overcurrent	O.C lights	The unit detects overcurrent in the DC main circuit and opens Tr gate.	• Short circuit between driver and motor.
Overvoltage protection	O.V lights	The unit opens Tr when the main circuit power voltage exceeds the rated value due to regenerative resistance.	• Too much load inertia. • Supplied power exceeds the rated value.
Overload protection	O.L lights	The unit opens Tr when the motor exceeds coil thermal time constant.	• Too much load torque. • Miswiring between A, B, and C phase. • Mechanical lock of motor axis.
Temp. rise of radiation fin	O.L lights	The unit opens Tr when the radiation fin of the inverter exceeds the rated value.	• Too much load torque. • Miswiring between A, B, and C phase. • Mechanical lock of motor axis.
Detection of signal disconnection	RE.E lights	The unit opens Tr when RE or PS signal is disconnected.	• Disconnection of encoder signal cables.
Abnormal	POWER lights OFF	The unit opens Tr when the power is lower it voltage than the rated value.	• Voltage down of supplied power. • Lack of the power capacity.
Overspeed	O.RUN lights	The unit opens Tr when the motor exceeds the rated speed.	• The motor rotates with more than the rated speed. • Disconnection of encoder signal cables.
Instantaneous stoppage of the power supply	POWER lights OFF	The unit opens Tr at the power failure for more than 40 ms.	• Instantaneous power failure of AC commercial line.
Detection of phase loss	O.C lights	Open Tr when an armature wire is disconnected	• Miswiring of power circuit.
Error counterover	O.RUN lights	When the error counter exceeds the designated number of bit, the driver clears the error counter, release servo lock, and opens Tr.	• Too high command pulse pulse frequency. • Missetting of position detector multiplication value.
Encoder error	RE.E lights	Open Tr when encoder abnormal occurs.	• Overheat of motor. • Miswiring of signal lines.
Lack of phase	O.C lights	One phase of main circuit is failure.	Supplied power is abnormal condition.

☐ Alarm contactor output (OMRON G2E-184P-H-M or equivalent)

Contactor section

Load	Resistance load (cosφ = 1)	Induction cosφ = 0.4 Load L/R = 7 mS
Rated load	24 VDC, 0.5 A	24 VDC, 0.3 A

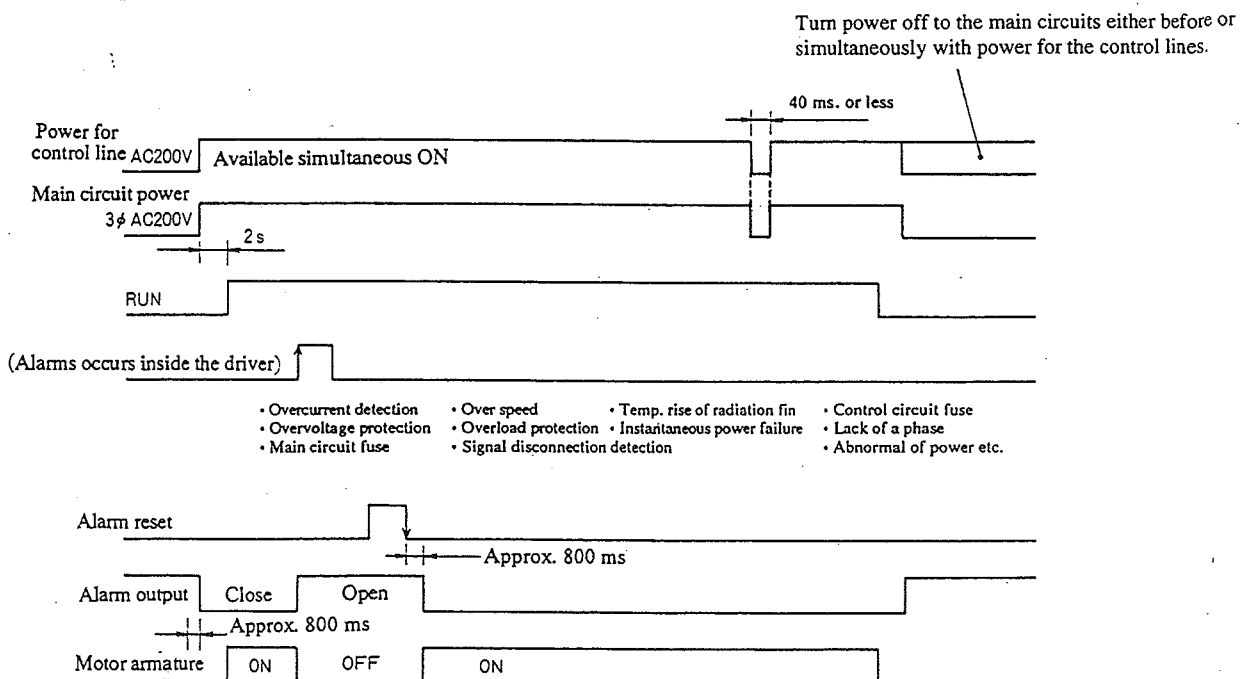Note: Never connect 100 VAC line to the alarm contactor output.

• Protections and alarm timing when the power ON, OFF and down.

In order to protect a built-in power transistor from misoperation of the servo driver, the following measures are provided:

1) At power ON, shut off operation signal inside the unit until each power supply returns to normal level. This interval is 400 ms. to 1.5 s.

2) At power OFF, shut off operation signal inside the unit while the control power in the unit being within the normal range.

If the stoppage time is less than 40 msec., servo abnormal alarm is not supplied.

3) Timing chart

Turn power off to the main circuits either before or simultaneously with power for the control lines.

40 ms. or less

Power for control line AC200V — Available simultaneous ON

Main circuit power 3φ AC200V — 2 s

RUN

(Alarms occurs inside the driver)

• Overcurrent detection	• Over speed	• Temp. rise of radiation fin	• Control circuit fuse
• Overvoltage protection	• Overload protection	• Instantaneous power failure	• Lack of a phase
• Main circuit fuse	• Signal disconnection detection		• Abnormal of power etc.

Alarm reset — Approx. 800 ms

Alarm output — Close | Open — Approx. 800 ms

Motor armature — ON | OFF | ON

Alarm signals output through relay contacts. It takes approx. 10 ms. to supply alarm output as relay output after the alarm occurs inside of the unit.

> **Be sure to secure 2 s. interval to put ON RUN signal after turning ON main circuit power. Simultaneous input of both may blown protective fuse due to surge in current.**
> **Turn off the main circuit power and control power simultaneously or turn off the main circuit power before turning off the control power.**

6. MAINTENANCE

☐ Cautions at alarm output

1. The unit outputs abnormal alarm as relay contact simultaneously at abnormal indication on LED.

   This output available even if the power of the servo driver is OFF.

   The contactor closes after approx. 800 ms. of control power OFF.

2. The unit shuts off RUN signal together with alarm output. Thus, the electrical brake of the motor (regenerative control) does not work.

   In order to stop the axis in this condition, make a circuit to trigger mechanical brake with this alarm contact signal.

3. Abnormal condition of control power automatically is released after ±15V being returned to normal condition. Other abnormal alarms are released by reset button, reset signal input, and reinput of power.

   Be careful that when the unit receives reset signal or power ON while inputting RUN signal, it will soon be in operation condition.

4. When an abnormal signal outputs, turn OFF main power and RUN signal.

   Leave control power ON, and check the abnormal condition with LED. Remove causes of the abnormal condition and restart operation.

> When overload (O.L) occurs, abnormal of mechanical section may be a cause. Check the mechanical section. Do not supply power more than 10 minutes after this alarm condition. Repeated overload may burnout motor coil.

5. When an alarm signal is output, check wirings, installation of the system.

6.2 Maintenance

□ Daily check

Confirm whether there are abnormal noise, loose screws, or abnormal heat in the motor, and operating ambient temperature while in operation.

There is no daily check item for the servo driver. Check ambient temperature, dust on the forced cooling fan.

□ Periodical check

● Servo motor

- Abnormal noise from the motor.
- Looseness of retention screws.
- Outside look.

● Servo driver

- Looseness of terminals, connectors, and retention screws.
- Dust in ventilation holes of the servo driver.

6. MAINTENANCE

6.3 Troubleshooting

When trouble occurs while in operation, confirm the cause and return to normal condition by referring to the following chart:

❑ Check by LED

LED lights	Protection function	Conditions	Causes
O.C	Fuse in main circuit	Blow fuse with overcurrent in DC main circuit.	• Short circuit between driver and motor.
	Detect overcurrent	Tr opens with overcurrent in DC main circuit.	• Short circuit between driver and motor.
	Detection of phase disconnection	Open Tr when one phase of power line disconnected.	• Disconnection of any phase of power line.
O.V	Protection from overvoltage	Tr opens with overvoltage in main power due to regenerative energy.	• Too much load inertia. • Too high input voltage. • Miswiring of A, B, and C phase
O.L	Temp. rise of radiation fin	Tr opens with rising temp. of inverter radiation fin.	• To much load torque. • Miswiring between A, B, and C phases. • Mechanical lock of motor shaft.
	Electronics thermal protection	Tr opens when excess of rated load reaches the motor.	• Too much load torque. • Miswiring of motor wires.
O.RUN	Overspeed	Tr opens with overspeed.	• Motor rotates exceeding the rated speed.
	Overflow of the error counter	Clears the error counter and makes free motor axis.	• Too high command pulse frequency. • Missetting of position detector multiplication figure.
RE.E	Detection of signal line disconnection	Open Tr by RE, PS signal disconnection.	• Signal disconnection of RE or PS.
	Overload protection	Open Tr by encoder temp. increase over the rated value.	• Too much load torque. • Overheat of motor.

Contact our service department

❏ Check motor conditions

Check abnormal condition due to mismatch of coupling center.

Noise: Confirm that AC gain is not excessive.

Confirm that the motor rotor is rotating smoothly.

Confirm that there is no abnormal sound by wear of ball bearings.

Thermal: Check that load actual torque is within the motor rated torque.

<u>When OL lights, wait at least 10 minutes to cool. Repeated alarm condition without cooling may damage the motor.</u>

Vibration: Vibration occurs at following conditions:

        (1) When AC gain increases too much.

        (2) When LAG.T increases too much.

        (3) When resonance point of mechanical section is within servo loop response range.

❏ The motor does not rotate even there is no alarm condition.

Confirm that the following signals of CN1 are set as shown below:

Signal name	
IPG	OFF
H.RET	OFF
ECRST	OFF

The motor cannot rotates even if one of above signals is OFF.

## 7.1 Structure of Motor and Driver

☐ **Structure of motor**

AC servo motor is a synchronous motor having rotating core of permanent magnet.

Fields consist of 3-phase coiling wires on iron core. Pole change in accordance with the position of a rotor is required for coiling wires which is not required for DC servo motors. Therefore, a pole sensor is installed together with an encoder.
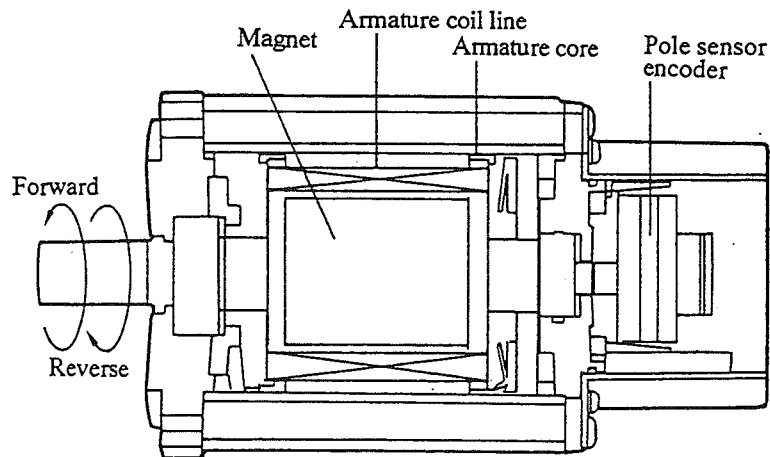
☐ **Structure of servo driver**
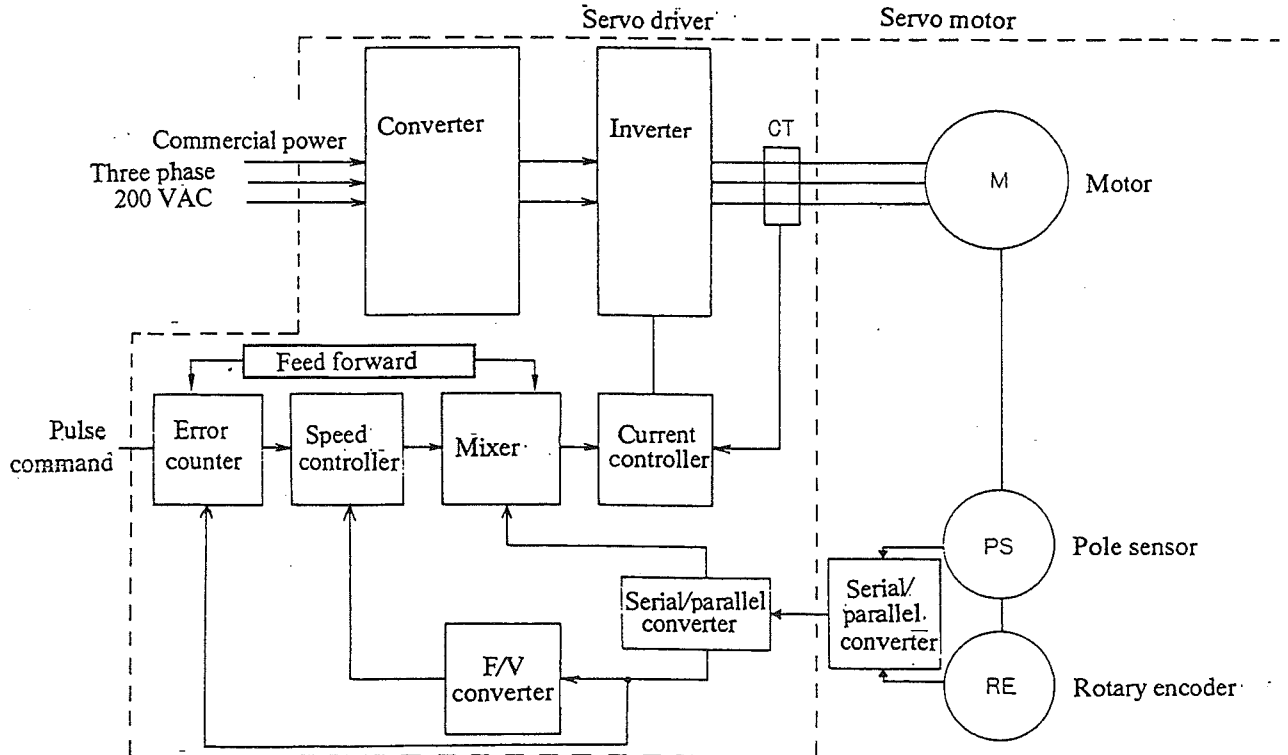
- **Converter**

  Changer commercial electric 200VAC to DC, and supply to main circuit of the servo driver.

- **Inverter**

  This section controls current supplied to field coil from DC power by PWM system.

- **Pole sensor**

  This is a sensor to control supply timing of the inverter AC current with detection of the motor rotor position.

- **Rotary encoder**

  Incremental encoder having precision of 1,000 P/R for control motor speed and positioning.

□ Inner configuration

7-2