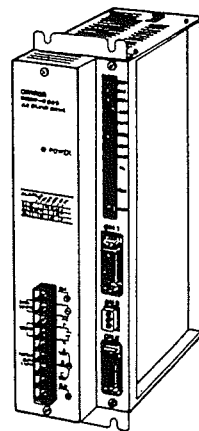# OMRON

USER'S MANUAL

OMNUC R SERIES

MODEL : R88D-RB04/RB05/RB10/RB15/RB20

(POWER UNIT SEPARATED ANALOG 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.
   • High voltage equipment is dangerous.
   • 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 fine positioning by controlling power to AC servo motor in compliance with analog input signal.

This series consists of AC servo drivers operative 60W to 1,100W motors.

Two models of power unit: 200 VAC, 3-phase input model and 100 VAC, single phase, are provided. The regenerative unit can absorb up to 40 W energy.

AC servo systems controlled by RB series drivers have the following features:

- Compactness and light weight.
- 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 with minimized ripple by sinusoidal wave method.
- Dynamic brake is installed.
- Extendable distance between the motor and driver up to 30 m when the standard cable is used.

Note: As for the power unit and regenerative unit, see the separate instruction manuals for each

1. GENERAL

1.2 Outline of Configuration

System configuration example using a unit is shown below.

- Using 200 VAC, 3-phase power

Power unit	Servo driver	Servo motor	Motor output	Regenerative unit
R88S-R305 R88S-R310 R88S-R310G R88S-R315	R88D-RB05	R88M-R10030	100W	R88A-RG50
	R88D-RB10	R88M-R20030	200W	
		R88M-R30030	300W	
	R88D-RB15	R88M-R45030	450W	
		R88M-R60030	600W	
	R88D-RB20	R88M-R82030	820W	
		R88M-R1K130	1,100W	
	R88D-RB04	R88M-R06030	60W	
		R88M-R11030	110W	

- Using 100 VAC, single phase power

Power unit	Servo driver	Servo motor	Motor output	Regenerative unit
R88S-R203 R88S-R205	R88D-RB05	R88M-R10030	100W	R88A-RG50
	R88D-RB10	R88M-R20030	200W	
		R88M-R30030	300W	
	R88D-RB15	R88M-R45030	450W	
		R88M-R60030	600W	
	R88D-RB20	R88M-R82030	820W	
	R88D-RB04	R88M-R06030	60W	
		R88M-R11030	110W	

Note: R88S-R310G has a built-in regenerative absorption circuit.

Motors for the R88M-R60030 (600 W) are also applicable with the R88D-RB20 driver.

For details, see Chapter 2: AC servo motor specification.

For selection of power unit, see the instruction manual for power units.

□ AC servo motor

• AC servo motors are available in 9 models: 60 W, 100 W, 110 W, 200 W, 300 W, 450 W, 600 W, 820 W and 1,100 W. Be sure to use proper servo motor suitable to the AC servo driver. (See previous page, item 1-2.)

□ AC servo driver

• AC servo drivers of 5 models can control AC servo motors of 60 W to 1,100 W. Types of AC servo drivers should be in accordance with each AC servo motor. (See previous page, item 1-2.)

□ Power unit

• This unit supplies power to a AC servo driver taking 100 VAC input power. The following models of power units are available.

R88S-R203	3A output
R88S-R205	5A output

• This unit supplies power to a AC servo driver taking 200 VAC input power. The following power unit models are available.

R88S-R305	6A output
R88S-R310	10A output
R88S-R310G	10A output with regenerative energy absorption circuit.
R88S-R315	15A output

□ Regenerative unit

• This is a unit to absorb regenerative energy. The following model is available.
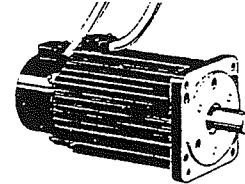
R88A-RG50

Note: For the power unit and regenerative unit, see separate instruction manuals.

1. GENERAL

☐ 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.
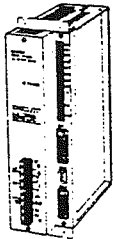
R88D-R
AC servo driver

R88M-R
AC servo motor 100 - 450 W

• 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 - 1,100 W

• Encoder line extension cable (R88A-CRR☐☐☐C)

This cable is to connect a connector cable assembled R series AC servo motors and AC servo drivers.

R88D-R
AC servo driver

R88M-R
AC servo motor 60 / 110 W

• 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 AC servo drivers.
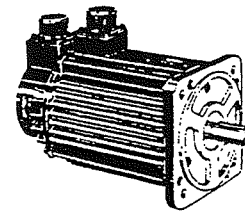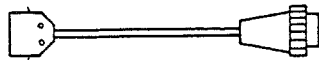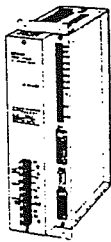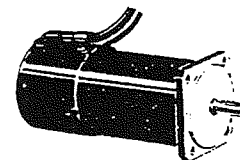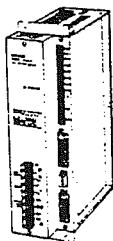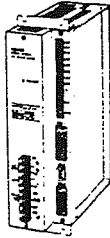

R88D-R
AC servo driver
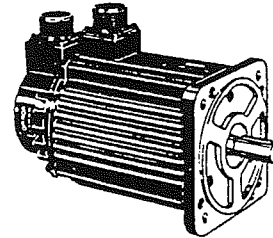
R88M-R
AC servo motor 600 - 1,100 W

• Power cable for 60 W and 110 W motor (R88A-CAR□□□S)

This cable is to connect armature connectors of 60 W and 110 W AC servo motors and AC servo drivers.

• Power cable for 60 W and 110 W motor (R88A-CAR□□□B)

This cable is to connect armature connectors of 60 W and 110 W brake-installed AC servo motors and AC servo drivers.
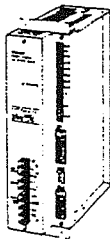
R88D-R
AC servo driver
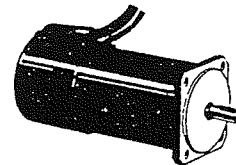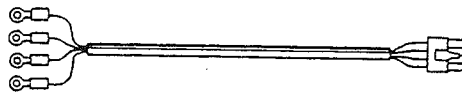
R88M-R
AC servo motor 60 - 110 W

• Encoder cable

Specifications	Length	Models
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, 1,100W (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
Motor capacity 60 W,110 W, (dual-side connector)	3 m	R88A-CRR003C
	5 m	R88A-CRR005C
	10 m	R88A-CRR010C
	15 m	R88A-CRR015C

• Power cable

Specifications	Length	Models
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
Motor capacity 60W,110W, (single-side connector)	3 m	R88A-CAR003S
	5 m	R88A-CAR005S
	10 m	R88A-CAR010S
	15 m	R88A-CAR015S
Motor capacity 60 W,110 W with brake. (single-side connector)	3 m	R88A-CAR003B
	5 m	R88A-CAR005B
	10 m	R88A-CAR010B
	15 m	R88A-CAR015B

1. GENERAL

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
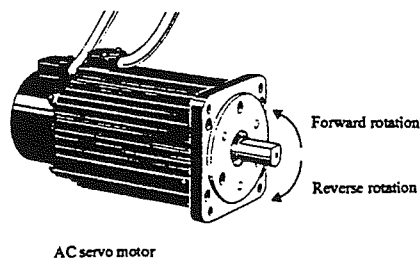
☐ Encoder output phase

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

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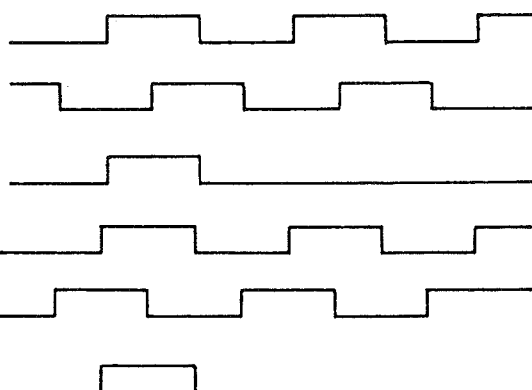
The system consists of an AC servo driver and an AC servo motor.

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

2.1 General Specifications of Servo Driver

Item	Standards	
Ambient operating temperature	0 to +55°C <Note>	
Ambient operating humidity	35 to 85% RH (without dew condensation)	
Storage temperature	-10 to +75°C, 35 to 85%RH (without dew condensation)	
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	More than 5 MΩ at 1,000 VDC, between power terminal and box.	
Voltage proof capacity	1 minute at 1,500 VAC 50/60 Hz, between power terminal and box.	
Structure	Installation inside a box type	
Weight	R88D-RB04/RB05/ RB10/RB15	Approx. 2.7 kg
	R88D-RB20	Approx. 3.0 kg

<Note> When the R88D-RB20(AC servo driver) is used with the R88M-R1K130 (1,100 W AC servo motor), it cannot operate in the area shown in slanting lines, below
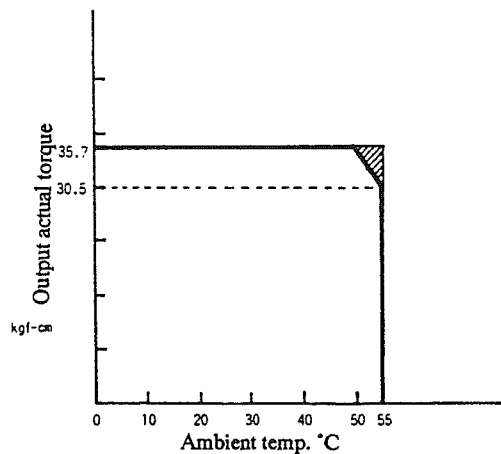
2. SPECIFICATION

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

☐ **Specifications of the speed control section and control input/output signals**

Item		Unit	Standard
Speed control	Speed control, Servo rigidity		1: 1000 Rated torque at 7.5 mV
	Load characteristics	%	Less than 0.2% at 0 to 100% load.
	Voltage characteristics	%	Less than 0.5% at 220 to 360 VDC.
	Temperature characteristics	%	Less than 1% at 25°C ±25°C.
	Frequency characteristics	Hz	Adjustable to more than 50 Hz with the same inertia of the motor.
	Rated command voltage	V	±10 VDC, ± 3,000 rpm.
	Input impedance	kΩ	Approx. 22 kΩ.
	Time constant	µs	20 µs.
	Run command		24 V, 12 mA contact or open collector
	Gain minimization		24 V, 12 mA contact or open collector
	Torque limit		24 V, 12 mA contact or open collector
	Alarm reset		24 V, 12 mA contact or open collector
	Auxiliary command voltage		± 3 to ± 10 VDC, ± 3,000 rmp.
	Input impedance	kΩ	Approx. 10 to 30 kΩ.
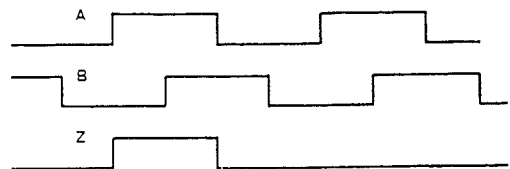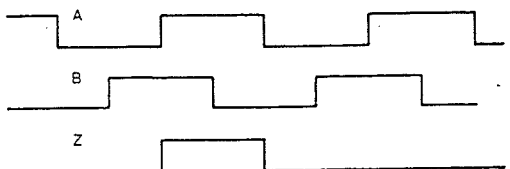
□ Specifications of servo driver

Item		Unit	Standard				
Power source	Main circuit	V	220 - 360VDC				
	Control circuit	V	170 - 253VAC,65VA, 50/60 Hz, (220 -360VDC)				
Output	Model		R88D-RB04	R88D-RB05	R88D-RB10	R88D-RB15	R88D-RB20
	Continuous	AO-P	1.7	1.7	3.3	5.0	7
	Maximum	AO-P	5.5	5.5	10	15	20
Speed feedback			Magnetic encoder 1000 PPR (Pulse Per Revolution)				
Protection functions			Overcurrent, overload ,overvoltage, and abnormal speed.				

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

□ Encoder output

Item	Standard
Output pulse	A, B phase: 1,000 PPR Z phase: 1 PPR
Output phase	At forward rotation At reverse rotation 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 condition	°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	2.03×10^{-3}	2.5×10^{-3}	3.66×10^{-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 applying an oil seal and a water proof connector, IP-54)			

Note 1: Servo motor model R88M-R60030 (600W) can be used with the servo driver model R88D-RB20. Is this case, max. torque becomes 60 kfg·cm or over.

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

2. SPECIFICATION

□ Specification of AC servo motor (3)

Item	Unit	R88M -R06030	R88M -R11030
Output power	W	60	110
Rated torque	kgf·cm	1.95	3.58
Rated speed	rpm	3,000	3,000
Instantaneous max. speed	rpm	4,000	4,000
Instantaneous max. torque	kgf·cm	6.5 or up	12 or up
Rotor inertia	kgf·cm·s^2	1.26×10^{-4}	2.0×10^{-4}
Torque constant	kgf·cm/A	1.22	2.54
Induction voltage constant	V/rps	0.75	1.57
Power rate	kW/s.	2.96	6.35
Mechanical time constant	ms	3.72	3.62
Coil resistance	Ω	4.3	11.5
Coil inductance	mH	8.5	25
Electrical time constant	ms	1.98	2.18
Weight	kg	0.95	1.25
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 (available to apply oil seal)		

Note: As for oil seal, see Chapter 4, item 1-3: Installation condition.

❏ 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:
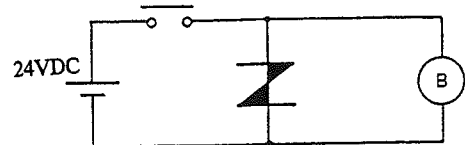
Type	Model	Mfg.	Application
Thyrister	C-5A3	ISHIZUKA ELECTRONICS CORP.	24VDC
Thyrister	V-3		24VDC
Varistor	Z15L470		24 VDC
Varistor	ERZ-C14DK470	MATSUSHITA ELECTRONICS COMPONENTS CO., LTD.	24 VDC
Spark killer	CR50500	OKAYA ELECTRIC INDUSTRIES.CO., LTD.	Compatible AC and DC

❏ 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			

• Weight

Item	Unit	R88M -R10030-B	R88M -R20030-B	R88M -R30030-B	R88M -R45030-B
Weight with brake	kg	1.8	2.7	3.4	5.8

Note: Values indicated in parentheses are not guaranteed.

2. SPECIFICATION

☐ Specifications of built-in brake motor (2)

• Brake specification

Item	Unit	R88M -R60030-B	R88M -R82030-B	R88M -R1K130-B
Brake inertia	kgf•cm•s²	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 with brake	kg	6.8	8.4	10.5

☐ Specifications of built-in brake motor (3)

• Brake specification

Item	Unit	R88M -R06030-B	R88M -R11030-B
Brake inertia	kgf•cm•s²	2.0×10^{-5}	2.0×10^{-5}
Excitation voltage	V	24 VDC	
Power consumption	W	6	6
Static friction torque	kgf•cm	5 or up	5 or up
Braking time constant	ms	(50)	(50)
Release time constant	ms	(100)	(100)
Allowable work (1)	kgf•m/time	16	16
Allowable work (2)	kgf•m/life	2×10^4	2×10^4
Backlash	axis angle	(±1.2°)	
Rated		Continuous rating	
Insulation class		Item F	

• Weight

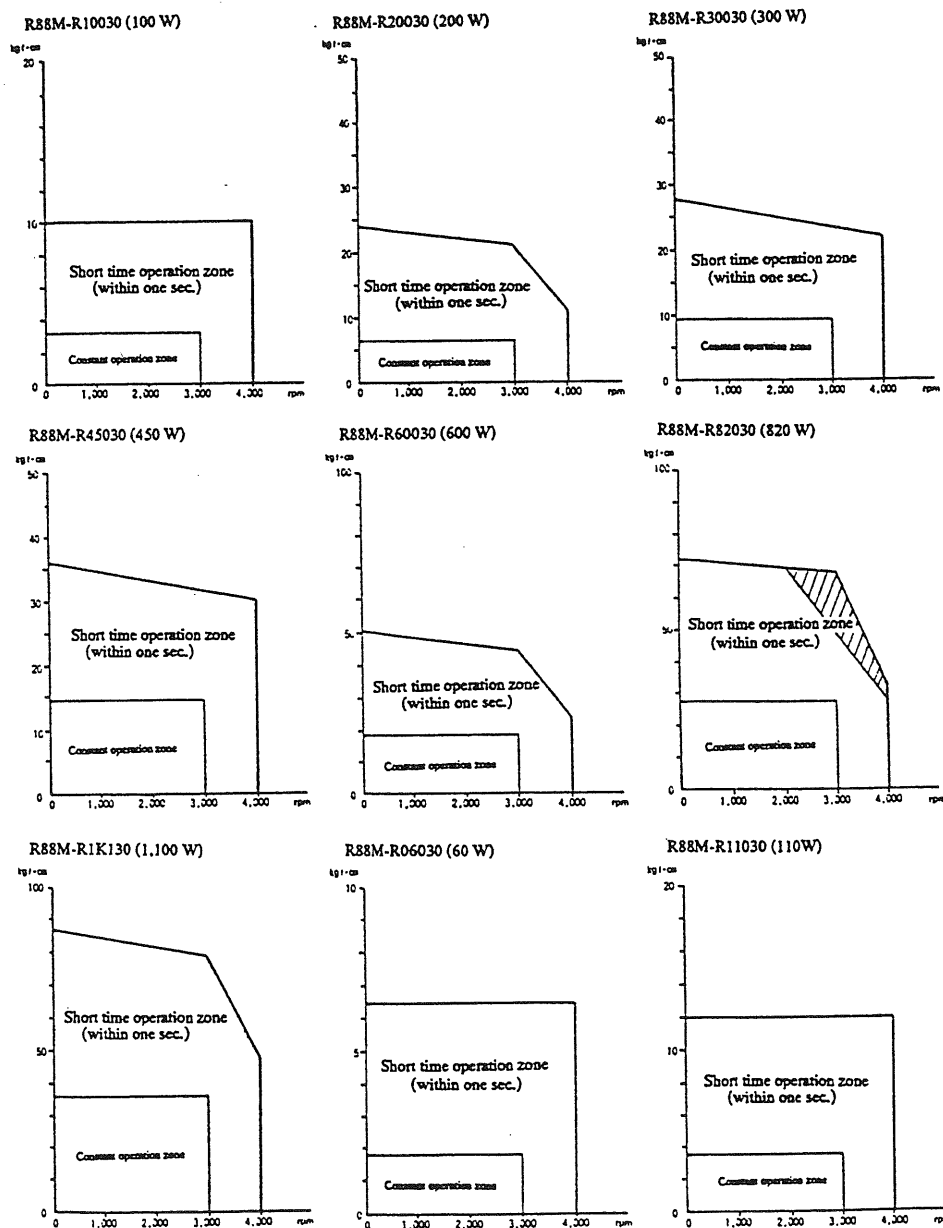| Item	Unit	R88M -R06030-B	R88M -R11030-B
Weight with brake	kg	1.3	1.6

Note: Values indicated in parentheses are not guaranteed.

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

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

Using the motor within the slanting line zone at 100 VAC is not available.

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)

R88M-R06030 (60 W)

R88M-R11030 (110W)

2. SPECIFICATION

## ☐ 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: 200 mm^2 metal board or equivalent.

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

R88M-R45030 Thickness: 12 mm, area: 200 mm^2 metal board or equivalent.

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

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

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

R88M-R06030 Thickness: 6 mm, area: 150 mm^2 metal board or equivalent.

R88M-R11030 Thickness: 6 mm, area: 200 mm^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.
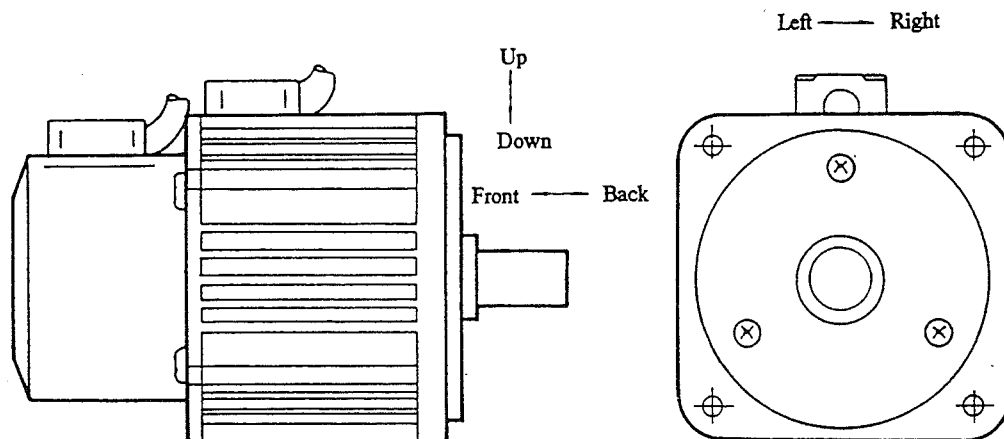
☐ Shockproof characteristics

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.

- **Allowable load to motor axis**

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

(unit : kgf)
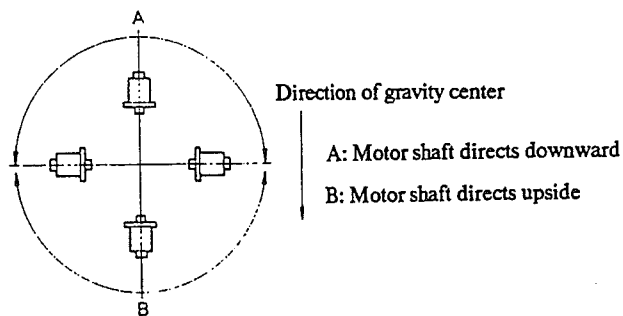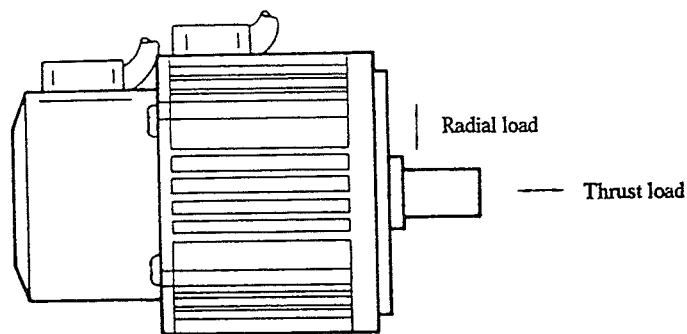
Type	Output	Radial load	Thrust load A	Thrust load B
R88M-R10030	100 W	11.5	3	3
R88M-R20030	200 W	19	8	7.5
R88M-R30030	300 W	20	8	7.5
R88M-R45030	450 W	34	12	11
R88M-R60030	600 W	36	12	11
R88M-R82030	820 W	38	12	11
R88M-R1K130	1,100 W	45	15	13
R88M-R06030	60 W	11.5	3	3
R88M-R11030	110 W	11.5	3	3

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.
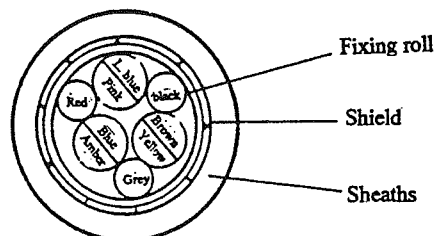

Radial load

—— Thrust load

Direction of gravity center

A: Motor shaft directs downward

B: Motor shaft directs upside

2. SPECIFICATION

☐ **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

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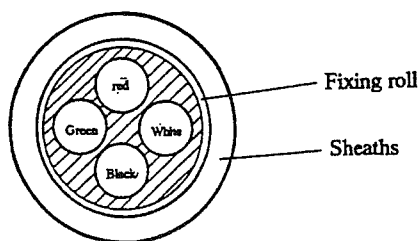
Item		Specification
Outside diameter	mm	Ø 8 ± 0.2
Conductor resistance	Ω/km	24.2 or less
Voltage proof	V/sec.	2,000
Insulation resistance	MΩ/km	3.5
Min. bending radial	mm	40

☐ AC servo driver

Model R88D-R B 05

Output current of nominal value.

Sign	04	05	10	15	20
Max. output current	5.5A	5.5A	10A	15A	20A

Means power unit separated analog 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
  060 : 60W
  100 : 100W
  110 : 110W
  200 : 200W
  300 : 300W
  450 : 450W
  600 : 600W
  820 : 820W
  1K1 : 1100W

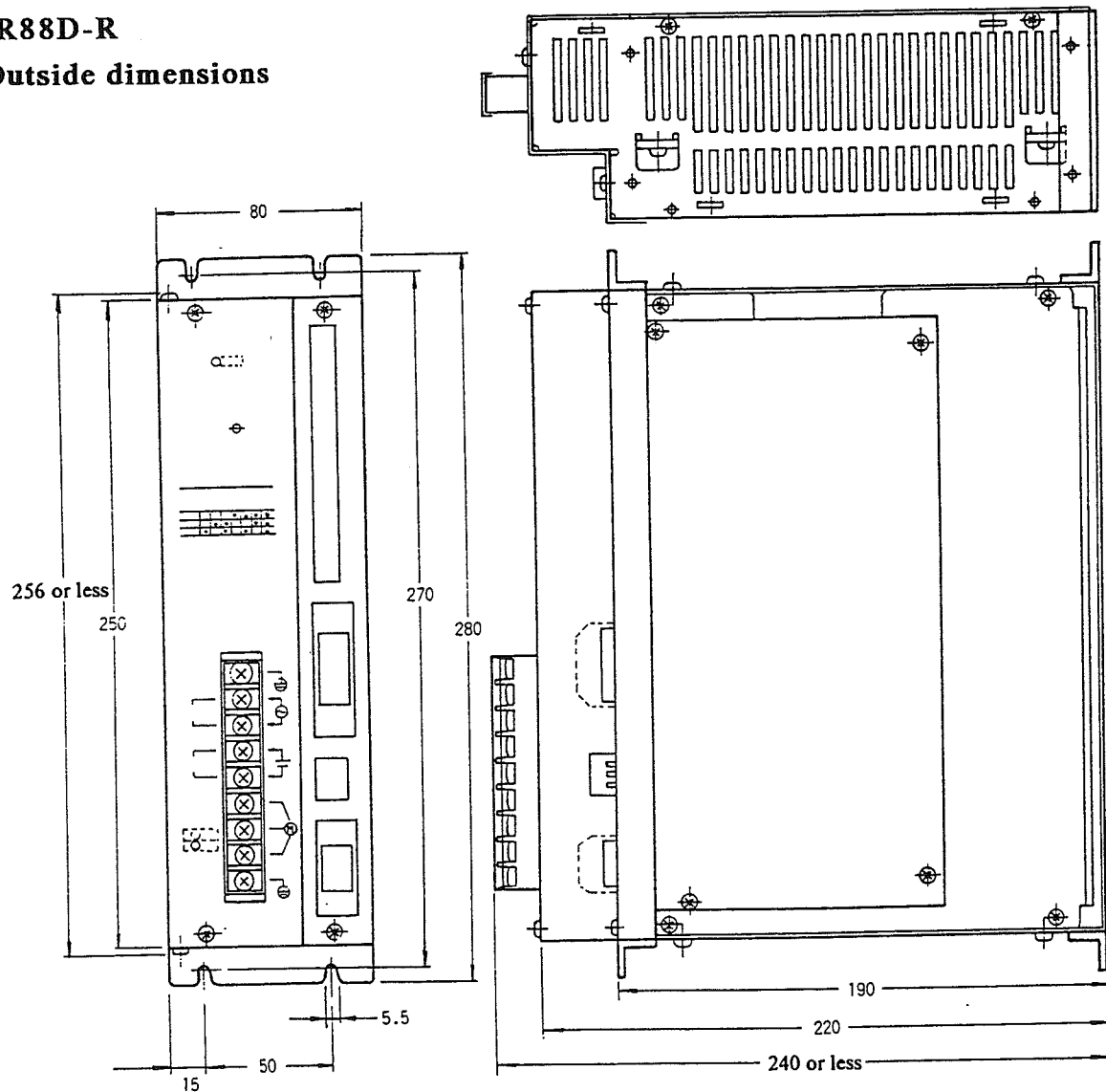Means "R" series.

Means servo motor.

4. DESIGN

4.1 Installation and Mounting

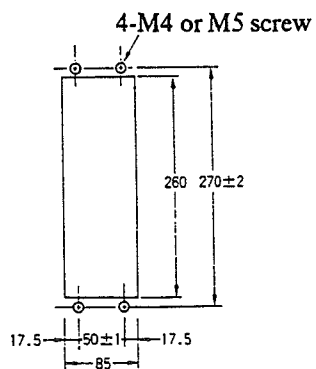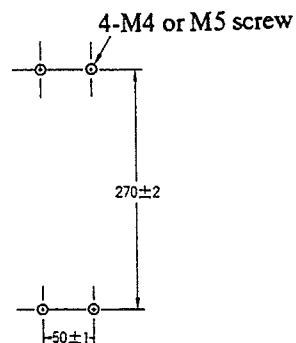### 4.1.1 Outside and installation dimensions of AC servo driver

□ R88D-R

• **Outside dimensions**

• **Panel installation dimensions**

4-M4 or M5 screw

260 270±2

17.5 — 50±1 — 17.5
85

• **Installation dimensions**

4-M4 or M5 screw

270±2

50±1

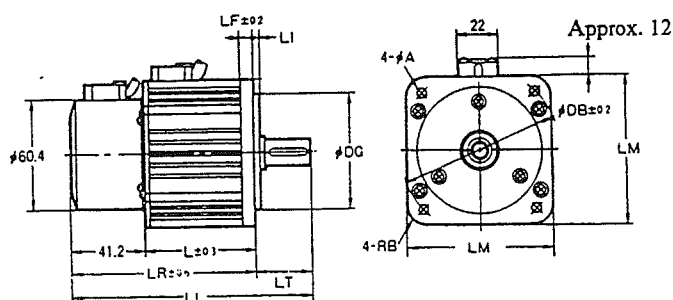## 4.1.2 Outside dimensions of AC servo motor

☐ Standard model

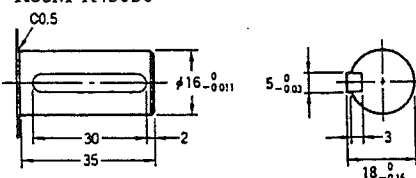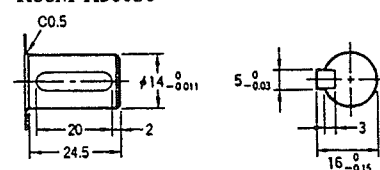• Models R88M-R10030, R88M-R20030, R88M-R30030, and R88M-R45030,
(100 to 450W)

Dim. (mm) Type	LL	LR	L	LF	U	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	$50_{-0.025}^{0}$	5	4
R88M-R20030	160.7	131.7	90.5	9	$3.5^{+0.3}$	$29^{+0.5}$	$80^{+0.4}$	90	$70_{-0.03}^{0}$	6	10
R88M-R30030	182.7	153.7	112.5	9	$3.5^{+0.3}$	$29^{+0.5}$	$80^{+0.4}$	90	$70_{-0.03}^{0}$	6	10
R88M-R45030	201.2	161.2	120.0	12	$4.0^{+0.1}$	$40^{+0.5}$	$120^{+1.5}$	130	$110_{-0.035}^{0}$	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,
(600 to 1,100 W)

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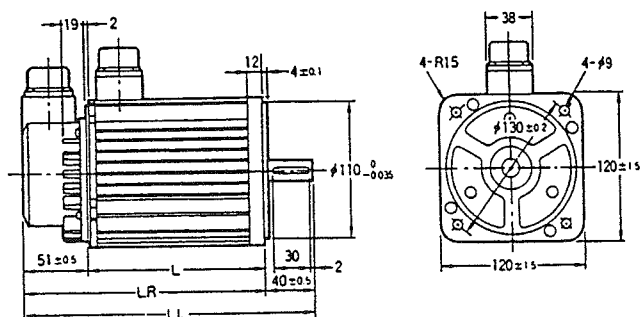
Shaft shape
R88M-R60030
R88M-R82030

R88M-R1K130
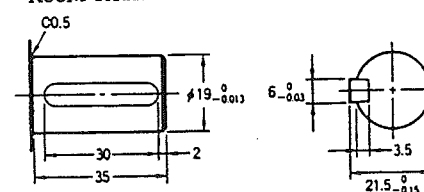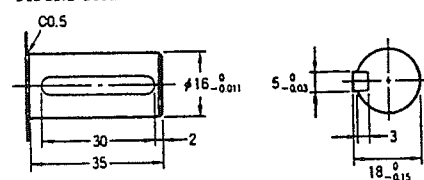
4. DESIGN

☐ Built-in brake model

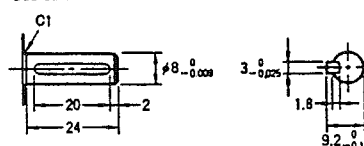### • Models R88M-R10030-B, R88M-R20030-B, R88M-R30030-B, and R88M-R45030-B (100 to 450W)

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	$50^{0}_{-0.025}$	5	4
R88M-R20030-B	192.7	163.7	122.5	9	$3.5^{+0.3}$	$29^{+0.5}$	$80^{+0.4}$	90	$70^{0}_{-0.03}$	6	10
R88M-R30030-B	219.7	190.2	149.0	9	$3.5^{+0.3}$	$29^{+0.5}$	$80^{+0.4}$	90	$70^{0}_{-0.03}$	6	10
R88M-R45030-B	227.7	187.7	146.5	12	$4.0^{+0.1}$	$40^{+0.5}$	$120^{+1.5}$	130	$110^{0}_{-0.035}$	9	15

Note) Lengths of armature wire and brake wire of built-in brake AC servo motors are 500 mm.
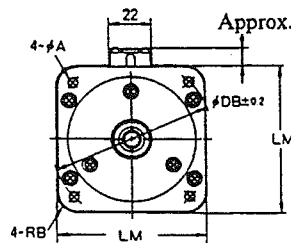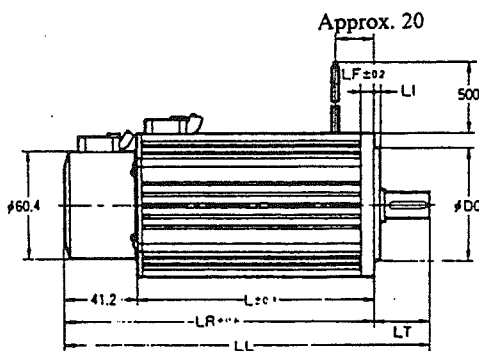
Shaft shape
R88M-R10030-B
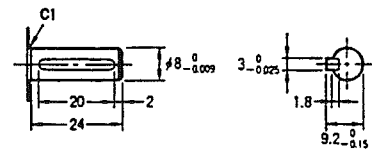
R88M-R20030-B
R88M-R30030-B
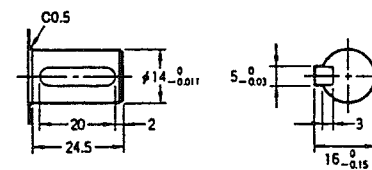
R88M-R45030-B
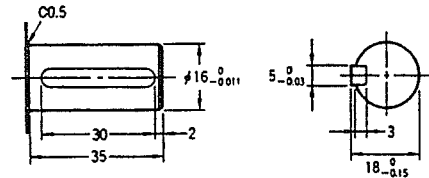
• Models R88M-R60030-B, R88M-R82030-B, R88M-R1K130-B, (600 to 1,100 W)
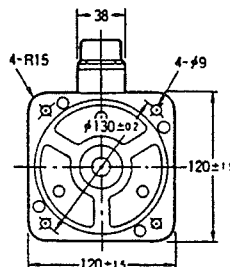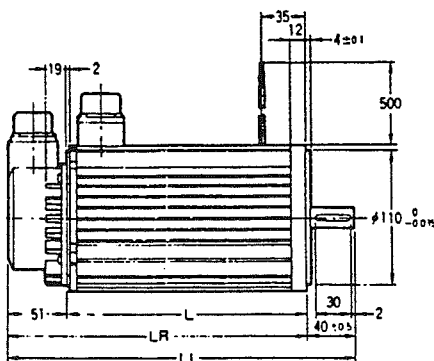
Type　Dim. (mm)	LL	LR	L
R88M-R60030-B	268.5	228.5	177.5
R88M-R82030-B	306.5	265.5	214.5
R88M-R1K130-B	350.5	310.5	259.5

Shaft shape
R88M-R60030-B
R88M-R82030-B
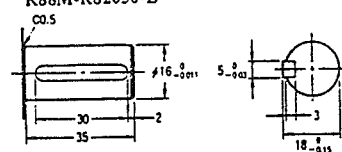
R88M-R1K130-B
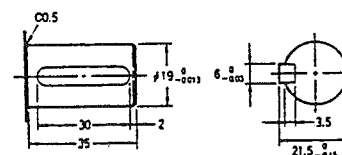
❑ Standard model

- Models R88M-R06030, R88M-R11030,
  (60/110W)

Dim. (mm) Type	LL	LR	L
R88M-R06030	146.5	116.5	66.5
R88M-R11030	164	134	83.5
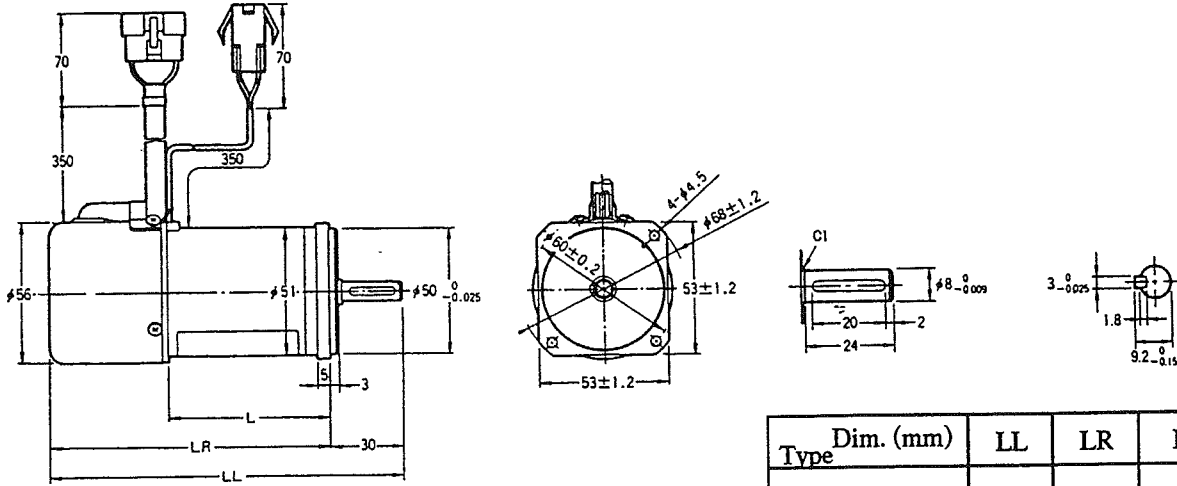
❑ Built-in brake model

- Models R88M-R06030-B, R88M-R11030-B,
  (60/110W)

Dim. (mm) Type	LL	LR	L
R88M-R06030	182.5	152.5	102.5
R88M-R11030	200	170	120
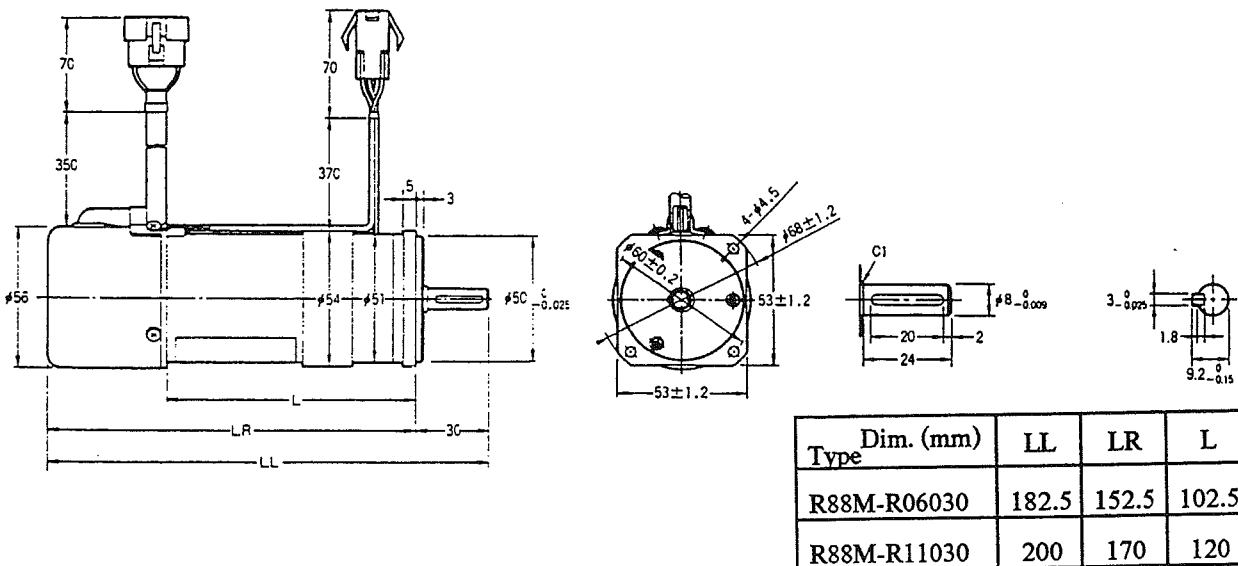
4. DESIGN

4.1.3 Installation conditions

□ **AC servo driver**

(1) Follow the installation diagram below while installing the unit.
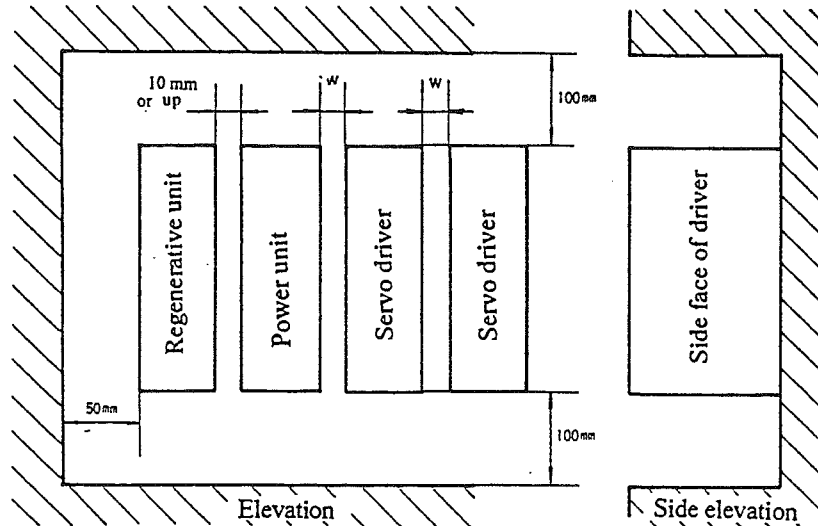
Model	W
R88D-RB04/RB05/RB10	0 mm or up (closed installation available)
R88D-RB15/RB20	10 mm or up

(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.

□ 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, 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 duet 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	IKO Tomson
R88M-R20030/R30030	OS15223	
R88M-R45030/R60030	AC0760AO	NOK
R88M-R82030		
R88M-R1K130	AC1013AO	
R88M-R06030/R11030	OS10173	IKO Tomson

(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.
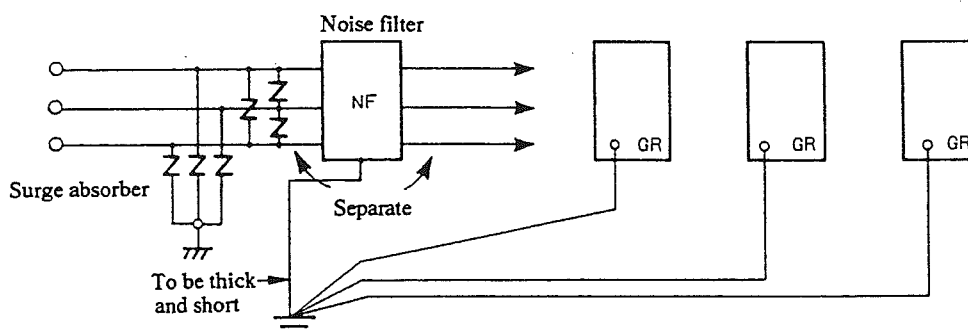
- Apply one-point earthing. Do not insert earthing line into the some ducts of filter output lines, motor power lines, and signal lines.
- In case of wiring in metal conduits and ducts, connect metal body with one point earthing as on the figure above.
- Insert surge absorber and noise filter on the AC lines.

☐ Terminal block for power and motor

Terminal block	Contents	Cable diameter	
		R88D-RB04/RB05/RB10	R88D-RB15/RB20
AC	Input for control power	0.75 mm^2	0.75 mm^2
DC (P, N)	Input for main circuit 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

Display and adjustment section

Power indication

Connector for control

Connector for monitor

Terminal block

Connector for encoder

4.2.2 Display, adjustment, and setting sections

□ Display section
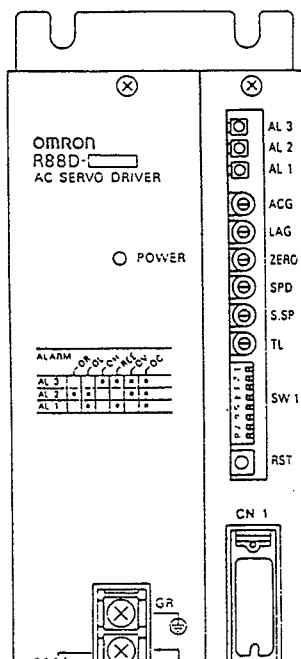
Indication			Function	Lighting condition
POWER			Control power indication	Control power (200 VAC) is input.
AL			Alarm display	
3	2	1		
●	●	●	OC Overcurrent	Motor current value exceeds the current limit value.
●	●	○	OV Overvoltage	Abnormal increase of main circuit DC voltage.
●	○	●	REE Encoder error	Encoder trouble. Disconnection of signal lines.
●	○	○	OH Temperature rise	Temperature of the driver radiation panel temperature abnormally rise.
○	●	●	OL Overload	Load to motor is too heavy.
○	●	○	OR Overspeed	Motor speed exceeds the limit (4,000 rpm).

● means light ON. ○ means light OFF.

4. DESIGN

☐ Adjustment section
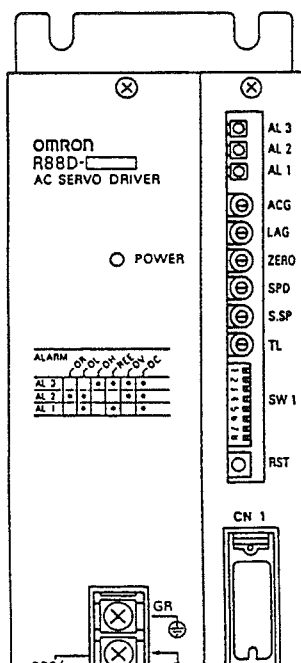
Indication	Volume	Function	Set value at factory
ACG	AC gain	Volume to adjust response characteristics. Adjust in compliance with load inertia.	"1"
LAG	Start correction	Volume to adjust overshoot and undershoot at start and stop.	"7"
ZERO	Zero balance	Volume to adjust motor rotation at 0 V speed command voltage.	Already adjusted to 0 rpm at 0 V.
SPD	Speed	Volume for speed adjustment. Applied to speed command (REF) input.	Set to 3,000 rpm at $\pm$ 10V
S.SP	Auxiliary speed	Volume to adjust auxiliary speed. Applied to aux. speed input.	Set to 3,000 rpm at $\pm$ 10V
TL	Torque limit	Volume to adjust current limit value for torque limit input.	Approx. 150 % of the rated torque.

Note 1: As for details of each adjustment, set item 5-3 "Adjustment."

Note 2: AGC and LAG are set so as not to vibrate at no load condition.

Note 3: Adjustment to optimum in compliance with load condition is required together with AC gain changeover (SW1-3, 4).

Note 4: Scale of adjustment volume dials are shown below.
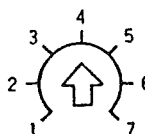
Setting of variable resistance and notch number.

☐ Setting section

Switch No.		Function	Set value at factory
SW1-1	Rotation direction change +	Switch to make motor rotates in forward direction by positive (+) speed command voltage.	ON
SW1-2	Rotation direction change -	Switch to make motor rotation direction reverse by positive (-) speed command voltage.	OFF
SW1-3	AC gain changeover	Changeover switch to adjust response characteristics. Set as the below in compliance with load inertia. To get optimum gain, adjust ACG and LAG volume.	OFF
SW1-4			OFF

Load inertia	SW1-3	SW1-4
Up 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

Switch No.		Function	Set value at factory
SW1-5	High range filter frequency changeover	Use this function if mechanical vibration noise does not stop with ACG volume adjustment.	OFF
SW1-6			OFF
SW1-7	Proportional control changeover	Switch to function the speed amplifier as proportional amplifier. To adjust proportional gain, use TL volume.	OFF
SW1-8	Dynamic brake	Switch to select dynamic brake function. It does not work with turning this switch ON.	ON
RST		Switch to release abnormal condition of the servo driver.	

Note 1: For adjustment details, see item 5-3.

Note 2. When both SW1-1 and 2 are set to ON or OFF, the motor cannot rotate. However, the motor may rotate slowly by drift of the servo driver.

4. DESIGN

☐ Terminal blocks for power source and motor

Sign	Name	Contents
GR	Ground	Case ground of the servo driver. Connect ground (earth) item 3 or up to improve noise-proof characteristics and secure safety.
200/220VAC	Power for control	Input terminal for control power.
280 VDC P N	Main circuit power	Input terminal for main circuit DC power. Supply DC voltage from a power unit.
MOTOR ABC	Connecting terminal for motor	Terminals to connect motor lines. Be sure not to misconnect any line. A: red B: white C: black
GR		Connect GR of the motor. GR: green

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.
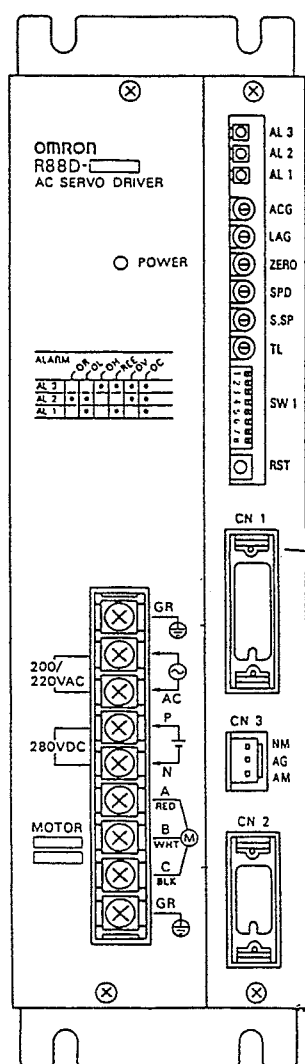
No.	Signal	Function
1	REF	Speed command input
2	AG	Analog ground
3	SREF	Aux. speed command
4	AG	Analog ground
5	AG	
6	EGND	Encoder signal ground Note 2
7	ALM1	Alarm output
8	ALM2	
9	SG	Shield ground
10	-	Note 1
11	-	NC
12	RUN	Operation ready command input
13	RESET	Alarm reset input
14	+A	Encoder A phase + output
15	-B	Encoder B phase - output
16	+Z	Encoder Z phase + output
17	-	Note 1
18	P15	+15 V output for speed setting
19	N15	-15 V output for speed setting
20	COM	+24 V common terminal for sequence
21	CLIM	Torque limit input
22	MING	Gain minimizing input
23	-A	Encoder A phase - output
24	+B	Encoder B phase + output
25	-Z	Encoder Z phase - output

Note 1: Do not connect to No. 10 and 17 pins.

Note 2: No. 6 pin (EGND) is ground for the encoder signal.

Do not connect shield ground and frame ground.
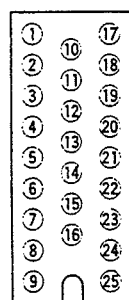
made by HONDA TSUSHIN KOGYO CO., LTD.
MR-25M (cable side)
MR-25L (cover)

4. DESIGN

□ Connector for motor signal

• Connector for motor signal (CN2)

Connector CN2 has terminals to input encoder and pole sensor signals.
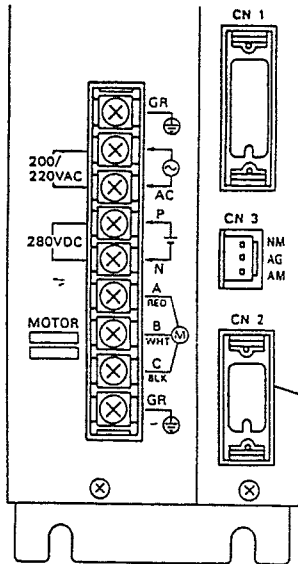
Connector for driver			Cable for motor		
No	Sign	Function	No	Cable dia.	Cable color
1	+5V	Encoder supply power +5VDC	H	AWG22	Red
2	+5V				
3	0V	GND terminal of encoder power	G	AWG22	Black
4	0V				
5	RG	Encoder return ground	A	AWG22	Gray
6	SG	Shield ground		Shield	
7	-	Note 1			
8	-	Note 1			
9	-	NC			
10	-	NC			
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.
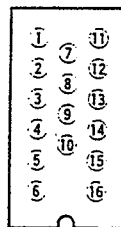
MR-16M (cable side)
MR-16L (cover)
made by HONDA TSUSHIN KOGYO CO., LTD.
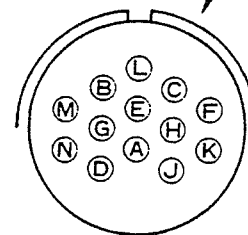
MS3106A20-11S (cable side)
MS3057A-12A (clamp)
made by AMPHENOL

□ Connector for monitor CN3

• Monitor terminal for motor rotation speed and current value.

JAPAN SOLDERLESS TERMINAL CO.,LTD.

VHR-3N (connector case)

LVH-21T (contact)

Sign	Function
NM	Speed monitor output
AG	Analog ground
AM	Current monitor output

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

Connector for motor signal
Made by AMPHENOL
MS3106A20-11S
(Cable side)
MS3057A-12A
(Cable cramp)

Connector for amateur
Made by AMPHENOL
MS3106A20-4S
(Cable side)
MS3057A-12A
(Cable cramp)

Connec-tor No.	Sign	Function	Cable	
			Cable size	Cable 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	
			Cable size	Cable 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	GR	Motor frame ground	AWG16 or up	Green

4. DESIGN

☐ Motor connector for 60W, 110W

Connector for motor signal
Made by JAPAN SOLDERLESS
TERMINAL MFG. CO., LTD
SMP-10V-NC
(Extension cable side: plug housing)
BHG-001GI-0.8BS (Contact socket)
Clamping tool: YC-12
Pull out tool: SMJ-06

Connector for amateur
Made by JAPAN SOLDERLESS
TERMINAL MFG. CO., LTD
MLP-04
(Extension cable side: plug
housing)
LLF-41T-1.3 (Contact socket)
Clamping tool: YC-7A
Pull out tool: LEJ-13

Pin No.	Cable color	Signal	Cable type
1	Red	+5V	AWG22
2	Black	0V	
3	Gray	RG	
4	Green	SG	
5	Blue	A+	AWG24
6	Orange	A-	
7	Pink	B+	
8	L. blue	B-	
9	Yellow	S+	
10	Brown	S-	

Pin No.	Cable color	Signal	Cable type
1	Red	A phase	AWG18 or up
2	White	B phase	
3	Black	C phase	
4	Green	GR	

☐ Connector for 60W, 110W motors with brake

Connector for motor signal
Made by JAPAN SOLDERLESS
TERMINAL MFG. CO., LTD
SMP-10V-NC
(Extension cable side: plug housing)
BHF-001GI-0.8BS (Contact socket)
Clamping tool: YC12
Pull out tool: SMJ-06

Connector for amateur
Made by JAPAN SOLDERLESS
TERMINAL MFG. CO., LTD
MLP-06
(Extension cable side: plug
housing)
LLF-41T-1.3 (Contact socket)
Clamping tool: YC-7A
Pull out tool: LEJ-13

Pin No.	Cable color	Signal	Cable type
1	Red	+5V	AWG22
2	Black	0V	
3	Gray	RG	
4	Green	SG	
5	Blue	A+	AWG24
6	Orange	A-	
7	Pink	B+	
8	L. blue	B-	
9	Yellow	S+	
10	Brown	S-	

Pin No.	Cable color	Signal	Cable type
1	Red	A phase	AWG18 or up
2	White	B phase	
3	Black	C phase	
4	Green	GR	
5	Blue	Brake	
6	Yellow	Brake	

4-17

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 one second or more after control power and main power are turned 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.

Note 7: Do not install contactors in the main circuit DC power (between the power unit and the driver).

4. DESIGN

□ Control input interface

Name of signal	Function	Specification	Interface
Speed command voltage (REF)	Motor rotates in accordance with speed command voltage. Forward rotation by +. Reverse rotation by -. To change rotation direction without changing polarity, set short pin SP101 between "C" and "-." Inside command voltage P15 and N15 is usable as speed command voltage.	±3,000 rpm at command voltage ±10V	
Aux. speed command voltage (SREF)	Add or reduce speed command voltage and to be used as synchronous control with multiple motors. Forward rotation by +. When speed command voltage is relatively low, use this terminal. Motor get ±3,000 rpm between ±3 to ±10 V.	±3,000 rpm at command voltage ±10V	
Run command (RUN)	Inputting run command, the driver turns to operation condition.		
Alarm reset (RESET)	The driver shut off operation signal by actuation of error detection circuit. To release this condition, the reset signal is used. Before reset, check indication LED.		
Torque limit (CLIM)	ON: This signal limits supply current to motor to preset value by "TL" volume.	Input voltage: 24VDC, 12 mA	
Minimizing gain (MING)	ON: This signal is used for minimizing the vibration of servo motor. However, this signal decrease servo lock power as gain of speed amplifier decreases.		
Positive common input for sequence (COM)	24 V sequence + common input.		

☐ **Control output interface**

Name of signal	Function	Specification	Interface
Alarm output (ALM1) (ALM2)	Contactor output. Open at abnormal condition. It also opens while the reset signal is input.	Rated contact load: 24 VDC, 0.5A At inductance load: 24 VDC, 0.3 A cosø = 0.4 L/R = 7 ms.	
Built-in command voltage (P15, N15)	Volume for speed command setting. By connecting an external volume, this voltage is useful as speed command voltage. Output current should be less than 5 mA.		
Speed monitor output (NM)	This is an output to monitor the speed of servo motor and comes from F/V voltage. Take care that this output has approx. ± 10% allowance.	CCW +7.5 V CW - 7.5 V at 3,000 rpm	
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.Take care that this output has approx.±20% allowance.	±12 V at the instant max.	
GND for monitor (AG)	Ground for monitor signal		
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 the lines according to its polarity.	EIA-RS-422 or equivalent	

4. DESIGN

4-3-2 Usage at 100 vAC input

Input power voltage of servo drivers are unified to 200 V. However, operation with 100 vAC using R88S-R203 and R88S-R205 power units is available. Then connection diagram is shown below.

When an alarm occurs at the servo driver with the connection above, be sure to turn OFF RUN command.

Model	Allowable regenerative energy	Average regenerative power
R88S-R203	28J	8W
R88S-R205	55J	12W

Note 1: Control power input is usable 220 to 360 VDC.

Note 2: Use servo drivers not to exceed control power input voltage more than 360 VDC.

When regenerative energy exceeds the values shown in the table at previous page, use R88S-R203, R88S-R205, or 88A-RG50, and connect referring the connection figure below.
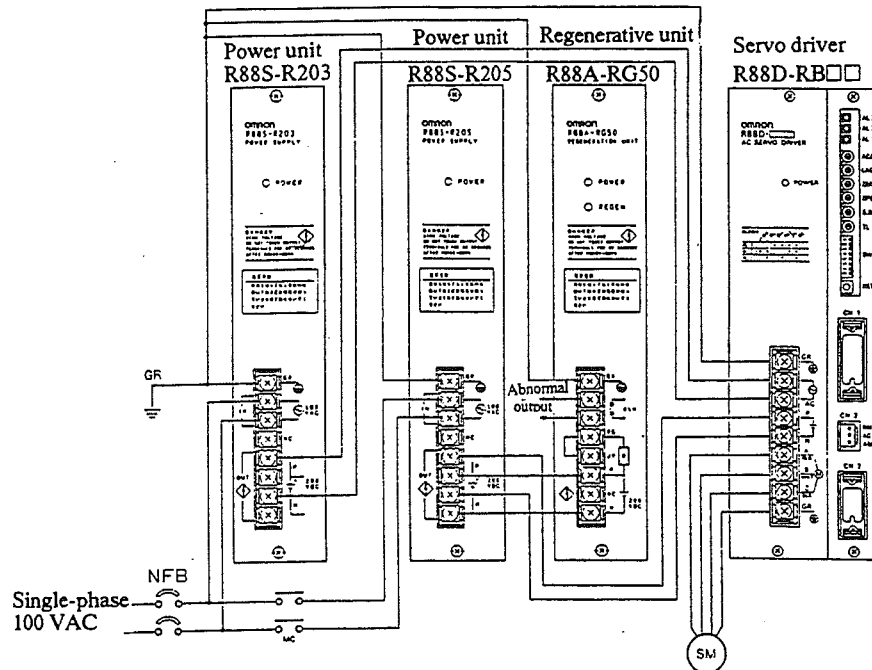
Note: Input the alarm output from the regenerative unit to the upper controller, and use as MC control of main circuit power input together with the servo driver alarm output.

4. DESIGN

4.3.3 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) Surge absorber (ZNR)

Model	Current	Mfg.
EZR-A20EL471	5 kA	MATSUSHITA ELECTRIC
EZR-A25EL471	10 kA	
EZR-A32EL471	20 kA	

(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. DESIGN

4.3.4 Calculation of regenerative energy

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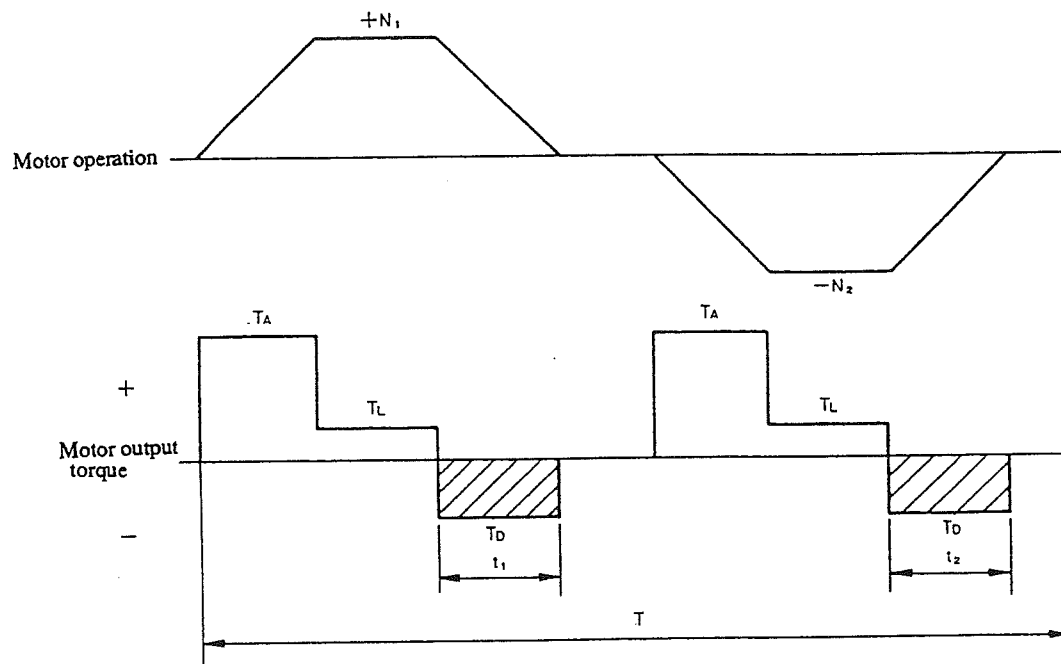
As shown above, regenerative energy occurs when motor output torque becomes negative. Regenerative energy in each section is given in the formula below:

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

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

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

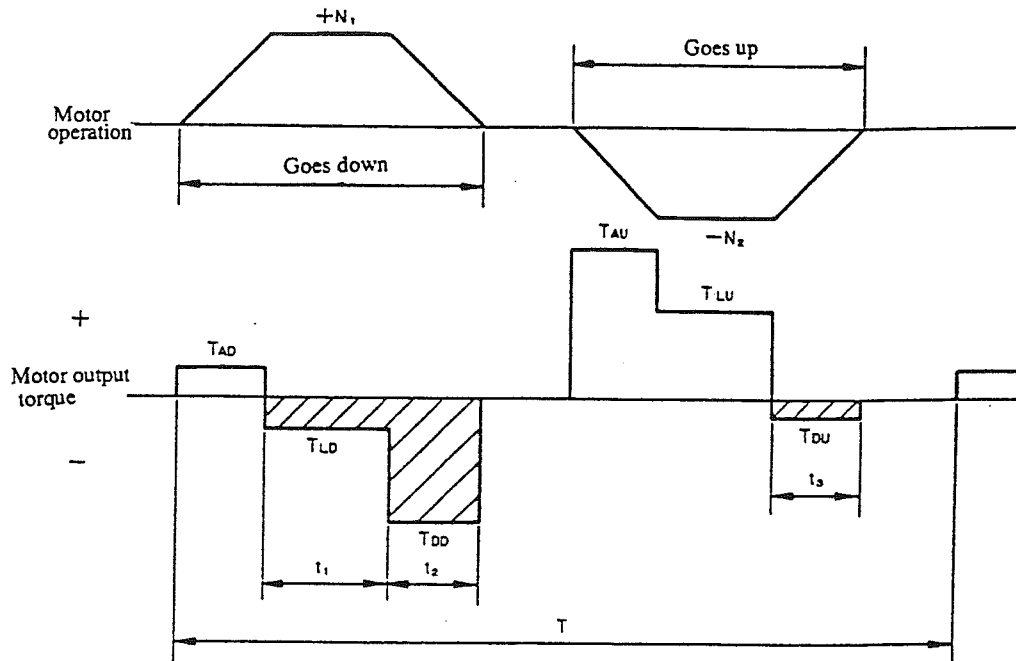T_D : Required deceleration torque (kgf·cm)

t_1, t_2 : Deceleration interval (s)

Average regenerative power is given in the formula below:

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

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

(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:

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

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

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

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. DESIGN

4.3.5 Absorption of regenerative energy

To absorb regenerative energy, use the exclusive regenerative units or regenerative power absorption circuit integrated power units.

• Power unit

Model	Input voltage	Allowable regenerative energy	Average regenerative power	Output current
R88S-R203	100 VAC	30 J	8 W	3 A
R88S-R205	100 VAC	60 J	12 W	5 A
R88S-R305	200 VAC	20 J	5 W	6 A
R88S-R310	200 VAC	40 J	10 W	10 A
R88S-R310G	200 VAC	200 J	20 W	10 A
R88S-R315	200 VAC	65 J	15 W	15 A

• Regenerative unit

Model	Allowable regenerative energy	Average regenerative power
R88A-RG50	250 J	40 W

Power units other than R88-S-R310, which has built-in regenerative power absorption circuit, are equipped with condensers to absorb regenerative energy.
When regenerative energy exceeds the allowable amount, speed down motor rotation or make longer deceleration interval.
Note: 1W = 1 J/S, 1 cal. = 4.2 J

5.1 Unpacking

□ **AC servo driver**

• Check the following items soon after opening the package.

Check whether the delivered goods are different from those ordered.

Check whether the combination of servo motors and servo drivers are correct by referring to Item 1, 1-2.

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

Accessories

CN1	connector plug	MR-25M	1 pc.
CN1	connector case	MR-25L	1 pc.
CN2	connector plug	MR-16M	1 pc.
CN2	connector case	MR-16L	1 pc.
CN3	Connector terminal	LVH-21T-P1.1	3 pcs.
CN3	Connector case	VHR-3N	1 pc.
Fixing metal			2 pcs.
Fixing screw		M4x6	4 pcs.
Instruction Manual			1 set

□ **AC servo motor**

Installation Manual   1 set

5. USAGE

5.2 Trial Operation

□ **Check items before operation.**

Confirm the following before start operations

1	Supplied power should be 170 to 242 VAC, 50/60 Hz.
2	Prepare a circuit to turn OFF 200 VAC of the power unit automatically when the servo driver or the power unit supplies servo alarm signals.
3	Remove the motor from machine during the trial operation. When it is installed, be ready to stop the motor anytime. Confirm that no one is near the machine.

• Changing rotation direction.

Changing rotation direction is done by switching No. 1 and No.2 of SW1 on the front panel.When positive (+) voltage is supplied to speed command, the motor rotates forward direction with the switch No.1 side, and backward direction with No.2 side.

(1) Check that the run signal (RUN) is not input and speed command voltage (REF) is 0 V. Otherwise, the motor rotates too 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 on control power input terminal (AC).

(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 command (RUN) signal.

With inputting RUN signal, the motor has holding torque.

If command pulse is supplied, be sure that motor rotates soon after inputting RUN signal.Even if speed command voltage is 0 V, the motor may rotate quite slowly by drift inside the servo driver. In this case, adjust zero balance volume to eliminate drift.

(7) Input command voltage

Gradually raise speed command voltage starting at 0 V, and check whether the motor is rotating smoothly in proportion to voltage raise.

When SW1 is ON, the motor rotates forward direction with positive (+) voltage, and backward direction with negative (-) voltage.

When SW2 is ON, the motor rotates backward direction with positive (+) voltage, and forward direction with negative (-) voltage.

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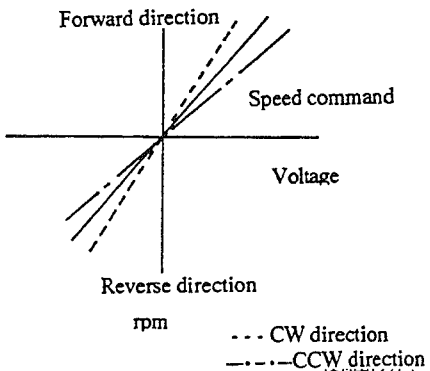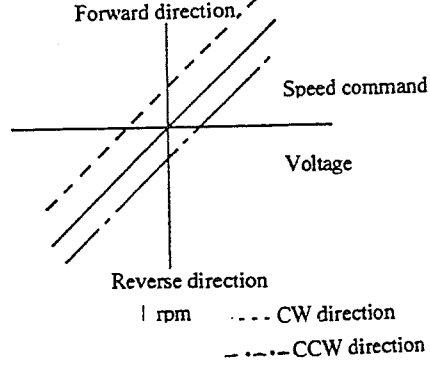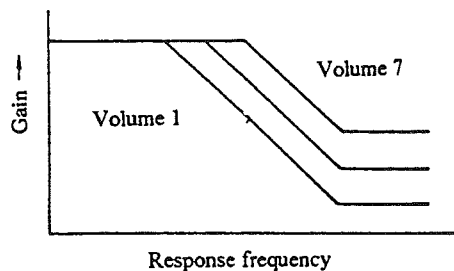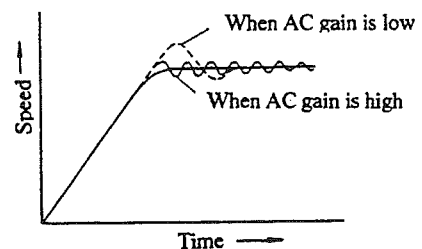
(9) Confirm other functions below...

• Gain minimizing (MING)	Decrease vibration of the servo motor. Servo lock power is weakened.
• Torque limit (CLIM)	Turn the torque limit volume (TL) toward CCW direction and check that motor torque is decreased.
• Alarm reset (RESET)	Check that after protection circuit - such as emergency input etc.- works, alarm condition is released by RESET input.

After confirmation of above, operate the motor with the rated operation cycle.
Check heat condition of the motor and driver after 2 to 3 hours of operation.
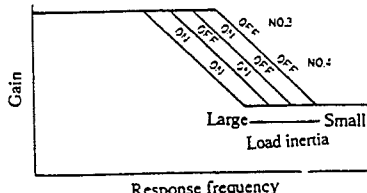
5. USAGE

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
Speed (SPD) Aux. speed (S.SP)	Adjust motor rotation speed Adjusted to get the rated rpm at speed command ± 10 V. To increase speed, turn volumes CW direction.	
Zero balance (ZERO)	Zero adjustment Adjust the motor rotation to almost zero at speed command 0 V.	
AC gain (ACG)	AC gain adjustment This is used to adjust response characteristics. Adjust in accordance with load inertia. To monitor response characteristics, use speed monitor signal.	AC gain increase and improves frequency characteristics by turning the volume in a clockwise direction. In case of a small load inertia, decrease the AC gain and vice-versa to minimize overshoot and undershoot. Too much AC gain causes vibration and an unstable condition for the motor.

Name of volume SW	Functions	Vibration by adjustment
Acceleration correction (LAG)	Acceleration correction Together with AC gain, adjust acceleration characteristics. It adjusts phase and gain at high range.	This volume improves response characteristics by increasing this value when the load rigidity is high enough. However, this is not effective when the load rigidity is low. Adjust within a range that does not cause vibration during rotation.
Torque control (TL)	This torque control is engaged by CLIM signal, and the maximum current value is limited by this setting value. (Switching ON bit 7 of the changeover SW1 makes variable proportional control gain by a variable resistance.)	Increase the setting value by turning the volume in the CW direction. Maximum setting is instantaneous maximum torque.
Rotation direction changeover SW-1 No.1 No.2	SW1-1 ON SW1-2 OFF Forward rotation by positive voltage. Reverse rotation by negative voltage. SW1-1 OFF SW1-2 ON Reverse rotation by positive voltage. Forward rotation by negative voltage.	When SW1-1, 1-2, both switch is turned ON or OFF, the motor cannot rotate.
AC gain changeover SW-1 No.3 No.4	This is a switch to adjust response characteristics. Adjust with load inertia. See the table at right for reference.	<table><tr><td>Load inertia</td><td>No.3</td><td>No.4</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 the AC gain volume.
Frequency changeover of high range filter.SW-1 No.5 No.6	When mechanical vibration and gain abnormal sound do not stop after adjustment, turn ON process 1 and process 2 switches orderly.	<table><tr><td>Process</td><td>No.5</td><td>No.6</td></tr><tr><td>Process 1</td><td>ON</td><td>OFF</td></tr><tr><td>Process 2</td><td>ON</td><td>ON</td></tr></table>
Proportional control changeover SW-1 No.7	Turning ON this switch makes variable proportional control gain by the TL volume.This is useful at proportional control.	
Dynamic brake SW-1 No.8	Select dynamic brake function between effective and ineffective.	SW1-8 ON: Ineffective brake function OFF: Effective brake function

The AC gain changeover reference graph shows Gain (vertical axis) vs Response frequency (horizontal axis) with No.2 and No.1 curves, ON/OFF markings, and Load inertia ranging from Large to Small.

6. MAINTENANCE

6.1 Protective and Check Functions

LED on the display section indicates operation and abnormal conditions of the servo driver.
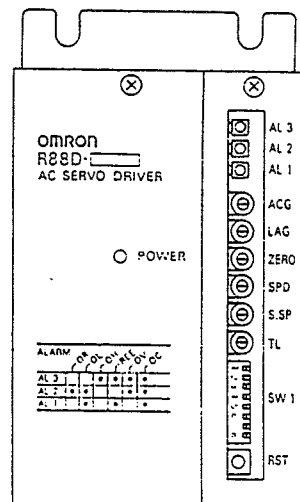
□ Green LED

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

☐ Red LED

Protective	Indicating LED			Function	Causes
	3	2	1		
Main circuit fuse (OC)	●	●	●	When an overcurrent is supplied to the main circuit, FUSE blows and opens circuit connection.	Short circuit inverter output.
Overcurrent detection (OC)	●	●	●	The driver detects when the DC main circuit receives overcurrent and shut off the inverter.	Short circuit inverter output.
Overvoltage protection (OV)	●	●	○	When main circuit voltage exceeds the rated value due to regenerative energy at motor deceleration, the inverter is shut off.	Much load inertia
Encoder signal disconnection detection (REE)	●	○	●	When encoder signal line or power line is disconnected, or motor overheats, the inverter is shut off.	Signal mis-wiring Signal line disconnection Motor overload
Temp. rise of radiation fin (OH)	●	○	○	The driver shuts off the inverter when temperature of the inverter radiation fin raise over the rated value	High driver environmental temperature. Too much load torque.
Overload protection (OL)	○	●	●	When much current due to overload flows longer than the rated time, the inverter is shut off.	Too much load torque.
Overspeed detection (OR)	○	●	○	The driver shuts off the inverter when the motor exceeds the rated speed.	The motor rotates with more than the rated speed.
Abnormal power				The driver shuts off the inverter when power is lower it voltage than the rated value.	Voltage down of supplied power.
Instantaneous stoppage of the power supply				The driver shuts off the inverter at the power failure for more than 40 msec.	Instantaneous power failure of control circuit.
Control power FUSE				The temp. FUSE is brown with high current to the control circuit. All indication turns OFF.	Malfunction in the control circuit.

● means light ON.   ○ means light OFF.

In order to protect the servo driver and servo motor, the above protective circuits are integrated. When a protective circuit works, the driver stops operation and supplies servo abnormal signal.

6. MAINTENANCE

## ☐ Alarm contactor output

• Contactor section

Load condition	Resistance load cosφ = 1.0	Induction load cosφ = 0.4 Load L/R = 7 ms
Rated load	24 VDC, 0.5 A	24 VDC, 0.3A

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

Time chart of servo driver power and at abnormal condition are shown below:

1) When power is input, the driver shut off RUN signal inside the unit until each power becomes normal level. This shut off interval is 400 to 500 ms.

2) When power failure interval is more than 40 ms., the unit detects and shut off RUN signal. Recovery interval is 400 to 500 ms.

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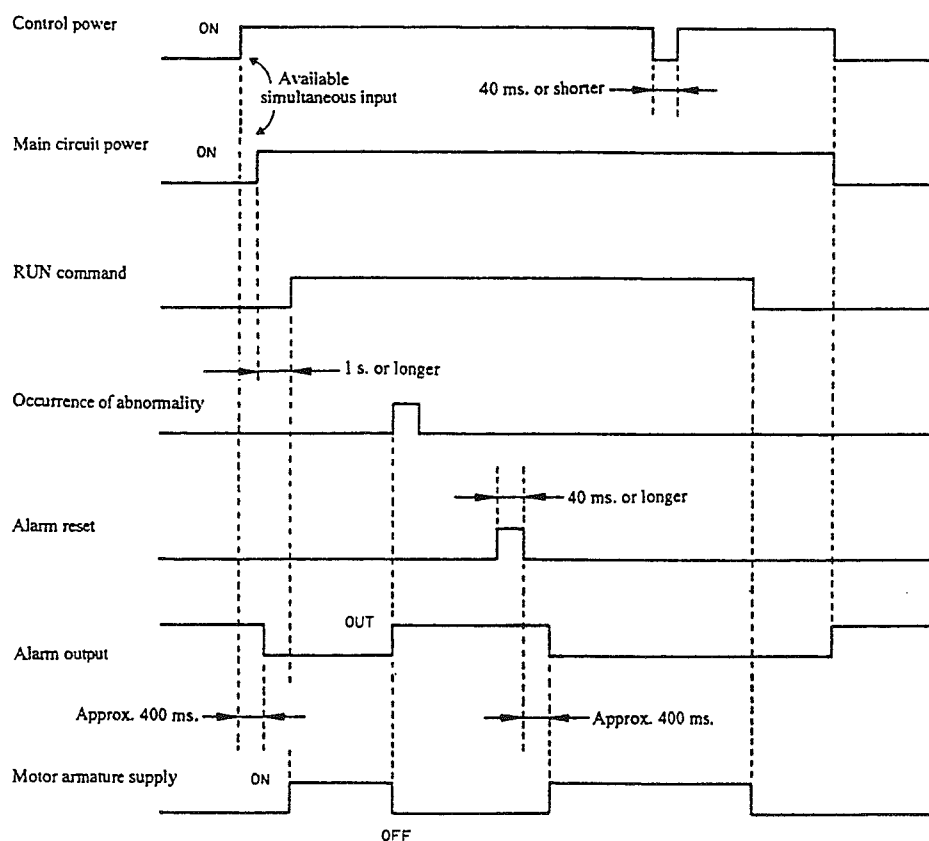
Alarm signals output through relay contacts. It takes approx. 10 ms. to supply alarm output as relay output after the alarm occurs inside of the unit.

□ Cautions at alarm output

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

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

    The contactor closes after approx. 400 ms. of control power ON.

2. The unit shuts off RUN signal together with alarm output.

    Do not actuate the inside dynamic brake more than one time within 5 minutes, or the inside resistance may burn out.

3. Alarms are released by reset button, reset signal, and the re-input of control power.

    When the unit receives reset signal or power ON while inputting RUN command, make sure it has been in operation for approx. 400 ms.

4. When an abnormal signal outputs, turn OFF the driving power input and operation command input.

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

> When an overload (OL) occurs, an abnormality in the mechanical section may be the cause. Check the mechanical section. Do not supply power more than 10 minutes after this alarm condition. Repeated overload may cause burnout in the motor coil.

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

□ Dynamic brake sequence

Operation time of the dynamic brake is shown below:
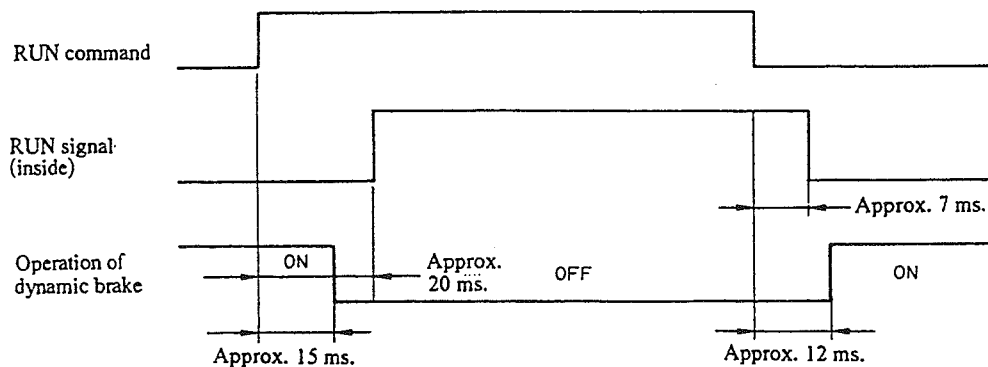
6. MAINTENANCE

6.2 Maintenance

☐ Daily check

Confirm for 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 and 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.

6.3 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
OC operation	Fuse in main circuit	Blow fuse with overcurrent in DC main circuit.	Short circuit or ground between driver and motor.
	Detect overcurrent	Inverter is shut off with overcurrent in DC main circuit.	Short circuit or ground between driver and motor.
OV operation	Overvoltage protection	Inverter is shuts off with more than 380 VDC in main circuit power due to regenerative energy.	Too much load inertia. Too high input voltage. Miswiring of A, B, C phase, and GR.
OL operation	Electronics thermal protection	Inverter is shut off when overcurrent than the rated is supplied to the motor longer than the rated interval.	Too much load inertia. Mechanical lock of motor shaft. Miswiring between A, B, and C phase.

Note) Prior to release from over load alarm condition, cool down the servo driver and motor more than 10 minutes. Immediate releases from the alarm and repeated restart may damage the motor coil.

OH operation	Temp rise of radiation fin	Inverter is shut off with rising temp. of inverter radiation fin.	Too much load torque. High temperature around the servo driver.
OR operation	Overspeed detection	Inverter is shut off with more than rated value of motor speed.	Motor rotates exceeding the rated speed (4,000 rpm).
REE operation	Encoder line	Inverter is shut off with disconnection of encoder signal lines or power lines.	Encoder line disconnected. Miswiring.
	Motor overload protection	Inverter is shut off by encoder inside temp. rises exceeding 85°C.	Too much load torque. Increasing of motor temp.

└─── Contact our service department.

6. MAINTENANCE

☐ 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 to indicate wear in 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 gain increases too much.

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

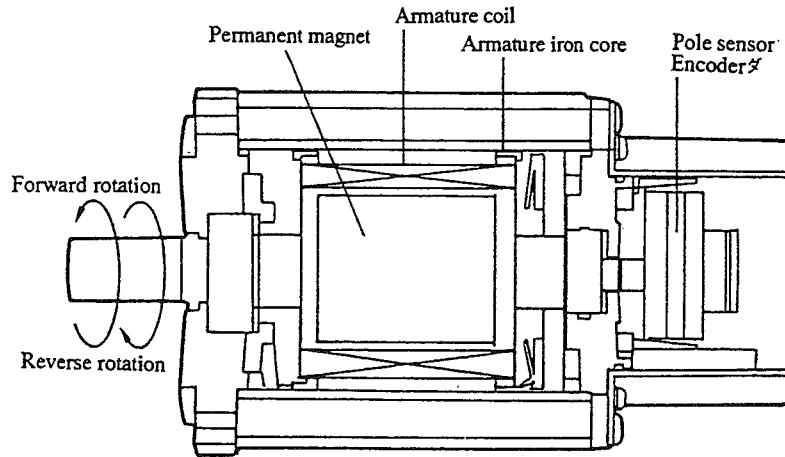# 7. CONFIGURATION, CONSTRUCTION AND OPERATION PRINCIPLE

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

7. CONFIGURATION, CONSTRUCTION AND OPERATION PRINCPLE

- **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 PPR for control motor speed and positioning.

□ Inner configuration