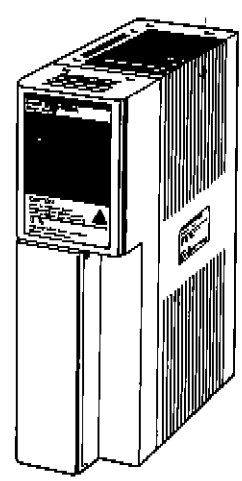
Cat. No. I509-E1-1A

OMRON

USER'S MANUAL



OMNUC H SERIES

MODEL: R88S-H205G/-H306G/-H310G

POWER UNIT FOR SERVO MOTOR

Thank you for choosing OMNUC H series products. But please note: improper use and handling will adversely affect product performance and may cause unanticipated accidents or shorten the product's life.
We ask you to read this manual thoroughly and handle and operate the unit carefully.

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.

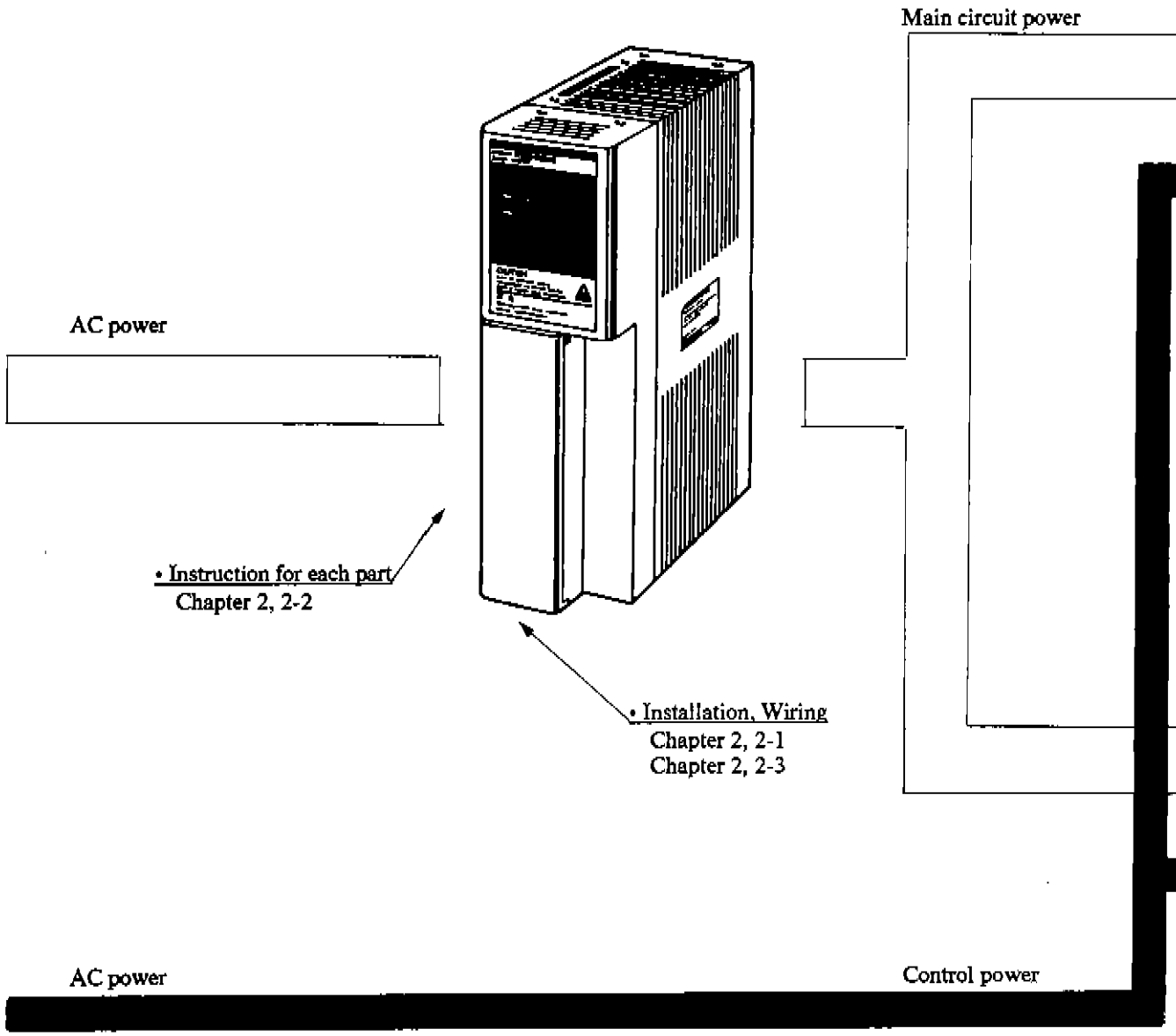
Check items before unpacking

- Check following points before removing package:
  - Delivered unit is exactly as ordered.
  - No damage caused during transportation.
  - No looseness of any screw or bolt.
  - Accessories are correctly delivered together with or attached to unit.
- Check that below accessories are delivered:

2 pcs of fitting metals
4 pcs. of fixing screws
Fuse for exchange
1 pc. of Model R88S-H205G 20A
2 pcs. of Model R88S-H306G 10A
2 pcs. of Model R88S-H310G 15A
1 volume of Instruction Book

VISUAL INDEX

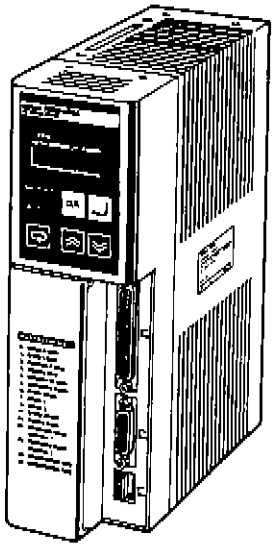
OMNUC H series
Power Unit



User's Manuals for OMNUC H series
☐ User's Manual for OMNUC H series AC Servo Driver.
☐ User's Manual for OMNUC H series Power Unit.

OMNUC H series Power Unit

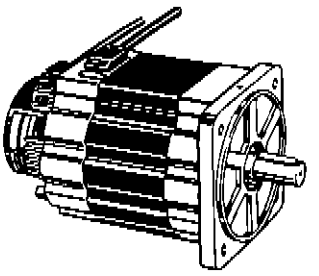
OMNUC H series
AC Servo Driver

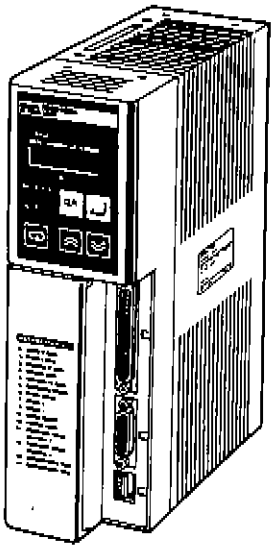


OMNUC H series
AC servo motor

Encoder signal

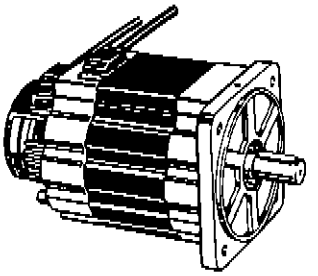
Power signal





Encoder signal

Power signal



How to select Power Unit	
☐ Selection of Power	Chapter 6, 6-1

Treatment at abnormality	
☐ Protection functions	Chapter 4, 4-1
☐ Troubleshooting	Chapter 4, 4-2

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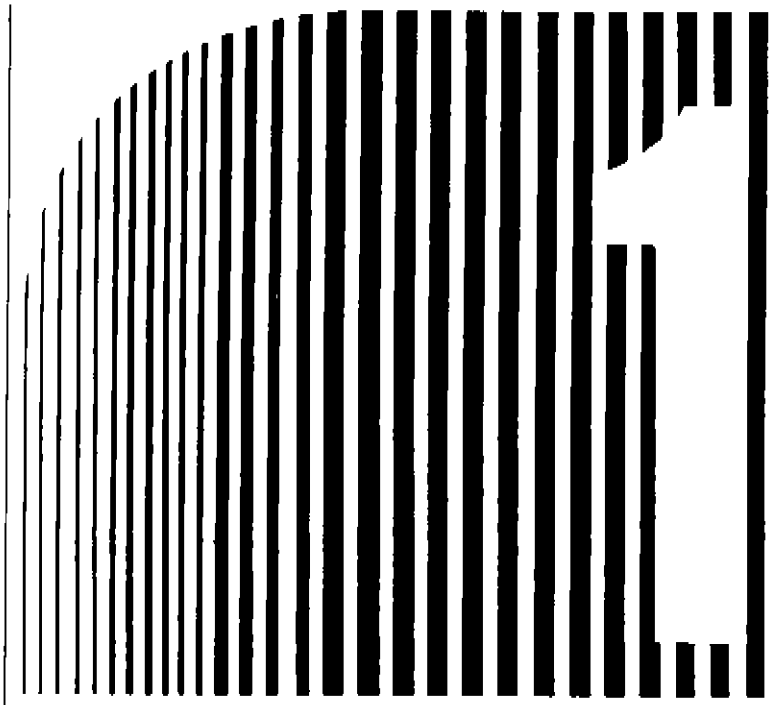


Chapter 1

• Outline •

Chapter 1. Outline

OMNUC H series Power Module has variations of the following models in compliance with rated input voltage and output voltage.

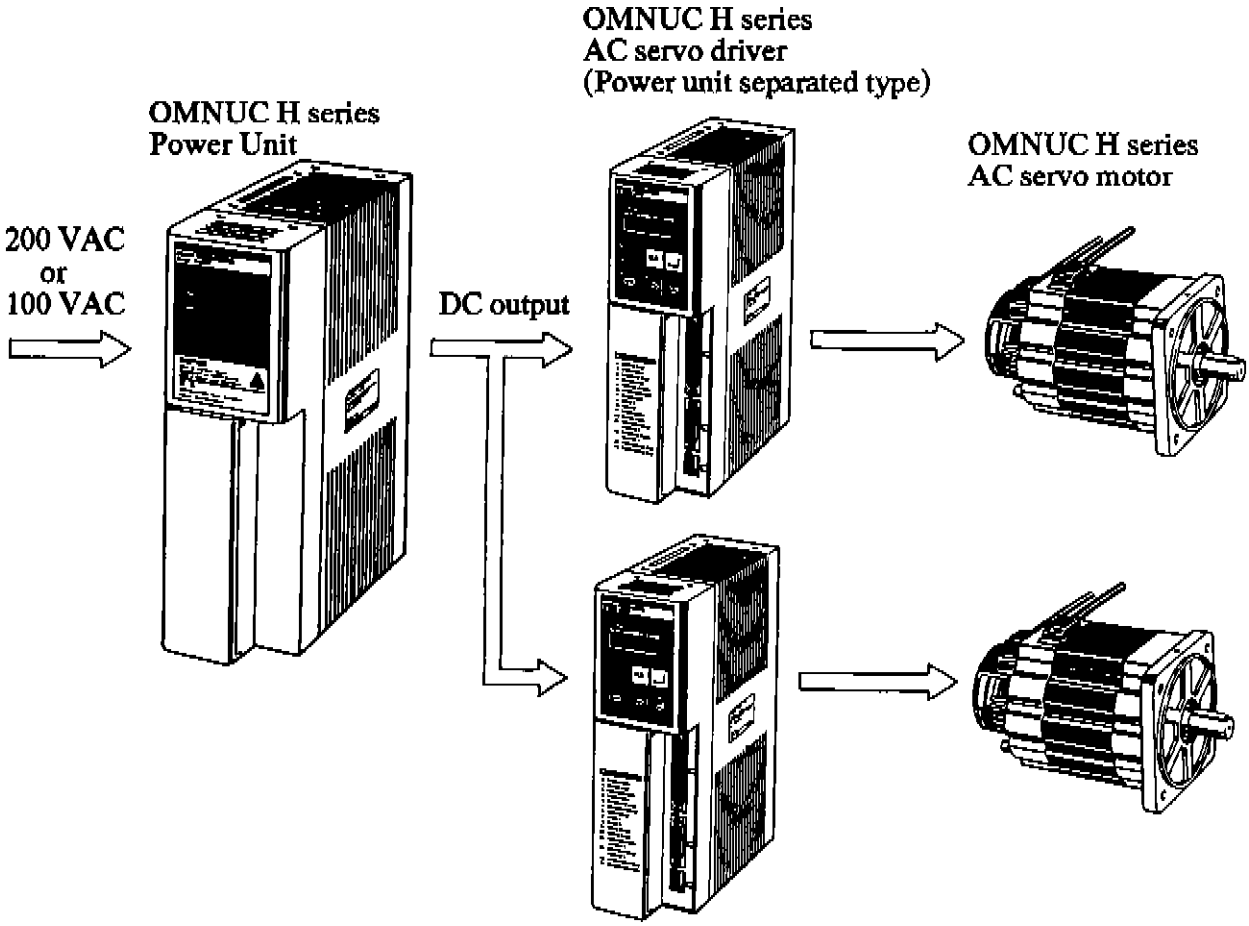
Model	Input voltage	Output current
R88S-H205G	100V, single-phase	5A
R88S-H306G	200V, 3-phase or	6A (3A)
R88S-H310G	Single-phase	11A (5A)

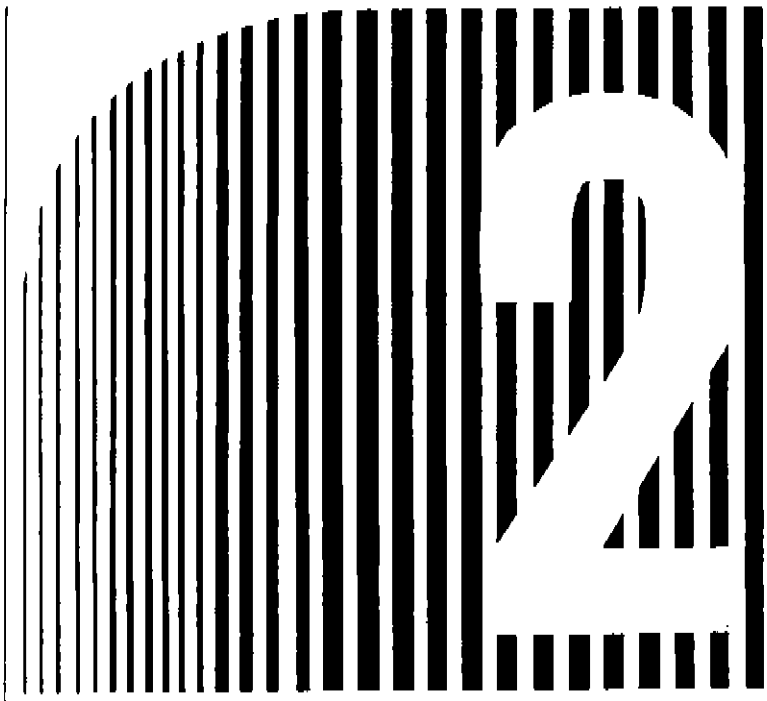
Figures in ( ) refer to output current at single-phase input.

■ Feature of Power Module

(1) No need to provide a transformer on input power line as units have rush current preventive circuit.
(2) Small ripple voltage thanks to large capacity smoothing capacitor (decreased torque ripple and beat phenomena).
(3) Optimum configuration of each system available by getting suitable input voltage and output current unit.
(4) Regenerative power absorbing circuit is provided for each model.

■ System Configuration





Chapter 2

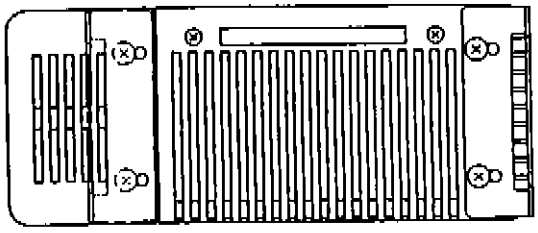
• Planning •

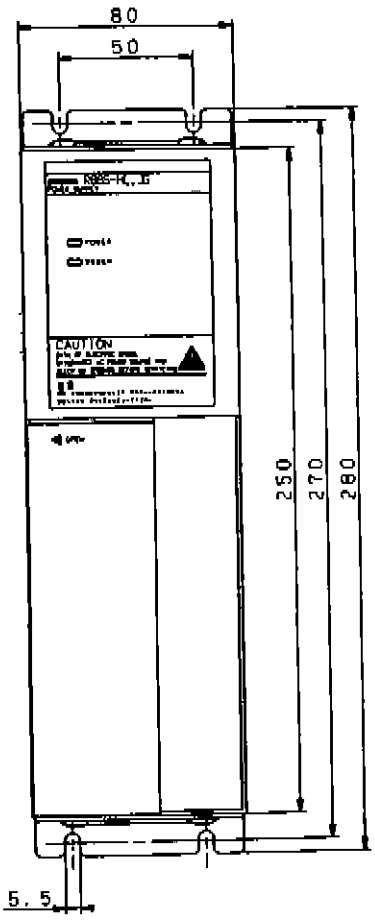
Chapter 2. Planning

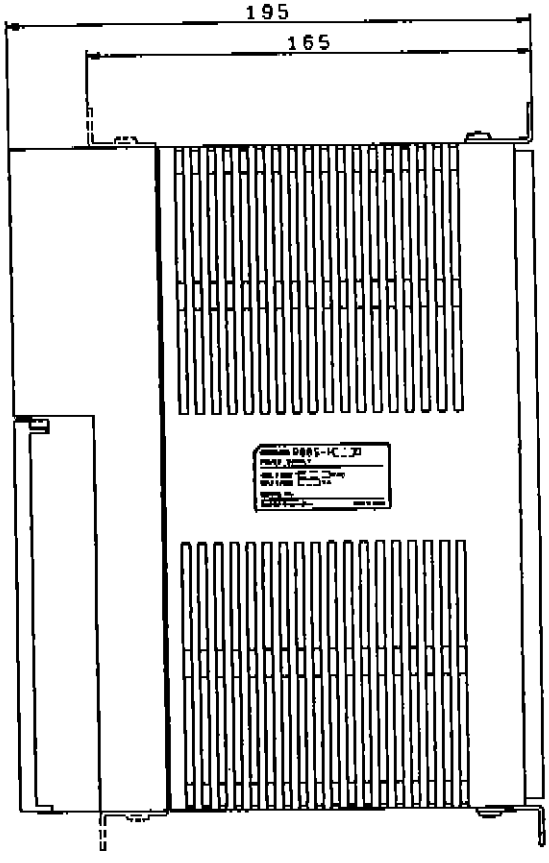
2-1 Installation

2-1-1 Outside Dimensions (R88S-H205G, R88S-H306G, R88S-H310G)

- **Outside dimensions**

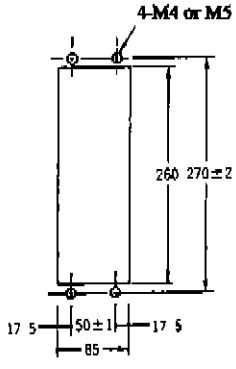




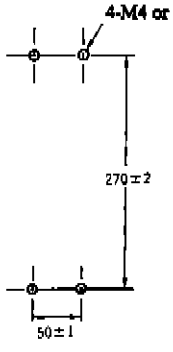


- **Installation dimensions**

  • Installation dimensions into a panel



  • Installation dimensions on a wall



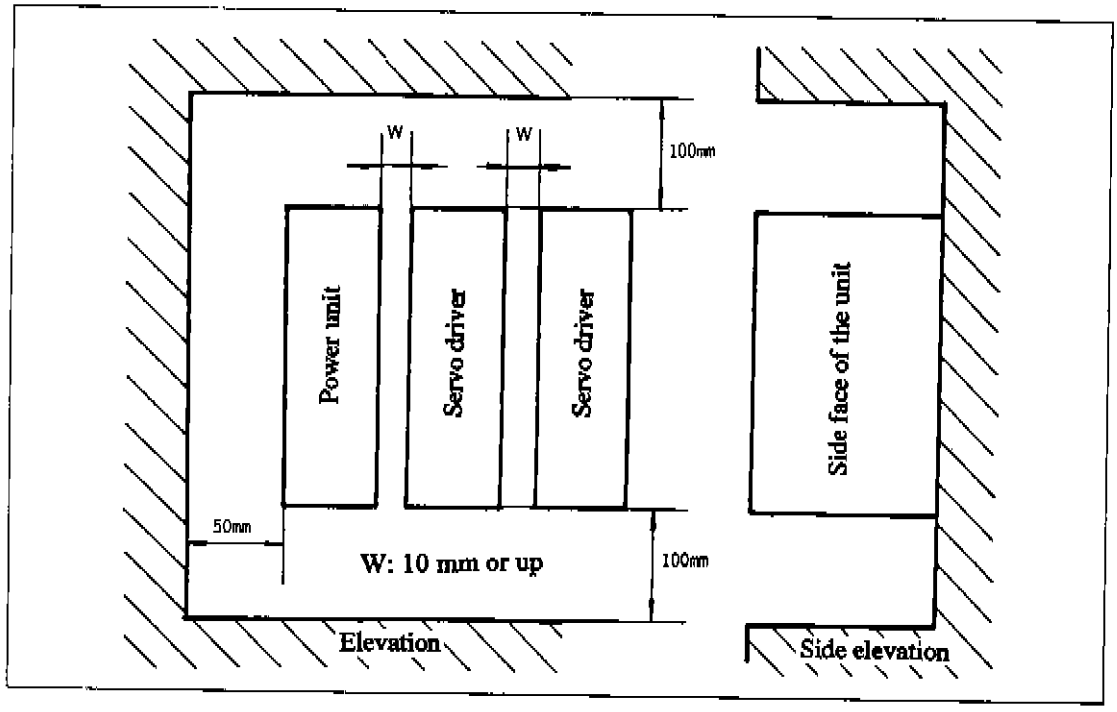
2-1-2 Installation Condition

(1) Operation environmental conditions

Operation environmental temperature:	0 to + 55°C
Operation 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)

(2) Space around the drivers

- When you install the power unit, note the dimensions below considering heat radiation from inside drivers.
- Install the power unit in a direction such that their model names are readable (vertical direction).



(3) Environmental temperature control

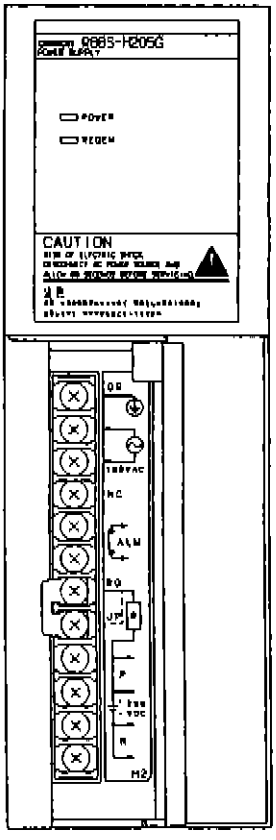
- When the power unit is installed in an enclosure such as a control box, provide a cooling fan or air conditioner to ensure that environmental temperature of each unit does not exceed +55°C.
- In order to enhance reliability of the drivers, we recommend that you use them where temperature does not rise.
- Surface of the power unit may raise temperature 30° compared with environmental temperature. Devices and wirings to be affected by thermal attack should be installed separate from the power unit.

(4) Prohibition of obstacle intrusion

- Take measures such as covering the power unit so that metal chips do not enter the unit by drilling while installation work. (Be sure to take out covers after works for thermal radiation.)
- Take care during installation and operation that metal powders, oil, water, etc. do not enter into the power unit.

2-2 Explanation of Each Part

■ R88S-H205G (100 VAC input type)



• Display section

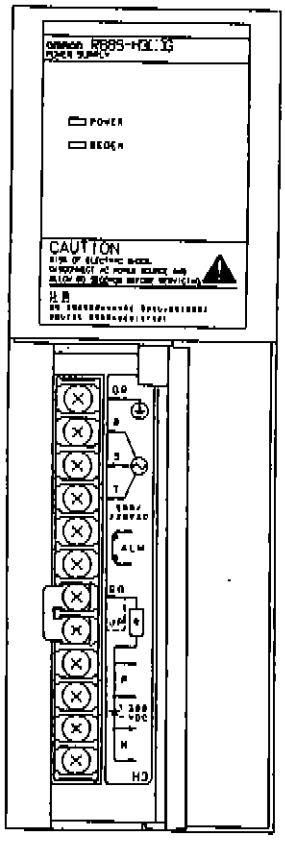
Display sign	Name	Description
POWER	Power indication	Lights ON when voltage outputs between P and N. To access the terminal, wait at least one minute after this green LED lights OFF and input 100 VAC is disconnected.
REGEN	Indication of regenerative operation	When voltage rises between P and N due to motor regenerative operation. To lower voltage, regenerative circuit works. This LED lights when current flows to the regenerative resistance.

• Terminal section

Display sign	Name	Description
GR	Frame ground	Frame ground of the unit. Connect this terminal with low impedance earth (item 3 or up).
100 VAC	Main circuit AC power input	AC power input of main circuit. Supply power within 85 and 127 VAC. Use 2 mm^2 cable as 400% of output current flows.
ALM	Alarm output	This contact opens when temperature of the unit radiation fin exceeds 85 ± 3°C.
RG	External regenerative resistance connection terminal	When a separate regenerative resistance is installed outside the unit, connect it with this terminal and P. Be sure to remove a short bar between described in the below column.
JP	Inside regenerative resistance terminal	Terminal for the inside regenerative resistance. Prior to using this resistance, be sure to short JP and RG with short bar. At delivery, this is shorted.
P, N 280 VDC	Main circuit DC power output	Main circuit DC power output to servo drivers. "P" as positive, "N" as negative outputs. Be careful that this terminal supplies × $2\sqrt{2}$ (240 to 350 VDC) of input voltage.

Caution: Be sure not to misconnect short circuit output terminals and P and N terminals. When output terminals are shorted, a fuse inside the unit may blow out or the unit may be damaged. When P and N are connected in reverse, output transistor module of servo driver may be broken.

■ R88S-H306G/-H310G (200/220 VAC input type)



• Display section

Display sign	Name	Description
POWER	Power indication	Lights ON when voltage outputs between P and N. To access the terminal, wait at least one minute after this green LED lights OFF and input 200 VAC is disconnected.
REGEN	Indication of regenerative operation	When voltage rises between P and N due to motor regenerative operation. To lower voltage, regenerative circuit works. This LED lights when current flows to the regenerative resistance.

• Terminal section

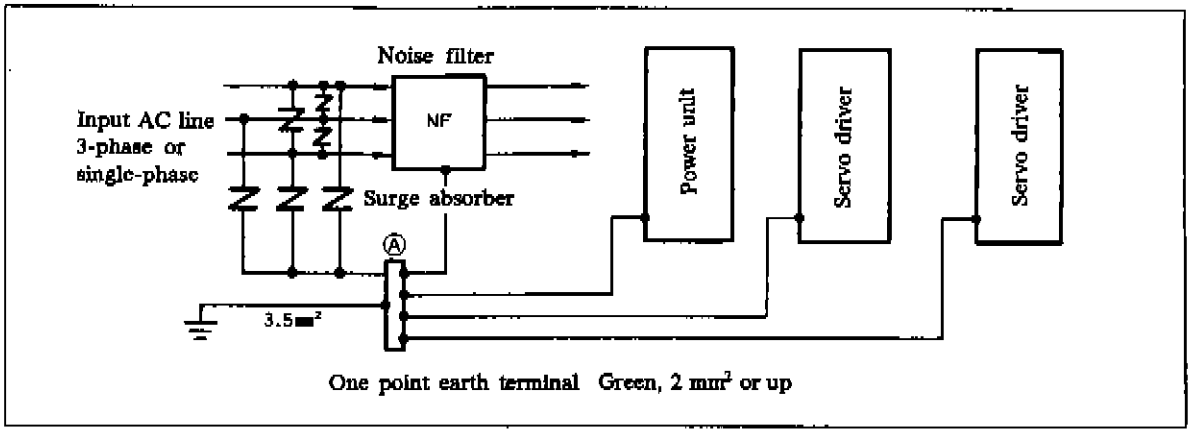
Display sign	Name	Description
GR	Frame ground	Frame ground of the unit. Connect this terminal with low impedance earth (item 3 or up).
R, S, T 200/220 VAC	Main circuit AC power input	AC power input of main circuit. Supply power within 170 and 253 VAC.
ALM	Alarm output	This contact opens when temperature of the unit radiation fin exceeds 85 ± 3°C.
RG	External regenerative resistance connection terminal	When a separate regenerative resistance is installed outside the unit, connect it with this terminal and P. Be sure to remove a short bar between JP and RG described in the below column.
JP	Inside regenerative resistance terminal	Terminal for the inside regenerative resistance. Prior to using this resistance, be sure to short JP and RG with short bar. At delivery, it is shorted.
P, N 280 VDC	Main circuit DC power output	Main circuit DC power output to servo drivers. "P" as positive, "N" as negative outputs. Be careful that this terminal supplies × $\sqrt{2}$ (240 to 350 VDC) of input voltage.

Caution: Be sure not to misconnect short circuit output terminals and P and N terminals. When output terminals are shorted, a fuse inside the unit may blow out or the unit may be damaged. When P and N are connected in reverse, output transistor module of servo driver may be broken.

2-2-1 Wiring

(1) Earth line

Wire ground line as follows so that the total system improves noiseproof characteristics



Note 1: Do not insert earthing line into the same ducts of signal lines, nor bundle them together.

Note 2: In case of wiring in metal conduits and ducts, connect metal body with Ⓐ.

(2) Wiring and cable size.

Connection terminal	Name	Cable size	Color
R, S, T	Main circuit power input	2.0 mm^2	Yellow
P, N	Main circuit DC power output	2.0 mm^2	P: Red N: Blue or black
RG	External regenerative resistance	1.25 mm^2	Red
ALM	Alarm output	0.75 mm^2	—
GR	Frame GND	2.0 mm^2	Green

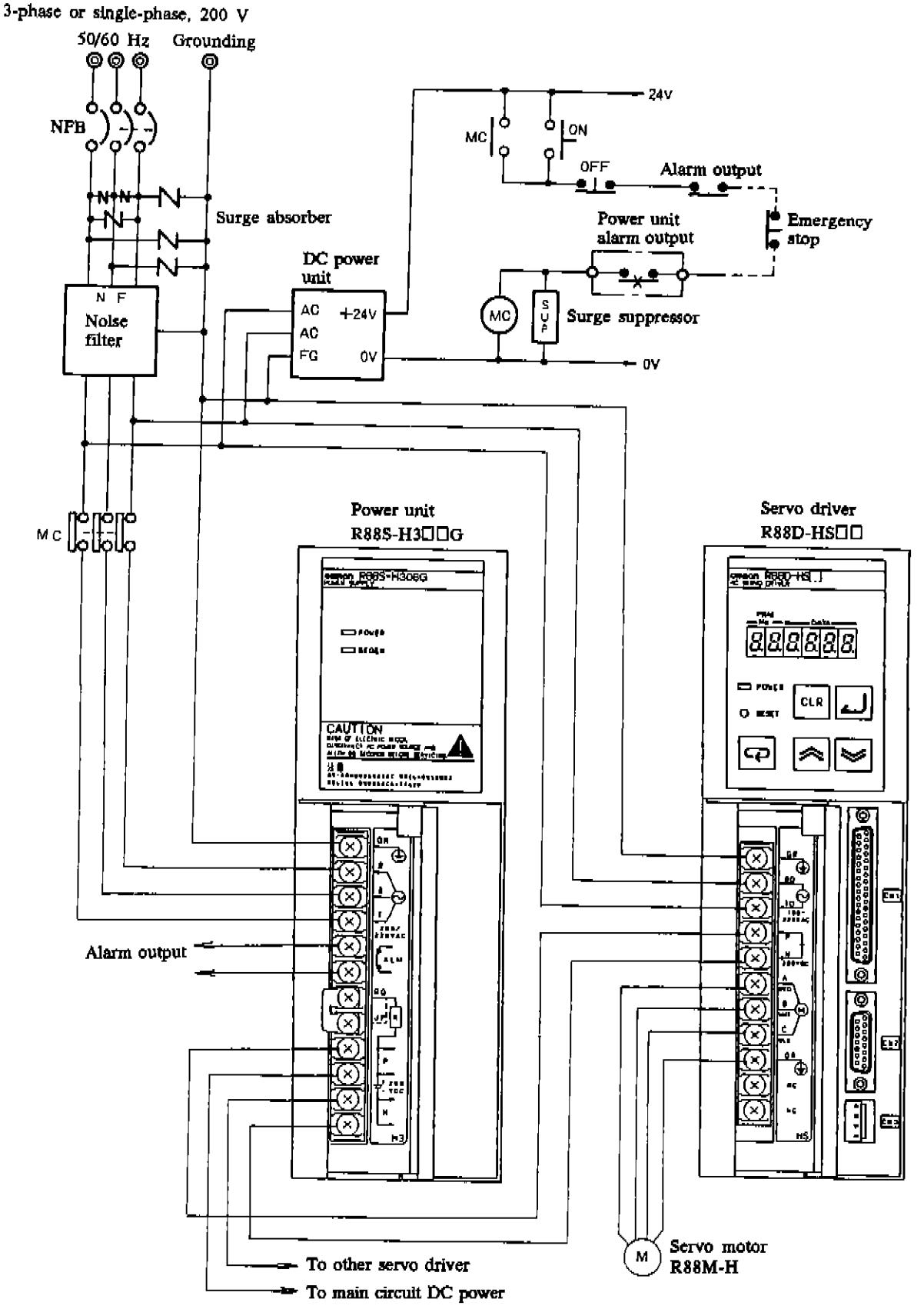
Note 1: Above figures show that HIV thermal proof vinyl cable (75°C) is used at ambient temperature 55°C.

Note 2: In order not to miswire main circuit DC power output, use red colored cable for P (+) and blue or black colored cable for N (-).

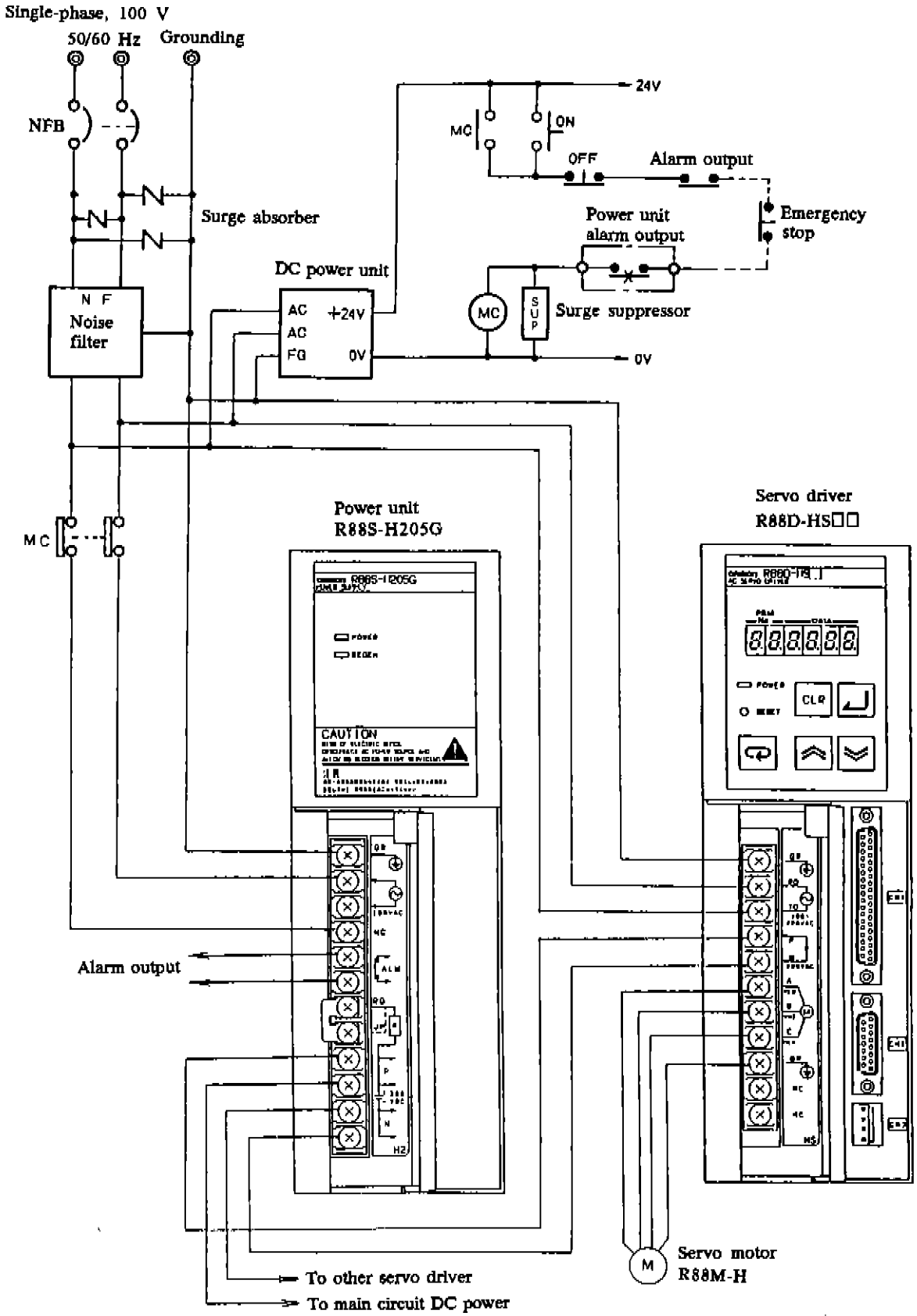
2-3 Connection with Support Equipment and External Equipment

2-3-1 Connection example

(1) Connection example at 200 VAC input (R88S-H306G, -H310G)



(2) Connection example at 100 VAC input (R88S-H205G)



2-3-2 Selection Examples of Outer Connecting Parts

We recommend use of the parts below, or equivalent.

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 sec. at 200% load).

(2) Noise filter (NF)

Phase	Model	Rated	Mfg.
Single phase	GT-205U	5A	TOKIN
	GT-210U	10A	
	GT-2150R	15A	
	GT-2200R	20A	
	ZAC2206-11	6A	TDK
	ZAC2210-11	10A	
	ZAG2220-11-P	20A	
	NFB2302H	30A	FDK
	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	15A	

(3) Magnet relay

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

(4) Surge absorber (ZNR)

Model	Surge immunity	Mfg.
ERZ-A20EL471	5 KA	MATSUSHITA ELECTRIC
ERZ-A25EL471	10 KA	
ERZ-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	

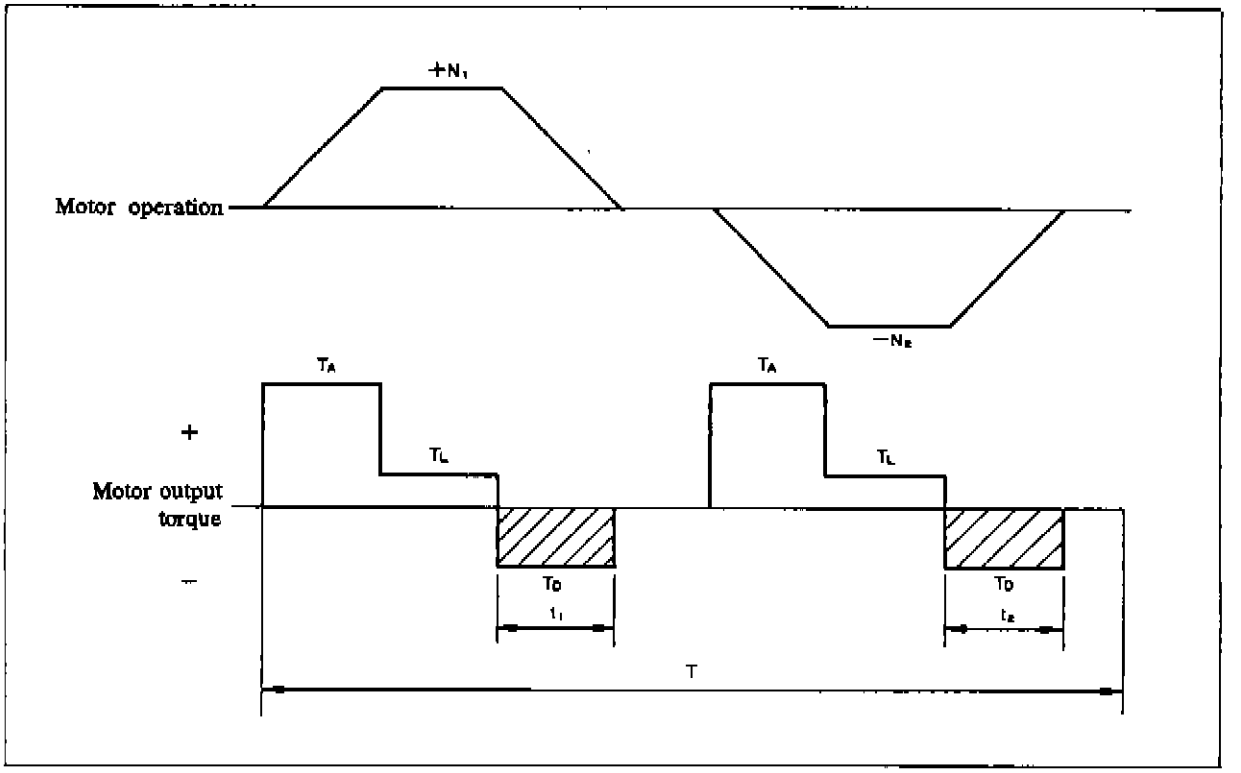
(6) Leakage breakers

- Select leakage breakers designed for inverters.
- Since switching operations take place inside the Servo Driver, high-frequency current leaks from the armature of the Servomotor. With inverter leakage breakers, high-frequency current is not detected, preventing the breaker from operating due to leakage current.
- When selecting leakage breakers, also remember to add the leakage current from devices other than the Servomotor, such as machines using a switching power supply, noise filters, and so on.
- For detailed information about the selection methods of leakage breakers, refer to catalogs provided by manufacturers.

2-4 Regenerative Energy

2-4-1 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:

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

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

N_1, N_2 : Number of motor revolutions at triggering deceleration [rpm]

T_D : Required deceleration torque [kgf·cm]

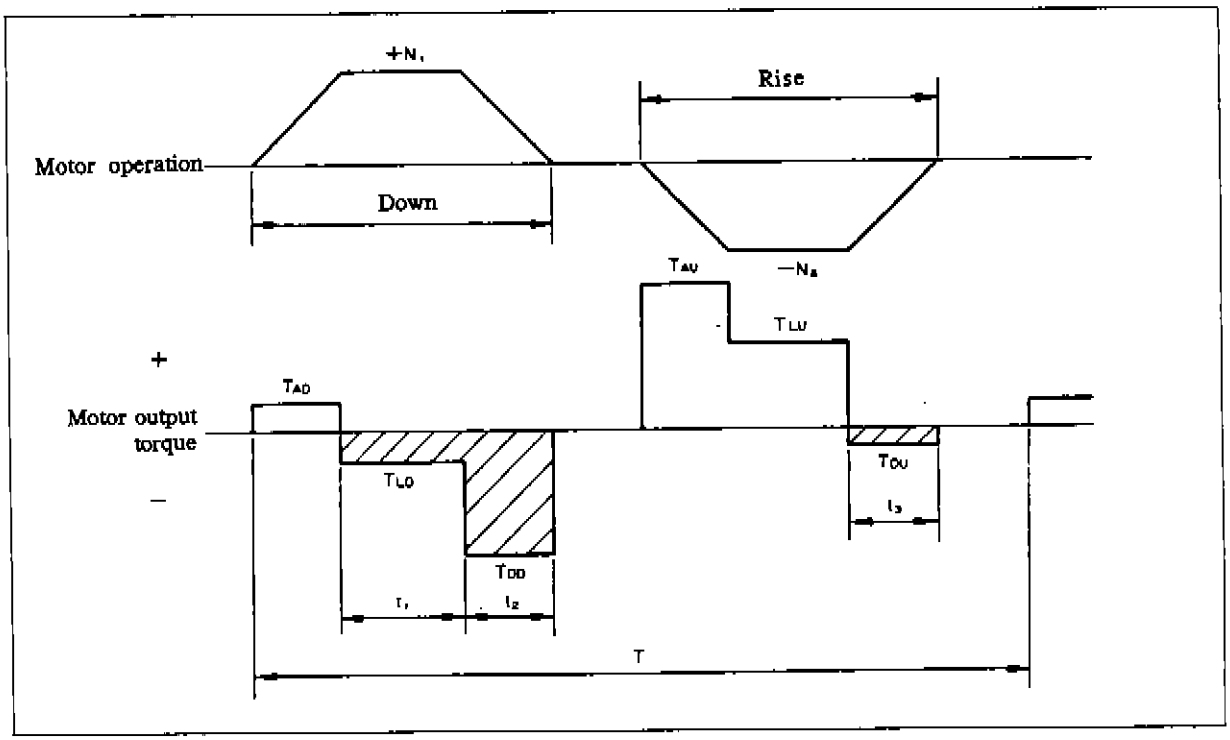
t_1, t_2 : Deceleration interval [sec.]

Average regenerative power is given in the formula below:

$$Eg = \frac{Eg_1 + Eg_2}{T} \ [W]$$ T: operation cycle [sec.]

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:

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

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

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

Average regenerative power is given in the formula below:

$$Eg = \frac{Eg_1 + Eg_2 + Eg_3}{T} \ [W]$$ T: operation cycle [sec.]

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

2-4-2 Absorption of Regenerative Energy

■ Regenerative capacity inside the power unit

Absorption capacity of regenerative energy of each power unit is as follows:

Model	Allowable regenerative energy at one regenerative operation (*)	Average regenerative power
R88S-H205G	200 J	15 W
R88S-H306G	200 J	20 W
R88S-H310G	200 J	10 W

* This figure is a general guide line.

Power consumption at main circuit DC current voltage 350 V with regenerative resistance 54Ω is,

$$P = \frac{V^2}{R} = \frac{350^2}{54} \fallingdotseq 2{,}270 \text{ W}$$

This means that allowable absorption energy is 227 J. Take an example of the following condition:

Motor capacity: 1100 W

Motor speed: 4,000 rpm

Deceleration torque: 80 [kgf-cm]

Deceleration time: 0.2 sec.

Regenerative energy with the conditions above is,

$$J_{RG} = \frac{1}{2} N \cdot T \cdot t \times 1.027 \times 10^{-2}$$

$$= \frac{1}{2} \times 4000 \times 80 \times 0.2 \times 1.027 \times 10^{-2}$$

$$\fallingdotseq 330 \text{ [J]}$$

However, absorption is possible as far as it does not exceed average regenerative energy.

(1 [W] = 1 [J/s] 1 [cal] = 4.2 [J])

When regenerative energy exceeds the rated value, add an external regenerative resistance. Prior to installing the external regenerative resistance, remove a short bar between JP and RG terminals, and connect the external regenerative resistance between P and RG.

■ External Regenerative Resistance

The following resistances are available.

(1) Model

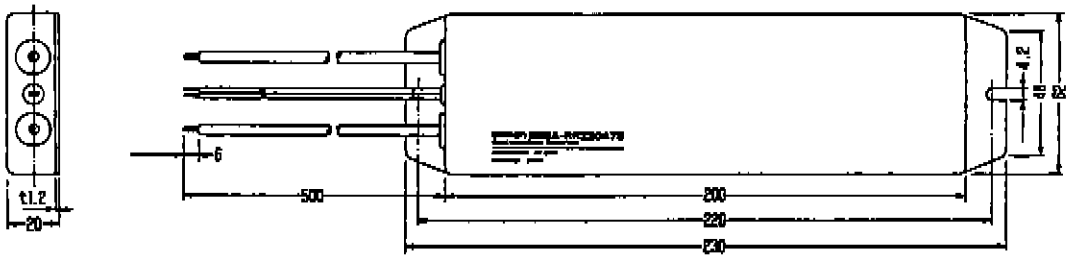
R88A-RR22047S

(2) Specifications and outside dimensions

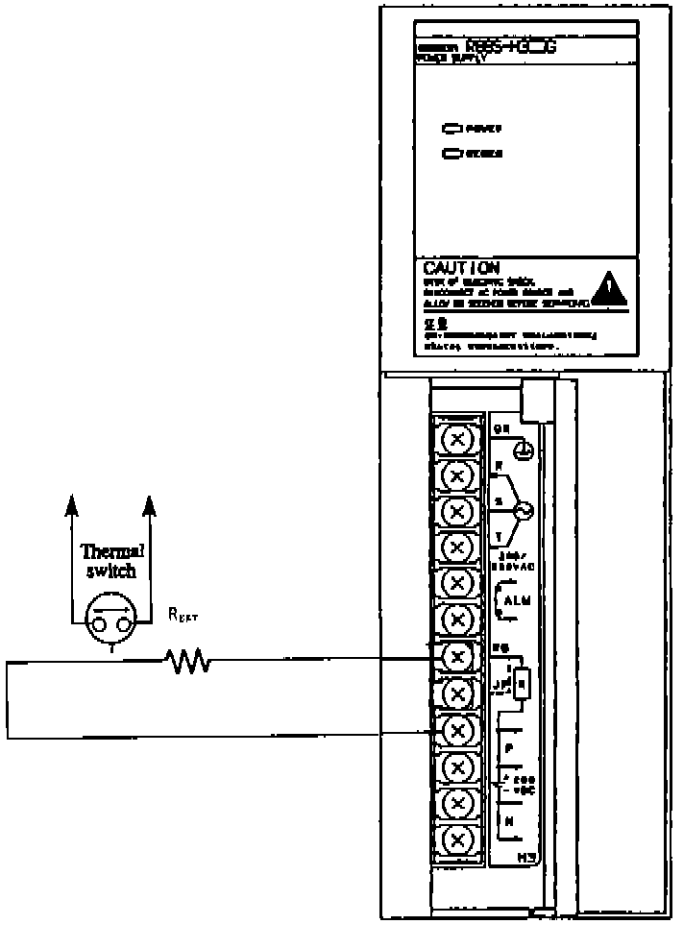
Nominal capacity	200 W
Regenerative absorption capacity	70 W *1
Resistance value	47 Ω ± 10 %
Radiation condition	t1.0 SPCC 350 × 350

*1 When 70 watt regenerative energy is absorbed, the resistance surface temperature raise 120°C than ambient temperature.
Therefore, never put flammable objects near by the regenerative resistance.

*2 This is thermal switch built-in type.

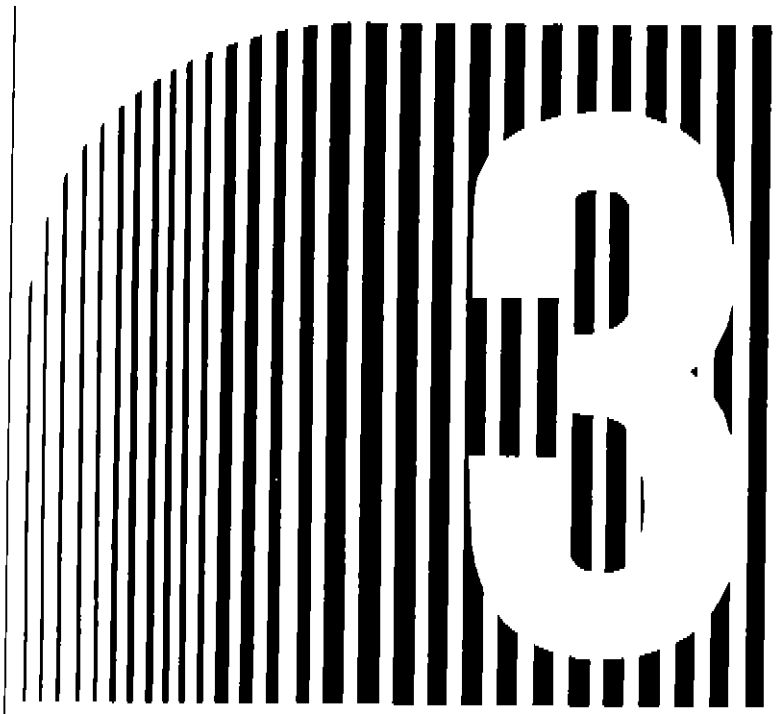


(3) Connection drawings



When you install an external regenerative resistance (REXT), remove a short bar between JP and RG terminals, and connect the external regenerative resistance between P and RG.

Note) Connect the thermal switch output to shut off power supply at contact open as well as ALM output of the power unit.



Chapter 3

• Operation •

Chapter 3. Operation

3-1 Cautions at Starting Operation

■ Check items prior to operation

(Also see the description of servo driver trial operation)

1. Check that polarity of main circuit DC power (P and N) is connected correctly.
   Miswiring may break servo drivers.
2. In case of R88S-H205G, input voltage range is single-phase 85 to 127 VAC. Inputting 200 V type power would brake the power unit as well as the driver.
3. Input voltage of R88S-H306G, R88S-H310G are 3-phase or single-phase 170 to 253 VAC.
4. Make a sequence circuit to shut off supply power to the power unit by abnormal signal from the servo driver.
5. At trial operation, disassemble the motor shaft from a mechanical section.
   If disassembly is unavailable, be ready to execute emergency stop any time.

■ Put on power

1. Input power to the servo driver and check that there is no abnormality. Then input power to the power unit.
2. Check that the power indication LED on the power unit lights.
   If it does not light, check power supply.
3. Check that the main circuit DC power voltage (P and N) should be 240 to 350 VDC.
4. After checking, turn OFF power once. In this stage, the power unit discharge voltage stored in a smoothing capacitor in the main circuit DC power through the resistance circuit. Check that "REGEN" LED is blinking in this discharging. Main circuit DC power voltage becomes 40 VDC or less after one minutes. Do not touch terminals during discharge operation.
5. Again, input AC power to the main circuit and adjust the driver.
   See the description of servo driver adjustment.
6. The power unit becomes 40 VDC one minute after shutting off power supply.
   However, it takes another 5 minutes to completely discharge.
   Do not short terminals during this interval as spark may occur.

3-2 Cautions at Handling

(1) Do not short circuit between P and N terminals of the power unit while in operation.
Short circuit makes large current flow by the inside smoothing capacitor and sparks may arise.

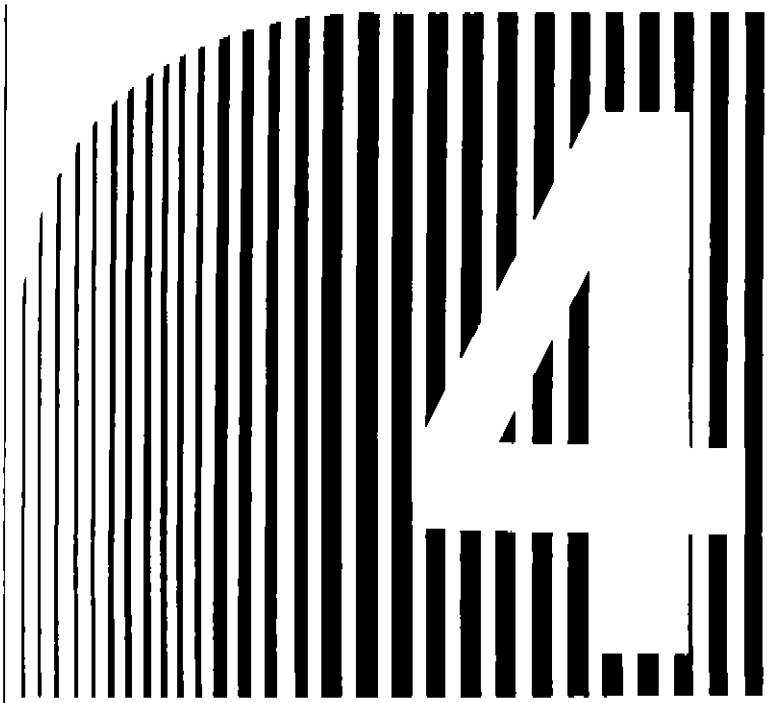
(2) Do not misconnect polarity of the main circuit DC power output (P and N).
Reverse connection brings same condition of short circuit through an inverter fly wheel diode and the inverter in the driver may be broken.
The power unit may be also damaged by line impedance due to short current flow through a rush current prevention resistance and relay contactors.

Cautions of electric shock

Do not touch main circuit DC power outputs (P, N) for some time after shutting off supply power to the power unit.
These terminal have DC output voltage 40 V or less for 5 minutes after power OFF.
Access one minute or more after shutting off power.

(3) Do not switch ON and OFF power to the unit frequently.
Wait at shortest one minute after turning OFF power. (Frequent turning power ON and OFF power will heat the rush current prevention resistance, the inside temperature fuse may blow out, and rush current prevention function become ineffective. As a result, parts may be aged.)

(4) For the power unit, do not use less than 85% of the rated AC power supply voltage to the main circuit.
Low supply voltage may not actuate relays in the rush current prevention circuit. Accordingly, the temperature fuse of the rush current prevention resistance in above item (3) may blow out.



Chapter 4

4

• Maintenance •

Chapter 4. Maintenance

4-1 Protection Functions

■ Operation Indication

POWER Power indication	Lights ON when the main circuit AC power is supplied. When DC output voltage still exists after power OFF, it lights dimly. Access the unit for maintenance after this indication completely turns OFF.
REGEN Regenerative indication	Lights ON when the power unit receives regenerative power from a servo driver and executes regenerative operation. Lights ON this LED even after AC power is OFF as it discharges electric load in the smoothing capacitor.

■ Protective Function

The power unit has the following protective functions.

Protective function	Operation	Causes
Main circuit fuse	Blow-out when excessive current flows in the main circuit	• Output lines are shorted. • Long time operation with over the rated continuous output current.
Temperature rise of radiation fin	Temperature of the radiation fin exceed 85°C and ALM contact opens due to temperature rise of the main circuit rectifier or the regenerative resistance.	• Load current over at ambient temperature. • Exceed regenerative capacity.

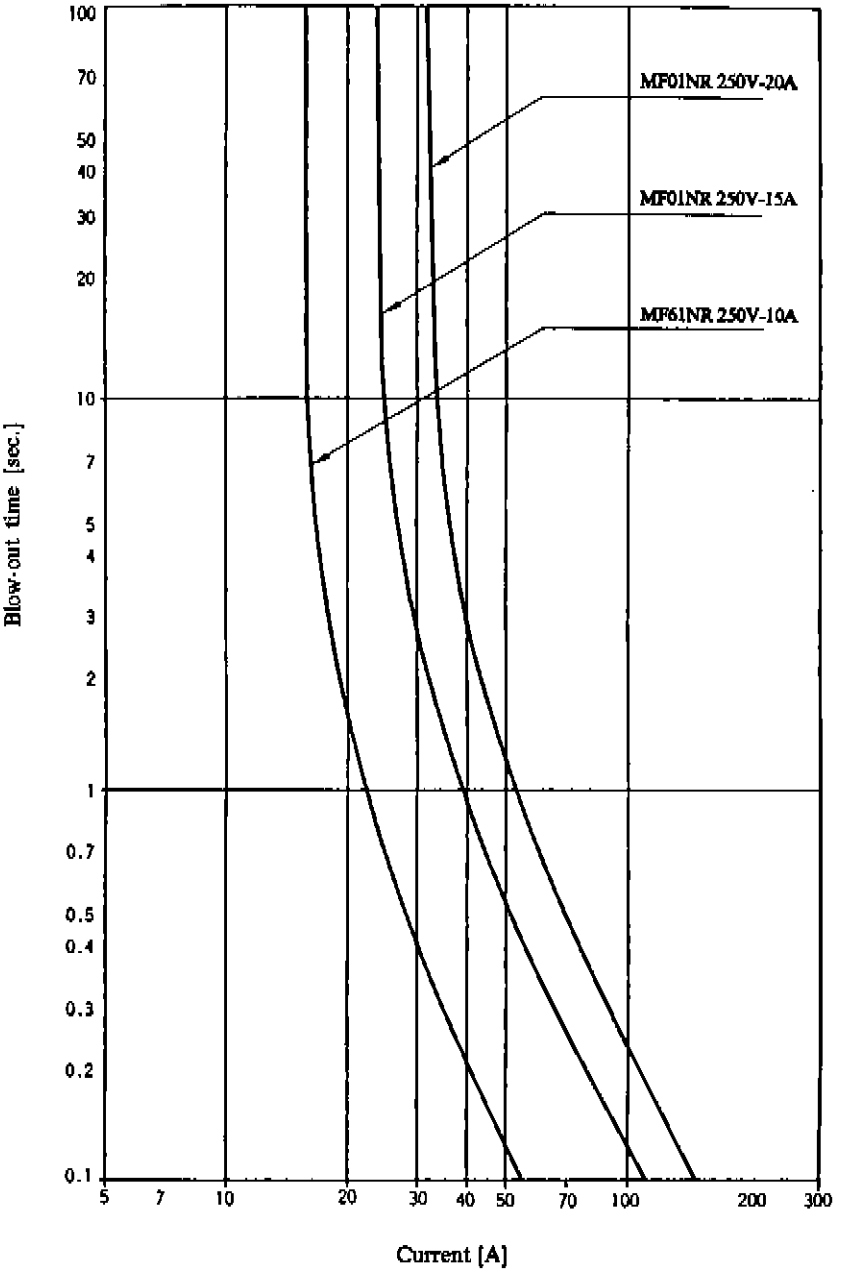
Installed fuse element of each model is as follows:

Power unit model	Type of fuse element
R88S-H205G	MF01NR 250V-20A
R88S-H306G	MF61NR 250V-10A
R88S-H310G	MF01NR 250V-15A

Chapter 4. Maintenance

The curbs below show fuse element blow-out characteristics.

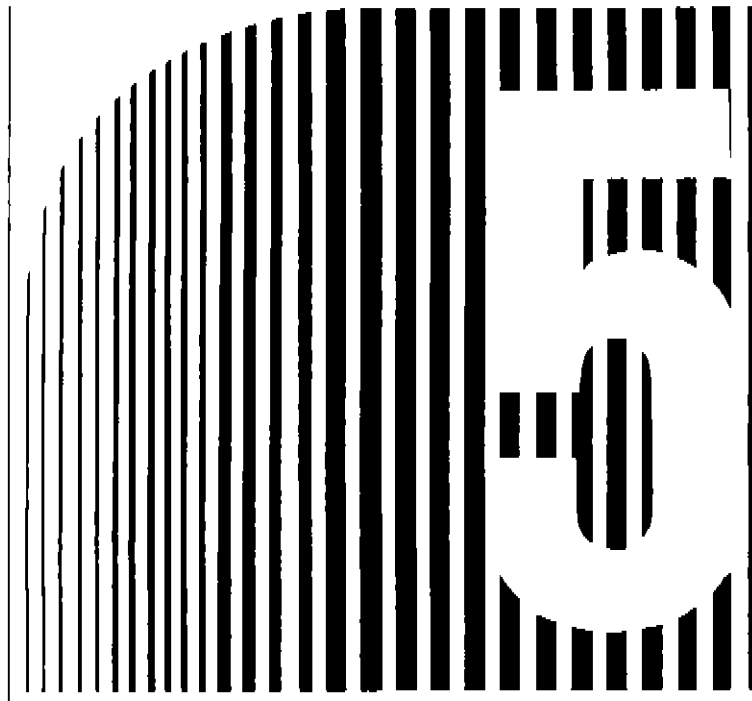
These characteristics are typical.



4-2 Troubleshooting

When trouble occurs while in operation, check causes and recover, referring to the table below.

Error condition	Causes/remedies
Power indication LED doesn't light ON after power ON.	Main circuit fuse blows out. Check short circuit. Check fuses.
Regenerative indication LED doesn't blink at shutting off power.	Too slow voltage down of the main circuit DC output (P, N). Malfunction of regenerative control circuit. Contact with our service center.
Though alarm output contactor opens, regenerative indication LED doesn't light ON.	Using the unit exceeding the continuous output current. Change to a larger capacity unit or share load by using 2 power units or more when using 2 drivers.
Though alarm output contactor opens, regenerative indication LED lights ON well.	Regenerative capacity overs Install a unit exclusive for a motor, or add external regenerative resistance.
Fuse blows out sometimes.	Over the limit of load current. Install another unit, or prepare a larger capacity unit.



Chapter 5

5

• Specifications •

Chapter 5. Specifications

(1) General specifications

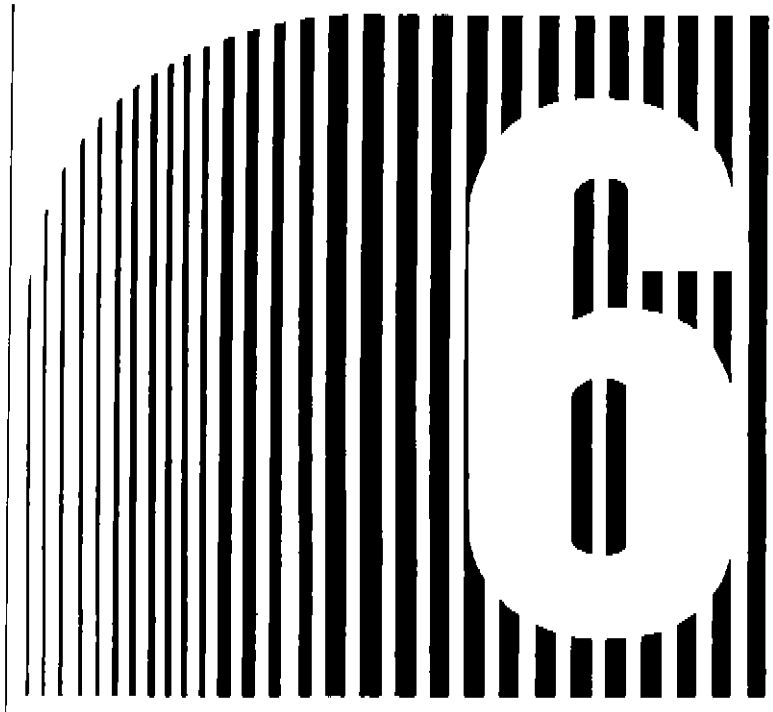
Operating ambient temperature	0 to + 55°C
Operating ambient humidity	35 to 85% RH (without dew condensation)
Storage ambient temperature	- 10 to + 75°C
Operating atmosphere	Without corrosive gas
Structure	Install in a board.
Insulation resistance	5 MΩ or up at 1,000 VDC megger between outside terminal and case.
Voltage proof	One minute at 1,500 VAC, 50/60 Hz between outside terminal and case.
Vibration proof	Lighter case between 2G and 0.15 mm single width at 10 to 150 Hz.
Shock proof	10 G or less at peak acceleration for each 3 times for X, Y, and Z directions

(1) Performance specifications

Item / Model	R88S-H205G	R88S-H306G	R88S-H310G
Input power voltage	100 V/110 V, 50/60 Hz	3-phase or single-phase, 200 V/220 V, 50/60 Hz	
Input voltage range	85 -127 VAC	170 - 253 VAC	
Output voltage	240 - 350 VDC	240 - 350 VDC	
Output current at 3-phase input	-	6 A	11 A
Output current at single-phase input	5 A	3 A	5 A
Input current at 3-phase input	-	8 A	12 A
Input current at single-phase input	17 A	7 A	12 A
Input power at 3-phase	-	3000 VA	5500 VA
Input power at single-phase	2000 VA	1500 VA	2700 VA
Input power factor	cosØ = 0.75	cosØ = 0.6 (at 3-phase input)	
Regenerative absorption power capacity	200 J	200 J	200 J
Average regenerative power capacity	15 W	20 W	10 W
Heating value	36 W (at 115 V)	55 W (at 220 V)	100 W (at 220 V)
Rush current	85 A	110 A	110 A
Fuse capacity	20 A	10 A	15 A
Alarm output capacity	Less than 240VAC - 3A or 24VDC - 3A		
Capacitor capacity (between P and N)	3000 μF	1410 μF	2820 μF
Weight	2.5 kg	2.2 kg	2.4 kg

Note 1: Above power factors are for reference only. They may vary by input power impedance.

Note 2: 1[W] = 1[J/S], 1 [cal] = 4.2 [J]



Chapter 6

• Technical Calculation •

Chapter 6. Technical Calculation

6-1 Selection of Power Unit

6-1-1 Selection by Servo Motor Capacity

■ Output Current of Power Unit

Model	Input voltage	Output current
R88S-H205G	100V, single-phase	5A
R88S-H306G	200V, 3-phase or	6A (3A)
R88S-H310G	Single-phase	11A (5A)

Figures in ( ) refer to output current at single-phase input.

■ Selection Method of Power Unit

Select Power Unit refer to output capacity of servo motor.

Multiply the figures to each motor capacity to be used, and total the results.

You can get required main circuit DC current by following formula.

$$1_A = \frac{\Sigma W_A}{200} [A]$$

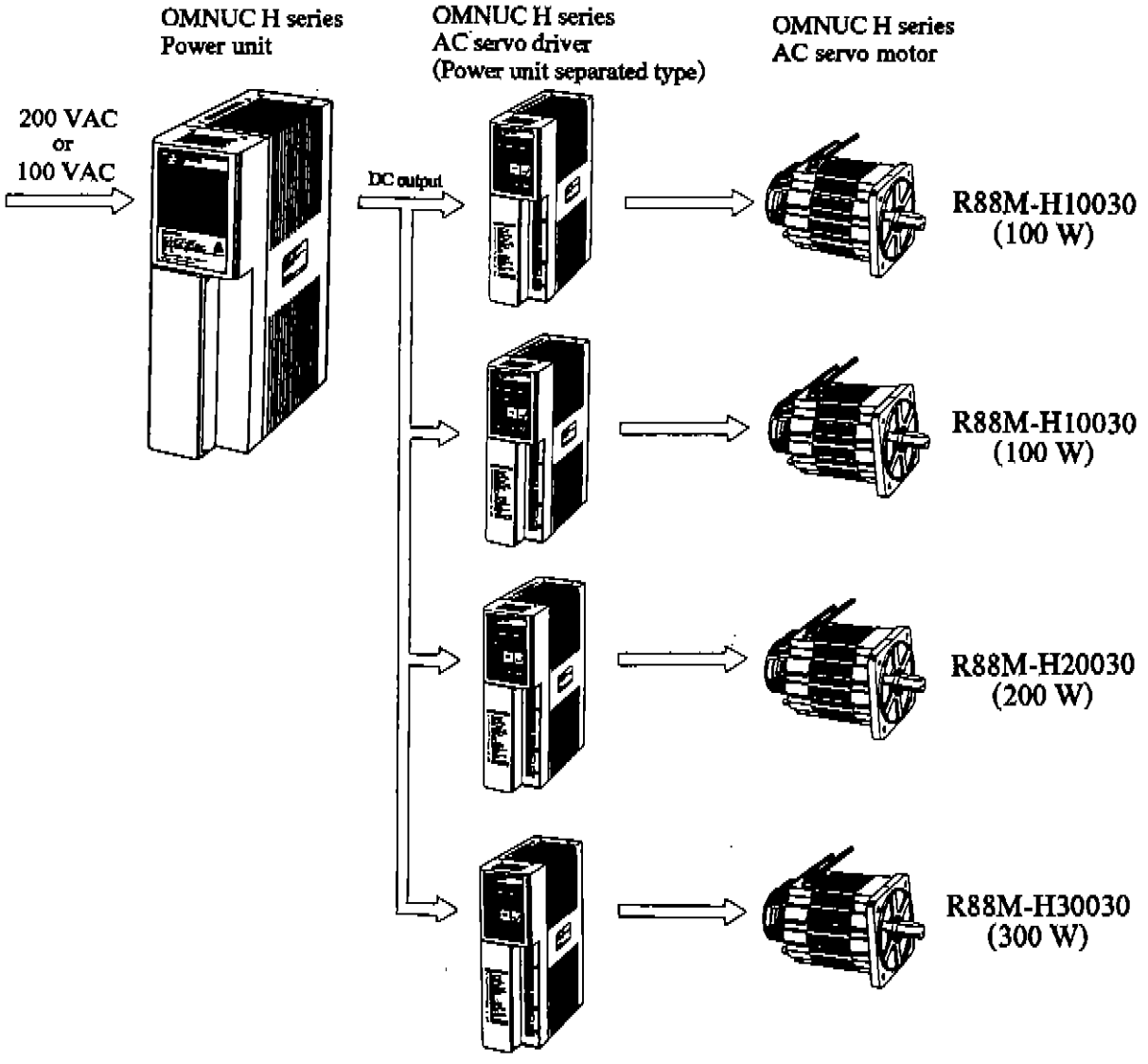
1_A : Required main circuit current

W_A : Nominal capacity of servo motor

Model	Output capacity	Figure (coefficient)	Nominal capacity (W_A)
R88M-H05030	50 W	2.0	100 W
R88M-H10030	100 W	1.6	160 W
R88M-H20030	200 W	1.5	300 W
R88M-H30030	300 W	1.0	300 W
R88M-H50030	500 W		500 W
R88M-H75030	750 W		750 W
R88M-H1K130	1100 W		1100 W

■ Selection Example of Power Unit

Selection calculation of the power unit in a system as below are as follows.



(Ex.)

R88M-H10030 × 2 sets

R88M-H20030 × 1 set

R88M-H30030 × 1 set

Total amount of nominal capacity:

$$\Sigma W_A = 160 \times 2 + 300 + 300 = 920 \text{ [W]}$$

Required main circuit current:

$$I_A = \frac{\Sigma W_A}{200} = \frac{920}{200} \fallingdotseq 4.6 \text{ [A]}$$

Therefore, required power unit is R88S-H205G or R88S-H306G.

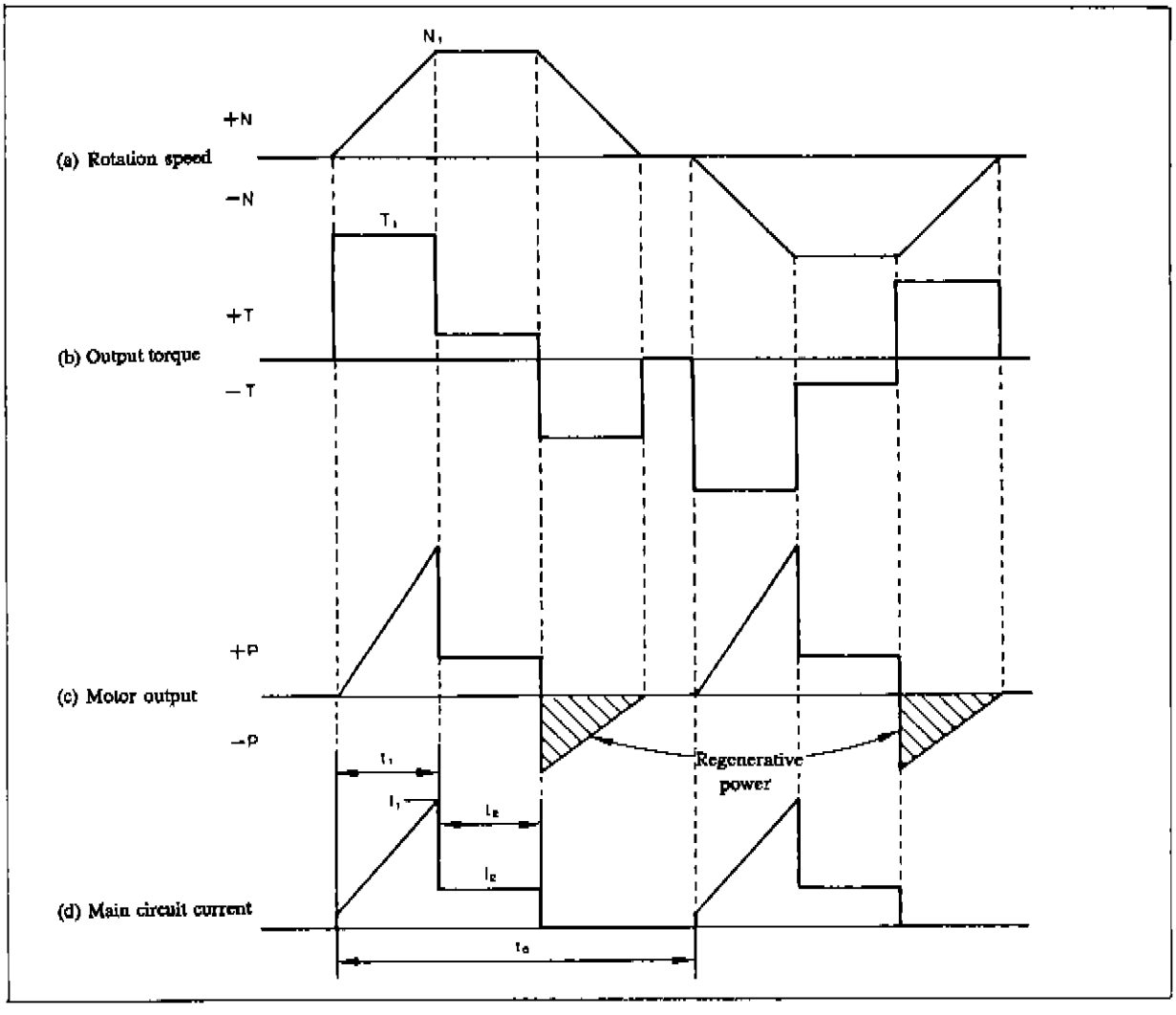
In case of single-phase, 200 V is used, the required power unit should be R88S-H310G.

6-1-2 Selection with Output Current

■ Difference of Output Current with Each System

Power and current to be supplied to servo driver is as follows:

(1) In case of horizontal installation of motor.



In case of horizontal installation of motor, the motor output at operation (a) in the figure above is given by the formula below:

$P \fallingdotseq 1.027\ NT \times 10^{-2}$ [W] N: No. of rotation (rpm)
T: Output torque (kgf·cm)

Motor output becomes (c) in the figure above. Negative zone is regenerative energy and is not supplied from input power.

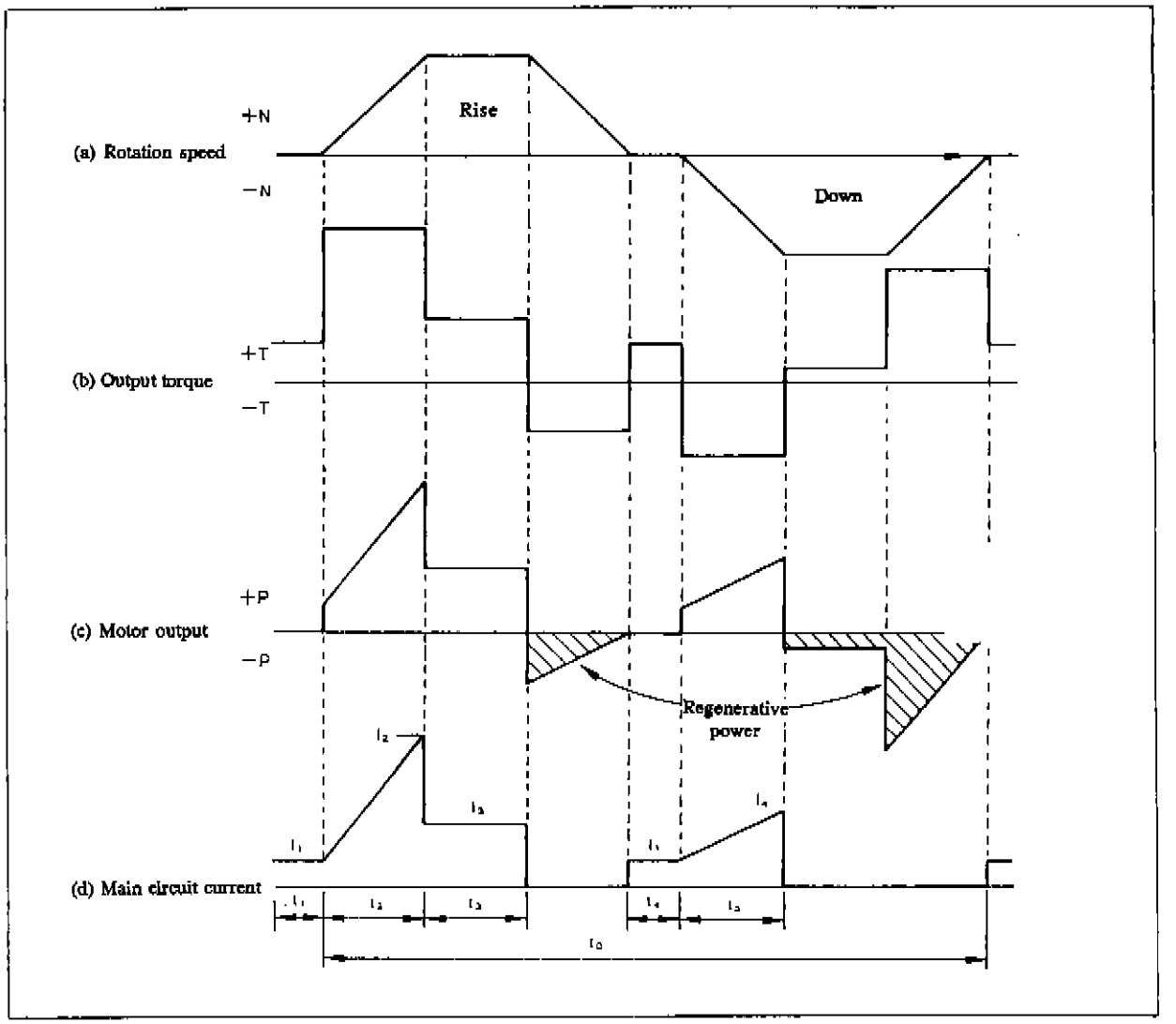
Therefore, actual output current becomes smaller. The main circuit current becomes as the above (d). It is given by the formula below:

$$I_{rms} \fallingdotseq \frac{\sqrt{\frac{1}{3} I_1^2 t_1 + I_2^2 t_2}}{t_0} \text{ [A]}$$

Compare this "I_{rms}" value with output current of each power unit nominated in 6-1, and select power unit so that "I_{rms}" value is below the selected power unit. To get I_1 and I_2, see the curb for output torque and main circuit DC current in 6-5.

Ex.) Using a motor R88M-H20030, when T_1 is 15 kgf·cm at N_1 = 3,000 rpm, I_1 becomes 3A.

(2) In case of vertical installation of motor



In case of motor vertical installation, holding current flows even at stop rotation. When regenerative energy at descending is generated, there is no power consumption from input power. Actual value of output current can be given as the same procedure of horizontal installation. As such, servo system having start and stop operation needs only small main circuit DC current compared with actual output torque, and the power unit does not need much output current. Actual circuit current of (d) shown above can be derived from the formula below:

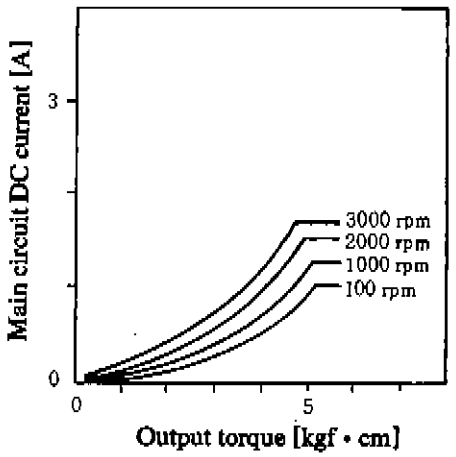
$$I_{rms} \fallingdotseq \frac{\sqrt{I_1^2\, t_1 + \frac{1}{3}(I_2^2+I_1\, I_2+I_1^2)\, t_2 + I_3^2\, t_3 + I_1^2\, t_4 + \frac{1}{3}(I_4^2+I_4\, I_1+I_1^2)\, t_5}}{t_0} \quad [A]$$

I_1: hold current I_2, I_3... : given by output torque and main circuit current in 6-5.
Compare this "I_{rms}" with output current value of each power unit in 6-1, and select a power unit so that the "I_{rms}" becomes less than the output current value.

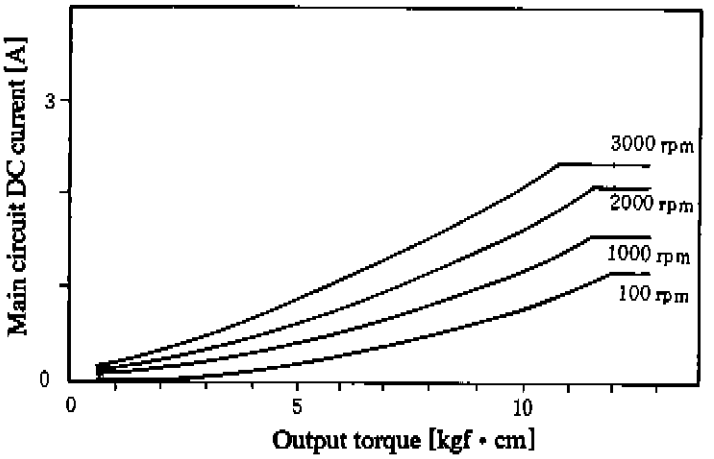
■ Output Torque and Main Circuit DC Current

Main circuit DC current varies in compliance with motor output torque and number of rotation. Output torque and main circuit DC current at each number of rotation are shown below:

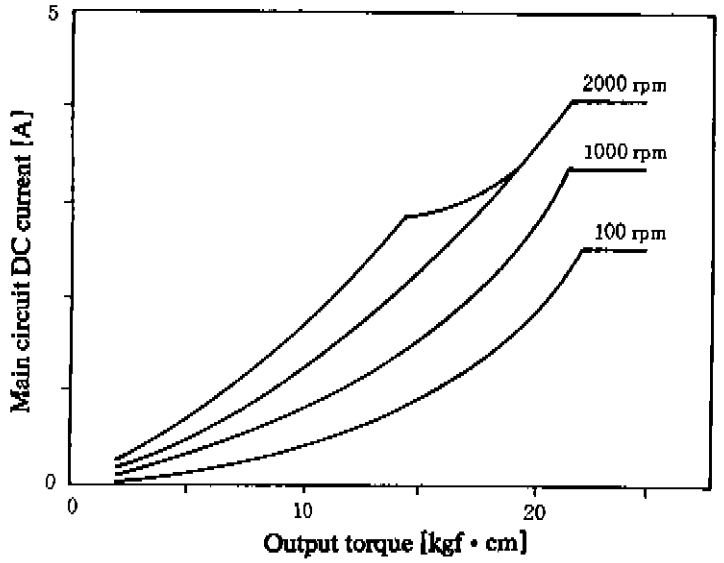
R88M-H50030



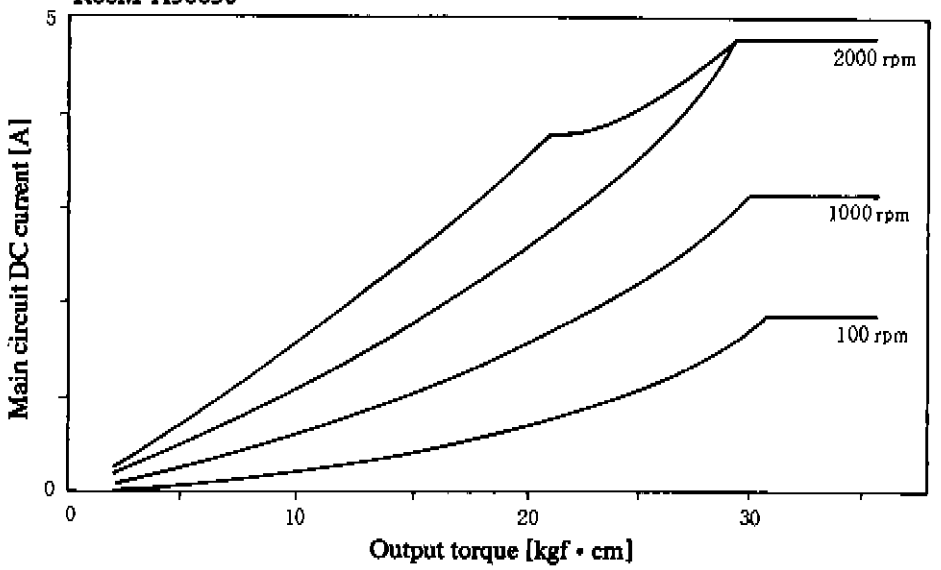
R88M-H10030



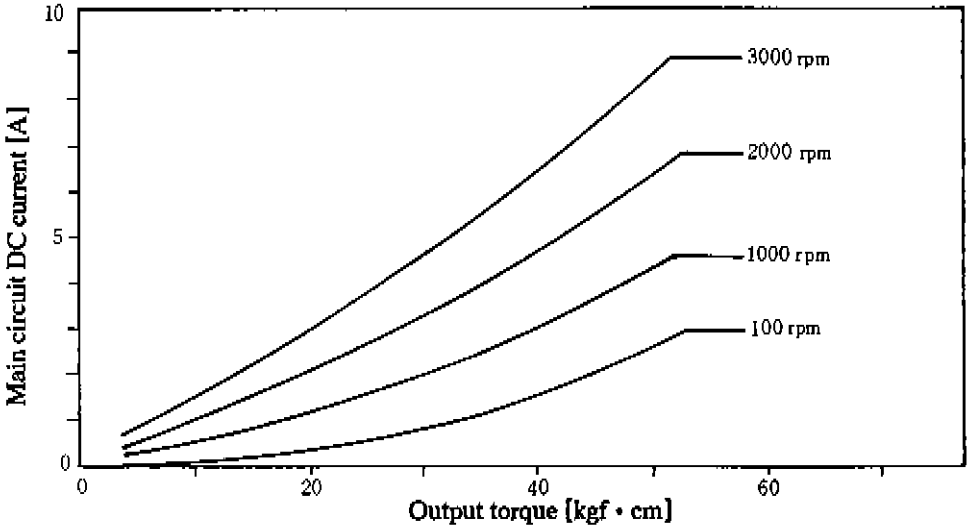
R88M-H20030



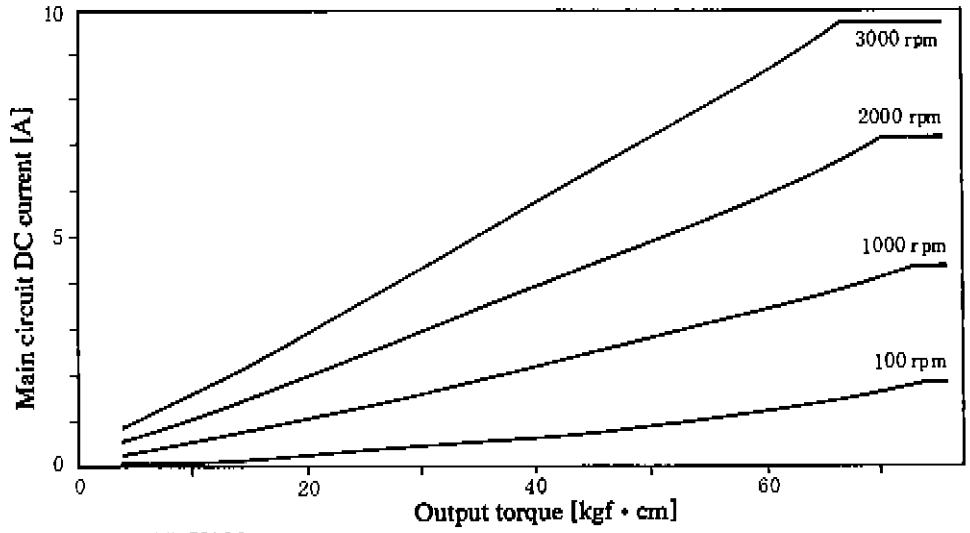
R88M-H30030



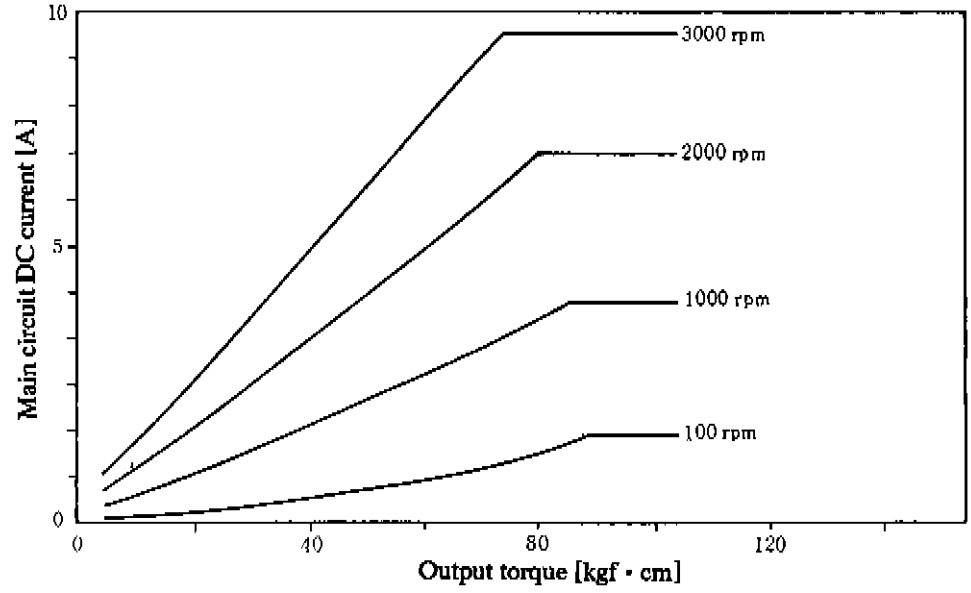
R88M-H50030



R88M-H75030



R88M-H1K130



<Note> These values of main circuit DC current are when main circuit DC voltages are 280 VDC (3-phase 200 VAC). When the main circuit voltage decreases, the current will increase in proportion to decrease of voltage, and vice versa.

Chapter 6. Technical Calculation

The table below shows rated torques, main circuit DC current at rated rotation speed of motors as well as main circuit DC current at instantaneous max. torque while in rated rotation speed.

Main circuit voltage: 280 VDC. Number of rotation: 3,000 rpm.

Motor model	At rated torque	At instantaneous max. torque
R88M-H05030	0.3 A	1.7 A
R88M-H10030	0.6 A	2.0 A
R88M-H20030	1.1 A	3.5 A
R88M-H30030	1.6 A	4.8 A
R88M-H50030	2.5 A	8.3 A
R88M-H75030	3.6 A	9.7 A
R88M-H1K130	5.4 A	10.6 A

Note 1: Above figures are standard value and ±10% allowance should be considered.

Note 2: The servo system increases main circuit current when main circuit voltage decreases, and vice versa as it has constant output power system.

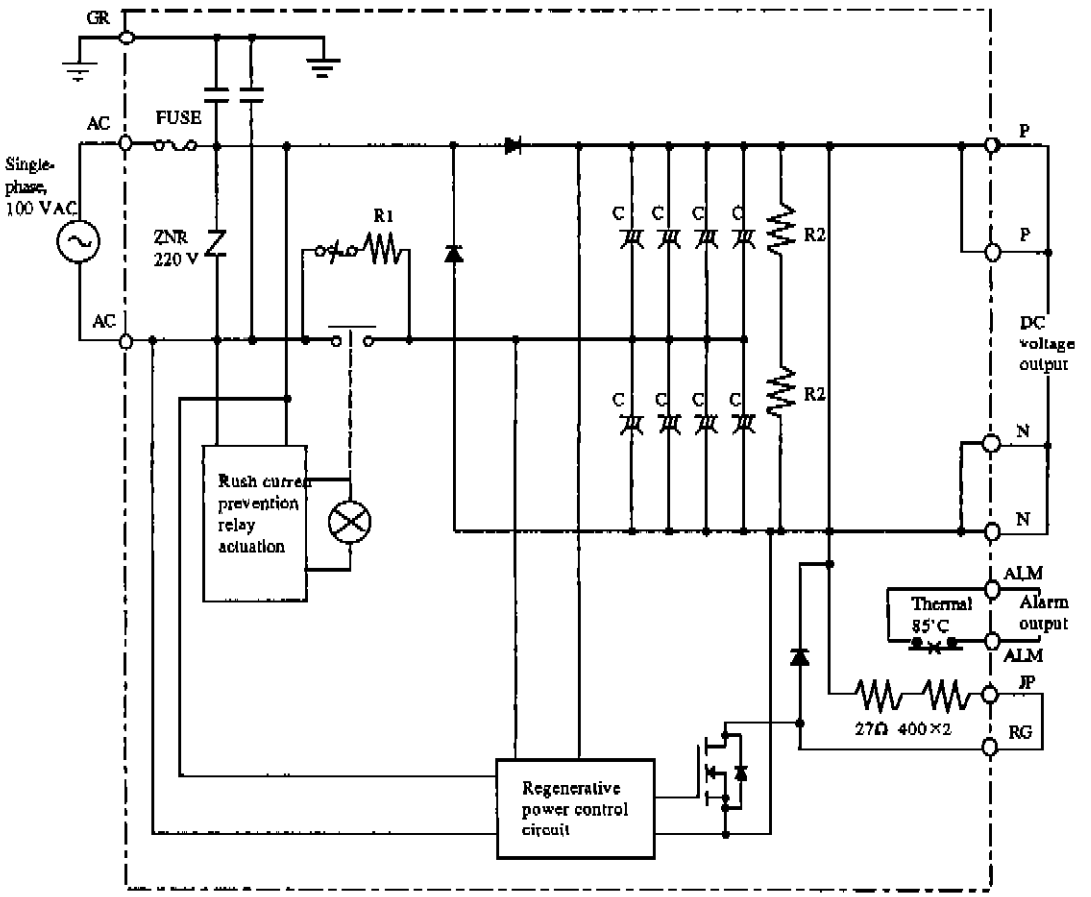
Note 3: Use as much current capacity cables as possible in order to endure required current at instantaneous max. torque and considering voltage drop.

Note 4: Design a system so as to make acceleration zone (instantaneous max. torque) become shorter than one second. Too much time in this zone may cause fuse to blow out.

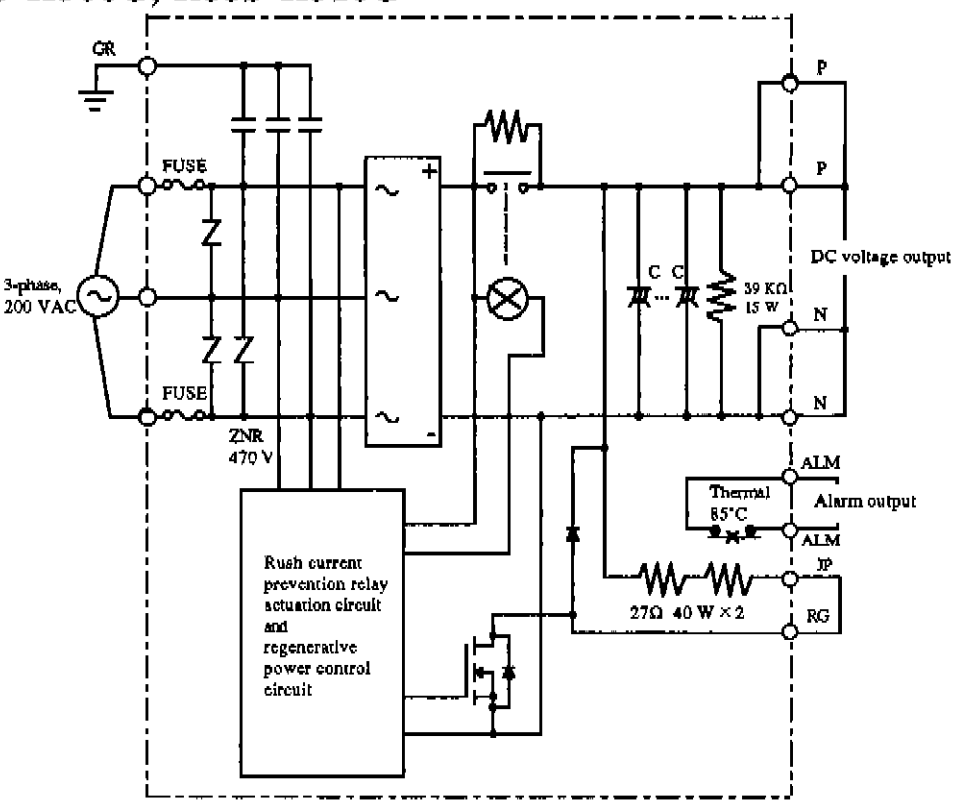
6-2 Inner Construction

6-2-1 Inner Circuit Construction

■ **R88S-H205G**

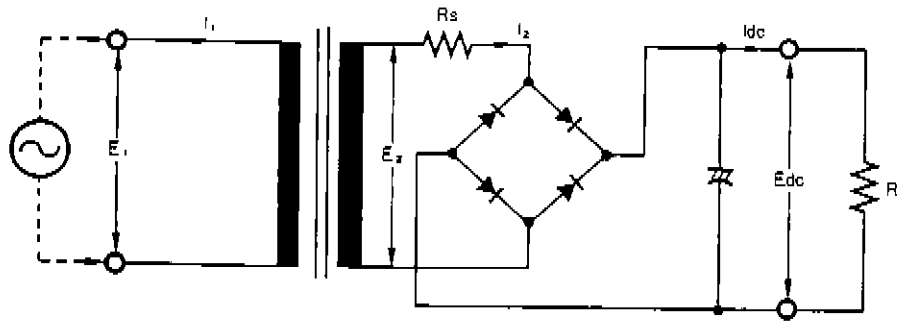


■ **R88S-H306G, R88S-H310G**



6-2-2 Constant Figures of Rectifier Circuit

■ Constant Figures of Single-Phase Full-Wave Rectifier Circuit

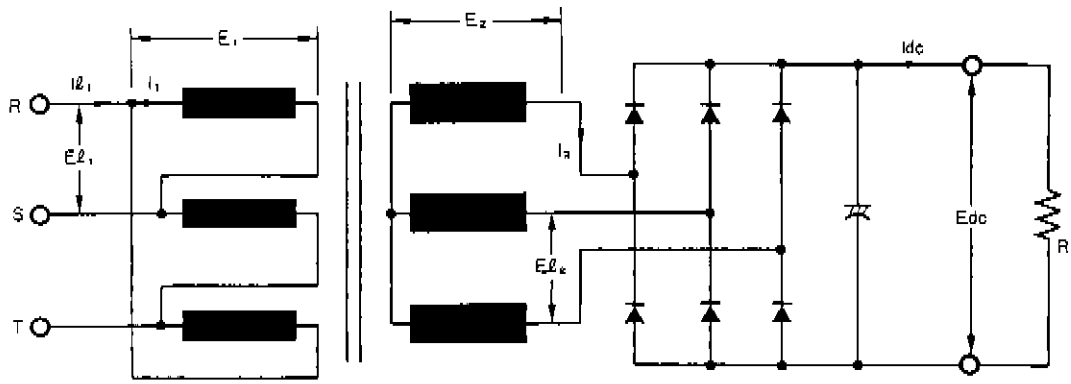


Transformer secondary voltage	E_2	V_{rms}	$0.85 \cdot E_{dc}$
Transformer secondary current	I_2	A_{rms}	$1.65 \cdot I_{dc}$
Transformer primary voltage	E_1	E_{rms}	$n \cdot E_2$
Transformer primary current	I_1	A_{rms}	$\frac{E_2}{E_1} \cdot I_2 \fallingdotseq \frac{I_2}{n}$
Transformer mean capacity	P_{AC}	VA	$1.5 \cdot E_{dc} \cdot I_{dc} \fallingdotseq 2E_2I_{dc}$
Rectifier element initial voltage	V_{DP}	V	$1.57E_{dc}$
Rush current	I_{2P}	A	$\sqrt{2}\ E_2/R_s$

Note 1: "n" means coiling ratio "n" = E_1/E_2

Note 2: R_s is supply power impedance looking at transformer secondary side.

■ 3-Phase Full-Wave Rectifier Circuit



When 3-phase transformer is used, connect with Δ-Y and Y-Δ. Connection to Y-Y causes imbalance of excitation.

Voltage and current at Δ connection are as follows:

Voltage between wires E L_1 = Phase voltage E_1

Cable current I L_1 = $\sqrt{3}$ phase current I_1

Voltage and current at Y connection are as follows:

Voltage between wires E L_2 = $\sqrt{3}$ phase voltage E_2

Cable current I L_2 = Phase current I_2

Constant figures of 3-phase full-wave rectifier circuit (at Δ-Y connection)

Voltage between secondary lines	EL_2	V_{rms}	$0.74 \cdot E_{dc}$
Secondary phase voltage	E_2	V_{rms}	$0.43 \cdot E_{dc}$
Secondary line current	I_2	A_{rms}	$0.82 \cdot I_{dc}$
Primary phase voltage	E_1	V_{rms}	$nE_2 = 0.43nE_{dc}$
Primary phase current	I_1	A_{rms}	$I_2/n = 0.82 \cdot I_{dc}/n$
Primary line current	IL_1	A_{rms}	$\sqrt{3}\ I_1 = 1.42 \cdot I_{dc}/n$
Transformer mean capacity		VA	$1.5 \cdot E_{dc} \cdot I_{dc} \fallingdotseq 2EL_2I_{dc}$
Rectifier element initial voltage	V_{DP}	V	$1.05E_{dc}$
Rush current	I_{2P}	A	$\sqrt{2}\ VL_2/R_S$

Note 1: "n" means coiling ratio "n" = E_1/E_2

Note 2: R_S is supply power impedance looking at transformer secondary side.