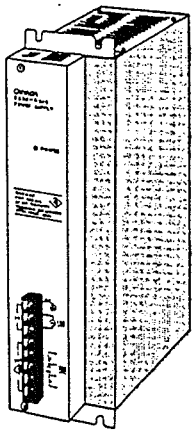
Cat No.I507-E1-1

OMRON

USER'S MANUAL



OMNUC R SERIES

MODEL : R88S-R203/R205/R305/R310/R310G/R315
MODEL : R88A-RG50

POWER UNIT FOR SERVO MOTOR
REGENERATIVE UNIT FOR SERVO MOTOR

Notes About Using This Manual

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

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

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

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

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

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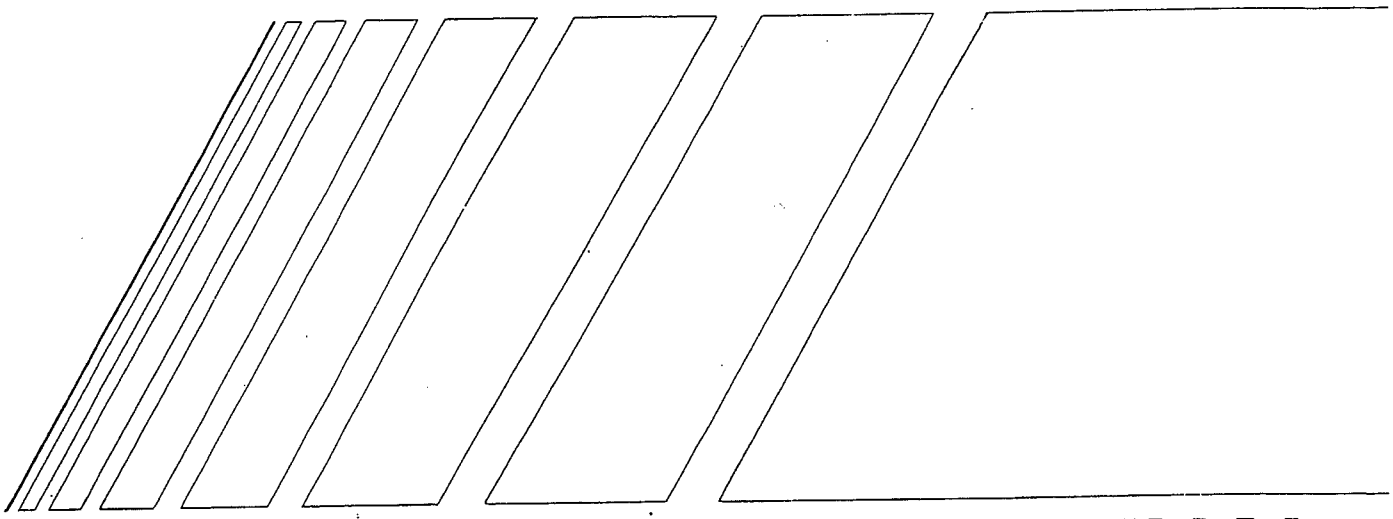

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INDEX

R series power units are the following models in compliance with input voltage and output current.

Model	Input voltage	Output current
R88S-R203	100 V, single-phase	3A
R88S-R205		5A
R88S-R305	200 V, 3-phase or single-phase	6A (3A)
R88S-R310		10 A (5A)
R88S-R310G		10 A (5A)
R88S-R315		15 A (7A)

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

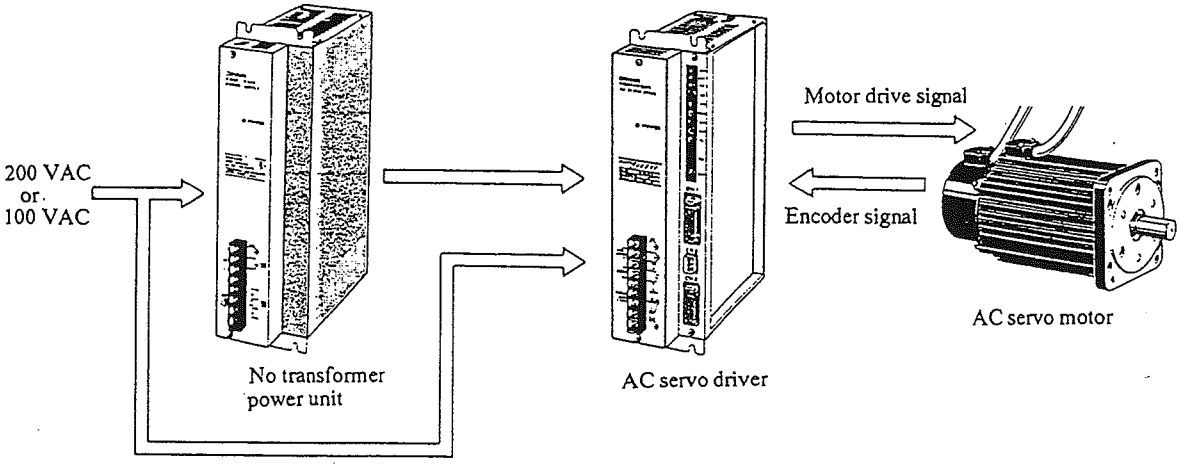
R88S-R310G has built-in regenerative absorption circuit. When regenerative power is more than the installed power unit, use separate type regenerative unit R88A-RG50.

□ Feature of this power unit series

(1) No need to input power transformer 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.



2. SPECIFICATIONS

2-1 General Specifications

Operating ambient temperature	0 to + 55°C
Operating ambient humidity	35 to 85% RH (without dew condensation)
Storage ambient temperature and humidity	- 10 to + 75°C and 35 to 85% RH (without dew condensation)
Operating atmosphere	Without corrosive gas.
Structure	Install in a board.
Insulation resistance	5 MΩ or up at 1,000 VDC megger between an outside terminal and the case.
Voltage proof	One minute at 1,500 VAC, 50/60 Hz between and outside terminal and the 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.

2-2.Performance Specification

□ R88S-R203, R88S-R205

Item	R88S-R203	R88S-R205
Input power voltage	Single-phase, 100 V/110 V, 50/60 Hz	
Input voltage range	85 V - 127 V AC	
Rectification system	Voltage doubler rectification system	
Output voltage	220 v to 357 V DC	
Output current	3A	5A
Input current	11A	18A
Required input power capacity	1,200 VA	2,000 VA
Input power factor	cosϕ = 0.75	cosϕ = 0.75
Regenerative absorption power capacity	30 J	60 J
Average regenerative power capacity	8 W	12 W
Heating value (at 110 V)	22 W	37 W
Rush current	55 A	85 A
Fuse capacity	15 A	20 A
Capacitor capacity (between P and N)	1,640 μF	3,000 μF
Weight	1.8 kgf	2.5 kgf

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]

☐ R88S-R305, R88S-R310, R88S-R315, R88S-R310G

Item / Model	R88S-R305	R88S-R310	R88S-R315	R88S-R310G
Input power voltage	Three-phase or single-phase, 200 V/220 V, 50/60 Hz			
Input voltage range	170 V to 253 V AC			
Output voltage	220 V to 356 V DC			
Output current at three-phase input	6 A	10 A	15 A	10 A
Output current at single-phase input	3 A	5 A	7 A	5 A
Input current at three-phase input	7 A	12 A	18 A	12 A
Input current at single-phase input	6 A	10 A	15 A	10 A
Input power at three-phase	2,700 VA	5,000 VA	7,500 VA	5,000 VA
Input power at single-phase	1,300 VA	2,700 VA	3,300 VA	2,700 VA
Power factor at three-phase input	$\cos\phi = 0.6$			
Regenerative absorption power capacity	20 J	40 J	65 J	200 J
Average regenerative power capacity	5 W	10 W	15 W	20 W
Heating value (at 220 V)	23 W	38 W	55 W	50 W
Rush current	70 A	100 A	100 A	110 A
Fuse capacity	10 A	15 A	20 A	15 A
Capacitor capacity (between P and N)	1,100 μF	2,350 μF	3,760 μF	2,350 μF
Weight	1.6 kgf	2.4 kgf	2.8 kgf	2.6 kgf

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

Note 2: Rush current may vary with input power impedance.

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

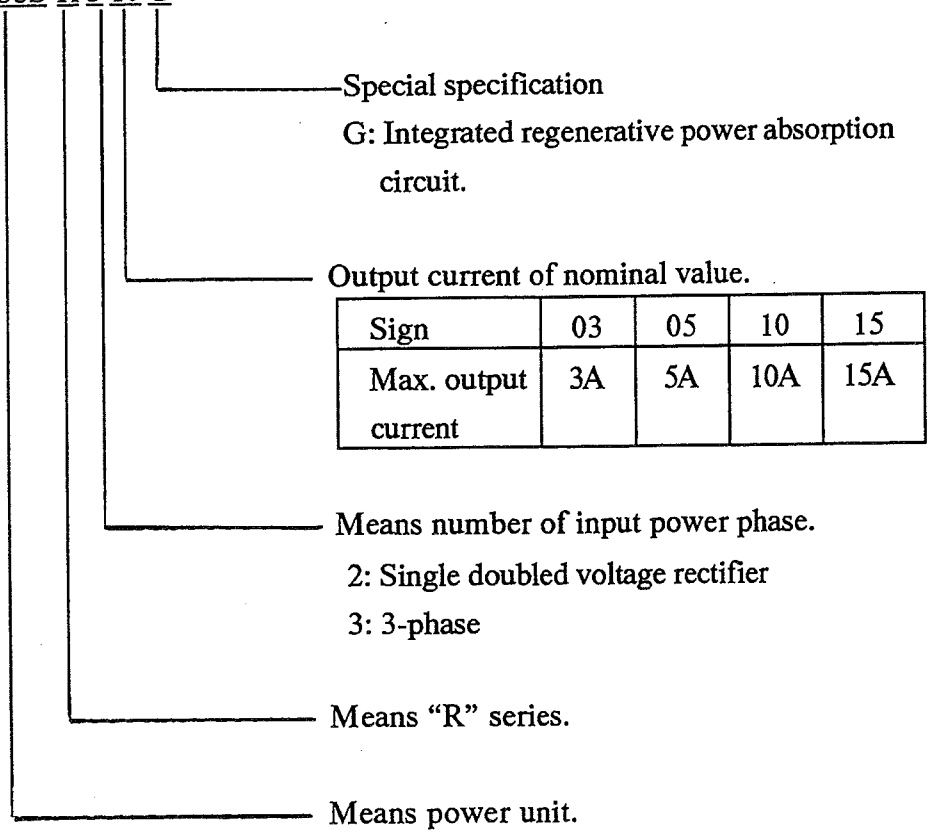
☐ R88A-RG50

Item Model	R88A-RG50
Regenerative absorption power capacity	250 J
Average regenerative power capacity	40 W
Regenerative operation start voltage	373 VDC ± 3V
Regenerative operation stop voltage	Operation voltage - 12V
Heating value (at no operation of regenerative ciruciut)	4 W
Fuse capacity	5 A
Outside regenerative resistance	47 Ω or up
Inside capacitor	220 μF
Weight	1.6 kgf

3. MODEL DENOMINATION

□ Power unit

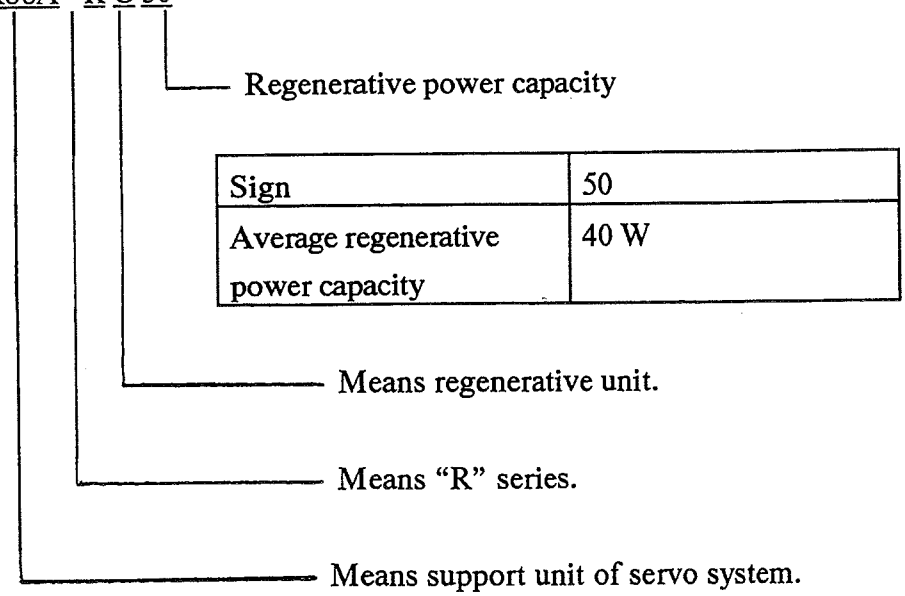
Model R88S-R 3 10 G



Sign	03	05	10	15
Max. output current	3A	5A	10A	15A

□ Regenerative unit

Model R88A - R G 50



Sign	50
Average regenerative power capacity	40 W

4-1.Selection by Using Servo Motor Capacity

Multiply the figures for each model for respecitive motor capacities, and total the results.

Model	Output capacity	Figure (coefficient)	Nominal capacity (Wa)
R88M-R10030	100 W	1.4	140 W
R88M-R20030	200 W	1.1	220 W
R88M-R30030	300 W	1.0	300 W
R88M-R45030	450 W		450 W
R88M-R60030	600 W		600 W
R88M-R82030	820 W		820 W
R88M-R1K130	1,100 W		1,100 W
R88M-R06030	60 W	2.0	120 W
R88M-R11030	110 W	1.5	165 W

Get total amout of nominal capacity with the formula below so that required main circuit DC current can be given.

$$I_A = \frac{\sum W_A}{200} [A]$$

Example: 2 sets of R88M-R20030, 1 set of R88M-R11030

When 1 set of R88M-R30030 is used, its nominal capacity is,

$$\sum W_A = 220 \times 2 + 165 + 300 = 905 [W]$$

Required main circuit current is,

$$I_A = \frac{\sum W_A}{200} = \frac{905}{200} \fallingdotseq 4.53 [A]$$

Therefore, required power unit is R88S-R305 or R88S-R205.

In case of single-phase, 200 V is used, the required power unit should be R88S-R310

( ) means current values with single-phase input.

Model	Input voltage	Output current
R88S-R203	Single-phase, 100 V	3 A
R88S-R205		5 A
R88S-R305	3-phase, 200 V or single phase 200 V	6 A (3A)
R88S-R310		10 A (5A)
R88S-R310G		10 A (5A)
R88S-R315		15 A (7A)

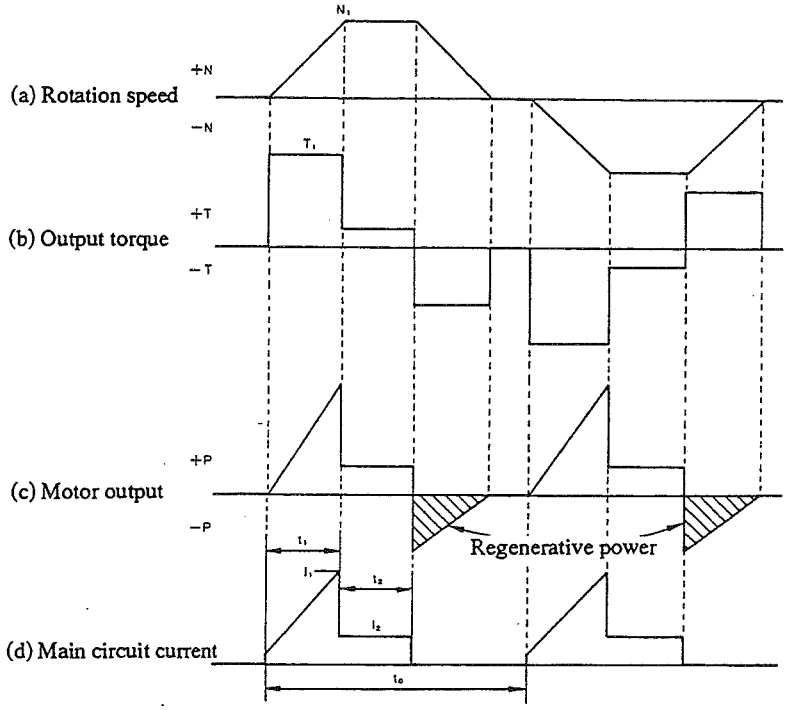
Note: Above calculation is simple selection method based on rated torque of motors. To select the optimum power unit for a system, see item 4-2: the selection with output current.

4-2 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) is given by the formula below:

$P \fallingdotseq 1.027\ NT \times 10^{-2}$ N: No. of rotation (rpm)

T: Output torque (kgf•cm)

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

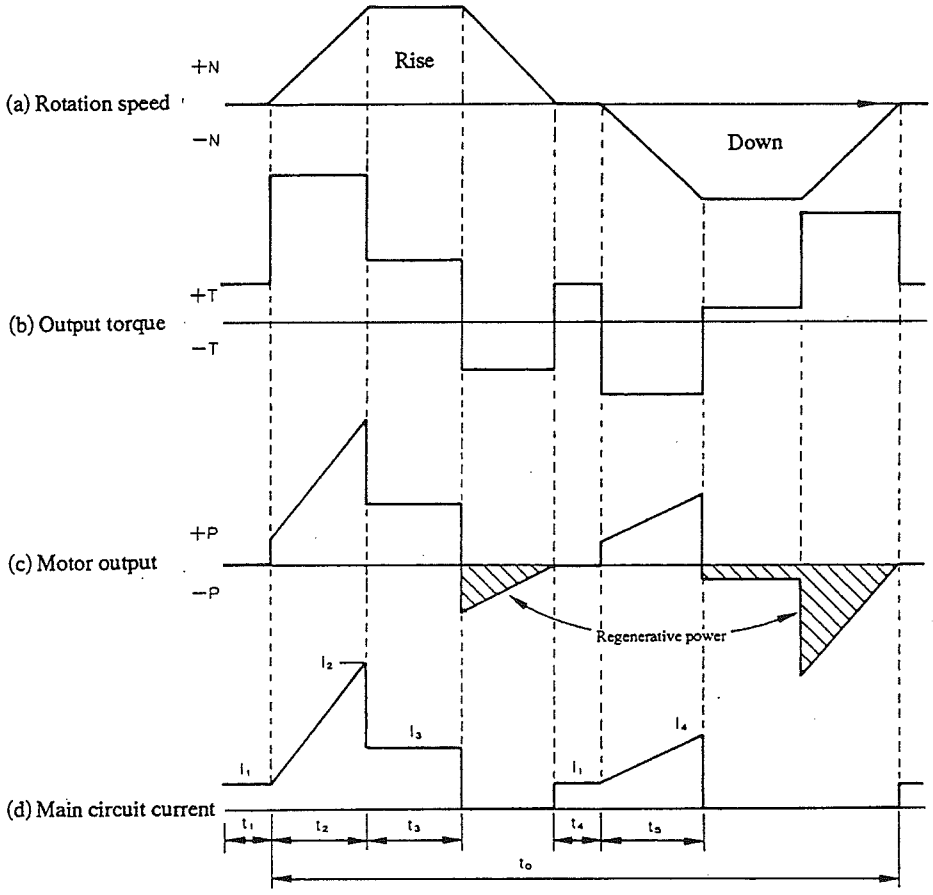
Therefore, actual output current becomes smaller. The main circuit current becomes as the above (d). It is given by the formula below:

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

Compare this Irms value with output current of each power unit nominated in 4-1, and select power unit that Irms 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 4-4.

Example: Using a motor R88M-R20030, 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 vertical installation of a motor, holding current flows even at stop rotation. When regenerative energy is down, there is no power consumption from input power. Actual current 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:

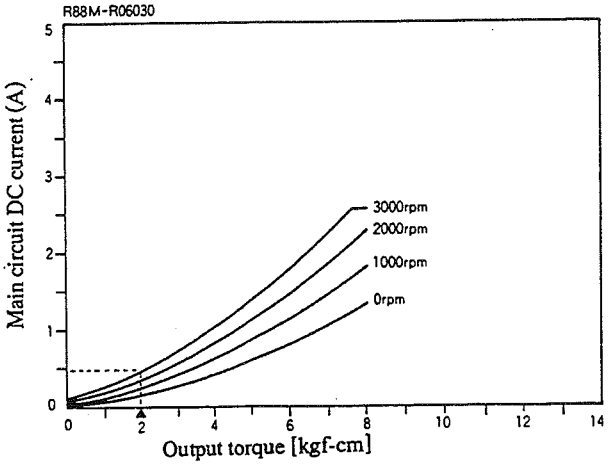
$$I_{rms} \fallingdotseq \frac{\sqrt{I_1^2\, t_1 + \frac{1}{3}(I_2^2+I_1I_2+I_1^2)\, t_2 + I_3^2\, t_3 + I_1^2\, t_4 + \frac{1}{3}(I_4^2+I_4I_1+I_1^2\, t_5)}}{t_0}$$

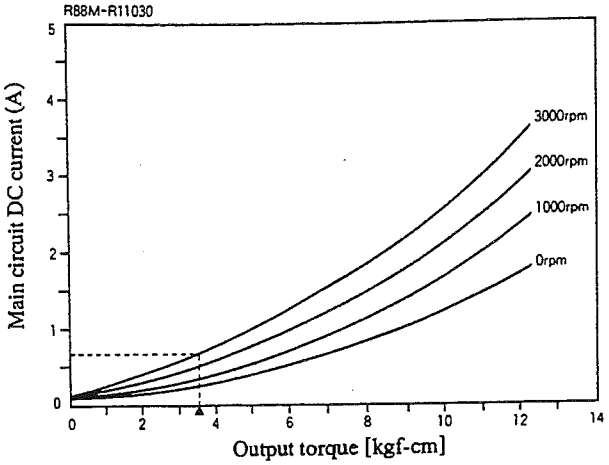
I1: stop torque I2, I3... : given by output torque and main circuit current in 4-4.
Compare this Irms with output current value of each power unit in 4-4, and select a power unit so that the Irms becomess less than the output current value.

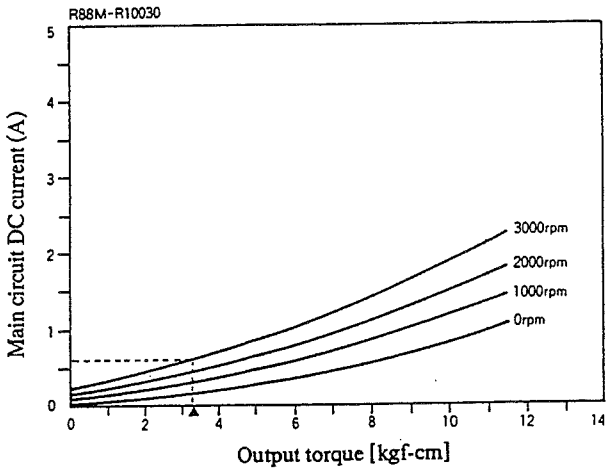
4. SELECTION OF MODELS

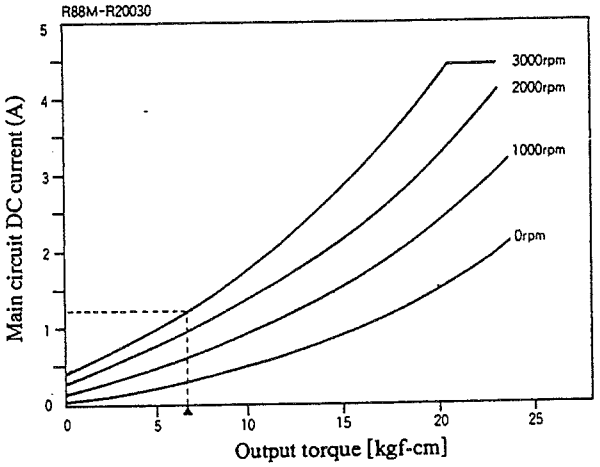
☐ Output torque and main circuit DC current

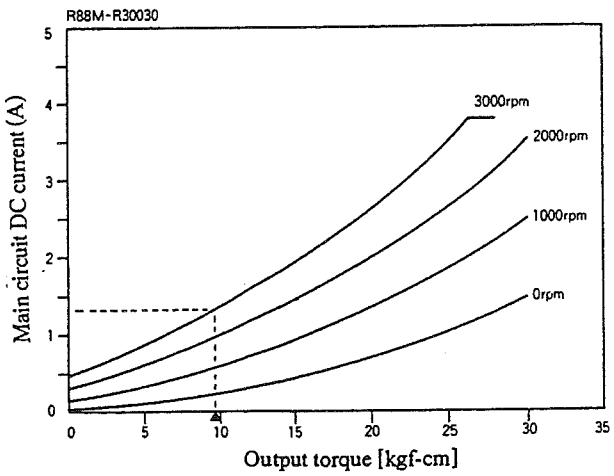
Main circuit DC current varies in compliance with motor output torque and number of rotation. Output torque and main circuit DC curret at each number of rotation are shown below:

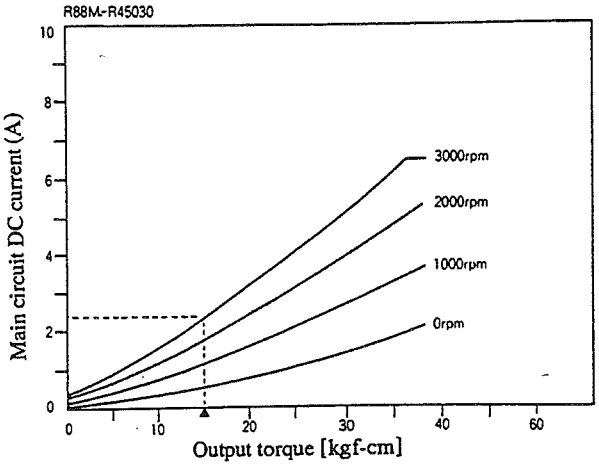


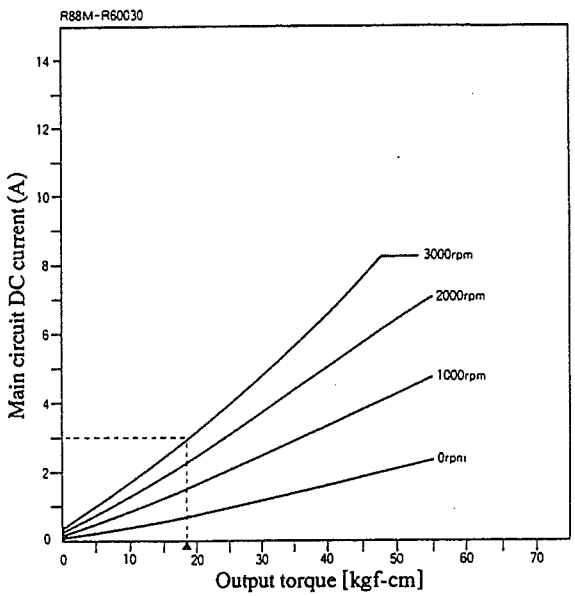


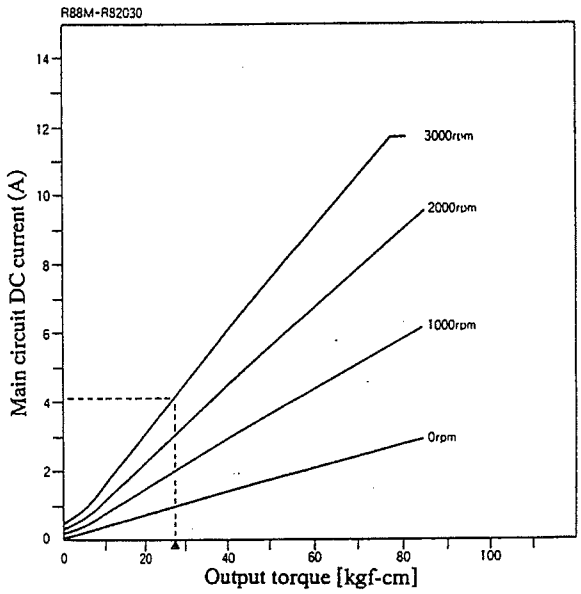


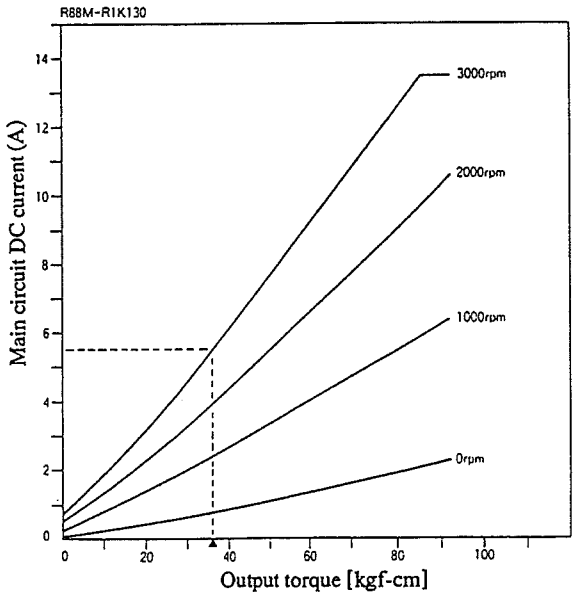












Note: These values of main circuit DC current are for when voltages are 280 VDC (3-phase 200 VAC).When the main circuit voltage decreases, the current will increase in proportion to decreasing rate of the voltage, and vice versa.

4. SELECTION OF MODELS

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

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

Motor model	At rated torque	At instantaneouns max. torque
R88M-R06030	0.6 A	2.6 A
R88M-R11030	0.8 A	4.3 A
R88M-R10030	0.7 A	2.5 A
R88M-R20030	1.1 A	4.4 A
R88M-R30030	1.5 A	3.8 A
R88M-R45030	2.4 A	6.5 A
R88M-R60030	3.0 A	8.2 A
R88M-R82030	4.2 A	12.8 A
R88M-R1K130	5.5 A	13.0 A

Note 1: Above figures are standard value and $\pm$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 fixed 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.

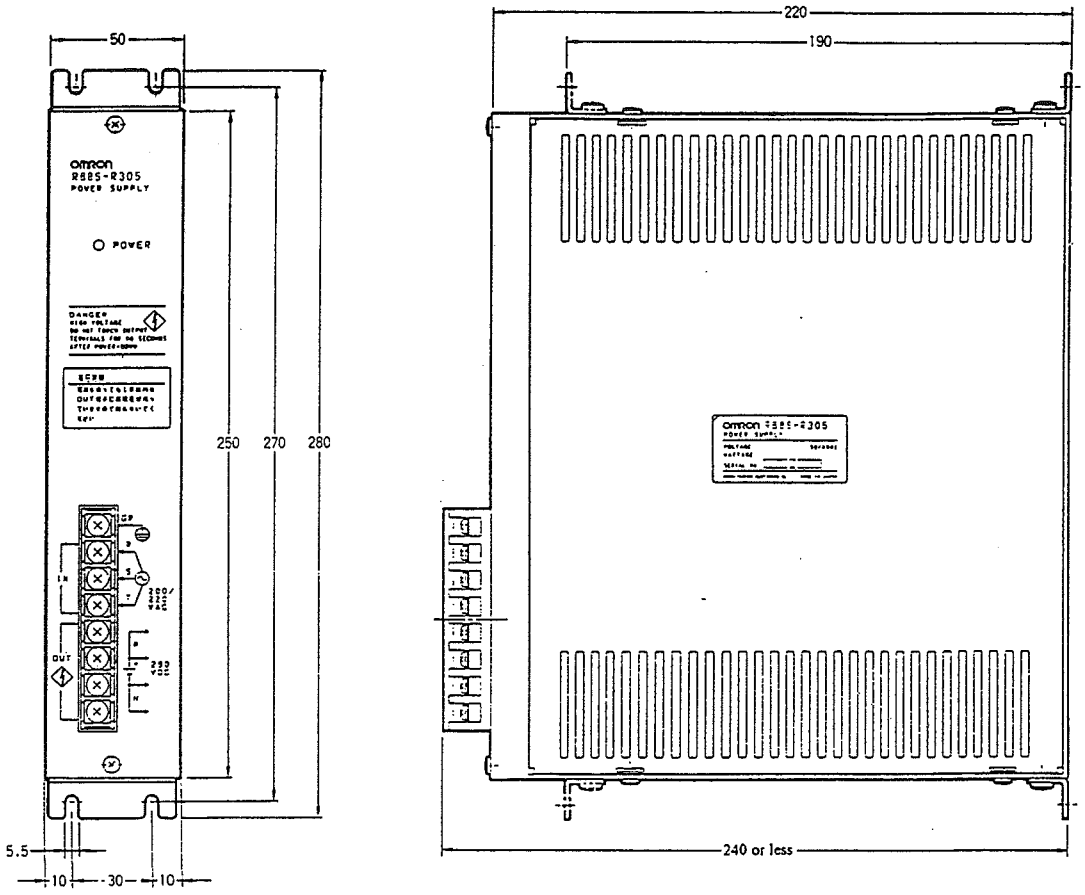
Note 4: Design a system to make acceleration zone (instantaneous max. torque) becomes shorter than one second. Too long in this zone may cause fuse to blow.

5-1.Installation

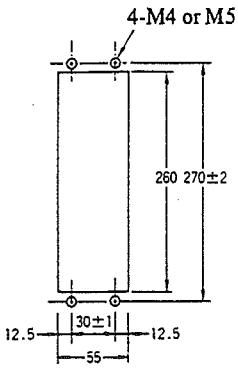
5-1-1 Outside, inside and installation dimensions of power units and regenerative units.

□ R88S-R203, R88S-R305, R88A-RG50

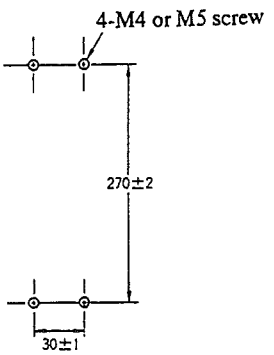
• Outside dimensions



• Panel installation dimensions

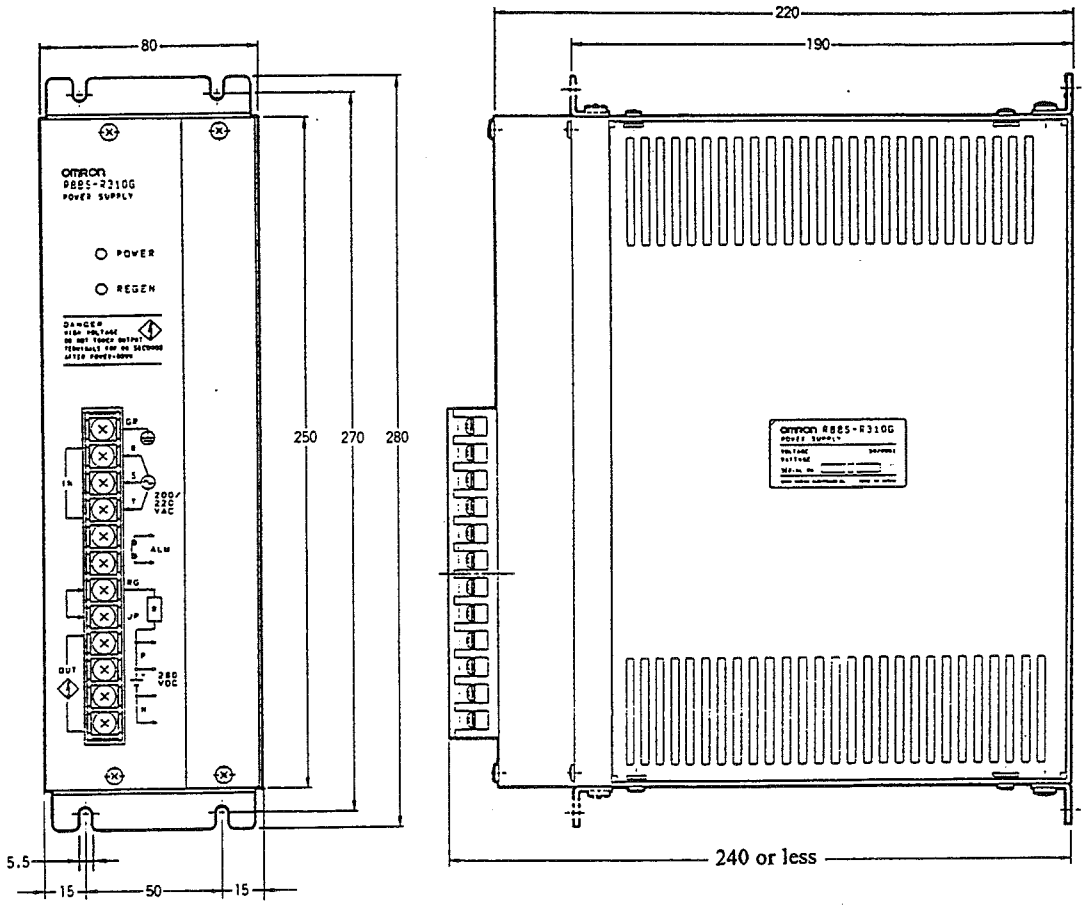


• Installation dimensions

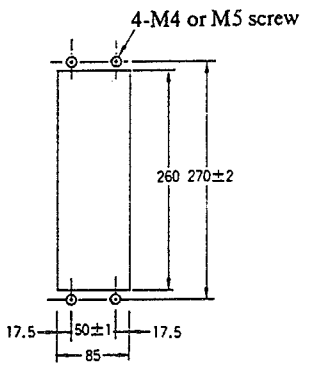


□ R88S-R205, R88S-R310, R88S-R315, R88S-R310G

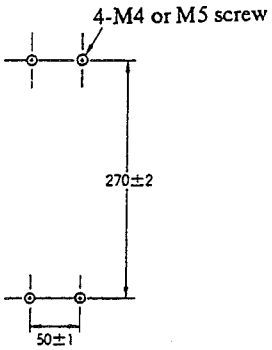
• Outside dimensions



• Panel installation dimensions



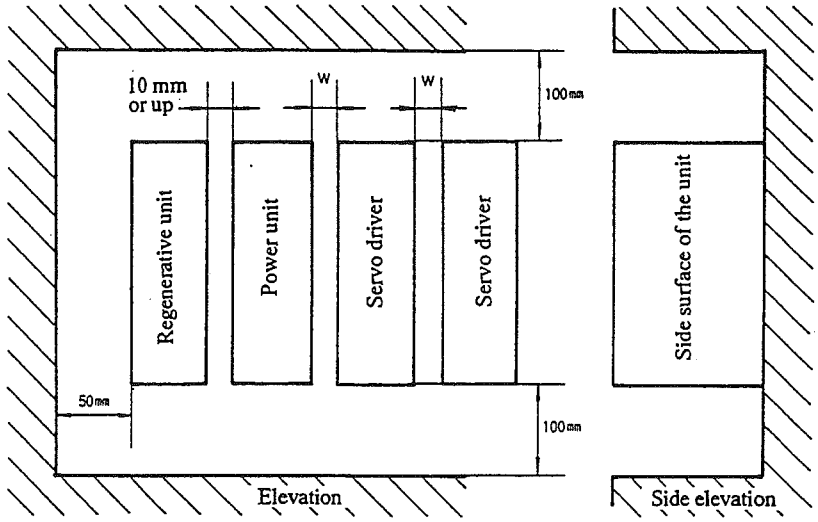
• Installation dimensions



5-1-2 Installation condition

☐ Power unit and regenerative unit

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



Analog input type driver

Model	W dimension
R88D-RB04/RB05/RB10	0 mm or up (Close instal-lation available)
R88D-RB15/RB20	10 mm or up

Pulse train input type driver

Model	W dimension
R88D-RR04/RR05/RR10	0 mm or up (Close instal-lation available)
RRD-RR15/RR20	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. Temperature of the regenerative unit may increase approx. 40°C.Therefore, keep away from other equipment and wiring which tends to be thermally affected.

(4) While installing the units 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) Operating environmental conditions

Operation ambient temperature: 0 to 55°C

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

Storage ambient temperature: -10 to +75°C

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

(6) Be careful to install the unit in the environment without increasing temperature.

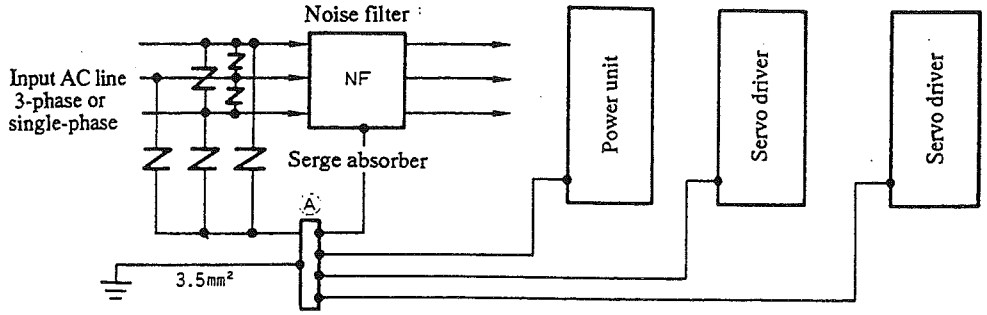
(7) Be careful not to let metal powder, oil mist, or water enter the unit.

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

5-1-3 Wiring

(1) Earth line

Wire earth line (ground line) as follows so that the total system secures noiseproof characteristics



One point earth terminal Green, 2 mm^2 or up

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

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

(2) Wiring and cable size.

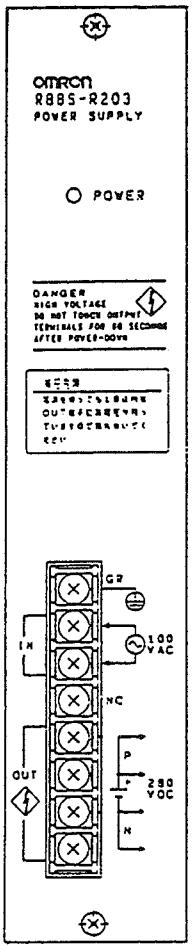
Connection terminal	Name	Cable size	Color
R.S.T	Main circuit power input	2.0 mm^2	Yellow
P.N	Main circuit DC power output	2.0 mm^2	P: Red N: Blue or black
RG	External regenerative resistance	1.25 mm^2	Red
ALM	Alarm output	0.75 mm^2	—
GR	Frame GND	2.0 mm^2	Green

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(-).

5-2 Explanation of each section

□ R88S-R203, R88S-R205



• Display section

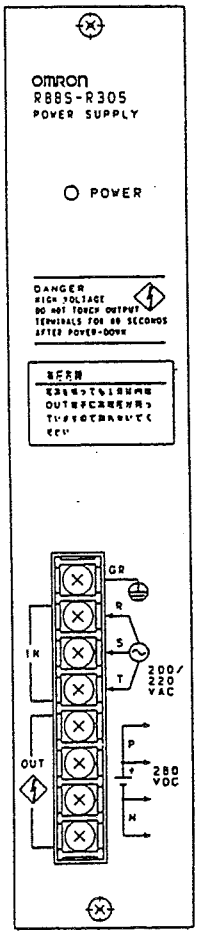
Display sign	Name	Description
POWER	Power indication	Lights ON when voltage outputs between P and N. To access the terminal, wait at lease one minute after this green LED lights OFF and input 100 VAC is disconnected.

• 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	Maim 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.
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 × $2\sqrt{2}$ (220V - 357 VDC)of input voltage.

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

□ R88S-R305, R88S-R310, R88S-R315



• Display section

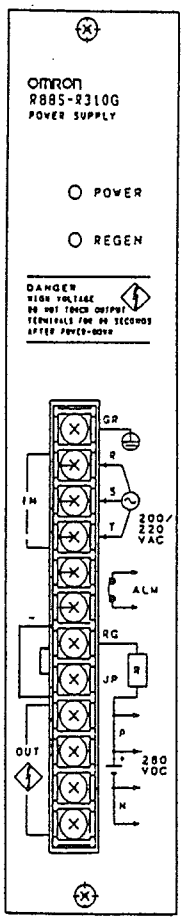
Display sign	Name	Description
POWER	Power indication	Lights ON when voltage outputs between P and N. To access the terminal, wait at lease one minute after this green LED lights OFF and input 200 VAC is disconnected.

• 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.
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 × $\sqrt{2}$ of input voltage.

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

□ R88S-R310G



• Display section

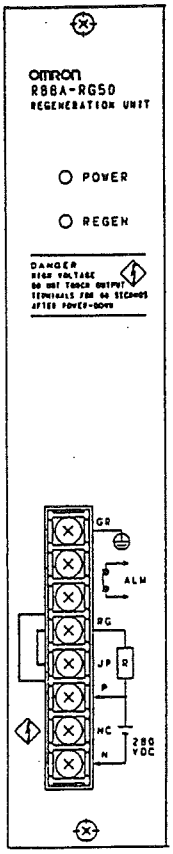
Display sign	Name	Description
POWER	Power indication	Lights ON when voltage outputs between P and N. To access the terminal, wait at lease one minute after this green LED lights OFF and input 200 VAC is disconnected.
REGEN	Indication of regenerative operation	When voltage rises between P and N due to 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	Maim 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.
JP	Inside regenerative resistance terminal	Terminal for the inside regenerative resistance. Prior to use this resistance, be sure to short JP and RG with short bar. At delivery, the unit is arranged to use the inside regenerative resistance.
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 × $\sqrt{2}$ of input voltage.

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

☐ R88A-RG50



• Display section

Display sign	Name	Description
POWER	Power indication	Lights ON when voltage outputs between P and N. To access the terminal, wait until this green LED lights OFF completely.
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.

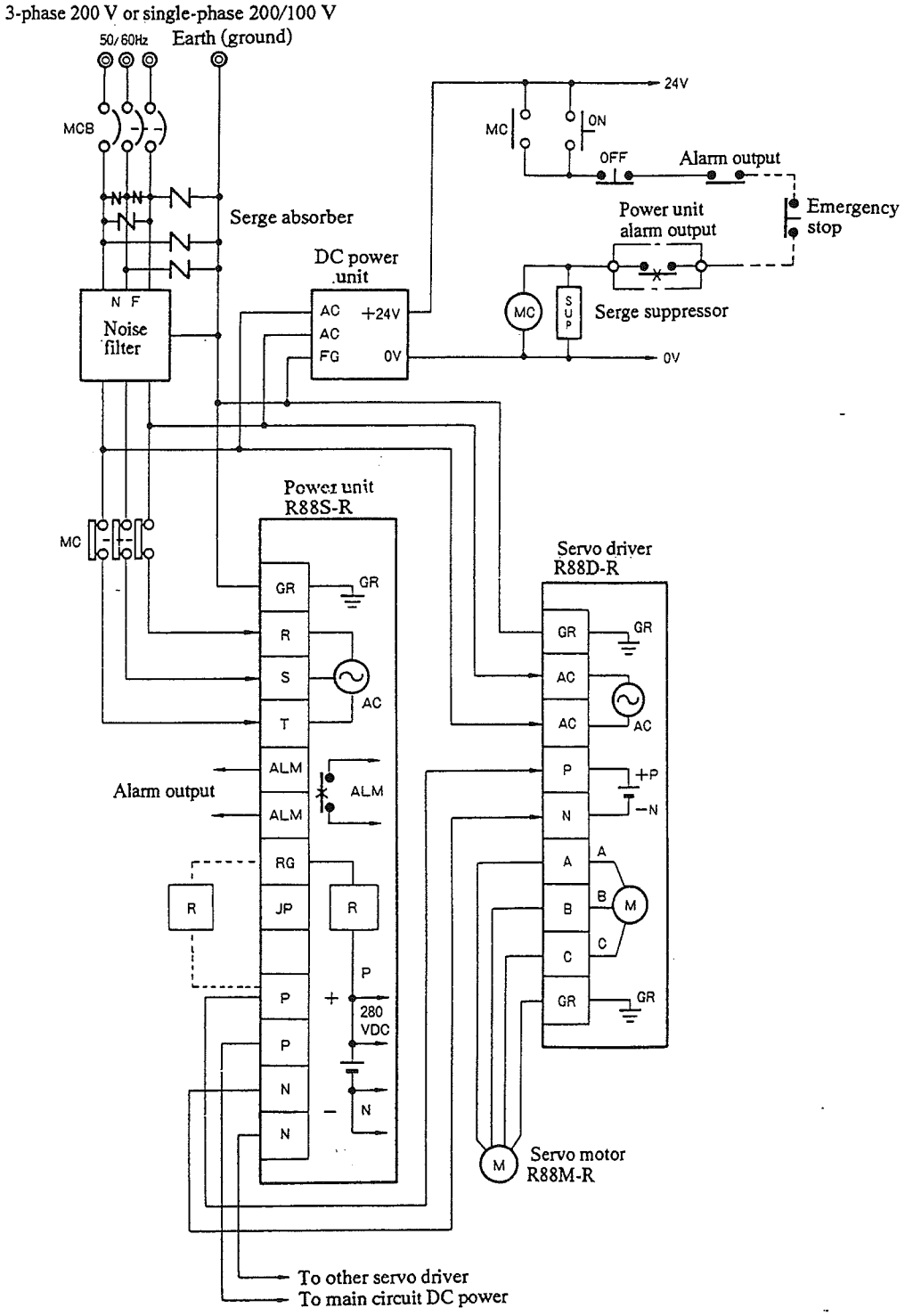
• Terminal section

Display sign	Name	Description
GR	Frame ground	Frame ground of the unit. Connect this terminal with low impedance earth (item 3 or up).
ALM	Alarm output	This contact opens when temperature of the unit radiation fin exceeds 90°± 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.
JP	Inside regenerative resistance terminal	Terminal for the inside regenerative resistance. Prior to use this resistance, be sure to short JP and RG with short bar. At delivery, the unit is arranged to use the inside regenerative resistance.
P.N 280 VDC	Main circuit DC power output	Main circuit DC power output to servo drivers.Connect P and N of the power unit.

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

5-3 Connection with Support Equipment and External Equipment

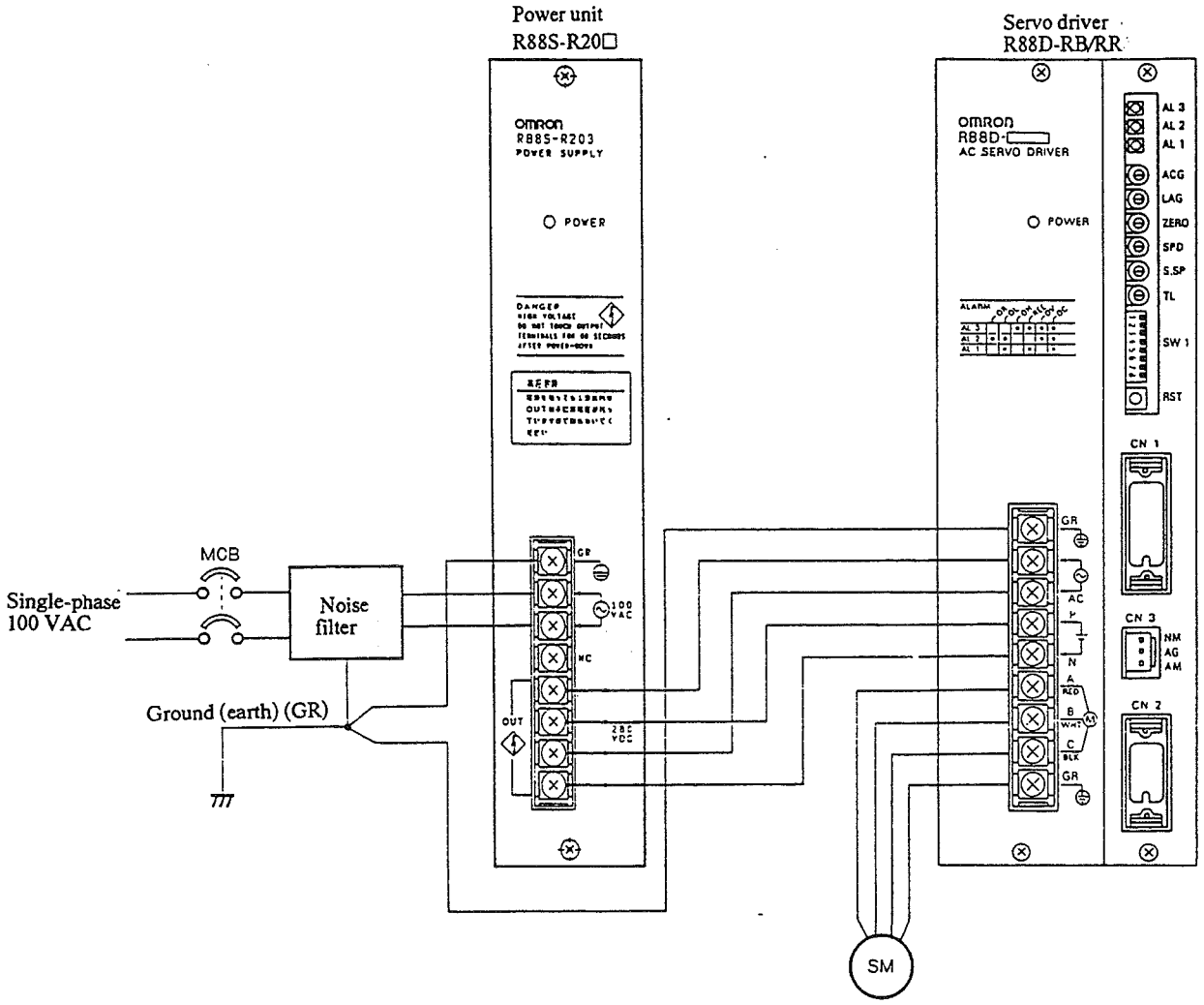
5-3-1 Connection example



Note: Power units without built-in regenerative power absorption circuit have no abnormal output terminal (ALM) and regenerative resistance terminal.

5-3-2 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.



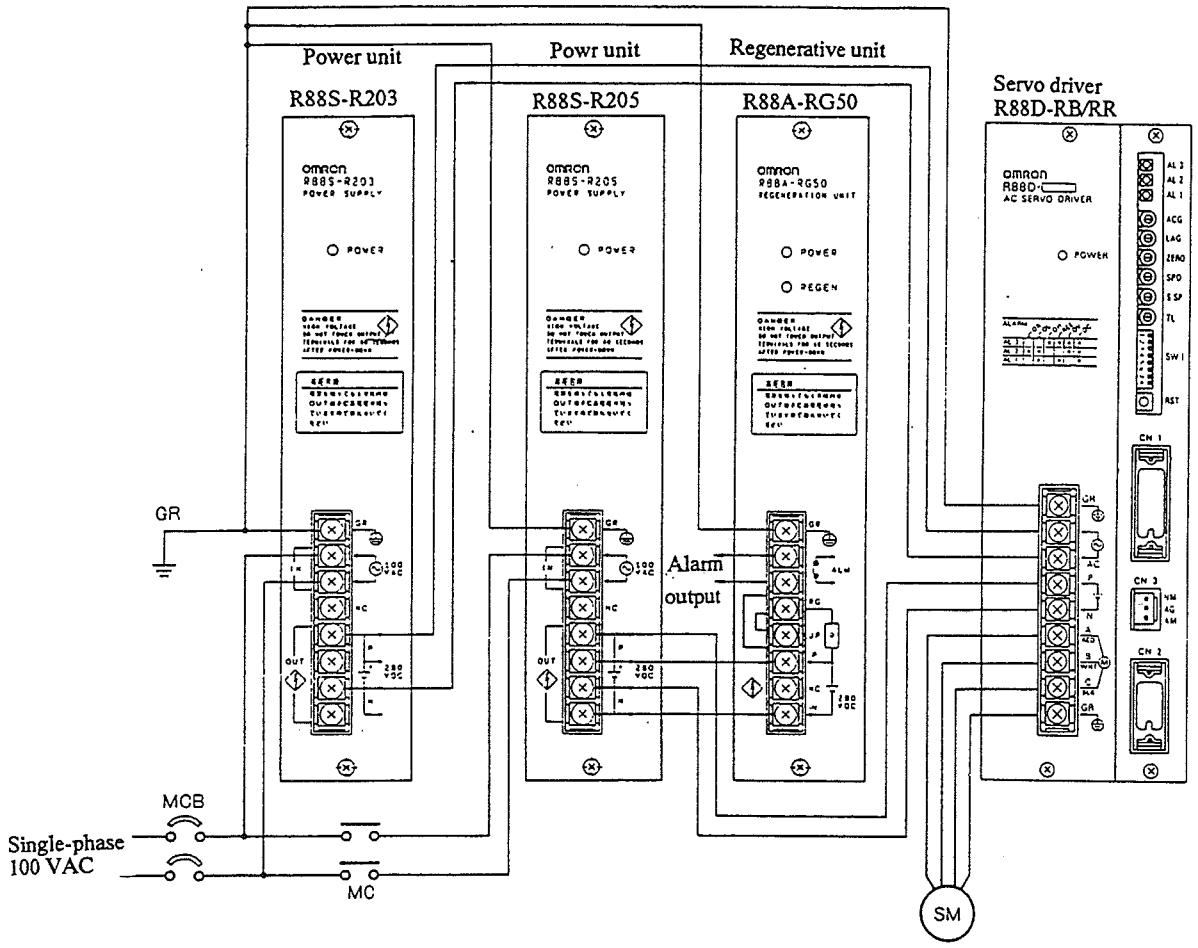
When an alarm occurs at the servo driver with the connection above, be sure to turn OFF RUN command.

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

Note 1: Control power input is usable 220 VDC 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.

5-3-3 Selection example of outer connecting parts

(1) No fuse breaker (MCB)

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-210U	10A	TOKIN
	GT-2150R	15A	
	GT-2200R	20A	
	ZAC2206-11	6A	TDK
	ZAC2210-11	10A	
	ZAG2220-11-P	20A	
	NFB2302H	30A	
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	20A	
	3SUP-A5J-E	5A	OKAYA ELECTRIC IND
	3SUP-A10J-E	10A	
	3SUP-A15J-E	15A	

(3) Magnet relay (MC)

Model	Current	Mfg.
MA415A	15A	**OMRON**
LC1-D163A60	18A	
LC1-D253A60	26A	

(4) Surge absorber (ZNR)

Model	Current	Mfg.
ERZ-A20EL471	5 KA	MATSUSHITA ELECTRIC
ERZ-A25EL471	10 KA	
ERZ-A32EL471	20 KA	

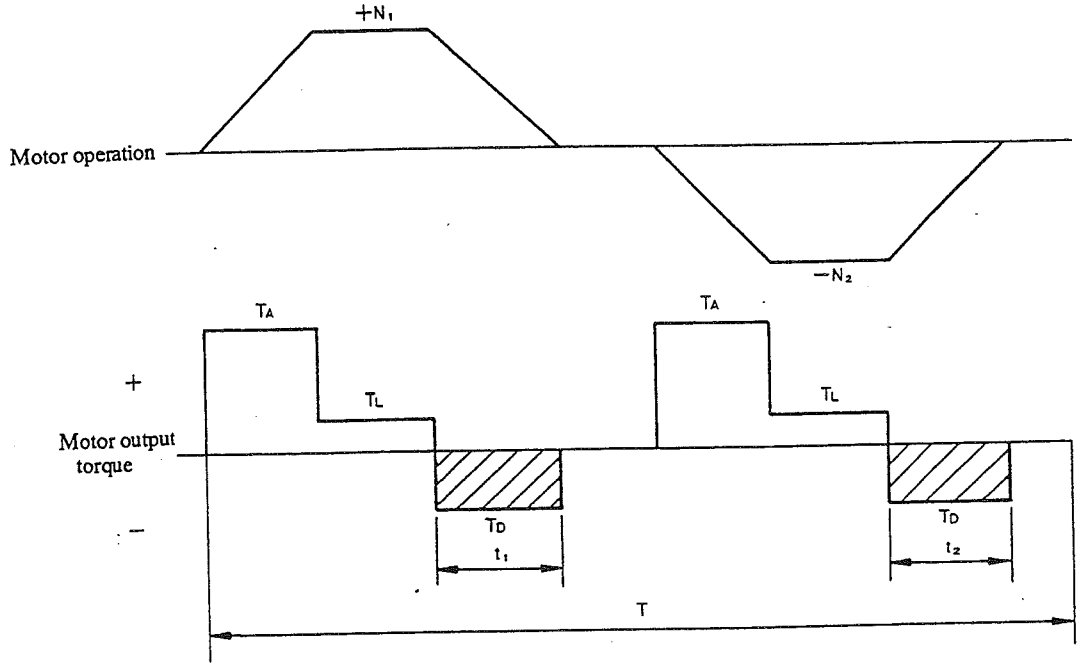
(5) Surge killer

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. REGENERATIVE ENERGY

6-1 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 : Number of motor revolutions at triggering deceleration (rpm)

T_D : Required deceleration torque (kgf•cm)

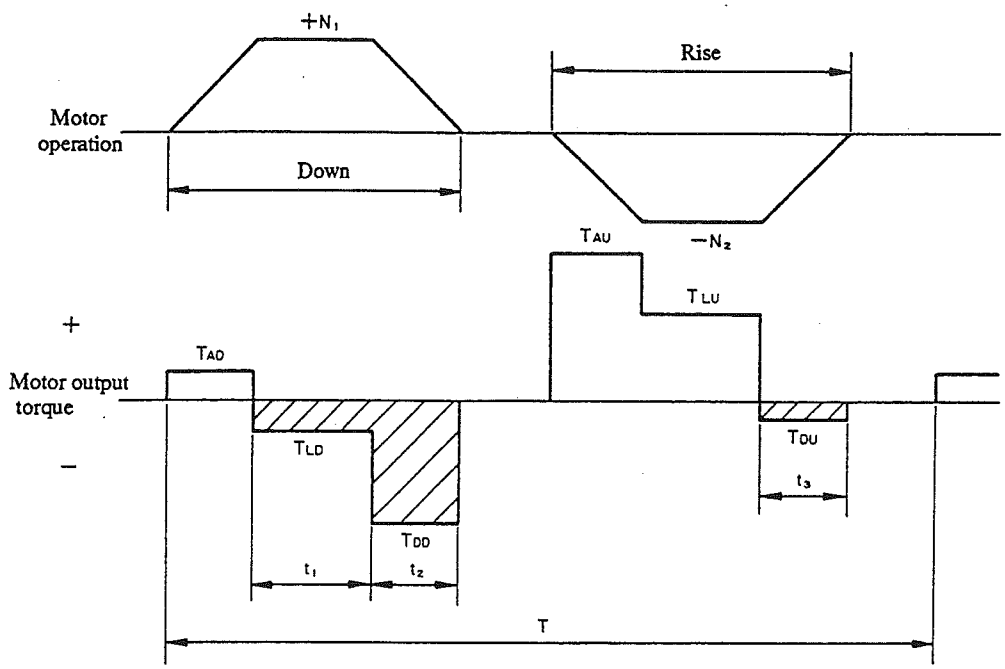
t_1, t_2 : Deceleration interval (sec)

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:

$$Eg \fallingdotseq \frac{(Eg_1 + Eg_2 + Eg_3)}{T} \ (W)$$ T: operation cycle (sec)

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

6-2 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	Average regenerative power
R88S-R203	30 J	8 W
R88S-R205	60 J	12 W
R88S-R305	20 J	5 W
R88S-R310	40 J	10 W
R88S-R315	65 J	15 W
R88S-R310G	200 J (Note 1)	20 W
R88A-RG50	250 J (Note 1)	40 W

Note 1: This figure is a general guide line. Power consumption at main circuit DC current voltage 350 V with regenerative resistance 47Ω is,

$$P = \frac{V^2}{R} = \frac{350^2}{47} \fallingdotseq 2{,}600 \text{ W}$$

This means that allowable absorption energy is 260 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,

$$J_{RG} = \frac{1}{2} N \cdot T \times 1.027 \times 10^{-3} \times 0.2 \fallingdotseq 330 \text{ [J]}$$

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

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

In case of R88S-R203/R205/R305/R310/R315 which does not have built-in regenerative power absorption circuit, when regenerative energy exceeds the rated value, use the regenerative unit R88A-RG50.

In case of R88S-R310G and R88A-RG50, 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 resistance are available. Select and order in accordance with regenerative capacity while checking delivery terms.

Model	Mfg.	Nominal capacity	Power at 120°C	Radiation condition
CF220N47ΩK	CHIBA OHM CO., LTD.	220W	60W	T1.0 SPCC 350 X 350
CAS200N47ΩK		200W	75W	T1.0 SPCC 350 X 350
CSA300N47ΩK		300W	90W	T1.0 SPCC 350 X 350
CSW400N47ΩK		400W	120W	T1.0 SPCC 350 X 350
MRS22N470K	MICRON INSTRUMENTS INC.	220W	60W	T1.0 SPCC 350 X 350
MLS20L470K		200W	80W	T1.0 SPCC 350 X 350
MLC30L470K		300W	110W	T1.0 SPCC 350 X 350
SMR220W47Ω	JAPAN REGISTOR MFG. CO., LTD	220W	60W	T1.0 SPCC 350 X 350

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

Set actuating temperature considering surrounding condition.

7. OPERATION

7-1 Unpack

Check the following points at unpack the case.

- There is no difference between delivered items and ordered items.
- There is no damage due to transportation.
- All accessories are delivered.

Accessories (packed in vinyl bag)

- 2 pcs. of fitting metal
- 4 pcs. of fitting screws M4 × 6
- Spare fuse

Unit model	Fuse capacity	Quantity
R88S-R203	15 A	1
R88S-R205	20 A	1
R88S-R305	10 A	2
R88S-R310	15 A	2
R88S-R315	20 A	2
R88S-R310G	15 A	2
R88A-RR50	5 A	-

Note: R88A-RG50 is not delivered spare fuse element.

7-2 Trial Operation

□ Check item 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-R203 and R88S-R205, input voltage range is single-phase 85 to 127 VAC. Inputting 200 V type power would broke the unit as well as the driver.
3. Input voltage of R88S-R305, R88S-R310, R88S-R315, and R88S-R310G 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 supply power.
3. While the system is in no load condition, the main circuit DC power voltage (P and N) should be 240 to 350 VDC. Check this voltage.
4. After above 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 an inside resistance. It becomes 50 VDC or less after one minutes. Do not touch terminals while this discharge operation. In case of R88S-R310G, "REGEN" LED flickers and discharge this voltage through the regenerative circuit. Check this operation at turn OFF power.
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 50 VDC one minute after shutting off power supply. However, it takes another few minutes to completely discharge. Do not short terminals during this interval as spark may occur.

7-3 Cautions at Handling

(1) Do not short circuit outputs of the power unit while in operation. Short circuit makes large current flow by the inside smoothing capacitor and spark 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 may be broken.
The power unit may be also damaged by line impedance due to short current flow to a rush current prevention resistance and relay contactors.

(3) **Soon after suhtting off supply power to the power unit, it generates approx. 350 V DC voltage. Touching P and N terminals is dangerous as electrical shock and burn may occur. Do not touch P and N terminals within one minute after shutting off power.**

(4) 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 head the rush current prevention resistance, the inside temperature fuse may blow, and rush current prevention function become ineffective. As a result, parts may be damaged.

(5) 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 (4) may blow.

8-1 Protection Functions

☐ Operation indication

POWER Power indication	Indicates that 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.

R88S-R310G and R88A-RG50 have the following "REGEN" indication beside the "POWER" indication.

REGEN Regenerative indication	Indicates that the power unit receives regenerative power from a servo driver and executes regenerative operation. R88S-R310G indicates 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.

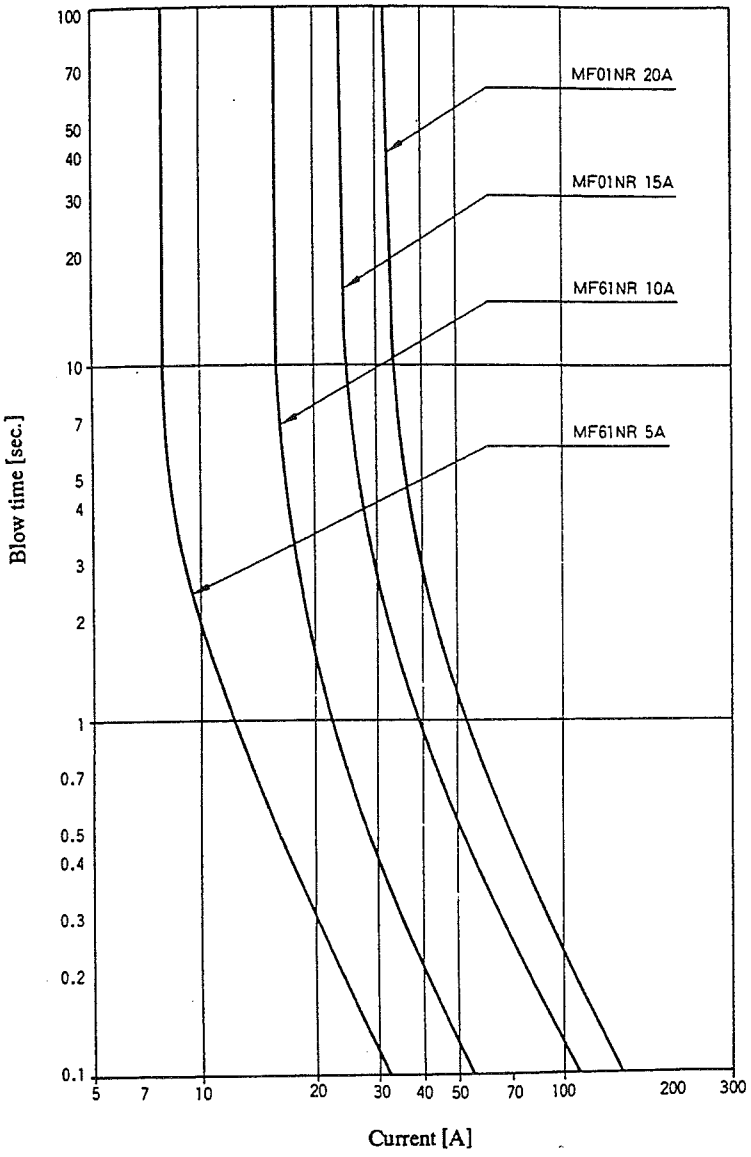
Protective function	Operation	Causes
Main circuit fuse	Blow when excessive current flows in the main circuit	• Output lines are shorted. • Long time operation with over the rated continuous output current.
Temperature rise of radiation fin	Temperature of the radiation fin exceed 85°C and ALM contact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

Installed fuse element of each model is as follows:

Power unit model	Fuse element model
R88S-R203	MF01NR 250V-15A
R88S-R205	MF01NR 250V-20A
R88S-R305	MF61NR 250V-10A
R88S-R310	MF01NR 250V-15A
R88S-R315	MF01NR 250V-20A
R88S-R310G	MF01NR 250V-15A
R88A-RG50	MF61NR 250V-5A

8. MAINTENANCE

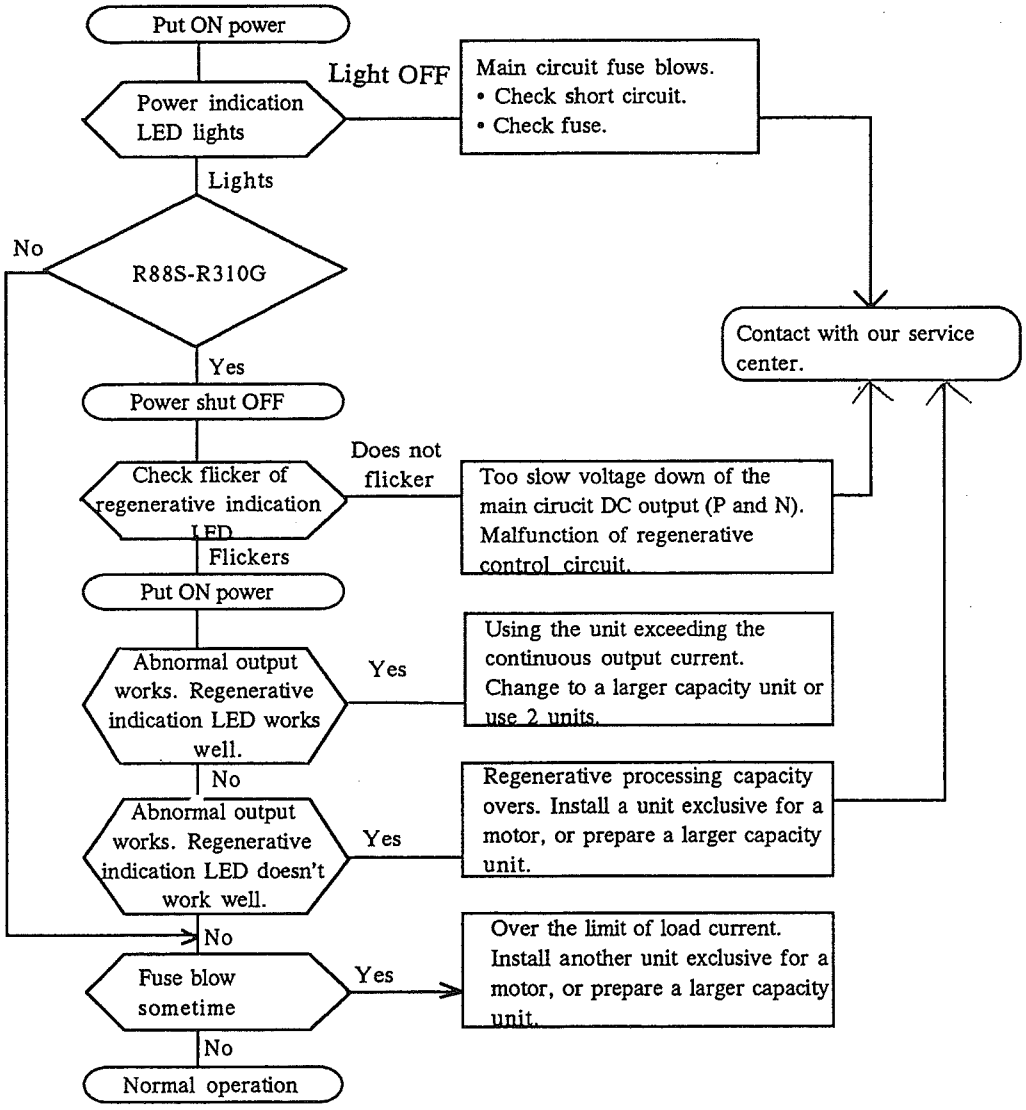
The curbs below show fuse element blow characteristics.
These characteristics are typical ones.



8-2 Troubleshooting

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

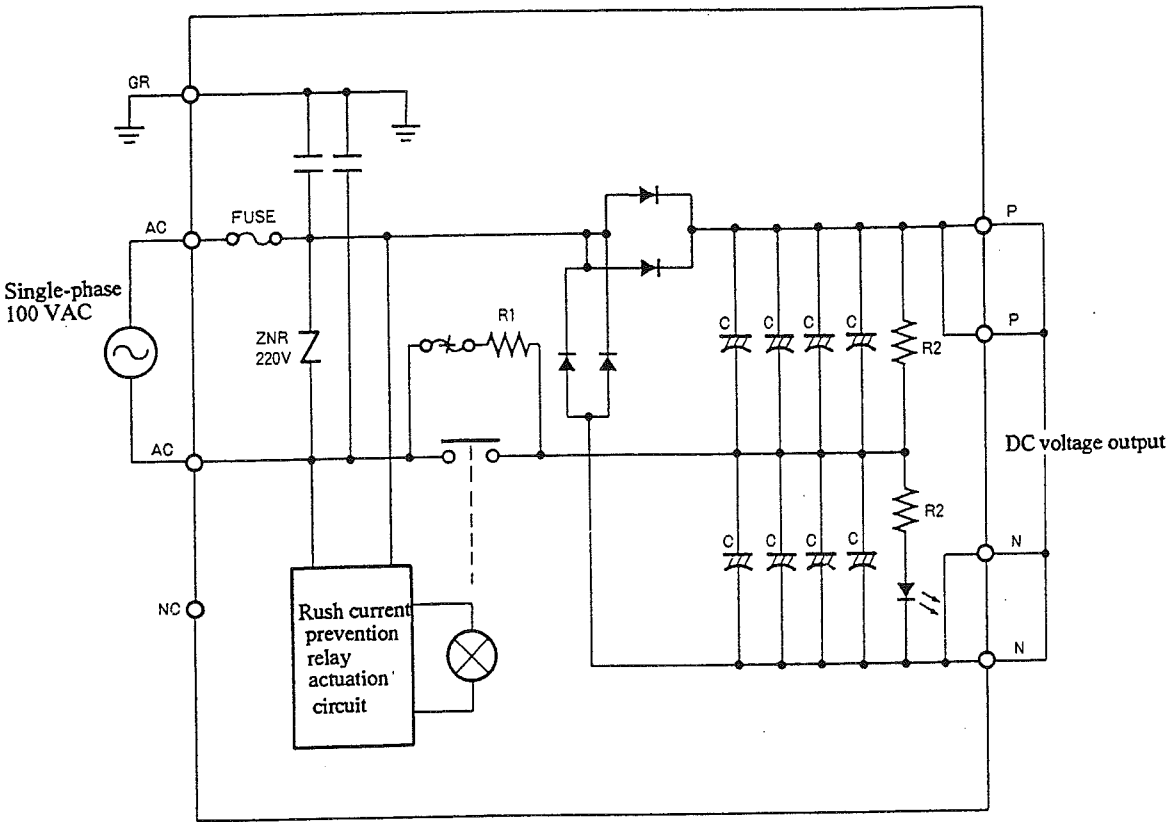
• Power unit



9. INNER CONSTRUCTION

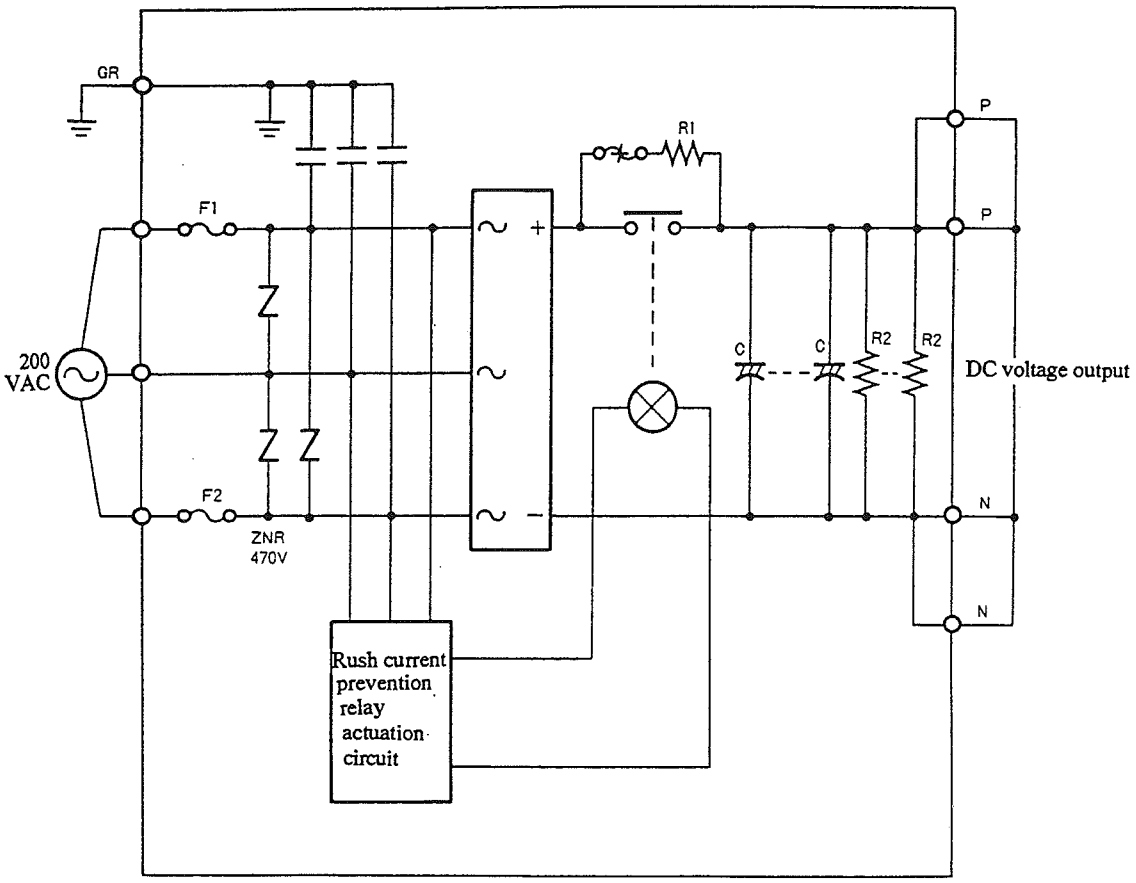
9-1 Inner Block

☐ R88S-R203, R88S-R205



Model	Capacitor C	Electric capacity between P and N	Rush current prevention resistance R_1	Discharge resistance R_2	Fuse element FUSE
R88S-R203	820μF	1,640μF	2.27 Ω	5.6 KΩ - 15W	15 A
R88S-R205	1,500μF	3,000μF	1.36 Ω	3.9 KΩ - 20W	20 A

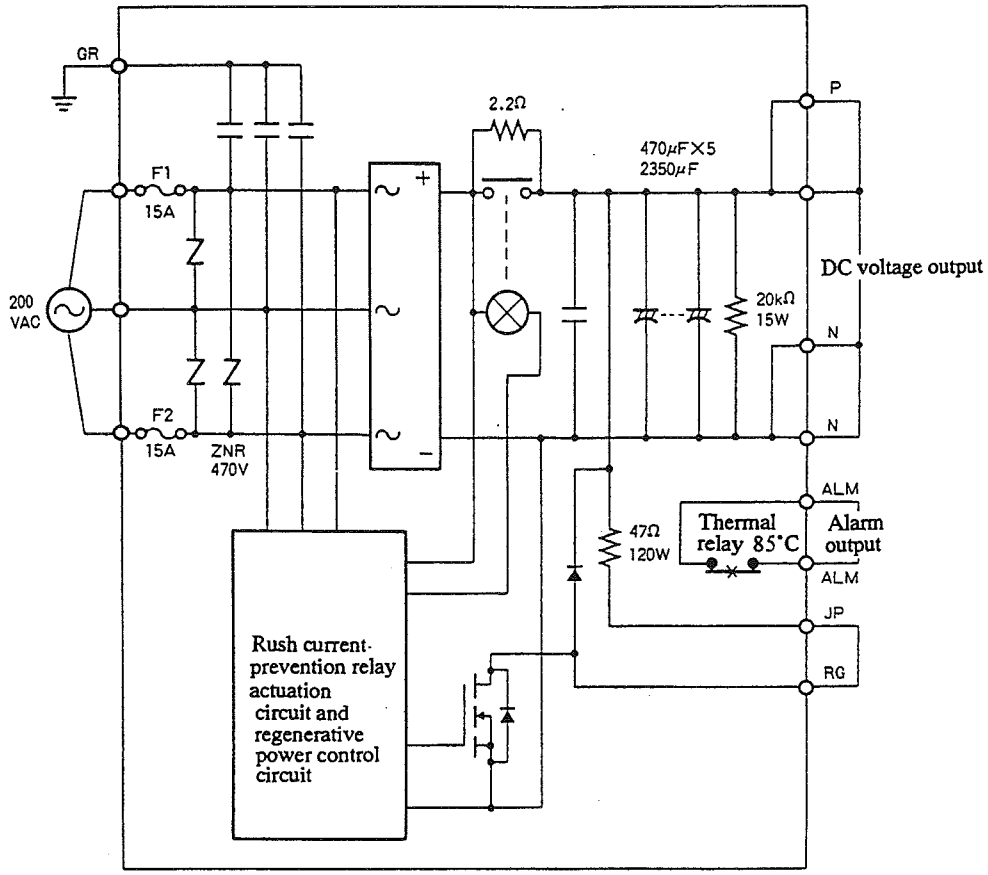
□ R88S-R305, R88S-R310, R88S-R315



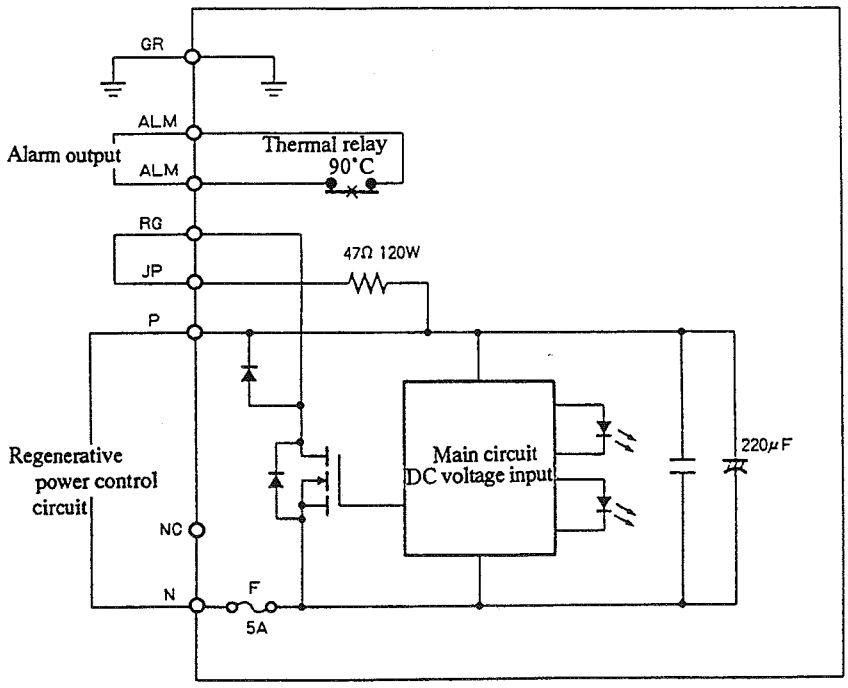
Model	Capacitor C	Electric capacity between P and N	Rush current prevention resistance R_1	Discharge resistance R_2	Fuse element F1, F2
R88S-R305	220μF × 5	1,100μF	3.4 Ω	15KΩ - 20W	10A
R88S-R310	470μF × 5	2.350μF	2.35 Ω	20KΩ - 15W × 2	15A
R88S-R315	470μF × 8	3,760μF	2.35 Ω	20KΩ - 15W × 3	20A

9. INNER CONSTRUCTION

☐ R88S-R310G

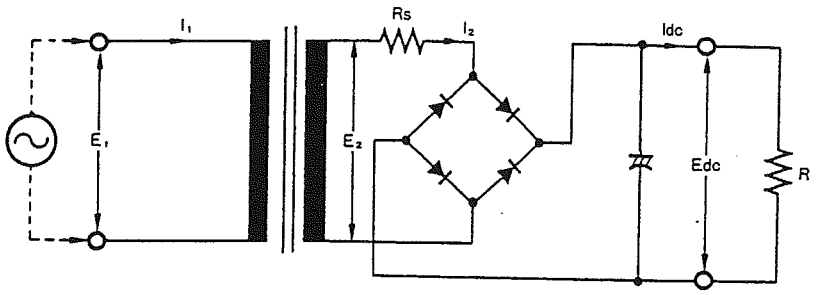


☐ R88A-RG50



9-2 Constants Figures of Rectifier Circuit

☐ Constants figures of single-phase full-wave rectifier circuit



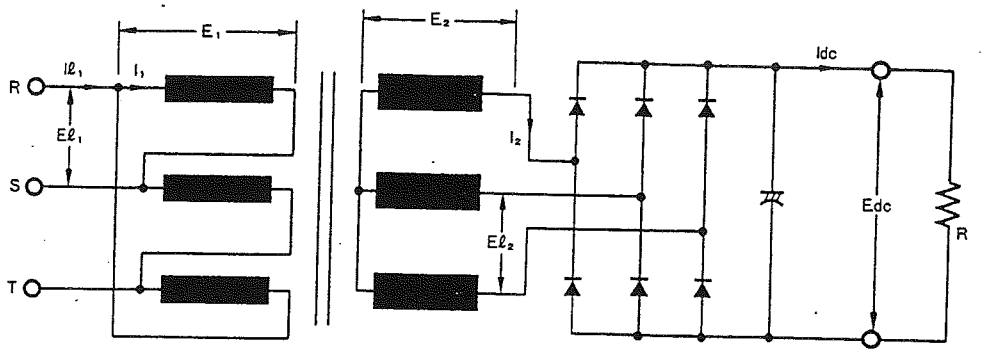
Transformer secondary voltage	E_2	V_{rms}	$0.85 \cdot E_{dc}$
Transformer secondary voltage	I_2	A_{rms}	$1.65 \cdot I_{dc}$
Transformer primary voltage	E_1	E_{rms}	$n \cdot E_2$
Transformer primary voltage	I_1	A_{rms}	$\frac{E_2}{E_1} \cdot I_2 = \frac{I_2}{n}$
Transformer mean capacity	P_{AC}	VA	$1.5 \cdot E_{dc} \cdot I_{dc} \fallingdotseq 2E_2I_{dc}$
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.

9. INNER CONSTRUCTION

☐ 3-phase full-wave rectifier circuit



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

Voltage and current at Δ connection are as follows:

Voltage between wires E L_1 = Phase voltage E_1

Cable current 1 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 1 L_2 = Phase current I_2

Constant figures of 3-phase full-wave rectifier circuit (at -ΔY 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 lin 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.

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