GENERAL CATALOGUE 2004/2005

Industrial Components




- Electromechanical Relays
- Timers
- Counters
- Programmable Relays
- Level Controllers
- Limit Switches
- Pushbutton Switches
- Low Voltage Switch Gear
- Temperature Controllers
- Solid State Relays
- Panel Indicators
- Power Supplies

Advanced Industrial Automation

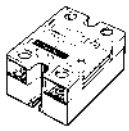
Cat. No. Y202-EN2-02 ICD

OMRON

Contents

Solid State Relays

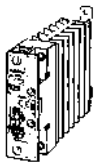
Solid State Relays

Classification		Control panel mounting type						
Model		G3NA				G3NE		
Appearance and dimensions								
Features		1-phase control				1-phase control		
Output	Load voltage	19..264 VAC				75..264 VAC		
	Current (A)	5	10	20	40	5	10	20
	di/dt	100	50	50		100	50	50
	dV/dt	200	100	100		200	500	100
	I^2t (A^2s)	24,5	112,5	260		24,5	125	260
	V_{DRM}, V_{CEO} (V)	600				600		
	Leakage current	5 mA at 100 VAC, 10 mA at 200 VAC				5 mA at 100 VAC, 10 mA at 200 VAC		
Zero-cross function		Yes				Yes		
Output	Load voltage	180..528 VAC						
	Current (A)	10	20	40	50			
	di/dt	100						
	dV/dt	300						
	I^2t (A^2s)	260		1800				
	V_{DRM}, V_{CEO} (V)	1200						
	Leakage current	10 mA at 200 VAC, 20 mA at 400 VAC						
Zero-cross function		Yes						
Output	Load voltage	4..220 VAC						
	Current (A)	5						
	di/dt	–						
	dV/dt	–						
	I^2t (A^2s)	–						
	V_{DRM}, V_{CEO} (V)	400						
	Leakage current	5 mA at 200 VDC						
Zero-cross function		No						
Operation indicator		Yes				Yes		
Rated input voltage		5..24 VDC, 100..120/200..240/100..240 VAC				5, 12, 24 VDC		
Mounting		Panel				Panel		
Approvals		UL, CSA, CE (TUV)				UL, CSA, CE (EN(IEC)), TUV		
Associate products		Heat-sinks available				Heat-sinks available		
Page No.		J-7				J-17		

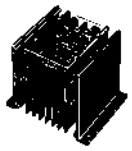
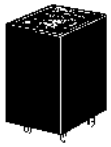
Note: **1.** V_{CEO}: Collector-emitter voltage

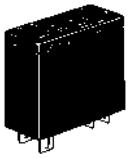
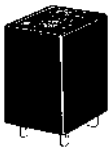
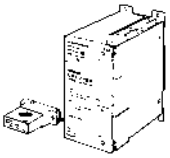
2. The above values are engineering data (reference values) for each output semiconductor incorporated by the respective SSRs.

3. When ordering a TÜV-approved G3NA model, add "-UTU" to the model number as shown below:
Example: G3NA-□□□B-UTU

Control panel mounting type									
G3PA				G3PB				G3PC	
									
1-phase control				1-phase and 3-phase control				1-phase control With Alarm output	
19..264 VAC				100...240 VAC & 200...400 VAC				75..264 VAC	
10	20	40	60	15	25	35	45	20	
50				50				50	
100				100				100	
260		810		260		1260		260	
600				600				600	
5 mA at 100 VAC, 10 mA at 200 VAC		10 mA at 200 VAC, 20 mA at 400 VAC		10 mA at 200 VAC				15 mA at 200 VAC	
Yes				Yes				Yes	
150..440 VAC				100..200 VAC & 200..400 VAC					
20		30		15	25	35	45		
100				50	50				
300				500	100				
260		1040		260	1040				
1000				1000					
20 mA at 400 VAC				10 mA at 200 VAC, 20 mA at 400 VAC					
Yes				Yes					
180..528 VAC				180..528 VAC					
20	30	60		15	25	35	45		
100				50	50				
300				500	100				
1040				121	260	1260			
1200				1000					
20 mA at 480 VAC				20 mA at 480 VAC					
Yes				Yes					
Yes				Yes				Yes	
5..24 VDC, 12..24 VDC, 24 VAC				5..24 VDC				12..24 VDC	
Din Rail & Panel				Din Rail & Panel				Din Rail & Panel	
UL, CSA, CE (EN(IEC))				UL, CSA, CE (EN(IEC))				UL, CSA, CE (VDE)	
Cycle Control Unit (G32A-EA); page X AC Input Unit (G32A-B); page X Voltage Detection Unit (G32A-C); page X Short-Circuit Unit (G32A-D); page X				Also available without heat-sinks				–	
J-21				J-37				J-59	

Solid State Relays

Classification		Control panel mounting type		Socket Mounting Models		
Model		**G3NH**		**G3B/BD**	**G3F/FD**	
Appearance and dimensions						
Features		1-phase control		Compatible with MK	Compatible with MY	
Output	**Load voltage**	75..264 VAC		75..264 VAC	75..264 VAC	
	Current (A)	75	150	5	2	3
	di/dt	150	200	50	50	
	dV/dt	500	500	500	250	
	I^2t (A^2s)	12800	26500	41,6	18	
	V_{DRM}, V_{CEO} (V)	600		600	600	
	Leakage current	30 mA at 200 VAC		5 mA at 100 VAC, 10 mA at 200 VAC	5 mA at 100 VAC, 10 mA at 200 VAC	
Zero-cross function		Yes		Yes	Yes	
Output	**Load voltage**	150..484 VAC		3..125 VDC	3..52.8 VDC	3..125 VDC
	Current (A)	75	150	3	3	2
	di/dt	150	200	–	–	
	dV/dt	500	500	–	–	
	I^2t (A^2s)	12800	26500	–	–	
	V_{DRM}, V_{CEO} (V)	600		150	80	
	Leakage current	60 mA at 200 VAC		5 mA at 125 VAC	5 mA at 50 VAC	0,1 mA at 100 VAC
Zero-cross function		Yes		No	No	
Operation indicator		Yes		Yes	Model dependent	
Rated input voltage		5..24 VDC, 100..240 VAC		5..24 VDC	5, 12, 24 VDC, 5..24 VDC, 100/110 VAC	
Mounting		Din Rail & Panel		Socket	Socket	
Approvals		None		CE ((VDE) VD-type)	CE ((VDE) VD-type)	
Associate products		Replaceable thyristors		PF083A, PL08, PLE08-0, PL08-Q, PF083A-E	PYF08A, PY08, PY08-02, PY08QN(2), PYF08A-E	
Page No.		This product is not shown in the catalogue. For more information please contact your local Omron sales office or download the data from www.eu.omron.com				

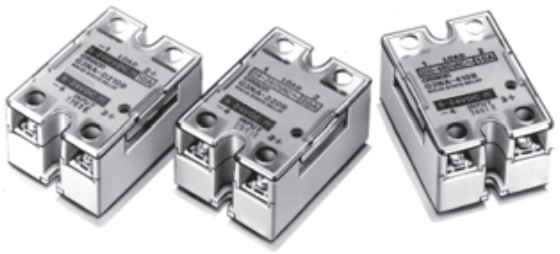
Socket Mounting Models			Power Regulator		
G3R-I/O		G3H/HD	G3PX		
					
I/O SSR Input module		Compatible with LY	Phase control, heater burn-out,bas-up function		
75..264 VAC	4..32 VDC	75..264 VAC	100..110 VAC		
2	0,1	3	20	40	60
30	–	50	50		100
300	–	250	100		500
10,4	–	18	260	1260	–
600	80	600	600	600	600
1,5 mA at 200 VAC	5 µA at 32 VDC	5 mA at 100 VAC, 10 mA at 200 VAC	10 mA at 100/110 VAC		
Yes	No	Yes	No		
4..60 VDC	4..200 VDC	3..52.8 VDC	200..230 VAC		
2	1	3	20	40	60
–		–	50		100
–		–	100		500
–		–	260	1260	–
80	400	80	600	600	600
1 mA at 50 VDC	1 mA at 200 VDC	5 mA at 50 VAC	20 mA at 200/220 VAC		
No		No	No		
Yes		Yes	Yes		
5, 12, 24 VDC, 5..24 VDC, 100..240 VAC		5, 12, 24 VDC, 5..24 VDC	5..24 VDC		
Socket		Socket	Din Rail & Panel		
UL, CSA, CE ((TÜV) UTU-type)		CE ((VDE) VD-type)	UL, CSA		
P2RF-05, P2RF-05-E, P2R-05P, P2R-05A, P2R-057P		PTF08A, PT08, PT08-0, PT08QN, PTF08A-E			
J-67		This product is not shown in the catalogue. For more information please contact your local Omron sales office or download the data from www.eu.omron.com			

Solid State Relays

Solid State Relays
G3NA

A Wide Range of Models with 5- to 50-A Output Currents and Up to 480-VAC/200-VDC Output Voltages

- All models feature the same compact dimensions to provide a uniform mounting pitch.
- Built-in varistor effectively absorbs external surges.
- Operation indicator (red LED) enables monitoring operation.
- Protective cover for greater safety.
- Standard models certified by UL and CSA and -UTU models by VDE (TÜV) (TÜV-version not available for G3NA-410B, G3NA-420B, and G3NA-440B).



Model Number Structure

■ Model Number Legend

G3NA-□□□□□-□
1 2 3 4 5 6 7

1. **Basic Model Name**
   G3NA: Solid State Relay
2. **Load Power Supply**
   Blank: AC output
   D: DC output
3. **Rated Load Power Supply Voltage**
   2: 200 VAC or 200 VDC
   4: 400 VAC
4. **Rated Load Current**
   05: 5 A
   10: 10 A
   20: 20 A
   40: 40 A
   50: 50 A
5. **Terminal Type**
   B: Screw terminals
6. **Zero Cross Function**
   Blank: Equipped with zero cross function (AC-output models only)
7. **Certification**
   Blank: Standard models (certified by UL and CSA)
   UTU: Certified by UL, CSA, and TÜV

Ordering Information

■ List of Models

Isolation	Zero cross function	Indicator	Rated output load	Rated input voltage	Model
Phototriac	Yes	Yes	5 A at 24 to 240 VAC*	5 to 24 VDC	G3NA-205B
Photocoupler				100 to 120 VAC	
				200 to 240 VAC	
Phototriac			10 A at 24 to 240 VAC*	5 to 24 VDC	G3NA-210B
Photocoupler				100 to 120 VAC	
				200 to 240 VAC	
			10 A at 200 to 480 VAC*	5 to 24 VDC	G3NA-410B
				100 to 240 VAC	
	---		10 A at 5 to 200 VDC	5 to 24 VDC	G3NA-D210B
				100 to 240 VAC	
Phototriac	Yes		20 A at 24 to 240 VAC*	5 to 24 VDC	G3NA-220B
Photocoupler				100 to 120 VAC	
				200 to 240 VAC	
			20 A at 200 to 480 VAC*	5 to 24 VDC	G3NA-420B
				100 to 240 VAC	
Phototriac			40 A at 24 to 240 VAC*	5 to 24 VDC	G3NA-240B
Photocoupler				100 to 120 VAC	
				200 to 240 VAC	
			40 A at 200 to 480 VAC*	5 to 24 VDC	G3NA-440B
				100 to 240 VAC	
			50 A at 200 to 480 VAC*	5 to 24 VDC	G3NA-450B

*Loss time increases under 75 VAC. (Refer to page 15.) Confirm operation with the actual load.

Note: 1. When ordering a TÜV-certified model, add "-UTU" to the model number as shown below. (There are no TÜV-certified versions of 400-V models.)
Example: G3NA-210B-UTU

2. When ordering, specify the rated input voltage.

■ Accessories (Order Separately)

Heat Sinks

The following heat sinks are thin and can be DIN-track mounted (except Y92B-P250).
See *Dimensions* for details.

Model	Applicable SSR
Y92B-N50	G3NA-205B, G3NA-210B, G3NA-D210B, G3NA-410B
Y92B-N100	G3NA-220B, G3NA-420B
Y92B-N150	G3NA-240B, G3NA-440B
Y92B-P250	G3NA-450B

Low-cost Models

Model	Applicable SSR
Y92B-A100	G3NA-205B, G3NA-210B, G3NA-D210B, G3NA-220B, G3NA-410B, G3NA-420B
Y92B-A150N	G3NA-240B, G3NA-440B
Y92B-A250	G3NA-440B

Mounting Bracket

Used to mount the G3NA with a mounting dimension of 56 mm.

Model	Applicable SSR
R99-11	G3NA-240B, G3NA-440B

See *Dimensions* for details. (Refer to page 13.)

Specifications

■ Ratings (at an Ambient Temperature of 25°C)

Input

Model	Rated voltage	Operating voltage	Impedance	Voltage level	
				Must operate voltage	Must release voltage
G3NA-2□□B	5 to 24 VDC	4 to 32 VDC	7 mA max.*	4 VDC max.	1 VDC min.
	100 to 120 VAC	75 to 132 VAC	36 kΩ±20%	75 VAC max.**	20 VAC min.**
	200 to 240 VAC	150 to 264 VAC	72 kΩ±20%	150 VAC max.**	40 VAC min.**
G3NA-4□□B	5 to 24 VDC	4 to 32 VDC	5 mA max.*	4 VDC max.	1 VDC min.
G3NA-D210B	100 to 240 VAC	75 to 264 VAC	72 kΩ±20%	75 VAC max.	20 VAC min.

Note: The input impedance is measured at the maximum value of the rated supply voltage (for example, with the model rated at 100 to 120 VAC, the input impedance is measured at 120 VAC).
*With constant current input circuit system. The impedance for the G3NA-□□□B-UTU is 15 mA max.
**Refer to the *Engineering Data* for further details.

Output

Model	Applicable load				
	Rated load voltage	Load voltage range	Load current (See note 1.)		Inrush current
			With heat sink (See note 2.)	Without heat sink	
G3NA-205B	24 to 240 VAC	19 to 264 VAC	0.1 to 5 A	0.1 to 3 A	60 A (60 Hz, 1 cycle)
G3NA-210B			0.1 to 10 A	0.1 to 4 A	150 A (60 Hz, 1 cycle)
G3NA-410B	200 to 480 VAC	180 to 528 VAC	0.2 to 10 A	0.2 to 4 A	
G3NA-220B	24 to 240 VAC	19 to 264 VAC	0.1 to 20 A	0.1 to 4 A	220 A (60 Hz, 1 cycle)
G3NA-420B	200 to 480 VAC	180 to 528 VAC	0.2 to 20 A	0.2 to 4 A	
G3NA-240B	24 to 240 VAC	19 to 264 VAC	0.1 to 40 A	0.1 to 6 A	440 A (60 Hz, 1 cycle)
G3NA-440B	200 to 480 VAC	180 to 528 VAC	0.2 to 40 A	0.2 to 6 A	
G3NA-450B	200 to 480 VAC	180 to 528 VAC	0.2 to 50 A	0.2 to 6 A	
G3NA-D210B	5 to 200 VDC	4 to 220 VDC	0.1 to 10 A	0.1 to 4 A	20 A (10 ms)

Note: 1. The load current varies depending on the ambient temperature. Refer to *Load Current vs. Ambient Temperature* under *Engineering Data*.
2. When OMRON's heat sink (refer to the accessories) or a heat sink of specified size is used.

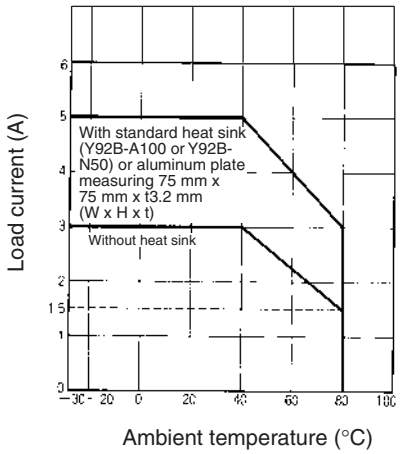
■ Characteristics

Item	G3NA-205B, -210B, -220B	G3NA-240B	G3NA-410B, -420B, -440B, -450B	G3NA-D210B
Operate time	1/2 of load power source cycle + 1 ms max. (DC input) 3/2 of load power source cycle + 1 ms max. (AC input)			1 ms max. (DC input) 30 ms max. (AC input)
Release time	1/2 of load power source cycle + 1 ms max. (DC input) 3/2 of load power source cycle + 1 ms max. (AC input)			5 ms max. (DC input) 30 ms max. (AC input)
Output ON voltage drop	1.6 V (RMS) max.		1.8 V (RMS) max.	1.5 V max.
Leakage current	5 mA max. (at 100 VAC) 10 mA max. (at 200 VAC)		10 mA max. (at 200 VAC) 20 mA max. (at 400 VAC)	5 mA max. (at 200 VDC)
Insulation resistance	100 MΩ min. (at 500 VDC)			
Dielectric strength	2,500 VAC, 50/60 Hz for 1 min			
Vibration resistance	Destruction: 10 to 55 to 10 Hz, 0.75-mm single amplitude			
Shock resistance	Destruction: 1,000 m/s^2			
Ambient temperature	Operating: –30°C to 80°C (with no icing or condensation) Storage: –30°C to 100°C (with no icing or condensation)			
Certified standards	UL508 File No. E64562/CSA C22.2 (No.0, No.14) File No. LR35535 (except for G3NA-450B) TÜV R9151660 (EN60950) (except for G3NA-4□0B)			
Ambient humidity	Operating: 45% to 85%			
Weight	Approx. 60 g	Approx. 70 g	Approx. 80 g	Approx. 70 g

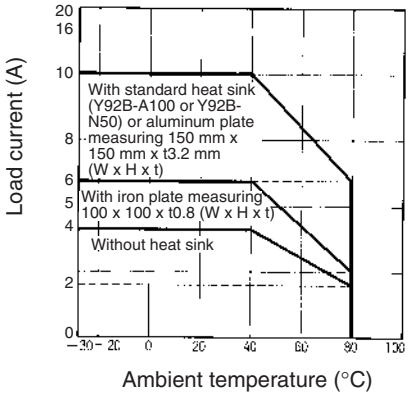
Engineering Data

Load Current vs. Ambient Temperature

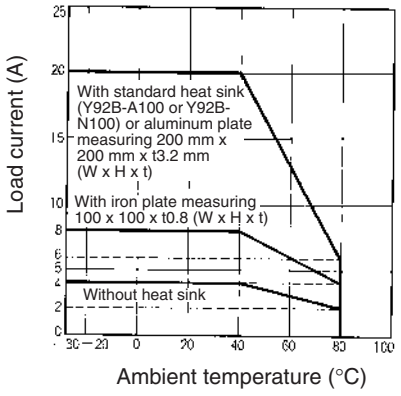
G3NA-205B



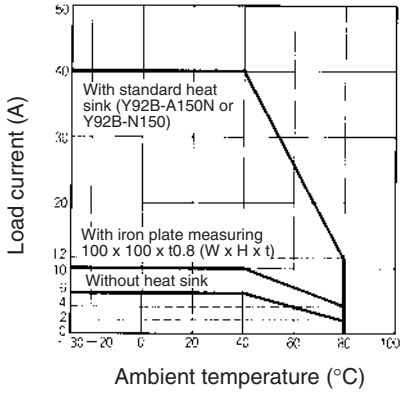
G3NA-210B/410B



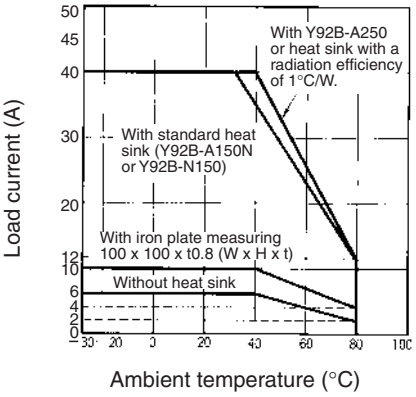
G3NA-220B/420B



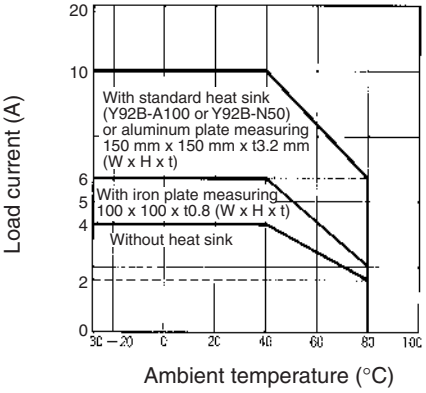
G3NA-240B



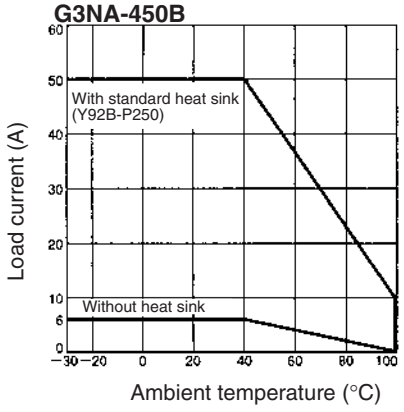
G3NA-440B



G3NA-D210B



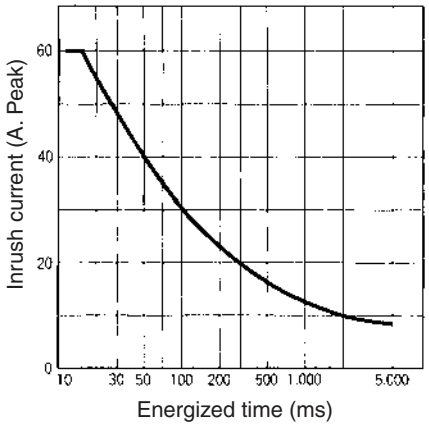
G3NA-450B



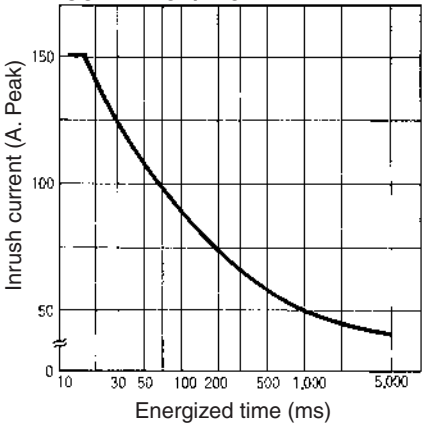
One Cycle Surge Current: Non-repetitive

Note: Keep the inrush current to half the rated value if it occurs repetitively.

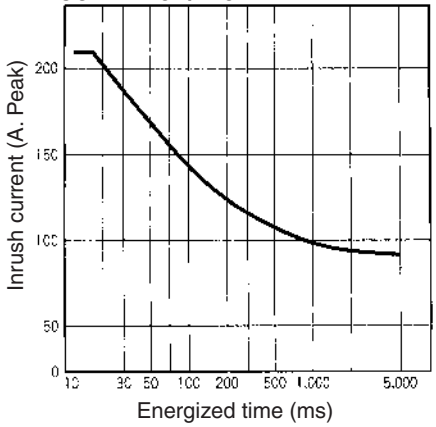
G3NA-205B



G3NA-210B/410B

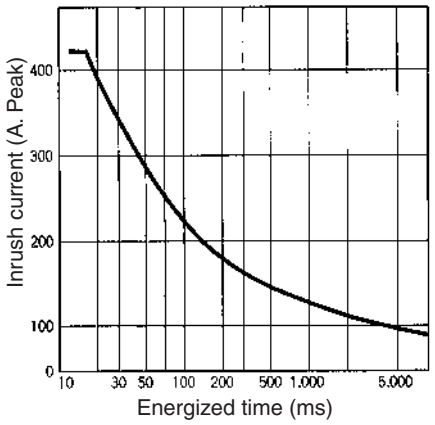


G3NA-220B/420B

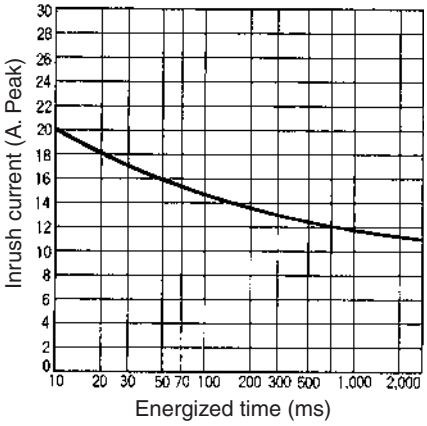


Temperature Characteristics (with Must Operate Voltage and Must Release Voltage)

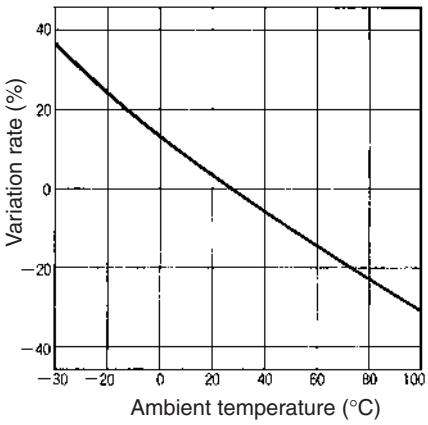
G3NA-240B/440B/450B



G3NA-D210B

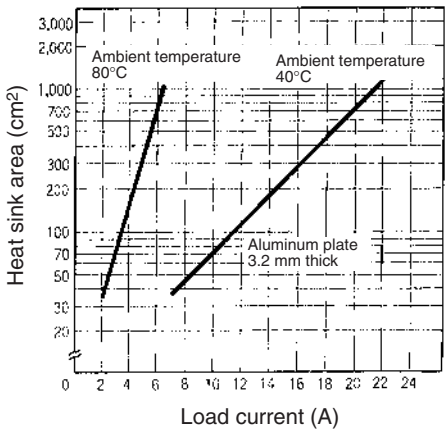


G3NA-2□□B AC Input



Heat Sink Area vs. Load Current

G3NA-220B



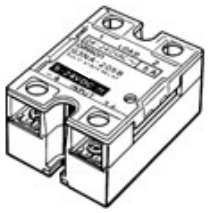
Note: The heat sink area refers to the combined area of the sides of the heat sink that radiate heat. For example, when a current of 18 A is allowed to flow through the SSR at 40°C, the graph shows that the heat sink area is about 450 cm^2. Therefore, if the heat sink is square, one side of the heat sink must be 15 cm ($\sqrt{450\ (cm^2)}/2$) or longer.

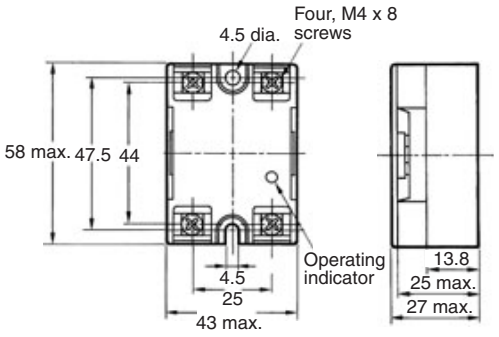
SSR

Dimensions

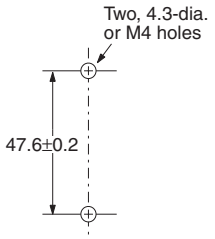
Note: All units are in millimeters unless otherwise indicated.

G3NA-205B, G3NA-210B, G3NA-220B, G3NA-410B, G3NA-420B

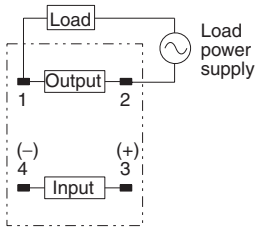




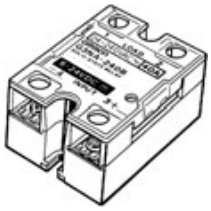
Mounting Holes

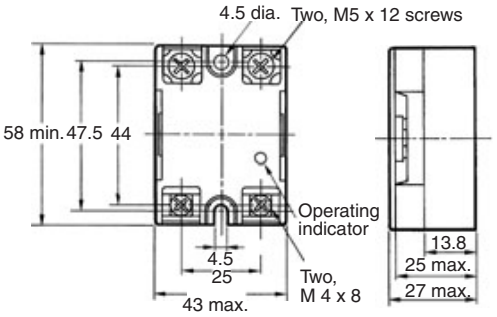


Terminal Arrangement/ Internal Connections (Top View)

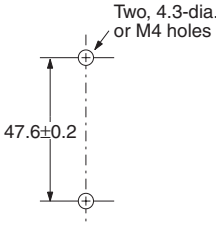


G3NA-240B, G3NA-440B, G3NA-450B

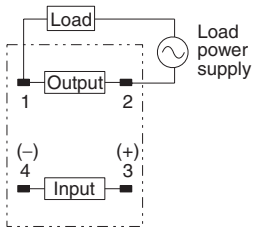




Mounting Holes

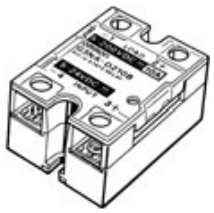


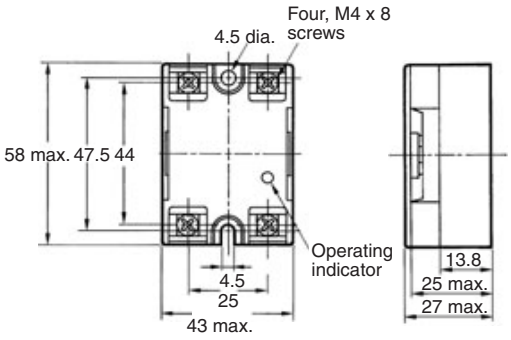
Terminal Arrangement/ Internal Connections (Top View)



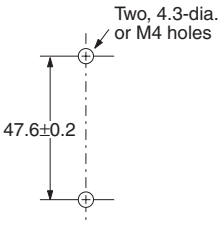
G3NA-D210B

Note: The load can be connected to either the positive or negative side.

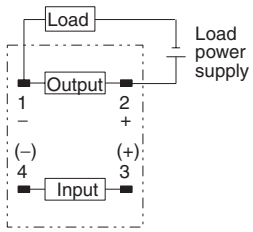




Mounting Holes



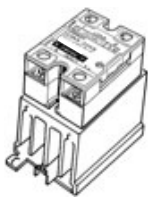
Terminal Arrangement/ Internal Connections (Top View)

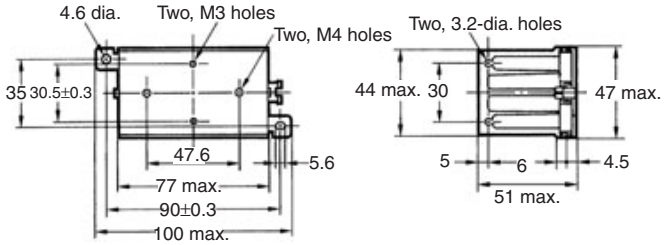


Heat Sink
Y92B-N50

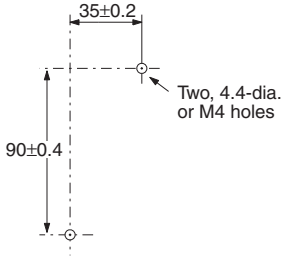
In the case of surface mounting, a 30% derating of the load current is required.

The orientation indicated by the external dimensions is not the correct mounting orientation. When opening mounting holes, refer to the mounting hole dimensions.



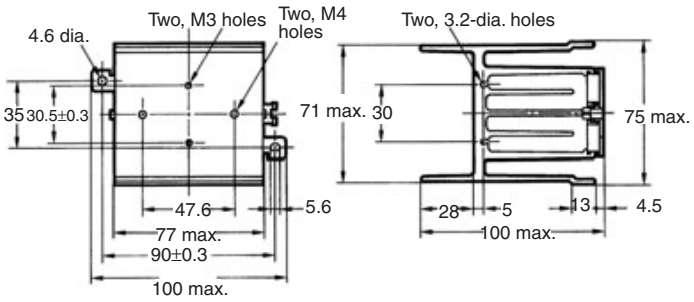


Mounting Holes

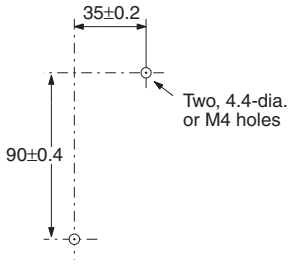


Weight: approx. 200 g

Y92B-N100

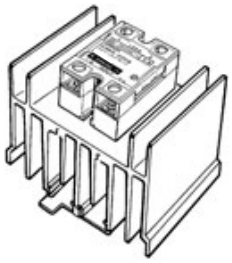


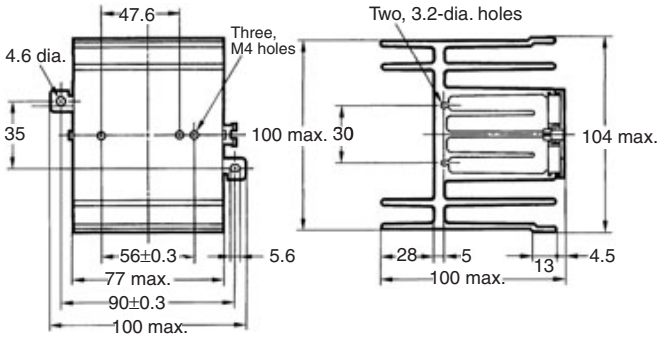
Mounting Holes



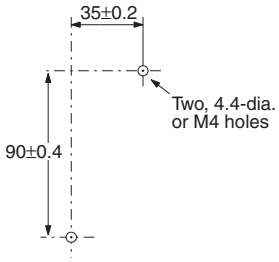
Weight: approx. 400 g

Y92B-N150



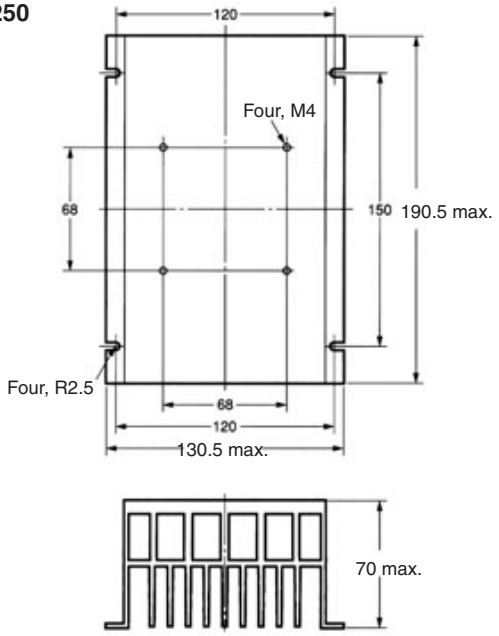


Mounting Holes

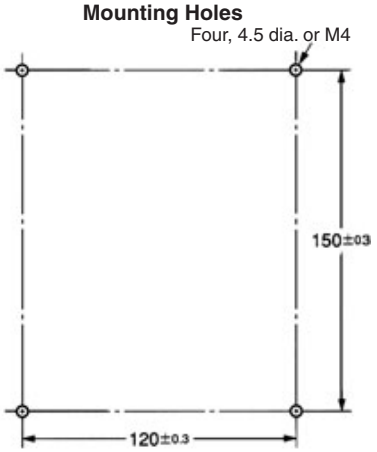


Weight: approx. 560 g

Y92B-P250

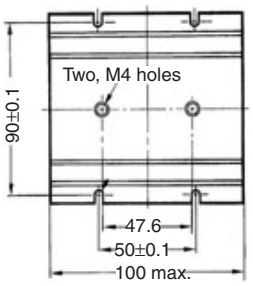


Mounting Holes



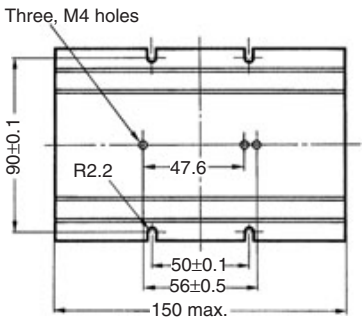
SSR

Y92B-A100



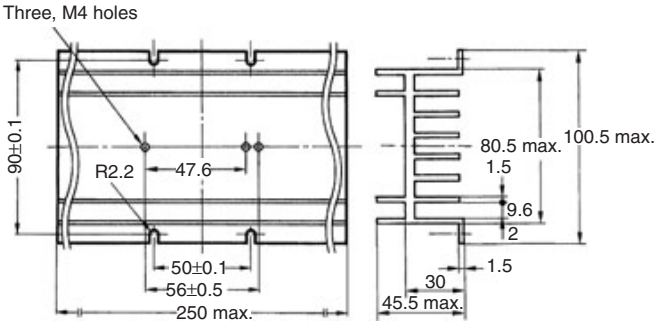
Weight: approx. 210 g

Y92B-A150N



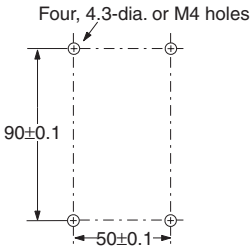
Weight: approx. 310 g

Y92B-A250



Weight: approx. 510 g

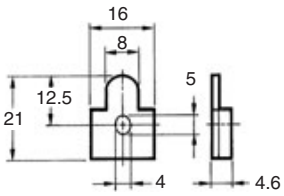
Mounting Holes
Y92B-A100
Y92B-A150N
Y92B-A250

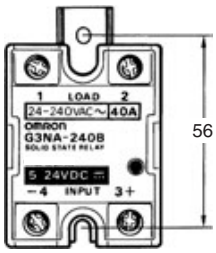


R99-11

Use Mounting Bracket R99-11 so that the G3NA-240B can be mounted with the same pitch as that of the G3N-240B.

Model	Applicable SSR
R99-11	G3NA-240B G3NA-440B





Safety Precautions

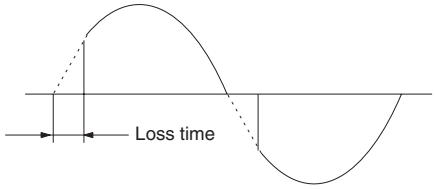
■ Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunction, or undesirable effect on product performance.

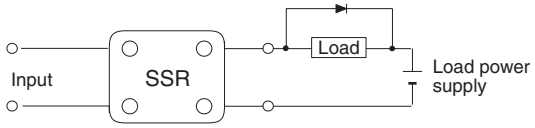
Load Connection

For an AC load, use a power supply rated at 50 or 60 Hz.
The maximum operating frequency is 10 Hz.
The G3NA has a built-in varistor for overvoltage protection.

At a low applied voltage, such as 24 VAC, the load current is not fully supplied. When the Unit is switched ON, the voltage required to power the Unit deprives the output signal of the necessary voltage level and thus creates loss time. The lower the load voltage is, the greater the loss time is. This condition, however, will not create any serious problems.



For a DC or L load, a diode should be connected in parallel the load to absorb the counter electromotive force of the load.

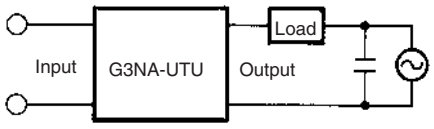


When attaching a heat sink to the G3NA, in order to facilitate heat dissipation, apply silicone grease or equivalent heat-conductive grease on the heat sink. (Toshiba Silicone, Shinetsu Silicone, etc.)

Tighten the mounting screws of the heat sink with a torque of 0.78 to 0.98 N·m.

Noise Terminal Voltage according to EN55011

The G3NA-UTU complies with EN55011 standards when a capacitor is connected to the load power supply as shown in the following circuit diagram.



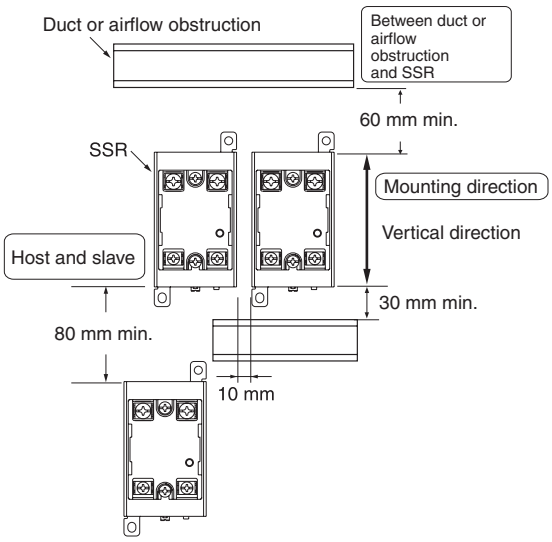
Recommended Capacitor: 1 μF, 250 VAC

The output terminal side of the G3NA-D210B is connected to a built-in diode for protecting the SSR from damage that may result from reverse connection. The SSR, however, cannot withstand one minute or more if the wires are connected in reverse. Therefore, pay the utmost attention not to make polarity mistakes on the load side.

Close Mounting

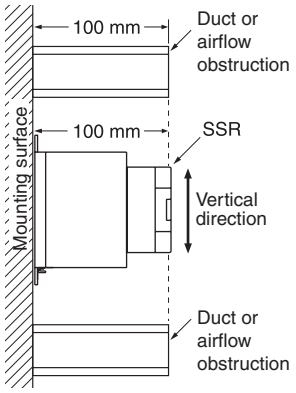
SSR Mounting Pitch

Panel Mounting



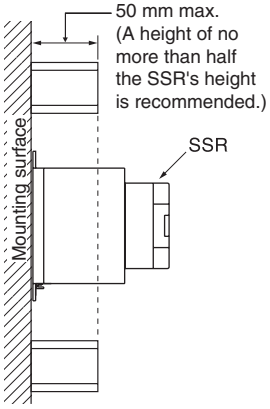
Relationship between SSRs and Ducts

Duct Height



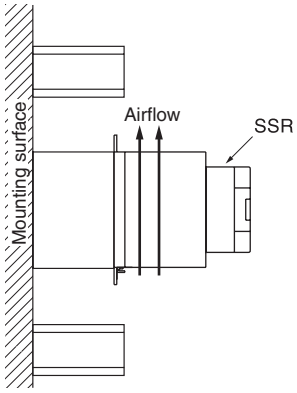
Do not surround the SSR with ducts, otherwise the heat radiation of the SSR will be adversely affected.

Countermeasure 1



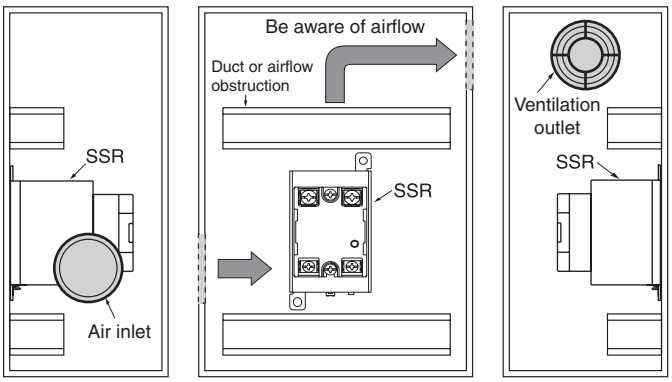
Use short ducts.

Countermeasure 2



If the ducts cannot be shortened, place the SSR on a metal base so that it is not surrounded by the ducts.

Ventilation



If the air inlet or air outlet has a filter, clean the filter regularly to prevent it from clogging to ensure an efficient flow of air.

Do not locate any objects around the air inlet or air outlet, otherwise the objects may obstruct the proper ventilation of the control panel.

A heat exchanger, if used, should be located in front of the SSRs to ensure the efficiency of the heat exchanger.

When attaching a heat sink to the SSR, apply silicone grease or an equivalent heat-conductive grease on the heat sink. (Toshiba Silicone: YG6260, Shinetsu Silicone: G746, etc.)

Tighten the mounting screws of the heat sink with a torque of 0.78 to 0.98 N·m.

When using the following models, connect the heat sink (steel plate on the bottom) to the ground: G3NA-D210B, G3NA-410B, G3NA-420B, and G3NA-440B.

Please reduce the ambient temperature of SSRs.

The rated load current of an SSR is measured at an ambient temperature of 25 or 40 °C.

An SSR uses a semiconductor in the output element. This causes the temperature inside the control panel to increase due to heating resulting from the passage of electrical current through the load. To restrict heating, attach a fan to the ventilation outlet or air inlet of the control panel to ventilate the panel. This will reduce the ambient temperature of the SSRs and thus increase reliability. (Generally, each 10 °C reduction in temperature will double the expected life.)

Load current (A)	5 A	10 A	20 A	40 A
Required number of fans per SSR	0.08	0.16	0.31	0.62

Example: For 10 SSRs with load currents of 10 A,
0.16 x 10 = 1.6
Thus, 2 fans would be required.

Size of fans: 92 mm^2, Air volume: 0.7 m^3/min,
Ambient temperature of control panel: 30 °C

If there are other instruments that generate heat in the control panel other than SSRs, additional ventilation will be required.

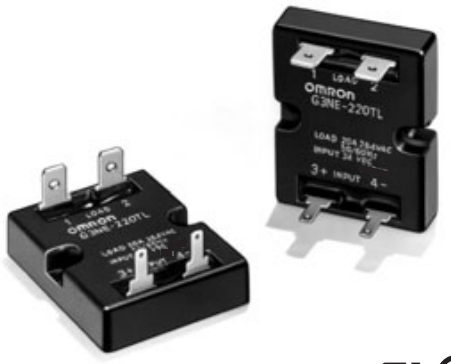
ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. K067-E1-05

Solid State Relays
G3NE

Compact, Low-cost, SSR Switching 5 to 20 A

- Wide load voltage range: 75 to 264 VAC. Both 100-V and 200-V loads can be handled with the same model.
- Dedicated, compact aluminum PCB and power elements used.
- Built-in varistor effectively absorbs external surges.
- Quick-connect #110 input terminals and #250 output connections. (#187 input terminals and #250 output connections are available.)
- "-US" models certified by UL, CSA, and IEC/EN (TÜV).



Model Number Structure

■ Model Number Legend

G3NE-□□□□-□-□
1 2 3 4 5 6 7

1. **Basic Model Name**
   G3NE: Solid State Relay
2. **Rated Load Power Supply Voltage**
   2: 200 VAC
3. **Rated Load Current**
   05: 5 A
   10: 10 A
   20: 20 A
4. **Terminal Type**
   T: Quick-connect terminals
5. **Zero Cross Function**
   Blank: Equipped with zero cross function
   L: Not equipped with zero cross function
6. **Special Specifications**
   Blank: Standard models
   2: #187 input terminals
7. **Certification**
   US: Certified by UL, CSA, and TÜV

Ordering Information

■ List of Models

Isolation	Zero cross function	Indicator	Rated output load	Rated input voltage	Model
Phototriac	Yes	No	5 A at 100 to 240 VAC	5, 12, 24 VDC	G3NE-205T-US G3NE-205T-2-US
			10 A at 100 to 240 VAC		G3NE-210T-US G3NE-210T-2-US
			20 A at 100 to 240 VAC		G3NE-220T-US G3NE-220T-2-US
	No		5 A at 100 to 240 VAC		G3NE-205TL-US G3NE-205TL-2-US
			10 A at 100 to 240 VAC		G3NE-210TL-US G3NE-210TL-2-US
			20 A at 100 to 240 VAC		G3NE-220TL-US G3NE-220TL-2-US

Note: When ordering, specify the input voltage.

■ Accessories (Order Separately)

Heat Sinks

The following heat sinks are thin and can be DIN-track mounted.
See *Dimensions* for details.

Model	Applicable SSR
Y92B-N50	G3NE-205T(L)(-2)-US/-210T(L)(-2)-US
Y92B-N100	G3NE-220T(L)(-2)-US

Specifications

■ Ratings (at an Ambient Temperature of 25°C)

Input

Rated voltage	Operating voltage	Voltage level		Input impedance	
		Must operate	Must release	With zero cross function	Without zero cross function
5 VDC	4 to 6 VDC	4 VDC max.	1 VDC min.	250 Ω±20%	300 Ω±20%
12 VDC	9.6 to 14.4 VDC	9.6 VDC max.		600 Ω±20%	800 Ω±20%
24 VDC	19.2 to 28.8 VDC	19.2 VDC max.		1.6 kΩ±20%	

Note: Each model has 5-VDC, 12-VDC, and 24-VDC input versions.

Output

Model	Applicable load				
	Rated load voltage	Load voltage range	Load current (See note 1.)		Inrush current
			With heat sink	Without heat sink	
G3NE-205T(L)(-2)-US	100 to 240 VAC	75 to 264 VAC	0.1 to 5 A	0.1 to 5 A	60 A (60 Hz, 1 cycle)
G3NE-210T(L)(-2)-US			0.1 to 10 A (See note 2.)	0.1 to 5 A	150 A (60 Hz, 1 cycle)
G3NE-220T(L)(-2)-US			0.1 to 20 A (See note 2.)	0.1 to 5 A	220 A (60 Hz, 1 cycle)

Note: 1. The load current varies depending on the ambient temperature. Refer to L*oad Current vs. Ambient Temperature* under *Engineering Data* for details.

2. These values apply when using a dedicated heat sink or a radiation plate of specified size.

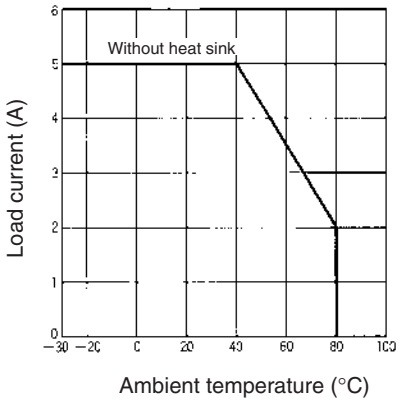
■ Characteristics

Item	G3NE-2□□T(-2)-US	G3NE-2□□TL(-2)-US
Operate time	1/2 of load power source cycle + 1 ms max.	1 ms max.
Release time	1/2 of load power source cycle + 1 ms max.	
Output ON voltage drop	1.6 V (RMS) max.	
Leakage current	2 mA max. (at 100 VAC) 5 mA max. (at 200 VAC)	
Insulation resistance	100 MΩ min. (at 500 VDC)	
Dielectric strength	2,000 VAC, 50/60 Hz for 1 min	
Vibration resistance	Destruction: 10 to 55 to 10 Hz, 0.75-mm single amplitude	
Shock resistance	Destruction: 1,000 m/s^2	
Ambient temperature	Operating: –30°C to 80°C (with no icing or condensation) Storage: –30°C to 100°C (with no icing or condensation)	
Ambient humidity	Operating: 45% to 85%	
Certified standards	UL508 File No.E64562/CSA C22.2 (No.0, No.14) File No. LR35535 TÜV R9051064 (VDE0435) (EN60950)	
Weight	Approx. 37 g	

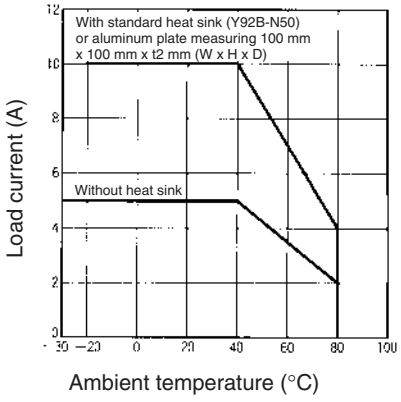
Engineering Data

Load Current vs. Ambient Temperature

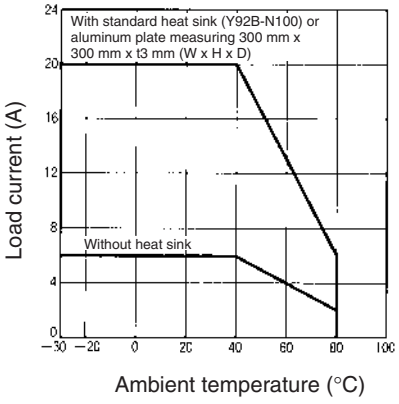
G3NE-205T(L)(-2)-US



G3NE-210T(L)(-2)-US



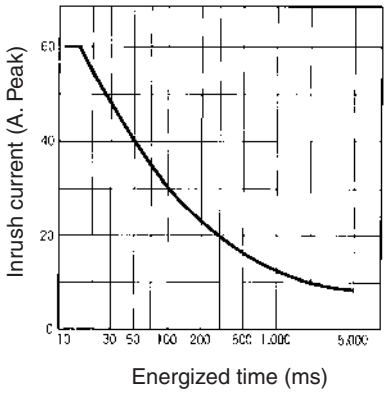
G3NE-220T(L)(-2)-US



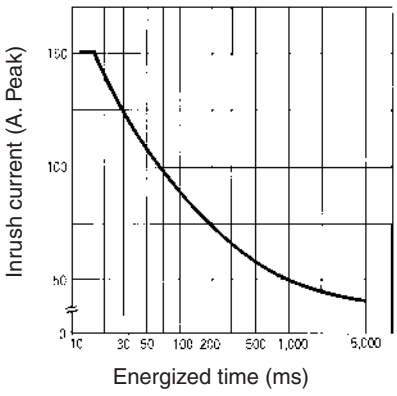
One Cycle Surge Current: Non-repetitive

Note: Keep the inrush current to half the rated value if it occurs repetitively.

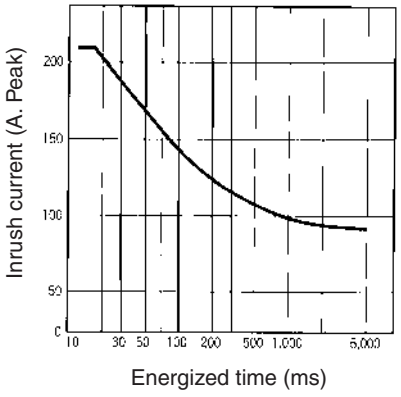
G3NE-205T(L)(-2)-US



G3NE-210T(L)(-2)-US



G3NE-220T(L)(-2)-US

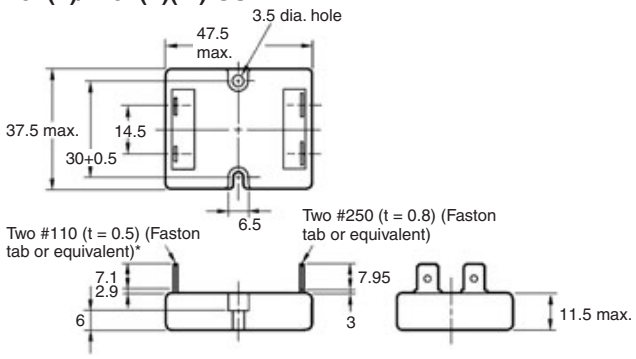


SSR

Dimensions

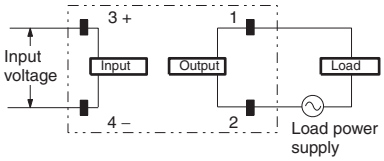
Note: All units are in millimeters unless otherwise indicated.

G3NE-205T(L)/210T(L)/220T(L)(-2)-US

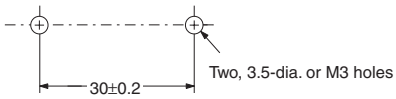


* G3NE-2□□T(L)-2-US: Two, #187 (t=0.5) (Faston tab or equivalent)

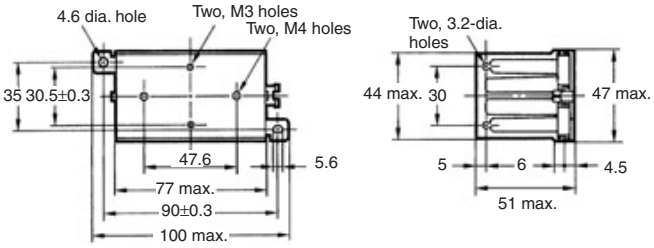
Terminal Arrangement/ Internal Connections (Top View)



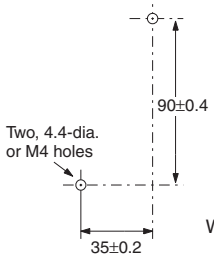
Mounting Holes



Heat Sink Y92B-N50

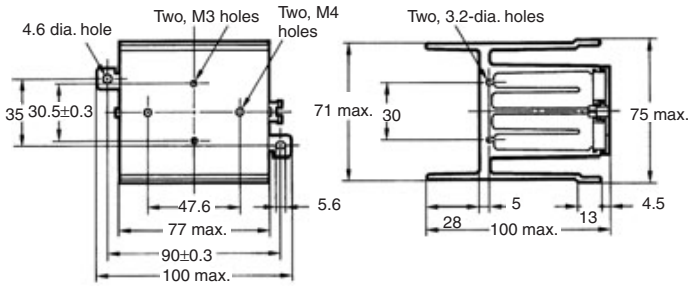


Mounting Holes

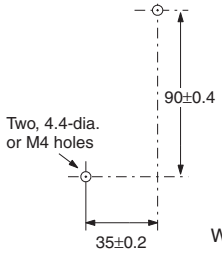


Weight: approx. 200 g

Y92B-N100



Mounting Holes



Weight: approx. 400 g

Safety Precautions

■ Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunction, or undesirable effect on product performance.

Do not apply excessive force to the terminals. Be careful when pulling or inserting the terminal clips for the Quick Connector (QC).

When attaching a heat sink to the G3NE, in order to facilitate heat dissipation, apply heat-conductive grease on the heat sink. Tighten the mounting screws of the heat sink with a torque of 0.59 to 0.98 N·m.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. K062-E1-05

In the interest of product improvement, specifications are subject to change without notice.

Solid State Relays
G3PA

Extremely Thin Relays Integrated with Heat Sinks

- Downsizing achieved through optimum design of heat sink.
- Mounting possible via screws or via DIN track.
- Close mounting possible for linking terminals. (Except for G3PA-260B-VD and G3PA-450B-VD-2.)
- Applicable with 3-phase loads.
- Replaceable power element cartridges.
- Comply with VDE 0160 (finger protection), with a dielectric strength of 4,000 V between input and load.
- Comply with VDE 0805, IEC 950.
- Certified by UL, CSA, and VDE (reinforced insulation).

Model Number Structure

■ Model Number Legend

G3PA-□□□□-□-□
1 2 3 4 5 6 7

1. **Basic Model Name**
   G3PA: Solid State Relay
2. **Rated Load Power Supply Voltage**
   2: 200 VAC
   4: 400 VAC
3. **Rated Load Current**
   10: 10 A
   20: 20 A
   30: 30 A
   40: 40 A
   50: 50 A
   60: 60 A
4. **Terminal Type**
   B: Screw terminals
5. **Zero Cross Function**
   Blank: Equipped with zero cross function
   L: Not equipped with zero cross function
6. **Certification**
   VD: Certified by UL, CSA, and VDE
7. **Special Specifications**
   Blank: Standard models
   2: 480-V models

Ordering Information

■ List of Models

Model	Isolation	Zero cross function	Indicator	Rated output load	Rated input voltage
G3PA-210B-VD	Phototriac coupler	Yes	Yes	10 A at 24 to 240 VAC	5 to 24 VDC
G3PA-220B-VD				20 A at 24 to 240 VAC	
G3PA-240B-VD				40 A at 24 to 240 VAC	
G3PA-260B-VD				60 A at 24 to 240 VAC	
G3PA-210BL-VD		No		10 A at 24 to 240 VAC	
G3PA-220BL-VD				20 A at 24 to 240 VAC	
G3PA-240BL-VD				40 A at 24 to 240 VAC	
G3PA-260BL-VD				60 A at 24 to 240 VAC	
G3PA-210B-VD		Yes		10 A at 24 to 240 VAC	24 VAC
G3PA-220B-VD				20 A at 24 to 240 VAC	
G3PA-240B-VD				40 A at 24 to 240 VAC	
G3PA-260B-VD				60 A at 24 to 240 VAC	
G3PA-420B-VD				20 A at 180 to 400 VAC	12 to 24 VDC
G3PA-430B-VD				30 A at 180 to 400 VAC	
G3PA-420B-VD-2				20 A at 200 to 480 VAC	
G3PA-430B-VD-2				30 A at 200 to 480 VAC	
G3PA-450B-VD-2				50 A at 200 to 480 VAC	

Note: When ordering, specify the rated input voltage.

Replacement Parts

Name	Carry current	Load voltage range	Model	Applicable SSR	VDE certification
Power Device Cartridge	10 A	19 to 264 VAC	G32A-A10-VD DC5-24	G3PA-210B-VD DC5-24	Yes
			G32A-A10L-VD DC5-24	G3PA-210BL-VD DC5-24	
			G32A-A10-VD AC24	G3PA-210B-VD AC24	
	20 A		G32A-A20-VD DC5-24	G3PA-220B-VD DC5-24	
			G32A-A20L-VD DC5-24	G3PA-220BL-VD DC5-24	
			G32A-A20-VD AC24	G3PA-220B-VD AC24	
	40 A		G32A-A40-VD DC5-24	G3PA-240B-VD DC5-24	
			G32A-A40L-VD DC5-24	G3PA-240BL-VD DC5-24	
			G32A-A40-VD AC24	G3PA-240B-VD AC24	
	60 A		G32A-A60-VD DC5-24	G3PA-260B-VD DC5-24	
			G32A-A60L-VD DC5-24	G3PA-260BL-VD DC5-24	
			G32A-A60-VD AC24	G3PA-260B-VD AC24	
	20 A	150 to 440 VAC	G32A-A420-VD DC12-24	G3PA-420B-VD DC12-24	
	30 A		G32A-A430-VD DC12-24	G3PA-430B-VD DC12-24	
	20 A	180 to 528 VAC	G32A-A420-VD-2 DC12-24	G3PA-420B-VD-2 DC12-24	
	30 A		G32A-A430-VD-2 DC12-24	G3PA-430B-VD-2 DC12-24	
	50 A		G32A-A450-VD-2 DC12-24	G3PA-450B-VD-2 DC12-24	

■ Other Units (Order Separately)

Units that Enable 2-line Switching of 3-phase Power

Name	Current flow	Model	Applicable SSR
Short-circuit Unit	10 A	G32A-D20	G3PA-210B-VD, G3PA-210BL-VD
	20 A		G3PA-220B-VD, G3PA-220BL-VD G3PA-420B-VD, G3PA-420B-VD-2
	30 A	G32A-D40	G3PA-430B-VD, G3PA-430B-VD-2
	40 A		G3PA-240B-VD, G3PA-240BL-VD

Specifications

■ Ratings (at an Ambient Temperature of 25°C)

Input

Model	Rated voltage	Operating Voltage range	Input current impedance	Voltage level	
				Must operate voltage	Must release voltage
G3PA-210B-VD	5 to 24 VDC	4 to 30 VDC	7 mA max.	4 VDC max.	1 VDC min.
G3PA-220B-VD					
G3PA-240B-VD					
G3PA-260B-VD					
G3PA-210BL-VD	5 to 24 VDC	4 to 30 VDC	20 mA max.	4 VDC max.	1 VDC min.
G3PA-220BL-VD					
G3PA-240BL-VD					
G3PA-260BL-VD					
G3PA-210B-VD	24 VAC	19.2 to 26.4 VAC	1.4 kΩ±20%	19.2 VAC max.	4.8 VAC min.
G3PA-220B-VD					
G3PA-240B-VD					
G3PA-260B-VD					
G3PA-420B-VD	12 to 24 VDC	9.6 to 30 VDC	7 mA max.	9.2 VDC max.	1 VDC min.
G3PA-430B-VD					
G3PA-420B-VD-2					
G3PA-430B-VD-2					
G3PA-450B-VD-2					

Output

Model	Applicable load			
	Rated load voltage	Load voltage range	Load current	Inrush current
G3PA-210B(L)-VD	24 to 240 VAC (50/60 Hz)	19 to 264 VAC (50/60 Hz)	0.1 to 10 A	150 A (60 Hz, 1 cycle)
G3PA-220B(L)-VD			0.1 to 20 A	220 A (60 Hz, 1 cycle)
G3PA-240B(L)-VD			0.5 to 40 A	440 A (60 Hz, 1 cycle)
G3PA-260B(L)-VD			0.5 to 60 A	440 A (60 Hz, 1 cycle)
G3PA-420B-VD	180 to 400 VAC (50/60 Hz)	150 to 440 VAC (50/60 Hz)	0.5 to 20 A	220 A (60 Hz, 1 cycle)
G3PA-430B-VD			0.5 to 30 A	440 A (60 Hz, 1 cycle)
G3PA-420B-VD-2	200 to 480 VAC (50/60 Hz)	180 to 528 VAC (50/60 Hz)	0.5 to 20 A	220 A (60 Hz, 1 cycle)
G3PA-430B-VD-2			0.5 to 30 A	440 A (60 Hz, 1 cycle)
G3PA-450B-VD-2			0.5 to 50 A	440 A (60 Hz, 1 cycle)

Refer to *Engineering Data* for further details.

■ Characteristics

Item	G3PA-210B(L)-VD	G3PA-220B(L)-VD	G3PA-240B(L)-VD	G3PA-260B(L)-VD	G3PA-420B-VD	G3PA-420B-VD-2	G3PA-430B-VD	G3PA-430B-VD-2	G3PA-450B-VD-2
Operate time	1/2 of load power source cycle + 1 ms max. (DC Input, -B models) 1 1/2 of load power source cycle + 1 ms max. (AC Input) 1 ms max. (-BL models)								
Release time	1/2 of load power source cycle + 1 ms max. (DC Input) 1 1/2 of load power source cycle + 1 ms max. (AC Input)								
Output ON voltage drop	1.6 V (RMS) max.				1.8 V (RMS) max.				
Leakage current	5 mA max. (at 100 VAC) 10 mA max. (at 200 VAC)		10 mA max. (at 100 VAC) 20 mA max. (at 200 VAC)		20 mA max. (at 400 VAC)	20 mA max. (at 480 VAC)	20 mA max. (at 400 VAC)	20 mA max. (at 480 VAC)	
I^2t	260 A^2s		1,260 A^2s		260 A^2s	1,800 A^2s	1,800 A^2s		1,800 A^2s
Insulation resistance	100 MΩ min. (at 500 VDC)								
Dielectric strength	4,000 VAC, 50/60 Hz for 1 min								
Vibration resistance	Destruction: 10 to 55 to 10 Hz, 0.375–mm single amplitude (Mounted to DIN track)								
Shock resistance	Destruction: 300 m/s^2 (mounted to DIN track)								
Ambient temperature	Operating: –30°C to 80°C (with no icing or condensation) Storage: –30°C to 100°C (with no icing or condensation)								
Certified standards	UL508, CSA C22.2 (No.14, No.950), EN60950 File No. 5915ÜG				UL508, CSA C22.2 (No.14), EN60947-4-3 File No. 6642ÜG	UL508, CSA C22.2 (No.14), EN60947-4-3 File No. 133127ÜG	UL508, CSA C22.2 (No.14), EN60947-4-3 File No. 6642ÜG	UL508, CSA C22.2 (No.14), EN60947-4-3 File No. 133127ÜG	
Ambient humidity	Operating: 45% to 85%								
Weight	Approx. 260 g	Approx. 340 g	Approx. 460 g	Approx. 900 g	Approx. 290 g	Approx. 290 g	Approx. 410 g	Approx. 410 g	Approx. 900 g

Operation

■ Replacement Parts

G32A-A Power Device Cartridge

The G32A-A Power Device Cartridge (a Triac Unit) can be replaced with a new one. When the temperature indicator has changed from pink to red, the triac circuitry may have malfunctioned possibly by an excessive flow of current, in which case, dismount the damaged cartridge for replacement.

The damaged cartridge can be replaced with a new one without disconnecting the wires from the G3PA.

Improve the heat radiation efficiency of the G3PA before replacing the cartridge.

The G32A-A Power Device Cartridge can withstand an excessive current for a short period of time, such as may be caused accidentally by the short circuitry of the load, in which case the temperature indicator will not turn red.

Be sure to turn OFF the power supply when replacing the Cartridge. Supplying power with the Cartridge removed may result in malfunction.

Appearance

G32A-A10(L)-VD **G32A-A20(L)-VD** **G32A-A40(L)-VD** **G32A-A60(L)-VD**




G32A-A420-VD(-2) **G32A-A430-VD(-2)** **G32A-A450-VD-2**



Replacing Power Device Cartridges

When replacing Power Device Cartridges, use the specified model. Using a Power Device Cartridge other than the specified one will result in faulty operation and destruction of the elements.

■ Replacement Procedure

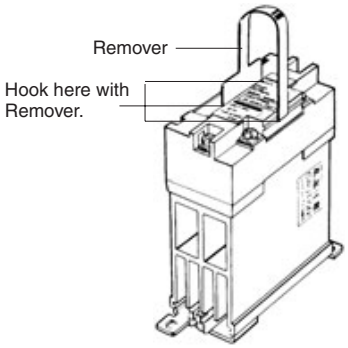
G32A-A10(L)-VD/G32A-A20(L)-VD/G32-A420-VD(-2)

Use the special tool (provided) to extract the cartridge for replacement with a new one.

Extraction

Follow the procedures below to dismount the Power Device Cartridge from the G3PA.

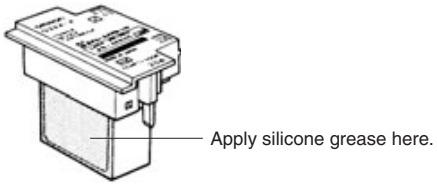
1. **Switch off the power.**
2. Remove the terminal cover.
3. Hook the indented part of the cartridge with the tool and pull up on the cartridge to remove it.



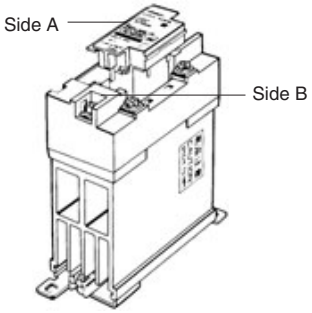
Mounting

Follow the procedures below to mount the Power Device Cartridge on the G3PA.

1. Apply silicone grease (provided with the G32A-A) to the entire surface of the heat sink.



2. Make sure that there is no dust or pieces of wire on the heat sink of the G32A-A or the G3PA.
3. Insert the cartridge into the opening of the G3PA so that the letters on the cartridge and those on the G3PA are in the same direction and side A and side B are even.



4. Attach the terminal cover.
5. Switch on the power and check the G3PA to be sure it works properly.

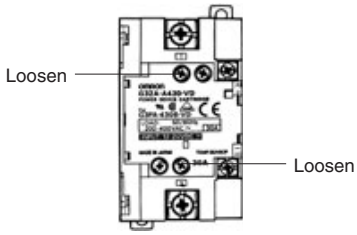
G32A-A40(L)-VD/G32A-A60(L)-VD/G32A-A430-VD(-2)/G32A-A450-VD-2

The G32A Power Device Cartridge is mounted and secured with screws to the G3PA Unit.

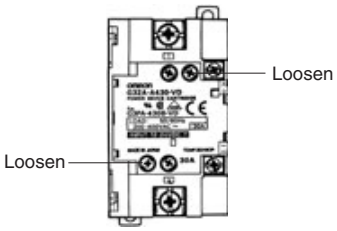
Extraction

Follow the procedures below to dismount the G32A-A Power Device Cartridge from the G3PA.

1. **Switch off the power.**
2. Remove the terminal cover.
3. Loosen the two centered screws on the sides to dismount the cartridge. The screws are connected to terminals 1 and 2.



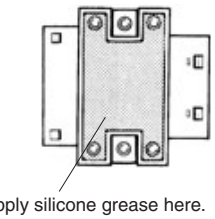
4. Loosen the screws on both the corners.



5. Hold the indented part of both the corners to dismount the cartridge.

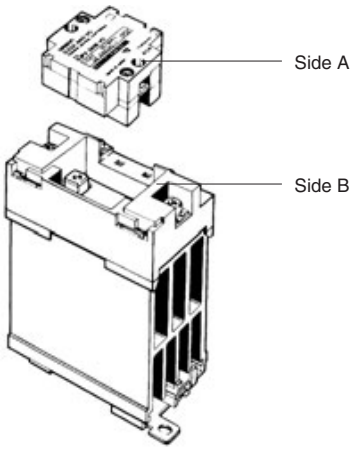
Mounting

1. Apply silicone grease to the entire surface of the heat sink.



2. Make sure that there is no dust or pieces of wire on the heat sink of the G32A-A or the G3PA.

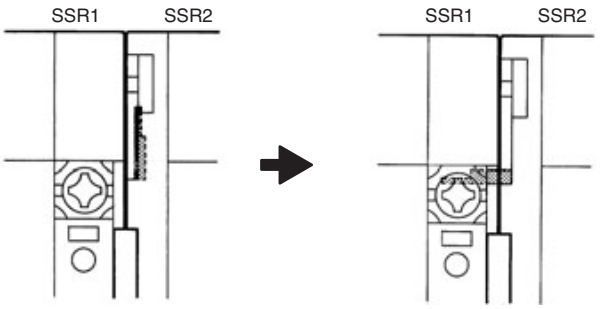
3. Insert the cartridge into the opening of the G3PA so that side A and side B are even.



4. Tighten the screws on both the corners with a tightening torque of 0.59 to 0.78 N·m.
5. Tighten the screws on both the sides with a tightening torque of 0.59 to 0.78 N·m.
6. Attach the terminal cover.
7. Switch on the power and check the G3PA to be sure it works properly.

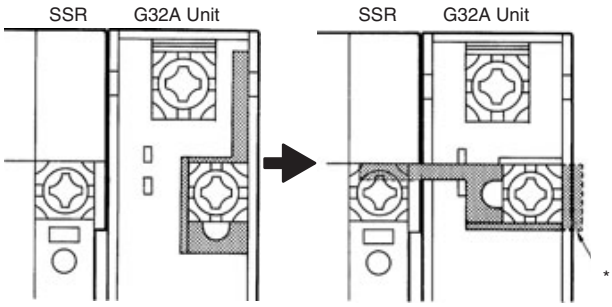
■ Linking Terminal Connection

• Connecting with linking terminal for G3PA-210B(L)-VD, -220B(L)-VD, -240B(L)-VD and G3PA-420B-VD(-2), G3PA-430B-VD(-2).



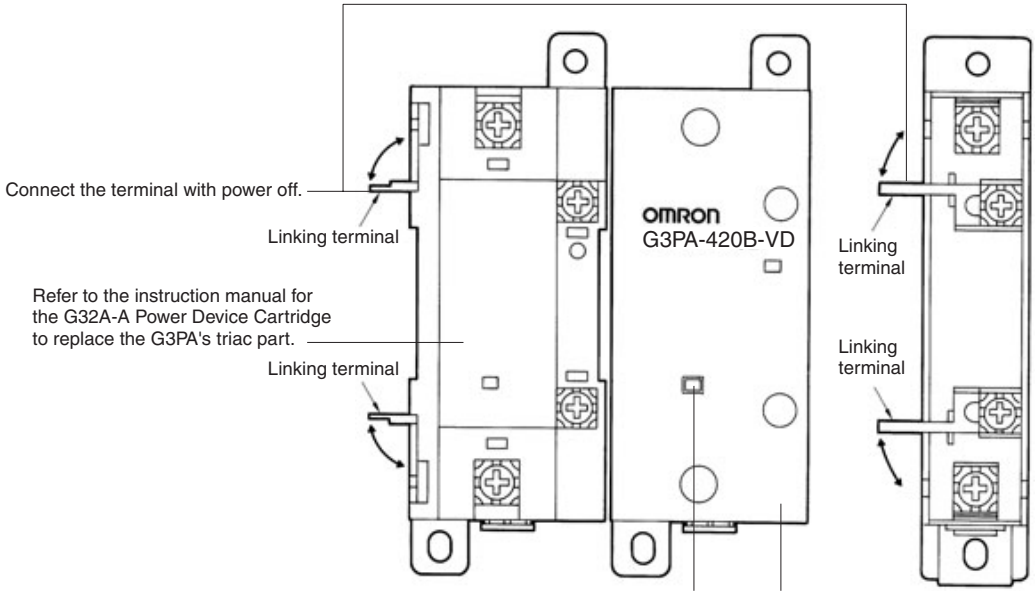
1. When SSRs are close mounted, loosen the M3.5 Sems screw and flip the linking terminal down.
2. Insert the linking terminal securely into the center of the screw and tighten the screw.

• Connecting with linking terminal for G32A.



* The cover will not fit if the terminal protrudes.

1. When SSR are close mounted, loosen the M3.5 Sems screw on the G32A and flip the linking terminal down.
2. Insert the linking terminal securely into the center of the screw and tighten the screw. Ensure that the linking terminal does not protrude.



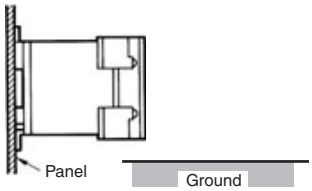
When the temperature indicator has turned from pink to red, the G32-A-A Power Device Cartridge may have malfunctioned, in which case the cartridge must be replaced with a new one.

Use the terminal cover to prevent accidents due to electric shock.

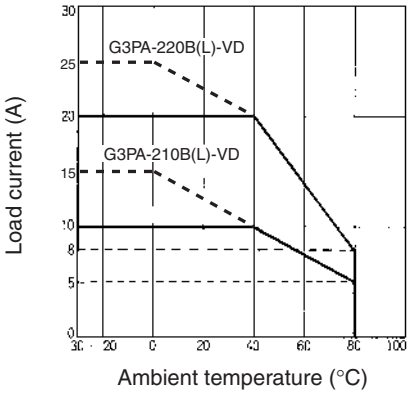
Engineering Data

Load Current vs. Ambient Temperature

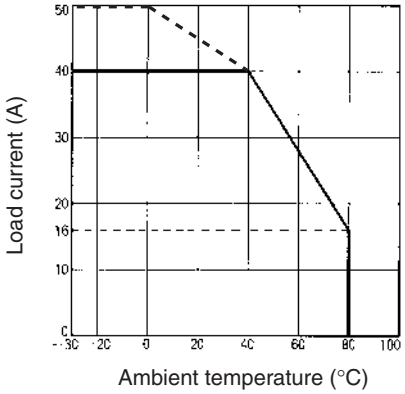
Vertical Mounting



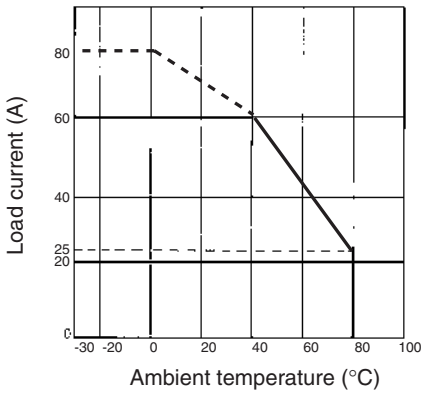
G3PA-210B(L)-VD, G3PA-220B(L)-VD



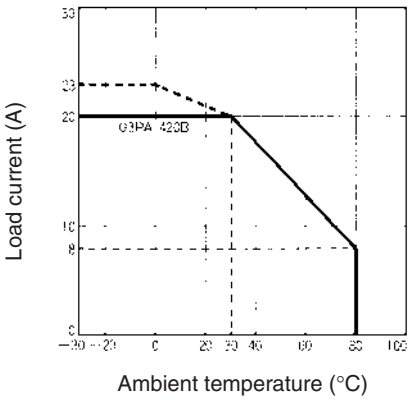
G3PA-240B(L)-VD



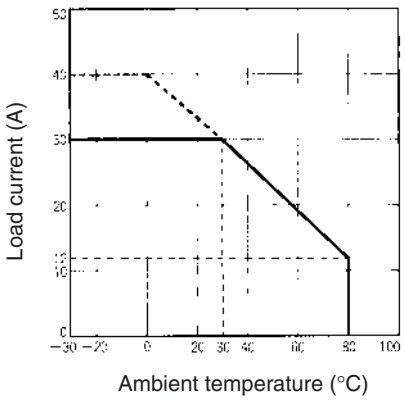
G3PA-260B(L)-VD



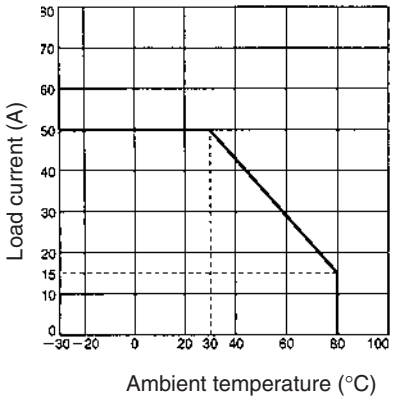
G3PA-420B-VD, G3PA-420B-VD-2



G3PA-430B-VD, G3PA-430B-VD-2



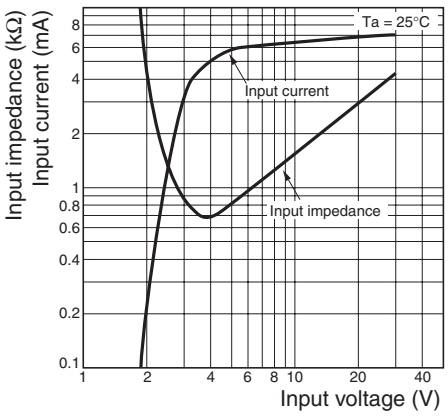
G3PA-450B-VD-2



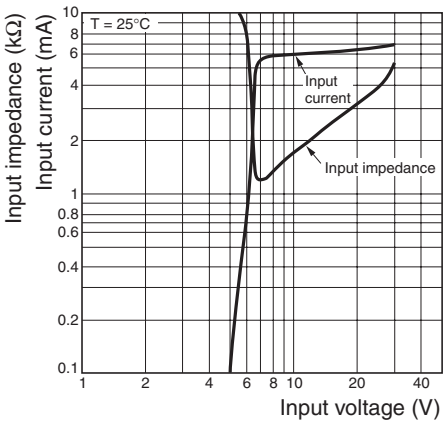
Note: Close mounting is possible for a maximum of three Units by reducing the load current by 20%. (A minimum clearance of 10 mm must be provided when mounting four or more Units.)

Input Voltage vs. Input Current

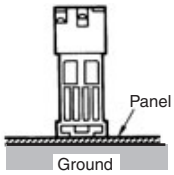
G3PA-2□0B-VD



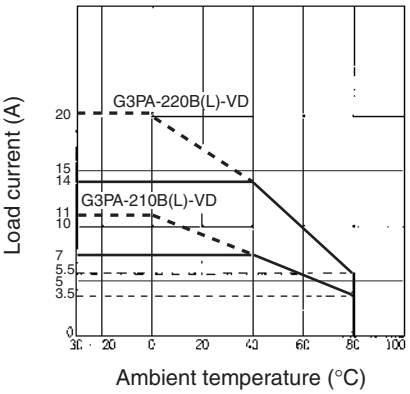
G3PA-4□0-VD, G3PA-4□-VD-2



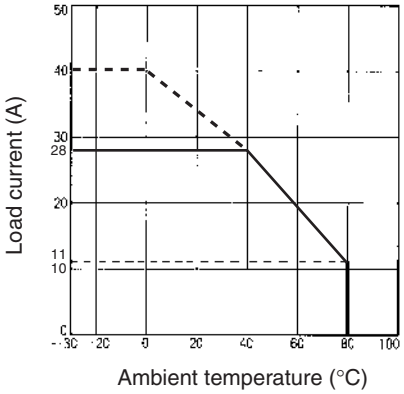
Horizontal Mounting



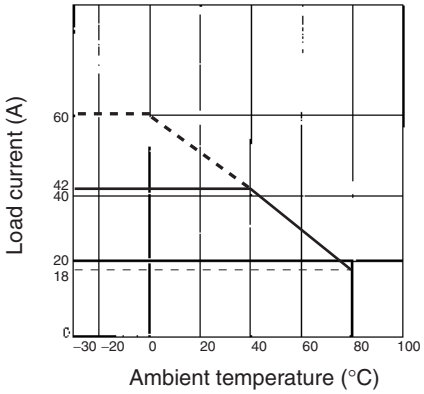
G3PA-210B(L)-VD, G3PA-220B(L)-VD



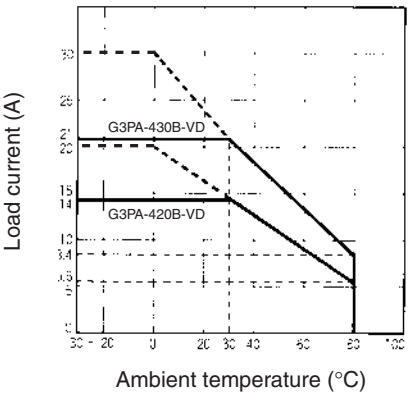
G3PA-240B(L)-VD



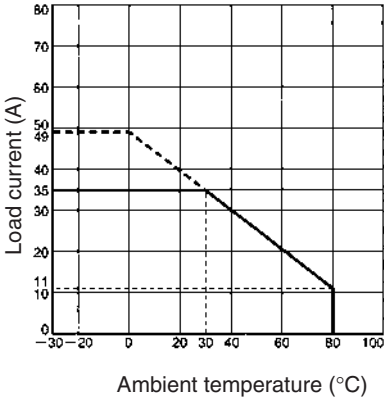
G3PA-260B(L)-VD



G3PA-420B-VD, G3PA-430B-VD
G3PA-420B -VD-2, G3PA-430B-VD-2

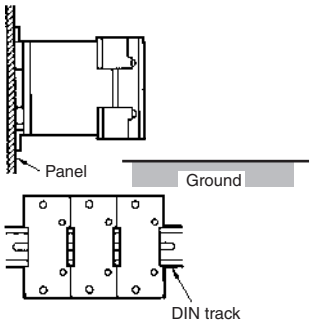


G3PA-450B-VD-2

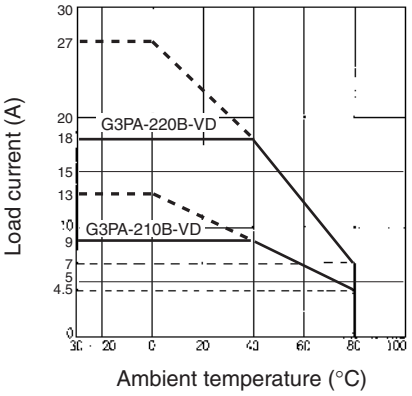


SSR

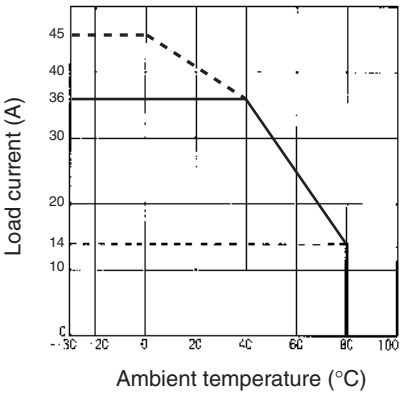
Close Mounting (Up to Three)



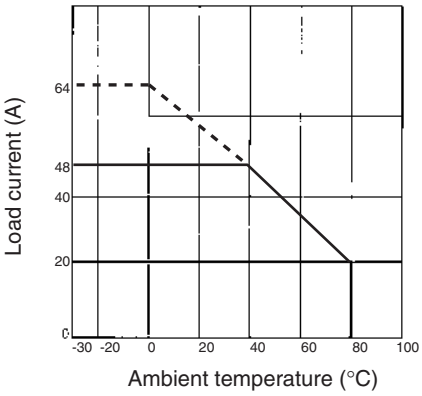
G3PA-210B(L)-VD, G3PA-220B(L)-VD



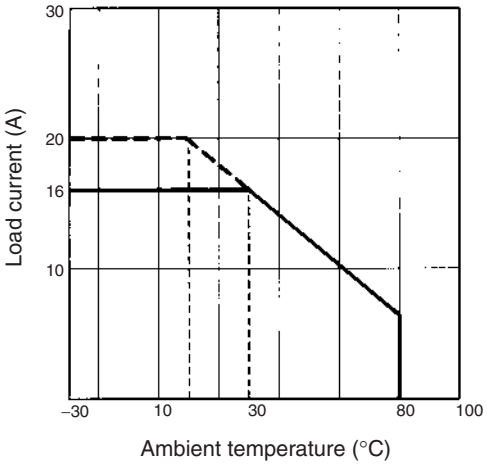
G3PA-240B(L)-VD



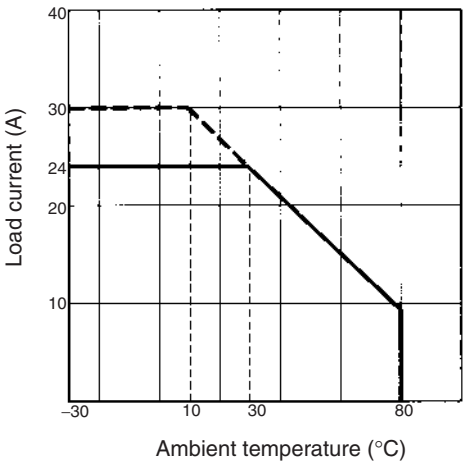
G3PA-260B(L)-VD



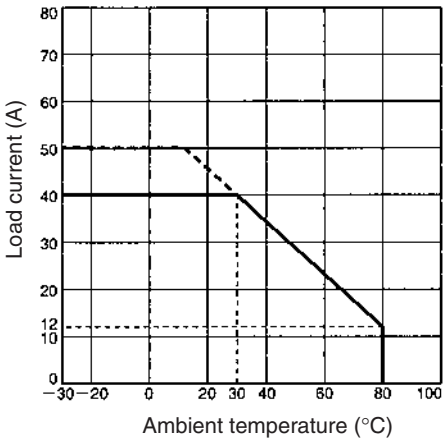
G3PA-420B-VD, G3PA-420B-VD-2



G3PA-430B-VD, G3PA-430B-VD-2



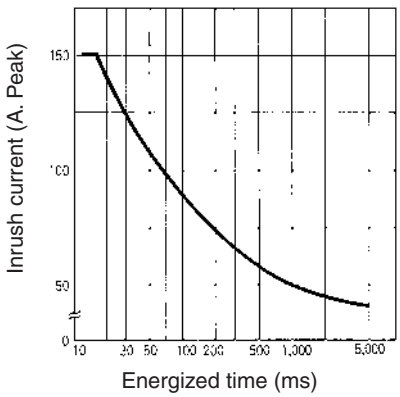
G3PA-450B-VD-2



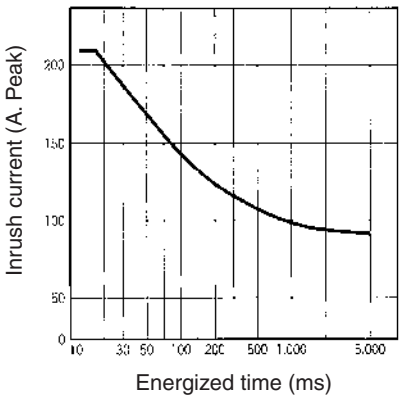
One Cycle Surge Current: Non-repetitive

Note: Keep the inrush current to half the rated value if it occurs repetitively.

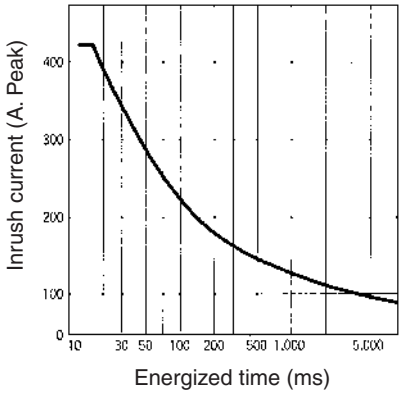
G3PA-210B(L)-VD



G3PA-220B(L)-VD, G3PA-420B-VD, G3PA-420B-VD-2



G3PA-240B(L)-VD/260B(L)-VD, G3PA-430B-VD, G3PA-430B-VD-2, G3PA-450B-VD-2

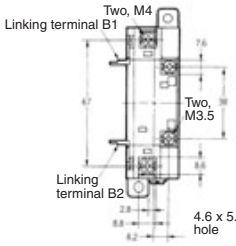


Dimensions

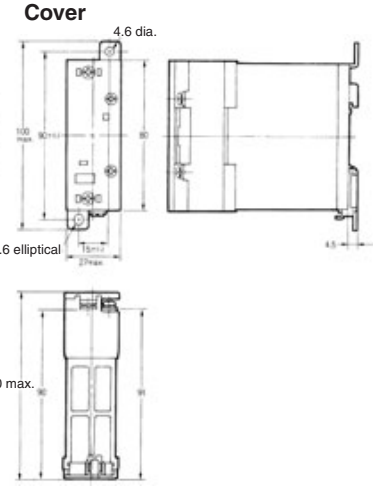
Note: All units are in millimeters unless otherwise indicated.

G3PA-210B(L)-VD

Without Terminal Cover

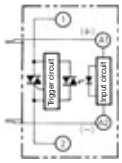


With Terminal Cover



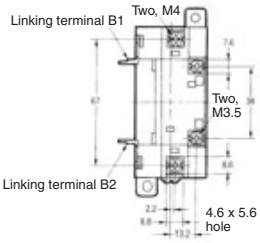
Mounting Holes

Terminal Arrangement/ Internal Connections

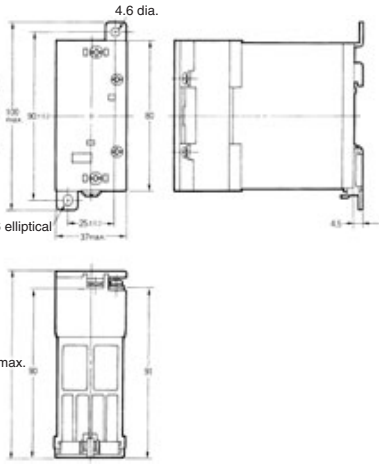


G3PA-220B(L)-VD

Without Terminal Cover

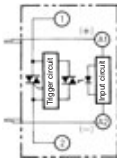


With Terminal Cover

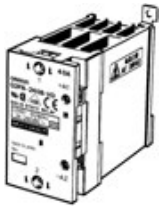


Mounting Holes

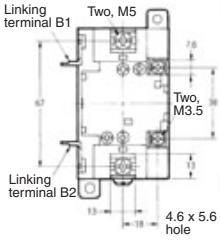
Terminal Arrangement/ Internal Connections



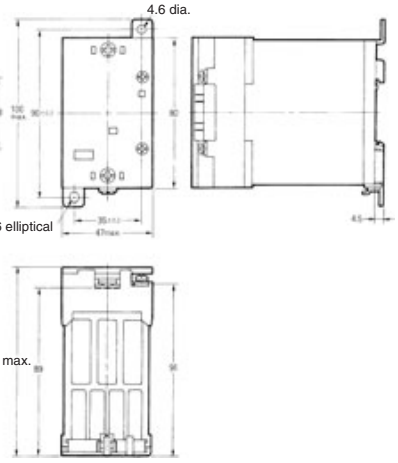
G3PA-240B(L)-VD



Without Terminal Cover

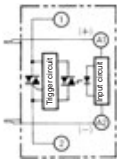


With Terminal Cover



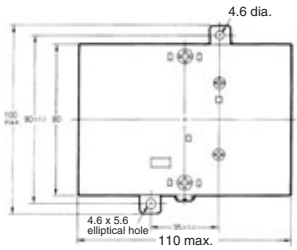
Mounting Holes

Terminal Arrangement/ Internal Connections



G3PA-260B(L)-VD
G3PA-450B-VD-2

With Terminal Cover



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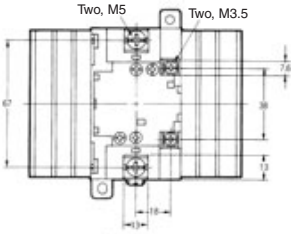
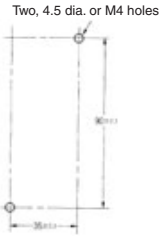
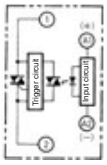
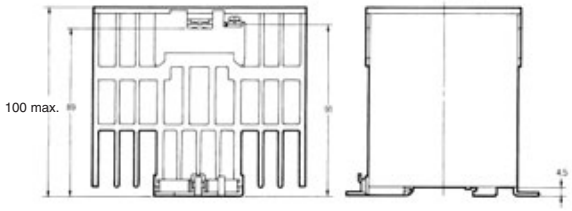


Mounting Holes

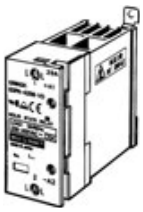


Terminal Arrangement/ Internal Connections

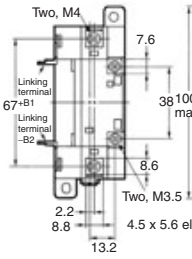




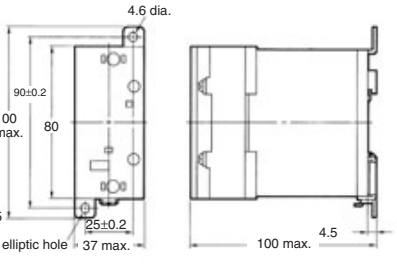
G3PA-420B-VD, G3PA-420B-VD-2

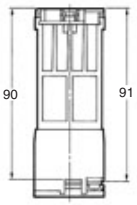


Without Terminal Cover

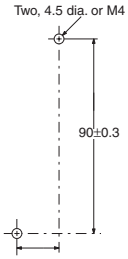


With Terminal Cover

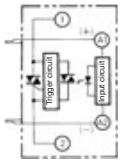




Mounting Holes

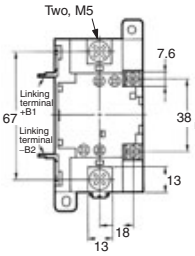


Terminal Arrangement/ Internal Connections

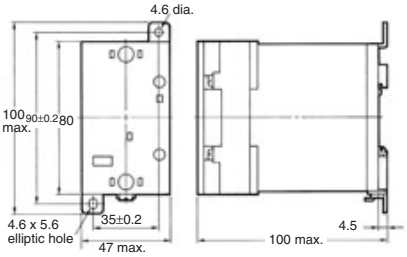


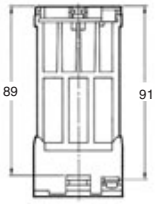
G3PA-430B-VD, G3PA-430B-VD-2

Without Terminal Cover

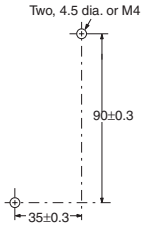


With Terminal Cover

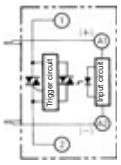




Mounting Holes



Terminal Arrangement/ Internal Connections



SSR

Safety Precautions

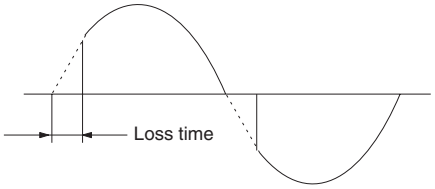
■ Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunction, or undesirable effect on product performance.

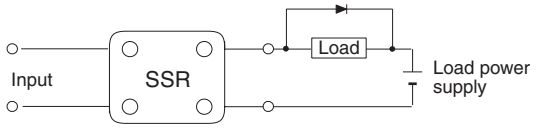
Load Connection

For an AC load, use a power supply rated at 50 or 60 Hz.
The maximum operating frequency is 10 Hz.
The G3PA-(VD) has a built-in varistor for overvoltage protection.

At a low applied voltage, such as 24 VAC, the load current is not fully supplied. When the Unit is switched ON, the voltage required to power the Unit deprives the output signal of the necessary voltage level and thus creates loss time. The lower the load voltage is, the greater the loss time is. This condition, however, will not create any serious problems.



For a DC or L load, a diode should be connected in parallel the load to absorb the counter electromotive force of the load.

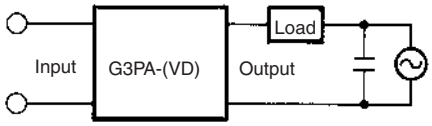


When attaching a heat sink to the G3PA-(VD), in order to facilitate heat dissipation, apply silicone grease or equivalent heat-conductive grease on the heat sink. (Toshiba Silicone, Shinetsu Silicone, etc.)

Tighten the mounting screws of the heat sink with a torque of 0.78 to 0.98 N·m.

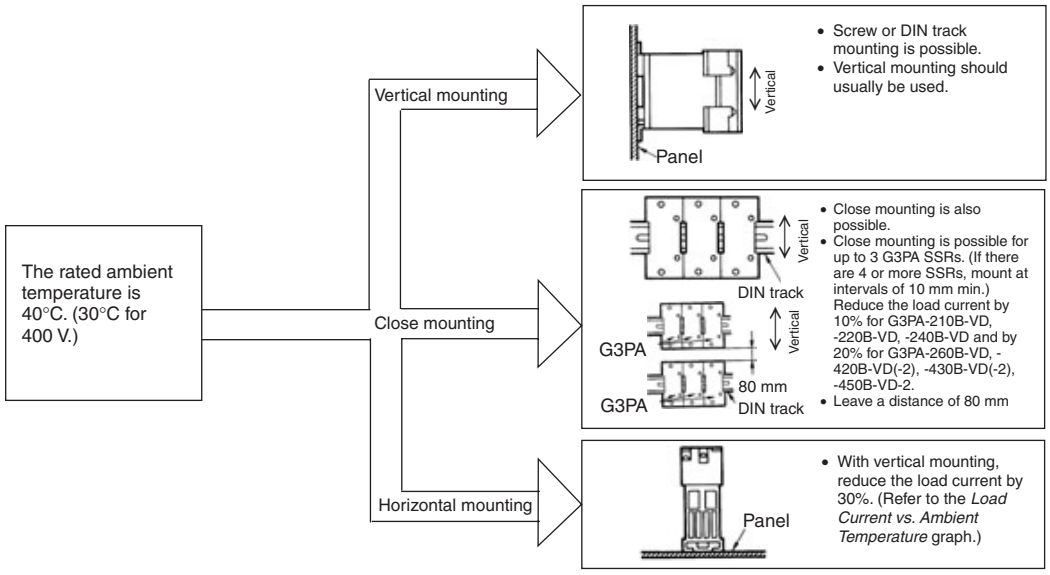
Noise Terminal Voltage according to EN55011

The G3PA-(VD) complies with EN55011 standards when a capacitor is connected to the load power supply as shown in the following circuit diagram.



Recommended Capacitor: 1 μF, 250 VAC

Mounting

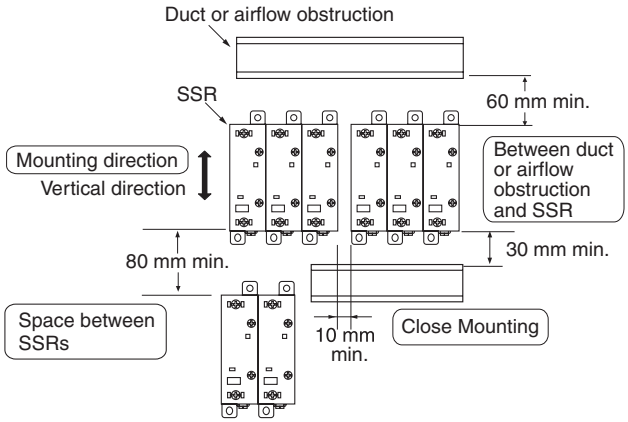


Note: Leave a distance of 60 mm min. between SSRs and ducts (especially above the SSR).

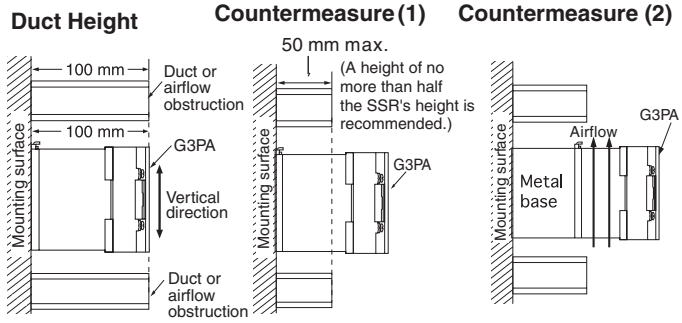
Close Mounting

SSR Mounting Pitch

Panel Mounting (At a rated ambient temperature of 40°C).



Relationship between SSRs and Ducts

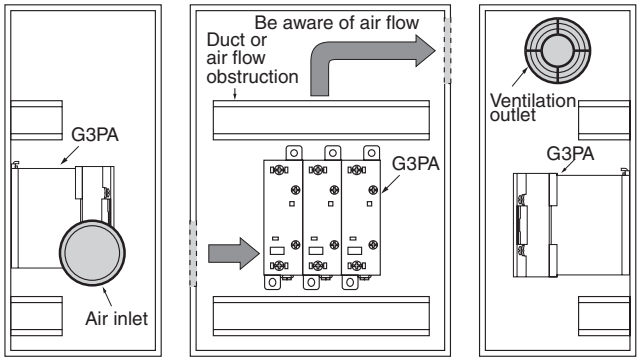


Do not surround the SSR with ducts, otherwise the heat radiation of the SSR will be adversely affected.

Use short ducts.

If the ducts cannot be shortened, place the SSR on a metal base so that it is not surrounded by the ducts.

Ventilation



If the air inlet or air outlet has a filter, clean the filter regularly to prevent it from clogging and ensure an efficient flow of air.

Do not locate any objects around the air inlet or air outlet, otherwise the objects may obstruct the proper ventilation of the control panel.

A heat exchanger, if used, should be located in front of the SSR Units to ensure the efficiency of the heat exchanger.

Please reduce the ambient temperature of SSRs.

The rated load current of an SSR is measured at an ambient temperature of 25 or 40 °C.

An SSR uses a semiconductor in the output element. This causes the temperature inside the control panel to increase due to heating resulting from the passage of electrical current through the load. To restrict heating, attach a fan to the ventilation outlet or air inlet of the control panel to ventilate the panel. This will reduce the ambient temperature of the SSRs and thus increase reliability. (Generally, each 10 °C reduction in temperature will double the expected life.)

Load current (A)	10 A	20 A	30 A	40 A	60 A
Required number of fans per SSR	0.16	0.31	0.47	0.62	0.93

Example: For 10 SSRs with load currents of 20 A,
0.31 x 10 = 3.1
Thus, 4 fans would be required.

Size of fans: 92 mm^2, Air volume: 0.7 m^3/min,
Ambient temperature of control panel: 30 °C

If there are other instruments that generate heat in the control panel other than SSRs, additional ventilation will be required.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. K094-E1-06

Solid State Relays (Single-phase)
G3PB

New Single-phase Solid State Relays with Compact Size for Heater Control

- Slim models with a thickness of only 22.5 mm are also available.
- Compact design achieved by optimizing heat sink shape.
- DIN track mounting possible in addition to screw mounting.
- Comply with EN60947-4-3 (IEC947-4-3) UL508, and CSA22.2 No. 14, and bear CE marking.

Model Number Structure

■ Model Number Legend

G3PB-□□□-□□-□
1 2 3 4 5 6 7

1. **Basic Model Name**
   G3PB: Solid State Relay
2. **Rated Load Power Supply Voltage**
   2: 200 VAC
3. **Rated Load Current**
   15: 15 A
   25: 25 A
   35: 35 A
   45: 45 A
4. **Terminal Type**
   B: Screw terminals
5. **Single-phase/3-phase and Number of Elements for 3-phase**
   Blank: Single-phase models
6. **Single-phase Type**
   Blank: DIN track mounting and built-in heat sink
7. **Certification**
   VD: Certified by UL, CSA, and VDE

Ordering Information

■ List of Models

Isolation method	Zero cross function	Operation indicator	Rated input voltage	Rated output load	Model number
Phototriac coupler	Yes	Yes (yellow)	12 to 24 VDC	15 A, 100 to 240 VAC	G3PB-215B-VD 12 to 24 VDC
				25 A, 100 to 240 VAC	G3PB-225B-VD 12 to 24 VDC
				35 A, 100 to 240 VAC	G3PB-235B-VD 12 to 24 VDC
				45 A, 100 to 240 VAC	G3PB-245B-VD 12 to 24 VDC

Note: When ordering, specify the rated input voltage.

■ Accessories (Order Separately)

Mounting Track	50 cm (1) x 7.3 mm (t)	PFP-50N
	1 m (1) x 7.3 mm (t)	PFP-100N
	1 m (1) x 16 mm (t)	PFP-100N2

Specifications

■ Ratings (at an Ambient Temperature of 25°C)

Input

Item	Common
Rated voltage	12 to 24 VDC
Operating voltage range	9.6 to 30 VDC
Rated input current	7 mA max.
Must operate voltage	9.6 VDC max.
Must release voltage	1 VDC min.
Insulation method	Phototriac
Operation indicator	Yellow LED

Output

Item	G3PB-215B-VD	G3PB-225B-VD	G3PB-235B-VD	G3PB-245B-VD
Rated load voltage	100 to 240 VAC			
Load voltage range	75 to 264 VAC			
Applicable load current (See note.)	0.1 to 15 A	0.1 to 25 A	0.5 to 35 A	0.5 to 45 A
Inrush current resistance (peak value)	150 A (60 Hz, 1 cycle)	220 A (60 Hz, 1 cycle)	440 A (60 Hz, 1 cycle)	
Permissible I^2t (half 60-Hz wave)	260 A^2s	260 A^2s	2,660 A^2s	
Applicable load (with Class-1 AC resistive load)	3 kW max. (at 200 VAC)	5 kW max. (at 200 VAC)	7 kW max. (at 200 VAC)	9 kW max. (at 200 VAC)

Note: The applicable load current varies depending on the ambient temperature. For details, refer to *Load Current vs. Ambient Temperature* in Engineering Data.

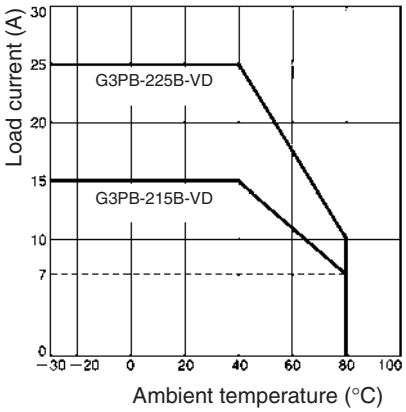
■ Characteristics

Item	G3PB-215B-VD	G3PB-225B-VD	G3PB-235B-VD	G3PB-245B-VD
Operate time	1/2 of load power source cycle + 1 ms max. (DC input)			
Release time	1/2 of load power source cycle + 1 ms max. (DC input)			
Output ON voltage drop	1.6 V (RMS) max.			
Leakage current	10 mA max. (at 200 VAC)			
Insulation resistance	100 MΩ min. (at 500 VDC)			
Dielectric strength	2,500 VAC, 50/60 Hz for 1 min			
Vibration resistance	Destruction: 10 to 55 to 10 Hz, 0.375-mm single amplitude (Mounted to DIN track)			
Shock resistance	Destruction: 294 m/s^2 (DIN track mounting)			
Ambient temperature	Operating: –30°C to 80°C (with no icing or condensation) Storage: –30°C to 100°C (with no icing or condensation)			
Ambient humidity	Operating: 45% to 85%			
Certified standards	UL508 File No. E64562 CSA22.2 No. 14 File No. LR35535 IEC947-4-3 File No. 6825 UG			
Weight	Approx. 240 g	Approx. 240 g	Approx. 400 g	Approx. 400 g

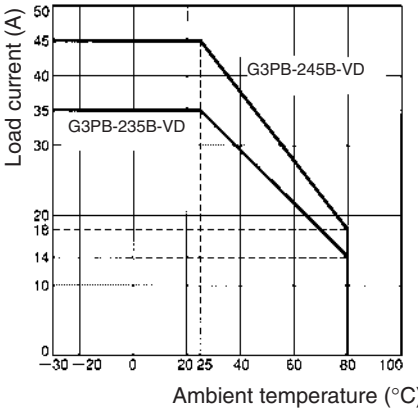
Engineering Data

Load Current vs. Ambient Temperature

G3PB-215B-VD
G3PB-225B-VD

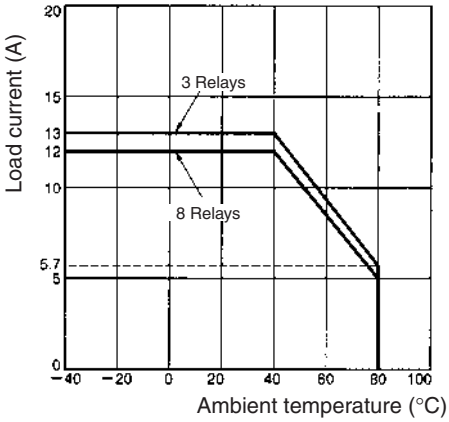


G3PB-235B-VD
G3PB-245B-VD

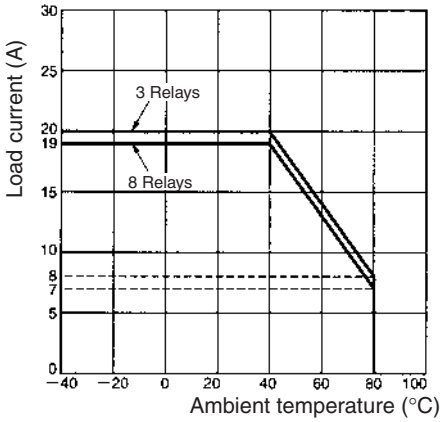


Close Mounting (3 Relays, 8 Relays)

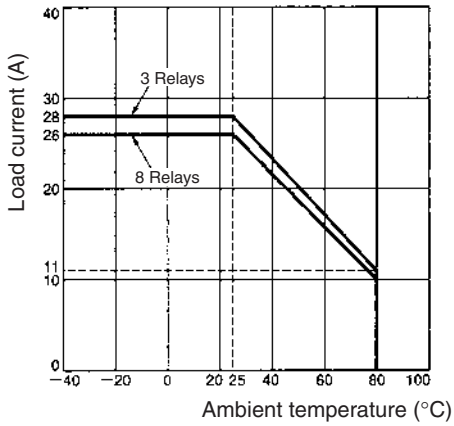
G3PB-215B-VD



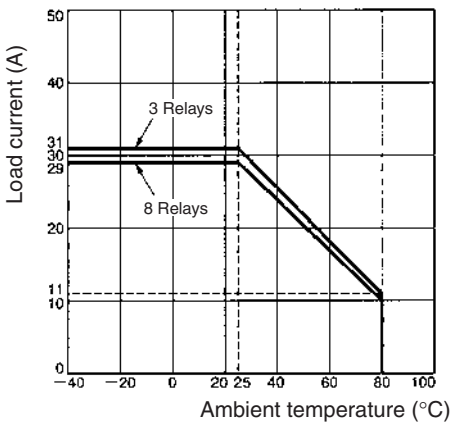
G3PB-225B-VD



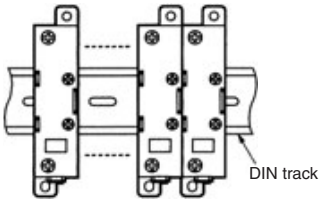
G3PB-235B-VD



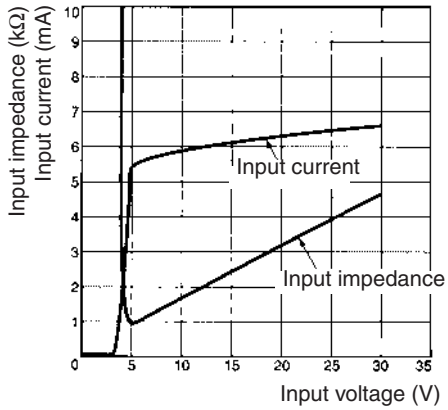
G3PB-245B-VD



Close Mounting Example



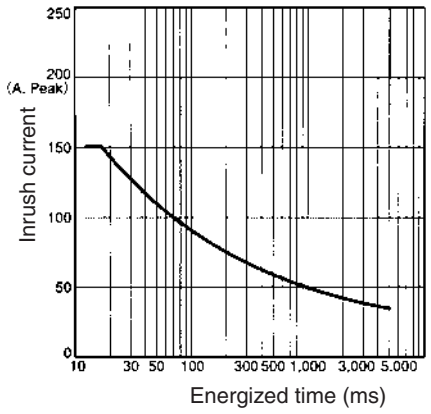
Input Voltage vs. Input Current and Input Voltage vs. Input Impedance



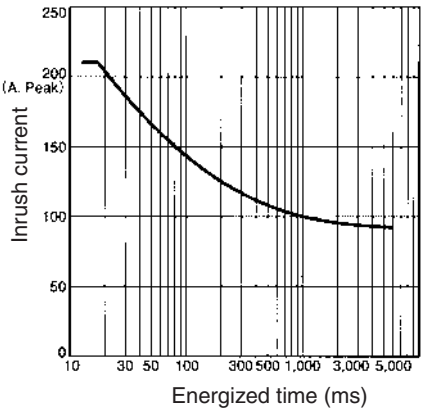
One Cycle Surge Current: Non-repetitive

Note: Keep the inrush current to half the rated value if it occurs repetitively.

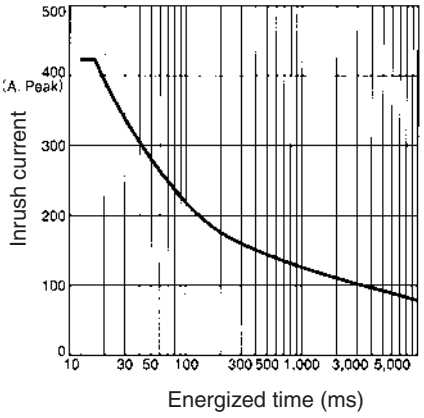
G3PB-215B-VD



G3PB-225B-VD



G3PB-235B-VD
G3PB-245B-VD

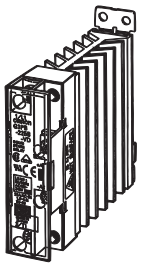


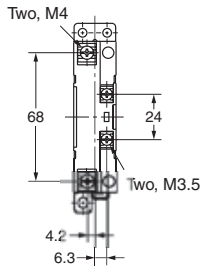
SSR

Dimensions

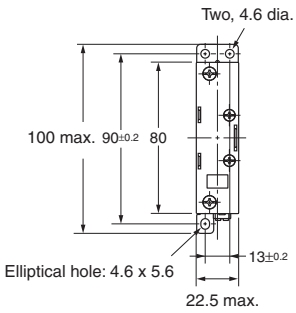
Note: All units are in millimeters unless otherwise indicated.

G3PB-215B-VD
G3PB-225B-VD

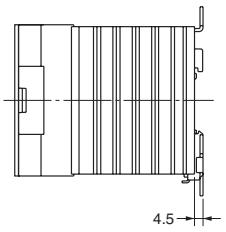




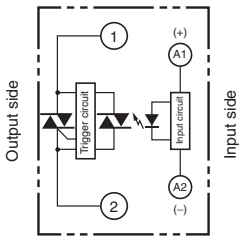
Note: Without terminal cover.



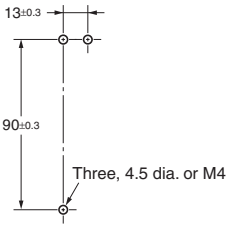
Note: With terminal cover.

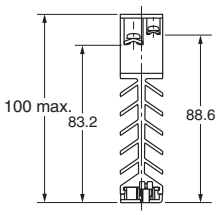


Terminal Arrangement/ Internal Circuit Diagram

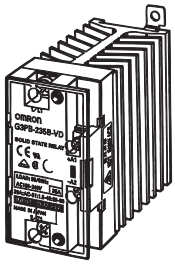


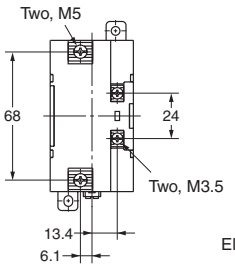
Mounting Holes



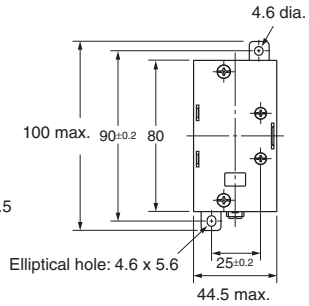


G3PB-235B-VD
G3PB-245B-VD

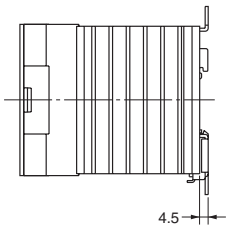




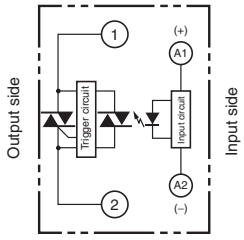
Note: Without terminal cover.



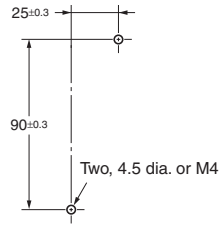
Note: With terminal cover.

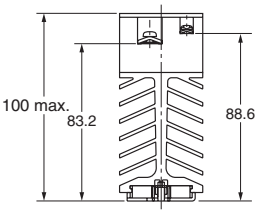


Terminal Arrangement/ Internal Circuit Diagram



Mounting Holes

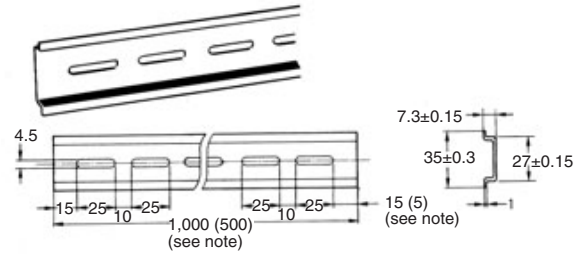




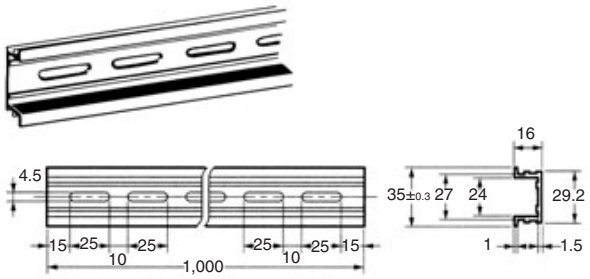
Accessories (Order Separately)

Mounting Tracks

PFP-100N, PFP-50N



PFP-100N2



Note: Values in parentheses indicate dimensions for the PFP-50N.

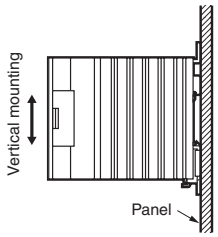
Safety Precautions

■ Precautions for Correct Use

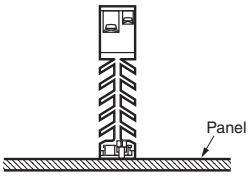
Please observe the following precautions to prevent failure to operate, malfunction, or undesirable effect on product performance.

Mounting Method

Vertical Mounting



Horizontal Mounting

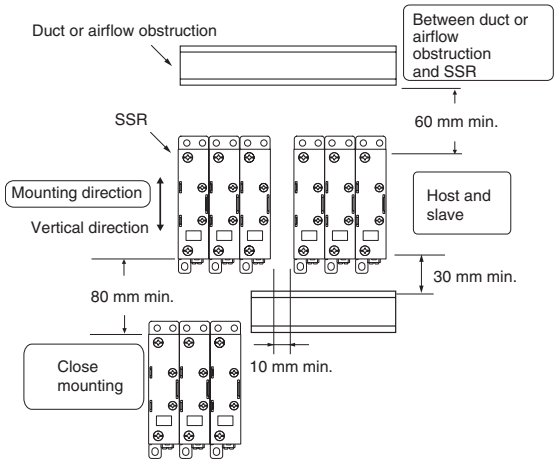


Note: Make sure that the load current is 50% of the rated load current when the G3PB is mounted horizontally.

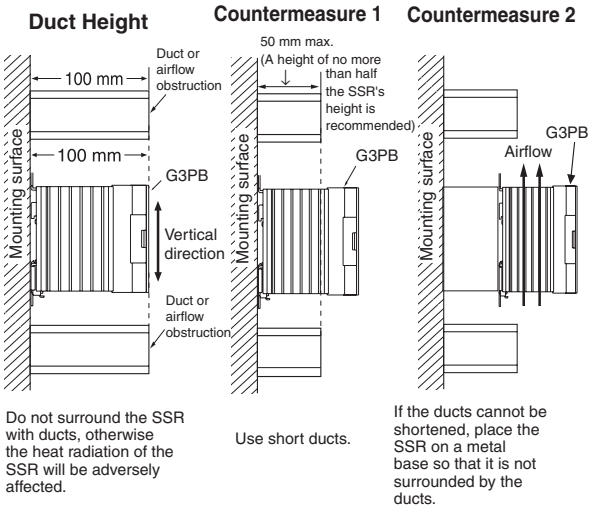
Close Mounting

SSR Mounting Pitch

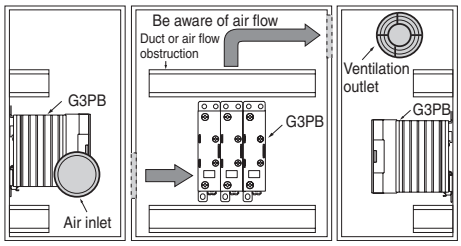
Panel Mounting



Relationship between SSRs and Ducts



Ventilation



If the air inlet or air outlet has a filter, clean the filter regularly to prevent it from clogging and ensure an efficient flow of air.

Do not locate any objects around the air inlet or air outlet, otherwise the objects may obstruct the proper ventilation of the control panel.

A heat exchanger, if used, should be located in front of the SSR Units to ensure the efficiency of the heat exchanger.

Please reduce the ambient temperature of SSRs.

The rated load current of an SSR is measured at an ambient temperature of 25 or 40 °C.

An SSR uses a semiconductor in the output element. This causes the temperature inside the control panel to increase due to heating resulting from the passage of electrical current through the load. To restrict heating, attach a fan to the ventilation outlet or air inlet of the control panel to ventilate the panel. This will reduce the ambient temperature of the SSRs and thus increase reliability. (Generally, each 10 °C reduction in temperature will double the expected life.)

Load current (A)	15 A	25 A	35 A	45 A
Required number of fans per SSR	0.23	0.39	0.54	0.70

Example: For 10 SSRs with load currents of 20 A,
0.23 x 10 = 2.3
Thus, 3 fans would be required.

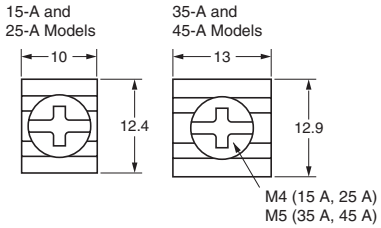
Size of fans: 92 mm^2, Air volume: 0.7 m^3/min,
Ambient temperature of control panel: 30 °C

If there are other instruments that generate heat in the control panel other than SSRs, additional ventilation will be required.

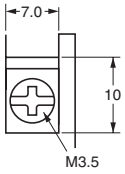
Wiring

- When using crimp terminals, refer to the terminal clearances shown below.

Output Terminal Section (Single-phase Models)



Input Terminal Section



- Make sure that all lead wires are appropriate for the current.
- Output terminals are charged even when the Relay is turned OFF. Touching the terminals may result in electric shock. To isolate the Relay from the power supply, install an appropriate circuit breaker between the power supply and the Relay.
  Be sure to turn OFF the power supply before wiring the Relay.

Tightening Torque

- Refer to the following and be sure to tighten each screw of the Relay to the specified torque in order to prevent the Relay from malfunctioning.

Item	Screw terminal diameter	Tightening torque
Input terminal	M3.5	0.8 N·m
Output terminal	M4	1.2 N·m
	M5	2.0 N·m

Solid State Contactors (Three-phase)
G3PB

Space and working time saved with new heat sink construction. Series now includes 480-VAC models to allow use in a greater range of applications.

- A comprehensive lineup that now includes 480-VAC models.
- Slim design with 3-phase output and built-in heat sinks.
- New heat sink construction with smaller mounting section.
- DIN track mounting supported as standard. (Screw mounting is also possible.)
- Certified by UL, CSA, and VDE.

Model Number Structure

■ Model Number Legend

G3PB-□□□-□□-□
1 2 3 4 5 6 7

1. **Basic Model Name**
   G3PB: Solid State Relay
2. **Rated Load Power Supply Voltage**
   2: 200 VAC
   5: 480 VAC
3. **Rated Load Current**
   15: 15 A
   25: 25 A
   35: 35 A
   45: 45 A
4. **Terminal Type**
   B: Screw terminals
5. **Single-phase/3-phase and Number of Elements for 3-phase**
   2: 3-phase, 2-element models
   3: 3-phase, 3-element models
6. **3-phase Type**
   N: DIN track mounting and built-in heat sink
7. **Certification**
   VD: Certified by UL, CSA, and VDE

Ordering Information

■ List of Models (Built-in Heat Sinks)

Applicable phase	Main circuit voltage	Zero cross function	Applicable heater capacity (with Class-1 AC resistive load)	Number of poles	Model
3	100 to 240 VAC	Yes	5.1 kW max. (15 A)	3	G3PB-215B-3N-VD
				2	G3PB-215B-2N-VD
			8.6 kW max. (25 A)	3	G3PB-225B-3N-VD
				2	G3PB-225B-2N-VD
			12.1 kW max. (35 A)	3	G3PB-235B-3N-VD
				2	G3PB-235B-2N-VD
			15.5 kW max. (45 A)	3	G3PB-245B-3N-VD
				2	G3PB-245B-2N-VD
	200 to 480 VAC		12.5 kW max. (15 A)	3	G3PB-515B-3N-VD
				2	G3PB-515B-2N-VD
			20.7 kW max. (25 A)	3	G3PB-525B-3N-VD
				2	G3PB-525B-2N-VD
			29.0 kW max. (35 A)	3	G3PB-535B-3N-VD
				2	G3PB-535B-2N-VD
			37.4 kW max. (45 A)	3	G3PB-545B-3N-VD
				2	G3PB-545B-2N-VD

Note: When ordering, specify the rated input voltage.

Specifications

■ Ratings (at an Ambient Temperature of 25°C)

Operating Circuit (Common)

Item	Common
Rated voltage	12 to 24 VDC
Operating voltage range	9.6 to 30 VDC
Rated input current (Impedance)	10 mA max. (at 24 VDC)
Must operate voltage	9.6 VDC max.
Must release voltage	1 VDC min.
Insulation method	Phototriac coupler
Operation indicator	Yellow LED

Main Circuit of Models with Built-in Heat Sinks

Item	G3PB-215B-3N-VD	G3PB-215B-2N-VD	G3PB-225B-3N-VD	G3PB-225B-2N-VD	G3PB-235B-3N-VD	G3PB-235B-2N-VD	G3PB-245B-3N-VD	G3PB-245B-2N-VD
Rated load voltage	100 to 240 VAC							
Load voltage range	75 to 264 VAC							
Applicable load current (See note.)	0.2 to 15 A		0.2 to 25 A		0.5 to 35 A		0.5 to 45 A	
Inrush current resistance (peak value)	150 A (60 Hz, 1 cycle)		220 A (60 Hz, 1 cycle)		440 A (60 Hz, 1 cycle)			
Permissible I^2t (half 60-Hz wave)	260 A^2s		2,660 A^2s		2,660 A^2s			

Item	G3PB-515B-3N-VD	G3PB-515B-2N-VD	G3PB-525B-3N-VD	G3PB-525B-2N-VD	G3PB-535B-3N-VD	G3PB-535B-2N-VD	G3PB-545B-3N-VD	G3PB-545B-2N-VD
Rated load voltage	200 to 480 VAC							
Load voltage range	180 to 528 VAC							
Applicable load current (See note.)	0.5 to 15 A		0.5 to 25 A		0.5 to 35 A		0.5 to 45 A	
Inrush current resistance (peak value)	220 A (60 Hz, 1 cycle)				440 A (60 Hz, 1 cycle)			
Permissible I^2t (half 60-Hz wave)	260 A^2s		1,040 A^2s		1,040 A^2s			

Note: Applicable load current varies depending on the ambient temperature. For details, refer to *Load Current vs. Ambient Temperature* in *Engineering Data.*

■ Characteristics

Models with Built-in Heat Sinks

Item	G3PB-215B-3N-VD	G3PB-215B-2N-VD	G3PB-225B-3N-VD	G3PB-225B-2N-VD	G3PB-235B-3N-VD	G3PB-235B-2N-VD	G3PB-245B-3N-VD	G3PB-245B-2N-VD
Operate time	1/2 of load power source cycle + 1 ms max. (DC input)							
Release time	1/2 of load power source cycle + 1 ms max. (DC input)							
Output ON voltage drop	1.6 V (RMS) max.							
Leakage current (See note.)	10 mA (at 200 VAC)							
Insulation resistance	100 MΩ min. (at 500 VDC)							
Dielectric strength	2,500 VAC, 50/60 Hz for 1 min							
Vibration resistance	Destruction: 10 to 55 to 10 Hz, 0.175-mm single amplitude (Mounted to DIN track)							
Shock resistance	Destruction: 294 m/s^2 (98 m/s^2 with reverse mounting)							
Ambient temperature	Operating: –30°C to 80°C (with no icing or condensation) Storage: –30°C to 100°C (with no icing or condensation)							
Ambient humidity	Operating: 45% to 85%							
Weight	Approx. 1.25 kg		Approx. 1.45 kg		Approx. 1.65 kg		Approx. 2.0 kg	
Certified standards	UL508, CSA22.2 No. 14, EN60947-4-3 (IEC947-4-3); Certified by VDE (From April 2001)							
EMC	Emission		EN55011 Group 1 Class B					
	Immunity	ESD	IEC947-4-3, EN61000-4-2 4 kV contact discharge 8 kV air discharge					
	Immunity	Electromagnetic	IEC947-4-3, EN61000-4-3 10 V/m (80 MHz to 1 GHz)					
	Immunity	EFT	IEC947-4-3, EN61000-4-4 2 kV AC power-signal line					
	Immunity	Surge transient	IEC947-4-3, EN61000-4-5 Normal mode ±1 kV, Common mode ±2 kV					
	Immunity	RF disturbance	IEC947-4-3, EN61000-4-6 10 V (0.15 to 80 MHz)					
	Immunity	Dips	IEC947-4-3, EN61000-4-11					

Note: The leakage current of phase S will be approximately $\sqrt{3}$ times larger if the 2-element model is applied.

Item	G3PB-515B-3N-VD	G3PB-515B-2N-VD	G3PB-525B-3N-VD	G3PB-525B-2N-VD	G3PB-535B-3N-VD	G3PB-535B-2N-VD	G3PB-545B-3N-VD	G3PB-545B-2N-VD
Operate time	1/2 of load power source cycle + 1 ms max. (DC input)							
Release time	1/2 of load power source cycle + 1 ms max. (DC input)							
Output ON voltage drop	1.8 V (RMS) max.							
Leakage current (See note.)	20 mA (at 480 VAC)							
Insulation resistance	100 MΩ min. (at 500 VDC)							
Dielectric strength	2,500 VAC, 50/60 Hz for 1 min							
Vibration resistance	Destruction: 10 to 55 to 10 Hz, 0.175-mm single amplitude (Mounted to DIN track)							
Shock resistance	Destruction: 294 m/s^2 (98 m/s^2 with reverse mounting)							
Ambient temperature	Operating: –30°C to 80°C (with no icing or condensation) Storage: –30°C to 100°C (with no icing or condensation)							
Ambient humidity	Operating: 45% to 85%							
Weight	Approx. 1.25 kg		Approx. 1.45 kg		Approx. 1.65 kg		Approx. 2.0 kg	
Certified standards	UL508, CSA22.2 No. 14, EN60947-4-3 (IEC947-4-3); Certified by VDE (From April 2001)							
EMC	Emission		EN55011 Group 1 Class B					
	Immunity	ESD	IEC947-4-3, EN61000-4-2 4 kV contact discharge 8 kV air discharge					
	Immunity	Electromagnetic	IEC947-4-3, EN61000-4-3 10 V/m (80 MHz to 1 GHz)					
	Immunity	EFT	IEC947-4-3, EN61000-4-4 2 kV AC power-signal line					
	Immunity	Surge transient	IEC947-4-3, EN61000-4-5 Normal mode ±1 kV, Common mode ±2 kV					
	Immunity	RF disturbance	IEC947-4-3, EN61000-4-6 10 V (0.15 to 80 MHz)					
	Immunity	Dips	IEC947-4-3, EN61000-4-11					

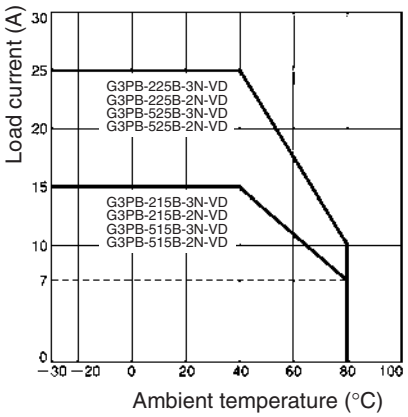
Note: The leakage current of phase S will be approximately $\sqrt{3}$ times larger if the 2-element model is applied.

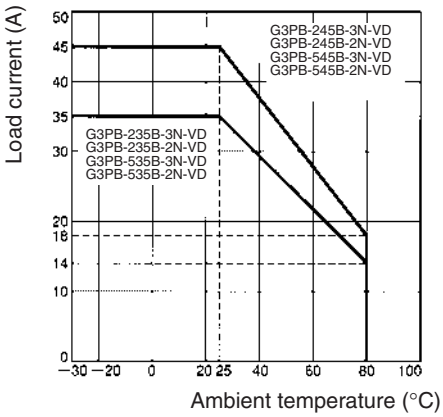
Engineering Data

Load Current vs. Ambient Temperature

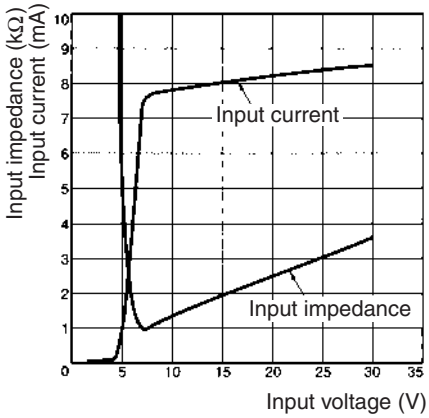
Models with Built-in Heat Sinks

G3PB-215B-3N-VD G3PB-225B-3N-VD G3PB-235B-3N-VD G3PB-245B-3N-VD
G3PB-215B-2N-VD G3PB-225B-2N-VD G3PB-235B-2N-VD G3PB-245B-2N-VD
G3PB-515B-3N-VD G3PB-525B-3N-VD G3PB-535B-3N-VD G3PB-545B-3N-VD
G3PB-515B-2N-VD G3PB-525B-2N-VD G3PB-535B-2N-VD G3PB-545B-2N-VD





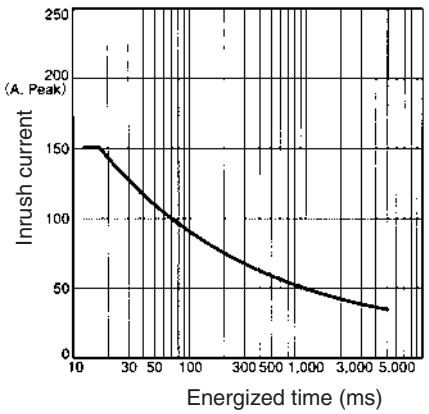
Input Voltage vs. Input Current and Input Voltage vs. Input Impedance



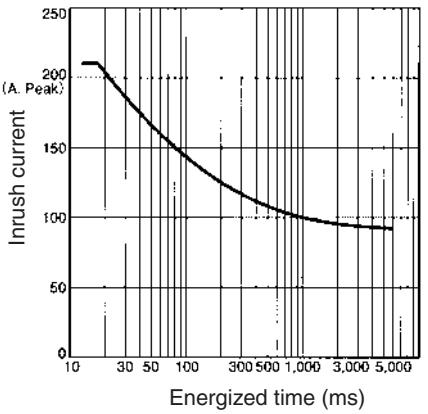
One Cycle Surge Current: Non-repetitive

Note: Keep the inrush current to half the rated value if it occurs repetitively.

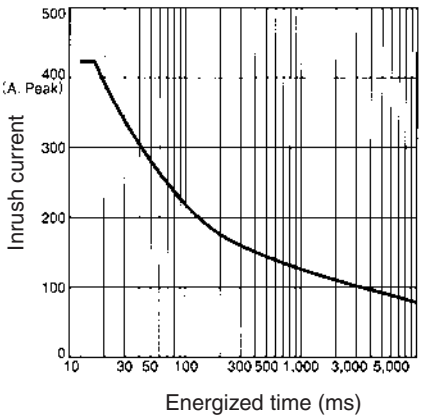
G3PB-215B-3N-VD
G3PB-215B-2N-VD



G3PB-225B-3N-VD G3PB-225B-2N-VD
G3PB-515B-3N-VD G3PB-515B-2N-VD
G3PB-525B-3N-VD G3PB-525B-2N-VD



G3PB-235B-3N-VD G3PB-245B-3N-VD
G3PB-235B-2N-VD G3PB-245B-2N-VD
G3PB-535B-3N-VD G3PB-545B-3N-VD
G3PB-535B-2N-VD G3PB-545B-2N-VD

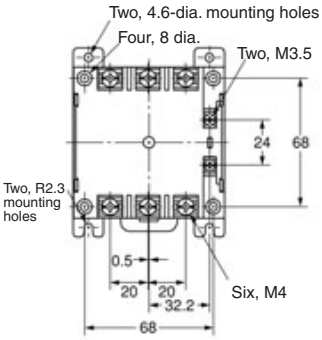


Dimensions

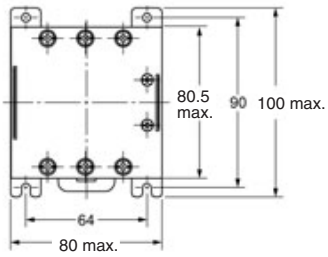
Note: All units are in millimeters unless otherwise indicated.

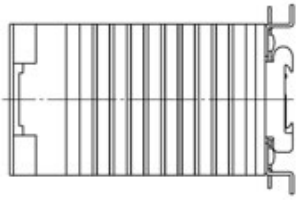
G3PB-215B-3N-VD G3PB-515B-3N-VD
G3PB-215B-2N-VD G3PB-515B-2N-VD
G3PB-225B-2N-VD G3PB-525B-2N-VD

Without Terminal Cover



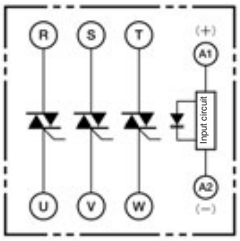
With Terminal Cover



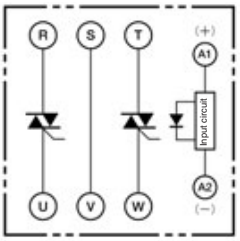


Terminal Arrangement/ Internal Connections

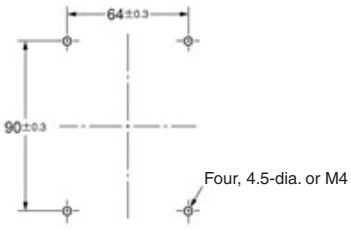
G3PB-□□□B-3N-VD

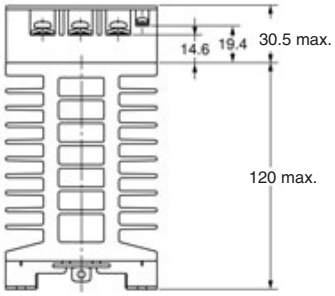


G3PB-□□□B-2N-VD

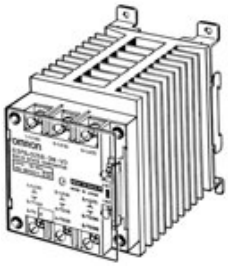


Mounting Hole Dimensions

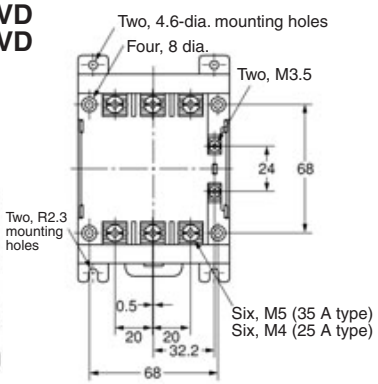




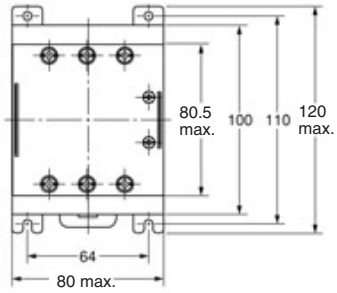
G3PB-225B-3N-VD
G3PB-235B-2N-VD
G3PB-525B-3N-VD
G3PB-535B-2N-VD

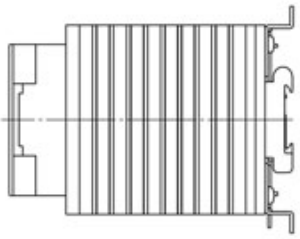


Without Terminal Cover



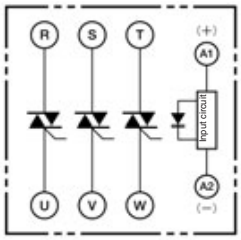
With Terminal Cover



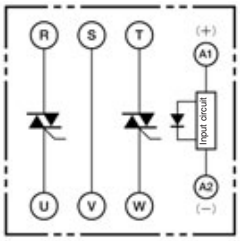


Terminal Arrangement/ Internal Connections

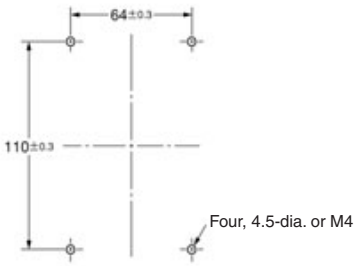
G3PB-□□□B-3N-VD

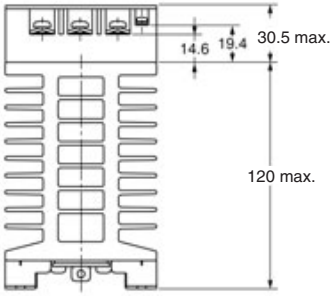


G3PB-□□□B-2N-VD

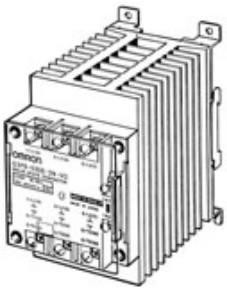


Mounting Hole Dimensions

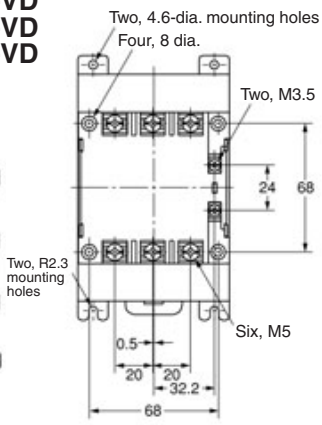




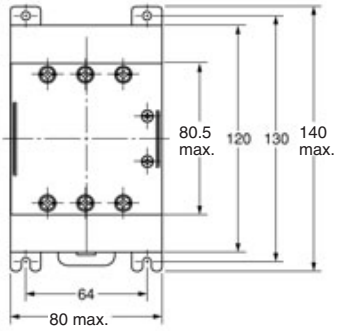
G3PB-235B-3N-VD
G3PB-245B-2N-VD
G3PB-535B-3N-VD
G3PB-545B-2N-VD

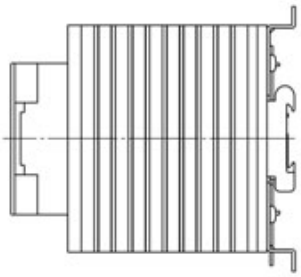


Without Terminal Cover



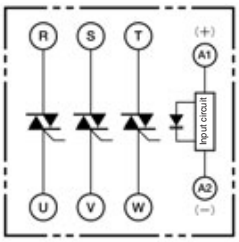
With Terminal Cover



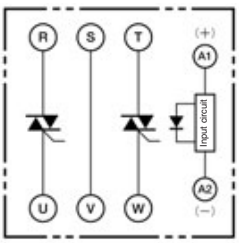


Terminal Arrangement/ Internal Connections

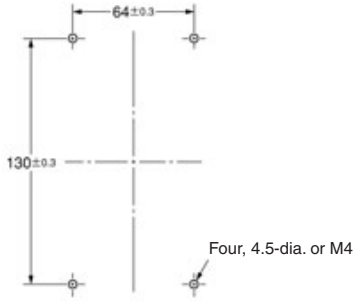
G3PB-□□□B-3N-VD

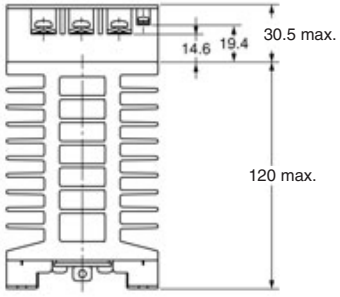


G3PB-□□□B-2N-VD



Mounting Hole Dimensions

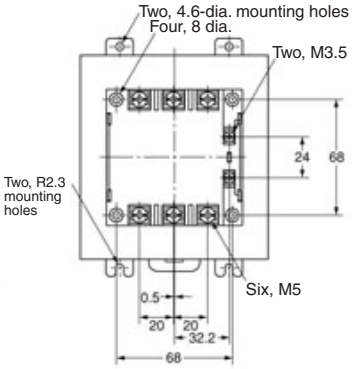




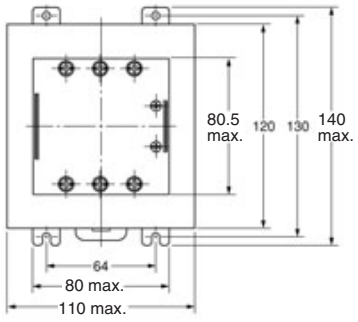
SSR

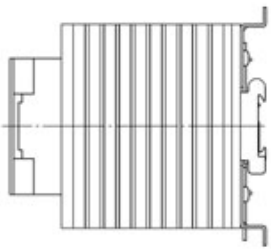
G3PB-245B-3N-VD
G3PB-545B-3N-VD

Without Terminal Cover



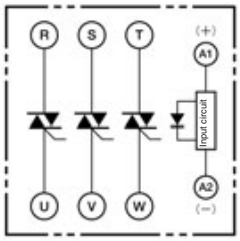
With Terminal Cover



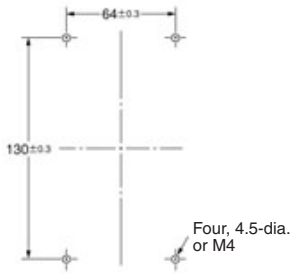


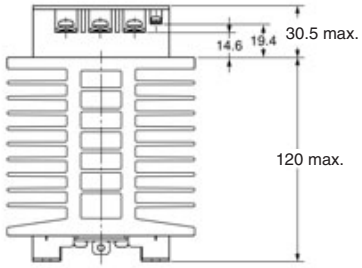
Terminal Arrangement/ Internal Connections

G3PB-□□□B-3N-VD



Mounting Hole Dimensions





Safety Precautions

■ Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunction, or undesirable effect on product performance.

Mounting Method

Since the Relay is heavy, firmly mount the DIN track and fix both ends with End Plates for DIN-track-mounting models.

Applicable DIN Tracks

The G3PB can be mounted to TH35-15Fe (IEC60715) DIN tracks. The manufacturers and models of DIN tracks to which mounting is possible are shown in the following table.

Manufacturer	Thickness	
	1.5 mm	2.3 mm
Schneider	AM1-DE200	---
WAGO	210-114, 210-197	210-118
PHOENIX	NS35/15	NS35/15-2.3

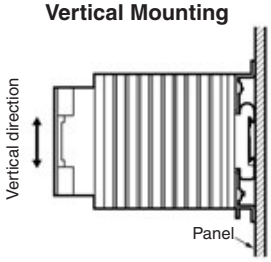
Direct Mounting

When mounting directly onto a panel, mount securely under the following conditions.

Screw diameter: M4
Tightening torque: 0.98 to 1.47 N·m

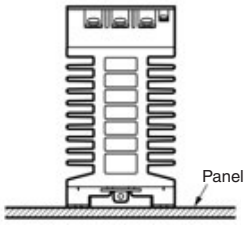
Mounted State

Vertical Mounting



Note: Mount the G3PB so that the markings can be read.

Horizontal Mounting

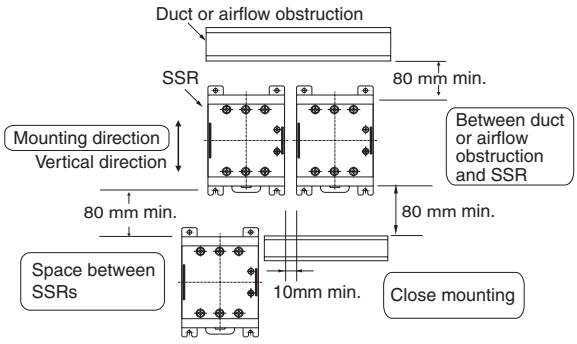


Note: When the G3PB is mounted horizontally, use at 50% of the rated load current.

Close Mounting

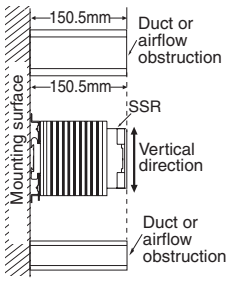
SSR Mounting Pitch

Panel Mounting



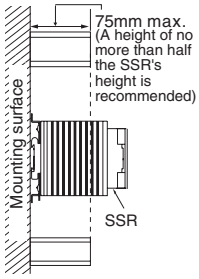
Relationship between SSRs and Ducts

Duct Height



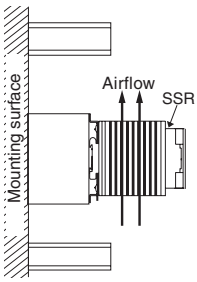
Do not surround the SSR with ducts, otherwise the heat radiation of the SSR will be adversely affected.

Countermeasure 1



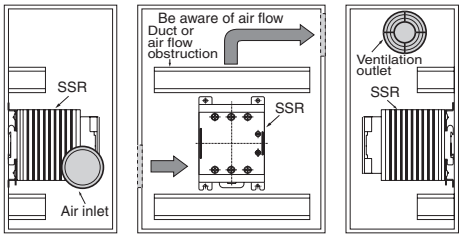
Use short ducts.

Countermeasure 2



If the ducts cannot be shortened, place the SSR on a metal base so that it is not surrounded by the ducts.

Ventilation



If the air inlet or air outlet has a filter, clean the filter regularly to prevent it from clogging and ensure an efficient flow of air.

Do not locate any objects around the air inlet or air outlet, otherwise the objects may obstruct the proper ventilation of the control panel.

A heat exchanger, if used, should be located in front of the SSR Units to ensure the efficiency of the heat exchanger.

Please reduce the ambient temperature of SSRs.

The rated load current of an SSR is measured at an ambient temperature of 25 or 40 °C.

An SSR uses a semiconductor in the output element. This causes the temperature inside the control panel to increase due to heating resulting from the passage of electrical current through the load. To restrict heating, attach a fan to the ventilation outlet or air inlet of the control panel to ventilate the panel. This will reduce the ambient temperature of the SSRs and thus increase reliability. (Generally, each 10 °C reduction in temperature will double the expected life.)

Three-element Devices

Load current (A)	15 A	25 A	35 A	45 A
Required number of fans per SSR	0.70	1.06	1.63	2.09

Two-element Devices

Load current (A)	15 A	25 A	35 A	45 A
Required number of fans per SSR	0.47	0.78	1.09	1.40

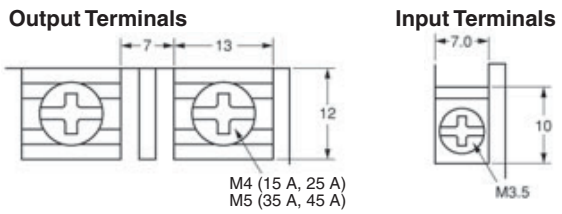
Example: For 10 SSRs with load currents of 11 A (3-element devices,
1.63 x 10 = 16.3
Thus, 17 fans would be required.

Size of fans: 92 mm^2, Air volume: 0.7 m^3/min,
Ambient temperature of control panel: 30 °C

If there are other instruments that generate heat in the control panel other than SSRs, additional ventilation will be required.

Wiring

When using crimp terminals, refer to the terminal clearances shown below.



- Make sure that all lead wires are thick enough for the current.
- Output terminals T1, T2, and T3 are charged regardless of whether the Unit is a 2- or 3-element model that is turned on or off. Do not touch these terminals, otherwise an electric shock may be received.

To isolate the Unit from the power supply, install an appropriate circuit breaker between the power supply and Unit.

Be sure to turn off the power supply before wiring the Unit.

- Terminal L2 and terminal T2 of the 2-element model are internally short-circuited to each other. Therefore, connect terminal L2 to the ground terminal side of the power supply. If terminal L2 is connected to a terminal other than the ground terminal, cover all the charged terminals, such as heater terminals, for the prevention of electric shock accidents and ground faults.

Tightening Torque

Refer to the following and be sure to tighten each screw of the Unit to the specified torque in order to prevent the Unit from malfunctioning.

Item	Screw terminal diameter	Tightening torque
Input terminal	M3.5	0.59 to 1.18 N·m
Output terminal	M4	0.98 to 1.47 N·m
	M5	1.47 to 2.45 N·m

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. J135-E1-03

Solid State Relays with Failure Detection Function
G3PC

Detects failures in SSR used for heater temperature control and simultaneously outputs alarm signal. This SSR supports the safe design of heater control systems, and contributes to maintenance improvements by the user.

- Main detection items:
  SSR short-circuits and SSR open-circuits
- Alarm output possible to NPN/PNP-input devices.
- The failure-detection function is built-in and power is supplied from the main circuit power supply making wiring simple.
- Slim design (width: 22.5 mm) incorporating a heat sink.
- In addition to screw mounting, DIN track mounting is also possible.
- Certified by EC, UL, and CSA.

Model Number Structure

■ Model Number Legend

G3PC-□□□-□
1 2 3 4 5

1. **Basic Model Name**
   G3PC: SSR with Failure Detection Function
2. **Rated Load Power Supply Voltage**
   2: 100 to 240 VAC
3. **Rated Load Current**
   20: 20 A (carry current)
4. **Terminal Type**
   B: Screw terminals
5. **Certification**
   VD: Certified by UL, CSA, and VDE

Ordering Information

■ List of Models

Insulation method	Zero cross function	Indicators	Rated output load	Model number
Phototriac coupler	Yes	Yes (See page 64)	20 A, 100 to 240 VAC (resistive load: AC, Class1)	G3PC-220B-VD

Note: When ordering, specify the rated input voltage.

■ Accessories (Order Separately)

Name	Dimensions	Model number
Mounting Track	50 cm (ℓ) × 7.3 mm (t)	PFP-50N
	1 m (ℓ) × 7.3 mm (t)	PFP-100N
	1 m (ℓ) × 16 mm (t)	PFP-100N2

Specifications

■ Ratings (at an Ambient Temperature of 25°C)

Detection Power Supply

Rated power supply voltage	100 to 240 VAC (50/60 Hz)
Operating voltage range	75 to 264 VAC (50/60 Hz)
Current consumption	15 mA AC max. (at 200 VAC)

Operating Circuit

Input method	Voltage input
Rated input voltage	12 to 24 VDC
Operating input voltage range	9.6 to 30 VDC
Must operate voltage	9.6 VDC max.
Must release voltage	1 VDC min.
Input current	7 mA DC max. (at rated input voltage)

Main Circuit

Rated load voltage	100 to 240 VAC (50/60 Hz)
Operating voltage range	75 to 264 VDC (50/60 Hz)
Rated carry current	20 A (Ta = 40)
Minimum load current	0.1 A
Inrush current resistance (peak value)	220 A (60 Hz, 1 cycle)
Permissible (I^2t)	260 A^2s
Applicable load (with Class-1 AC resistive load)	4 kW (at 200 VAC)

Alarm Output

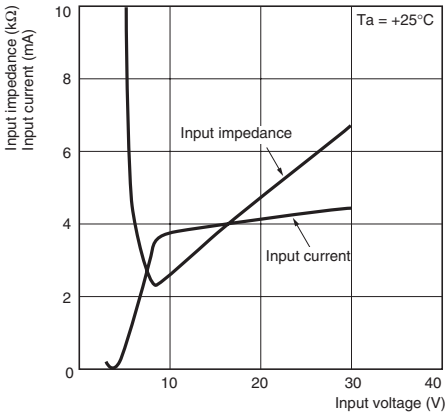
Output OFF collector voltage	30 VDC max.
Maximum carry current	0.1 A
Output form	Independent NPN open collector

■ Characteristics

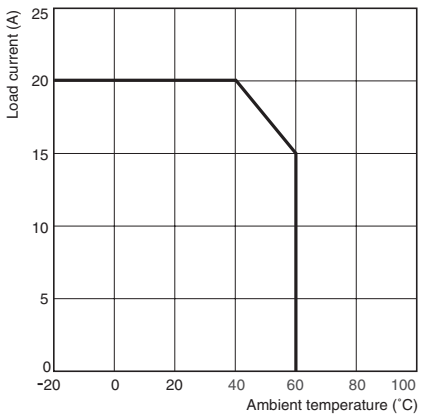
Operate time			1/2 of load power source cycle + 1 ms max.
Release time			1/2 of load power source cycle + 1 ms max.
Main circuit	**Output ON voltage drop**		1.6 V rms max.
	OFF leakage current		10 mA max. (at 200 VAC)
Alarm output	**Output ON voltage drop**		1.5 V max.
	OFF leakage current		0.1 mA max.
Insulation resistance			100 MΩ min. (at 500 VDC)
Dielectric strength			2,500 VAC, 50/60 Hz for 1 min
Vibration resistance			Destruction: 10 to 55 to10 Hz, 0.35-mm single amplitude
Shock resistance			Destruction: 294 m/s^2
Ambient temperature			Operating: -20 to 60°C (with no icing or condensation) Storage: -30 to 70°C (with no icing or condensation)
Ambient humidity			45% to 85%
Weight			Approx. 300 g
Certified standards			UL508, CSA22.2 No. 14, EN60947-4-3 (IEC947-4-3); Certified by VDE
EMC		Emission	EN55011 Group 1 Class B
		Immunity ESD	IEC947-4-3, EN61000-4-2 4 kV contact discharge 8 kV air discharge
		Immunity Electromagnetic	IEC947-4-3, EN61000-4-3 10 V/m (80 MHz to 1 GHz)
		Immunity EFT	IEC947-4-3, EN61000-4-4 2 kV AC power-signal line
		Immunity Surge transient	IEC947-4-3, EN61000-4-5 2 kV
		Immunity RF disturbance	IEC947-4-3, EN61000-4-6 10 V (0.15 to 80 MHz)
		Immunity Dips	IEC947-4-3, EN61000-4-11

Engineering Data

Input Voltage vs. Input Current
Input Voltage vs. Input Impedance

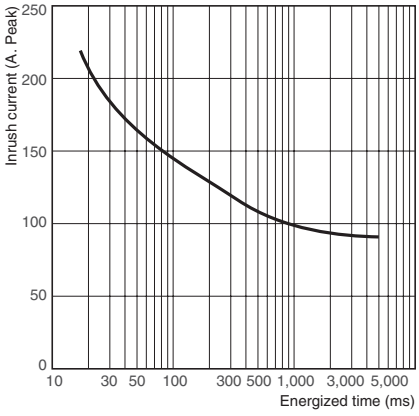


Load Current vs. Ambient Temperature



One Cycle Surge Current: Non-repetitive

The figure will be less than 1/2 the rated value for repetitive input.



SSR

Operation

■ Failure Detection Function

Conditions for SSR Failure Detection

Failure mode (See note 1.)	Operating input (between terminals A1 and A2)	Detection time	Alarm display (See note 3.)	Alarm display (between terminals X1 and X2) (See note 3.)
SSR short-circuit	OFF	0.5 s max. (See note 2.)	Red	Open collector transistor output
SSR half-wave short-circuit	OFF			
SSR open-circuit	ON			
SSR half-wave open-circuit	ON			

Note: 1. The contents of each of the above failure modes is as follows:
SSR short-circuit: SSR output circuit remains in the ON state.
SSR half-wave short-circuit: SSR output circuit remains in the ON state in one direction.
SSR open-circuit: SSR output circuit remains in the OFF state.
SSR half-wave open-circuit: SSR output circuit remains in the OFF state in one direction.
In addition to the failure modes listed above, detection of circuit disconnections for the load circuit is also possible. (As a rough guide, circuit disconnection will be detected if the load impedance is greater than or equal to 1 MΩ.)

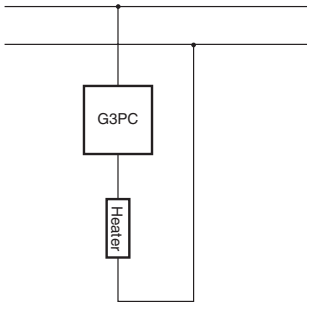
2. The same power supply is used for both the detection and for the output circuit and so detection is not performed during power interruptions.

3. If power supply (terminal 3) is in the open state, the SSR will still turn ON and OFF in the same way but the failure detection function and alarm display will not operate properly.

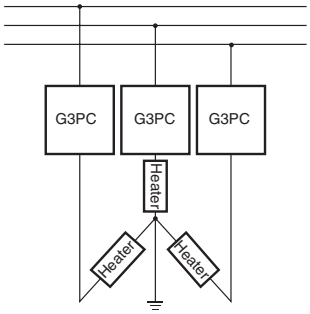
Connection Diagrams (Main Circuit)

The following diagrams show the applicable load connection configurations for SSR failure detection.

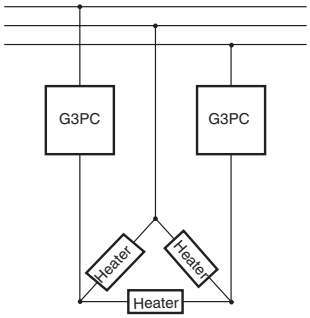
Single Phase



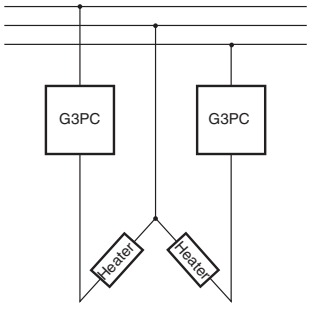
3-phase Star Connection



3-phase Delta Connection (3-phase, 2-wire Switching)



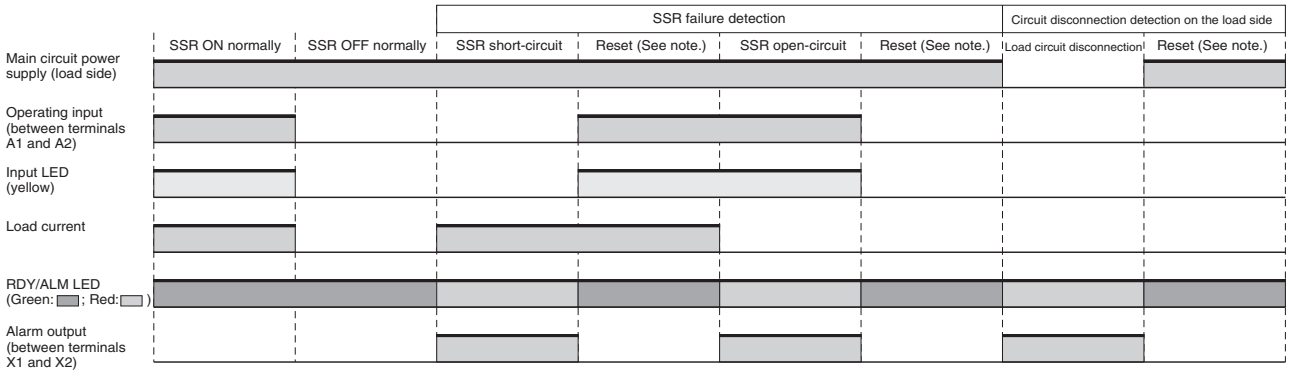
3-phase V Connection



Note: 1. With 3-phase connection, so that the power supply voltage is applied between the G3PC's terminals 1/L1 and 3, connect the desired phase to terminal 3.

2. Above mentioned products are 200V only. They are not suitable for three-phase 400V, but for three-phase 220V only.

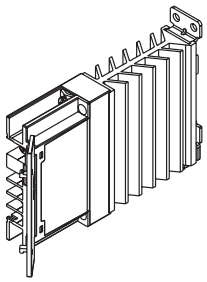
Timing Chart

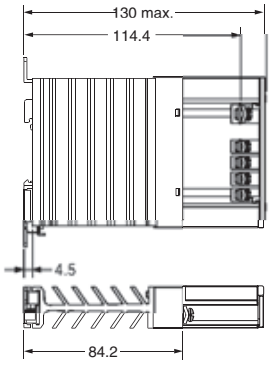


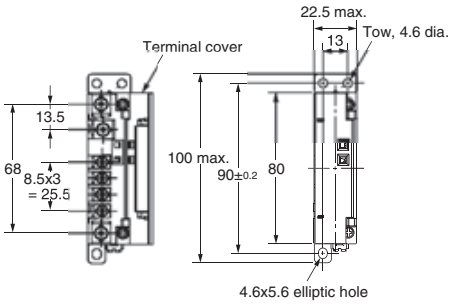
Note: After failure detection, if the detection conditions differ to the conditions given under *Conditions for SSR Failure Detection*, alarm output is reset.

Dimensions

G3PC-220B-VD

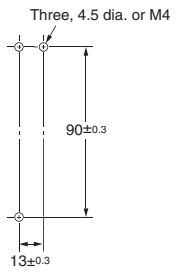






Note The above diagram is for when the terminal cover is open.

Mounting Holes

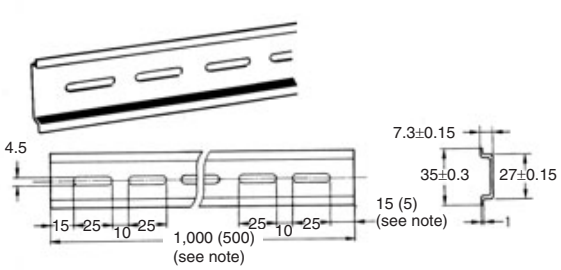


Note The above diagram is for when the terminal cover is closed.

Accessories (Order Separately)

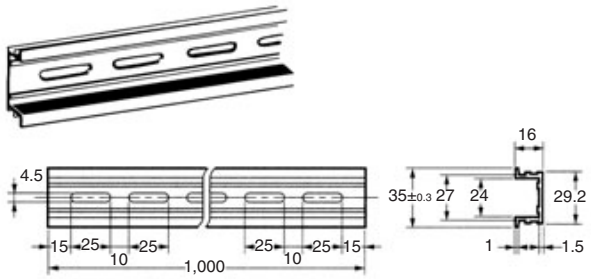
Mounting Tracks

PFP-100N, PFP-50N



Note Values in parentheses indicate dimensions for the PFP-50N.

PFP-100N2



SSR

Installation

■ External Specifications

Terminal Arrangement

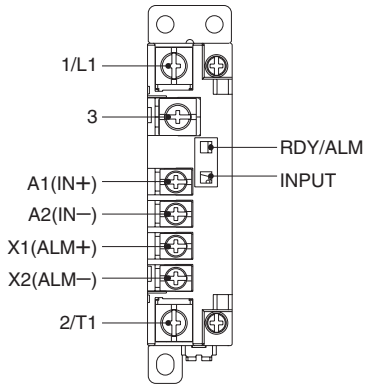
Terminal name	Terminal number	Screw size
Main circuit terminals (output)	1/L1, 2/T1	M4
Detection power supply terminal (input)	3	
Operating circuit terminals (input)	A1, A2	M3.5
Alarm output terminals (output)	X1, X2	

Indicators

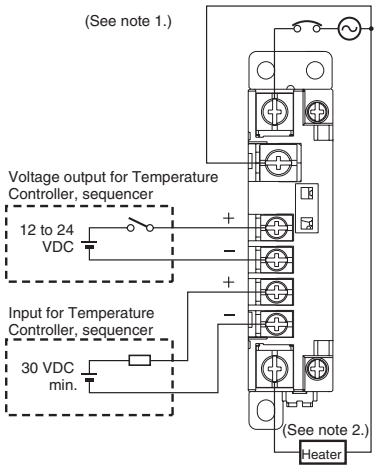
Name	Symbol	Color	Meaning
Status indicators	RDY	Green	SSR normal
	ALM	Red	SSR failure detection and circuit disconnection detection
Input indicator	INPUT	Yellow	Operating

Note: The same indicator is used as both the power supply indicator and the alarm indicator.

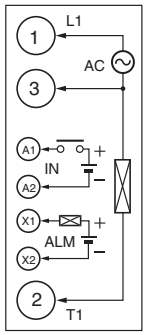
Appearance



■ Connection Example



Display Labels



Note: 1. If the detection power supply terminal (terminal 3) is not connected, failure detection is not performed and so be sure to connect this terminal.

2. If the load is connected to terminal 1/L1, failure detection may not operate correctly and so connect the load to terminal 2/T1.

3. With inductive loads (relay coil, etc.), connect back-current prevention diodes to both sides of the load.

Safety Precautions

■ Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunction, or undesirable effect on product performance.

Mounting Method

DIN Track Mounting

When mounting to a DIN track, mount the G3PC until it clicks into place, otherwise it become loose during use and fall. Fix both ends with end plates.

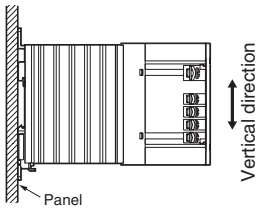
Panel Mounting

When mounting directly to a panel, observe the following conditions:

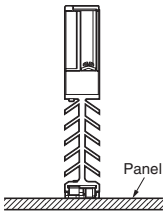
Screw diameter: M4

Tightening torque: 0.98 to 1.47 N·m

Vertical Mounting

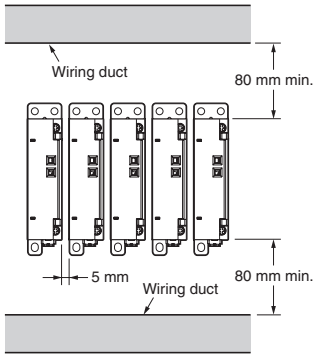


Horizontal Mounting



Note: Use the G3PC at a load current of 50% of the rated load current when it is mounted horizontally.

Close Mounting

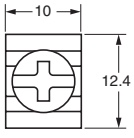


Note: Use the G3PC at a load current of 80% of the rated load current when it is mounted side by side.

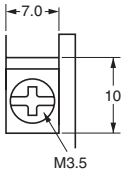
Wiring

- When using crimp terminals, observe the terminal clearances shown below.

Main Circuit Power Supply (Terminals 1 to 3)



Operating Input/Alarm Output (Terminals A1, A2, X1, and X2)



- Make sure that all lead wires are of a thickness appropriate for the current.
- The output terminals are charged, and touching them may result in electric shock, even when the G3PC is OFF. Separate the outputs from the power supply by installing a circuit-breaker at a higher level in the circuit.

Tightening Torque

Be sure to tighten the screws to the specified torques given below. Not doing so may result in malfunction.

Terminal number	Screw terminal diameter	Tightening torque
A1, A2, X1, X2	M3.5	0.59 to 1.18 N·m
1/L1, 2/T1, 3	M4	0.98 to 1.47 N·m

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. J127-E1-03

Solid State Relays
G3R-I/O

Compact SSRs for I/O Interface with High Dielectric Strength Requirements

- High-speed models with optimum input ratings for a variety of sensors are available.
- Input Modules and Output Modules that can be used for the G2R are available.
- Use a coupler conforming to VDE 0884 and assuring an I/O dielectric strength of 4,000 V.
- Incorporate an easy-to-see monitoring indicator.
- -UTU models certified by UL, CSA, and TÜV.

Model Number Structure

■ Model Number Legend

G3R-□□□□□□□-□-□
1 2 3 4 5 6 7 8 9 10

1. **Basic Model Name**
   G3R: Solid State Relay
2. **I/O Classification**
   I: Input module
   O: Output module
3. **Load Power Supply Type**
   A: Switches AC loads
   D: Switches DC loads
4. **Rated Load Power Supply Voltage**
   Z: 24 VDC
   X: 48 VDC
   2: 240 VAC
5. **Rated Load Current**
   R1: 0.1 A
   01: 1 A
   02: 2 A
6. **Terminal Type**
   S: Plug-in terminals
7. **Zero Cross Function**
   Z: Equipped with zero cross function
   L: Not equipped with zero cross function
   Blank: DC-output model
8. **Operation Indicator**
   N: Equipped with operation indicator
9. **Response Speed (only for DC Input Models)**
   I: Low-speed (10 Hz)
   Blank: High-speed (1 kHz)
10. **Certification**
    UTU: Certified by UL, CSA, and TÜV

Ordering Information

■ List of Models

Input Module

Isolation	Indicator	Response speed	Logic level		Rated input voltage	Model
			Supply voltage	Supply current		
Photocoupler	Yes	---	4 to 32 VDC	0.1 to 100 mA	100 to 240 VAC	G3R-IAZR1SN-UTU
		High-speed (1 kHz)			5 VDC	G3R-IDZR1SN-UTU
					12 to 24 VDC	
		Low-speed (10 Hz)			5 VDC	G3R-IDZR1SN-1-UTU
					12 to 24 VDC	

Output Module

Isolation	Indicator	Zero cross function	Rated output load	Rated input voltage	Model
Phototriac	Yes	Yes	2 A at 100 to 240 VAC	5 to 24 VDC	G3R-OA202SZN-UTU
		No			G3R-OA202SLN-UTU
Photocoupler		---	2 A at 5 to 48 VDC		G3R-ODX02SN-UTU
			1.5 A at 48 to 200 VDC		G3R-OD201SN-UTU

Note: When ordering, specify the rated input voltage.

■ Accessories (Order Separately)

Track/Surface Mounting Socket (Recommended)

Model	Number of poles
P2RF-05-E	1 pole (G2R: 1 pole usage)

Note: Refer to page 72 for details on other Sockets.

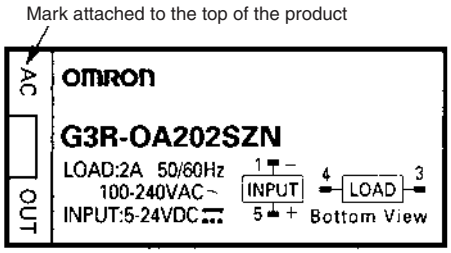
Connecting Socket Attaching Plate

Model	Applicable Socket
P2R-P	P2R-05A

■ I/O Indication

I/O module classification and AC/DC use are indicated on the mark affixed to the top of the product.

Mark indication	Specification
AC IN	Input module, AC input
DC IN	Input module, DC input
AC OUT	Output module, AC output
DC OUT	Output module, DC output



Specifications

■ Ratings (at an Ambient Temperature of 25°C)

Input Module

Input

Model	Rated voltage	Operating voltage	Input current	Must operate voltage	Must release voltage
G3R-IAZR1SN-UTU	100 to 240 VAC	60 to 264 VAC	15 mA max.	60 VAC max.	20 VAC min.
G3R-IDZR1SN-UTU	5 VDC	4 to 6 VDC	8 mA max.	4 VDC max.	1 VDC min.
	12 to 24 VDC	6.6 to 32 VDC		6.6 VDC max.	3.6 VDC min.
G3R-IDZR1SN-1-UTU	5 VDC	4 to 6 VDC		4 VDC max.	1 VDC min.
	12 to 24 VDC	6.6 to 32 VDC		6.6 VDC max.	3.6 VDC min.

Output

Model	Logic level supply voltage	Logic level supply current
G3R-IAZR1SN-UTU	4 to 32 VDC	0.1 to 100 mA
G3R-IDZR1SN-UTU		
G3R-IDZR1SN-1-UTU		

Output Module

Input

Model	Rated voltage	Operating voltage	Input current	Must operate voltage	Must release voltage
G3R-OA202SZN-UTU	5 to 24 VDC	4 to 32 VDC	15 mA max. (at 25°C)	4 VDC max.	1 VDC min.
G3R-OA202SLN-UTU					
G3R-ODX02SN-UTU			8 mA max.		
G3R-OD201SN-UTU					

Output

Model	Rated load voltage	Load voltage range	Load current (See note.)	Inrush current
G3R-OA202SZN-UTU	100 to 240 VAC	75 to 264 VAC	0.05 to 2 A	30 A (60 Hz, 1 cycle)
G3R-OA202SLN-UTU				
G3R-ODX02SN-UTU	5 to 48 VDC	4 to 60 VDC	0.01 to 2 A	8 A (10 ms)
G3R-OD201SN-UTU	48 to 200 VDC	40 to 200 VDC	0.01 to 1.5 A	8 A (10 ms)

Note: The minimum current value is measured at 10°C min.

■ Characteristics

Input Module

Item	G3R-IAZR1SN-UTU	G3R-IDZR1SN-UTU	G3R-IDZR1SN-1-UTU
Operate time	20 ms max.	0.1 ms max.	15 ms max.
Release time	20 ms max.	0.1 ms max.	15 ms max.
Response frequency	10 Hz	1 kHz	10 Hz
Output ON voltage drop	1.6 V max.		
Leakage current	5 μA max.		
Insulation resistance	100 MΩ min. between input and output		
Dielectric strength	4,000 VAC, 50/60 Hz for 1 min between input and output		
Vibration resistance	10 to 55 to 10 Hz, 0.75-mm single amplitude		
Shock resistance	1,000 m/s^2		
Ambient temperature	Operating: –30°C to 80°C (with no icing) Storage: –30°C to 100°C (with no icing)		
Certified standards	UL508 File No. E64562 CSA C22.2 (No. 14, No. 950) File No. LR35535 TÜV File No. R9650094 (EN60950)		
Ambient humidity	Operating: 45% to 85%		
Weight	Approx. 18 g		

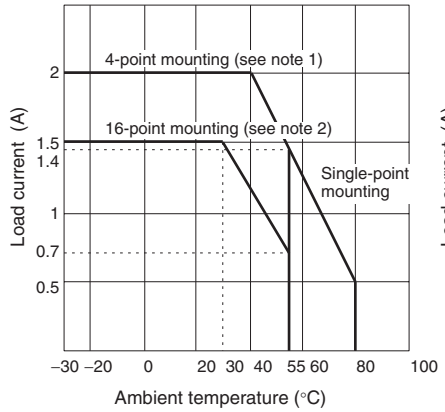
Output Module

Item	G3R-OA202SZN-UTU	G3R-OA202SLN-UTU	G3R-ODX02SN-UTU	G3R-OD201SN-UTU
Operate time	1/2 of load power source cycle + 1 ms max.	1 ms max.	1 ms max.	
Release time	1/2 of load power source cycle + 1 ms max.		2 ms max.	
Response frequency	20 Hz		100 Hz	
Output ON voltage drop	1.6 V max.			2.5 V max.
Leakage current	1.5 mA max.		1 mA max.	
Insulation resistance	100 MΩ min. between input and output			
Dielectric strength	4,000 VAC, 50/60 Hz for 1 min between input and output			
Vibration resistance	Destruction: 10 to 55 to 10 Hz, 0.75-mm single amplitude			
Shock resistance	Destruction: 1,000 m/s^2			
Ambient temperature	Operating: –30°C to 80°C (with no icing) Storage: –30°C to 100°C (with no icing)			
Certified standards	UL508 File No. E64562 CSA C22.2 (No. 14, No. 950) File No. LR35535 TÜV File No. R9650094 (EN60950)			
Ambient humidity	Operating: 45% to 85%			
Weight	Approx. 18 g			

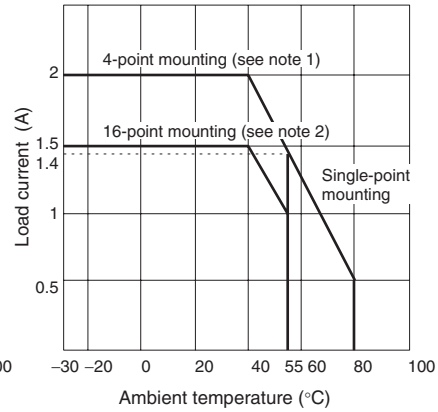
Engineering Data

Load Current vs. Ambient Temperature

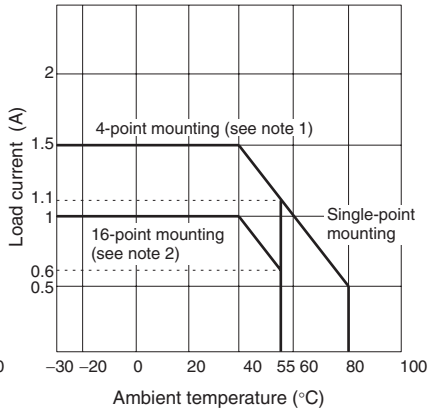
G3R-OA202SZN-UTU/OA202SLN-UTU



G3R-ODX02SN-UTU (4 to 60 VDC)



G3R-OD201SN-UTU (40 to 200 VAC)

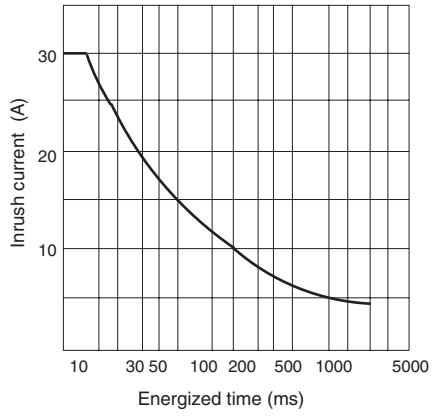


Note: 1. When G730-Z0M04-B is mounted.
2. When G70A-Z0C16 is mounted.

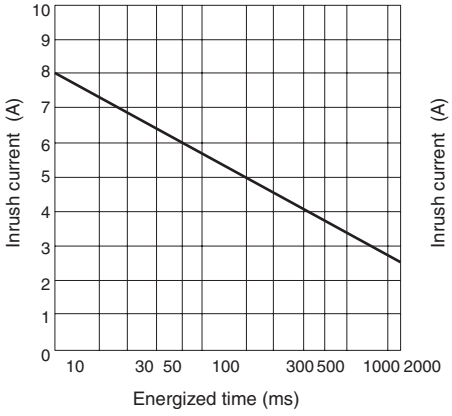
One Cycle Surge Current: Non-repetitive

Note: Keep the inrush current to half the rated value if it occurs repetitively.

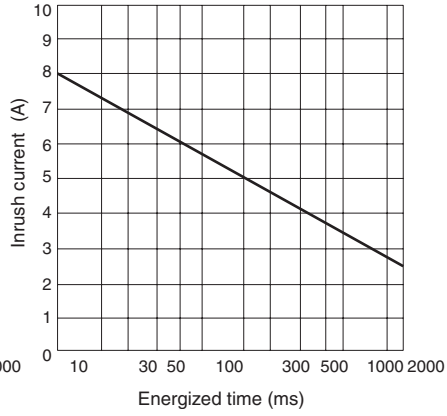
G3R-OA202SZN-UTU/OA202SLN-UTU



G3R-ODX02SN-UTU



G3R-OD201SN-UTU

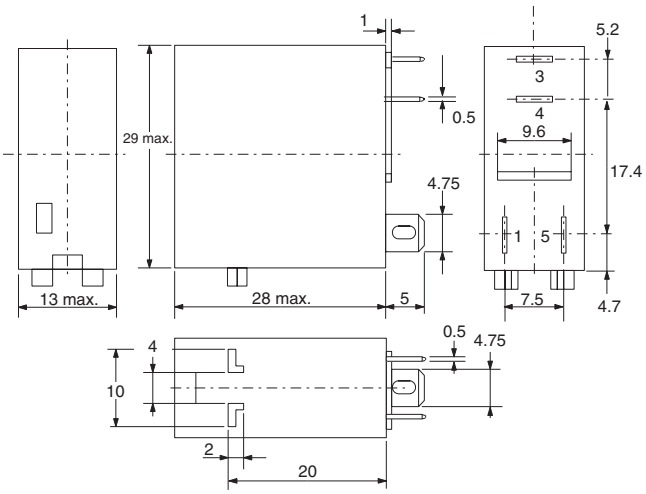


SSR

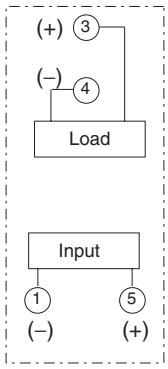
Dimensions

Note: All units are in millimeters unless otherwise indicated.

G3R



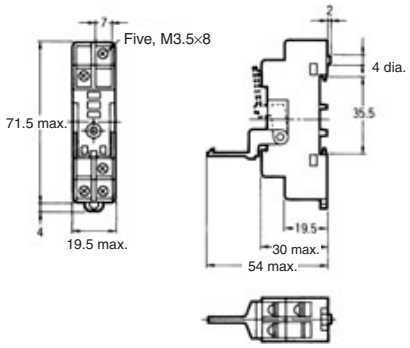
Terminal Arrangement/ Internal Connections (Bottom View)

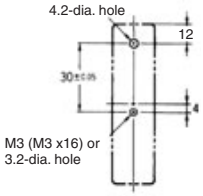


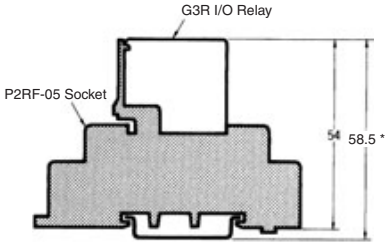
Connecting Sockets

Connecting Socket Attaching Plates

P2RF-05

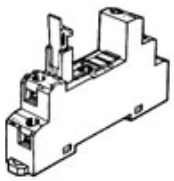


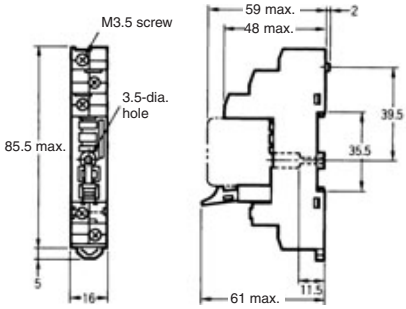


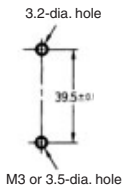


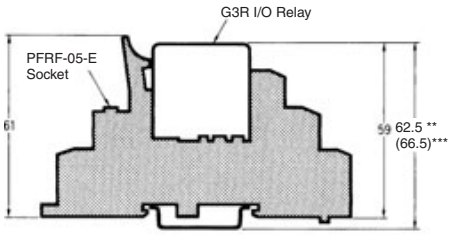
* Indicates a value when using the PFP-□N Supporting Rail.
The value is 67.5 when using the PFP-□N2.

P2RF-05-E





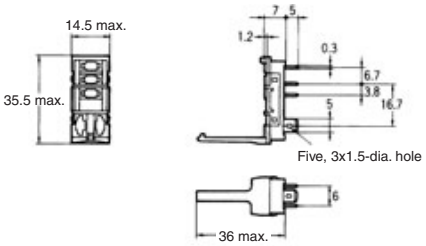


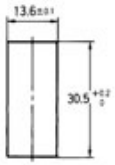


** Indicates a value when using the PFP-□N Supporting Rail with the P2RF-05-E
The value is 71.5 when using the PFP-□N2.

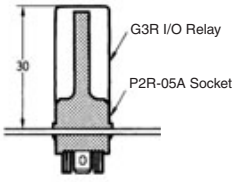
*** Indicates a value when using the PFP-□N Supporting Rail with the P2RF-08-E
The value is 75.5 when using the PFP-□N2.

P2R-05A

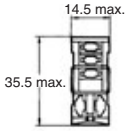


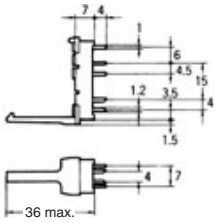


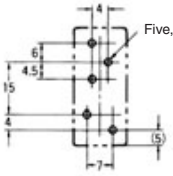
(Panel thickness must be 1.6 to 2.0 mm.)



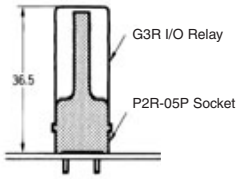
P2R-05P



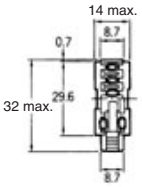


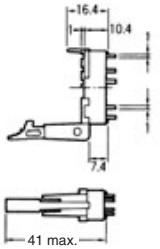


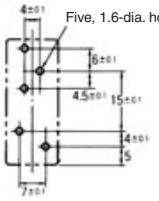
Dimensional tolerance is ±0.1.

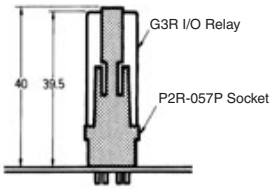


P2R-057P



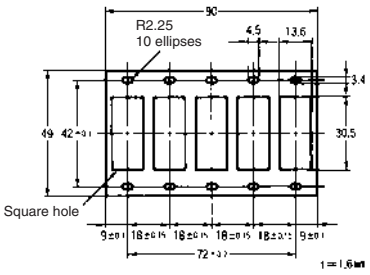






Socket Mounting Plate

Use the Socket Mounting Plate when arranging several Sockets in a row.



G70A I/O Block Base

■ Ordering Information

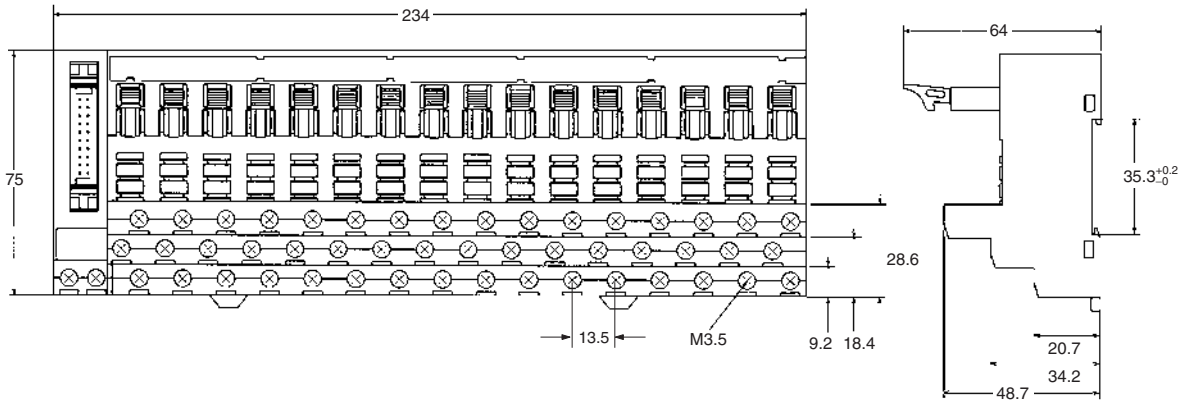
Classification	Internal I/O circuit common	Rated voltage	Model
Output	NPN (+ common)	24 VDC	G70A-ZOC16-3
	PNP (– common)	24 VDC	G70A-ZOC16-4
Input	NPN/PNP	110 VDC max., 240 VAC max. (See note.)	G70A-ZIM16-5

Note: Each relay to be mounted must incorporate a coil that has proper specifications within the maximum rated voltage range.

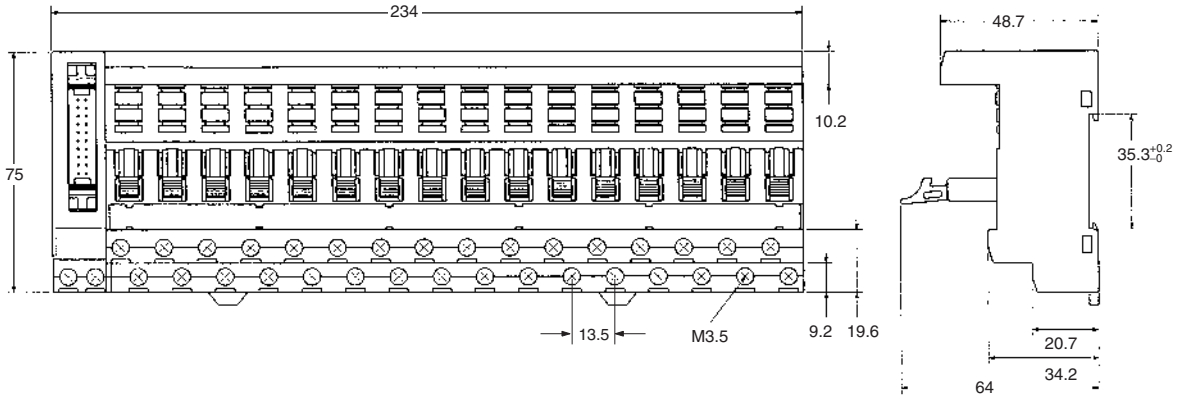
■ Dimensions

Note: All units are in millimeters unless otherwise indicated.

G70A-ZOC16 (Output)

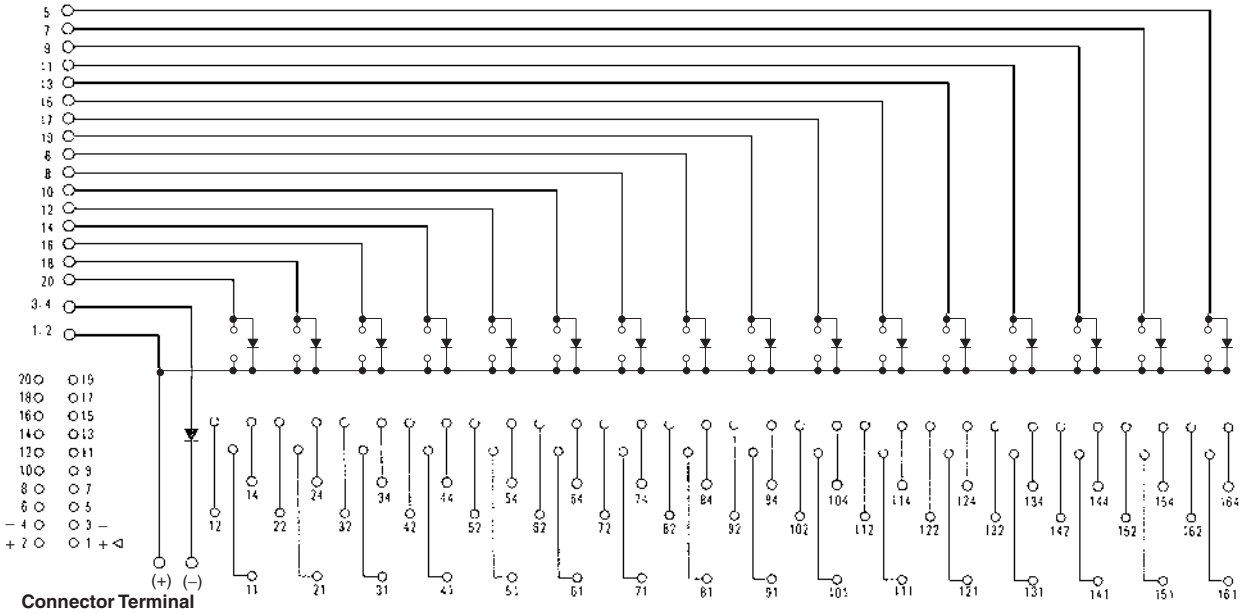


G70A-ZIM16 (Input)



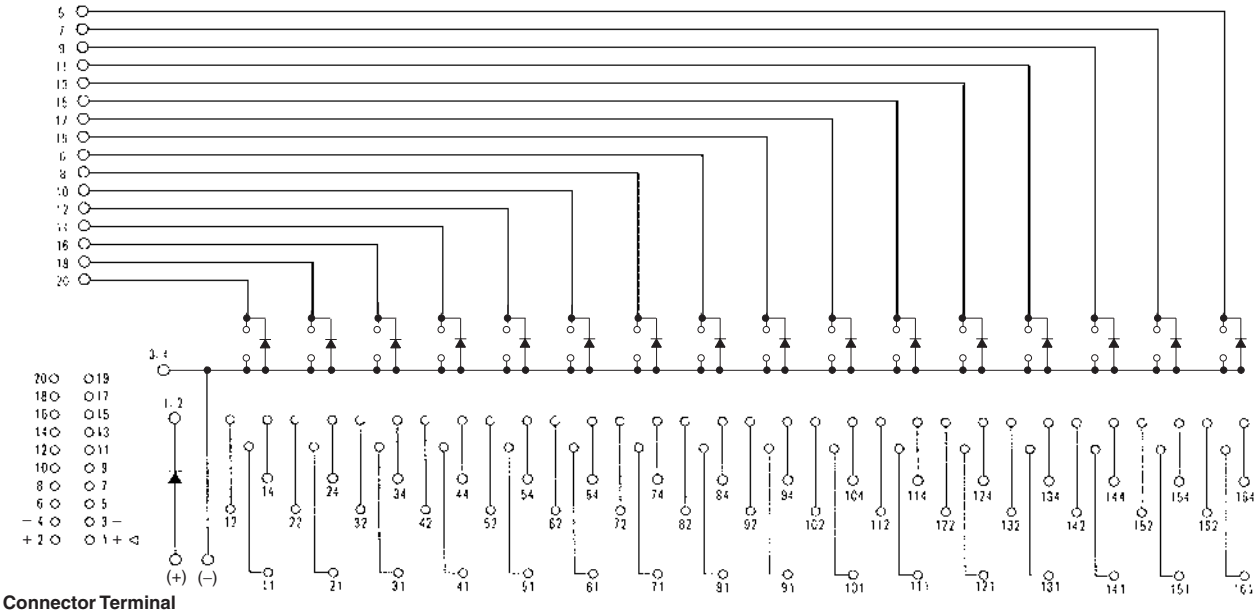
■ Terminal Arrangement/Internal Connection

G70A-ZOC16-3 (NPN)



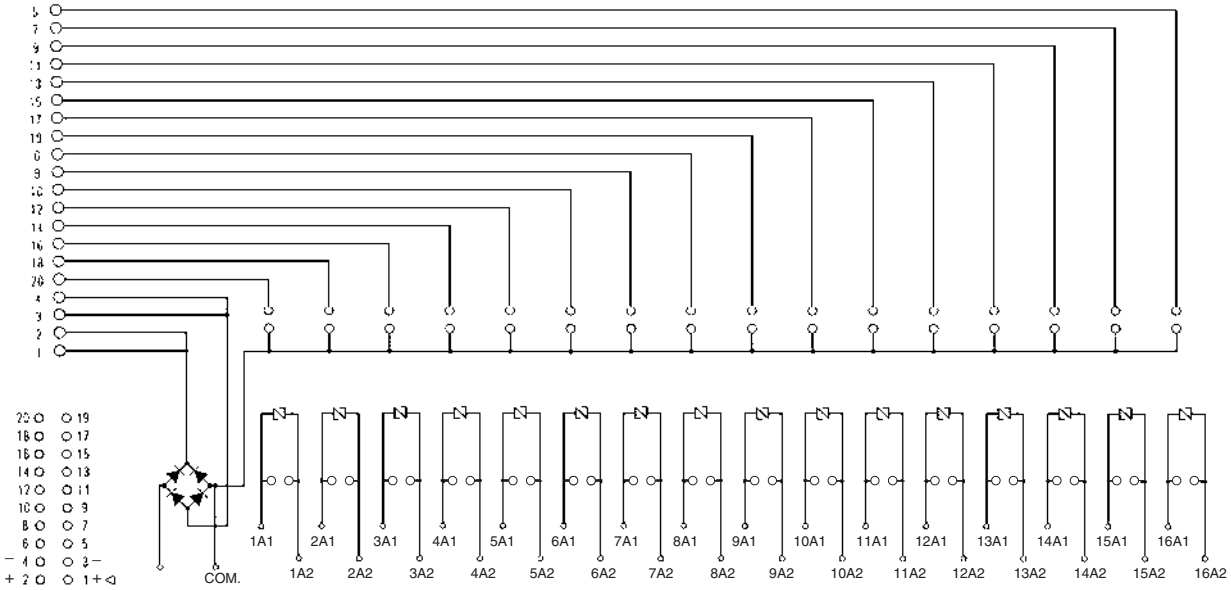
Connector Terminal Arrangement (Top View)

G70A-ZOC16-4 (PNP)



Connector Terminal Arrangement (Top View)

G70A-ZIM16-5 (NPN/PNP)



Connector Terminal Arrangement (Top View)

Safety Precautions

■ Precautions for Correct Use

Please observe the following precautions to prevent failure to operate, malfunction, or undesirable effect on product performance.

Connection

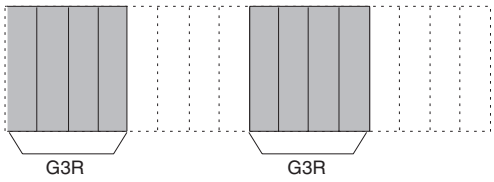
With the SSR for DC switching, the load can be connected to either positive or negative output terminal of the SSR.

Protective Element

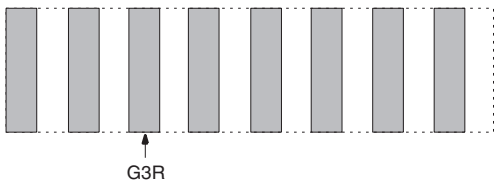
Since the SSR does not incorporate an overvoltage absorption component, be sure to connect an overvoltage absorption component when using the SSR under an inductive load.

Precaution of Mounting Output Modules

With up to four G3R SSRs mounted closely and side by side, 2-A loads can be switched.



With a G3R SSRs mounted every other slot, 2-A loads can be switched.



ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. K091-E1-04

SSRs
Technical Information

J What Are SSRs?

(1) Difference between SSRs and Mechanical Relays

SSRs (Solid State Relays) have no movable contacts. SSRs are not very different in operation from mechanical relays that have movable contacts. SSRs, however, employ semiconductor switching elements, such as thyristors, triacs, diodes, and transistors. Furthermore, SSRs employ optical semiconductors called photocouplers to isolate input and output signals. Photocouplers change electric signals into optical signals and relay the signals through space, thus fully isolating the input and output sections while relaying the signals at high speed.

SSRs consist of electronic parts with no mechanical contacts. Therefore, SSRs have a variety of features that mechanical relays do not incorporate. The greatest feature of SSRs is that SSRs do not use switching contacts that will physically wear out.

SSRs are ideal for a wide range of applications due to the following performance characteristics.

- They provide high-speed, high-frequency switching operations.
- They have no contact failures.
- They generate little noise.
- They have no arc noise.

(2) Control of SSRs (ON/OFF Control, Cycle Control, Phase Control)

ON/OFF control is a form of control where a heater is turned ON or OFF by turning an SSR ON or OFF in response to voltage output signals from a Temperature Controller. The same kind of control is also possible with an electromagnetic relay but if control where the heater is turned ON and OFF at intervals of a few seconds over a period of several years, then an SSR must be used.

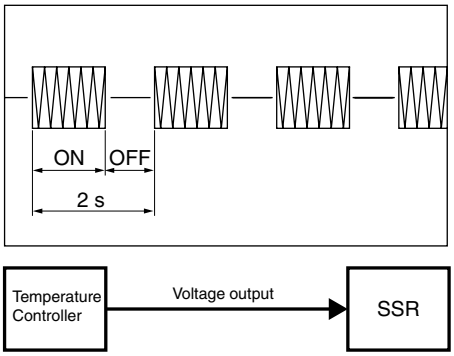
With cycle control (G32A-EA), output voltage is turned ON/OFF at a fixed interval of 0.2 s. Control is performed in response to current output from a Temperature Controller in the range 4 to 20 mA.

Note Precaution for Cycle Control
With cycle control, current flows five times every second (because the control cycle is 0.2 s). With a transformer load, the following problems may occur due to the large input current (approximately 10 times the rated current), and controlling the power at the transformer primary side may not be possible.

1. The SSR may be destroyed if there is not sufficient leeway in the SSR rating.
2. The breaker on the load circuit may be tripped.

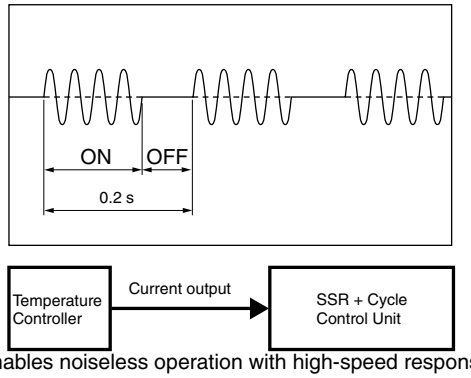
With phase control, output is changed every half-cycle in response to current output signals in the range 4 to 20 mA from a Temperature Controller. Using this form of control, high-precision temperature control is possible, and is used widely with semiconductor equipment.

ON/OFF Control



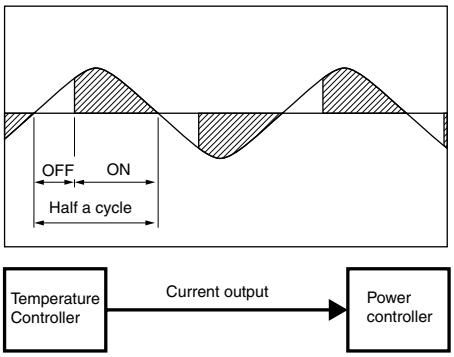
Enables low-cost, noiseless operation without maintenance requirements.

Cycle Control



Enables noiseless operation with high-speed response.

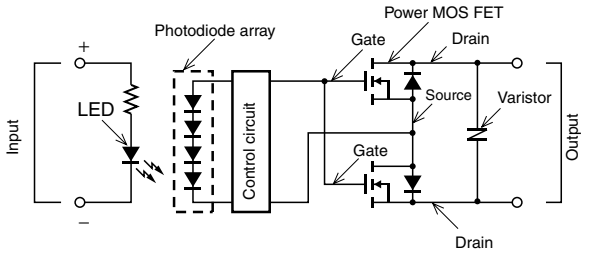
Phase Control (Single Phase)



Enables precise temperature control and increases the heater's service life.

(3) Configuration and Operating Principle of MOS FET Relays

MOS FET relays are SSRs that use power MOS FETs in output elements. In order to operate the power MOS FETs, photodiode arrays are used as light-receiving elements. When current flows into the input terminal, the LED lights. This light generates a photoelectromotive force in the photodiode array, and this acts as a gate voltage that turns ON the power MOS FET. By connecting 2 power MOS FETs using a source common, control of AC loads is possible. There are models for control of DC loads, which have just one power MOS FET. (Refer to Q43, Q44, and Q45 in Q&A.)

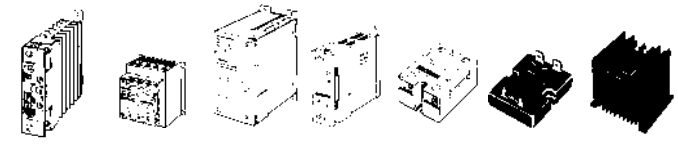
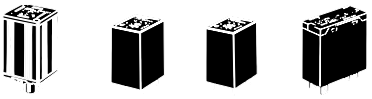


There is no varistor in the G3VM MOS FET relay for signalling.

(4) SSR Classifications

SSRs can be classified by appearance, such as panel-mounting models, socket models, or PCB models, or by applications, as shown below. The optimum SSR can be selected depending on the purpose, and this is another important feature of SSRs.

Classification by Application

Application	Recommended SSRs
Heater Control These SSRs are applicable to machines which require highly sensitive temperature control for turning heaters ON and OFF, such as molding equipment, packaging machines, and solderers. These SSRs feature plug-in models, replaceable power element cartridge models, and built-in heat sink model. They meet the high-capacity, high ON/OFF frequency requirements of heater control.	 Single-phase G3PB, Three-phase G3PB, G3PX, G3PA, G3NA, G3NE, G3NH
Motor Control These SSRs are applicable to machines which require motor inching operation and reversible operation, such as machine tools, conveyors, and packaging equipment. They have high-speed response time and high ON/OFF frequency, required for inching and reversible operation.	 G3J, G3NA, G3NE
I/O These SSRs meet the requirements for isolated transmission of control output from PCs and Position Controllers to an actuator. In particular, the G3DZ and G3RZ Relays use MOS FET in the output element to allow shared use of the Relays in both low-leakage-current AC and DC circuits.	 G3TB, G3DZ, G3S (D), G3R (I/O), G3RZ, G3TA
Panel-mounted Interfaces These SSRs are the same shape as general-purpose relays, they have the same sockets and can be mounted according to their respective shapes. They are ideal for interface applications where high-frequency switching is required, and can also be used in a wide variety of general-purpose applications, such as directly switching loads.	 G3B, G3F, G3H, G3R

(5) SSR Glossary

Terms		Meaning
Insulation	**Basic insulation**	Insulation for basic protection from electric shock (IEC950 1.2.9.2)
	Supplemental insulation	Independent insulation provided outside of basic insulation to protect from electric shock when the basic insulation breaks down (IEC950 1.2.9.3)
	Reinforced insulation	A single-layer of insulation (IEC950 1.2.9.5) that provides the same protection from electric shock as double insulation (insulation including both basic and supplemental insulation) according to conditions stipulated in IEC950 standards
Circuit functions	**Zero cross circuit**	A circuit which starts operation with the AC load voltage at close to zero-phase.
	Trigger circuit	A circuit for controlling the triac or thyristor trigger signal, which turns the load current ON and OFF.
Input	**Isolated input circuit**	If the external circuit is prone to generating noise, or if wires from external sources are prone to the influence of inductive noise, in order to prevent malfunctions due to noise, it is necessary to electrically isolate internal circuits and external circuits (output circuits). An isolated input circuit is a circuit that isolates inputs and outputs by using components that are not connected electrically but that can transmit signals, such as contact relays or photocouplers.
	Photocoupler	A component that runs the electric signal into a light emitter (e.g., LED), changes it to a light signal, and then returns it to an electric signal using a photoelectric conversion element, such as a photo transistor. The space used for transferring the light signal is isolated thus providing good insulation and a high propagation speed.
	Rated voltage	The voltage that serves as the standard value of an input signal voltage
	Must-operate voltage	Minimum input voltage when the output status changes from OFF to ON.
	Input impedance	The impedance of the input circuit and the resistance of current-limiting resistors used. Impedance varies with the input signal voltage in case of the constant current input method.
	Operating voltage	The permissible voltage range within which the voltage of an input signal voltage may fluctuate.
	Reset voltage	Maximum input voltage when the output status changes from ON to OFF.
	Input current	The current value when the rated voltage is applied.
Output	**Load voltage**	This is the effective value for the power supply voltage that can be used for load switching or in the continuous-OFF state.
	Maximum load current	The effective value of the maximum current that can continuously flow into the output terminals under specified cooling conditions (i.e., the size, materials, thickness of the heat sink, and an ambient temperature radiating condition).
	Leakage current	The effective value of the current that can flow into the output terminals when a specified load voltage is applied to the SSR with the output turned OFF.
	Output ON voltage drop	The effective value of the AC voltage that appears across the output terminals when the maximum load current flows through the SSR under specified cooling conditions (such as the size, material, and thickness of heat sink, ambient temperature radiation conditions, etc.).
	Minimum load current	The minimum load current at which the SSR can operate normally.
	Snubber circuit	A circuit consisting of a resistor R and capacitor C, which prevents faulty ignition from occurring in the SSR triac by suppressing a sudden rise in the voltage applied to the triac.
	Semiconductor output element (switching element)	This is a generic name for semiconductors such as the thyristor, triac, power transistor, and power MOS FET. In particular, triacs are often used in SSRs because they allow switching to be performed with one element.
	Repetitive peak OFF-state voltage (VDRM)	This is a rating for an output semiconductor that used in an SSR for AC loads.
	Collector-emitter voltage (VCEO)	This is a rating for an output semiconductor that used in an SSR for DC loads.
Characteristics	**Operating time**	A time lag between the moment a specified signal voltage is imposed to the input terminals and the output is turned ON.
	Release time	A time lag between the moment the imposed signal input is turned OFF and the output is turned OFF.
	Insulation resistance	The resistance between the input and output terminals or I/O terminals and metal housing (heat sink) when DC voltage is imposed.
	Dielectric strength	The effective AC voltage that the SSR can withstand when it is applied between the input terminals and output terminals or I/O terminals and metal housing (heat sink) for more than 1 minute.
	Ambient temperature and humidity (operating)	The ranges of temperature and humidity in which the SSR can operate normally under specified cooling, input/output voltage, and current conditions.
	Storage temperature	The temperature range in which the SSR can be stored without voltage imposition.
Others	**Inrush current resistance**	A current which can be applied for short periods of time to the electrical element.
	Counter-electromotive force	Extremely steep voltage rise which occurs when the load switched or turned OFF.
	Recommended applicable load	The recommended load capacity which takes into account the safety factors of ambient temperature and inrush current.
	Bleeder resistance	The resistance connected in parallel to the load in order to increase apparently small load currents, so that the ON/OFF of minute currents functions normally. (It is also used to shunt leakage currents.)

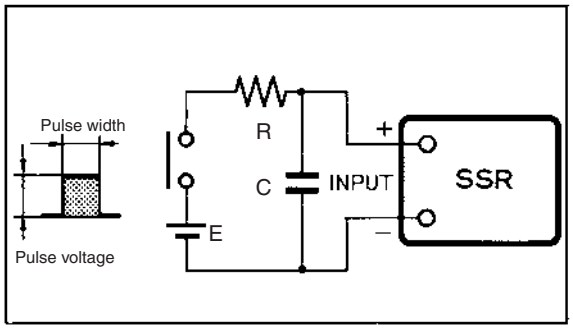
2-1 Input Circuit

(1) Input Noise

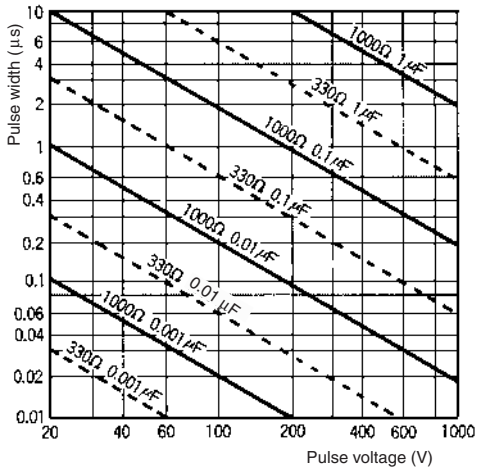
SSRs need only a small amount of power to operate. This is why the input terminals must shut out electrical noise as much as possible. Noise applied to the input terminals may result in malfunction. The following describe measures to be taken against pulse noise and inductive noise.

1. Pulse Noise

A combination of capacitor and resistor can absorb pulse noise effectively. The following is an example of a noise absorption circuit with capacitor C and resistor R connected to an SSR.



The value of R and C must be decided carefully. The value of R must not be too large or the supply voltage (E) will not be able to satisfy the required input voltage value. The larger the value of C is, the longer the release time will be, due to the time required for C to discharge electricity.



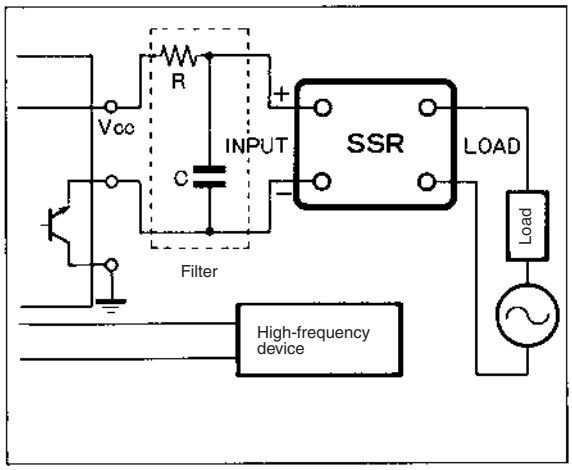
Note For low-voltage models, sufficient voltage may not be applied to the SSR because of the relationship between C, R, and the internal impedance. When deciding on a value for R, check the input impedance for the SSR.

2. Inductive Noise

Do not wire power lines alongside the input lines. Inductive noise may cause the SSR to malfunction. If inductive noise is imposed on the input terminals of the SSR, use the following cables according to the type of inductive noise, and reduce the noise level to less than the reset voltage of the SSR.

Twisted-pair wires: For electromagnetic noise
Shielded cable: For static noise

A filter consisting of a combination of capacitor and resistor will effectively reduce noise generated from high-frequency equipment.



Note R: 20 to 100 Ω
C: 0.01 to 1 µF

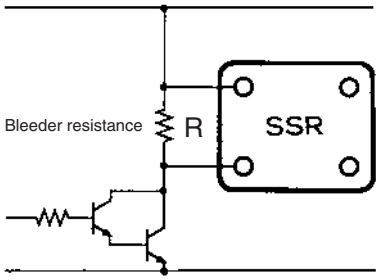
(2) Input Conditions

1. Input Voltage Ripples

When there is a ripple in the input voltage, set so that the peak voltage is lower than the maximum operating voltage and the root voltage is above the minimum operating voltage.

2. Countermeasures for Leakage Current

When the SSR is powered by transistor output, the reset voltage may be insufficient due to leakage current of transistor during power OFF. To counteract this, connect bleeder resistance R as shown in the diagram below and set the resistance so that the voltage applied to both ends of the resistance is less than half of the reset voltage of the SSR.



The bleeder resistance R can be obtained in the way shown below.

$$R \leq \frac{E}{I_L - I}$$

E: Voltage applied at both ends of the bleeder resistance = half of the reset voltage of the SSR

I_L: Leakage current of the transistor

I: Reset current of the SSR

The actual value of the reset current is not given in the datasheet and so when calculating the value of the bleeder resistance, use the following formula.

$$\text{Reset current for SSR} = \frac{\text{Minimum value of reset voltage}}{\text{Input impedance}}$$

For SSRs with constant-current input circuits (e.g., G3NA, G3PA, G3PB), calculation is performed at 0.1 mA.

The calculation for the G3M-202P DC24 is shown below as an example.

$$\text{Reset current I} = \frac{1\ \text{V}}{1.6\ \text{k}\Omega} = 0.625\ \text{mA}$$

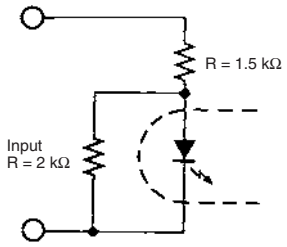
$$\text{Bleeder resistance R} = \frac{1\ \text{V} \times 1/2}{\text{IL} - 0.625\ \text{mA}}$$

3. ON/OFF Frequency

The ON/OFF frequency should be set to 10 Hz maximum for AC load ON/OFF and 100 Hz maximum for DC load ON/OFF. If ON/OFF occurs at frequencies exceeding these values, SSR output will not be able to follow up.

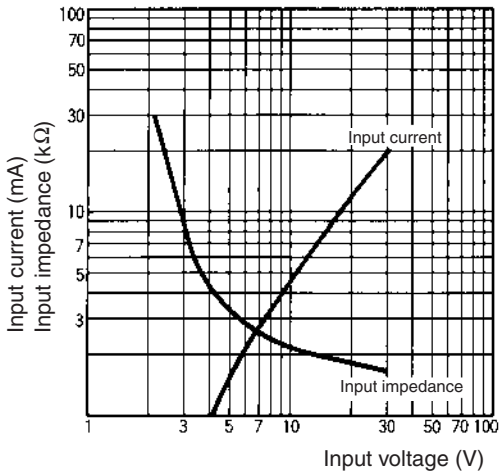
4. Input Impedance

In SSRs which have wide input voltages (such as G3F and G3H), the input impedance varies according to the input voltage and changes in the input current. If the input voltage is low, the influence of the voltage drop for the input LED is large, and the input impedance will be higher than expected. If the voltage is so high that the LED voltage drop can be ignored, the input impedance will be close to the resistance R.

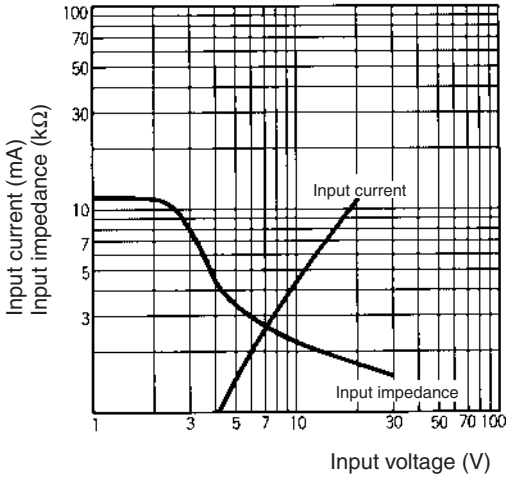


For semiconductor-driven SSRs, changes in voltage can cause malfunction of the semiconductor, so be sure to check the actual device before usage. See the following examples. Refer to the SSR's datasheet for the impedance of individual SSR models.

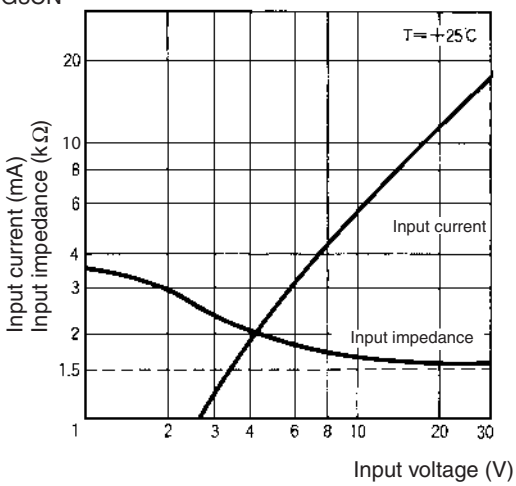
Applicable Input Impedance for a Photocoupler-type SSR without Indicators (Example)
G3F, G3H (Without Indicators)



Applicable Input Impedance for a Photocoupler-type SSR with Indicators (Example)
G3B, G3F, G3H (With Indicators)



Applicable Input Impedance (Example)
G3CN



SSR

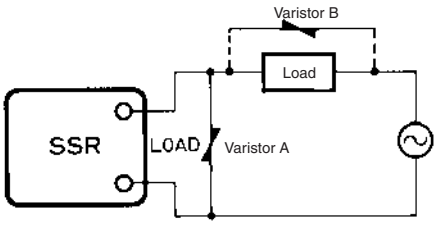
2-2 Output Circuit

(1) AC ON/OFF SSR Output Noise Surges

If there is a large voltage surge in the AC current being used by the SSR, the C/R snubber circuit built into the SSR between the SSR load terminals will not be sufficient to suppress the surge, and the SSR transient peak element voltage will be exceeded, causing over-voltage damage to the SSR.

There are SSR models that do not have a built-in surge absorbing varistor. (Refer to the SSR's datasheet for details.) When switching the inductive load ON and OFF, be sure to take countermeasures against surge, such as adding a surge absorbing element.

In the following example, a surge voltage absorbing element is added. Basically, if the SSR does not have a built-in varistor, A will be effective, and if the SSR does have a built-in varistor, B will be effective. In practice, it is necessary to confirm correct operation under actual operating conditions.

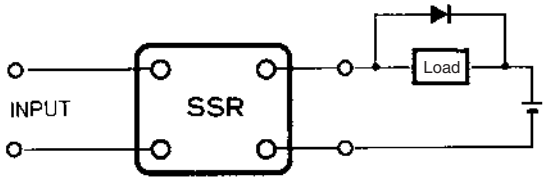


Select an element which meets the conditions in the table below as the surge absorbing element.

Voltage	Varistor voltage	Surge resistance
100 to 120 VAC	240 to 270 V	1,000 A min.
200 to 240 VAC	440 to 470 V	
380 to 480 VAC	820 to 1,000 V	

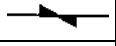
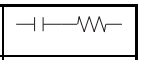
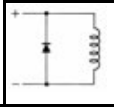
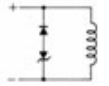
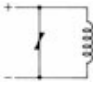
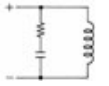
(2) DC ON/OFF SSR Output Noise Surges

When an L load, such as a solenoid or electromagnetic valve is connected, connect a diode that prevents counter-electromotive force. If the counter-electromotive force exceeds the withstand voltage of the SSR output element, it could result in damage to the SSR output element. To prevent this, insert the element parallel to the load, as shown in the following diagram and table.



As an absorption element, the diode is the most effective at suppressing the counter-electromotive force. The release time for the solenoid or electromagnetic valve will, however, increase. Be sure to check the circuit before use. To shorten the time, connect a Zener diode and a regular diode in series. The release time will be shortened at the same rate that the Zener voltage (Vz) of the Zener diode is increased.

- Absorption Element Example

Absorption element				
	Diode	Diode + Zener diode	Varistor	CR
Effectiveness	❍	❍	Δ	×
				

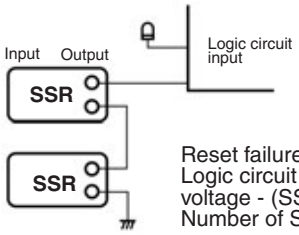
(Reference)

1. Selecting a Diode
   Withstand voltage = $V_{RM} \geq$ Power supply voltage × 2
   Forward current = $I_F \geq$ load current
2. Selecting a Zener Diode
   Zener voltage = Vz < SSR's connector-emitter voltage - (Power supply voltage + 2 V)
   Zener surge reverse power = P_{RSM} > Vz × Load current × Safety factor (2 to 3)

Note When the Zener voltage is increased (Vz), the Zener diode capacity (P_{RSM}) is also increased.

(3) AND Circuits with DC Output SSRs

Use the G3DZ or G3RZ for the following type of circuit. Do not use standard SSRs, or otherwise the circuit may not be reset.



Reset failure will occur in the following case:
Logic circuit input voltage < Power supply voltage - (SSR's output ON voltage drop x Number of SSRs)

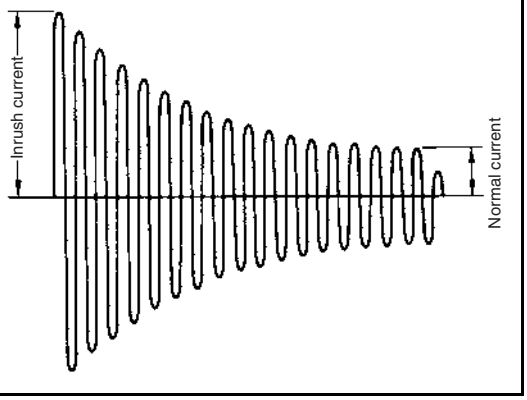
(4) Self-holding Circuits

Self-holding circuits must use mechanical relays. SSRs cannot be used to design self-holding circuits.

(5) Selecting an SSR with Differing Loads

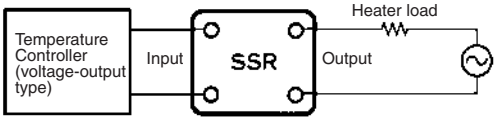
The following provides examples of the inrush currents for different loads.

- AC Load and Inrush Current

Load	 Solenoid	 Incandescent lamp	 Motor	 Relay	 Capacitor	 Resistance load
Inrush current/ Normal current	Approx. 10 times	Approx. 10 to 15 times	Approx. 5 to 10 times	Approx. 2 to 3 times	Approx. 20 to 50 times	1
Waveform						

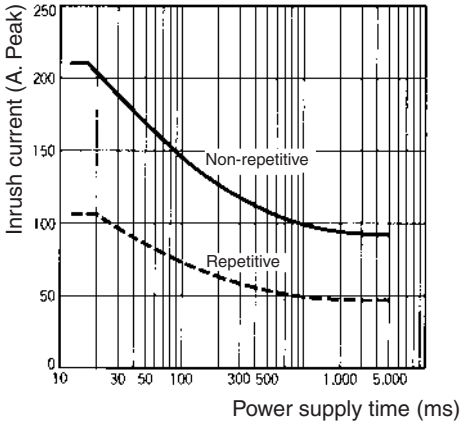
1. Heater Load (Resistive Load)

Load without an inrush current. Generally used together with a voltage-output temperature controller for heater ON/OFF switching. When used with an SSR with zero cross function, suppresses most noise generated. This type of load does not, however, include all-metal and ceramic heaters. Since the resistance values at normal temperatures of all-metal and ceramic heaters are low, an overcurrent will occur in the SSR, causing damage. For switching of all-metal and ceramic heaters, select a Power Controller (G3PX) with a long soft-start time, or a constant-current type SSR.



2. Lamp Load

Large inrush current flows through incandescent lamps, halogen lamps, and so on (approx. 10 to 15 times higher than the rated current value). Select an SSR so that the peak value of inrush current does not exceed half the inrush current resistance of the SSR. Refer to “Repetitive” (indicated by dashed lines) shown in the following figure. When a repetitive inrush current of greater than half the inrush current resistance is applied, the output element of the SSR may be damaged.(Refer to Q37 in Q&A.)



If an SSR is used to switch a fluorescent lamp, the waveform of the power supply voltage will be distorted, and flickering will occur. Fluorescent lamps are discharge tubes, and have transformers for producing high voltages. For this reason, noise and harmonics are generated as a result of distortions in the power supply voltage, small phase gaps, and differences in positive and negative ON-voltages.

3. Motor Load

When a motor is started, an inrush current of 5 to 10 times the rated current flows and the inrush current flows for a longer time. In addition to measuring the startup time of the motor or the inrush current during use, ensure that the peak value of the inrush current is less than half the inrush current resistance when selecting an SSR. The SSR may be damaged by counter-electromotive force from the motor. So when the SSR is turned OFF, be sure to install overcurrent protection.

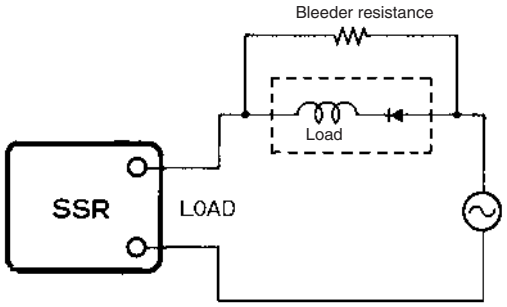
4. Transformer Load

When the SSR is switched ON, an energizing current of 10 to 20 times the rated current flows through the SSR for 10 to 500 ms. If there is no load in the secondary circuit, the energizing current will reach the maximum value. Select an SSR so that the energizing current does not exceed half the inrush current resistance of the SSR. (Refer to page 84.)

5. Half-wave Rectified Circuit

AC electromagnetic counters and solenoids have built-in diodes, which act as half-wave rectifiers. For these types of loads, a half-wave AC voltage does not reach the SSR output. For SSRs with the zero cross function, this can cause them not to turn ON. Two methods for counteracting this problem are described below.

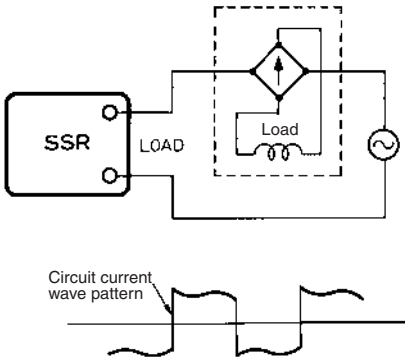
(a)Connect a bleeder resistance with approximately 20% of the SSR load current.



(b) Use SSRs without the zero cross function.

6. Full-wave Rectified Loads

AC electromagnetic counters and solenoids have built-in diodes which act as full-wave rectifiers. The load current for these types of loads has a rectangular wave pattern, as shown in the diagram below.



Accordingly, AC SSRs use a triac (which turns OFF the element only when the circuit current is 0 A) in the output element. If the load current waveform is rectangular, it will result in a SSR reset error. When switching ON and OFF a load whose waves are all rectified, use a -V model or Power MOS FET Relay.

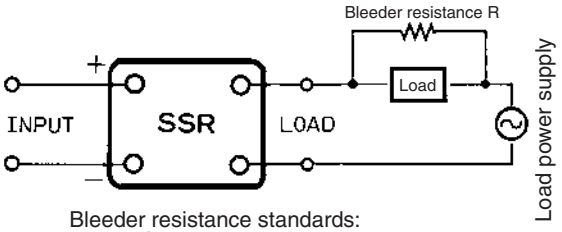
-V-model SSRs: G3F-203SL-V, G3H-203SL-V
Power MOS FET Relay: G3DZ, G3RZ, G3FM

7. Small-capacity Loads

Even when there is no input signal to the SSR there is a small leakage current (I_L) from the SSR output (LOAD). If this leakage current is larger than the load release current the SSR may fail to reset.

Connect the bleeder resistance R in parallel to increase the SSR switching current.

$R < \frac{E}{I_L - I}$ E: Load (relays etc.) reset voltage
I: Load (relays etc.) reset current

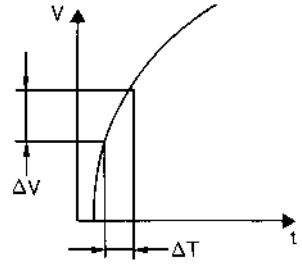


Bleeder resistance standards:
100-VAC power supply, 5 to 10 kΩ, 3 W
200-VAC power supply, 5 to 10 kΩ, 15 W

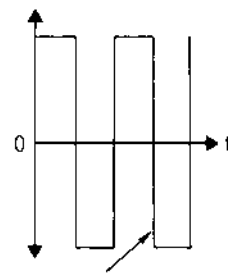
A voltage equal to this SSR's leakage current I_L (mA) × Impedance of the load is applied to both ends of the resistance. A bleeder resistance is used to make this voltage less than the load's reset voltage.

8. Inverter Load

Do not use an inverter-controlled power supply as the load power supply for the SSR. Waveforms for inverter-controlled voltages are rectangular. Semiconductor output elements (triac, thyristor) may not be able to respond to the steep voltage increases (dV/dt becomes extremely large), and the SSR may fail to reset (also called turn-OFF problem or commutating dV/dt failure). An inverter-controlled power supply may be used on the input side provided the effective voltage is within the normal operating voltage range of the SSR.



ΔV/ΔT = dV/dt: voltage increase ratio



The dV/dt ratio tends to infinity, so the SSR will not turn OFF.

9. Capacitive Load

The supply voltage plus the charge voltage of the capacitor is applied to both ends of the SSR when it is OFF. Therefore, use an SSR model with an input voltage rating twice the size of the supply voltage.

Limit the charge current of the capacitor to less than half the peak inrush current value allowed for the SSR.

(6) Inrush Currents to Transformer Loads

The inrush current from a transformer load will reach its peak when the secondary side of the transformer is open, when no mutual reactance will work. It will take half a cycle of the power supply frequency for the inrush current to reach its peak, the measurement of which without an oscilloscope will be difficult.

The inrush current can be, however, estimated by measuring the DC resistance of the transformer.

Due to the self-reactance of the transformer in actual operation, the actual inrush current will be less than the calculated value.

I peak = V peak/R = ($\sqrt{2}$ × V)/R

If the transformer has a DC resistance of 3 Ω and the load power supply voltage is 220 V, the following inrush current will flow.

I peak = (1.414 × 220)/3 = 103.7 A

The inrush current resistance of OMRON's SSRs is specified on condition that the SSRs are in non-repetitive operation. If your application requires repetitive SSR switching, use an SSR with an inrush current resistance twice as high as the rated value (Ipeak).

In the case above, use the G3□□-220□ with an inrush current resistance of 207.4 A or more.

The DC resistance of the transformer can be calculated back from the inrush current resistance by using the following formula.

R = V peak/I peak = ($\sqrt{2}$ × V)/I peak

For applicable SSRs based on the DC resistance, refer to the tables on page 85.

These tables list SSRs with corresponding inrush current conditions. When using SSRs to actual applications, however, check that the steady-state currents of the transformers satisfy the rated current requirement of each SSR.

SSR Rated Current

G3□□-240□

The underlined two digits refer to the rated current (i.e., 40 A in the case of the above model).

Three digits may be used for the G3NH only.

G3NH: G3NH-□075B = 75 A
G3NH-□150B = 150 A

Condition 1: The ambient temperature of the SSR (the temperature inside the panel) is within the rated value specified.

Condition 2: The right heat sink is provided to the SSR.

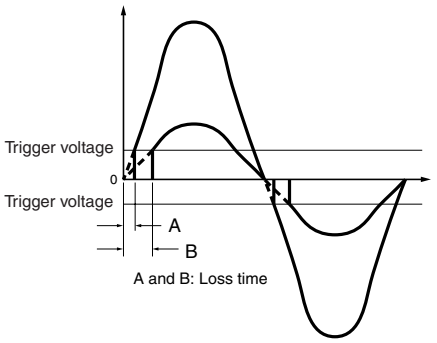
2-3 Load Power Supply

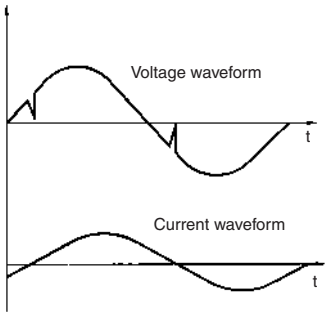
(1) Low AC Voltage Loads

If the load power supply is used under voltage below the minimum operating load voltage of the SSR, the loss time of the voltage applied to the load will become longer than that of the SSR operating voltage range. See the following load example. (The loss time is A < B.)

Make sure that this loss time will not cause problems, before operating the SSR.

If the load voltage falls below the trigger voltage the SSR will not turn ON, so be sure to set the load voltage to 75 VAC minimum. (24 VAC for G3PA-VD and G3NA-2□□B.)





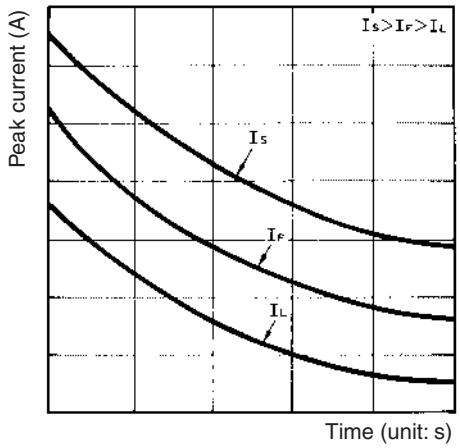
An inductance (L) load causes a current phase delay as shown above. Therefore, the loss is not as great as that caused by a resistive (R) load. This is because a high voltage is already imposed on the SSR when the input current to the SSR drops to zero and the SSR is turned OFF.

2-4 Fail-safe Concept

(1) Short-circuit Protection (Fuse Selection) and Overcurrent Protection

A short-circuit current or an overcurrent flowing through the load of the SSR will damage the output element of the SSR. Connect a quick-break fuse in series with the load as an overcurrent protection measure.

Design a circuit so that the protection coordination conditions for the quick-break fuse satisfy the relationship between the SSR surge resistance (I_S), quick-break fuse current-limiting feature (I_F), and the load inrush current (I_L), shown in the following chart.



Provide an appropriate non-fuse breaker to each machine for the overcurrent protection of the machine.

2-5 Heat Radiation Consideration

(1) SSR Heat Radiation

Triacs, thyristors, and power transistors are semiconductors that can be used for an SSR output circuit. These semiconductors have a residual voltage internally when the SSR is turned ON. This is called output-ON voltage drop. If the SSR has a load current, the Joule heating of the SSR will result consequently. The heating value P (W) is obtained from the following formula.

Heating value P (W) = Output-ON voltage drop (V) x Carry current (A)

For example, if a load current of 8 A flows from the G3NA-210B, the following heating value will be obtained.

P = 1.6 V × 8 A = 12.8 W

If the SSR employs power MOS FET for SSR output, the heating value is calculated from the ON-state resistance of the power MOS FET instead.

In that case, the heating value P (W) will be obtained from the following formula.

P (W) = Load current^2 (A) x ON-state resistance (Ω)

If the G3RZ with a load current of 0.5 A is used, the following heating value will be obtained.

P (W) = 0.5^2 A × 2.4 Ω = 0.6 W

The ON-state resistance of a power MOS FET rises with an increase in the junction temperature of a power MOS FET. Therefore, the ON-state resistance varies while the SSR is in operation. If the load current is 80% of the load current or higher, as a simple method, the ON-state resistance will be multiplied by 1.5.

P (W) = 1^2 A × 2.4 Ω × 1.5 = 3.6 W

The SSR in usual operation switches a current of approximately 5 A with no heat sink used. If the SSR must switch a higher current, a heat sink will be required. The higher the load current is, the larger the heat sink size will be. If the switching current is 10 A or more, the size of the SSR with a heat sink will exceed a single mechanical relay. This is a disadvantage of SSRs for circuit downsizing purposes.

(2) Heat Sink Selection

SSR models with no heat sinks incorporated (i.e., the G3NA, G3NE, and three-phase G3PB) need external heat sinks. When using any of these SSRs, select an ideal combination of the SSR and heat sink according to the load current.

The following combinations are ideal, for example.

G3NA-220B: Y92B-N100
G3NE-210T(L): Y92B-N50
G3PB-235B-3H-VD: Y92B-P200

A standard heat sink equivalent to an OMRON-made one can be used, on condition that the thermal resistance of the heat sink is lower than that of the OMRON-made one.

For example, the Y92B-N100 has a thermal resistance of 1.63°c/w.

If the thermal resistance of the standard heat sink is lower than this value (i.e., 1.5°c/w, for example), the standard heat sink can be used for the G3NA-220B.

Thermal resistance indicates a temperature rise per unit (W). The smaller the value is, the higher the efficiency of heat radiation will be.

(3) Calculating Heat Sink Area

An SSR with an external heat sink can be directly mounted to control panels under the following conditions.

- If the heat sink is made of steel used for standard panels, do not apply a current as high as or higher than 10 A, because the heat conductivity of steel is less than that of aluminum. Heat conductivity (in units of W • m • °C) varies with the material as described below.
  Steel: 20 to 50
  Aluminum: 150 to 220
  The use of an aluminum-made heat sink is recommended if the SSR is directly mounted to control panels. Refer to the data sheet of the SSR for the required heat sink area.
- Apply heat-radiation silicon grease or a heat conductive sheet between the SSR and heat sink. There will be a space between the SSR and heat sink attached to the SSR. Therefore, the generated heat of the SSR cannot be radiated properly without the grease. As a result, the SSR may be overheated and damaged or deteriorated.

(4) Control Panel Heat Radiation Designing

Control equipment using semiconductors will generate heat, regardless of whether SSRs are used or not. The failure rate of semiconductors greatly increases when the ambient temperature rises. It is said that the failure rate of semiconductors will be doubled when the temperature rises 10°C.

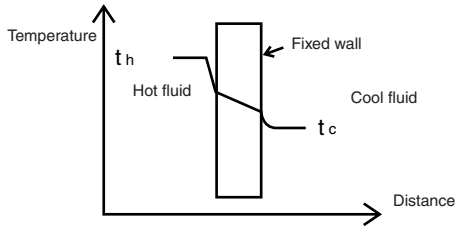
Therefore, it is absolutely necessary to suppress the interior temperature rise of the control panel in order to ensure the long, reliable operation of the control equipment. In this respect, it can be said that the installation of a cooling fan is inevitable.

Heat-radiating devices in a wide variety exists in the control panel. As a matter of course, it is necessary to consider the total temperature rise as well as local temperature rise of the control panel. The following description provides information on the total heat radiation designing of the control panel.

As shown below, the heat conductivity Q will be obtained from the following formula, provided that t_h and t_c are the temperature of the hot fluid and that of the cool fluid separated by the fixed wall.

Q = k (t_h - t_c) A

Where, k is an overall heat transfer coefficient (W/m^2°C). This formula is called a formula of overall heat transfer.



When this formula is applicable to the heat conductivity of the control panel under the following conditions, the heat conductivity Q will be obtained as shown below.

Average rate of overall heat transfer of control panel: k (W/m^2°C)

Internal temperature of control panel: T_h (°C)

Ambient temperature: T_c (°C)

Surface area of control panel: S (m^2)

Q = k × (T_h - T_c) × S

The required cooling capacity is obtained from the following formula under the following conditions.

Desired internal temperature of control panel: T_h (°C)

Total internal heat radiation of control panel: P_1 (W)

Required cooling capacity: P_2 (W)

$P_2 = P_1 - k \times (T_h - T_c) \times S$

The overall heat transfer coefficient k of a standard fixed wall in a place with natural air ventilation will be 4 to 12 (W/m^2°C). In the case of a standard control panel with no cooling fan, it is an empirically known fact that a coefficient of 4 to 6 (W/m^2°C) is practically applicable. Based on this, the required cooling capacity of the control panel is obtained as shown below.

Example

- Desired internal temperature of control panel: 40°C
- Ambient temperature: 30°C
- Control panel size 2.5 × 2 × 0.5 m (W × H × D)
  Self-sustained control panel (with the bottom area excluded from the calculation of the surface area)
- SSR: 20 G3PA-240B Units in continuous operation at 30 A.

• Total heat radiation of all control devices except SSRs: 500 W

P1 = Output-ON voltage drop 1.6 V × Load current 30 A × 20 SSRs + Total heat radiation of all control devices except SSRs = 960 W + 500 W = 1460 W

Heat radiation Q from control panel: Q

Q2 = Rate of overall heat transfer 5 × (40°C - 30°C) × (2.5 m × 2 m × 2 + 0.5m × 2 m × 2 + 2.5 m × 0.5 m) = 662.5 W

Therefore, the required cooling capacity P2 will be obtained from the following formula.

P2 = 1,460 - 663 = 797 W

Therefore, heat radiation from the surface of the control panel is insufficient. More than a heat quantity of 797 W needs to be radiated outside the control panel.

Usually, a ventilation fan with a required capacity will be installed. If the fan is not sufficient. An air conditioner for the control panel will be installed. The air conditioner is ideal for the long-time operation of the control panel because it will effectively dehumidify the interior of the control panel and eliminate dust gathering in the control panel.

Axial-flow fan: OMRON's R87B, R87F, and R87T Series

(5) Types of Cooling Device

Axial-flow Fans (for Ventilation)

These products are used for normal types of cooling and ventilation. OMRON's Axial-flow Fan lineup includes the R87F and R87T Series.

Note OMRON does not produce heat exchangers.

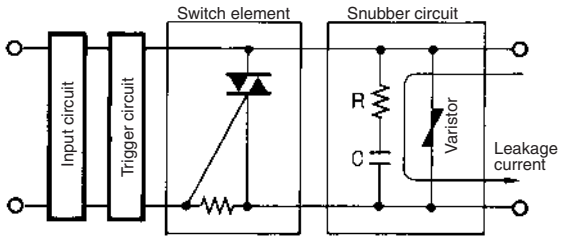
Note OMRON does not produce air conditioners for control panels.

3 Mounting and Installation

3-1 Operation

(1) Leakage Current

A leakage current flows through a snubber circuit in the SSR even when there is no power input. Therefore, always turn OFF the power to the input or load and check that it is safe before replacing or wiring the SSR.



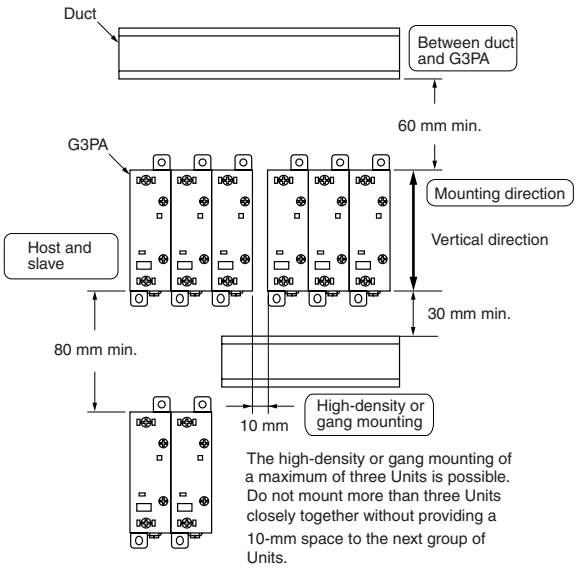
3-2 Panel Mounting

If SSRs are mounted inside an enclosed panel, the radiated heat of the SSR will stay inside, thus not only dropping the carry-current capacity of the SSRs but also adversely affecting other electronic device mounted inside. Open some ventilation holes on the upper and lower sides of the control panel before use.

The following illustrations provide a recommended mounting example of G3PA Units. They provide only a rough guide and so be sure to confirm operating conditions.

(1) SSR Mounting Pitch

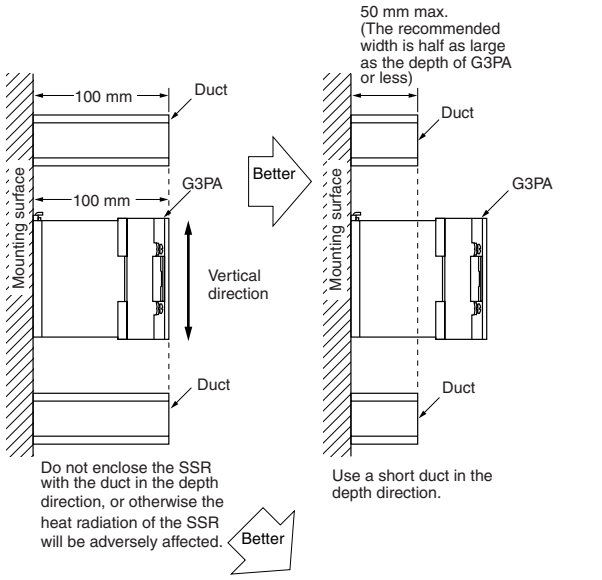
Panel Mounting

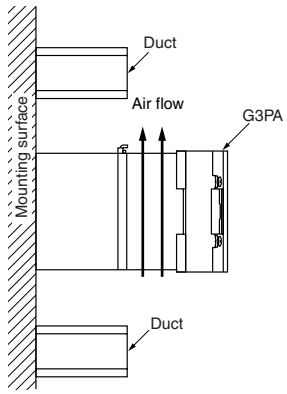


The high-density or gang mounting of a maximum of three Units is possible. Do not mount more than three Units closely together without providing a 10-mm space to the next group of Units.

(2) Relationship between SSRs and Ducts

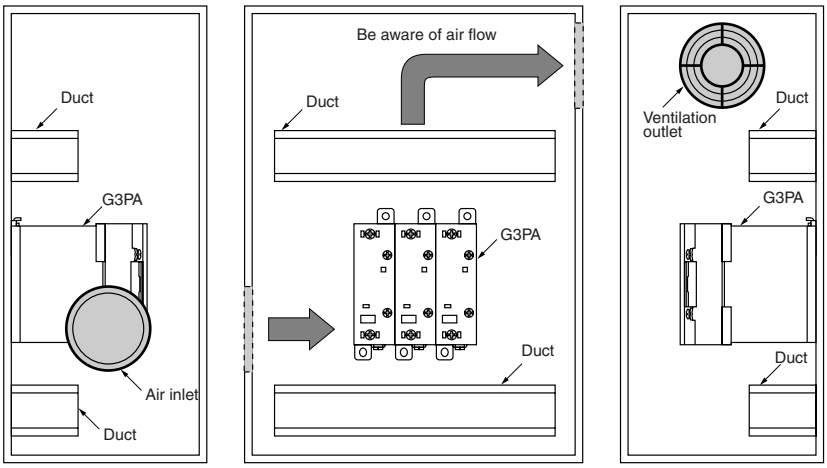
Duct Depth





If the height of the ducts cannot be lowered, place the SSRs on a metal base so that they are not surrounded by the ducts.

(3) Ventilation



If the air inlet or air outlet has a filter, clean the filter regularly to prevent it from clogging and ensure an efficient flow of air.

Do not locate any objects around the air inlet or air outlet, or otherwise the objects may obstruct the proper ventilation of the control panel.

A heat exchanger, if used, should be located in front of the G3PA Units to ensure the efficiency of the heat exchanger.

3-3 Operation and Storage Environment Precautions

(1) Ambient Temperature (Operating)

The rated operating ambient temperature of an SSR is determined proper ventilation. If the heat radiation conditions of the SSR, such as fresh air supply or ventilation is improper, the operating ambient temperature will exceed the rated value. As a result, the SSR will fail to operate or burn out.

When using SSRs, check that the circuits are designed to satisfy the conditions specified under *Load Currents vs. Ambient Temperatures*.

Be aware that the operating ambient temperature will be excessive, depending on the environmental conditions (e.g., weather and indoor air-conditioning conditions) or operating conditions (e.g., enclosed panel mounting).

4 SSR Reliability

4-1 Failure Rate and Life Expectancy

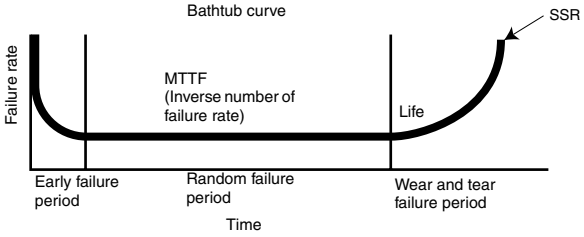
It is said that the failure rate of an electronic component or product can be expressed by a bathtub curve.

- Decreasing failure rate: Early failure period (e.g. design or manufacturing fault)
- Constant failure rate: Random failure period
- Increasing failure rate: Wear and tear failure period

Semiconductors such as triacs or thyristors are used for SSR output and so the SSR is not subject to mechanical wear. Therefore, the life expectancy of the SSR depends on the failure rate of internal components. For example, the rate for the G3M-202P is 321 Fit (1 Fit = 10^{-9} = λ (malfunctions/time)). The MTTF calculated from this value is as follows:

MTTF = 321 /λ_{60} = 3.12 x 10^6 (time)

With the SSR, however, unlike a single semiconductor, even if is used correctly, heat-stress resulting from changes in the ambient temperature or heat generated by the SSR itself may have several adverse effects, such as deterioration in the solder in components or a drop in the illumination efficiency of the built-in coupler's LED, and may result in failure. These factors will determine the actual lifetime of the SSR. With OMRON SSRs, we estimate that these failures due to deterioration will start to occur after approximately 10 years, but this figure may vary with the ambient conditions.



5 Q&A

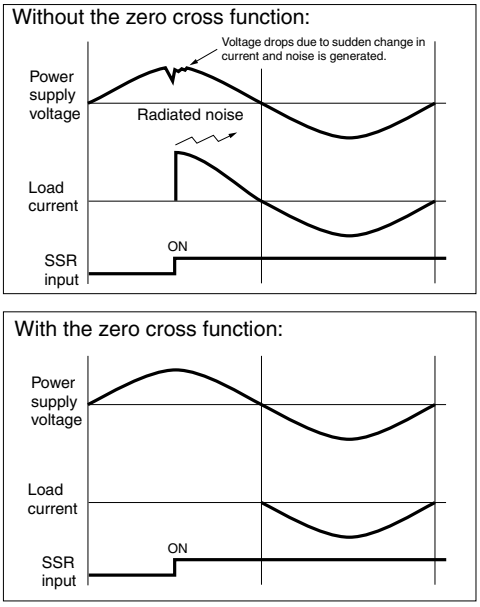
■ Q1. What is the zero cross function?

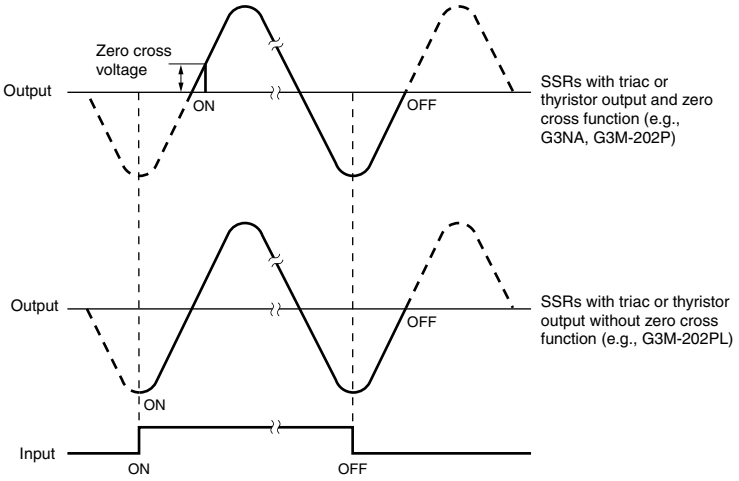
The zero cross function turns ON the SSR when the AC load voltage is close to 0 V, thus suppressing the noise generation of the load current when the load current rises quickly.

The generated noise will be partly imposed on the power line and the rest will be released in the air. The zero cross function effectively suppresses both noise paths.

A high inrush current will flow when the lamp is turned ON, for example. When the zero cross function is used, the load current always starts from a point close to 0 V. This will suppress the inrush current more than SSRs without the zero cross function.

It is ideal for the load current to start from 0 V when the zero cross function is used. Due to circuit restrictions, however, the load current will start from a point that is 0 ± 20 V. The difference in voltage between this point and the 0 V point is called zero cross voltage.





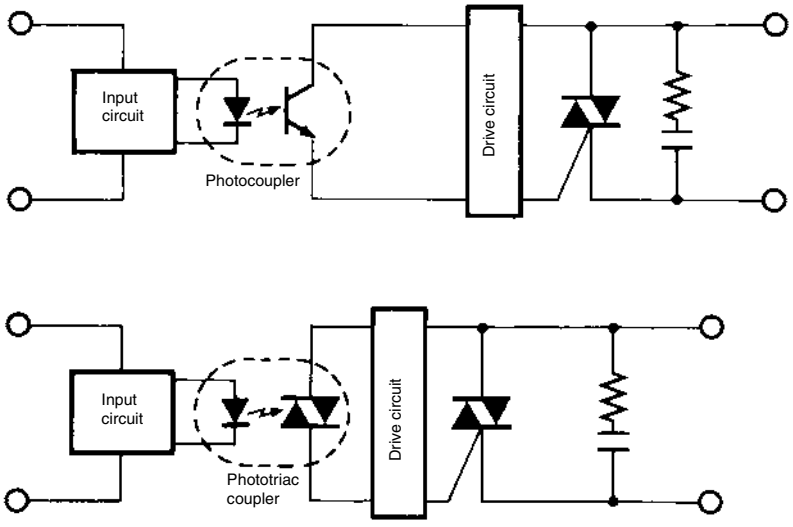
Zero Cross

■ Q2. Why does the input current vary with the SSR?

An SSR with photocoupler isolation has a different input current from an SSR with phototriac isolation.

An SSR with a zero cross function with photocoupler isolation does not require a high input current because the photocoupler ensures efficient signal transmission. The SSR, however, requires a drive circuit of complicated construction.

Photocoupler input current < Phototriac input current

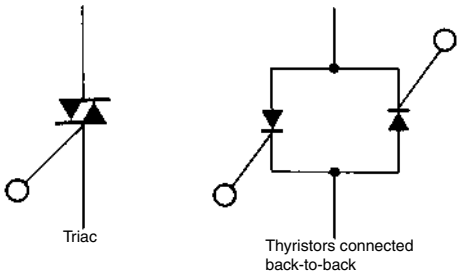


Zero Cross, Photocoupler, and Phototriac

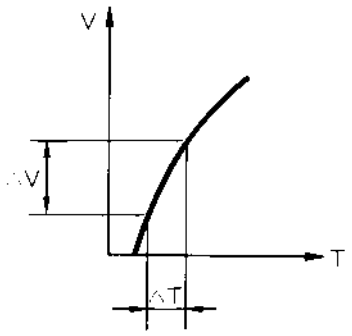
■ Q3. What is the difference in switching with a thyristor and a triac?

There is no difference between them as long as resistive loads are switched. For inductive loads, however, thyristors are superior to triacs due to the back-to-back connection of the thyristors.

For the switching element, an SSR uses either a triac or a pair of thyristors connected back-to-back.



There is a difference between thyristors and triacs in response time to rapid voltage rises or drops. This difference is expressed by dv/dt (V/μs) (Refer to Q5 on page 92). This value of thyristors is larger than that of triacs. Triacs can switch inductive motor loads that are as high as 3.7 kW. Furthermore, a single triac can be the functional equivalent of a pair of thyristors connected back-to-back and can thus be used to contribute to downsizing SSRs.



ΔV/∇T = dv/dt: Voltage rise rate

	Resistive load		Inductive load	
	40 A max.	Over 40 A	3.7 kW max.	Over 3.7 kW
Triac	OK	OK	OK	Not as good
Two thyristors	OK	OK	OK	OK

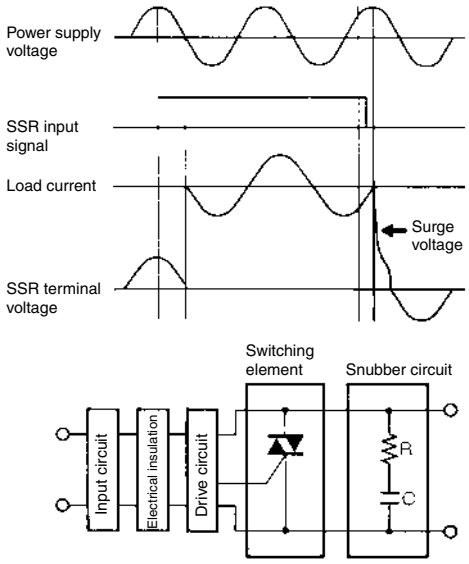
Thyristors, Triacs, and dv/dt

■ Q4. What is a snubber circuit?

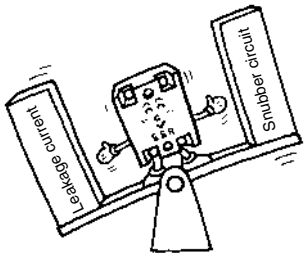
When SSRs with triac or thyristor outputs are used to switch inductive loads, excessive voltage changes will occur within a short period when the triacs or thyristors are turned ON and OFF. As a result, the SSRs will malfunction (make mistakes in firing time). A snubber circuit is designed to suppress excessive voltage changes.

The characteristics of triacs or thyristors for excessive voltages are expressed by dv/dt. The limit value that turns ON these output semiconductor elements is called the critical rate-of-rise of the OFF-state voltage (or static dv/dt). The limit value that cannot turn OFF the output semiconductor elements is called commutation dv/dt.

A snubber circuit suppresses surge. If the surge voltage is high, however, the output semiconductor elements will be damaged. Therefore, when an SSR with no built-in surge absorbing element (i.e., a varistor) is used for an inductive load, for example, the SSR will need a surge suppressing measure other than the snubber circuit.



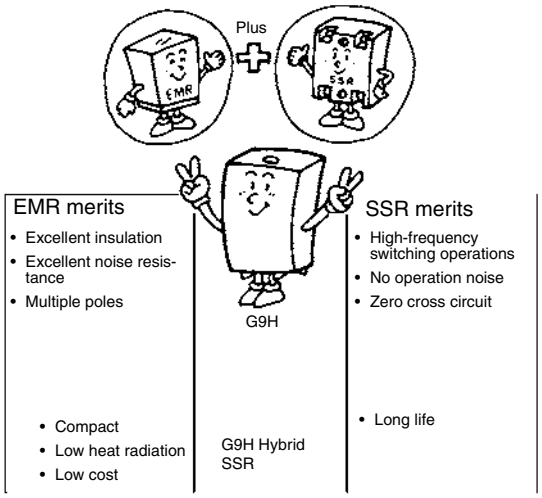
However a snubber circuit is the main cause of current leakage from an SSR. The relationship between the snubber circuit and current leakage is like balancing a seesaw. With the snubber effect increased, the leakage current will increase. With the leakage current suppressed, the SSR will be adversely affected by noise. OMRON selects the best snubber circuit constant for each model according to the rated current of the model.

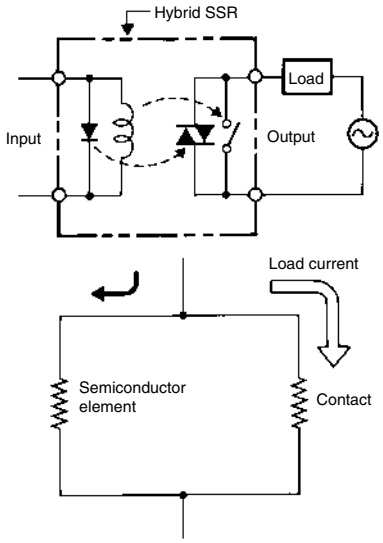


Static dv/dt, Commutation dv/dt, Snubber Circuits, and Leakage Current

■ Q5. What is a hybrid SSR?

A hybrid SSR is a relay that turns the load ON and OFF with a semiconductor element but uses a mechanical relay for normal operation. In other words, a hybrid SSR is a combination of an EMR (electromagnetic relay) and SSR.





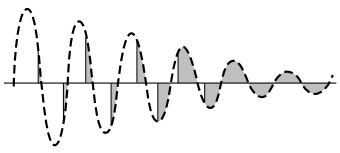
Principle of Operation

When the hybrid SSR input is turned ON, the triac turns ON and then the contact turns ON. At that time, the resistance of the contact will be lower than that of the triac, causing most of the load current to flow to the contact. When the SSR input is turned OFF, the contact and triac are turned OFF. The triac is turned OFF after the current to the contact is turned OFF, and therefore, no arc will result. This is the reason a hybrid SSR ensures a long service life.

Hybrid SSR

■ Q6. What is the soft start function?

The soft start function increases the AC output of SSRs gradually to 100% using phase control. This suppresses the inrush current of the load power supply that results when the load power supply is turned ON, making it possible to start the load smoothly. This function can be used to effectively control motor and halogen lamp loads. A soft start function is incorporated in the G3PX Power Controller and the G3J-series SSRs for motor control.



Soft Start Function

■ Q7. What do the model numbers mean?

The following model legend applies to OMRON's SSRs.

G3-□□-□□□□□□□□□-□□

12 3 4 5 6 7 8 9

1. **Product Classification**
   The prefix G indicates that the product is a relay.
2. **Basic Model Code**
   The number 3 indicates that the product is an SSR.
3. **A specific alphabetic character for the model**.
4. **A specific alphabetic character for the model**.
5. **Load Power Supply Voltage**
   Used only for series products and not for standard models.
   1: Maximum operating voltage is 100 to 200 VAC or DC.
   2: Maximum operating voltage is 200 to 300 VAC or DC.
   4: Maximum operating voltage is 400 to 500 VAC or DC.
6. **Load Current**
   Indicates the maximum load current.
   Example: ooo075: 75 A
   ooo150: 150 A
   ooR5: 0.5 A
   oo10: 10 A
7. **Terminal Shape**
   B: Screw terminals
   P: PCB terminals
   S: Plug-in terminals (for special sockets)
   T: Tab terminals
8. **Zero Cross Function**
   None: Yes
   L: No
9. **Suffix Code**
   A code specifying a series product, approved standards, or specific characteristics such as the number of elements.

For the G3NA-220B, for example, the load power supply voltage is 200 V, the load current is 20 A, the zero cross function and screw terminals are provided. For the G3M-102PL, the load power supply voltage is 100 V, the load current is 2 A, the zero cross function is not provided, and PCB terminals are provided.

Model Legend

■ Q8. What is the difference between recommended values and rated values?

The maximum load current of an SSR is determined on the assumption that the SSR is used independently connected to a resistive load. The expected actual operating conditions of the SSR are, however, tougher due to the fluctuation of the power supply voltage or the panel space. The recommended values of the SSR are provided in consideration of a 20% to 30% safety margin based on the rated values.

A larger safety margin will be required if an inductive load, such as a transformer or motor, is used due to the inrush current that will flow.

Recommended Loads

■ Q9. What is the meaning of I^2t for fuse selection?

When a fuse is connected to an SSR, the I^2t of the SSR is the integral value of an inrush current that flows for a specified time from the fuse into the SSR when the SSR is turned ON.

The following table provides permissible I^2t values for the respective SSRs. When using a high-speed breaking fuse for an SSR, check that the I^2t is the same as or less than the specified value.

I^2t Values

G3NA-210B	$121A^2s$
G3NA-220B	$260A^2s$
G3NA-240B	$2660A^2s$

Fuse and I^2t

■ Q10. Is it possible to connect SSRs in series?

Yes, it is. SSRs are connected in series mainly to prevent short circuit failures. Each SSR connected in series shares the burden of the surge voltage. Therefore, the SSRs are protected from overvoltage.

A high operating voltage, however, cannot be applied to the SSRs connected in series. The reason is that the SSRs cannot share the burden of the load voltage due to the difference between the SSRs in operating time and reset time when the load is switched.

Series Connections

■ Q11. Is it possible to connect two 200-VAC SSRs in series to a 400-VAC load?

No, it is not. The two SSRs are slightly different to each other in operating time. Therefore, 400 VAC will be imposed on the SSR with a longer operating time.

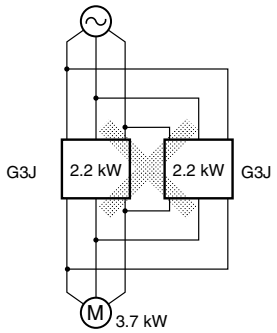
Series Connections

■ Q12. Is it possible to connect SSRs in parallel?

Yes, it is. SSRs are connected in parallel mainly to prevent open circuit failures. Usually, only one of the SSR is turned ON due to the difference in output ON voltage drop between the SSRs. Therefore, it is not possible to increase the load current by connecting the SSRs in parallel.

If an ON-state SSR in operation is open, the other SSR will turn ON when the voltage is applied, thus maintaining the switching operation of the load.

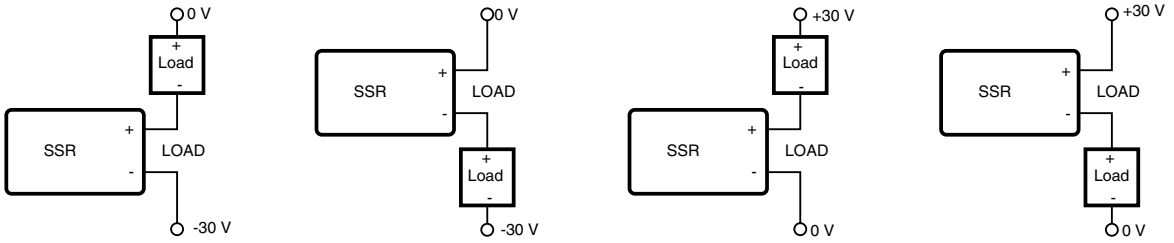
Do not connect two or more SSRs in parallel to drive a load exceeding the capacity each SSRs; the SSRs may fail to operate.



Parallel Connections

■ Q13. Is it possible to connect a DC output load to a negative electrode? Can either a positive or negative load be connected?

Any of the following connections will work. If the load has positive and negative polarities, be sure to connect the load with the polarities corresponding in the way shown below.



Negative Power Supply

■ Q14. What portion of the power factor of the load is practically applicable?

A power factor range between COSϕ 1 and about 0.4 is available. If the power factor is less than 0.4, the phase gap between the current and the voltage will become large, and even if the current becomes 0, an overvoltage state with a changing voltage will occur. In this state, if dv/dt exceeds the allowable value for the SSR, the SSR will not be able to turn OFF, and the SSR will malfunction. (Refer to Q5 on page 92.)

Power Factor

■ Q15. Why is the minimum load current for most SSRs limited to 0.1 A?

Triac or transistor output elements have a minimum holding current. Considering the ambient operating temperature, the minimum load current based on the minimum holding current is 0.1 A.

If the load current is less than 0.1 A, the output element cannot maintain the ON-status of the load. As a result, the output waveform may oscillate or may not turn ON.

Usually, an SSR operating at 200 V has a maximum leakage current of 10 mA. To prevent load reset failures caused by the leakage current, the minimum load current is limited to 0.1 A on the assumption that the minimum reset current is 10% of the rated value.

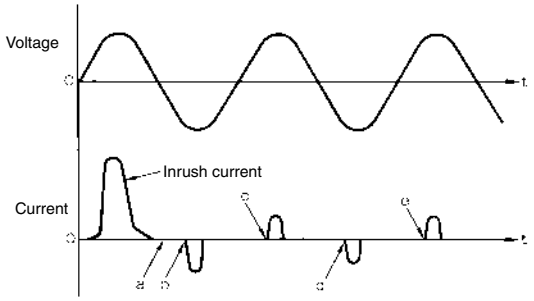
Therefore, for example, if a load with a rated current of 50 mA is used, the leakage current with the SSR turned OFF will be 20% of the rated value. This may cause reset failures, depending on the load.

Two characteristics of SSRs with power MOS FET output elements (e.g., G3DZ, G3RZ), are that a holding current is unnecessary, and the leakage current is small. Switching is possible for loads as small as 100 μA at 200 VAC.

Minimum Load Current

■ Q16. Why is the current not stable when the power supply is switched ON and OFF?

The power supply for an SSR is a capacitive load due to the built-in smoothing capacitance of the power supply. As clearly shown in the graph below, there are periods where almost no current flows and periods where the capacitance changes quickly.



When the voltage is supplied to the SSR, the SSR will turn ON. Around point a, where there is virtually no current flow, however, the SSR will turn OFF. The moment the charge current starts flowing at point b, the SSR will turn ON. At point c, the SSR will turn ON. If the SSR does not turn ON at point b in time, the capacitance will not be fully charged. Therefore, when the SSR turns ON at point c, a high current will flow into the capacitance to supplement the insufficient charge at point b. The same operation is repeated at point d and point e. As a result, the current flow into the SSR is not stable. To solve this problem, a bleeder resistor can be connected in parallel to the power supply so that a current will always flow into the bleeder resistance, thus keeping the SSR turned ON.

Bleeder Resistor Values

100 VAC	5 to 10 kΩ	3 W
200 VAC	5 to 10 kΩ	15 W

Switching Power Supply and Bleeder Resistance

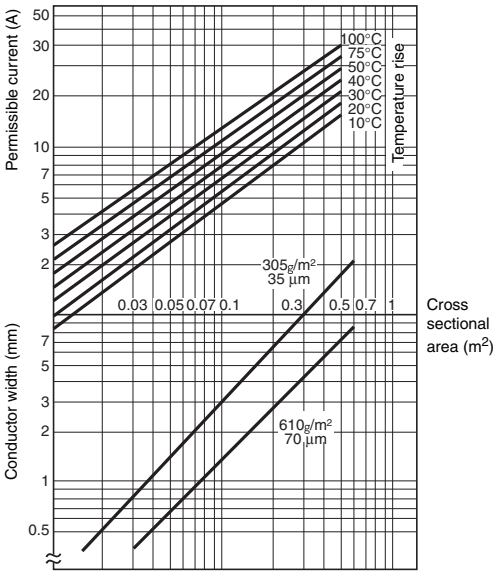
■ Q17 What are the ideal pattern widths and pitches on a PCB?

The required pattern widths and pitches vary with a the operating conditions, such as the PCB materials and ambient temperature. An example of design standards is provided below.

Conductor Pattern Width and Thickness

A standard copper foil is 35 or 70 μm thick. The width of the foil is determined by the carry current and permissible temperature rise. See the following graph for a simple reference.

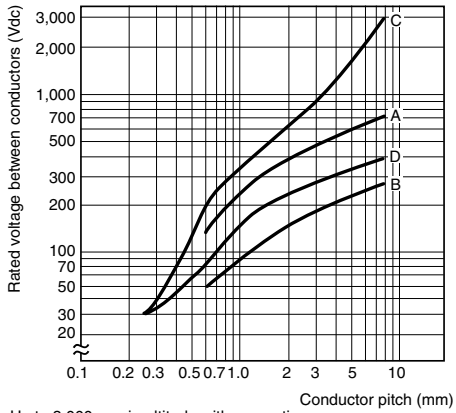
Conductor Widths vs. Permissible Currents (IEC Publication 326-3)



Conductor Pitches

The conductor pitches on a PCB vary with the insulation characteristics and the degree of environmental stress. See the following graph for a standard reference. If the PCB is manufactured in accordance with the Electrical Appliance and Material Control Law or some international safety standards (e.g., UL, CSA, and VDE), however, the requirements of the standards will take precedence. Wider conductor pitches can be used for multi-layer PCBs.

Operating Voltages vs. Conductor Pitches (IEC Publication 326-3)



A: Up to 3,000 mm in altitude with no coating.
B: Over 3,000 and less than 15,000 mm in altitude with no coating.
C: Up to 3,000 mm in altitude with coating.
D: Over 3,000 mm in altitude with coating.

PCB, Pattern Width, and Pattern Pitch

■ Q18. Is it possible to protect the motor with an SSR and mechanical thermal?

Yes, it is.

If the inrush current resistance of the SSR does not match the protective characteristics of the thermal, however, the SSR may be destroyed by overcurrent within a short period. The period is so short that the motor will not burn out.

In this case, a high-speed breaking fuse can be used to protect the SSR.

Recommended thermal relays with harmonized protection are listed for the G3J, which is an SSR for three-phase motors to which a thermal relay can be mounted.

Thermal

■ Q19. What precautions are necessary for forward/reverse operation of the single-phase motor?

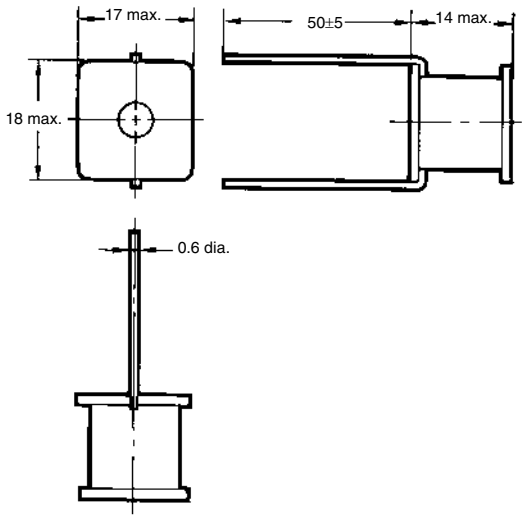
Refer the following table for the protection of capacitor motors driven by SSRs.

Single-phase 100 V	Load current of recommended SSR	Protection of motor in forward/reverse operation	
		R	L
25 W	AC 2 to 3 A	R = 6 Ω, 10 W	Choke coil
40 W			
60 W	AC 5 A	R = 4 Ω, 20 W	
90 W		R = 3 Ω, 40 to 50 W	

Single-phase 200 V	Load current of recommended SSR	Protection of motor in forward/reverse operation	
		R	L
25 W	AC 2 to 3 A	R = 12 Ω, 10 W	Choke coil
40 W			
60 W	AC 5 A	R = 12 Ω, 20 W	
90 W		R = 8 Ω, 40 W	

1. When the motor is in forward/reverse operation, a voltage that is twice as high as the power supply voltage may be imposed on an SSR that is OFF due to the LC resonance of the motor. OMRON's PCB SSR product ranges cover a maximum of 200 VAC. Therefore, SSRs cannot be used to control motors in forward/reverse operation at 200 VAC in some cases. Before starting the forward/reverse operation of the motor at 200 VAC, measure the voltage that is imposed on the SSR turned OFF and make sure that the SSRs are operable.

G32-OG1 Choke Coil



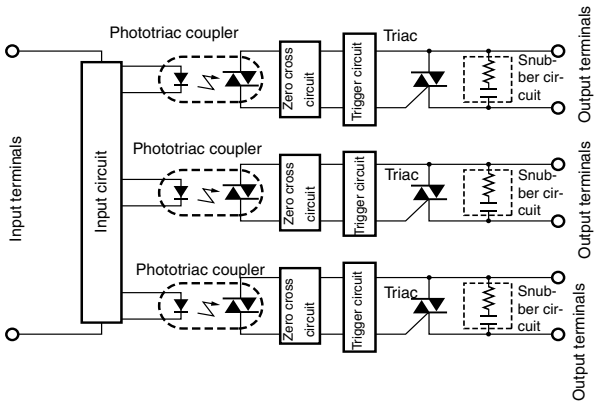
Forward/Reverse Operation

■ Q20. Is it possible to use a three-phase SSR to turn three single-phase circuits ON and OFF?

Three output circuits of the G3J single-function model and those of the G3PB are all separated from each other. Therefore, the output phases can be connected to independent circuits.

Do not use the G3J-S or G3J-T for single-phase circuits, or otherwise the start/stop function will not operate normally.

Configuration



Three-phase SSR

■ Q21. Why is a time lag required between the forward operation and reverse operation of a three-phase motor?

The forward or reverse operation of a three-phase motor is selected by switching two phases. If the SSR for the forward operation of the motor turns ON simultaneously with that for the reverse operation of the motor, a phase short circuit results through the SSRs, thus destroying the SSRs. The reset time of the SSRs fluctuates within a maximum of a half cycle. Therefore, if the forward operation and reverse operation of the motor are switched quickly, both SSRs may turn ON at the same time destroying them.

When either one of the SSRs is turned OFF, the motor will generate counter-electromotive force, which easily causes the SSRs to malfunction. To prevent this, a longer time lag (at least 30 ms) will be required to switch between the forward and reverse operation of the motor.

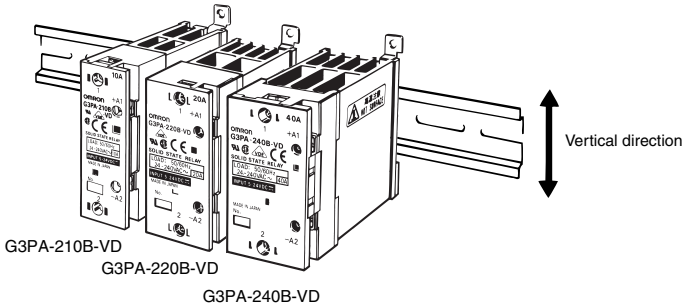
Time Lag and Forward/Reverse Operation

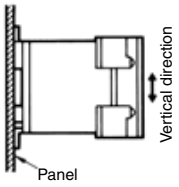
■ Q22. Does an SSR have a mounting direction?

An SSR consists of semiconductor elements. Therefore, unlike mechanical relays that incorporate movable parts, gravity changes have no influence on the characteristics of the SSR.

Changes in the heat radiation of an SSR may, however, limit the carry current of the SSR.

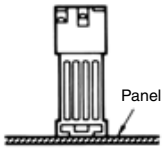
An SSR should be mounted vertically. If the SSR has to be mounted horizontally, check with the SSR's datasheet. If there is no data available for the SSR, use with a load current at least 30% lower than the rated load current.





Vertical mounting

Mount the SSR vertically.



Flat Mounting

The SSR may be mounted on a flat surface, provided that the load current applied is 30% lower than the rated load current.

Mounting Direction

■ Q23. What precautions are required for high-density mounting or gang mounting?

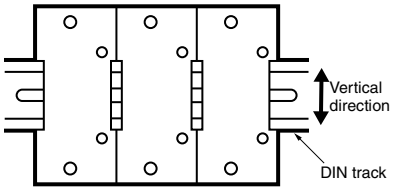
In the case of high-density or gang mounting of SSRs, check the relevant data in the SSR datasheet. If there is no data, check that the load current applied is 70% of the rated load current. A 100% load current can be applied if groups of three SSRs are mounted in a single row with a space as wide as a single SSR between adjacent groups.

If the SSRs are mounted in two or more rows, it is necessary to confirm the temperature rise of the SSR separately.

With side-by-side high-density or gang mounting of SSRs with heat sinks, reduce the load current to 80% of the rated load current.

Refer to the SSR's datasheet for details.

G3PA

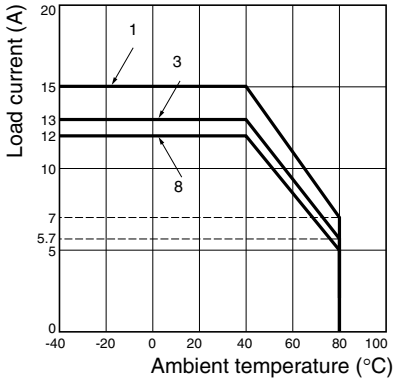


Do not mount more than a group of three Units closely together without providing a 10-mm space to the next group.

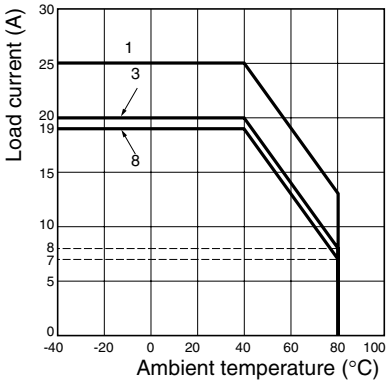
G3PB

Characteristic Data
High-density or Gang Mounting (3 or 8 Units)

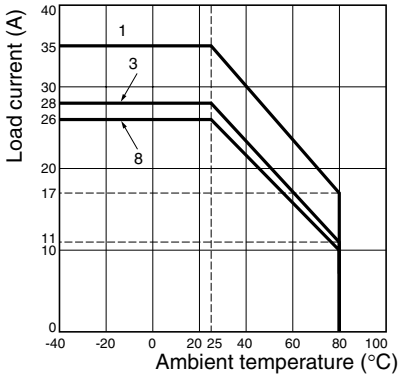
G3PB-215B-VD



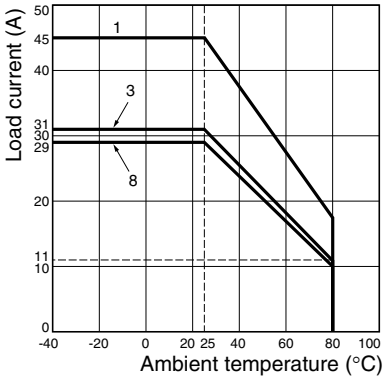
G3PB-225B-VD



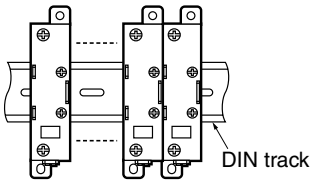
G3PB-235B-VD



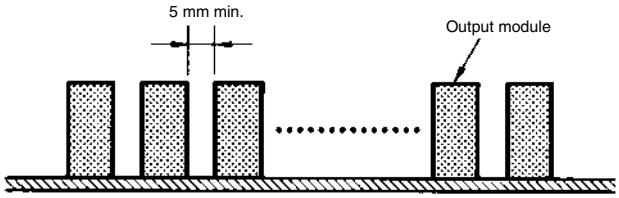
G3PB-245B-VD



Example of high-density or gang mounting



G3TB

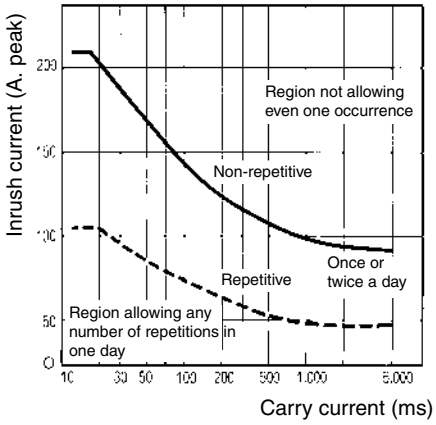


Close-mounting of Output Modules
Provide a minimum space of 5 mm between adjacent SSRs. A load of 3 A can be switched with a maximum of 16 points.

High-density or Gang Mounting

■ Q24. What is the non-repetitive inrush current?

The datasheet of an SSR gives the non-repetitive inrush current of the SSR. The concept of the non-repetitive inrush current of an SSR is the same as an absolute maximum rating of an element. Once the inrush current exceeds the level of the non-repetitive inrush current, the SSR will be destroyed. Therefore, check that the maximum inrush current of the SSR in usual ON/OFF operation is 1/2 of the non-repetitive inrush current. Unlike mechanical relays that may result in contact abrasion, the SSR will provide good performance as long as the actual inrush current is a maximum of 1/2 of the non-repetitive inrush current. If the SSR is in continuous ON/OFF operation and a current exceeding the rated value flows frequently, however, the SSR may overheat and a malfunction may result. Check that the SSR is operated with no overheating. Roughly speaking, inrush currents that are less than the non-repetitive inrush current and greater than the repetitive inrush current can be withstood once or twice a day (e.g., this level of inrush current can be withstood in cases where power is supplied to devices once a day).



Non-repetitive Inrush Current

■ Q25. What kind of failure do SSRs have most frequently?

OMRON's data indicates that most failures are caused by overvoltage or overcurrent as a result of the short-circuiting of SSRs. This data is based on SSR output conditions, which include those resulting from the open or short circuit failures on the input side.

	Failure	Load condition
Input	Short	Does not turn ON.
	Open	Does not turn ON.
Output	Output triac short circuit (80% of failures)	Does not turn OFF.
	Output triac open circuit (20% of failures)	Does not turn ON.

Failure

■ Q26. What will happen if the load voltage exceeds the upper limit?

OMRON's G3NA, G3NE, and G3PA SSRs, which have a built-in varistor, have a rated load voltage of 264 VAC. These SSRs withstand a maximum of 264 VAC. The built-in varistor operates when the load voltage in actual operates exceeds around 400 VAC and the varistor will be destroyed.

OMRON's G3M or G3CN or G3F SSR does not incorporate a varistor. These SSRs with 200-VAC output withstand a maximum of 264 VAC. The output triac of the SSR in actual operation will be destroyed due to an overvoltage of approximately 600 VAC, provided that the AC is a sine wave current with no distortion or noise.

For an ordinary power supply, there will be an increase in the failure rate of the SSR if the load voltage exceeds 264 VAC.

Overvoltage

■ Q27. Is it possible to replace a defective part in an SSR?

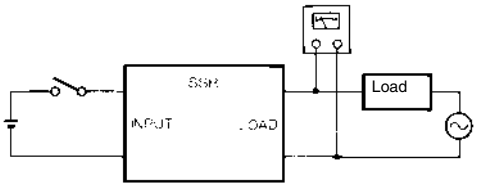
It is possible to replace the power elements of the G3PX, G3PA, and G3NH. No parts of any other OMRON's SSR are replaceable because the SSR is sealed with plastic resin.

Parts Replacement

■ Q28. How can we use a multimeter to check if the SSR is ON or OFF?

The resistance of the load terminals of the SSR does not make clear changes when the input turns ON and OFF.

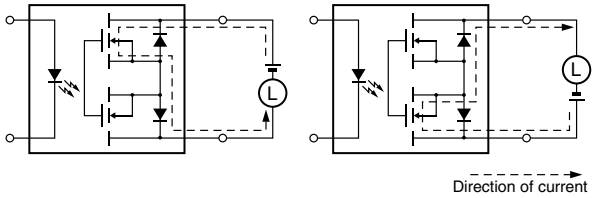
Connect a dummy load to the output terminals and check the voltage of the load terminals with the input ON and OFF. The output voltage will be close to the load power supply voltage with the SSR turned OFF. The voltage will drop to approximately 1 V with the SSR turned ON. This is more clearly checked if the dummy load is a lamp with an output of about 100 W.



Multimeter Check

■ Q29. Why can MOS FET relays be used for both AC and DC loads?

With power MOS FET relays, because 2 MOS FET relays are connected in series in the way shown on the right, the load power supply can be connected in either direction. Also, because power MOS FET elements have a high dielectric strength, they can be used for AC loads, where the polarity changes every cycle.

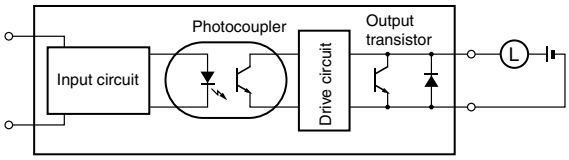


MOS FET Relays

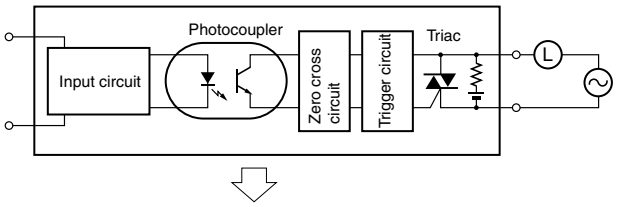
■ Q30. What are the differences between SSRs and power MOS FET relays?

Number 1: There are SSRs for DC loads and SSRs for AC loads.

SSR for DC Loads (e.g., G3SD)



SSR for AC Loads (e.g., G3H)

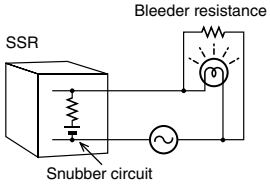


Power MOS FET relays can be used for both DC loads and AC loads.

Number 2: The leakage current for power MOS FET relays is small compared to that for SSRs.

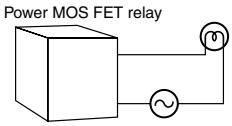
SSRs

The lamp (see below) is faintly light by the leakage current. A bleeder resistance is added to prevent this. With SSRs, a snubber circuit is required to protect the output element.



Power MOS FET Relays

The leakage current is very small (10 μA max.) and so the lamp does not light. This is because a snubber circuit is not required to protect the MOS FET output element. A varistor is used to protect the MOS FET.



A bleeder resistance is not required and so circuits can be simplified and production costs reduced.

MOS FET Relays

SSR

■ Q31. What kind of applications can power MOS FET relays be used for?

1. Applications where it is not known whether the load connected to the relay is AC or DC.
   Example: Alarm output of robot controller.
2. Applications with high-frequency switching of loads, such as for solenoid valves, where the relay (e.g., G2R) has to be replaced frequently.
   Power MOS FET relays have a longer lifetime than other relays and so the replacement frequency is less.
   The terminals of the G3RZ are compatible with those of the G2R-1A-S and so these models can be exchanged.

   Note Confirm the input voltage, polarity, and output capacity before application.
3. Applications with high-voltage DC loads.
   In order to switch a 125-VDC, 1-A load with a relay, an MM2XP or equivalent is required. With the G3RZ power MOS FET relay, however, switching at this size is possible.
4. Applications where SSRs are used with a bleeder resistance.
   The leakage current for power MOS FET relays is very small (10 μA max.) and so a bleeder resistance is not required.

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