White Paper

Issue Date: December 2024

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Contribution of OMRON's high-capacity relays in solving social issues

In recent years, energy-related equipment such as solar power generation systems, energy storage, and electric vehicles (EVs) has been introduced in large numbers to areas where there is a demand, and the conventional infrastructure of large-scale centralized power supplies is being transformed to coexist with small-scale distributed power supplies. These distributed power supplies are becoming essential for decarbonization and energy security, but their safety and reliability must be ensured while pursuing efficiency as energy infrastructure.
OMRON is working to expand its lineup of high-capacity relays for use in distributed power supplies to contribute to solving social issues by improving usability and energy efficiency through reductions in size and weight as well as contact resistance. At the same time, we are committed to ensuring that the quality of our products can be used safely and reliably.

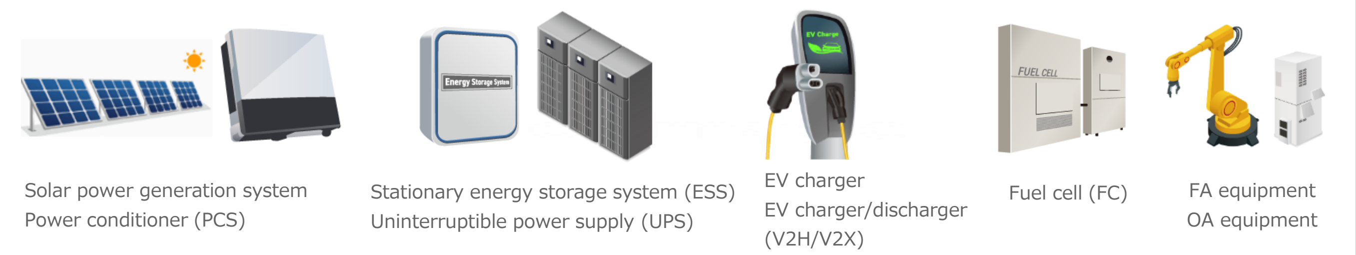

Figure 1: Application examples where OMRON's high-capacity relays are focused

Value provided by G5PZ-X

G5PZ-X is a PCB relay rated 200 VDC as a single unit and 400 VDC / 450 VDC when two units are connected in series. It is particularly suitable for switching main circuits and inrush current prevention circuits of rectifier circuits for 200 VAC systems where 300 - 400 VDC is used, DC power supplies for data centers, and household storage batteries. Compared to standard relays which are only limited to unidirectional switching, this relay has the switching capability equivalent to general DC relays in both directions. It can switch high-voltage DC voltages over 60 V into a compact package, thus contributing to equipment miniaturization, especially in storage battery charging/discharging circuits.

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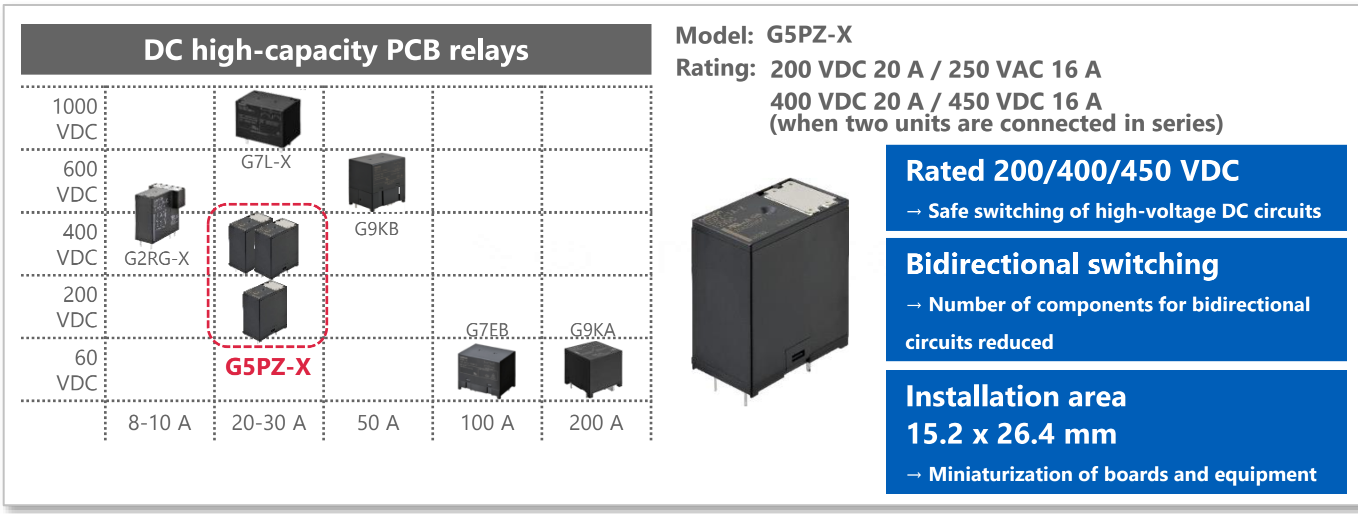

Figure 2: DC high-capacity relay lineup and G5PZ-X features and offered value

Market trend: Expanding use of DC distributed power supplies and DC power supplies

In recent years, as efforts to solve environmental issues such as the SDGs and decarbonization have become increasingly important, solar power generation has been installed in homes and businesses. On the other hand, such natural energy power generation is an uncontrolled power supply whose output is dependent on weather conditions. In addition, a separate regulating power supply is needed to match the supply and demand of electricity. As one means of achieving this, storage batteries are increasingly being installed alongside solar power generation.

Generally, AC electricity is used for power distribution. Both solar generation system and storage batteries are DC power supplies, but technology is being developed to increase energy efficiency and reliability by directly connecting them in a DC circuit instead of through an AC distribution line. But DC is more difficult to interrupt than AC, and energy-related equipment, especially those that carry relatively large currents, require a means to quickly and reliably interrupt the current in an emergency.

OMRON is developing DC power relay products to help solve such social issues. Through the development of technology to efficiently diminish the arc discharge that occurs when a DC current is interrupted, this product is smaller and lighter than conventional electromagnetic contactors and can be mounted on PCBs, contributing to the spread and expansion of energy-related equipment that is compact and can be mass-produced.

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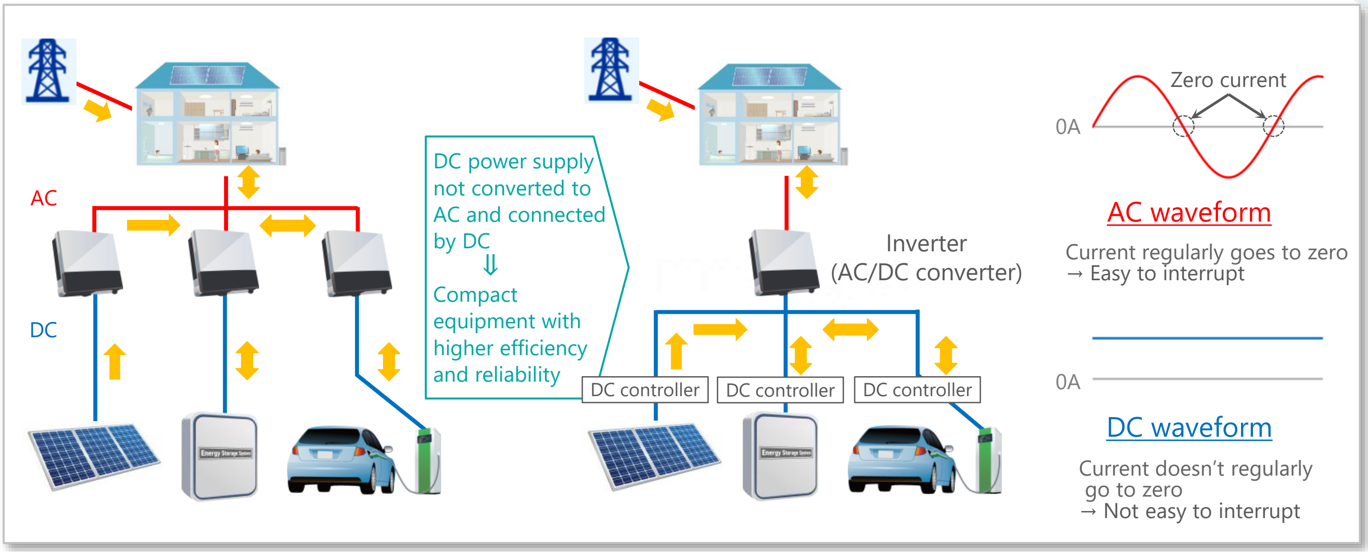

Figure 3: AC and DC interconnections of various DC distributed power supplies (DC link)

In data centers and telecommunication buildings, where high reliability is required, uninterruptible power supplies (UPS) are installed to prepare for power outages, and the development of DC power supply technology is underway to directly connect the storage batteries in the UPS, which are DC power supplies, to servers that operate on DC, without passing through AC power distribution lines. In 2012, the International Telecommunication Union (ITU), a United Nations agency in the telecommunications field, approved ITU-T Recommendation L.1200 (Interface Specifications for DC Power Feed Systems) in 2012 and defined a DC power supply interface for ICT equipment with a minimum voltage of 260 VDC and a maximum voltage of 400 VDC.

The G5PZ-X achieves a rated load of 400 VDC 20 A / 450 VDC 16 A by connecting two units in series, making it suitable for the DC voltage range required by stationary energy storage systems (ESS) attached to solar power generation systems and DC power supply systems in data centers and other facilities.

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

App example: Switching DC power supply circuits (ESS, UPS, etc.)

The G5PZ-X can be used to open and close DC power circuits up to 450 VDC 16 A or 400 VDC 20 A, and to interrupt current in an emergency. Particularly, ESS and UPS with internal storage batteries physically open the circuit when the equipment is not in operation to prevent accidents such as electric shocks and short circuits, since the storage batteries always have voltage. And if an emergency occurs while the equipment is in operation, the current is immediately interrupted, and the equipment is shut down.

In recent years, the voltage of storage batteries has increased in line with the need for larger capacity storage batteries. Storage batteries with a voltage exceeding 60 VDC, which is considered a dangerous voltage in IEC62368-1 (formerly IEC60950-1), which specifies the safety of telecommunications technology equipment, are now used in household and commercial and industrial (C&I) equipment, increasing the level of safety requirements.

The G5PZ-X is suitable for use in circuits with such high voltages, because it can be used in DC circuits with 200 VDC as a single unit and 400 VDC/450 VDC when two units are connected in series. In addition, its bidirectional switching capability is particularly suitable for charging and discharging circuits for storage batteries such as ESS and UPS. For example, if the voltage fluctuation range of the storage battery is 300 to 400 VDC, it can be adapted to charge and discharge about 6 kW.

The G5PZ-X is compact and lightweight and can be mounted on printed circuit boards, contributing to the reduction in the size and weight of equipment and labor-saving manufacturing processes compared to conventional electromagnetic contactors.

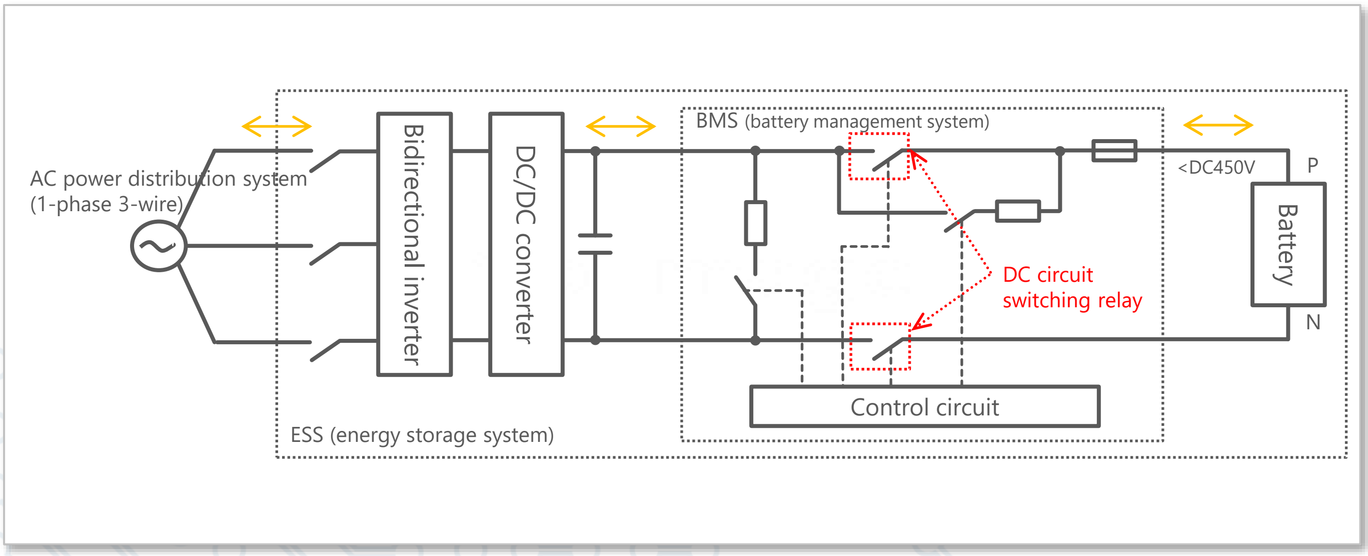

Figure 4: Example of use of DC circuit switching in ESS

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

App example: Switching inrush current protection circuit and discharge circuit (ESS, UPS, etc.)

The G5PZ-X can also be used in inrush current protection circuits (precharge circuits) to limit the excessive charging current to the internal capacitor when the equipment starts up, and in discharging circuits to discharge the internal capacitor to a safe voltage when the equipment stops.
Inrush current prevention and discharging circuits are generally attached to the DC power circuits of the ESS and UPS mentioned above. When the equipment is shut down, the storage batteries are disconnected, and the capacitors are discharged using the discharge circuit to bring them down to a lower voltage that is safe. On the other hand, when the equipment starts up, the storage batteries are connected via the inrush current prevention circuit, and the capacitors are charged from the storage batteries. Then, when the voltage of the capacitors becomes almost equal to the voltage of the storage batteries, the switch of the DC power circuit is closed and the inrush current protection circuit is opened to put the equipment into operation.

In both cases, a voltage equivalent to that of the storage battery is applied between the terminals of the switch when the circuit is open. As with the aforementioned switching applications for DC power circuits, the need for the switch that can handle high voltages has increased in recent years.
Generally, inrush current protection and discharging circuits consist of relays and other switches and resistors that limit the charging and discharging currents, and they are connected in series or parallel with the capacitor, respectively. The larger the capacitance of the capacitor or the resistance of the limiting resistor, the longer the time required for charging or discharging, so select an appropriate resistance value according to the design target time. The peak value of the charging current or discharging current is determined by the resistance value and the power supply voltage (voltage of the storage battery), so select a switch capable of turning on and off that current.
In general, the current flowing through inrush current protection circuits and discharging circuits is often smaller than the current in the main circuit, so the G5PZ-X may be applicable to inrush current prevention and discharging circuits in ESS and UPS with outputs exceeding 10 kW. However, the design of inrush current prevention circuits and discharging circuits is affected by factors other than the output of the equipment, so please determine applicability after conducting detailed design and testing.

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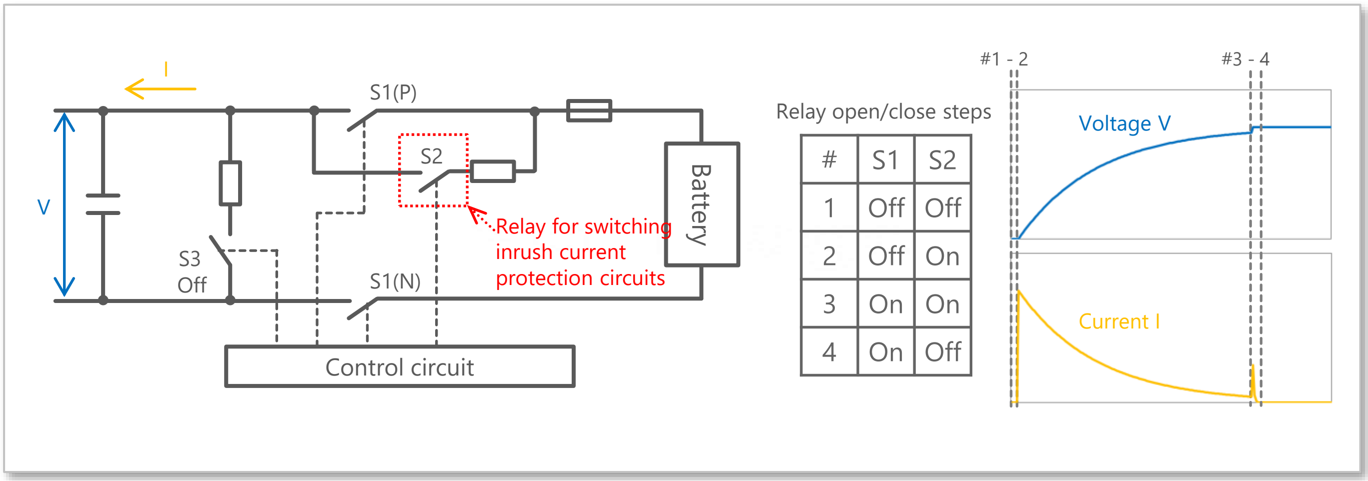
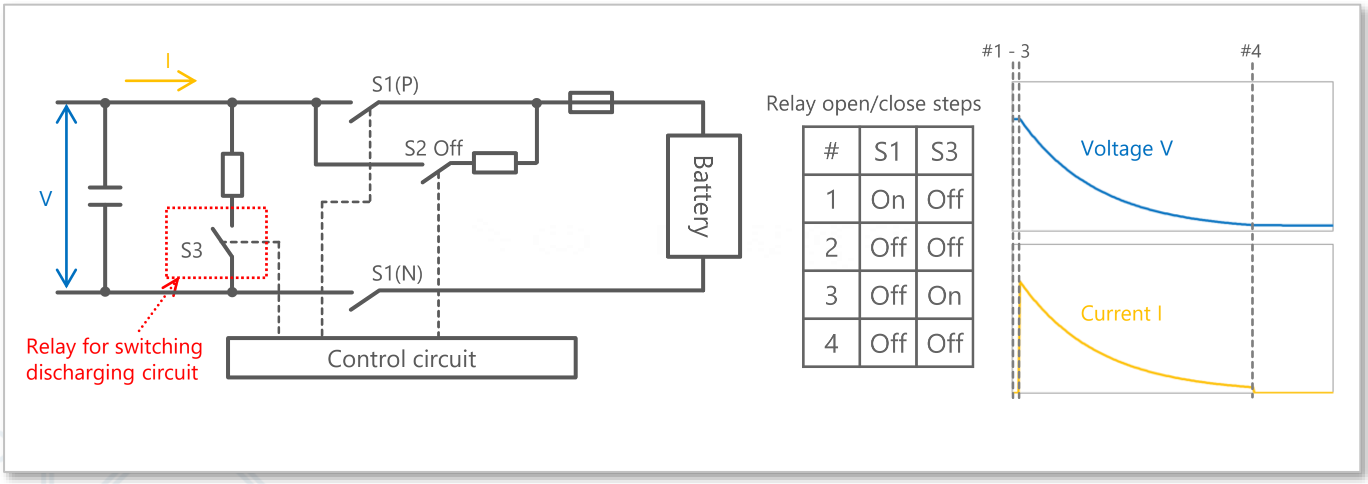
App example: Switching DC power supply circuits (ESS, UPS, etc.)



#	S1	S2
1	Off	Off
2	Off	On
3	On	On
4	On	Off

Figure 5: Application example for inrush current prevention circuit (precharge circuit) in ESS



#	S1	S3
1	On	Off
2	Off	Off
3	Off	On
4	Off	Off

Figure 6: Application example for discharging circuits in ESS

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

App example: DC superimposition interruption of AC circuits

The G5PZ-X has not only a DC rating but also an AC rating, so it can be used in AC circuits within its rating.
Alternating current has a point at which the current goes to zero at a fixed cycle (zero-crossing point), and the circuit can be opened at that timing. Direct current, however, has no zero-crossing point, so continuous current must be forcibly interrupted. When this happens, an arc discharge is generated between the contacts. If the relay is not capable of cutting the arc discharge, it may fail due to welded contacts. In general, AC relays do not have DC interrupting capability, so interrupting a current with a superimposed DC component may cause the relay to fail.
Power conditioner (PCS) is a device that converts DC electricity from solar power generation systems and storage batteries into alternating current to supply power to the power systems and loads. Although it outputs pure AC electricity under normal conditions, DC components may be superimposed on the AC output due to some abnormality. When a DC component is detected in the AC output, the power conditioner will shut down for protection. If an AC relay without DC interrupting capability interrupts the current with the superimposed DC component, a failure may occur. However, the G5PZ-X with its DC interrupting capability can reliably interrupt even currents with the superimposed DC component.
Future power distribution systems will include not only power conditioners for solar power generation systems and storage batteries but also many DC distributed power supplies and DC power supplies. The possibility of DC components being superimposed on AC power lines is increasing, and the G5PZ-X, rated for both AC and DC, will help realize highly reliable current interruption.

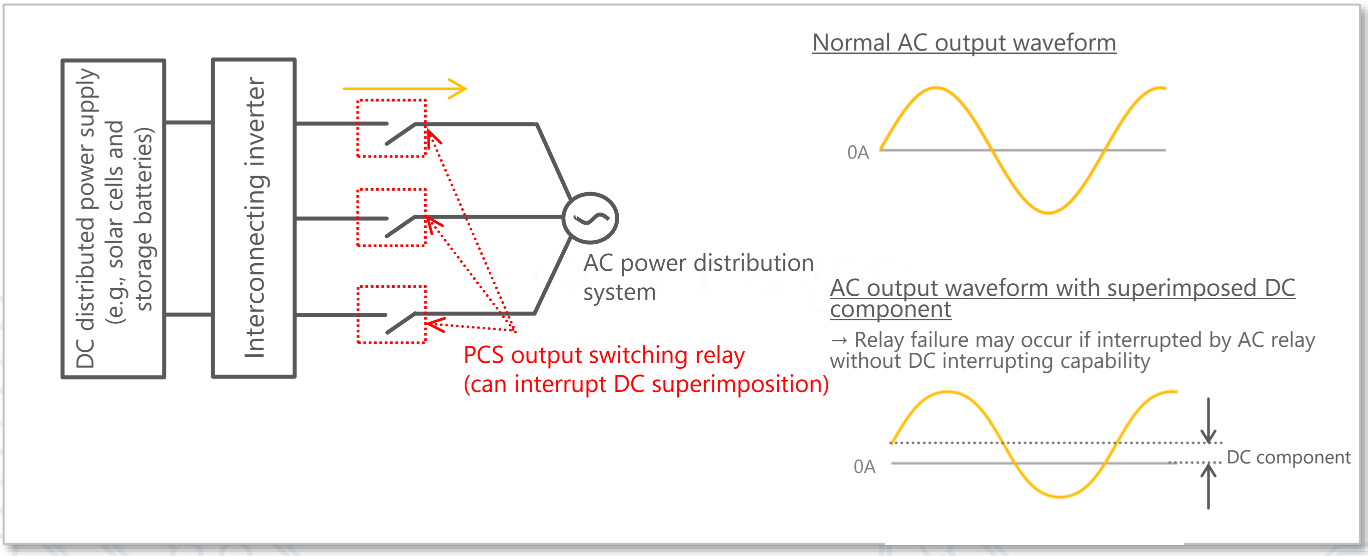


Figure 7: Example of use of DC superimposition interruption of AC circuit in PCS

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Product feature: 2-Contact Series Connection (400 VDC 20 A / 450 VDC 16 A)

G5PZ-X is a relay that can be used with 2 units(2-Contact) connected in series. One unit can switch (resistive load) 200 VDC 20A , and two units can switch 400 VDC 20A / 450 VDC 16A.
When designing a 400V-class printed circuit board, two units should be placed on the board. The compact footprint of the G5PZ-X allows you greater flexibility in PCB design.

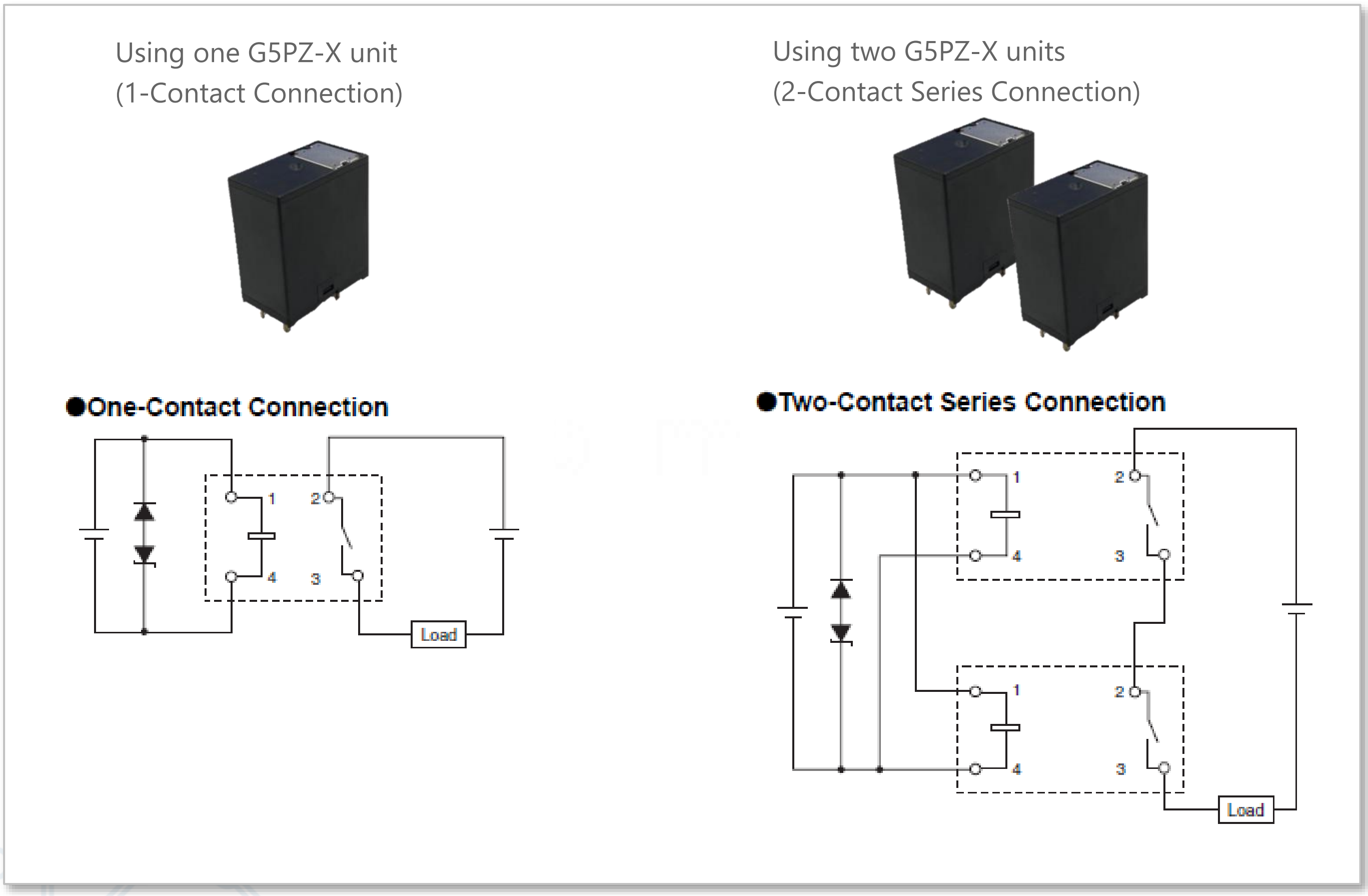


Figure 8: G5PZ-X wiring diagram

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Product feature: Bidirectional switching

In energy storage systems (ESS), for example, where charging and discharging take place, current flows in both forward and reverse directions. In such an application, relays must be capable of interrupting current in both directions.
Conventional polarized relays (capable of interrupting only one direction) require the use of two relays in parallel for bidirectional interruption, but the G5PZ-X can fulfill this function in a single unit (Figure 9).

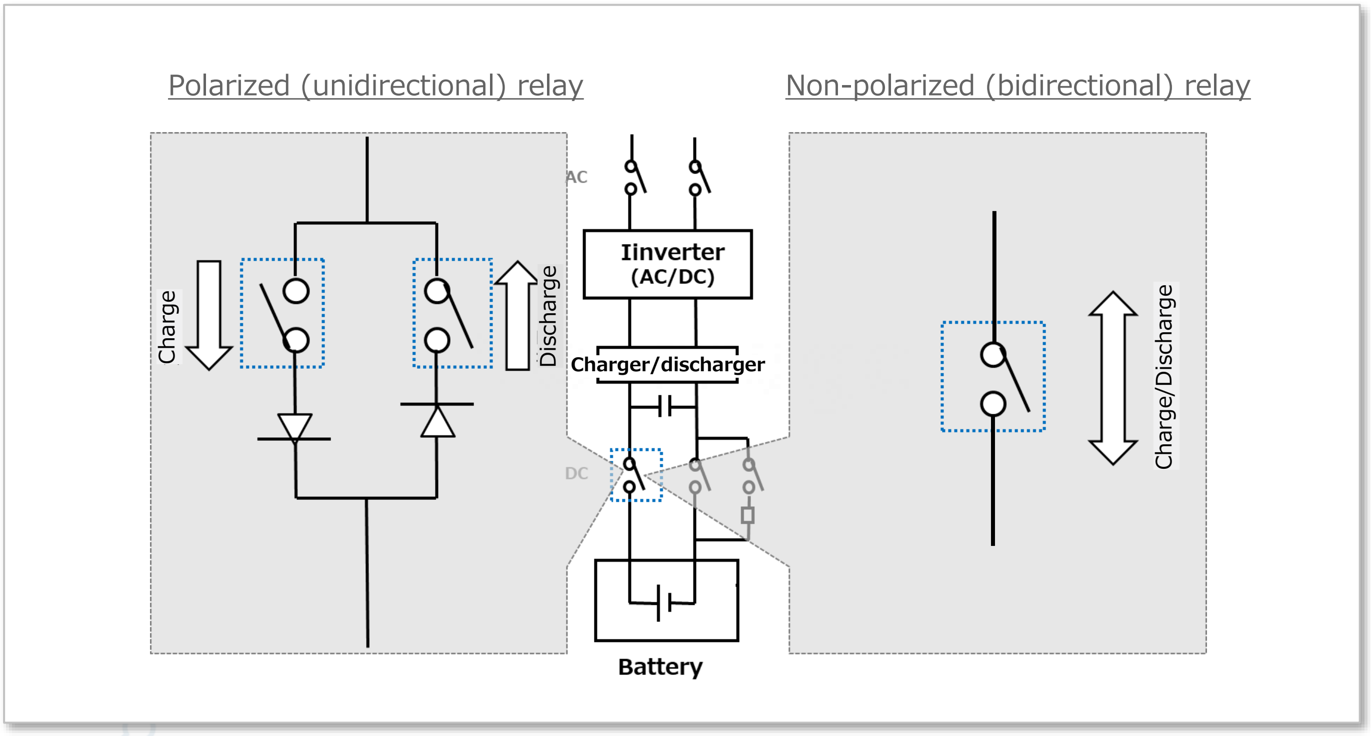
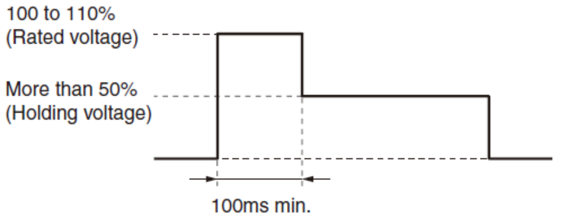


Figure 9: Bidirectional switching

Rated 400 VDC 20 A / 450 VDC 16 A
(when 2-contact series connection)
Bidirectionally switchable PCB power relay G5PZ-X

Product feature: Low power consumption and holding voltage compatible

The G5PZ-X supports holding voltage (50% of rated voltage). By setting the coil voltage to holding voltage when the relay is turned on, the coil power consumption can be reduced by 75% to 133 mW.



	Applied coil voltage	Coil resistance*	Power consumption
Rated voltage	100~110%	272Ω(DC12V) 1087Ω (DC24V)	Approx. 530mW
Holding voltage	50%		Approx. 133mW

*The coil resistance are measured at a coil temperature of 23°C with a tolerance of ±10%.

Figure 10: Coil voltage reduction after relay operation (holding voltage)

Product feature: AC and DC ratings

The G5PZ-X has both DC and AC (when used as a single unit) switching capability. Please consider applying it to AC circuits as well as DC circuits.

	Electrical durability
Using one G5PZ-X unit (1-Contact Connection) 	10,000 times @ 200 VDC, 20 A 100,000 times @ 200 VDC, 0.25 A 100,000 times @ 250 VAC, 16 A (1 sec ON-9 sec OFF @ 85°C)
Using two G5PZ-X units (2-Contact Series Connection) 	10,000 times @ 400 VDC, 20 A 10,000 times @ 450 VDC, 16 A 100,000 times @ 400 VDC, 0.25 A (1 sec ON-9 sec OFF @ 85°C)

Figure 11: G5PZ-X electrical durability

For the latest product information, please refer to the datasheet on our website.

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Product Specifications

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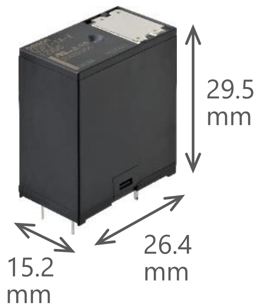
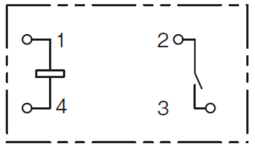


(Dimensions are maximum values)

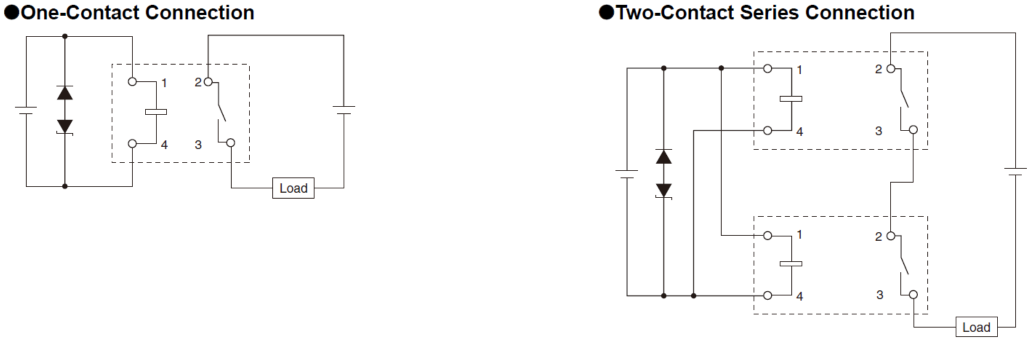


Item		1-contact connection	2-contact series connection
Coil	Coil voltage	12 VDC, 24 VDC	
	Power consumption	ca. 530 mW (ca. 133 mW at 50% holding voltage)	
Contact	Contact form	1a	1a x 2 series connection
	Rated load (Resistive load)	200 VDC 20 A / 277 VAC 16 A	400 VDC 20 A / 450 VDC 16 A
	Rated carry current	20 A	
	Max. switching voltage	200 VDC / 277 VAC	450 VDC
	Max. switching current	20 A	
Durability	Mechanical	2,000,000 times or more (switching frequency 18,000/h)	
	Electrical (Resistive load)	200 VDC 20 A 10,000 times	400 VDC 20 A 10,000 times
		200 VDC 0.25 A 100,000 times	450 VDC 16 A 10,000 times
		250 VAC 16 A 100,000 times	400 VDC 0.25A 100,000 times
		(Switching frequency 1-second ON - 9-second OFF at 85°C)	
Ambient temperature range		-40 to +85°C (with no icing or condensation)	
Terminal shape		PCB terminals	
Safety standards		UL, TUV, CQC	
Weight		Approx. 15 g	Approx. 15 g x 2 units

Figure 12: G5PZ-X specifications

Circuit diagram

The G5PZ-X provides a rated load of 400 VDC 20 A / 450 VDC 16 A by connecting two units (two contacts) in series. For 1-contact and 2-contact connections, connect them as shown in Figure 13, respectively. There is no polarity for either the coil or the contacts.



Note. The diode and zener diode are for the absorption of coil surge. (The coil does not have a polarity.)
The opening/closing part does not have a polarity.

Figure 13: G5PZ-X circuit diagram

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Overseas standard certification

The G5PZ-X is UL/TUV/CQC certified to overseas standards for the rating of 2-unit series connection in addition to the rating of a single unit. The certified rating values of overseas standards are different from the performance values specified individually. For the latest product information, please refer to the datasheet on our website.

UL Recognized: c UL us (File No. E41515)

Model	Contact form	Coil ratings	Contact ratings	Number of test operations
G5PZ-1A-X	1a (One-contact connection)	12, 24 VDC	20 A, 200 VDC (Resistive) 85°C	10,000
			16 A, 277 VAC (Resistive) 85°C	6,000
	1a (Two-contact series connection)	12, 24 VDC	20 A, 400 VDC (Resistive) 85°C *1	10,000
			16 A, 450 VDC (Resistive) 85°C *1	10,000

*1. Two-contact series connections only comply with UL standards

EN/IEC, TÜV Certified: (Certificate No. R50408241)

Model	Contact form	Coil ratings	Contact ratings	Number of test operations
G5PZ-1A-X	1a (One-contact connection)	12, 24 VDC	20 A, 200 VDC (Resistive) 85°C	10,000
			16 A, 277 VAC (Resistive) 85°C	6,000
	1a (Two-contact series connection)	12, 24 VDC	20 A, 400 VDC (Resistive) 85°C	10,000
			16 A, 450 VDC (Resistive) 85°C	10,000

CQC Certified: (Certificate No. CQC21002317552)

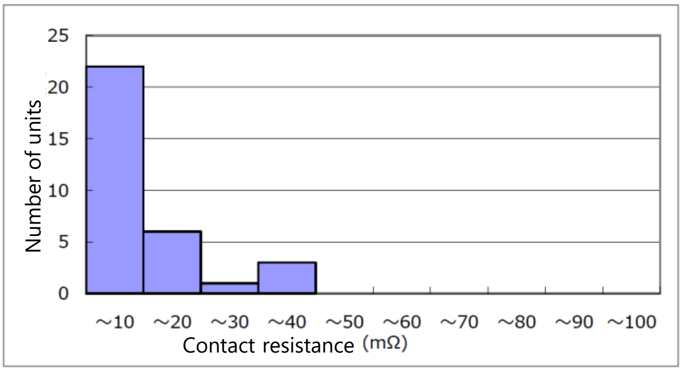
Model	Contact form	Coil ratings	Contact ratings	Number of test operations
G5PZ-1A-X	1a (One-contact connection)	12, 24 VDC	20 A, 200 VDC (Resistive) 85°C	10,000
			16 A, 277 VAC (Resistive) 85°C	6,000
	1a (Two-contact series connection)	12, 24 VDC	20 A, 400 VDC (Resistive) 85°C	10,000
			16 A, 450 VDC (Resistive) 85°C	10,000

Figure 14: G5PZ-X overseas standard certified ratings

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Reference data: Initial contact resistance

The initial contact resistance of the G5PZ-X is 100 mΩ or less as rated performance. As shown in the graph below, the product's actual performance value is less than 50 mΩ, achieving stable low contact resistance.



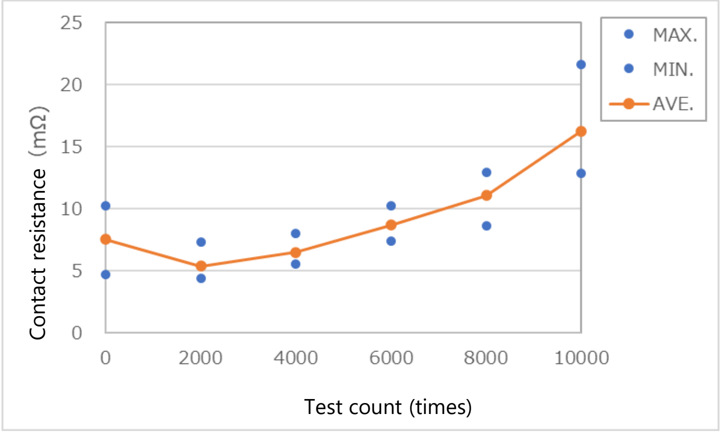
<Evaluation conditions>
200 VDC 20 A
1s ON / 9s OFF
85℃

<Measurement conditions>
5 VDC 1 A

Figure 15: G5PZ-X initial contact resistance (for one contact)

Reference data: Contact resistance after electrical durability testing

The G5PZ-X can maintain low contact resistance even after electrical durability evaluation. The graph below shows that the resistance remains low at around 17 mΩ even after durability test evaluation, compared to around 7.5 mΩ initially, contributing to low heat generation throughout the product life cycle.



<Evaluation conditions>
200 VDC 20A
1s ON / 9s OFF
85℃

<Measurement conditions>
5 VDC 1 A

Figure 16: G5PZ-X contact resistance after electrical durability testing

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Reference data: Electrical durability G5PZ-X（Two-contact series connection）

In order to meet a wide range of customer load requests, we disclose durability curves. Please make use of this information when designing your products to consider whether or not to apply relays. However, these data are actual values, not guaranteed values.

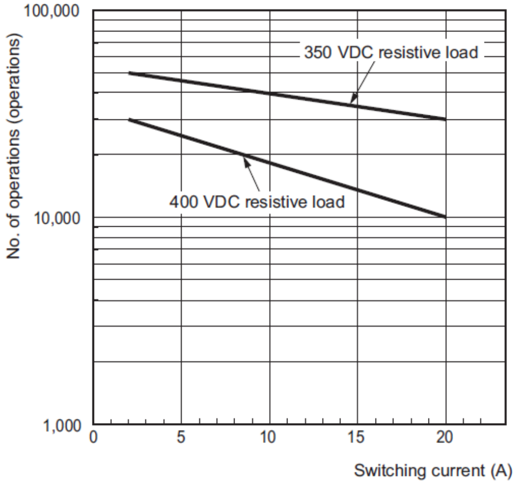


Figure 17: Electrical durability

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Usage explanation: Operating coil circuit

The G5PZ-X has a coil power consumption of 530 mW at rated coil voltage, but this is reduced to 133 mW at 50% holding voltage. PWM control is another way to reduce coil power consumption.
The G5PZ-X can be used in either way according to the reference circuit diagram.

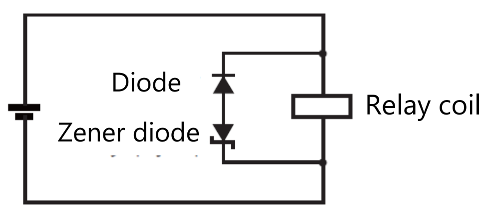


Figure 18: Diode / Zener diode connection

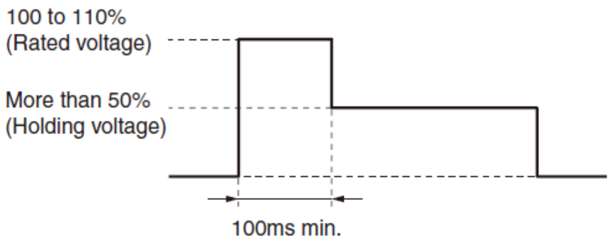
Use diodes to absorb coil surges. In addition, Zener diodes must be used in conjunction with the G5PZ-X to maintain its switching performance. The diode must be connected with the reverse polarity of the voltage applied to the coil.

- The recommended Zener voltage for Zener diodes is 1 to 3 times of the coil rated voltage.
- Dielectric withstanding voltage of the diode must be at least 10 times as large as the rated coil voltage value. The forward current of the diode must be the same as or larger than the coil current value.

Usage explanation: Holding voltage circuit

● **Holding voltage**

Even when a holding voltage is used, the rated coil voltage must first be applied for 0.1 second. The range of the rated coil voltage should be set to 100% and the holding voltage to 50% (Figure 19).



	Applied coil voltage	Coil resistance*	Coil power consumption
Rated voltage	100 to 110%	272Ω(DC12V) 1087Ω (DC24V)	Approx. 530mW
Holding voltage	50%		Approx. 133mW

* The coil resistances were measured at a coil temperature of 23°C with a tolerances of ±10%.

Figure 19: Coil voltage reduction after relay operation

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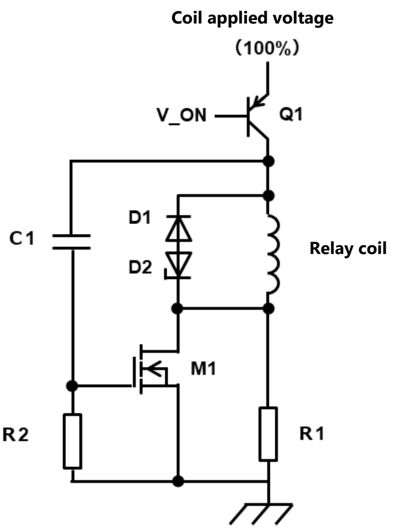
● CR method

The CR system consists of a holding voltage circuit that passes current through a capacitor to operate a relay. The feature of this method is that it is relatively easy to control, as it is automatically shifted to a holding voltage state by simply applying the rated coil voltage to the drive circuit as usual. The coil current is reduced by the resistor (R1), resulting in reduced power consumption. Determine the resistance value (R1) so that the coil voltage is 45 to 60% or more. Note that if the same resistor as the coil resistor is used for R1, the coil current will be halved, and the power consumption of the entire circuit can be halved. (Figures 20 and 21)



Symbol	Component	Selection method
Q1	Relay drive transistor	"Vce" is more than the coil voltage plus ZD voltage. "Ic" is equal to or more than coil rated current.
D1	Surge absorbing diode	"If" is equal to or more than the rated coil current. "Vr" is 2 to 3 times the coil voltage.
D2	Zener diode	Zener voltage specified in catalog Wattage is the shear head surge reverse current (power) greater than or equal to the relay's rated current (power)
C1	Time constant capacitor	When applying the rated voltage to the coil for 100 ms, the time constant C x R should be approximately 70ms to 80ms. Note: Adjust to suit the gate sensitivity and capacitance of the MOS FET.
M1	Current switching MOS FET	Select at "Vds" more than the coil voltage plus ZD voltage. Select "Ids" more than the coil current.
R1	Coil current limiting resistor	Resistance value: Determined according to the holding voltage (%) Power consumption: More than resistance multiplied by the square of the holding current
R2	Time constant resistor	When applying the rated voltage to the coil for 100 ms, the time constant C x R should be approximately 70ms to 80ms. Note: Adjust to suit the gate sensitivity and capacitance of the MOS FET.

Figure. 20: Recommended holding voltage CR circuit example and peripheral component selection method

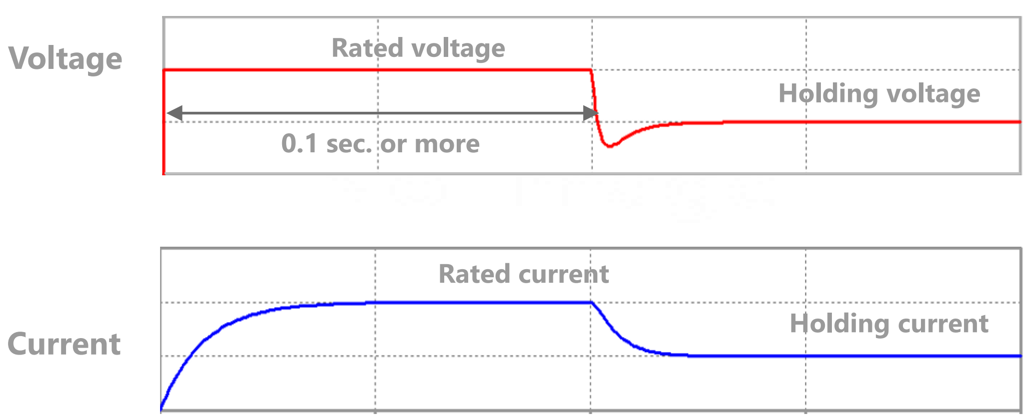


Figure 21: Example of coil voltage and current waveforms in CR circuit

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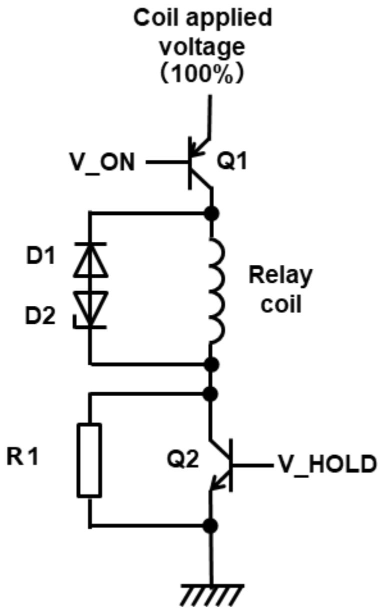
● Switching method (1)

A holding voltage circuit can be configured simply by adding a current-limiting resistor (R1) and a switching element (Q2). The coil current is reduced by turning off the switch (Q2) after the rated voltage is applied to the coil. By making R1 the same as the coil resistance, the power consumption of the entire circuit can be reduced by half. (See Figures 22 and 23)



Symbol	Component	Selection method
Q1	Relay drive transistor	"Vce" is more than the coil voltage plus ZD voltage. "Ic" is equal to or more than coil rated current.
D1	Surge absorbing diode	"If" is equal to or more than the rated coil current. "Vr" is 2 to 3 times the coil voltage.
D2	Zener diode	Zener voltage specified in catalog Wattage is the shear head surge reverse current (power) greater than or equal to the relay's rated current (power)
R1	Coil current limiting resistor	Resistance value: Determined according to the holding voltage (%) Power consumption: More than resistance multiplied by the square of the holding current
Q2	Holding voltage switching transistor	"Vce" is more than the coil voltage plus ZD voltage. "Ic" is equal to or more than coil rated current.

Figure 22: Recommended holding voltage circuit example with switch, and peripheral component selection method

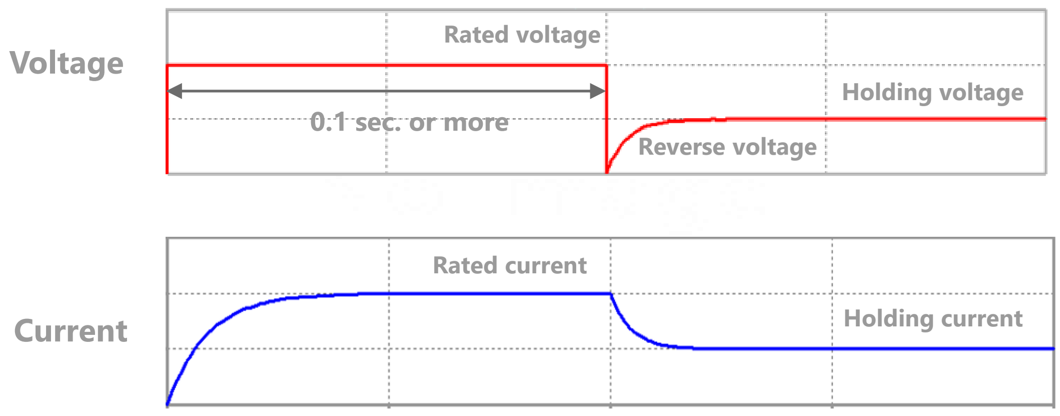
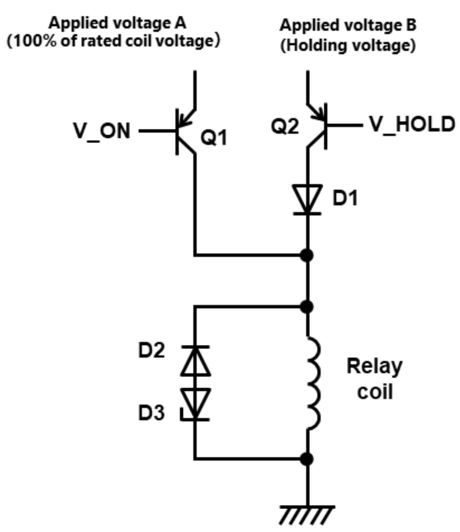


Figure 23: Example of coil voltage and current waveforms in holding circuit with switch

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

● **Switching method (2)**

If a low voltage (B) for holding the coil is available in addition to the rated coil voltage (A), it can be switched to the holding voltage by means of a switch. Switching to 50% voltage will reduce the current to 50%, thus greatly reducing the power consumption of the entire circuit to 1/4 of the rated value. (See Figures. 24 and 25).



Symbol	Component	Selection method
Q1	Relay drive transistor	"Vce" is more than the coil voltage plus ZD voltage. "Ic" is equal to or more than coil rated current.
Q2	Holding current transistor	"Vce" is more than the coil voltage plus ZD voltage. "Ic" is equal to or more than coil rated current.
D1	Backflow prevention diode	"Vr" is more than the rated coil voltage. "If" is more than 50% of the rated coil current.
D2	Surge absorbing diode	"If" is equal to or more than the rated coil current. "Vr" is 2 to 3 times the coil voltage.
D3	Zener Diode	Zener voltage specified in catalog Wattage is the shear head surge reverse current (power) greater than or equal to the relay's rated current (power).

Figure 24: Recommended holding voltage circuit example with switch, and peripheral component selection method

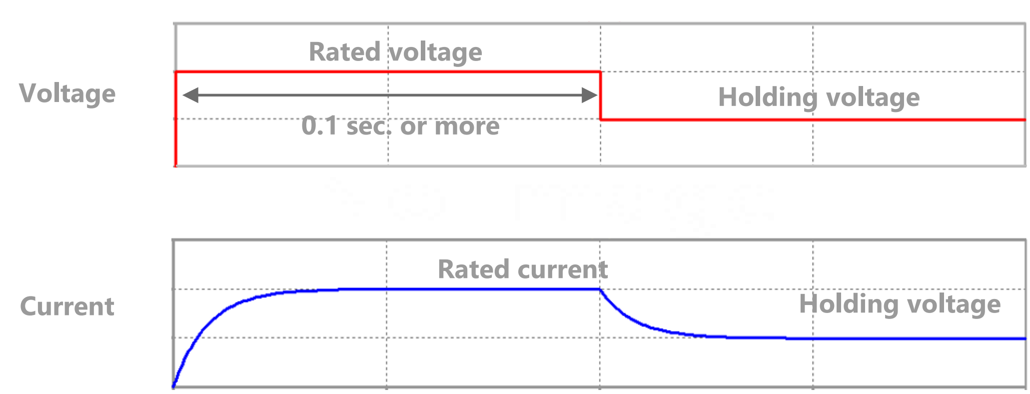


Figure 25: Example of coil voltage and current waveforms in holding circuit with switch

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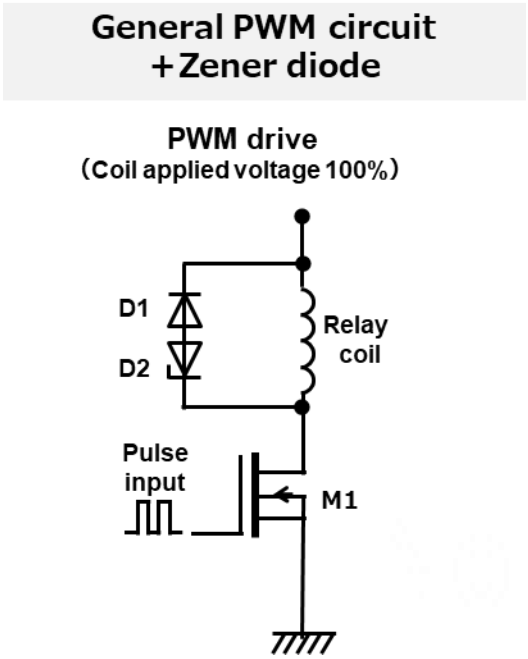
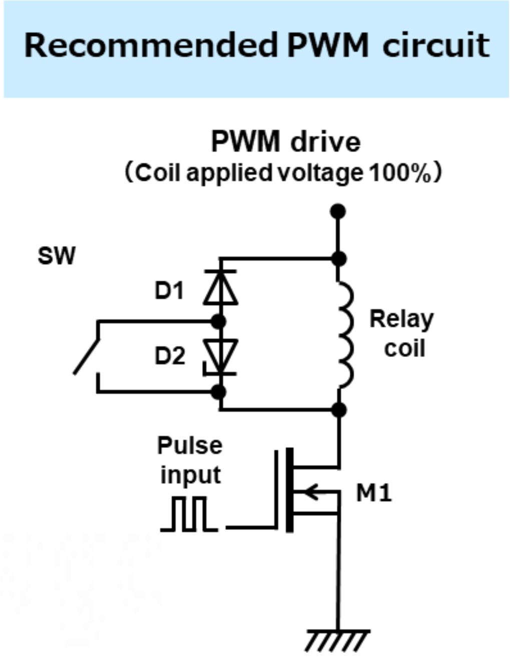
●PWM (Pulse Width Modulation) control

In PWM control, a general PWM control circuit is not recommended to avoid power loss due to the Zener diode. A switch should be mounted in parallel with the Zener diode and bypassed during PWM control (Figure 26). When the relay is turned off, first turn off the switch to turn off the applied voltage of the drive circuit, then the relay is normally turned off by the Zener diode + diode. (Figure 26)

When PWM output is available, the coil current can be reduced without adding any special components by turning the MOS FET for relay drive ON/OFF at high speed (recommended frequency 10 kHz or higher). When the ON/OFF ratio is set to 50%, the coil current is reduced to approximately 50% and the time during which power is consumed is also halved, thus greatly reducing the power consumption of the entire circuit to 1/4 of the rated value. (Figure 27).





* Due to the Zener diode, the PWM circuit may not operate as expected.

Symbol	Component	Selection method
D1	Surge absorbing diode	"If" is equal to or more than the rated coil current. "Vr" is 2 to 3 times the coil voltage.
D2	Zener diode	Zener voltage specified in catalog Wattage is the shear head surge reverse current (power) greater than or equal to the relay's rated current (power)
M1	PWM control MOS FET	Select at "Vds" more than the coil voltage plus ZD voltage. Select "Ids" more than the coil current.
SW	Mechanical relay for ZD bypass	A small relay, such as a signal relay, is sufficient

Figure 26: Recommended PWM control circuit example and peripheral component selection method

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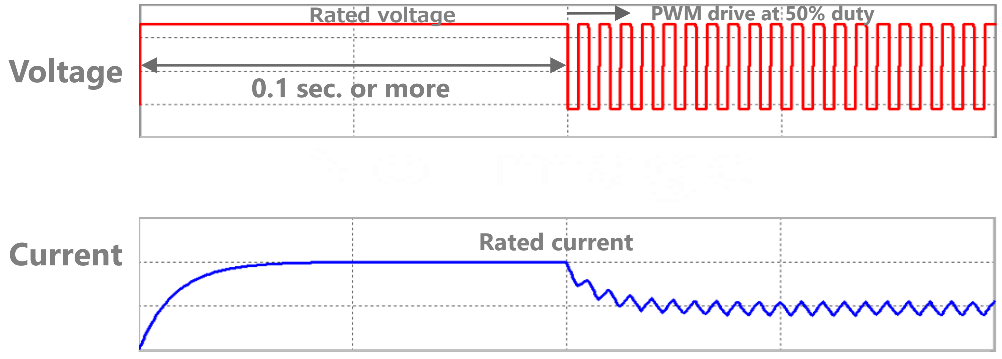

Figure 27: Example of coil voltage and current waveforms in PWM control circuits

Rated 400 VDC 20 A / 450 VDC 16 A (when 2-contact series connection) Bidirectionally switchable PCB power relay G5PZ-X

Figure 28 compares the coil currents at each duty ratio. A typical PWM circuit requires a duty ratio of 86% or more to keep the relay on. This causes the relay to generate more heat than in the recommended holding state because of the increased power consumption. The effect of power savings is also reduced.
On the other hand, the recommended PWM circuit can meet the criteria for holding coil current with a duty ratio of 45% or higher.

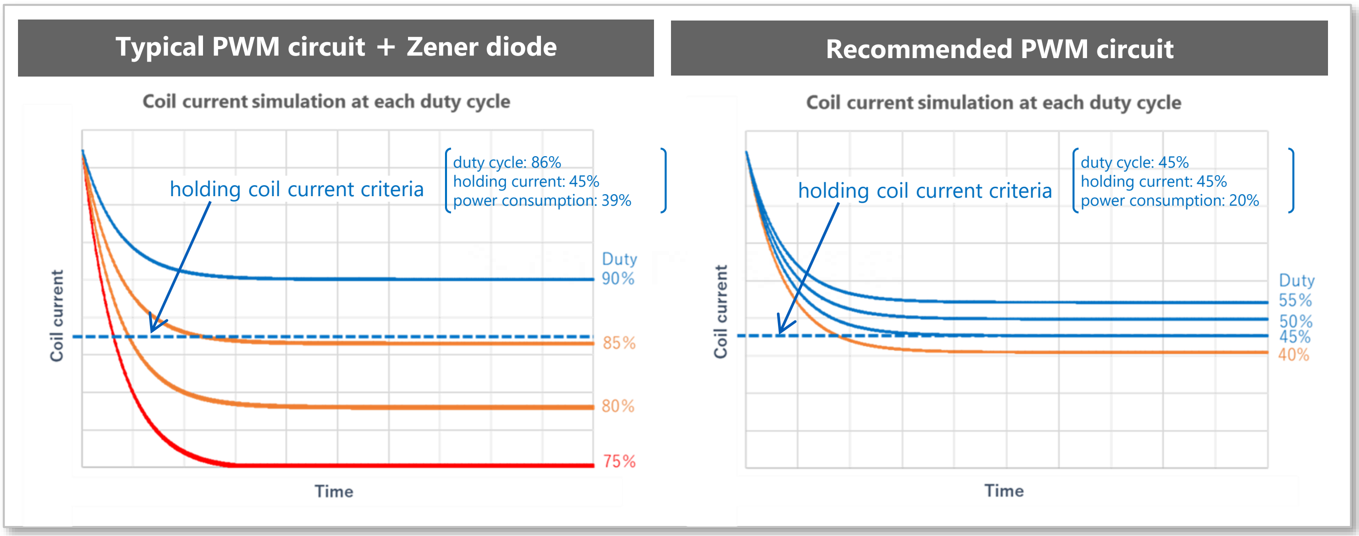

Figure 28: Reference circuit for PWM control circuit

White Paper

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