White Paper

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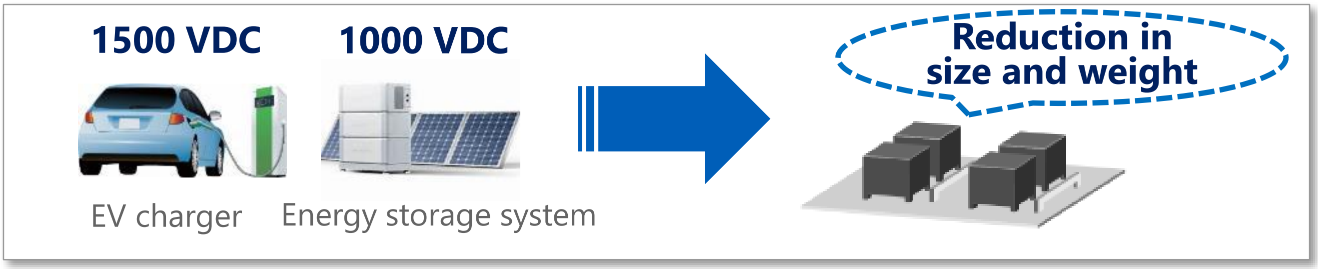
DC power relay G9KJ, significantly downsized through optimized specifications and specialized for precharge circuits

Summary

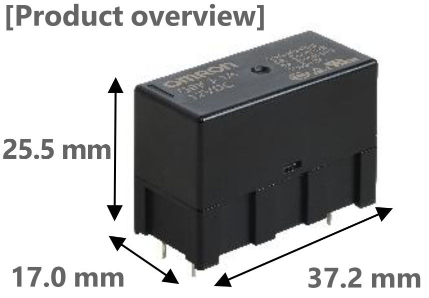
In recent years, energy-related equipment has become increasingly high voltage. For example, the maximum voltage standard for EV chargers has increased to 1500 VDC, and in energy storage systems, hybridization with solar power generation has led to the need for DC lines to be designed for 1000 VDC or higher. Although the capacity range continues to change significantly like this, the need for smaller and lighter equipment remains constant. However, relays capable of controlling high voltages and large currents are large in size, and it is common for multiple relays to be used on the same board, which poses the challenge that equipment also becomes larger as voltage and capacity increase.



[Figure 1: Market needs]

The G9KJ is a PCB relay optimized for precharge circuits in energy storage systems, EV quick chargers, power conditioners, and V2H applications operating at high voltages of 1000 to 1500 VDC.
By optimizing the specifications, we have achieved a significant reduction in size and weight compared to general screw-type relays.

[Product overview]



Contact type	SPST-NO (1a)
Rated load (resistive load)	1,500 VDC making 25 A, carrying 5 A, breaking 0 A 40 VDC 5 A
Rated carry current	5:00 AM
Max. switching voltage	Making: 1500 VDC Breaking: 40 VDC
Max. switching current	Making: 50 A, breaking: 5 A
Weight	Approx. 16 g

[Value proposition]

Precharge specialized relay: Achieves overwhelming compactness and weight reduction

[Major application examples]

[Figure 2: Specification overview, value proposition, and main applications]

Value Proposition (G9KJ)

<Overwhelmingly Compact Size & PCB Design>

As equipment capacity increases, electronic components capable of handling higher voltages are required. However, this increases the size of the components, which poses challenges for the weight and size of the entire equipment especially when multiple units are used. However, the G9KJ achieves a compact size that is normally unattainable in the range exceeding 1000 VDC by optimizing its specifications for the precharge circuit, contributing to a significant reduction in size and weight compared to conventional screw-type relays. Furthermore, the use of PCB terminals eliminates the need to fasten the relay with screws, enabling significant reductions in wiring work and wiring space.

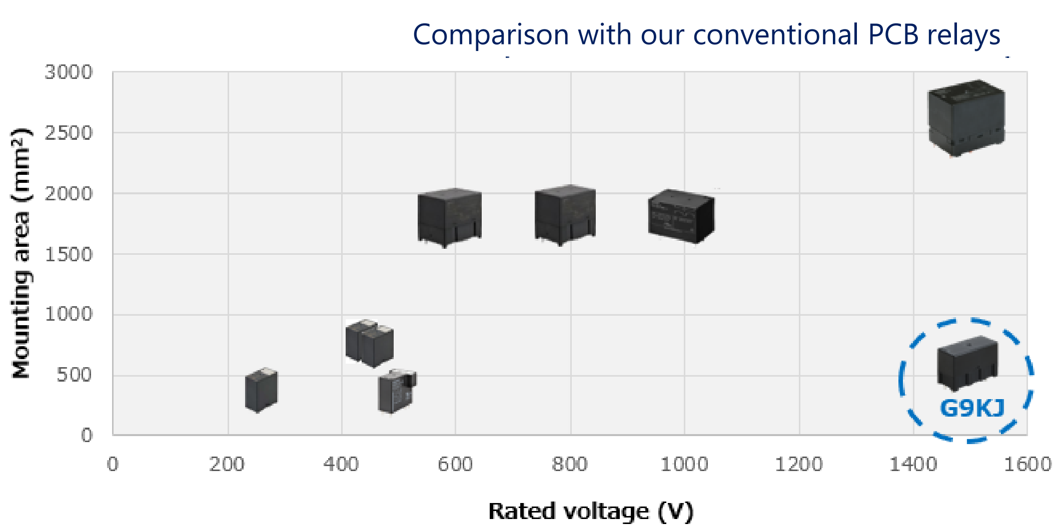
Screw-type relay (General screw-terminal relay rated for 1500 VDC)

G9KJ (PCB terminal relay rated for 1500 VDC)

	Screw-type relay	G9KJ
Mounting area	3100㎟	**600㎟** Approx.80% reduction
Volume	143520㎣	**16126㎣** Approx.89% reduction
Weight	Approx.160g	**Approx.16g** Approx.90% reduction

* According to OMRON's research in July 2025

[Figure 3: Performance comparison between a general screw-type relay and the G9KJ]



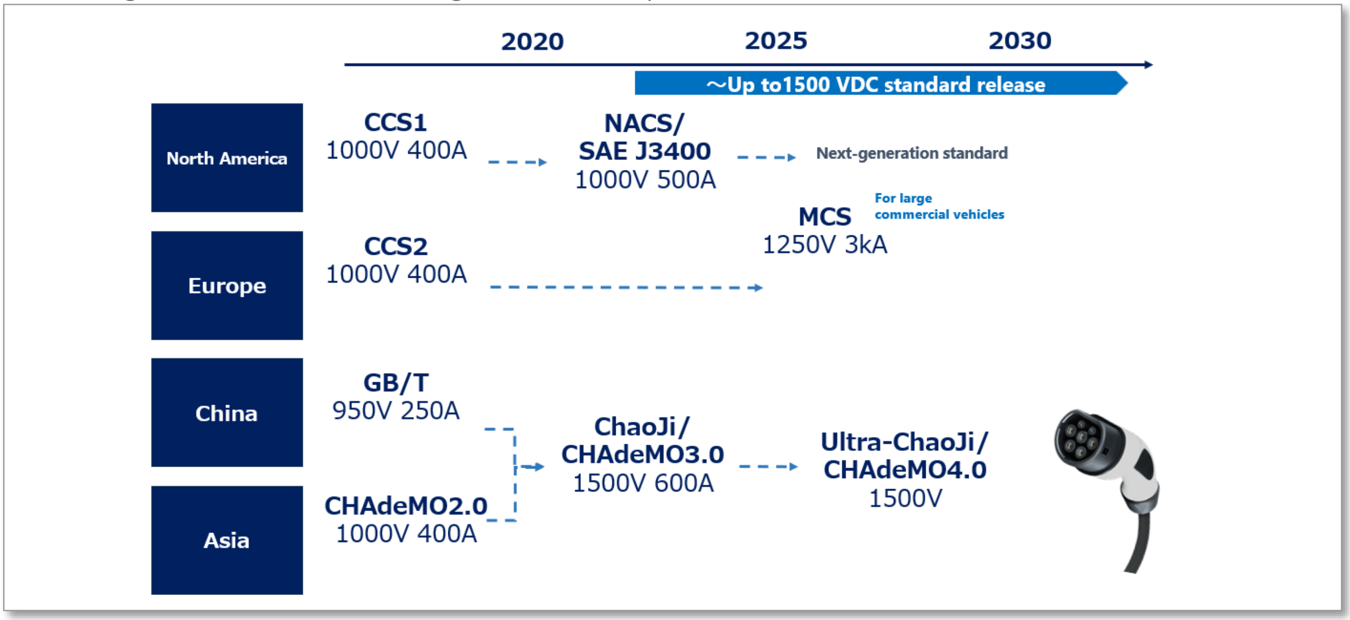
* According to OMRON's research in July 2025

[Figure 4: Comparison of rated voltage and mounting area]

Market Trends (EV Chargers)

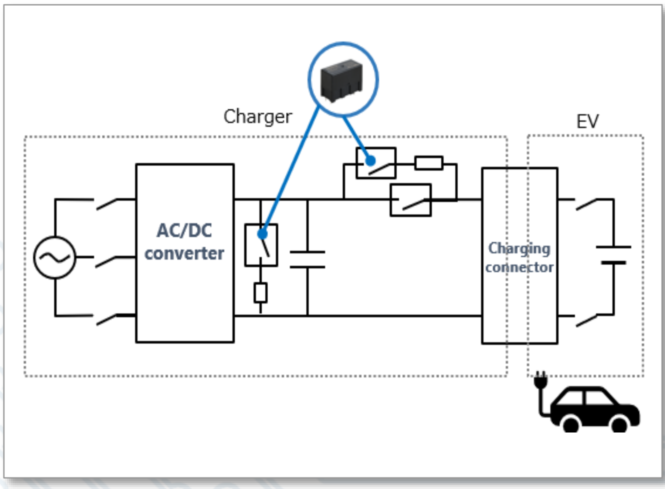
(1) EV Chargers

Since 2020, the voltage standard for EV chargers has begun transitioning to the 800 VDC range. Charging standards continue to expand further, and the likelihood of future expansion into the 1500 VDC range is increasing. Especially for public chargers, the need for the 1000 VDC range has already become apparent from the perspective of compatibility with all vehicle models and long-term use, and the next-generation 1500 VDC range is also anticipated.

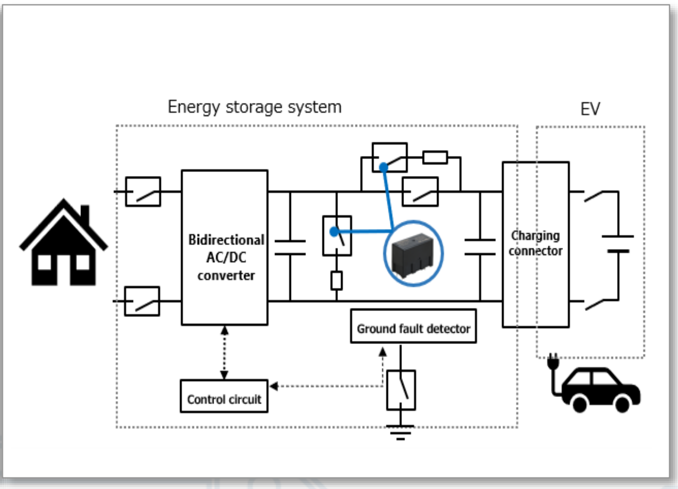


[Figure 5: Changes in EV charger capacity range]

The G9KJ can be considered for use in inrush current protection circuits and discharge circuits in EV quick chargers (Mode 4). It is a compact relay specifically designed for precharge applications and is significantly smaller in size than our conventional PCB relays and general screw-type relays.



[Figure 6: Application example (EV charger: Mode 4) and G9KJ installation locations]

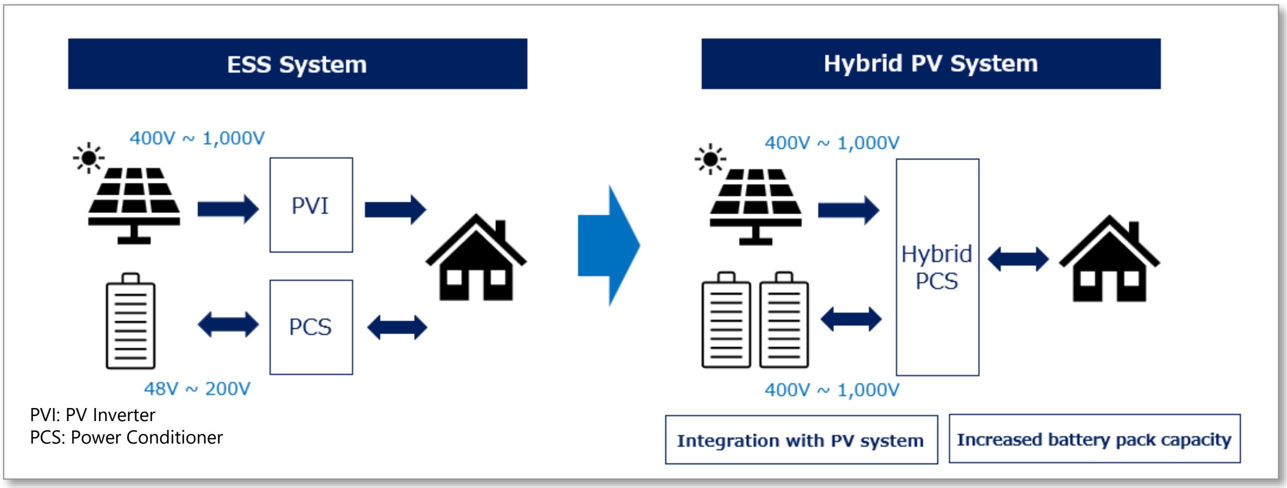


[Figure 7: Application example (V2H) and G9KJ installation locations]

Market Trends (Energy Storage Systems)

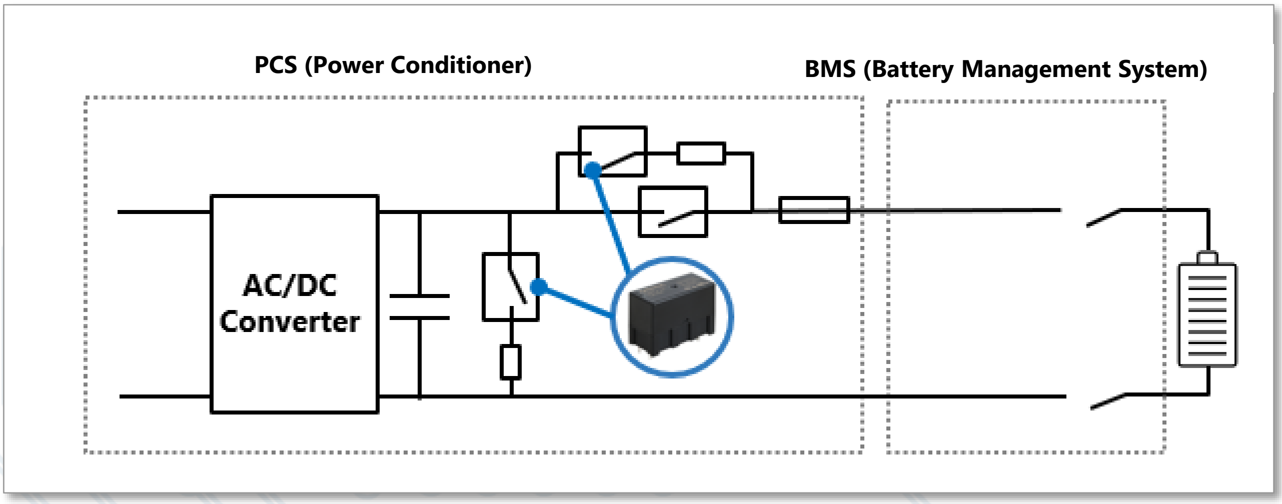
(2) Energy Storage Systems

Just like EV chargers, energy storage systems are also moving toward higher voltages. Due to hybridization with PV systems and safety standard requirements, the demand for 1000 VDC in home energy storage systems is becoming apparent.(See Figure 8) Similarly, the demand for 1500 VDC is becoming commonplace in large-scale energy storage systems as well. Increasing voltage levels not only improves energy conversion efficiency but also brings benefits in many areas including integration with EVs and renewable energy sources, and compliance with international standards.



[Figure 8: Changes in the capacity range of home energy storage system]

The G9KJ can be considered for use in the precharge circuit and discharge circuit within energy storage systems. It is a compact relay specifically designed for precharge applications, achieving a significant size reduction compared to our conventional PCB relays and general screw-type relays.



[Figure 9: Application example (energy storage system) and G9KJ installation locations]

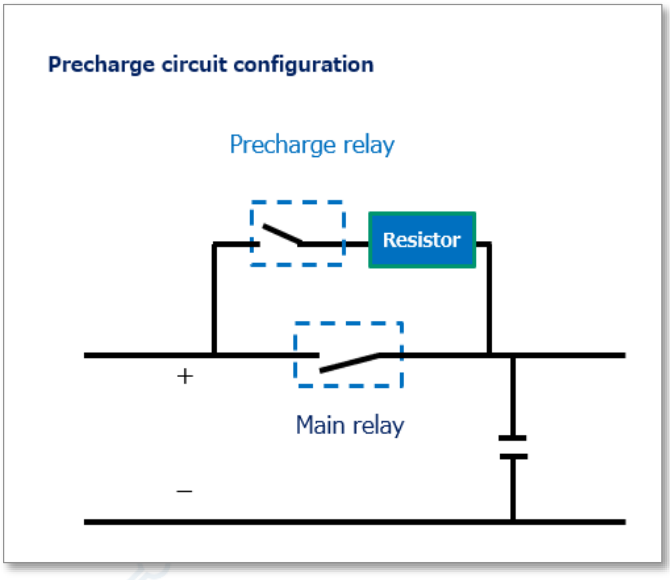
Precharge Circuit and the Role of G9KJ

<Precharge Circuit Configuration & Relay Load Characteristics>

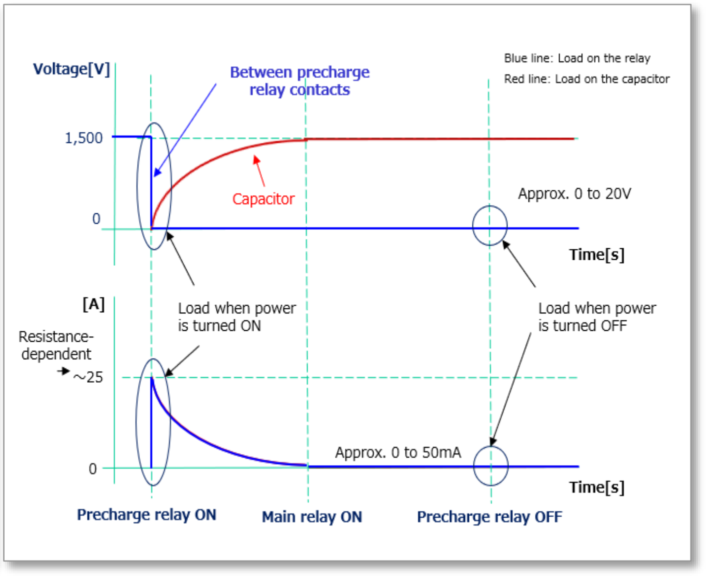
A precharge circuit is a circuit designed to prevent electronic components such as relays used to control electrical loads, from being damaged by the large current that flows instantaneously when power is applied.

The precharge circuit consists of a precharge relay and a resistor connected in parallel with the main relay. (See Figure 10)
The precharge relay operates in the following order: Precharge relay ON → Main relay ON → Precharge relay OFF. In this case, when power is turned ON, an input current load corresponding to the operating voltage and resistance occurs between the contacts of the precharge relay. However, power is turned OFF, current is still flowing through the main relay, causing the precharge relay to be in a no-load or nearly no-load condition. (See Figure 11)

The G9KJ has a minimum specification for handling load when power is turned OFF, but compared to the performance of conventional relays, this specification is optimized for precharge circuits capable of handling the instantaneous load when power is turned ON.



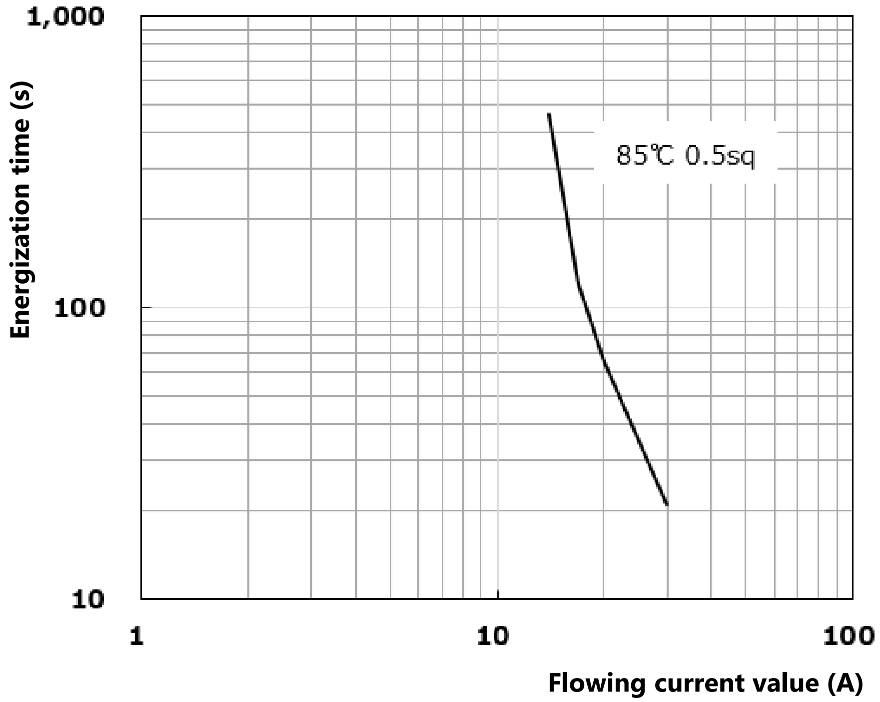
[Figure 10: Precharge circuit configuration]



[Figure 11: Precharge relay operation sequence]

Flowing Current vs. Energization Time Curve for G9KJ

The rated current of the G9KJ is 5A, but when actually used in a precharge circuit, a current greater than 5A will flow for several seconds to tens of seconds. The results of evaluating the current and duration for which this relay can be used are shown in the figure below. Please refer to this information when considering the use of this relay.



* According to OMRON's research in July 2025
Note: This graph shows only reference data based on evaluations conducted by our company and does not guarantee actual measured values.

[Figure 12: Flowing current vs. energization time curve]

Overseas Certification Ratings for G9KJ

The G9KJ has obtained UL/C-UL, TÜV, and CQC certifications. (See Figure 13) The certified ratings for overseas standards differ from the individually specified performance values, so please check them before use.

UL/C-ULRecognized: cURus (File No. E549211)

Model	Coil ratings	Contact ratings	Number of test operations
G9KJ-1A	12 VDC, 24 VDC	Making 25 A, carrying 5 A, breaking 0 A 1,500 VDC (Resistive) at 85°C	120,000
		40 VDC 5 A (Resistive) at 85°C	6,000

EN/IEC, TÜV Certificated: (Certificate No..R50690600)

Model	Coil ratings	Contact ratings	Number of test operations
G9KJ-1A	12 VDC, 24 VDC	Making 25 A, carrying 5 A, breaking 0 A 1,500 VDC (Resistive) at 85°C	120,000
		40 VDC 5 A (Resistive) at 85°C	6,000

CQC Certificated: CQC (Certificate No. CQC25002483924)

Model	Coil ratings	Contact ratings	Number of test operations
G9KJ-1A	12 VDC, 24 VDC	Making 25 A, carrying 5 A, breaking 0 A 1,500 VDC (Resistive) at 85°C	120,000
		40 VDC 5 A (Resistive) at 85°C	6,000

Insulation data		
Creepage distance - between coil and contact		25 mm min.
Clearance - between coil and contact		14 mm min.
Type of insulation - between coil and contact		Basic insulation
Type of interruption		Micro disconnection
Conditions of insulation data		
Material group of insulation		IIIa
Pollution degree (external environment of the relay)		3
Rated insulation voltage		1,500V (DC only)
Overvoltage category	Altitude up to 2,000 m	III
	Altitude up to 4,000 m	II
Other data		
Category of protection (IEC61810-1)		RTII
Flammability class (UL94)		V-0
Coil insulation system (UL1446)		Class B

[Figure 13: List of overseas standard certification ratings for G9KJ]

White Paper

Other Reference Materials

The support page providing more detailed information on how to select relays for pre-charge (inrush current protection) circuits in energy storage systems is available for your reference. Please refer to the following when making selections or encountering difficulties.

- OMRON America：https://components.omron.com/us-en/solutions/relays/high-capacity-relays/inrush-prevention-circuits
- OMRON Europe：https://components.omron.com/eu-en/solutions/relays/high-capacity-relays/inrush-prevention-circuits
- OMRON Asia Pacific：https://components.omron.com/sg-en/solutions/relays/high-capacity-relays/inrush-prevention-circuits

Additionally, the special page introducing the characteristics of each circuit and the lineup of compatible relays for EV chargers is available for your reference. Please make use of this as well.

- OMRON America：https://components.omron.com/us-en/solutions/relays/mode4
- OMRON Europe：https://components.omron.com/eu-en/solutions/relays/mode4
- OMRON Asia Pacific：https://components.omron.com/sg-en/solutions/relays/mode4

For the latest product specification information, please refer to the data sheet.

- OMRON America：https://components.omron.com/us-en/datasheet_pdf/K361-E1.pdf
- OMRON Europe：https://components.omron.com/eu-en/datasheet_pdf/K361-E1.pdf
- OMRON Asia Pacific：https://components.omron.com/sg-en/datasheet_pdf/K361-E1.pdf

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