White Paper

Issue Date: June 5th

G9KC, 4-pole High Power PCB Relay Switching 40 A 480 VAC

Introduction

As Electric Vehicles (EVs) become popular around the world, the demand for dependable EV Supply Equipment (EVSE) or EV Chargers are also increasing. However, it is still one of the hurdles for drivers to shift to EV with the concern for relying on finding charging stations that are available and performing well (range anxiety) whenever needed. To effectively reduce this concern, it is important to ensure more reliable and efficient charging spots and shorter charging times.

For these issues, Omron contribute to achieving high performance and compact/ light weight EVSEs by providing G9KC, a compact and low heat generation PCB relay.

For AC EV charging stations which are relatively inexpensive types of EVSEs, a 4-pole high power relay G9KC can be applicable to 22 kW of charging capability with its low heat generation.
The 4-pole structure of G9KC can replace larger multipole contactors and 3 or 4 single-pole relays with one G9KC for 3-phase (3-wire or 4-wire) power supply models.
Heat generated by switching and carrying devices for main current paths is one of major causes contributing to excessive temperature rise inside a charging station. The low contact resistance (the guaranteed initial contact resistance of less than 6 mΩ) of G9KC contributes towards preventing parts in a charging station from overheating which could cause a temporary charging power limitation.
Compared with contactors, G9KC can be mounted on printed circuit board (PCB), which contribute to smaller and lighter charging station design, saving labour cost in production by mounting/ wiring process automation and improving quality.

[Fig. 1 Picture of G9KC]

G9KC has been meticulously designed and developed to high Japanese standards meeting the demands for accelerating EV charging infrastructure deployment with confidence under full load conditions. Besides, G9KC can also be applicable for other applications as illustrated in Fig. 2.

[Fig. 2 Application examples]

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Contributing to EV/EV Supply Equipment Market

■ Policies and targets for future EV adoption

(According to our own research as of 20th May 2024)

Governments around the world are setting future targets for EV adoption.

Japan	100% of new car sales of light duty vehicles (LDV) should be Electrified Vehicles* by 2035.
USA	More than 35% of new car sales of LDV should be EVs by 2030.
EU	No new car sales of internal combustion engine (ICE) vehicles except for using e-fuel by 2035.
China	More than 50% of new car sales should be EV, PHV and FCV by 2035.

*Electrified Vehicle: Vehicles propelled by electric power including EV(Electric Vehicle), HEV(Hybrid Electric Vehicle), PHV(Plug-in Hybrid electric Vehicle), BEV(Battery Electric Vehicle) and FCV(Fuel-Cell Vehicle).

Charging infrastructure development is also important for EV adoption. Governments are setting targets and announcing supports for the development. The politic activities are accelerating investments on R&D and production for EV charging facilities.

Japan	30,000 spots of public fast EV chargers and 120,000 spots of public slow EV chargers installed by 2030.
USA	$7.5 billion subsidy program (CFI) for charging infrastructure development and targeting 500,000 spots of EV charging installed by 2030.
Germany	1 million spots of public EV charging spots installed by 2030.
China	2.5 million spots of EV charging in Shanghai by 2025. More than 2.3 millions of EV charging piles installed in Zhejiang by 2025, 900,000 spots of them installed in rural areas.

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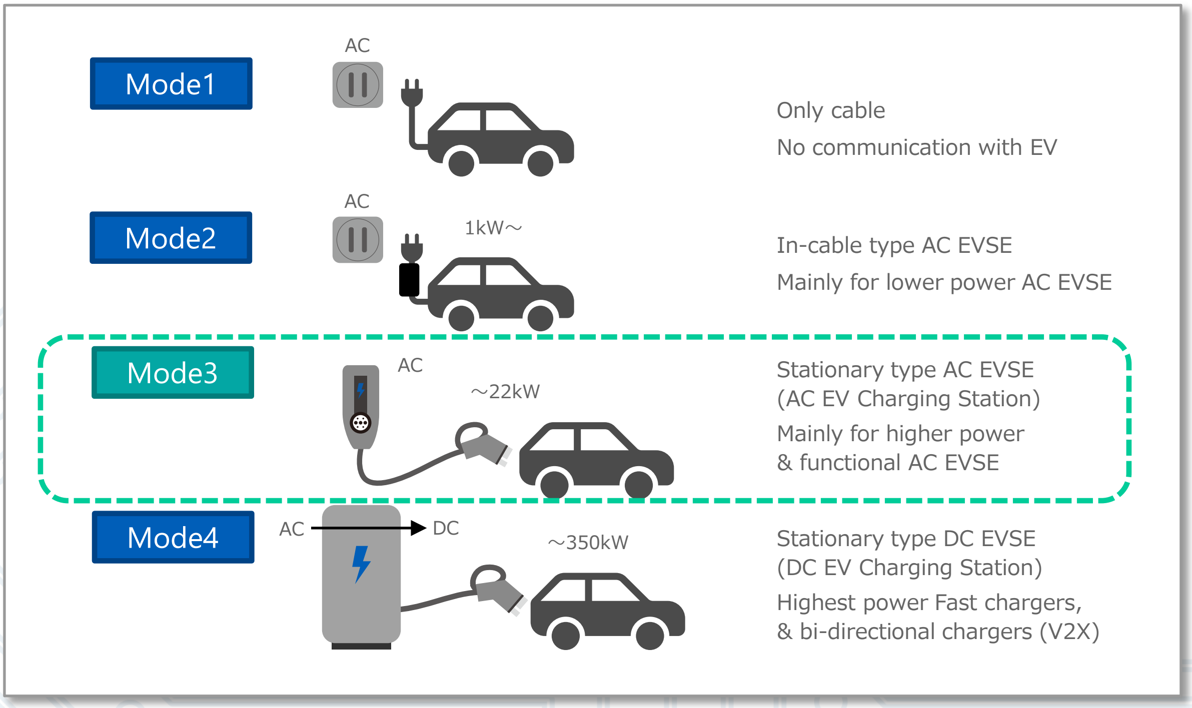
■ Classification of EV Supply Equipment (EVSE)

There are a variety of standards related to EVSE. IEC 61851-1 is one of major standards classifies EVSE into 4 charging modes as Mode 1 to 4.

Mode1	AC EV Supply Equipment	EVSE supplies AC electric power to EV. On-board charger (OBC) converts AC to DC and charges battery on EV.
Mode2		
Mode3		
Mode4	DC EV Supply Equipment	EVSE receives AC or DC electric power, converts it to DC, and directly charges battery on EV.

Although AC EVSE (Mode 1 to 3) is sometimes referred to as an EV charger, it is not a charger per se but instead is providing the switching under the control of the On-Board Charger (OBC). AC EVSEs are generally used or installed in houses, offices, shopping centers, etc. More than 90% of EVSEs installed in the market are AC EVSE on a unit basis (Reference: IEA EV Outlook).

Mode 1 is least adopted because it does not have safety communication with the EV. In-cable type Mode 2 and stationary type Mode 3 (also known as AC EV charging station) are major classes AC EVSEs. Note that G9KC has been designed and tested for stationary use *only*, suitable for Mode 3.



[Fig. 3 Classification of EVSE]

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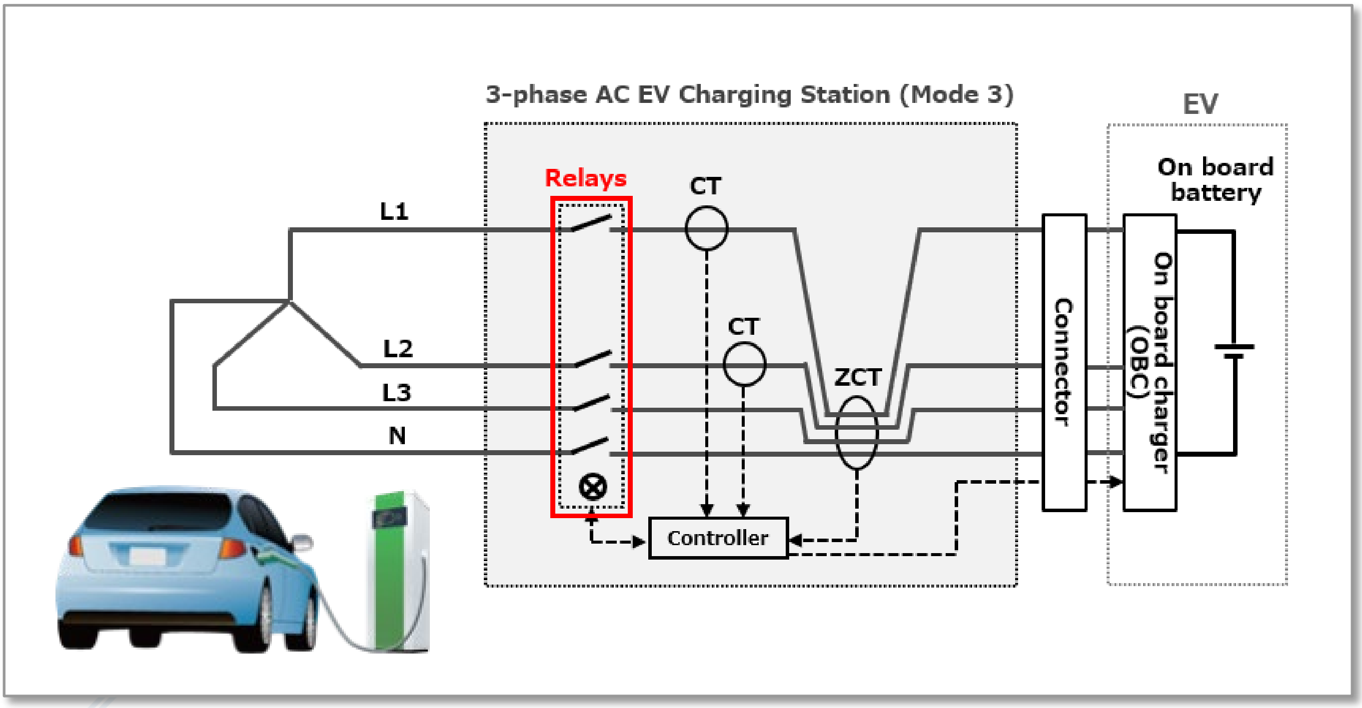
■ Typical configuration of AC EV charging station (Mode 3)

A 3-phase AC EV charging station can provide faster charging capability compared to a single-phase station. For 3-phase 4-wire electric power distribution system, a simultaneously 4-pole switching device is required to safely disconnect incoming AC supply. G9KC was expressly developed to meet the high electrotechnical demands especially for 3-phase AC EV charging station.

Fig. 4 shows a typical configuration of 3-phase AC EV charging station.

In some parts of northern and central Europe, 3-phase AC EV charging stations is fitted as standard in residential and increasingly in commercial, industrial (C&I) private and public areas where more efficient charging is highly desirable.



[Fig. 4 Typical Configuration of 3-phase AC EV Charging Station]

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■ IEC standards related to switching devices for AC EV charging station

IEC standards related to devices switching main current path in AC EV charging station (Mode 3), which are one of major applications for G9KC, include IEC 61851-1 and IEC 62955. Requirements with which G9KC is compliant are described below.

1. IEC 61851-1: Electric vehicle conductive charging system – Part 1: General requirements

a) Mode 1 to 4

Charging modes of Mode 1 to 4 are specified.

b) Characteristics of relay

Following characteristics are required for devices switching main current path.

- 50,000 cycles of switching with load of contact category CC 2.
- Withstanding 100 us of 230 A inrush current
- Clearance and creepage distance requirement base on IEC 60664-1

c) Fault detection

Monitoring of the switching contacts is recommended to protect against electric shock in case of fault of operation.

2. IEC 62955: Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles

a) Mechanically coupled multipole

All moving contacts of multipole detecting device shall be mechanically coupled so that all poles except the neutral make (first) and break (last) substantially together.

3-phase 4-wire distribution system is popular worldwide so 4-pole switching device to disconnect live lines at the same time is needed.

b) Short circuit current capability

AC EV charging station should have short circuit tests on specified conditions and should not be lead to dangerous situations while and after test procedures. Higher capacity 3-phase AC EV charging station mainly for EU market is generally required to have short circuit tests on the conditions based on rated current of 32 A and rated conditional short circuit current of 3 kA.

c) Minimum clearance between live parts (main contact gap)

Minimum clearance between live parts when main contacts are in the open position requires 3.0 mm (up to 2,000 m of altitude). For charging station specified at up to 3,000 m of altitude, 3.42 mm of minimum clearance is required considering a coefficient for higher altitude.

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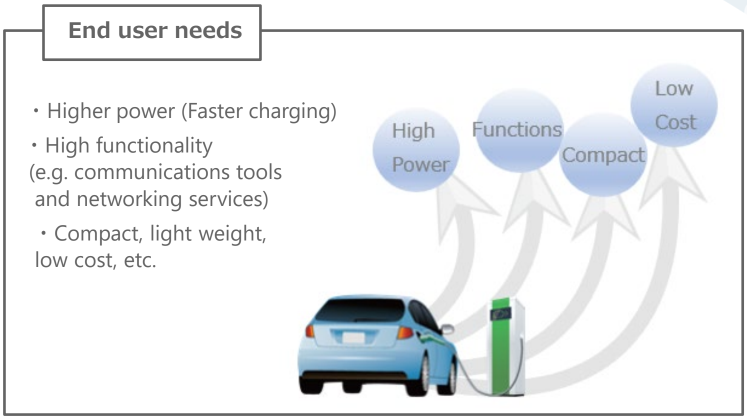
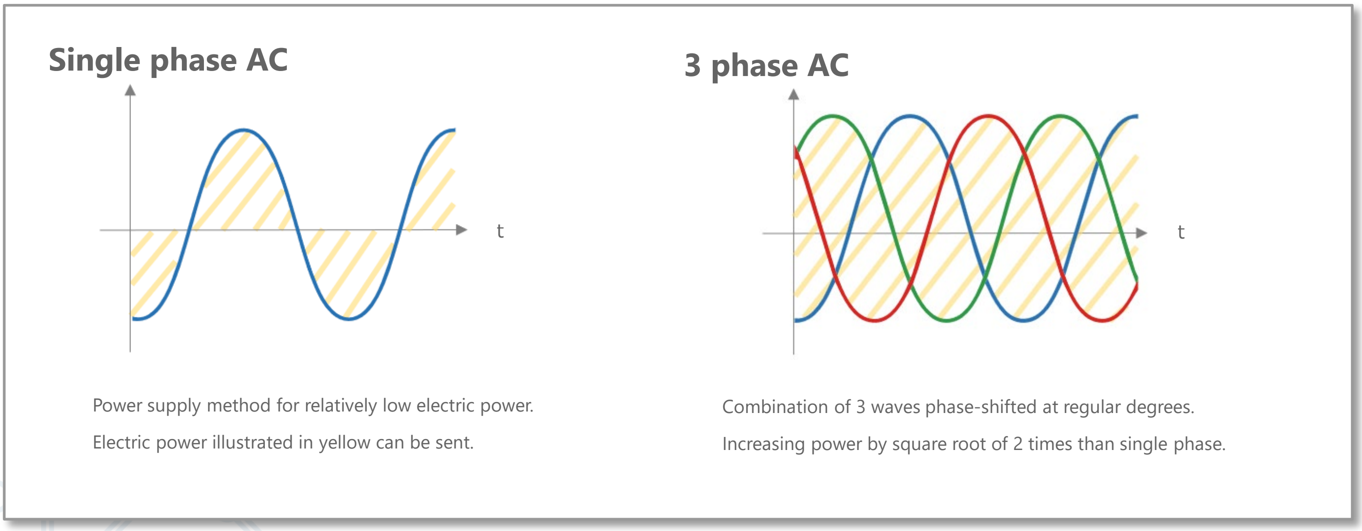
■ Competitive product needs

With the EV related market expected to see high growth, many suppliers are entering the market of AC EV charging station, which have a relatively simple structure and are easier to design. They need competitive products to survive in this market.



■ Needs for higher power AC EV charging station

In the development of charging infrastructure, in addition to increasing the number of charging stations, it is also important to improve charging speed, and higher power charging stations are required. For higher power providing by AC EV charging station, there are options to apply higher current or 3 phase power supply.



[Fig. 5 Single phase AC and 3 phase AC]

On the other hand, higher power designs generally require larger size and heavier weight, which could cause inconvenience and/ or higher costs to end users such as constraint of installation space, additional installation costs and permanently occupied space. Designers should consider to reduce size and weight to solve the issues.
G9KC contributes to solving the issues especially focusing on a range of 22 kW (32A) in high power AC EV charging stations.

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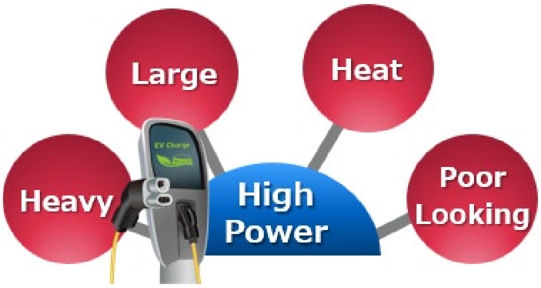
Design Issues for AC EV Charging Station

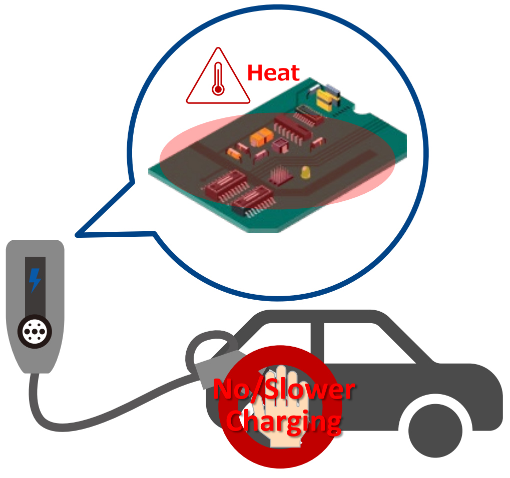
Major design issues for high power AC EV charging stations are as follows,

1. Thermal issues caused by heat generated inside a charging station

For faster charging, higher charging current is required. The higher charging current often requires higher rating electronic parts and heat dissipation parts, which can result in larger less appealing charger designs to users. Recently, stylish and compact charging stations have been released into the market and designers are looking for higher rating and smaller parts to compete with them.

PCB relays have until recently generally had higher contact resistance than contactors. Applying relays to main current paths of higher power charging stations could have a risk of over temperature for electronic parts inside the charging stations caused by heat generation from relays. AC EV charging stations which do not have parts generating a lot of heat like power converters are generally designed based on convection cooling (no forced air or fan). Typically, AC EV charging stations are manufactured to an IP54 semi-sealed and IK08 impact rating, Installed on a wall outside further contributes to the potential of heat build-up insider the chargers enclosure.





Temperature inside charging station rises by heat generated from a relay and the station stops charging or limits charging power temporarily, which cause slower charging speed.

In general EV charging stations have temperature sensors inside providing a protecting function to stop charging or to reduce charging current temporarily while the monitored temperature is over the threshold. So whilst the functions of over temperature protection or charging current limitation, charging stations can prevent internal parts from having a failure but end users experience inconvenience not being able to charge or at a lower rates leading to an extended charge time.

Selection of lower contact resistance relays to reduce heat generation and keep inner temperature low when designers aim to use PCB relays. Of course, it is important to have a low contact resistance not only at the initial but also throughout the expected lifetime.

[Fig. 6 Image of slower charging caused by relay heat generation]

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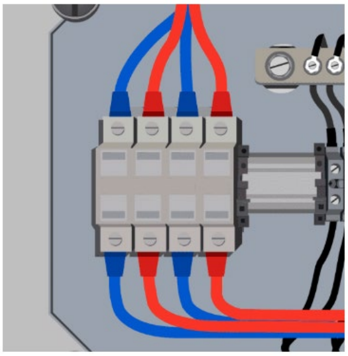
2. Productivity and cost issues

Contactors are commonly used to switch high current paths in industrial equipment including EV charging station. However, fixing and wiring contactors with screws requires more assembly man-hours and production costs than PCB relays. To survive in growing but competitive EV charging station market, charging station suppliers need to reduce costs and improve their production capacity.



3. Product safety issues

An AC EV charging station breaks the main path relay switching device while not charging to prevent end users from getting electric shock by accidentally touching connector terminals. However, in case the relay switching device has a failure and is welded in a closed position, it could cause a dangerous incident. To keep end users safe, it is important to detect the abnormal situation and quickly notify end users of the situation such as by displaying and ringing an alarm not to use it.

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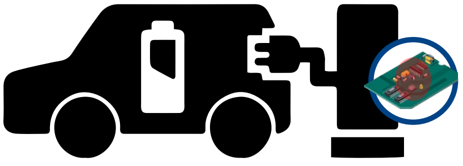
Solutions for Design Issues

G9KC will provide the following solutions to above mentioned issues.

1. Solutions to thermal issues for higher power and compact stations

- **For higher power**

G9KC has an initial contact resistance of ≤6 mΩ guaranteed. It is lower than that of other 4-pole PCB relays with same/ similar contact ratings in the market. Besides, not only at initial, G9KC will keep its lower contact resistance stably with no critical increase during and after electrical endurance tests. With low contact resistance, G9KC has the possibility with good PCB design to generate less heat. Lower temperature rise inside has the potential to reduce the number of operating cycles limiting charging power contributing to keep high charging performance. In addition, lower temperature rise also contributes to extended electrical life.



Keeping high charging performance by selecting relay with low heat generation.

- **For compact size**

Commonly, selecting higher rating electric parts will make a charging station heavier and larger. PCB relays are generally smaller and lighter than contactors and can reduce cabling and the number of screws and cables in a station. By replacing contactors with G9KC relays, it's possible to make charging stations smaller.

Overall, G9KC contributes to providing higher power, smaller and lighter charging stations, and reducing product costs and installation costs.

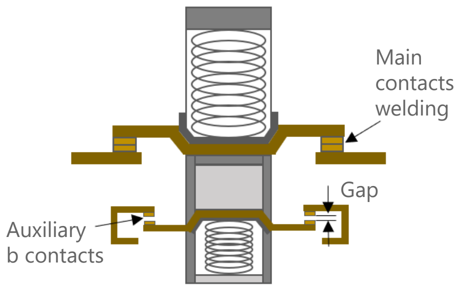
2. Solutions to productivity and cost issues

G9KC is designed to be used on PCB and contributes to production process automation, which in turn brings benefits such as less assembly costs, higher productivity and reducing human errors.

3. Solutions to product safety issues

G9KC has an auxiliary contact option (G9KC-4A1B only). By utilizing an auxiliary contact, it is possible to constantly monitor open/ close status of main contacts and detect an abnormal situation. This integration of mechanical conductive path detection of main load contact welding failure is preferred over all other detection methods and is simper and more cost effective to apply. The utilization of a type B Auxiliary contact can provide a reliable main load contact weld detection solution as required by IEC61851.

G9KC includes an auxiliary contact structure (called as mirror contact structure) fully compliant with IEC 60947-4-1 Annex F (F.7.2), which requires main contacts and auxiliary contacts mechanically linked and more than 0.5 mm of contact gap between auxiliary contacts when main contacts have a welding failure. With this reliable monitoring method, G9KC can contribute to keeping end users safe.



With a link of main contacts and auxiliary contacts, auxiliary contacts should keep impulse withstanding voltage of 2.5kV or contact gap of 0.5 mm between open contacts with no coil excitation when main contacts have a welding failure.

[Fig. 7 Image of mirror contact structure]

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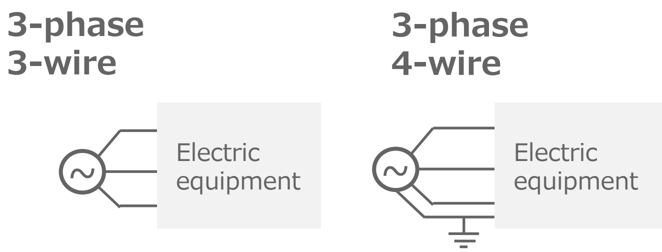
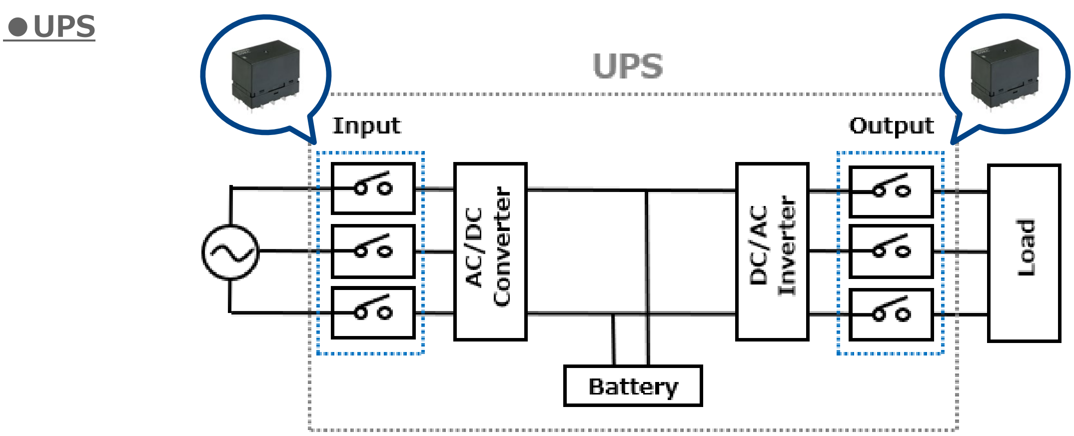
Potential Applications Other than EV Charging Station

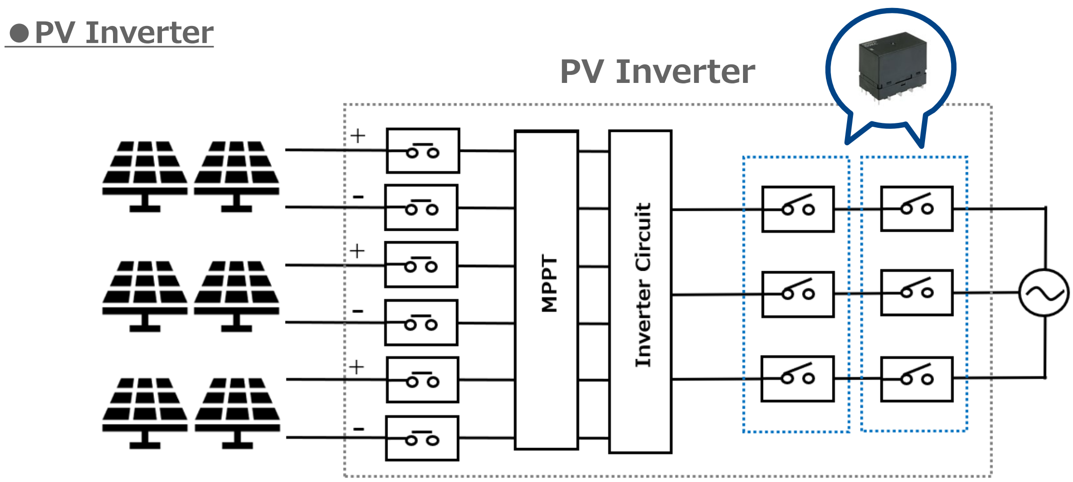
G9KC can contribute to switching main current paths of 3-phase 3-wire or 4-wire power supply for safety in various applications other than EVSE. For example, G9KC could be applied for switching input and output main current paths in UPS and switching output current paths to the grid in PV inverters.



Application Examples

- Multiphase EV Charger
- Solar PV Inverter/ Hybrid Inverter
- Commercial & Industrial (C&I) Inverter/ Converter
- Uninterruptable Power Supply (UPS)
- Balance of System (BOS)
- Battery Energy Storage Systems (BESS)
- Diversified and bidirectional DC charging systems





[Fig. 8 Schematic diagrams of G9KC applications]

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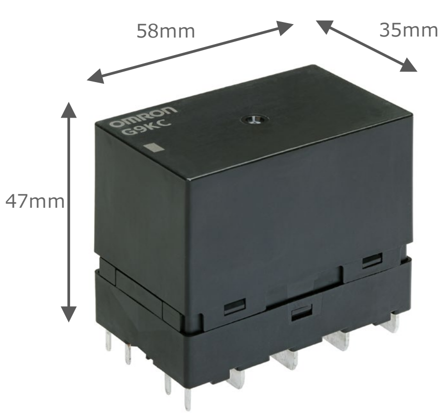
Specifications of G9KC

G9KC provides switching main current paths of 3-phase 3-wire or 4-wire power supply for safety in various applications other than EVSE. For example, G9KC could be applied for switching input and output main current paths in UPS and switching output current paths to the grid in PV inverters.

G9KC is a compact 4-pole 40 A high power PCB relay whose volume is 57% of our 4-pole 40 A contactor's volume (according to our own research as of April 2024). The guaranteed initial contact resistance of G9KC is less than ≤6 mΩ, although the guaranteed contact resistance of other 40A relays in the market are 10 to 100 mΩ max. Actual contact resistances measured by voltage drop method on 40 A 5 VDC (after 3 min.) for main contacts and 1 A 5 VDC for auxiliary contacts were around 0.6 to 1.0 mΩ. (Refer to Fig. 13 for the data).

G9KC has normally-closed auxiliary contacts (as an option) compliant with the mirror contact structure specified by IEC 60947-4-1 Annex F (F.7.2). By utilizing the auxiliary contacts, equipment with G9KC can detect a failure of the relay main contacts instantly and stop the operation safely.

G9KC passed the short circuit tests specified by IEC 62955 which is one of safety standards related to AC EV charging station (Mode 3).



Product Type：
G9KC-4A/ G9KC-4A1B

項目		G9KC-4A	G9KC-4A1B
Coil	Coil voltage	12VDC, 24VDC	12VDC, 24VDC
	Power consumption	Approx.5,000mW (Approx.613mW(when applying holding voltage at 35%))	Approx.5,000mW (Approx.613mW（when applying holding voltage at 35%）)
Contacts	Contact form	4PST-NO (4a)	4PST-NO (4a) + SPST-NC (1b)
	Rated load (resistive)	Main contact : 480VAC 40A/277VAC 32A	Main contact : 480VAC 40A/277VAC 32A Auxiliary contact : 277VAC 1A/30VDC 1A
	Contact resistance	Main contact : 6mΩ max.	Main contact : 6mΩ max. Auxiliary contact : 100mΩ max.
	Contact gap	Main contact : 3.6mm min.	Main contact : 3.6mm min.
Durability	Mechanical	1,000,000 operations min (at 10,800 operations/h)	100,000 operations min (at 10,800 operations/h)
	Electrical (Resistive)	Main contact: 32 A at 277 VAC 50,000 operations min. 40 A at 480 VAC 30,000 operations min. (Switching frequency: 1 second ON - 9 seconds OFF)	Main contact: 32 A at 277 VAC 50,000 operations min. 40 A at 480 VAC 30,000 operations min. Auxiliary contact: 1 A at 277 VAC 100,000 operations min. 1 A at 30 VDC 100,000 operations min. (Switching frequency: 1 second ON - 9 seconds OFF)
Ambient operating temperature		40°C to 85°C (with no icing or condensation)	40°C to 85°C (with no icing or condensation)
Terminal type		PCB	PCB
Safety Standard Approval		UL/C-UL, TUV, CQC	UL/C-UL, TUV, CQC

[Fig. 9 Product specifications of G9KC]

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Approval Standard and Insulation Performance

G9KC has been approved by safety standard certification authorities of UL/C-UL, TUV and CQC (Fig. 10). Approved ratings by those authorities could be different from ratings specified by Omron so please confirm them before use.

UL/C-UL Certificated: cULus (File No. E41515)

Model	Contact form	Coil ratings	Contact ratings	Number of test operations
G9KC-4A	4a	12, 24 VDC *1	277 VAC 32 A (Resistive) 85°C	50,000
			277 VAC 40 A (Resistive) 85°C	30,000
G9KC-4A1B	4a	12, 24 VDC *1	277 VAC 32 A (Resistive) 85°C	50,000
			277 VAC 40 A (Resistive) 85°C	30,000
	1b	12, 24 VDC *1	277 VAC 1 A (Resistive) 85°C	100,000
			30 VDC 1 A (Resistive) 85°C	100,000

*1. Holding voltage of 35% (after applying rated voltage to coil for 0.1 seconds)

EN/IEC, TÜV Certificated: (Certificate No. R50624494)

Model	Contact form	Coil ratings	Contact ratings	Number of test operations
G9KC-4A	4a	12, 24 VDC *1	277 VAC 32 A (Resistive) 85°C	50,000
			480 VAC 40 A (Resistive) 85°C	30,000
G9KC-4A1B	4a	12, 24 VDC *1	277 VAC 32 A (Resistive) 85°C	50,000
			480 VAC 40 A (Resistive) 85°C	30,000
	1b	12, 24 VDC *1	277 VAC 1 A (Resistive) 85°C	100,000
			30 VDC 1 A (Resistive) 85°C	100,000

*1. Holding voltage of 35% (after applying rated voltage to coil for 0.1 seconds)

CQC Certificated: CQC (Certificate No. CQC24002430461)

Model	Contact form	Coil ratings	Contact ratings	Number of test operations
G9KC-4A	4a	12, 24 VDC *1	277 VAC 32 A (Resistive) 85°C	50,000
			480 VAC 40 A (Resistive) 85°C	30,000
G9KC-4A1B	4a	12, 24 VDC *1	277 VAC 32 A (Resistive) 85°C	50,000
			480 VAC 40 A (Resistive) 85°C	30,000
	1b	12, 24 VDC *1	277 VAC 1 A (Resistive) 85°C	100,000
			30 VDC 1 A (Resistive) 85°C	100,000

*1. Holding voltage of 35% (after applying rated voltage to coil for 0.1 seconds)

Creepage distance (requirement value)		8 mm min. (Between main contacts and coil)
Clearance (requirement value)		6.3 mm min. (Between main contacts and coil)
Insulation material group		IIIa
Type of insulation	between contacts and coil	Basic (480 V, OV-cat.III, Pollution degree 3) (Main contact)
	between open contacts	Micro disconnection at 480 V and Full disconnection at 277 V (Main contact)
Rated insulation system		277 V / 480 V (Main contact)
Rated voltage system		277 V / 480 V (Main contact)
Category of protection (IEC61810-1)		RTII
Flammability class (UL94)		V-0
Coil insulation system (UL)		Class F

Compliant Standard

IEC62955:2018

Main contact: 9.11.2.3 a) + 9.11.2.2

Main contact: 9.11.2.3 b) + 9.11.2.3 c)

I_p = 1.85 kA, I^2t = 4.5 kA^2s ($I_n \le 32$ A, I_{nc} and $I_{\Delta c}$ = 3 kA)

I_m = 500 A, U = 277 VAC

[Fig. 10 Approved/compliant ratings and insulation conditions]

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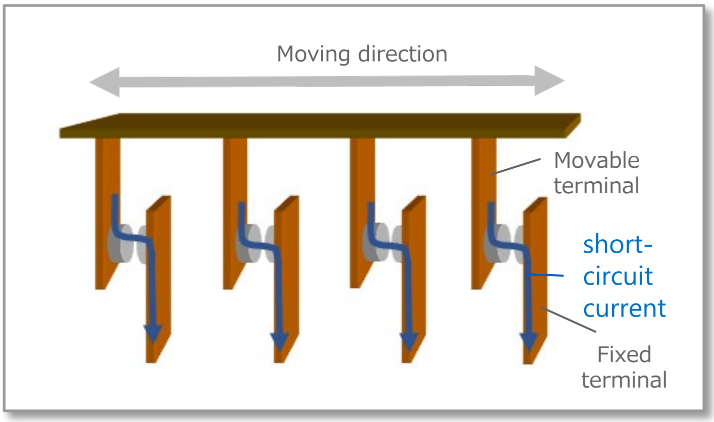
Solutions for Design Issues

● Low contact resistance at initial and even after electrical endurance test

G9KC has a strength in lower contact resistance at initial and even after electrical endurance test compared to other relays with same/ similar contact ratings in the market by utilizing our own contact force design (According to our own research as of May 2024). G9KC can contribute to keeping high charging performance and compact size design of AC EV charging station by generating lower heat from its lower contact resistance. (Refer to Fig. 13, Fig. 14 and Fig. 15 for actual measured data).

● Design for IEC 62955 compliant

G9KC has been designed as a mechanically coupled 4-pole structure. In addition, it has been designed and tested to have a short circuit capability on the conditions of 3 kA conditional rated short current and 32 A rated current specified by IEC 62955.

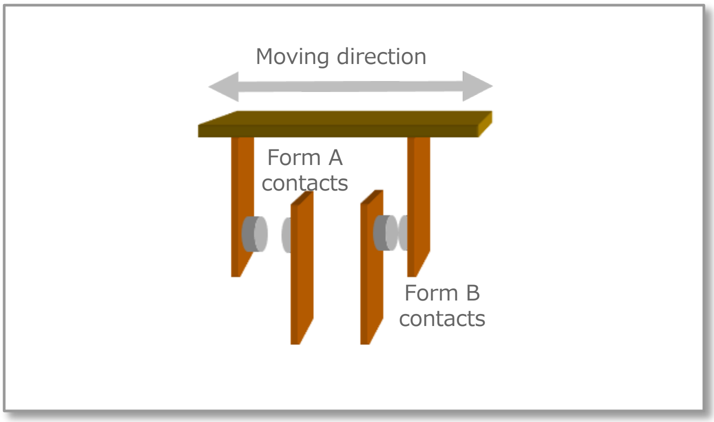


[Fig. 11 Image of mechanically coupled 4-pole structure]

● Design for IEC 61851-1 compliant

G9KC has been designed and tested to meet 50,000 cycles of electrical endurance required by IEC 61851-1 on the condition of 32 A 277 VAC.

Additionally, an auxiliary contact option which is compliant with mirror contact structure specified by IEC 60947-4-1 is useful to monitor main load contact status specified by IEC 61851-1.



[Fig. 12 Image of mirror contact structure]

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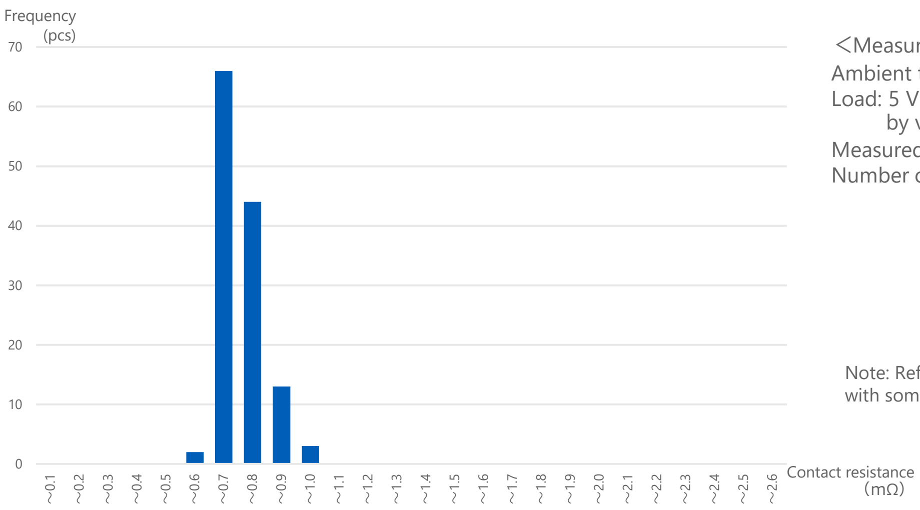
Distribution of G9KC Initial Contact Resistance Data

Contact resistance is one of key characteristics for high power relays, which mainly causes temperature rise of parts inside and outside a relay while applying high current. Lower contact resistance makes less heat stress in solder on terminals and parts surrounding the relay, which can with good design practice improve the reliability of PCB design.

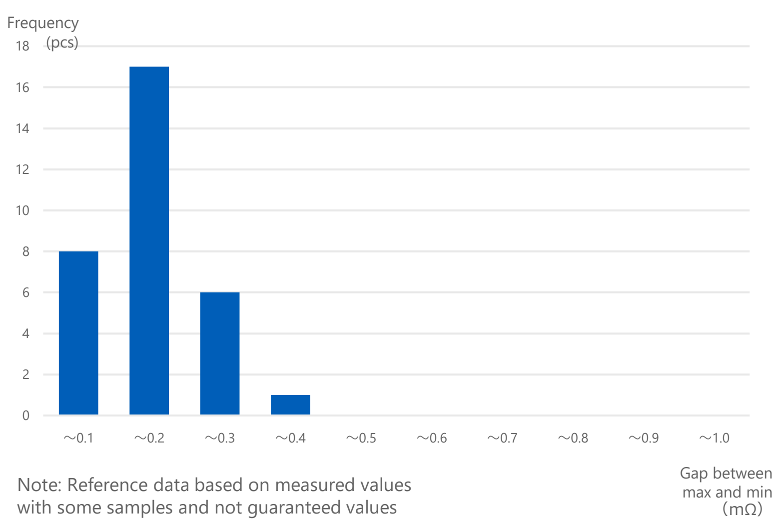
G9KC exhibits initial low, stable contact resistance. Typical spread of contact resistance under full load conditions is around 0.6 – 1.0 mΩ.



<Measuring conditions for contact resistance>
Ambient temperature: 23℃
Load: 5 VDC 40 A
by voltage drop method
Measured timing: after 3 min
Number of samples: 32 relays (128 contacts)

Note: Reference data based on measured values with some samples and not guaranteed values.

[Fig. 13 Distribution of G9KC initial contact resistances data]



Note: Reference data based on measured values with some samples and not guaranteed values

[Fig. 14 Distribution of gaps between max. and min. contact resistances in a relay of G9KC]

As a result of initial contact resistance measurement with 32 pcs (128 contacts) of G9KC, the average value was around 0.71 mΩ and the maximum variation between all contact sets is 0.15 mΩ.

Omron provides stable high quality relays with our own accumulated technologies.

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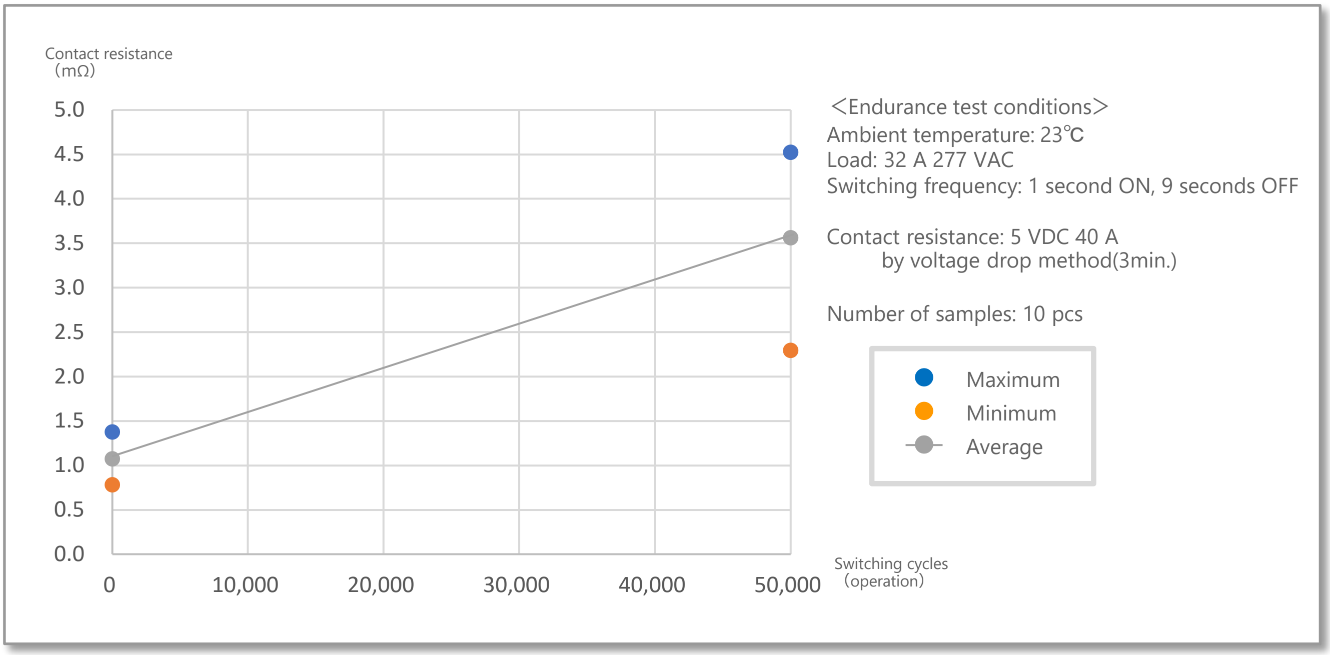
Contact Resistance Data before/after Electrical Endurance Test

Contact resistances are increasing by deterioration of contacts after switching. Our own accumulated technologies with rich experience in mechanical design, material design and manufacturing of relays can achieve smaller contact resistance rise in G9KC after electrical endurance test. Fig. 15 reveals around 3.5 mΩ of average contact resistance after 50,000 cycles of switching on the load of 32 A 277 VAC.



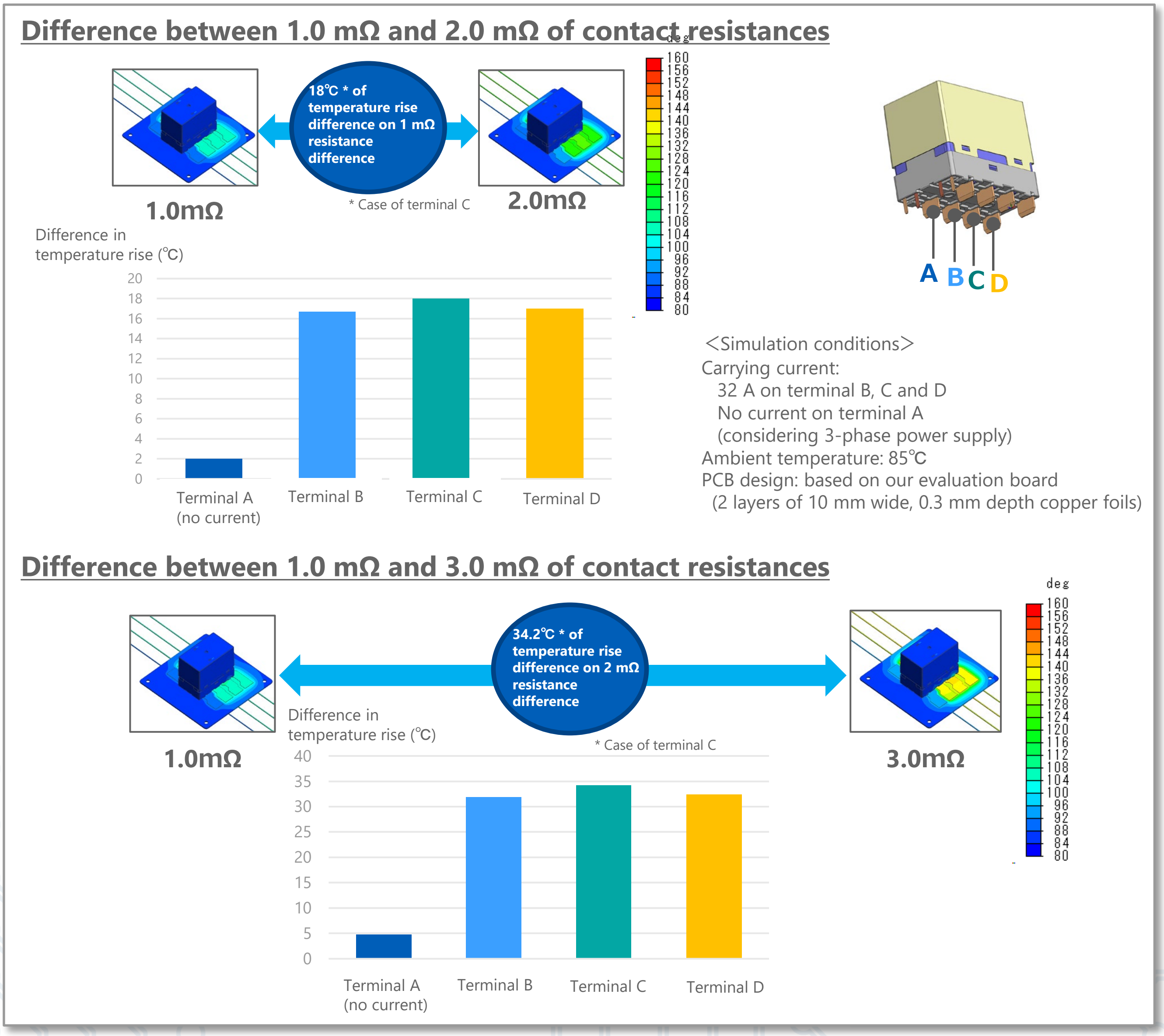
[Fig. 15 Contact resistances of G9KC after electrical endurance test]

G9KC, 4-pole High Power PCB Relay Switching 40 A 480 VAC

Thermal Simulation on relay terminal temperature

The difference in contact resistance greatly affects amount of heat generated by a relay. Fig. 16 shows temperature rises on relay terminals and temperature distribution around relay terminals on the conditions of 1 mΩ, 2 mΩ, and 3 mΩ of contact resistance.

The difference of temperature rises on terminal C which has a largest difference is calculated as 18℃ comparing 2.0 mΩ case to 1.0 mΩ case (1 mΩ of difference), 34.2℃ comparing 3.0 mΩ case to 1.0 mΩ case (2 mΩ of difference). The simulation results explain even the difference of 1 mΩ can make a significant change in temperatures on relay terminals.



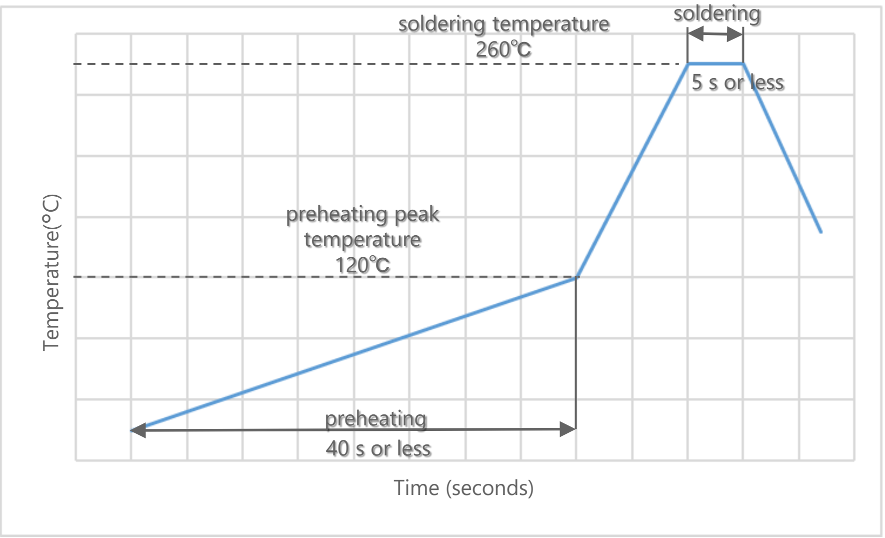
[Fig.16 Thermal simulation results considering difference in contact resistances]

G9KC, 4-pole High Power PCB Relay Switching 40 A 480 VAC

Soldering conditions for mounting G9KC on PCB

High power relays such as G9KC which carry continuously applied high carry current require large terminals to prevent overheating. However, a large terminal requires care and attention to ensure good solderability.

With a flow soldering machine, follow the temperature profile shown in Fig. 17 on the backside of PCB.



Note: This is just a reference information based on our evaluation and not guarantees proper soldering conditions. Please evaluate it by yourself to find a proper condition in your application.

[Fig. 17 Temperature profile for Flow solder mounting on backside of PCB]

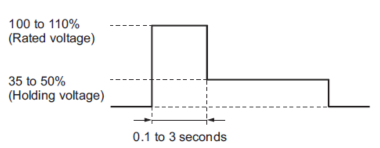
Ensure a solder bath, solders terminals of G9KC at 280 ℃ for 20 seconds or less.

G9KC, 4-pole High Power PCB Relay Switching 40 A 480 VAC

Recommended Drive Circuit

G9KC should be used with reduced coil holding voltage. With coil voltage reduction, a coil power consumption can be saved to approx. 0.6 to 1.3 W at 35% to 50% holding voltage, although a power consumption at rated voltage is approx. 5.0 to 6.0 W.

While a relay is turned on (excited), its coil keeps consuming energy. Especially for applications which keep a relay turned on for a long time can have the benefit of power saving by reducing the coil voltage to a range of holding voltage after rated voltage applied for a short time.



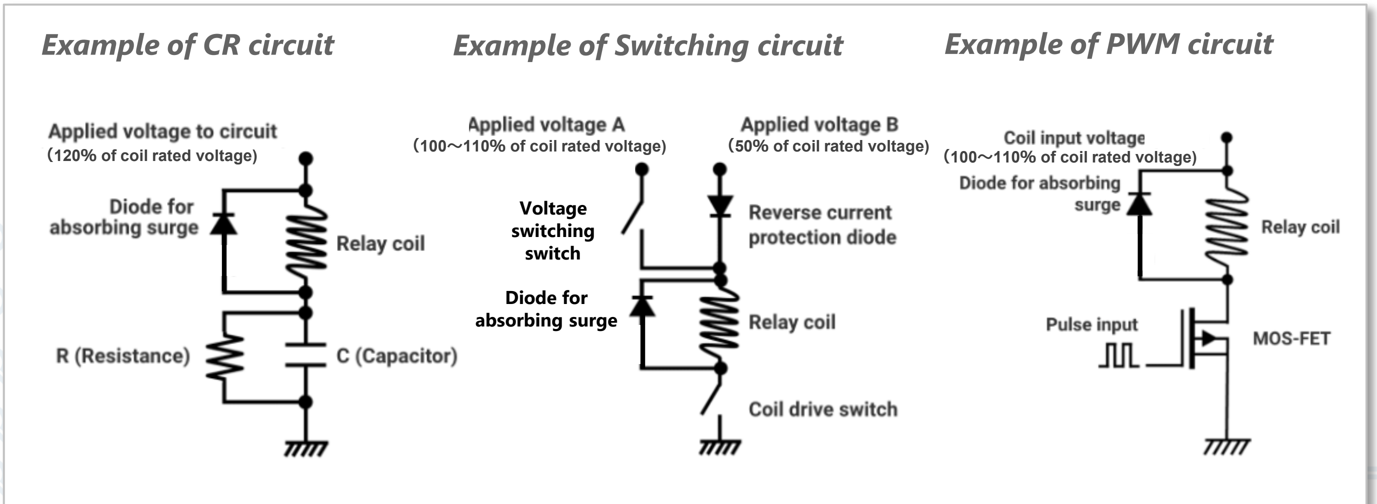
	Applied coil voltage	Coil resistance ✻	Coil power consumption
Rated voltage	100 to 110%	28.8 Ω (DC12) 115 Ω (DC24)	Approx. 5 to 6 W
Holding voltage	35 to 50%		Approx. 0.6 to 1.3 W

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

[Fig. 18 Coil voltage reduction (holding voltage)]

When turning G9KC on, apply 100 to 110% of rated voltage to coil for 0.1 to 3.0 seconds first, then reduce the voltage to 35 to 50% of rated voltage (Fig.18).

There are some ways to design the holding voltage circuit such as the CR circuit composed of capacitor and resistor, the switching circuit composed of switching device and resistor, and the PWM circuit controlling the coil power by high frequency switching with semiconductor switching device (Fig. 19).



[Fig. 19 Examples of holding voltage circuits]

G9KC, 4-pole High Power PCB Relay Switching 40 A 480 VAC

Other related materials

As electric vehicles (EV) markets are seeing rapid growth, the demand for high performance EV charging stations which can provide useful and energy-efficient charging experiences are increasing. This website will give you solution examples with G9KC for issues which EV charging station designs are facing.

https://components.omron.com/us-en/solutions/relays/G9KC

The technical support website for high power relays answering frequently asked questions such as counter electromotive voltage of coils, holding voltage, and the effects of magnetic fields when DC relays are used. Please also visit the site for your help.

https://components.omron.com/us-en/solutions/relays/power-relays-support

White Paper

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G9KC, 4-pole High Power PCB Relay Switching 40 A 480 VAC

For the latest product specification information, please refer to the G9KC datasheet.

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