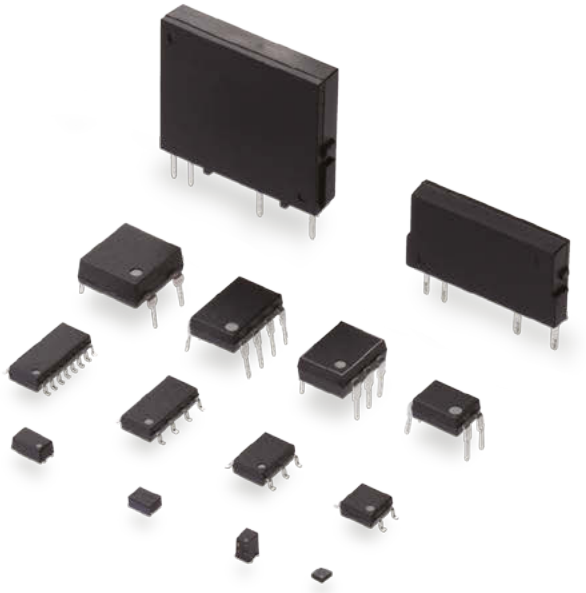
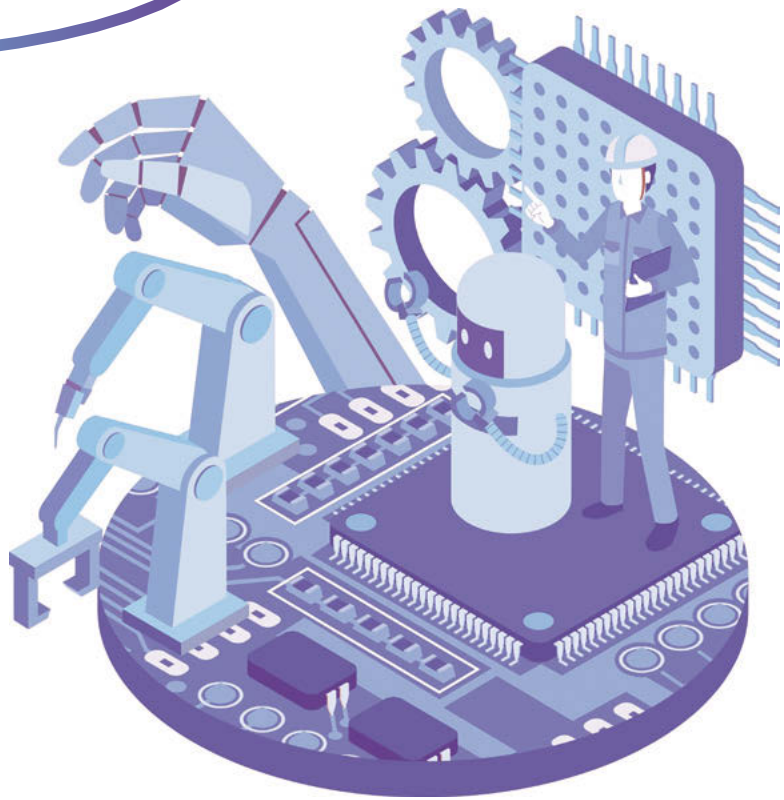
Panasonic INDUSTRY

Proposal for replacing a mechanical relay with a PhotoMOS





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Purpose of this document

PhotoMOS products, composed of semiconductors, are currently used in various applications.
This document provides you with references (precautions, circuit examples, etc.) when considering to replace a mechanical relay (signal relay in many cases) with a PhotoMOS.

Mechanical relay Versus PhotoMOS

Characteristic	Mechanical relay (signal relay operating at 2 A or less)	PhotoMOS	Advantage
Output	Metal contact	MOSFET	No mechanical contact
Contact life	Limited by the number of switching cycles (tens of thousands to tens of millions times)	Not limited by the number of switching actions	Long service life
Operation noise	Emits noise	None	Silent operation
Chattering	Emits chattering	None	High reliability
Turn on time	Up to 10 ms	0.01 to 5 ms	High-speed operation
Contact resistance (On-resistance)	Up to 0.05 Ω Contact deterioration from the initial state	0.01 to 500 Ω Stable switching	High reliability (High resistance is a disadvantageous factor.)
Input power consumption	50 to 400 mW	5 to 50 mW	Low power consumption
Mounting area	60 to 150 mm²	4 to 74 mm²	Miniaturization

* An example of a circuit in which a mechanical relay is replaced with a PhotoMOS is presented.
When actually considering replacement, please contact a Panasonic sales representative.

Matters of precautions when replacing a mechanical relay with a PhotoMOS

1 Rated voltage and current

A mechanical relay rarely fails when an applied load current or voltage slightly exceeds the rated current or voltage.
In contrast, a semiconductor breaks the moment an applied load current or voltage exceeds the rated value.
Therefore, the mechanical relay can to some extent withstand inrush or surge current generated by a connected load, whereas PhotoMOS is immediately destroyed by such intense current. This must be taken into consideration.

2 Off-State Condition Across Output Terminals

(1) Withstand voltage on the output side

The mechanical relay has its contacts completely insulated from each other by physical space (air gap) when under a normal open circuit condition.
PhotoMOS, on the other hand, does not have any insulating air gap and is therefore not completely insulated when turned off.
Since there is no insulating space, however, the possibility of arc generation is eliminated which allows for PhotoMOS to perform better when switching a DC load compared to mechanical relays.

(2)Leakage current on the output side

The mechanical relay has negligible leakage current when turned off.
PhotoMOS, however, does generate a small leakage current across the output side.
An example of a leakage current from PhotoMOS is shown in Table 1 and Fig. 1.
(* Some of the actual values are less than nA and can be screened for lower values.)

Table 1 Example of a leak current

Feature	Part number example	Leak current
General use type	AQY212S	1 uA or less
RF type (high-frequency)	AQY222R2V	10 nA or less

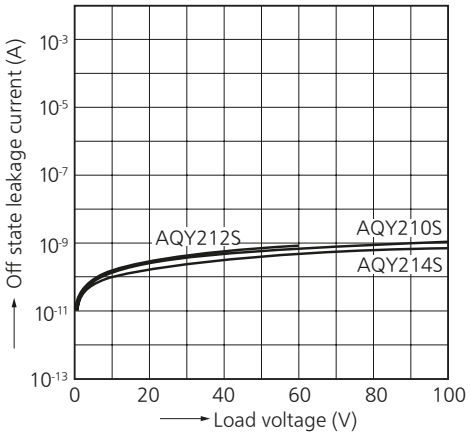


Fig. 1 Off state leakage current vs. load voltage characteristics

Matters of precautions when replacing a mechanical relay with a PhotoMOS

3 On-resistance

The mechanical relay has On-resistance (contact resistance) ranging from several mΩ to several tens of mΩ. The PhotoMOS has an On-resistance and On-voltage-drop that vary depending on product types. However, unlike mechanical relays, the On-resistance value of PhotoMOS is very stable over the entire switching cycle life. Table 2 shows an example of the On-resistance of the PhotoMOS.

Table 2 Example of the On-resistance of PhotoMOS

Load voltage	Part number example	On-resistance (Typ.)
60 V	AQY212S	0.83 Ω
60 V(high-capacity)	AQV252G3S	0.033 Ω
400 V	AQV214	30 Ω
1,500 V	AQV258H5	315 Ω

4 Input Operating Power

While mechanical relays may have both DC and AC coil actuation types available options, most PhotoMOS are DC power driven types (current driven types using current limiting resistance).

5 Ambient temperature characteristics

Ambient temperature characteristics indicate an ambient temperature range in which the PhotoMOS can operate normally (serviceable) under specified allowable load current conditions. As the ambient temperature is increased, the load current flow capability of the relay decreases. See data on load current - ambient temperature characteristics. Fig. 2 shows a typical example.

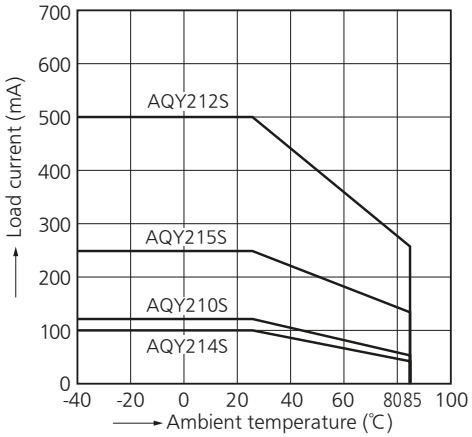


Fig. 2 Load current vs. ambient temperature characteristics

Matters of precautions when replacing a mechanical relay with a PhotoMOS

5 Ambient temperature characteristics

There are other characteristics which are affected by the ambient temperature as seen in the examples displayed in Fig. 3 - 5 below. For detailed information, see the data sheet on each PhotoMOS type.

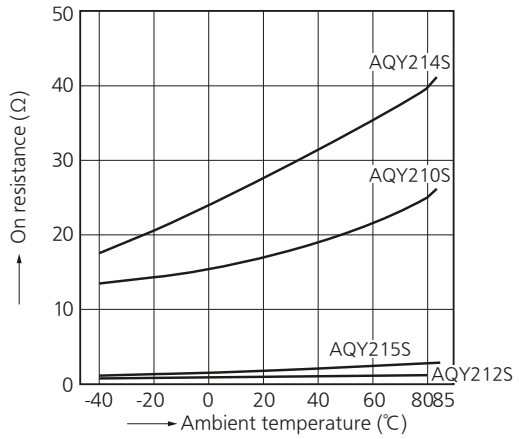


Fig. 3 On resistance vs. ambient temperature characteristics

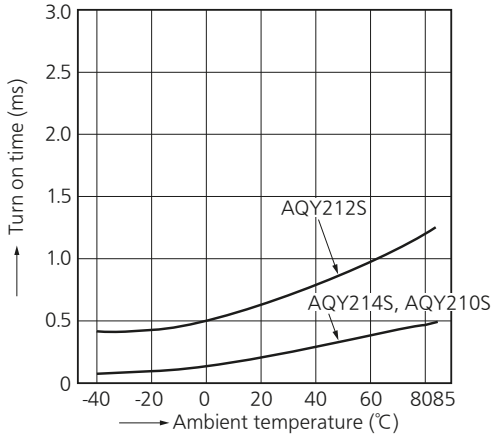


Fig. 4 Turn on time vs. ambient temperature characteristics

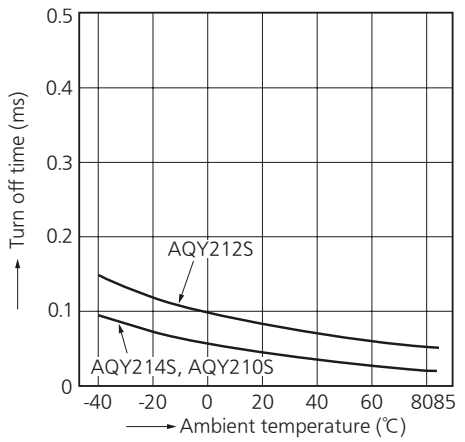


Fig. 5 Turn off time vs. ambient temperature characteristics

6 Contact arrangement

Typically, PhotoMOS has a 1 Form A contact arrangement, but there is also a 1 Form B contact arrangement.
In contrast, mechanical relays have a wider variety of different contact arrangement (1 Form C, etc.).
If PhotoMOS with a Form C contact arrangement is needed, please contact a Panasonic sales representative.

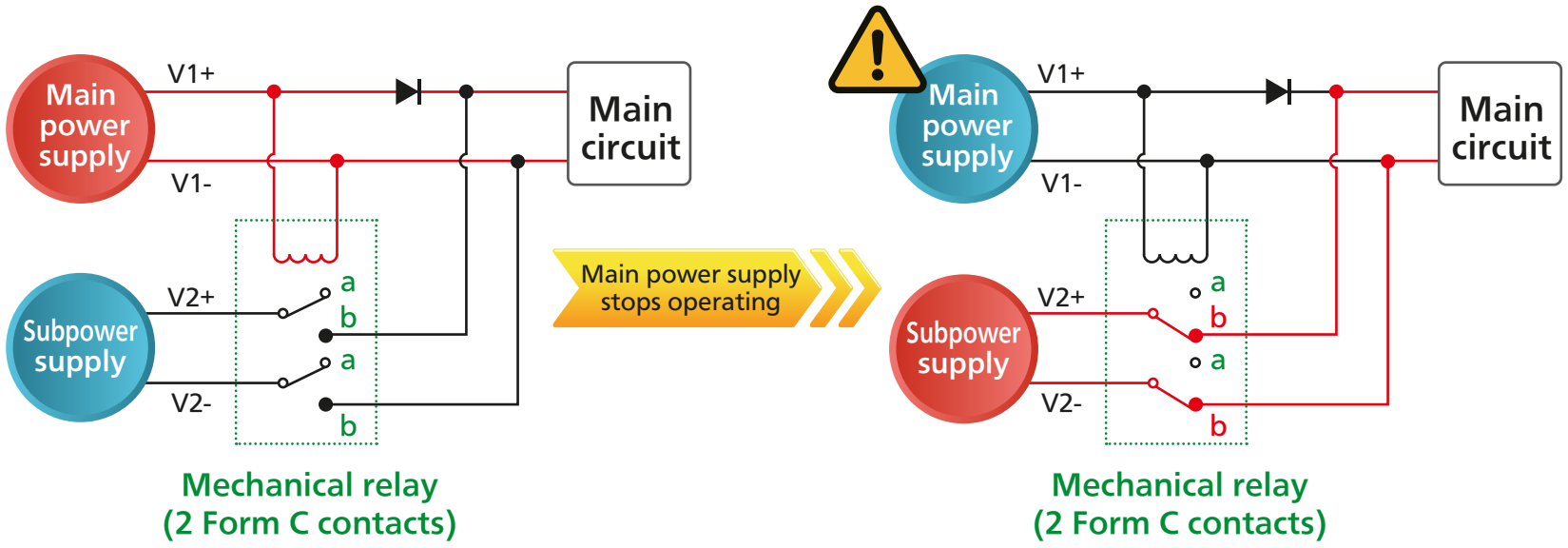
Example 1) Switching-to-subpower-supply circuit

What is a switching-to-subpower-supply circuit?

Application examples:
Security equipment, intercom, etc.

The following circuit switches to a subpower supply when the main power supply develops an issue and stops operating. This circuit is often used in security equipment and the like, where a failure would cause serious trouble.

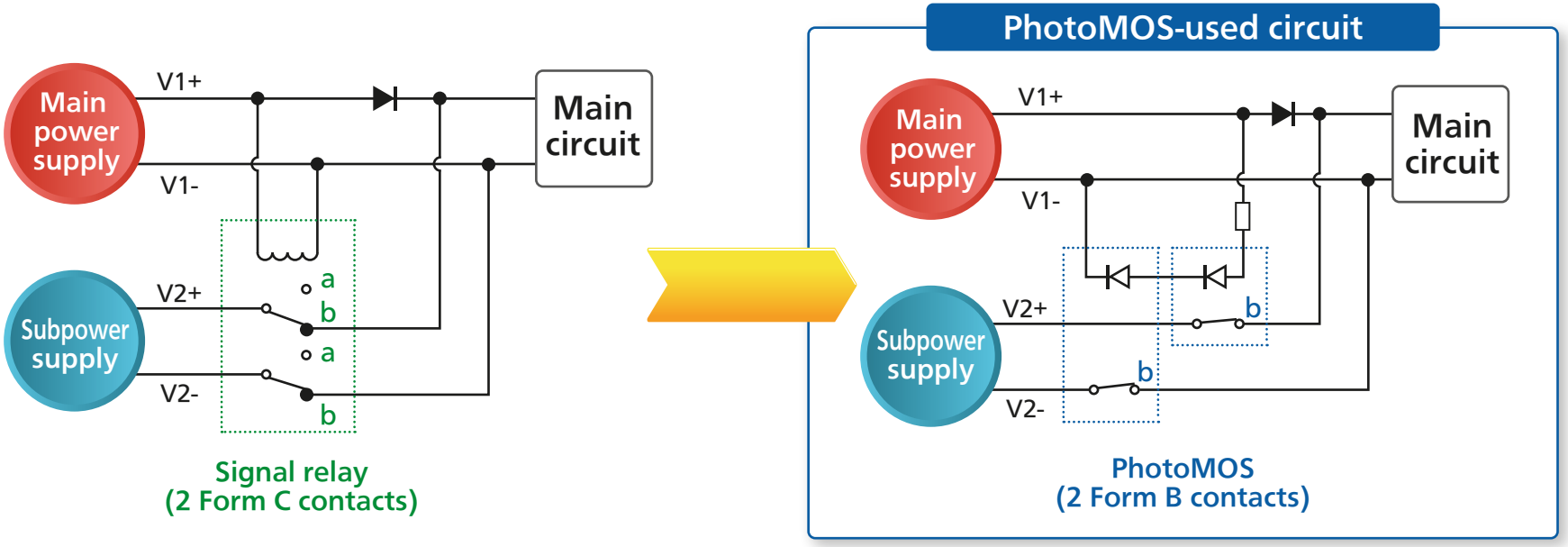
Switching-to-subpower-supply circuit



The relay opens and closes the contacts to switch the Main Circuit over from the main power supply to the Sub-power supply.

Example 1) Switching-to-subpower-supply circuit

Replacing the mechanical relay with the PhotoMOS offers several advantages.



Three advantages of replacing mechanical relays with PhotoMOS

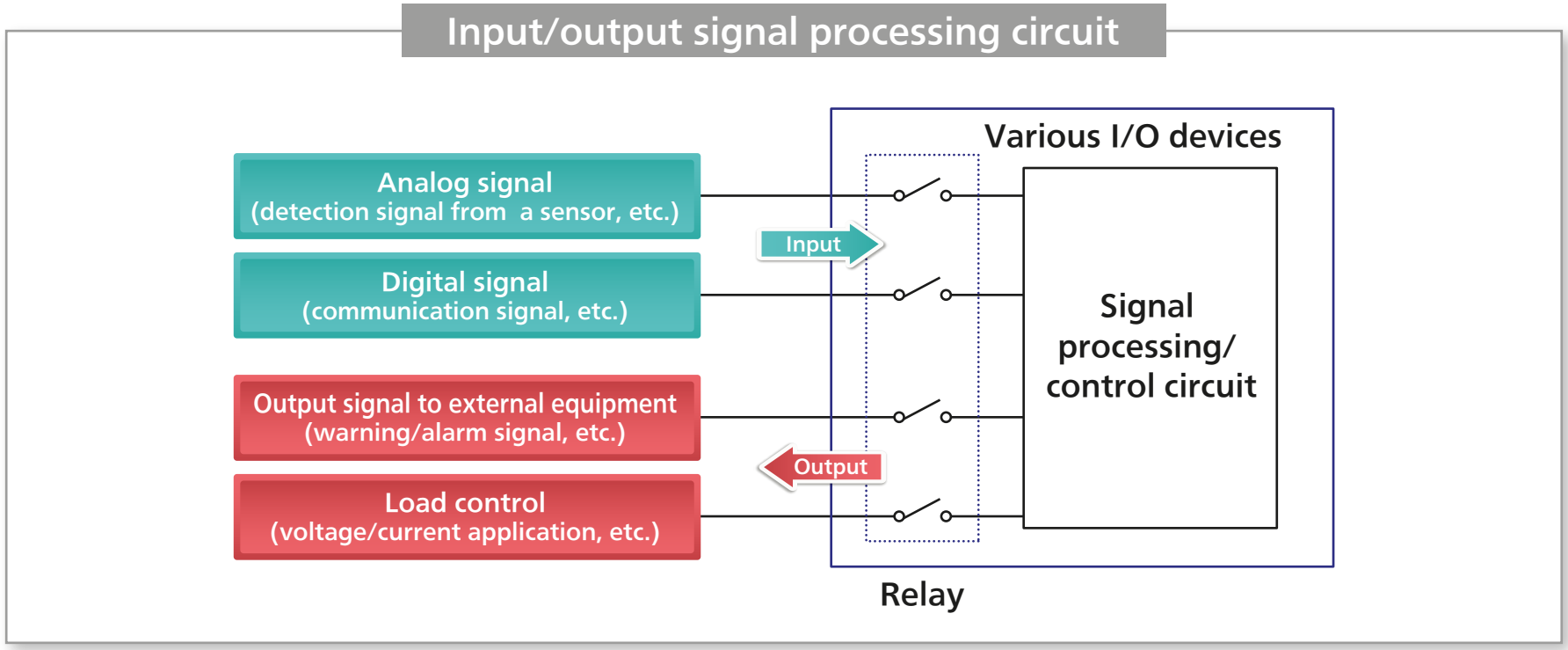
1	Long life	The contacts have an infinite switching life, contributing to a drop in the failure rate of the equipment.
2	High-speed processing	Due to a faster operation speed, the faster response time for detecting a power outage and switching from the main power supply to the sub power supply.
3	Low power consumption	PhotoMOS consumes less current which contributes to a reduction in power consumption by the equipment.

Example 2) Input/output signal processing circuit

What is an input/output signal processing circuit?

Application examples: PLC, warning device, inspection apparatus, etc.

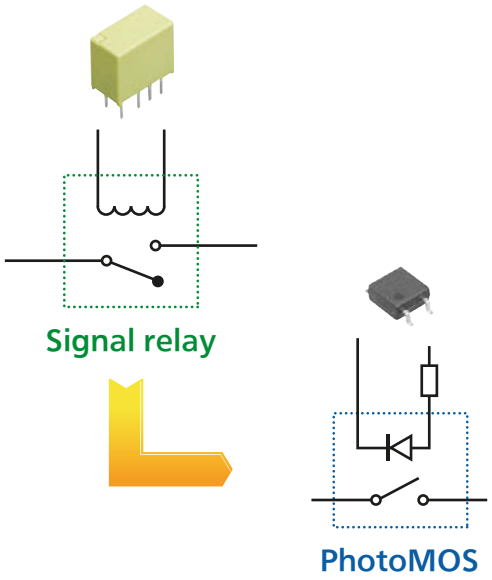
The circuit below incorporates relays into a PLC or similar device which receives incoming signals from external equipment and releases outputs signals to external equipment.

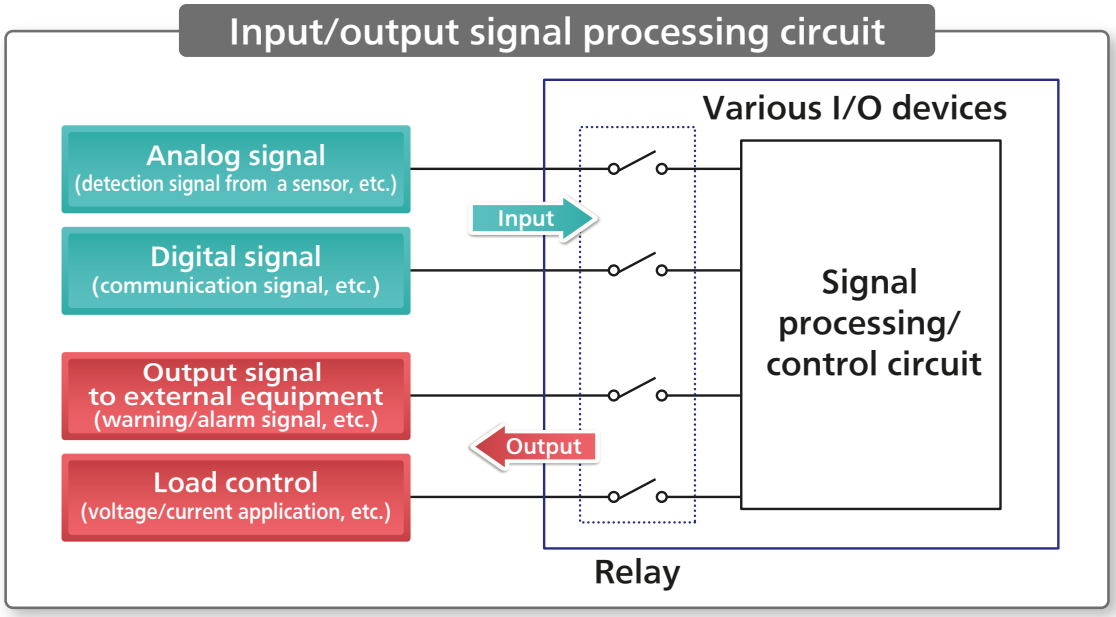


The relays function as switches operating signal reception and signal output as well as route switching functions.

Example 2) Input/output signal processing circuit

Replacing the mechanical relay with the PhotoMOS offers several advantages.





Three advantages of replacing mechanical relays with PhotoMOS

1 Long life
The contacts have an infinite switching life, contributing to a drop in the failure rate of the equipment.

2 High-speed processing
A faster operation speed leads to faster signal input/output.

3 Miniaturization
Small size of PhotoMOS contributes to miniaturization of installed devices.

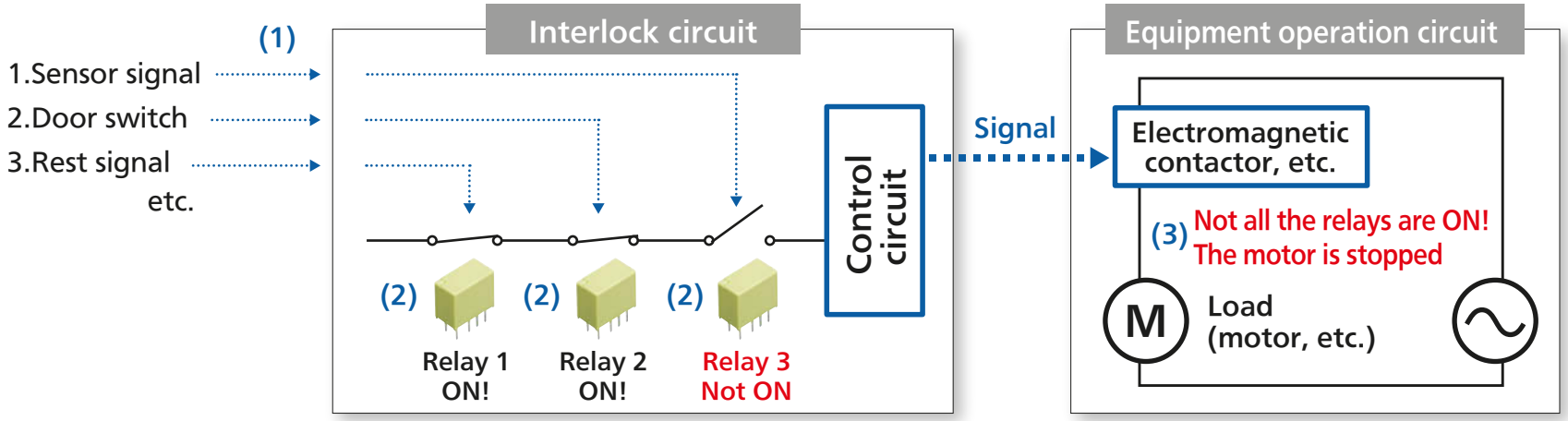
Example 3) Interlock circuit

What is an interlock circuit?

Application examples: Semiconductor manufacturing device, production facility, processor, printer, etc.

An interlock circuit keeps devices safe when issues arise.
For example, when a printer cover is left open, the interlock circuit serves the role of shutting off the power and stopping printer operation for safety.

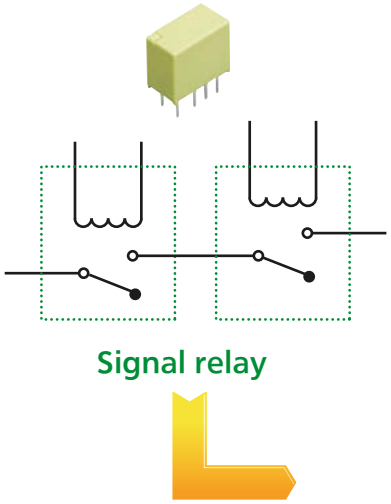
(1) Various sensors send equipment status signals to the interlock circuit.
(2) When an incoming signal is problematic, the interlock circuit switches a relay off.
(3) If any of the relays within the interlock circuit are off, the interlock circuit sends a stop signal to the equipment operation circuit to stop the equipment.

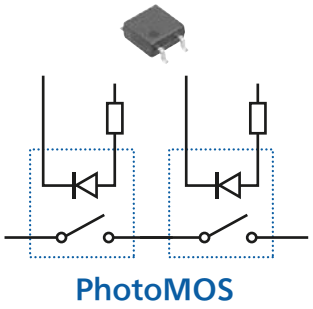


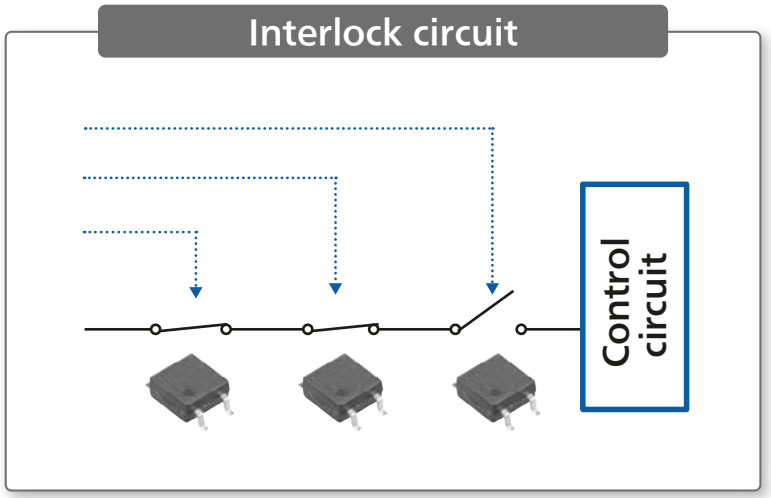
Each relay transmits a sensor signal by switching on and off.

Example 3) Interlock circuit

Replacing the mechanical relay with the PhotoMOS offers several advantages.







* Please carefully consider the safety design of the circuit before use.

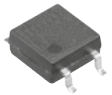
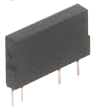
Three advantages of replacing mechanical relays with PhotoMOS

1	Long life	The contacts have an infinite life, contributing to a drop in the failure rate of the equipment.
2	High-speed processing	A faster operation speed leads to a higher sensor signal transmission rate.
3	Miniaturization	The smaller size of PhotoMOS reduces the overall size of the interlock circuit.

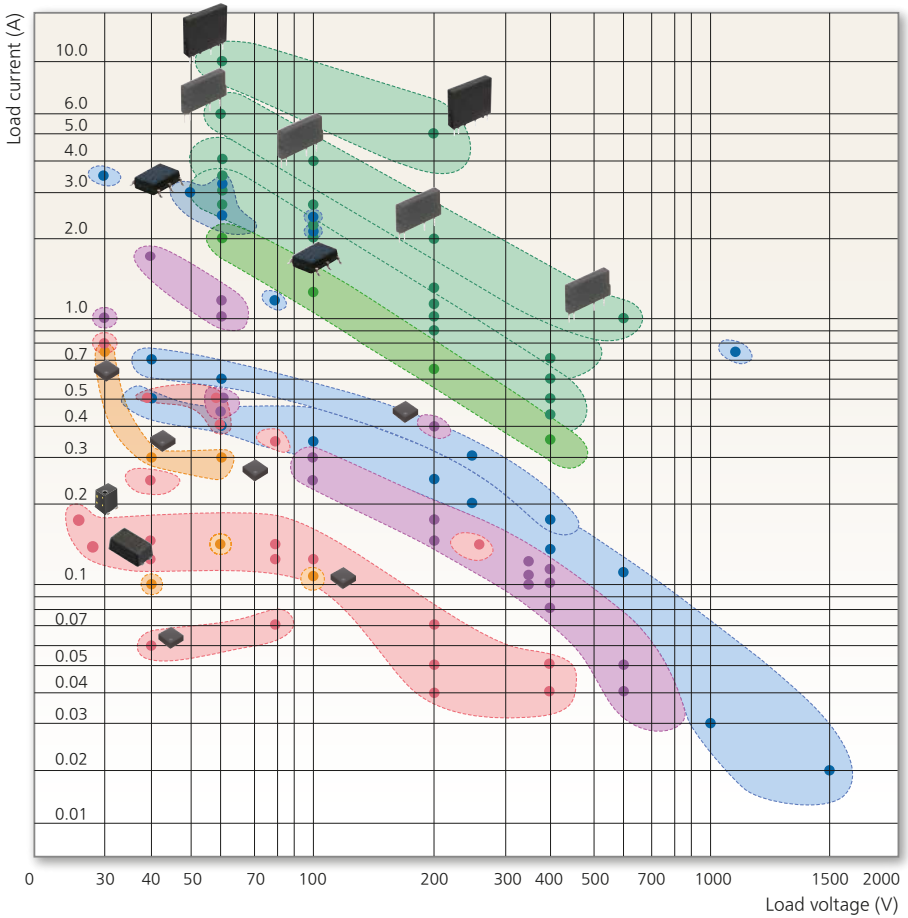
Reference part number

If considering to replace a mechanical relay with a PhotoMOS, please contact a Panasonic sales representative.

Part type for reference (example)

Type	Feature	Part number	Load voltage	Load current	On-resistance (Typ.)
GU	General use	AQY212S 	60 V	0.5 A	0.83 Ω
HE	High capacity	AQV252G3S 	60 V	3.3 A	0.033 Ω
RF	High frequency	AQY222R2VY 	60 V	0.4 A	0.8 Ω
GU	General use	AQY214EH 	400 V	0.12 A	26 Ω
Power	High capacity	AQZ206G2 	600 V	1 A	0.52 Ω
HE	High voltage	AQV258H5 	1500 V	0.02 A	315 Ω

PhotoMOS lineup



Click here for PhotoMOS Web page

Please contact Panasonic for mechanical relays as well.

Panasonic offers a full product lineup of mechanical relays in addition to PhotoMOS.

Signal Relays (2A or less)

Search by → | Search by Specifications - Comparison Table | Lineup | Contact Arrangement / Rating | Size

Selector Chart (PDF) → | Enter Signal Relay's Part No. | Search

Return to Signal Relays Home →

Lineup

	Series	Features	Contact arrangement	Max. switching current	Nominal coil voltage	Terminal shape	Operating power	Downloads
	GN Relays	High sensitivity, 100 mW operating power, 2 Form C, 1 A, compact size and slim relays	2c	1A	DC	SMD,THD	100mW to 230mW	CAD data Catalogs
	GQ Relays	High sensitivity, 100 mW operating power, 2 Form C, 2 A, compact size and flat relays	2c	2A	DC	SMD,THD	100mW to 230mW	CAD data Catalogs
	GQ Relays TH Types	Small size controlled 3.5 A inrush current possible	2c	2A	DC	SMD,THD	100mW to 230mW	CAD data Catalogs
	TX Relays	2,000 Vrms dielectric strength, 2 Form C and 2 A relays	2c	2A	DC	SMD,THD	140mW,200mW	CAD data Catalogs
	TX-D Relays	6,000 V surge withstand voltage, 2 Form C and 2 A high dielectric strength relays	2c	2A	DC	SMD,THD	150mW to 270mW	CAD data Catalogs
	TX-S Relays	High sensitivity, 50 mW operating power, 2 Form C and 1 A relays	2c	1A	DC	SMD,THD	50mW to 170mW	CAD data Catalogs
	TQ Relays	Flat, 5 mm 2 Form C, 2 A, Surface mount terminal relays	2c	1A	DC	THD	100mW to 300mW	CAD data Catalogs

Power Relays (Over 2A)

Search by → | Search by Specifications Comparison Table | Search by Lineup | Search by Contact Rating / Contact Arrangement

Selector Chart (PDF) → | Enter Power Relay's Part No. | Search

Return to Power Relays (Over 2A) Home →

Lineup

Specification Search — All Clear

▸ Contact arrangement: Not specified ▸ Max. switching current: Not specified

▸ Terminal shape: Not specified

Refine Search

27 products were found. 1 to 27 are now being displayed.

Series	Features	Contact arrangement	Max. switching current	Terminal shape	Downloads
DE Relays	Compliant with European safety standards, 1 Form A/2 Form A/1 Form A 1 Form B 10 A/8 A Polarized power relays	1a,1a1b,2a	8A,10A	THD	CAD data Catalogs
DJ Relays	High insulation, 1 pole/2 pole 16 A, Polarized power relays	1a,1b,1c,1a1b,2a,2b,2c	10A,16A	THD	CAD data Catalogs
DJ H Relays	Suitable for lighting and motor load, 1 Form A 50 A, Latching relays	1a	50A	THD	CAD data Catalogs
DK Relays	1 Form A 10 A, 1 Form A 1 Form B/2 Form A 8 A, Small polarized power relays	1a,1a1b,2a	8A,10A	THD	CAD data Catalogs
DS Power Relays	1 Form A 8 A (AC) / 5 A (DC) , 1 Form A 1 Form B/2 Form A 5 A (AC/DC) , Small polarized power relays	1a,1a1b,2a	5A,8A	THD	CAD data Catalogs
DY Relays	1 Form A 10 A, 1 Form A 1 Form B 8 A, Small polarized power relays	1a,1a1b	8A,10A	THD	CAD data Catalogs
DW Relays	1 Form A 8 A/16 A, Small, Polarized power relays (latching type)	1a	8A,16A	THD	CAD data Catalogs

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Specifications are subject to change without notice.
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