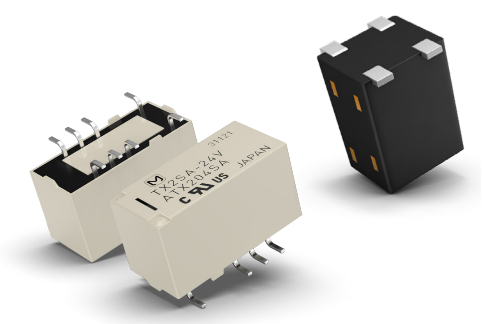
Panasonic
INDUSTRY

Semiconductor- and Electromechanical Relays

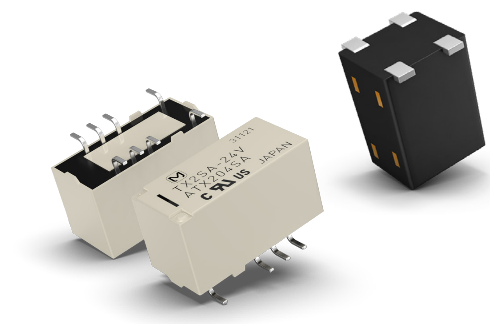
Electrically controlled switches are used in many applications because of their relative simplicity, long life, and reliability. Semiconductor relays are a modern alternative for the traditional electromechanical relay that prevent wear as a contactless system.

Application Note



Your Committed Enabler

Versatile switching



Product

Semiconductor and electromechanical relays

Purpose

Relays are the optimal switching solution for a wide variety of applications, including industry or home appliances, telecommunications, precision measurement, the automotive sector, and many other areas in a growing global economy.

Features

Long lifetime

Stable behaviour

Compact size

High switching speed

High vibration and shock resistance

No bouncing and no switching noise

Versatile switching

Facts & Figures

For many years, the electromechanical relay was the only choice for realizing a switching function for an electrical output circuit, which results from the relative movement of mechanical parts. Today's non-polarized relays employ an increased number of design details to offer advanced features. By employing permanent magnets in the magnetic circuit of the relay, efficient polarized relays offer new advantages, such as reduced coil power consumption, higher contact force and bistable behavior. Due to arcs created during switching and mechanical effects, the electromechanical relay suffers wear during its lifetime. As a contactless system, semiconductor technology prevents this.

Panasonic Industry offers two types of semiconductor relays, each with their own strengths: MOSFET-based (PhotoMOS®) and Triac-based (SSR) relays. The technical differences between electromechanical relays and semiconductor-based relays are as shown on the right.

In a nutshell – one system's strength is the other's weakness. However, semiconductor relays do offer an increased lifetime with stable behavior realized by small control currents. Both semiconductor relays have a galvanic isolation between input and output whereby the control signal from the input side is optically detected by a special driver IC circuit triggering the switching operation at the output side. The major difference between the two different technologies can be found in the semiconductor device switching the output: PhotoMOS® relays employ two MOSFETs while SSRs utilize Triacs.

	PhotoMOS & SSR	EMR
Advantages	Contact reliability Long lifetime Low control current Switching frequency Noiseless operation No contact area Shock resistant	High breakdown voltage Surge and noise resistant Form A/B/C contacts Load current µA to A Galvanic isolation of open output No leakage current
Disadvantages	Leakage current Weak against voltage surge Higher contact resistance	High volume Coil energy consumption Unstable contact resistance Contact wears out Operation creates noise Contact bouncing Creates contact arcs

Versatile switching

Facts & Figures

PhotoMOS® relays work through a connection between the input pins and a light-emitting diode. This LED is located on the upper part of the relay and if a current flows through it, it starts emitting infrared light. Below the LED, an array of solar cells is integrated into an optoelectronic device, located at least 0.4 mm from the LED. The optoelectronic device serves as a control circuit for switching the power MOSFETs and therefore the load circuit. These DMOS transistors are source-coupled because of their intrinsic bulk-drain-diode in connection with drain and source. Thus, a single transistor is only capable of switching a DC voltage since the diode will become forward biased if load polarity reverses. Hence using a PhotoMOS® relay for switching AC voltages requires two source-coupled DMOSFETs.

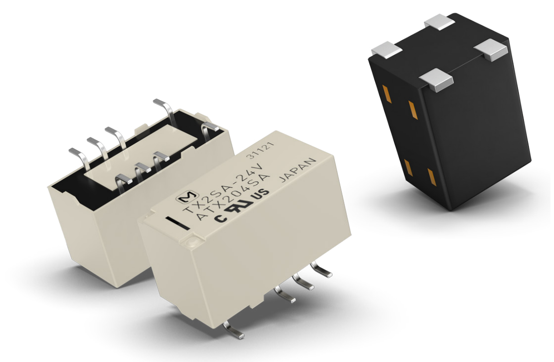
When it comes to switching main network voltages and high currents, Solid State Relays (SSR) surpass PhotoMOS® relays. The SSR is composed of a low current control input side (typical 5 mA to 20 mA, depending on the type of SSR) and a high current load side, whereby the relay provides an electrical I/O isolation of several thousand volts. When current flows through the LED on the input side, it emits light which is detected by a trigger circuit after passing through a silicon resin. The trigger circuit acts like a small triac device and is used to trigger the gate of a larger triac that switches the load in the presence of a load voltage across the triac's output. Once triggered to an on-state, the triac maintains this state until the load current crosses zero and the trigger pulse on the input is absent. The constructional distinction of the output element of PhotoMOS® and SSR causes different preferred applications for the two semiconductor relay types:

	PhotoMOS & SSR	EMR
Advantages	Controls small analog signals Low leakage currrent AC and DC loads Form A/B contacts Small size	Best at control of 100/200 VAC and 50/60 Hz High capacity control possible (up to 40 A) High switching speed
Disadvant.	Output capacity	High leakage current Protection circuit necessary 1 Form A only Heat sink

There are also common characteristics between the two types of semiconductor relays: Both are sensitive to overvoltages and excessive currents, which leads to power dissipation and causes internal destruction by thermal stress. However, if requirements like long lifetime, stable behavior, small size and switching speed are critical, semiconductor relays are the optimal choice.

Learn more about PhotoMOS® technology

Get here the PhotoMOS® relay App!



Application Note - How to solve various tasks with Semiconductor and Electromechanical Relays
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Notes: Data and descriptions in this document are subject to change without notice.
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