PhotoMOS with Short Circuit Protection (Latch Type)

'Small size, reliability and low power consumption' are requirements for components used to switch signal outputs in sensors, control units or on measurement cards. An important function is the galvanic isolation of sensitive electronics from possible disturbances on the output side, e.g. voltage peaks or overcurrents, which can arise due to short circuits or improper use. The new shortcircuit protected PhotoMOS family from Panasonic Electric Works is optimally prepared to meet these challenges. It ideally combines high switching speed with low control current and reliable overcurrent protection. The internal structure of a PhotoMOS relay and the protective function is described in detail below.

The internal circuit of a PhotoMOS relay can be illustrated easily: on the input side of the switching element a light emitting diode is located. If a current flows through the LED it starts emitting light. This light is converted to a photo voltage by solar cells located at least 0.4 mm away. This photoelectric voltage drives the gate of two interconnected DMOSFET. This is the principle structure of every PhotoMOS relay, which is available in different packages (SSOP, SOP, DIL or SIL).

However, PhotoMOS relays are continuously being developed further. Panasonic Electric Works is extending its product catalogue by enhancing the standard types of PhotoMOS relays with a protective element. The protective circuit is located on the output side of the component and recognizes inadmissibly high currents. The advantage of the protective feature is twofold: the DMOSFET on the output side and the load circuit is protected against an overcurrent. As soon as a dangerous load current arises, it is recognized by the protective unit and a counter measure is introduced.

The behaviour in case of such an error is illustrated in the following diagram. With the short circuit protected PhotoMOS (latching type) the load circuit is completely switched off and can be switched on again only after the input signal has been reset. This is represented in Figure 1. If an input current of 3 mA or more flows through the LED, the output of the semiconductor relay has a low impedance of 35 Ω and a load current begins to flow. If the load current increases above the limiting value of 200 mA (Load short circuit), this is detected by the protective circuit (Load short detected). The load current is interrupted, even if, as shown in Figure 1, a continuous input current is supplied. Only after resetting the input signal, the output can be switched on again and the relay assumes its normal switching operation (see Figure 1).

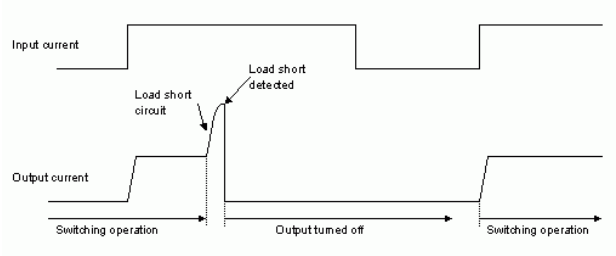

Figure 1: Timing diagram

The protective circuit senses a short circuit with the help of resistors (shunts). These are located in the output side of the PhotoMOS relay. The shunts do not significantly increase the on-resistance of the relay. Excessive current in the event of an error leads to a voltage drop across the shunt. With the short circuit proof PhotoMOS type the voltage drop across the shunt is used as an input signal for an asymmetrical flip-flop gate. The flip-flop controls the gate voltage of the DMOSFET and switches off the output. The flip-flop and thus the normal switching operation can be reset only by removing and applying the LED input current.
A crucial plus of the integrated protective circuit is temperature behaviour. With an increase in temperature, electrical resistance rises. Therefore a load current produces a higher power dissipation in the circuit's parts and may lead to malfunction. But because of increased resistor values at higher temperatures the voltage drop across the shunt in the relay rises. The protective circuit responds to lower currents, thus has a negative temperature coefficient. Hence it can protect the load circuit more effectively against increased power dissipation and destruction.

In addition to this protective function, there are other reasons to prefer overcurrent protected PhotoMOS to conventional solutions with protection devices: by integrating the protective mechanism in the relay, costs are reduced, developing the circuit is eased, and space is saved.