PhotoMOS with Short Circuit Protection (Non 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 short circuit 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 current limited type recognizes a transient overcurrent and limits it to a less critical value. After applying an input current the load circuit is conductible (typical 0.55 Ω) and a current flows through the load. In case of an error this current increases and is detected by the protective circuit. The occurrence of such a case is represented in Figure1 (Load short and Load short detected). The PhotoMOS closes and opens the load circuit alternately. By delimiting the voltage peak value at the output resistance of the relay to a maximum of 7 V and the alternating change of output resistance the load current begins to oscillate (see Figure1). After the output disturbance has dissapeared, the currentlimited PhotoMOS behaves like a conventional semiconductor switch again.

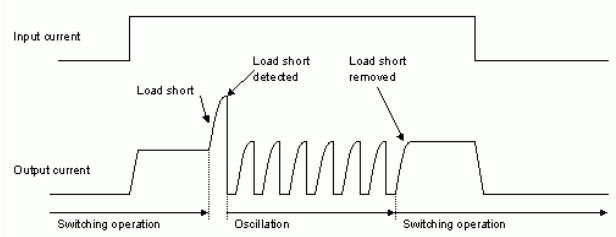

Figure1: Timing Chart

The load current's root mean square value is decreased by the oscillation of the output. This is regulated such, that the resulting power loss does not exceed the component's maximum permissible energy dissipation (max. 500 mW). Thus the relay prevents an excessive increase in energy dissipation and rise in temperature in the component. This differs from conventional currentlimited devices that increase their on-resistance, whereby power dissipation rises to a self-destructing level. The currentlimited type AQV112KL from Panasonic Electric Works can handle an increased load current for a longer period of time without suffering damage.

The protective circuit senses a short circuit with the help of a control circuit. This control circuit initializes an input signal for an astable trigger stage which controls the DMOSFET's gate voltage. This results in the alternate switching of the load circuit and reduction of the RMS value of the 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 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 in the control circuit 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.

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Besides the integrated protective mechanism PhotoMOS relays offer further advantages over other electrical and electromechanical switching elements:

- Galvanic separation of the input and output side (up to 5000 V AC)
- No offset voltage and small signal switching (DC and AC) possible
- Controlled with low input currents
- Small leakage currents (< 1 μA)
- Stable on-resistance over lifetime (a few mΩ to 60 Ω)
- Small size, no preferred position
- Vibration and shock resistant
- No switching noise

The enormous product variety allows numerous applications for PhotoMOS relays: they can be used for switching small motors or power supplies, for signal in- and outputs in industrial applications or for multiplexing measurement values or signals on bus systems.