

# 10 ELECTRONICS IN AND AROUND POWER RELAYS

## 10.1 Electronic control of relays

In addition to standard transistor control circuits, (see chapter 5) other electronic circuits are widely used to extend a relays function such as in timer relays or to reduce the power consumption of the relay's coil.

### Timer relays

Customized integrated circuits are used in the control circuits of timer relays. The power relay is the interface between these circuits and the load.

Some control circuits are packaged in the form of plug in modules, which can be inserted into a relay socket to extend the relays functions.

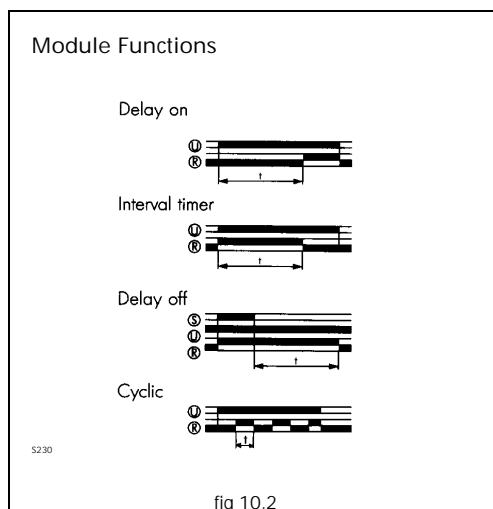


fig 10.2

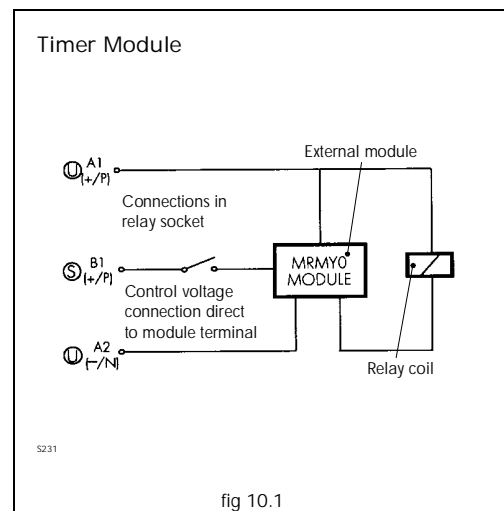


fig 10.1

Standard functions can include delay on, delay off, cyclic and interval timers.

Using this method, a standard industrial power relay may be converted into a multi-pole timer.

### Energy saving circuits

The combination of electronics and monostable or bistable relays, can reduce the power needed to switch or to keep the relay pulled in.

This can be achieved by using a custom integrated circuit which operates in the following way: when energization voltage is applied, the duration of the energization current is only

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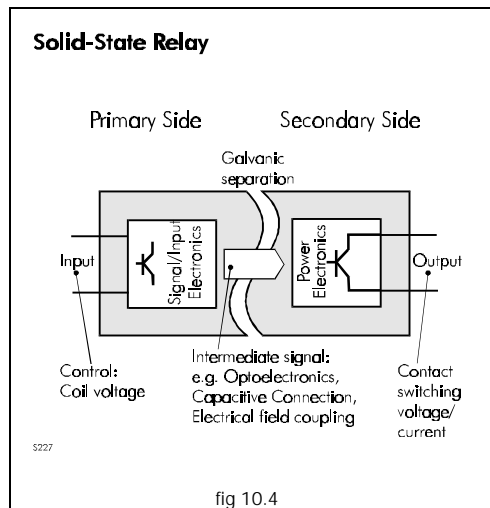
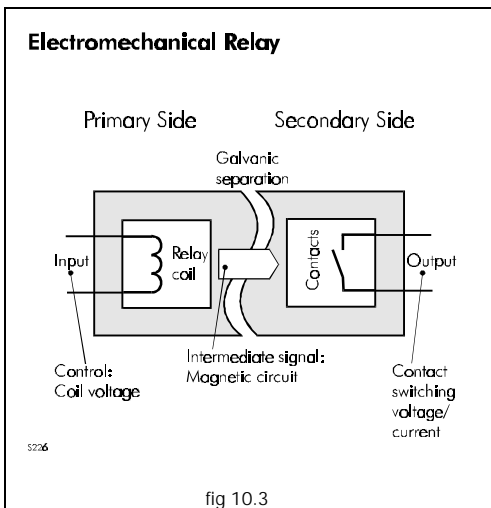
very short, and, when switched off, a capacitor supplies the necessary energy to reset the relay. Depending on the duty cycle and "on" time, energy savings can be considerable.

Other integrated circuits are designed to be an interface between low power electronic circuits and relay coils. These circuits can be directly interfaced with TTL, CMOS and other electronic components (e.g. microprocessors) and can be connected to bus systems.

### 10.2 Solid state relays

Solid state relays (SSRs) have similar functions to electromechanical relays but the relays are "contactless", using electronic components such as triacs, thyristors and power transistors as the switching element. The basic design differences are shown in fig 10.3 and fig 10.4.

The application of an input signal to an SSR switches the output from a non conducting to a conducting state, switching the load circuit on and off.

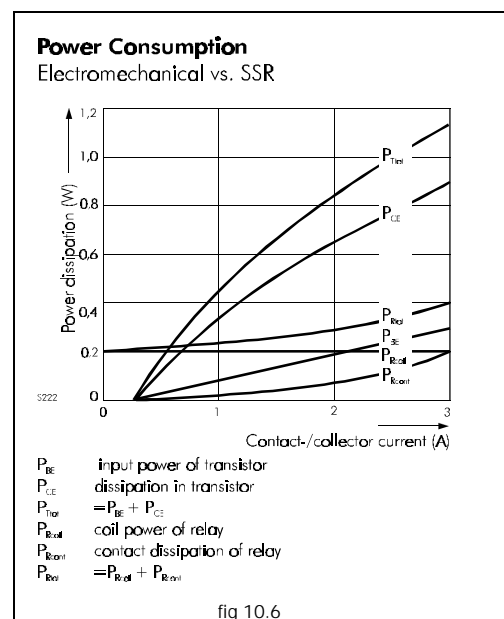
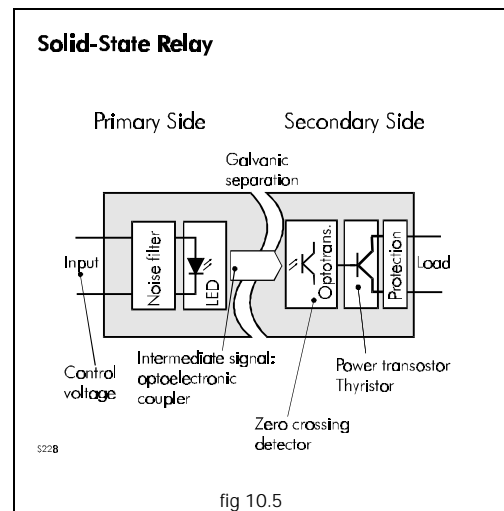


Different methods of achieving galvanic isolation between input and output are used, e.g. opto couplers or capacitive/inductive signal transmission and different switching elements are necessary to switch AC and DC loads.

Both electromechanical and solid state relays have their advantages and disadvantages depending on the load to be switched. When selecting a relay for a specific application the following should be considered.

Electromechanical relays

- offer more contact configurations such as N/O, N/C and C/O.
- can be multi poled to switch more than one load circuit
- contacts are suitable for AC and DC switching
- have flexible contact arrangements and materials suitable for a wide range of applications, from signal to high power switching.
- have high resistance to overloads and short circuits
- have low contact resistance and therefore low voltage drop across the contacts. This contact resistance is less than the ON resistance of a semiconductor junction, which, when switching high power loads, heat generated within the switching element has to be dissipated, often leading to the need for an external cooling device.
- have far higher isolation resistance and dielectric strength between open contacts
- consume constant pull-in power, independent of contact load
- have high resistance to external magnetic and electrical influences such as spikes and strong electric fields and therefore do not require additional protection circuits against switching transients and spikes.
- need less space for comparable high power switching
- are lower in cost



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Therefore, electromechanical relays should be used when:

- products require a wide range of switching applications
- switching either AC loads or DC loads of unknown polarity
- protection against overload involves the use of costly protection circuits
- only low input power is available
- high galvanic separation between all contacts and between input and output is required
- there is likely to be electrical interference
- low heat dissipation is required

COMPARISON ELECTROMECHANICAL RELAY (EMR) SOLID STATE RELAY (SSR)		
Characteristic	SSR	EMR
contact configurations (C/O)	-	+
multiple poles/contacts	-	+
switching different loads (AC, DC)	-	+
voltage drop in ON-state	-	+
zero current/voltage switching	+	-
switching frequency	+	-
electrical life	+	-
galvanic separation of load circuit	-	+
dark currents in OFF-state	-	+
overload capability	-	+
resistance against surges	-	+
input power	+	-
response time	+	-
bistable versions	-	+
bouncing	+	-
vibration and shock resistance	+	-
dimensions	-	+
cost	-	+

fig 10.7

Solid state relays

- have a restricted switching range and capacity, limited by the chip size and the thermal resistance of the relay.
- have only a N/O output
- need different switching elements for AC and DC
- can offer longer switching life due to the "contactless" system
- can switch AC loads at specific points in the cycle, e.g. switching off when the load current crosses zero and switching on when the load voltage crosses zero
- can have high switching reliability under certain conditions
- are highly susceptible to external electrical influences such as surges, spikes and strong electric fields
- require protection circuits and ultra fast fuses
- have no galvanic separation in the load circuit in the off state
- can have leakage currents across the switching element (7.5-15mA). For power types this dissipated energy, in the off state, can be up to 3W.
- require higher input power for higher output switching.
- in most cases, can be controlled directly from other electronic circuits
- often require a heatsink when switching high currents, due to the heat generated in the switching element. This increases overall component size
- have no electrical connection between input and output. Consequently, power for the switching element has to be taken from the load circuit resulting in a decrease in the overall switching power
- respond quickly and do not suffer from contact bounce
- are quiet
- have high resistance to vibration and shock

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- are not affected by dust, gases or other contaminants

Therefore, solid state relays should be used when:

- applications demand high switching speed or frequency
- high electrical life is needed
- switching without arc or bouncing is required
- direct control by electronic circuits is necessary
- high resistance to vibration and shock is wanted

This comparison shows that the SSR is not a replacement for the electromechanical power relay, but is a component suited to particular applications, complimenting the range of power relays.