DESIGN OF A STATIC RELAY

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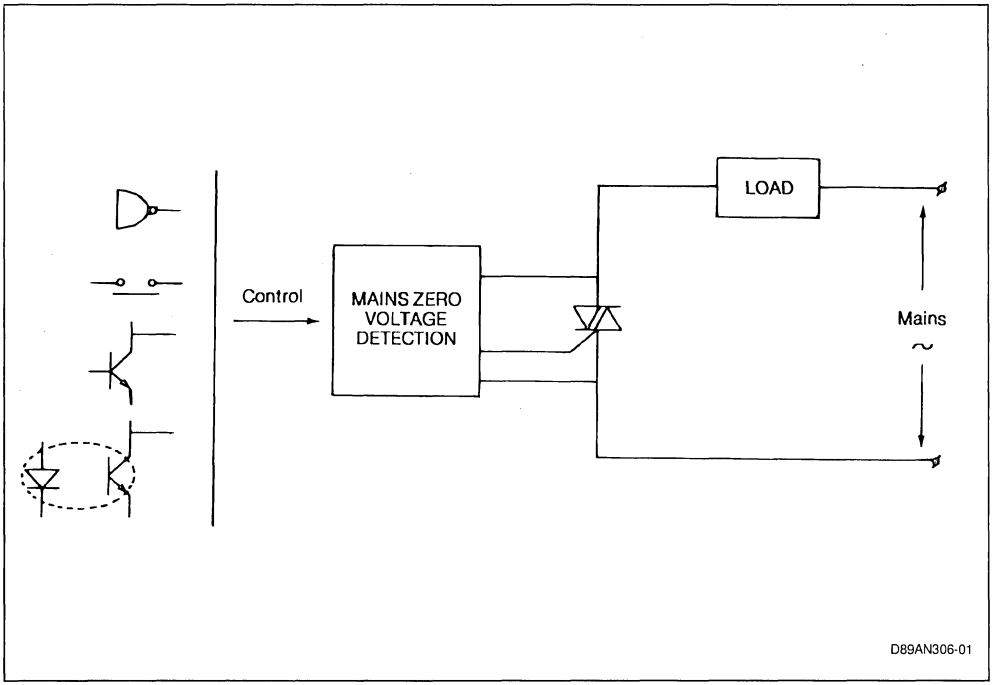
The switching of a resistive load on the mains generates electromagnetic disturbances whose level is in keeping with the voltage at the time of firing.
These disturbances can be reduced by switching on the load when the mains voltage approaches 0.
The convenience of firing control, the absence of rebound, and the response time of a semiconductor device enable designing static relays which guarantee this synchronous type of switching.
The "mains zero" detection function can be obtained by a circuit using discrete components.

This note provides a review of the principle of static relays as well as the method of calculation for the circuit component.

OPERATION A STATIC RELAY

The static relay consists of a power component, the triac, triggered by a circuit ensuring the functions of "mains zero" detection and interfacing with the input signal.

Figure 1 : Block Diagram of Static Relay.



OPERATING PRINCIPE

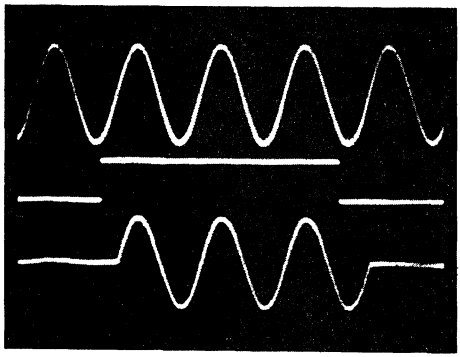
The firing of the triac can only take place when the mains voltage is close to 0 volt (± 30 V max).

For a long-duration input signal (> 10 ms), the triac is fired at the mains voltage zero. It continues to conduct for the full duration of this signal until the current drops to zero after disappearance of the input signal.

An input pulse (< 10 ms) should coincide with the passing through zero of the mains voltage to enable conduction of the triac (figure 2b).

Figure 2 : Synchronous Static Relay: Waveforms

Figure 2a : Long Duration Input Signal (> 10 ms).



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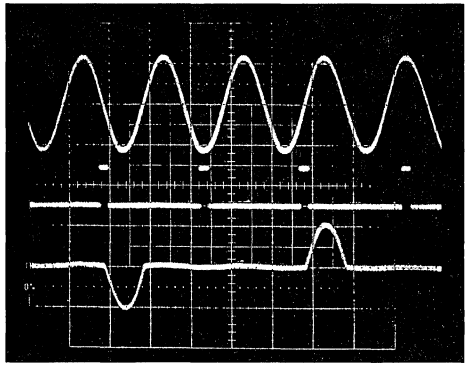
Mains voltage : V = 300 V/d.
Input signal : V = 10 V/d.
Mains current : I = 1 A/d.
T = 10 ms/d.

Figure 2b : Short Duration Input Pulse (< 10 ms).



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The triac is fired only when the input signal coincides with the passage through zero of the mains voltage.
Mains voltage : V = 300 V/d.
Input signal : V = 10 V/d.
Main current : I = 1 A/d.
T = 10 ms/d.

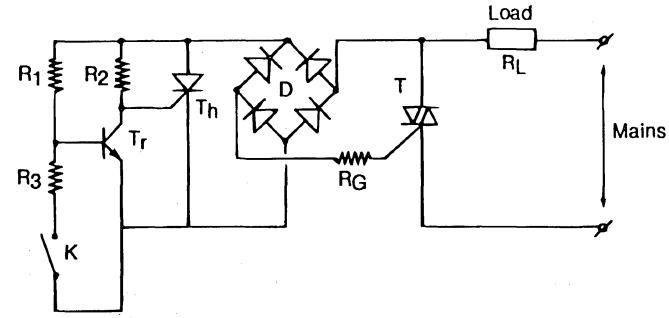
CHARACTERISTICS OF THE STATIC RELAY :

- Closing of the circuit when the mains voltage passes through zero (resistive and capacitive loads).
- Control of the static relay by very low signals (logic circuits, optocouplers, etc.).
- Insensitive to shocks and vibrations.
- High switching speed.
- No rebound.
- No electromagnetic disturbances.
- Opening of the circuit when the current passes through zero.

STATIC RELAY WITH DISCRETE COMPONENTS:

The triac triggering circuit consists of a transistor T_r and a sensitive thyristor T_h. This circuit is biased by the mains voltage after full wave rectification (figure 3).

Figure 3 : Schematic Diagram of a Static Relay with Discrete Components.



Triggering by closing control at mains zero voltage

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