Circuit description

The LM 339 is a quad voltage comparator with open collector outputs.

Comparator U1a is configured as a Schmitt Trigger; it has hysteresis due to positive feedback via Ra and R4.

The positive going threshold is set by R5 and Rb.
If the voltage Vin is below the lower threshold, then the output of U1b is since the output of the U1a is

open.

The negative going threshold is set by Ra and R4.

Thus there is no interaction when adjusting Ra and Rb.

The supply voltage is shifted by about 18 Volt by Z1.

The Zener diode eliminates the error that can occur due to the "voltage multiplication effect" that can occur

if a resistor is used in lieu of Z1.

Thus any change in the 36 Volt supply voltage is shifted (without attenuation) to the junction of Z1, R1 &

R2.

When the voltage at the cathode of Z1 reaches about 40.5 Volt, the voltage Vin will be about 22.5 Volt which

is the upper threshold of the of the Schmitt Trigger.

Alternator noise will be attenuated by the Low Pass Filter formed by R1 & C1. The 3 dB point as at about 7.2

Hz.

After a brief delay (about 0.1 second) due to R1 & C1, the voltage at + input of U1a will reach the trigger

level & so the output of U1a, will fall rapidly due to the positive feedback to approximately 0 Volt.

The other 3 comparators are referenced to about 4.9 volt due to the voltage divider formed by resistors R7

and R8.

Therefore the outputs of these 3 comparators will change as the voltage V1 passes through 4.9 volt.

The output of U1b will go high and the output of U1a will go low.

Consequently the threshold level of U1a will fall to about 21 volt.

The output of U1c will go low & turn on the LED.

The output of U1d will go high thus turning the FET Q1 on which operates the relay.

When the voltage at the cathode of Z1 decreases about 39 Volt, the voltage Vin will be about 21 Volt which is

the lower threshold of the of the Schmitt Trigger.

Thus, after the brief delay due to R1 & C1, V1 will go High, V2 will go Low; the LED will go off & the relay

will release.

Hence the circuit returns to its initial state.