TSM101 USED IN A VOLTAGE SUPERVISOR

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This technical note shows how to use the TSM101 integrated circuit to realize a voltage supervisor.

An example of realization is given.

1 - TSM101 PRESENTATION

The TSM101 integrated circuit incorporates a high stability series band gap voltage reference, two ORed operational amplifiers and a current source (Figure 1).

Figure 1 : TSM101 Schematic Diagram
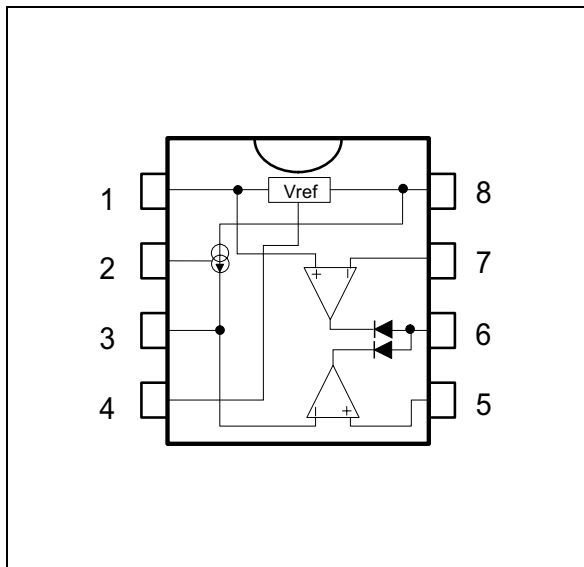
2 - PRINCIPLE OF OPERATION AND SCHEMATIC DIAGRAM

The two operational amplifiers are used as comparators.

The first operator has its + input wired to the internal 1.24V reference and the second one its - input wired to 1.24V.

As the two operators are OR-ed internally, the output (pin 6) is low if :

• the negative input (V7) of the first operator (pin 7) is higher than 1.24V

• the positive input (V5) of the second operator (pin 5) is lower than 1.24V.

A resistor network (R1, R2, R3) is used to bias the input of the two operators, when the input voltage is out of the limits, the output (pin 6) is close to zero.

This signal can be used directly to power an optocoupler.

In our application, we have added a transistor (Q1).

This transistor is driven via a Zener diode (D1).

This circuit has two advantages :

1 - this Zener diode avoids problems encountered with many voltage supervisors : when the supply voltage is lower than the operating voltage of those circuits, the behavior is erratic.

The minimum operating voltage of the TSM101 is 5V. With a 4.7V Zener diode, the transistor Q1 will never be saturated if the supply voltage is lower than 5V whatever the output of the TSM101.

2 - the optocoupler is ON only if the input voltage is inside the specified range.

3 - CALCULATION OF THE ELEMENTS

Let assume :

• $V_{min.}$ = minimum threshold voltage

• $V_{max.}$ = maximum threshold voltage

• V_{CC} = nominal voltage

We have the following equations :

$$V5 = \frac{(V_{min.} \times (R1+R2))}{\Sigma R} = V_{ref}$$

$$V7 = \frac{(V_{max.} \times R1)}{\Sigma R} = V_{ref}$$

$$R1 = \frac{V_{re} \times \Sigma R_{f)}}{V_{max.}}$$

$$R2 = \frac{V_{ref} \times \Sigma R}{V_{min.}} = - R1$$

Example :
Supervision of a 12V +-5% power supply :

- $V_{min.}$ = 11.4V $V_{max.}$ = 12.6V

We take $R\Sigma$ = 24kΩ (500μA in the resistor network)
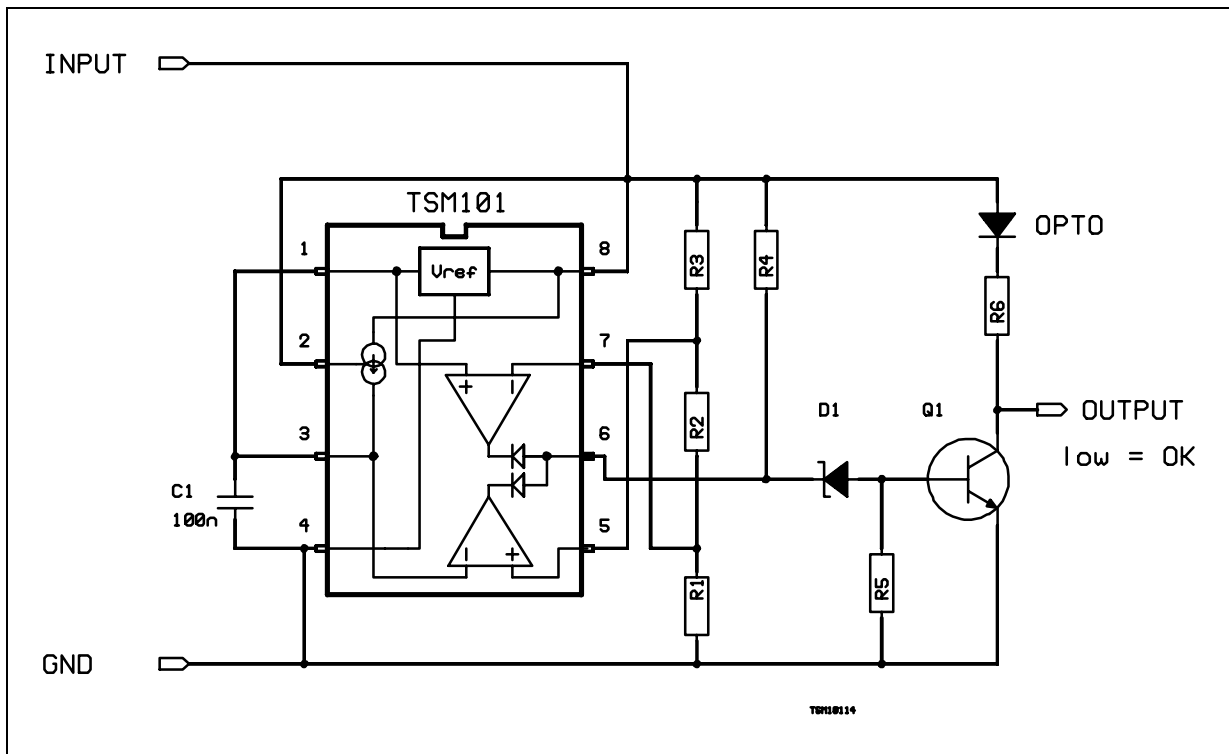
- D1 = 4.7V Zener diode

Ib (Q1) = 500μA when ON and a current of 10mA in the opto-coupler when ON

then :

- R1 = 2.36kΩ
- R2 = 200Ω
- R3 = 21.43kΩ
- R4 = 12kΩ
- R5 = 10kΩ
- R6 = 1kΩ

The complete schematic of the voltage supervisor is represented on Figure 2.

Figure 2 : Voltage Supervisor with TSM101