INTRODUCTION

Microchip’s TC54 series of voltage detectors are designed to supersede a variety of discrete comparator circuits and bipolar technology voltage detectors.

These voltage detectors are especially suited for application in battery powered systems because of their extremely low 1µA operating current. Each part is laser programmed to the desired trip point voltage over the range of 1.1V to 6.0V in 100mV steps. For complete design flexibility, complementary or open-drain output versions are available. TC54 package options include surface mount SOT-23A and SOT-89 or through-hole TO-92 types.

OPERATION

The TC54 equivalent circuit is shown in Figure 1. The internal precision temperature-compensated reference and comparator circuit consistently monitor V_{IN} for an under-voltage condition. When such a condition occurs, the output is forced to the active (LOW) state and remains there until V_{IN} is once again within tolerance. As shown in the timing diagram of Figure 1, the output is forced active when \( V_{IN} < (–V_{DET}) \) (Where \( (–V_{DET}) \) is the threshold voltage) and returns HIGH when \( V_{IN} \) exceeds \( (–V_{DET}) \) plus 5% hysteresis (example: if \( (–V_{DET}) = 2.0V \), the output will go HIGH when \( V_{IN} > 2.1V \)).

TC54 AS A MICROCONTROLLER RESET GENERATOR

Reset generators external to the microcontroller are necessary in systems that have slowly rising power supplies. It is necessary to hold the microcontroller in its reset state until the power supply has reached a valid operating level. Commonly used simple Schmitt trigger/capacitor circuits are inadequate since they do not accurately monitor the power supply voltage tolerance. The TC54 series overcomes this problem with precise voltage detection. Figure 2 shows a reset circuit using a TC54 replacing bipolar integrated voltage detectors (see Table 1).
MODIFYING THE TRIP POINT, $-V_{\text{DET}}$

Although the TC54 has a pre-programmed $-V_{\text{DET}}$, it is sometimes necessary to make adjustments during prototyping. This can be accomplished by connecting an external resistor divider to a TC54 which has a $-V_{\text{DET}}$ lower than that of $V_{\text{SOURCE}}$ (Figure 3).

To maintain detector accuracy, the bleeder current through the divider should be significantly higher than the 1µA operating current required by the TC54. A reasonable value for this bleeder current is 100µA (100 times the 1µA required by the TC54). For example, if $-V_{\text{DET}} = 2V$ and the desired trip point is 2.5V, the value of $R_1 + R_2$ is 25kΩ ($2.5V/100µA$). The value of $R_1 + R_2$ can be rounded to the nearest standard value and plugged into the equation of Figure 3 to calculate values for $R_1$ and $R_2$. 1% tolerance resistors are recommended.

$$V_{\text{SOURCE}} \left( \frac{R_1}{R_1 + R_2} \right) = (-V_{\text{DET}})$$

Where:

- $V_{\text{SOURCE}} =$ Voltage to be monitored
- $(-V_{\text{DET}}) =$ Threshold Voltage Setting of TC54

**Note:** In this example, $V_{\text{SOURCE}}$ must be greater than $(-V_{\text{DET}})$.
Low operating power and small physical size make the TC54 series ideal for many voltage detector applications, such as those shown in Figures 4, 5 and 6. Figure 4 shows a low-voltage gate drive protection circuit, which prevents overheating of the logic-level MOSFET due to insufficient gate voltage. When the input signal is below the threshold of the TC54VN, its output grounds the gate of the MOSFET. Figures 5 and 6 show the TC54 in conventional voltage monitoring applications.
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