

Using the Microchip TC54 Voltage Detector

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 $1\mu\text{A}$ 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 $V_{\text{IN}} < (-V_{\text{DET}})$ (Where $(-V_{\text{DET}})$ is the threshold voltage) and returns HIGH when V_{IN} exceeds $(-V_{\text{DET}})$ plus 5% hysteresis (example: if $(-V_{\text{DET}}) = 2.0\text{V}$, the output will go HIGH when $V_{\text{IN}} > 2.1\text{V}$).

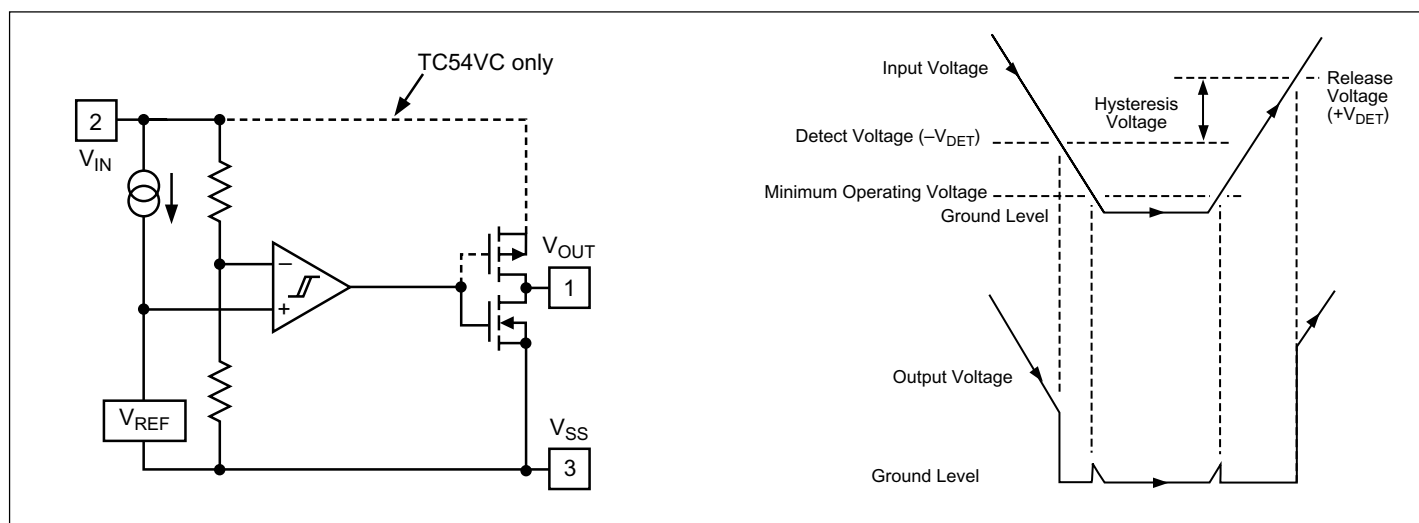


FIGURE 1: TC54 block diagram and timing.

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).

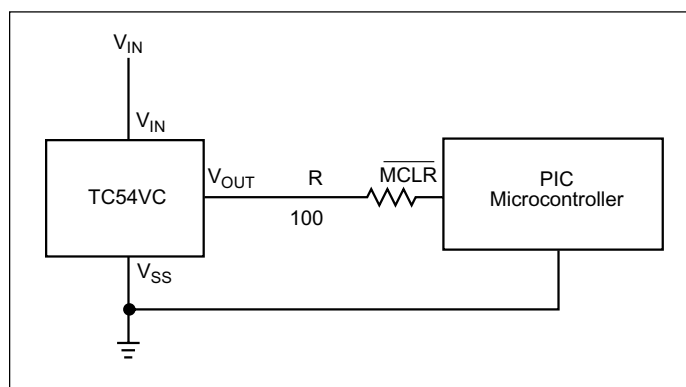


FIGURE 2: Microcontroller reset circuit using TC54.

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MFGR	MICROCHIP PART#	MICROCHIP #	DESCRIPTION	ATTRIBUTE
Motorola	MC33064P-5	TC54VN4502EZB	4.5V trip, -40 to +85C, TO-92	500 times less power
Motorola	MC34064P-5	TC54VN4502EZB	4.5V trip, 0 to +70C, TO-92	500 times less power
Motorola	MC34164P-3	TC54VN2702EZB	2.7V trip, 0 to +70C, TO-92	10 times less power
Motorola	MC34164P-5	TC54VN4302EZB	4.3V trip, 0 to +70C, TO-92	10 times less power
Motorola	MC33164P-3	TC54VN2702EZB	2.7V trip, -40 to +85C, TO-92	10 times less power
Motorola	MC33164P-5	TC54VN4302EZB	4.3V trip, -40 to +85C, TO-92	10 times less power
T.I.	TL7757ILP	TC54VN4502EZB	4.5V trip, -40 to +85C, TO-92	2000 times less power
T.I.	TL7757CLP	TC54VN4502EZB	4.5V trip, 0 to +70C, TO-92	2000 times less power

Table 1: TC54 cross reference listing.

MODIFYING THE TRIP POINT, $-V_{DET}$

Although the TC54 has a pre-programmed $-V_{DET}$, 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 $-V_{DET}$ lower than that of V_{SOURCE} (Figure 3).

To maintain detector accuracy, the bleeder current through the divider should be significantly higher than the $1\mu A$ operating current required by the TC54. A reasonable value for this bleeder current is $100\mu A$ (100 times the $1\mu A$ required by the TC54). For example, if $-V_{DET} = 2V$ and the desired trip point is $2.5V$, the value of $R1 + R2$ is $25k\Omega$ ($2.5V/100\mu A$). The value of $R1 + R2$ can be rounded to the nearest standard value and plugged into the equation of Figure 3 to calculate values for $R1$ and $R2$. 1% tolerance resistors are recommended.

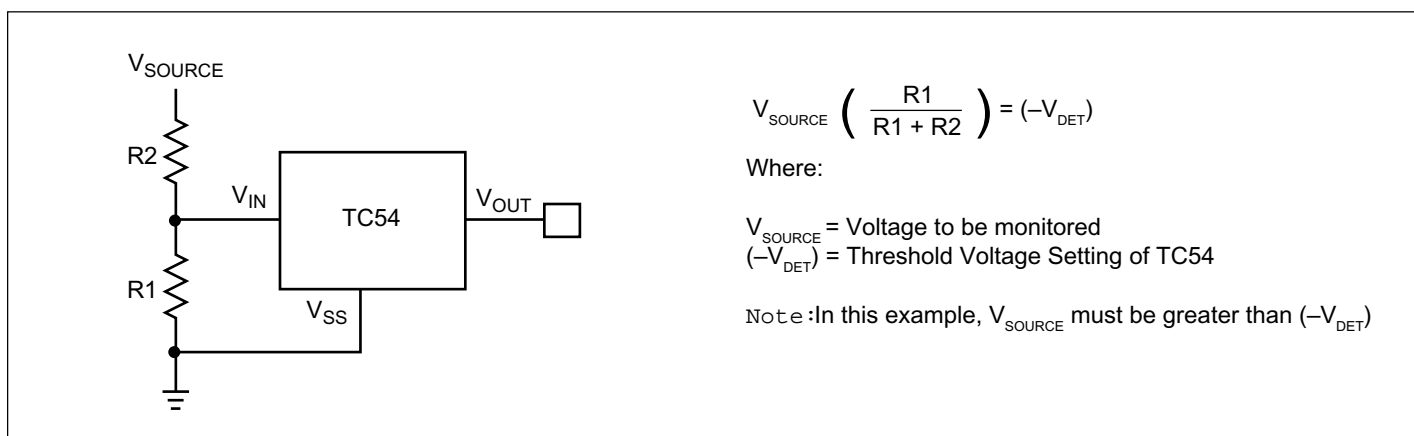


Figure 3: Modify trip point of TC54 using external resistor divider.

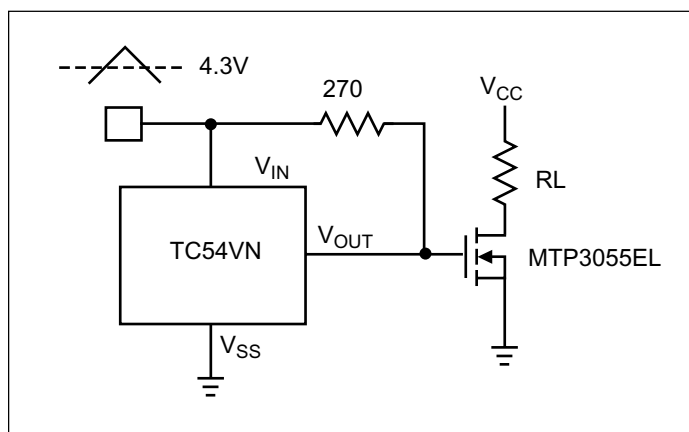


Figure 4: MOSFET low drive protection.

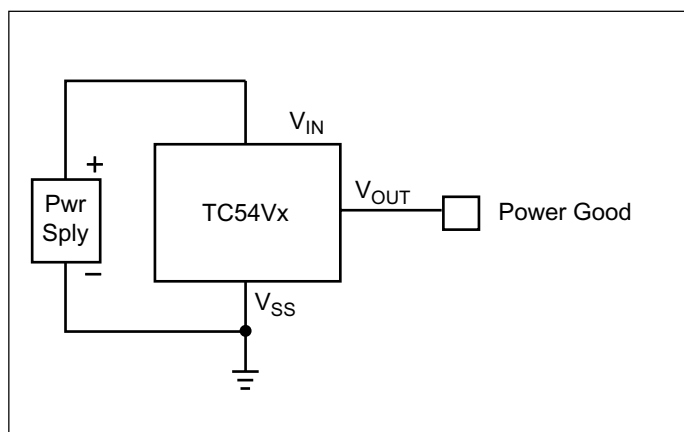


Figure 6: Power good monitor.

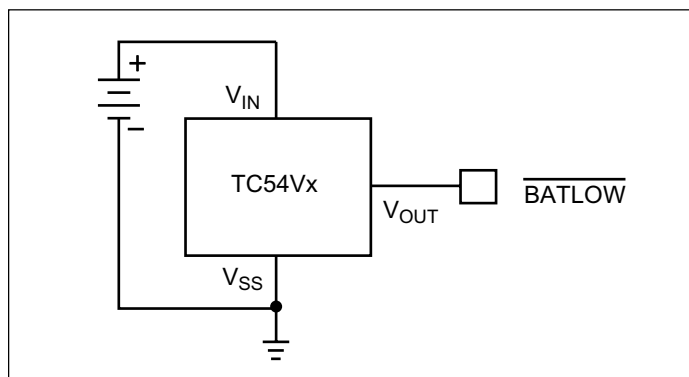


Figure 5: Battery voltage monitor.

OTHER APPLICATIONS

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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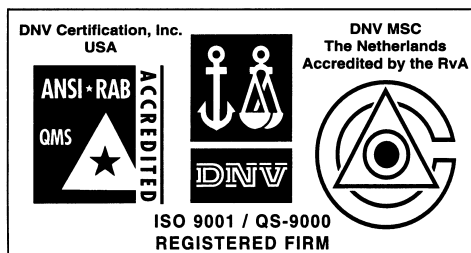
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