

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 $V_{\text{IN}} > 2.1\text{V}$).

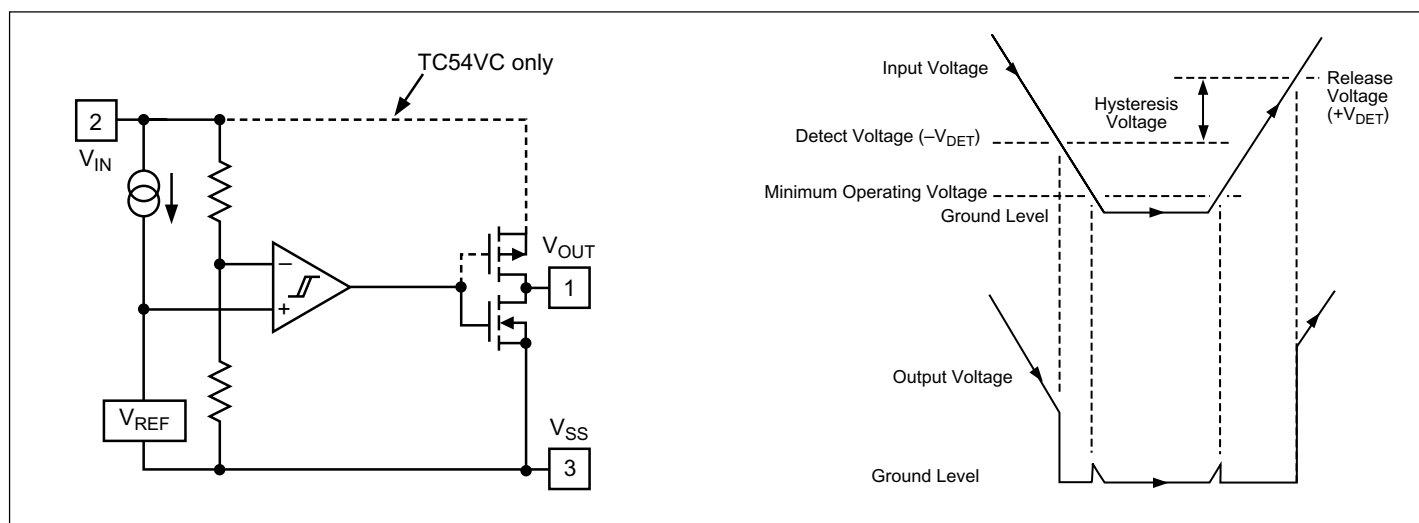


FIGURE 1: TC54 block diagram and timing.

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).

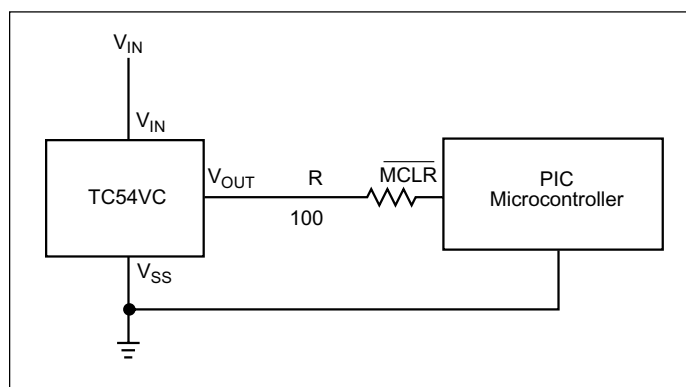


FIGURE 2: Microcontroller reset circuit using TC54.

AN2

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.

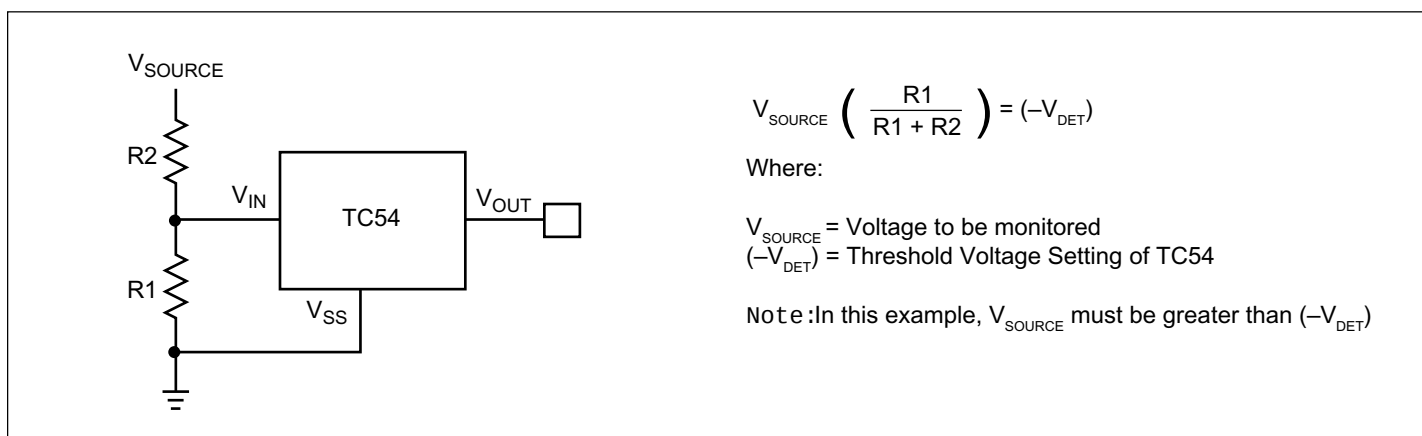


Figure 3: Modify trip point of TC54 using external resistor divider.

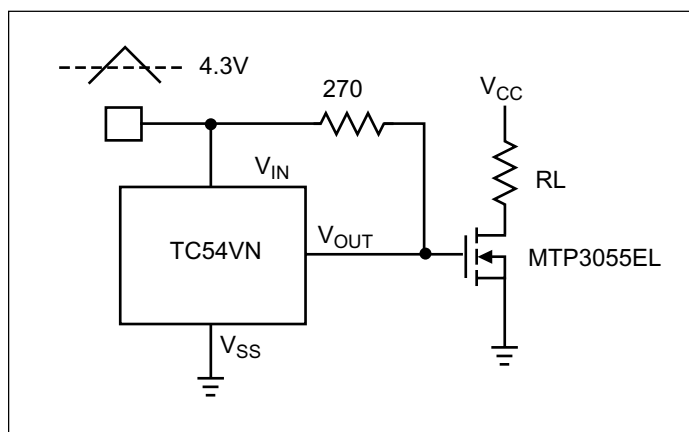


Figure 4: MOSFET low drive protection.

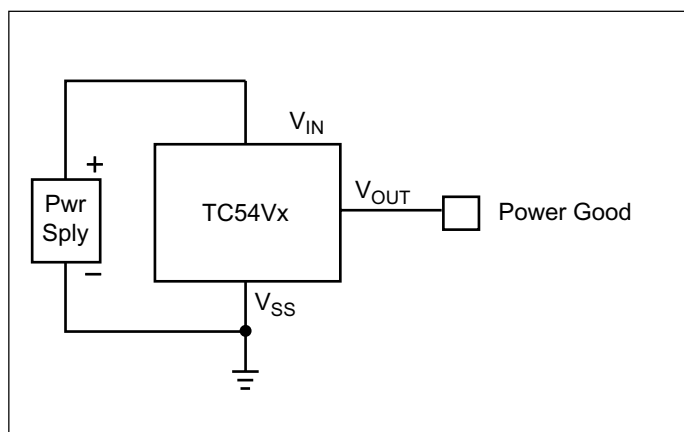


Figure 6: Power good monitor.

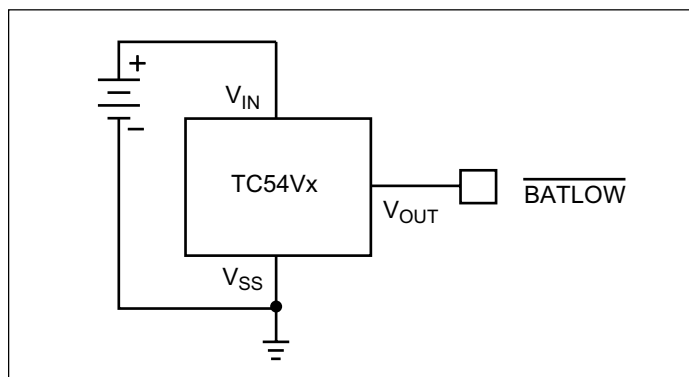


Figure 5: Battery voltage monitor.

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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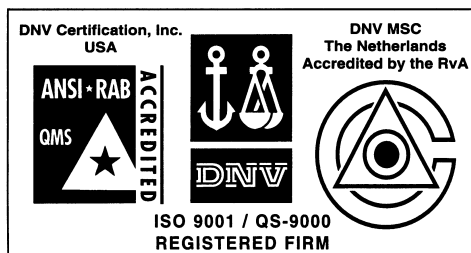
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WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200 Fax: 480-792-7277
Technical Support: 480-792-7627
Web Address: <http://www.microchip.com>

Rocky Mountain

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-7456

Atlanta

500 Sugar Mill Road, Suite 200B
Atlanta, GA 30350
Tel: 770-640-0034 Fax: 770-640-0307

Austin - Analog

8303 MoPac Expressway North
Suite A-201
Austin, TX 78759
Tel: 512-345-2030 Fax: 512-345-6085

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Boston - Analog

Unit A-8-1 Millbrook Tarry Condominium
97 Lowell Road
Concord, MA 01742
Tel: 978-371-6400 Fax: 978-371-0050

Chicago

333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Dayton

Two Prestige Place, Suite 130
Miamisburg, OH 45342
Tel: 937-291-1654 Fax: 937-291-9175

Detroit

Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Los Angeles

18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

New York

150 Motor Parkway, Suite 202
Hauppauge, NY 11788
Tel: 631-273-5305 Fax: 631-273-5335

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia

Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing

Microchip Technology Consulting (Shanghai)
Co., Ltd., Beijing Liaison Office
Unit 915
New China Hong Kong Manhattan Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu

Microchip Technology Consulting (Shanghai)
Co., Ltd., Chengdu Liaison Office
Rm. 2401, Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-6766200 Fax: 86-28-6766599

China - Fuzhou

Microchip Technology Consulting (Shanghai)
Co., Ltd., Fuzhou Liaison Office
Rm. 531, North Building
Fujian Foreign Trade Center Hotel
73 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7557563 Fax: 86-591-7557572

China - Shanghai

Microchip Technology Consulting (Shanghai)
Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen

Microchip Technology Consulting (Shanghai)
Co., Ltd., Shenzhen Liaison Office
Rm. 1315, 13/F, Shenzhen Kerry Centre,
Renminnan Lu
Shenzhen 518001, China
Tel: 86-755-2350361 Fax: 86-755-2366086

Hong Kong

Microchip Technology Hongkong Ltd.
Unit 901, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

India

Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaughnessy Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

Korea

Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-334-8870 Fax: 65-334-8850

Taiwan

Microchip Technology Taiwan
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Denmark

Microchip Technology Denmark ApS
Regus Business Centre
Lautrup høj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France

Arizona Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - 1er Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany

Arizona Microchip Technology GmbH
Gustav-Heinemann Ring 125
D-81739 Munich, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Germany - Analog

Lochamer Strasse 13
D-82152 Martinsried, Germany
Tel: 49-89-895650-0 Fax: 49-89-895650-22

Italy

Arizona Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom

Arizona Microchip Technology Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820