TC51

1μA Voltage Detector with Output Delay

Features

- Precise Detection Thresholds: ±2.0%
- Small Package: 3-Pin SOT-23A
- Low Supply Current: Typ. 1μA
- Wide Detection Range: 1.6V to 6.0V
- Wide Operating Voltage Range: 0.7V to 10V
- Built-in Delay Circuit: 50msec to 200 msec
- Open-Drain Output

Applications

- Battery Voltage Monitoring
- Microprocessor Reset
- System Brown-out Protection

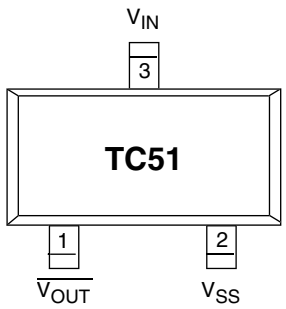
Device Selection Table

Part Number	Package	Temp. Range
TC51-xxxxxxxxxx	3-Pin SOT-23A	-40°C to +85°C

Other output voltages are available. Please contact Microchip Technology Inc. for details.

Package Type

3-Pin SOT-23A



NOTE: 3-Pin SOT-23A is equivalent to the EIAJ SC-59.

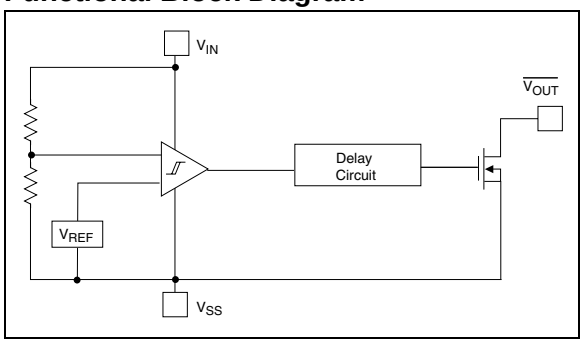
General Description

The TC51 is a very low power, open drain output, CMOS voltage detector with built-in delay. It is particularly well-suited for battery powered applications because of its extremely low 1μA operating current and small surface-mount packaging. Each part is laser-trimmed to the desired threshold voltage, which can be specified from 1.6V to 6.0V. The standard built-in output delay is 50msec-200msec.

The device includes a comparator, low-current high-precision reference, laser-programmed voltage divider, hysteresis circuit and output driver with digital delay timer.

In operation, the TC51's output ($\overline{V_{OUT}}$) remains in the logic HIGH state as long as V_{IN} is greater than the specified threshold voltage (V_{DET}-). When V_{IN} falls below V_{DET}-, the output is immediately driven to a logic LOW. $\overline{V_{OUT}}$ remains LOW until V_{IN} rises above V_{DET}- by an amount V_{HYST}, whereupon it returns to a logic HIGH after expiration of the built-in delay time.

Functional Block Diagram



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1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings*

Input Voltage .....+12V
Output Current 50mA
Output Voltage: Open Drain .....(V_{SS} – 0.3V) to 12V
Power Dissipation ($T_A \leq 70°C$):
3-Pin SOT-23A 240mW
Operating Temperature Range.....-40°C to +85°C
Storage Temperature Range.....-65°C to +150°C

*Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

TC51 ELECTRICAL SPECIFICATIONS

Electrical Characteristics: T_A = 25°C, unless otherwise specified.						
Symbol	**Parameter**	**Min**	**Typ**	**Max**	**Units**	**Test Conditions**
V_{IN}	Operating Voltage	0.7	—	10.0	V	(V_{DET}-) = 1.6 to 6.0V
I_{SS}	Quiescent Current	— — — — —	0.9 1.0 1.3 1.6 2.0	2.6 3.0 3.4 3.8 4.2	µA	V_{IN} = 1.5V V_{IN} = 2.0V V_{IN} = 3.0V V_{IN} = 4.0V V_{IN} = 5.0V
V_{DET}-	Threshold Voltage	V_T x 0.98	V_T ± 0.5%	V_T x 1.02	V	Note 1
V_{HYST}	Hysteresis Voltage	V_{DET}- x 0.02	V_{DET}- x 0.05	V_{DET}- x 0.08	V	
I_{OUT}	Output Current	— —	2.2 7.7 10.1 11.5 13.0	— —	mA	V_{OL} = 0.5V, V_{IN} = 1.0V V_{IN} = 2.0V V_{IN} = 3.0V V_{IN} = 4.0V V_{IN} = 5.0V
T_{DLY}	Delay Time	50	—	200	msec	Standard
T_C (V_{DET}-)	Tempco of (V_{DET}-)	—	±100	—	ppm/°C	-40°C ≤ T_A ≤ 85°C

Note 1: V_T is the factory programmed threshold voltage setting.

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2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

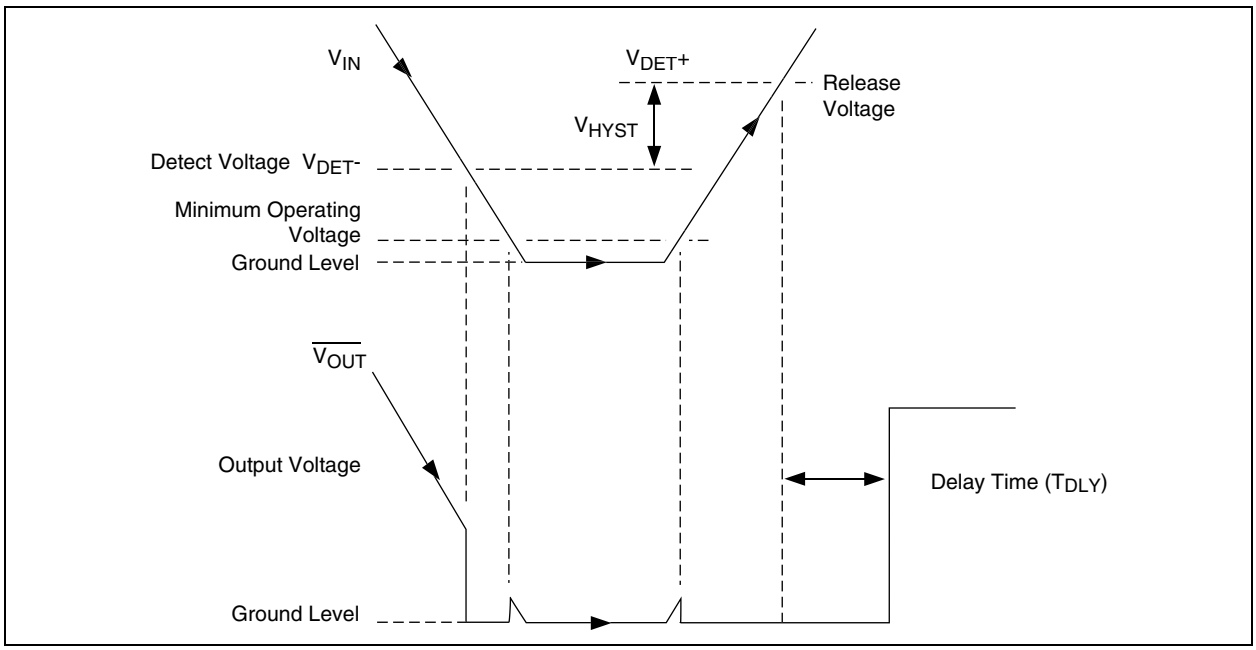
Pin No. (3-Pin SOT-23A)	Symbol	Description
1	$\overline{V_{OUT}}$	Digital output. This output goes low when V_{IN} drops below V_{DET}- and returns high when V_{IN} rises above V_{DET}- + V_{HYST}. (See Figure 3-1, Timing Diagram).
2	V_{SS}	Ground terminal.
3	V_{IN}	Analog input. This pin is both the power supply input and the voltage to be monitored.

3.0 DETAILED DESCRIPTION

In normal steady-state operation, when $V_{IN} > V_{DET}-$, the output is high, see Figure 3-1. If and when the input falls below $V_{DET}-$, the output pulls down (Logic 0) to V_{SS}. Generally, V_{OUT} can pull down to within 0.5V of V_{SS} at rated output current and input voltage. (Also see Section 1.0, Electrical Characteristics).

The output, $\overline{V_{OUT}}$, stays valid until the input voltage falls below the minimum operating voltage, V_{INMIN}, of 0.7V. Below this minimum operating voltage, the output is undefined. During power-up or anytime V_{IN} has fallen below V_{INMIN}, $\overline{V_{OUT}}$ will remain undefined until V_{IN} rises above V_{INMIN}, at which time the output becomes valid. $\overline{V_{OUT}}$ is maintained in its active low state while $V_{INMIN} < V_{IN} < V_{DET}+$. ($V_{DET}+ = V_{DET}- + V_{HYST}$). If and when the input rises above $V_{DET}+$, the output will assume its inactive state after Delay Time (T_{DLY}).

FIGURE 3-1: TIMING DIAGRAM



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4.0 APPLICATIONS INFORMATION

4.1 Processor $\overline{\text{RESET}}$ Supervisor

Figure 4-1 shows the TC51 used as a processor reset supervisor. Because the TC51 is available in threshold settings of 1.6V to 6.0V, the user can choose the reset single threshold setting best suited to the system power supply voltage at hand. Also, the 1µA supply current is significantly lower than its nearest competitor.

As shown in the timing diagram (Figure 3-1), $\overline{V_{OUT}}$ is low for voltages between 0.7V and $V_{DET}+$. The TC51 activates its on-board delay timer once the power supply voltage is within tolerance (i.e., greater than $V_{DET}+$). $\overline{V_{OUT}}$ is released after delay time (T_{DLY}).

Should the power supply voltage momentarily dip ("brown-out" condition), the TC51 immediately drives and holds the processor $\overline{\text{RESET}}$ input low. $\overline{\text{RESET}}$ is released after the power supply voltage is again within tolerance, and after the delay timer expires. $\overline{\text{RESET}}$ is driven and held low when power fails (power-off or "blackout"), and is maintained down low to a supply voltage of 0.7V.

FIGURE 4-1: PROCESSOR $\overline{\text{RESET}}$ SUPERVISOR

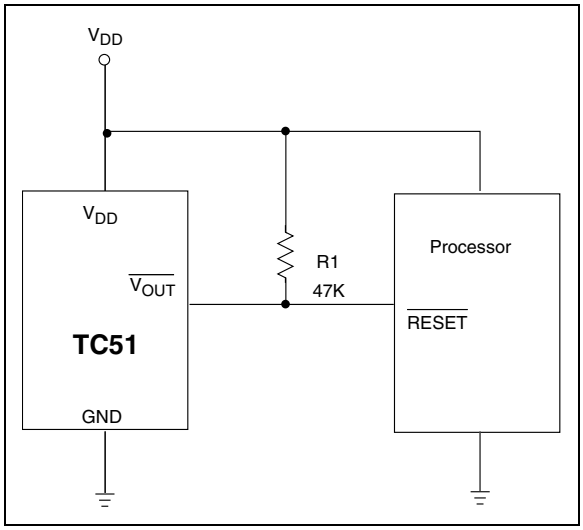
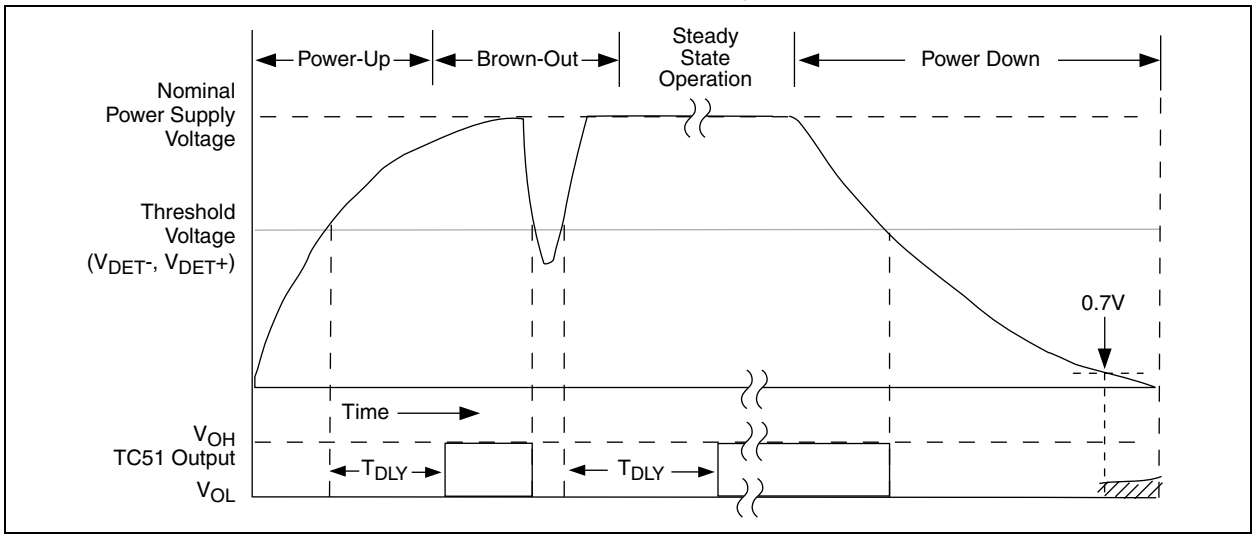


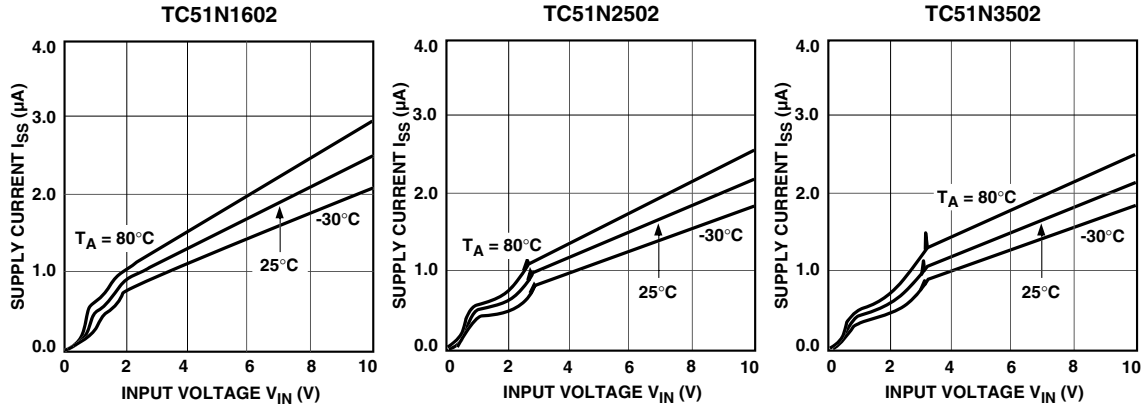
FIGURE 4-2: TC51 OPERATION DURING POWER-UP, BROWN-OUT AND POWER DOWN



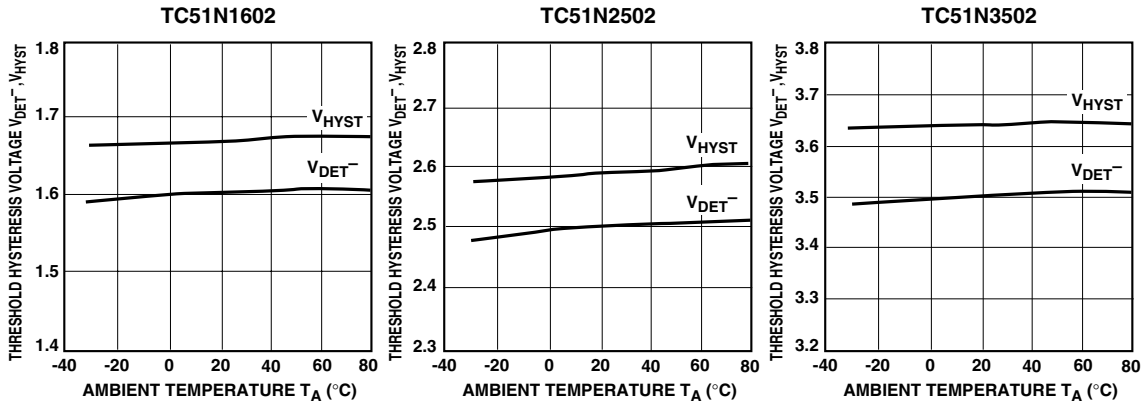
5.0 TYPICAL CHARACTERISTICS

Note: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

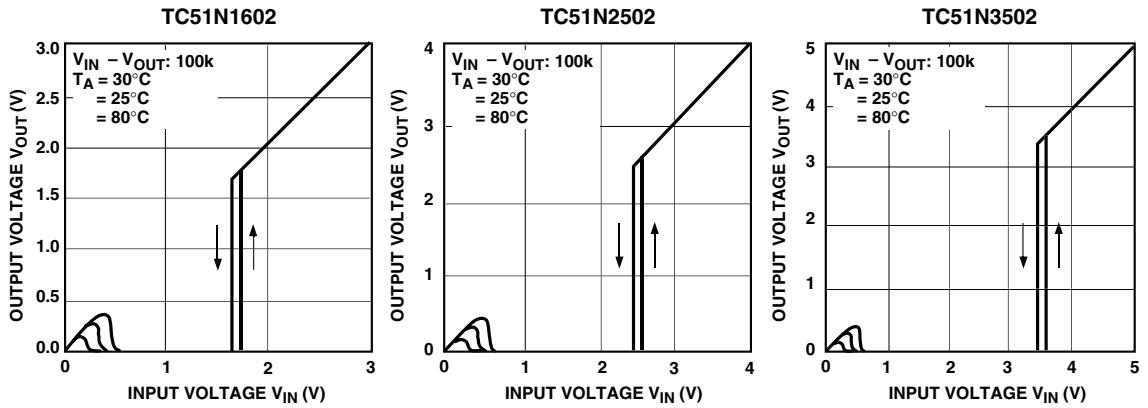
1. SUPPLY CURRENT VS. INPUT VOLTAGE



2. THRESHOLD VOLTAGE, HYSTERESIS VOLTAGE VS. AMBIENT TEMPERATURE



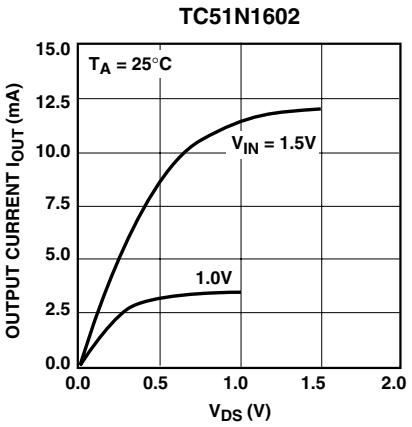
3. OUTPUT VOLTAGE VS. INPUT VOLTAGE

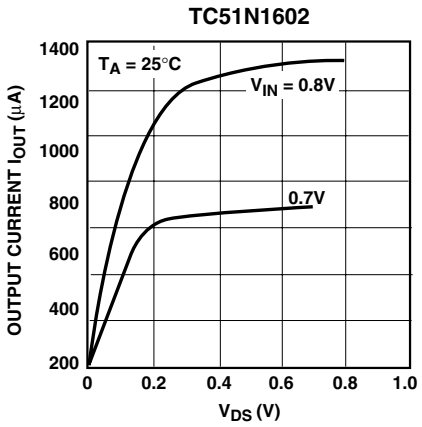


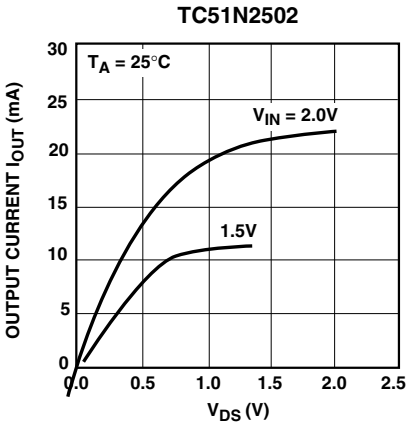
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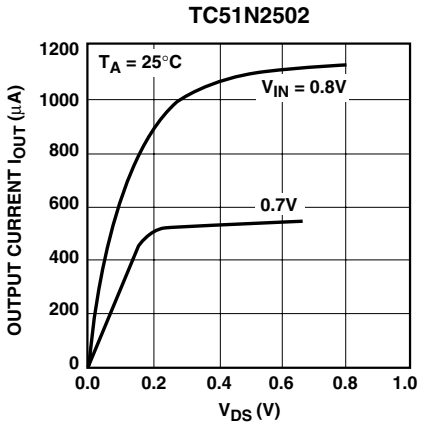
5.0 TYPICAL CHARACTERISTICS (CONTINUED)

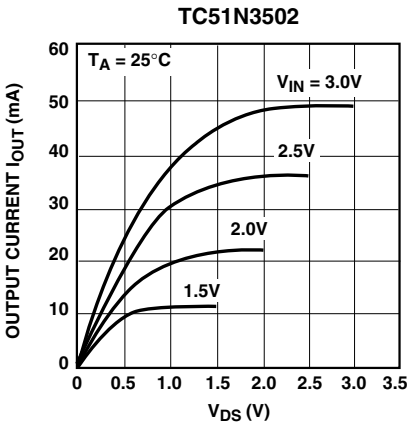
4. OUTPUT CURRENT VS. V_{DS}

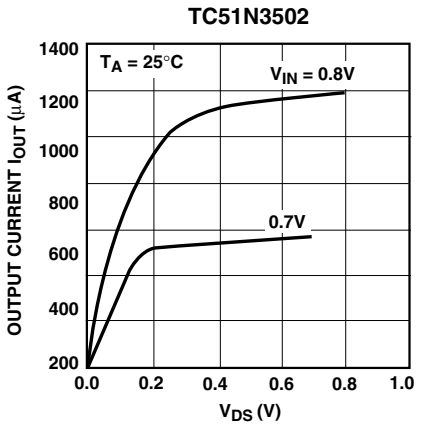








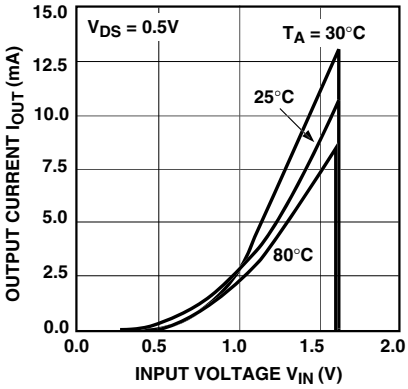




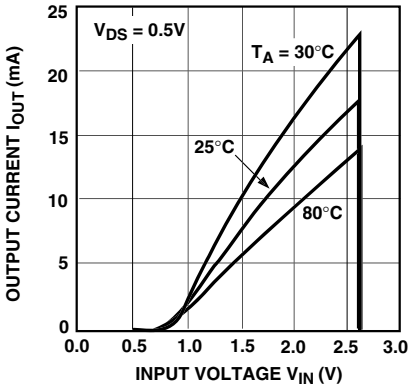
5.0 TYPICAL CHARACTERISTICS (CONTINUED)

5. OUTPUT CURRENT VS. INPUT VOLTAGE

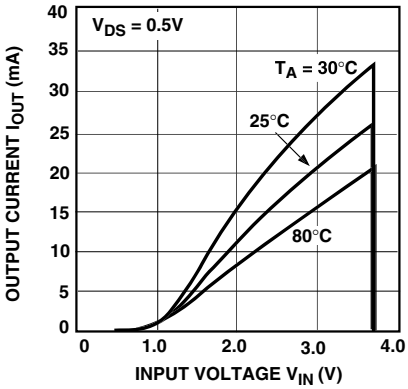
TC51N1602



TC51N2502



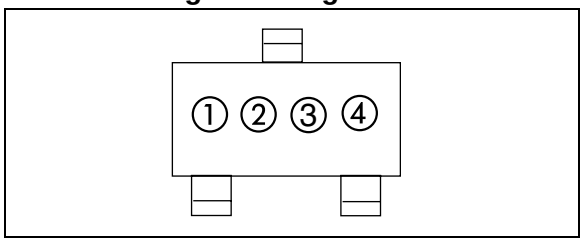
TC51N3502



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6.0 PACKAGING INFORMATION

6.1 Package Marking Information



① represents N-channel indication and integer part of output voltage

Symbol	Output	Voltage
K	Nch	0.
L	Nch	1.
M	Nch	2.
N	Nch	3.
P	Nch	4.
R	Nch	5.
S	Nch	6.

② represents first decimal of output voltage

Symbol	Voltage
0	.0
1	.1
2	.2
3	.3
4	.4
5	.5
6	.6
7	.7
8	.8
9	.9

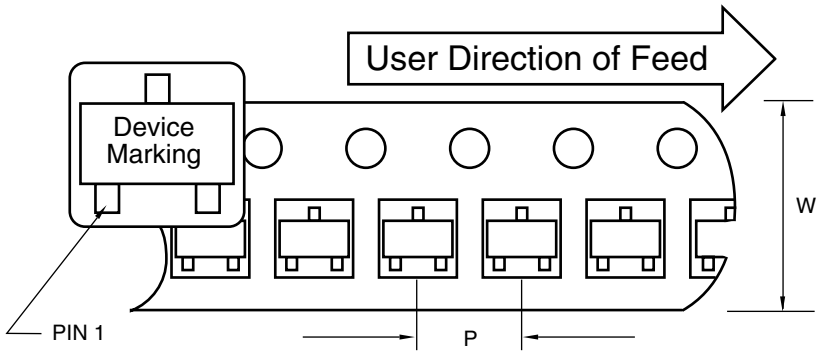
③ represents delay time

Symbol	Delay Time
5	50ms-200ms

④ represents assembly lot code

6.2 Taping Form

Component Taping Orientation for 3-Pin SOT-23A (EIAJ SC-59) Devices



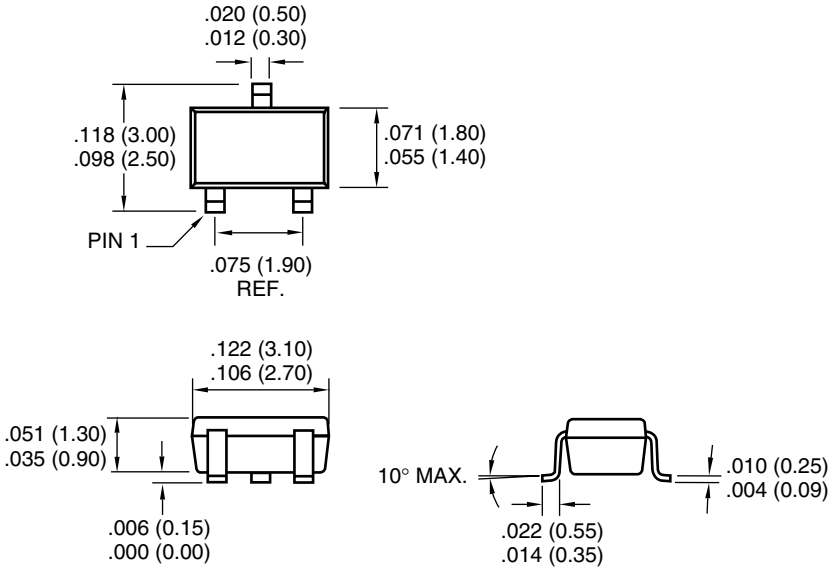
Standard Reel Component Orientation
for TR Suffix Device
(Mark Right Side Up)

Carrier Tape, Number of Components Per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
3-Pin SOT-23A	8 mm	4 mm	3000	7 in

6.3 Package Dimensions

SOT-23A-3



Dimensions: inches (mm)

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PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART CODE	TC51	N	18	0	2	E	CB	XX

Output Configuration:
N = Open Drain

Detected Voltage:
Ex: 18 = 1.8V

Output Delay:
0 = 50msec-200msec (standard)

Tolerance:
2 = ±2%

Temperature:
E: -40°C to +85°C

Package Type and Pin Count:
CB: 3-Pin SOT-23A (equivalent to EIAJ SC-59)

Taping Direction:
TR: Standard Taping

Sales and Support

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3. The Microchip Worldwide Site (www.microchip.com)

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

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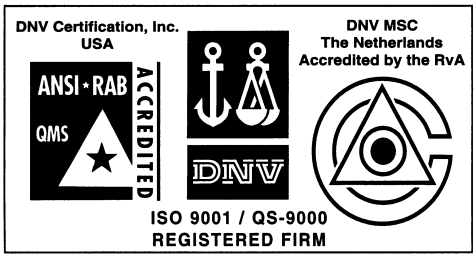
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