

VOLTAGE DETECTOR

FEATURES

- Precise Detection Thresholds Standard $\pm 2.5\%$
- Small Packages SOT-23A-5 Surface Mount
SOT-89-3 Surface Mount
TO-92 Thru-hole Package
- Low Current Drain Typ. $1\mu\text{A}$
- Voltage Detection Range 0.9V to 6.0V
- Operating Voltage Range 0.7V to 10.0V

APPLICATIONS

- Microprocessor Reset
- Battery Status Indicator
- Level Discriminator
- Power-failure Detector
- Switching Circuit in Battery Backup
- Waveform Shaping Circuit

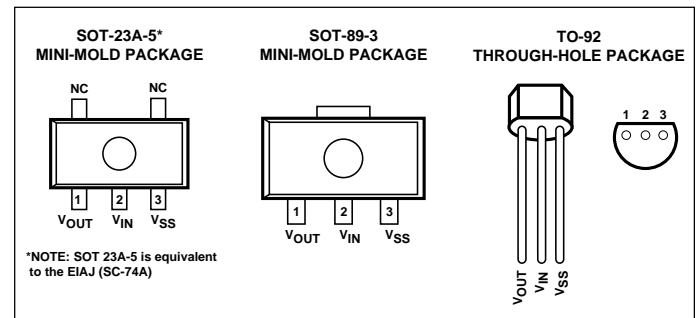
GENERAL DESCRIPTION

The TC44 Series are CMOS voltage detectors, suited especially for battery-powered applications because of their extremely low $1\mu\text{A}$ operating current and small surface-mount packaging. Each part is laser trimmed to the desired threshold voltage which can be ordered in the range of 0.9V to 6.0V, in 0.1V steps.

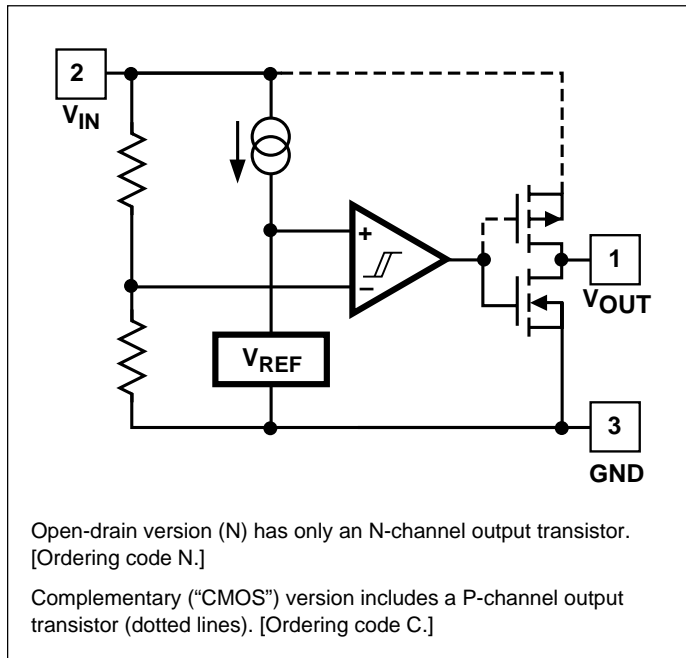
The design includes a comparator, low-current high-precision reference, laser-trimmed divider, hysteresis circuit and output driver. The latter is available in either an open-drain or complementary ("CMOS") configuration.

In operation, the TC44 output (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 driven to a logic LOW. V_{OUT} remains LOW until V_{IN} rises above V_{DET} by an amount V_{HYST} , whereupon it resets to a logic HIGH.

PIN CONFIGURATIONS



FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

PART CODE TC44 V X XX X X X XX XXX

- Output form:** _____
N = Nch Open Drain
C = CMOS Output
- Detected Voltage:** _____
Ex: 09 = 0.9V; 60 = 6.0V
- Extra Feature Code:** Fixed: 0 _____
- Tolerance:** 3: $\pm 2.5\%$ _____
- Temperature:** E: - 40°C to +85°C _____
- Package Type and Pin Count:** _____
CT: SOT-23A-5, MB SOT-89-3, ZB: TO-92-3
- Taping Direction:** _____
713: Right Taping
723: Left Taping
no suffix: TO-92 Bulk

TC44 Series

ABSOLUTE MAXIMUM RATINGS

Supply Voltage V_{IN}	12V	Power Dissipation: SOT-23-5	240mW
Output Voltage: CMOS	$(V_{SS} - 0.3)$ to $(V_{IN} + 0.3)$	SOT-89-3	400mW
Open Drain	12V	TO-92	440mW
Output Current	70mA	Storage Temperature	-65°C to $+150^{\circ}\text{C}$
Operating Temperature	-40°C to $+85^{\circ}\text{C}$	Lead Temperature (Soldering, 10 sec)	260°C

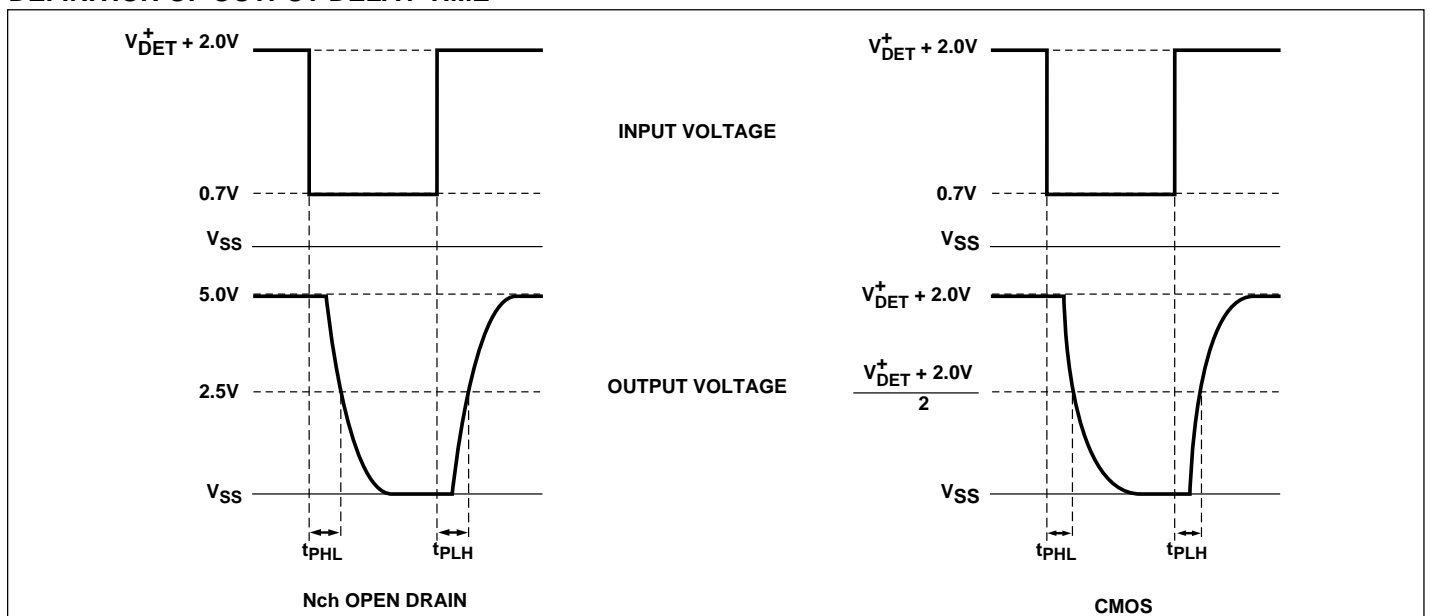
ELECTRICAL CHARACTERISTICS: $T_A = 25^{\circ}\text{C}$, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{DET}^-	Threshold Voltage		(V_{DET}^-) $\times 0.975$	—	(V_{DET}^-) $\times 1.025$	V
V_{HYST}	Hysteresis Range		(V_{DET}^-) $\times 0.03$	(V_{DET}^-) $\times 0.05$	(V_{DET}^-) $\times 0.07$	V
I_{SS}	Quiescent Current	$V_{IN} = 1\text{V}$ (Output = ON) (Note 1)	—	1.0	—	μA
V_{IN}	Operating Voltage		0.7	—	10.0	V
I_{OUT}	Output Current	N-channel $V_{DET}^- = 4.5\text{V}$ 2.7V 0.9V P-channel $V_{DET}^- = 4.5\text{V}$ 2.7V 0.9V (Note 2)	$V_{DS} = 0.5\text{V}$ $V_{IN} = 4.0\text{V}$ 2.5V 0.8V $V_{DS} = 0.5\text{V}$ $V_{IN} = 5.0\text{V}$ 3.0V 1.0V	— 12.0 7.2 0.45 0.6 0.4 0.05	—	— mA mA
$\frac{\Delta(V_{DET}^-)}{\Delta T_A}$	Tempco of (V_{DET}^-)			± 100		ppm/ $^{\circ}\text{C}$

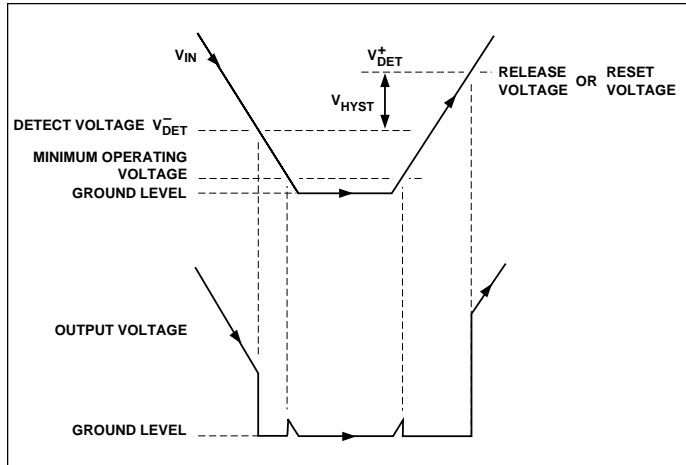
NOTE 1: When V_{IN} drops to 1.5 volts or less, I_{SS} is approximately 0.5 – 1.0 μA . At $(V_{DET}^-) \pm 1\text{V}$, it is approximately 1.5 μA . For I_{SS} at higher values of V_{IN} or over temperature, see the appropriate curves.

NOTE 2: These are average values for devices in the "ON" condition (V_{IN} lower than V_{DET}^- for the N-channel output, and V_{IN} higher than V_{DET}^- for the P-channel output).

DEFINITION OF OUTPUT DELAY TIME



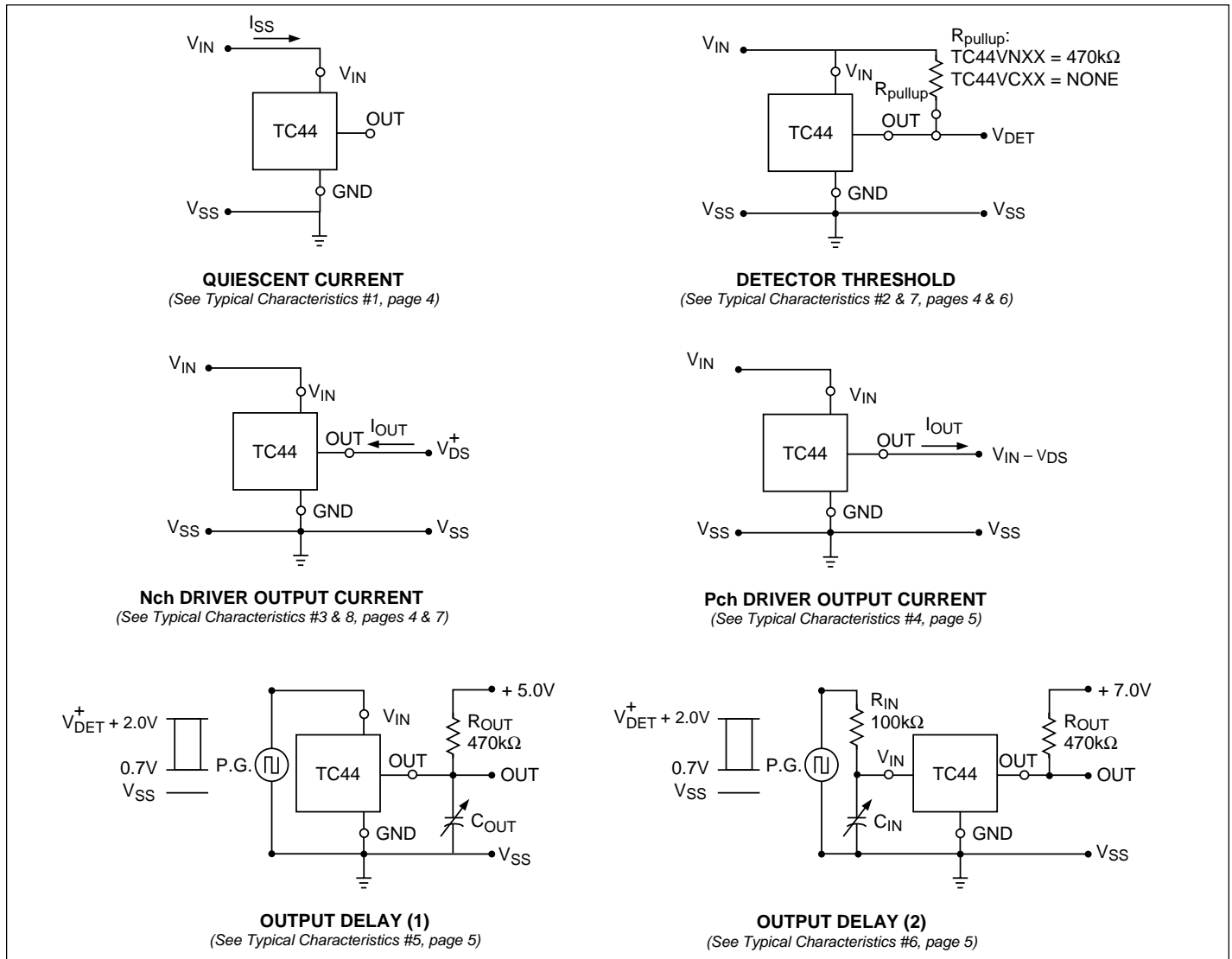
TIMING CHART



DESCRIPTION OF OPERATION

- When an input voltage (V_{IN}) is larger than the detected voltage (V_{DET}^-), V_{IN} will equal V_{OUT} (OFF mode in Nch open drain).
- When V_{IN} is lower than V_{DET}^- , V_{OUT} will equal V_{SS} .
- When V_{IN} drops below the minimum operating voltage (V_{MIN}), V_{OUT} will be undefined.
- When V_{IN} rises from ground potential (GND), the output will be undefined when V_{IN} is between GND and V_{MIN} . V_{OUT} will be equal to V_{SS} when V_{IN} is between V_{MIN} and the release voltage (V_{DET}^+).
- The difference between V_{DET}^+ and V_{DET}^- is V_{HYST} .

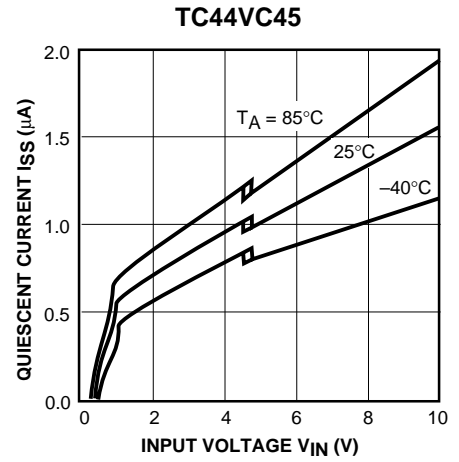
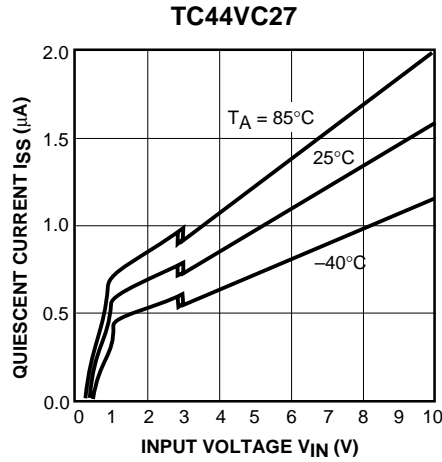
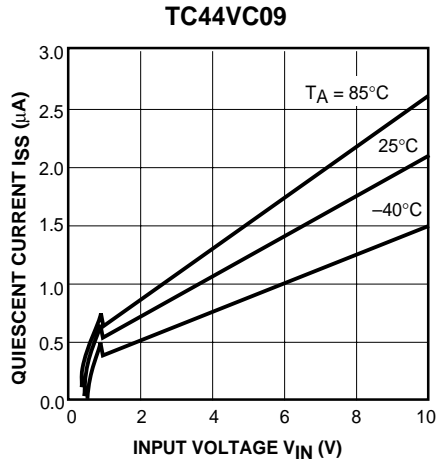
TEST CIRCUITS



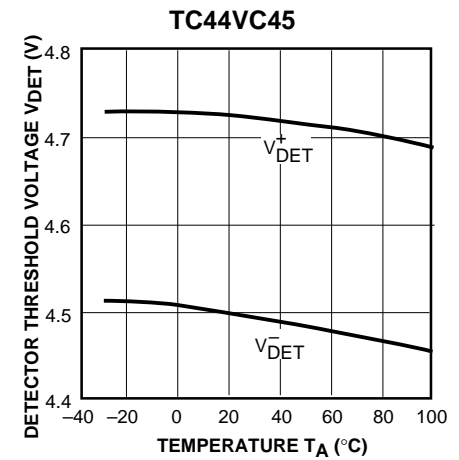
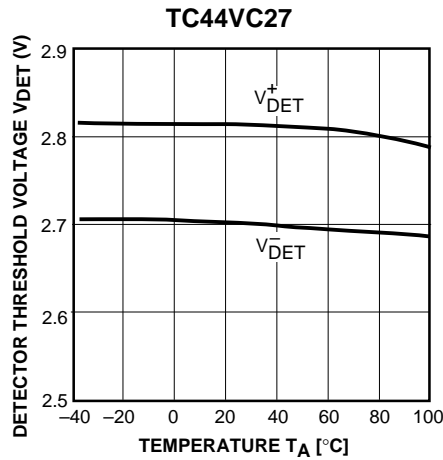
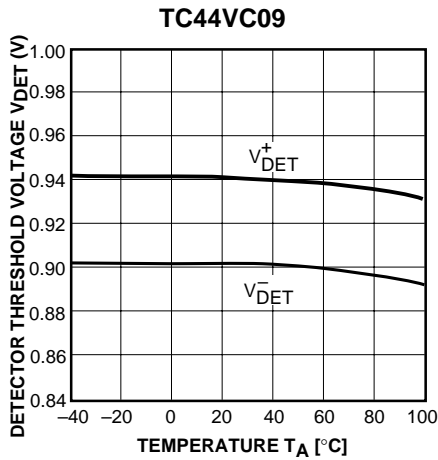
TC44 Series

TYPICAL CHARACTERISTICS

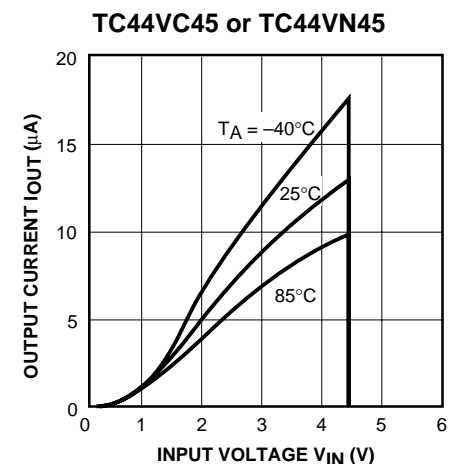
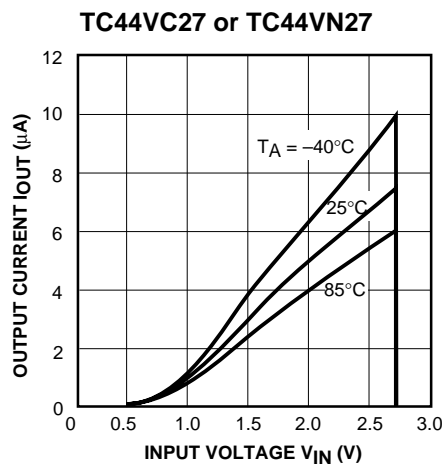
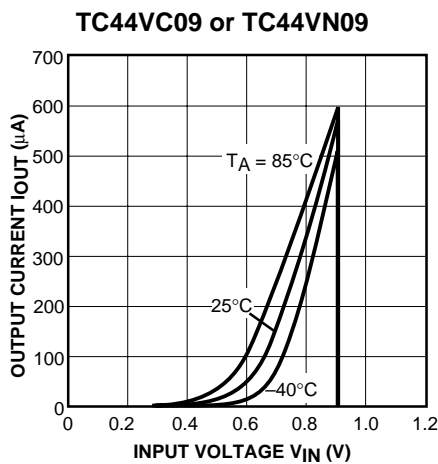
1) Quiescent Current vs. Input Voltage



2) Detector Threshold vs. Temperature

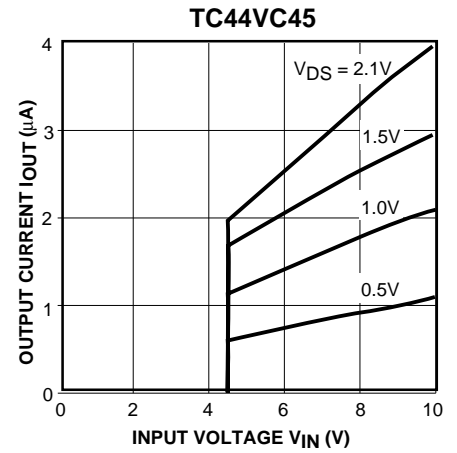
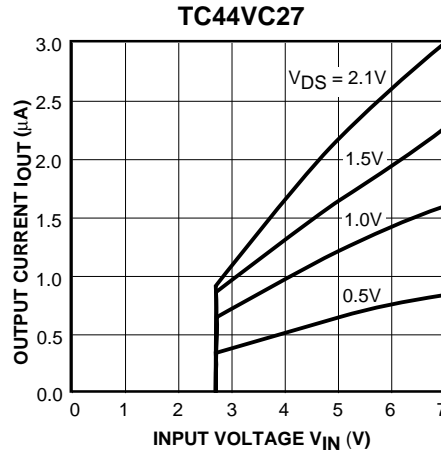
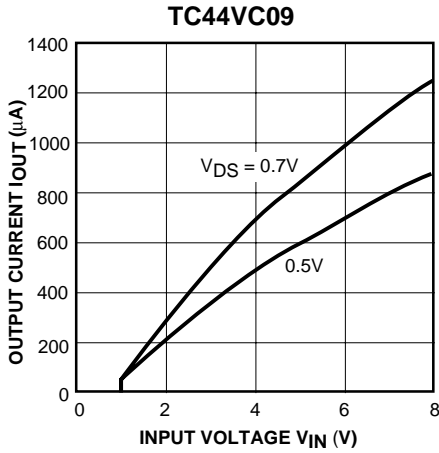


3) Nch Driver Output Current vs. Input Voltage

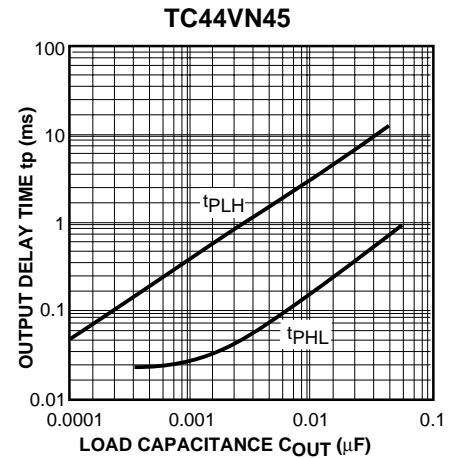
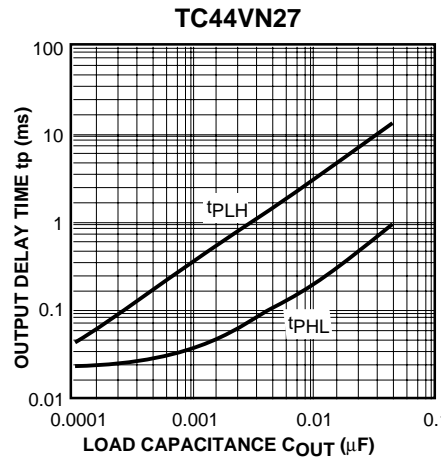
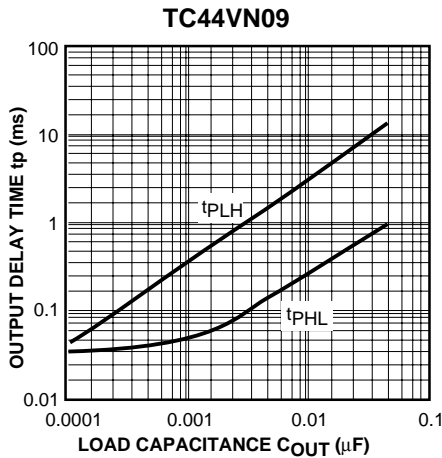


TYPICAL CHARACTERISTICS (CONT.)

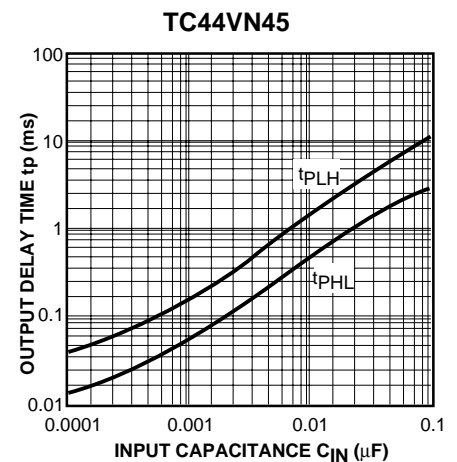
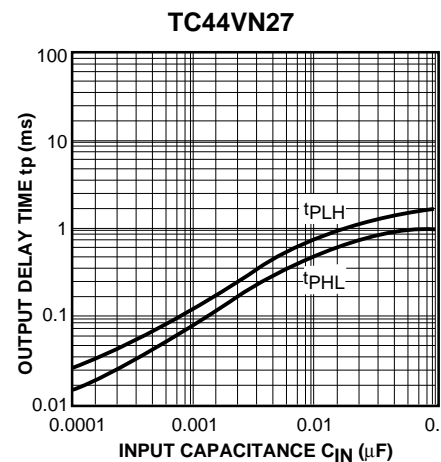
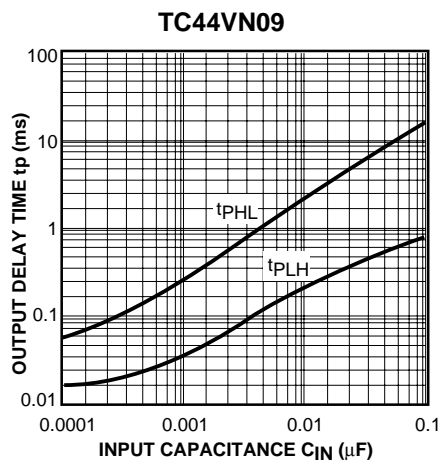
4) Pch Driver Output Current vs. Input Voltage ($T_A = 25^\circ\text{C}$)



5) Output Delay vs. Load Capacitance ($T_A = 25^\circ\text{C}$)



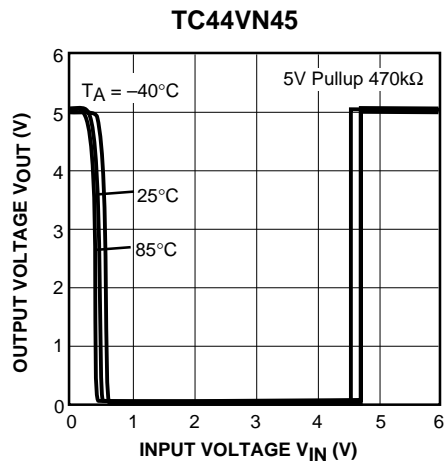
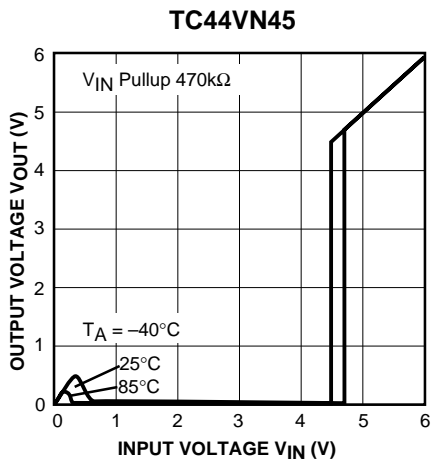
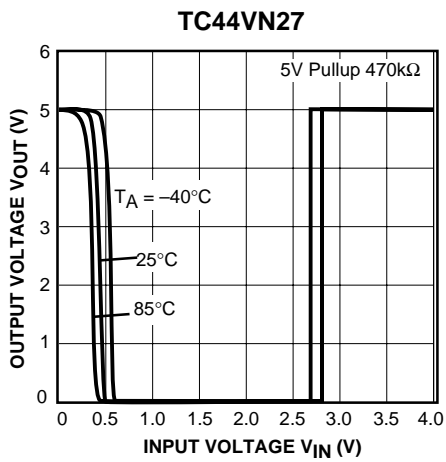
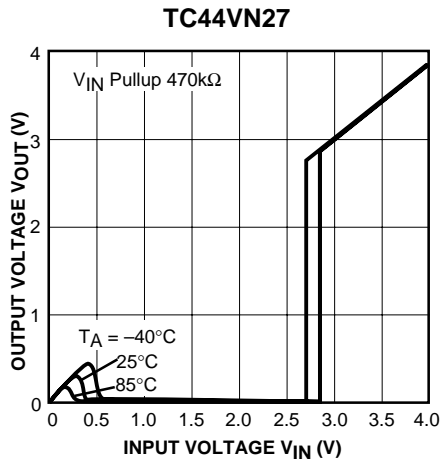
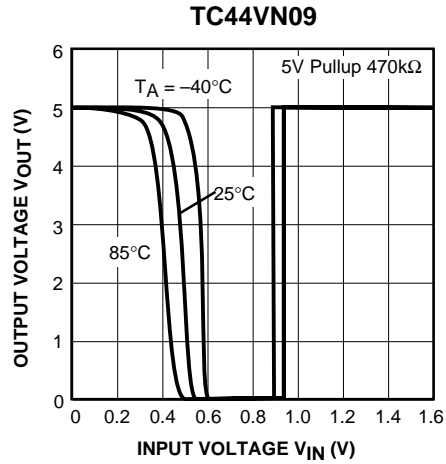
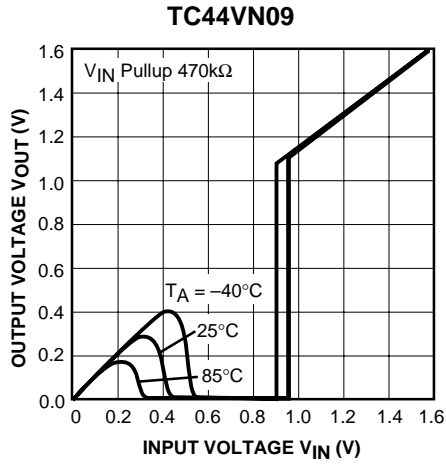
6) Output Delay vs. Input Capacitance (External)



TC44 Series

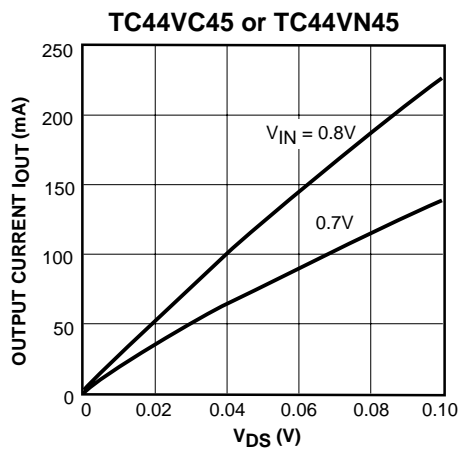
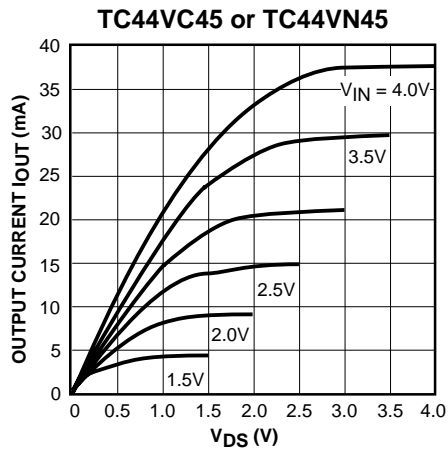
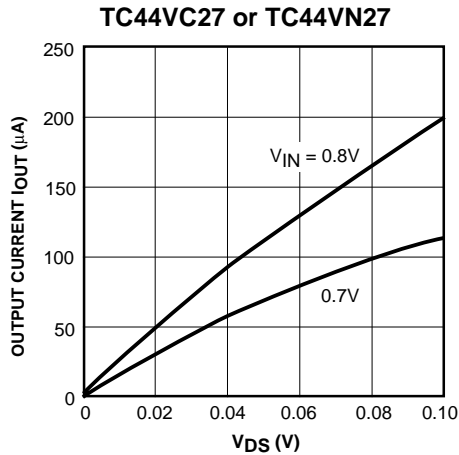
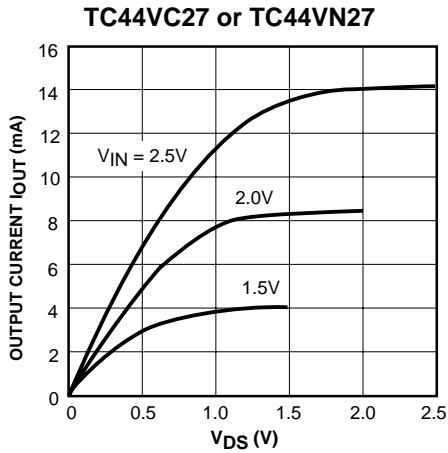
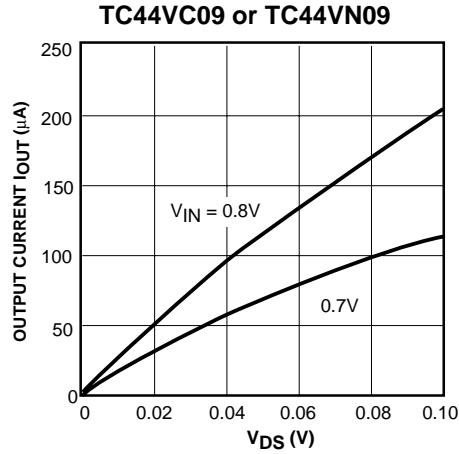
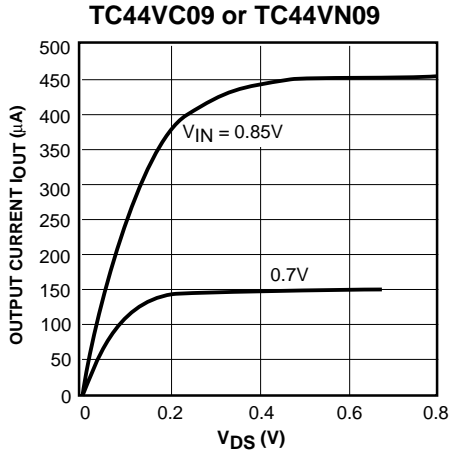
TYPICAL CHARACTERISTICS (CONT.)

7) Output Voltage vs. Input Voltage



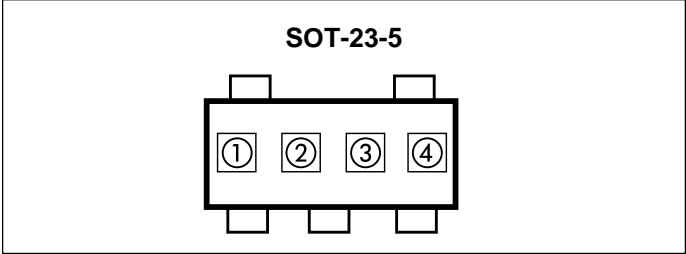
TYPICAL CHARACTERISTICS (CONT.)

8) Nch Driver Output Current vs. V_{DS} ($T_A = 25^\circ\text{C}$)



TC44 Series

MARKING



② = output (Nch or CMOS) plus first voltage digit

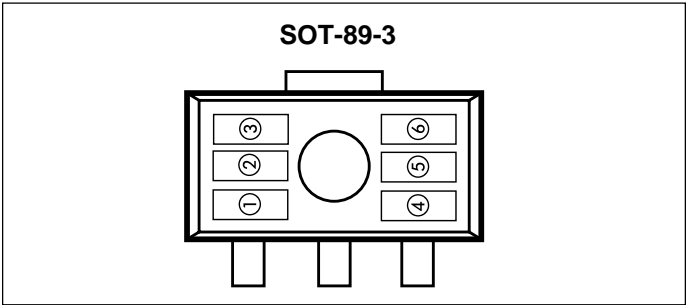
0 1 2 3 4 5 6

Nch N P R S T U V ex: CMOS 3.X = ○(K)○○

CMOS G H J K L M N

① = first voltage decimal ex: CMOS 3.4 = (4)(K)○○

③ & ④ = assembly lot number



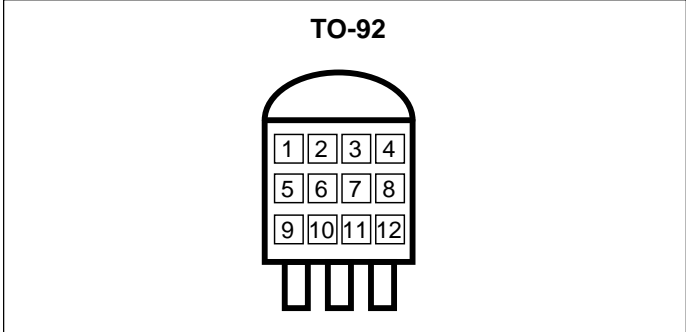
① = T (fixed)

② = first voltage digit (0-6)

③ = first voltage decimal (0-9)

④ = output (Nch = A, CMOS = C)

⑤ and ⑥ = lot assembly number



①, ② & ③ = 44V (fixed)

④ = output (C = CMOS, N = Nch)

⑤ = first voltage digit (0-6)

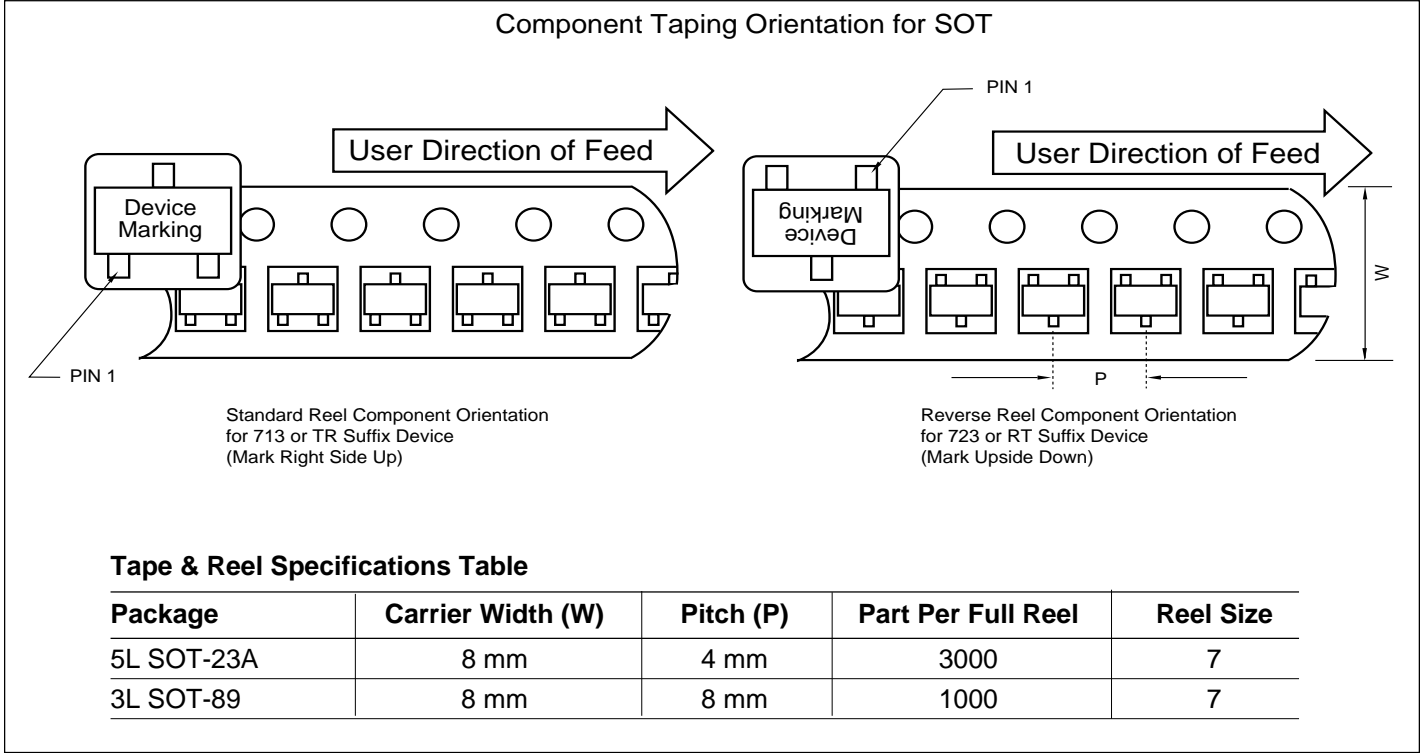
⑥ = first voltage decimal (0-9)

⑦ = fixed: 0

⑧ = $V_{DET} \pm \text{tolerance}$: 3 = $\pm 2.5\%$

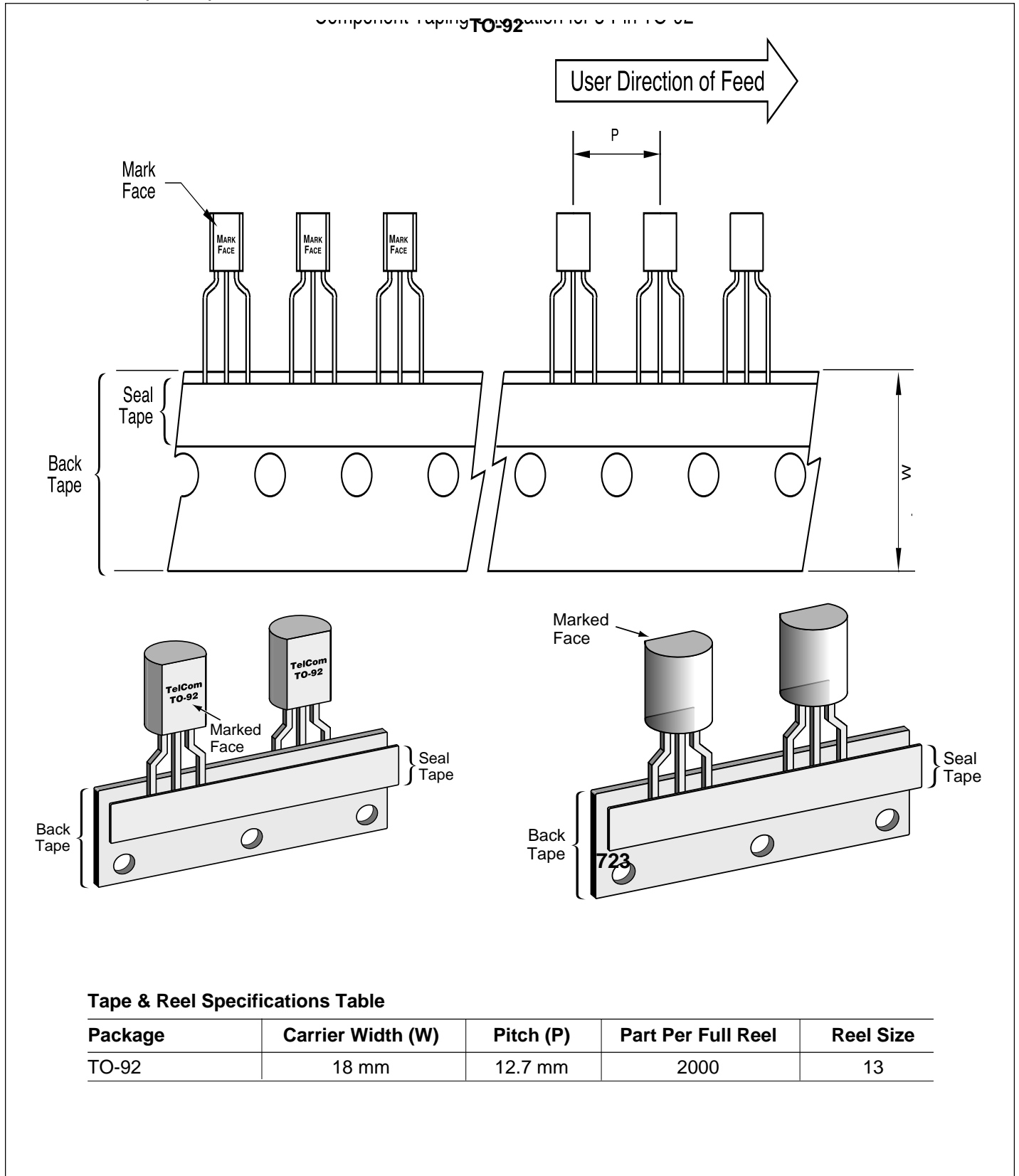
⑨, ⑩, ⑪ & ⑫ = assembly lot number

TAPING FORMS



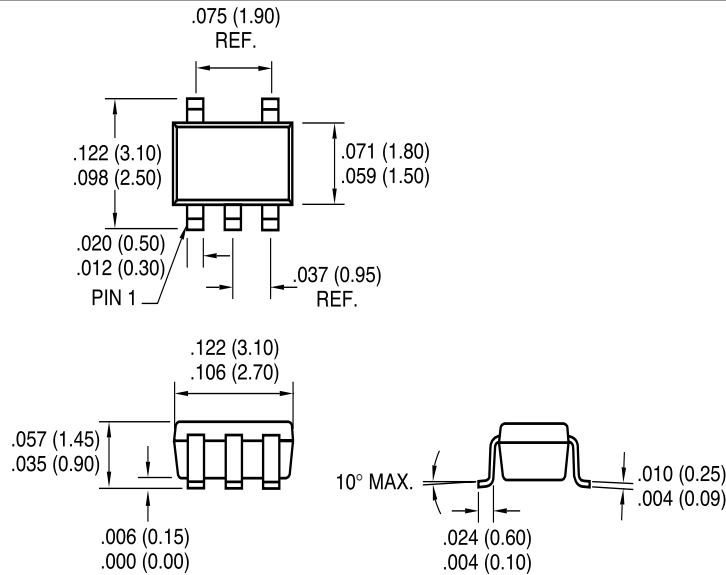
TC44 Series

TAPING FORM (CONT.)



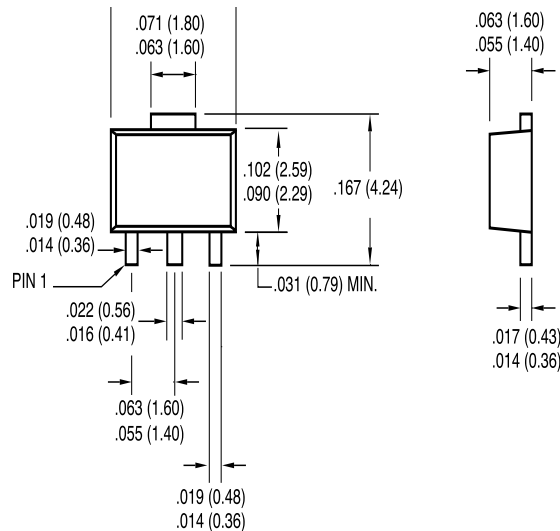
PACKAGE DIMENSIONS

*SOT-23A-5

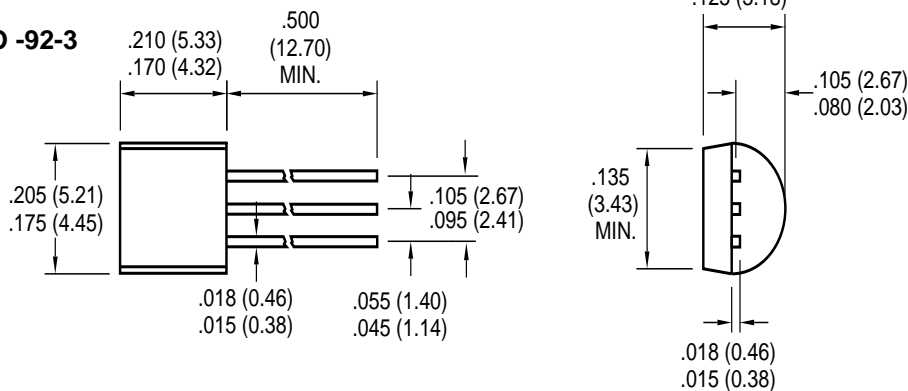


NOTE: SOT-23A-5 is equivalent to EIAJ (SC-74A)

SOT-89-3



TO -92-3



Dimensions: inches (mm)

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