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## **NTE943, NTE943M, & NTE943SM Integrated Circuit Low Power, Low Offset, Dual Voltage Comparator**

### **Description:**

The NTE943, NTE943M, and NTE943SM consist of two independent precision voltage comparators with an offset voltage specification as low as 2.0mV max for two comparators which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though operated from a single power supply voltage.

Application areas include limit comparators, simple analog to digital converters; pulse, squarewave and time delay generators; wide range VCO; MOS clock timers; multivibrators and high voltage digital logic gates. These devices are designed to directly interface with TTL and CMOS. When operated from both plus and minus power supplies they will directly interface with MOS logic where their low power drain is a distinct advantage over standard comparators.

### **Features:**

- Wide Single Supply  
Voltage Range: 2.0V to 36V  
Dual Supplies:  $\pm 1.0V$  to  $\pm 18V$
- Low Supply Current Drain (0.8mA) – Independent of Supply Voltage (1.0mW/Comparator at 5V)
- Low Input Biasing Current: 25nA
- Low Input Offset Current:  $\pm 5nA$
- Maximum Offset Voltage:  $\pm 3mV$
- Input Common-Mode Voltage Range Includes Ground
- Differential Input Voltage Range Equal to the Power Supply Voltage
- Low Output Saturation Voltage: 240mV @ 4mA
- Output Voltage Compatible with TTL, DTL, ECL, MOS, and CMOS Logic Systems
- Available in 3 Different Case Styles:
  - 8-Lead Metal Can: NTE943
  - 8-Lead Mini DIP: NTE943M
  - 8-Lead SOIC (Surface Mount): NTE943SM

**Absolute Maximum Ratings:**

Supply Voltage, V+	36V or ±18V
Differential Input Voltage (Note 1)	36V
Input Voltage	−0.3V to +36V
Power Dissipation (Note 2)	
NTE943	660mW
NTE943M	780mW
NTE943SM	510mW
Output Short Circuit to GND (Note 3)	Continuous
Input Current ( $V_{IN} < -0.3V$ ), Note 4)	50mA
Operating Temperature Range	0° to +70°C
Storage Temperature Range	−65° to +150°C
Lead Temperature (During Soldering, 10 sec)	+260°C

- Note 1. Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than −0.3V (or 0.3V below the the magnitude of the negative power supply, if used).
- Note 2. For operating at elevated temperature, these devices must be derated based on a 125°C maximum junction temperature and a thermal resistance of 127°C/W which applies for the device soldered in a printed circuit board, operating in a still air ambient. The low bias dissipation and the “ON–OFF” characteristic of the output keeps the chip dissipation very small ( $P_D \leq 100mW$ ), provided the output transistors are allowed to saturate.
- Note 3. Short circuits from the output to V+ can cause excessive heating and eventual destruction. When considering short circuits to GND, the maximum output current is approximately 20mA independent of the magnitude of V+.
- Note 4. This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector–base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the comparators to go to the V+ voltage level (or to GND for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than −0.3V.

**Electrical Characteristics:** ( $0^\circ \leq T_A \leq +70^\circ C$ ,  $V_+ = 5V$  unless otherwise specified)

Parameter	Test Conditions	Min	Typ	Max	Unit
Input Offset Voltage	Note 5	–	–	±9.0	mV
	$T_A = +25^\circ C$ , Note 5	–	±1.0	±5.0	mV
Input Offset Current	$I_{IN(+)} - I_{IN(-)}$ $V_{CM} = 0V$	–	–	±150	nA
	$I_{IN(+)} - I_{IN(-)}$ $V_{CM} = 0V$ , $T_A = +25^\circ C$	–	±5.0	±50	nA
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range, $V_{CM} = 0V$ , Note 6	–	–	250	nA
	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range, $V_{CM} = 0V$ , $T_A = +25^\circ C$ , Note 6	–	25	250	nA

- Note 5. At output switch point,  $V_O \cong 1.4V$ ,  $R_S = 0\Omega$ , with V+ from 5V to 30V and over the full input common-mode range (0V to V+ −1.5V), at 25°C.
- Note 6. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the reference or input lines.

**Electrical Characteristics (Cont'd):** ( $0^{\circ} \leq T_A \leq +70^{\circ}\text{C}$ ,  $V_+ = 5\text{V}$  unless otherwise specified)

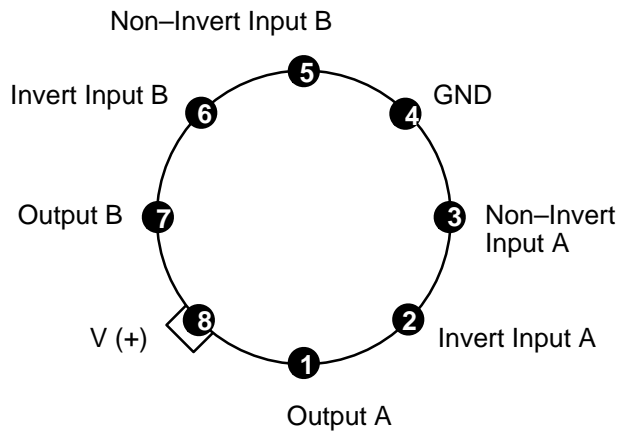
Parameter	Test Conditions	Min	Typ	Max	Unit
Input Common-Mode Voltage Range	$V_+ = 30\text{V}$ , Note 7	0	–	$V_+ - 2.0$	V
	$V_+ = 30\text{V}$ , $T_A = +25^{\circ}\text{C}$ , Note 7	0	–	$V_+ - 1.5$	V
Supply Current	$R_L = \infty$ on all Components, $T_A = +25^{\circ}\text{C}$	–	0.4	1.0	mA
	$R_L = \infty$ on all Amps, $V_+ = 36\text{V}$ , $T_A = +25^{\circ}\text{C}$	–	1	25	mA
Voltage Gain	$R_L \geq 15\text{k}\Omega$ , $V_+ = 15\text{V}$ , $V_O = 1\text{V}$ to $11\text{V}$ , $T_A = +25^{\circ}\text{C}$	50	200	–	V/mV
Large Signal Response Time	$V_{IN} = \text{TTL Logic Swing}$ , $V_{REF} = 1.4\text{V}$ , $V_{RL} = 5\text{V}$ , $R_L = 1.5\text{k}\Omega$ , $T_A = +25^{\circ}\text{C}$	–	300	–	ns
Response Time	$V_{RL} = 5\text{V}$ , $R_L = 1.5\text{k}\Omega$ , $T_A = +25^{\circ}\text{C}$ , Note 7	–	1.3	–	$\mu\text{s}$
Output Sink Current	$V_{IN(-)} = 1\text{V}$ , $V_{IN(+)} = 0$ , $V_O \geq 1.5\text{V}$ , $T_A = +25^{\circ}\text{C}$	6	16	–	mA
Saturation Voltage	$V_{IN(-)} = 1\text{V}$ , $V_{IN(+)} = 0$ , $I_{SINK} \leq 4\text{mA}$	–	–	700	mV
	$V_{IN(-)} = 1\text{V}$ , $V_{IN(+)} = 0$ , $I_{SINK} \leq 4\text{mA}$ , $T_A = +25^{\circ}\text{C}$	–	250	400	mV
Output Leakage Current	$V_{IN(-)} = 0$ , $V_{IN(+)} = 1\text{V}$ , $V_O = 30\text{V}$	–	–	1.0	$\mu\text{A}$
	$V_{IN(-)} = 0$ , $V_{IN(+)} = 1\text{V}$ , $V_O = 5\text{V}$ , $T_A = +25^{\circ}\text{C}$	–	0.1	–	nA
Differential Input Voltage	Keep All $V_{IN}$ 's $\geq 0\text{V}$ (or $V_-$ , if Used), Note 1	–	–	36	V

Note 1. Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than  $-0.3\text{V}$  (or  $0.3\text{V}$  below the the magnitude of the negative power supply, if used).

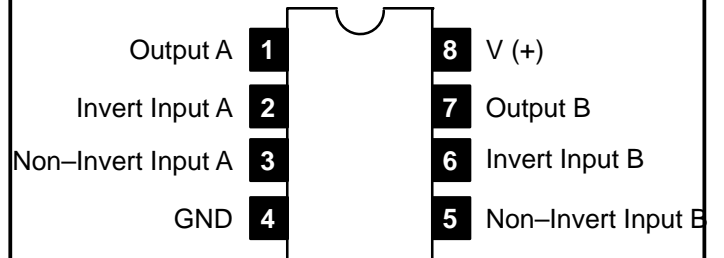
Note 7. The response time specified is for a  $100\text{mV}$  input step with  $5\text{mV}$  overdrive. For larger overdrive signals  $300\text{ns}$  can be obtained.

### Pin Connection Diagram

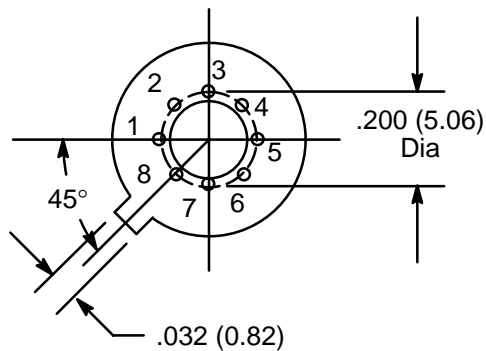
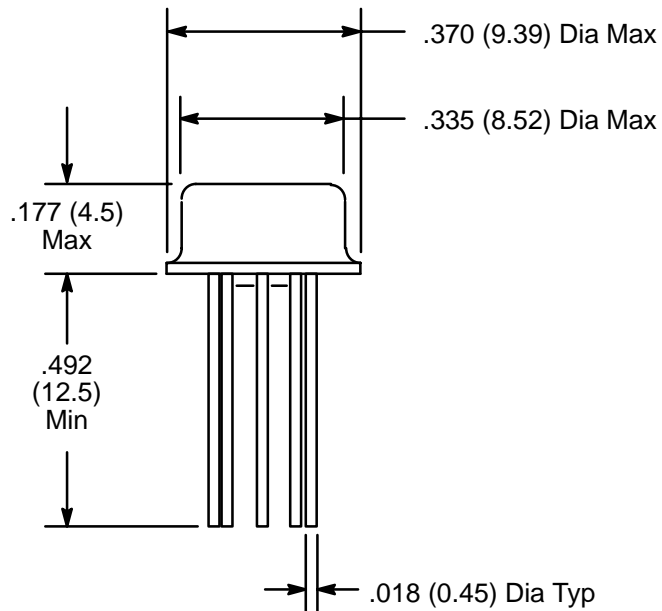
**NTE943**  
(Top View)



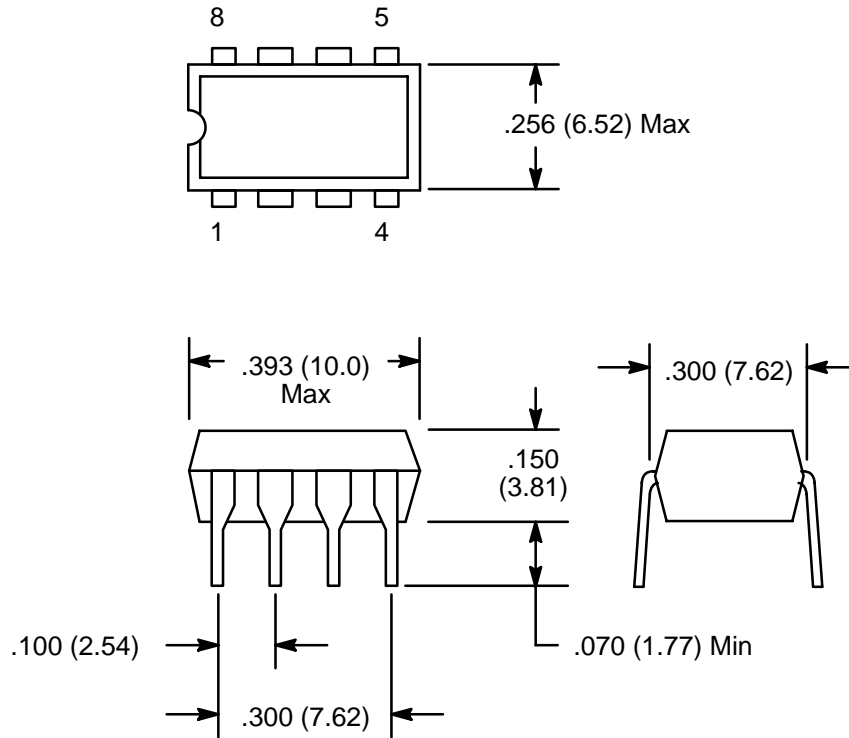
**NTE943M**  
**NTE943SM**



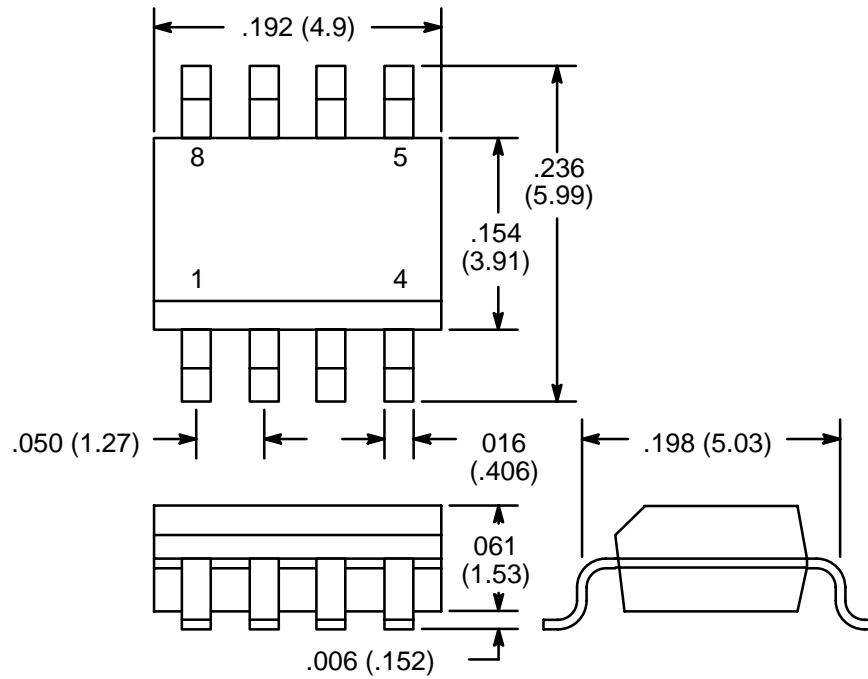
**NTE943**



### NTE943M



### NTE943SM



NOTE: Pin1 on Beveled Edge

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