

## NTE938 & NTE938M Integrated Circuit Precision Operational Amplifier (OP Amp)

### **Description:**

The NTE938 and NTE938M operational amplifiers provide high input impedance, low input offsets and temperature drifts, and low noise. This series of amplifiers is particularly useful for applications where high-accuracy and low-drift performance are essential. In addition, high-speed performance may be improved by employing feed-forward compensation techniques to maximize slew rate without compromising other performance criteria.

The NTE938 and NTE938M offer extremely low input offset voltage and drift specifications allowing usage in even the most critical applications without external offset nulling.

### **Features:**

- Available in Two Packages Styles:  
    8-Lead Metal Can (NTE938)  
    8-Lead DIP (NTE938M)
- Operation From a Wide Range of Power Supply Voltages
- Low Input Bias and Offset Currents
- Low Input Offset Voltage and Guaranteed Offset Voltage Drift Performance
- High Input Impedance

### **Absolute Maximum Ratings:** ( $T_A = +25^\circ\text{C}$ unless otherwise specified)

|                                                     |                                     |
|-----------------------------------------------------|-------------------------------------|
| Power Supply Voltage, $V_{CC}$ , $V_{EE}$ .....     | $\pm 18\text{V}$                    |
| Input Voltage (Note 2), $V_I$ .....                 | $\pm 15\text{V}$                    |
| Input Differential Current (Note 2), $I_{ID}$ ..... | $\pm 10\text{mA}$                   |
| Output Short-Circuit Duration, $t_S$ .....          | Indefinite                          |
| Operating Junction Temperature, $T_J$               |                                     |
| NTE938 .....                                        | $+175^\circ\text{C}$                |
| NTE938M .....                                       | $+150^\circ\text{C}$                |
| Operating Ambient Temperature Range, $T_A$ .....    | $0^\circ$ to $+70^\circ\text{C}$    |
| Storage Temperature Range, $T_{Stg}$ .....          | $-65^\circ$ to $+150^\circ\text{C}$ |

Note 1. **NTE938** is a **discontinued** device and **no longer available**.

Note 2. For supply voltages less than  $\pm 15\text{V}$ , the maximum input voltage is equal to the supply voltage.

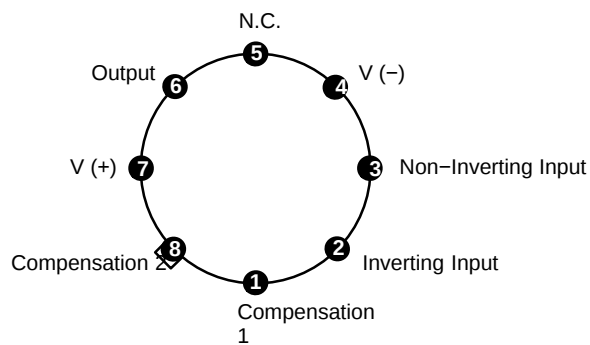
Note 3. The inputs are shunted with back-to-back diodes for over-voltage protection. Therefore, excessive current will flow if a differential input voltage in excess of  $1.0\text{V}$  is applied between the inputs unless some limiting resistance is used.

**Electrical Characteristics:** ( $T_A = +25^{\circ}\text{C}$ ,  $5\text{V} \leq V_{CC} \leq 15\text{V}$ ,  $-15\text{V} \leq V_{EE} \leq -5\text{V}$  unless otherwise specified)

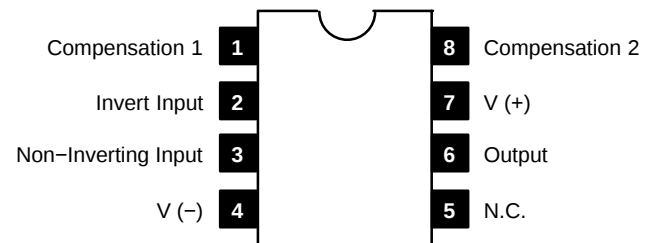
| Parameter                                                   | Symbol                   | Test Conditions                                                                                                                                | Min      | Typ       | Max       | Unit                           |
|-------------------------------------------------------------|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------|-----------|--------------------------------|
| Input Offset Voltage                                        | $V_{IO}$                 |                                                                                                                                                | –        | 2.0       | 7.5       | mV                             |
|                                                             |                          | $T_A = 0^{\circ} \text{ to } +70^{\circ}\text{C}$                                                                                              | –        | –         | 10        | mV                             |
| Input Offset Current                                        | $I_{IO}$                 |                                                                                                                                                | –        | 0.2       | 1.0       | nA                             |
|                                                             |                          | $T_A = 0^{\circ} \text{ to } +70^{\circ}\text{C}$                                                                                              | –        | –         | 1.5       | nA                             |
| Input Bias Current                                          | $I_{IB}$                 |                                                                                                                                                | –        | 1.5       | 7.0       | nA                             |
|                                                             |                          | $T_A = 0^{\circ} \text{ to } +70^{\circ}\text{C}$                                                                                              | –        | –         | 10        | nA                             |
| Input Resistance                                            | $r_i$                    |                                                                                                                                                | 10       | 40        | –         | $\text{M}\Omega$               |
| Power Supply Currents                                       | $I_{CC}, I_{EE}$         | $V_{CC} = +15\text{V}, V_{EE} = -15\text{V}$                                                                                                   | –        | $\pm 0.3$ | $\pm 0.8$ | mA                             |
| Large Signal Voltage Gain                                   | $A_{VOL}$                | $V_{CC} = +15\text{V}, V_{EE} = -15\text{V}, V_O = \pm 10\text{V}, R_L \geq 10\text{k}\Omega$                                                  | 25       | 300       | –         | V/mV                           |
|                                                             |                          | $V_{CC} = +15\text{V}, V_{EE} = -15\text{V}, V_O = \pm 10\text{V}, R_L \geq 10\text{k}\Omega, T_A = 0^{\circ} \text{ to } +70^{\circ}\text{C}$ | 15       | –         | –         | V/mV                           |
| Average Temperature Coefficient of Input Offset Temperature | $\Delta V_{IO}/\Delta T$ | $0^{\circ} \leq T_A \leq +70^{\circ}\text{C}$                                                                                                  | –        | 6         | 30        | $\mu\text{V}/^{\circ}\text{C}$ |
| Average Temperature Coefficient of Input Offset Current     | $\Delta I_{IO}/\Delta T$ |                                                                                                                                                | –        | 2         | 10        | $\text{pA}/^{\circ}\text{C}$   |
| Input Voltage Range                                         | $V_{IR}$                 | $V_{CC} = +15\text{V}, V_{EE} = -15\text{V}$                                                                                                   | $\pm 14$ | –         | –         | V                              |
| Common Mode Rejection Ratio                                 | CMRR                     | $R_S \leq 50\text{k}\Omega$                                                                                                                    | 80       | 100       | –         | dB                             |
| Supply Voltage Rejection Ratio                              | PSRR                     | $R_S \leq 50\text{k}\Omega$                                                                                                                    | 80       | 96        | –         | dB                             |
| Output Voltage Range                                        | $V_{OR}$                 | $V_{CC} = +15\text{V}, V_{EE} = -15\text{V}, R_L = 10\text{k}\Omega$                                                                           | $\pm 13$ | $\pm 14$  | –         | V                              |

### Pin Connection Diagram

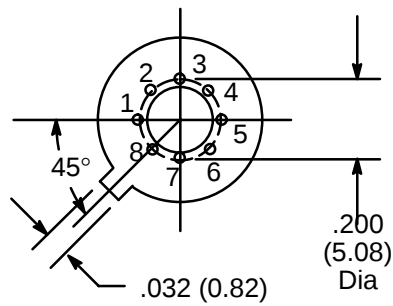
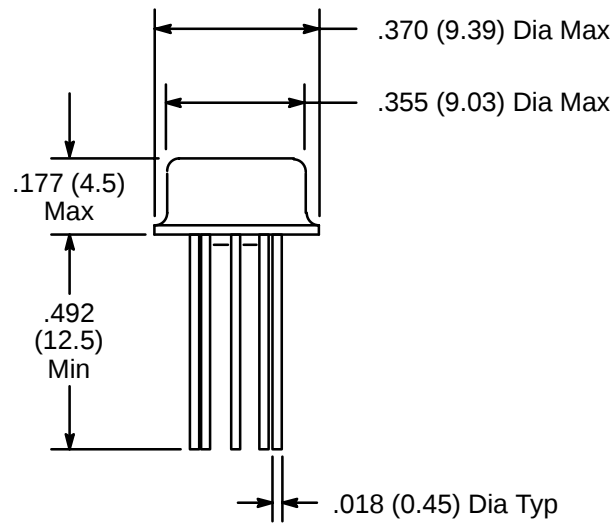
**NTE938**  
(Top View)



**NTE938M**



# NTE938



# NTE938M

