

## NTE859/NTE859SM Integrated Circuit Quad, Low Noise, JFET Input Operational Amplifier

### **Description:**

The NTE859 (14-Lead DIP) and NTE859SM (SOIC-14 Surface Mount) JFET-input operational amplifiers are low noise amplifiers with low noise input bias, offset currents, and fast slew rate. The low harmonic distortion and low noise make these devices ideally suited as amplifiers for high-fidelity and audio preamplifier applications. Each amplifier features JFET-inputs (for high input impedance) coupled with bipolar output stages all integrated on a single monolithic chip.

### **Features:**

- Low Power Consumption
- Wide Common-Mode and Differential Voltage Ranges
- Low Input Bias and Offset Currents
- Output Short-Circuit Protection
- Low Total Harmonic Distortion: 0.003% Typ
- Low Noise:  $V_n = 18\text{nV}/\sqrt{\text{Hz}}$  Typ
- High Input Impedance: JFET-Input Stage
- Internal Frequency Compensation
- Latch-Up Free Operation
- High Slew Rate:  $13\text{V}/\mu\text{s}$  Typ

### **Absolute Maximum Ratings:** ( $T_A = 0$ to $+70^\circ\text{C}$ unless otherwise specified)

|                                                                             |                                     |
|-----------------------------------------------------------------------------|-------------------------------------|
| Supply Voltage (Note 1), $V_{CC}(+)$ .....                                  | 18V                                 |
| Supply Voltage (Note1), $V_{CC}(-)$ .....                                   | -18V                                |
| Differential Input Voltage (Note 2), $V_{ID}$ .....                         | $\pm 30\text{V}$                    |
| Input Voltage Range (Note 1, Note 3), $V_{IDR}$ .....                       | $\pm 15\text{V}$                    |
| Duration of Output Short Circuit (Note 4), $t_S$ .....                      | Unlimited                           |
| Power Dissipation ( $T_A = +25^\circ\text{C}$ ), $P_D$ .....                | 680mW                               |
| Derate Above $25^\circ\text{C}$ .....                                       | $10\text{mW}/^\circ\text{C}$        |
| Operating Ambient Temperature Range, $T_A$ .....                            | $0^\circ$ to $+70^\circ\text{C}$    |
| Storage Temperature Range, $T_{stg}$ .....                                  | $-65^\circ$ to $+150^\circ\text{C}$ |
| Lead Temperature (During Soldering, 1/16" from Case for 10sec), $T_L$ ..... | $+260^\circ\text{C}$                |

Note 1. All voltage values, except differential voltages, are with respect to the midpoint between  $V_{CC}(+)$  and  $V_{CC}(-)$ .

Note 2. Differential voltages are at the non-inverting input pin with respect to the inverting pin.

Note 3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15V, whichever is less.

Note 4. The output may be shorted to GND or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

**Electrical Characteristics:** ( $V_{CC} = \pm 15V$ ,  $T_A = 0$  to  $+70^\circ C$  unless otherwise specified)

| Parameter                                                              | Symbol          | Test Conditions                                                                        |                     | Min      | Typ        | Max | Unit             |
|------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------|---------------------|----------|------------|-----|------------------|
| Input Offset Voltage                                                   | $V_{IO}$        | $V_O = 0$ , $R_S = 50\Omega$                                                           | $T_A = +25^\circ C$ | –        | 3          | 10  | mV               |
|                                                                        |                 |                                                                                        |                     | –        | –          | 13  | mV               |
| Temperature Coefficient of Input Offset Voltage                        | $\alpha V_{IO}$ | $V_O = 0$ , $R_S = 50\Omega$                                                           |                     | –        | 10         | –   | $\mu V/^\circ C$ |
| Input Offset Current                                                   | $I_{IO}$        | $V_O = 0$ , Note 6                                                                     | $T_A = +25^\circ C$ | –        | 5          | 100 | pA               |
|                                                                        |                 |                                                                                        |                     | –        | –          | 2   | nA               |
| Input Bias Current                                                     | $I_{IB}$        | $V_O = 0$ , Note 6                                                                     | $T_A = +25^\circ C$ | –        | 30         | 200 | pA               |
|                                                                        |                 |                                                                                        |                     | –        | –          | 7   | nA               |
| Common-Mode Input Voltage Range                                        | $V_{ICR}$       | $T_A = +25^\circ C$                                                                    |                     | $\pm 11$ | $\pm 12$   | –   | V                |
| Maximum Peak Output Voltage Range                                      | $V_{OM}$        | $R_L = 10k\Omega$ , $T_A = +25^\circ C$                                                |                     | $\pm 12$ | $\pm 13.5$ | –   | V                |
|                                                                        |                 | $R_L = \geq 10k\Omega$                                                                 |                     | $\pm 12$ | –          | –   | V                |
|                                                                        |                 | $R_L = \geq 2k\Omega$                                                                  |                     | $\pm 10$ | $\pm 12$   | –   | V                |
| Large-Signal Differential Voltage Amplification                        | $A_{VD}$        | $V_O = \pm 10V$ ,<br>$R_L \geq 2k\Omega$                                               | $T_A = +25^\circ C$ | 25       | 200        | –   | V/mV             |
|                                                                        |                 |                                                                                        |                     | 15       | –          | –   | V/mV             |
| Unity-Gain Bandwidth                                                   | $B_1$           | $T_A = +25^\circ C$                                                                    |                     | –        | 3          | –   | MHz              |
| Input Resistance                                                       | $r_i$           | $T_A = +25^\circ C$                                                                    |                     | –        | $10^{12}$  | –   | $\Omega$         |
| Common-Mode Rejection Ratio                                            | CMRR            | $V_{IC} = V_{ICRmin}$ , $V_O = 0$ , $R_S = 50\Omega$ ,<br>$T_A = +25^\circ C$          |                     | 70       | 86         | –   | dB               |
| Supply Voltage Rejection Ratio<br>( $\Delta V_{CC\pm}/\Delta V_{IO}$ ) | $k_{SVR}$       | $V_{CC} = \pm 15V$ to $\pm 9V$ , $V_O = 0$ ,<br>$R_S = 50\Omega$ , $T_A = +25^\circ C$ |                     | 70       | 86         | –   | dB               |
| Supply Current (Per Amplifier)                                         | $I_{CC}$        | No Load, $V_O = 0$ , $T_A = +25^\circ C$                                               |                     | –        | 1.4        | 2.5 | mA               |
| Crosstalk Attenuation                                                  | $V_{O1}/V_{O2}$ | $A_{VD} = 100$ , $T_A = +25^\circ C$                                                   |                     | –        | 120        | –   | dB               |

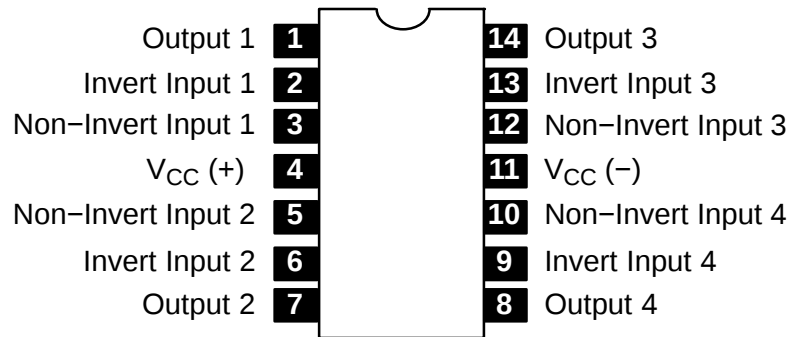
Note 5. All characteristics are measured under open-loop conditions with zero common-mode voltage unless otherwise specified.

Note 6. Input bias currents of a FET-input operational amplifier are normal junction reverse currents, which are temperature sensitive. Pulse techniques must be used that will maintain the junction temperatures as close to the ambient temperature as is possible.

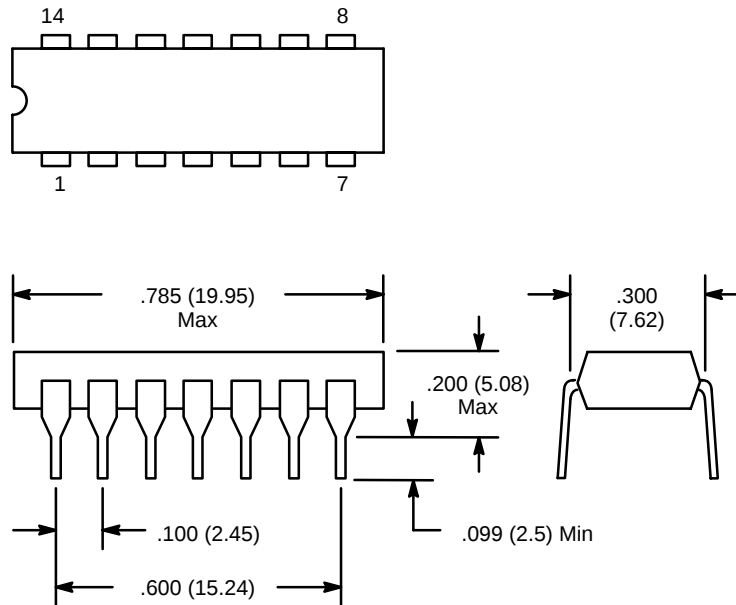
**Operating Characteristics:** ( $V_{CC} = \pm 15V$ ,  $T_A = +25^\circ C$  unless otherwise specified)

| Parameter                      | Symbol | Test Conditions                                                             |                       | Min | Typ   | Max | Unit           |
|--------------------------------|--------|-----------------------------------------------------------------------------|-----------------------|-----|-------|-----|----------------|
| Slew Rate at Unity Gain        | SR     | $V_I = 10V$ , $R_L = 2k\Omega$ , $C_L = 100pF$                              |                       | 8   | 13    | –   | V/ $\mu s$     |
| Rise Time Overshoot Factor     | $t_r$  | $V_I = 10V$ , $R_L = 2k\Omega$ , $C_L = 100pF$                              |                       | –   | 0.1   | –   | $\mu s$        |
|                                |        |                                                                             |                       | –   | 10    | –   | %              |
| Equivalent Input Noise Voltage | $V_n$  | $R_S = 100\Omega$                                                           | $f = 1kHz$            | –   | 18    | –   | $nV/\sqrt{Hz}$ |
|                                |        |                                                                             | $f = 10Hz$ to $10kHz$ | –   | 4     | –   | $\mu V$        |
| Equivalent Input Noise Current | $I_n$  | $R_S = 100\Omega$ , $f = 1kHz$                                              |                       | –   | 0.01  | –   | $pA/\sqrt{Hz}$ |
| Total Harmonic Distortion      | THD    | $V_{O(rms)} = 10V$ , $R_S \leq 1k\Omega$ , $R_L \geq 2k\Omega$ , $f = 1kHz$ |                       | –   | 0.003 | –   | %              |

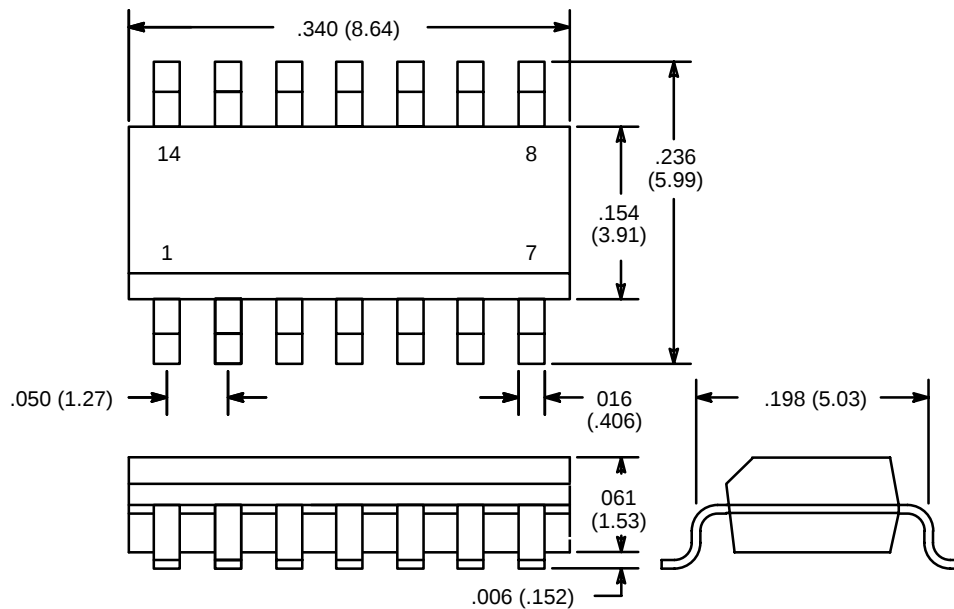
### Pin Connection Diagram



### NTE859 (14-Lead DIP)



### NTE859SM (SOIC-14)



NOTE: Pin1 on Beveled Edge