# GL358

## DUAL OPERATIONAL AMPLIFIER

## Description

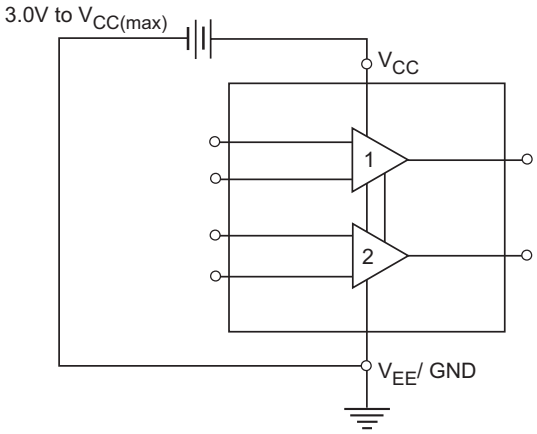
Utilizing the circuit designs perfected for two operational amplifiers, these dual operational amplifiers feature low power drain, a common mode input voltage range extending to GND/ $V_{EE}$, and single supply or split supply operation.

These amplifiers have several distinct advantages over standard operational amplifier types in single supply applications. They can operate at supply voltages as low as 3.0 V or as high as 32 V, with quiescent currents about one-ifth of those associated with the MC1741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

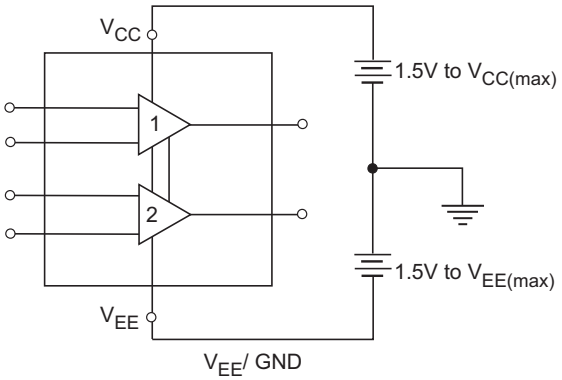
## Features

- **Short Circuit Protected Outputs**
- **True Differential Input Stage**
- **Single Supply Operation: 3.0 V to 32 V**
- **Low Input Bias Currents**
- **Internally Compensated**
- **Common Mode Range Extends to Negative Supply**
- **Single and Split Supply Operation**
- **ESD Clamps on the Inputs Increase**
- **Ruggedness of the Device without Affecting Operation**

### SINGLE SUPPLY

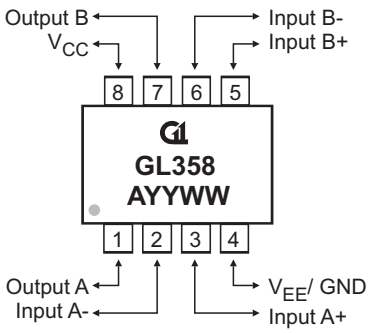



### SPLIT SUPPLIUES

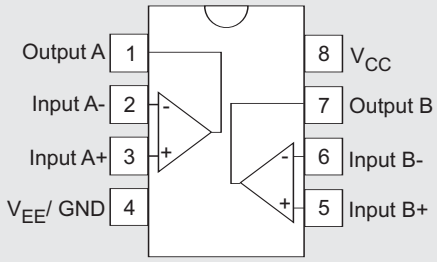


## ◆ MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)

**SOP-8**




A : Assembly Location
YY : Year
W W : Weekly




## ◆ ORDERING INFORMATION

| Ordering Number | Package | Shipping |
|---|---|---|
| GL358S8T | SOP-8 | 100 Units / Tube |
| GL358S8R | SOP-8 | 2,500 Units/Tape &Reel |

* For detail ordering number identification, please see last page.

## ◆ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | VALUE | UNIT |
|---|---|---|---|
| Power Supply Voltage<br>Single Supply<br>Split Supllies | $V_{CC}$<br>$V_{CC}$, $V_{EE}$ | 32<br>16 | Vdc |
| Input Differential Voltage Range (Note 1 ) | $V_{IDR}$ | 32 | Vdc |
| Input Common Mode Voltage Range(Note 2) | $V_{ICR}$ | -0.3 to 32 | Vdc |
| Output Short Circuit Duration | $t_{SC}$ | Continuous | - |
| Junction Temperature | $T_J$ | 150 | C |
| Thermal Resistance, Junction - to - Air (Note 3) | $R_{\theta JA}$ | 238 | C/ W |
| Operating Ambient Temperature Range | $T_A$ | 0 to +70 | C |
| Storage Temperature Range | $T_{STG}$ | -55 to +125 | C |
| ESD Tolerance - Human Body Model (Note 4) | - | 2000 | V |

**Note 1:** Split Power Supplies.
**Note 2:** For Supply Voltages less 32V the absolute maximum input voltage is equal to the supply voltage.
**Note 3:** RθJA for Case 846A
**Note 4:** ESD data avilable upon request.

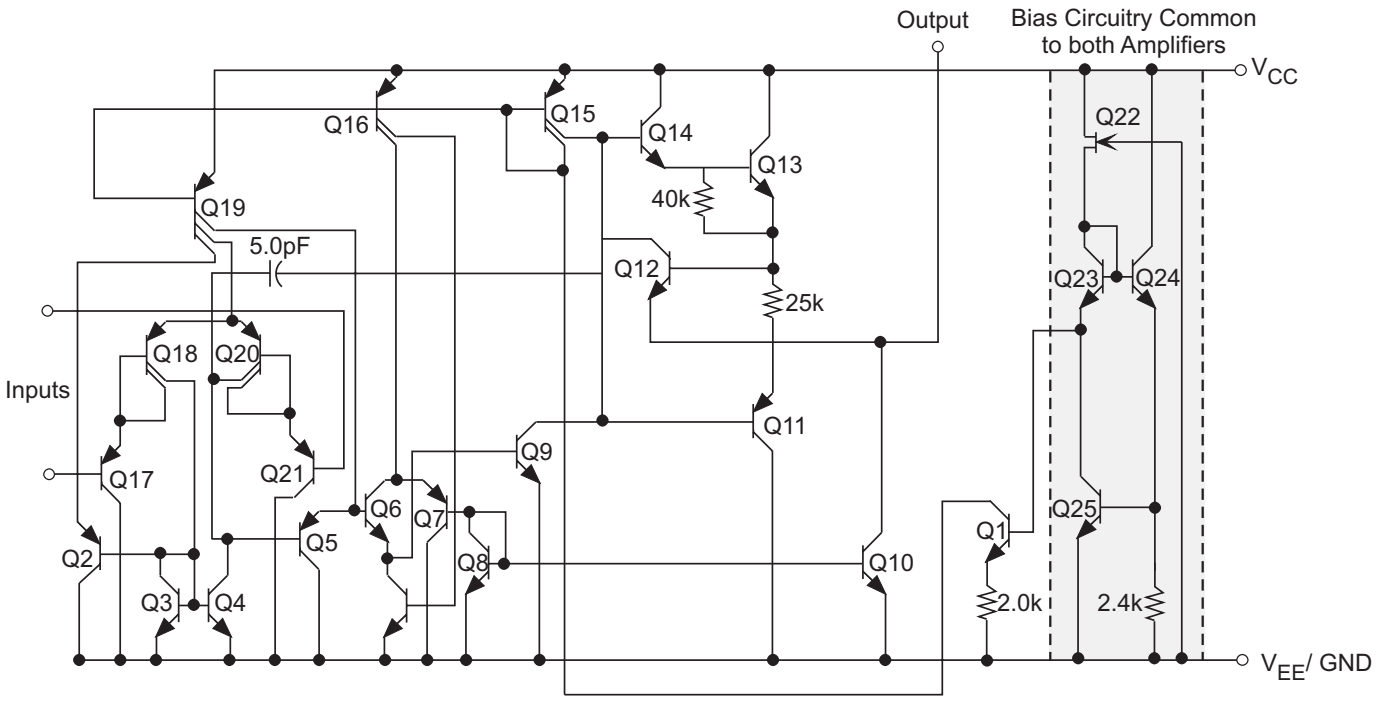
## ◆ ELECTRICAL CHARACTERISTICS

($V_{CC}$ = 5V, at specified free - air temperature, unless otherwise specified)

| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Input Offset Voltage | $V_{IO}$ | $V_{CC}$ = 5V to MAX<br>$V_{CC}$ = $V_{ICR}$min<br>$V_O$ = 1.4V | 25C | | 3 | 7 | mV |
| | | | Full range | | | 9 | |
| Average Temperature Coefficient of Input Offset Voltage | $\alpha V_{IO}$ | | Full range | | 7 | | V/C |
| Input Offset Current | $I_{IO}$ | $V_O$ = 1.4V | 25C | | 2 | 50 | nA |
| | | | Full range | | | 150 | |
| Average Temperature Coefficient of Input Offset Voltage | $\alpha I_{IO}$ | | Full range | | 10 | | pA/ C |
| Input Bias Current | $I_{IB}$ | $V_O$ = 1.4V | 25C | | -20 | -250 | nA |
| | | | Full range | | | -500 | |
| Common-Mode Input Voltage Range | $V_{ICR}$ | $V_{CC}$ = 5V to MAX | 25C | 0 to $V_{CC}$-1.5 | | | V |
| | | | Full range | 0 to $V_{CC}$-2 | | | |
| High - Level Output Voltage | $V_{OH}$ | $R_L \geq 2k\Omega$ | 25C | $V_{CC}$-1.5 | | | V |
| | | $V_{CC}$=MAX, $R_L$=2kΩ | Full range | 26 | | | |
| | | $V_{CC}$=MAX, $R_L \geq 10k\Omega$ | Full range | 27 | 28 | | |
| Low - Level Output Voltage | $V_{OL}$ | $R_L \geq 10k\Omega$ | Full range | | 5 | 20 | mV |
| Large - Signal Differential Voltage Amplification | $A_{VD}$ | $V_{CC}$=15V, $V_O$=1V to 11V,<br>$R_L \geq 2k\Omega$ | 25C | 25 | 100 | | V/ mV |
| | | | Full range | 15 | | | |
| Common Mode Rejection Ration | CMRR | $V_{CC}$ = 5V to MAX,<br>$V_{IC}$ = $V_{ICR}$min | 25C | 65 | 80 | | dB |
| Supply Voltage Rejection Ration | $k_{SVR}$ | $V_{CC}$ = 5V to MAX | 25C | 65 | 100 | | dB |
| Crosstalk Attenuation | $V_O1/V_O2$ | f = 1kHz to 20kHz | 25C | | 120 | | dB |
| Output Current | $I_O$ | $V_{CC}$ = 15V, $V_O$ = 0,<br>$V_{ID}$ = 1V | 25C | -20 | -30 | | mA |
| | | | Full range | -10 | | | |
| | | $V_{CC}$ = 15V, $V_O$ =15V,<br>$V_{ID}$ = -1V | 25C | 10 | 20 | | |
| | | | Full range | 5 | | | |
| | | $V_O$ = 200mV, $V_{ID}$ = -1 | 25C | 12 | 30 | | uA |
| Short - Circuit Output Current | $I_{OS}$ | $V_{CC}$ at 5V, $V_O$ = 0,<br>GND at -5V | 25C | | 40 | 60 | mA |
| Supply current (two amplifiers) | $I_{CC}$ | $V_O$ = 2.5V, no load | Full range | | 0.7 | 1.2 | mA |
| | | $V_{CC}$ = MAX, $V_O$ = 0.5$V_{CC}$<br>no load | Full range | | 1 | 2 | |

* All characteristics are measured under open loop conditions with zero common-mode input voltage unless otherwise specified. MAX $V_{CC}$ for testing purposes is 30V. Full range is 0C to 70C.

## SCHEMATIC BLOCK DIAGRAM




## CIRCUIT DESCRIPTION

The GM358 series is made by using two internally compensated, andtwo - stage operational amplifiers. The first stage of each consists of differential input devices Q20 and Q18, with input buffer transistors Q21 and Q17, and the differential to single ended converter Q3 and Q4. The first stage performs not only the first stage gain function, but also performs the level shifting and transconductance reduction functions. By reducing the transconductance, a smaller compensation capacitor (only 5.0 pF) can be employed, thus saving chip area. The transconductance reduction is accomplished by splitting the collectors of Q20 and Q18.

Another feature of this input stage is that the input common mode range can include the negative supply or ground, in single supply operation, without saturating either the input devices or the differential to single - ended converter. The second stage consists a standard current source load amplifier stage.

Each amplifier is biased from an internal voltage regulator, which has a low temperature coefficient thus giving each amplifier good temperature characteristics as well as excellent power supply rejection.

## ◆ Typical Performance Characteristics

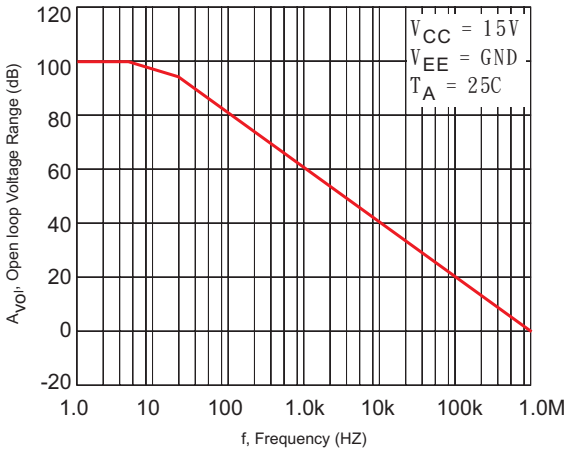



**Figure 1. Large-Signal Open Loop Voltage Gain**

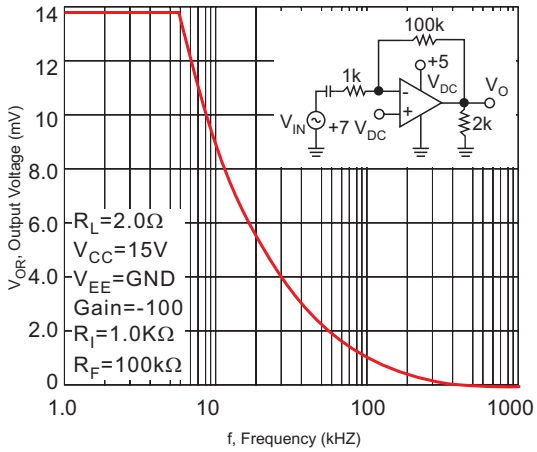



**Figure 2. Large - Signal Frequency Response**

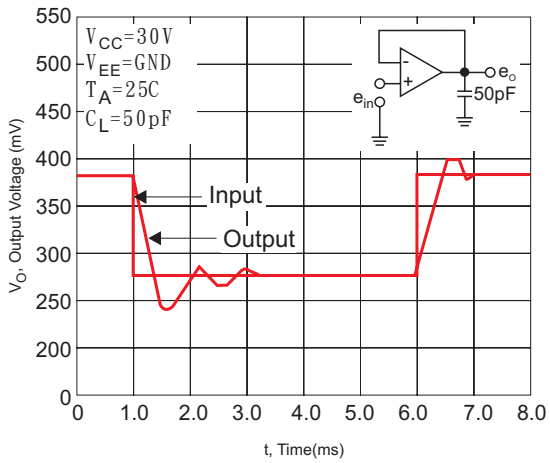



**Figure 3. Small Signal Voltage Follower Pulse Response (Noninverting)**

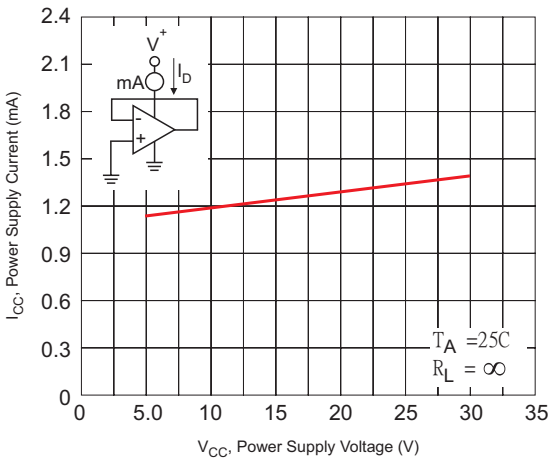



**Figure 4. Power Supply Current versus Power Supply Voltage**

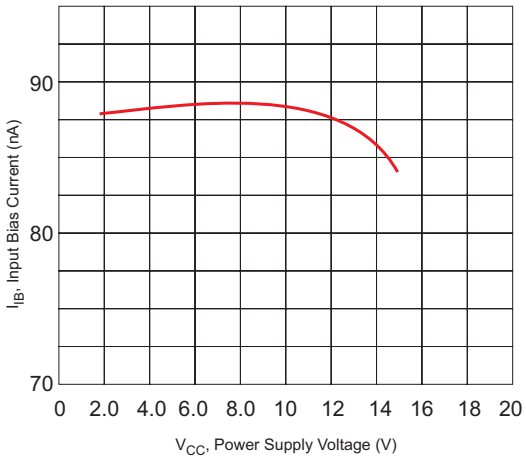



**Figure 5. Input Bias Current versus Supply Voltage**

## ◆ TYPICAL APPLICATIONS

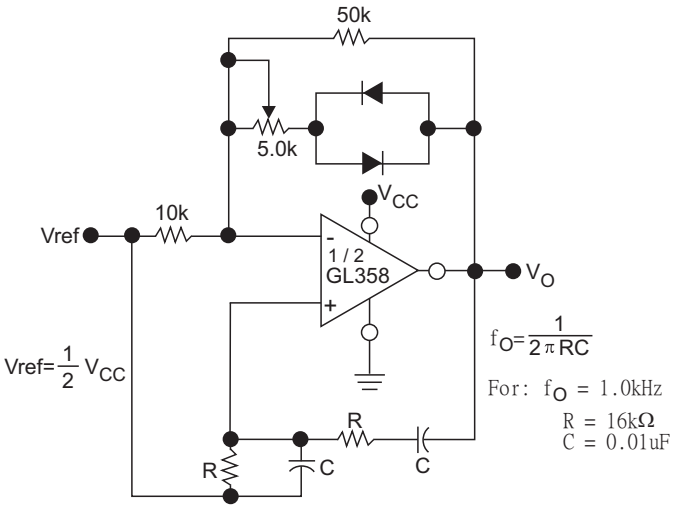



**Figure 6. Wien Bridge Oscillator**

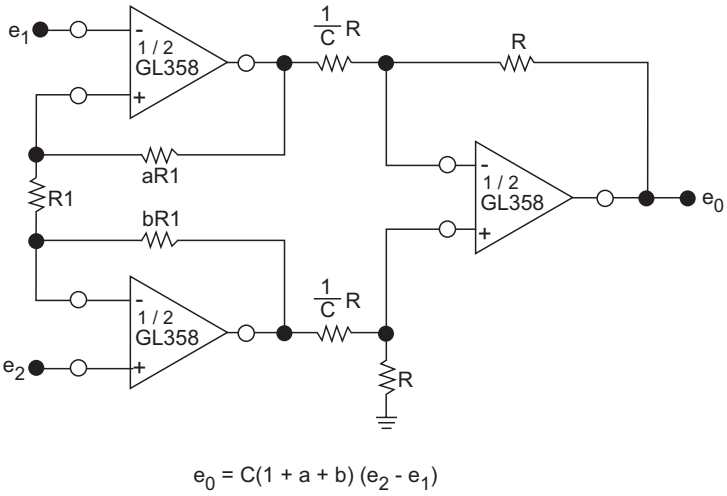



**Figure 7. High Impedance Differential Amplifier**

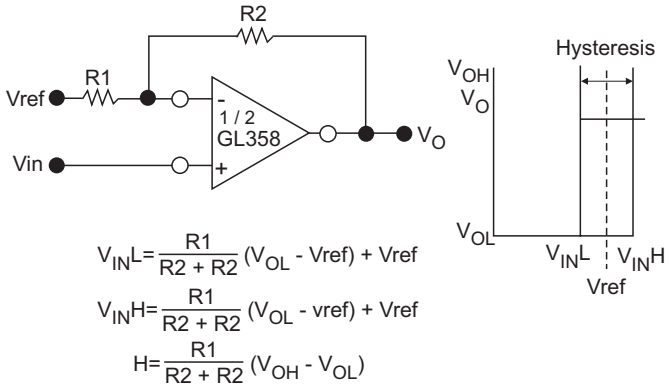



**Figure 8. Comparator with Hysteresis**

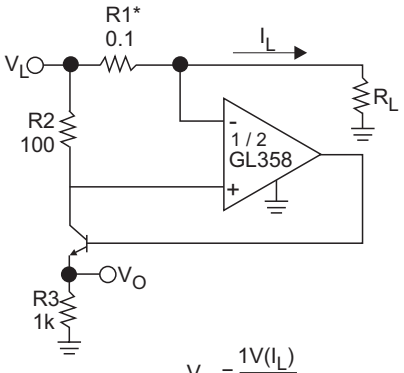
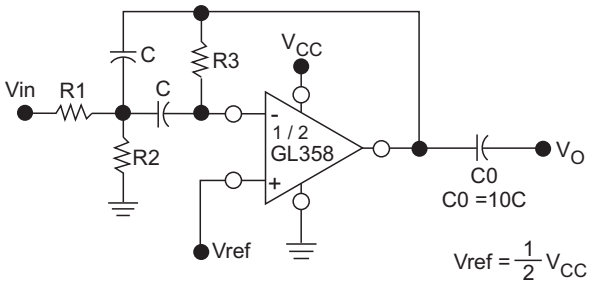



**Figure 10. Current Monitor**




Given: $f_0$ = center frequency
$A(f_0)$ = gain center frequency

Choose value $f_0$, C

Then: $R3 = \frac{Q}{\pi f_0 C}$

$R1 = \frac{R3}{2 A(f_0)}$

$R2 = \frac{R1\ R3}{4Q^2\ R1 - R2}$

For less than 10% error from operational amplifier. $\frac{Q_0 f_0}{BW} < 0.1$
Where $f_0$ and BW are expressed in Hz.

If source impedance varies, filter may be preceded with voltage follower buffer to stabilize filter parameter.

**Figure 9. Multiple Feedback Bandpass Filter**

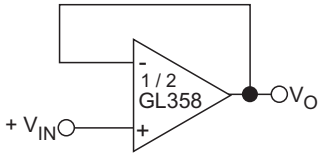



**Figure 11. Voltage Follower**

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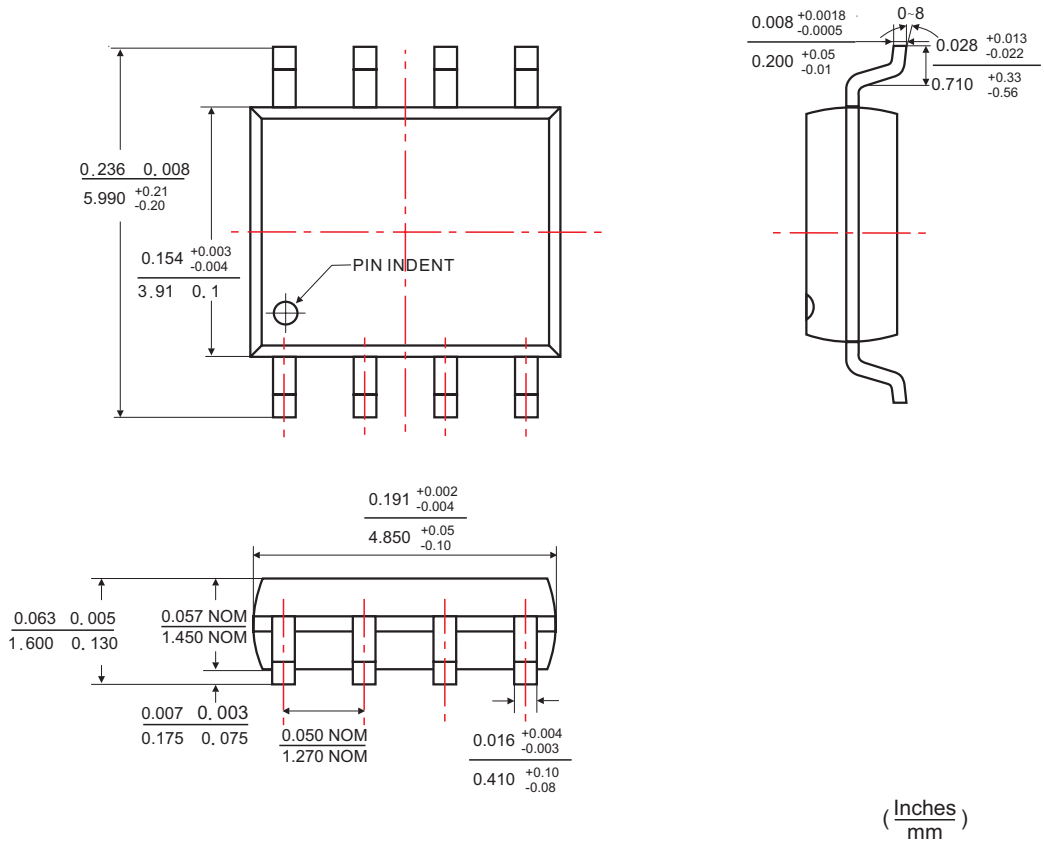
## DUAL OPERATIONAL AMPLIFIER

### ◆ SOP-8 PACKAGE OUTLINE DIMENSIONS




( Inches / mm )

### ◆ ORDERING NUMBER