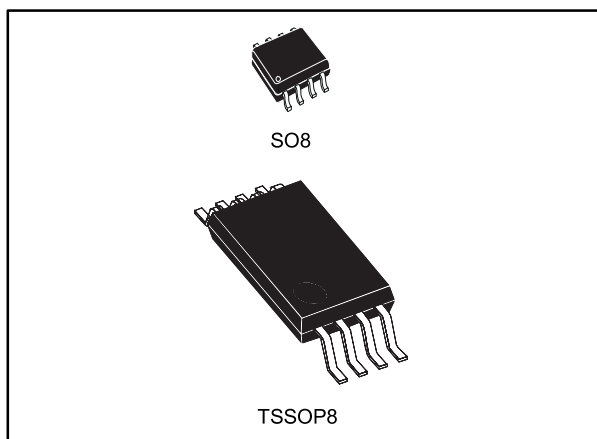


**General purpose JFET dual operation amplifiers**

Datasheet - production data

**Description**

The TL082, TL082A and TL082B are high speed JFET input dual operational amplifiers incorporating well-matched, high voltage JFET and bipolar transistors in a monolithic integrated circuit.

The devices feature high slew rates, low input bias and offset current, and low offset voltage temperature coefficient.

**Features**

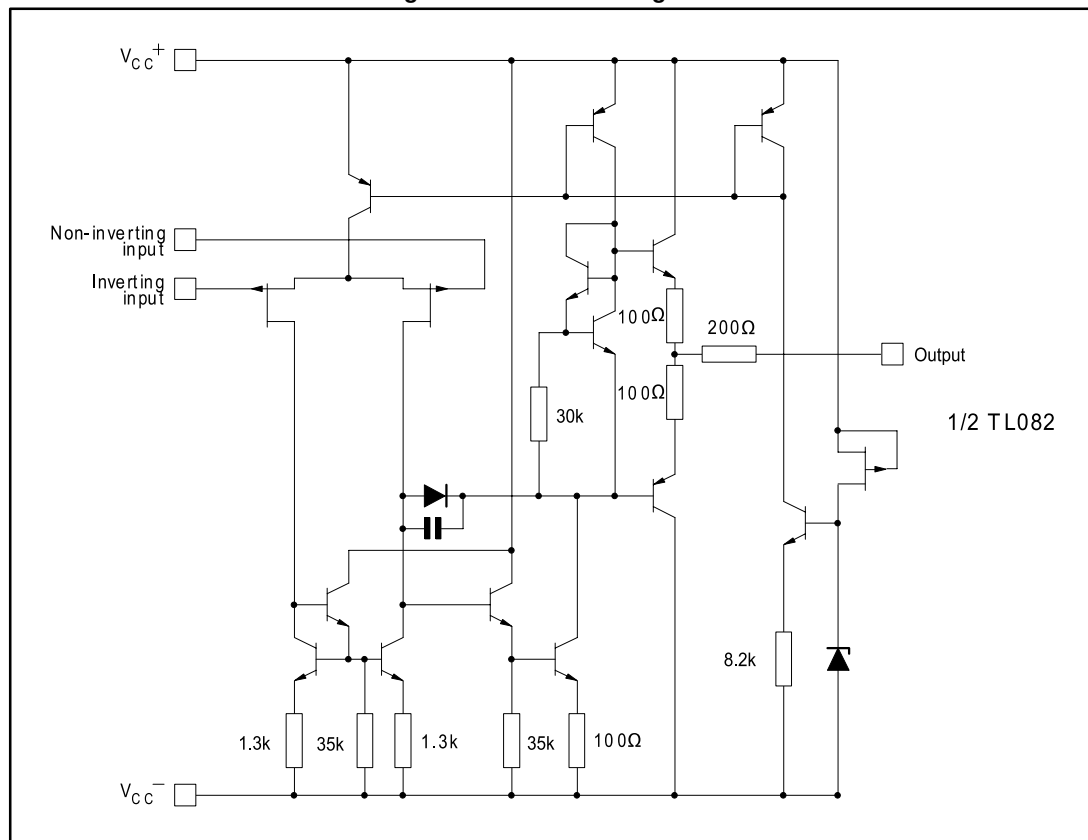
- Wide common-mode (up to  $V_{CC}^+$ ) and differential voltage range
- Low input bias and offset current
- Output short-circuit protection
- High input impedance JFET input stage
- Internal frequency compensation
- Latch up free operation
- High slew rate: 16 V/ $\mu$ s (typical)

## Contents

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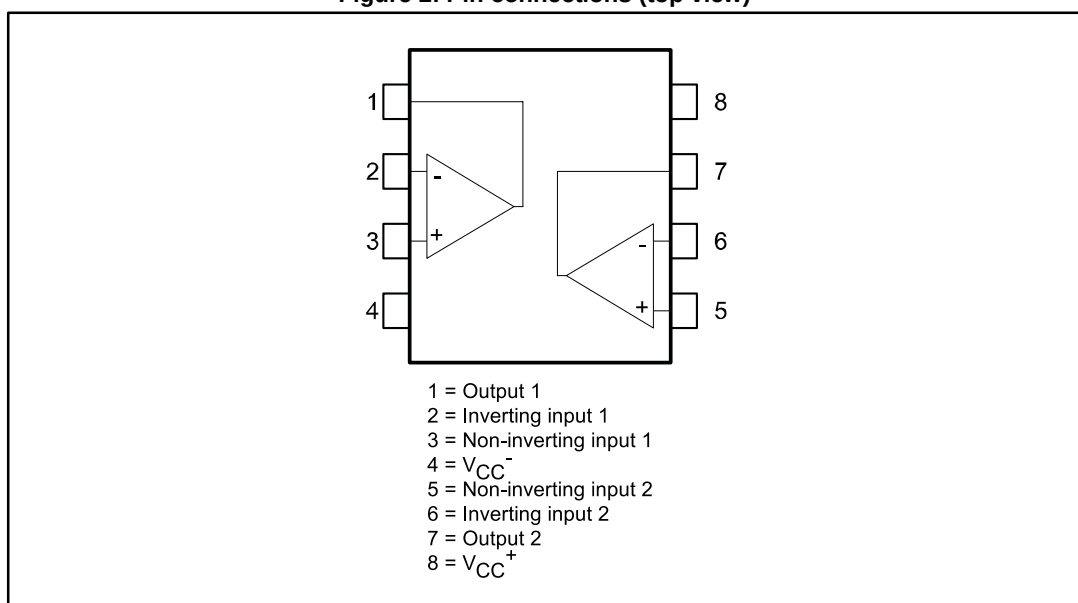
# 1 Schematic diagram

Figure 1: Schematic diagram



## 2 Pin connections

Figure 2: Pin connections (top view)



### 3 Absolute maximum ratings and operating conditions

Table 1: Absolute maximum ratings

| Symbol            | Parameter                                                |        | TL082I, AI, BI | TL082C, AC, BC | Unit |
|-------------------|----------------------------------------------------------|--------|----------------|----------------|------|
| V <sub>CC</sub>   | Supply voltage <sup>(1)</sup>                            |        | ±18            |                | V    |
| V <sub>in</sub>   | Input voltage <sup>(2)</sup>                             |        | ±15            |                |      |
| V <sub>id</sub>   | Differential input voltage <sup>(3)</sup>                |        | ±30            |                |      |
| P <sub>tot</sub>  | Power dissipation                                        |        | 680            |                | mW   |
| R <sub>thja</sub> | Thermal resistance<br>junction-to-ambient <sup>(4)</sup> | SO8    | 125            |                | °CW  |
|                   |                                                          | TSSOP8 | 120            |                |      |
| R <sub>thjc</sub> | Thermal resistance<br>junction-to-case                   | SO8    | 40             |                |      |
|                   |                                                          | TSSOP8 | 37             |                |      |
|                   | Output short-circuit duration <sup>(5)</sup>             |        | Infinite       |                |      |
| T <sub>stg</sub>  | Storage temperature range                                |        | -65 to 150     |                | °C   |
| ESD               | HBM: human body model <sup>(6)</sup>                     |        | 1              |                | kV   |
|                   | MM: machine model <sup>(7)</sup>                         |        | 200            |                | V    |
|                   | CDM: charged device model <sup>(8)</sup>                 |        | 1500           |                |      |

**Notes:**

<sup>(1)</sup>All voltage values, except differential voltage, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between V<sub>CC</sub><sup>+</sup> and V<sub>CC</sub><sup>-</sup>.

<sup>(2)</sup>The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.

<sup>(3)</sup>Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.

<sup>(4)</sup>Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuit on all amplifiers.

<sup>(5)</sup>The output may be shorted to ground or to either supply. Temperature and/or supply voltages must be limited to ensure that the dissipation rating is not exceeded.

<sup>(6)</sup>Human body model: 100 pF discharged through a 1.5 kΩ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.

<sup>(7)</sup>Machine model: a 200 pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω), done for all couples of pin combinations with other pins floating.

<sup>(8)</sup>Charged device model: all pins plus package are charged together to the specified voltage and then discharged directly to the ground.

Table 2: Operating conditions

| Symbol            | Parameter                            | TL082I, AI, BI | TL082C, AC, BC | Unit |
|-------------------|--------------------------------------|----------------|----------------|------|
| V <sub>CC</sub>   | Supply voltage                       | 6 to 36        |                | V    |
| T <sub>oper</sub> | Operating free-air temperature range | -40 to 105     | 0 to 70        | °C   |

## 4 Electrical characteristics

Table 3: VCC = ±15V, Tamb = +25°C (unless otherwise specified)

| Symbol           | Parameter                                                                                                                        | TL082I, AC, AI, BC, BI |           |      | TL082C |           |      | Unit  |
|------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|------|--------|-----------|------|-------|
|                  |                                                                                                                                  | Min.                   | Typ.      | Max. | Min.   | Typ.      | Max. |       |
| V <sub>io</sub>  | Input offset voltage, R <sub>S</sub> = 50 Ω, T <sub>amb</sub> = 25 °C, TL082                                                     |                        | 3         | 10   |        | 3         | 10   | mV    |
|                  | Input offset voltage, R <sub>S</sub> = 50 Ω, T <sub>amb</sub> = 25 °C, TL082A                                                    |                        | 3         | 6    |        |           |      |       |
|                  | Input offset voltage, R <sub>S</sub> = 50 Ω, T <sub>amb</sub> = 25 °C, TL082B                                                    |                        | 1         | 3    |        |           |      |       |
|                  | Input offset voltage, R <sub>S</sub> = 50 Ω, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub> , TL082                      |                        |           | 13   |        |           | 13   |       |
|                  | Input offset voltage, R <sub>S</sub> = 50 Ω, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub> , TL082A                     |                        |           | 7    |        |           |      |       |
|                  | Input offset voltage, R <sub>S</sub> = 50 Ω, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub> , TL082B                     |                        |           | 5    |        |           |      |       |
| DV <sub>io</sub> | Input offset voltage drift                                                                                                       |                        | 10        |      |        | 10        |      | μV/°C |
| I <sub>io</sub>  | Input offset current, T <sub>amb</sub> = 25 °C <sup>(1)</sup>                                                                    |                        | 5         | 100  |        | 5         | 100  | pA    |
|                  | Input offset current, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub> <sup>(1)</sup>                                      |                        |           | 4    |        |           | 10   | nA    |
| I <sub>ib</sub>  | Input bias current, T <sub>amb</sub> = 25 °C                                                                                     |                        | 20        | 200  |        | 20        | 400  | pA    |
|                  | Input bias current, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>                                                       |                        |           | 20   |        |           | 20   | nA    |
| A <sub>vd</sub>  | Large signal voltage gain, R <sub>L</sub> = 2 kΩ, V <sub>o</sub> = ±10 V, T <sub>amb</sub> = 25 °C                               | 50                     | 200       |      | 25     | 200       |      | V/mV  |
|                  | Large signal voltage gain, R <sub>L</sub> = 2 kΩ, V <sub>o</sub> = ±10 V, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub> | 25                     |           |      | 15     |           |      |       |
| SVR              | Supply voltage rejection ratio, R <sub>S</sub> = 50 Ω, T <sub>amb</sub> = 25 °C                                                  | 80                     | 86        |      | 70     | 86        |      | dB    |
|                  | Supply voltage rejection ratio, R <sub>S</sub> = 50 Ω, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>                    | 80                     |           |      | 70     |           |      |       |
| I <sub>cc</sub>  | Supply current, no load, T <sub>amb</sub> = 25 °C                                                                                |                        | 1.4       | 2.5  |        | 1.4       | 2.5  | mA    |
|                  | Supply current, no load, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>                                                  |                        |           | 2.5  |        |           | 2.5  |       |
| V <sub>icm</sub> | Input common mode voltage range                                                                                                  | ±11                    | 15<br>-12 |      | ±11    | 15<br>-12 |      | V     |
| CMR              | Common mode rejection ratio, R <sub>S</sub> = 50 Ω, T <sub>amb</sub> = 25 °C                                                     | 80                     | 86        |      | 70     | 86        |      | dB    |
|                  | Common mode rejection ratio, R <sub>S</sub> = 50 Ω, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>                       | 80                     |           |      | 70     |           |      |       |
| I <sub>os</sub>  | Output short-circuit current, T <sub>amb</sub> = 25 °C                                                                           | 10                     | 40        | 60   | 10     | 40        | 60   | mA    |
|                  | Output short-circuit current, T <sub>min</sub> ≤ T <sub>amb</sub> ≤ T <sub>max</sub>                                             | 10                     |           | 60   | 10     |           | 60   |       |

| Symbol          | Parameter                                                                                                                                                                                        | TL082I, AC, AI, BC, BI |           |      | TL082C |           |      | Unit                   |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------|------|--------|-----------|------|------------------------|
|                 |                                                                                                                                                                                                  | Min.                   | Typ.      | Max. | Min.   | Typ.      | Max. |                        |
| $\pm V_{opp}$   | Output voltage swing,<br>$T_{amb} = 25\text{ }^{\circ}\text{C}$ , $R_L = 2\text{ k}\Omega$                                                                                                       | 10                     | 12        |      | 10     | 12        |      | V                      |
|                 | Output voltage swing,<br>$T_{amb} = 25\text{ }^{\circ}\text{C}$ , $R_L = 10\text{ k}\Omega$                                                                                                      | 12                     | 13.5      |      | 12     | 13.5      |      |                        |
|                 | Output voltage swing,<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 2\text{ k}\Omega$                                                                                                          | 10                     |           |      | 10     |           |      |                        |
|                 | Output voltage swing,<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 10\text{ k}\Omega$                                                                                                         | 12                     |           |      | 12     |           |      |                        |
| SR              | Slew rate, $T_{amb} = 25\text{ }^{\circ}\text{C}$ , $V_{in} = 10\text{ V}$ ,<br>$R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , unity gain                                                    | 8                      | 16        |      | 8      | 16        |      | V/ $\mu$ s             |
| $t_r$           | Rise time, $T_{amb} = 25\text{ }^{\circ}\text{C}$ , $V_{in} = 20\text{ mV}$ ,<br>$R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , unity gain                                                   |                        | 0.1       |      |        | 0.1       |      | $\mu$ s                |
| $K_{ov}$        | Overshoot, $T_{amb} = 25\text{ }^{\circ}\text{C}$ , $V_{in} = 20\text{ mV}$ ,<br>$R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ , unity gain                                                   |                        | 10        |      |        | 10        |      | %                      |
| GBP             | Gain bandwidth product, $T_{amb} = 25\text{ }^{\circ}\text{C}$ ,<br>$V_{in} = 10\text{ mV}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ ,<br>$F = 100\text{ kHz}$                         | 2.5                    | 4         |      | 2.5    | 4         |      | MHz                    |
| $R_i$           | Input resistance                                                                                                                                                                                 |                        | $10^{12}$ |      |        | $10^{12}$ |      | $\Omega$               |
| THD             | Total harmonic distortion, $T_{amb} = 25\text{ }^{\circ}\text{C}$ ,<br>$F = 1\text{ kHz}$ , $R_L = 2\text{ k}\Omega$ , $C_L = 100\text{ pF}$ ,<br>$A_v = 20\text{ dB}$ , $V_o = 2\text{ V}_{pp}$ |                        | 0.01      |      |        | 0.01      |      | %                      |
| $e_n$           | Equivalent input noise voltage, $R_s = 100\text{ }\Omega$ ,<br>$F = 1\text{ kHz}$                                                                                                                |                        | 15        |      |        | 15        |      | nV/ $\sqrt{\text{Hz}}$ |
| $\phi_m$        | Phase margin                                                                                                                                                                                     |                        | 45        |      |        | 45        |      | degrees                |
| $V_{o1}/V_{o2}$ | Channel separation, $A_v = 100$                                                                                                                                                                  |                        | 120       |      |        | 120       |      | dB                     |

**Notes:**

<sup>(1)</sup>The input bias currents are junction leakage currents which approximately double for every  $10^{\circ}\text{C}$  increase in the junction temperature.

## 5 Electrical characteristic curves

Figure 3: Maximum peak-to-peak output voltage versus frequency

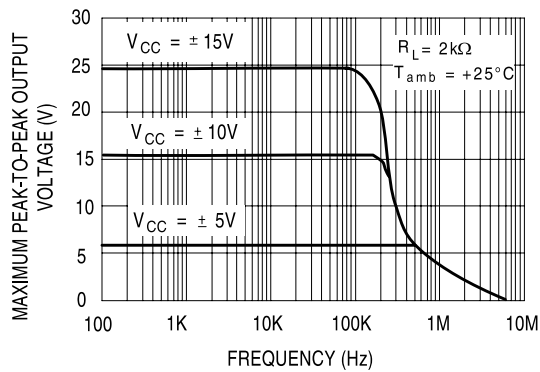


Figure 4: Maximum peak-to-peak output voltage versus frequency

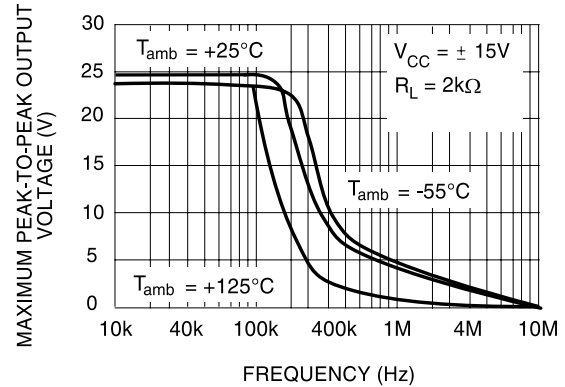


Figure 5: Maximum peak-to-peak output voltage versus load resistance

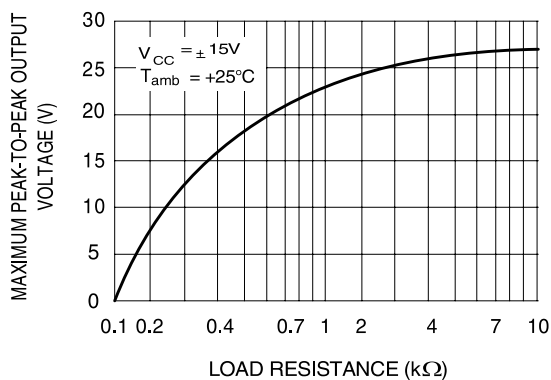


Figure 6: Maximum peak-to-peak output voltage versus frequency

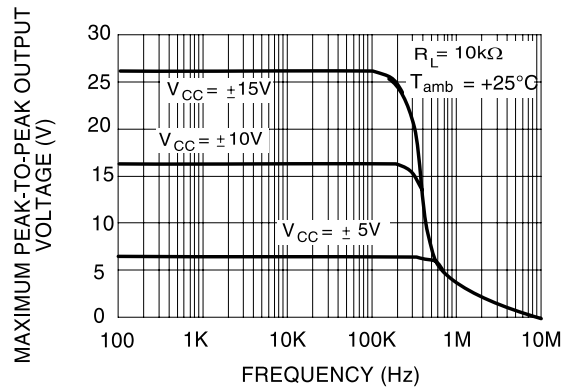


Figure 7: Maximum peak-to-peak output voltage versus free air temperature

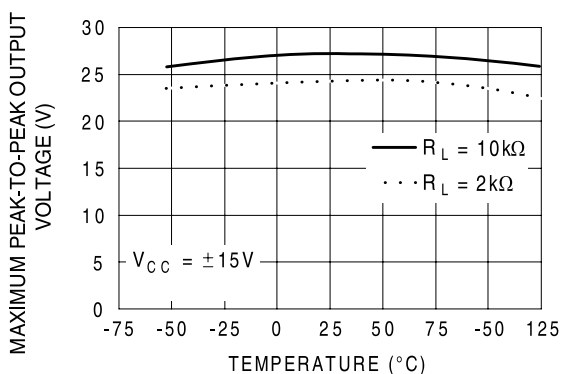


Figure 8: Maximum peak-to-peak output voltage versus supply voltage

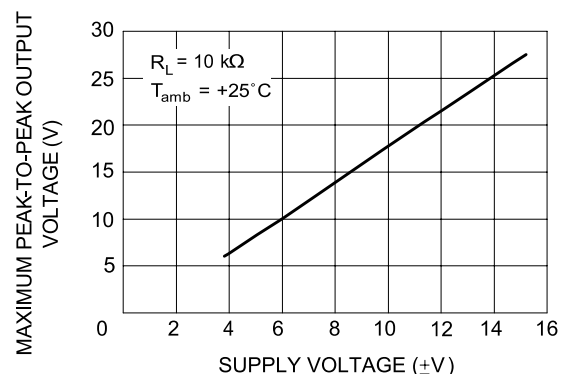


Figure 9: Input bias current versus free air temperature

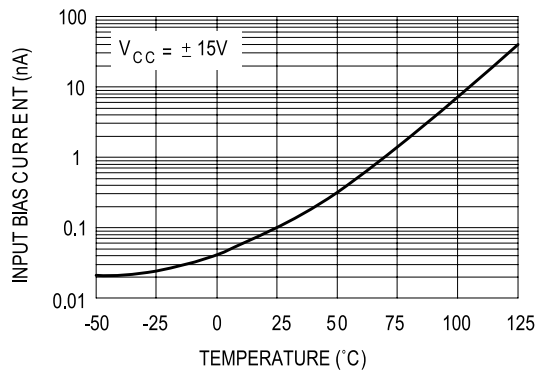


Figure 10: Large signal differential voltage amplification and phase shift versus frequency

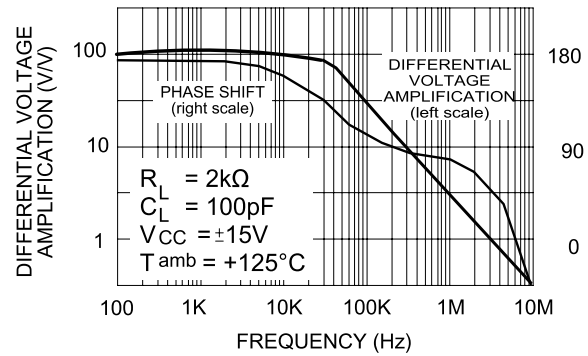


Figure 11: Supply current per amplifier versus free air temperature

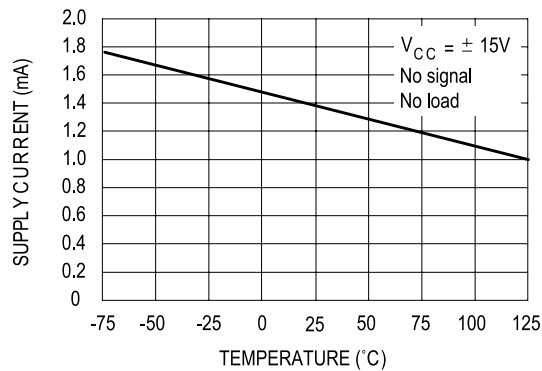


Figure 12: Large signal differential voltage amplification versus free air temperature

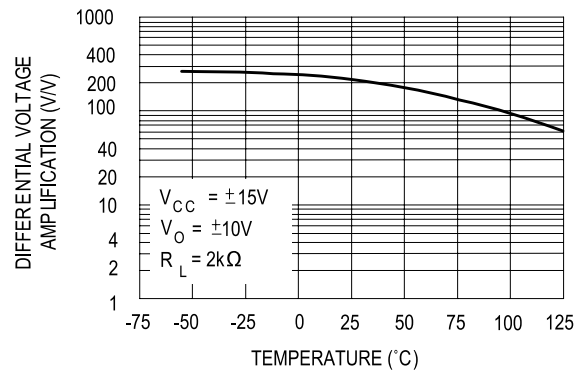


Figure 13: Total power dissipation versus free air temperature

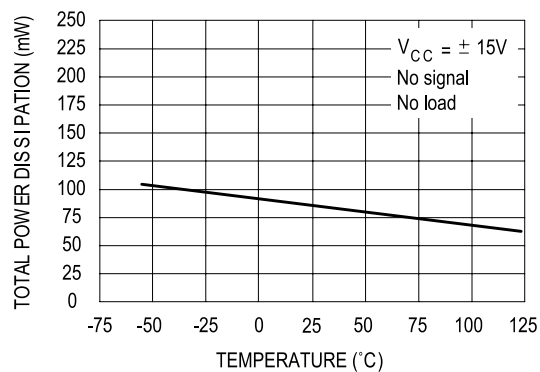


Figure 14: Supply current per amplifier versus supply voltage

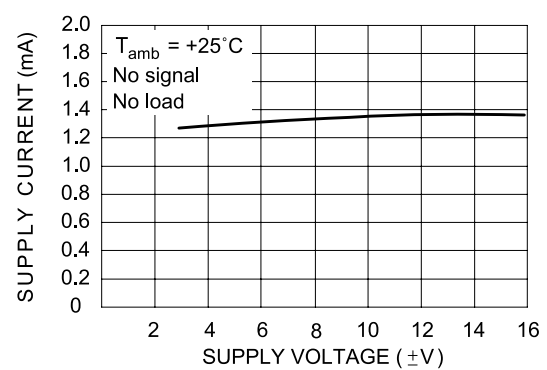


Figure 15: Common-mode rejection ratio versus free air temperature

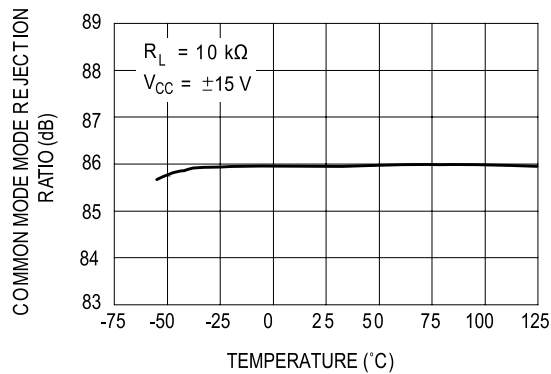


Figure 16: Output voltage versus elapsed time

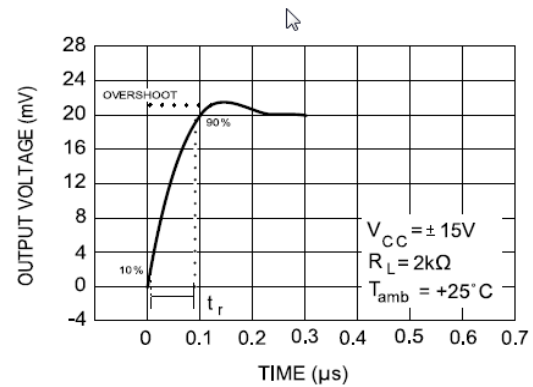


Figure 17: Voltage follower large signal pulse response

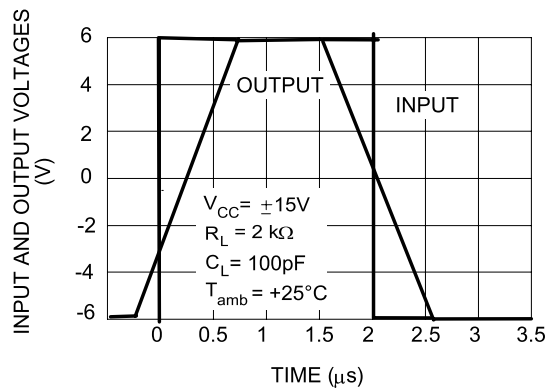


Figure 18: Equivalent input noise voltage versus frequency

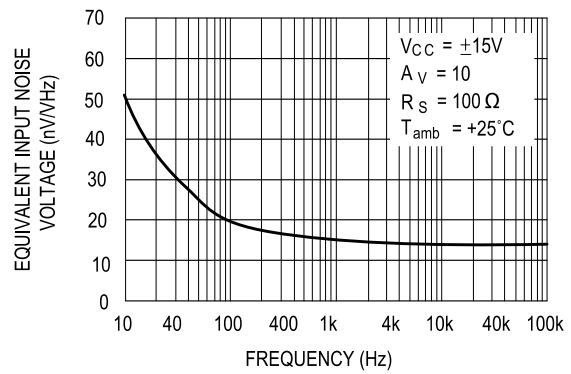
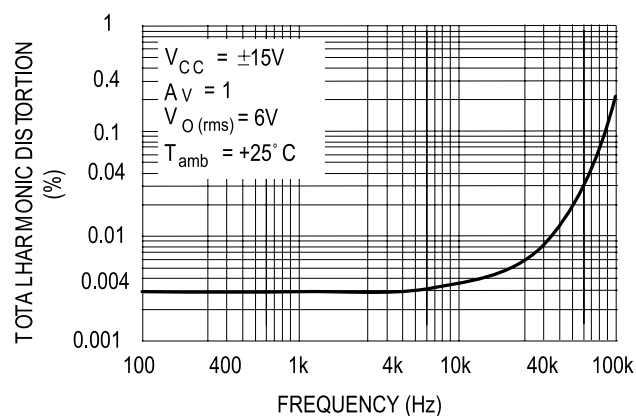


Figure 19: Total harmonic distortion versus frequency



## 6 Parameter measurement information

Figure 20: Voltage follower

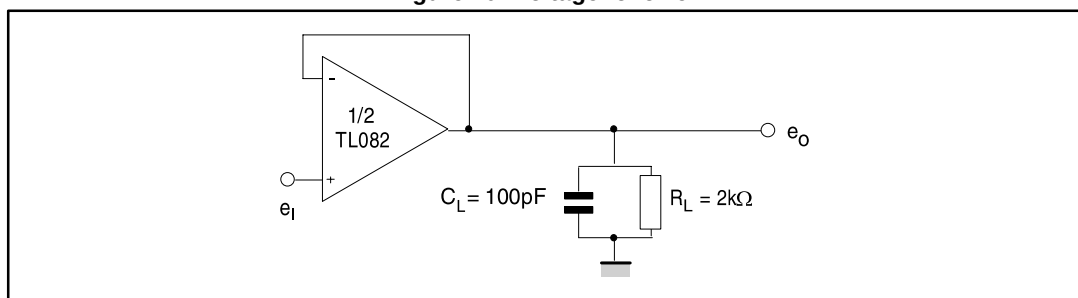
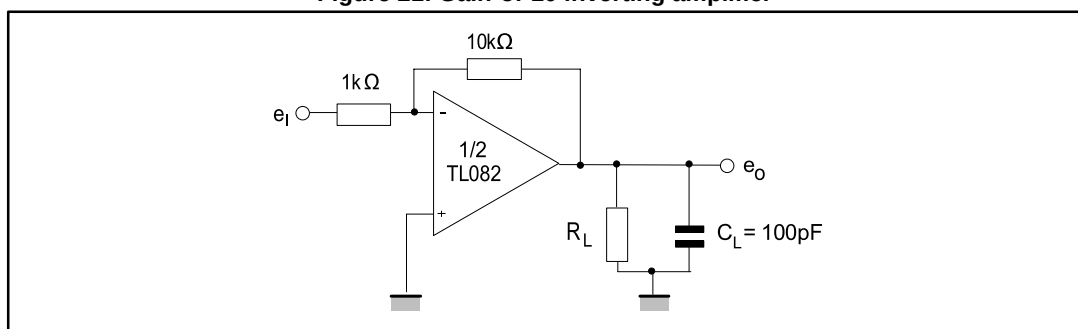
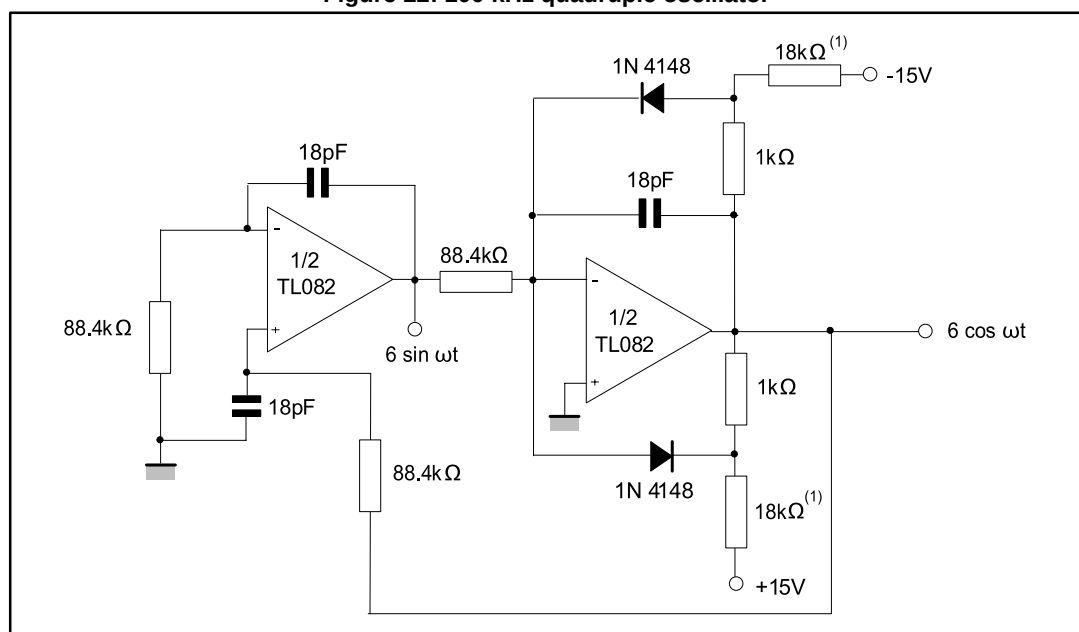


Figure 21: Gain-of-10 inverting amplifier



## 7 Typical applications

Figure 22: 100 kHz quadruple oscillator



1. These resistor values may be adjusted for a symmetrical output

## 8 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: **[www.st.com](http://www.st.com)**. ECOPACK® is an ST trademark.

## 8.1 SO8 package information

Figure 23: SO8 package outline

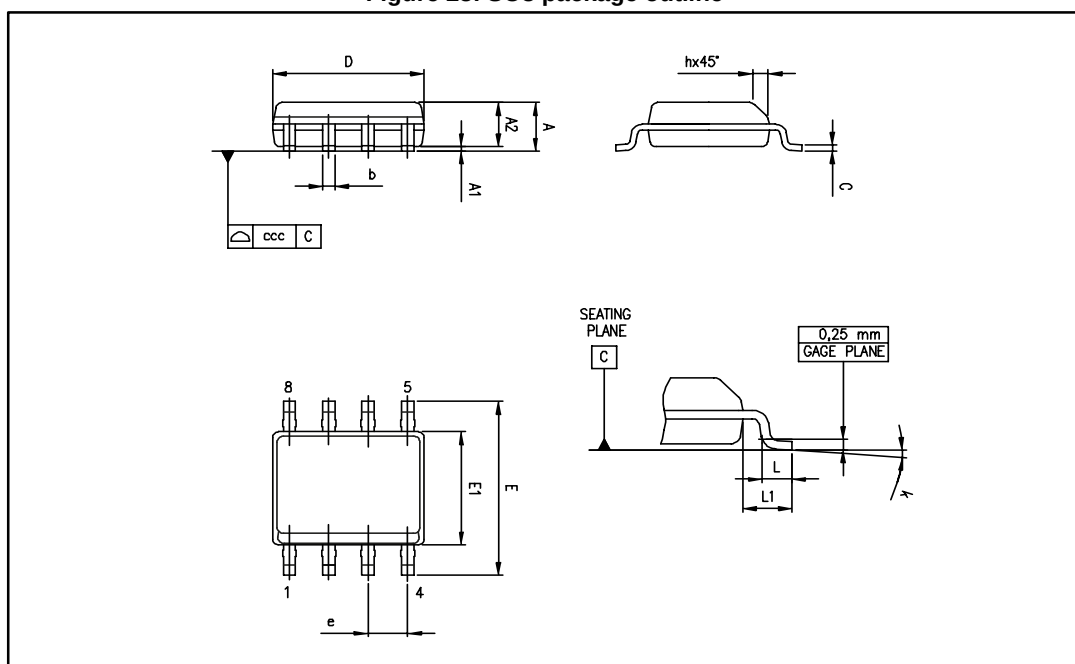


Table 4: SO8 mechanical data

| Ref. | Dimensions  |      |      |        |       |       |
|------|-------------|------|------|--------|-------|-------|
|      | Millimeters |      |      | Inches |       |       |
|      | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A    |             |      | 1.75 |        |       | 0.069 |
| A1   | 0.10        |      | 0.25 | 0.004  |       | 0.010 |
| A2   | 1.25        |      |      | 0.049  |       |       |
| b    | 0.28        |      | 0.48 | 0.011  |       | 0.019 |
| c    | 0.17        |      | 0.23 | 0.007  |       | 0.010 |
| D    | 4.80        | 4.90 | 5.00 | 0.189  | 0.193 | 0.197 |
| E    | 5.80        | 6.00 | 6.20 | 0.228  | 0.236 | 0.244 |
| E1   | 3.80        | 3.90 | 4.00 | 0.150  | 0.154 | 0.157 |
| e    |             | 1.27 |      |        | 0.050 |       |
| h    | 0.25        |      | 0.50 | 0.010  |       | 0.020 |
| L    | 0.40        |      | 1.27 | 0.016  |       | 0.050 |
| L1   |             | 1.04 |      |        | 0.040 |       |
| k    | 1°          |      | 8°   | 1°     |       | 8°    |
| ccc  |             |      | 0.10 |        |       | 0.004 |

## 8.2 TSSOP8 package information

Figure 24: TSSOP8 package outline

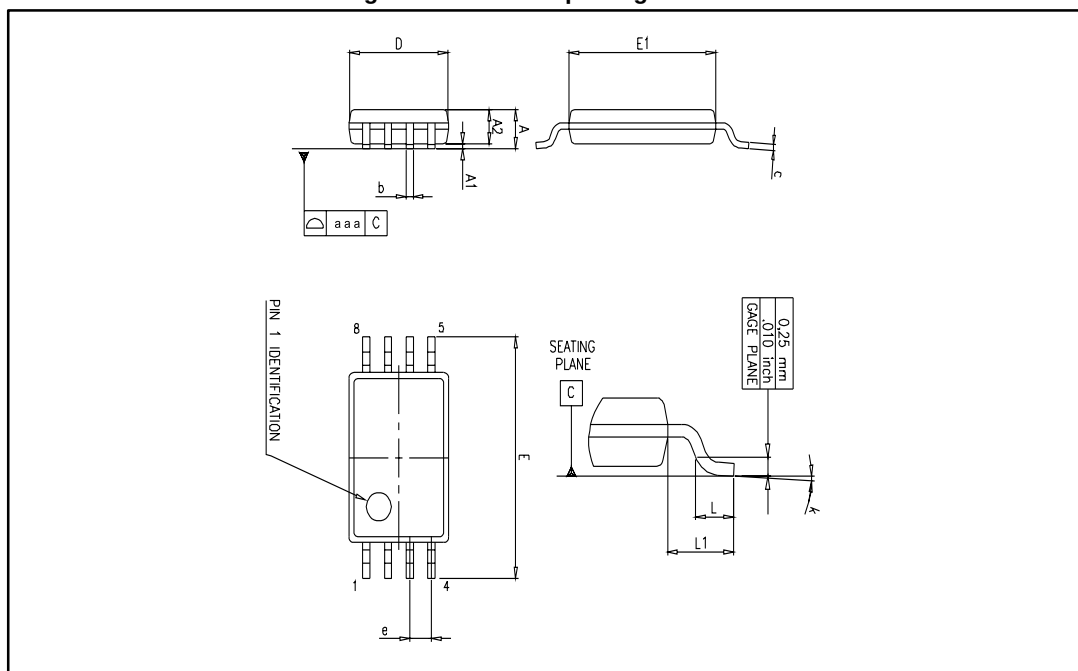


Table 5: TSSOP8 mechanical data

| Ref. | Dimensions  |      |      |        |        |       |
|------|-------------|------|------|--------|--------|-------|
|      | Millimeters |      |      | Inches |        |       |
|      | Min.        | Typ. | Max. | Min.   | Typ.   | Max.  |
| A    |             |      | 1.2  |        |        | 0.047 |
| A1   | 0.05        |      | 0.15 | 0.002  |        | 0.006 |
| A2   | 0.80        | 1.00 | 1.05 | 0.031  | 0.039  | 0.041 |
| b    | 0.19        |      | 0.30 | 0.007  |        | 0.012 |
| c    | 0.09        |      | 0.20 | 0.004  |        | 0.008 |
| D    | 2.90        | 3.00 | 3.10 | 0.114  | 0.118  | 0.122 |
| E    | 6.20        | 6.40 | 6.60 | 0.244  | 0.252  | 0.260 |
| E1   | 4.30        | 4.40 | 4.50 | 0.169  | 0.173  | 0.177 |
| e    |             | 0.65 |      |        | 0.0256 |       |
| k    | 0°          |      | 8°   | 0°     |        | 8°    |
| L    | 0.45        | 0.60 | 0.75 | 0.018  | 0.024  | 0.030 |
| L1   |             | 1    |      |        | 0.039  |       |
| aaa  |             | 0.1  |      |        | 0.004  |       |

## 9 Ordering information

Table 6: Order codes

| Order code                | Temperature range      | Package | Packing               | Marking |
|---------------------------|------------------------|---------|-----------------------|---------|
| TL082ID                   | -40 °C to 105 °C       | SO8     | Tube or tape and reel | 082I    |
| TL082IDT                  |                        |         |                       |         |
| TL082IPT                  |                        | TSSOP8  | Tape and reel         |         |
| TL082CD                   | 0 °C to 70 °C          | SO8     | Tube or tape and reel | 082C    |
| TL082CDT                  |                        |         |                       |         |
| TL082CPT                  |                        | TSSOP8  | Tape and reel         |         |
| TL082ACDT                 |                        | SO8     | Tube or tape and reel | 082AC   |
| TL082BCDT                 | 082BC                  |         |                       |         |
| TL082IYDT <sup>(1)</sup>  | SO8 (automotive grade) | 082IY   |                       |         |
| TL082AIYDT <sup>(1)</sup> |                        | 82AIY   |                       |         |
| TL082BIYDT <sup>(1)</sup> |                        | 82BIY   |                       |         |

**Notes:**

<sup>(1)</sup>Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 and Q 002 or equivalent.

## 10 Revision history

**Table 7: Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                          |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02-Apr-2001 | 1        | Initial release.                                                                                                                                                                                                                                                                 |
| 2002-2003   | 2-7      | Internal revisions.                                                                                                                                                                                                                                                              |
| 30-Apr-2004 | 8        | Format update.                                                                                                                                                                                                                                                                   |
| 06-Mar-2007 | 9        | Added ESD information in Table 1 on page 4.<br>Expanded order codes table and added automotive grade order codes. See Table 7 on page 16.<br>Added Table 2: Operating conditions on page 4.<br>Updated package information to make it compliant with the latest JEDEC standards. |
| 12-Jun-2008 | 10       | Removed information concerning military temperature range (TL082M*, TL082AM*, TL082BM*).                                                                                                                                                                                         |
| 10-Jun-2016 | 11       | Removed DIP8 package and all obsolete order codes<br>Updated document layout<br><a href="#">Table 4</a> : added L1 dimension<br><a href="#">Figure 24</a> : removed silhouette and added package outline                                                                         |

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