



# TS1871-TS1872-TS1874

1.8V input/output rail-to-rail  
low power operational amplifiers

## Features

- Operating range from  $V_{CC} = 1.8V$  to  $6V$
- Rail-to-rail input and output
- Extended  $V_{icm}$  ( $V_{DD} - 0.2V$  to  $V_{CC} + 0.2V$ )
- Low supply current ( $400\mu A$ )
- Gain bandwidth product ( $1.6MHz$ )
- High unity gain stability
- ESD tolerance ( $2kV$ )
- Latch-up immunity
- Available in SOT23-5 micro package

## Applications

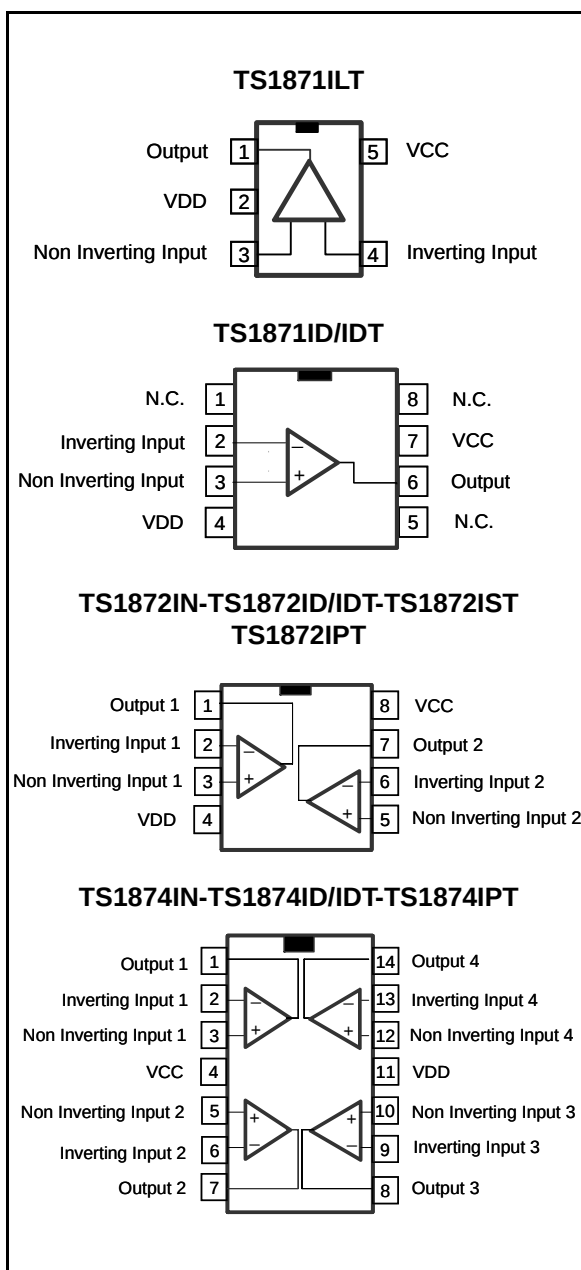
- Battery-powered applications (toys)
- Portable communication devices (cell phones)
- Audio driver (headphone drivers)
- Laptop/notebook computers

## Description

The TS187x (single, dual and quad) is an operational amplifier family able to operate with voltages as low as  $1.8V$  and that features both input and output rail-to-rail.

The common mode input voltage extends  $200mV$  beyond the supply voltages at  $25^{\circ}C$  while the output voltage swing is within  $100mV$  of each rail with a  $600\Omega$  load resistor. This device consumes typically  $400\mu A$  per channel while offering  $1.6MHz$  of gain-bandwidth product. The amplifier provides high output drive capability typically at  $65mA$  load.

These features make the TS187x family ideal for sensor interface, battery-supplied and portable applications.



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# 1 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings**

| Symbol     | Parameter                                             | Value                            | Unit |
|------------|-------------------------------------------------------|----------------------------------|------|
| $V_{CC}$   | Supply voltage <sup>(1)</sup>                         | 7                                | V    |
| $V_{id}$   | Differential input voltage <sup>(2)</sup>             | $\pm 1$                          | V    |
| $V_{in}$   | Input voltage                                         | $V_{DD} - 0.3$ to $V_{CC} + 0.3$ | V    |
| $T_{stg}$  | Storage temperature                                   | -65 to +150                      | °C   |
| $T_j$      | Maximum junction temperature                          | 150                              | °C   |
| $R_{thja}$ | Thermal resistance junction to ambient <sup>(3)</sup> |                                  |      |
|            | SOT23-5                                               | 250                              | °C/W |
|            | DIP8                                                  | 85                               |      |
|            | DIP14                                                 | 66                               |      |
|            | MiniSO-8                                              | 190                              |      |
|            | SO-8                                                  | 125                              |      |
|            | SO-14                                                 | 103                              |      |
|            | TSSOP8                                                | 120                              |      |
|            | TSSOP14                                               | 100                              |      |
| $R_{thjc}$ | Thermal resistance junction to case                   |                                  |      |
|            | SOT23-5                                               | 81                               | °C/W |
|            | DIP8                                                  | 41                               |      |
|            | DIP14                                                 | 33                               |      |
|            | MiniSO-8                                              | 39                               |      |
|            | SO-8                                                  | 40                               |      |
|            | SO-14                                                 | 31                               |      |
|            | TSSOP8                                                | 37                               |      |
|            | TSSOP14                                               | 32                               |      |
| ESD        | HBM: human body model <sup>(4)</sup>                  | 2                                | kV   |
|            | MM: machine model <sup>(5)</sup>                      | 200                              | V    |
|            | CDM: charged device model <sup>(6)</sup>              | 1.5                              | kV   |
|            | Latch-up immunity                                     | 200                              | mA   |
|            | Lead temperature (soldering, 10 sec)                  | 250                              | °C   |
|            | Output short-circuit duration                         | see note <sup>(7)</sup>          |      |

1. All voltage values, except differential voltage are with respect to network terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal. If  $V_{id} > \pm 1V$ , the maximum input current must not exceed  $\pm 1mA$ . When  $V_{id} > \pm 1V$ , add an input series resistor to limit input current.
3. Short-circuits can cause excessive heating. Destructive dissipation can result from simultaneous short-circuits on all amplifiers.
4. Human body model: A 100pF capacitor is charged to the specified voltage, then discharged through a 1.5k $\Omega$  resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
5. Machine model: A 200pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 $\Omega$ ). This is done for all couples of connected pin combinations while the other pins are floating.
6. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.
7. Short-circuits from the output to  $V_{CC}$  can cause excessive heating. The maximum output current is approximately 80mA, independent of the magnitude of  $V_{CC}$ . Destructive dissipation can result from simultaneous short-circuits on all amplifiers.

**Table 2. Operating conditions**

| Symbol     | Parameter                                                                                                                                                                  | Value                                                    | Unit               |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------|
| $V_{CC}$   | Supply voltage                                                                                                                                                             | 1.8 to 6                                                 | V                  |
| $V_{icm}$  | Common mode input voltage range<br>$T_{oper} = 25^{\circ}\text{C}$ , $1.8 \leq V_{CC} \leq 6\text{V}$<br>$T_{min} < T_{oper} < T_{max}$ , $1.8 \leq V_{CC} \leq 6\text{V}$ | $V_{DD} - 0.2$ to $V_{CC} + 0.2$<br>$V_{DD}$ to $V_{CC}$ | V                  |
| $T_{oper}$ | Operating free air temperature range                                                                                                                                       | -40 to + 125                                             | $^{\circ}\text{C}$ |

## 2 Electrical characteristics

**Table 3. Electrical characteristics at  $V_{CC} = +1.8V$   
with  $V_{DD} = 0V$ ,  $C_L$  &  $R_L$  connected to  $V_{CC}/2$ , and  $T_{amb} = 25^\circ C$  (unless otherwise specified)<sup>(1)</sup>**

| Symbol          | Parameter                                                              | Conditions                                                                                                                                                                      | Min.                         | Typ.         | Max.                     | Unit             |
|-----------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------|--------------------------|------------------|
| $V_{io}$        | Input offset voltage                                                   | $V_{icm} = V_{out} = V_{CC}/2$<br>TS1871A/2A/4A<br>$T_{min} \leq T_{amb} \leq T_{max}$<br>TS1871/2/4<br>$T_{min} \leq T_{amb} \leq T_{max}$                                     |                              | 0.1          | 1<br>1.5<br>3<br>6       | mV               |
| $\Delta V_{io}$ | Input offset voltage drift                                             |                                                                                                                                                                                 |                              | 2            |                          | $\mu V/^\circ C$ |
| $I_{io}$        | Input offset current                                                   | $V_{icm} = V_{out} = V_{CC}/2$ <sup>(2)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                            |                              | 3            | 30<br>60                 | nA               |
| $I_{ib}$        | Input bias current                                                     | $V_{icm} = V_{out} = V_{CC}/2$ <sup>(1)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                            |                              | 40           | 125<br>150               | nA               |
| CMR             | Common mode rejection ratio<br>$20 \log (\Delta V_{ic}/\Delta V_{io})$ | $0 \leq V_{icm} \leq V_{CC}$ , $V_{out} = V_{CC}/2$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                      | 55<br>52                     | 77           |                          | dB               |
| $A_{vd}$        | Large signal voltage gain                                              | $V_{out} = 0.5V \text{ to } 1.3V$<br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$                                                                                                      | 77<br>70                     | 92<br>85     |                          | dB               |
| $V_{OH}$        | High level output voltage                                              | $V_{id} = 100mV$<br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 2k\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 600\Omega$  | 1.65<br>1.62<br>1.65<br>1.62 | 1.77<br>1.74 |                          | V                |
| $V_{OL}$        | Low level output voltage                                               | $V_{id} = -100mV$<br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 2k\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 600\Omega$ |                              | 88<br>115    | 100<br>150<br>100<br>150 | mV               |
| $I_o$           | Output source current                                                  | $V_{id} = 100mV$ , $V_O = V_{DD}$                                                                                                                                               | 20                           | 65           |                          | mA               |
|                 | Output sink current                                                    | $V_{id} = -100mV$ , $V_O = V_{CC}$                                                                                                                                              | 20                           | 65           |                          |                  |
| $I_{CC}$        | Supply current (per amplifier)                                         | $V_{out} = V_{CC}/2$<br>$A_{VCL} = 1$ , no load<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                          |                              | 400          | 560<br>600               | $\mu A$          |
| GBP             | Gain bandwidth product                                                 | $R_L = 10k\Omega$ , $C_L = 100pF$ , $f = 100kHz$                                                                                                                                | 0.9                          | 1.6          |                          | MHz              |
| SR              | Slew rate                                                              | $R_L = 10k\Omega$ , $C_L = 100pF$ , $A_V = 1$                                                                                                                                   | 0.38                         | 0.54         |                          | V/ $\mu s$       |
| $\phi_m$        | Phase margin                                                           | $C_L = 100pF$                                                                                                                                                                   |                              | 53           |                          | Degrees          |
| en              | Input voltage noise                                                    | $f = 1kHz$                                                                                                                                                                      |                              | 27           |                          | nV/ $\sqrt{Hz}$  |
| THD             | Total harmonic distortion                                              |                                                                                                                                                                                 |                              | 0.01         |                          | %                |

1. All parameter limits at temperatures different from  $25^\circ C$  are guaranteed by correlation.

2. Maximum values include unavoidable inaccuracies of the industrial tests.

**Table 4. Electrical characteristics at  $V_{CC} = +3V$   
with  $V_{DD} = 0V$ ,  $C_L$  &  $R_L$  connected to  $V_{CC}/2$ , and  $T_{amb} = 25^\circ C$  (unless otherwise specified)<sup>(1)</sup>**

| Symbol          | Parameter                                                              | Conditions                                                                                                                                                                      | Min.                         | Typ.         | Max.                     | Unit             |
|-----------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------|--------------------------|------------------|
| $V_{io}$        | Input offset voltage                                                   | $V_{icm} = V_{out} = V_{CC}/2$<br>TS1871A/2A/4A<br>$T_{min} \leq T_{amb} \leq T_{max}$<br>TS1871/2/4<br>$T_{min} \leq T_{amb} \leq T_{max}$                                     |                              | 0.1          | 1<br>1.5<br>3<br>6       | mV               |
| $\Delta V_{io}$ | Input offset voltage drift                                             |                                                                                                                                                                                 |                              | 2            |                          | $\mu V/^\circ C$ |
| $I_{io}$        | Input offset current                                                   | $V_{icm} = V_{out} = V_{CC}/2$ <sup>(2)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                            |                              | 3            | 30<br>60                 | nA               |
| $I_{ib}$        | Input bias current                                                     | $V_{icm} = V_{out} = V_{CC}/2$ <sup>(1)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                            |                              | 4            | 125<br>150               | nA               |
| CMR             | Common mode rejection ratio<br>$20 \log (\Delta V_{ic}/\Delta V_{io})$ | $0 \leq V_{icm} \leq V_{CC}$ , $V_{out} = V_{CC}/2$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                      | 60<br>57                     | 80           |                          | dB               |
| $A_{vd}$        | Large signal voltage gain                                              | $V_{out} = 0.5V$ to $2.5V$<br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$                                                                                                             | 80<br>74                     | 92<br>95     |                          | dB               |
| $V_{OH}$        | High level output voltage                                              | $V_{id} = 100mV$<br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 2k\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 600\Omega$  | 2.82<br>2.80<br>2.82<br>2.80 | 2.95<br>2.95 |                          | V                |
| $V_{OL}$        | Low level output voltage                                               | $V_{id} = -100mV$<br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 2k\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 600\Omega$ |                              | 88<br>115    | 120<br>160<br>120<br>160 | mV               |
| $I_o$           | Output source current                                                  | $V_{id} = 100mV$ , $V_O = V_{DD}$                                                                                                                                               | 20                           | 80           |                          | mA               |
|                 | Output sink current                                                    | $V_{id} = -100mV$ , $V_O = V_{CC}$                                                                                                                                              | 20                           | 80           |                          |                  |
| $I_{CC}$        | Supply current (per amplifier)                                         | $V_{out} = V_{CC}/2$<br>$A_{VCL} = 1$ , no load<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                          |                              | 450          | 650<br>690               | $\mu A$          |
| GBP             | Gain bandwidth product                                                 | $R_L = 10k\Omega$ , $C_L = 100pF$ , $f = 100kHz$                                                                                                                                | 1                            | 1.7          |                          | MHz              |
| SR              | Slew rate                                                              | $R_L = 10k\Omega$ , $C_L = 100pF$ , $A_V = 1$                                                                                                                                   | 0.42                         | 0.6          |                          | V/ $\mu s$       |
| $\phi_m$        | Phase margin                                                           | $C_L = 100pF$                                                                                                                                                                   |                              | 53           |                          | Degrees          |
| en              | Input voltage noise                                                    | $f = 1kHz$                                                                                                                                                                      |                              | 27           |                          | nV/ $\sqrt{Hz}$  |
| THD             | Total harmonic distortion                                              |                                                                                                                                                                                 |                              | 0.01         |                          | %                |

1. All parameter limits at temperatures different from  $25^\circ C$  are guaranteed by correlation.

2. Maximum values include unavoidable inaccuracies of the industrial tests.

**Table 5. Electrical characteristics at  $V_{CC} = +5V$   
with  $V_{DD} = 0V$ ,  $C_L$  &  $R_L$  connected to  $V_{CC}/2$ , and  $T_{amb} = 25^\circ C$  (unless otherwise specified) <sup>(1)</sup>**

| Symbol          | Parameter                                                                 | Conditions                                                                                                                                                                                        | Min.                         | Typ.         | Max.                     | Unit             |
|-----------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------|--------------------------|------------------|
| $V_{io}$        | Input offset voltage                                                      | $V_{icm} = V_{out} = V_{CC}/2$<br>TS1871A/2A/4A<br>$T_{min} \leq T_{amb} \leq T_{max}$<br>TS1871/2/4<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                       |                              | 0.1          | 1<br>1.5<br>3<br>6       | mV               |
| $\Delta V_{io}$ | Input offset voltage drift                                                |                                                                                                                                                                                                   |                              | 2            |                          | $\mu V/^\circ C$ |
| $I_{io}$        | Input offset current                                                      | $V_{icm} = V_{out} = V_{CC}/2$ <sup>(2)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                              |                              | 3            | 30<br>60                 | nA               |
| $I_{ib}$        | Input bias current                                                        | $V_{icm} = V_{out} = V_{CC}/2$ <sup>(1)</sup><br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                                              |                              | 70           | 130<br>150               | nA               |
| CMR             | Common mode rejection ratio<br>$20 \log (\Delta V_{ic}/\Delta V_{io})$    | $0 \leq V_{icm} \leq V_{CC}$ , $V_{out}$ not equal to $V_{CC}/2$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                           | 65<br>62                     | 85           |                          | dB               |
| SVR             | Supply voltage rejection ratio<br>$20 \log (\Delta V_{cc}/\Delta V_{io})$ | $V_{CC} = 1.8$ to $5V$                                                                                                                                                                            | 70                           | 90           |                          | dB               |
| $A_{vd}$        | Large signal voltage gain                                                 | <b><math>V_{out} = 1V</math> to <math>4V</math></b><br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$                                                                                                      | 83<br>77                     | 92<br>85     |                          | dB               |
| $V_{OH}$        | High level output voltage                                                 | <b><math>V_{id} = 100mV</math></b><br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 2k\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 600\Omega$  | 4.80<br>4.75<br>4.80<br>4.75 | 4.95<br>4.90 |                          | V                |
| $V_{OL}$        | Low level output voltage                                                  | <b><math>V_{id} = -100mV</math></b><br>$R_L = 2k\Omega$<br>$R_L = 600\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 2k\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$ , $R_L = 600\Omega$ |                              | 88<br>115    | 130<br>188<br>130<br>188 | mV               |
| $I_o$           | Output source current                                                     | $V_{id} = 100mV$ , $V_O = V_{DD}$                                                                                                                                                                 | 20                           | 80           |                          | mA               |
|                 | Output sink current                                                       | $V_{id} = -100mV$ , $V_O = V_{CC}$                                                                                                                                                                | 20                           | 80           |                          |                  |
| $I_{CC}$        | Supply current (per amplifier)                                            | <b><math>V_{out} = V_{CC}/2</math></b><br>$A_{VCL} = 1$ , no load<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                          |                              | 500          | 835<br>875               | $\mu A$          |
| GBP             | Gain bandwidth product                                                    | $R_L = 10k\Omega$ , $C_L = 100pF$ , $f = 100kHz$                                                                                                                                                  | 1                            | 1.8          |                          | MHz              |
| SR              | Slew rate                                                                 | $R_L = 10k\Omega$ , $C_L = 100pF$ , $A_V = 1$                                                                                                                                                     | 0.42                         | 0.6          |                          | V/ $\mu s$       |
| $\phi_m$        | Phase margin                                                              | $C_L = 100pF$                                                                                                                                                                                     |                              | 55           |                          | Degrees          |
| en              | Input voltage noise                                                       | $f = 1kHz$                                                                                                                                                                                        |                              | 27           |                          | nV/ $\sqrt{Hz}$  |
| THD             | Total harmonic distortion                                                 |                                                                                                                                                                                                   |                              | 0.01         |                          | %                |

1. All parameter limits at temperatures different from  $25^\circ C$  are guaranteed by correlation.
2. Maximum values include unavoidable inaccuracies of the industrial tests.

Figure 1. Input offset voltage distribution

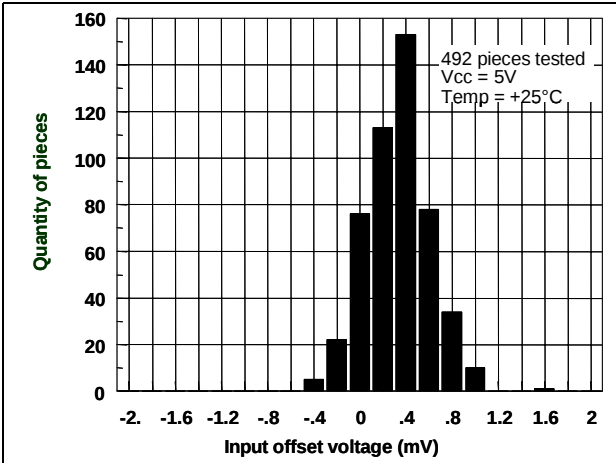


Figure 2. Input offset voltage vs. temperature

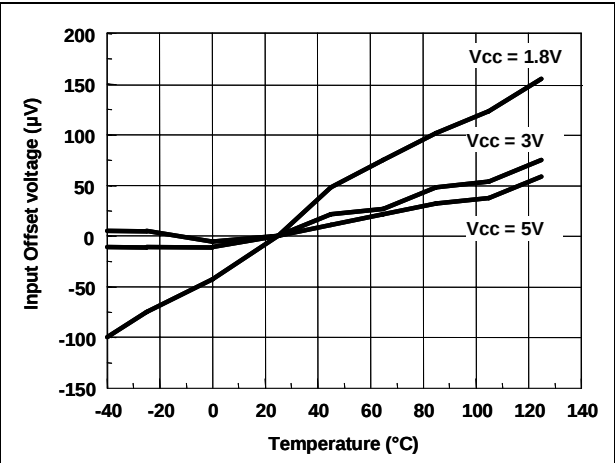


Figure 3. Input bias current vs. temperature

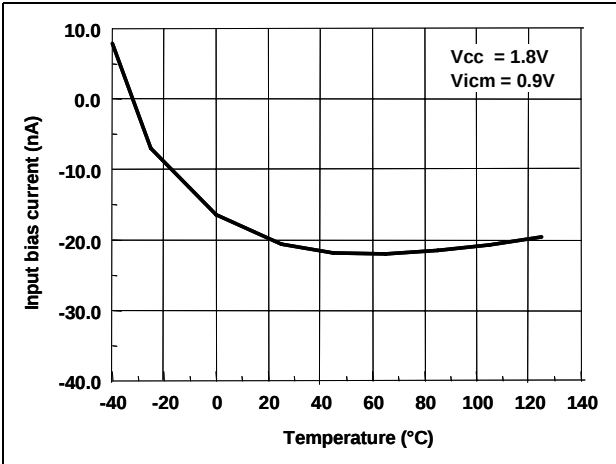


Figure 4. Input bias current vs. temperature

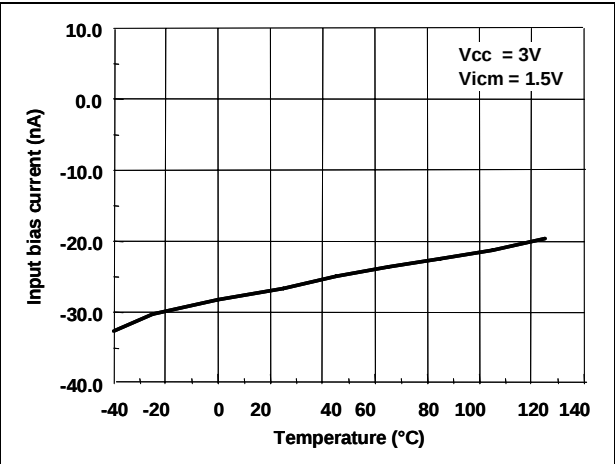


Figure 5. Supply current/amplifier vs. supply voltage

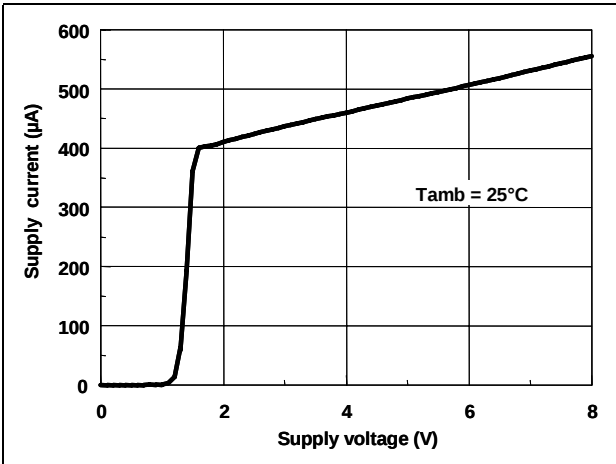


Figure 6. Supply current/amplifier vs. temperature

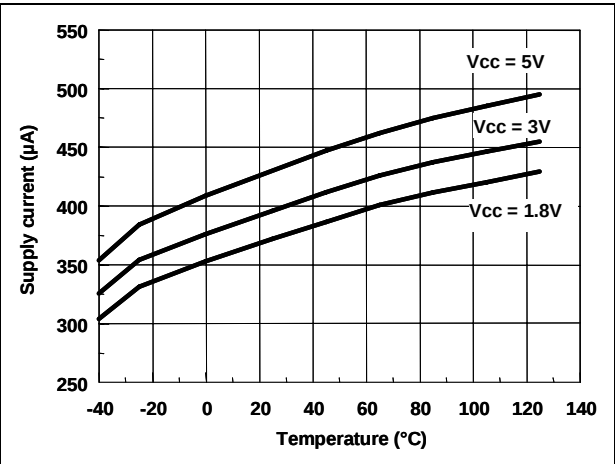


Figure 7. Common mode rejection vs. temperature

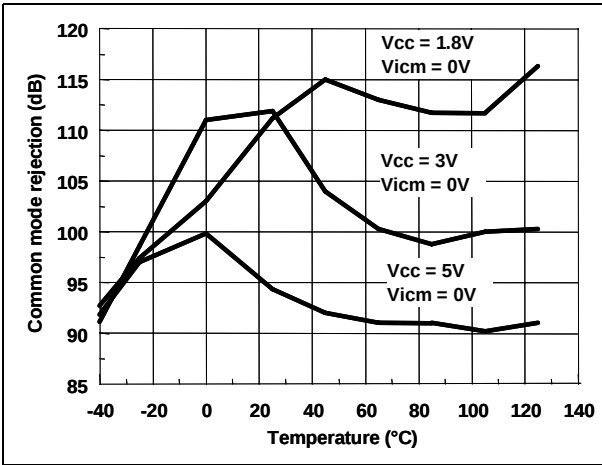


Figure 8. Supply voltage rejection vs. temperature

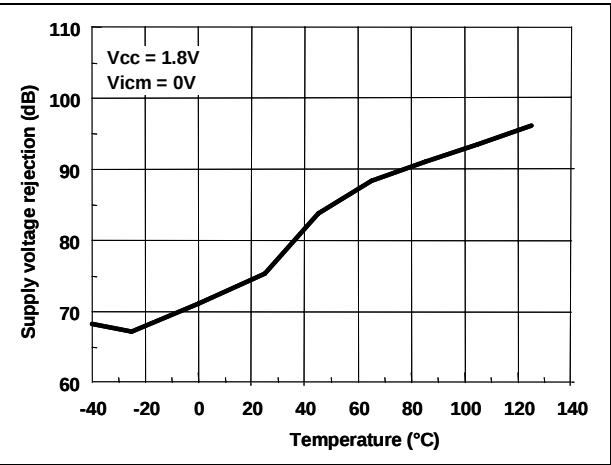


Figure 9. Supply voltage rejection vs. temperature

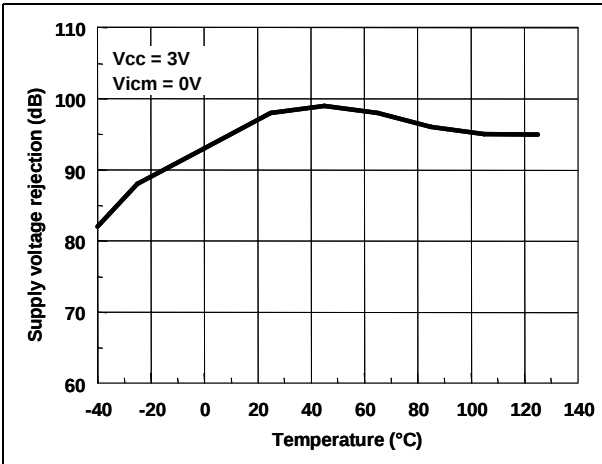


Figure 10. Supply voltage rejection vs. temperature

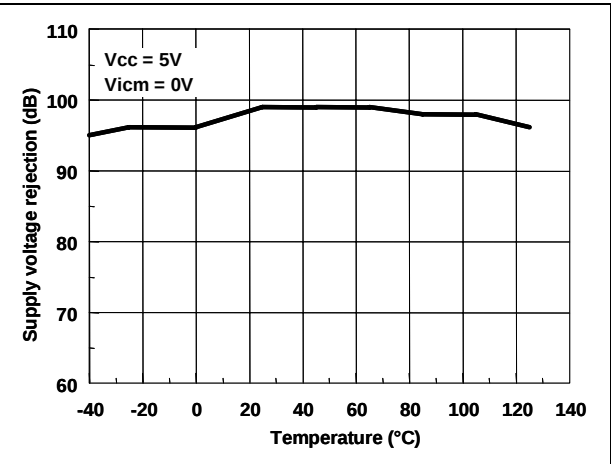


Figure 11. Power supply voltage rejection vs. frequency

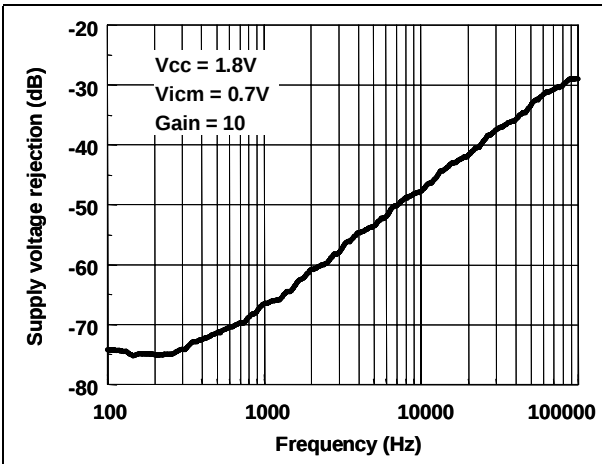


Figure 12. Open loop gain vs. frequency

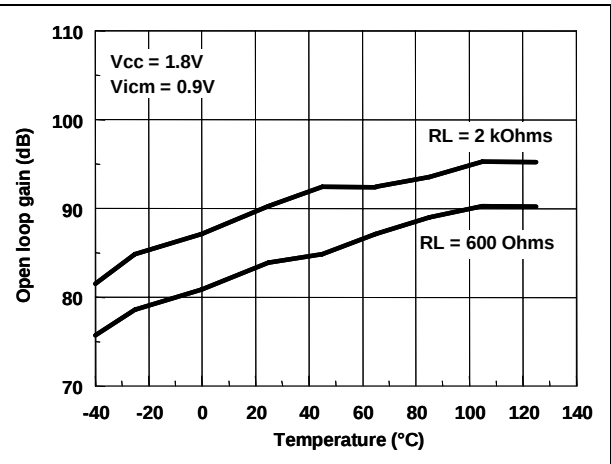


Figure 13. Open loop gain vs. temperature

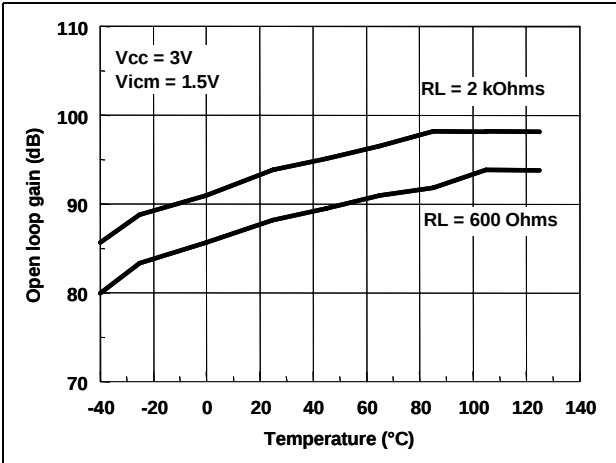


Figure 14. Open loop gain vs. temperature

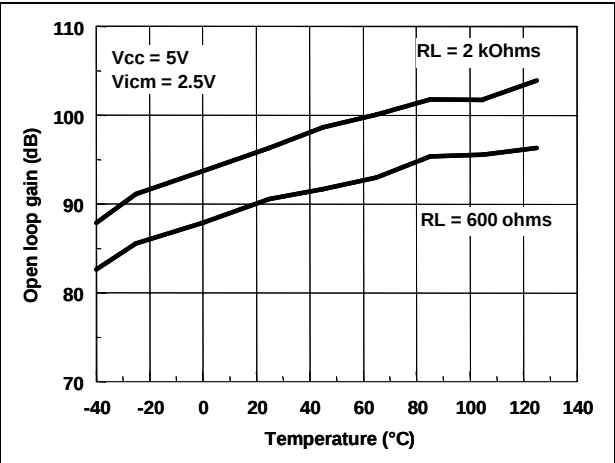


Figure 15. High level output voltage vs. temperature

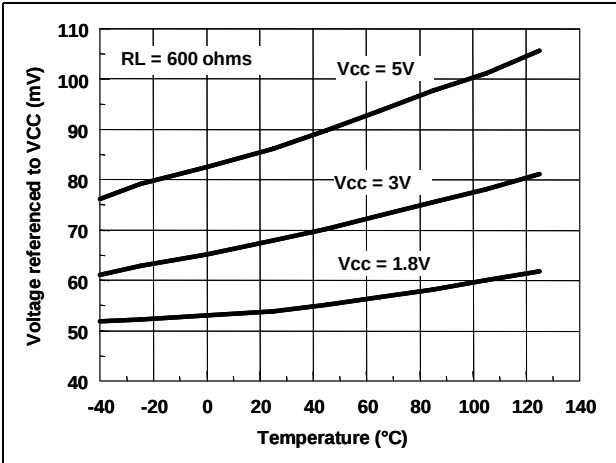


Figure 16. Low level output voltage vs. temperature

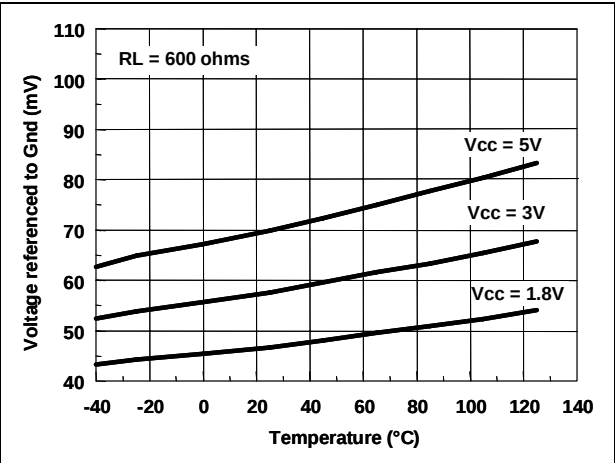


Figure 17. High level output voltage vs. temperature

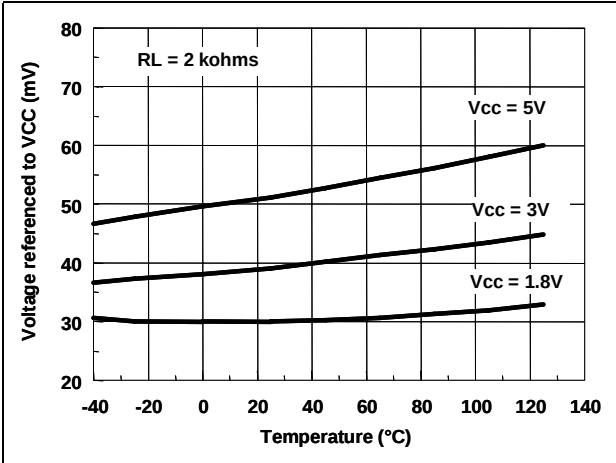


Figure 18. Low level output voltage vs. temperature

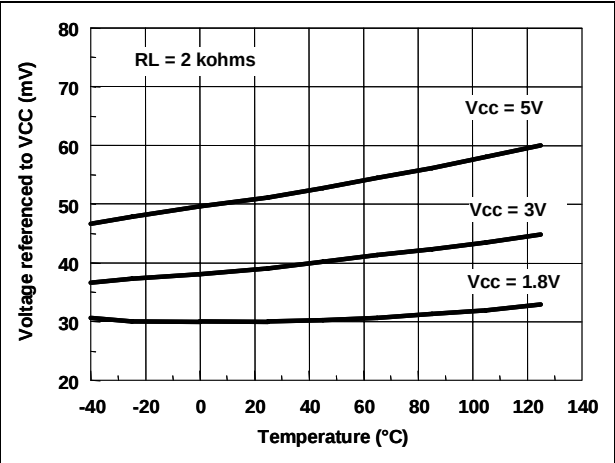


Figure 19. Output current vs. temperature

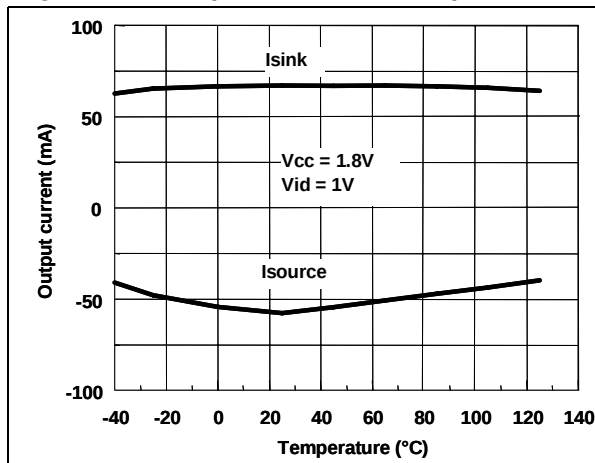


Figure 20. Output current vs. temperature

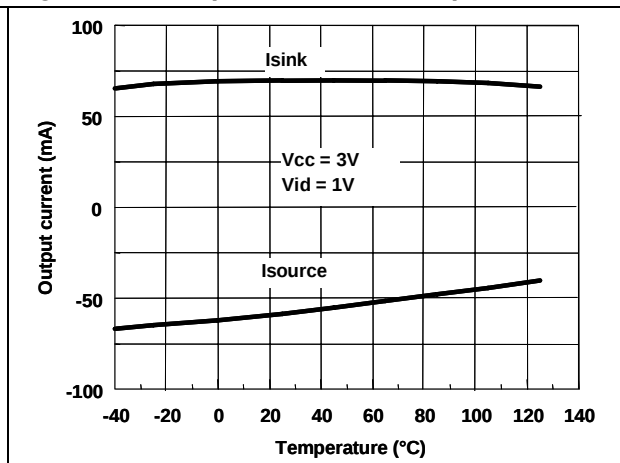


Figure 21. Output current vs. temperature

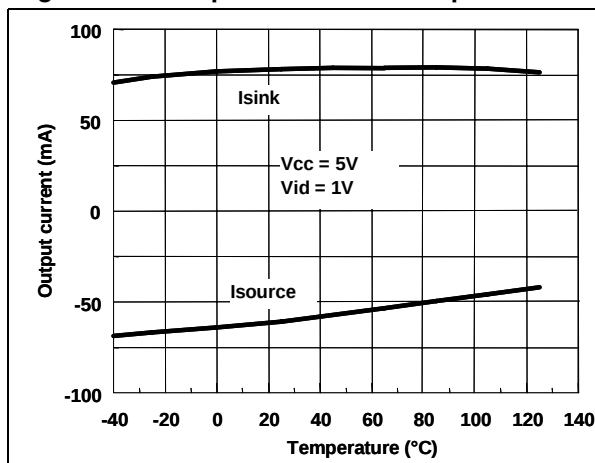


Figure 22. Output current vs. output voltage

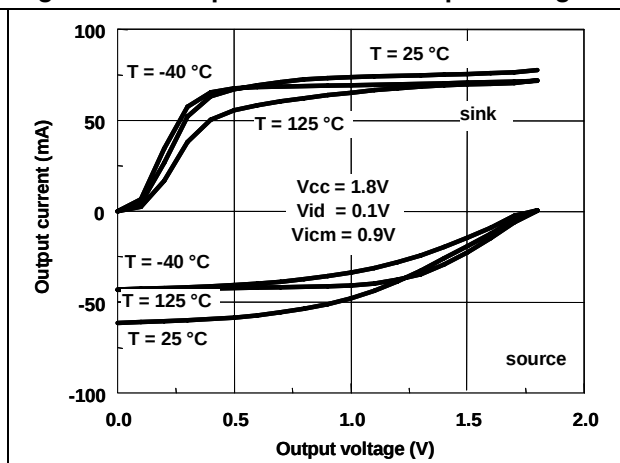


Figure 23. Output current vs. output voltage

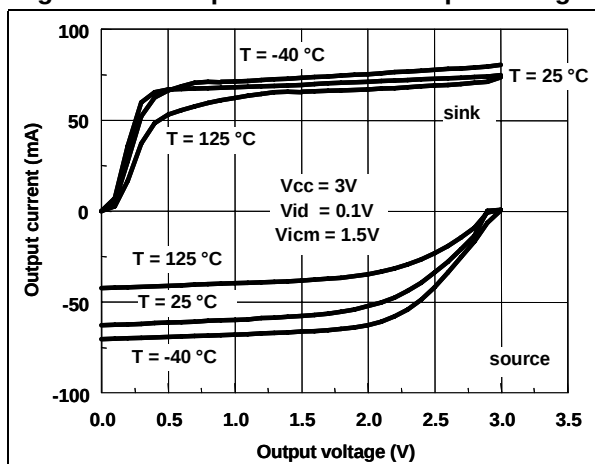


Figure 24. Output current vs. output voltage

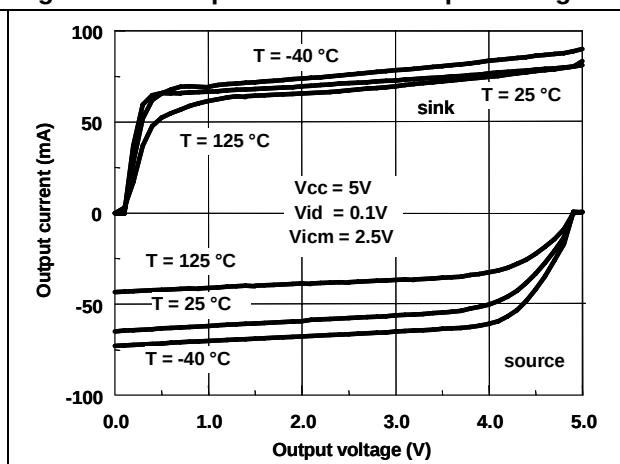


Figure 25. Gain and phase vs. frequency

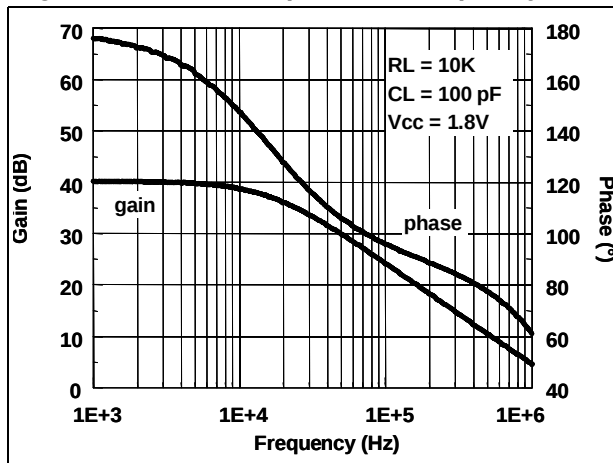


Figure 26. Gain and phase vs. frequency

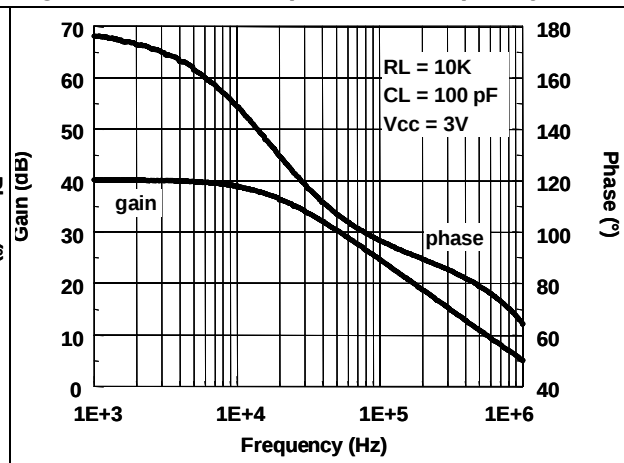


Figure 27. Gain and phase vs. frequency

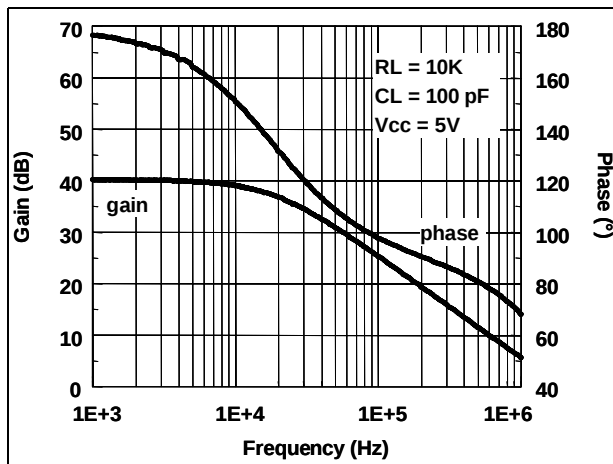


Figure 28. Gain bandwidth product vs. temperature

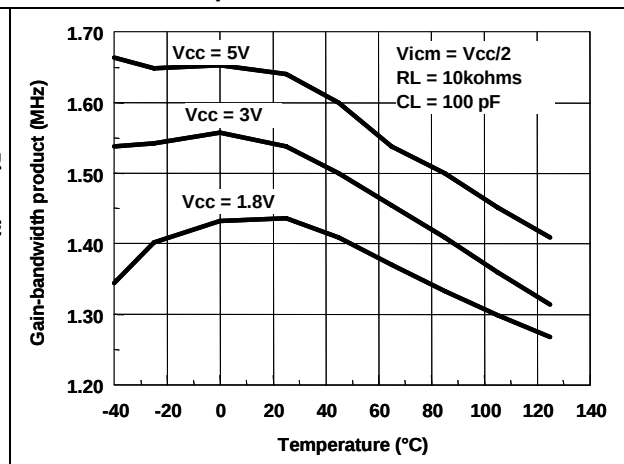


Figure 29. Gain bandwidth product vs. supply voltage

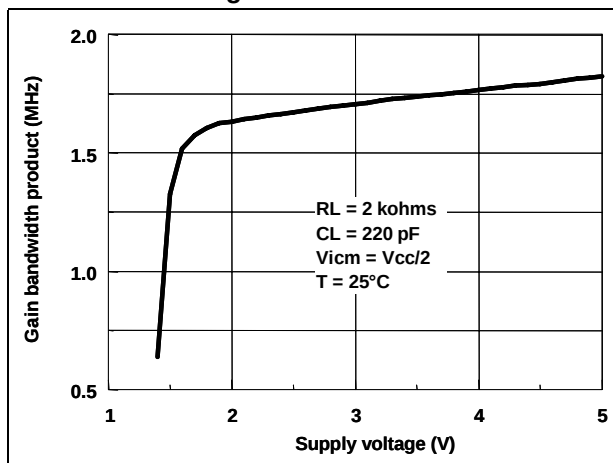


Figure 30. Slew rate vs. temperature

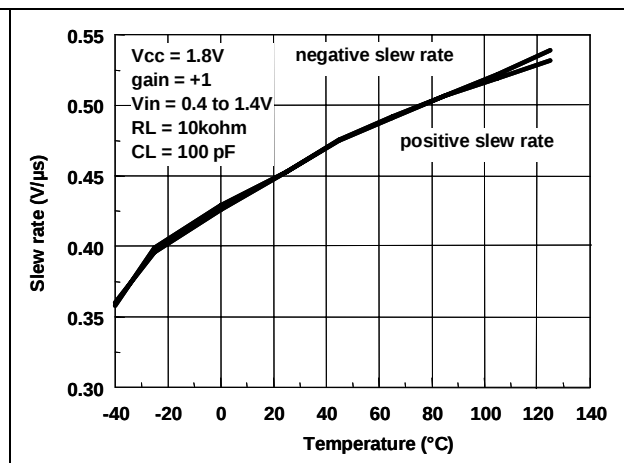


Figure 31. Slew rate vs. temperature

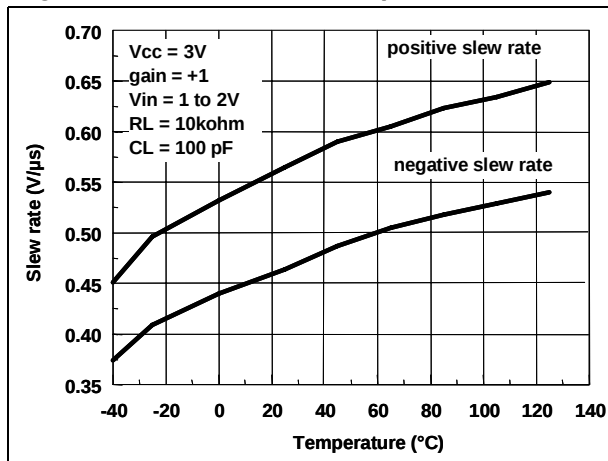


Figure 32. Slew rate vs. temperature

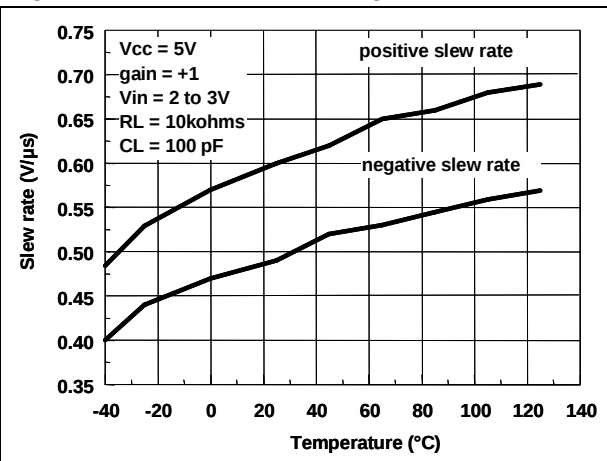


Figure 33. Phase margin vs. load capacitor

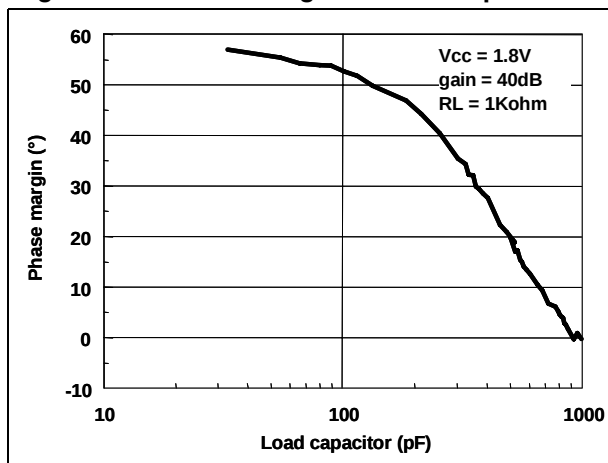


Figure 34. Phase margin vs. output current

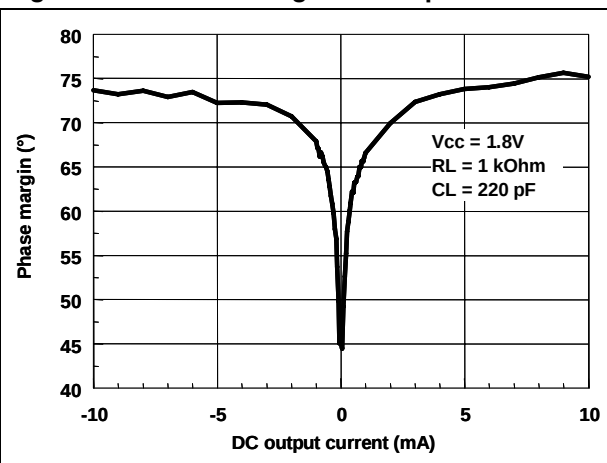


Figure 35. Gain margin vs. output current

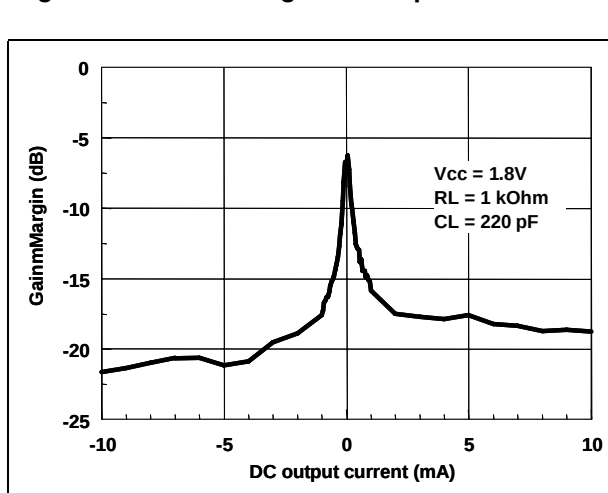


Figure 36. Equivalent input noise vs. frequency

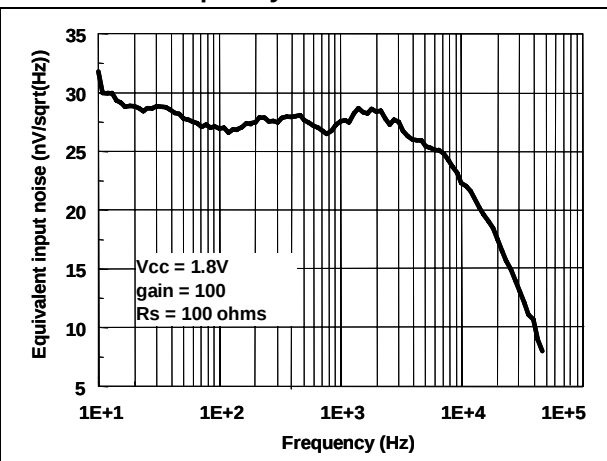


Figure 37. Distortion vs. output voltage

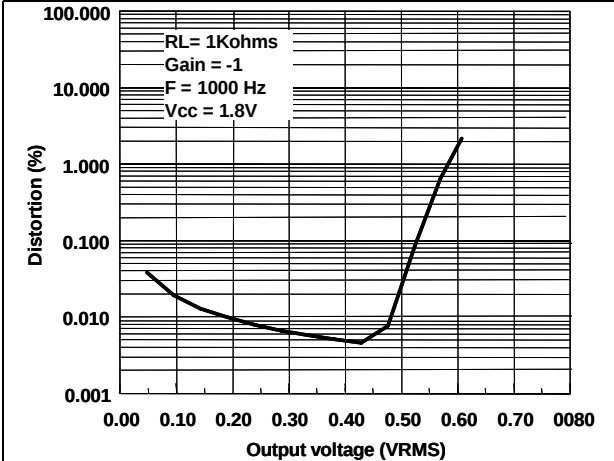


Figure 38. Distortion vs. output voltage

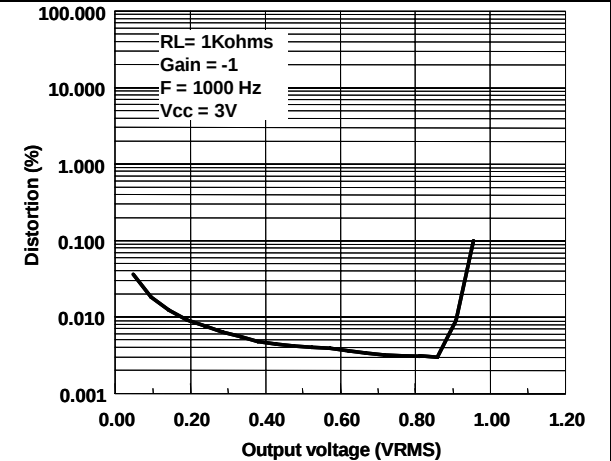


Figure 39. Distortion vs. output voltage

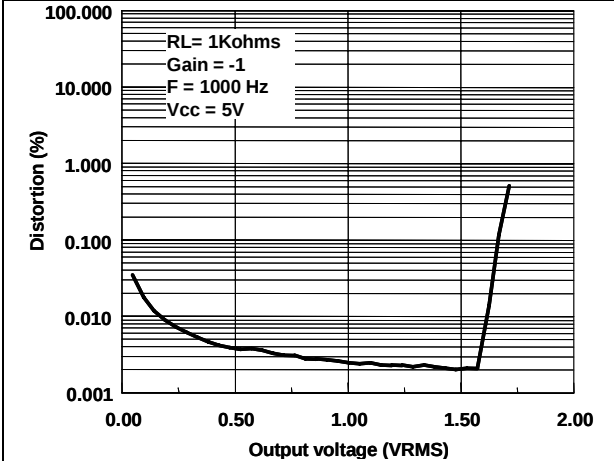


Figure 40. Distortion vs. output voltage

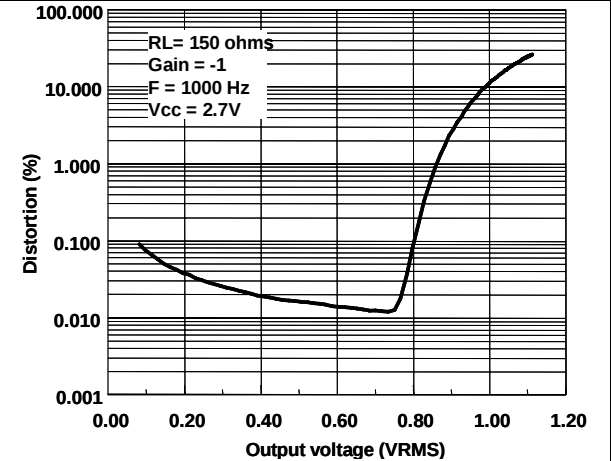


Figure 41. Distortion vs. output voltage

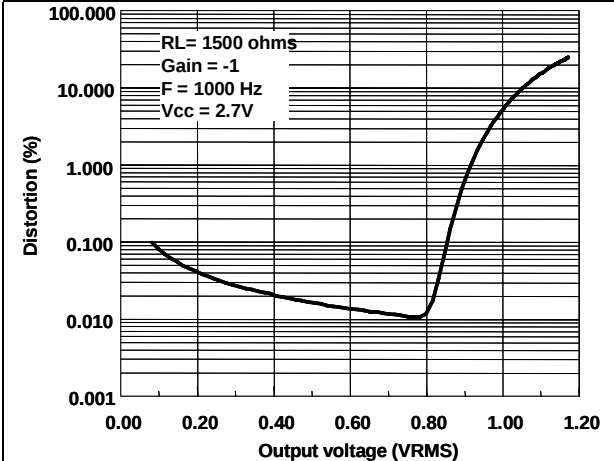


Figure 42. Distortion vs. output voltage

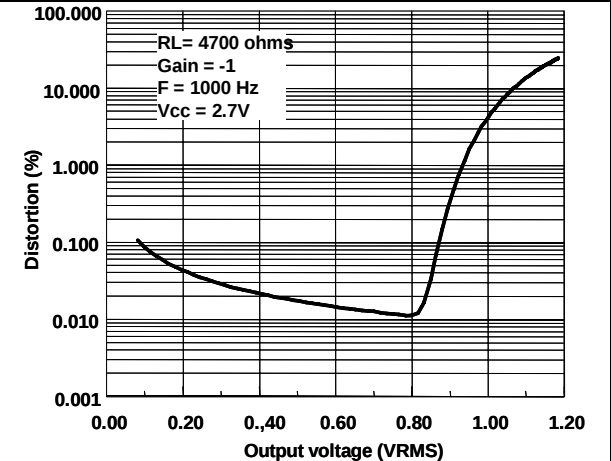


Figure 43. Distortion vs. frequency

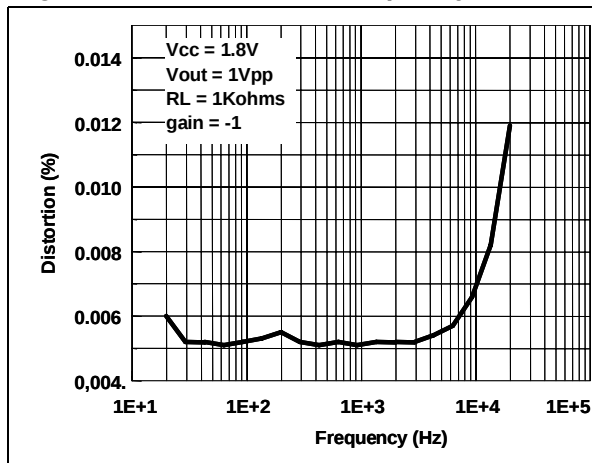


Figure 44. Distortion vs. frequency

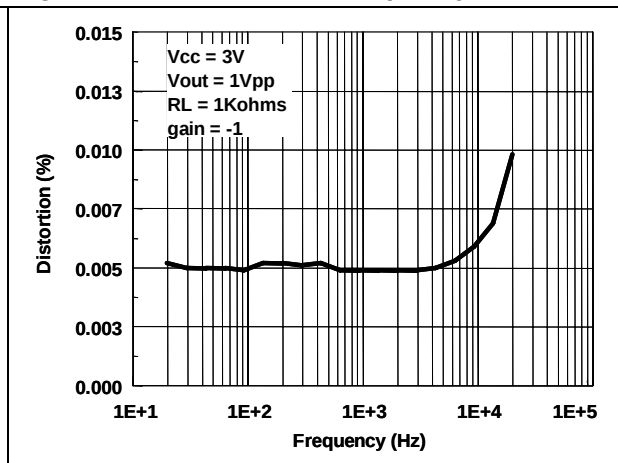


Figure 45. Distortion vs. frequency

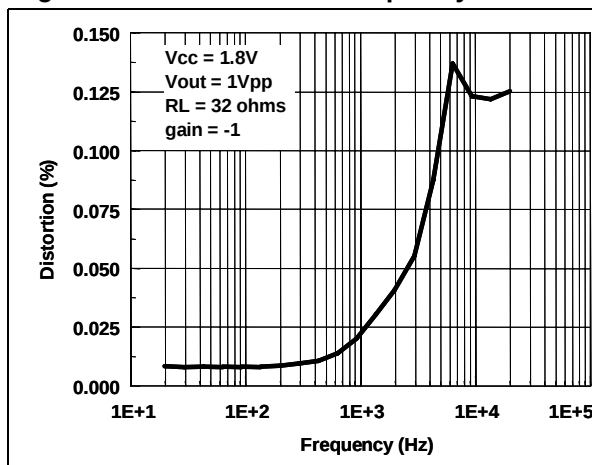


Figure 46. Distortion vs. frequency

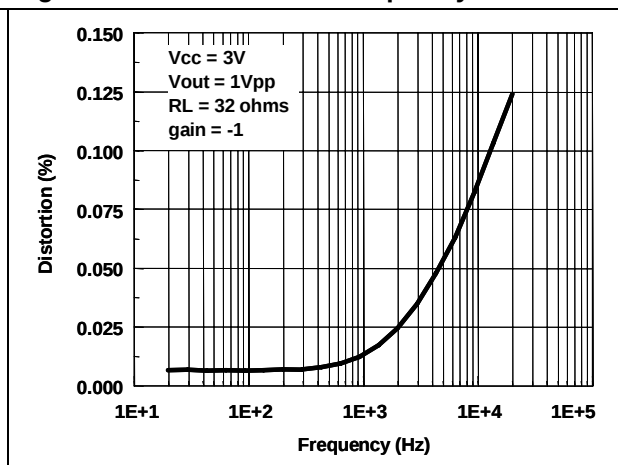
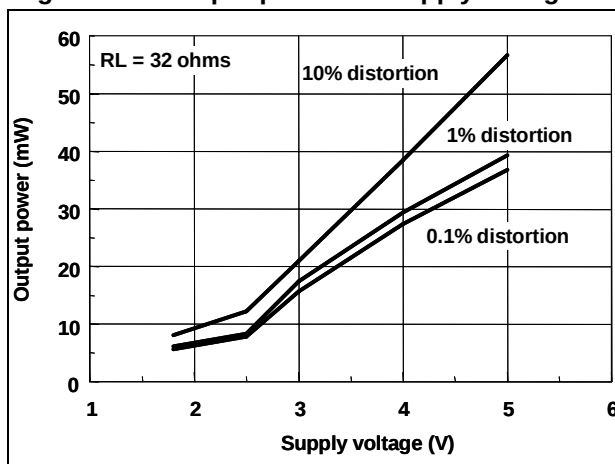


Figure 47. Output power vs. supply voltage



### 3 Package information

In order to meet environmental requirements, STMicroelectronics offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an STMicroelectronics trademark. ECOPACK specifications are available at: [www.st.com](http://www.st.com).

#### 3.1 SOT23-5 package information

Figure 48. SOT23-5 package mechanical drawing

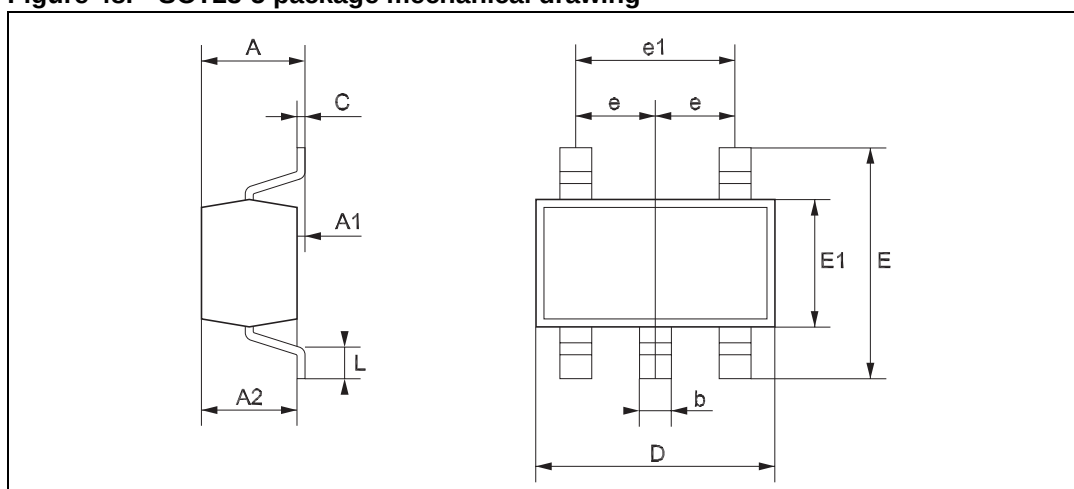


Table 6. SOT23-5 package mechanical data

| Ref. | Dimensions  |      |      |       |      |       |
|------|-------------|------|------|-------|------|-------|
|      | Millimeters |      |      | Mils  |      |       |
|      | Min.        | Typ. | Max. | Min.  | Typ. | Max.  |
| A    | 0.90        |      | 1.45 | 35.4  |      | 57.1  |
| A1   | 0.00        |      | 0.15 | 0.00  |      | 5.9   |
| A2   | 0.90        |      | 1.30 | 35.4  |      | 51.2  |
| b    | 0.35        |      | 0.50 | 13.7  |      | 19.7  |
| C    | 0.09        |      | 0.20 | 3.5   |      | 7.8   |
| D    | 2.80        |      | 3.00 | 110.2 |      | 118.1 |
| E    | 2.60        |      | 3.00 | 102.3 |      | 118.1 |
| E1   | 1.50        |      | 1.75 | 59.0  |      | 68.8  |
| e    |             | 0.95 |      |       | 37.4 |       |
| e1   |             | 1.9  |      |       | 74.8 |       |
| L    | 0.35        |      | 0.55 | 13.7  |      | 21.6  |

## 3.2 DIP8 package information

Figure 49. DIP8 package mechanical drawing

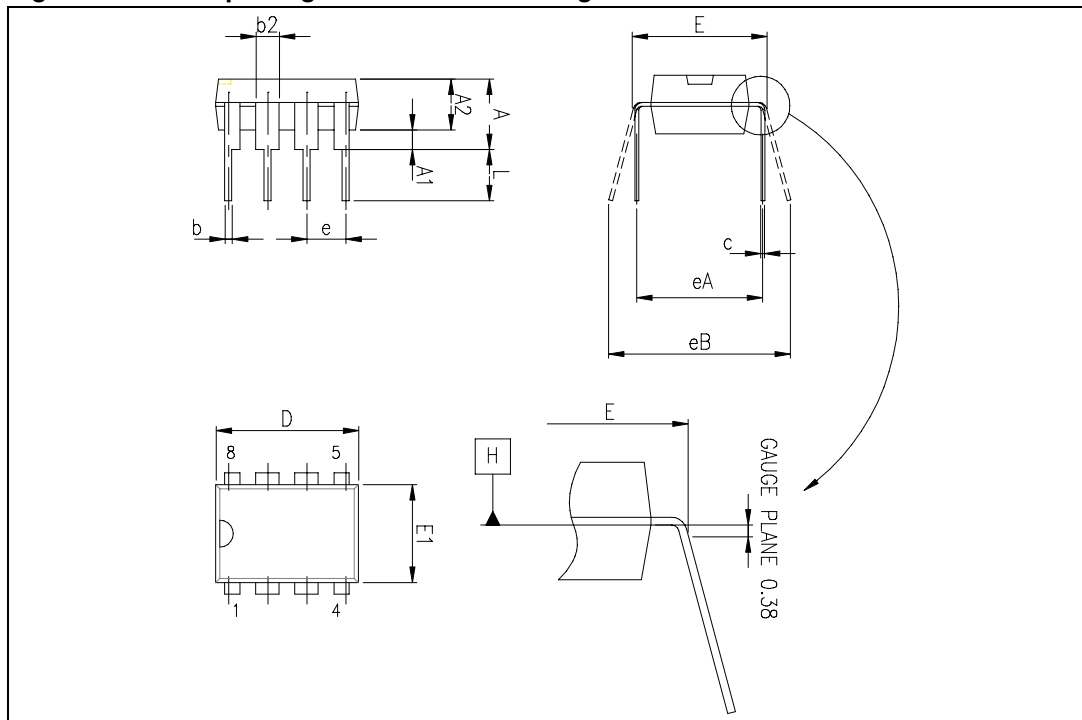


Table 7. DIP8 package mechanical data

| Ref. | Dimensions  |      |       |        |       |       |
|------|-------------|------|-------|--------|-------|-------|
|      | Millimeters |      |       | Inches |       |       |
|      | Min.        | Typ. | Max.  | Min.   | Typ.  | Max.  |
| A    |             |      | 5.33  |        |       | 0.210 |
| A1   | 0.38        |      |       | 0.015  |       |       |
| A2   | 2.92        | 3.30 | 4.95  | 0.115  | 0.130 | 0.195 |
| b    | 0.36        | 0.46 | 0.56  | 0.014  | 0.018 | 0.022 |
| b2   | 1.14        | 1.52 | 1.78  | 0.045  | 0.060 | 0.070 |
| c    | 0.20        | 0.25 | 0.36  | 0.008  | 0.010 | 0.014 |
| D    | 9.02        | 9.27 | 10.16 | 0.355  | 0.365 | 0.400 |
| E    | 7.62        | 7.87 | 8.26  | 0.300  | 0.310 | 0.325 |
| E1   | 6.10        | 6.35 | 7.11  | 0.240  | 0.250 | 0.280 |
| e    |             | 2.54 |       |        | 0.100 |       |
| eA   |             | 7.62 |       |        | 0.300 |       |
| eB   |             |      | 10.92 |        |       | 0.430 |
| L    | 2.92        | 3.30 | 3.81  | 0.115  | 0.130 | 0.150 |

### 3.3 SO-8 package information

Figure 50. SO-8 package mechanical drawing

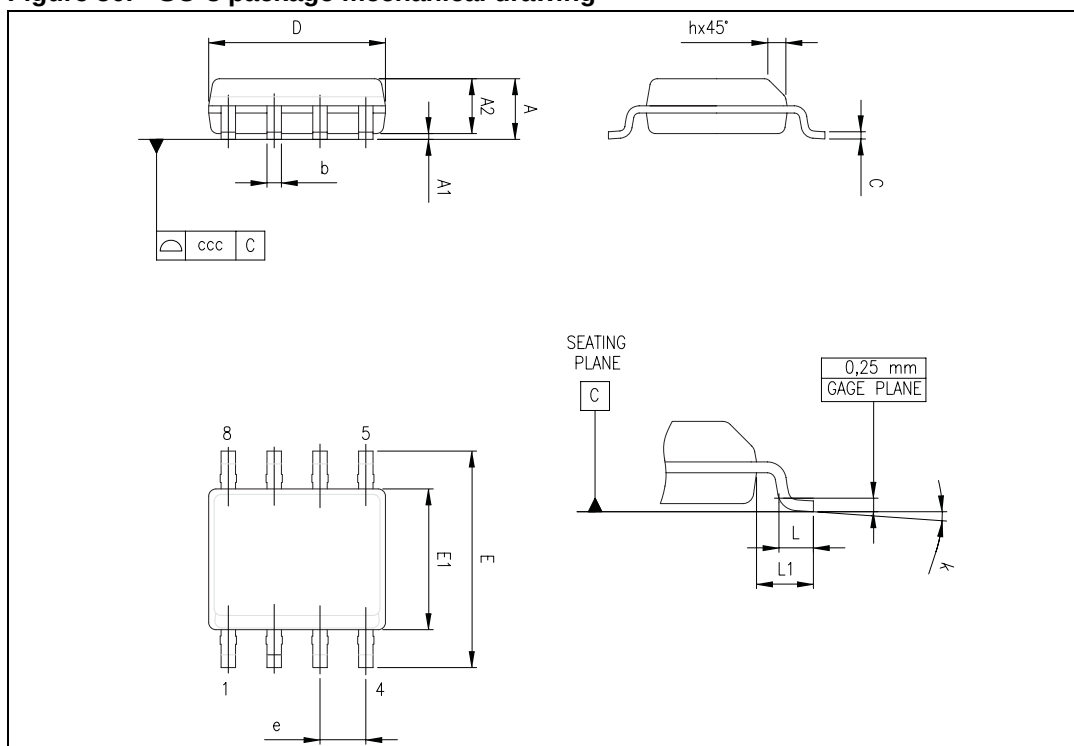


Table 8. SO-8 package mechanical data

| 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 |
| H    | 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 |
| k    | 1°          |      | 8°   | 1°     |       | 8°    |
| ccc  |             |      | 0.10 |        |       | 0.004 |

### 3.4 TSSOP8 package information

Figure 51. TSSOP8 package mechanical drawing

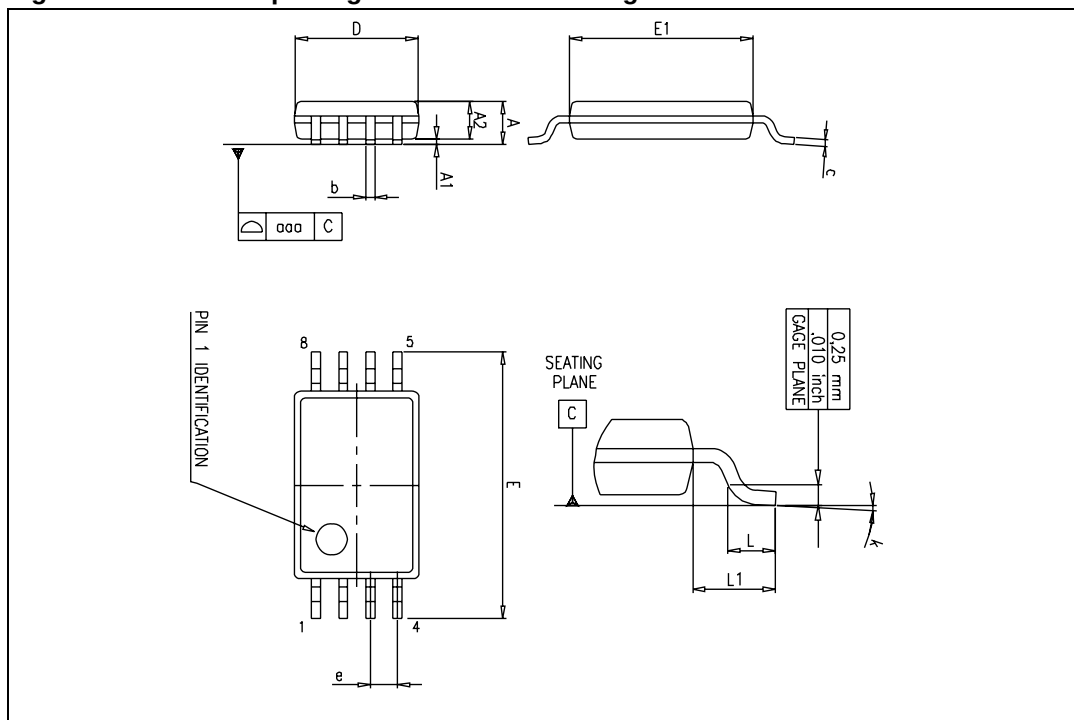


Table 9. TSSOP8 package mechanical data

| 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  |       |

### 3.5 MiniSO-8 package

Figure 52. MiniSO-8 package mechanical drawing

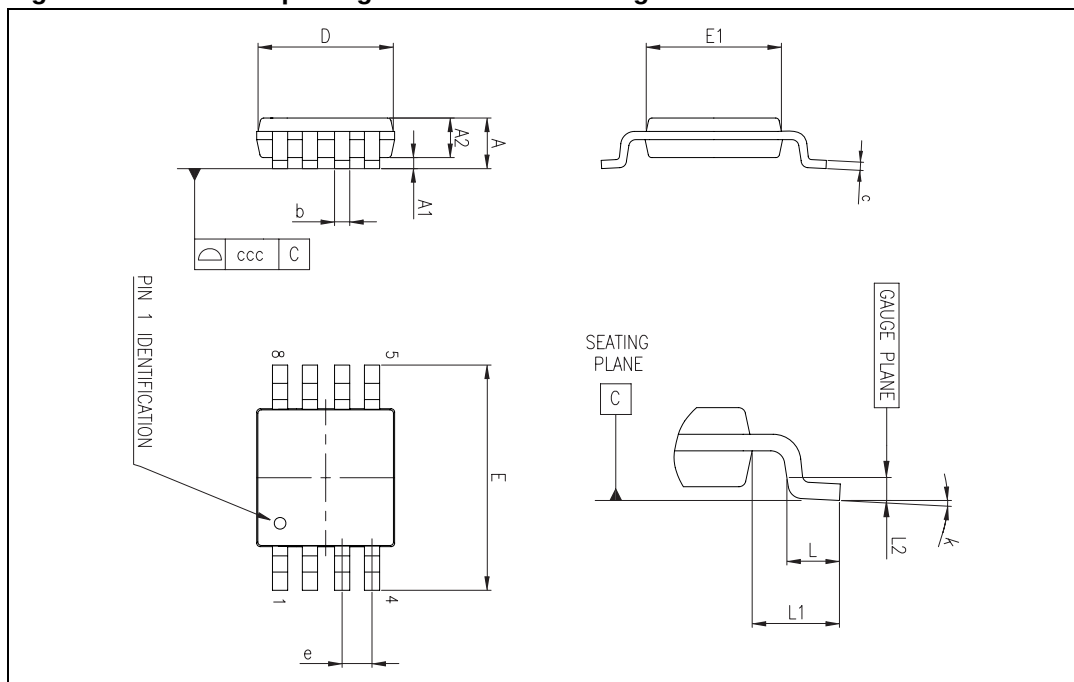


Table 10. MiniSO-8 package mechanical data

| Ref. | Dimensions  |      |      |        |       |       |
|------|-------------|------|------|--------|-------|-------|
|      | Millimeters |      |      | Inches |       |       |
|      | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A    |             |      | 1.1  |        |       | 0.043 |
| A1   | 0           |      | 0.15 | 0      |       | 0.006 |
| A2   | 0.75        | 0.85 | 0.95 | 0.030  | 0.033 | 0.037 |
| b    | 0.22        |      | 0.40 | 0.009  |       | 0.016 |
| c    | 0.08        |      | 0.23 | 0.003  |       | 0.009 |
| D    | 2.80        | 3.00 | 3.20 | 0.11   | 0.118 | 0.126 |
| E    | 4.65        | 4.90 | 5.15 | 0.183  | 0.193 | 0.203 |
| E1   | 2.80        | 3.00 | 3.10 | 0.11   | 0.118 | 0.122 |
| e    |             | 0.65 |      |        | 0.026 |       |
| L    | 0.40        | 0.60 | 0.80 | 0.016  | 0.024 | 0.031 |
| L1   |             | 0.95 |      |        | 0.037 |       |
| L2   |             | 0.25 |      |        | 0.010 |       |
| k    | 0°          |      | 8°   | 0°     |       | 8°    |
| ccc  |             |      | 0.10 |        |       | 0.004 |

### 3.6 DIP14 package information

Figure 53. DIP14 package mechanical drawing

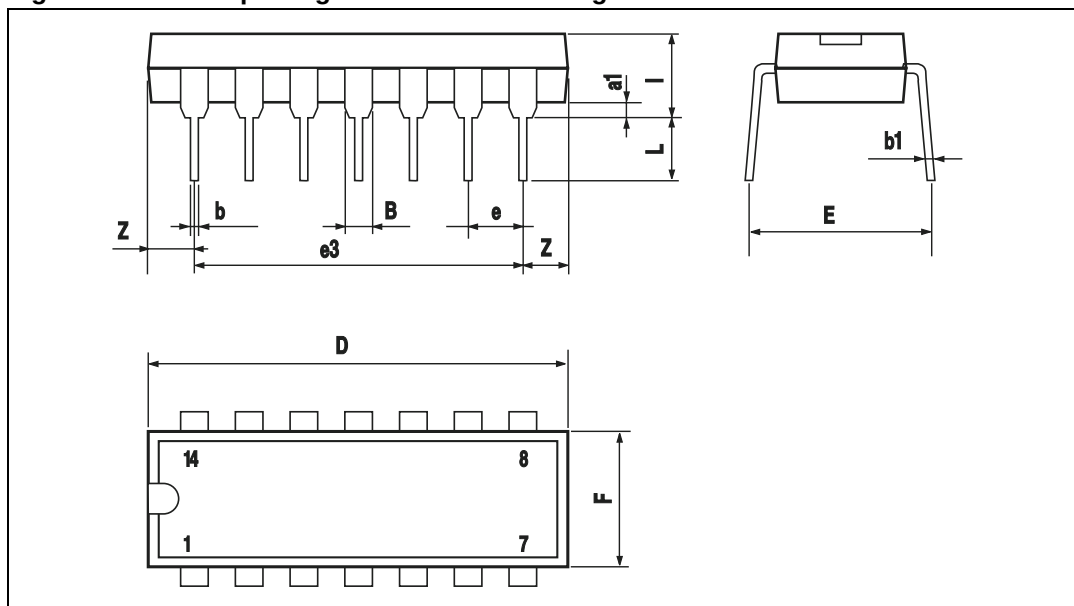


Table 11. DIP14 package mechanical data

| Ref. | Dimensions  |       |      |        |       |       |
|------|-------------|-------|------|--------|-------|-------|
|      | Millimeters |       |      | Inches |       |       |
|      | Min.        | Typ.  | Max. | Min.   | Typ.  | Max.  |
| a1   | 0.51        |       |      | 0.020  |       |       |
| B    | 1.39        |       | 1.65 | 0.055  |       | 0.065 |
| b    |             | 0.5   |      |        | 0.020 |       |
| b1   |             | 0.25  |      |        | 0.010 |       |
| D    |             |       | 20   |        |       | 0.787 |
| E    |             | 8.5   |      |        | 0.335 |       |
| e    |             | 2.54  |      |        | 0.100 |       |
| e3   |             | 15.24 |      |        | 0.600 |       |
| F    |             |       | 7.1  |        |       | 0.280 |
| I    |             |       | 5.1  |        |       | 0.201 |
| L    |             | 3.3   |      |        | 0.130 |       |
| Z    | 1.27        |       | 2.54 | 0.050  |       | 0.100 |

### 3.7 SO-14 package information

Figure 54. SO-14 package mechanical drawing

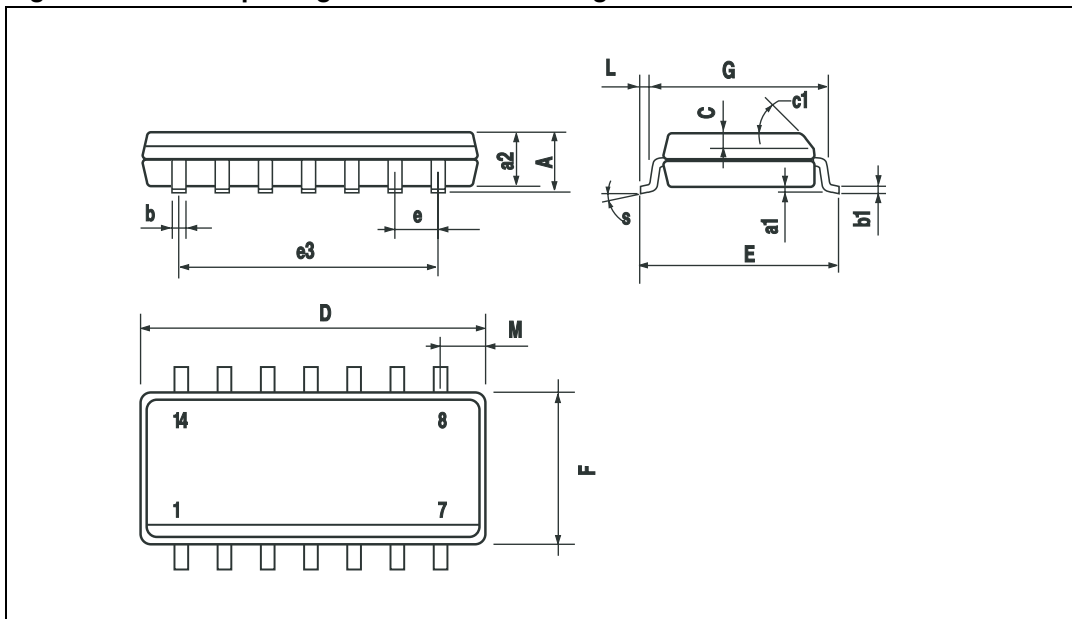


Table 12. SO-14 package mechanical data

| Ref. | Dimensions  |      |      |        |       |       |
|------|-------------|------|------|--------|-------|-------|
|      | Millimeters |      |      | Inches |       |       |
|      | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A    |             |      | 1.75 |        |       | 0.068 |
| a1   | 0.1         |      | 0.2  | 0.003  |       | 0.007 |
| a2   |             |      | 1.65 |        |       | 0.064 |
| b    | 0.35        |      | 0.46 | 0.013  |       | 0.018 |
| b1   | 0.19        |      | 0.25 | 0.007  |       | 0.010 |
| C    |             | 0.5  |      |        | 0.019 |       |
| c1   | 45° (typ.)  |      |      |        |       |       |
| D    | 8.55        |      | 8.75 | 0.336  |       | 0.344 |
| E    | 5.8         |      | 6.2  | 0.228  |       | 0.244 |
| e    |             | 1.27 |      |        | 0.050 |       |
| e3   |             | 7.62 |      |        | 0.300 |       |
| F    | 3.8         |      | 4.0  | 0.149  |       | 0.157 |
| G    | 4.6         |      | 5.3  | 0.181  |       | 0.208 |
| L    | 0.5         |      | 1.27 | 0.019  |       | 0.050 |
| M    |             |      | 0.68 |        |       | 0.026 |
| S    | 8° (max.)   |      |      |        |       |       |

### 3.8 TSSOP14 package information

Figure 55. TSSOP14 package mechanical drawing

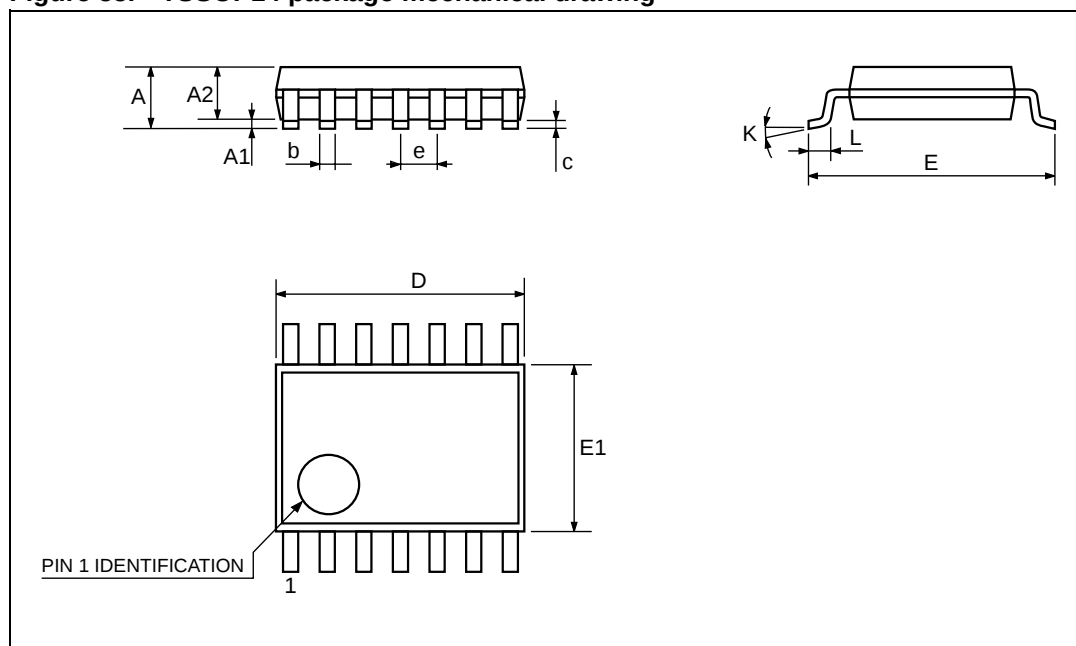


Table 13. TSSOP14 package mechanical data

| Ref. | Dimensions  |          |      |        |            |        |
|------|-------------|----------|------|--------|------------|--------|
|      | Millimeters |          |      | Inches |            |        |
|      | Min.        | Typ.     | Max. | Min.   | Typ.       | Max.   |
| A    |             |          | 1.2  |        |            | 0.047  |
| A1   | 0.05        |          | 0.15 | 0.002  | 0.004      | 0.006  |
| A2   | 0.8         | 1        | 1.05 | 0.031  | 0.039      | 0.041  |
| b    | 0.19        |          | 0.30 | 0.007  |            | 0.012  |
| c    | 0.09        |          | 0.20 | 0.004  |            | 0.0089 |
| D    | 4.9         | 5        | 5.1  | 0.193  | 0.197      | 0.201  |
| E    | 6.2         | 6.4      | 6.6  | 0.244  | 0.252      | 0.260  |
| E1   | 4.3         | 4.4      | 4.48 | 0.169  | 0.173      | 0.176  |
| e    |             | 0.65 BSC |      |        | 0.0256 BSC |        |
| K    | 0°          |          | 8°   | 0°     |            | 8°     |
| L1   | 0.45        | 0.60     | 0.75 | 0.018  | 0.024      | 0.030  |

## 4 Ordering information

Table 14. Order codes

| Order code                                                       | Temperature range | Package                        | Packing                | Marking             |
|------------------------------------------------------------------|-------------------|--------------------------------|------------------------|---------------------|
| TS1871ID/IDT<br>TS1871AID/AIDT                                   | -40°C to +125°C   | SO-8                           | Tube or<br>tape & reel | 1871I<br>1871AI     |
| TS1871IYD/IYDT <sup>(1)</sup><br>TS1871AIYD/AIYDT <sup>(1)</sup> |                   | SO-8<br>(Automotive grade)     | Tube or<br>tape & reel | 1871Y<br>1871AY     |
| TS1871ILT<br>TS1871AILT                                          |                   | SOT23-5L                       | Tape & reel            | K171<br>K172        |
| TS1871IYLT <sup>(1)</sup><br>TS1871AIYLT <sup>(1)</sup>          |                   | SOT23-5L<br>(Automotive grade) | Tape & reel            | K182<br>K183        |
| TS1872IN<br>TS1872AIN                                            |                   | DIP8                           | Tube                   | 1872IN<br>1872AIN   |
| TS1872ID/IDT<br>TS1872AID/AIDT                                   |                   | SO-8                           | Tube or<br>tape & reel | 1872I<br>1872AI     |
| TS1872IYD/IYDT <sup>(1)</sup><br>TS1872AIYD/AIYDT <sup>(1)</sup> |                   | SO-8<br>(Automotive grade)     | Tube or<br>tape & reel | 1872Y<br>1872AY     |
| TS1872IPT<br>TS1872AIPT                                          |                   | TSSOP8                         | Tape & reel            | 1872I<br>1872A      |
| TS1872IYPT <sup>(1)</sup><br>TS1872AIYPT <sup>(1)</sup>          |                   | TSSOP8<br>(Automotive grade)   | Tape & reel            | 1872Y<br>872AY      |
| TS1872IST<br>TS1872AIST                                          |                   | MiniSO-8                       | Tape & reel            | K171<br>K172        |
| TS1874IN<br>TS1874AIN                                            |                   | DIP14                          | Tube<br>Tube           | 1874IN<br>1874AIN   |
| TS1874ID/IDT<br>TS1874AID/AIDT                                   |                   | SO-14                          | Tube or<br>tape & reel | 1874I<br>1874AI     |
| TS1874IYD/IYDT <sup>(1)</sup><br>TS1874AIYD/AIYDT <sup>(1)</sup> |                   | SO-14<br>(Automotive grade)    | Tube or<br>tape & reel | TS1874Y<br>TS1874AY |
| TS1874IPT<br>TS1874AIPT                                          |                   | TSSOP14                        | Tape & reel            | 1874I<br>1874AI     |
| TS1874IYPT <sup>(1)</sup><br>TS1874AIYPT <sup>(1)</sup>          |                   | TSSOP14<br>(Automotive grade)  | Tape & reel            | TS1874Y<br>TS1874AY |

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent are on-going.

## 5 Revision history

**Table 15. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1-Apr-2002  | 1        | First release.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2-Jan-2005  | 2        | Modifications on AMR <a href="#">Table 1 on page 3</a> (explanation of $V_{id}$ and $V_i$ limits).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 21-May-2007 | 3        | <p>Added limits over temperature range in <a href="#">Table 3 on page 5</a>, <a href="#">Table 4 on page 6</a>, <a href="#">Table 5 on page 7</a>.</p> <p>Added SVR in <a href="#">Table 5</a> (SVR parameter removed from <a href="#">Table 3</a> and <a href="#">Table 4</a>).</p> <p>Added equivalent input voltage noise in <a href="#">Table 3</a>, <a href="#">Table 4</a>, and <a href="#">Table 5</a>.</p> <p>Added <math>R_{thjc}</math> values in <a href="#">Table 1</a>.</p> <p>Added automotive grade part numbers to order codes table.</p> <p>Moved order codes table to <a href="#">Section 4 on page 24</a>.</p> <p>Updated format of package information.</p> |
| 17-Jan-2008 | 4        | Updated footnote for automotive grade order codes in <a href="#">Table 14</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

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