

Low power, high accuracy, general-purpose operational amplifier

Datasheet — production data

Features

- Low power consumption: 400 μ A max at 5 V
- Low power shutdown mode: 50 nA max
- Low offset voltage: 0.8 mV max at 25°C
- Tiny packages
- Extended temperature range: -40°C to +125°C
- Low supply voltage: 2.5 V - 5.5 V
- Gain bandwidth product: 5.5 MHz
- Automotive qualification

Benefits

- Longer lifetime in battery-powered applications
- Higher accuracy without calibration
- Smaller form factor than equivalent competitor devices
- Application performances guaranteed over wide temperature range

Related products

- See TSV85x series for lower power consumption (180 μ A max at 5 V)

Applications

- Battery-powered applications
- Portable devices
- Automotive signal conditioning
- Active filtering
- Medical instrumentation

Description

The LMV82x and LMV82xA series of single, dual, and quad operational amplifiers offer low voltage operation with rail-to-rail output swing. They outperform the industry standard LMV321, especially with regard to the gain bandwidth



product (5.5 MHz). The LMV821, LMV822 and LMV824 are offered with standard pinouts.

The LMV820, LMV823, and LMV825 include a power-saving shutdown feature that reduces the supply current to a maximum of 50 nA at 25 °C.

The wide temperature range, high ESD tolerance, and automotive grade qualification make them particularly suitable for use in harsh automotive applications.

Table 1. Device summary

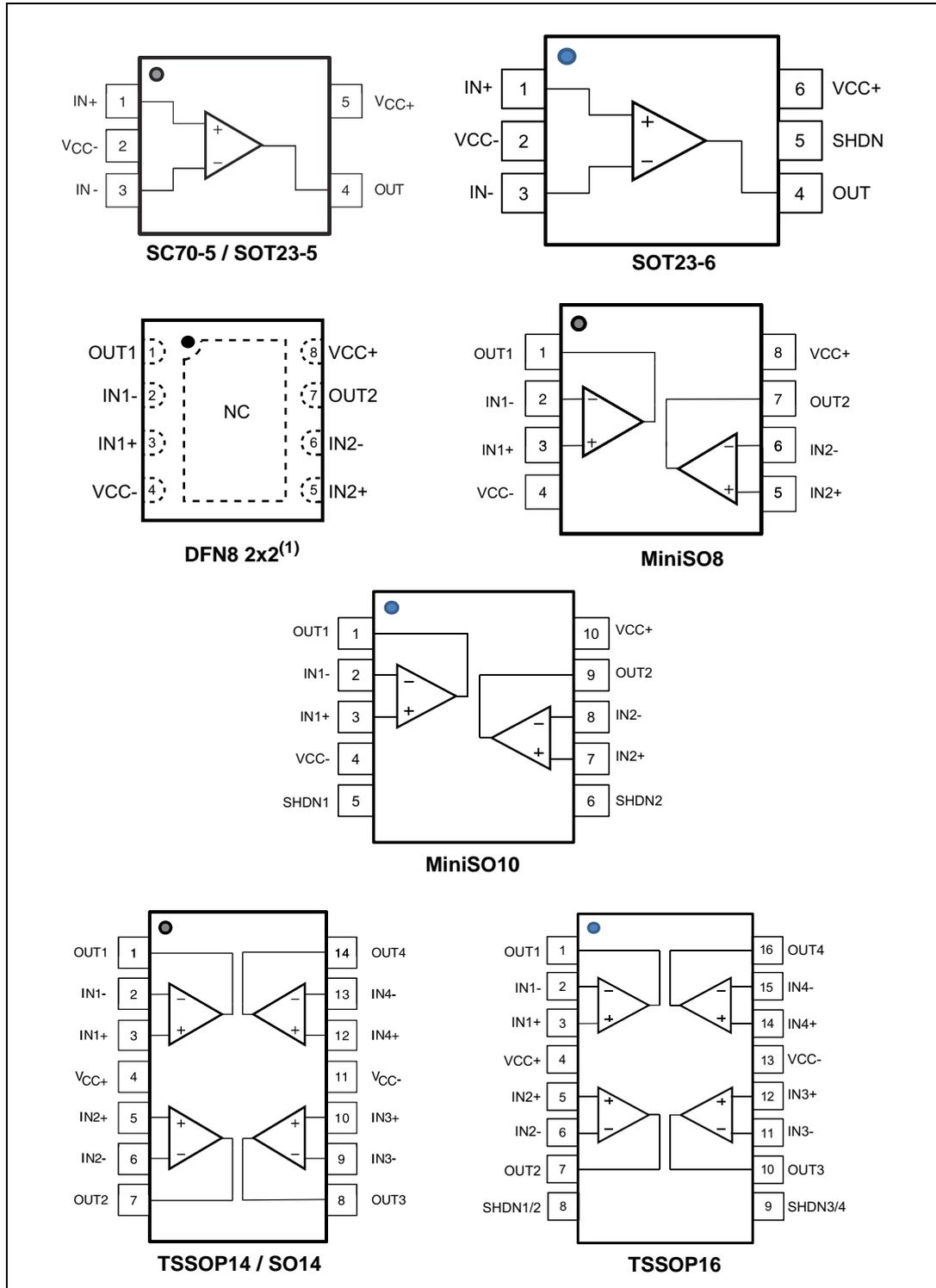
| | Without shutdown | | With shutdown | |
|--------|------------------|--------------|---------------|--------------|
| | Standard Vio | Enhanced Vio | Standard Vio | Enhanced Vio |
| Single | LMV821 | LMV821A | LMV820 | LMV820A |
| Dual | LMV822 | LMV822A | LMV823 | LMV823A |
| Quad | LMV824 | LMV824A | LMV825 | LMV825A |

Contents

| | | |
|----------|--|-----------|
| 1 | Package pin connections | 3 |
| 2 | Absolute maximum ratings and operating conditions | 4 |
| 3 | Electrical characteristics | 6 |
| 4 | Application information | 16 |
| | 4.1 Operating voltages | 16 |
| | 4.2 Input common mode range | 16 |
| | 4.3 Rail-to-rail output | 16 |
| | 4.4 Input offset voltage drift over temperature | 16 |
| | 4.5 PCB layouts | 16 |
| | 4.6 Macromodel | 16 |
| | 4.7 Shutdown function | 17 |
| 5 | Package information | 18 |
| | 5.1 SC70-5 (or SOT323-5) package information | 19 |
| | 5.2 SOT23-5 package information | 20 |
| | 5.3 SOT23-6 package information | 21 |
| | 5.4 DFN8 2 x 2 mm package information | 22 |
| | 5.5 MiniSO-8 package information | 23 |
| | 5.6 MiniSO-10 package information | 24 |
| | 5.7 TSSOP14 package information | 25 |
| | 5.8 TSSOP16 package information | 26 |
| | 5.9 SO-8 package information | 27 |
| | 5.10 SO-14 package information | 28 |
| 6 | Ordering information | 29 |
| 7 | Revision history | 31 |

1 Package pin connections

Figure 1. Pin connections for each package (top view)



1. The exposed pad of DFN8 2x2 can be connected to VCC- or left floating.

2 Absolute maximum ratings and operating conditions

Table 2. Absolute maximum ratings (AMR)

| Symbol | Parameter | Value | Unit |
|------------|--|------------------------------------|------|
| V_{CC} | Supply voltage ⁽¹⁾ | 6 | V |
| V_{id} | Differential input voltage ⁽²⁾ | $\pm V_{CC}$ | |
| V_{in} | Input pins (IN+ and IN- pins) voltage ⁽³⁾ | $V_{CC-} - 0.3$ to $V_{CC+} + 0.3$ | |
| I_{in} | Input current ⁽⁴⁾ | 10 | mA |
| SHDN | Shutdown voltage ⁽⁵⁾ | $V_{CC-} - 0.2$ to $V_{CC+} + 0.2$ | V |
| T_{stg} | Storage temperature | -65 to +150 | °C |
| R_{thja} | Thermal resistance junction to ambient ⁽⁶⁾⁽⁷⁾ | | °C/W |
| | – SC70-5 | 205 | |
| | – SOT23-5 | 250 | |
| | – DFN8 2x2 | 57 | |
| | – MiniSO8 | 190 | |
| | – SO8 | 125 | |
| | – TSSOP14 | 100 | |
| | – SO14 | 105 | |
| | – SOT23-6 | 240 | |
| | – MiniSO10 | 113 | |
| – TSSOP16 | 95 | | |
| T_j | Maximum junction temperature | 150 | °C |
| ESD | HBM: human body model (except shutdown pin) ⁽⁸⁾ | 4 | kV |
| | HBM: human body model (shutdown pin) ⁽⁸⁾ | 3.5 | |
| | MM: machine model ⁽⁹⁾ | 250 | V |
| | CDM: charged device model ⁽¹⁰⁾ | 1.3 | kV |
| | CDM: charged device model LMV825 ⁽¹⁰⁾ | 1 | |
| | Latch-up immunity | 200 | mA |

- All voltage values, except the differential voltage are with respect to the network ground terminal.
- Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
- $V_{CC-} - V_{in}$ must not exceed 6 V, V_{in} must not exceed 6 V.
- The input current must be limited by a resistor in series with the inputs.
- $V_{CC-} - V_{shdn}$ must not exceed 6 V, V_{in} must not exceed 6 V.
- Short-circuits can cause excessive heating and destructive dissipation.
- R_{th} are typical values.
- Human body model: a 100 pF capacitor is discharged through a 1.5 k Ω resistor between two pins of the device. This is done for all couples of pin combinations while other pins are floating.
- Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of pin combinations while other pins are floating.
- Charged device model: all pins and package are charged together to the specified voltage and then discharged directly to ground.

Table 3. Operating conditions

| Symbol | Parameter | Value | Unit |
|------------|--------------------------------------|----------------------------------|------|
| V_{CC} | Supply voltage | 2.5 to 5.5 | V |
| V_{ICM} | Common mode input voltage range | $V_{CC-} - 0.2$ to $V_{CC+} - 1$ | |
| T_{oper} | Operating free air temperature range | -40 to +125 | °C |

3 Electrical characteristics

Table 4. Electrical characteristics at $V_{CC+} = 2.5\text{ V}$ with $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, and R_L connected to $V_{CC}/2$ (unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|--|---|------|------|------|------|
| DC performance | | | | | | |
| V_{io} | Input offset voltage | LMV82xA | | | 0.8 | mV |
| | | LMV82x | | | 3.5 | |
| | | LMV82xA, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 2 | |
| | | LMV82x, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 4 | |
| $V_{CC-V_{OH}}$ | High level output voltage | $R_L = 600\ \Omega$ | | | 220 | |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 320 | |
| | | $R_L = 2\ \text{k}\Omega$ | | | 120 | |
| | | $R_L = 2\ \text{k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 220 | |
| V_{OL} | Low level output voltage | $R_L = 600\ \Omega$ | | | 220 | |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 320 | |
| | | $R_L = 2\ \text{k}\Omega$ | | | 120 | |
| | | $R_L = 2\ \text{k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 200 | |
| I_{out} | $I_{sink} (V_{out} = V_{CC})$ $V_{id} = -1\text{ V}$ | | 5 | | | mA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 5 | | | |
| | $I_{source} (V_{out} = 0\text{ V})$ $V_{id} = 1\text{ V}$ | | 5 | | | |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 5 | | | |

Table 5. Shutdown characteristics $V_{CC} = 2.5\text{ V}$

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|---|---|--------------|------|------|------|
| DC performance | | | | | | |
| I_{CC} | Supply current in shutdown mode (all operators) $\overline{\text{SHDN}} = V_{CC-}$ | $T = 25\text{ }^{\circ}\text{C}$ | | 2.5 | 50 | nA |
| | | $-40\text{ }^{\circ}\text{C} < T < 85\text{ }^{\circ}\text{C}$ | | | 200 | |
| | | $-40\text{ }^{\circ}\text{C} < T < 125\text{ }^{\circ}\text{C}$ | | | | 1.5 |
| t_{on} | Amplifier turn-on time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$, $V_{\text{out}} = V_{CC-}$ to $V_{CC-} + 0.2\text{ V}$ | | 300 | | ns |
| t_{off} | Amplifier turn-off time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$, $V_{\text{out}} = V_{CC+} - 1\text{ V}$ to $V_{CC+} - 1.2\text{ V}$ | | 20 | | |
| V_{IH} | $\overline{\text{SHDN}}$ logic high | | $V_{CC-0.5}$ | | | V |
| V_{IL} | $\overline{\text{SHDN}}$ logic low | | | | 0.5 | |
| I_{IH} | $\overline{\text{SHDN}}$ current high | $\overline{\text{SHDN}} = V_{CC+}$ | | 10 | | pA |
| I_{IL} | $\overline{\text{SHDN}}$ current low | $\overline{\text{SHDN}} = V_{CC-}$ | | 10 | | |
| I_{OLeak} | Output leakage in shutdown mode | $\overline{\text{SHDN}} = V_{CC-}$ | | 50 | | |
| | | $-40\text{ }^{\circ}\text{C} < T < 125\text{ }^{\circ}\text{C}$ | | 1 | | nA |

1. See [Section 4.7: Shutdown function on page 17](#).

Table 6. Electrical characteristics at $V_{CC+} = 2.7\text{ V}$ with $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, and R_L connected to $V_{CC}/2$ (unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------|--|---|------|------|------|-------------------------------|
| DC performance | | | | | | |
| V_{io} | Input offset voltage | LMV82xA | | | 0.8 | mV |
| | | LMV82x | | | 3.5 | |
| | | LMV82xA, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 2 | |
| | | LMV82x, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 4 | |
| $\Delta V_{io}/\Delta T$ | Input offset voltage drift ⁽¹⁾ | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | 1 | | $\mu\text{V}/^\circ\text{ C}$ |
| I_{io} | Input offset current ($V_{out} = V_{CC}/2$) | | | 0.5 | 30 | nA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | 1 | 50 | |
| I_{ib} | Input bias current ($V_{out} = V_{CC}/2$) | | | 60 | 120 | nA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 180 | |
| CMR | Common mode rejection ratio $20 \log (\Delta V_{icm}/\Delta V_{io})$ $V_{ic} = 0\text{ V}$ to $V_{CC}-1\text{ V}$, $V_{out} = V_{CC}/2$ | | 70 | 75 | | dB |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 68 | | | |
| A_{vd} | Large signal voltage gain $V_{out} = 0.5\text{ V}$ to $(V_{CC}-0.5\text{ V})$ | $R_L = 600\ \Omega$ | 90 | 100 | | dB |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 85 | | | |
| | | $R_L = 2\ \text{k}\Omega$ | 95 | 100 | | |
| | | $R_L = 2\ \text{k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 90 | | | |
| $V_{CC}-V_{OH}$ | High level output voltage | $R_L = 600\ \Omega$ | | | 200 | mV |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 300 | |
| | | $R_L = 2\ \text{k}\Omega$ | | | 100 | |
| | | $R_L = 2\ \text{k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 200 | |
| V_{OL} | Low level output voltage | $R_L = 600\ \Omega$ | | | 200 | mV |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 300 | |
| | | $R_L = 2\ \text{k}\Omega$ | | | 120 | |
| | | $R_L = 2\ \text{k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 200 | |
| I_{out} | I_{sink} ($V_{out} = V_{CC}$) $V_{id} = -1\text{ V}$ | | 15 | 26 | | mA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 12 | | | |
| I_{out} | I_{source} ($V_{out} = 0\text{ V}$) $V_{id} = 1\text{ V}$ | | 15 | 21 | | mA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 12 | | | |
| I_{CC} | Supply current (per channel) No load, $V_{out} = V_{CC}/2$ | | | 220 | 300 | μA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 500 | |

Table 6. Electrical characteristics at $V_{CC+} = 2.7\text{ V}$ with $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, and R_L connected to $V_{CC}/2$ (unless otherwise specified) (continued)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|-----------------------------------|---|------|----------|------|--------------------------------------|
| AC performance | | | | | | |
| GBP | Gain bandwidth product | $R_L > 1\text{ M}\Omega$, $C_L = 22\text{ pF}$ | | 5.5 | | MHz |
| F_u | Unity gain frequency | | | 4.5 | | |
| Φ_m | Phase margin | | | 60 | | degrees |
| G_m | Gain margin | | | 10 | | dB |
| SR | Slew rate | $R_L > 1\text{ M}\Omega$, $C_L = 22\text{ pF}$, $V_{out} = 0.5\text{ V to }V_{CC} - 0.5\text{ V}$ | 1.2 | 1.7 | | V/ μs |
| e_n | Equivalent input noise voltage | $f = 1\text{ kHz}$ $f = 10\text{ kHz}$ | | 18 15 | | $\frac{\text{nV}}{\sqrt{\text{Hz}}}$ |
| i_n | Equivalent input noise current | $f = 1\text{ kHz}$ | | 0.30 | | $\frac{\text{pA}}{\sqrt{\text{Hz}}}$ |
| THD+N | Total harmonic distortion + noise | $f_{in} = 1\text{ kHz}$, $A_{CL} = 1$, $R_L = 100\text{ k}\Omega$ $V_{icm} = V_{CC}/2$, $BW = 22\text{ kHz}$, $V_{out} = 3\text{ V}_{pp}$ | | 0.001 | | % |

Table 7. Shutdown characteristics $V_{CC} = 2.7\text{ V}$

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|---|---|-----------------|------|------|------|
| DC performance | | | | | | |
| I_{CC} | Supply current in shutdown mode (all operators) | $\overline{\text{SHDN}} = V_{CC-}$ | | 2.5 | 50 | nA |
| | | $-40^\circ\text{C} < T < 85^\circ\text{C}$ | | | 200 | |
| | | $-40^\circ\text{C} < T < 125^\circ\text{C}$ | | | | 1.5 |
| t_{on} | Amplifier turn-on time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$, $V_{out} = V_{CC-} \text{ to } V_{CC+} + 0.2\text{ V}$ | | 300 | | ns |
| t_{off} | Amplifier turn-off time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$, $V_{out} = V_{CC+} - 1\text{ V to }V_{CC+} - 1.2\text{ V}$ | | 20 | | |
| V_{IH} | $\overline{\text{SHDN}}$ logic high | | $V_{CC-} - 0.5$ | | | V |
| V_{IL} | $\overline{\text{SHDN}}$ logic low | | | | 0.5 | |
| I_{IH} | $\overline{\text{SHDN}}$ current high | $\overline{\text{SHDN}} = V_{CC+}$ | | 10 | | pA |
| I_{IL} | $\overline{\text{SHDN}}$ current low | $\overline{\text{SHDN}} = V_{CC-}$ | | 10 | | |
| I_{OLeak} | Output leakage in shutdown mode | $\overline{\text{SHDN}} = V_{CC-}$ | | 50 | | |
| | | $-40^\circ\text{C} < T < 125^\circ\text{C}$ | | 1 | | nA |

1. See [Section 4.7: Shutdown function on page 17](#).

Table 8. Electrical characteristics at $V_{CC+} = 5\text{ V}$ with $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC}/2$, $T_{amb} = 25^\circ\text{ C}$, and R_L connected to $V_{CC}/2$ (unless otherwise specified)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--------------------------|---|--|------|------|------|-------------------------------|
| DC performance | | | | | | |
| V_{io} | Input offset voltage | LMV82xA | | | 0.8 | mV |
| | | LMV82x | | | 3.5 | |
| | | LMV82xA, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 2 | |
| | | LMV82x, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 4 | |
| $\Delta V_{io}/\Delta T$ | Input offset voltage drift ⁽¹⁾ | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | 1 | | $\mu\text{V}/^\circ\text{ C}$ |
| I_{io} | Input offset current ($V_{out} = V_{CC}/2$) | | | 0.5 | 30 | nA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | 1 | 50 | |
| I_{ib} | Input bias current ($V_{out} = V_{CC}/2$) | | | 60 | 120 | nA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 180 | |
| CMR | Common mode rejection ratio 20 $\log(\Delta V_{icm}/\Delta V_{io})$ $V_{ic} = 0\text{ V}$ to $V_{CC}-1\text{ V}$, $V_{out} = V_{CC}/2$ | | 72 | 90 | | dB |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 70 | | | |
| SVR | Supply voltage rejection ratio 20 $\log(\Delta V_{CC}/\Delta V_{io})$ | $V_{CC} = 2.5$ to 5 V | | | | dB |
| | | | 70 | 75 | | |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 65 | | | |
| A_{vd} | Large signal voltage gain $V_{out} = 0.5\text{ V}$ to $(V_{CC}-0.5\text{ V})$ | $R_L = 600\ \Omega$ | 95 | 100 | | dB |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 90 | | | |
| | | $R_L = 2\text{ k}\Omega$ | 95 | 100 | | |
| | | $R_L = 2\text{ k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 90 | | | |
| $V_{CC}-V_{OH}$ | High level output voltage | $R_L = 600\ \Omega$ | | | 250 | mV |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 400 | |
| | | $R_L = 2\text{ k}\Omega$ | | | 150 | |
| | | $R_L = 2\text{ k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 200 | |
| V_{OL} | Low level output voltage | $R_L = 600\ \Omega$ | | | 250 | mV |
| | | $R_L = 600\ \Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 300 | |
| | | $R_L = 2\text{ k}\Omega$ | | | 150 | |
| | | $R_L = 2\text{ k}\Omega$, $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 200 | |
| I_{out} | I_{sink} ($V_{out} = V_{CC}$) $V_{id} = -1\text{ V}$ | | 35 | 43 | | mA |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 25 | | | |
| | I_{source} ($V_{out} = 0\text{ V}$) $V_{id} = 1\text{ V}$ | | 60 | 70 | | |
| | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | 50 | | | | |
| I_{CC} | Supply current (per channel) No load, $V_{out} = V_{CC}/2$ | | | 300 | 400 | $\mu\text{ A}$ |
| | | $-40^\circ\text{ C} < T < 125^\circ\text{ C}$ | | | 600 | |

Table 8. Electrical characteristics at $V_{CC+} = 5\text{ V}$ with $V_{CC-} = 0\text{ V}$, $V_{icm} = V_{CC-}/2$, $T_{amb} = 25^\circ\text{ C}$, and R_L connected to $V_{CC-}/2$ (unless otherwise specified) (continued)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|-----------------------------------|--|------|----------|------|------------------------|
| AC performance | | | | | | |
| GBP | Gain bandwidth product | $R_L > 1\text{ M}\Omega$, $C_L = 22\text{ pF}$ | | 5.5 | | MHz |
| F_u | Unity gain frequency | | | 4.5 | | |
| Φ_m | Phase margin | | | 60 | | degrees |
| G_m | Gain margin | | | 10 | | dB |
| SR | Slew rate | $R_L > 1\text{ M}\Omega$, $C_L = 22\text{ pF}$, $V_{out} = 0.5\text{ V}$ to $V_{CC-} - 0.5\text{ V}$ | 1.4 | 1.9 | | V/ μ s |
| e_n | Equivalent input noise voltage | $f = 1\text{ kHz}$ $f = 10\text{ kHz}$ | | 16 13 | | $\frac{nV}{\sqrt{Hz}}$ |
| i_n | Equivalent input noise current | $f = 1\text{ kHz}$ | | 0.30 | | $\frac{pA}{\sqrt{Hz}}$ |
| THD+N | Total harmonic distortion + noise | $f_{in} = 1\text{ kHz}$, $A_{CL} = 1$, $R_L = 100\text{ k}\Omega$, $V_{icm} = V_{CC-}/2$, $BW = 22\text{ kHz}$, $V_{out} = 3\text{ Vpp}$ | | 0.001 | | % |

1. See [Section 4.4: Input offset voltage drift over temperature](#).

Table 9. Shutdown characteristics $V_{CC} = 5\text{ V}$

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|---|--|------------------|------|------|------|
| DC performance | | | | | | |
| I_{CC} | Supply current in shutdown mode (all operators) SHDN = V_{CC-} | $T = 25^\circ\text{C}$ | | 2.5 | 50 | nA |
| | | $-40^\circ\text{C} < T < 85^\circ\text{C}$ | | | 200 | |
| | | $-40^\circ\text{C} < T < 125^\circ\text{C}$ | | | | 1.5 |
| t_{on} | Amplifier turn-on time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$, $V_{out} = V_{CC-}$ to $V_{CC+} + 0.2\text{ V}$ | | 300 | | ns |
| t_{off} | Amplifier turn-off time ⁽¹⁾ | $R_L = 2\text{ k}\Omega$, $V_{out} = V_{CC+} - 1\text{ V}$ to $V_{CC+} - 1.2\text{ V}$ | | 20 | | |
| V_{IH} | $\overline{\text{SHDN}}$ logic high | | V_{CC-} 0.5 | | | V |
| V_{IL} | $\overline{\text{SHDN}}$ logic low | | | | 0.5 | |
| I_{IH} | $\overline{\text{SHDN}}$ current high | $\overline{\text{SHDN}} = V_{CC+}$ | | 10 | | pA |
| I_{IL} | $\overline{\text{SHDN}}$ current low | $\overline{\text{SHDN}} = V_{CC-}$ | | 10 | | |
| I_{OLeak} | Output leakage in shutdown mode | $\overline{\text{SHDN}} = V_{CC-}$ | | 50 | | |
| | | $-40^\circ\text{C} < T < 125^\circ\text{C}$ | | 1 | | nA |

1. See [Section 4.7: Shutdown function on page 17](#).

Figure 2. Supply current vs. supply voltage at $V_{icm} = V_{CC}/2$

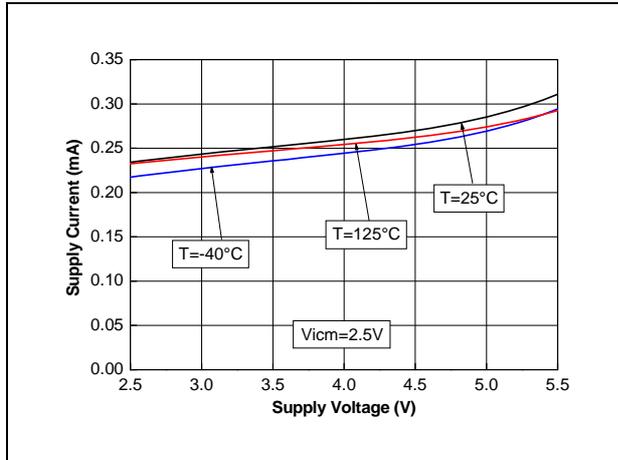


Figure 3. Supply current vs. V_{icm} at $V_{CC} = 5V$

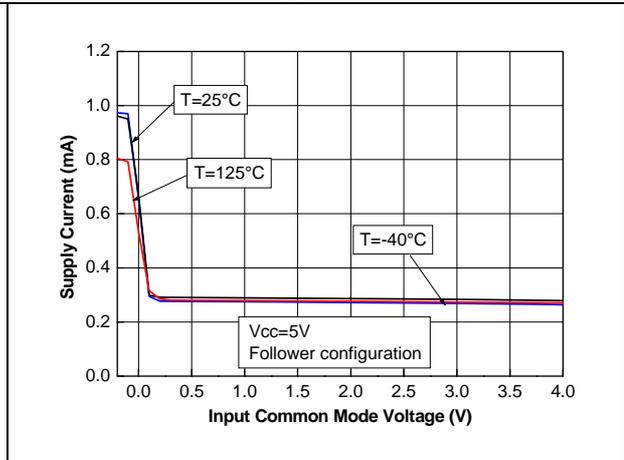


Figure 4. V_{io} distribution at $V_{CC} = 5V$

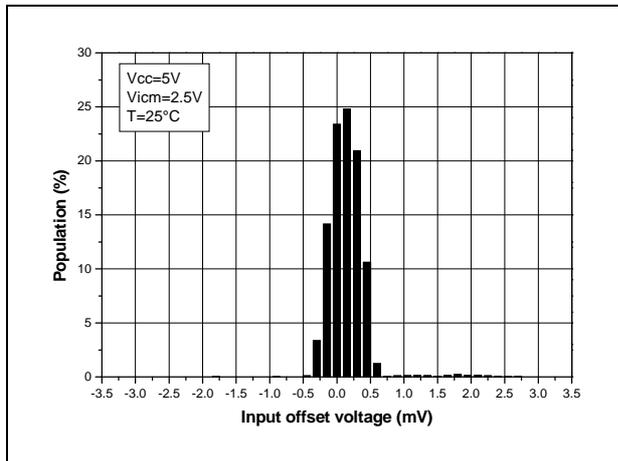


Figure 5. Input offset voltage vs. input common mode voltage at $V_{CC} = 5V$

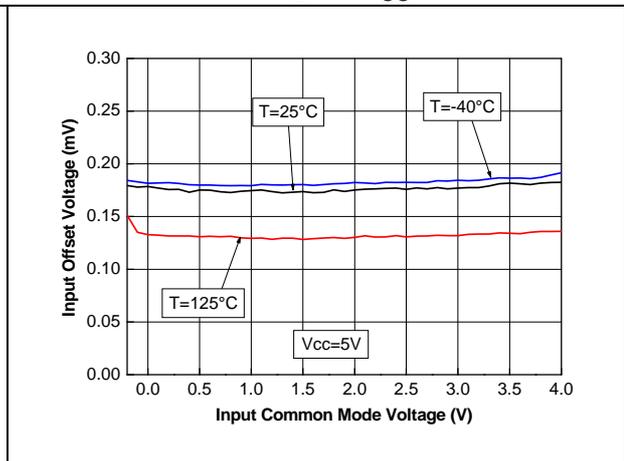


Figure 6. Output current vs. output voltage at $V_{CC} = 2.7V$

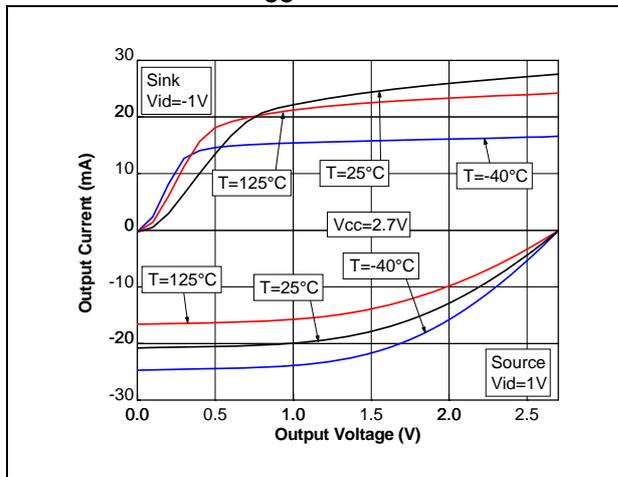


Figure 7. Output current vs. output voltage at $V_{CC} = 5V$

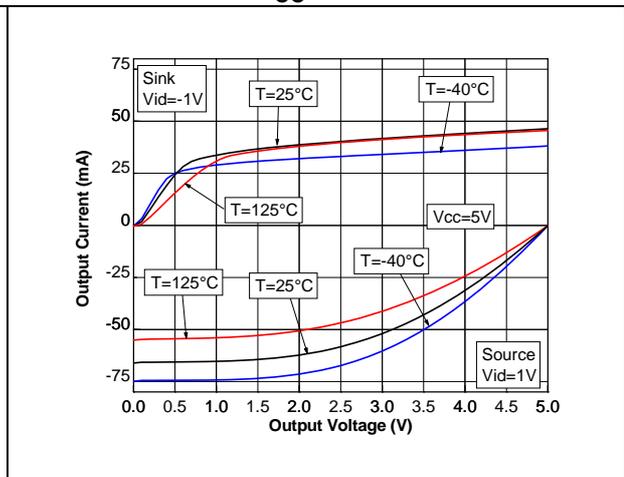


Figure 8. Output current vs. supply voltage at $V_{icm} = V_{CC}/2$

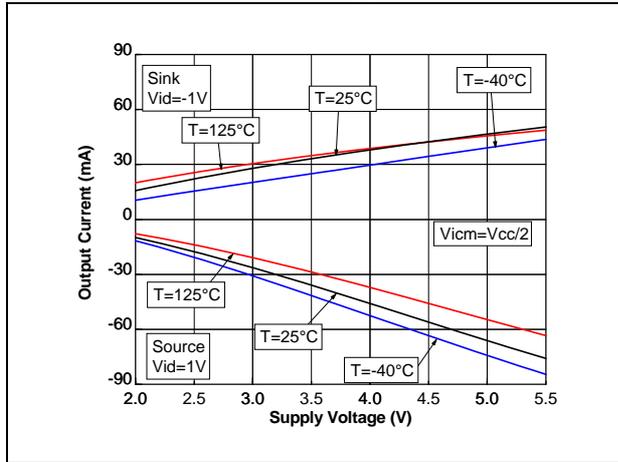


Figure 9. Voltage gain and phase with $C_L = 40 \text{ pF}$

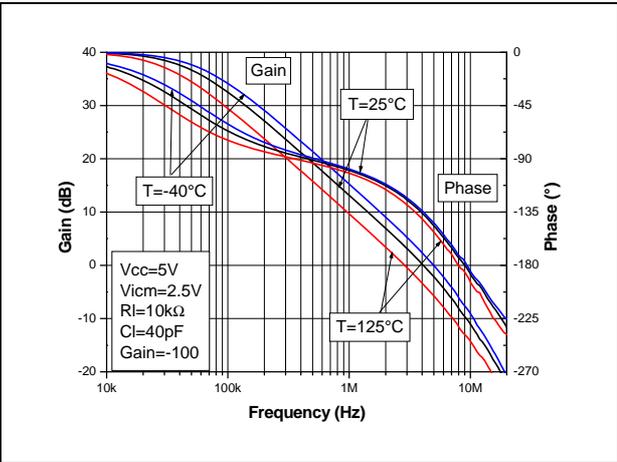


Figure 10. Voltage gain and phase with $C_L = 100 \text{ pF}$

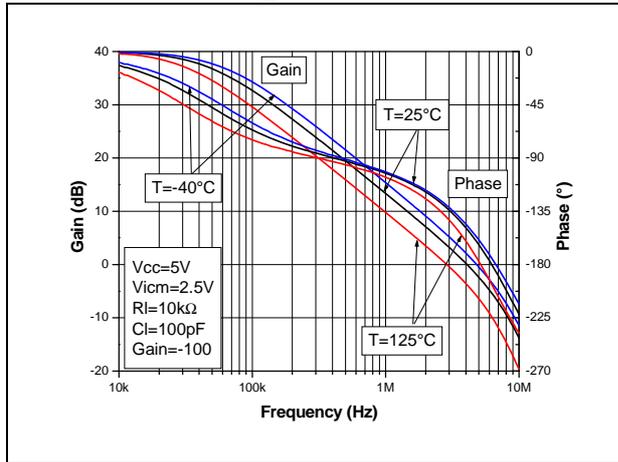


Figure 11. Voltage gain and phase with $C_L = 200 \text{ pF}$

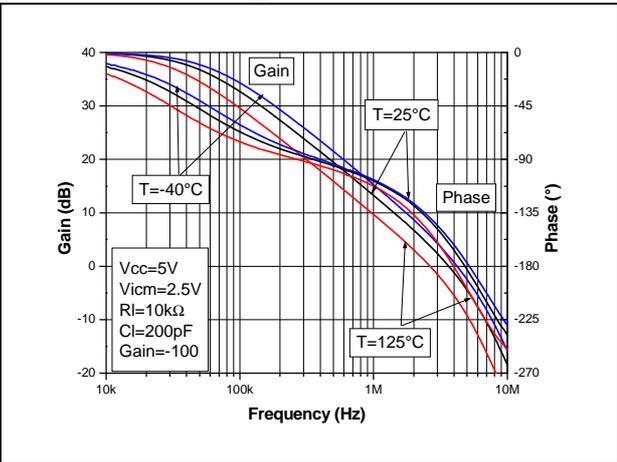


Figure 12. Phase margin vs. output current at $V_{CC} = 5 \text{ V}$

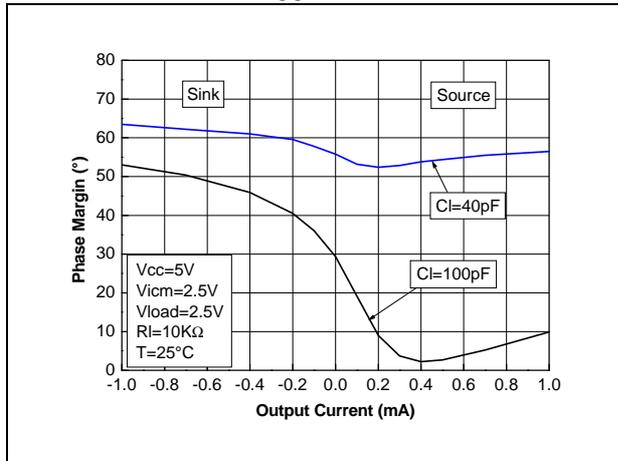


Figure 13. Stability in follower configuration

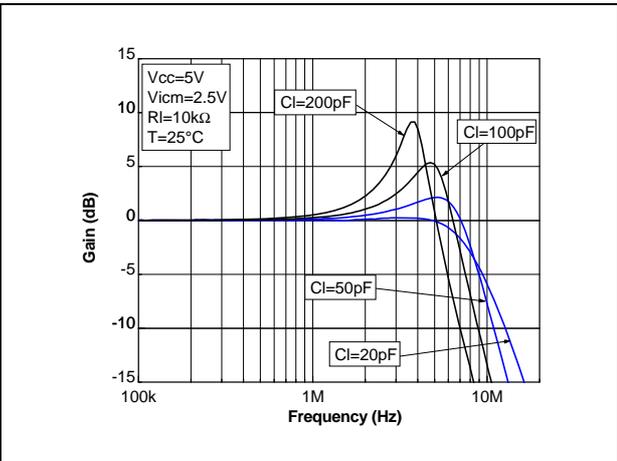


Figure 14. Positive and negative slew rate vs. supply voltage

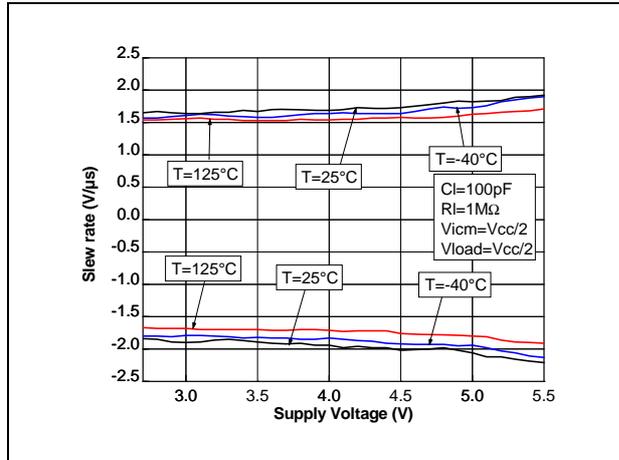


Figure 15. Positive slew rate at V_{CC} = 5 V with C_L = 100 pF

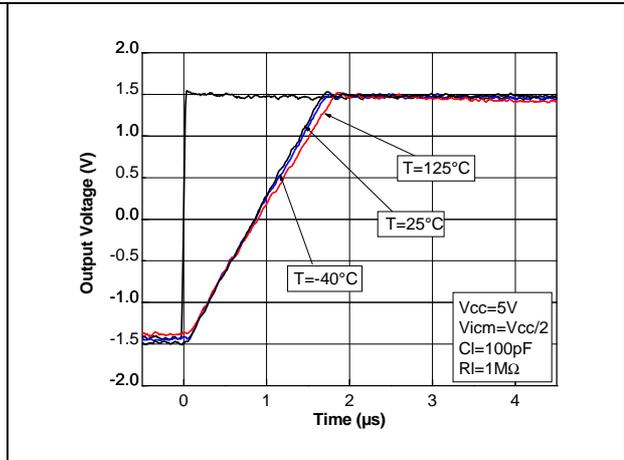


Figure 16. Negative slew rate at V_{CC} = 5 V with C_L = 100 pF

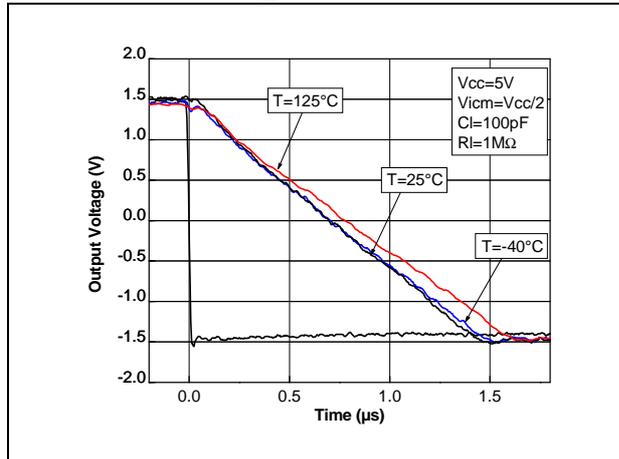


Figure 17. Noise vs. frequency at V_{CC} = 5 V

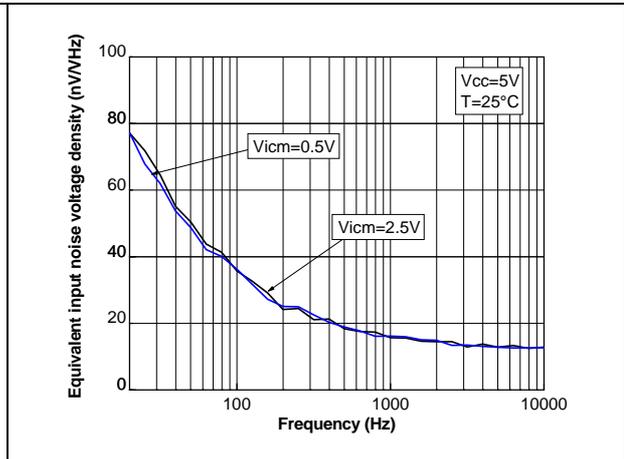


Figure 18. 0.1 Hz to 10 Hz noise at V_{CC} = 5 V

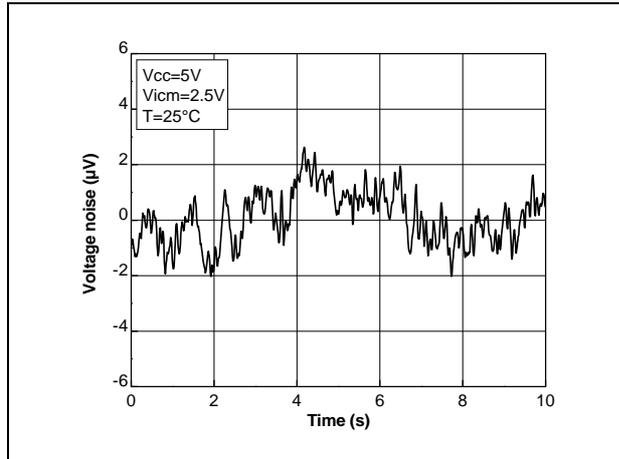


Figure 19. Distortion + noise vs. frequency

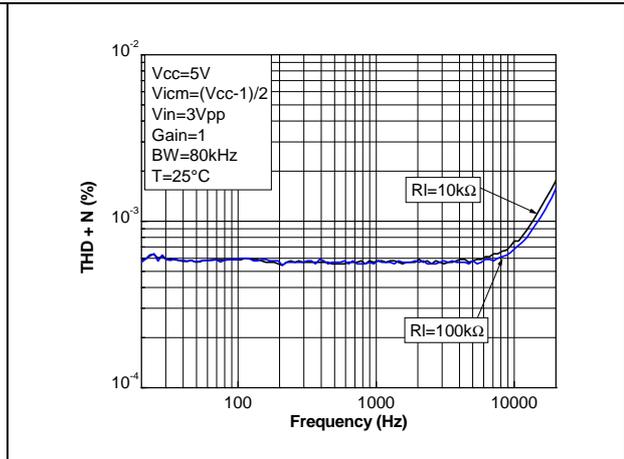
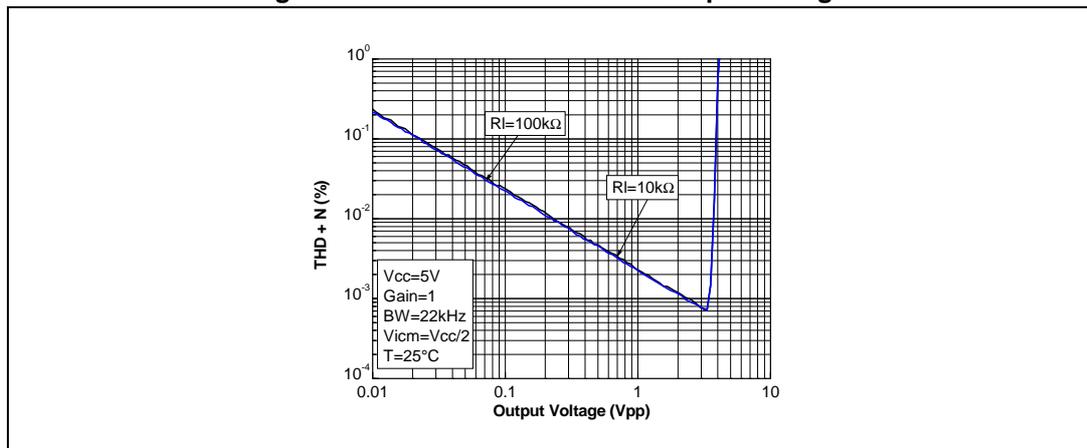


Figure 20. Distortion + noise vs. output voltage



4 Application information

4.1 Operating voltages

The LMV82x and LMV82xA can operate from 2.5 to 5.5 V. The devices' parameters are fully specified for 2.5, 2.7, and 5 V power supplies. Additionally, the main specifications are guaranteed at extended temperature ranges from -40° C to +125° C.

4.2 Input common mode range

The LMV82x and LMV82xA devices have an input common mode range that includes ground. The input common mode range is extended from $V_{CC-} - 0.2$ V to $V_{CC+} - 1$ V, with no output phase reversal.

4.3 Rail-to-rail output

The operational amplifiers' output levels can go close to the rails: 150 mV maximum above and below the rail when connected to a 2 k Ω resistive load to $V_{CC}/2$.

4.4 Input offset voltage drift over temperature

The maximum input voltage drift over temperature variation is defined in [Equation 1](#).

Equation 1

$$\frac{\Delta V_{io}}{\Delta T} = \max \left| \frac{V_{io}(T) - V_{io}(25^{\circ}\text{C})}{T - 25^{\circ}\text{C}} \right|$$

for $T_{\min} < T < T_{\max}$.

4.5 PCB layouts

For correct operation, it is advised to add 10 nF decoupling capacitors as close as possible to the power supply pins.

4.6 Macromodel

Accurate macromodels of the LMV82x and LMV82xA are available on STMicroelectronics' web site at www.st.com. These models are a trade-off between accuracy and complexity (that is, time simulation) of the LMV82x and LMV82xA operational amplifiers. They emulate the nominal performances of a typical device within the specified operating conditions mentioned in the datasheet. They also help to validate a design approach and to select the right operational amplifier, *but they do not replace on-board measurements*.

4.7 Shutdown function

The operational amplifier is enabled when the $\overline{\text{SHDN}}$ pin is pulled high. To disable the amplifier, the SHDN pin must be pulled down to V_{CC-} . When in shutdown mode, the amplifier output is in a high impedance state. The SHDN pin must never be left floating but tied to V_{CC+} or V_{CC-} .

The turn-on and turn-off times are calculated for an output variation of ± 200 mV. *Figure 21* and *Figure 22* show the test configurations. *Figure 23* and *Figure 24* show the respective results with these test configurations.

Figure 21. Test configuration for turn-on time (Vout pulled down)

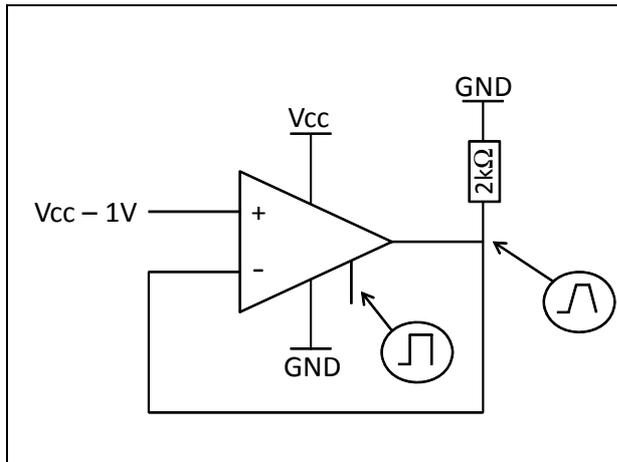


Figure 22. Test configuration for turn-off time (Vout pulled down)

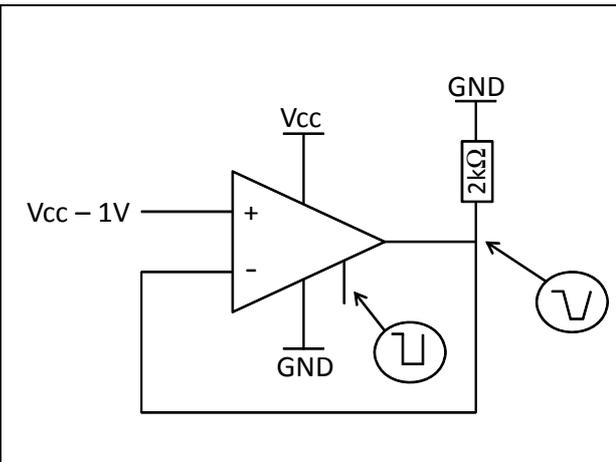


Figure 23. Turn-on time, $V_{CC} = 5$ V, V_{out} pulled down, $T = 25^\circ\text{C}$

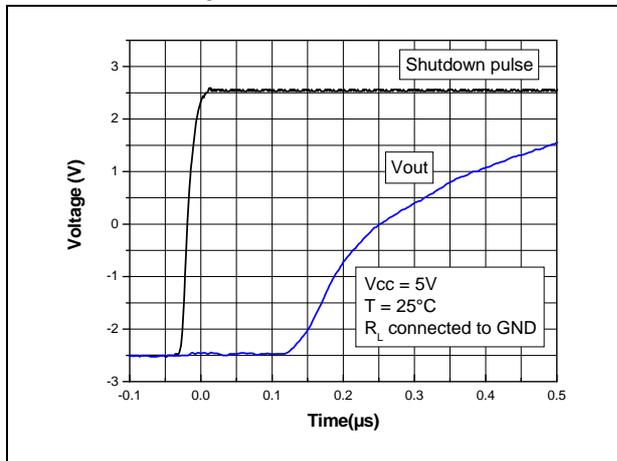
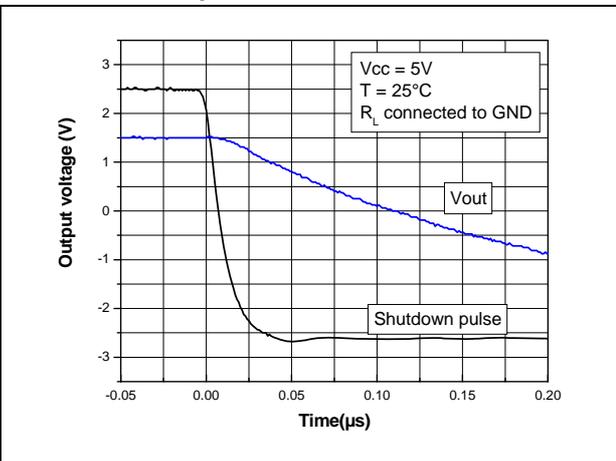


Figure 24. Turn-off time, $V_{CC} = 5$ V, V_{out} pulled down, $T = 25^\circ\text{C}$



5 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. ECOPACK[®] is an ST trademark.

5.1 SC70-5 (or SOT323-5) package information

Figure 25. SC70-5 (or SOT323-5) package mechanical drawing

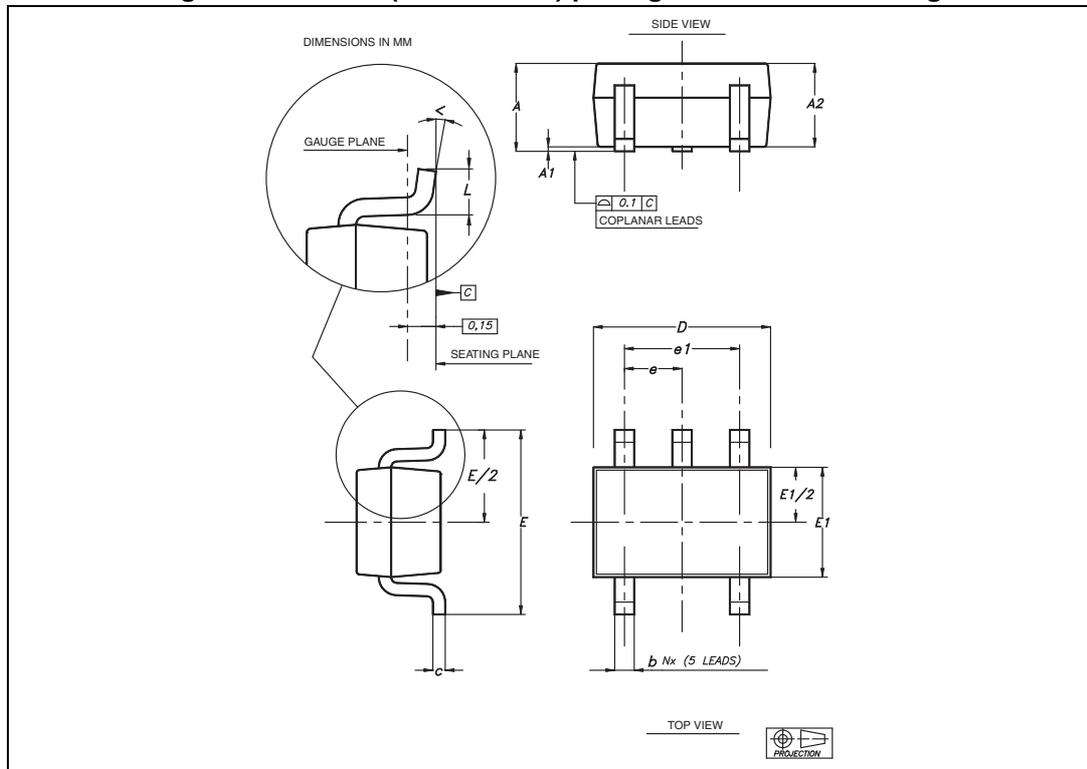


Table 10. SC70-5 (or SOT323-5) package mechanical data

| Ref | Dimensions | | | | | |
|----------|-------------|------|-----------|-----------|-------|-----------|
| | Millimeters | | | Inches | | |
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.80 | | 1.10 | 0.032 | | 0.043 |
| A1 | | | 0.10 | | | 0.004 |
| A2 | 0.80 | 0.90 | 1.00 | 0.032 | 0.035 | 0.039 |
| b | 0.15 | | 0.30 | 0.006 | | 0.012 |
| c | 0.10 | | 0.22 | 0.004 | | 0.009 |
| D | 1.80 | 2.00 | 2.20 | 0.071 | 0.079 | 0.087 |
| E | 1.80 | 2.10 | 2.40 | 0.071 | 0.083 | 0.094 |
| E1 | 1.15 | 1.25 | 1.35 | 0.045 | 0.049 | 0.053 |
| e | | 0.65 | | | 0.025 | |
| e1 | | 1.30 | | | 0.051 | |
| L | 0.26 | 0.36 | 0.46 | 0.010 | 0.014 | 0.018 |
| α | 0° | | 8° | 0° | | 8° |

5.2 SOT23-5 package information

Figure 26. SOT23-5 package mechanical drawing

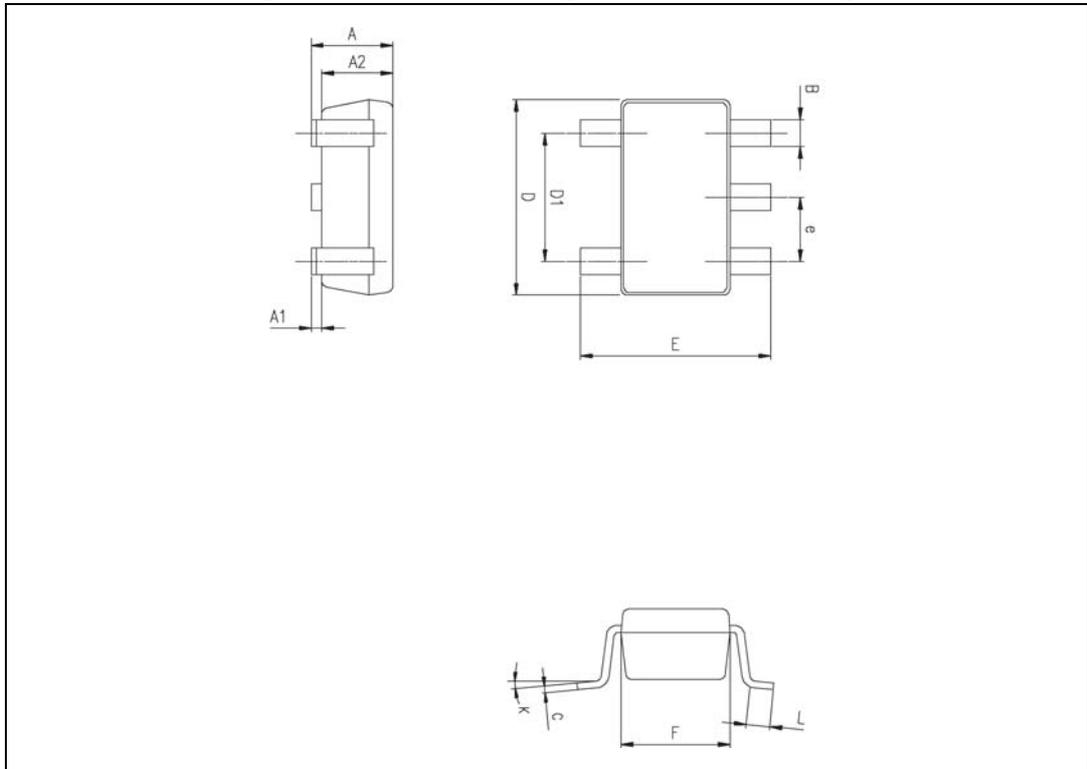


Table 11. SOT23-5 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.90 | 1.20 | 1.45 | 0.035 | 0.047 | 0.057 |
| A1 | | | 0.15 | | | 0.006 |
| A2 | 0.90 | 1.05 | 1.30 | 0.035 | 0.041 | 0.051 |
| B | 0.35 | 0.40 | 0.50 | 0.013 | 0.015 | 0.019 |
| C | 0.09 | 0.15 | 0.20 | 0.003 | 0.006 | 0.008 |
| D | 2.80 | 2.90 | 3.00 | 0.110 | 0.114 | 0.118 |
| D1 | | 1.90 | | | 0.075 | |
| e | | 0.95 | | | 0.037 | |
| E | 2.60 | 2.80 | 3.00 | 0.102 | 0.110 | 0.118 |
| F | 1.50 | 1.60 | 1.75 | 0.059 | 0.063 | 0.069 |
| L | 0.10 | 0.35 | 0.60 | 0.004 | 0.013 | 0.023 |
| K | 0 ° | | 10 ° | 0 ° | | 10 ° |

5.3 SOT23-6 package information

Figure 27. SOT23-6 package mechanical drawing

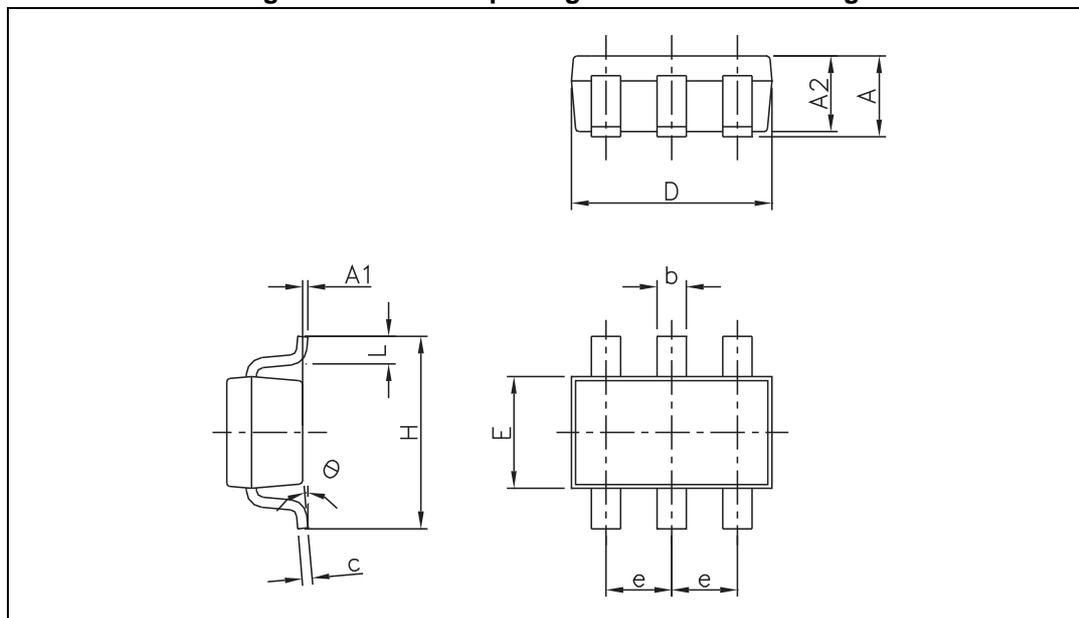


Table 12. SOT23-6 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.90 | | 1.45 | 0.035 | | 0.057 |
| A1 | | | 0.10 | | | 0.004 |
| A2 | 0.90 | | 1.30 | 0.035 | | 0.051 |
| b | 0.35 | | 0.50 | 0.013 | | 0.019 |
| c | 0.09 | | 0.20 | 0.003 | | 0.008 |
| D | 2.80 | | 3.05 | 0.110 | | 0.120 |
| E | 1.50 | | 1.75 | 0.060 | | 0.069 |
| e | | 0.95 | | | 0.037 | |
| H | 2.60 | | 3.00 | 0.102 | | 0.118 |
| L | 0.10 | | 0.60 | 0.004 | | 0.024 |
| θ | 0° | | 10° | 0° | | 10° |

5.4 DFN8 2 x 2 mm package information

Figure 28. DFN8 2 x 2 mm package mechanical drawing (pitch 0.5 mm)

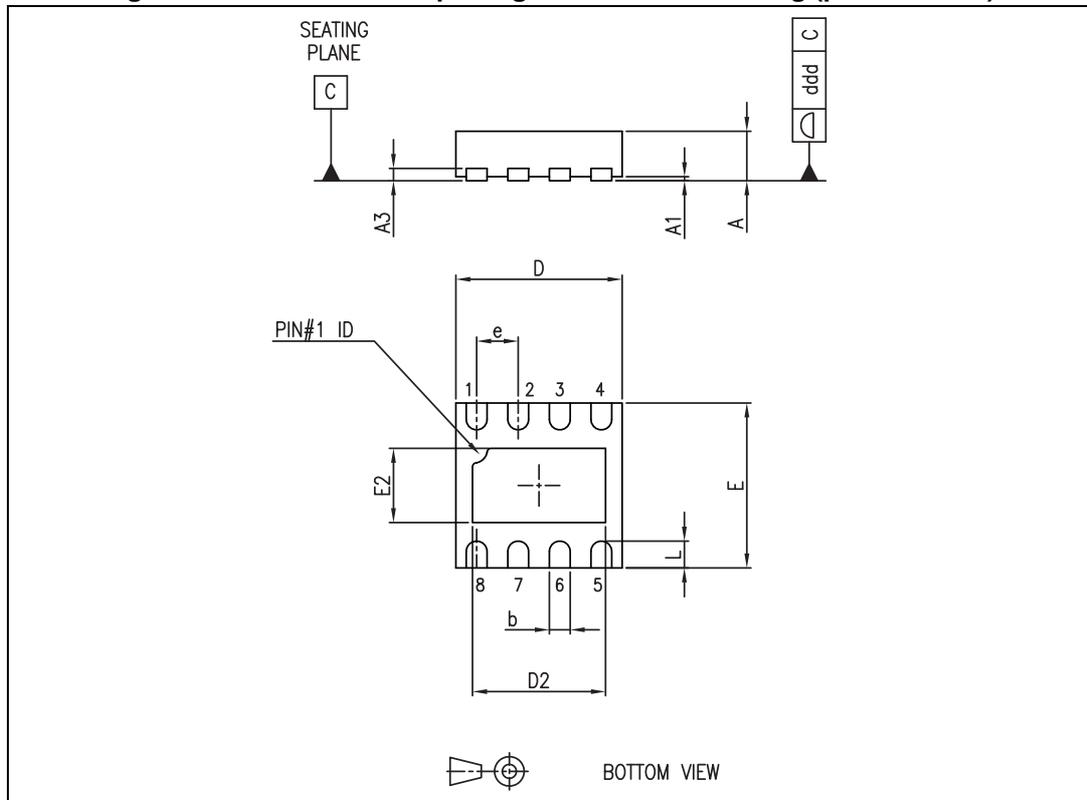


Table 13. DFN8 2 x 2 mm package mechanical data (pitch 0.5 mm)

| Ref. | Dimensions | | | | | |
|------|-------------|------|-------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 0.51 | 0.55 | 0.60 | 0.020 | 0.022 | 0.024 |
| A1 | | | 0.05 | | | 0.002 |
| A3 | | 0.15 | | | 0.006 | |
| b | 0.18 | 0.25 | 0.30 | 0.007 | 0.010 | 0.012 |
| D | 1.85 | 2.00 | 2.15 | 0.073 | 0.079 | 0.085 |
| D2 | 1.45 | 1.60 | 1.70 | 0.057 | 0.063 | 0.067 |
| E | 1.85 | 2.00 | 2.15 | 0.073 | 0.079 | 0.085 |
| E2 | 0.75 | 0.90 | 1.00 | 0.030 | 0.035 | 0.040 |
| e | | 0.50 | | | 0.020 | |
| L | | | 0.425 | | | 0.017 |
| ddd | | | 0.08 | | | 0.003 |

5.5 MiniSO-8 package information

Figure 29. MiniSO-8 package mechanical drawing

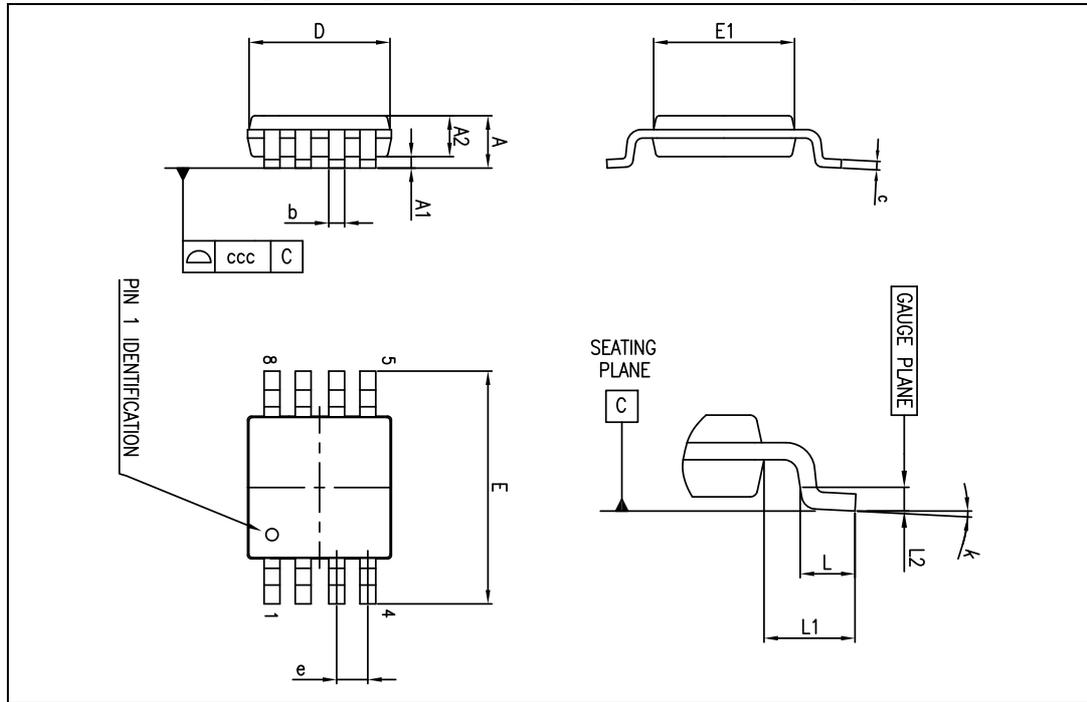


Table 14. MiniSO-8 package mechanical data

| 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 |

5.6 MiniSO-10 package information

Figure 30. MiniSO-10 package mechanical drawing

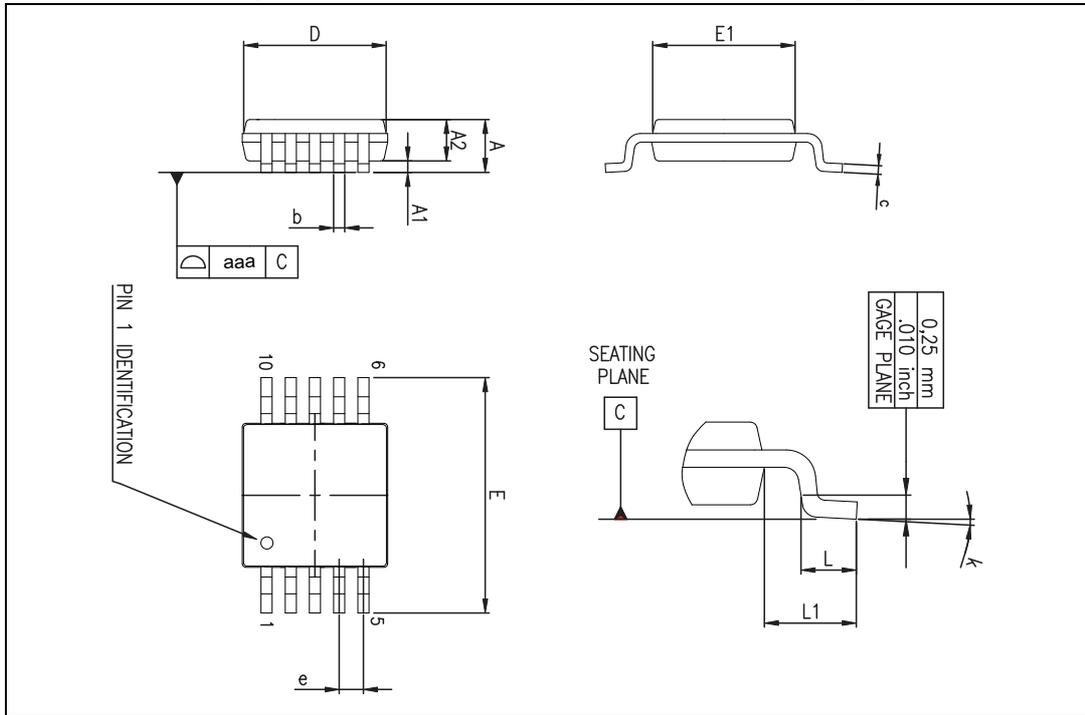


Table 15. MiniSO-10 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|------|--------|-------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.10 | | | 0.043 |
| A1 | 0.05 | 0.10 | 0.15 | 0.002 | 0.004 | 0.006 |
| A2 | 0.78 | 0.86 | 0.94 | 0.031 | 0.034 | 0.037 |
| b | 0.25 | 0.33 | 0.40 | 0.010 | 0.013 | 0.016 |
| c | 0.15 | 0.23 | 0.30 | 0.006 | 0.009 | 0.012 |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| E | 4.75 | 4.90 | 5.05 | 0.187 | 0.193 | 0.199 |
| E1 | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| e | | 0.50 | | | 0.020 | |
| L | 0.40 | 0.55 | 0.70 | 0.016 | 0.022 | 0.028 |
| L1 | | 0.95 | | | 0.037 | |
| k | 0° | 3° | 6° | 0° | 3° | 6° |
| aaa | | | 0.10 | | | 0.004 |

5.7 TSSOP14 package information

Figure 31. TSSOP14 package mechanical drawing

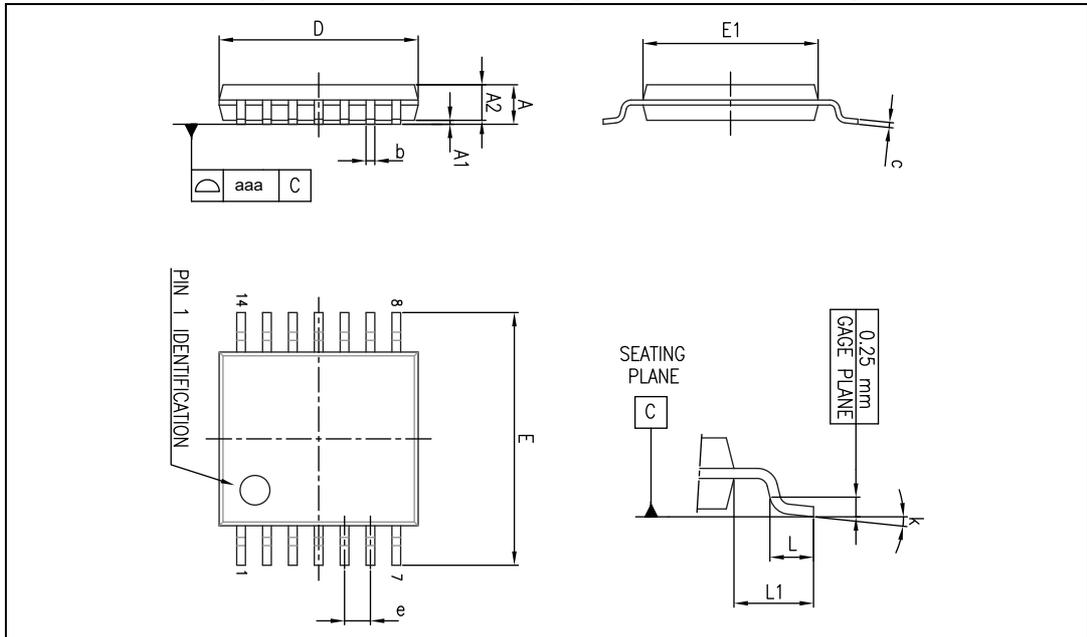


Table 16. TSSOP14 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|------|--------|--------|--------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.20 | | | 0.047 |
| A1 | 0.05 | | 0.15 | 0.002 | 0.004 | 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 | | 0.0089 |
| D | 4.90 | 5.00 | 5.10 | 0.193 | 0.197 | 0.201 |
| E | 6.20 | 6.40 | 6.60 | 0.244 | 0.252 | 0.260 |
| E1 | 4.30 | 4.40 | 4.50 | 0.169 | 0.173 | 0.176 |
| e | | 0.65 | | | 0.0256 | |
| L | 0.45 | 0.60 | 0.75 | 0.018 | 0.024 | 0.030 |
| L1 | | 1.00 | | | 0.039 | |
| k | 0° | | 8° | 0° | | 8° |
| aaa | | | 0.10 | | | 0.004 |

5.8 TSSOP16 package information

Figure 32. TSSOP16 package mechanical drawing

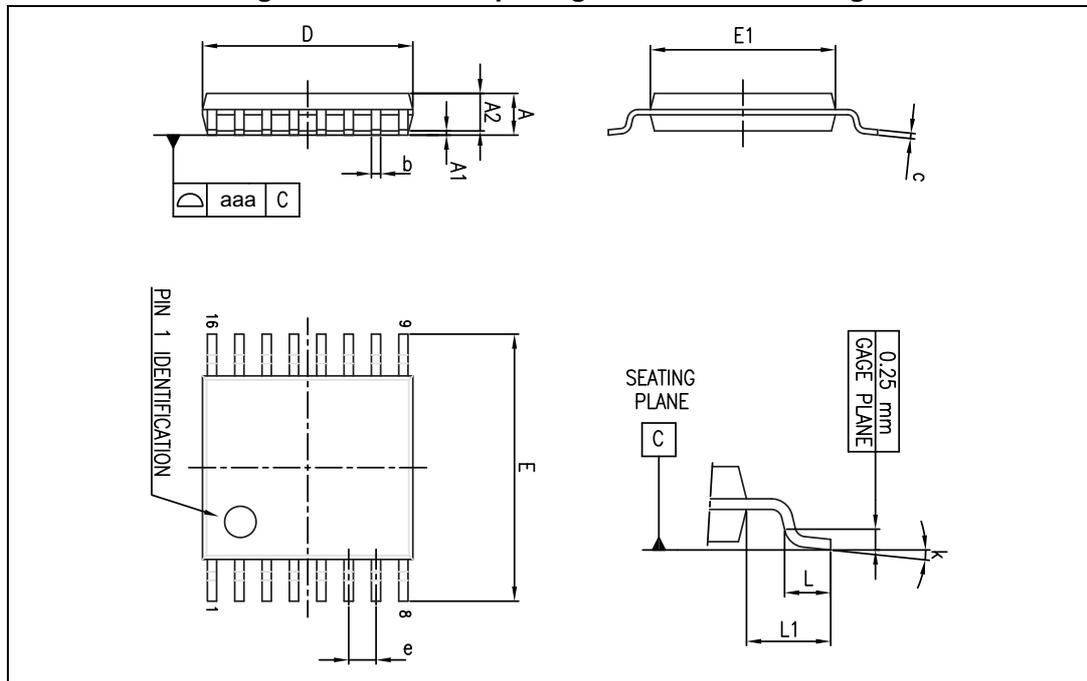


Table 17. TSSOP16 package mechanical data

| Ref. | Dimensions | | | | | |
|------|-------------|------|------|--------|--------|-------|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.20 | | | 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 | 4.90 | 5.00 | 5.10 | 0.193 | 0.197 | 0.201 |
| 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 | | 1.00 | | | 0.039 | |
| aaa | | | 0.10 | | | 0.004 |

5.9 SO-8 package information

Figure 33. SO-8 package mechanical drawing

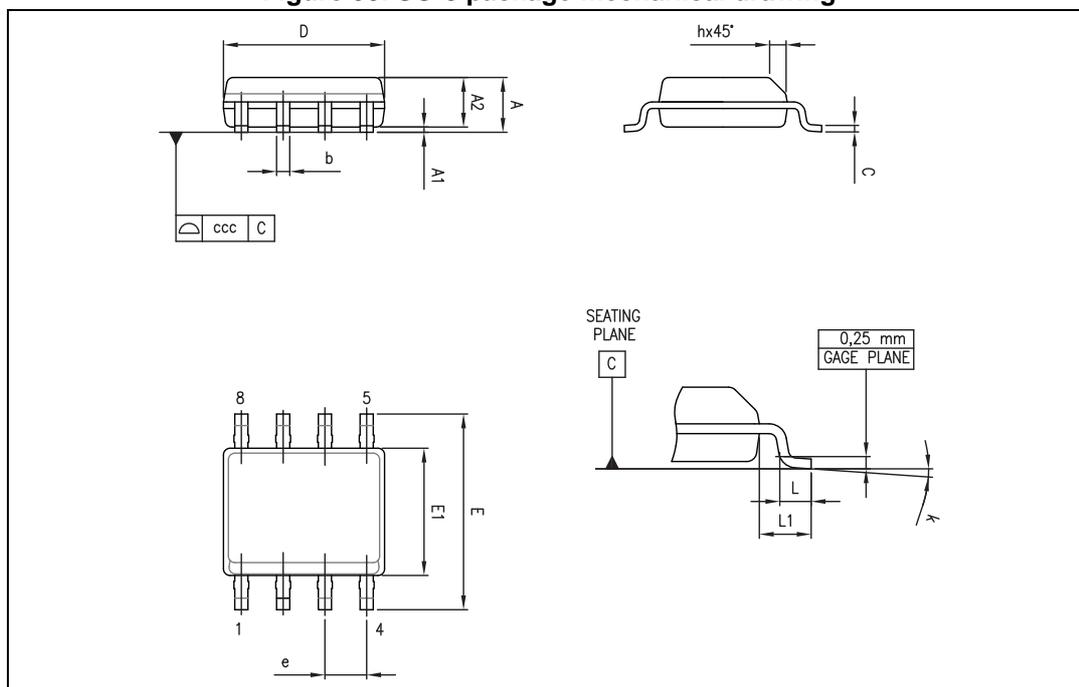


Table 18. SO-8 package mechanical data

| 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 |
| 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 |

5.10 SO-14 package information

Figure 34. SO-14 package mechanical drawing

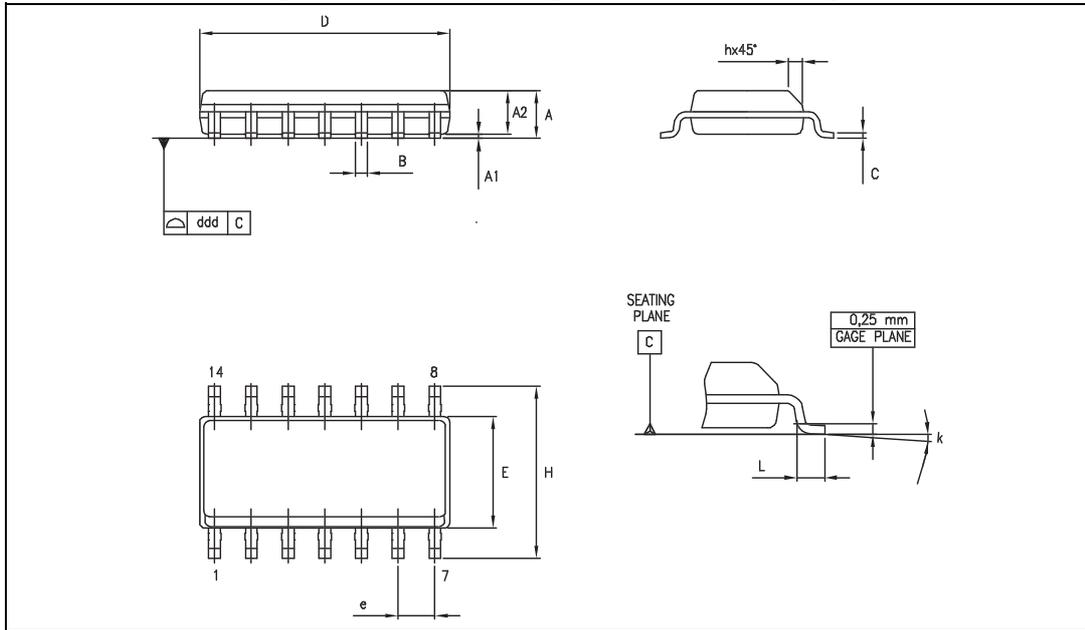


Table 19. SO-14 package mechanical data

| Dimensions | | | | | | |
|------------|-------------|------|------|--------|------|-------|
| Ref. | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 1.35 | | 1.75 | 0.05 | | 0.068 |
| A1 | 0.10 | | 0.25 | 0.004 | | 0.009 |
| A2 | 1.10 | | 1.65 | 0.04 | | 0.06 |
| B | 0.33 | | 0.51 | 0.01 | | 0.02 |
| C | 0.19 | | 0.25 | 0.007 | | 0.009 |
| D | 8.55 | | 8.75 | 0.33 | | 0.34 |
| E | 3.80 | | 4.0 | 0.15 | | 0.15 |
| e | | 1.27 | | | 0.05 | |
| H | 5.80 | | 6.20 | 0.22 | | 0.24 |
| h | 0.25 | | 0.50 | 0.009 | | 0.02 |
| L | 0.40 | | 1.27 | 0.015 | | 0.05 |
| k | 8° (max.) | | | | | |
| ddd | | | 0.10 | | | 0.004 |

6 Ordering information

Table 20. Order codes

| Order code | Temperature range | Package | Packing | Marking |
|------------|-------------------|----------|-------------|----------|
| LMV821ICT | -40 °C to +125 °C | SC70-5 | Tape & reel | K1S |
| LMV821ILT | | SOT23-5 | | K155 |
| LMV822IQ2T | | DFN8 2x2 | | K1S |
| LMV822IST | | MiniSO8 | | K155 |
| LMV822IDT | | SO8 | | LMV822I |
| LMV824IPT | | TSSOP14 | | LMV824I |
| LMV824IDT | | SO14 | | LMV824I |
| LMV821AICT | -40 °C to +125 °C | SC70-5 | Tape & reel | K1T |
| LMV821AILT | | SOT23-5 | | K156 |
| LMV822AIST | | MiniSO8 | | K156 |
| LMV822AIDT | | SO8 | | LMV822AI |
| LMV824AIPT | | TSSOP14 | | LMV824AI |
| LMV824AIDT | | SO14 | | LMV824AI |

Table 21. Order codes (with shutdown pin)

| Order code | Temperature range | Package | Packing | Marking |
|------------|-------------------|----------|-------------|----------|
| LMV820ILT | -40 °C to +125 °C | SOT23-6 | Tape & reel | K155 |
| LMV823IST | | MiniSO10 | | K155 |
| LMV825IPT | | TSSOP16 | | LMV825I |
| LMV820AILT | -40 °C to +125 °C | SOT23-6 | Tape & reel | K156 |
| LMV823AIST | | MiniSO10 | | K156 |
| LMV825AIPT | | TSSOP16 | | LMV825AI |

Table 22. Order codes (automotive grade parts)

| Order code | Temperature range | Package | Packing | Marking |
|-------------|--|---------|-------------|-----------|
| LMV821IYLT | -40 ° C to +125 ° C Automotive grade ⁽¹⁾ | SOT23-5 | Tape & reel | K167 |
| LMV822IYST | | MiniSO8 | | K167 |
| LMV822IYDT | | SO8 | | LMV822IY |
| LMV824IYDT | | SO14 | | LMV824IY |
| LMV824IYPT | | TSSOP14 | | |
| LMV821AIYLT | -40 ° C to +125 ° C Automotive grade ⁽¹⁾ | SOT23-5 | Tape & reel | K168 |
| LMV822AIYST | | MiniSO8 | | K168 |
| LMV822AIYDT | | SO8 | | LMV822AY |
| LMV824AIYDT | | SO14 | | LMV824AIY |
| LMV824AIYPT | | TSSOP14 | | |

1. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q002 or equivalent.

7 Revision history

Table 23. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 10-Nov-2011 | 1 | Initial release. |
| 06-Jul-2012 | 2 | Addition of automotive grade parts. |
| 29-Jan-2013 | 3 | <i>Description</i> and <i>Section 4.6: Macromodel</i> : small text changes. Updated <i>Figure 1</i> . Updated titles of <i>Figure 3</i> , <i>Figure 13</i> , and <i>Figure 27</i> . Updated <i>Table 10</i> , <i>Table 11</i> , <i>Table 12</i> , and <i>Table 22: Order codes</i> (automotive grade parts). <i>Section 4.7: Shutdown function</i> : added explanation of <i>Figure 23</i> and <i>Figure 24</i> . |
| 10-Apr-2017 | 4 | Updated <i>Table 13</i> : "L" dimension changed from 0.5 mm to 0.425 mm. Minor text revisions throughout the document, |

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2017 STMicroelectronics – All rights reserved