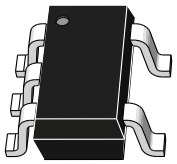
# LMC7101

Datasheet

## Tiny, low power, 16 V single operational amplifier for cost-optimized systems



SOT23-5

## Features

- Low power consumption: 235 µA typ. at 5 V
- Supply voltage: 3 V to 16 V
- Gain bandwidth product: 900 kHz typ.
- Offset voltage: 3 mV maximum
- Low input bias current: 1 pA typ.
- High tolerance to ESD: 4 kV
- Wide temperature range: -40 °C to +125 °C
- Rail-to-Rail input and output
- SOT23-5 package

## Applications

- Industrial and automotive signal conditioning
- Active filtering
- Power savings in power-conscious applications
- Medical instrumentation
- High impedance sensors
- Easy interfacing with high impedance sensors

## Description

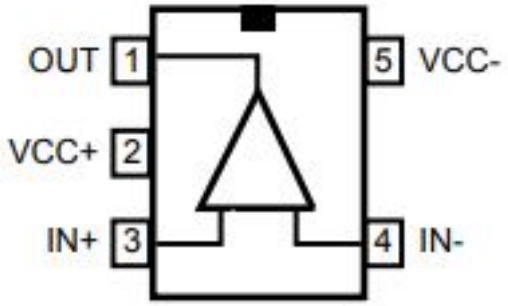
The LMC7101 operational amplifier benefits from STMicroelectronics® 16 V CMOS technology to offer state-of-the-art accuracy and performance in the smallest industrial packages. The LMC7101 offers an outstanding speed/power consumption ratio, 900 kHz gain bandwidth product while consuming only 250 µA at 16 V.
Such features make the LMC7101 ideal for sensor interfaces and industrial signal conditioning. The wide temperature range and high ESD tolerance ease use in harsh automotive applications.

| Product status link |
|---|
| LMC7101 |

| Related products | |
|---|---|
| See TSX631 | for reduced power consumption (45 µA, 200 kHz) |
| See TSX921 | for higher gain bandwidth products (10 MHz) |

# 1 Pinout information

Figure 1. **Pin connections (top view)**



# 2 Absolute maximum ratings and operating conditions

**Table 1. Absolute maximum ratings (AMR)**

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage (1) | | 18 | V |
| $V_{id}$ | Differential input voltage (2) | | $\pm V_{CC}$ | |
| $V_{in}$ | Input voltage (3) | | $(V_{CC-})$ - 0.2 to $(V_{CC+})$ + 0.2 | |
| $I_{in}$ | Input current (4) | | 10 | mA |
| $T_{stg}$ | Storage temperature | | -65 to 150 | °C |
| $T_j$ | Maximum junction temperature | | 150 | |
| $R_{thja}$ | Thermal resistance junction-to-ambient (5)(6) | SOT23-5 | 250 | °C/W |
| ESD | HBM: human body model (7) | | 4 | kV |
| | MM: machine model (8) | | 200 | V |
| | CDM: charged device model (9) | | 1.5 | kV |
| | Latch-up immunity | | 200 | mA |

1. *All voltage values, except the differential voltage are with respect to the network ground terminal.*
2. *The differential voltage is the non-inverting input terminal with respect to the inverting input terminal.*
3. *$V_{cc}$ - $V_{in}$ must not exceed 18 V, Vin must not exceed 18 V*
4. *Input current must be limited by a resistor in series with the inputs.*
5. *$R_{th}$ are typical values.*
6. *Short-circuits can cause excessive heating and destructive dissipation.*
7. *Human body model: 100 pF discharged through a 1.5 kΩ resistor between two pins of the device, done for all couples of pin combinations with other pins floating.*
8. *Machine model: a 200 pF cap is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω), done for all couples of pin combinations with other pins floating.*
9. *Charged device model: all pins plus package are charged together to the specified voltage and then discharged directly to ground.*

**Table 2. Operating conditions**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CC}$ | Supply voltage | 3 to 16 | V |
| $V_{icm}$ | Common-mode input voltage range | $(V_{CC-})$ - 0.1 to $(V_{CC+})$ + 0.1 | |
| $T_{oper}$ | Operating free-air temperature range | -40 to 125 | °C |

# 3 Electrical characteristics

**Table 3. Electrical characteristics at $V_{CC+}$ = 3.3 V with $V_{CC-}$ = 0 V, $V_{icm}$ = $V_{CC}$/2, $T_{amb}$ = 25 ° C, and $R_L$ = 10 kΩ connected to $V_{CC}$/2 (unless otherwise specified)**

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DC performance** | | | | | | |
| $V_{io}$ | Offset voltage | T = 25 °C | | | 3 | mV |
| | | -40 °C < T < 125 °C | | | 5 | |
| $\Delta V_{io}/\Delta T$ | Input offset voltage drift | -40 °C < T < 125 °C | | 1 | | µV/°C |
| $I_{ib}$ | Input bias current, $V_{out}$ = $V_{CC}$/2 | T = 25 °C | | 1 | 100 (1) | pA |
| | | -40 °C < T < 125 °C | | 1 | 200 (1) | |
| $I_{io}$ | Input offset current, $V_{out}$ = $V_{CC}$/2 | T = 25 °C | | 1 | 100 (1) | |
| | | -40 °C < T < 125 °C | | 1 | 200 (1) | |
| CMR1 | Common mode rejection ratio, CMR = 20 log ($\Delta V_{ic}/\Delta V_{io}$), $V_{ic}$ = -0.1 V to $V_{CC}$ - 1.5 V, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | 63 | 80 | | dB |
| | | -40 °C < T < 125 °C | 59 | | | |
| CMR2 | Common mode rejection ratio, CMR = 20 log ($\Delta V_{ic}/\Delta V_{io}$), $V_{ic}$ = -0.1 V to $V_{CC}$ + 0.1 V, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | 47 | 66 | | |
| | | -40 °C < T < 125 °C | 45 | | | |
| $A_{vd}$ | Large signal voltage gain, $V_{out}$ = 0.5 V to ($V_{CC}$ - 0.5 V), $R_L$ > 1 MΩ | T = 25 °C | 85 | | | |
| | | -40 °C < T < 125 °C | 83 | | | |
| $V_{OH}$ | High-level output voltage, $V_{OH}$ = $V_{CC}$ - $V_{out}$ | T = 25 °C | | | 70 | mV |
| | | -40 °C < T < 125 °C | | | 100 | |
| $V_{OL}$ | Low-level output voltage | T = 25 °C | | | 70 | |
| | | -40 °C < T < 125 °C | | | 100 | |
| $I_{out}$ | $I_{sink}$, $V_{out}$ = $V_{CC}$ | T = 25 °C | 4.3 | 5.3 | | mA |
| | | -40 °C < T < 125 °C | 2.5 | | | |
| | $I_{source}$, $V_{out}$ = 0 V | T = 25 °C | 3.3 | 4.3 | | |
| | | -40 °C < T < 125 °C | 2.5 | | | |
| $I_{CC}$ | Supply current, per channel, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | | 220 | 300 | µA |
| | | -40 °C < T < 125 °C | | | 350 | |
| **AC performance** | | | | | | |
| GBP | Gain bandwidth product | $R_L$ = 10 kΩ, $C_L$ = 100 pF | 600 | 800 | | kHz |
| $F_u$ | Unity gain frequency | | | 690 | | |
| ϕm | Phase margin | | | 55 | | Degrees |
| $G_m$ | Gain margin | | | 9 | | dB |
| SR | Slew rate | $R_L$ = 10 kΩ, $C_L$ = 100 pF, $V_{out}$ = 0.5 V to $V_{CC}$ - 0.5 V | | 1 | | V/µs |
| $e_n$ | Equivalent input noise voltage density | f = 1 kHz | | 55 | | nV/√Hz |
| | | f = 10 kHz | | 29 | | |

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $\int e_n$ | Low-frequency peak-to-peak input noise | Bandwidth, f = 0.1 to 10 Hz | | 16 | | µVpp |
| THD+N | Total harmonic distortion + noise | Follower configuration, $f_{in}$ = 1 kHz, $R_L$ = 100 kΩ, $V_{icm}$ = ($V_{CC}$ -1.5 V)/2, BW = 22 kHz, $V_{out}$ = 1 $V_{pp}$ | | 0.004 | | % |

1. *Guaranteed by design*

**Table 4. Electrical characteristics at $V_{CC+}$ = 5 V with $V_{CC-}$ = 0 V, $V_{icm}$ = $V_{CC}$/2, $T_{amb}$ = 25 ° C, and $R_L$ = 10 kΩ connected to $V_{CC}$/2 (unless otherwise specified)**

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DC performance** | | | | | | |
| $V_{io}$ | Offset voltage | T = 25 °C | | | 3 | mV |
| | | -40 °C < T < 125 °C | | | 5 | |
| $\Delta V_{io}/\Delta T$ | Input offset voltage drift | -40 °C < T < 125 °C | | 1 | | µV/°C |
| $\Delta V_{io}$ | Long-term input offset voltage drift | T = 25 °C (1) | | 5 | | nV/√month |
| $I_{ib}$ | Input bias current, $V_{out}$ = $V_{CC}$/2 | T = 25 °C | | 1 | 100 (2) | pA |
| | | -40 °C < T < 125 °C | | 1 | 200 (2) | |
| $I_{io}$ | Input offset current, $V_{out}$ = $V_{CC}$/2 | T = 25 °C | | 1 | 100 (2) | |
| | | -40 °C < T < 125 °C | | 1 | 200 (2) | |
| CMR1 | Common mode rejection ratio, CMR = 20 log ($\Delta V_{ic}/\Delta V_{io}$), $V_{ic}$ = -0.1 V to $V_{CC}$ - 1.5 V, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | 66 | 84 | | dB |
| | | -40 °C < T < 125 °C | 63 | | | |
| CMR2 | Common mode rejection ratio, CMR = 20 log ($\Delta V_{ic}/\Delta V_{io}$), $V_{ic}$ = -0.1 V to $V_{CC}$ + 0.1 V, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | 50 | 69 | | |
| | | -40 °C < T < 125 °C | 47 | | | |
| $A_{vd}$ | Large signal voltage gain, $V_{out}$ = 0.5 V to ($V_{CC}$ - 0.5 V), $R_L$ > 1 MΩ | T = 25 °C | 85 | | | |
| | | -40 °C < T < 125 °C | 83 | | | |
| $V_{OH}$ | High-level output voltage, $V_{OH}$ = $V_{CC}$ - $V_{out}$ | $R_L$ = 10 kΩ, T = 25 °C | | | 70 | mV |
| | | $R_L$ = 10 kΩ, -40 °C < T < 125 °C | | | 100 | |
| $V_{OL}$ | Low-level output voltage | $R_L$ = 10 kΩ, T = 25 °C | | | 70 | |
| | | $R_L$ = 10 kΩ, -40 °C < T < 125 °C | | | 100 | |
| $I_{out}$ | $I_{sink}$ | $V_{out}$ = $V_{CC}$, T = 25 °C | 11 | 14 | | mA |
| | | $V_{out}$ = $V_{CC}$, -40 °C < T < 125 °C | 8 | | | |
| | $I_{source}$ | $V_{out}$ = 0 V, T = 25 °C | 9 | 12 | | |
| | | $V_{out}$ = 0 V, -40 °C < T < 125 °C | 7 | | | |
| $I_{CC}$ | Supply current, per channel, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | | 235 | 350 | µA |
| | | -40 °C < T < 125 °C | | | 400 | |
| **AC performance** | | | | | | |
| GBP | Gain bandwidth product | $R_L$ = 10 kΩ, $C_L$ = 100 pF | 700 | 850 | | kHz |
| $F_u$ | Unity gain frequency | | | 730 | | |

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| ϕm | Phase margin | $R_L$ = 10 kΩ, $C_L$ = 100 pF | | 55 | | Degrees |
| $G_m$ | Gain margin | | | 9 | | dB |
| SR | Slew rate | $R_L$ = 10 kΩ, $C_L$ = 100 pF, $V_{out}$ = 0.5 V to $V_{CC}$ - 0.5 V | | 1.1 | | V/µs |
| $e_n$ | Equivalent input noise voltage density | f = 1 kHz | | 55 | | nV/√Hz |
| | | f = 10 kHz | | 29 | | |
| $\int e_n$ | Low-frequency peak-to-peak input noise | Bandwidth, f = 0.1 to 10 Hz | | 15 | | µVpp |
| THD+N | Total harmonic distortion + noise | Follower configuration, $f_{in}$ = 1 kHz, $R_L$ = 100 kΩ, $V_{icm}$ = ($V_{CC}$ -1.5 V)/2, BW = 22 kHz, $V_{out}$ = 2 $V_{pp}$ | | 0.002 | | % |

1. *Typical value is based on the $V_{io}$ drift observed after 1000h at 125 °C extrapolated to 25 °C using the Arrhenius law and assuming an activation energy of 0.7 eV. The operational amplifier is aged in follower mode configuration.*
2. *Guaranteed by design*

**Table 5. Electrical characteristics at $V_{CC+}$ = 16 V with $V_{CC-}$ = 0 V, $V_{icm}$ = $V_{CC}$/2, $T_{amb}$ = 25 ° C, and $R_L$ = 10 kΩ connected to $V_{CC}$/2 (unless otherwise specified)**

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **DC performance** | | | | | | |
| $V_{io}$ | Offset voltage | T = 25 °C | | | 3 | mV |
| | | -40 °C < T < 125 °C | | | 5 | |
| $\Delta V_{io}/\Delta T$ | Input offset voltage drift | -40 °C < T < 125 °C | | 1 | | µV/°C |
| $\Delta V_{io}$ | Long-term input offset voltage drift | T = 25 °C (1) | | 1.6 | | nV/√month |
| $I_{ib}$ | Input bias current, $V_{out}$ = $V_{CC}$/2 | T = 25 °C | | 1 | 100 (2) | pA |
| | | -40 °C < T < 125 °C | | 1 | 200 (2) | |
| $I_{io}$ | Input offset current, $V_{out}$ = $V_{CC}$/2 | T = 25 °C | | 1 | 100 (2) | |
| | | -40 °C < T < 125 °C | | 1 | 200 (2) | |
| CMR1 | Common mode rejection ratio, CMR = 20 log ($\Delta V_{ic}/\Delta V_{io}$), $V_{ic}$ = -0.1 V to $V_{CC}$ - 1.5 V, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | 76 | 95 | | dB |
| | | -40 °C < T < 125 °C | 72 | | | |
| CMR2 | Common mode rejection ratio, CMR = 20 log ($\Delta V_{ic}/\Delta V_{io}$), $V_{ic}$ = -0.1 V to $V_{CC}$ + 0.1 V, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | 60 | 78 | | |
| | | -40 °C < T < 125 °C | 56 | | | |
| SVR | Common mode rejection ratio, 20 log ($\Delta V_{CC}/\Delta V_{io}$), $V_{CC}$ = 3 V to 16 V, $V_{out}$ = $V_{icm}$ = $V_{CC}$/2 | T = 25 °C | 76 | 90 | | |
| | | -40 °C < T < 125 °C | 72 | | | |
| $A_{vd}$ | Large signal voltage gain, $V_{out}$ = 0.5 V to ($V_{CC}$ - 0.5 V), $R_L$ > 1 MΩ | T = 25 °C | 85 | | | |
| | | -40 °C < T < 125 °C | 83 | | | |
| $V_{OH}$ | High-level output voltage, $V_{OH}$ = $V_{CC}$ - $V_{out}$ | $R_L$ = 10 kΩ, T = 25 °C | | | 70 | mV |
| | | $R_L$ = 10 kΩ, -40 °C < T < 125 °C | | | 100 | |
| $V_{OL}$ | Low-level output voltage | $R_L$ = 10 kΩ, T = 25 °C | | | 70 | |

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OL}$ | Low-level output voltage | $R_L$ = 10 kΩ, -40 °C < T < 125 °C | | | 100 | mV |
| $I_{out}$ | $I_{sink}$ | $V_{out}$ = $V_{CC}$, T = 25 °C | 40 | 92 | | mA |
| | | $V_{out}$ = $V_{CC}$, -40 °C < T < 125 °C | 35 | | | |
| | $I_{source}$ | $V_{out}$ = 0 V, T = 25 °C | 30 | 90 | | |
| | | $V_{out}$ = 0 V, -40 °C < T < 125 °C | 25 | | | |
| $I_{CC}$ | Supply current, per channel, $V_{out}$ = $V_{CC}$/2, $R_L$ > 1 MΩ | T = 25 °C | | 250 | 360 | µA |
| | | -40 °C < T < 125 °C | | | 400 | |
| **AC performance** | | | | | | |
| GBP | Gain bandwidth product | $R_L$ = 10 kΩ, $C_L$ = 100 pF | 750 | 900 | | kHz |
| $F_u$ | Unity gain frequency | | | 750 | | |
| ϕm | Phase margin | | | 55 | | Degrees |
| $G_m$ | Gain margin | | | 9 | | dB |
| SR | Slew rate | $R_L$ = 10 kΩ, $C_L$ = 100 pF, $V_{out}$ = 0.5 V to $V_{CC}$ - 0.5 V | | 1.1 | | V/µs |
| $e_n$ | Equivalent input noise voltage density | f = 1 kHz | | 48 | | nV/√Hz |
| | | f = 10 kHz | | 27 | | |
| $\int e_n$ | Low-frequency peak-to-peak input noise | Bandwidth, f = 0.1 to 10 Hz | | 15 | | µVpp |
| THD+N | Total harmonic distortion + noise | Follower configuration, $f_{in}$ = 1 kHz, $R_L$ = 100 kΩ, $V_{icm}$ = ($V_{CC}$ -1.5 V)/2, BW = 22 kHz, $V_{out}$ = 5 $V_{pp}$ | | 0.0005 | | % |

1. *Typical value is based on the $V_{io}$ drift observed after 1000h at 125 °C extrapolated to 25 °C using the Arrhenius law and assuming an activation energy of 0.7 eV. The operational amplifier is aged in follower mode configuration.*
2. *Guaranteed by design*

# 4 Electrical characteristic curves

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

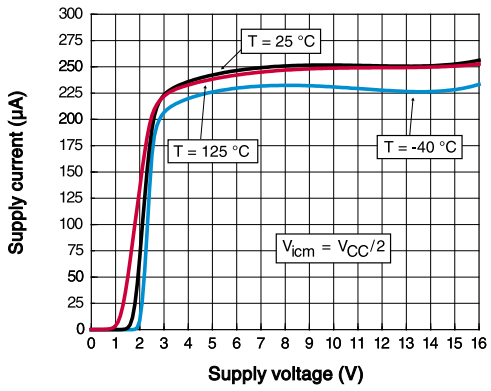



**Figure 3. Output current vs. output voltage at $V_{CC}$ = 3.3 V**

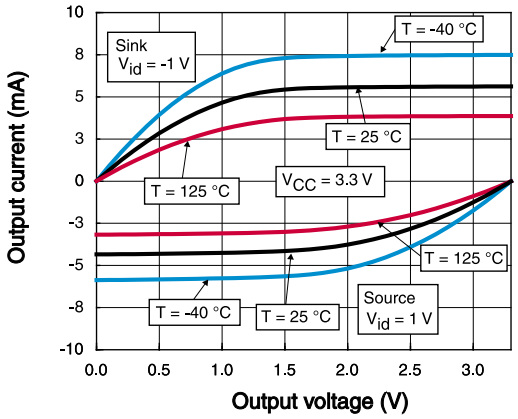



**Figure 4. Output current vs. output voltage at $V_{CC}$ = 5 V**

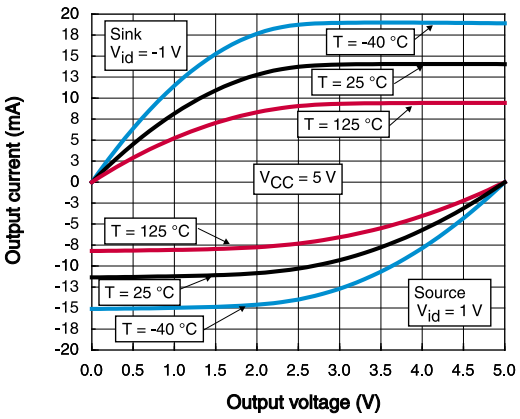



**Figure 5. Output current vs. output voltage at $V_{CC}$ = 16 V**

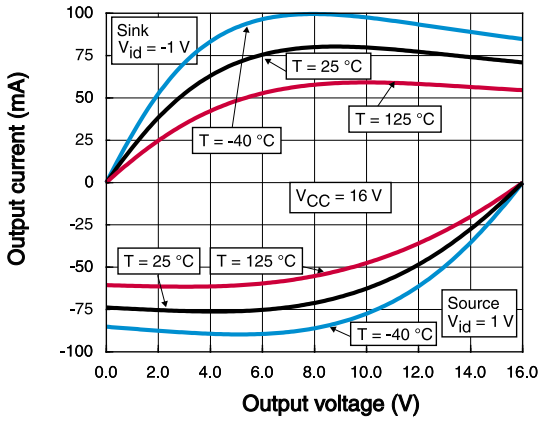



**Figure 6. Bode diagram at $V_{CC}$ = 3.3 V**

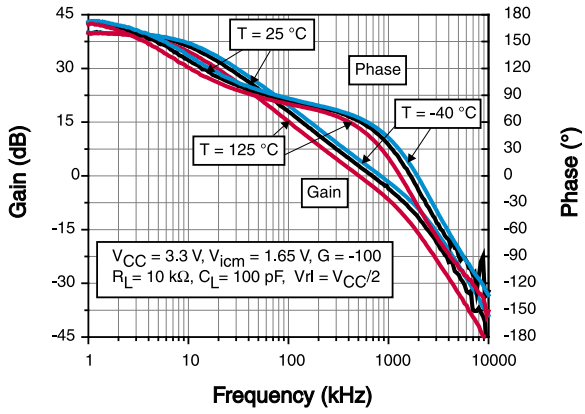



**Figure 7. Bode diagram at $V_{CC}$ = 5 V**

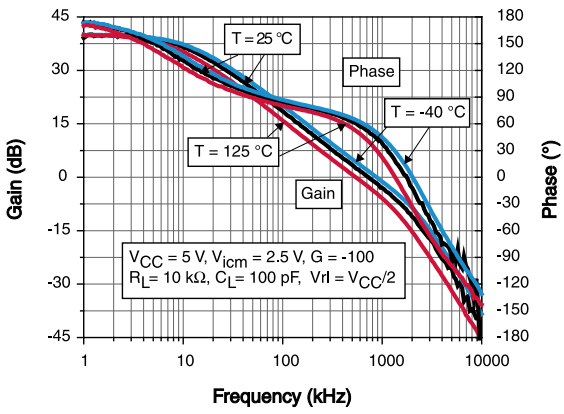


**Figure 8. Bode diagram at $V_{CC}$ = 16 V**

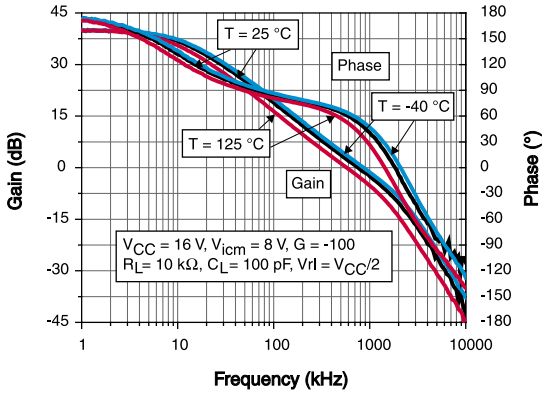



**Figure 9. Phase margin vs. capacitive load at $V_{CC}$ = 12 V**

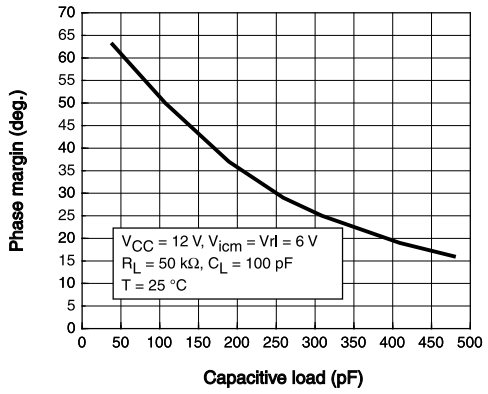



**Figure 10. GBP vs. input common-mode voltage at $V_{CC}$ = 12 V**

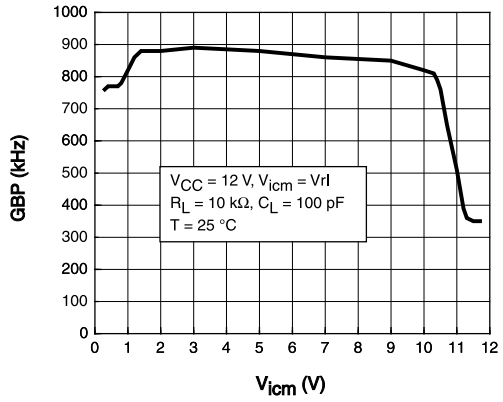



**Figure 11. $A_{vd}$ vs. input common-mode voltage at $V_{CC}$ = 12 V**

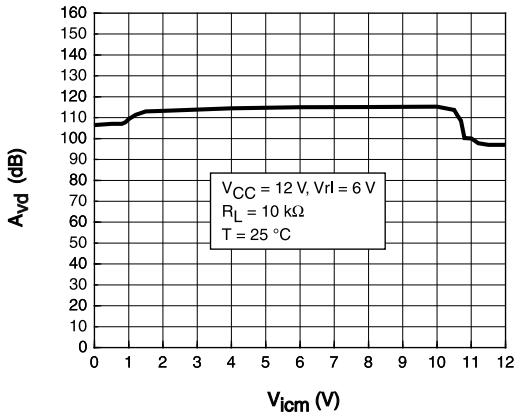



**Figure 12. Slew rate vs. supply voltage**

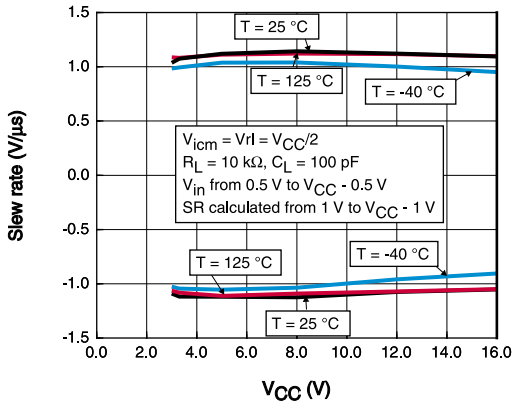



**Figure 13. Noise vs. frequency at $V_{CC}$ = 3.3 V**

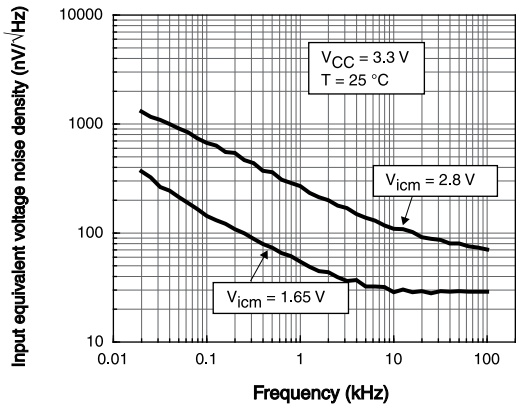


**Figure 14. Noise vs. frequency at $V_{CC}$ = 5 V**

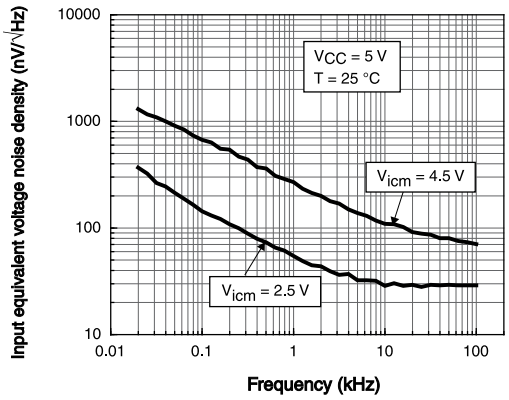



**Figure 15. Noise vs. frequency at $V_{CC}$ = 16 V**

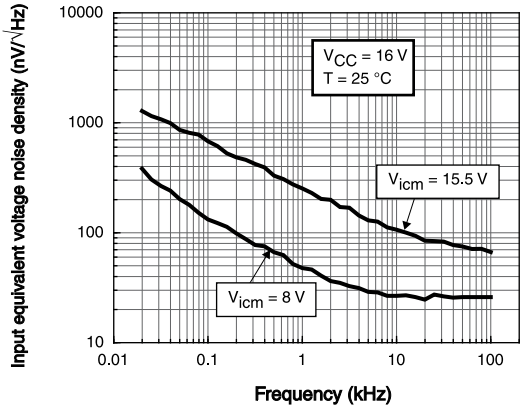



**Figure 16. Distortion and noise vs. output voltage amplitude**

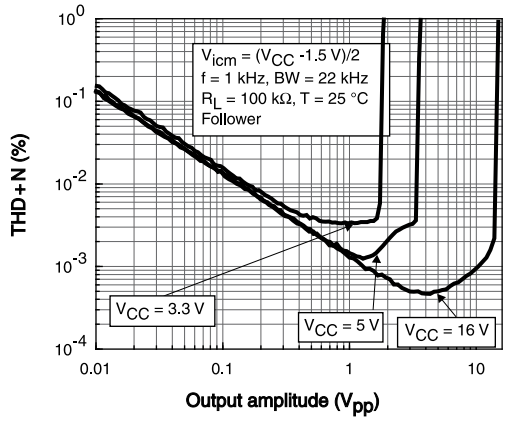



**Figure 17. Distortion and noise vs. amplitude at $V_{icm}$ = $V_{CC}$/2 and $V_{CC}$ = 12 V**

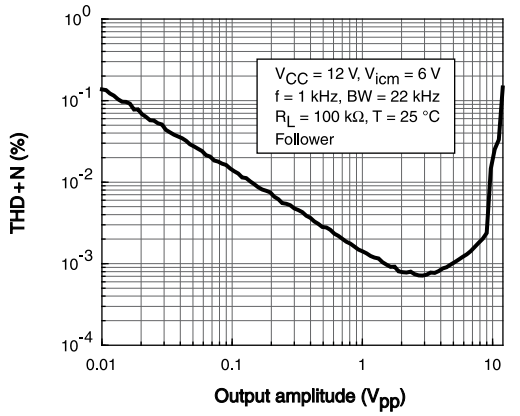
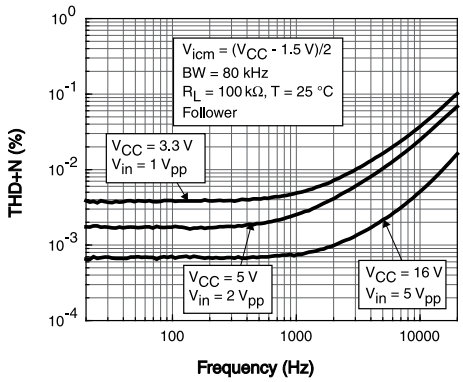



**Figure 18. Distortion and noise vs. frequency**



# 5 Application information

## 5.1 Operating voltages

The LMC7101 amplifier can operate from 3 V to 16 V. Its parameters are fully specified at 3.3 V, 5 V, and 16 V power supplies. However, the parameters are very stable in the full $V_{CC}$ range. Additionally, the main specifications are guaranteed in extended temperature ranges from -40 to 125 ° C.

## 5.2 Rail-to-rail input

The LMC7101 device is built with two complementary PMOS and NMOS input differential pairs. The devices have a rail-to-rail input, and the input common mode range is extended from ($V_{CC}$-) - 0.1 V to ($V_{CC}$+) + 0.1 V.

However, the performance of this device is clearly optimized for the PMOS differential pairs (which means from ($V_{CC}$-) - 0.1 V to ($V_{CC}$+) - 1.5 V).

Beyond ($V_{CC}$+) - 1.5 V, the operational amplifiers are still functional but with degraded performance, as can be observed in the electrical characteristics section of this datasheet (mainly $V_{io}$ and GBP). These performances are suitable for a number of applications that need to be rail-to-rail.

The devices are designed to prevent phase reversal.

## 5.3 Long term input offset voltage drift

To evaluate product reliability, two types of stress acceleration are used:

- Voltage acceleration, by changing the applied voltage
- Temperature acceleration, by changing the die temperature (below the maximum junction temperature allowed by the technology) with the ambient temperature.

The voltage acceleration has been defined based on JEDEC results, and is defined using Equation 2.

**Equation 2**

$$A_{FV} = e^{\beta \cdot (V_S - V_U)}$$

Where:

$A_{FV}$ is the voltage acceleration factor

$\beta$ is the voltage acceleration constant in 1/V, constant technology parameter ($\beta$ = 1)

$V_S$ is the stress voltage used for the accelerated test

$V_U$ is the voltage used for the application

The temperature acceleration is driven by the Arrhenius model, and is defined in Equation 3.

**Equation 3**

$$A_{FT} = e^{\frac{E_a}{k} \cdot \left(\frac{1}{T_U} - \frac{1}{T_S}\right)}$$

Where:

$A_{FT}$ is the temperature acceleration factor

$E_a$ is the activation energy of the technology based on the failure rate

k is the Boltzmann constant ($8.6173 \times 10^{-5}$ eV.K$^{-1}$)

$T_U$ is the temperature of the die when $V_U$ is used (K)

$T_S$ is the temperature of the die under temperature stress (K)

The final acceleration factor, $A_F$, is the multiplication of the voltage acceleration factor and the temperature acceleration factor (Equation 4).

**Equation 4**

$$A_F = A_{FT} \times A_{FV}$$

$A_F$ is calculated using the temperature and voltage defined in the mission profile of the product. The $A_F$ value can then be used in Equation 5 to calculate the number of months of use equivalent to 1000 hours of reliable stress duration.

**Equation 5**

$$\text{Months} = A_F \times 1000\ \text{h} \times 12\ \text{months} / (24\ \text{h} \times 365.25\ \text{days})$$

To evaluate the op amp reliability, a follower stress condition is used where $V_{CC}$ is defined as a function of the maximum operating voltage and the absolute maximum rating (as recommended by JEDEC rules).

The $V_{io}$ drift (in µV) of the product after 1000 h of stress is tracked with parameters at different measurement conditions (see Equation 6).

**Equation 6**

$$V_{CC} = \max V_{op} \text{ with } V_{icm} = V_{CC} / 2$$

The long term drift parameter ($\Delta V_{io}$), estimating the reliability performance of the product, is obtained using the ratio of the $V_{io}$ (input offset voltage value) drift over the square root of the calculated number of months (Equation 7).

**Equation 7**

$$\Delta V_{io} = \frac{V_{io}\text{drift}}{\sqrt{(\text{months})}}$$

Where $V_{io}$ drift is the measured drift value in the specified test conditions after 1000 h stress duration.

## 5.4 PCB layouts

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

## 5.5 Macromodel

Accurate macromodels of the LMC7101 device are available on the STMicroelectronics' website at: www.st.com. These models are a trade-off between accuracy and complexity (that is, time simulation) of the LMC7101 operational amplifier. They emulate the nominal performance 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*.

# 6 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.

## 6.1 SOT23-5 package information

**Figure 19. SOT23-5 package outline**

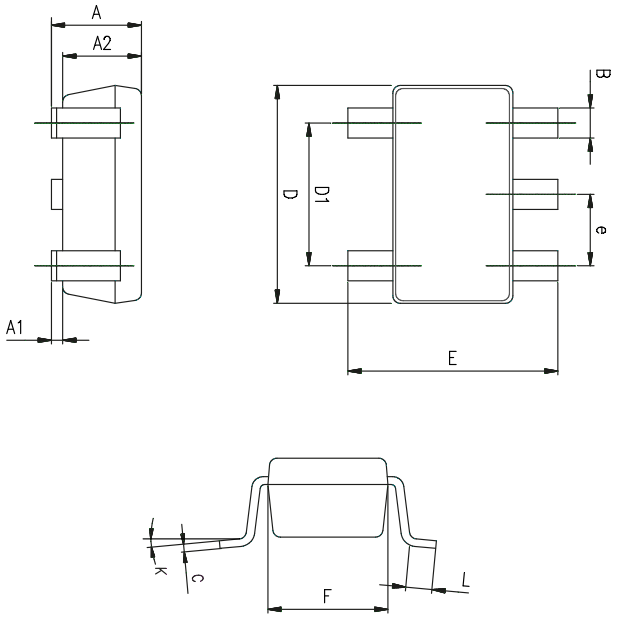



**Table 6. SOT23-5 mechanical data**

| 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 | 0.014 | 0.016 | 0.020 |
| C | 0.09 | 0.15 | 0.20 | 0.004 | 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 | 0.014 | 0.024 |
| K | 0 degrees | | 10 degrees | 0 degrees | | 10 degrees |

# 7 Ordering information

Table 7. **Order codes**

| Order code | Temperature range | Package | Packing | Marking |
|---|---|---|---|---|
| LMC7101ILT | -40 to 125 °C | SOT23-5 | Tape and reel | K23 |

## Revision history

Table 8. **Document revision history**

| Date | Revision | Changes |
|---|---|---|
| 09-Nov-2020 | 1 | Initial release. |

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