

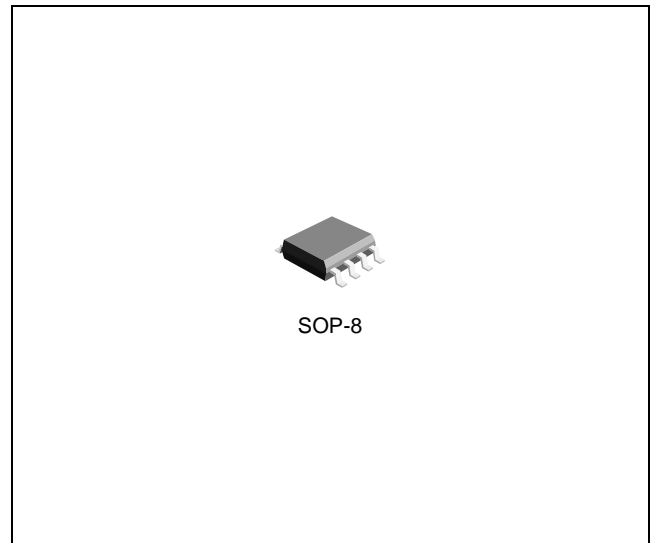
## FEATURES

- Wide range of supply voltages
- Low supply current drain independent of supply voltage
- Low input biasing current
- Low input offset voltage and offset current
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- DC voltage gain 100V/mV Typ.
- Internally frequency compensation

## DESCRIPTION

The LM2904G consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, DC gain blocks and all the conventional op amp circuits.



## ORDERING INFORMATION

| Device   | Package |
|----------|---------|
| LM2904GD | SOP-8   |

ABSOLUTE MAXIMUM RATINGS (Note 1)

| CHARACTERISTIC                     | SYMBOL    | MIN. | MAX.             | UNIT        |
|------------------------------------|-----------|------|------------------|-------------|
| Supply Voltage                     | $V_{CC}$  | -    | 45 or $\pm 22.5$ | V           |
| Differential Input Voltage         | $V_{ID}$  | -    | 45               | V           |
| Input Voltage Range (either input) | $V_{IC}$  | -0.3 | 45               | V           |
| Input Current ( $V_{ID} = -0.3V$ ) | $I_{IN}$  | -    | 50               | mA          |
| Maximum Junction Temperature       | $T_J$     | -40  | 125              | $^{\circ}C$ |
| Storage Temperature Range          | $T_{STG}$ | -65  | 150              | $^{\circ}C$ |

Note 1. Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS (Note 2)

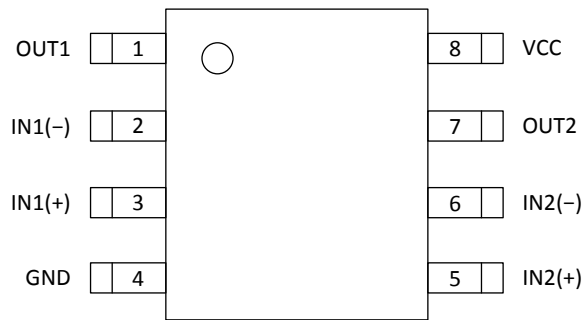
| CHARACTERISTIC                      | SYMBOL           | MIN. | MAX. | UNIT |
|-------------------------------------|------------------|------|------|------|
| Supply Voltage ([VCC+] – [VCC-])    | V <sub>CC</sub>  | 5    | 40   | V    |
| Input Voltage Range (either input)  | V <sub>IC</sub>  | -    | 40   | V    |
| Operating Ambient Temperature Range | T <sub>OPR</sub> | -40  | 125  | °C   |

Note 2. The device is not guaranteed to function outside its operating ratings.

## ORDERING INFORMATION

| Package | Order No. | Description                 | Supplied As | Status |
|---------|-----------|-----------------------------|-------------|--------|
| SOP-8   | LM2904GD  | Dual Operational Amplifiers | Tape & Reel | Active |

## PIN CONFIGURATION



SOP-8

## PIN DESCRIPTION

| Pin No. | Pin Name | Pin Function                           |
|---------|----------|--|
| 1       | OUT1     | Output of the Amplifier 1              |
| 2       | IN1(-)   | Inverting Input of the Amplifier 1     |
| 3       | IN1(+)   | Non-inverting Input of the Amplifier 1 |
| 4       | GND      | Ground or Negative Supply (VCC-)       |
| 5       | IN2(+)   | Non-inverting Input of the Amplifier 2 |
| 6       | IN2(-)   | Inverting Input of the Amplifier 2     |
| 7       | OUT2     | Output of the Amplifier 2              |
| 8       | VCC      | Positive Power Supply (VCC+)           |

## ELECTRICAL CHARACTERISTICS

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

| SYMBOL          | PARAMETER  | TEST CONDITIONS   | $T_A$      | MIN | TYP | MAX          | UNIT             |
|-----------------|--|---|------------|-----|-----|--------------|------------------|
| $V_{IO}$        | Input Offset Voltage   | $V_{CC} = 5V$ to MAX,<br>$V_{IC} = V_{ICR}$ min, $V_O = 1.4V$ | 25°C       | -   | 3   | 7            | mV               |
|                 |  |   | Full range | -   | -   | 9            |                  |
| $\alpha V_{IO}$ | Average Temperature Coefficient of Input Offset Voltage          |   | Full range | -   | 7   | -            | $\mu V/^\circ C$ |
| $I_{IO}$        | Input Offset Current   | $V_O = 1.4V$  | 25°C       | -   | 2   | 50           | nA               |
|                 |  |   | Full range | -   | -   | 150          |                  |
| $\alpha I_{IO}$ | Average Temperature Coefficient of Input Offset Current          |   | Full range | -   | 10  | -            | $\mu A/^\circ C$ |
| $I_{IB}$        | Input Bias Current   | $V_O = 1.4V$  | 25°C       | -   | -20 | -250         | nA               |
|                 |  |   | Full range | -   | -   | -500         |                  |
| $V_{ICR}$       | Common-mode Input Voltage Range                                  | $V_{CC} = 5V$ to MAX  | 25°C       | 0   | -   | $V_{CC}-1.5$ | V                |
|                 |  |   | Full range | 0   | -   | $V_{CC}-2.0$ |                  |
| $V_{OH}$        | High-Level Output Voltage  | $V_{CC} = MAX$ , $R_L = 2k\Omega$                             | Full range | 26  | -   | -            | V                |
|                 |  | $V_{CC} = MAX$ , $R_L \geq 10k\Omega$                         | Full range | 27  | 28  | -            |                  |
| $V_{OL}$        | Low-Level Output Voltage   | $R_L \geq 10k\Omega$  | Full range | -   | 5   | 20           | mV               |
| $A_{VD}$        | Large-Signal Differential Voltage Amplification                  | $V_{CC} = 15V$ , $V_O = 1V$ to 11V,<br>$R_L \geq 2k\Omega$    | 25°C       | 25  | 100 | -            | V/mV             |
|                 |  |   | Full range | 15  | -   | -            |                  |
| CMRR            | Common-mode Rejection Ratio                                      | $V_{CC} = 5V$ to MAX,<br>$V_{IC} = V_{ICR}$ min               | 25°C       | 65  | 80  | -            | dB               |
| PSRR            | Supply Voltage Rejection Ratio ( $\Delta V_{CC}/\Delta V_{IO}$ ) | $V_{CC} = 5V$ to MAX  | 25°C       | 65  | 100 | -            | dB               |
| $V_{O1}/V_{O2}$ | Crosstalk Attenuation  | $f = 1kHz$ to 20kHz   | 25°C       | -   | 120 | -            | dB               |
| $I_{O+}$        | Output Source Current  | $V_{CC} = 15V$ , $V_{ID} = 1V$ ,<br>$V_O = 0V$                | 25°C       | -30 | -50 | -            | mA               |
|                 |  |   | Full range | -20 | -   | -            |                  |
| $I_{O-}$        | Output Sink Current  | $V_{CC} = 15V$ , $V_{ID} = -1V$ ,<br>$V_O = 15V$              | 25°C       | 15  | 35  | -            | mA               |
|                 |  |   | Full range | 7   | -   | -            |                  |
|                 |  | $V_{ID} = -1V$ , $V_O = 200mV$                                | 25°C       | 15  | 28  | -            | mA               |
|                 |  |   | 25°C       | 12  | 50  | -            | $\mu A$          |
| $I_{SC}$        | Output Short-Circuit Current                                     | $V_{ID} = -1V$ , $V_O = 0V$                                   | 25°C       | -   | 50  | 70           | mA               |
| $I_{CC}$        | Supply Current   | $V_{CC} = 2.5V$ , No Load                                     | Full range | -   | 0.7 | 1.2          | mA               |
|                 |  | $V_{CC} = MAX$ , $V_O = 0.5V_{CC}$ ,<br>No Load               | Full range | -   | 1   | 2            |                  |

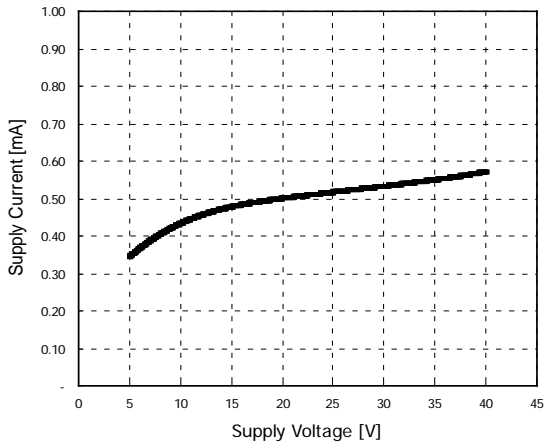
**ELECTRICAL CHARACTERISTICS** (continued)

| SYMBOL | PARAMETER                 | TEST CONDITIONS  | T <sub>A</sub> | MIN | TYP  | MAX | UNIT |
|--------|---------------------------|--|----------------|-----|------|-----|------|
| SR     | Slew Rate                 | V <sub>CC</sub> = 15V,<br>V <sub>IN</sub> = 0.5V to 3V,<br>R <sub>L</sub> = 2kΩ, C <sub>L</sub> = 100pF,<br>Unity Gain | 25°C           | -   | 0.7  | -   | V/μs |
| GBW    | Gain Bandwidth            | V <sub>CC</sub> = MAX, f = 100kHz,<br>V <sub>IN</sub> = 10mV, R <sub>L</sub> = 2kΩ,<br>C <sub>L</sub> = 100pF          | 25°C           | -   | 700  | -   | kHz  |
| THD    | Total Harmonic Distortion | f = 1kHz, A <sub>V</sub> = 20dB,<br>R <sub>L</sub> = 2kΩ, V <sub>O</sub> = 2Vpp,<br>C <sub>L</sub> = 100pF             | 25°C           | -   | 0.04 | -   | %    |

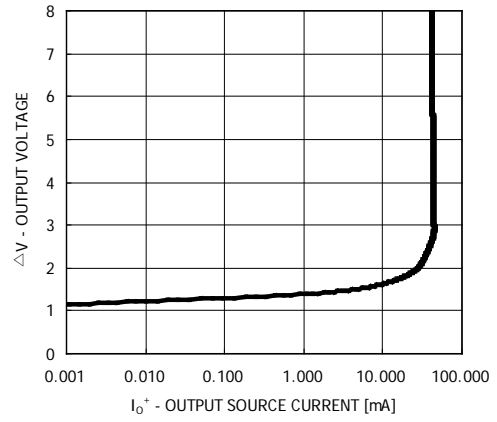
Note 3. Temperature full range is -40°C to +125°C. V<sub>CC</sub> MAX for testing purpose is 36V.

Note 4. All characteristics are measure under open loop conditions with zero common-mode input voltage unless otherwise specified.

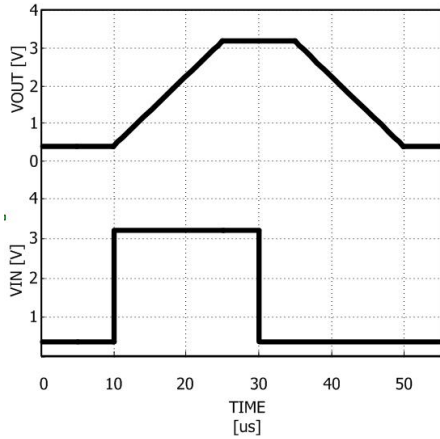
## TYPICAL OPERATING CHARACTERISTICS



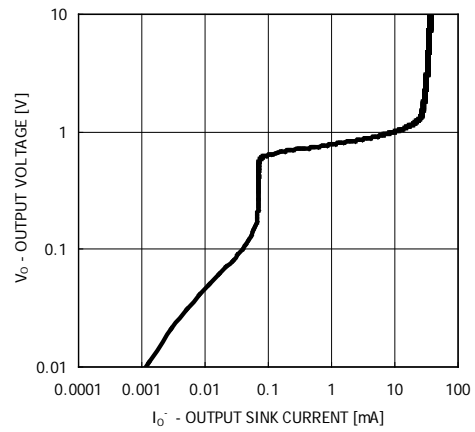
Supply current vs. Supply voltage



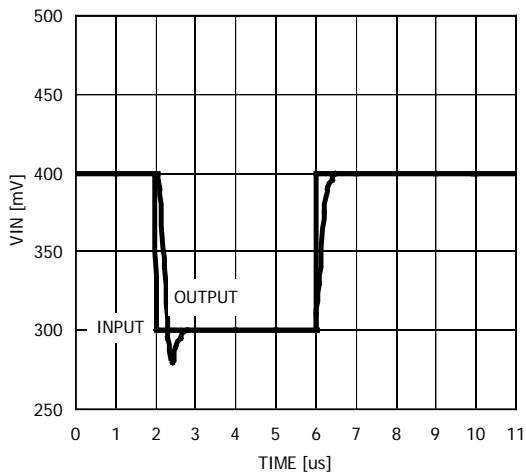
Current Sourcing vs. Output Characteristics



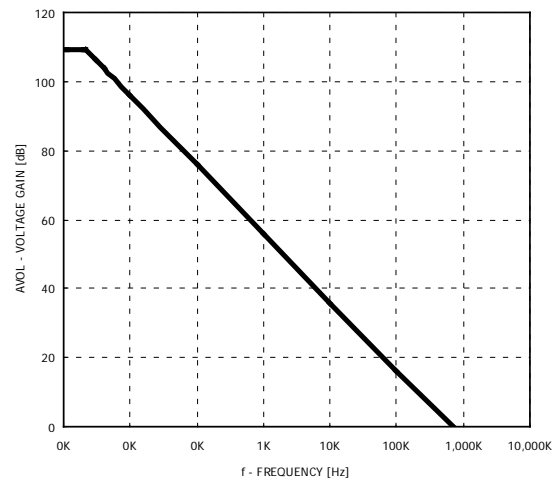
Voltage Follower Pulse Response



Current Sinking vs. Output Characteristics



Voltage Follower Pulse Response (Small Signal)



Open Loop Frequency Response

## REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.