



LM2904B

LINEAR INTEGRATED CIRCUIT

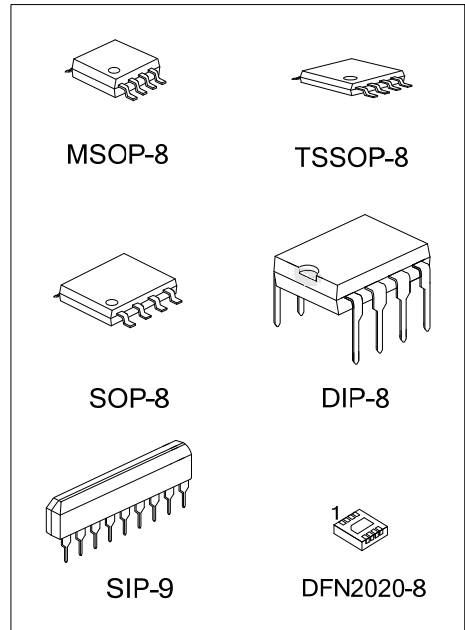
DUAL OPERATIONAL AMPLIFIER

DESCRIPTION

The UTC **LM2904B** consists of two independent high gain, internally frequency compensated operational amplifier. It can be operated from a single power supply and also split power supplies.

FEATURES

- *Internally frequency compensated for unity gain.
- *Wide power supply range 3V - 36V.
- *Input common-mode voltage range include ground.
- *Large DC voltage gain.
- *High ESD (2kV, HBM)



ORDERING INFORMATION

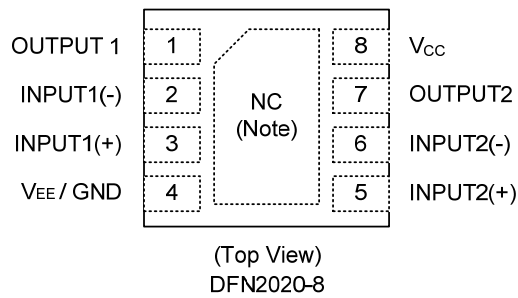
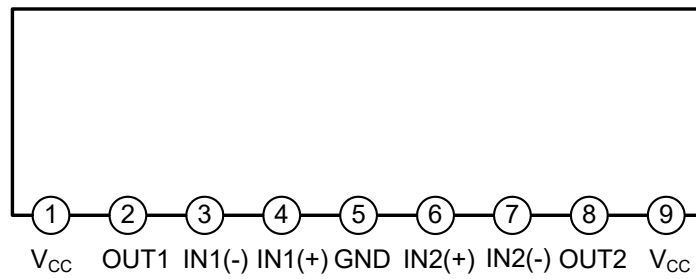
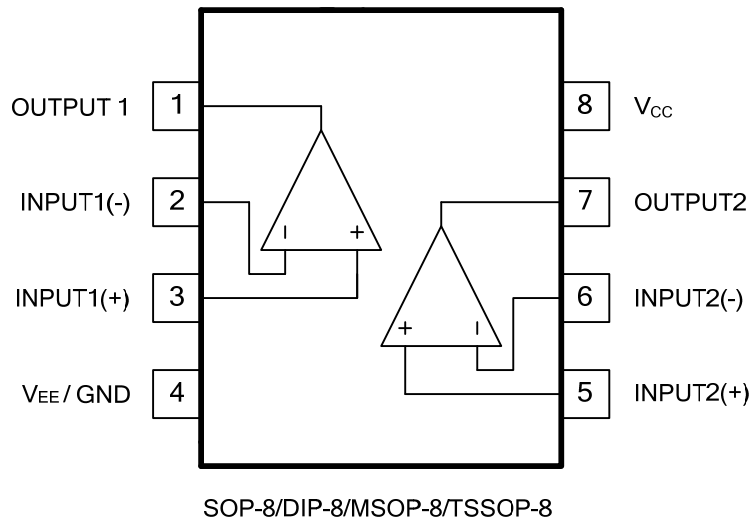
| Ordering Number | | Package | Packing |
|---------------------|---------------------|-----------|-----------|
| Lead Free | Halogen-Free | | |
| LM2904BL-D08-T | LM2904BG-D08-T | DIP-8 | Tube |
| LM2904BL-L09-T | LM2904BG-G09-T | SIP-9 | Tube |
| LM2904BL-P08-R | LM2904BG-P08-R | TSSOP-8 | Tape Reel |
| LM2904BL-S08-R | LM2904BG-S08-R | SOP-8 | Tape Reel |
| LM2904BL-SM1-R | LM2904BG-SM1-R | MSOP-8 | Tape Reel |
| LM2904BL-K08-2020-R | LM2904BG-K08-2020-R | DFN2020-8 | Tape Reel |

| | |
|--|---|
| <p>LM2904BG-D08-T</p> <p>(1) Packing Type (2) Package Type (3) Green Package</p> | <p>(1) T: Tube, R: Tape Reel (2) D08: DIP-8, G09: SIP-9, S08: SOP-8, P08: TSSOP-8, SM1: MSOP-8, K08-2020: DFN2020-8 (3) G: Halogen Free and Lead Free, L: Lead Free</p> |
|--|---|

MARKING

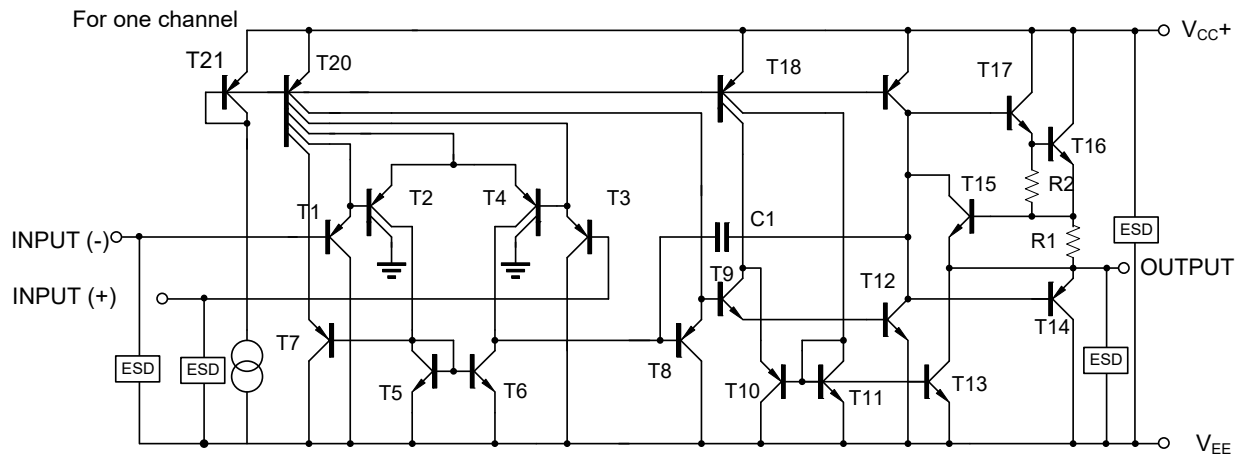
| DIP-8 | SOP-8/MSOP-8 | TSSOP-8 |
|-------|--------------|---------|
| | | |
| SIP-9 | DFN2020-8 | |
| | | |

■ PIN DESCRIPTION



Note: No connect.

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|--------------------------------|---|---------------|----------------|------|
| Supply Voltage | | V_{CC} | ± 20 or 40 | V |
| Differential Input Voltage | | $V_{I(DIFF)}$ | ± 32 | V |
| Input Voltage | | V_I | -0.3 ~ +40 | V |
| Output Short to Ground | | | Continuous | |
| Power Dissipation | SIP-9 | P_D | 750 | mW |
| | DIP-8 | | 625 | mW |
| | SOP-8 | | 440 | mW |
| | TSSOP-8 | | 360 | mW |
| | MSOP-8 | | 300 | mW |
| | DFN2020-8 | | 830 | mW |
| Electrostatic Discharge | Human-Body Model (HBM) Per JESD22-A114/115 | $V_{(ESD)}$ | 2000 | V |
| Junction Temperature | | T_J | +150 | °C |
| Operating Temperature (Note 2) | | T_{OPR} | -40 ~ +125 | °C |
| Storage Temperature | | T_{STG} | -65 ~ +150 | °C |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

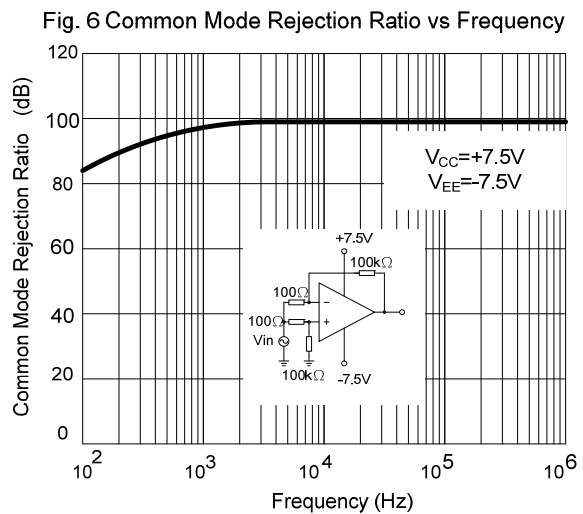
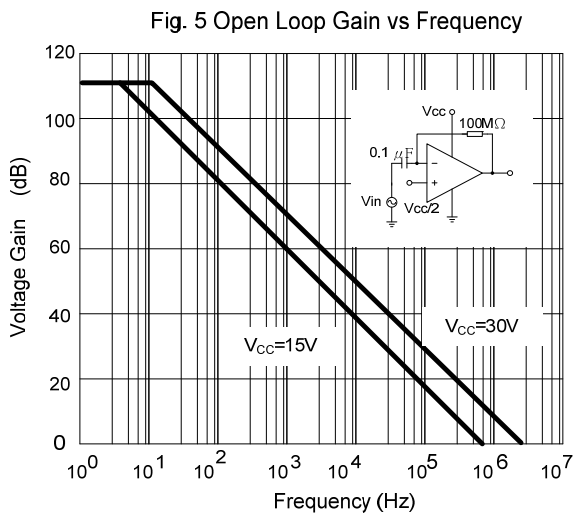
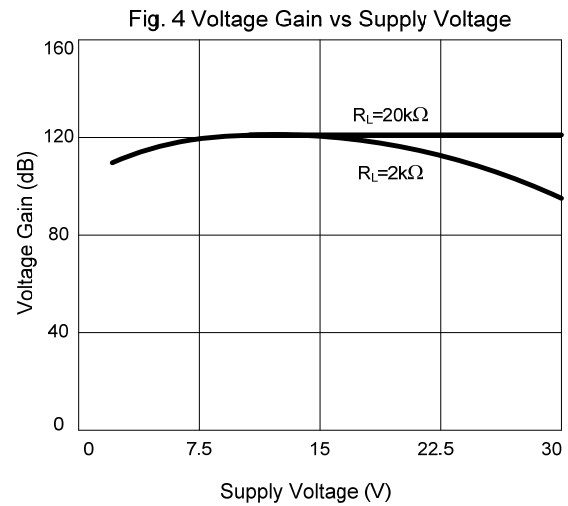
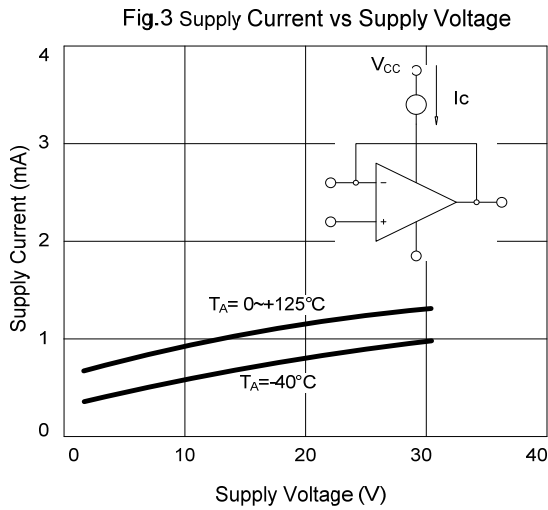
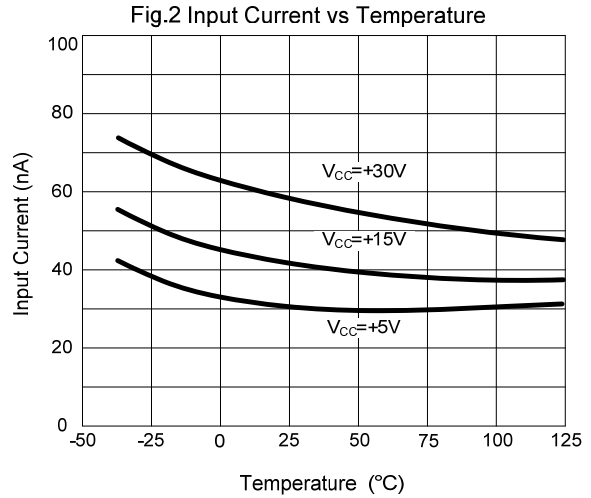
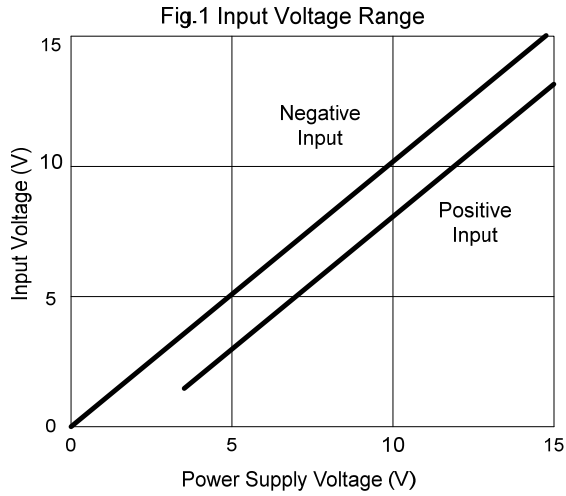
Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. It is guarantee by design, not 100% be tested.

■ ELECTRICAL CHARACTERISTICS ($V_{CC} - V_{EE} = 5 \sim 36V$, $T_A = 25^\circ C$, unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT | |
|---------------------------------|---------------|---|----------------|----------------|----------------|------------|----|
| Input Offset Voltage | $V_{I(OFF)}$ | | | 1.0 | 3.0 | mV | |
| Input Common Mode Voltage | $V_{I(CM)}$ | $V_{CC} = 3V \sim 36V$ | 0 | | $V_{CC} - 1.5$ | V | |
| Input Offset Current | $I_{I(OFF)}$ | | | 5 | 20 | nA | |
| Input Bias Current | $I_{I(BIAS)}$ | | | 10 | 40 | nA | |
| Output Voltage Swing | V_{OH} | $I_O = 50\mu A$ | $V_{CC} - 1.5$ | $V_{CC} - 1.4$ | | V | |
| | | $I_O = 1mA$ | $V_{CC} - 1.6$ | $V_{CC} - 1.5$ | | V | |
| | | $I_O = 5mA$ | $V_{CC} - 1.7$ | $V_{CC} - 1.6$ | | V | |
| | V_{OL} | $I_O = 50\mu A$ | | | 20 | | mV |
| | | $I_O = 1mA$ | | | 0.75 | 1 | V |
| | | | | | | | |
| Large Signal Voltage Gain | A_V | $V_{CC} = 15V$, $R_L \geq 10K\Omega$ $V_{O(P)} = 1V \sim 11V$ | 90 | 96 | | dB | |
| Supply Current/Amplifier | I_Q | $R_L = \infty$, $V_{CC} = 36V$ | | | 800 | μA | |
| | | $R_L = \infty$, $V_{CC} = 5V$ | | 320 | 460 | μA | |
| Short Circuit Current to Ground | I_{SC} | $V_{CC} = \pm 10V$, $V_O = 0V$ | | 50 | 70 | mA | |
| Output Current | I_{SOURCE} | $V_I(+)=1V$, $V_I(-)=0V$ $V_{CC} = 15V$, $V_O = V_{EE}$ | 20 | 50 | | mA | |
| | | $V_I(+)=0V$, $V_I(-)=1V$ $V_{CC} = 15V$, $V_O = V_{CC}$ | 10 | 40 | | mA | |
| | I_{SINK} | $V_I(+)=0V$, $V_I(-)=1V$ $V_{CC} = 15V$, $V_{O(P)} = 200mV$ | 60 | 135 | | μA | |
| | | | | | | | |
| Common Mode Rejection Ratio | CMRR | $V_{CC} = 3V \sim 36V$ | 80 | 100 | | dB | |
| Power Supply Rejection Ratio | PSRR | | 95 | 100 | | dB | |
| Channel Separation | CS | $f = 1KHZ \sim 20KHZ$ | | 120 | | dB | |
| Gain Bandwidth Product | GBW | | | 1.1 | | MHz | |
| Slew Rate | SR | | | 0.6 | | V/ μs | |

TYPICAL CHARACTERISTICS



TYPICAL CHARACTERISTICS (Cont.)

Fig. 7 Voltage Follower Pulse Response

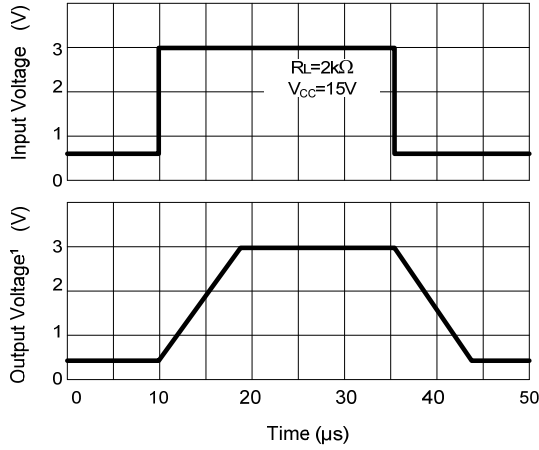


Fig. 8 Voltage Follower Response (Small Signal)

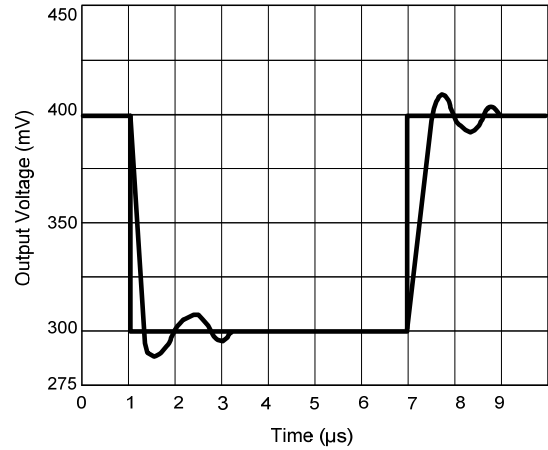


Fig. 9 Gain vs. Large Signal Frequency

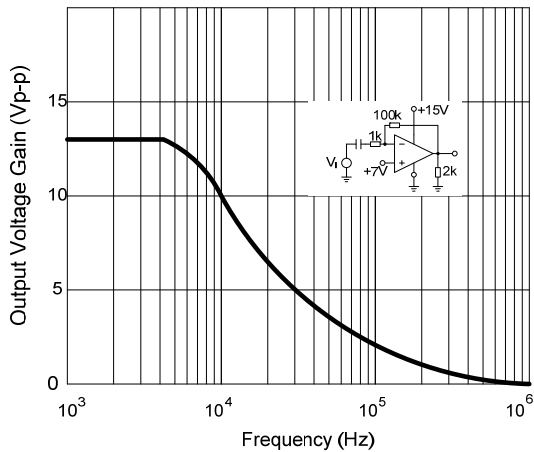


Fig. 10 Output Source Current vs Output Voltage

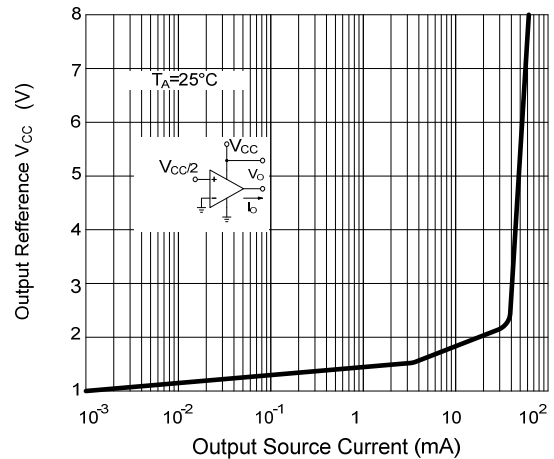


Fig. 11 Output Sink Current vs Output Voltage

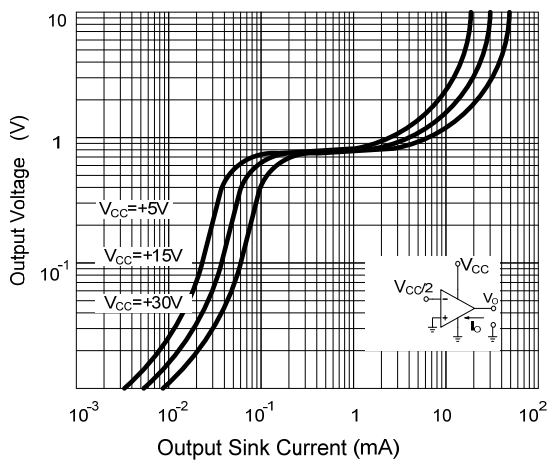
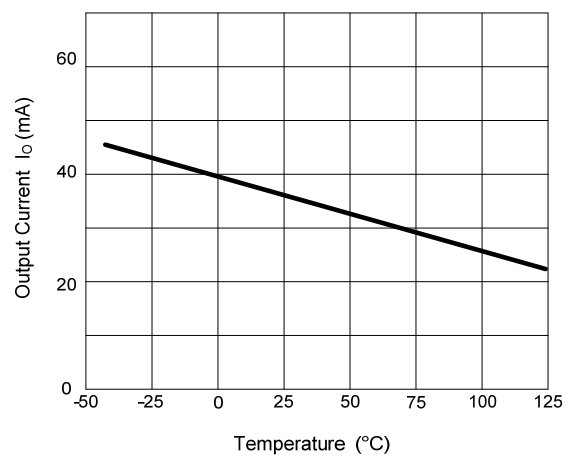


Fig. 12 Current Limiting vs Temperature



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