# Signetics

# AU2904
## Low Power Dual Operational Amplifier

*Preliminary Specification*

**Linear Products**

## DESCRIPTION

The AU2904 consists of two independent, high-gain, internally frequency-compensated operational amplifiers designed specifically to operate from a single power supply over a wide range of voltages. Operation from dual power supplies is also possible, and the low power supply current drain is independent of the magnitude of the power supply voltage.
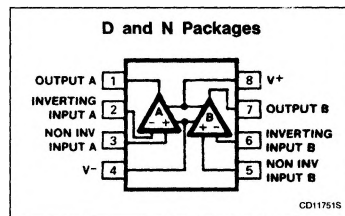
## UNIQUE FEATURES

In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

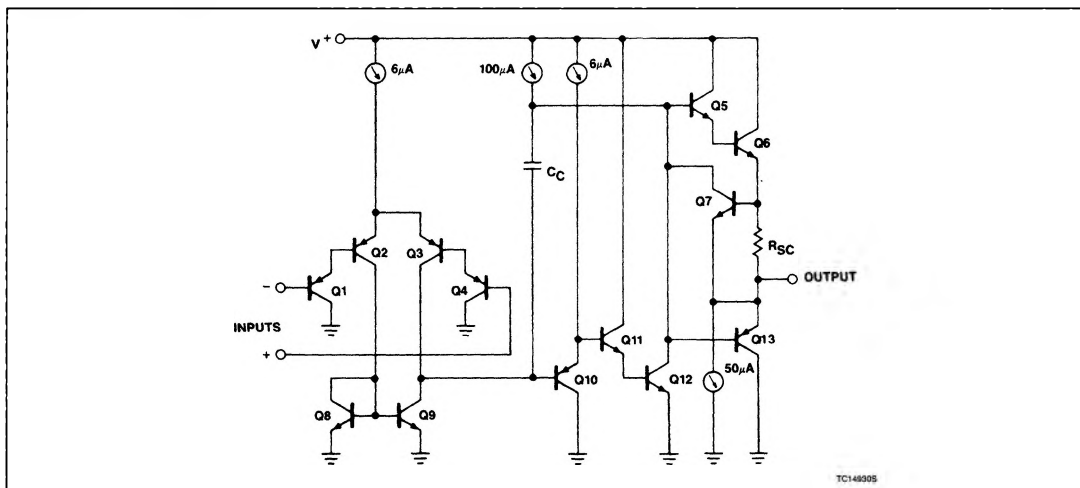The unity gain crossover frequency and the input bias current are temperature-compensated.

## FEATURES

- **Internally frequency-compensated for unity gain**
- **Large DC voltage gain: 100dB**
- **Wide bandwidth (unity gain): 1MHz (temperature-compensated)**
- **Wide power supply range**
  Single supply: $3V_{DC}$ to $30V_{DC}$ or dual supplies: $\pm 1.5V_{DC}$ to $\pm 15V_{DC}$
- **Very low supply current drain (400$\mu$A): essentially independent of supply voltage (1mW/op amp at $+5V_{DC}$)**
- **Low input bias current: $45nA_{DC}$ (temperature-compensated)**
- **Low input offset voltage: $2mV_{DC}$ and offset current: $5nA_{DC}$**
- **Differential input voltage range equal to the power supply voltage**
- **Large output voltage: $0V_{DC}$ to $V+ - 1.5V_{DC}$ swing**

## PIN CONFIGURATION

**D and N Packages**

| | | |
|---|---|---|
| OUTPUT A | 1 | 8 V+ |
| INVERTING INPUT A | 2 | 7 OUTPUT B |
| NON INV INPUT A | 3 | 6 INVERTING INPUT B |
| V− | 4 | 5 NON INV INPUT B |

CD11751S

## EQUIVALENT CIRCUIT



TC14930S

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## ORDERING INFORMATION

| DESCRIPTION | TEMPERATURE RANGE | ORDER CODE |
|---|---|---|
| 8-Pin Plastic DIP | −40°C to +125°C | AU2904N |
| 8-Pin Plastic SO | −40°C to +125°C | AU2904D |

## ABSOLUTE MAXIMUM RATINGS

| SYMBOL | PARAMETER | RATING | UNIT |
|---|---|---|---|
| $V_S$ | Supply voltage V+ | 32 or ±16 | $V_{DC}$ |
| | Differential input voltage | 32 | $V_{DC}$ |
| $V_{IN}$ | Input voltage | −0.3 to +32 | $V_{DC}$ |
| $P_{DMAX}$ | Maximum power dissipation, $T_A$ = 25°C (still-air)[1]<br>N package<br>D package | <br><br>1160<br>780 | <br><br>mW<br>mW |
| | Output short-circuit to GND[5]<br>V+ < 15$V_{DC}$ and $T_A$ = 25°C | <br>Continuous | |
| $T_A$ | Operating ambient temperature range<br>AU2904 | <br>−40 to +125 | °C |
| $T_{STG}$ | Storage temperature range | −65 to +150 | °C |
| $T_{SOLD}$ | Lead soldering temperature (10sec max) | 300 | °C |

**NOTES:**
1. Derate above 25°C, at the following rates:
   N package at 9.3mW/°C
   D package at 6.2mW/°C

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## DC ELECTRICAL CHARACTERISTICS $T_A = 25°C$, $V+ = +5V$, unless otherwise specified.

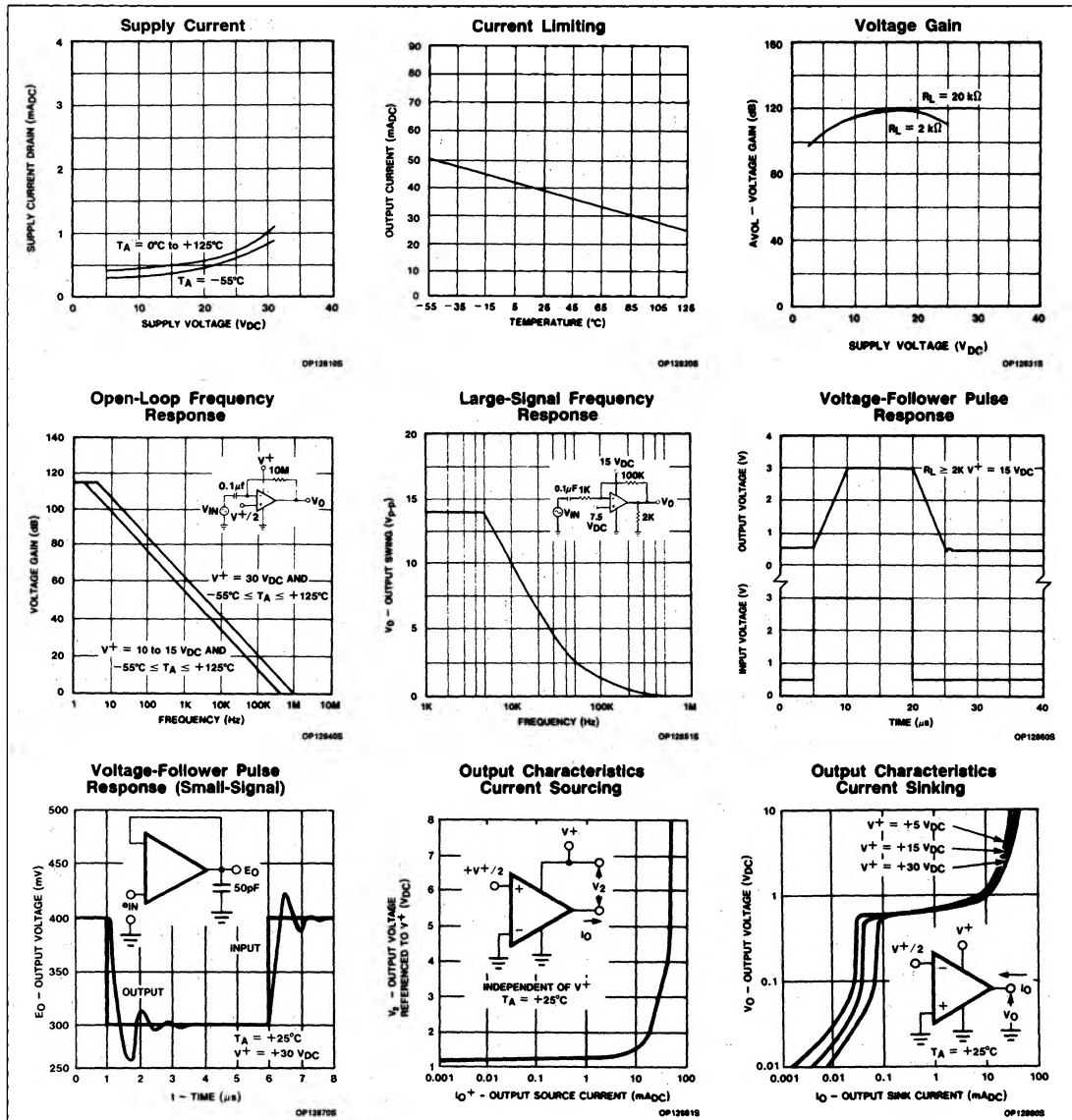| SYMBOL | PARAMETER | TEST CONDITIONS | AU2904 | | | UNIT |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $V_{OS}$ | Offset voltage[1] | $R_S = 0\Omega$ | | ±2 | ±7 | mV |
| | | $R_S = 0\Omega$, over temp. | | | ±9 | mV |
| $V_{OS}$ | Drift | $R_S = 0\Omega$, over temp. | | 7 | | µV/°C |
| $I_{OS}$ | Offset current | $I_{IN}(+) - I_{IN}(-)$ | | ±5 | ±50 | nA |
| | | Over temp. | | | ±150 | nA |
| $I_{OS}$ | Drift | Over temp. | | 10 | | pA/°C |
| $I_{BIAS}$ | Input current[2] | $I_{IN}(+)$ or $I_{IN}(-)$ | | 45 | 250 | nA |
| | | Over temp., $I_{IN}(+)$ or $I_{IN}(-)$ | | 40 | 500 | nA |
| $I_{BIAS}$ | Drift | Over temp. | | 50 | | pA/°C |
| $V_{CM}$ | Common-mode voltage range[3] | $V+ = 30V$ | 0 | | $V+ - 1.5$ | V |
| | | Over temp., $V+ = 30V$ | 0 | | $V+ - 2.0$ | V |
| CMRR | Common-mode rejection ratio | $V+ = 30V$ | 65 | 70 | | dB |
| $V_{OH}$ | Output voltage swing | $R_L \geqslant 2k\Omega$, $V+ = 30V$, over temp. | 26 | | | V |
| | | $R_L \geqslant 10k\Omega$, $V+ = 30V$, over temp. | 27 | 26 | | V |
| $V_{OL}$ | Output voltage swing | $R_L \geqslant 10k\Omega$, Over temp. | | 5 | 20 | mV |
| $I_{CC}$ | Supply current | $R_L = \infty$, $V+ = 30V$ $R_L = \infty$ on all amplifiers, Over temp., $V+ = 30V$ | | 0.5 0.6 | 1.0 1.2 | mA mA |
| $A_{VOL}$ | Large-signal voltage gain | $R_L \geqslant 2k\Omega$, $V_{OUT} \pm 10V$, $V+ = 15V$ Over temp. | 25 15 | 100 | | V/mV V/mV |
| PSRR | Supply voltage rejection ratio | $R_S = 0\Omega$ | 65 | 100 | | dB |
| | Amplifier-to-amplifier coupling[4] | f = 1kHz to 20kHz (input referred) | | −120 | | dB |
| $I_{OUT}$ | Output current Source | $V_{IN+} = +1V_{DC}$, $V_{IN-} = 0V_{DC}$, $V+ = 15V_{DC}$ | 20 | 40 | | mA |
| | | $V_{IN+} = +1V_{DC}$, $V_{IN-} = 0V_{DC}$, $V+ = 15V_{DC}$, over temp. | 10 | 20 | | mA |
| | Sink | $V_{IN-} = +1V_{DC}$, $V_{IN+} = 0V_{DC}$, $V+ = 15V_{DC}$ | 10 | 20 | | mA |
| | | $V_{IN-} = +1V_{DC}$, $V_{IN+} = 0V_{DC}$, $V+ = 15V_{DC}$, over temp. | 5 | 8 | | mA |
| | | $V_{IN+} = 0V$, $V_{IN-} = +1V_{DC}$, $V_O = 200mV$ | 12 | 50 | | µA |
| $I_{SC}$ | Short circuit current[5] | | | 40 | 60 | mA |
| | Differential input voltage[3] | | | | $V+$ | V |
| GBW | Unity gain bandwidth | $T_A = 25°C$ | | 1 | | MHz |
| SR | Slew rate | $T_A = 25°C$ | | 0.3 | | V/µs |
| $V_{NOISE}$ | Input noise voltage | $T_A = 25°C$, f = 1kHz | | 40 | | nV/√Hz |

**NOTES:**
1. $V_O \cong 1.4V$, $R_S \approx 0\Omega$ with $V_{CC}$ from 5V to 30V and over full input common-mode range ($0V_{DC}+$ to $V_{CC} - 1.5V$).
2. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
3. The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is $V+ - 1.5$, but either or both inputs can go to +32V without damage.
4. Due to proximity of external components, insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of coupling increases at higher frequencies.
5. Short-circuits from the output to $V+$ can cause excessive heating and eventual destruction. The maximum output current is approximately 40mA independent of the magnitude of $V+$. At values of supply voltage in excess of $+15V_{DC}$, continuous short-circuits can exceed the power dissipation ratings and cause eventual destruction.
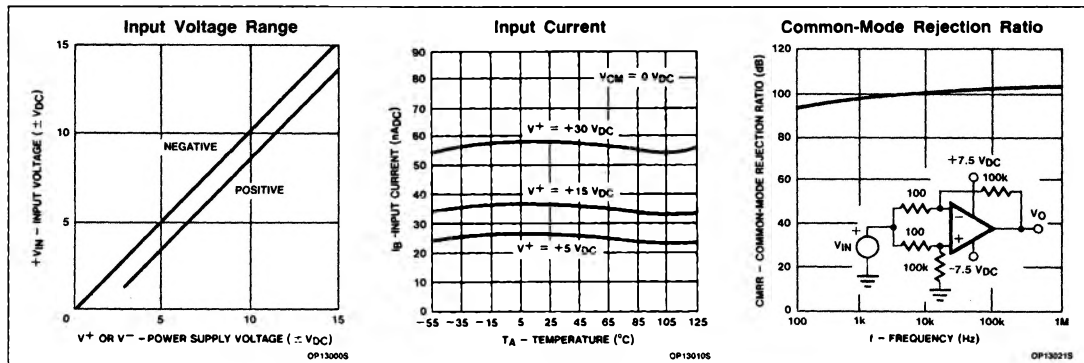
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## TYPICAL PERFORMANCE CHARACTERISTICS

### Supply Current



OP12810S

### Current Limiting



OP12820S

### Voltage Gain



OP12831S

### Open-Loop Frequency Response



OP12940S

### Large-Signal Frequency Response



OP12851S

### Voltage-Follower Pulse Response



OP12860S

### Voltage-Follower Pulse Response (Small-Signal)



OP12870S

### Output Characteristics Current Sourcing



OP12881S

### Output Characteristics Current Sinking



OP12890S

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## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

**Input Voltage Range**

**Input Current**

**Common-Mode Rejection Ratio**

## TYPICAL APPLICATIONS

**Single Supply Inverting Amplifier**

**Input Biasing Voltage-Follower**

**Non-Inverting Amplifier**