

## Low-power / Low-voltage Precision Amplifier

### Features

- Low Offset:
  - 10  $\mu\text{V}$  Typ.
- Low Drift:
  - 0.05  $\mu\text{V}/^\circ\text{C}$  Max.
- Low Noise:
  - 22  $\text{nV}/\sqrt{\text{Hz}}$
- Open-loop Voltage Gain:
  - 135 dB Typ.
- Rail-to-Rail Inputs
- Rail-to-Rail Output Swing
  - to within 20 mV of supply voltage
- 1.0 mA Supply Current
- Slew rate:
  - 0.25  $\text{V}/\mu\text{s}$

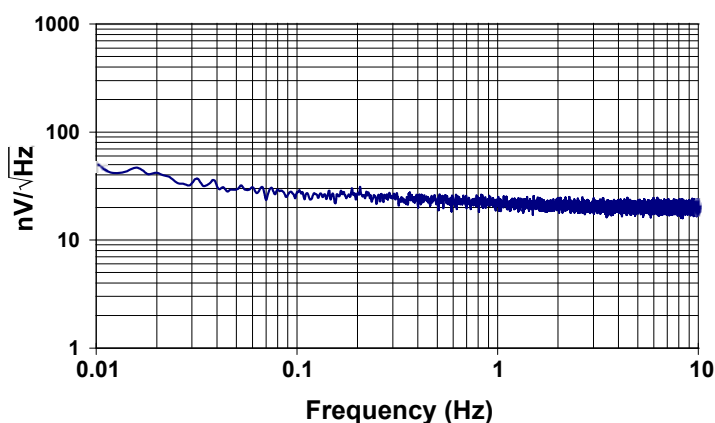
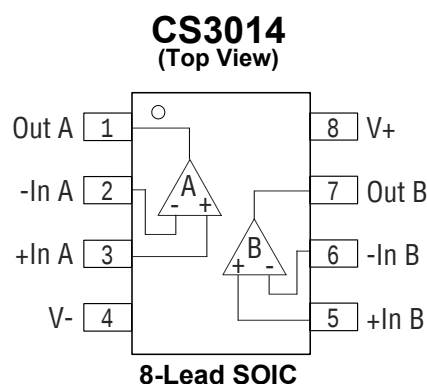
### Applications

- Thermocouple/Thermopile Amplifiers
- Load Cell and Bridge Transducer Amplifiers
- Precision Instrumentation
- Battery-powered Systems

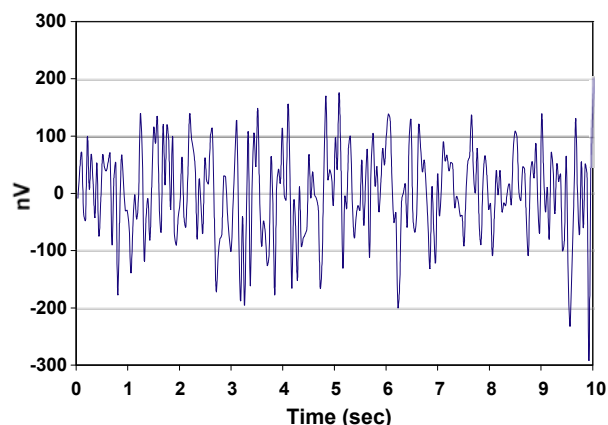
### Description

The CS3004 dual amplifier is designed for precision amplification of low-level signals. These amplifiers achieve excellent offset stability, high open loop gain, and low noise. The devices also exhibit excellent CMRR and PSRR. The common mode input range includes the supply rails. The amplifiers operate with any supply voltage from 2.7 V to 5 V ( $\pm 1.35$  V to  $\pm 2.50$  V).

### Pin Configuration



Noise vs. Frequency (Measured)



0.01 Hz to 10 Hz Noise Performance

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## 1. CHARACTERISTICS AND SPECIFICATIONS

### 1.1 5 V Electrical Characteristics

V+ = +5 V, ±5%; V- = 0V; VCM = 2.5 V; Unless otherwise noted, T<sub>A</sub> = 25° C (See Note 1).

| Parameter                                      |   | Min        | Typ   | Max        | Unit              |
|------------------------------------------------|---|------------|-------|------------|-------------------|
| Input Offset Voltage (Note 2)                  | • | -          | ±10   | ±20        | μV                |
| Average Input Offset Drift (Note 2)            | • | -          | ±0.01 | ±0.05      | μV/°C             |
| Input Bias Current                             | • | -          | ±170  | ±250       | pA                |
|                                                | • | -          | -     | ±1.5       | nA                |
| Input Offset Current                           | • | -          | ±340  | ±500       | pA                |
|                                                | • | -          | -     | ±3.0       | nA                |
| Input Noise Voltage Density                    |   | -          | 22    | -          | nV/√Hz            |
| R <sub>S</sub> = 100 Ω, f <sub>0</sub> = 1 Hz  |   | -          | 22    | -          | nV/√Hz            |
| R <sub>S</sub> = 100 Ω, f <sub>0</sub> = 1 kHz |   | -          | -     | -          | -                 |
| Input Noise Voltage                            |   | -          | 460   | -          | nV <sub>p-p</sub> |
| 0.1 to 10 Hz                                   |   | -          | -     | -          | -                 |
| Input Noise Current Density                    |   | -          | 100   | -          | fA/√Hz            |
| f <sub>0</sub> = 1 Hz                          |   | -          | -     | -          | -                 |
| Input Noise Current                            |   | -          | 1.9   | -          | pA <sub>p-p</sub> |
| 0.1 to 10 Hz                                   |   | -          | -     | -          | -                 |
| Input Voltage Range (Note 2)                   | • | V-         | -     | V+         | V                 |
| Common Mode Rejection Ratio (dc)               | • | 105        | 120   | -          | dB                |
| Power Supply Rejection Ratio                   | • | 100        | 120   | -          | dB                |
| Large Signal Voltage Gain                      |   | -          | 145   | -          | dB                |
| (Note 3) R <sub>L</sub> = 2 kΩ to V+/2         | • | 112        | 135   | -          | dB                |
| Output Voltage Swing                           |   | (V+ - 200) | -     | (V- + 200) | mV                |
| (Note 4) R <sub>L</sub> = 2 kΩ to V+/2         | • | (V+ - 20)  | -     | (V- + 20)  | mV                |
| R <sub>L</sub> = 100 kΩ to V+/2                |   | -          | -     | -          | -                 |
| Slew Rate                                      |   | -          | 0.25  | -          | V/μs              |
| R <sub>L</sub> = 2 k, 100 pF                   |   | -          | -     | -          | -                 |
| Overload Recovery Time                         |   | -          | 40    | -          | μs                |
| Supply Current                                 | • | -          | 1.0   | 1.25       | mA                |
| Oscillator Frequency                           |   | -          | 125   | -          | kHz               |
| Input Capacitance                              |   | -          | 1.5   | -          | pF                |
| Differential                                   |   | -          | -     | -          | -                 |
| Common Mode                                    |   | -          | 10    | -          | pF                |

- Notes:
1. Symbol “•” denotes specification applies over -40 to +125 ° C.
  2. This parameter is guaranteed by design and/or laboratory characterization.
  3. Guaranteed within the output limits of (V+ - 0.2 V) to (V- + 0.2 V).
  4. Specifies the worst case drive voltage relative to the supply rail under stated load conditions.

## 1.2 3 V Electrical Characteristics

V+ = +3 V, ±10%; V- = 0V; VCM = 1.5 V; Unless otherwise noted, T<sub>A</sub> = 25° C (See Note 5).

| Parameter                                      |   | Min        | Typ   | Max        | Unit              |
|------------------------------------------------|---|------------|-------|------------|-------------------|
| Input Offset Voltage (Note 6)                  | • | -          | ±10   | ±20        | μV                |
| Average Input Offset Drift (Note 6)            | • | -          | ±0.01 | ±0.05      | μV/°C             |
| Input Bias Current                             | • | -          | ±110  | ±150       | pA                |
|                                                | • | -          | -     | ±1.0       | nA                |
| Input Offset Current                           | • | -          | ±220  | ±300       | pA                |
|                                                | • | -          | -     | ±2.0       | nA                |
| Input Noise Voltage Density                    |   |            |       |            |                   |
| R <sub>S</sub> = 100 Ω, f <sub>0</sub> = 1 Hz  |   | -          | 22    | -          | nV/√Hz            |
| R <sub>S</sub> = 100 Ω, f <sub>0</sub> = 1 kHz |   | -          | 22    | -          | nV/√Hz            |
| Input Noise Voltage                            |   | -          | 460   | -          | nV <sub>p-p</sub> |
| Input Noise Current Density                    |   | -          | 100   | -          | fA/√Hz            |
| Input Noise Current                            |   | -          | 1.9   | -          | pA <sub>p-p</sub> |
| Input Voltage Range (Note 6)                   | • | V-         | -     | V+         | V                 |
| Common Mode Rejection Ratio (dc)               | • | 105        | 120   | -          | dB                |
| Power Supply Rejection Ratio                   | • | 100        | 120   | -          | dB                |
| Large Signal Voltage Gain                      |   | -          | 145   | -          | dB                |
| (Note 7) R <sub>L</sub> = 2 kΩ to V+/2         | • | 112        | 135   | -          | dB                |
| Output Voltage Swing                           |   |            |       |            |                   |
| (Note 8) R <sub>L</sub> = 2 kΩ to V+/2         | • | (V+ - 200) | -     | (V- + 200) | mV                |
| R <sub>L</sub> = 100 kΩ to V+/2                |   | (V+ - 20)  | -     | (V- + 20)  | mV                |
| Slew Rate                                      |   | -          | 0.25  | -          | V/μs              |
| Overload Recovery Time                         |   | -          | 40    | -          | μs                |
| Supply Current                                 | • | -          | 1.0   | 1.25       | mA                |
| Oscillator Frequency                           |   | -          | 125   | -          | kHz               |
| Input Capacitance                              |   |            |       |            |                   |
| Differential                                   |   | -          | 1.5   | -          | pF                |
| Common Mode                                    |   | -          | 10    | -          | pF                |

Notes: 5. Symbol “•” denotes specification applies over -40 to +125 ° C.

6. This parameter is guaranteed by design and laboratory characterization.

7. Guaranteed within the output limits of (V+ - 0.2 V) to (V- + 0.2 V).

8. Specifies the worst case drive voltage relative to the supply rail under stated load conditions.

### 1.3 Absolute Maximum Ratings

| Parameter                    | Min T        | yp | Max          | Unit |
|------------------------------|--------------|----|--------------|------|
| Supply Voltage [(V+) – (V-)] | 2.7          | -  | 5.5          | V    |
| Input Voltage                | (V-) – (0.3) | -  | (V+) + (0.3) | V    |
| Storage Temperature Range    | -65          | -  | +150         | °C   |

## 2. TYPICAL PERFORMANCE PLOTS

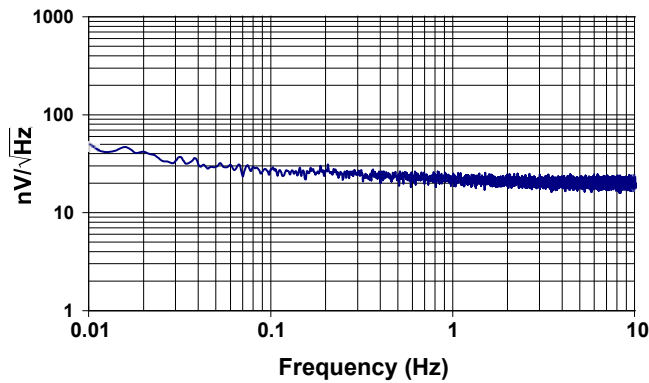


Figure 1. Noise vs. Frequency (Measured)

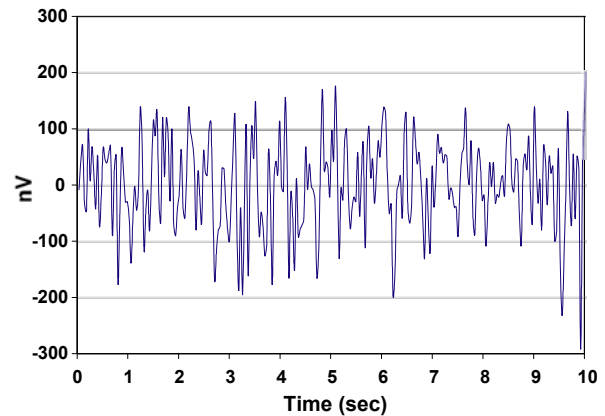


Figure 2. 0.01 Hz to 10 Hz Noise

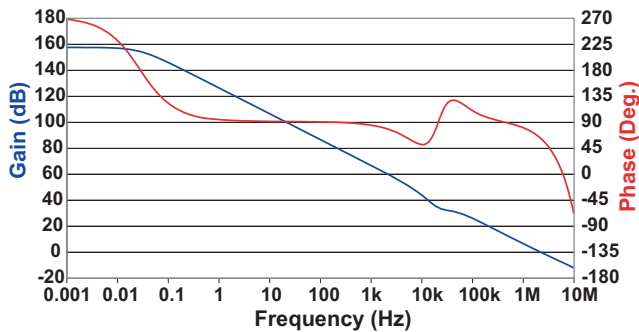


Figure 3. Gain & Phase vs. Frequency (2.7 V)

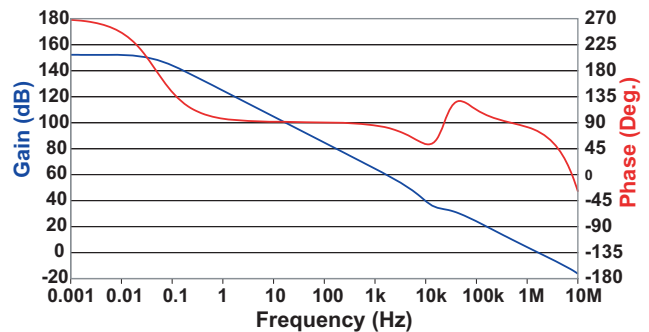


Figure 4. Gain & Phase vs. Frequency (5 V)

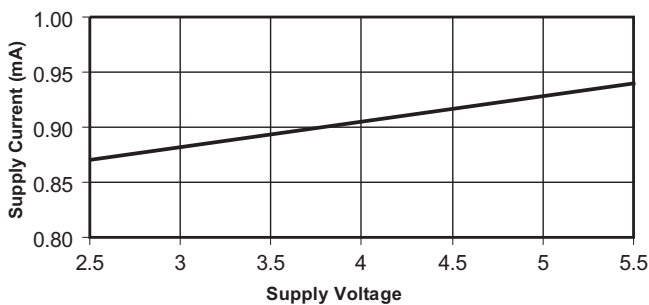


Figure 5. Supply Current vs. Supply Voltage

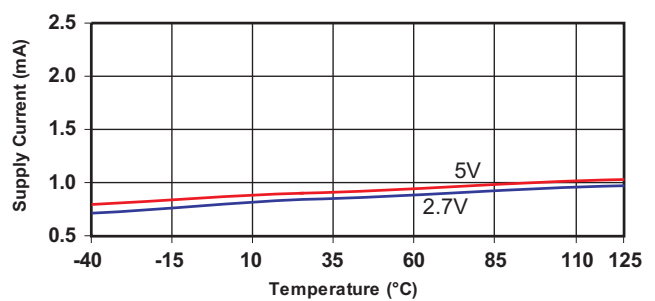
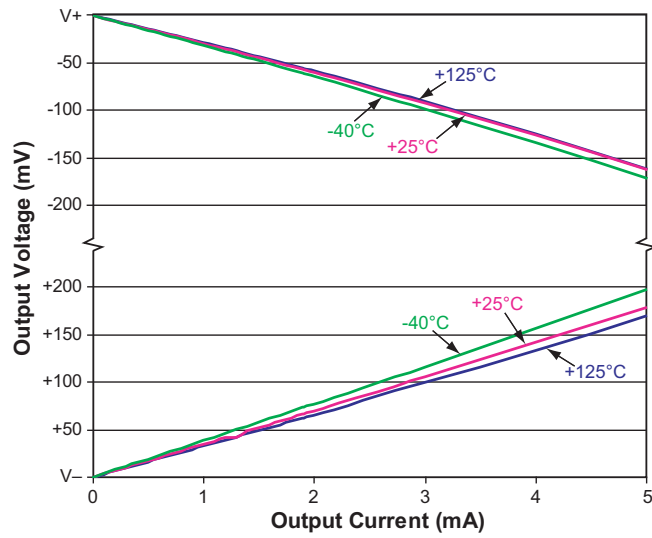
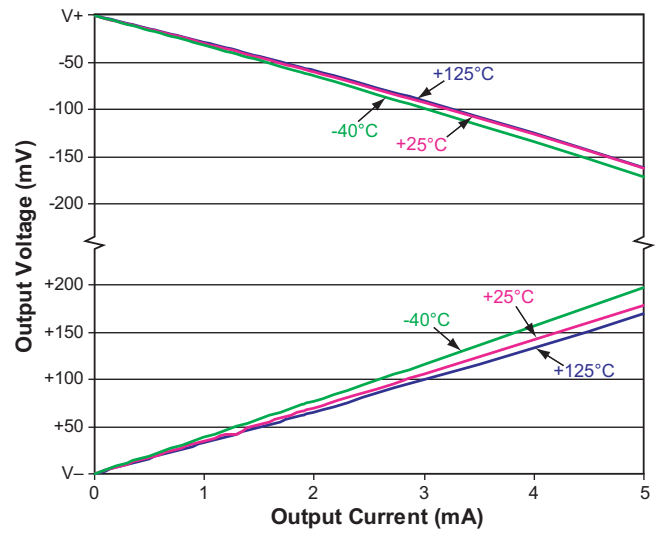


Figure 6. Supply Current vs. Temperature

## Typical Performance Plots (Cont.)



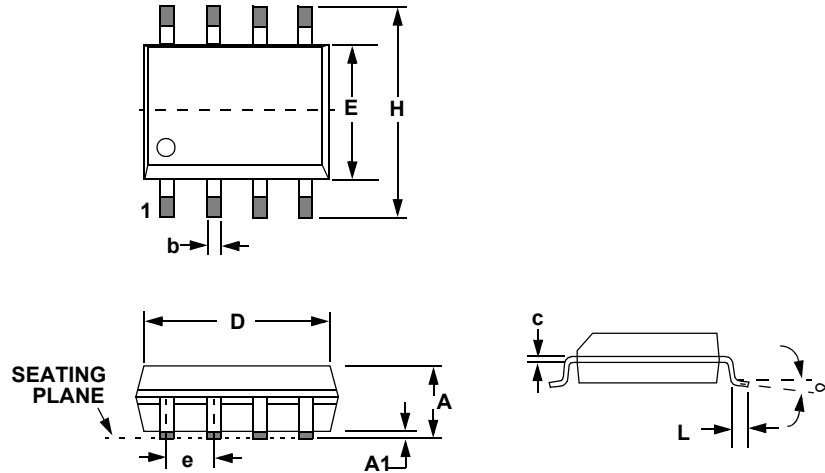
**Figure 7. Voltage Swing vs. Output Current (2.7 V)**



**Figure 8. Voltage Swing vs. Output Current (5 V)**

### 3. PACKAGE DRAWINGS

#### 8L SOIC (150 MIL BODY) PACKAGE DRAWING



| DIM | INCHES |       | MILLIMETERS |      |
|-----|--------|-------|-------------|------|
|     | MIN    | MAX   | MIN         | MAX  |
| A   | 0.053  | 0.069 | 1.35        | 1.75 |
| A1  | 0.004  | 0.010 | 0.10        | 0.25 |
| B   | 0.013  | 0.020 | 0.33        | 0.51 |
| C   | 0.007  | 0.010 | 0.19        | 0.25 |
| D   | 0.189  | 0.197 | 4.80        | 5.00 |
| E   | 0.150  | 0.157 | 3.80        | 4.00 |
| e   | 0.040  | 0.060 | 1.02        | 1.52 |
| H   | 0.228  | 0.244 | 5.80        | 6.20 |
| L   | 0.016  | 0.050 | 0.40        | 1.27 |
| ∞   | 0°     | 8°    | 0°          | 8°   |

**JEDEC # : MS-012**

#### 4. ORDERING INFORMATION

| Part #     | Temperature Range | Package Description    |
|------------|-------------------|------------------------|
| CS3014-FSZ | -40 °C to +125 °C | 8-lead SOIC, Lead Free |

#### 5. ENVIRONMENTAL, MANUFACTURING, & HANDLING INFORMATION

| Model Number | Peak Reflow Temp | MSL Rating* | Max Floor Life |
|--------------|------------------|-------------|----------------|
| CS3014-FSZ   | 260 °C           | 2           | 365 Days       |

\* MSL (Moisture Sensitivity Level) as specified by IPC/JEDEC J-STD-020.

## 6. REVISION HISTORY

| Revision | Date     | Changes                                                                |
|----------|----------|------------------------------------------------------------------------|
| A1       | FEB 2007 | First public release.                                                  |
| F1       | AUG 2007 | Updated to "Final" per QPL process.                                    |
| F2       | JUL 2009 | Removed lead-containing SOIC & QFN packages from ordering information. |

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## Contacting Cirrus Logic Support

For all product questions and inquiries contact a Cirrus Logic Sales Representative.  
To find one nearest you go to <http://www.cirrus.com>

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