

## Dual Low-power / Low-voltage Precision Amplifier

### Features

- Low Offset:
  - 10  $\mu$ V Typ.
- Low Drift:
  - 0.05  $\mu$ V/ $^{\circ}$ C Max.
- Low Noise:
  - 22 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 V/ $\mu$ s

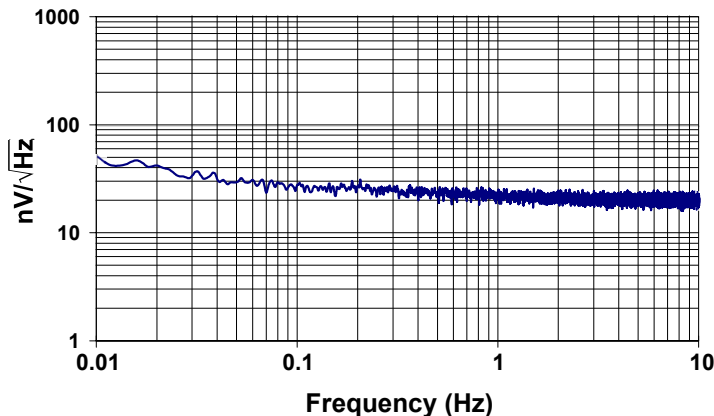
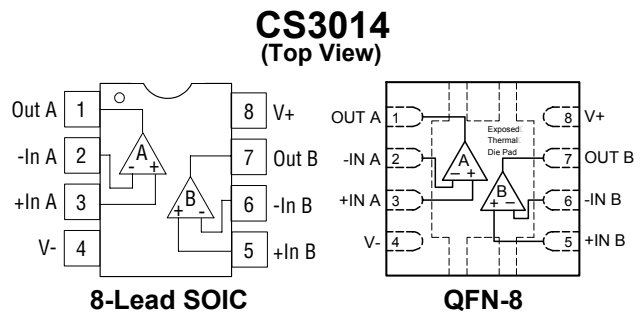
### Applications

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

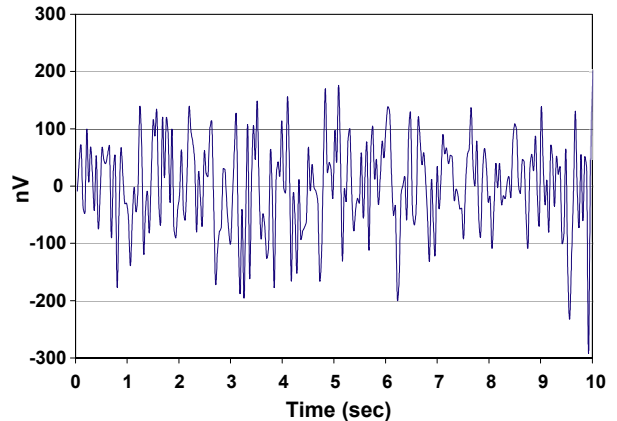
### Description

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 Configurations



Noise vs. Frequency (Measured)



0.01 Hz to 10 Hz Noise Performance

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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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#### IMPORTANT NOTICE

"Preliminary" product information describes products that are in production, but for which full characterization data is not yet available.

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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	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	0.1 to 10 Hz	-	460	-	nV <sub>p-p</sub>
Input Noise Current Density	f <sub>0</sub> = 1 Hz	-	100	-	fA/√Hz
Input Noise Current	0.1 to 10 Hz	-	1.9	-	pA <sub>p-p</sub>
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	-	dB
Output Voltage Swing	R <sub>L</sub> = 2 kΩ to V+/2	•	(V+ - 200)	(V- + 200)	mV
(Note 4)	R <sub>L</sub> = 100 kΩ to V+/2	•	(V+ - 20)	(V- + 20)	mV
Slew Rate	R <sub>L</sub> = 2 k, 100 pF	-	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:
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 = 2.5 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			0.1 to 10 Hz	460	nV <sub>p-p</sub>
Input Noise Current Density			f <sub>0</sub> = 1 Hz	100	fA/√Hz
Input Noise Current			0.1 to 10 Hz	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					
			R <sub>L</sub> = 2 kΩ to V+/2	145	dB
(Note 7)	•	112	135	-	dB
Output Voltage Swing					
			R <sub>L</sub> = 2 kΩ to V+/2	(V+ - 200)	mV
(Note 8)	•	(V+ - 20)	-	(V- + 200)	mV
			R <sub>L</sub> = 100 kΩ to V+/2	(V- + 20)	mV
Slew Rate			R <sub>L</sub> = 2 k, 100 pF	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	Typ	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. PERFORMANCE PLOTS

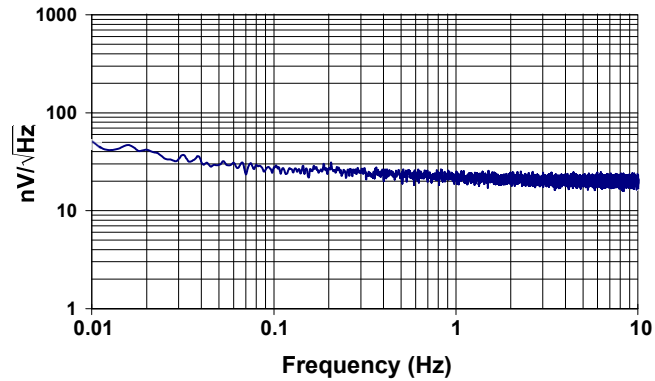


Figure 1. Noise vs Frequency (Measured)

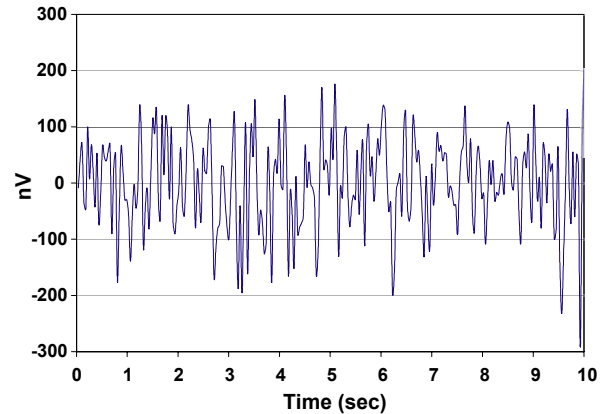


Figure 2. 0.01 Hz to 10 Hz Noise

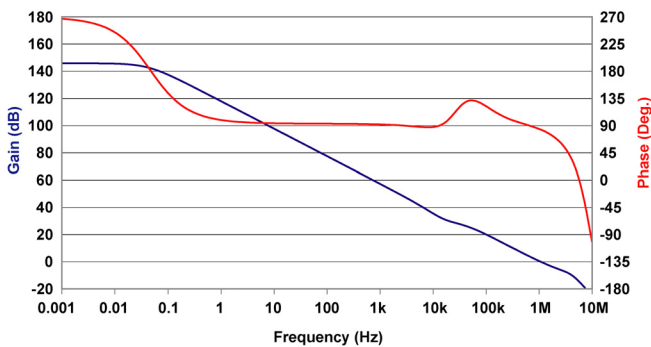


Figure 3. Gain vs. Phase (2.7 V)

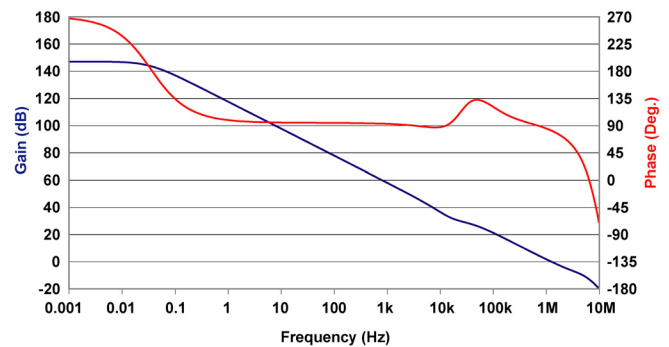


Figure 4. Gain vs. Phase (5 V)

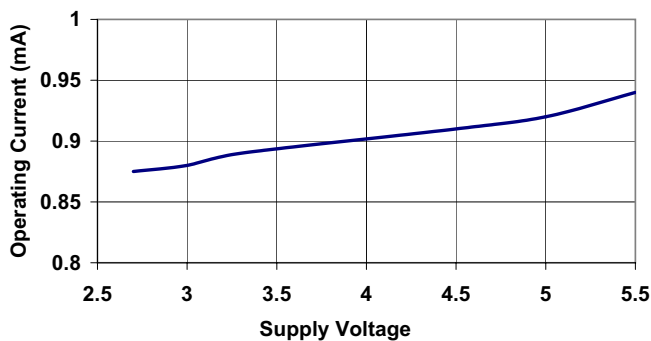


Figure 5. Supply Current vs. Supply Voltage

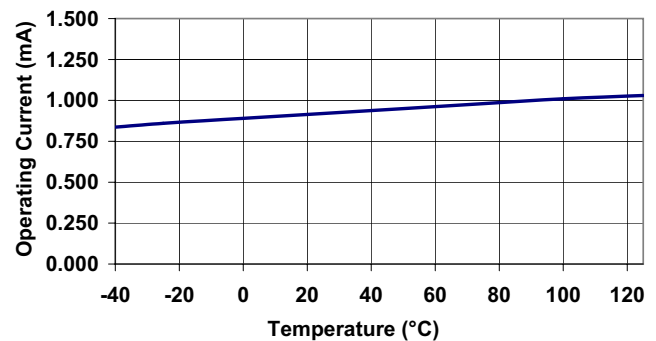
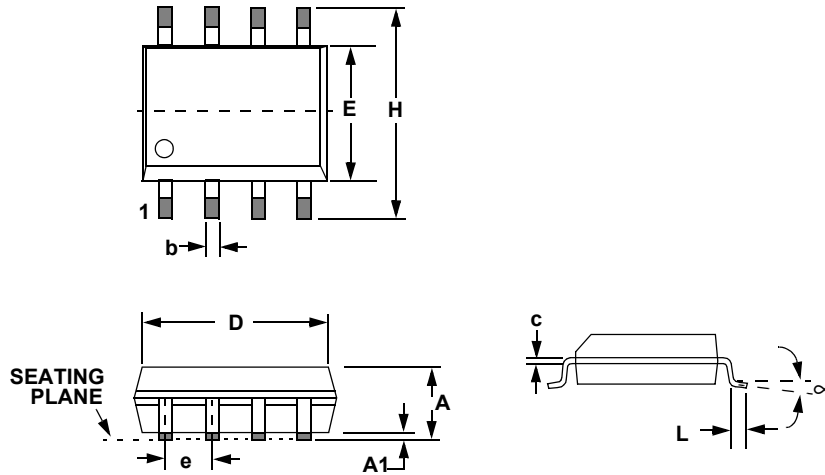


Figure 6. Supply Current vs. Temperature

**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-FS	-40 °C to +125 °C	8-lead SOIC
CS3014-FSZ	-40 °C to +125 °C	8-lead SOIC, Lead Free
CS3014-FNZ	-40 °C to +125 °C	8-lead QFN, Lead Free

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

Model Number	Peak Reflow Temp	MSL Rating*	Max Floor Life
CS3014-FS	240 °C	2	365 Days
CS3014-FSZ	260 °C		
CS3014-FNZ			

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