

Low Power Chopper Stabilized Operational Amplifier with Internal Capacitors

April 1989

FEATURES

- Low Supply Current 200 μ A
- No External Components Required
- Maximum Offset Voltage 10 μ V
- Maximum Offset Voltage Drift 0.1 μ V/ $^{\circ}$ C
- Single Supply Operation 4.75V to 16V
- Input Common Mode Range Includes Ground
- Output Swings to Ground
- Typical Overload Recovery Time 25ms

APPLICATIONS

- 4mA-20mA Current Loops
- Thermocouple Amplifiers
- Electronic Scales
- Medical Instrumentation
- Strain Gauge Amplifiers
- High Resolution Data Acquisition

DESCRIPTION

The LTC1049 is a high performance low power chopper stabilized operational amplifier. The two sample-and-hold capacitors usually required externally by other chopper stabilized amplifiers are integrated on the chip. Further, the LTC1049 offers superior DC and AC performance with a nominal supply current of only 200 μ A.

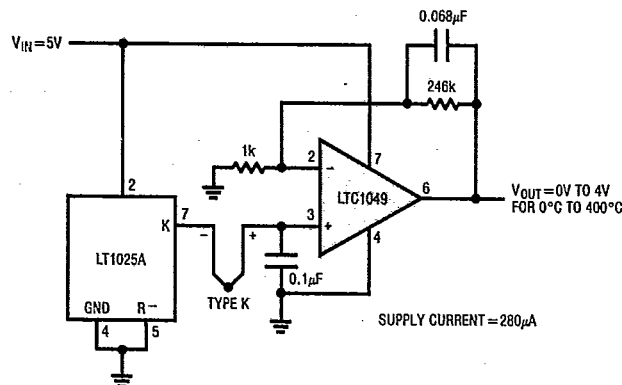
The LTC1049 has an offset voltage of 0.5 μ V, with drift of 0.01 μ V/ $^{\circ}$ C, 0.1Hz to 10Hz input noise voltage is 3 μ Vp-p and typical voltage gain is 160dB. The slew rate is 0.8V/ μ s with the gain bandwidth product of 0.8MHz.

Overload recovery times from positive and negative saturation conditions are 6ms and 25ms respectively, a very significant improvement over chopper amplifiers using external capacitors.

The LTC1049 is available in standard 8-pin metal can, plastic and ceramic dual in line packages as well as an 8-pin SO package. The LTC1049 can be a plug-in replacement for most standard op amps with improved performance.

TYPICAL APPLICATION

Single Supply Thermocouple Amplifier



ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage (V^+ to V^-)18V
Input Voltage($V^+ + 0.3V$) to ($V^- - 0.3V$)
Output Short Circuit DurationIndefinite
Operating Temperature Range	
LTC1049M $-55^{\circ}C$ to $125^{\circ}C$
LTC1049C $-40^{\circ}C$ to $85^{\circ}C$
Storage Temperature Range $-65^{\circ}C$ to $150^{\circ}C$
Lead Temperature (Soldering, 10 sec.) $300^{\circ}C$

PACKAGE/ORDER INFORMATION

<p>TOP VIEW NC (CASE)</p> <p>H PACKAGE 8-LEAD TO-5 METAL CAN</p>	<p>ORDER PART NUMBER</p> <p>LTC1049MH LTC1049CH</p>
<p>TOP VIEW</p> <p>J PACKAGE 8-LEAD CERAMIC DIP</p> <p>N PACKAGE 8-LEAD PLASTIC DIP</p>	<p>LTC1049MJ8 LTC1049CJ8 LTC1049CN8</p>
<p>TOP VIEW</p> <p>SO PACKAGE 8-LEAD PLASTIC SOIC</p>	<p>LTC1049CS8</p>

ELECTRICAL CHARACTERISTICS

$V_S = \pm 5V$, T_A = operating temperature range, unless otherwise specified.

PARAMETER	CONDITIONS	LTC1049M			LTC1049C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	$T_A = 25^{\circ}C$ (Note 3)		± 2	± 10		± 2	± 10	μV
Average Input Offset Drift	(Note 3)	●	± 0.02	± 0.1		± 0.02	± 0.1	$\mu V/^{\circ}C$
Long Term Offset Voltage Drift			50			50		nV/\sqrt{mo}
Input Offset Current	$T_A = 25^{\circ}C$	●	± 30	± 60 ± 150		± 30	± 100 ± 150	pA
Input Bias Current	$T_A = 25^{\circ}C$	●	± 15	± 30 ± 800		± 15	± 50 ± 150	pA
Input Noise Voltage	0.1Hz to 10Hz		3.0			3.0		μV_{p-p}
	0.1Hz to 1Hz		1.0			1.0		μV_{p-p}
Input Noise Current	$f = 10Hz$ (Note 4)		2.0			2.0		fA/\sqrt{Hz}
Common Mode Rejection Ratio	$V_{CM} = V^-$ to 2.7V	●	115	130		110	130	dB
Power Supply Rejection Ratio	$V_S = \pm 2.375V$ to $\pm 8V$	●	115	130		110	130	dB
Large Signal Voltage Gain	$R_L = 100k\Omega$, $V_{OUT} = \pm 4.9V$	●	130	160		130	160	dB

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LTC1049

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ELECTRICAL CHARACTERISTICS

$V_S = \pm 5V$, $T_A =$ operating temperature range, unless otherwise specified.

PARAMETER	CONDITIONS	LTC1049M			LTC1049C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Maximum Output Voltage Swing	$R_L = 10k\Omega$ $T_A = 25^\circ C$	-4.9/ +4.2			-4.9/ +4.2			V
		-4.6/ +3.2			-4.6/ +3.2			V
	$R_L = 100k\Omega$	± 4.9 ± 4.97			± 4.9 ± 4.97			V
Slew Rate	$R_L = 10k\Omega$, $C_L = 50pF$	0.8			0.8			V/ μs
Gain Bandwidth Product		0.8			0.8			MHz
Supply Current	No Load $T_A = 25^\circ C$	200 270			200 300			μA
		400			450			μA
Internal Sampling Frequency		700			700			Hz

The ● denotes the specifications which apply over the full operating temperature range.

Note 1: Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

Note 2: Connecting any terminal to voltages greater than V^+ or less than V^- may cause destructive latch up. It is recommended that no sources operating from external supplies be applied prior to power-up of the LTC1049.

Note 3: These parameters are guaranteed by design. Thermocouple effects preclude measurement of these voltage levels in high speed automatic test systems. V_{OS} is measured to a limit determined by test equipment capability.

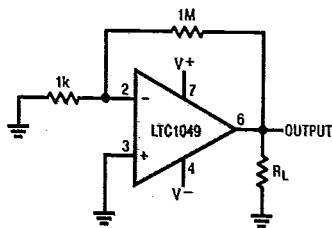
Note 4: Current Noise is calculated from the formula:

$$I_N = \sqrt{2q \cdot Ib}$$

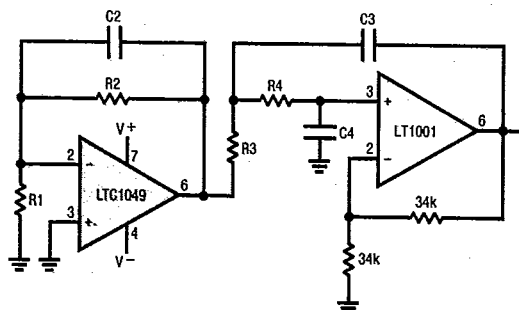
where $q = 1.6 \times 10^{-19}$ Coulomb.

TEST CIRCUITS

Electrical Characteristics Test Circuit



DC to 10Hz and DC to 1Hz Noise Test Circuit



BANDWIDTH	R1	R2	R3	R4	C2	C3	C4
10Hz	16.2 Ω	162k	16.2k	16.2 Ω	0.1 μF	1.0 μF	1.0 μF
1Hz	16.2 Ω	162k	162k	162k	1.0 μF	1.0 μF	1.0 μF