

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.

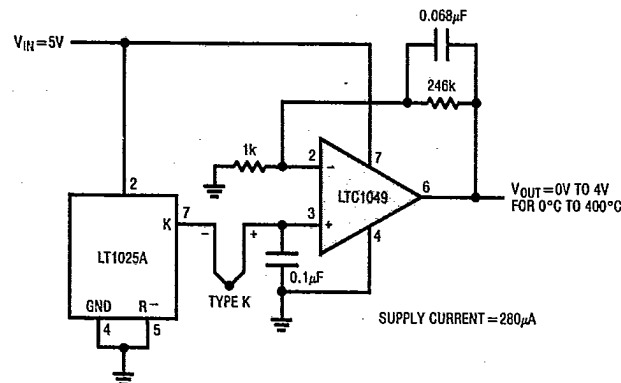
The LTC1049 has an offset voltage of 0.5 μ V, with drift of 0.01 μ V/ $^{\circ}$ C, 0.1Hz to 10Hz input noise voltage is 3 μ Vp-p and typical voltage gain is 160dB. The slew rate is 0.8V/ μ s with the gain bandwidth product of 0.8MHz.

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°C to 125°C
LTC1049C -40°C to 85°C
Storage Temperature Range -65°C to 150°C
Lead Temperature (Soldering, 10 sec.)300°C

PACKAGE/ORDER INFORMATION

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

ELECTRICAL CHARACTERISTICS

V_S = ±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°C (Note 3)		±2	±10		±2	±10	μV
Average Input Offset Drift	(Note 3)	●	±0.02	±0.1		±0.02	±0.1	μV/°C
Long Term Offset Voltage Drift			50			50		nV/√mo
Input Offset Current	T _A = 25°C	●	±30	±60 ±150		±30	±100 ±150	pA
Input Bias Current	T _A = 25°C	●	±15	±30 ±800		±15	±50 ±150	pA
Input Noise Voltage	0.1Hz to 10Hz		3.0			3.0		μVp-p
	0.1Hz to 1Hz		1.0			1.0		μVp-p
Input Noise Current	f = 10Hz (Note 4)		2.0			2.0		fA/√Hz
Common Mode Rejection Ratio	V _{CM} = V ⁻ to 2.7V	●	115	130		110	130	dB
Power Supply Rejection Ratio	V _S = ±2.375V to ±8V	●	115	130		110	130	dB
Large Signal Voltage Gain	R _L = 100kΩ, V _{OUT} = ±4.9V	●	130	160		130	160	dB

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LTC1049

T-79-33

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.

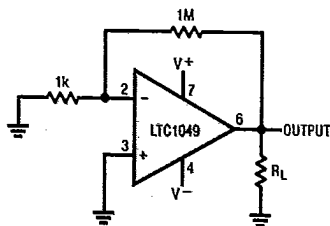
Note 4: Current Noise is calculated from the formula:

$$I_N = \sqrt{(2q \cdot I_b)}$$

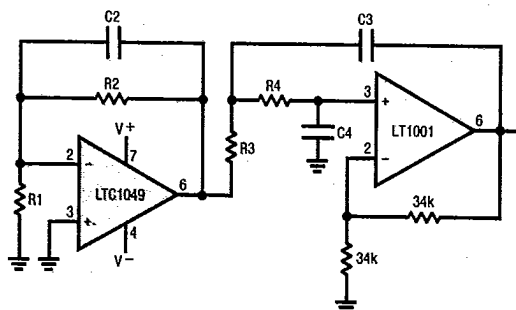
where $q = 1.6 \times 10^{-19}$ Coulomb.

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