LINEAR TECHNOLOGY CORP

PRELIMINARY

T-79-33 LTC1049

Low Power Chopper Stabilized Operational Amplifier with Internal Capacitors

April 1989

FEATURES

- Low Supply Current 200μA
- No External Components Required
- Maximum Offset Voltage 10μV
- Maximum Offset Voltage Drift 0.1μV/°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 200μA.

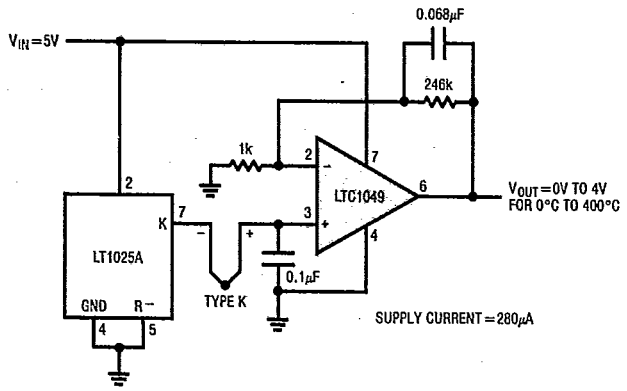
The LTC1049 has an offset voltage of 0.5μV, with drift of 0.01μV/°C, 0.1Hz to 10Hz input noise voltage is 3μVp-p and typical voltage gain is 160dB. The slew rate is 0.8V/μs with the gain bandwidth product of 0.8MHz.

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



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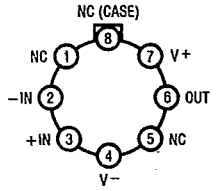
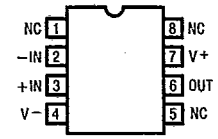
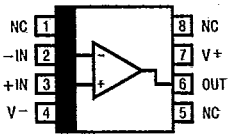
ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage (V^+ to V^-) 18V
Input Voltage .....(V^+ + 0.3V) to (V^- – 0.3V)
Output Short Circuit Duration .....Indefinite
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

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

ELECTRICAL CHARACTERISTICS

V_S = ±5V, T_A = operating temperature range, unless otherwise specified.

PARAMETER	CONDITIONS		LTC1049M MIN	LTC1049M TYP	LTC1049M MAX	LTC1049C MIN	LTC1049C TYP	LTC1049C MAX	UNITS
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		±30	±100	pA
		●			±150			±150	pA
Input Bias Current	T_A = 25°C			±15	±30		±15	±50	pA
		●			±800			±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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ELECTRICAL CHARACTERISTICS

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

PARAMETER	CONDITIONS		LTC1049M MIN	LTC1049M TYP	LTC1049M MAX	LTC1049C MIN	LTC1049C TYP	LTC1049C MAX	UNITS
Maximum Output Voltage Swing	$R_L = 10k\Omega$ $T_A = 25°C$			−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 $T_A = 25°C$			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.

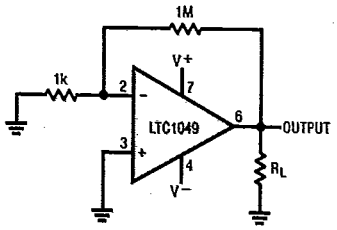
Note 4: Current Noise is calculated from the formula:

$$I_N = \sqrt{(2q \cdot 1b)}$$

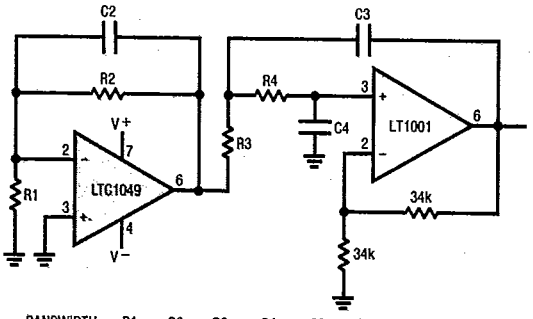
where $q = 1.6 \times 10^{-19}$ Coulomb.

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	16.2Ω	162k	16.2k	16.2Ω	0.1μF	1.0μF	1.0μF
1Hz	16.2Ω	162k	162k	162k	1.0μF	1.0μF	1.0μF