LTC1069-7

Linear Phase 8th Order Lowpass Filter

November 1996

FEATURES

- 8th Order, Linear Phase Filter in SO-8 Package
- Raised Cosine Amplitude Response
- –43dB Attenuation at Twice f_{CUTOFF}
- Wideband Noise: 160µV_{RMS}
- Operates form Single 5V Supply to ±5V Power Supplies
- Clock-Tunable to 200kHz with ±5V Supplies
- Clock-Tunable to 140kHz with Single 5V Supply

APPLICATIONS

- Digital Communication Filter
- Antialiasing Filter with Linear Phase
- Smoothing Filters

DESCRIPTION

The LTC®1069-7 is a monolithic, clock-tunable, linear phase, 8th order lowpass filter. The amplitude response of the filter approximates a raised cosine filter with an alpha of one. The gain at the cutoff frequency is –3dB and the attenuation at twice the cutoff frequency is 43dB. The cutoff frequency of the LTC1069-7 is set by an external clock and is equal to the clock frequency divided by 25. The ratio of the internal sampling frequency to the cutoff frequency is 50:1. The LTC1069-7 can be operated from a single 5V supply up to dual ±5V supplies. A maximum of 200kHz cutoff frequency can be obtained with dual ±5V supplies.

The gain and phase response of the LTC1069-7 can be used in digital communication systems where pulse shaping and channel bandwidth limiting must be carried out. Also, any system that requires an analog filter with linear phase and sharp roll-off in the vicinity of its cutoff frequency can use the LTC1069-7.

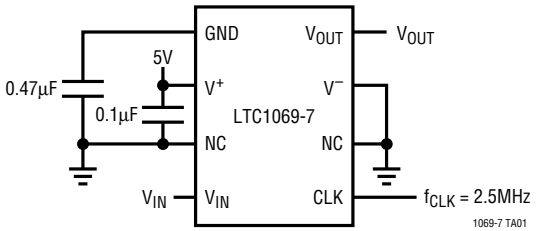
The LTC1069-7 has a wide dynamic range. With ±5V supplies and an input range of 0.1V_{RMS} to 2V_{RMS}, the signal-to-(noise + THD) ratio is ≥60dB. The wideband noise of the LTC1069-7 is 160µV_{RMS}. *Unlike other LTC1069-X filters, the typical passband gain of the LTC1069-7 is equal to –1V/V.*

The LTC1069-7 is available in an SO-8 package.

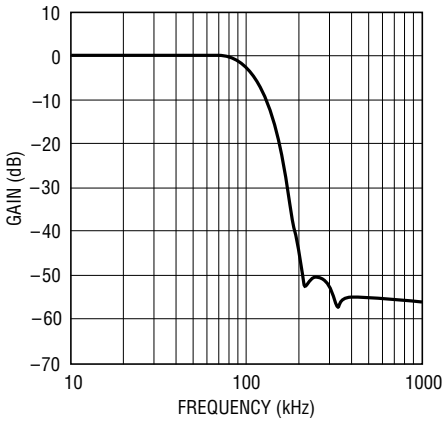
Other filter responses with lower power/speed specifications can be obtained. Please contact LTC Marketing.

TYPICAL APPLICATION

Single 5V Supply, Linear Phase 100kHz Lowpass Filter



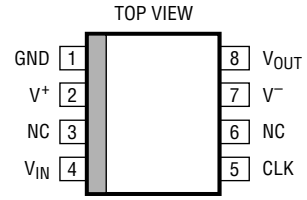
Frequency Response



ABSOLUTE MAXIMUM RATINGS

Total Supply Voltage (V^+ to V^-) 12V
Power Dissipation 400mW
Operating Temperature Range
LTC1069-7C ..... 0°C to 70°C
LTC1069-7I ..... –40°C to 85°C
Storage Temperature ..... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



S8 PACKAGE
8-LEAD PLASTIC SO
T_{JMAX} = 125°C, θ_{JA} = 110°C/W

ORDER PART NUMBER
LTC1069-7CS8 LTC1069-7CSI
S8 PART MARKING
10697 10697I

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS

f_{CUTOFF} is the filter's cutoff frequency and is equal to $f_{CLK}/25$. The f_{CLK} signal level is TTL or CMOS (max clock rise or fall time ≤ 1μs), R_L = 10k, T_A = 25°C, unless otherwise specified. All AC gains are measured relative to the passband gain.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Passband Gain ($f_{IN} \le 0.2f_{CUTOFF}$)	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 1kHz, V_{IN} = 1V_{RMS}	 ●		–0.10	±0.75 ±0.90	dB dB
	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 1kHz, V_{IN} = 0.5V_{RMS}	 ●		–0.10	±0.75 ±0.90	dB dB
Gain at 0.25f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 25kHz, V_{IN} = 1V_{RMS}	 ●	 –0.55	–0.30	 –0.1	dB dB
	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 5kHz, V_{IN} = 0.5V_{RMS}	 ●	 –0.30	–0.05	 0.15	dB dB
Gain at 0.50f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 50kHz, V_{IN} = 1V_{RMS}	 ●	 –1.40	–1.0	 –0.35	dB dB
	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 10kHz, V_{IN} = 0.5V_{RMS}	 ●	 –0.60	–0.30	 0	dB dB
Gain at 0.75f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 75kHz, V_{IN} = 1V_{RMS}	 ●	 –2.1	–1.65	 –0.80	dB dB
	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 15kHz, V_{IN} = 0.5V_{RMS}	 ●	 –1.15	–0.75	 –0.25	dB dB
Gain at f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 100kHz, V_{IN} = 1V_{RMS}	 ●	 –4.0	–3.5	 –2.7	dB dB
	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 20kHz, V_{IN} = 0.5V_{RMS}	 ●	 –3.3	–2.9	 –2.4	dB dB
Gain at 1.5f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 150kHz, V_{IN} = 1V_{RMS}	 ●	 –19	–16.5	 –14	dB dB
	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 30kHz, V_{IN} = 0.5V_{RMS}	 ●	 –20	–18.1	 –17	dB dB
Gain at 2.0f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 200kHz, V_{IN} = 1V_{RMS}	 ●	 –49	–43	 –38	dB dB
	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 40kHz, V_{IN} = 0.5V_{RMS}	 ●	 –43	–41	 –39	dB dB

ELECTRICAL CHARACTERISTICS

f_{CUTOFF} is the filter's cutoff frequency and is equal to f_{CLK}/25. The f_{CLK} signal level is TTL or CMOS (max clock rise or fall time ≤ 1μs), R_L = 10k, T_A = 25°C, unless otherwise specified. All AC gains are measured relative to the passband gain.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Gain at 5.0f_{CUTOFF}	V_S = 4.75V, f_{CLK} = 500kHz f_{TEST} = 100kHz, V_{IN} = 0.5V_{RMS}		–63	–59	–55	dB
Gain at f_{CUTOFF} (160kHz)	V_S = ±5V, f_{CLK} = 4MHz f_{TEST} = 160kHz, V_{IN} = 1V_{RMS}			–2.1		dB
Phase at 0.5f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 50kHz			–30.5		Deg
Phase at f_{CUTOFF}	V_S = ±5V, f_{CLK} = 2.5MHz f_{TEST} = 100kHz			–235		Deg
Passband Phase Deviation from Linear Phase (Note 1)	V_S = ±5V, f_{CLK} = 500kHz f_{TEST} = 50kHz			–3.0		Deg
Output DC Offset (Input at GND)	V_S = ±5V, f_{CLK} = 500kHz V_S = 4.75V, f_{CLK} = 400kHz			50 25	 125	mV mV
Output Voltage Swing	V_S = ±5V V_S = 4.75V	● ●	±3.5 2.6	±4.0 3.6		V V_{P-P}
Power Supply Current	V_S = ±5V, f_{CLK} = 500kHz	 ●		18	26 29	mA mA
	V_S = 4.75V, f_{CLK} = 400kHz	 ●		13	15 16.5	mA mA

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

Note 1: Phase Deviation = 1/2(Phase at 0Hz – Phase at f_{CUTOFF}) – (Phase at 0Hz – Phase at 0.5f_{CUTOFF})

Phase at 0Hz = 180° (guaranteed by design)

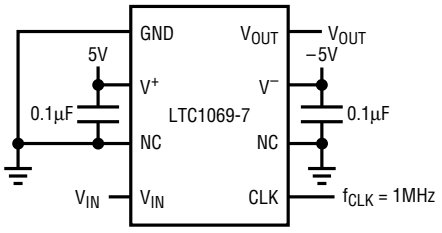
Example: An LTC1069-7 has Phase at 0.5f_{CUTOFF} = –30.5° and Phase at f_{CUTOFF} = –235°.

Passband Phase Deviation from Linear Phase

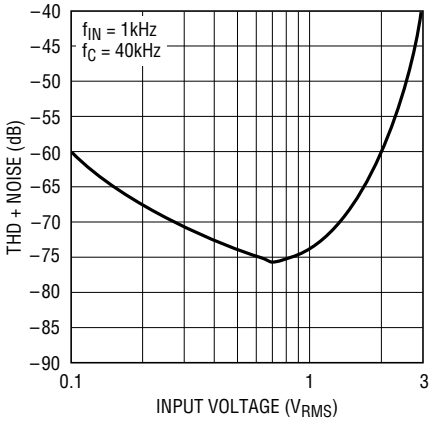
= 1/2[180° – (–235°)] – [(180° – (–30.5°)] = –3°

TYPICAL APPLICATION

Dual Supply Operation



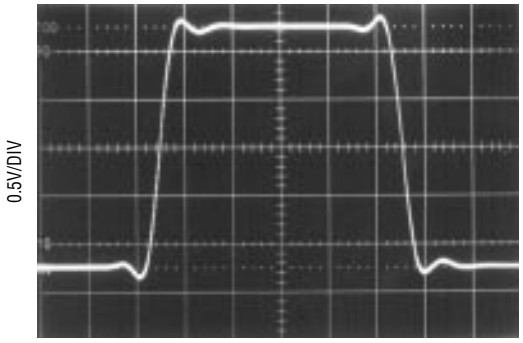
THD + NOISE VS AMPLITUDE



1069-7 TA03

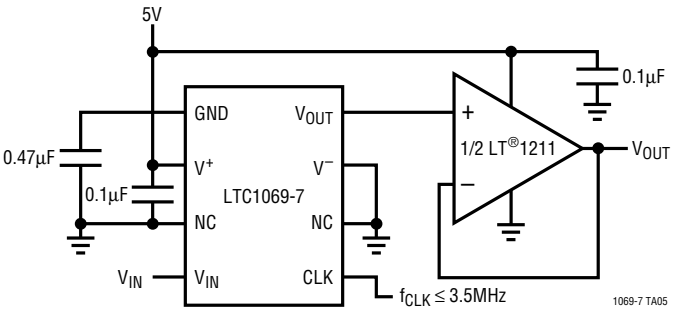
TYPICAL APPLICATION

Transient Response



V_S = ±5V 10µs/DIV
f_{CLK} = 2.5MHz
$f_C = f_{CUTOFF}$ = 100kHz
V_{IN} = 2.5V_{P-P} SQUARE WAVE AT 10kHz

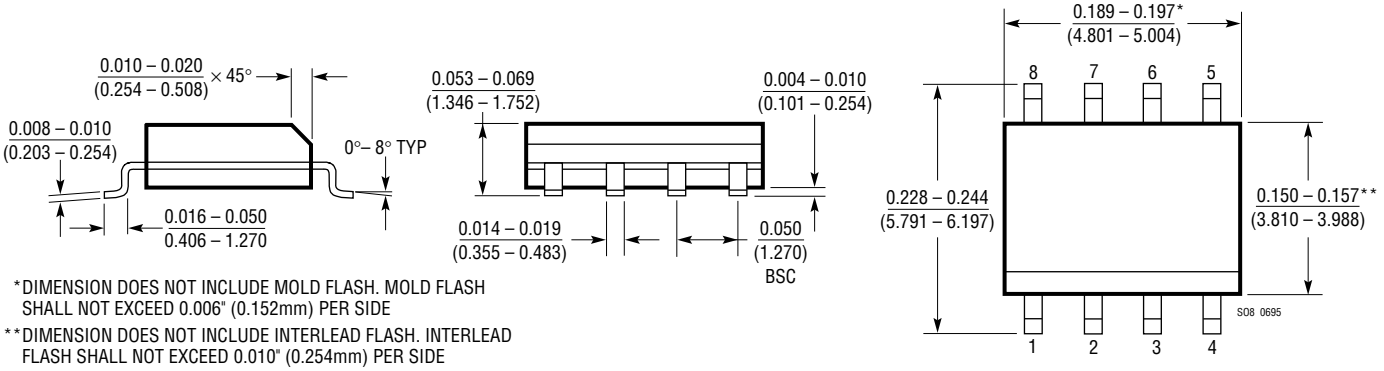
Single Supply Operation



PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

S8 Package
8-Lead Plastic Small Outline (Narrow 0.150)
(LTC DWG # 05-08-1610)



*DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

**DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC1064-3	Linear Phase, Bessel 8th Order Filter	f_{CLK}/f_C = 75/1 or 150/1, Very Low Noise
LTC1064-7	Linear Phase, 8th Order Lowpass Filter	f_{CLK}/f_C = 50/1 or 100/1, $f_{C(MAX)}$ = 100kHz
LTC1164-7	Low Power, Linear Phase Lowpass Filter	f_{CLK}/f_C = 50/1 or 100/1, I_S = 2.5mA, V_S = 5V
LTC1264-7	Linear Phase 8th Order Lowpass Filter	f_{CLK}/f_C = 25/1 or 50/1, f_C = 200kHz

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