Low Power, High Accuracy Quad Universal Filter Building Block

February 1998

FEATURES

- **Four Identical 2nd Order Filters in an SSOP Package**
- **Center Frequency Error: ±0.3%**
- **Low Noise: ≤40μV_{RMS} per 2nd Order Section, Q ≤ 5**
- **High Dynamic Range: THD + Noise ≤ 0.01%**
- Low DC Offsets: ≤10mV per 2nd Order Section
- Clock-to-Center Frequency Ratio: 50:1
- No Aliasing for Input Frequencies up to 100 × f_{CUTOFF}
- Maximum Center Frequency up to 50kHz (V_S = ±5V)
- Operates from ±1.57V to ±5V Power Supplies

APPLICATIONS

- Low Power Linear Phase Bandpass Filters (Up to 40kHz, V_S = Single 5V)
- Dual 4th Order Phase Matched Filters (Up to 40kHz, V_S = Single 5V)
- Low Power Tone Detectors (High Selectivity Bandpass Filters up to 30kHz, V_S = Single 5V)

DESCRIPTION

The LTC®1068-50 consists of four identical, low noise, high accuracy 2nd order switched-capacitor filter building blocks. Each building block, together with three to five resistors, can provide 2nd order filter functions like low-pass, bandpass, highpass and notch. High precision, high performance, quad 2nd order, dual 4th order or 8th order filters can also be designed with an LTC1068-50. The center frequency of each 2nd order section is tuned by an external clock. The clock-to-center frequency ratio is internally set to 50:1 and can be modified by external resistors.

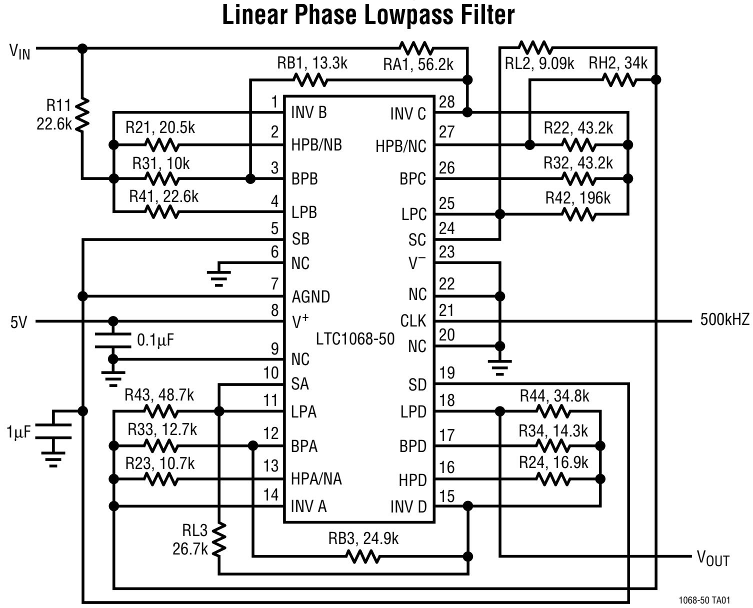
The sampling rate of the LTC1068-50 is twice the clock frequency. The maximum input frequency can approach twice the clock frequency before aliasing occurs.

A customized version of the LTC1068-50 in a 16-lead SO with internal thin film resistors can be obtained. Clock-to-center frequency ratios higher or lower than 50:1 can also be obtained. Please contact LTC Marketing for details.

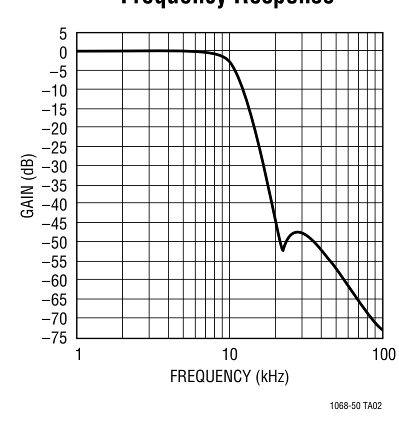
The LTC1068-50 is available in a 28-pin SSOP surface mount package and is supported by FilterCAD™ 2.0 filter design software.

TYPICAL APPLICATION

Low Power, Single 5V Supply, 10kHz, 8th Order, Linear Phase Lowpass Filter



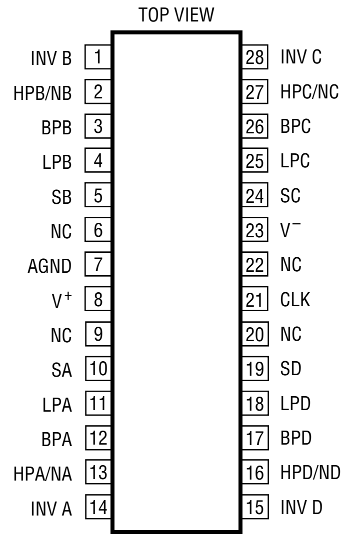
Frequency Response



ABSOLUTE MAXIMUM RATINGS

Total Supply Voltage (V^+ to V^-) 12V
Power Dissipation 500mW
Operating Temperature Range
  LTC1068CG-50 .... 0°C to 70°C
  LTC1068IG-50 .... –40°C to 85°C
Input Voltage at Any Pin ... $V^- - 0.3V \le V_{IN} \le V^+ + 0.3V$
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION



G PACKAGE
28-LEAD PLASTIC SSOP
$T_{JMAX} = 125°C, \theta_{JA} = 95°C/W$

ORDER PART NUMBER

LTC1068CG-50
LTC1068IG-50

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS

(Internal Op Amps) $V_S = \pm 5V$, $T_A = 25°C$, unless otherwise specified.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Operating Supply Voltage Range			3.14		±5.5	V
Voltage Swings	$V_S = 3.14V$, $R_L = 5k$ (Note 1) $V_S = 4.75V$, $R_L = 5k$ (Note 2) $V_S = \pm 5V$, $R_L = 5k$	● ● ●	1.2 2.6 ±3.4	1.8 3.6 ±4.1		V_{P-P} V_{P-P} V
Output Short-Circuit Current (Source/Sink)	$V_S = 3.14V$ (Note 1) $V_S = \pm 5V$			17/6 20/15		mA mA
DC Open-Loop Gain	$R_L = 5k$			85		dB
GBW Product				4		MHz
Slew Rate				10		V/µs
Analog Ground Voltage	$V_S = 5V$, Voltage at Pin 7 (AGND) (Note 3)			2.175		V

(Complete Filter) $T_A = 25°C$, unless otherwise specified.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Clock-to-Center Frequency, f_{CLK}/f_O (Note 5)	$V_S = 3.14V$, $f_{CLK} = 250kHz$, Mode 1 (Note 1), $f_O = 5kHz$, $Q = 5$, $V_{IN} = 0.34V_{RMS}$, R1 = R3 = 49.9k, R2 = 10k	 ●		50 ± 0.3%	50 ± 0.8% 50 ± 0.9%	
	$V_S = \pm 5V$, $f_{CLK} = 500kHz$, Mode 1, $f_O = 10kHz$, $Q = 5$, $V_{IN} = 1V_{RMS}$, R1 = R3 = 49.9k, R2 = 10k	 ●		50 ± 0.3%	50 ± 0.8% 50 ± 0.9%	
Clock-to-Center Frequency Ratio, Side-to-Side Matching (Note 5)	$V_S = 3.14V$, $f_{CLK} = 250kHz$, $Q = 5$ (Note 1) $V_S = \pm 5V$, $f_{CLK} = 500kHz$, $Q = 5$	● ●		±0.25 ±0.25	±0.9 ±0.9	% %
Q Accuracy (Note 5)	$V_S = 3.14V$, $f_{CLK} = 250kHz$, $Q = 5$ (Note 1) $V_S = \pm 5V$, $f_{CLK} = 500kHz$, $Q = 5$	● ●		±1 ±1	±3 ±3	% %

ELECTRICAL CHARACTERISTICS (Complete Filter) T_A = 25°C, unless otherwise specified.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
f_O Temperature Coefficient				±1		ppm/°C
Q Temperature Coefficient				±5		ppm/°C
DC Offset Voltage (Note 5) (See Table 1)	V_S = ±5V, f_{CLK} = 500kHz, V_{OS1} (DC Offset of Input Inverter)	●		0	±15	mV
	V_S = ±5V, f_{CLK} = 500kHz, V_{OS2} (DC Offset of First Integrator)	●		–2	±25	mV
	V_S = ±5V, f_{CLK} = 500kHz, V_{OS3} (DC Offset of Second Integrator)	●		–5	±40	mV
Clock Feedthrough	V_S = ±5V, f_{CLK} = 500kHz			0.16		mV_{RMS}
Maximum Clock Frequency	V_S = ±5V, Q ≤ 1.6, Mode 1			3.4		MHz
Power Supply Current	V_S = 3.14V, f_{CLK} = 250kHz (Note 1) V_S = 4.75V, f_{CLK} = 250kHz (Note 2) V_S = ±5V, f_{CLK} = 500kHz	● ● ●		3.0 4.3 6.0	5 8 11	mA mA mA

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

Note 1: Production testing for single 3.14V supply is achieved by using the equivalent dual supplies of 1.7696V and –1.3704V. Note 3 is an explanation for using nonsymmetrical power supplies.

Note 2: Production testing for single 4.75V supply is achieved by using the equivalent dual supplies of 2.6771V and –2.0729V. Note 3 is an explanation for using nonsymmetrical power supplies.

Note 3: Pin 7 (AGND) is the internal analog ground of the device. For single supply applications this pin should be bypassed with a 1µF capacitor. The biasing voltage of AGND is set with an internal resistive divider from Pin 8 to Pin 23, the value of AGND = 0.435 • V^+.

Note 4: See typical performance characteristics.

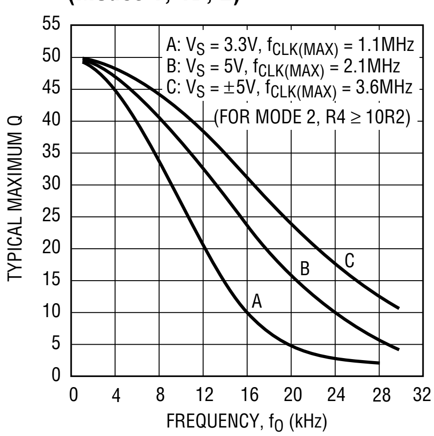
Note 5: Side D is guaranteed by design.

Table 1. Output DC Offsets One 2nd Order Section

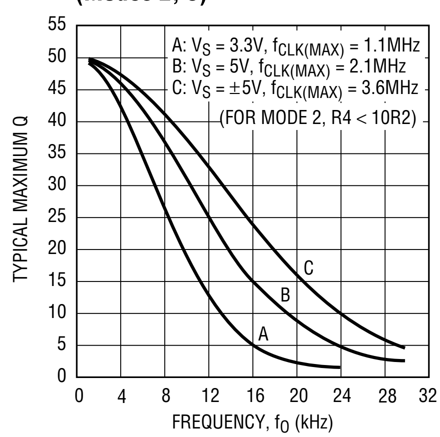
MODE	V_{OSN}	V_{OSBP}	V_{OSLP}
1	V_{OS1}[(1/Q) + 1 + ‖H_{OLP}‖] – V_{OS3}/Q	V_{OS3}	V_{OSN} – V_{OS2}
1B	V_{OS1}[(1/Q) + 1 + R2/R1] – V_{OS3}/Q	V_{OS3}	~(V_{OSN} – V_{OS2})(1 + R5/R6)
2	[V_{OS1}(1 + R2/R1 + R2/R3 + R2/R4) – V_{OS3}(R2/R3)X [R4/(R2 + R4)] + V_{OS2}[R2/(R2 + R4)]	V_{OS3}	V_{OSN} – V_{OS2}
3	V_{OS2}	V_{OS3}	V_{OS1}[1 + R4/R1 + R4/R2 + R4/R3] – V_{OS2}(R4/R2) – V_{OS3}(R4/R3)

TYPICAL PERFORMANCE CHARACTERISTICS

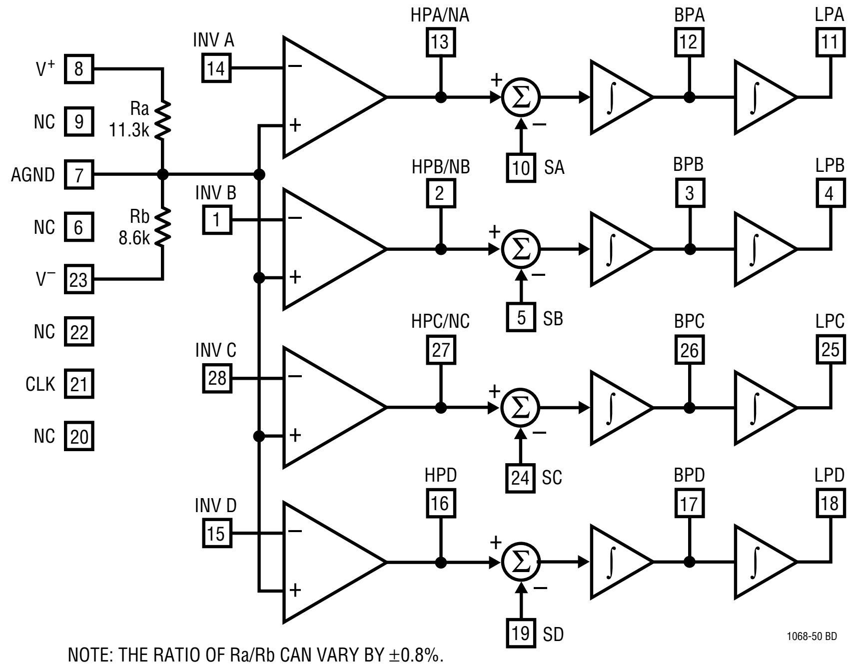
Maximum Q vs Frequency (Modes 1, 1B, 2)



Maximum Q vs Frequency (Modes 2, 3)



BLOCK DIAGRAM

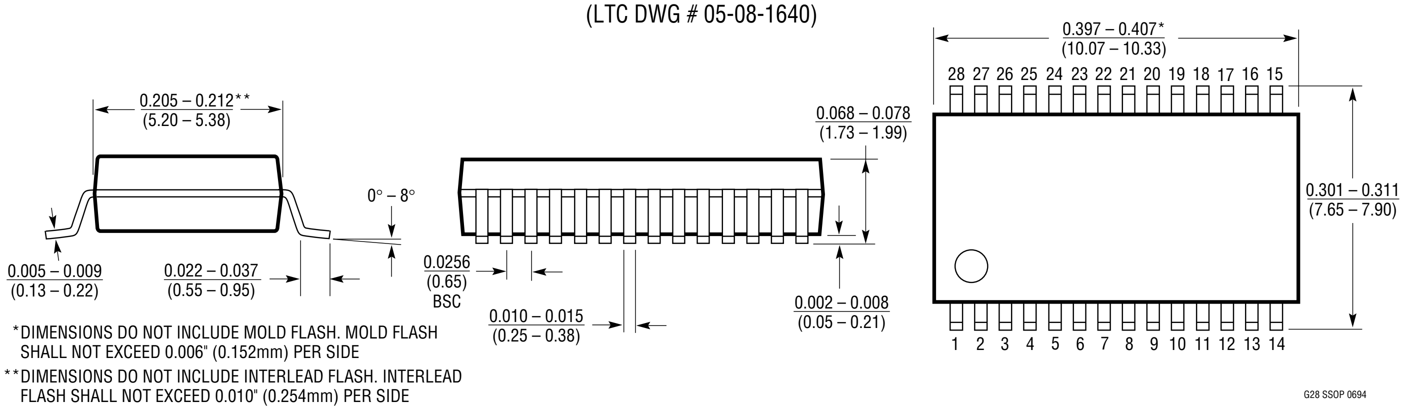


NOTE: THE RATIO OF Ra/Rb CAN VARY BY ±0.8%.
THE ABSOLUTE VALUE OF Ra OR Rb CAN VARY BY ±25%

PACKAGE DESCRIPTION

Dimensions in inches (millimeters) unless otherwise noted.

G Package
28-Lead Plastic SSOP (0.209)
(LTC DWG # 05-08-1640)



*DIMENSIONS DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE
**DIMENSIONS DO NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC1068	Low Noise Universal Filter	100:1 Clock-to-f_O Ratio, f_C to 50kHz
LTC1068-25	High Speed Universal Filter	25:1 Clock-to-f_O Ratio, f_C to 200kHz
LTC1068-200	Universal Filter	200:1 Clock-to-f_O Ratio, f_C to 25kHz
LTC1064	Universal Filter	50:1 and 100:1 Clock-to-f_O Ratios, f_C to 100kHz, V_S = Up to ±7.5V
LTC1164	Low Power Universal Filter	50:1 and 100:1 Clock-to-f_O Ratios, f_C to 20kHz, V_S = Up to ±7.5V
LTC1264	High Speed Universal Filter	20:1 Clock-to-f_O Ratio, f_C to 200kHz, V_S = Up to ±7.5V

Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7417 • (408) 432-1900
FAX: (408) 434-0507 • TELEX: 499-3977 • www.linear-tech.com
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