

High Performance Switched Capacitor Universal Filter

FEATURES

- All Filter Parameters *Guaranteed* over Temperature
- Wide Center Frequency Range (0.1Hz to 40kHz)
- Low Noise Wide Dynamic Range
- Operates from $\pm 2.5V$ Supply up to $\pm 8V$
- Low Power Consumption
- *Guaranteed* Clock to Center Frequency Accuracy of 0.8% or Better
- *Guaranteed* Low Offset Voltages over Temperature
- Very Low Center Frequency and Q Tempco
- Clock Input T²L or CMOS Compatible
- Separate Highpass (or Notch or Allpass), Bandpass, Lowpass Outputs

APPLICATIONS

- Sinewave Oscillators
- Sweepable Bandpass/Notch Filters
- Full Audio Frequency Filters
- Tracking Filters

DESCRIPTION

The LTC1059 consists of a general purpose, high performance, active filter building block and an uncommitted op amp. The filter building block together with an external clock and 2 to 5 resistors can produce various second order functions which are available at its three output pins. Two out of three always provide lowpass and bandpass functions while the third output pin can produce notch or highpass or allpass. The center frequency of these functions can be tuned from 0.1Hz to 40kHz and it is dependent on an external clock or an external clock and a resistor ratio. The filter can handle input frequencies up to 100kHz. The uncommitted op amp can be used to obtain additional allpass and notch functions, for gain adjustment or for cascading techniques.

Higher than second order filter functions can be obtained by cascading the LTC1059 with the LTC1060 dual universal filter or LTC1061 triple universal filter. Any classical filter realization (such as Butterworth, Cauer, Bessel and Chebyshev) can be formed.

The LTC1059 can be operated with single or dual supplies ranging from $\pm 2.37V$ to $\pm 8V$ (or 4.74V to 16V single supply).

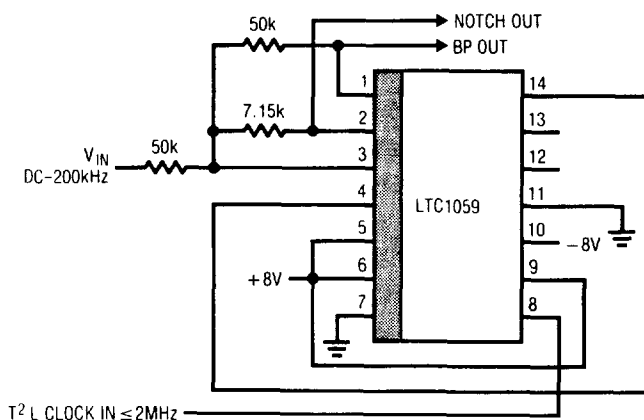
The LTC1059 is manufactured by using Linear Technology's enhanced LTCMOS™ silicon gate process.

LTCMOS™ is a trademark of Linear Technology Corp.

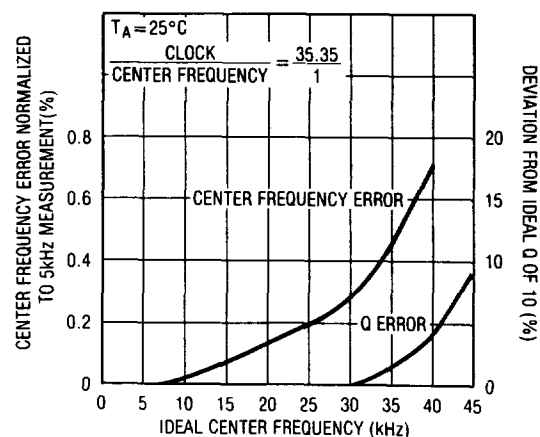
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TYPICAL APPLICATION

Wide Range 2nd Order Bandpass/Notch Filter with Q = 10



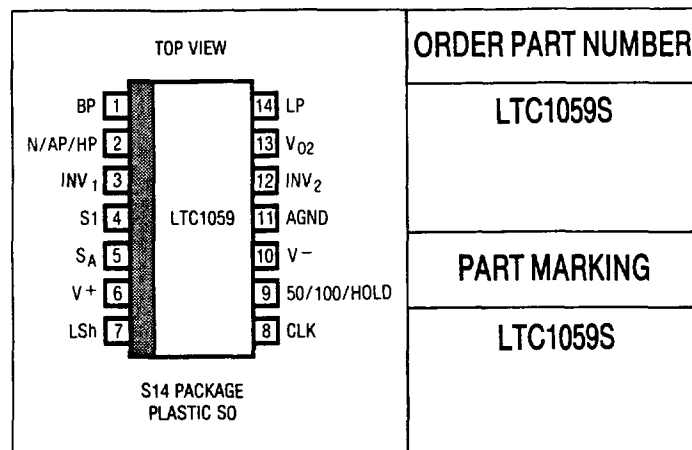
Center Frequency and Q Error



ABSOLUTE MAXIMUM RATINGS

Supply Voltage 18V
 Operating Temperature Range $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$
 Storage Temperature Range -65°C to 150°C
 Lead Temperature (Soldering, 10sec) 300°C

PACKAGE/ORDER INFORMATION



ELECTRICAL CHARACTERISTICS

(Complete Filter) $V_S = \pm 5\text{V}$, $T_A = 25^{\circ}\text{C}$, T²L clock input level unless otherwise specified.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Center Frequency Range, f_o	$f_o \times Q \leq 400\text{kHz}$, Mode 1		0.1-40k		Hz
	$f_o \times Q \leq 1.6\text{MHz}$, Mode 1		0.1-18k		Hz
	$f_o \times Q \leq 250\text{kHz}$, Mode 3, $V_S = \pm 7.5\text{V}$		0.1-20k		Hz
	$f_o \times Q \leq 1\text{MHz}$, Mode 3, $V_S = \pm 7.5\text{V}$		0.1-16k		Hz
Input Frequency Range			0-200k		Hz
Clock to Center Frequency Ratio (Note 1)	Mode 1, 50:1, $f_{\text{CLK}} = 250\text{kHz}$, $Q = 10$	●		$50 \pm 0.8\%$	
	Mode 1, 100:1, $f_{\text{CLK}} = 500\text{kHz}$, $Q = 10$	●		$100 \pm 0.8\%$	
Q Accuracy (Note 1)	Mode 1, 50:1 or 100:1, $f_o = 5\text{kHz}$, $Q = 10$	●	± 0.5	5	%
f_o Temperature Coefficient	Mode 1, $f_{\text{CLK}} < 500\text{kHz}$		5		ppm/ $^{\circ}\text{C}$
Q Temperature Coefficient	Mode 1, $f_{\text{CLK}} < 500\text{kHz}$, $Q = 10$		15		ppm/ $^{\circ}\text{C}$
DC Offset V_{OS1} (Note 2)	●	$f_{\text{CLK}} = 250\text{kHz}$, 50:1, S_{AB} High	2	15	mV
		$f_{\text{CLK}} = 500\text{kHz}$, 100:1, S_{AB} High	3	40	mV
		$f_{\text{CLK}} = 250\text{kHz}$, 50:1, S_{AB} Low	6	80	mV
		$f_{\text{CLK}} = 500\text{kHz}$, 100:1, S_{AB} Low	2	30	mV
		$f_{\text{CLK}} = 250\text{kHz}$, 50:1	4	60	mV
		$f_{\text{CLK}} = 500\text{kHz}$, 100:1	2	30	mV
V_{OS2}	●	$f_{\text{CLK}} = 250\text{kHz}$, 50:1	2	30	mV
		$f_{\text{CLK}} = 500\text{kHz}$, 100:1	4	60	mV
DC Low Pass Gain Accuracy	Mode 1, $R1 = R2 = 50\text{k}\Omega$	●	± 0.1	2	%
BP Gain Accuracy at f_o	Mode 1, $Q = 10$, $f_o = 5\text{kHz}$		± 0.1		%
Clock Feedthrough	$f_{\text{CLK}} \leq 1\text{MHz}$		10		mV
Max. Clock Frequency	Mode 1, $Q < 5$, $V_S \geq \pm 5\text{V}$		2		MHz
Power Supply Current	●		3.5	5.5	mA
				7	mA

Note 1: An LTC1059S with improved Q and clock to center frequency ratio accuracy can be made available upon special request.

Note 2: For definition of the DC offset voltages, refer to the LTC1059 data sheet. An LTC1059S with improved DC offset specifications can be made available upon special request.

ELECTRICAL CHARACTERISTICS (Complete Filter) $V_S = \pm 2.37V$, $T_A = 25^\circ C$ unless otherwise specified

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Center Frequency Range	$f_o \times Q \leq 120kHz$, Mode 1, 50:1		0.1-12k		Hz
	$f_o \times Q \leq 120kHz$, Mode 3, 50:1		0.1-10k		Hz
Input Frequency Range			60k		Hz
Clock to Center Frequency Ratio	Mode 1, 50:1, $f_{CLK} = 250kHz$, $Q = 10$		$50 \pm 0.8\%$		
	Mode 1, 100:1, $f_{CLK} = 250kHz$, $Q = 10$		$100 \pm 0.8\%$		
Q Accuracy	Mode 1, $f_{CLK} = 250kHz$, $Q = 10$ 50:1 and 100:1		± 2		%
Max. Clock Frequency			700k		Hz
Power Supply Current			1.5	2.5	mA

ELECTRICAL CHARACTERISTICS (Internal Op Amps) $T_A = 25^\circ C$ unless otherwise specified

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Voltage Range		± 2.375		± 8	V
Voltage Swings	$V_S = \pm 5V$, $R_L = 5k$ (Pins 1, 14) $R_L = 3.5k$ (Pins 2, 13)	± 3.8	± 4.2		V
		± 3.6			V
Input Offset Voltage			1	15	mV
Input Bias Current			3		pA
Output Short Circuit Current	$V_S = \pm 5V$		25/3		mA
DC Open Loop Gain	$V_S = \pm 5V$		80		dB
GBW	$V_S = \pm 5V$		2		MHz
Slew Rate	$V_S = \pm 5V$		7		V/ μs

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