

Resistor Programmable Active Audio Filter Data Sheet

MSRAAF

Description

The resistor programmable continuous audio filter IC is a CMOS chip that can be configured for either a lowpass, bandpass, highpass, allpass or notch filter. Butterworth, Bessel, elliptic and Chebyshev filters can be implemented. The frequency range covers the audio spectrum to 80 kHz. The low power mode has a frequency range to 10 kHz. A power down pin reduces current consumption when the filter is not in use. The 8 pin part is a single filter stage, the 16 pin part offers a dual filter stage. Between 2 and 5 external resistors set the filter characteristics depending on the desired response. Q can be set from between 0.25 and 50. No clock signal is required.

Absolute Maximum Ratings

Power Supply Voltage	+6V
Storage Temperature	-60 to +150 C
Operating Temperature	0 to 70 C

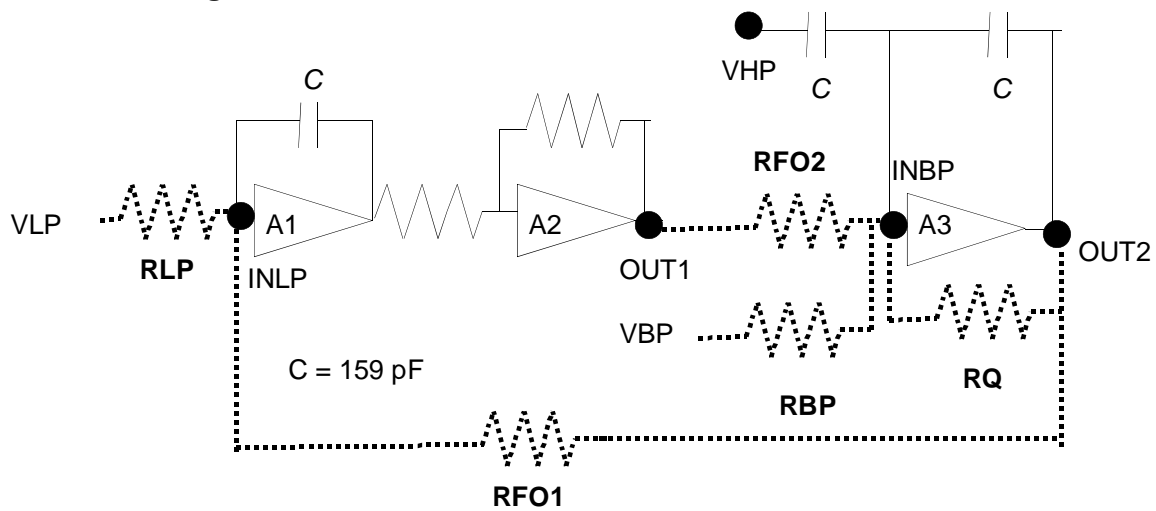
Features

- Independent Q, frequency and gain adjustments
- Low sensitivity to external resistor variation
- Operates up to 80 kHz
- Q range from 0.25 to 50
- Low Power Operation
- Low Voltage Operation
- On Chip Power Save Pin Cascadable for Higher Order Filtering

Applications

- Spectrum Analyzers
- General Purpose Systems
- Portable Systems
- Anti-Alias Filters
- Reconstruction Filters
- Telecommunications
- Tracking Filters
- Harmonic Analysis
- Noise Analysis
- Data Communication
- Wireless Applications

Block Diagram





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Electrical Characteristics _____

(VDD = +5.0V, T = 25° C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DC Specifications						
Operating Voltage	VDD		2.7	5	5.5	V
Supply Current	IDD	MSRAAF1; or MSRAAF2 and PWR = HI		2		mA
Supply Current	IDD	MSRAAF3, or MSRAAF2 and PWR = LO		500		uA
Power Down Current		PD = HI		100		uA
AC Specifications						
Gain	Av		-0.5	0	0.5	dB
Signal to Noise Ratio				95		dB
Distortion	THD				0.1	%
Signal Swing		1 kHz	4	4.5		V p-p
Input Impedance	ZIN	fIN = 1 kHz		1		Mohm
Output Drive	Io			1		mA
Output Impedance	Zo	fIN = 1 kHz		500		ohm
Output Capacitive Load				50		pF
Center Frequency Range	Fo	PWR = HI	0.001	50	80	kHz
Center Frequency Range	Fo	PWR = LOW	0.001	5	10	kHz
fo Accuracy				+/- 3		%
Q Range	Q		0.25		50	

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Pin Description

16 Pin Package

- 1. VDDA Positive Power Supply, Typically 2.5 Volts for Split Supply, 5.0 Volts for Single Supply
- 2. OUTA 2 Output 2 for Channel A
- 3. OUTA 1 Output 1 for Channel A
- 4. INBPA Bandpass Input for Channel A
- 5. INHPA Highpass Input for Channel A
- 6. INLPA Lowpass Input for Channel A
- 7. VSS Negative Power Supply, Typically -2.5 Volts for Split Supply. 0 Volts for Single Supply
- 8. PD Power Down Pin, CMOS level, Hi = Power Down
- 9. GND GND Pin, 0V for Split Supplies 2.5 Volts Typical for Single Supply
- 10. BIAS Bias Pin (OPEN)
- 11. INLPB Low Pass Input for Channel B
- 12. INHPB High Pass Input for Channel B
- 13. INBPB Band Pass Input for Channel B
- 14. OUTB 1 Output 1 for Channel B
- 15. OUTB 2 Output 2 for Channel B
- 16. PWR Set Bias Current for Filter Stages, LO=Low power, HI=normal power

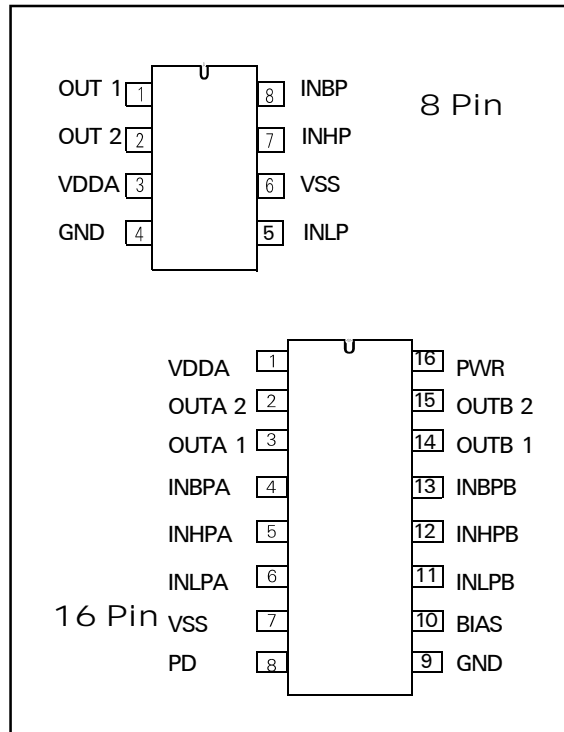
8 Pin Package

- 1. OUT 1 Output 1
- 2. OUT 2 Output 2
- 3. VDD Positive Power Supply, Typically 2.5 Volts for Split Supply, 5.0 Volts for Single Supply
- 4. GND Ground Pin, 0V for Split Supplies, 2.5 Volts Typical for Single Supply
- 5. INLP Low Pass Input
- 6. VSS Negative Power Supply, Typically -2.5 Volts for Split Supply, 0 Volts for Single Supply
- 7. INHP High Pass Input
- 8. INBP Band Pass Input

Ordering Information

Part Number	Package
MSRAAF1P	8 Pin DIP
MSRAAF2P	16 Pin DIP
MSRAAF3P	8 Pin DIP
MSRAAF1S	8 Pin SOIC
MSRAAF2S	16 Pin SOIC
MSRAAF3S	8 Pin SOIC

Pin Configuration



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$$(RFO1 * RFO2)^{1/2} = 1E9/Fo$$

$$RQ = Q * RFO2 ((RFO1/RFO2)^{1/2})$$

SIMPLIFIED

If $RFO1 = RFO2$; $RFO1=RFO2=1E9/Fo$

$$RQ = Q * RFO2$$

LOWPASS KLP = Lowpass Gain

$$RLP = RFO1/KLP ; RBP = \infty ; INHP \text{ to GND}$$

BANDPASS KBP = Bandpass Gain

$$RBP = RQ/KBP ; RLP = \infty ; INHP \text{ to GND}$$

HIGHPASS Gain = 1

$$RLP = \infty ; RBP = \infty$$

NOTCH

$$RLP = RFO1 ; RBP = \infty$$

ALL PASS

An External Op Amp Inverter is required

$$RLP = RFO1 ; RBP = RQ ; R1 = R2$$

LOWPASS ELLIPTIC

An External Resistor Divider is required on INHP

$$RLP = RFO1 ; RBP = \infty$$

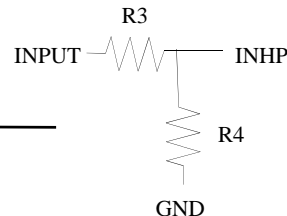
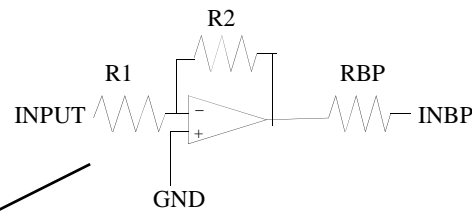
$$FZ = Fo * (((R2 + R1)/R2)^{1/2})$$

HIGHPASS ELLIPTIC

$$RLP = (Fo/Fz)^2 * RFO1 ; RBP = \infty$$

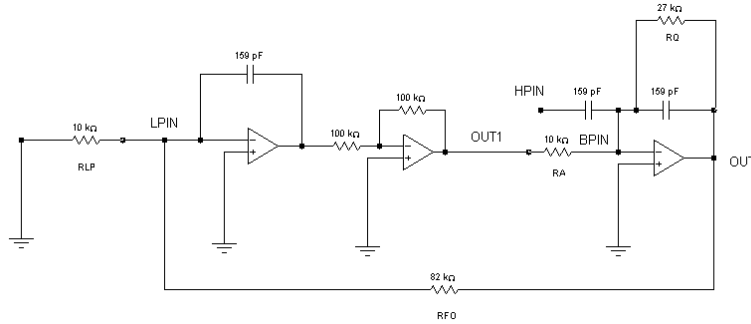
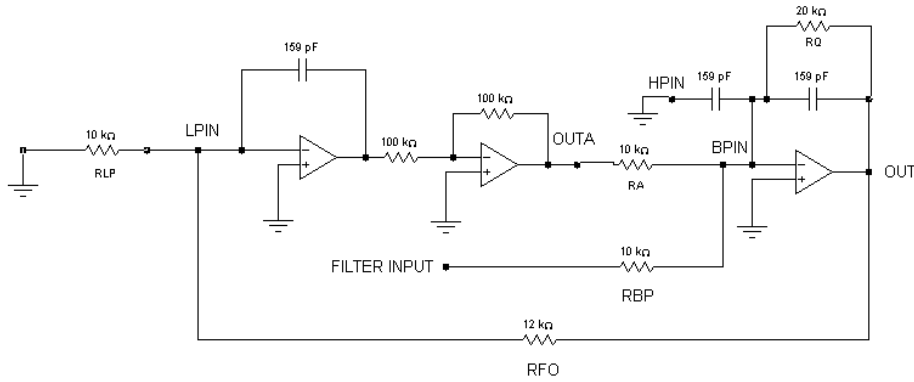
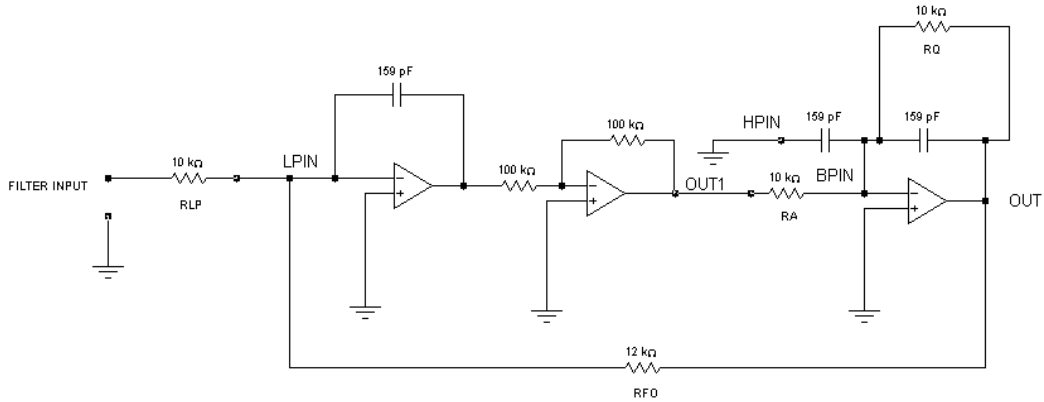
Choosing RFO

For applications where Q is ≥ 1 , making $RFO1 = RFO2$ will usually be a good simplification. For applications where Q is significantly less than one, the maximum signal can be reduced. For example, if $Q = 0.5$, $RFO2 = 100K$ and $RQ = 50K$, the signal at OUT1 will be twice OUT2 and will clip for large signals. By using the general equations, it can be seen that one solution to this problem would be to make $RFO2 = RQ = 50K$ and $RFO1 = 200K$.



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STANDARD PRODUCTS

MSGEQ5A	Five Band Graphic Equalizer
MSGEQ7	Seven Band Graphic Equalizer
MSHFS1-6	Selectable High Frequency LP/BP Filter
MSFS1-6	Selectable Lowpass/Bandpass Filter
MSCAHF	Selectable High Frequency Active Lowpass/Bandpass Filter
MSU1F1-4, MSU2F1	Resistor Programmable Universal Active Filter
MSU1HF1-4, MSU2HF1	High Frequency Resistor Programmable Universal Active Filter
MSELP	Switched Capacitor Elliptic Lowpass Filter with Op Amps
MSNBLP	Switched Capacitor Butterworth Lowpass Filter
MSLE/B/C5L/M	Switched Capacitor General Purpose Lowpass Filter
MS2LFS	Dual Selectable Low Voltage Lowpass/Bandpass Filter
MSLFS	Selectable Low Voltage Lowpass/Bandpass Filter
MSHN1-6	Selectable High Pass/Notch Filter
MSRAAF	Resistor Programmable Active Audio Filter
MSRAHF	Resistor Programmable Active High Frequency Filter
MSDET	Tone Detector
MSEPAF	Electrically Programmable Active Filter
MSCBT	Communications Baseband Transceiver
MSLV14	14 MHz Video Lowpass Filter



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