PRODUCT SPECIFICATIONS — LINEAR INTEGRATED CIRCUITS

Ground Sensing Quad Operational Amplifier

Raytheon

RC3403A, RC3503A

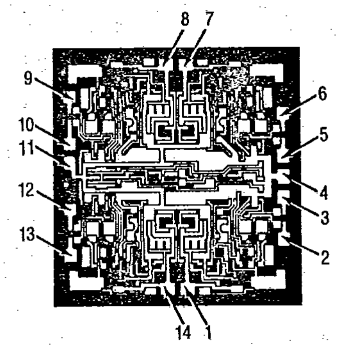
Features

- Class AB output stage — no crossover distortion
- Output voltage swings to ground in single supply operation
- High slew rate — 1.2V/μS
- Single or split supply operation
- Wide supply operation — +2.5V to +36V or ±1.25V to ±18V
- Pin compatible with LM324 and MC3403
- Low power consumption — 0.8mA/amplifier
- Common mode range includes ground

Description

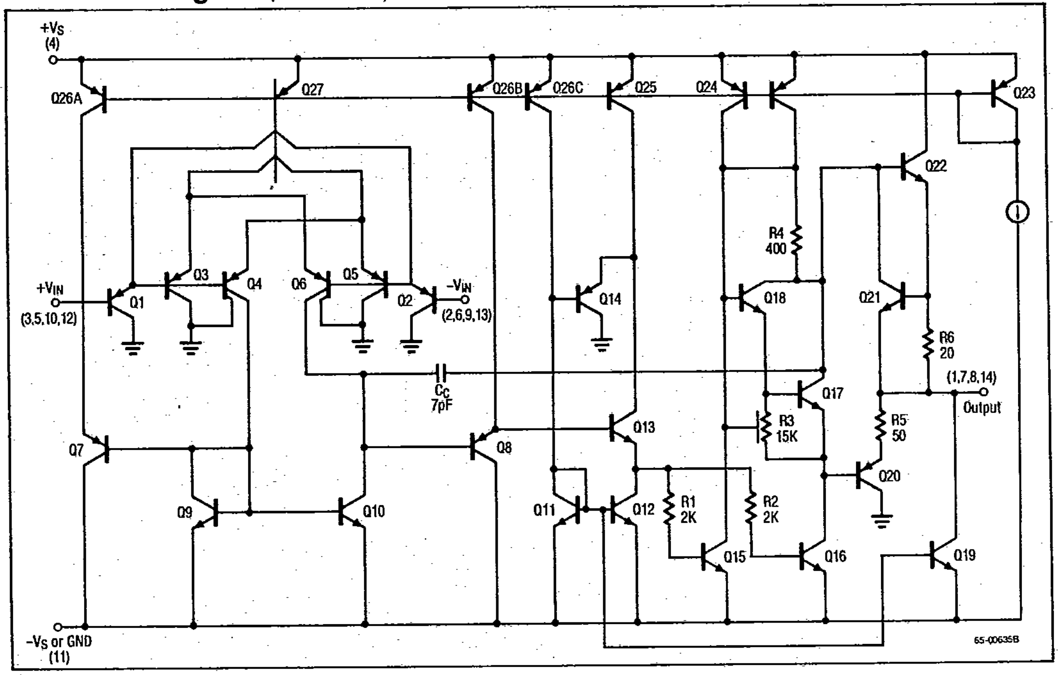
The RC/RV3403A and RM3503A are high performance ground sensing quad operational amplifiers featuring improved DC specifications equal to or better than the standard 741 type general purpose op amp. The ground sensing differential input stage of these op amps provides increased slew rate compared to 741 types.

Mask Pattern



Die Size: 80 x 84 mils
Min. Pad Dimensions: 4 x 4 mils

Schematic Diagram (1/4 Shown)



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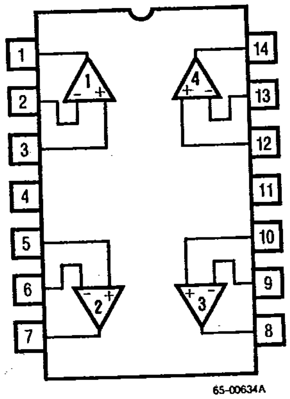
Connection Information

14-Lead Dual In-Line Package (Top View)



Pin	Function
1	Output 1
2	-Input 1
3	+Input 1
4	$+V_S$
5	+Input 2
6	-Input 2
7	Output 2
8	Output 3
9	-Input 3
10	+Input 3
11	$-V_S$ (GND)
12	+Input 4
13	-Input 4
14	Output 4

Thermal Characteristics

	14-Lead Plastic DIP	14-Lead Ceramic DIP
Max. Junction Temp.	125°C	175°C
Max. P_D $T_A < 50°C$	468mW	1042mW
Therm. Res. θ_{JC}	—	60°C/W
Therm. Res. θ_{JA}	160°C/W	120°C/W
For $T_A > 50°C$ Derate at	6.25mW per °C	8.33mW per °C

Absolute Maximum Ratings

Supply Voltage .... +36V or ±18V
Input Voltage .... -0.3V to +36V
Differential Input Voltage 36V
Storage Temperature
Range .... -65°C to +150°C
Operating Temperature Range
RM3503A ....-55°C to +125°C
RC3403A .... 0°C to +70°C
RV3403A .... -40°C to +85°C
Lead Soldering Temperature
(60 Sec) .... +300°C

Ordering Information

Part Number	Package	Operating Temperature Range
RC3403ADC RC3403ADB	Ceramic Plastic	0°C to +70°C 0°C to +70°C
RV3403ADB	Plastic	-40°C to +85°C
RM3503ADC RM3503ADC/883*	Ceramic Ceramic	-55°C to +125°C -55°C to +125°C

*MIL-STD-883, Level C Processing

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Low Voltage Electrical Characteristics (V_S = +5V, $-V_S$ = GND, and T_A = +25°C)

Parameters	Test Conditions	RM3503A			RC/RV3403A			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$R_S \leq 0\Omega$		2.0	5.0		2.0	10	mV
Input Bias Current			-150	-500		-150	-500	nA
Input Offset Current			30	50		30	50	nA
Supply Current	$R_L = \infty$ All Amplifiers		2.5	4.0		2.5	5.0	mA
Large Signal Voltage Gain	$R_L \geq 2k\Omega$	20	200		20	200		V/mV
Output Voltage Swing[1]	$R_L \geq 10k\Omega$	3.5			3.5			V_{p-p}
Channel Separation	1kHz ≤ F ≤ 200kHz (Input Referred)		120			120		dB
Power Supply Rejection Ratio		86			76			dB

Note: 1. Output will swing to ground.

Electrical Characteristics Guaranteed Over Temperature (V_S = ±15V)

Parameters	Test Conditions	RM3503A			RC3403A			RV3403A			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$R_S \leq 0\Omega$			6.0			10			10	mV
Input Bias Current				-1500			-800			-1500	nA
Input Offset Current				200			200			200	nA
Large Signal Voltage Gain	$R_L \geq 2k\Omega$	25			15			15			V/mV
Output Voltage Swing	$R_L \geq 2k\Omega$	±10			±10			±10			V

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Electrical Characteristics ($V_S = \pm15V$, $T_A = +25°C$)

Parameters	Test Conditions	RM3503A			RC/RV3403A			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$R_S \leq 0\Omega$		2.0	4.0*		2.0	6.0*	mV
Input Bias Current			-150	-400*		-150	-500	nA
Input Offset Current			30	±50		±30	±50	nA
Input Voltage Range		0		$+V_S-2$	0		$+V_S-2$	V
Supply Current	$R_L = \infty$ On All Op Amps		3.0	4.0		3.0	5.0*	mA
Large Signal Voltage Gain	$R_L \geq 2k\Omega$	50	100		25*	100		V/mV
Output Voltage Swing	$R_L \geq 2k\Omega$	±13	±14		±13	±14		V
Common Mode Rejection Ratio	DC	70	90		70	90		dB
Channel Separation	1kHz to 20kHz		120			120		dB
Output Source Current	$V_{IN+} = 1V$, $V_{IN-} = 0V$	20	40		20	40		mA
Output Sink Current		10	20		10	20		mA
Unity Gain Bandwidth			1.0			1.0		MHz
Slew Rate	$A_V = 1$, $-10 \leq V_I < +10$		1.2*			1.2*		V/μS
Distortion (Crossover)	$f = 20kHz$, $V_O = 10V_{p-p}$		1.0			1.0		%
Power Bandwidth	$V_O = 10V_{p-p}$		40			40		kHz
Power Supply Rejection Ratio		86	94		80	94		dB

*Significantly improved performance.

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Electrical Characteristics Comparison RC3403A, MC3403, LM324

Max Ratings	RC3403A			MC3403			LM324			Units
Supply Voltage	+36 or ±18			+36 or ±18			+32 or ±16			V
Differential Input Voltage	36			36			32			V
Input Voltage	36			36			32			V
Electrical Characteristics	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Units**
Test Conditions		±15			±15			+5.0		V
Input Offset Voltage		2.0	6.0		2.0	8.0		2.0	7.0	mV
Input Offset Current		±30	±50		±30	±50		±5.0	±50	nA
Input Bias Current		150	500		200	500		45	500	nA
Input Voltage Range	0		$+V_S$ -2				0		$+V_S$ -1.5	V
Supply Current		3.0	5.0		2.8	7.0		0.8	2.0	mA
Large Signal Voltage Gain	25	100		20	200			100		V/mV
Output Voltage Swing	±13	±14		±1.0	±13				$+V_S$ -1.5	V
Common Mode Rejection Ratio	70	90		70	90			85		dB
Power Supply Rejection Ratio	80	94		76	90			100		dB
Unity Gain Bandwidth		1.0			1.0			1.0		MHz
Slew Rate		1.2			0.6			0.4		V/µS
Output Sink Current	10	20						20		mA
Output Source Current	20	40					20	40		mA
Channel Separation		120			120			120		dB
Distortion (Crossover)		1.0			1.0					%

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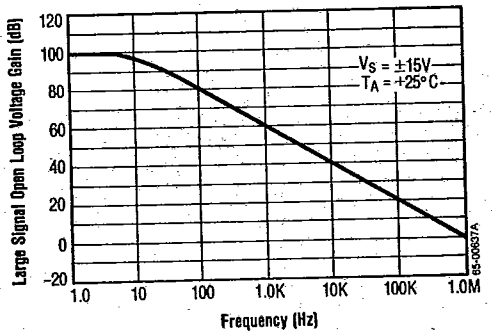
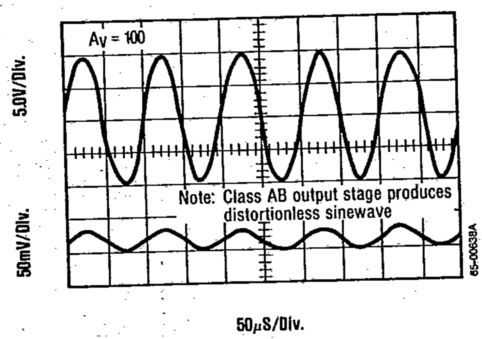
Typical Performance Characteristics

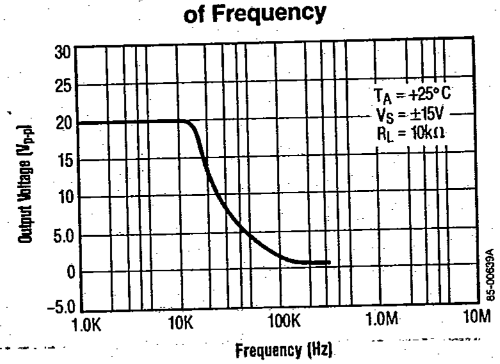
Large Signal Open Loop Voltage Gain as a Function of Frequency



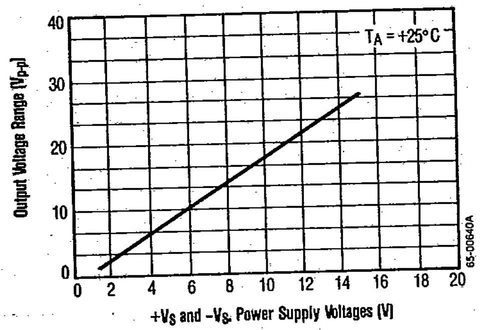
Sinewave Response



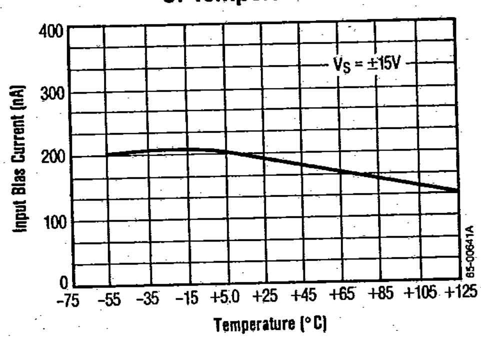
Output Voltage as a Function of Frequency



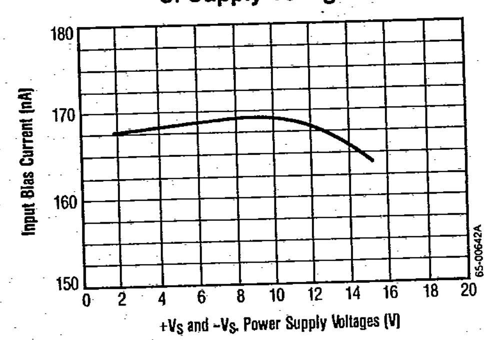
Output Swing as a Function of Supply Voltage



Input Bias Current as a Function of Temperature



Input Bias Current as a Function of Supply Voltage



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Typical Applications

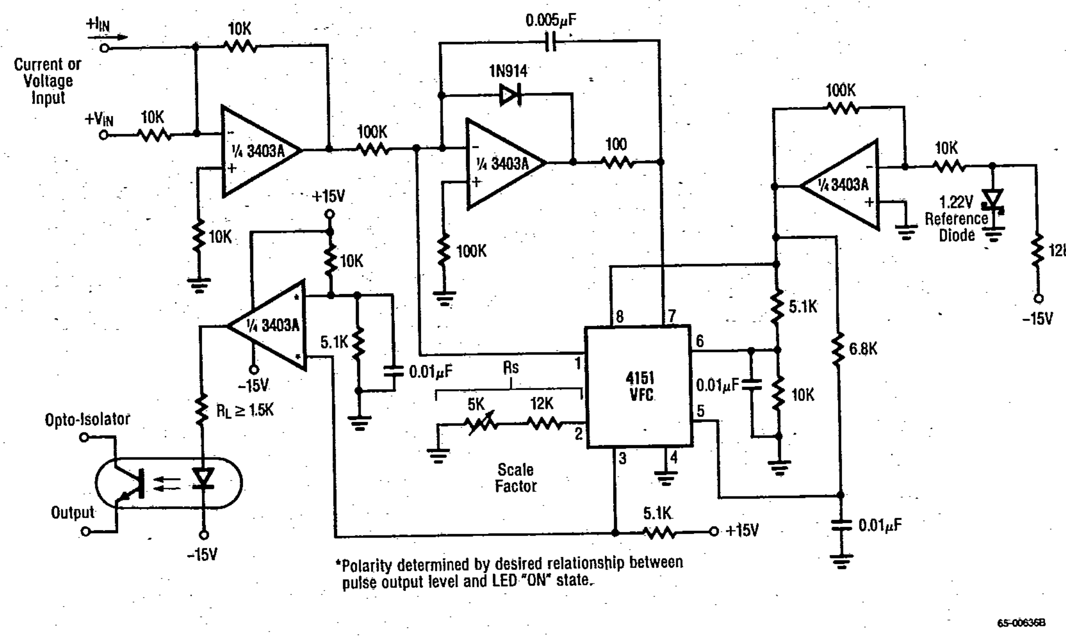

Figure 1. Precision Voltage-to-Frequency Converter With Isolated Output

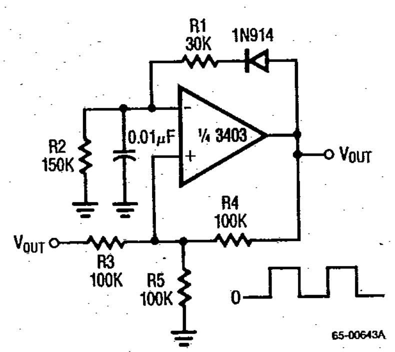

Figure 2. Pulse Generator

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Typical Applications (Continued)

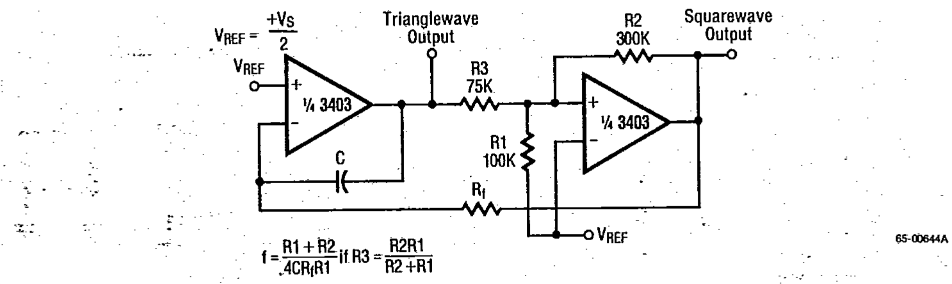

Figure 3. Function Generator

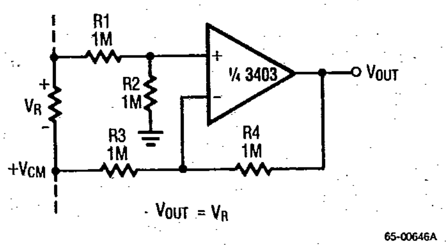

Figure 4. Ground Referencing a Differential Input Signal

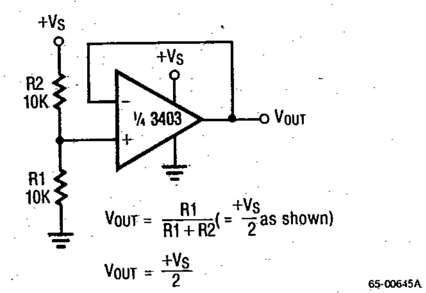

Figure 5. Voltage Reference

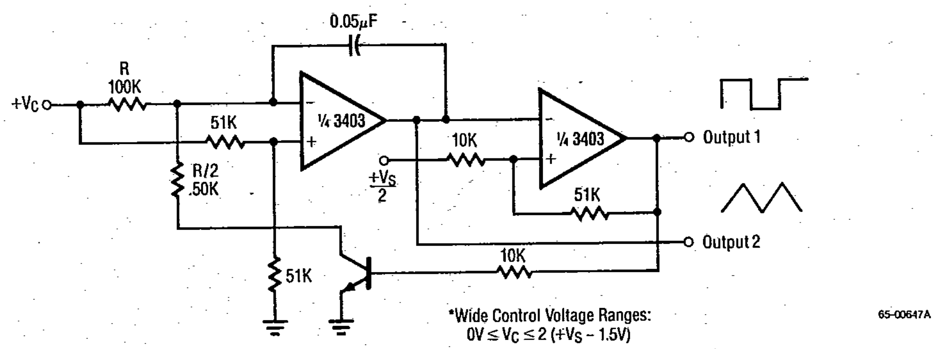

Figure 6. Voltage Controlled Oscillator

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Typical Applications (Continued)

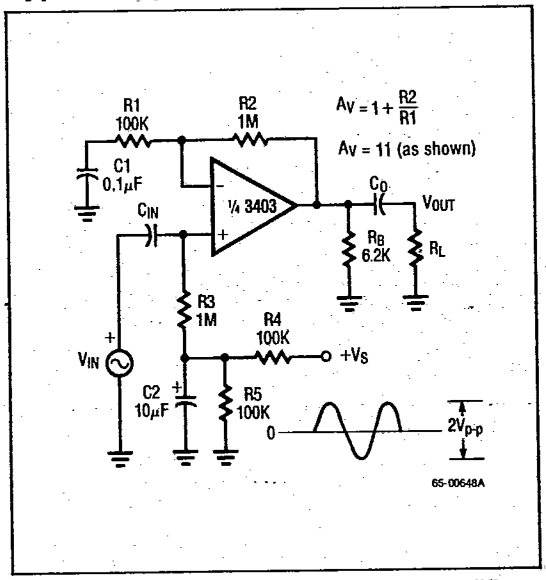


Figure 7. AC Coupled Non-Inverting Amplifier

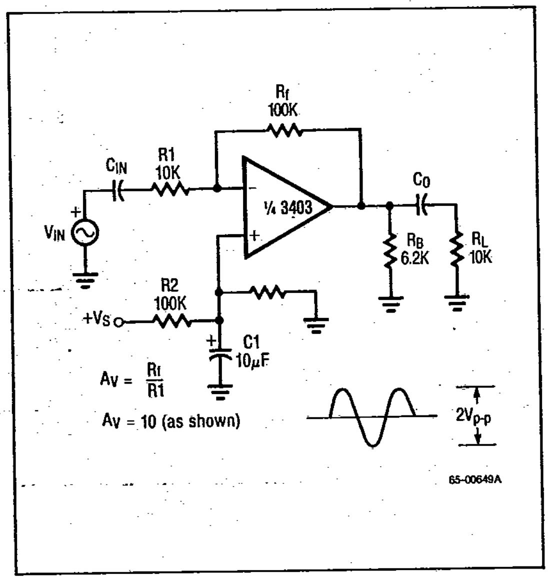


Figure 8. AC Coupled Inverting Amplifier

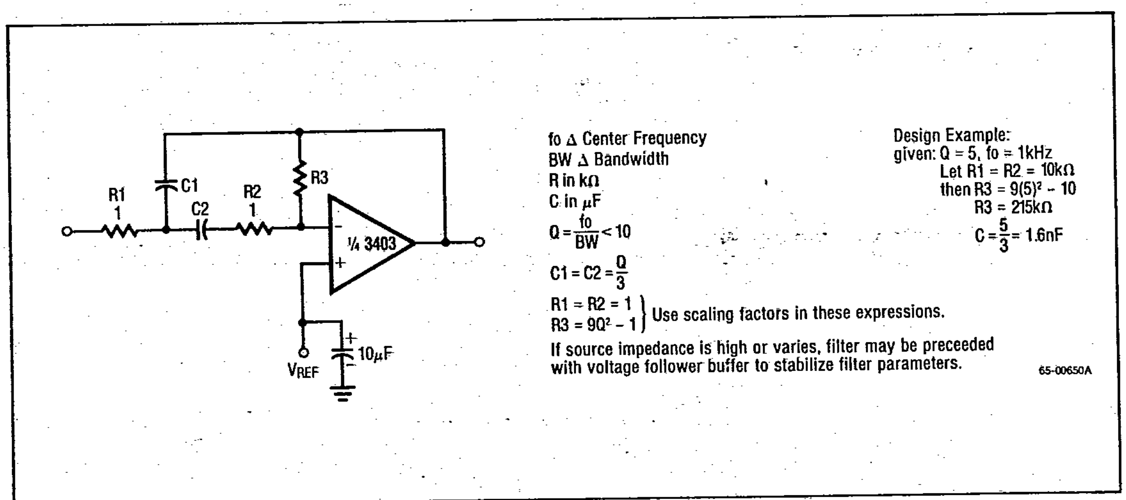


Figure 9. Multiple Feedback Bandpass Filter

Typical Applications (Continued)

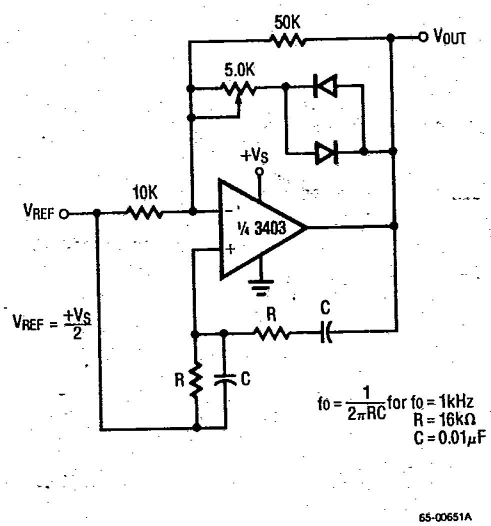
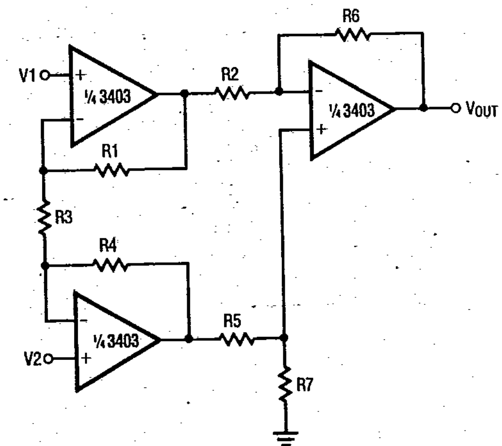


Figure 10. Wein Bridge Oscillator



$V_{OUT} = C(1 + a + b)(V2 - V1)$

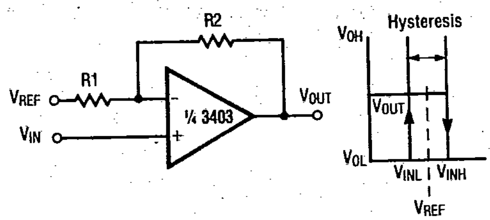
$\frac{R2}{R5} = \frac{R6}{R7}$ for best CMRR

$R1 = R4$

$R2 = R5$

$\text{Gain} = \frac{R6}{R2}\left(1 + \frac{2R1}{R3}\right) = C(1 + a + b)$

Figure 11. High Impedance Differential Amplifier



$V_{INL} = \frac{R1}{R1 + R2}(V_{OL} - V_{REF}) + V_{REF}$

$V_{INH} = \frac{R1}{R1 + R2}(V_{OH} - V_{REF}) + V_{REF}$

$H = \frac{R1}{R1 + R2}(V_{OH} - V_{OL})$

Figure 12. Comparator With Hysteresis

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Typical Applications (Continued)

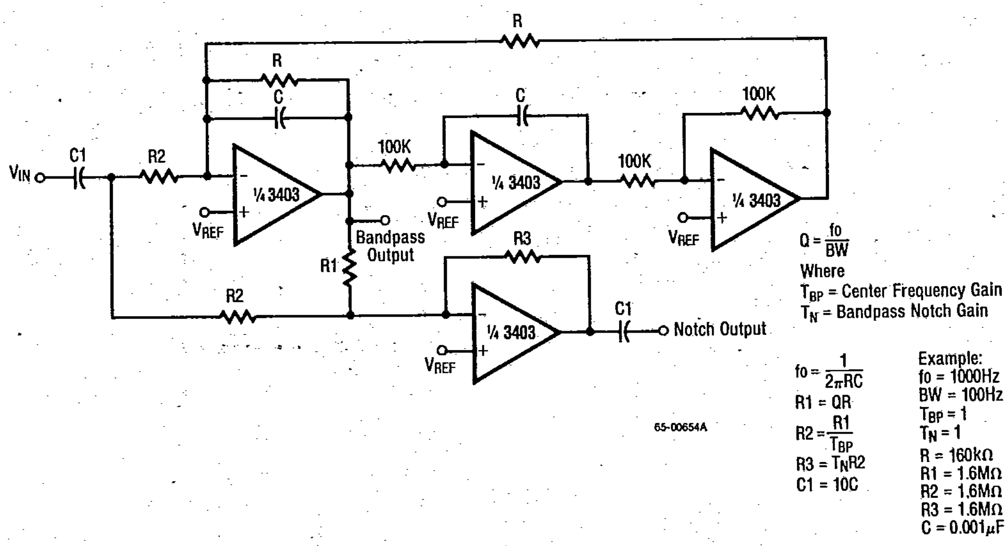

Figure 13. Bi-Quad Filter