# RC4136 General Performance Quad 741 Operational Amplifier

## Features

- Unity gain bandwidth — 3 MHz
- Short circuit protection
- No frequency compensation required
- No latch-up
- Large common mode and differential voltage ranges
- Low power consumption
- Parameter tracking over temperature range
- Gain and phase match between amplifiers

## Description

The 4136 is made up of four 741 type independent high gain operational amplifiers internally compensated and constructed on a single silicon chip using the planar epitaxial process.

This amplifier meets or exceeds all specifications for 741 type amplifiers. Excellent channel separation allows the use of the 4136 quad amplifier in all 741 operational amplifier applications providing the highest possible packaging density.

The specially designed low noise input transistors allow the 4136 to be used in low noise signal processing applications such as audio preamplifiers and signal conditioners.

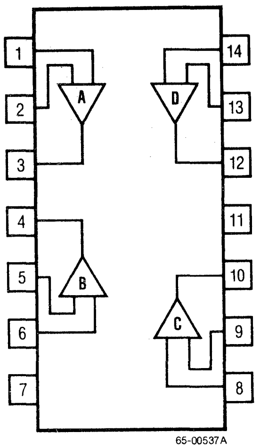
## Ordering Information

| Part Number | Package | Operating Temperature Range |
|---|---|---|
| RC4136N | N | 0°C to +70°C |
| RC4136M | M | 0°C to +70°C |
| RV4136N | N | -25° C to +85°C |
| RV4136D | D | -25° C to +85°C |
| RM4136D | D | -55°C to +125°C |
| RM4136D/883B* | D | -55°C to +125°C |

Notes:
*/883B suffix denotes Mil-Std-883, Level B processing
N = 14-lead plastic DIP
D = 14-lead ceramic DIP
M = 14-lead plastic SOIC
Contact a Raytheon sales office or representative for ordering information on special package/temperature range combinations.

## Connection Information

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

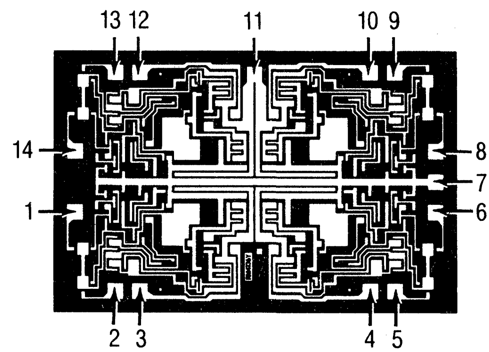



| Pin | Function |
|---|---|
| 1 | -Input (A) |
| 2 | +Input (A) |
| 3 | Output (A) |
| 4 | Output (B) |
| 5 | +Input (B) |
| 6 | -Input (B) |
| 7 | $-V_S$ |
| 8 | -Input (C) |
| 9 | +Input (C) |
| 10 | Output (C) |
| 11 | $+V_S$ |
| 12 | Output (D) |
| 13 | +Input (D) |
| 14 | -Input (D) |

## Thermal Characteristics

| | 14-Lead Small Outline | 14-Lead Plastic DIP | 14-Lead Ceramic DIP |
|---|---|---|---|
| Max. Junction Temp. | 125°C | 125°C | 175°C |
| Max. $P_D$ $T_A$ <50°C | 300 mW | 468 mW | 1042 mW |
| Therm. Res $\theta_{JC}$ | — | — | 50°C/W |
| Therm. Res. $\theta_{JA}$ | 200°C/W | 160°C/W | 120°C/W |
| For $T_A$ >50°C Derate at | 5.0 mW per °C | 6.25 mW per °C | 8.33 mW/ per °C |

## Mask Pattern




**Die Size: 99 x 64 mils**
**Min. Pad Dimensions: 4 x 4 mils**

## Absolute Maximum Ratings

Supply Voltage
- RM4136 ............................................±22V
- RC4136, RV4136 ...............................±18V

Input Voltage* ..........................................±30V
Differential Input Voltage ............................30V
Output Short Circuit Duration** ..........Indefinite
Storage Temperature
- Range ...............................-65°C to +150°C

Operating Temperature Range
- RM4136 ............................-55°C to +125°C
- RV4136 ..............................-25°C to +85°C
- RC4136 ................................0°C to +70°C

Lead Soldering Temperature
- (DIP, 60 sec) .................................+300°C
- (SO-14, 10 sec)..............................+260°C

*For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
**Short circuit may be to ground, typically 45 mA.

## Electrical Characteristics ($V_S$ = ±15V and $T_A$ = +25°C, unless otherwise noted)

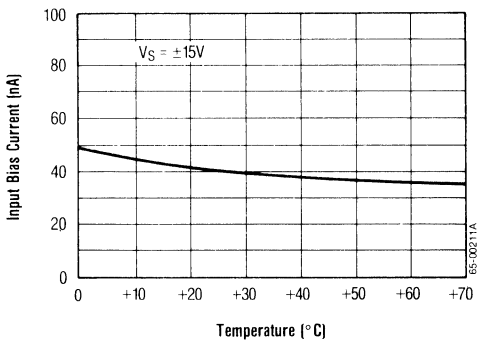
| Parameters | Test Conditions | RM4136 Min | RM4136 Typ | RM4136 Max | RC/RV4136 Min | RC/RV4136 Typ | RC/RV4136 Max | Units |
|---|---|---|---|---|---|---|---|---|
| Input Offset Voltage | $R_S \leq 10k\Omega$ | | 0.5 | 5.0 | | 0.5 | 6.0 | mV |
| Input Offset Current | | | 5.0 | 200 | | 5.0 | 200 | nA |
| Input Bias Current | | | 40 | 500 | | 40 | 500 | nA |
| Input Resistance | | 0.3 | 5.0 | | 0.3 | 5.0 | | MΩ |
| Large Signal Voltage Gain | $R_L \geq 2k\Omega$, $V_{OUT}$ = ±10V | 50 | 300 | | 20 | 300 | | V/mV |
| Output Voltage Swing | $R_L \geq 10k\Omega$ | ±12 | ±14 | | ±12 | ±14 | | V |
| | $R_L \geq 2k\Omega$ | ±10 | ±13 | | ±10 | ±13 | | |
| Input Voltage Range | | ±12 | ±14 | | ±12 | ±14 | | V |
| Common Mode Rejection Ratio | $R_S \leq 10k\Omega$ | 70 | 100 | | 70 | 100 | | dB |
| Power Supply Rejection Ratio | $R_S \leq 10k\Omega$ | 76 | 100 | | 76 | 100 | | dB |
| Power Consumption | $R_L = \infty$, All Outputs | | 210 | 340 | | 210 | 340 | mW |
| Transient Response<br>Rise Time | $V_{IN}$ = 20mV, $R_L$ = 2kΩ | | 0.13 | | | 0.13 | | µS |
| Overshoot | $C_L \leq$ 100pF | | 5.0 | | | 5.0 | | % |
| Unity Gain Bandwidth | | | 3.0 | | | 3.0 | | MHz |
| Slew Rate | $R_L \geq 2k\Omega$ | | 1.5 | | | 1.0 | | V/µS |
| Channel Separation | f = 1.0kHz, $R_S$ = 1kΩ | | 90 | | | 90 | | dB |
| **The following specifications apply for -55°C ≤ $T_A$ ≤ +125°C for RM4136; 0°C ≤ $T_A$ ≤ +70°C for RC4136; -25°C ≤ $T_A$ ≤ +85°C for RV4136, $V_S$ = ±15V** | | | | | | | | |
| Input Offset Voltage | $R_S \leq 10k\Omega$ | | | 6.0 | | | 7.5 | mV |
| Input Offset Current<br>RM/RC4136 | | | | 500 | | | 300 | nA |
| RV4136 | | | | | | | 500 | |
| Input Bias Current<br>RM/RC4136 | | | | 1500 | | | 800 | nA |
| RV4136 | | | | | | | 1500 | |
| Large Signal Voltage Gain | $R_L \geq 2k\Omega$, $V_{OUT}$ = ±10V | 25 | | | 15 | | | V/mV |
| Output Voltage Swing | $R_L \geq 2k\Omega$ | ±10 | | | ±10 | | | V |
| Power Consumption | | | 240 | 400 | | 240 | 400 | mW |

## Electrical Characteristics Comparison ($V_S$ = ±15V and $T_A$ +25°C unless otherwise noted)

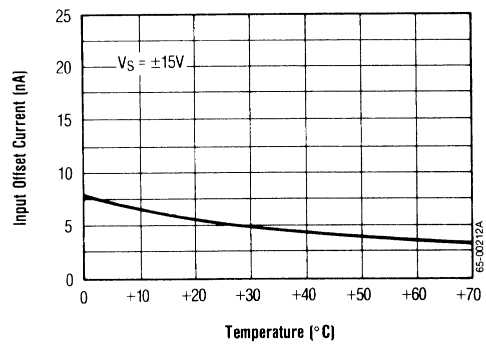
| Parameter | RC4136 (Typ) | RC741 (Typ) | LM324 (Typ) | Units |
|---|---|---|---|---|
| Input Offset Voltage | 0.5 | 2.0 | 2.0 | mV |
| Input Offset Current | 5.0 | 10 | 5.0 | nA |
| Input Bias Current | 40 | 80 | 55 | nA |
| Input Resistance | 5.0 | 2.0 | | MΩ |
| Large Signal Voltage Gain ($R_L$ = 2kΩ) | 300 | 200 | 100 | V/mV |
| Output Voltage Swing ($R_L$ = 2kΩ) | ±13V | ±13V | $\lvert +V_S - 1.2V \rvert$ to $-V_S$ | V |
| Input Voltage Range | ±14V | ±13V | $\lvert +V_S - 1.5V \rvert$ to $-V_S$ | V |
| Common Mode Rejection Ratio | 100 | 90 | 85 | dB |
| Power Supply Rejection Ratio | 100 | 90 | 100 | dB |
| Transient Response Rise Time | 0.13 | 0.3 | | μS |
| Overshoot | 5.0 | 5.0 | | % |
| Unity Gain Bandwidth | 3.0 | 0.8 | 0.8 | MHz |
| Slew Rate | 1.0 | 0.5 | 0.5 | V/μS |
| Input Noise Voltage Density (f = 1kHz) | 10 | 22.5 | | nV/$\sqrt{Hz}$ |
| Short Circuit Current | ±45 | ±25 | | mA |

# Typical Performance Characteristics

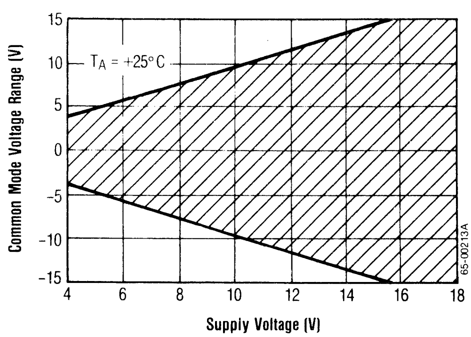
### Input Bias Current as a Function of Ambient Temperature



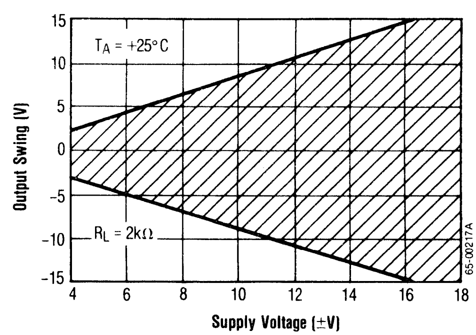

### Input Offset Current as a Function of Ambient Temperature



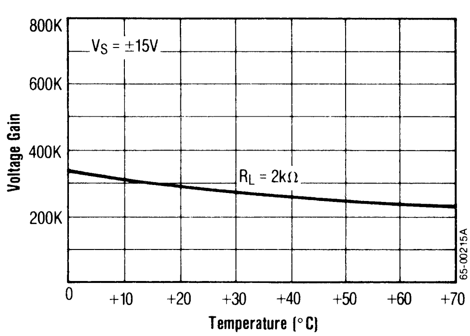

### Common Mode Range as a Function of Supply Voltage



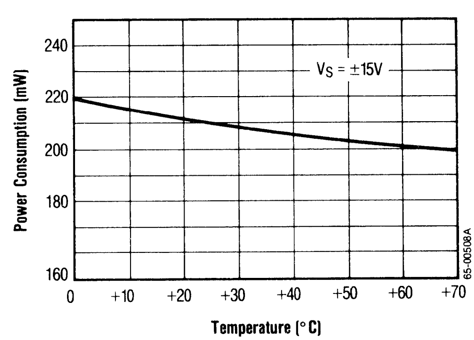

### Typical Output Voltage as a Function of Supply Voltage




### Open Loop Gain as a Function of Temperature

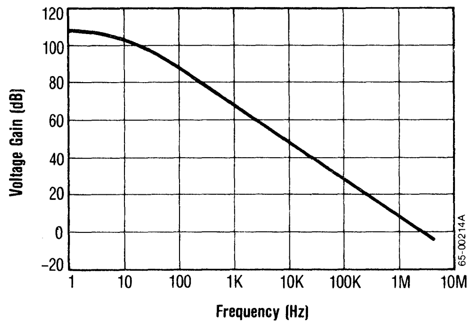



### Power Consumption as a Function of Ambient Temperature

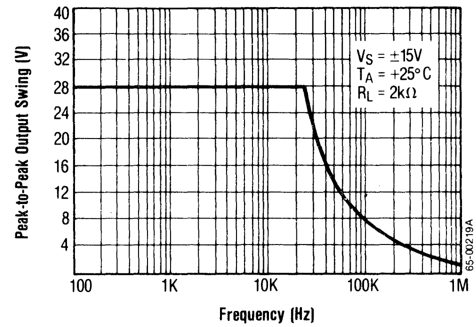


# Typical Performance Characteristics (Continued)

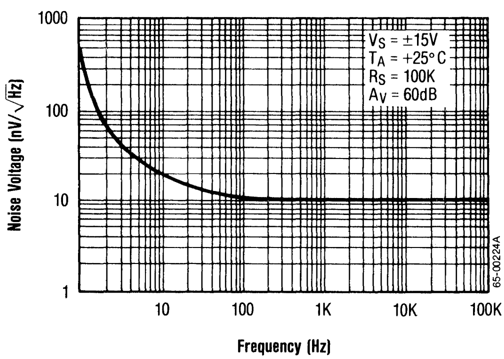
### Open Loop Voltage Gain as a Function of Frequency



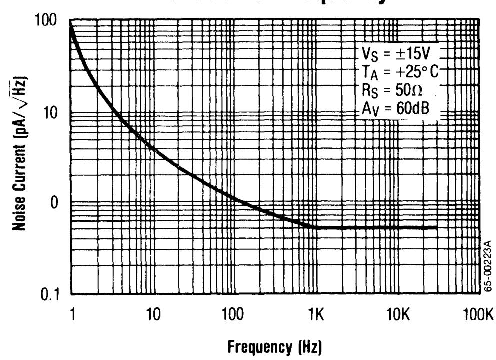

### Output Voltage Swing as a Function of Frequency



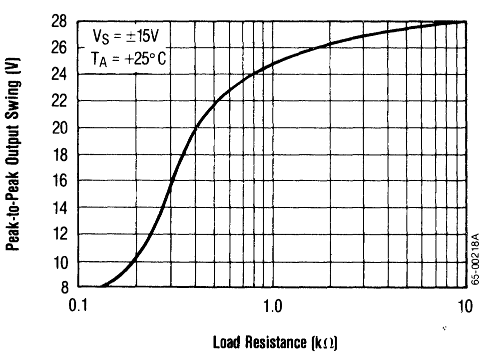

### Input Noise Voltage as a Function of Frequency



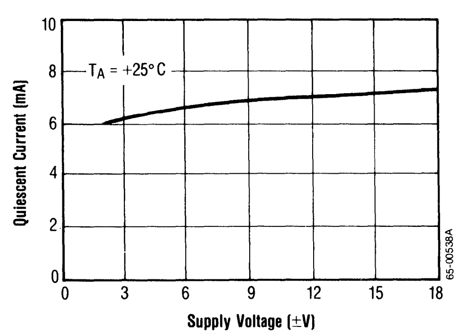

### Input Noise Current as a Function of Frequency




### Output Voltage Swing as a Function of Load Resistance

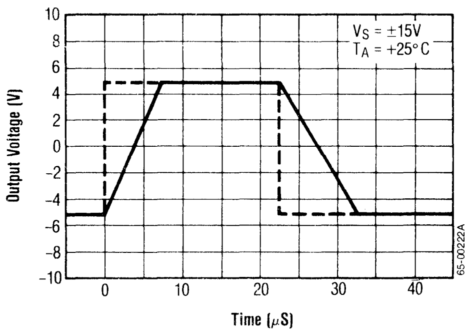



### Quiescent Current as a Function of Supply Voltage

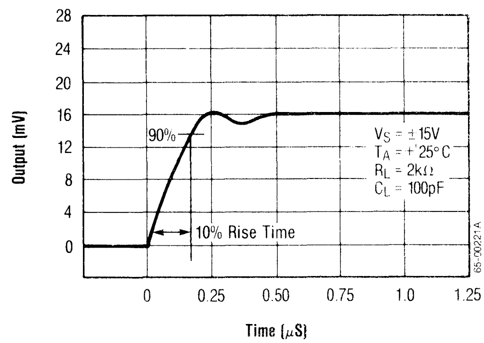


# Typical Performance Characteristics (Continued)

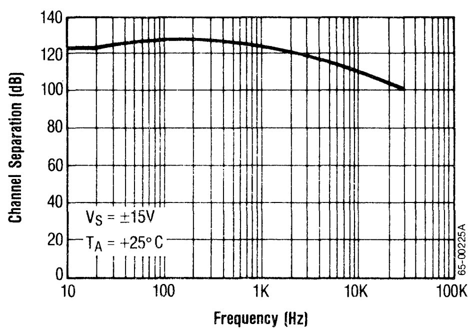
### Voltage Follower Large Signal Pulse Response



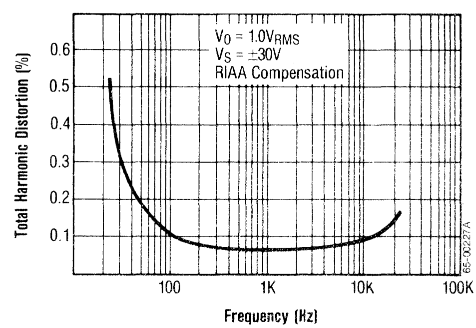

### Transient Response



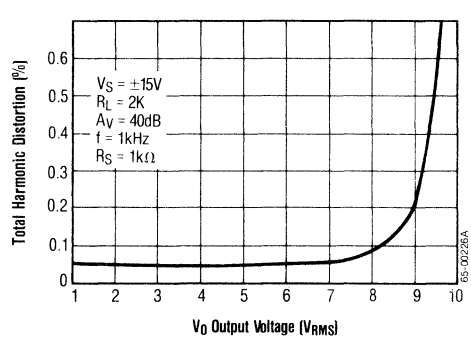

### Channel Separation




### Distortion vs. Frequency




### Total Harmonic Distortion vs. Output Voltage

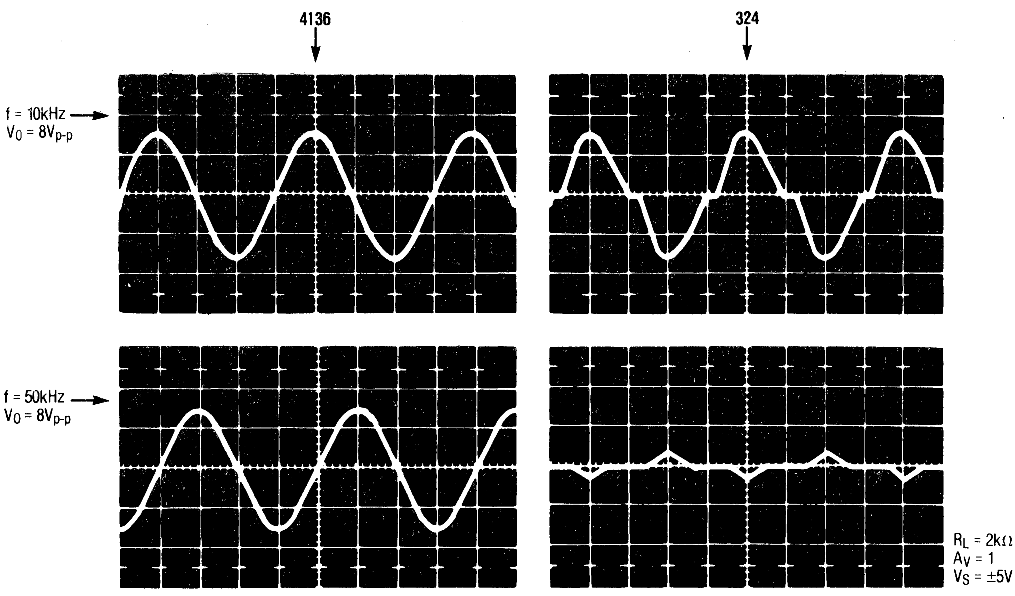


## 4136 Versus 741

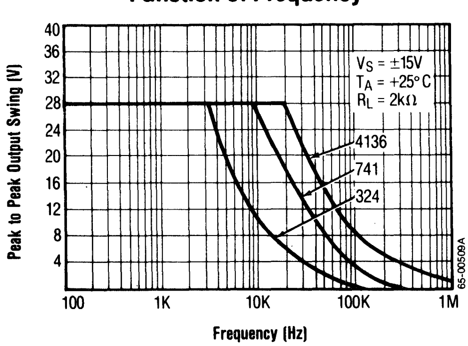
Although the 324 is an excellent device for single-supply applications where ground sensing is important, it is a poor substitute for four 741s in split supply circuits.

The simplified input circuit of the 4136 exhibits much lower noise than that of the 324 and exhibits no crossover distortion as compared with the 324 (see illustration). The 324 shows serious crossover distortion and pulse delay in attempting to handle a large signal input pulse.

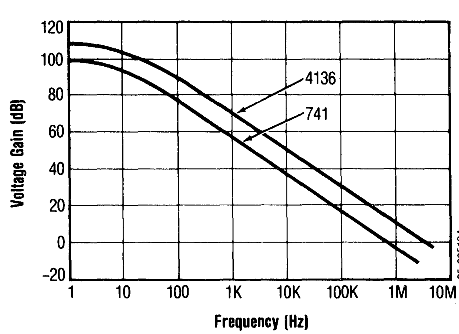
### Comparative Crossover Distortion



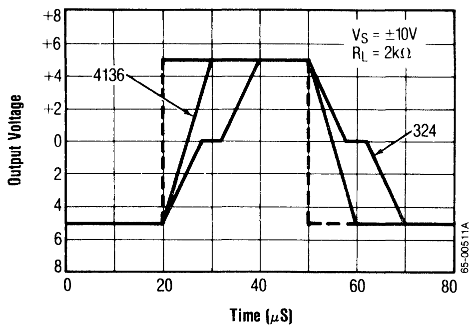

### Output Voltage Swing as a Function of Frequency



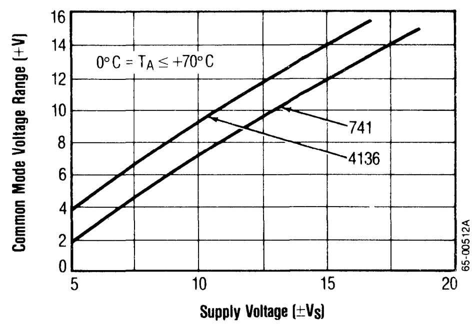

### Open Loop Voltage Gain as a Function of Frequency



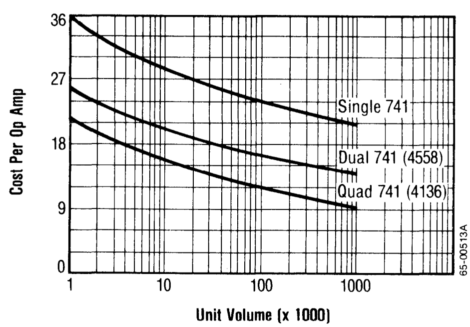
### Voltage Follower Large Signal Pulse Response




### Input Common Mode Voltage Range as a Function of Supply Voltage

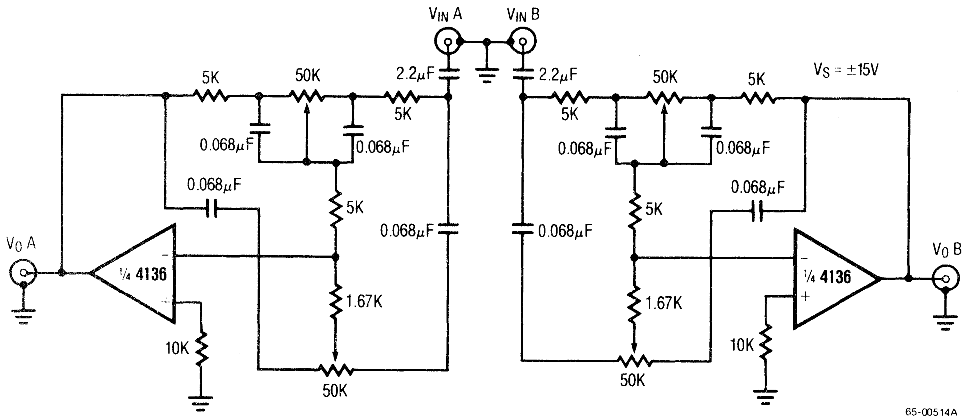



### Unit Cost Comparisons

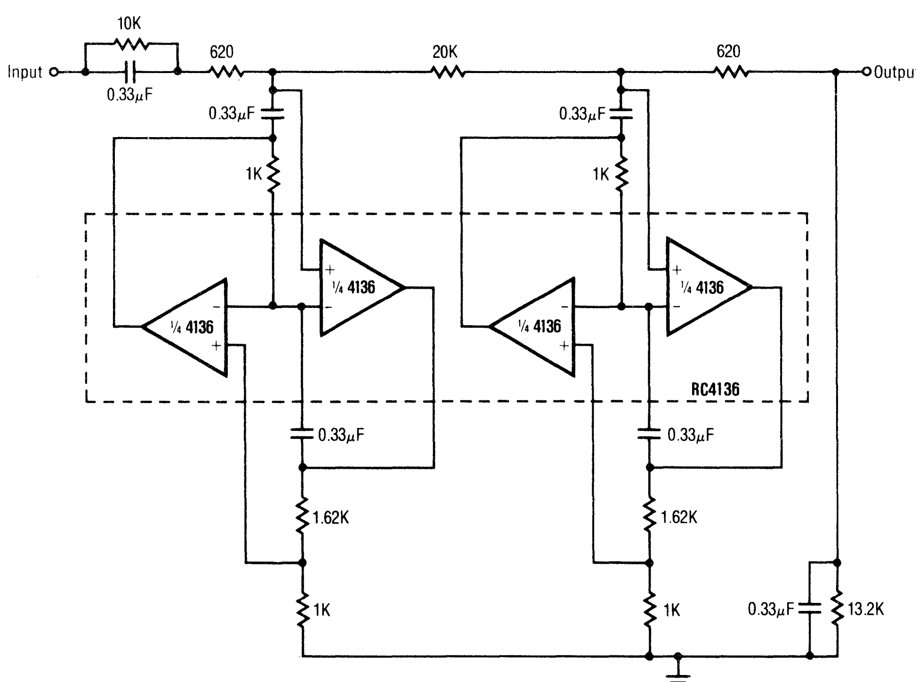


# Typical Applications

### Stereo Tone Control

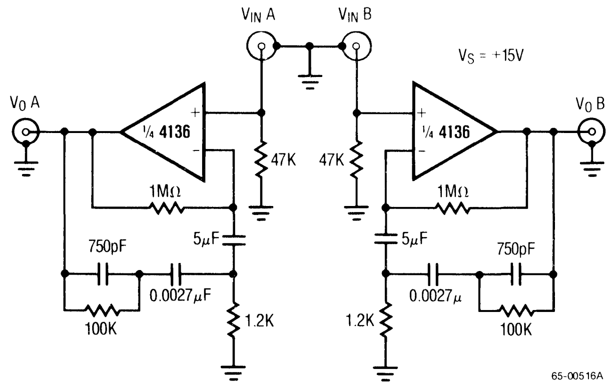



### 400 Hz Lowpass Butterworth Active Filter

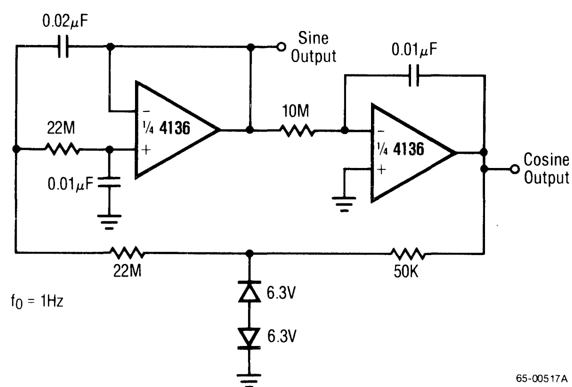


# Typical Applications (Continued)

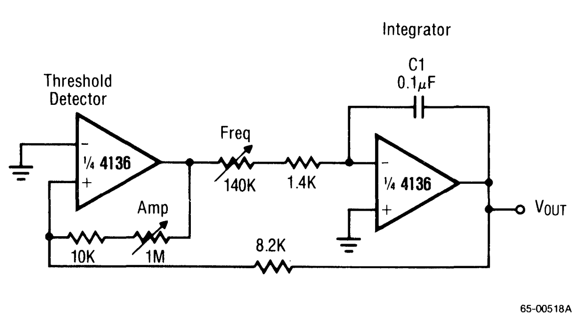
## RIAA Preamplifier




## Low Frequency Sine Wave Generator With Quadrature Output

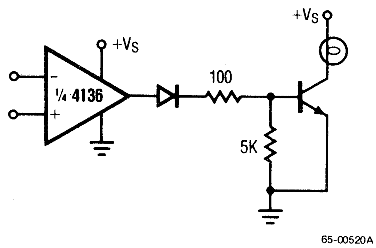



## Triangular-Wave Generator

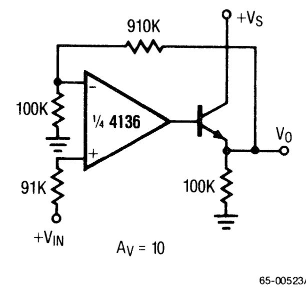


# Typical Applications (Continued)

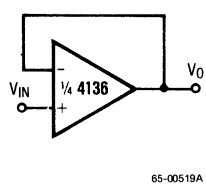
### Lamp Driver



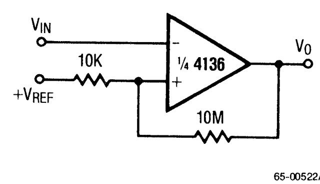

### Power Amplifier



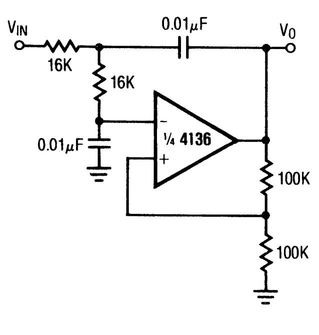

### Voltage Follower



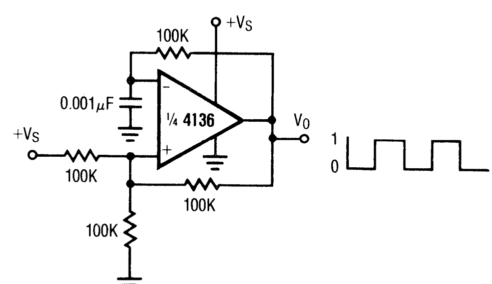

### Comparator With Hysteresis




### DC Coupled 1 kHz Lowpass Active Filter

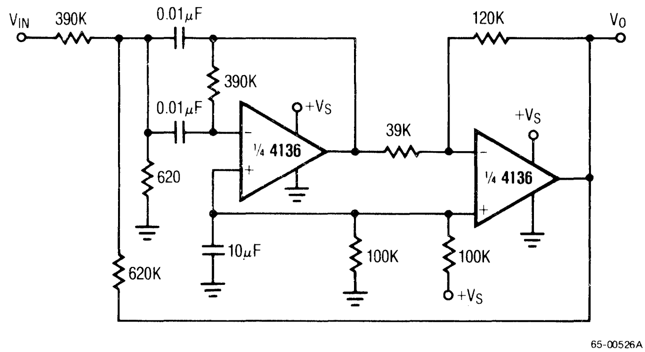



### Squarewave Oscillator

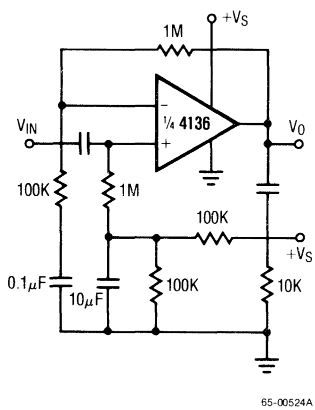


## Typical Applications (Continued)

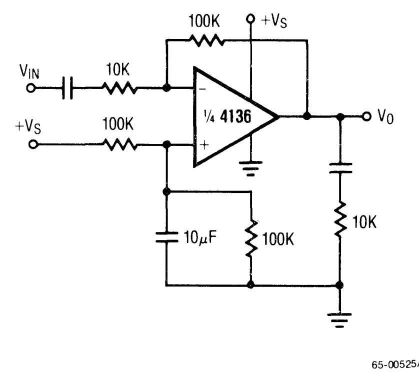
### 1 kHz Bandpass Active Filter



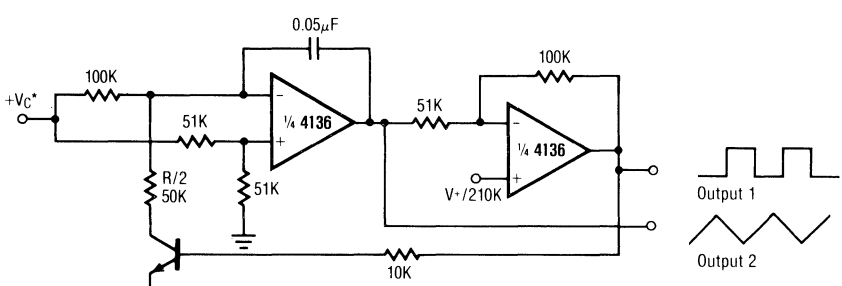

### AC Coupled Non-Inverting Amplifier




### AC Coupled Inverting Amplifier




### Voltage Controlled Oscillator (VCO)




*Wide Control Voltage Range: $0V < V_C < 2\,(+V_S - 1.5V)$

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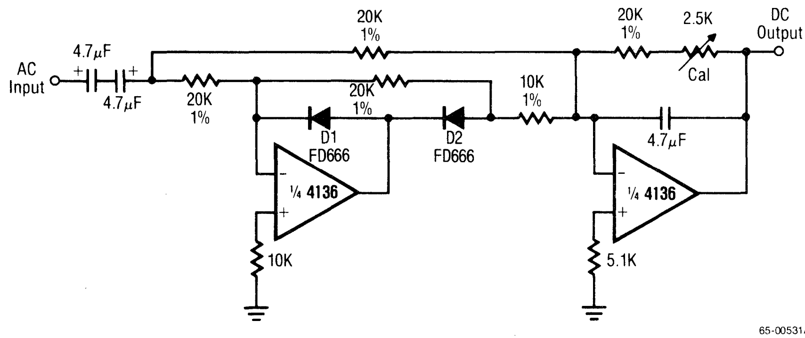
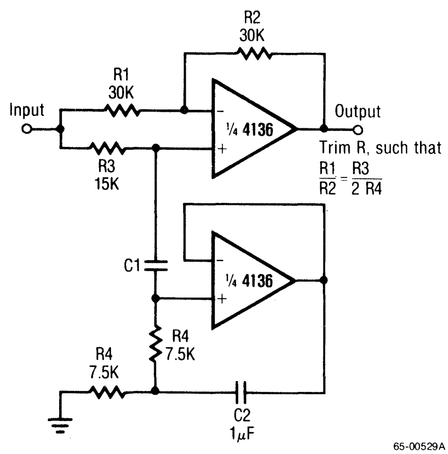
# Typical Applications (Continued)

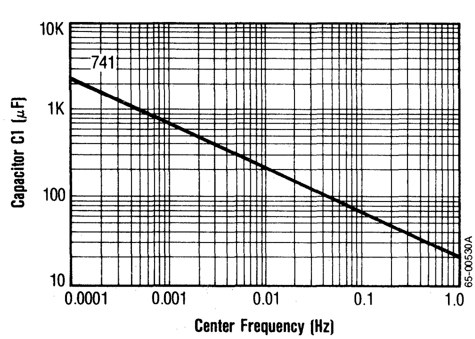
### Full-Wave Rectifier and Averaging Filter




### Notch Filter Using the 4136 as a Gyrator

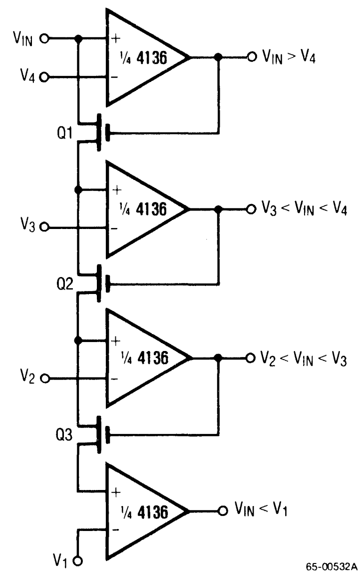



### Notch Frequency as a Function of C1

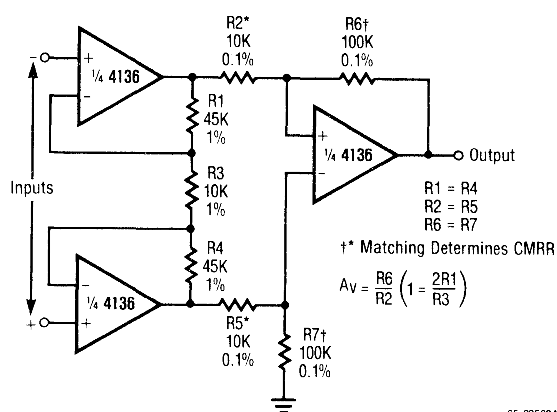


## Typical Applications (Continued)

### Multiple Aperture Window Discriminator

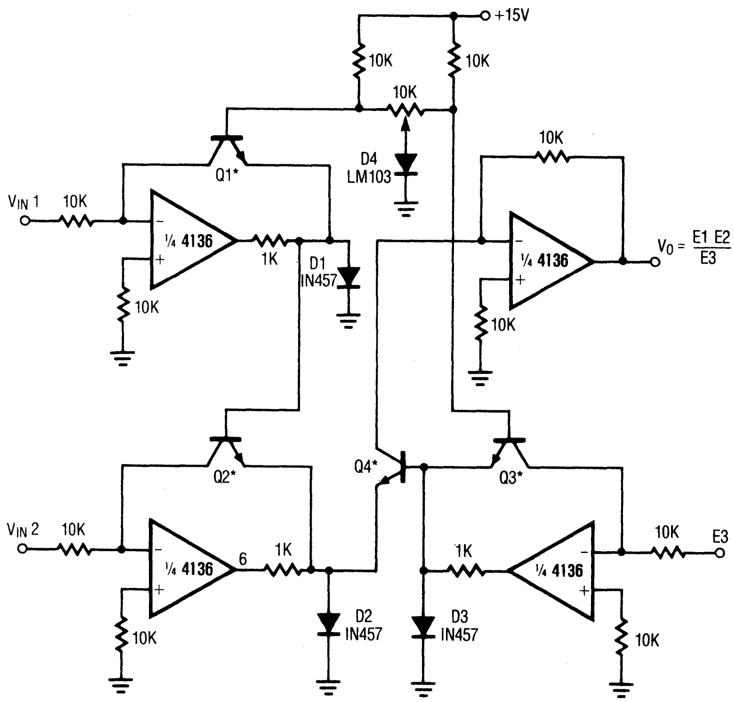



### Differential Input Instrumentation Amplifier With High Common Mode Rejection



# Typical Applications (Continued)

### Analog Multiplier/Divider




*Matched Transistors

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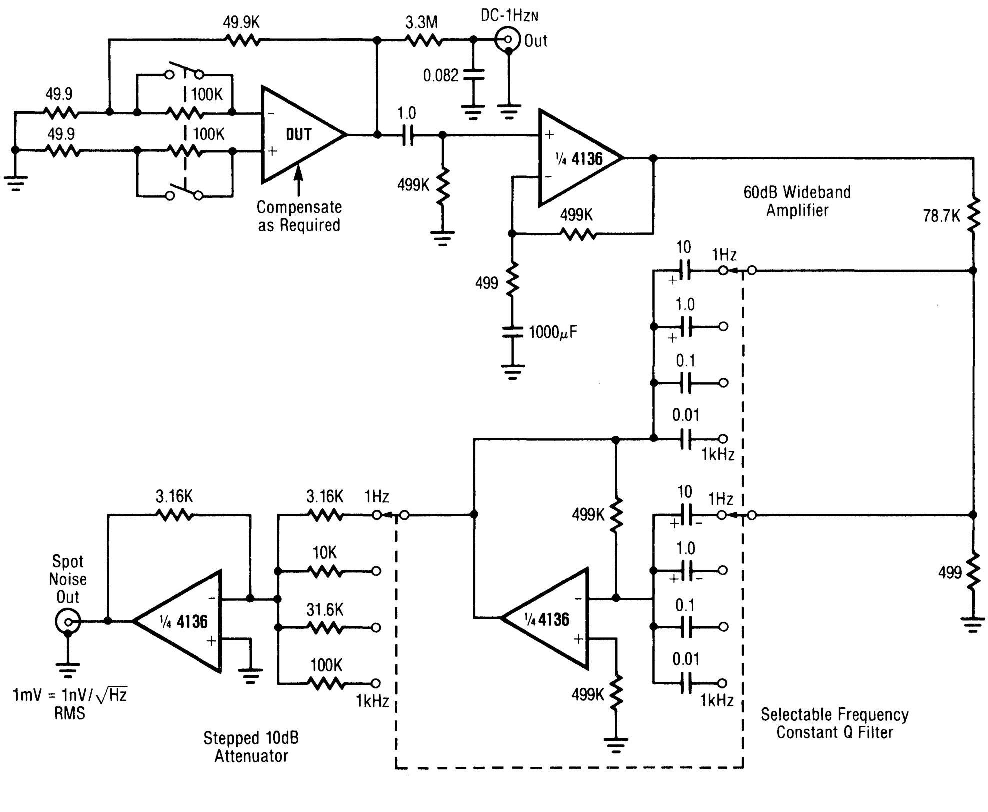
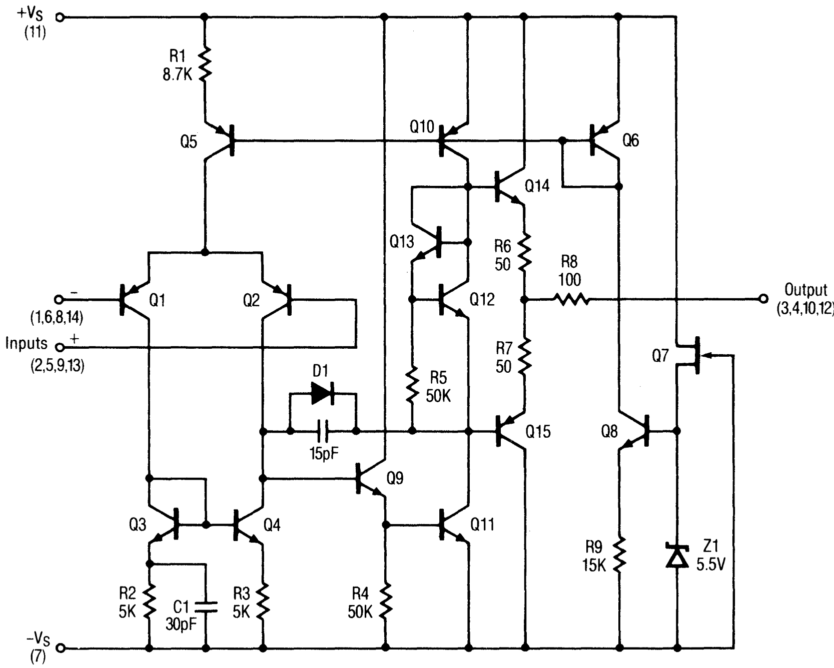
# Typical Applications (Continued)

## Spot Noise Measurement Test Circuit



## Schematic Diagram

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