

LM4136

Quad Operational Amplifier

General Description

The LM4136 monolithic quad operational amplifier consists of four independent high gain, internally frequency compensated operational amplifiers. The specifically designed low noise input transistors allow the LM4136 to be used in low noise signal processing applications such as audio preamplifiers and signal conditioners. The simplified output stage completely eliminates crossover distortion under any load conditions, has large source and sink capacity, and is short-circuit protected. A novel current source stabilizes output parameters over a wide power supply voltage range.

Features

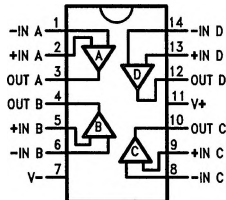
- Unity gain bandwidth—3.0 MHz
- Continuous short circuit protection
- No frequency compensation required
- No latch up
- Large common mode and differential voltage range
- LM741 operational amplifier type performance
- Parameter tracking over temperature range
- Gain and phase match between amplifiers

Applications

- Audio preamplifiers
- Signal conditioning

Connection Diagram

14-Lead DIP and SO-14 Package



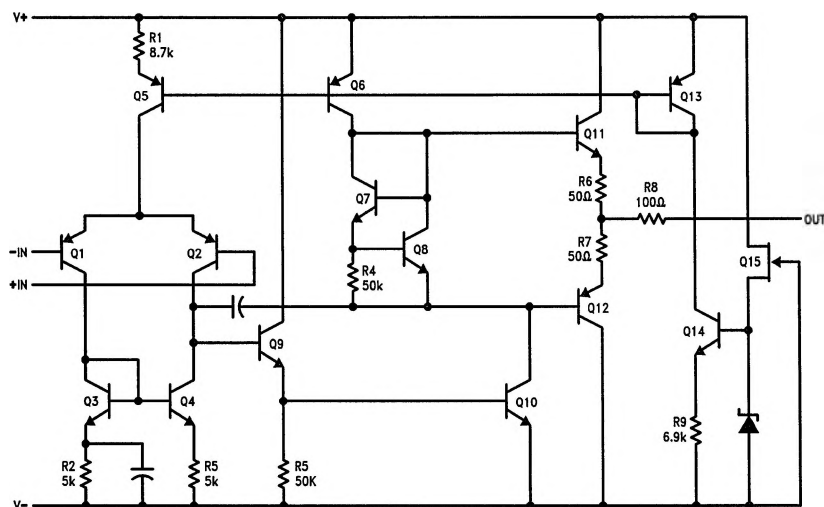
Top View

TL/H/10065-1

Ordering Information

Device Code	NS Package Number	Package Description
LM4136CJ	J14A	Ceramic DIP
LM4136CN	N14A	Molded DIP
LM4136CM	M14A	Molded Surface Mount

Equivalent Circuit (1/4 of Circuit)



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Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Storage Temperature Range

Ceramic DIP	−65°C to +175°C
Molded DIP and SO-14	−65°C to +150°C

Operating Temperature Range

0°C to +70°C

Lead Temperature

Ceramic DIP (Soldering, 60 sec.)	300°C
Molded DIP and SO-14 (Soldering, 10 sec.)	265°C

Internal Power Dissipation (Notes 1, 2)

14L-Ceramic DIP	1.36W
14L-Molded DIP	1.04W
SO-14	0.93W

Supply Voltage ±18V

Differential Input Voltage (Note 3) ±30V

Input Voltage (Note 1) ±15V

Output Short Circuit Duration (Note 4) Indefinite

ESD Tolerance 1000V

LM4136

Electrical Characteristics $T_A = 25^\circ\text{C}$, $V_{CC} = \pm 15\text{V}$ unless otherwise specified

Symbol	Parameter		Conditions	Min	Typ	Max	Units
V_{IO}	Input Offset Voltage		$R_S \leq 10\text{ k}\Omega$		0.5	6.0	mV
I_{IO}	Input Offset Current				5.0	200	nA
I_{IB}	Input Bias Current				40	500	nA
Z_I	Input Impedance			0.3	5.0		M Ω
P_C	Power Consumption				210	340	mW
CMR	Common Mode Rejection		$R_S \leq 10\text{ k}\Omega$	70	90		dB
V_{IR}	Input Voltage Range			±12	±14		V
PSRR	Power Supply Rejection Ratio		$R_S \leq 10\text{ k}\Omega$		30	150	$\mu\text{V/V}$
A_{VS}	Large Signal Voltage Gain		$R_L \geq 2.0\text{ k}\Omega$, $V_O = \pm 10\text{V}$	20	300		V/mV
V_{OP}	Output Voltage Swing		$R_L = 10\text{ k}\Omega$	±12	±14		V
			$R_L = 2.0\text{ k}\Omega$	±10	±13		
TR	Transient Response	Rise Time	$V_I = 20\text{ mV}$, $R_L = 2.0\text{ k}\Omega$, $C_L = 100\text{ pF}$, $A_V = 1.0$		0.13		μs
		Overshoot			5.0		%
BW	Bandwidth		$A_V = 1.0$		3.0		MHz
SR	Slew Rate		$R_L = 2.0\text{ k}\Omega$, $A_V = 1.0$		1.0		V/ μs
CS	Channel Separation		$f = 10\text{ kHz}$, $R_S = 1.0\text{ k}\Omega$ Open Loop		105		dB
			$f = 10\text{ kHz}$, $R_S = 1.0\text{ k}\Omega$ $A_V = 100$		105		

The following specifications apply over the range of $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$

V_{IO}	Input Offset Voltage	$R_S \leq 10\text{ k}\Omega$			7.5	mV
I_{IO}	Input Offset Current				300	nA
I_{IB}	Input Bias Current				800	nA
P_C	Power Consumption	$T_A = T_{A\text{ Max}}$		180	300	mW
		$T_A = T_{A\text{ Min}}$		240	400	
A_{VS}	Large Signal Voltage Gain	$R_L \geq 2.0\text{ k}\Omega$, $V_O = \pm 10\text{V}$	15			V/mV
V_{OP}	Output Voltage Swing	$R_L = 2.0\text{ k}\Omega$, $V_{CC} = \pm 15\text{V}$	±10			V

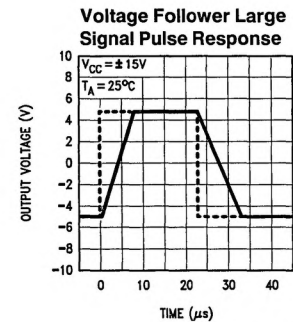
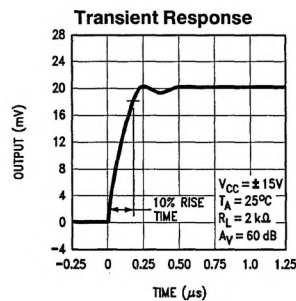
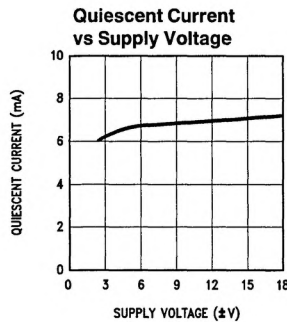
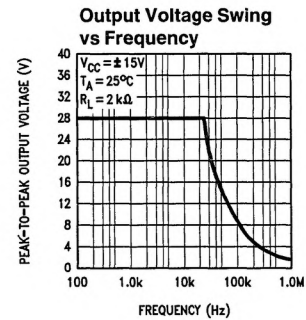
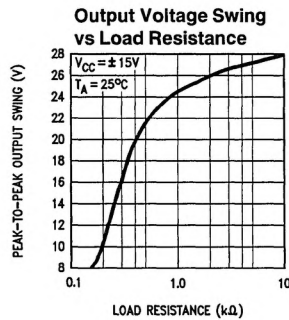
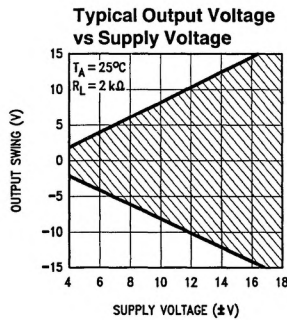
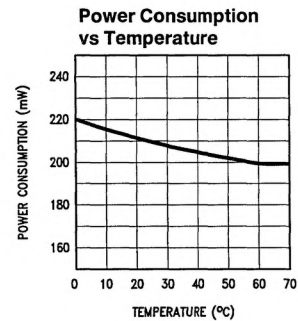
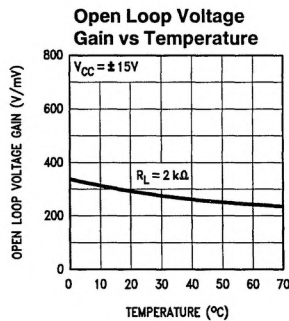
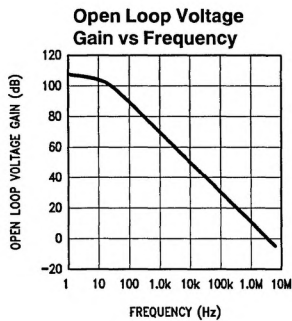
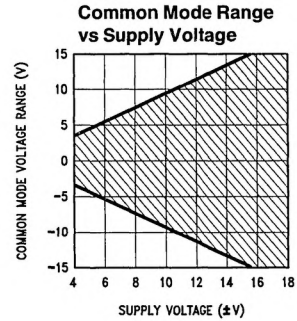
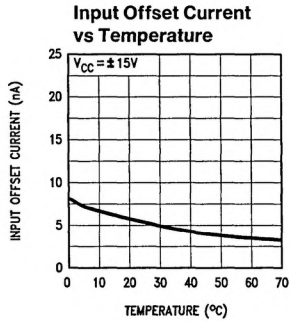
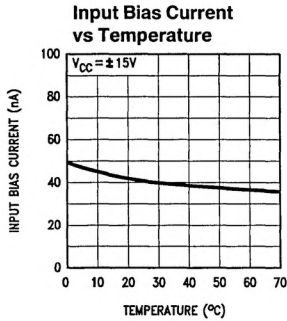
Note 1: $T_{J\text{ Max}} = 150^\circ\text{C}$ for the Molded DIP and SO-14, and 175°C for the Ceramic DIP.

Note 2: Ratings apply to ambient temperature at 25°C . Above this temperature, derate the 14L-Ceramic DIP at $9.1\text{ mW}/^\circ\text{C}$, the 14L-Molded DIP at $8.3\text{ mW}/^\circ\text{C}$, and the SO-14 at $7.5\text{ mW}/^\circ\text{C}$.

Note 3: For supply voltage less than $\pm 15\text{V}$, the absolute maximum input voltage is equal to the supply voltage.

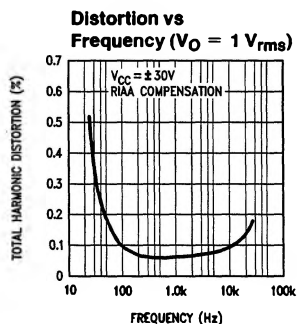
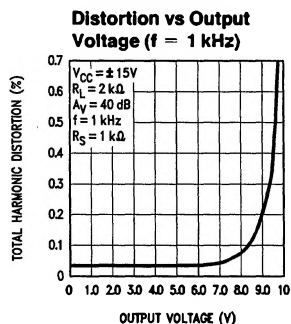
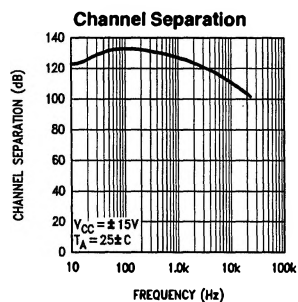
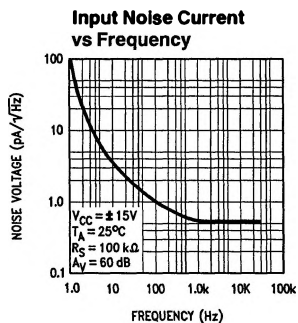
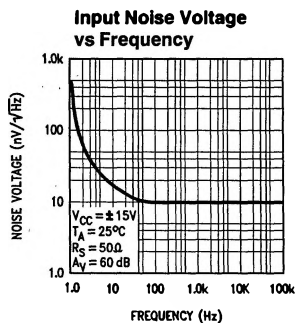
Note 4: Short circuit may be to ground, one amplifier only.

Typical Performance Characteristics



TL/H/10065-3

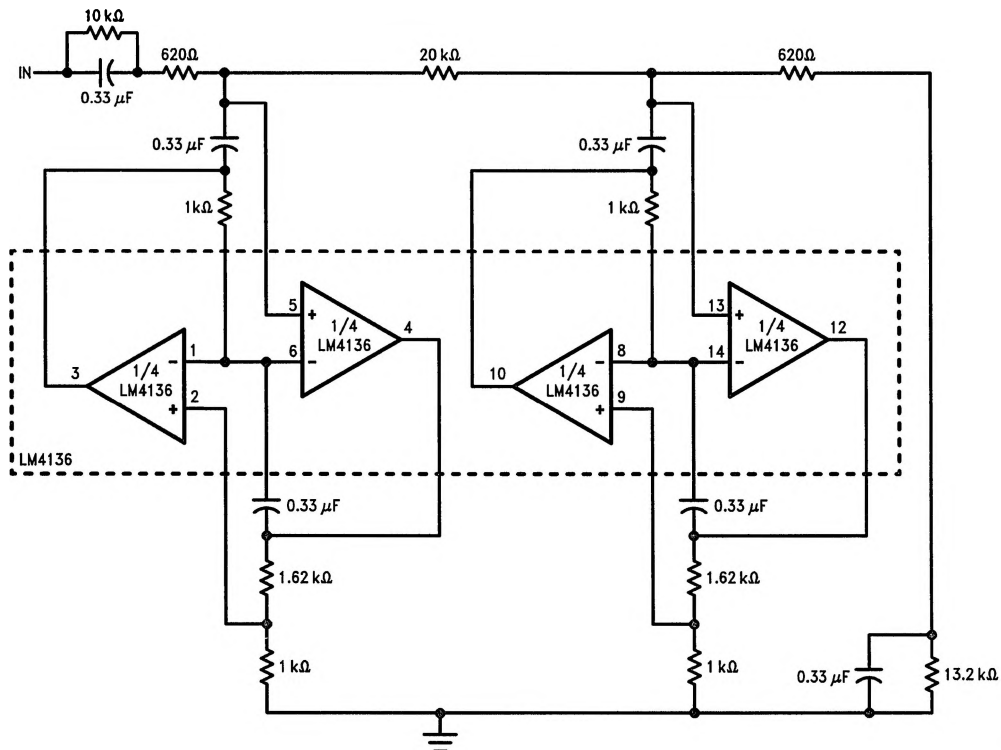
Typical Performance Characteristics (Continued)



TL/H/10065-4

Typical Applications

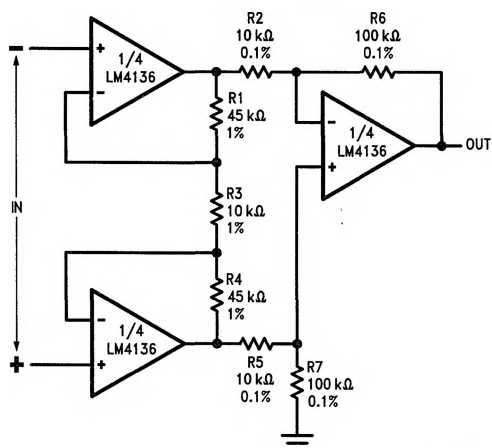
400 Hz Lowpass Butterworth Active Filter



TL/H/10065-5

Typical Applications (Continued)

Differential Input Instrumentation Amplifier with High Common Mode Rejection

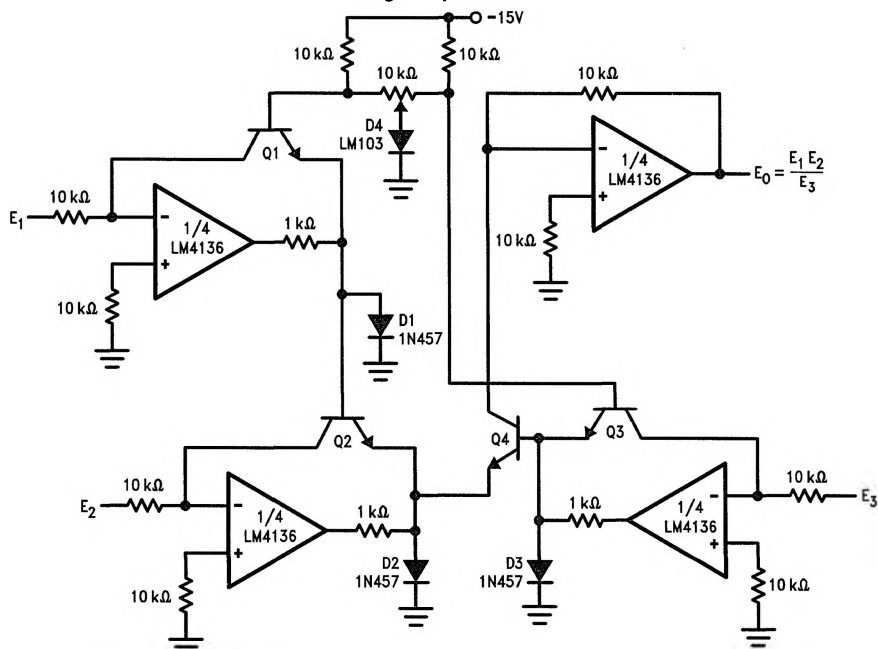


$$A_v = \frac{R_6}{R_2} \left(1 + \frac{2 R_1}{R_3} \right)$$

Matching determines CMRR:
 $R_1 = R_4$
 $R_2 = R_5$
 $R_6 = R_7$

TL/H/10065-6

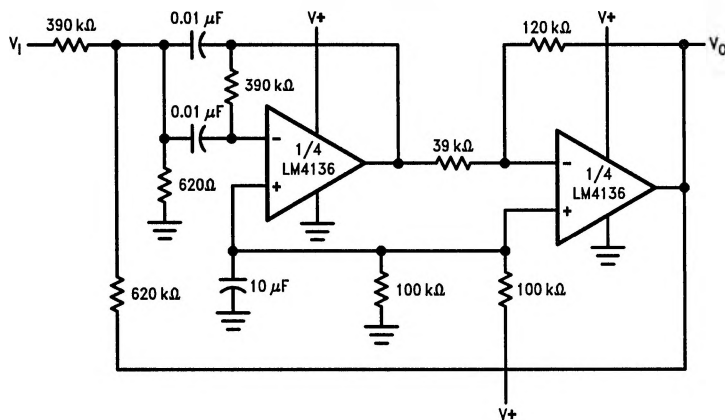
Analog Multiplier/Divider



TL/H/10065-7

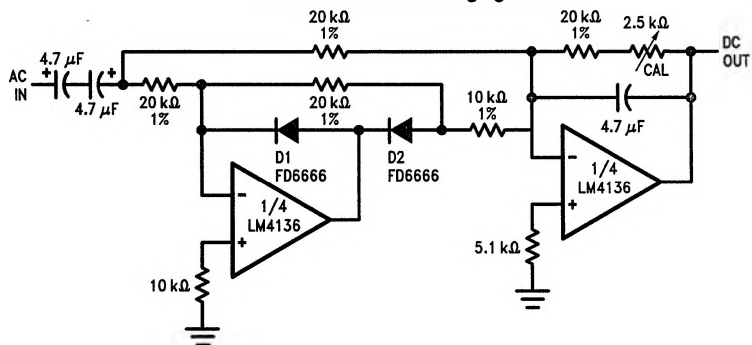
Typical Applications (Continued)

1 kHz Bandpass Active Filter



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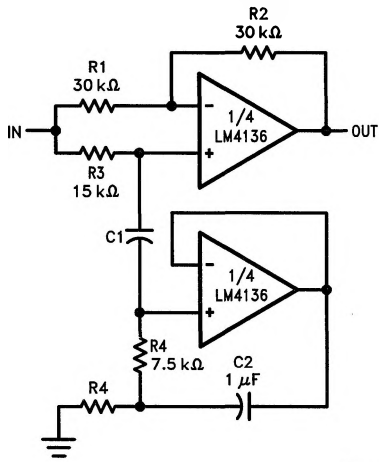
Full-Wave Rectifier and Averaging Filter



TL/H/10065-9

Typical Applications (Continued)

Notch Filter Using the LM4136 as a Gyrator

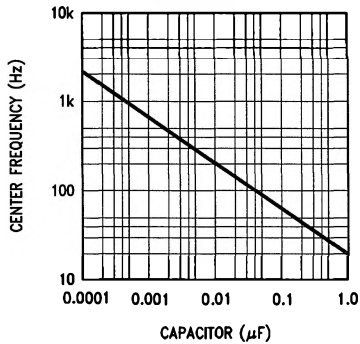


Trim R, Such That

$$\frac{R1}{R2} = \frac{R3}{2 R4}$$

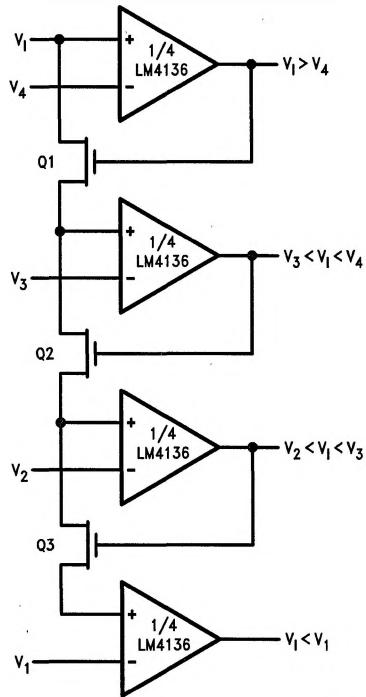
TL/H/10065-10

Notch Frequency vs Capacitor



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Multiple Aperture Window Discriminator



TL/H/10065-11