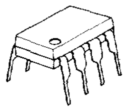
DUAL LOW-NOISE PREAMPLIFIER

NJM387

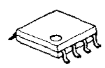
The NJM387 is a dual preamplifier for the amplification of low level signals in applications requiring optimum noise performance. Each of the two amplifiers is completely independent, with an internal power supply decoupler-regulator, providing 110 dB supply rejection and 60 dB channel separation. Other outstanding features include high gain (104 dB), large output voltage swing $(V^{+}-2)$Vp-p, and wide power bandwidth (75kHz, 20Vp-p).

The NJM387 operates from a single supply across the wide range of 8V to 40V. The amplifiers are internally compensated for gains greater than 10. The NJM387 is available in an 8-lead dual-in-line package.

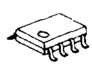
■ Package Outline



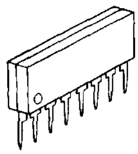
NJM387D



NJM387M



NJM387E



NJM387L

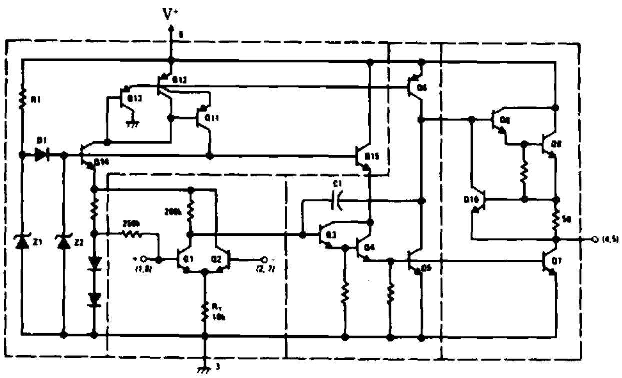
■ Absolute Maximum Ratings (Ta=25°C)

Supply Voltage	V^{+}	40V
Power Dissipation	P_D (D-Type)	500mW
	(M,E-Type)	300mW
	(L-Type)	700mW
Operating Temperature Range	T_{opr}	−20~+75°C
Storage Temperature Range	T_{stg}	−40~+125°C

■ Features

· Low noise	0.65μVrms input noise
· High gain	104 dB open loop
· Single supply operation	
· Wide supply range	8 to 40V
· Power supply rejection	110dB
· Large output voltage swing	$(V^{+}-2)$Vp-p
· Wide bandwidth	15MHz unity gain
· Power bandwidth	75kHz, 20 Vp-p
· Internally compensated	
· Short circuit protected	

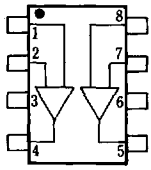
■ Equivalent Circuit



(Pin No. is DIP)

■ Connection Diagram

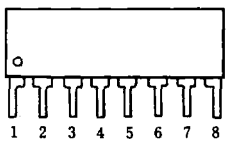
D,M,E-Type
(Top View)



(Top View)

PIN FUNCTION
1. A+INPUT
2. A−INPUT
3. GND
4. A OUTPUT
5. B OUTPUT
6. V^{+}
7. B−INPUT
8. B+INPUT

L-Type



■ Electrical Characteristics (Ta=25°C, V^+=14V)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Voltage Gain	Av	open Loop, f=100Hz	—	104	—	dB
Supply Current	I_{CC}	V^+=8~40V, $R_L=\infty$	—	10	—	mA
Input Resistance						
Positive Input	$R_{IN}(P)$		50	100	—	kΩ
Negative Input	$R_{IN}(N)$		—	200	—	kΩ
Input Current						
Negative Input	$I_I(N)$		—	0.5	3.1	μA
Output Resistance	R_o	Open Loop	—	150	—	Ω
Output Current						
Source	I_{SOURCE}		—	8	—	mA
Sink	I_{SINK}		—	2	—	mA
Maximum Output Voltage Swing	V_{OM}		—	V^+-2	—	V
Maximum Input Voltage	V_{INMAX}	Linear Operation	—	—	300	mV·rms
Supply Voltage Rejection Ratio	SVR	f=1kHz	—	110	—	dB
Channel Separation	CSR	f=1kHz	40	60	—	dB
Large Signal Frequency Response	W_{PG}	$20V_{p-p}$, V^+=24V	—	75	—	kHz
Total Harmonic Distortion	THD	GAIN60dB, f=1kHz	—	0.1	0.5	%
Equivalent Input Noise Voltage	V_{NI}	Rs=600Ω, BW=10Hz~10kHz, A Rank	—	0.65	0.9	μV·rms
		B Rank	—	—	1.8	μV·rms

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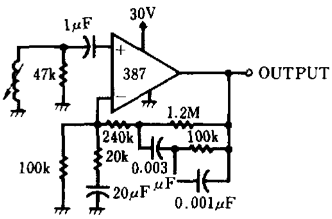
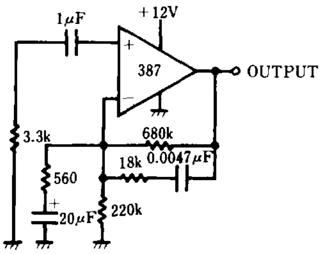
■ Typical Applications

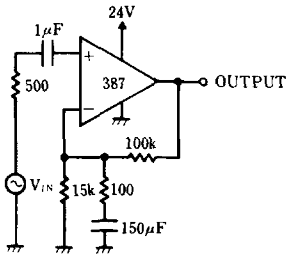
RIAA Equalizer Amplifier



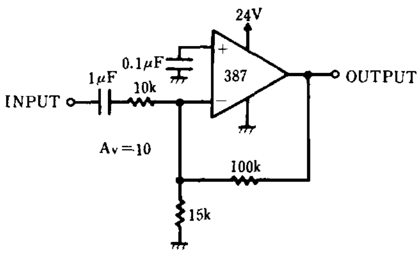
NAB Tape Circuit



Flat Gain Circuit (60dB)



Inverting Amplifier, Ultra-Low Distortion



■ Application Hints

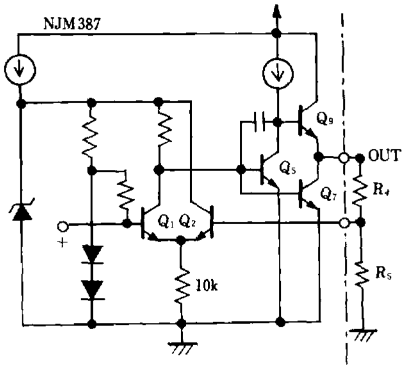
• Setting of DC bias

Set the output terminal voltage to $V^+/2$ for using NJM387. Set the R_5 current to be higher than $10 \times Q_2I_B$ so as to ensure that $Q_2I_B = 0.5\mu A$. Since the Q_1 base is biased by two diodes to $2 \times V_{BE}$, or 1.2V, the maximum value of R_5 is expressed by;

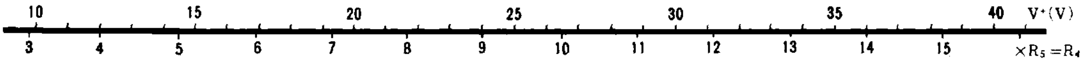
$$R_5\ \text{Max} = \frac{2V_{BE}}{10 \times Q_2I_B} = \frac{1.2}{5 \times 10^{-6}} = 240k\Omega$$

$$R_4 = \frac{V^+/2 - 2V_{BE}}{2V_{BE}/R_5}$$

$$= \left(\frac{V^+}{2.4} - 1\right) R_5 \quad \cdots\cdots\cdots\cdots\cdots\cdots (1)$$



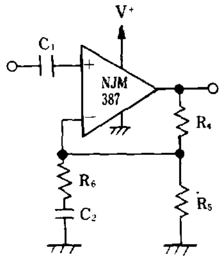
R_4 is obtainable from equation (1) by selecting R_5 to be lower than 240kΩ and setting V^+. It is recommended to utilize the following nomograph as a simple method. The scale corresponding to V^+ shows the magnification of R_5 for obtaining R_4. R_4 is obtained by $R_4 = 20k\Omega \times 7.3 \fallingdotseq 150k\Omega$ when $V^+ = 20V$, the magnification is 7.3, and $R_5 = 20k\Omega$.



• Setting of AC gain

In case of AC operation, R_5 is neglected by C_2
Accordingly, the AC gain is obtained by;

$$\frac{R_4 + R_6}{R_6} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (2)$$



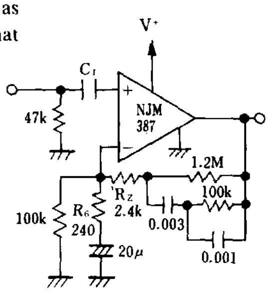
In this case, the frequency to drop the low-pass characteristic by 3dB is obtained by;

$$f = \frac{1}{2\pi C_2 R_6}$$

• Setting of high-pass gain

A low-pass filter circuit, an RIAA equalizer amplifier circuit, or other such circuits as the high-pass feedback amount increases require Rz as shown in the right figure, so that the high-pass feedback resistance does not become zero.
Set the Rz value to the following to ensure stable operation.

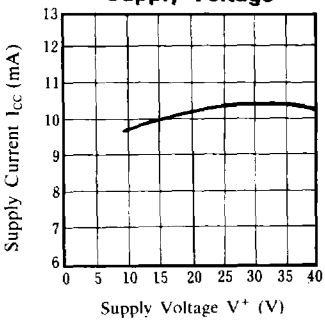
$$\frac{Rz}{R_6} > 10$$



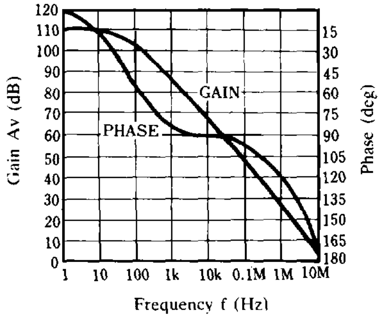
A constant must be selected to prevent the operation with a gain of lower than 10.

■ **Typical Characteristics**

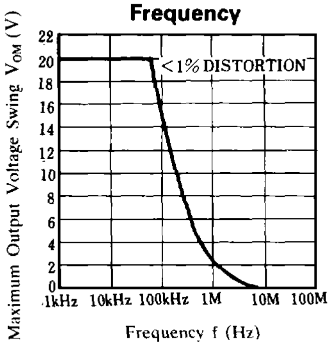
Supply Current vs. Supply Voltage



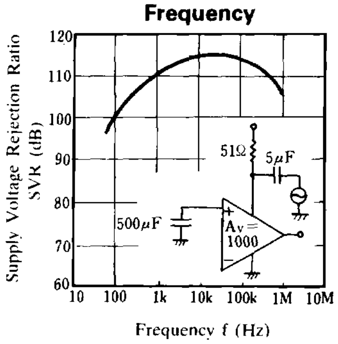
Gain and Phase Response



Maximum Output Voltage Swing vs. Frequency

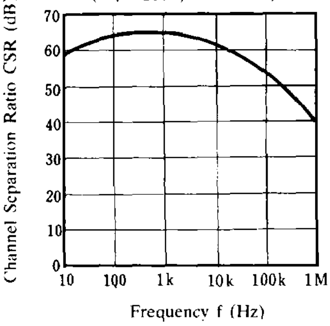


Supply Voltage Rejection Ratio vs. Frequency



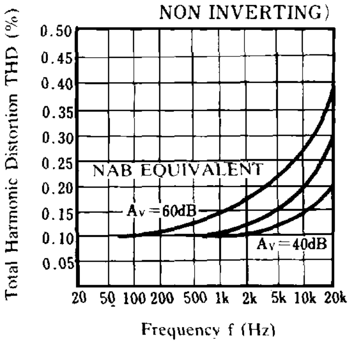
Channel Separation Ratio vs. Frequency

(A_V=1000, V^+=12V)

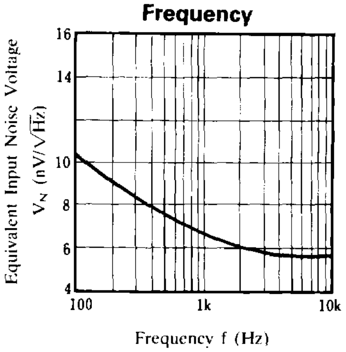


THD vs. Frequency Non Inverting Amplifier

(V^+=14V, V_O=3V_{rms}, NON INVERTING)

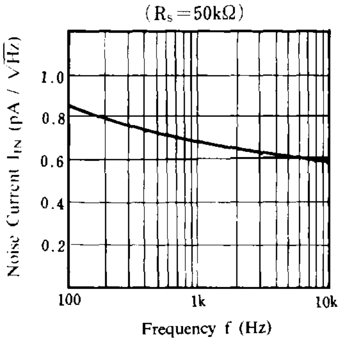


Equivalent Input Noise Voltage vs. Frequency



Noise Current vs. Frequency

(R_s=50kΩ)



THD vs. Frequency Inverting Amplifier

(V^+=24V, V_O=5V_{rms}, INVERTING)