Raytheon 399-851

RC4227CN

RC/RM4227 Precision Monolithic Dual Operational Amplifier

Features

- Very low noise
  Spectral noise density — 3.0nV/$\sqrt{Hz}$
  1/f noise corner frequency — 2.7Hz
- Very low V_{OS} drift
  0.2μV/Mo
  0.2μV/°C
- High gain — 1.8 × 10^6V/V
- High output drive capability — ±10V into 1K load
- High slew rate — 2.7V/μS
- Wide gain bandwidth product — 8MHz
- Good common mode rejection ratio — 126dB
- Low input offset voltage — 20μV typ
- Low frequency noise — 0.08μV_{p-p} 0.1Hz to 10Hz
- Low input offset current — 9nA typ
- Standard dual 8-lead pinout

Description

The 4227 is designed for instrumentation grade signal conditioning where low noise (both spectral density and burst), wide bandwidth, and high slew rate are required along with low input offset voltage, low input offset temperature coefficient, and low input bias currents. These features are all available in a device which is internally compensated for excellent phase margin (70°) in a unity gain configuration. Digital nulling techniques performed at wafer sort make it feasible to guarantee temperature stable input offset voltages as low as 75μV max. Input bias current cancellation techniques are used to obtain ±55nA max. input bias currents.

The 4227 is especially useful for instrumentation and professional quality audio systems. The 4227 has an undistorted output up to its power bandwidth frequency of 34kHz, and an undistorted output of 8.0V_{p-p} at 100kHz. This device provides performance adequate for the most demanding high fidelity applications.

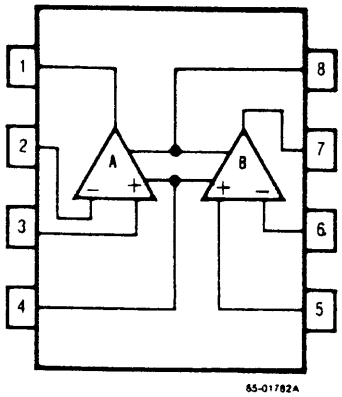
In addition to providing superior performance for the professional audio market the 4227 design uniquely addresses the needs of the instrumentation designer. Power supply rejection and common mode rejection are both in excess of 120dB. A phase margin of 70° at unity gain guards against peaking (and ringing) in low gain feedback circuits. Stable operation can be obtained with capacitive loads up to 2000pF[1]. The drift performance is, in fact, so good that the system designer must be cautioned that stray thermoelectric voltages generated by dissimilar metals at the contacts to the input terminals are enough to degrade its performance. For this reason it is also important to keep both input terminals at the same relative temperature.

The performance of the 4227 is achieved through the usage of precision amplifier design techniques coupled with a process that combines nitride transistors and capacitors with precision thin-film resistors. The die size savings of nitride capacitors and thin film resistors allow for the 4227 to be offered in an 8-pin minidip package and fit the industry standard dual op amp pinout.

[1]By decoupling the load capacitance with a series resistor of 50 or more, load capacitances larger than 2000pF can be accommodated.

Connection Information

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



Pin	Function
1	Output A
2	Input A Inverting
3	Input A Non-Inverting
4	$-V_S$
5	Input B Non-Inverting
6	Input B Inverting
7	Output B
8	$+V_S$

Ordering Information

Part Number	Package	Operating Temperature Range
RC4227FDE	Ceramic	0°C to +70°C
RC4227GDE	Ceramic	0°C to +70°C
RC4227FNB	Plastic	0°C to +70°C
RC4227GNB	Plastic	0°C to +70°C
RM4227BDE	Ceramic	-55°C to +125°C
RM4227BDE/883B*	Ceramic	-55°C to +125°C

*MIL-STD-883, Level B Processing

Absolute Maximum Ratings

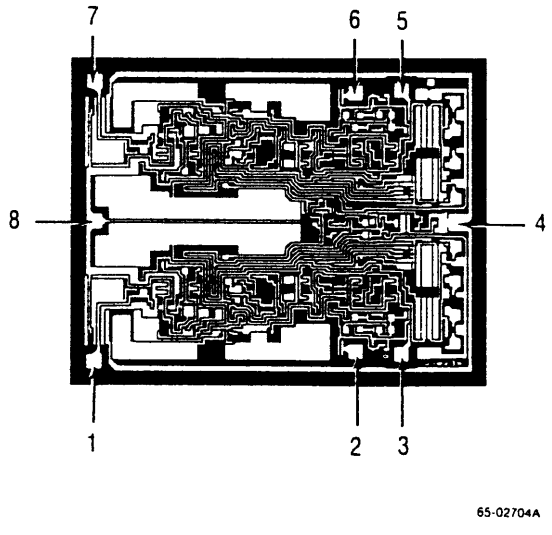
Supply Voltage ..... +18V
Input Voltage[1] ..... ±18V
Differential Input Voltage 0.7V
Internal Power Dissipation 658mW
Output Short Circuit Duration ..... Indefinite
Storage Temperature
Range ..... -65°C to +150°C
Operating Temperature Range
4227B ..... -55°C to +125°C
4227F/G ..... 0°C to +70°C
Lead Soldering Temperature
(60 Sec) ..... +300°C

[1]For supply voltages less than ±18V, the absolute maximum input voltage is equal to the supply voltage.

Thermal Characteristics

	8-Lead Ceramic DIP	8-Lead Plastic DIP
Max. Junction Temp.	175°C	125°C
Max. P_D T_A < 50°C	833mW	468mW
Therm. Res. θ_{JC}	45°C/W	---

Mask Pattern



Die Size: 115 × 90 mils
Min. Pad Dimensions: 4 × 4 mils

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

Parameters	Test Conditions	4227B/F			4227G			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltge[3]			20	75		30	150	μV
Long Term Input Offset Voltage Stability[1]			0 3			0.4		μV/Mo
Input Offset Current			±9.0	±50		±12	±75	nA
Input Bias Current			±12	±55		±15	±80	nA
Input Noise Voltage	0.1Hz to 10Hz		0.08			0.08		μV_{p-p}
Input Noise Voltage Density	f_0 = 10Hz		3.8			3.8		$\frac{nV}{\sqrt{Hz}}$
	f_0 = 30Hz		3.3			3.3		
	f_0 = 1000Hz		3.2			3.2		
Input Noise Current Density	f_0 = 10Hz		1.7			1.7		$\frac{pA}{\sqrt{Hz}}$
	f_0 = 30Hz		1.0			1.0		
	f_0 = 1000Hz		0.4			0.4		
Input Resistance (Diff. Mode)			5.0			4.0		MΩ
Input Resistance (Com. Mode)			2.5			2.0		GΩ
Input Voltage Range[2]		±11	±12.3		±11	±12.3		V
Common Mode Rejection Ratio	V_{CM} = ±11V	100	123		90	120		dB
Power Supply Rejection Ratio	V_S = ±4.0V to ±16.5V	100	120		90	118		dB
Large Signal Voltage Gain	$R_L \geq 2.0k\Omega$, V_O = ±10V	250	800		100	700		V/mV
	$R_L \geq 1.0k\Omega$, V_O = ±10V	150	400			400		
	V_O = ±1.0V, V_S = ±4.0V $R_L \geq 1.0k\Omega$	100	200		75	200		
Output Voltage Swing	$R_L \geq 2.0k\Omega$	±12	±13.8		±12	±13.8		V
	$R_L \geq 1k\Omega$	±11	±12		±11	±12		
Slew Rate[2]	$R_L \geq 2.0k\Omega$	1.5	2.7		1.5	2.7		V/μS
Gain Bandwidth Product[2]		5.0	8.0		5.0	8.0		MHz
Open Loop Output Resistance	V_O = 0, I_O = 0		70			70		Ω
Power Consumption	R_L = ∞		180	240		180	300	mW
Crosstalk		110	126		110	126		dB

Notes: 1. Long Term Input Offset Voltage Stability refers to the average trend line of V_{OS} vs. Time over extended periods after the first 30 days of operation. Excluding the initial hour of operation, changes in V_{OS} during the first 30 operating days are typically 2.5μV.
2. Guaranteed by design.
3. Input Offset Voltage measurements are performed by automated test equipment approximately .5 seconds after application of power.
Caution: The input protection diodes do not allow the device to be removed or inserted into the circuit without first removing power.

Electrical Characteristics ($V_S = \pm 15V$, $-55°C \leq T_A \leq +125°C$ unless otherwise noted)

Parameters	Test Conditions	4227B			Units
		Min	Typ	Max	
Input Offset Voltage[1]			50	200	μV
Average Input Offset Voltage Drift[2]			0.3	1.3	μV/°C
Input Offset Current			±22	±95	nA
Input Bias Current			±28	±95	nA
Input Voltage Range		±10	±11.5		V
Common Mode Rejection Ratio	$V_{CM} = \pm 10V$	90	119		dB
Power Supply Rejection Ratio	$V_S = \pm 4V$ to $\pm 16.5V$	94	114		dB
Large Signal Voltage Gain	$R_L > 2.0k\Omega$, $V_O = \pm 10V$	100	300		V/mV
Output Voltage Swing	$R_L > 2.0k\Omega$	±11	±13.2		V
Power Consumption	$R_L = \infty$		240	360	mW

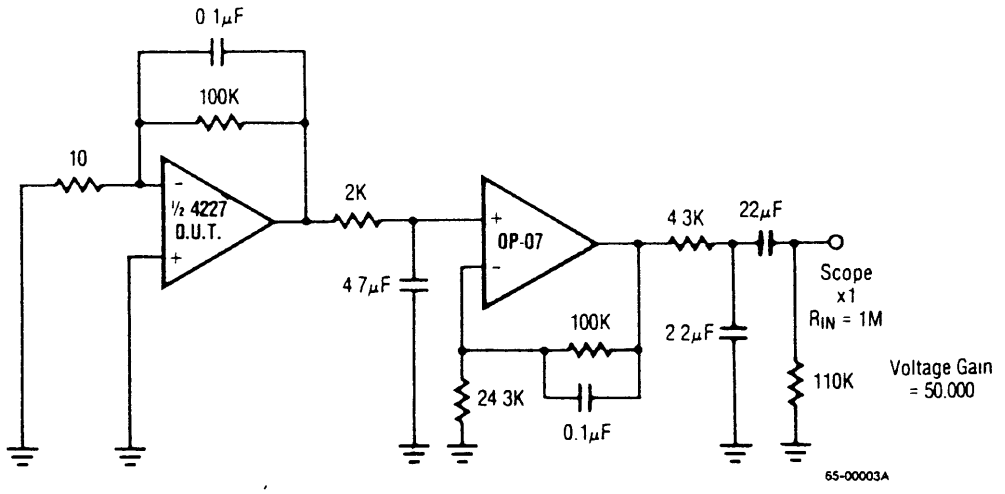
Notes: 1. Input offset voltage measurements are performed by automated test equipment approximately 0.5 seconds after application of power.
2. This parameter is tested on a sample basis only.

Electrical Characteristics ($V_S = \pm 15V$, $0°C \leq T_A \leq +70°C$ unless otherwise noted)

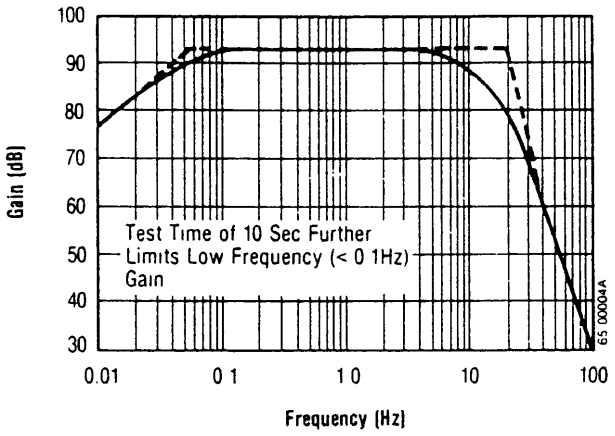
Parameters	Test Conditions	4227F			4227G			Units
		Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage			40	150		85	250	μV
Average Input Offset Voltage Drift[2]			0.3	1.3		0.4		μV/°C
Input Offset Current			±14	±95		±20	±135	nA
Input Bias Current			±18	±95		±25	±150	nA
Input Voltage Range		±10	±11.8		±10	±11.8		V
Common Mode Rejection Ratio	$V_{CM} = \pm 10V$	90	121		85	118		dB
Power Supply Rejection Ratio	$V_S = \pm 4V$ to $\pm 16.5V$	94	116		90	114		dB
Large Signal Voltage Gain	$R_L > 2.0k\Omega$, $V_O = \pm 10V$	100	500		75	500		V/mV
Output Voltage Swing	$R_L > 2.0k\Omega$	±11	±13.5		±11	±13.5		V
Power Consumption	$R_L = \infty$		240	360		240	360	mW

Typical Performance Characteristics

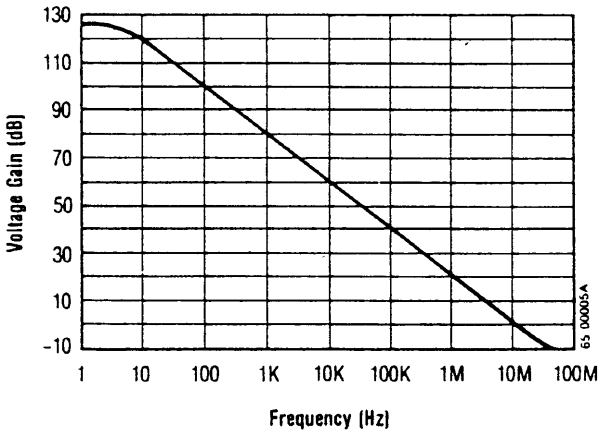
0.1Hz to 10Hz Noise Test Circuit (1/2 Shown)



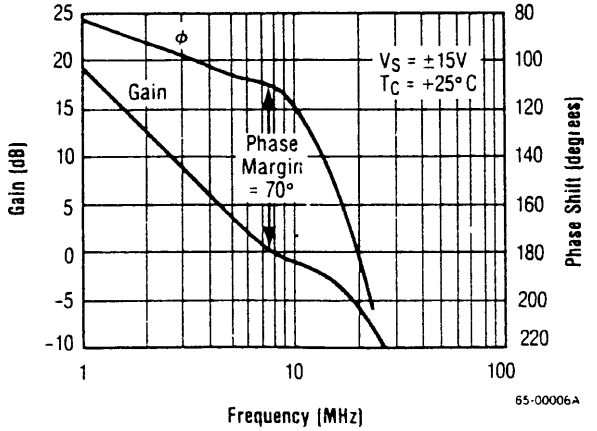
0.1Hz to 10Hz Peak-to-Peak Noise Tester Frequency Response



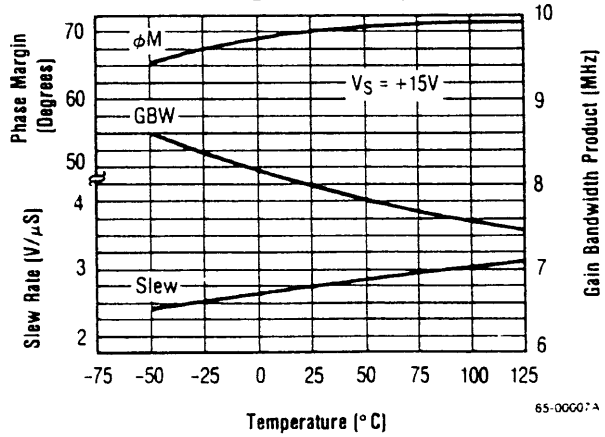
Open Loop Gain vs. Frequency



Gain, Phase Shift vs. Frequency

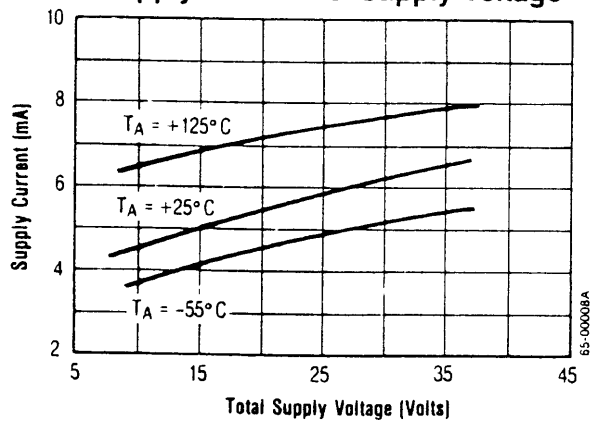


Slew Rate, Gain Bandwidth Product, Phase Margin vs. Temperature

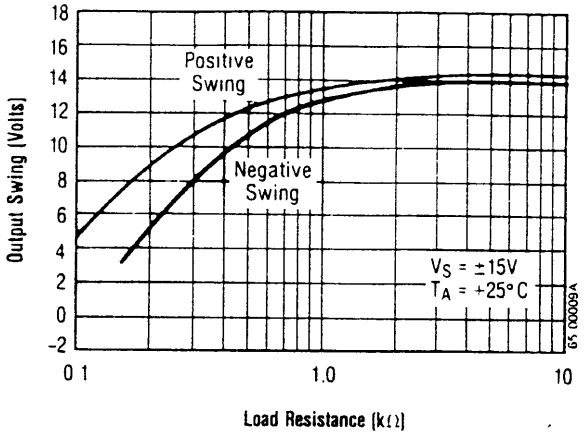


Typical Performance Characteristics (Continued)

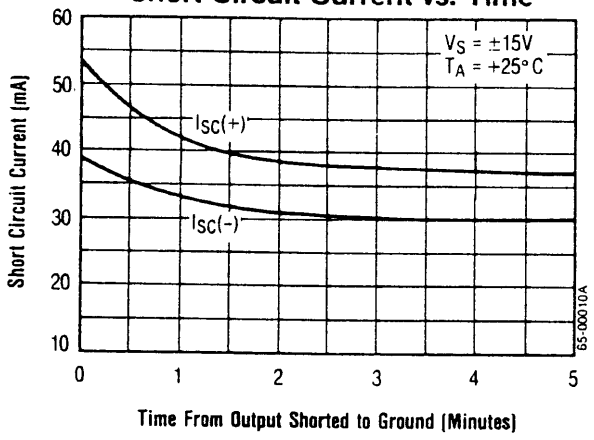
Supply Current vs. Supply Voltage



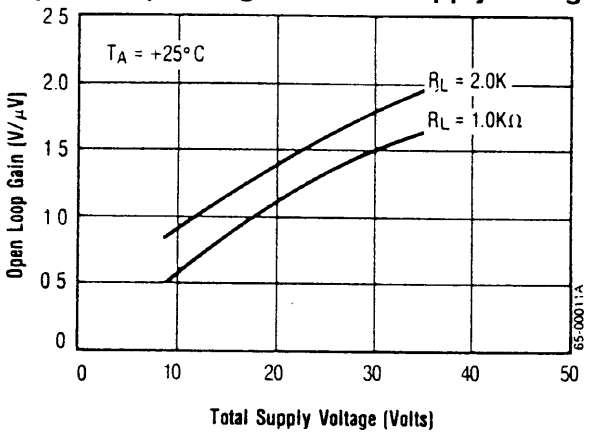
Maximum Output Swing vs. Resistive Load



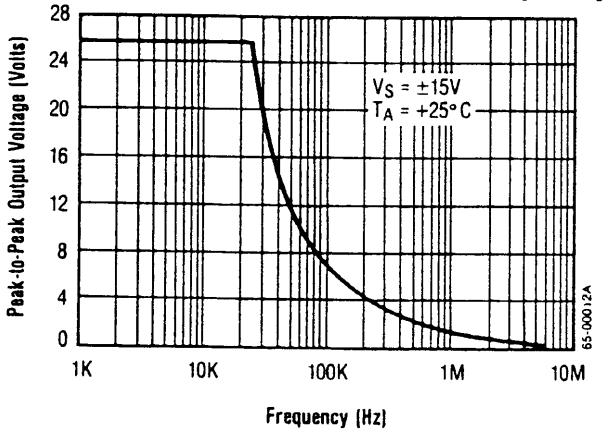
Short Circuit Current vs. Time



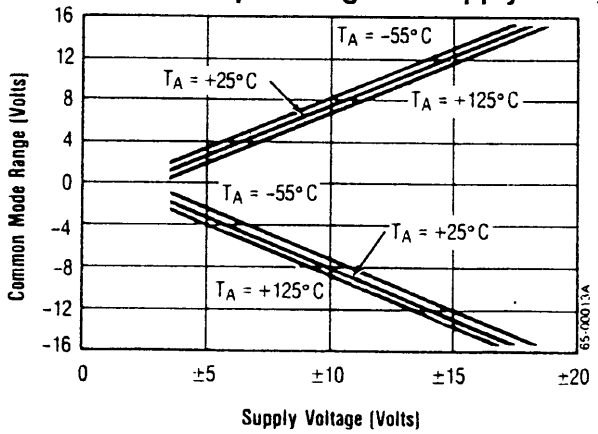
Open Loop Voltage Gain vs. Supply Voltage



Maximum Undistorted Output vs. Frequency

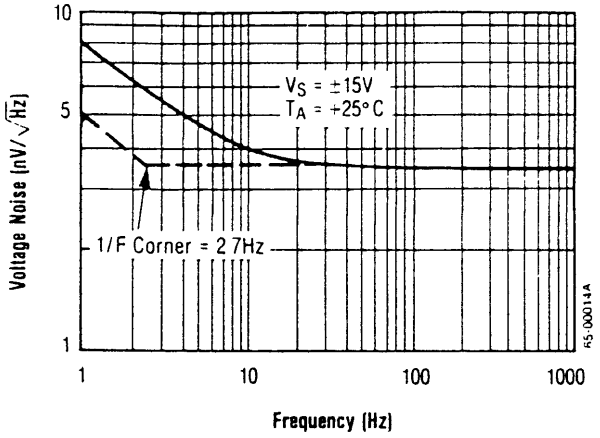


Common Mode Input Range vs. Supply Voltage

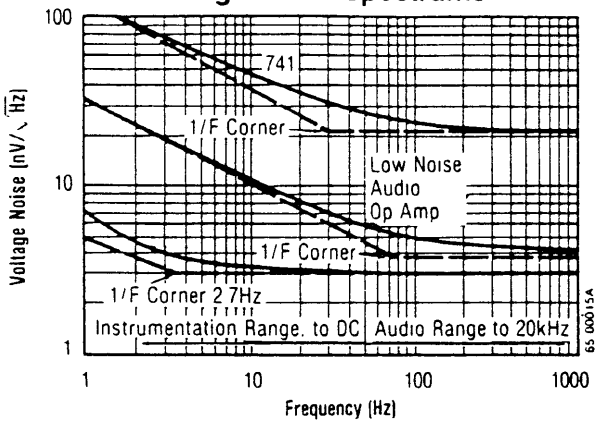


Typical Performance Characteristics (Continued)

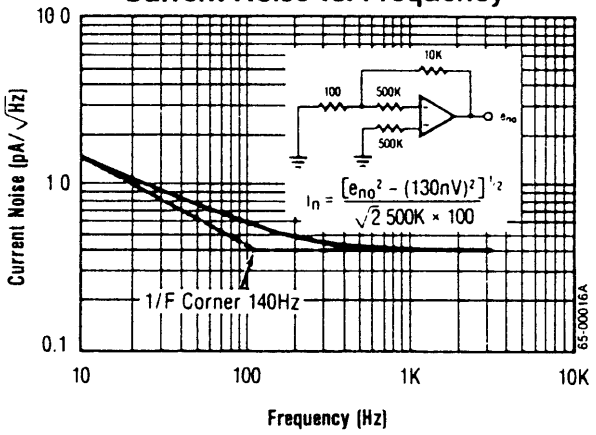
4227 Voltage Noise vs. Frequency



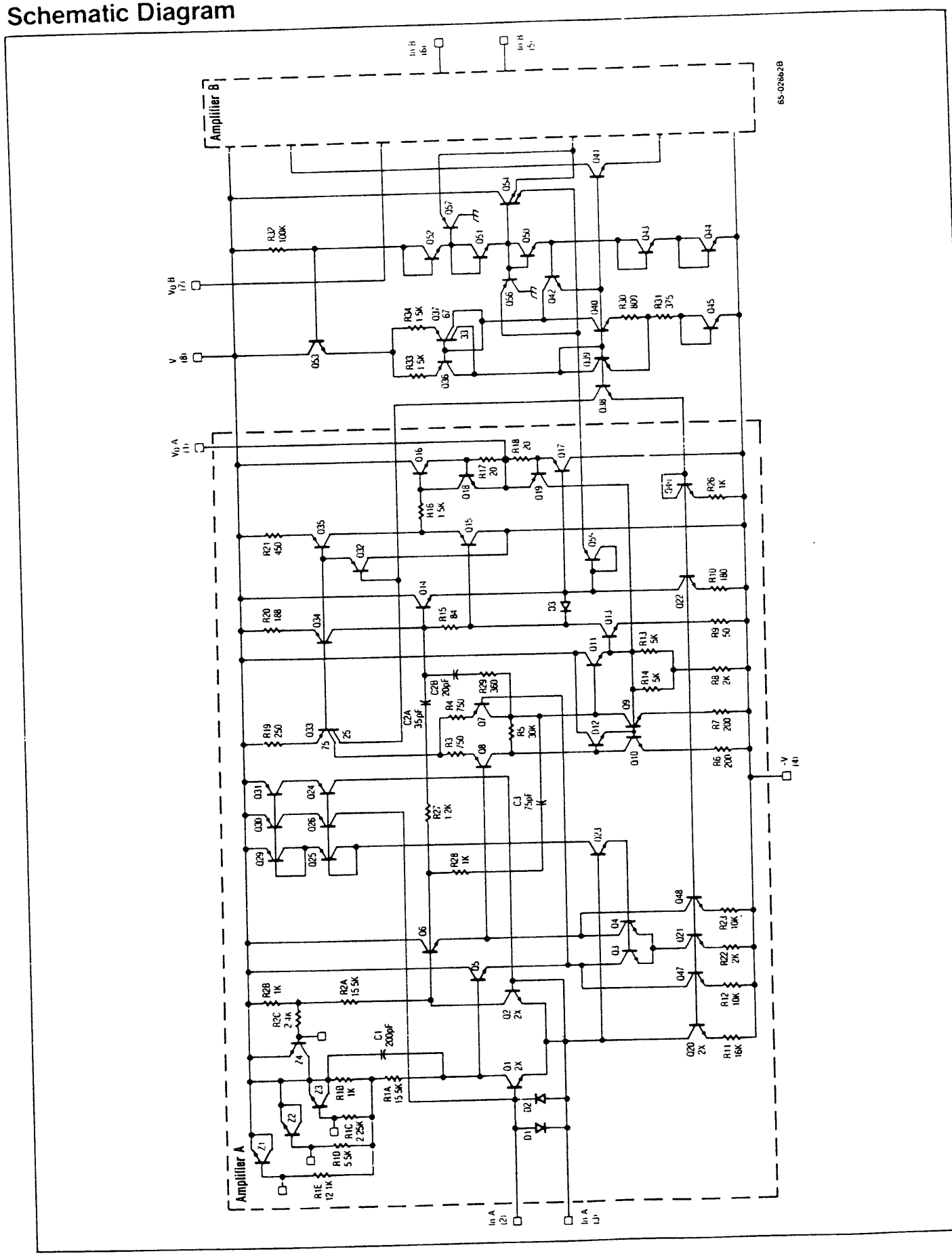
A Comparison of Op Amp Voltage Noise Spectrums



Current Noise vs. Frequency

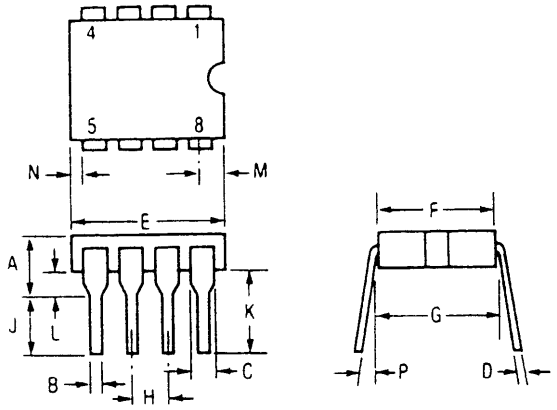


Schematic Diagram



Packaging Information

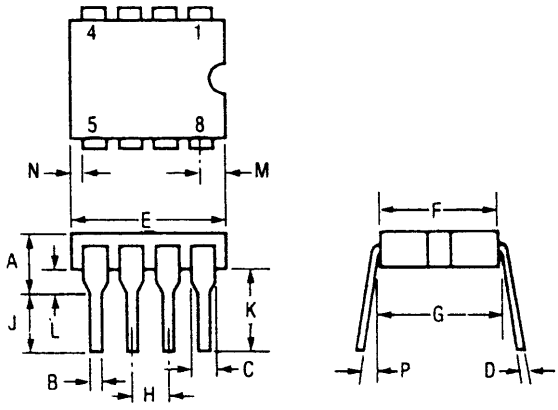
8-Lead Ceramic Dual In-Line Package



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A		200		5 08
B	014	023	0 36	0 58
C	030	070	0 76	1 78
D	008	015	0 20	0 38
E		390		9 91
F	220	310	5 59	7 87
G	290	.320	7 37	8 13
H	100 BSC		2 54 BSC	
J	125	200	3 18	5 08
K	150		3 81	
L	015	060	0.38	1 52
M		045		1 14
N	005		0 13	
P	0°	15°	0°	15°

65-012038

8-Lead Plastic Dual In-Line Package



Dimension	Inches		Millimeters	
	Min.	Max.	Min.	Max.
A	115	.125	2.92	3 17
B	.015	021	0.38	0 53
C	.030	.070	0 76	1 78
D	.010	.015	0 25	0 38
E	.360	400	9 14	10 16
F	.240	260	6 09	6 60
G	.290	310	7.37	7 87
H	.090	.110	2.29	2.79
J	.120	135	3.05	3.43
K	.140	165	3 56	4 18
L	.020	030	0 51	0 75
M	.025	.050	0 64	1 27
N	.005		0.13	
P	0°	15°	0°	15°

65-011928