

Features

- High Speed 10V/ μ s
- Wide Unity Gain Bandwidth 8.5MHz
- Low Noise 3nV/ $\sqrt{\text{Hz}}$ at 1KHz
- Low V_{OS} 10 μ V
- High CMRR 126dB
- High Gain 1800V/mV

Applications

- High Speed Signal Conditioners
- Wide Bandwidth Instrumentation Amplifiers
- Low Level Transducer Amplifiers
- Fast, Low Level Voltage Comparators
- Highest Quality Audio Preamplifiers
- Pulse/Rf Amplifiers

Description

The HA-5127 monolithic operational amplifier features an unparalleled combination of precision DC and wideband high speed characteristics. Utilizing the Harris D. I. technology and advanced processing techniques, this unique design unites low noise (3nV/ $\sqrt{\text{Hz}}$) precision instrumentation performance with high speed (10V/ μ s) wideband capability.

This amplifier's impressive list of features include low V_{OS} (10 μ V), wide unity gain-bandwidth (8.5MHz), high open loop gain (1800V/mV), and high CMRR (126 dB). Additionally, this flexible device operates over a wide supply range ($\pm 5\text{V}$ to $\pm 20\text{V}$) while consuming only 140mW of power.

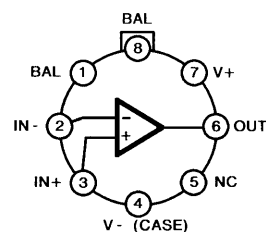
Using the HA-5127 allows designers to minimize errors while maximizing speed and bandwidth.

This device is ideally suited for low level transducer signal amplifier circuits. Other applications which can utilize the HA-5127's qualities include instrumentation amplifiers, pulse amplifiers, audio preamplifiers, and signal conditioning circuits.

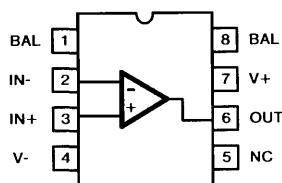
This device can easily be used as a design enhancement by directly replacing the 725, OP25, OP06, OP07, OP27 and OP37. The HA-5127 is available in TO-99 Metal Can and Ceramic 8 pin Mini-DIPs. For the military grade product, refer to the HA-5127/883 data sheet.

Pinouts

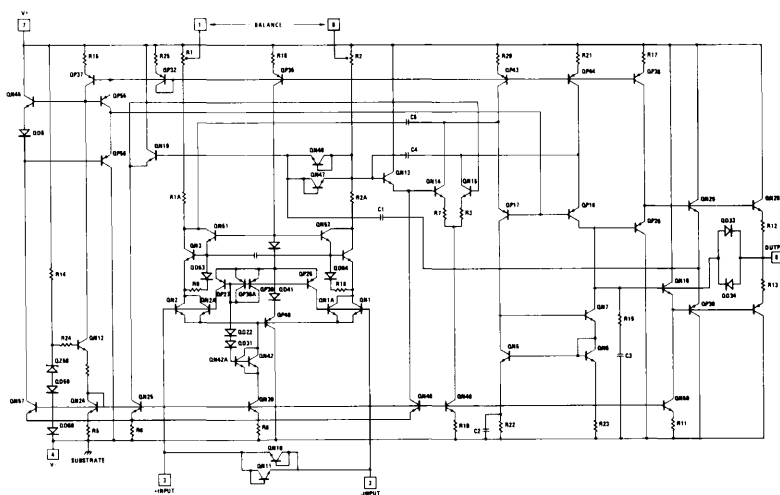
TOP VIEWS
HA2-5127 (TO-99 METAL CAN)



HA7-5127 (CERAMIC MINI-DIP)



Schematic



Specifications HA-5127

HA-5127

2

OP AMPS &
COMPARATORS

Absolute Maximum Ratings (Note 1)

$T_A = +25^{\circ}\text{C}$ Unless Otherwise Stated
Voltage Between V^+ and V^- Terminals..... $\pm 22\text{V}$
Differential Input Voltage (Note 2)..... $\pm 0.7\text{V}$
Internal Power Dissipation..... 500mW
Output Current..... Full Short Circuit Protection

Operating Temperature Ranges

HA-5127; 27A-2..... $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$
HA-5127; 27A-5..... $0^{\circ}\text{C} \leq T_A \leq +75^{\circ}\text{C}$
Storage Temperature Range..... $-65^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$

Electrical Specifications $V^+ = 15\text{V}$, $V^- = -15\text{V}$, $C_L \leq 50\text{pF}$, $R_S \leq 100\Omega$

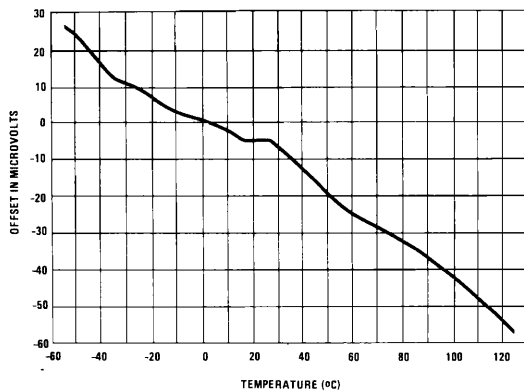
PARAMETER	TEMP	HA-5127A			HA-5127			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
INPUT CHARACTERISTICS								
Offset Voltage	+25°C		10	25		30	100	μV
	Full		30	60		70	300	μV
Average Offset Voltage Drift	Full		0.2	0.6		0.4	1.8	μV/°C
Bias Current	+25°C		±10	±40		±15	±80	nA
	Full		±20	±60		±35	±150	nA
Offset Current	+25°C		7	35		12	75	nA
	Full		15	50		30	135	nA
Common Mode Range	Full	±10.3	±11.5		±10.3	±11.5		V
Differential Input Resistance (Note 3)	+25°C	1.5	6		0.8	4		MΩ
Input Noise Voltage 0.1Hz to 10Hz (Note 4)	+25°C		0.08	.18		0.09	0.25	μV _{p-p}
Input Noise Voltage Density (Note 5)	+25°C							nV/√Hz
f ₀ = 10 Hz			3.5	5.5		3.8	8.0	
f ₀ = 30 Hz			3.1	4.5		3.3	5.6	
f ₀ = 1000 Hz			3.0	3.8		3.2	4.5	
Input Noise Current Density (Note 5)	+25°C							pA/√Hz
f ₀ = 10 Hz			1.7	4.0		1.7		
f ₀ = 30 Hz			1.0	2.3		1.0		
f ₀ = 1000 Hz			0.4	0.6		0.4	0.6	
TRANSFER CHARACTERISTICS								
Large Signal Voltage Gain (Note 6)	+25°C	1000	1800		700	1500		V/mV
	Full	600	1200		300	800		V/mV
Common Mode Rejection Ratio (Note 7)	Full	114	126		100	120		dB
Minimum Stable Gain	+25°C	1			1			V/V
Unity-Gain-Bandwidth	+25°C	5	8.5		5	8.5		MHz
OUTPUT CHARACTERISTICS								
Output Voltage Swing R _L = 600Ω	+25°C	±10.0	±11.5		±10.0	±11.5		V
R _L = 2KΩ	Full	±11.7	±13.8		±11.4	±13.5		V
Full Power Bandwidth (Note 8)	+25°C	111	160		111	160		KHz
Output Resistance, Open Loop	+25°C		70			70		Ω
TRANSIENT RESPONSE (Note 9)								
Rise Time	+25°C			150			150	ns
Slew Rate (Note 11)	+25°C	7	10		7	10		V/μs
Settling Time (Note 10)	+25°C		1.5			1.5		μs
Overshoot	+25°C		20	40		20	40	%
POWER SUPPLY CHARACTERISTICS								
Supply Current	+25°C		3.5			3.5		mA
	Full			4.0			4.0	mA
Power Supply Rejection Ratio (Note 12)	Full		2	4		16	51	μV/V

NOTES:

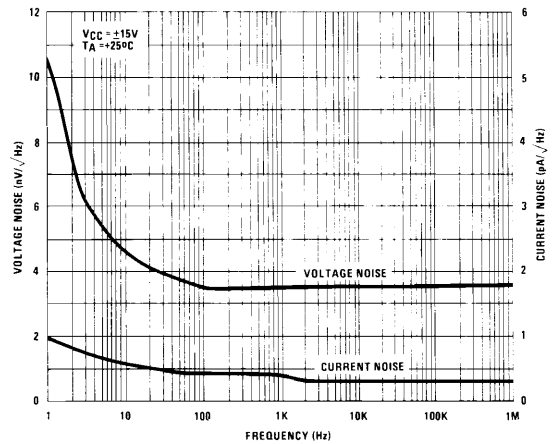
1. Absolute maximum ratings are limiting values, applied individually, beyond which the serviceability of the circuit may be impaired. Functional operability under any of these conditions is not necessarily implied.
2. For differential input voltages greater than 0.7V, the input current must be limited to 25mA to protect the back-to-back input diodes.
3. This parameter value is based upon design calculations.
4. Refer to Typical Performance section of the data sheet.
5. Sample tested.
6. $V_{OUT} = \pm 10V$, $R_L = 2K\Omega$
7. $V_{CM} = \pm 10V$
8. Full power bandwidth guaranteed based on slew rate measurement using: $FPBW = \frac{Slew\ Rate}{2\pi V_{PEAK}}$
9. Refer to Test Circuits section of the data sheet.
10. Settling time is specified to 0.1% of final value for a 10V output step and $A_v = -1$.
11. $V_{OUT} = 10V$ Step
12. $V_S = \pm 4V$ to $\pm 18V$

Typical Performance Curves Unless Otherwise Specified: $T_A = +25^\circ C$, $V_{SUPPLY} = \pm 15V$

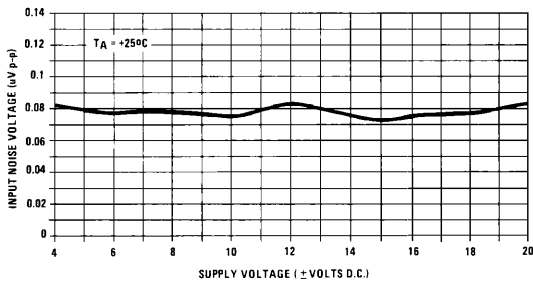
**OFFSET VOLTAGE
TYPICAL DRIFT vs. TEMPERATURE**



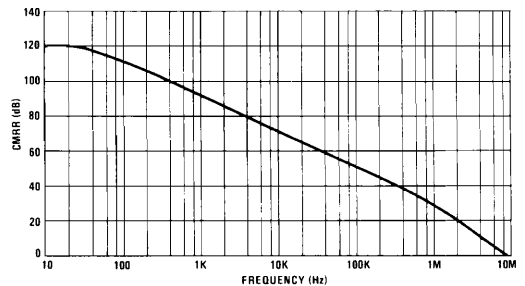
NOISE CHARACTERISTICS



NOISE vs. SUPPLY VOLTAGE

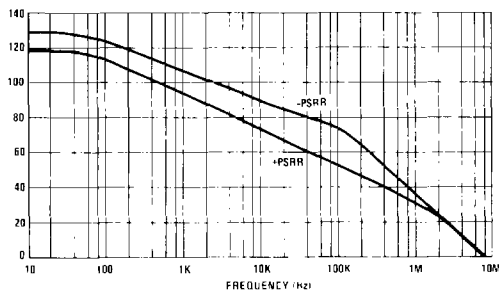


CMRR vs. FREQUENCY

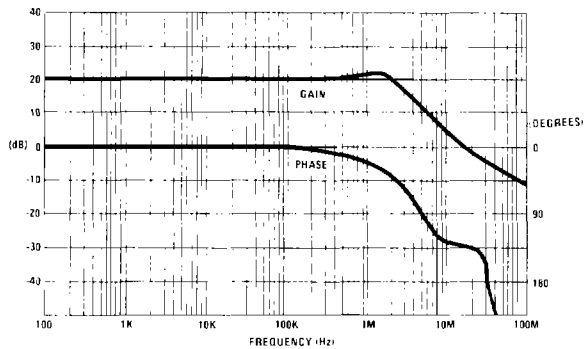
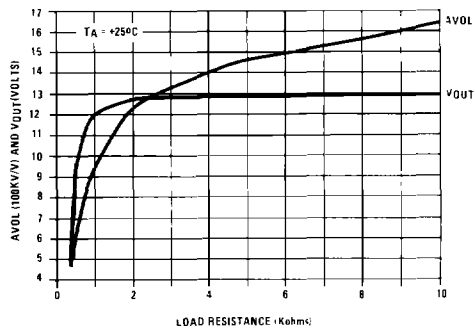


Typical Performance Curves Unless Otherwise Specified: $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$

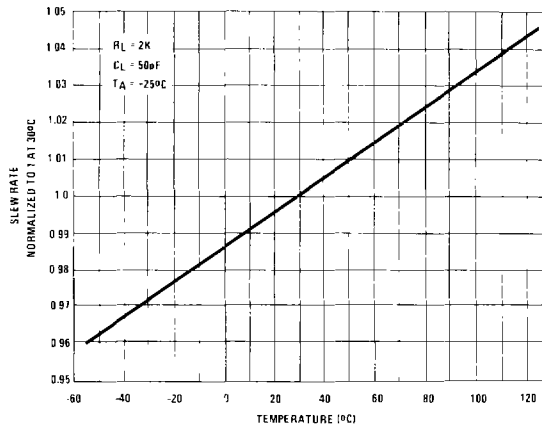
PSRR vs. FREQUENCY



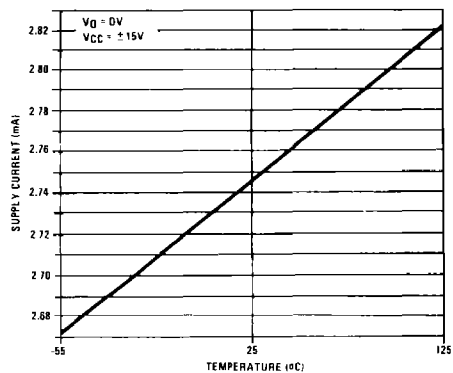
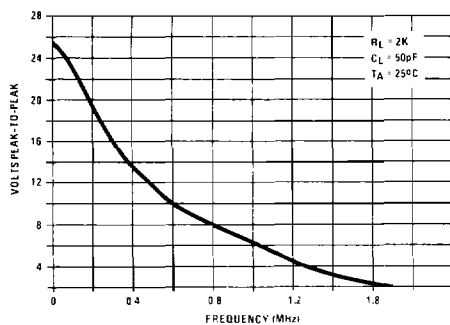
CLOSED LOOP GAIN AND PHASE vs. FREQUENCY

AVOL AND V_{OUT} vs. LOAD RESISTANCE

NORMALIZED SLEW RATE vs. TEMPERATURE

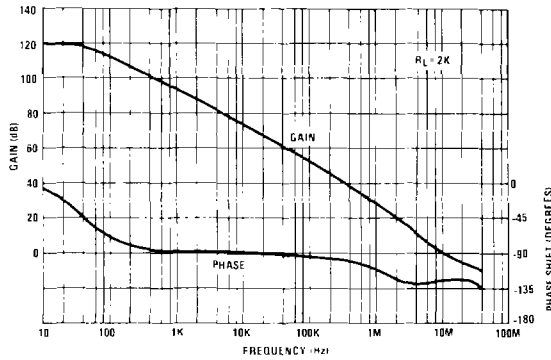


SUPPLY CURRENT vs. TEMPERATURE

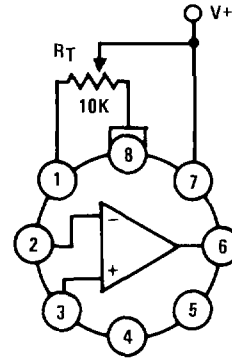
 $V_{\text{OUT MAX}}$ vs. FREQUENCY
UNDISTORTED SINEWAVE OUTPUT

Typical Performance Curves Unless Otherwise Specified: $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$

OPEN LOOP GAIN AND PHASE vs. FREQUENCY

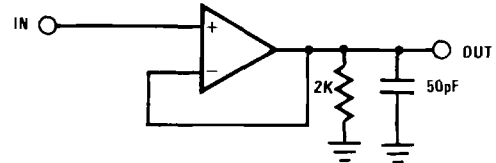
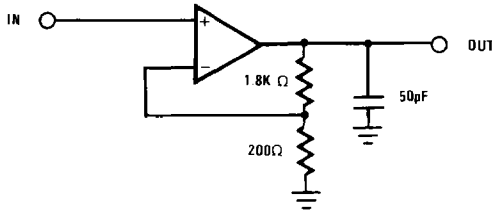


SUGGESTED OFFSET VOLTAGE ADJUSTMENT

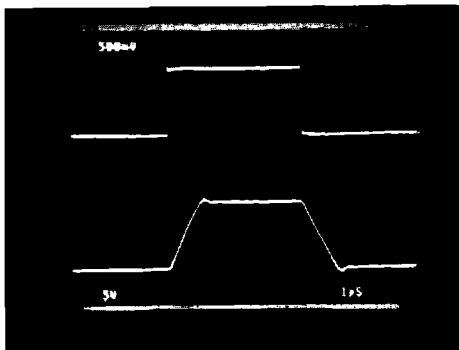


Tested Offset Adjustment Range is $|V_{OS} + 1\text{mV}|$ minimum referred to output. Typical range is $\pm 4\text{mV}$ with $R_T = 10\text{k}\Omega$.

LARGE AND SMALL SIGNAL RESPONSE TEST CIRCUIT

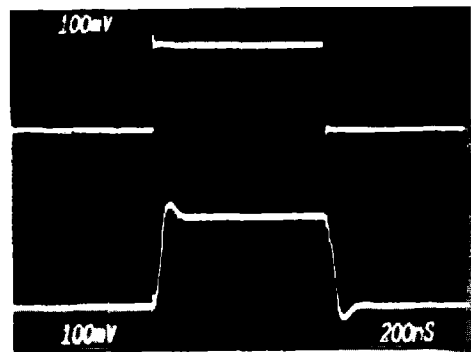


LARGE SIGNAL RESPONSE



Vertical Scale: (Volts: Input = $0.5\text{V}/\text{Div.}$)
(Output = $5\text{V}/\text{Div.}$)
Horizontal Scale: (Time = $1\mu\text{S}/\text{Div.}$)

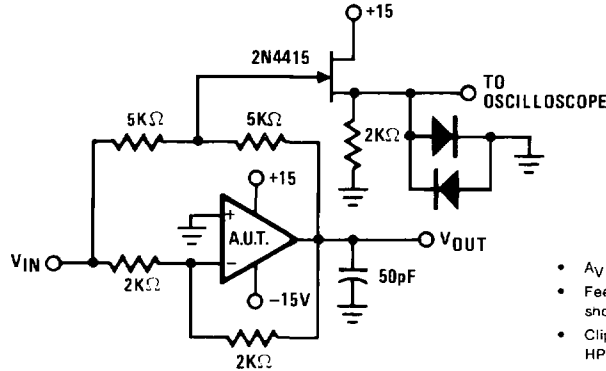
SMALL SIGNAL RESPONSE



Vertical Scale: (Volts: $100\text{mV}/\text{Div.}$)
Horizontal Scale: ($200\text{nS}/\text{Div.}$)

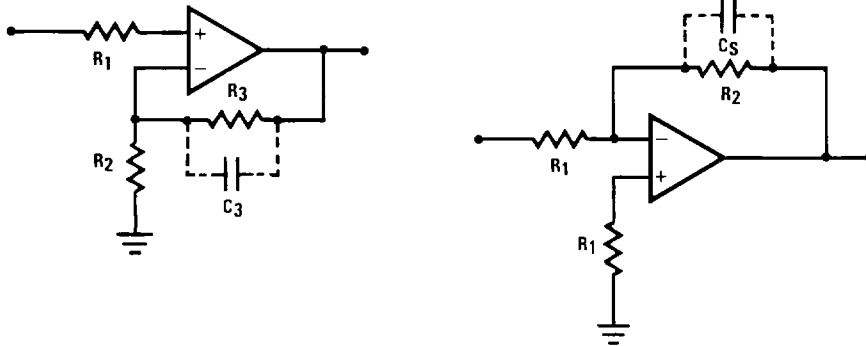
Typical Performance Curves Unless Otherwise Specified: $T_A = +25^\circ\text{C}$, $V_{\text{SUPPLY}} = \pm 15\text{V}$

SETTLING TIME TEST CIRCUIT



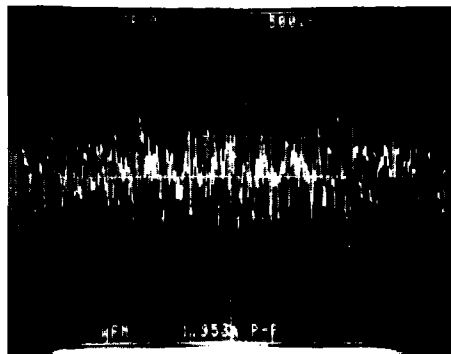
- $A_V = -1$
- Feedback and summing resistors should be 0.1% matched.
- Clipping diodes are optional. HP5082-2810 recommended.

SUGGESTED STABILITY CIRCUITS



Low resistances are preferred for low noise applications as a $1\text{K}\Omega$ resistor has $4\text{nV}/\sqrt{\text{Hz}}$ of thermal noise. Total resistances of greater than $10\text{K}\Omega$ on either input can reduce stability. In most high resistance applications a few picofarads of capacitance across the feedback resistor will improve stability.

0.1Hz TO 10Hz NOISE WITH $A_{CL} = 25,000\text{V/V}$



Horizontal Scale - 1sec/Div
Vertical Scale - 0.002 $\mu\text{V}/\text{Div}$
0.08 $\mu\text{Vp-p}$

Die Characteristics

Transistor Count	63	
Die Dimensions	65 x 104.3 x 19mils	
	(1700 x 2600 x 480 μ m)	
Substrate Potential*	V-	
Process	Bipolar-DI	
Thermal Constants ($^{\circ}$ C/W)	θ_{ja}	θ_{jc}
HA7-5127, Ceramic Mini-DIP	160	79
HA2-5127, TO-99 Metal Can	172	48

*The substrate may be left floating (Insulating Die Mount) or it may be mounted on a conductor at V- potential.