Data Sheet September 1998 File Number 2912.3

8MHz, Precision, JFET Input Operational Amplifier

The Intersil HA-5170 is a precision, JFET input, operational amplifier which features low noise, low offset voltage and low offset voltage drift. Constructed using FET/Bipolar technology, the Intersil Dielectric Isolation (DI) process, and laser trimming this amplifier offers low input bias and offset currents. This operational amplifier design also completely eliminates the troublesome errors due to warm-up drift.

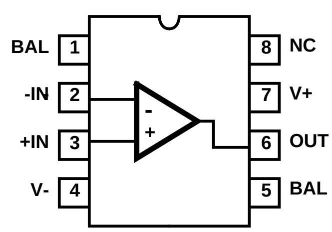
Complementing these excellent input characteristics are dynamic performance characteristics never before available from precision operational amplifiers. An 8V/µs slew rate and 8MHz bandwidth allow the designer to extend precision instrumentation applications in both speed and bandwidth. These characteristics make the HA-5170 well suited for precision integrator amplifier designs.

The superior input characteristics also make the HA-5170 ideally suited for transducer signal amplifiers, precision voltage followers and precision data acquisition systems. For application assistance, please refer to Application Note AN540 addressing specifically this device.

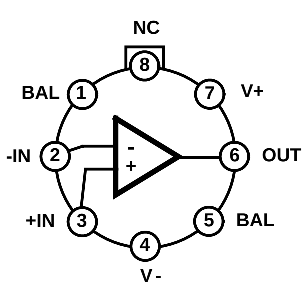
Military version (-8) product and data sheets available upon request.

Pinouts

HA-5170
(CERDIP)
TOP VIEW



HA-5170
(METAL CAN)
TOP VIEW



Features

- Low Offset Voltage 100µV
- Low Offset Voltage Drift . . . . .2µV/^{o}C
- Low Noise. . . . . 10nV/$\sqrt{Hz}$
- High Open Loop Gain. 600kV/V
- Wide Bandwidth 8MHz
- Unity Gain Stable

Applications

- High Gain Instrumentation Amplifiers
- Precision Data Acquisition
- Precision Integrators
- Precision Threshold Detectors
- For Further Design Ideas, Refer to Application Note 540

Ordering Information

PART NUMBER	TEMP. RANGE (^{o}C)	PACKAGE	PKG. NO.
HA2-5170-5	0 to 75	8 Pin Metal Can	T8.C
HA7-5170-5	0 to 75	8 Ld CERDIP	F8.3A

Absolute Maximum Ratings

Voltage Between V+ and V- Terminals 44V
Differential Input Voltage 30V
Output Short Circuit Duration. . . . . Indefinite

Operating Conditions

Temperature Range
HA-5170-5 . . . . 0^oC to 75^oC

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} ($^oC/W$)	θ_{JC} ($^oC/W$)
CERDIP Package.	135	50
Metal Can Package	155	67

Maximum Junction Temperature . . . . 175^oC
Maximum Storage Temperature Range . . . . -65^oC to 150^oC
Maximum Lead Temperature (Soldering 10s) . . . . 300^oC

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

Electrical Specifications

$V_{SUPPLY} = \pm15V$, Unless Otherwise Specified

PARAMETER	TEST CONDITIONS	TEMP. (^oC)	HA-5170-5			UNITS
			MIN	TYP	MAX	
INPUT CHARACTERISTICS						
Offset Voltage		25	-	0.1	0.3	mV
		Full	-	-	0.5	mV
Average Offset Voltage Drift (Note 3)		Full	-	2	5	$\mu V/^oC$
Bias Current		25	-	20	100	pA
		Full	-	0.1	2	nA
Bias Current Average Drift		Full	-	3	-	$pA/^oC$
Offset Current		25	-	3	60	pA
		Full	-	-	0.1	nA
Offset Current Average Drift (Note 3)		Full	-	0.3	1	$pA/^oC$
Common Mode Range		Full	±10	+15.1	-	V
		Full	-	-12	-	V
Differential Input Capacitance		25	-	80	100	pF
Differential Input Resistance (Note 3)		25	1×10^{10}	6×10^{10}	-	Ω
Input Capacitance (Single Ended)		25	-	12	-	pF
Input Noise Voltage (Note 3)	0.1Hz to10Hz	25	-	0.5	5	μV_{P-P}
Input Noise Voltage Density (Note 3)	f = 10Hz	25	-	20	150	$nV/\sqrt{Hz}$
	f = 100Hz	25	-	12	50	$nV/\sqrt{Hz}$
	f = 1000Hz	25	-	10	25	$nV/\sqrt{Hz}$
Input Noise Current Density (Note 3)	f = 10Hz	25	-	0.05	-	$pA/\sqrt{Hz}$
	f = 100Hz	25	-	0.01	-	$pA/\sqrt{Hz}$
	f = 1000Hz	25	-	0.01	0.1	$pA/\sqrt{Hz}$
TRANSFER CHARACTERISTICS						
Large Signal Voltage Gain	$V_{OUT} = \pm10V$, $R_L = 2k\Omega$	25	300	600	-	kV/V
		Full	250	-	-	kV/V
Common Mode Rejection Ratio	$\Delta V_{CM} = \pm10V$	Full	90	100	-	dB

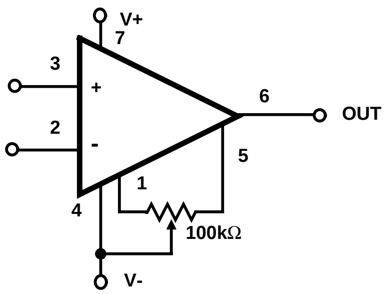
Electrical Specifications V_{SUPPLY} = ±15V, Unless Otherwise Specified **(Continued)**

PARAMETER	TEST CONDITIONS	TEMP. (°C)	HA-5170-5 MIN	HA-5170-5 TYP	HA-5170-5 MAX	UNITS
Minimum Stable Gain		25	1	-	-	V/V
Closed Loop Bandwidth	A_{VCL} = +1	25	4	8	-	MHz
OUTPUT CHARACTERISTICS						
Output Voltage Swing	R_L = 2kΩ	25	±10	±12	-	V
Full Power Bandwidth (Note 4)	R_L = 2kΩ	25	80	120	-	kHz
Output Current (Note 5)	V_{OUT} = ±10V	25	±10	±15	-	mA
Output Resistance (Note 3)	Open Loop, 100Hz	25	-	45	100	Ω
TRANSIENT RESPONSE						
Rise Time	Note 2	25	-	45	100	ns
Slew Rate	Note 2	25	5	8	-	V/µs
Settling Time (Notes 3, 7)		25	-	1	5	µs
POWER SUPPLY CHARACTERISTICS						
Supply Current		Full	-	1.9	2.5	mA
Power Supply Rejection Ratio (Note 8)		Full	90	105	-	dB

NOTES:

2. See “Test Circuits and Waveforms” section.
3. Parameter is not 100% tested. 90% of all units meet or exceed these specifications.
4. Full power bandwidth guaranteed based on slew rate measurement using: $FPBW = \frac{\text{Slew Rate}}{2\pi V_{PEAK}}$.
5. I_{SC} turns on at ≅ 23mA.
6. Settling time is measured to 0.1% of final value for a 10V output step and A_V = -1.
7. V+ = +15V, V- = -10V to -20V and V- = -15V, V+ = +10V to +20V.

Test Circuits and Waveforms



Tested Offset Adjustment Range is |V_{OS} + 1mV| minimum referred to output. Typical range is ±5mV with R_T = 1kΩ and ±15mV with R_T = 100kΩ.

FIGURE 1. V_{OS} ADJUSTMENT

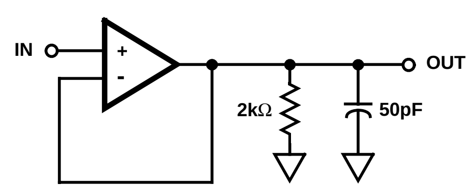
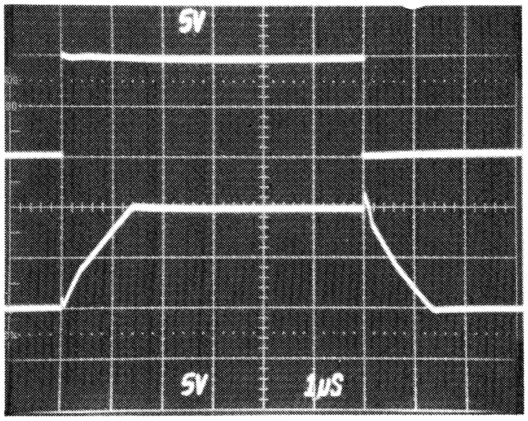


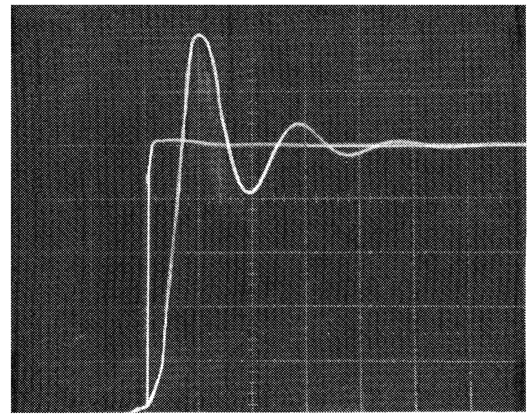
FIGURE 2. LARGE AND SMALL SIGNAL RESPONSE CIRCUIT

Test Circuits and Waveforms (Continued)



Vertical Scale: 5V/Div.
Horizontal Scale: 1µs/Div.

LARGE SIGNAL RESPONSE



Vertical Scale: 10mV/Div.
Horizontal Scale: 100ns/Div.

SMALL SIGNAL RESPONSE

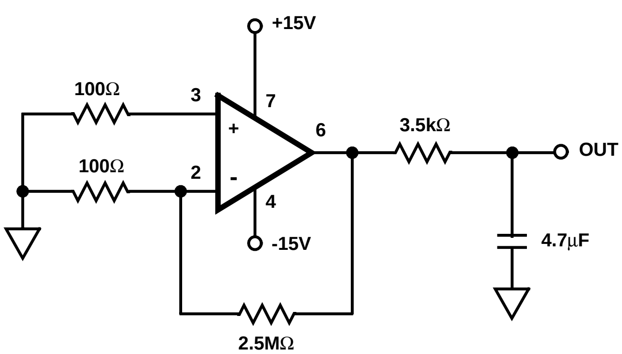
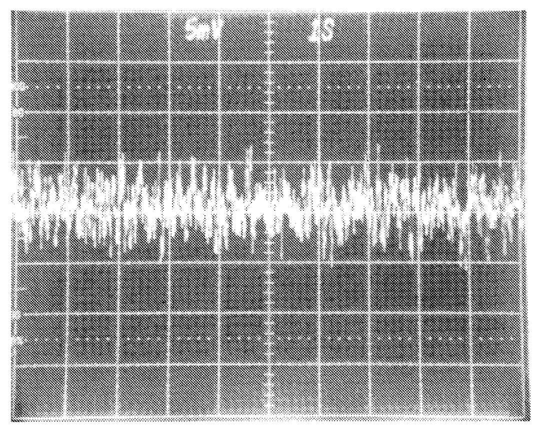


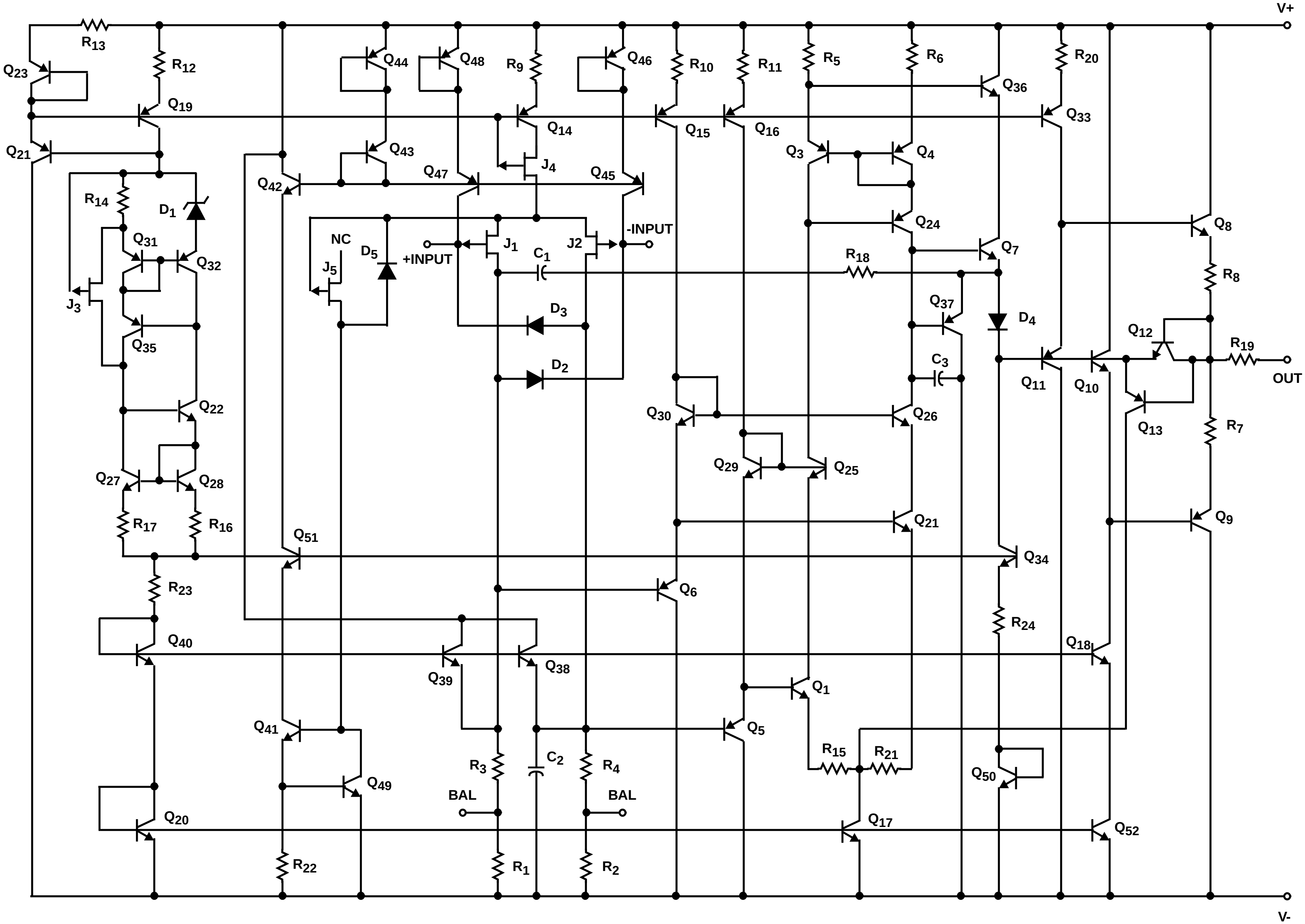
FIGURE 3. LOW FREQUENCY NOISE TEST CIRCUIT



Vertical Scale: 200nV/Div. (Noise Referred to Input)
5mV/Div. at Output, A_{VCL} = 25,000
Horizontal Scale: 1s/Div.

HA-5170 LOW FREQUENCY NOISE (0.1Hz TO 10Hz)

Schematic Diagram



Typical Performace Curves

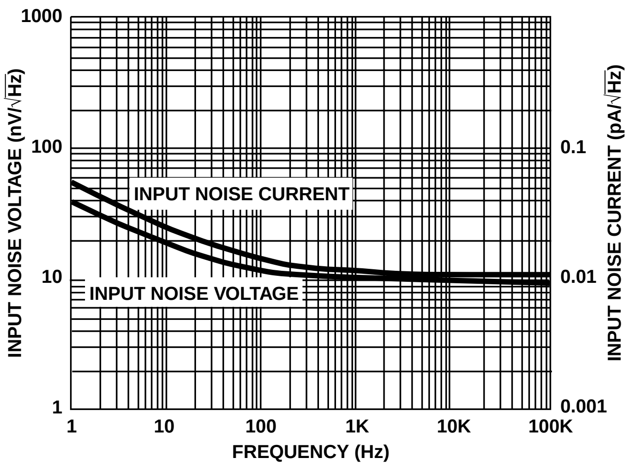


FIGURE 4. INPUT NOISE vs FREQUENCY

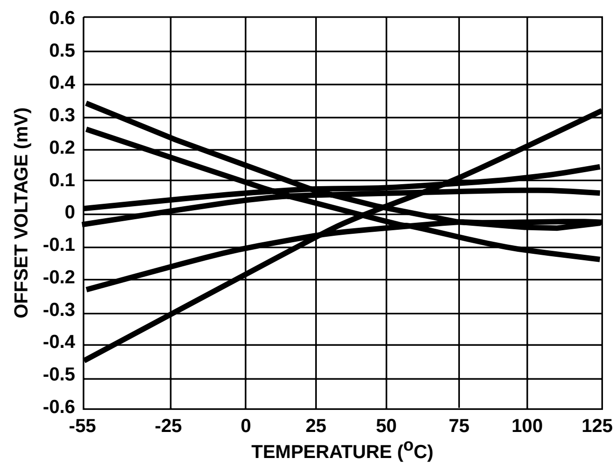


FIGURE 5. OFFSET VOLTAGE DRIFT vs TEMPERATURE OF REPRESENTATIVE UNITS

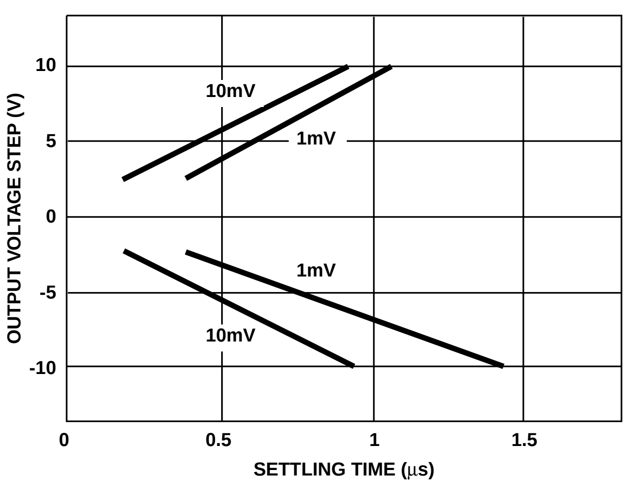


FIGURE 6. SETTLING TIME FOR VARIOUS OUTPUT STEP VOLTAGES

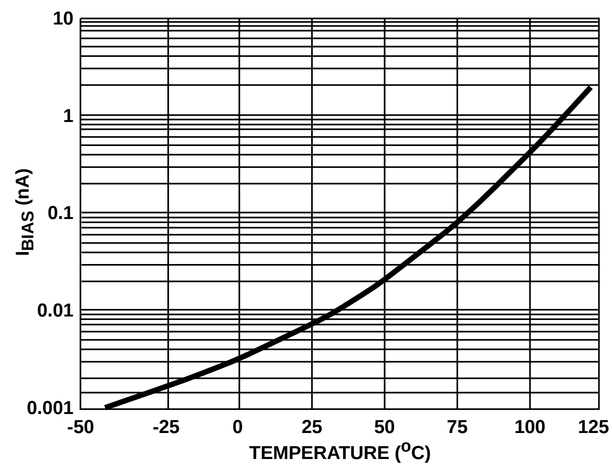


FIGURE 7. BIAS CURRENT vs TEMPERATURE

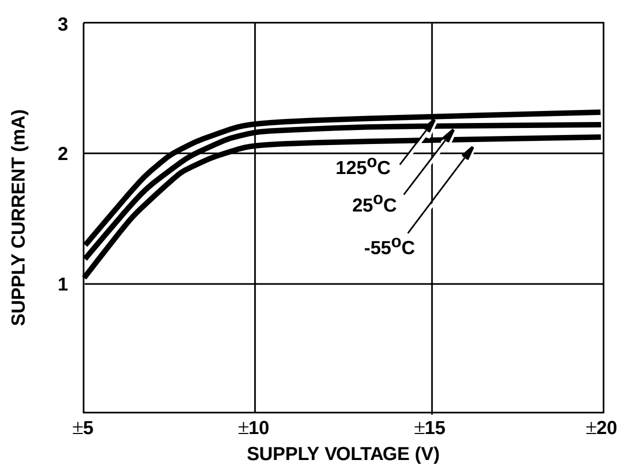


FIGURE 8. POWER SUPPLY CURRENT vs SUPPLY VOLTAGE

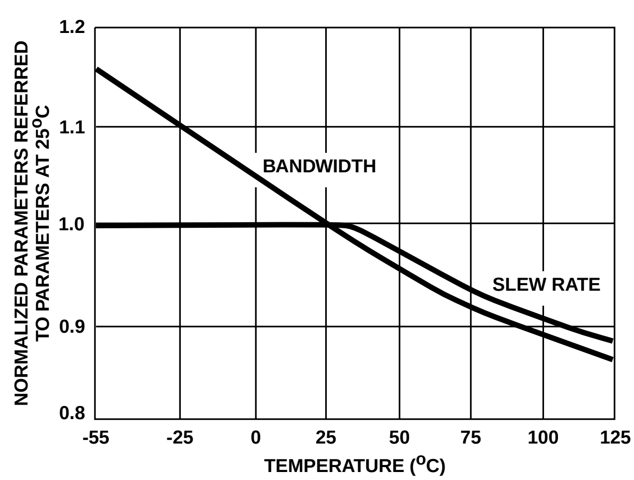


FIGURE 9. NORMALIZED AC PARAMETERS vs TEMPERATURE

Typical Performace Curves (Continued)

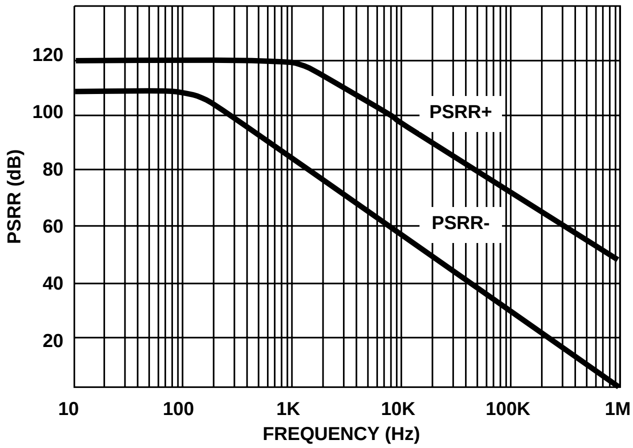


FIGURE 10. POWER SUPPLY REJECTION RATIO vs FREQUENCY

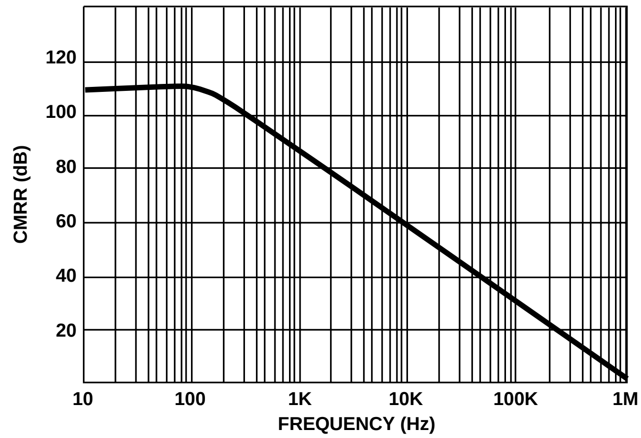


FIGURE 11. COMMON MODE REJECTION RATIO vs FREQUENCY

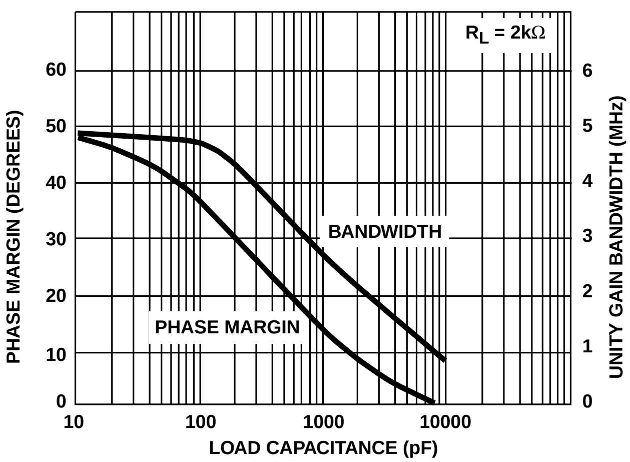


FIGURE 12. SMALL SIGNAL BANDWIDTH AND PHASE MARGIN vs LOAD CAPACITANCE

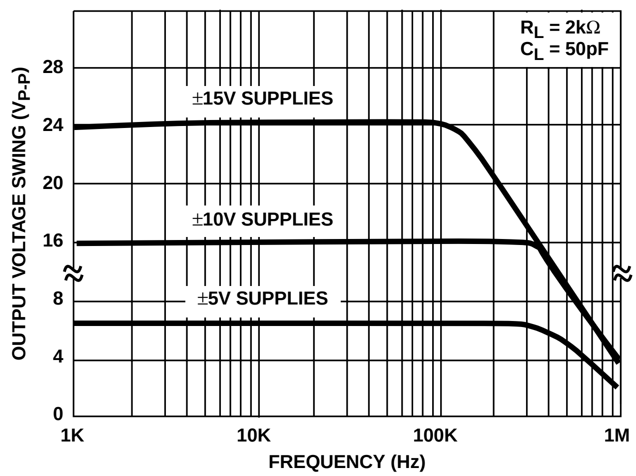


FIGURE 13. OUTPUT VOLTAGE SWING vs FREQUENCY AND SUPPLY VOLTAGE

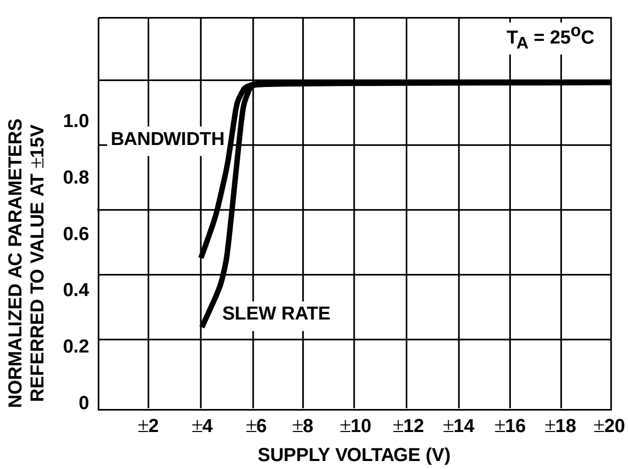


FIGURE 14. NORMALIZED AC PARAMETERS vs SUPPLY VOLTAGE

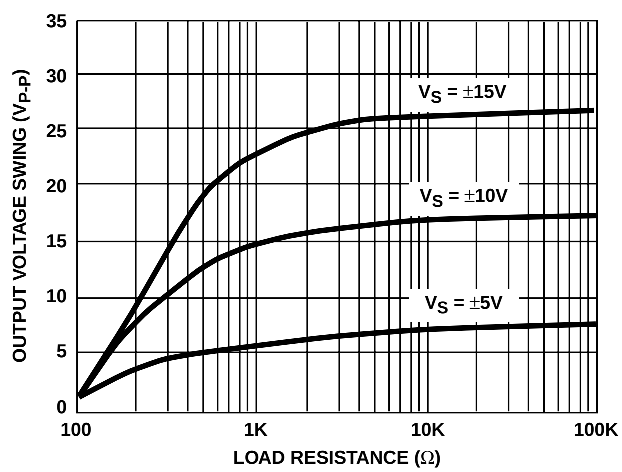


FIGURE 15. MAXIMUM OUTPUT VOLTAGE SWING vs LOAD RESISTANCE

Typical Performace Curves (Continued)

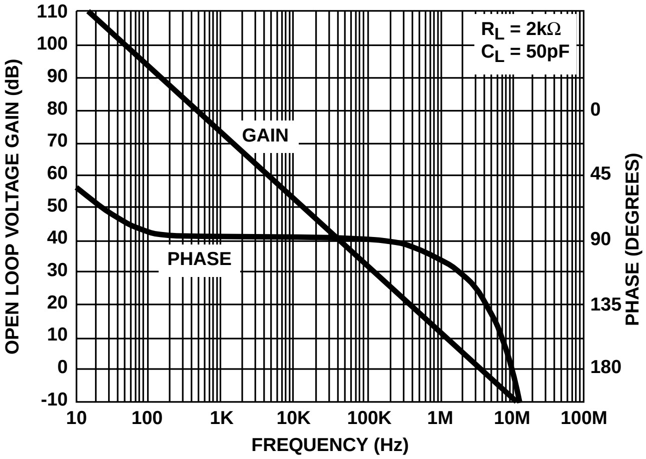


FIGURE 16. OPEN LOOP FREQUENCY RESPONSE

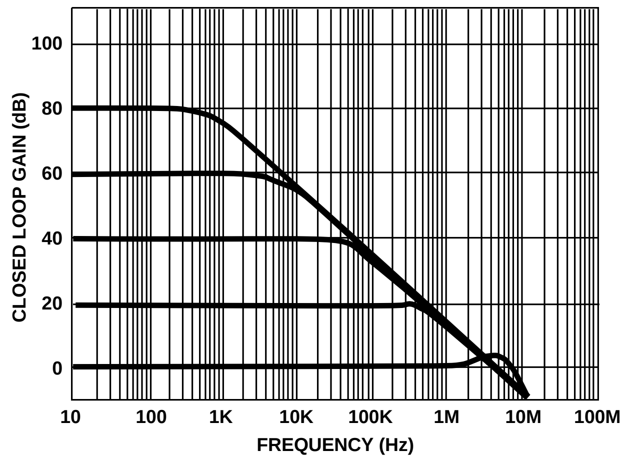


FIGURE 17. CLOSED LOOP FREQUENCY RESPONSE FOR VARIOUS CLOSED LOOP GAINS

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