Radiation Hardened 36V Quad Precision Low Power Operational Amplifier With Enhanced SET Performance

ISL70419SEH

The ISL70419SEH contains four very high precision amplifiers featuring the perfect combination of low noise vs power consumption. Low offset voltage, low I_{BIAS} current and low temperature drift making them the ideal choice for applications requiring both high DC accuracy and AC performance. The combination of high precision, low noise, low power and small footprint provides the user with outstanding value and flexibility relative to similar competitive parts.

Applications for these amplifiers include precision active filters, medical and analytical instrumentation, precision power supply controls, and industrial controls.

The ISL70419SEH is offered in a 14 Ld hermetic ceramic flatpack package. The device is offered in an industry standard pin configuration and operates over the extended temperature range from -55°C to +125°C.

Applications

- Precision instrumentation
- Spectral analysis equipment
- Active filter blocks
- Thermocouples and RTD reference buffers
- Data acquisition
- Power supply control

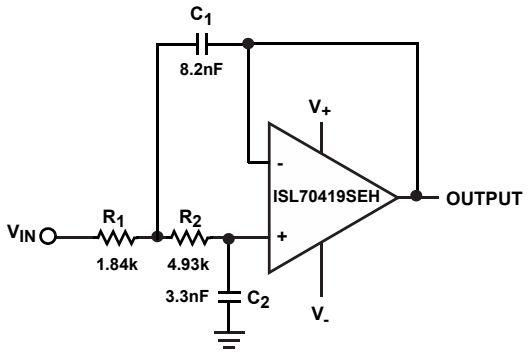
Features

- **Electrically screened to DLA SMD# 5962-14226**
- **Low input offset voltage. . . . . ±110µV, Max.**
- **Superb offset temperature coefficient. . . . . 1µV/°C, Max.**
- **Input bias current . . . . . ±15nA, Max.**
- **Input bias current TC . . . . . ±5pA/°C, Max.**
- **Low current consumption 440µA**
- Voltage noise . . . . . 8nV/√Hz
- Wide supply range . . . . . 4.5V to 36V
- Operating temperature range. . . . . -55°C to +125°C
- Radiation environment
  - SEL/SEB LET_{TH} (V_S = ±36V). . . . . 86.4 MeV•cm^2/mg
  - SET recovery time . . . . . < 10µs @ 60 MeV•cm^2/mg
  - Total dose HDR (50-300rad(Si)/s). . . . . 300krad(Si)
  - Total dose LDR (10mrad(Si)/s) . . . . . 100krad(Si) *

* Product capability established by initial characterization. The EH version is acceptance tested on a wafer-by-wafer basis to 50krad(Si) at low dose rate.

Related Literature

AN1936, ISL70419SEHEV1Z Evaluation Board User's Guide



SALLEN-KEY LOW PASS FILTER (f_C = 10kHz)

FIGURE 1. TYPICAL APPLICATION

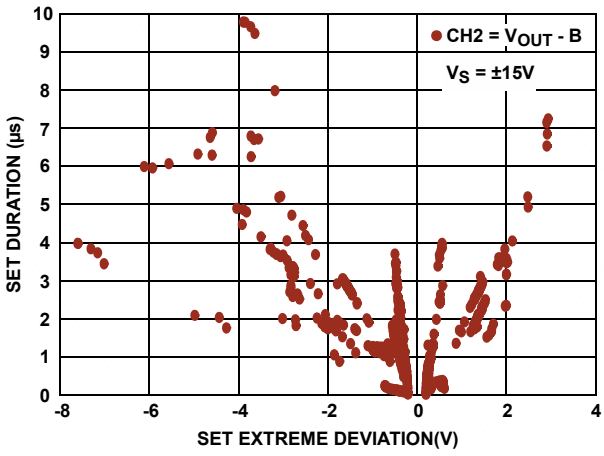


FIGURE 2. SET DEVIATION vs DURATION FOR LET = 60 MeV•cm^2/mg

Ordering Information

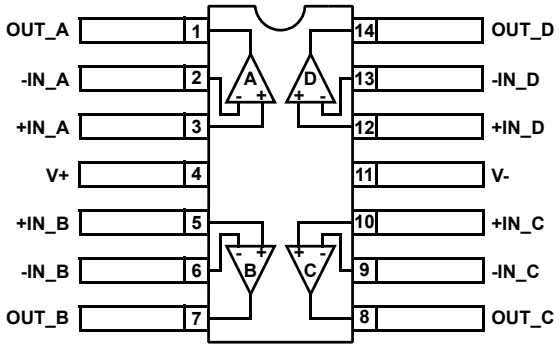
ORDERING/SMD NUMBER	PART NUMBER (Notes 1, 2)	TEMPERATURE RANGE (°C)	PACKAGE (Rohs Compliant	PKG. DWG. #
5962F1422601VXC	ISL70419SEHVF	-55 to +125	14 Ld Flatpack with EPAD	K14.C
ISL70419SEHF/PROTO	ISL70419SEHF/PROTO	-55 to +125	14 Ld Flatpack with EPAD	K14.C
5962F1422601V9AX	ISL70419SEHVX	-55 to +125	DIE	
ISL70419SEHX/SAMPLE	ISL70419SEHX/SAMPLE	-55 to +125	DIE	
ISL70419SEHEV1Z	Evaluation Board			

NOTES:

1. These Intersil Pb-free Hermetic packaged products employ 100% Au plate - e4 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations.
2. Specifications for Rad Hard QML devices are controlled by the Defense Logistics Agency Land and Maritime (DLA). The SMD numbers listed in the “Ordering Information” table must be used when ordering.

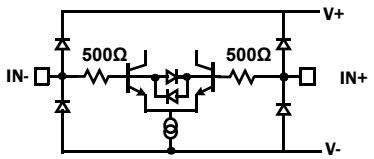
Pin Configuration

ISL70419SEH
(14 LD FLATPACK)
TOP VIEW

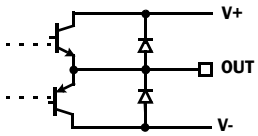


Pin Descriptions

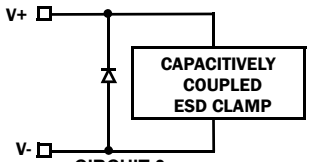
PIN NUMBER	PIN NAME	EQUIVALENT CIRCUIT	DESCRIPTION
1	OUT_A	Circuit 2	Amplifier A output
2	-IN_A	Circuit 1	Amplifier A inverting input
3	+IN_A	Circuit 1	Amplifier A non-inverting input
4	V+	Circuit 3	Positive power supply
5	+IN_B	Circuit 1	Amplifier B non-inverting input
6	-IN_B	Circuit 1	Amplifier B inverting input
7	OUT_B	Circuit 2	Amplifier B output
8	OUT_C	Circuit 2	Amplifier C output
9	-IN_C	Circuit 1	Amplifier C inverting input
10	+IN_C	Circuit 1	Amplifier C non-inverting input
11	V-	Circuit 3	Negative power supply
12	+IN_D	Circuit 1	Amplifier D non-inverting input
13	-IN_D	Circuit 1	Amplifier D inverting input
14	OUT_D	Circuit 2	Amplifier D output
	EPAD	N/A	EPAD under Package (Unbiased, tied to package lid)



CIRCUIT 1



CIRCUIT 2



CIRCUIT 3

Absolute Maximum Ratings

Maximum Supply Voltage 42V
Maximum Supply Voltage (LET = 86.4 MeV • cm^2/mg). 36V
Maximum Differential Input Current 20mA
Maximum Differential Input Voltage 20V
Min/Max Input Voltage . . . . . V- - 0.5V to V+ + 0.5V
Max/Min Input current for Input Voltage >V+ or <V- . . . . . ±20mA
Output Short-Circuit Duration (1 output at a time). . . . . Indefinite
ESD Rating
Human Body Model (Tested per MIL-PRF-883 3015.7). 2kV
Machine Model (Tested per EIA/JESD22-A115-A) 200V
Charged Device Model (Tested per JESD22-C101D) 750V

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
14 Ld Flatpack (Notes 3, 4).	35	8

Maximum Storage Temperature Range . . . . . -65°C to +150°C
Maximum Junction Temperature (T_{JMAX}) . . . . . +150°C
Pb-Free Reflow Profile . . . . . see TB493

Recommended Operating Conditions

Ambient Operating Temperature Range . . . . . -55°C to +125°C
Maximum Operating Junction Temperature . . . . . +150°C
Supply Voltage . . . . . 10V (±5V) to 30V (±15V)

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

3. θ_{JA} is measured in free air with the component mounted on a high effective thermal conductivity test board with “direct attach” features. See Tech Brief TB379.
4. For θ_{JC}, the "case temp" location is the center of the package underside.

Electrical Specifications

V_S ± 15V, V_{CM} = 0, V_O = 0V, T_A = +25°C, unless otherwise noted. **Boldface limits apply across the operating temperature range, -55°C to +125°C; over a total ionizing dose of 300krad(Si) with exposure at a high dose rate of 50 - 300rad(Si)/s; or across a total ionizing dose of 50krad(Si) with exposure at a low dose rate of <10mrad(Si)/s.**

PARAMETER	DESCRIPTION	TEST CONDITIONS	MIN (Note 5)	TYP	MAX (Note 5)	UNITS
V_{OS}	Input Offset Voltage			10	85	µV
					110	µV
TCV_{OS}	Offset Voltage Drift	guaranteed by characterization not tested		0.1	**1**	µV/°C
I_B	Input Bias Current		-2.5	0.08	2.5	nA
		T_A = -55°C to +125°C	-5		5	nA
		over high and low dose radiation	-15		15	nA
TCI_B	Input Bias Current Temperature Coefficient	guaranteed by characterization not tested	**-5**	**1**	**5**	pA/°C
I_{OS}	Input Offset Current		-2.5	0.08	2.5	nA
		T_A = -55°C to +125°C	-3		3	nA
		over high and low dose radiation	-10		10	nA
TCI_{OS}	Input Offset Current Temperature Coefficient	guaranteed by characterization not tested	**-3**	**0.42**	**3**	pA/°C
V_{CM}	Input Voltage Range	guaranteed by CMRR test	**-13**		**13**	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = -13V to +13V	120	145		dB
			120			dB
PSRR	Power Supply Rejection Ratio	V_S = ±2.25V to ±20V	120	145		dB
			120			dB
A_{VOL}	Open-Loop Gain	V_O = -13V to +13V, R_L = 10kΩ to ground	3,000	14,000		V/mV
V_{OH}	Output Voltage High	R_L = 10kΩ to ground	13.5	13.7		V
			13.2			V
		R_L = 2kΩ to ground	13.3	13.55		V
			13.0			V

Electrical Specifications $V_S \pm 15V$, $V_{CM} = 0$, $V_O = 0V$, $T_A = +25°C$, unless otherwise noted. **Boldface limits apply across the operating temperature range, -55°C to +125°C; over a total ionizing dose of 300krad(Si) with exposure at a high dose rate of 50 - 300rad(Si)/s; or across a total ionizing dose of 50krad(Si) with exposure at a low dose rate of <10mrad(Si)/s. (Continued)**

PARAMETER	DESCRIPTION	TEST CONDITIONS	MIN (Note 5)	TYP	MAX (Note 5)	UNITS
V_{OL}	Output Voltage Low	R_L = 10kΩ to ground		-13.7	-13.5	V
					-13.2	V
		R_L = 2kΩ to ground		-13.55	-13.3	V
					-13.0	V
I_S	Supply Current/Amplifier			0.44	0.625	mA
					0.75	mA
I_{SC}	Short-Circuit Current			43		mA
V_{SUPPLY}	Supply Voltage Range	guaranteed by PSRR	**± 2.25**		**± 20**	V
AC SPECIFICATIONS						
GBWP	Gain Bandwidth Product	A_V = 1k, R_L = 2kΩ		1.5		MHz
e_{nVp-p}	Voltage Noise V_{P-P}	0.1Hz to 10Hz		0.25		μV_{P-P}
e_n	Voltage Noise Density	f = 10Hz		10		nV/√Hz
e_n	Voltage Noise Density	f = 100Hz		8.2		nV/√Hz
e_n	Voltage Noise Density	f = 1kHz		8		nV/√Hz
e_n	Voltage Noise Density	f = 10kHz		8		nV/√Hz
in	Current Noise Density	f = 1kHz		0.1		pA/√Hz
THD + N	Total Harmonic Distortion	1kHz, G = 1, $V_O = 3.5V_{RMS}$, R_L = 2kΩ		0.0009		%
		1kHz, G = 1, $V_O = 3.5V_{RMS}$, R_L = 10kΩ		0.0005		%
TRANSIENT RESPONSE						
SR	Slew Rate, V_{OUT} 20% to 80%	A_V = 11, R_L = 2kΩ, $V_O = 4V_{P-P}$	0.3	0.5		V/µs
			0.2			V/µs
t_r, t_f, Small Signal	Rise Time 10% to 90% of V_{OUT}	A_V = 1, $V_{OUT} = 50mV_{P-P}$, R_L = 10kΩ to V_{CM}		130	450	ns
					625	ns
	Fall Time 90% to 10% of V_{OUT}	A_V = 1, $V_{OUT} = 50mV_{P-P}$, R_L = 10kΩ to V_{CM}		130	600	ns
					700	ns
t_s	Settling Time to 0.1% 10V Step; 10% to V_{OUT}	A_V = -1, $V_{OUT} = 10V_{P-P}$, R_L = 5kΩ to V_{CM}		21		µs
	Settling Time to 0.01% 10V Step; 10% to V_{OUT}	A_V = -1, $V_{OUT} = 10V_{P-P}$, R_L = 5kΩ to V_{CM}		24		µs
	Settling Time to 0.1% 4V Step; 10% to V_{OUT}	A_V = -1, $V_{OUT} = 4V_{P-P}$, R_L = 5kΩ to V_{CM}		13		µs
	Settling Time to 0.01% 4V Step; 10% to V_{OUT}	A_V = -1, $V_{OUT} = 4V_{P-P}$, R_L = 5kΩ to V_{CM}		18		µs
t_{OL}	Output Positive Overload Recovery Time	A_V = -100, $V_{IN} = 0.2V_{P-P}$, R_L = 2kΩ to V_{CM}		5.6		µs
	Output Negative Overload Recovery Time	A_V = -100, $V_{IN} = 0.2V_{P-P}$, R_L = 2kΩ to V_{CM}		10.6		µs
OS+	Positive Overshoot	A_V = 1, $V_{OUT} = 10V_{P-P}$, R_f = 0Ω R_L = 2kΩ to V_{CM}		15		%
					33	%
OS-	Negative Overshoot	A_V = 1, $V_{OUT} = 10V_{P-P}$, R_f = 0Ω R_L = 2kΩ to V_{CM}		15		%
					33	%

Electrical Specifications

V_S ± 5V, V_{CM} = 0, V_O = 0V, T_A = +25°C, unless otherwise noted. **Boldface limits apply over the operating temperature range, -55°C to +125°C; over a total ionizing dose of 300krad(Si) with exposure at a high dose rate of 50 - 300krad(Si)/s; or over a total ionizing dose of 50krad(Si) with exposure at a low dose rate of <10mrad(Si)/s.**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 5)	TYP	MAX (Note 5)	UNIT
V_{OS}	Input Offset Voltage			10	150	µV
					250	µV
TCV_{OS}	Offset Voltage Drift	guaranteed by characterization not tested		0.1	**1**	µV/°C
I_B	Input Bias Current		-2.5	0.08	2.5	nA
		T_A = -55°C to +125°C	-5		5	nA
		over high and low dose radiation	-15		15	nA
TCI_B	Input Bias Current Temperature Coefficient	guaranteed by characterization not tested	**-5**	**1**	**5**	pA/°C
I_{OS}	Input Offset Current		-2.5	0.08	2.5	nA
		T_A = -55°C to +125°C	-3		3	nA
		over high and low dose radiation	-10		10	nA
TCI_{OS}	Input Offset Current Temperature Coefficient	guaranteed by characterization not tested	**-3**	**0.42**	**3**	pA/°C
V_{CM}	Input Voltage Range	guaranteed by CMRR test	**-3**		**3**	V
CMRR	Common-Mode Rejection Ratio	V_{CM} = -3V to +3V	120	145		dB
			120			dB
PSRR	Power Supply Rejection Ratio	V_S = ±2.25V to ±5V	120	145		dB
			120			dB
A_{VOL}	Open-Loop Gain	V_O = -3.0V to +3.0V R_L = 10kΩ to ground	3,000	14,000		V/mV
V_{OH}	Output Voltage High	R_L = 10kΩ to ground	3.5	3.7		V
			3.2			V
		R_L = 2kΩ to ground	3.3	3.55		V
			3.0			V
V_{OL}	Output Voltage Low	R_L = 10kΩ to ground		-3.7	-3.5	V
					-3.2	V
		R_L = 2kΩ to ground		-3.55	-3.3	V
					-3.0	V
I_S	Supply Current/Amplifier			0.44	0.625	mA
					0.75	mA
I_{SC}	Short-Circuit Current			43		mA
AC SPECIFICATIONS						
GBWP	Gain Bandwidth Product	A_V = 1k, R_L = 2kΩ		1.5		MHz
e_{np-p}	Voltage Noise	0.1Hz to 10Hz		0.25		$µV_{P-P}$
e_n	Voltage Noise Density	f = 10Hz		12		nV/√Hz
e_n	Voltage Noise Density	f = 100Hz		8.6		nV/√Hz
e_n	Voltage Noise Density	f = 1kHz		8		nV/√Hz
e_n	Voltage Noise Density	f = 10kHz		8		nV/√Hz
in	Current Noise Density	f = 1kHz		0.1		pA/√Hz

Electrical Specifications $V_S \pm 5V$, $V_{CM} = 0$, $V_O = 0V$, $T_A = +25°C$, unless otherwise noted. **Boldface limits apply over the operating temperature range, -55°C to +125°C; over a total ionizing dose of 300krad(Si) with exposure at a high dose rate of 50 - 300krad(Si)/s; or over a total ionizing dose of 50krad(Si) with exposure at a low dose rate of <10mrad(Si)/s. (Continued)**

PARAMETER	DESCRIPTION	CONDITIONS	MIN (Note 5)	TYP	MAX (Note 5)	UNIT
TRANSIENT RESPONSE						
SR	Slew Rate, V_{OUT} 20% to 80%	$A_V = 11$, $R_L = 2k\Omega$, $V_O = 4V_{P-P}$		0.5		V/µs
t_r, t_f, Small Signal	Rise Time 10% to 90% of V_{OUT}	$A_V = 1$, $V_{OUT} = 50mV_{P-P}$, $R_L = 10k\Omega$ to V_{CM}		130		ns
	Fall Time 90% to 10% of V_{OUT}	$A_V = 1$, $V_{OUT} = 50mV_{P-P}$, $R_L = 10k\Omega$ to V_{CM}		130		ns
t_S	Settling Time to 0.1% 4V Step; 10% to V_{OUT}	$A_V = -1$, $V_{OUT} = 4V_{P-P}$, $R_L = 5k\Omega$ to V_{CM}		12		µs
	Settling Time to 0.01% 4V Step; 10% to V_{OUT}	$A_V = -1$, $V_{OUT} = 4V_{P-P}$, $R_L = 5k\Omega$ to V_{CM}		19		µs
t_{OL}	Output Positive Overload Recovery Time	$A_V = -100$, $V_{IN} = 0.2V_{P-P}$ $R_L = 2k\Omega$ to V_{CM}		7		µs
	Output Negative Overload Recovery Time	$A_V = -100$, $V_{IN} = 0.2V_{P-P}$ $R_L = 2k\Omega$ to V_{CM}		5.8		µs
OS+	Positive Overshoot	$A_V = 1$, $V_{OUT} = 10V_{P-P}$, $R_f = 0\Omega$ $R_L = 2k\Omega$ to V_{CM}		15		%
OS-	Negative Overshoot	$A_V = 1$, $V_{OUT} = 10V_{P-P}$, $R_f = 0\Omega$ $R_L = 2k\Omega$ to V_{CM}		15		%

NOTE:

5. Compliance to datasheet limits is assured by one or more methods: production test, characterization and/or design.

Typical Performance Curves

V_S = ±15V, V_{CM} = 0V, R_L = Open, T_A = +25°C, unless otherwise specified.

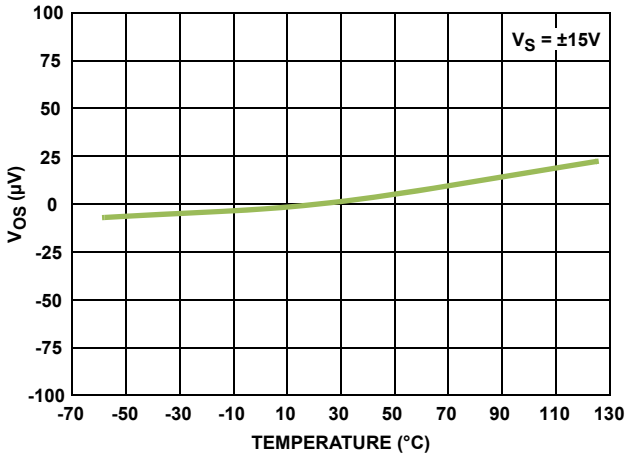


FIGURE 3. V_{OS} vs TEMPERATURE

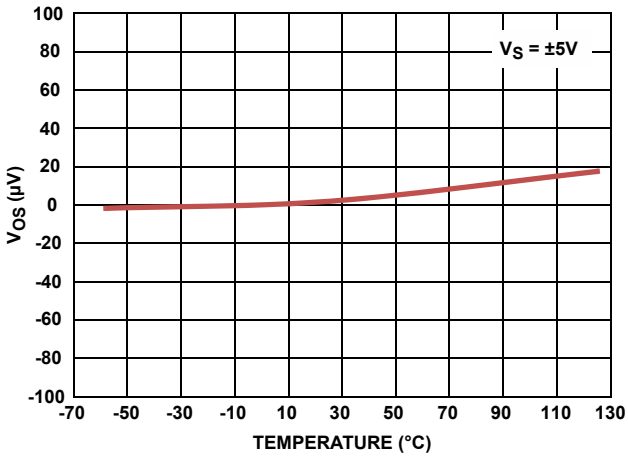


FIGURE 4. V_{OS} vs TEMPERATURE

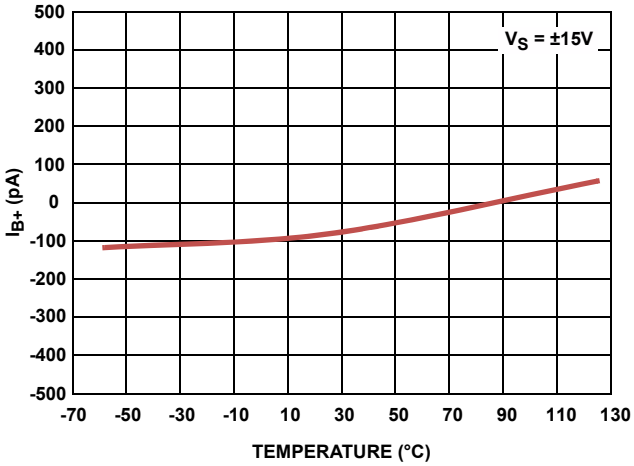


FIGURE 5. I_{B+} vs TEMPERATURE

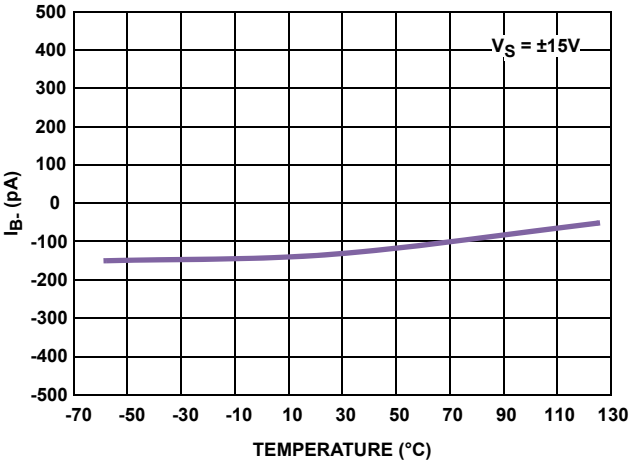


FIGURE 6. I_{B-} vs TEMPERATURE

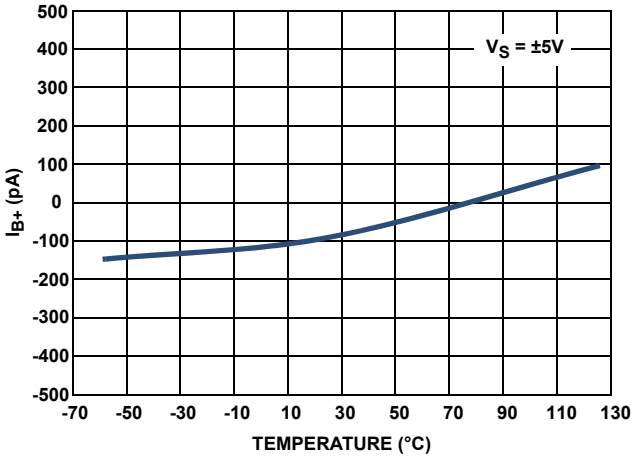


FIGURE 7. I_{B+} vs TEMPERATURE

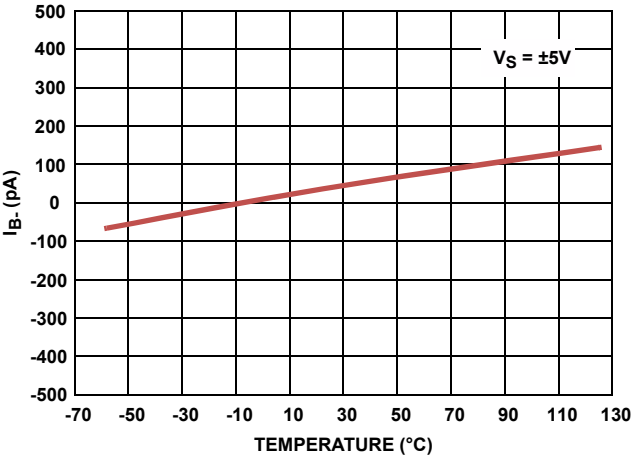


FIGURE 8. I_{B-} vs TEMPERATURE

Typical Performance Curves

V_S = ±15V, V_{CM} = 0V, R_L = Open, T_A = +25°C, unless otherwise specified. **(Continued)**

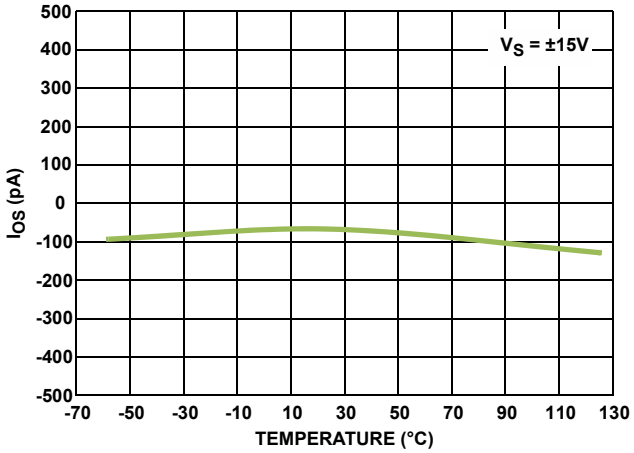


FIGURE 9. I_{OS} vs TEMPERATURE

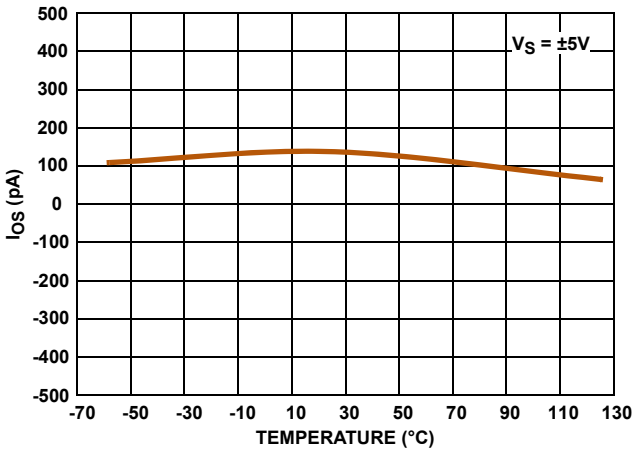


FIGURE 10. I_{OS} vs TEMPERATURE

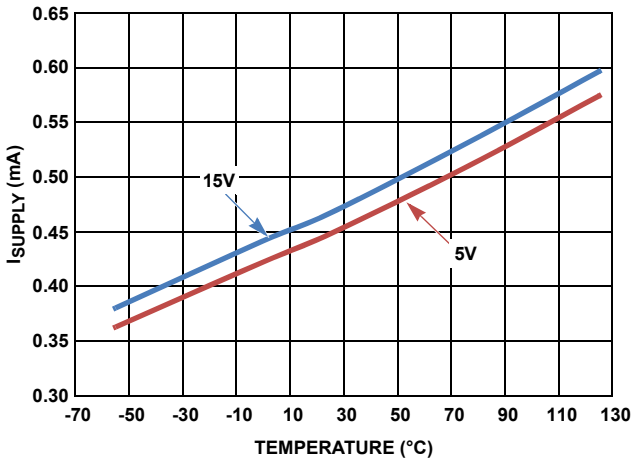


FIGURE 11. SUPPLY CURRENT PER AMP vs TEMPERATURE

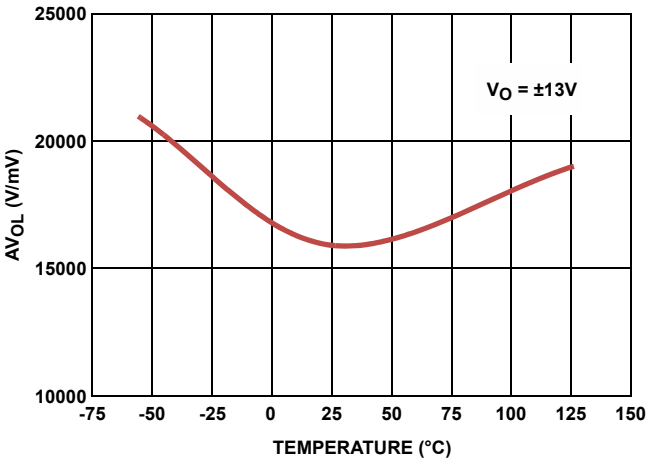


FIGURE 12. AV_{OL} vs TEMPERATURE

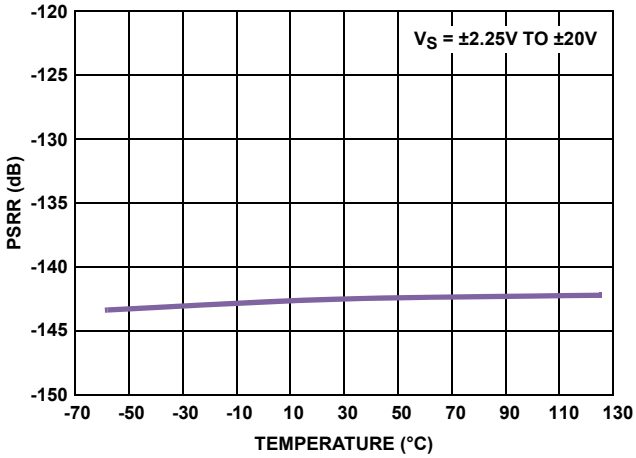


FIGURE 13. PSRR vs TEMPERATURE

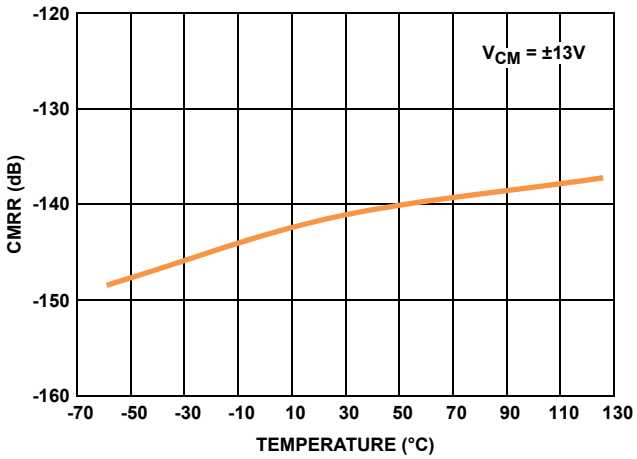


FIGURE 14. CMRR vs TEMPERATURE

Typical Performance Curves

V_S = ±15V, V_{CM} = 0V, R_L = Open, T_A = +25°C, unless otherwise specified. **(Continued)**

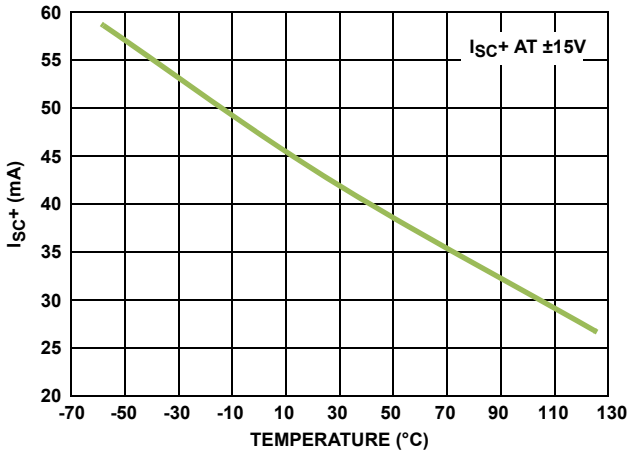


FIGURE 15. SHORT CIRCUIT CURRENT vs TEMPERATURE

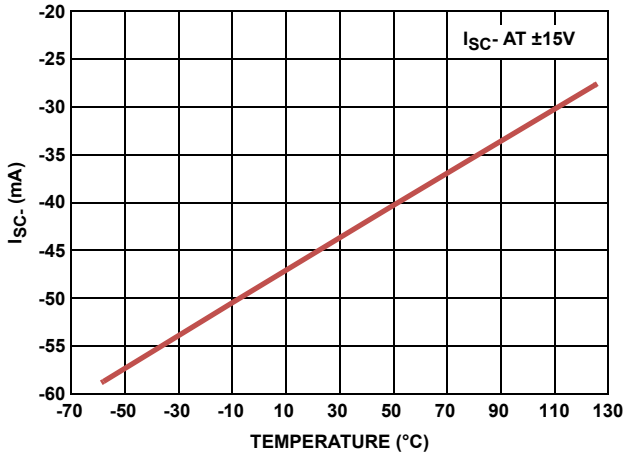


FIGURE 16. SHORT CIRCUIT CURRENT vs TEMPERATURE

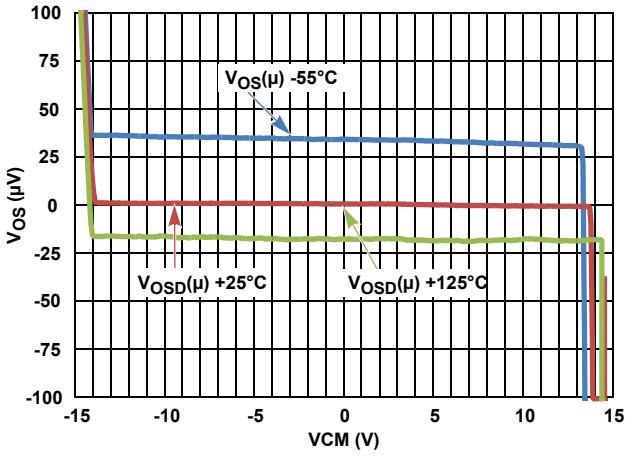


FIGURE 17. INPUT V_{OS} vs INPUT COMMON MODE VOLTAGE, V_S = ±15

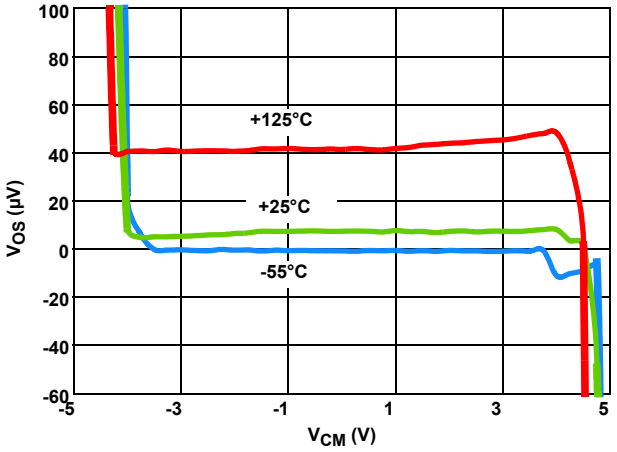


FIGURE 18. INPUT V_{OS} vs INPUT COMMON MODE VOLTAGE, V_S = ±5V

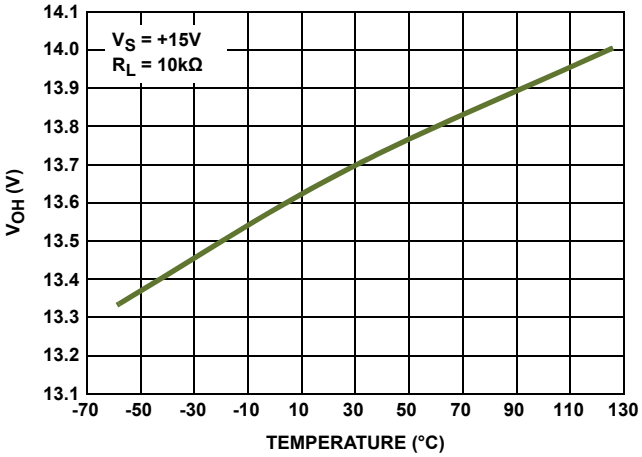


FIGURE 19. V_{OUT} vs TEMPERATURE

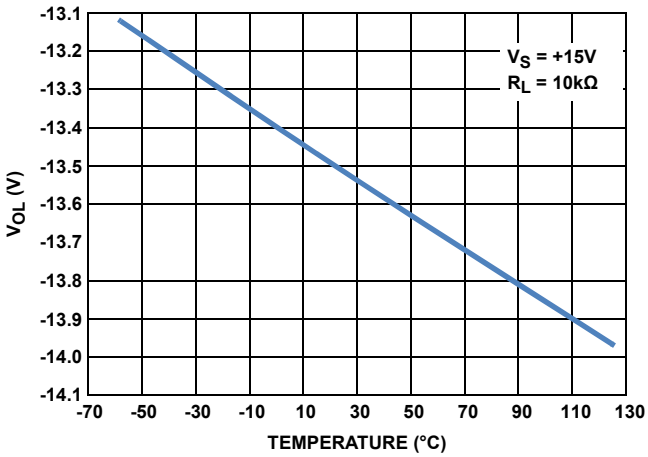


FIGURE 20. V_{OUT} vs TEMPERATURE

Typical Performance Curves

V_S = ±15V, V_{CM} = 0V, R_L = Open, T_A = +25°C, unless otherwise specified. **(Continued)**

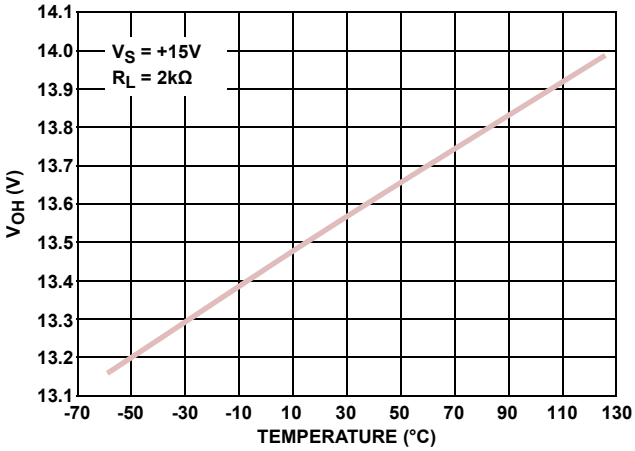


FIGURE 21. V_{OUT} vs TEMPERATURE

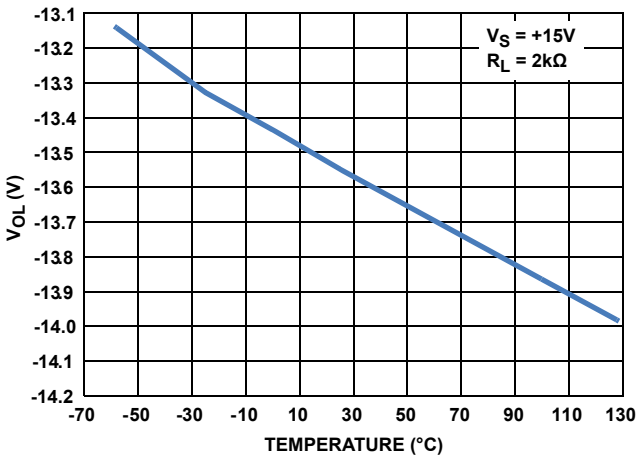


FIGURE 22. V_{OUT} vs TEMPERATURE

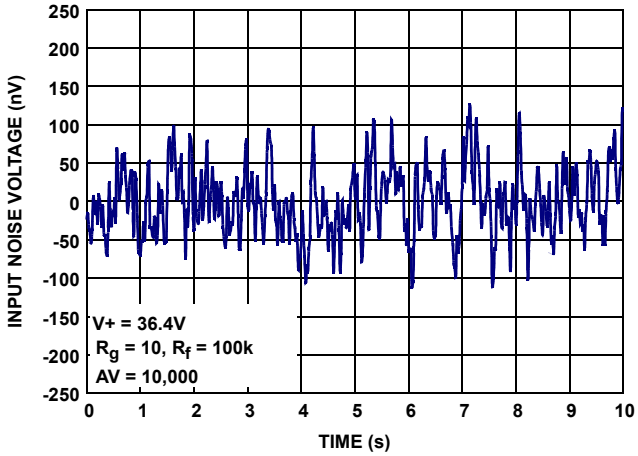


FIGURE 23. INPUT NOISE VOLTAGE 0.1Hz to 10Hz

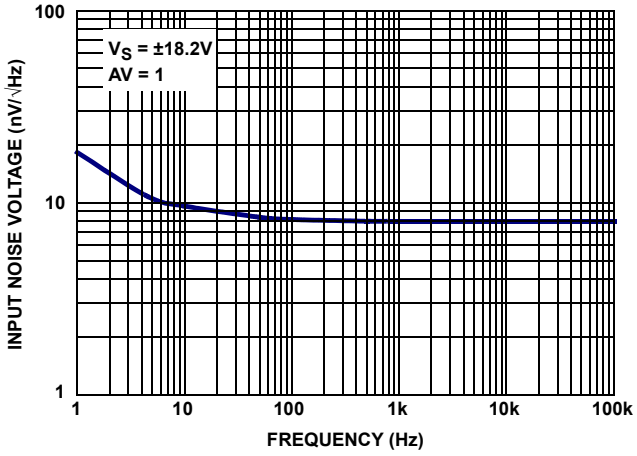


FIGURE 24. INPUT NOISE VOLTAGE SPECTRAL DENSITY

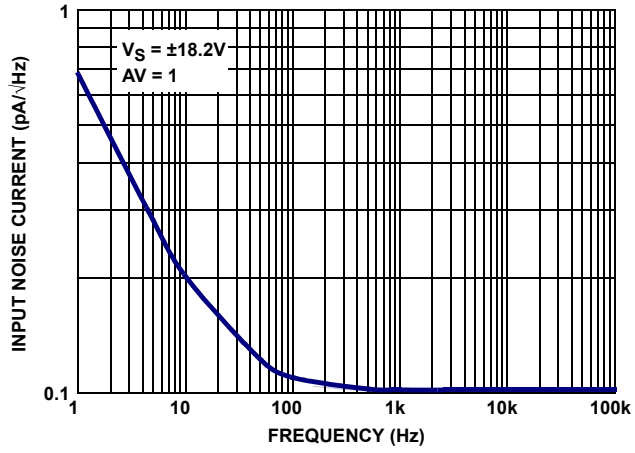


FIGURE 25. INPUT NOISE CURRENT SPECTRAL DENSITY

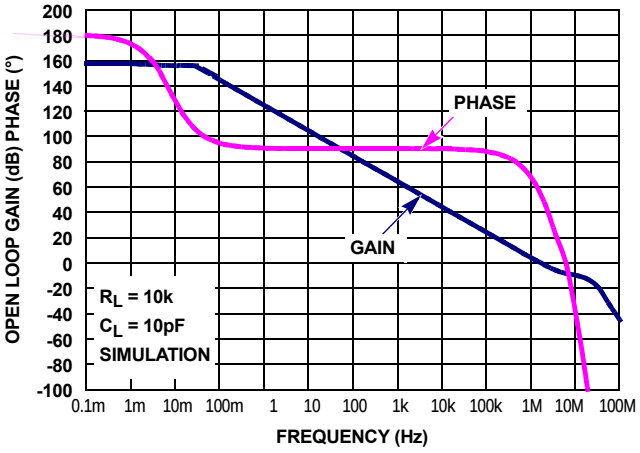


FIGURE 26. OPEN-LOOP GAIN, PHASE vs FREQUENCY, R_L = 10kΩ, C_L = 10pF

Typical Performance Curves

V_S = ±15V, V_{CM} = 0V, R_L = Open, T_A = +25°C, unless otherwise specified. **(Continued)**

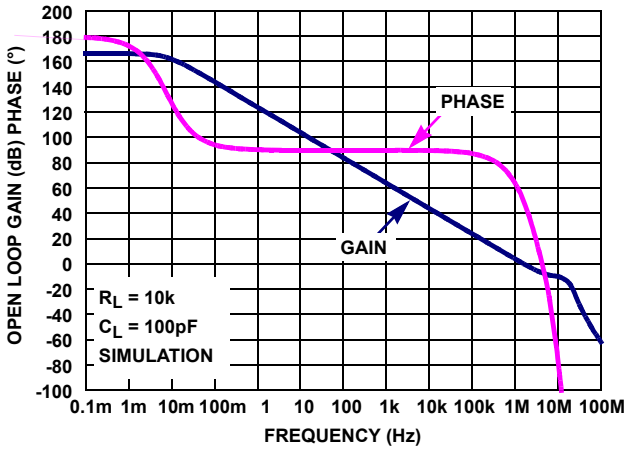


FIGURE 27. OPEN-LOOP GAIN, PHASE vs FREQUENCY, R_L = 10kΩ, C_L = 100pF

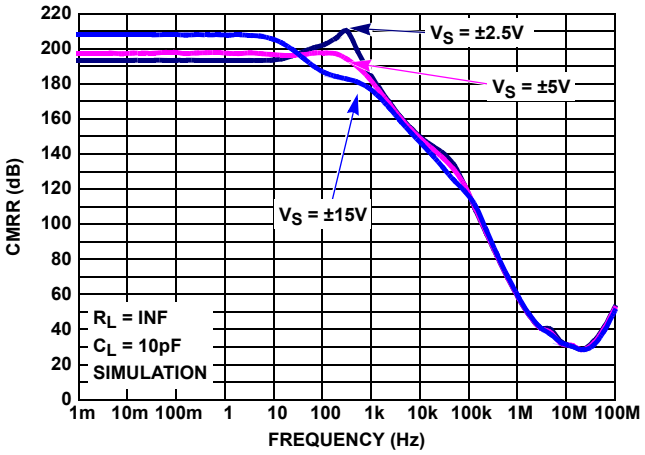


FIGURE 28. CMRR vs FREQUENCY, V_S = ±2.25, ±5V, ±15V

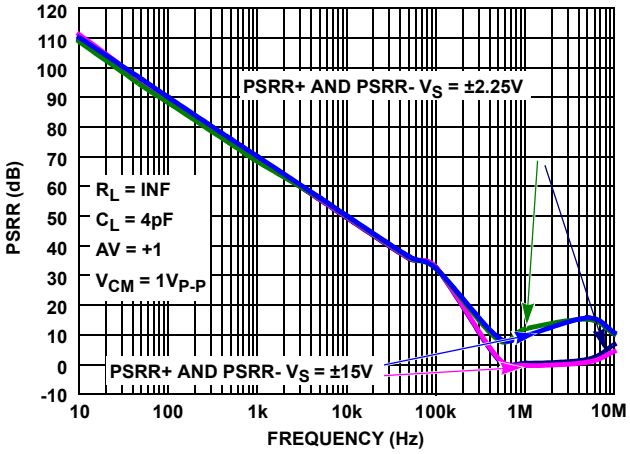


FIGURE 29. PSRR vs FREQUENCY, V_S = ±5V, ±15V

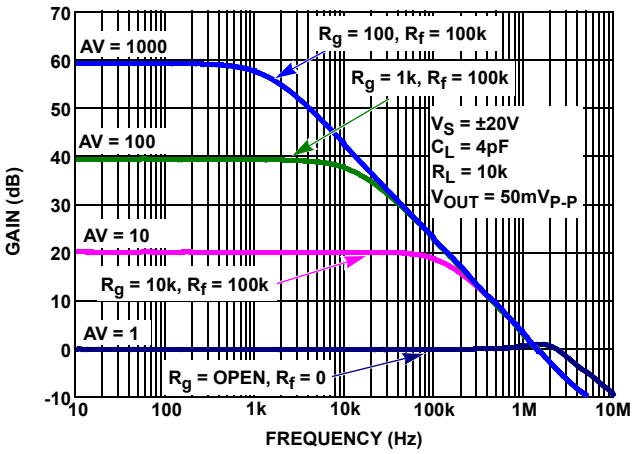


FIGURE 30. FREQUENCY RESPONSE vs CLOSED LOOP GAIN

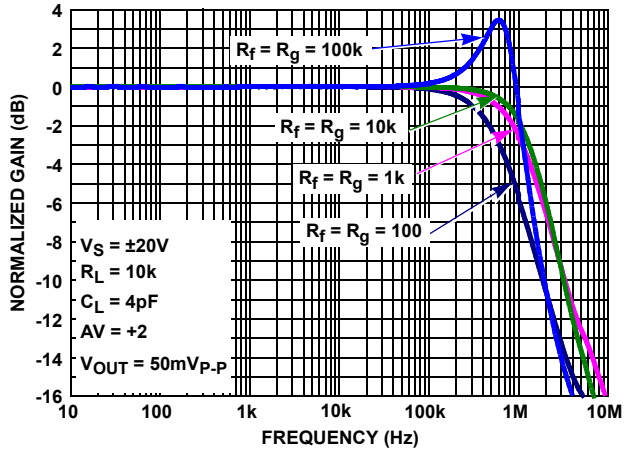


FIGURE 31. FREQUENCY RESPONSE vs FEEDBACK RESISTANCE R_f/R_g

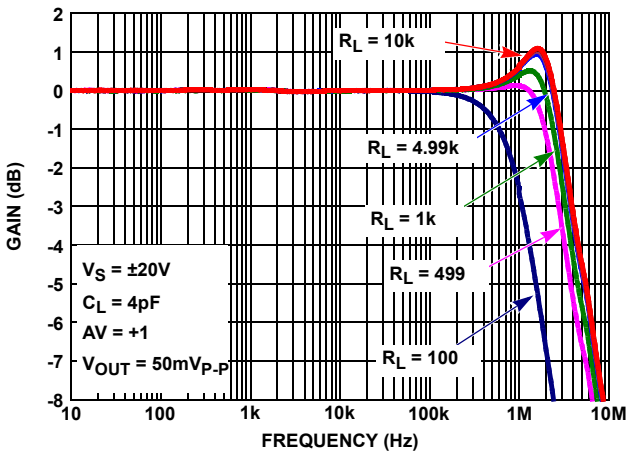


FIGURE 32. GAIN vs FREQUENCY vs R_L

Typical Performance Curves

V_S = ±15V, V_{CM} = 0V, R_L = Open, T_A = +25°C, unless otherwise specified. **(Continued)**

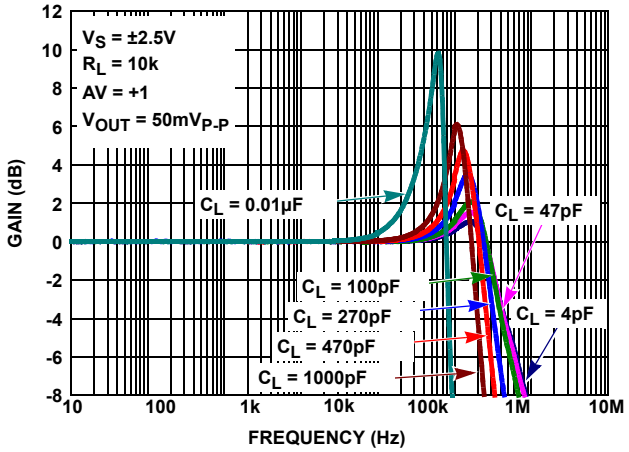


FIGURE 33. GAIN vs FREQUENCY vs C_L

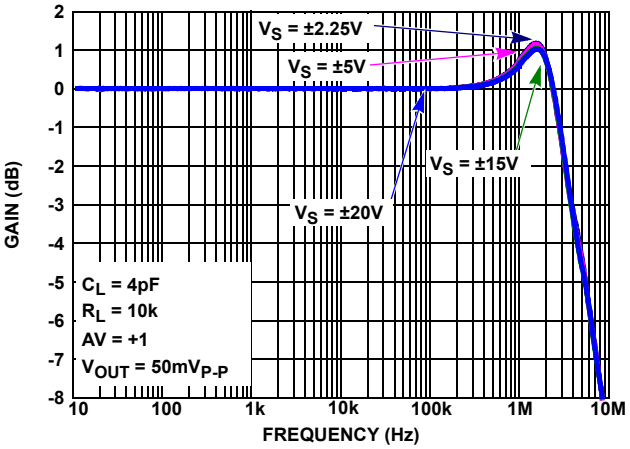


FIGURE 34. GAIN vs FREQUENCY vs SUPPLY VOLTAGE

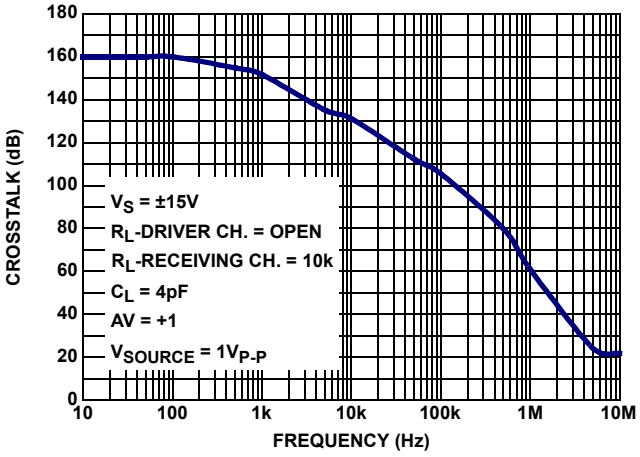


FIGURE 35. CROSSTALK, V_S = ±15V

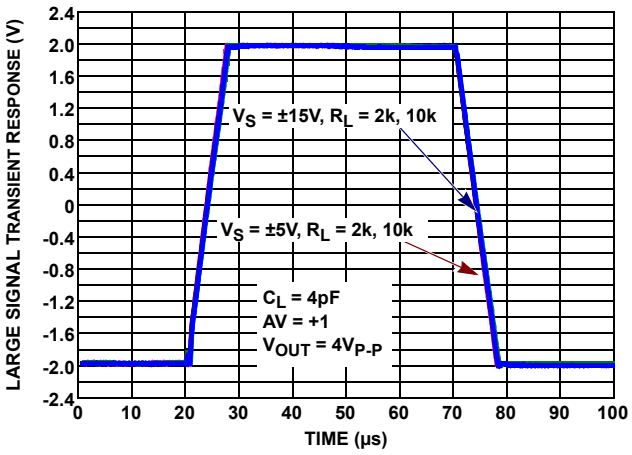


FIGURE 36. LARGE SIGNAL TRANSIENT RESPONSE vs R_L V_S = ±5V, ±15V

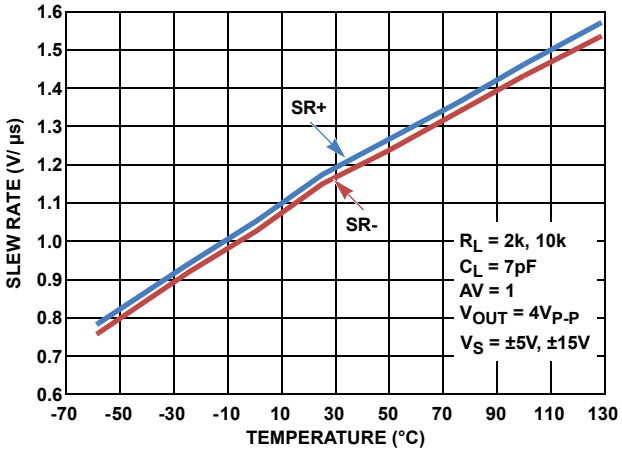


FIGURE 37. SLEW RATE vs TEMPERATURE V_S = ±5V, ±15V

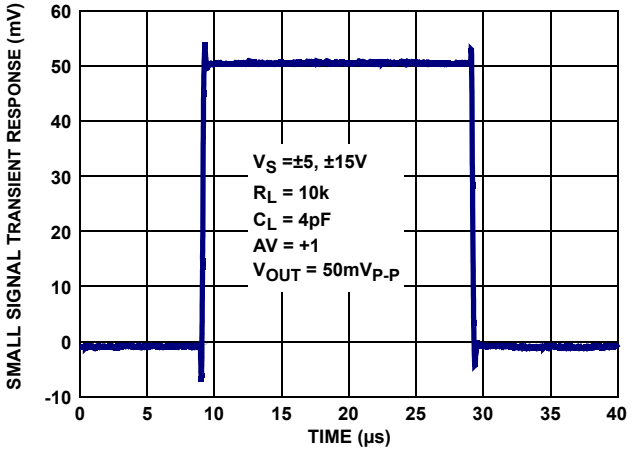


FIGURE 38. SMALL SIGNAL TRANSIENT RESPONSE, V_S = ±5V, ±15V

Typical Performance Curves

V_S = ±15V, V_{CM} = 0V, R_L = Open, T_A = +25°C, unless otherwise specified. **(Continued)**

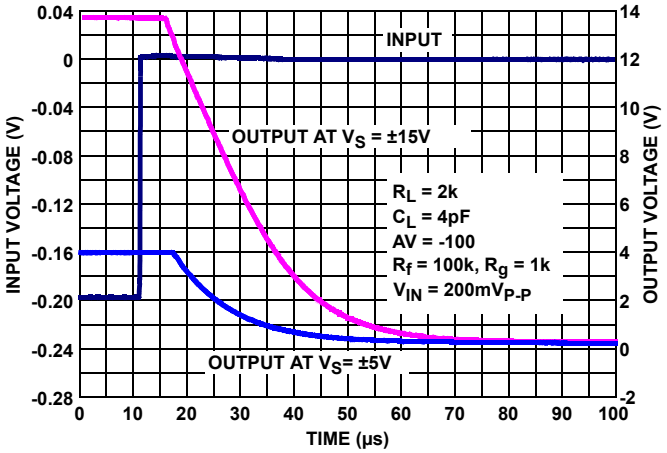


FIGURE 39. POSITIVE OUTPUT OVERLOAD RESPONSE TIME, V_S = ±5V, ±15V

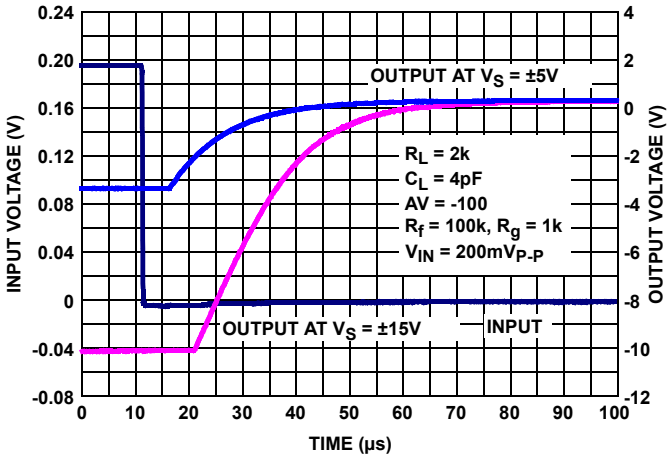


FIGURE 40. NEGATIVE OUTPUT OVERLOAD RESPONSE TIME, V_S = ±5V, ±15V

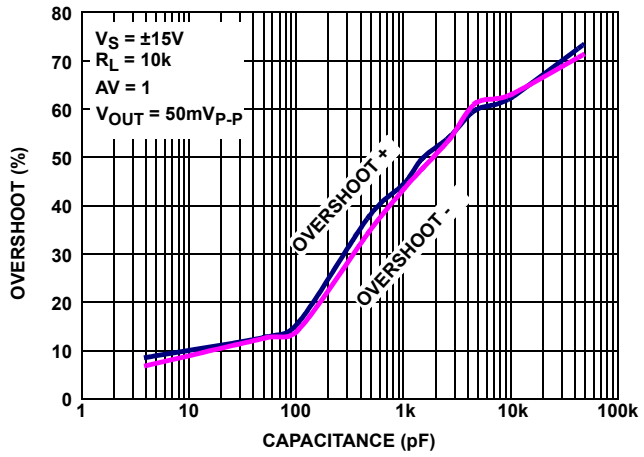


FIGURE 41. % OVERSHOOT vs LOAD CAPACITANCE, V_S = ±15V

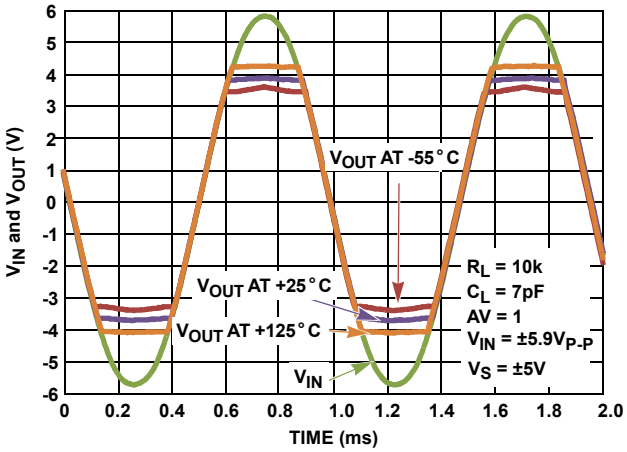


FIGURE 42. OUTPUT PHASE REVERSAL RESPONSE vs TEMPERATURE

Post High Dose Radiation Characteristics Unless otherwise specified, V_S ± 15V, V_{CM} = 0, V_O = 0V, T_A = +25°C. **This data is typical mean test data post radiation exposure at a high dose rate of 50 - 300rad(Si)/s. This data is intended to show typical parameter shifts due to high dose rate radiation. These are not limits nor are they guaranteed.**

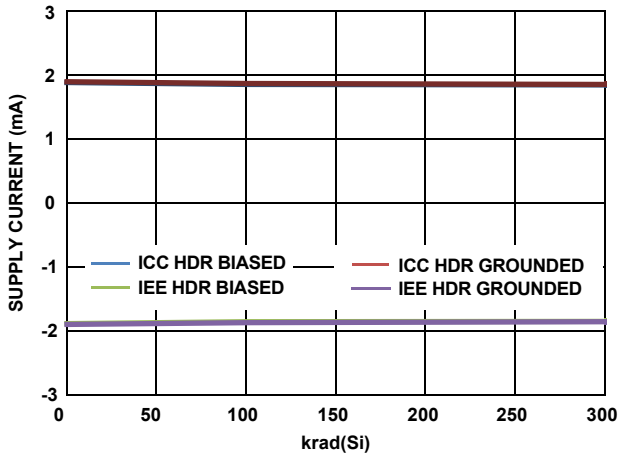


FIGURE 43. SUPPLY CURRENT vs HIGH DOSE RATE RADIATION

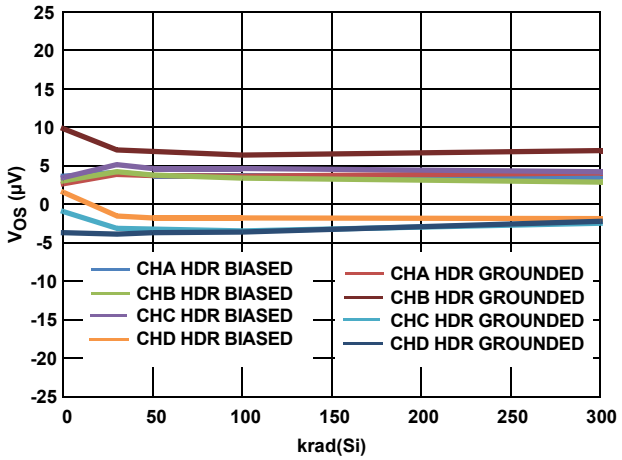


FIGURE 44. V_{OS} vs HIGH DOSE RATE RADIATION

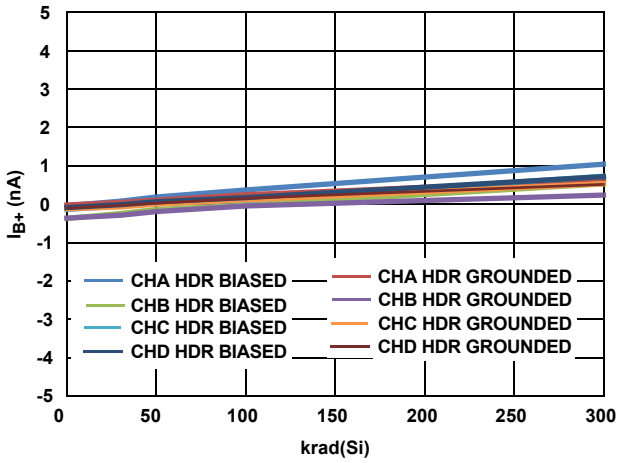


FIGURE 45. I_{B+} vs HIGH DOSE RATE RADIATION

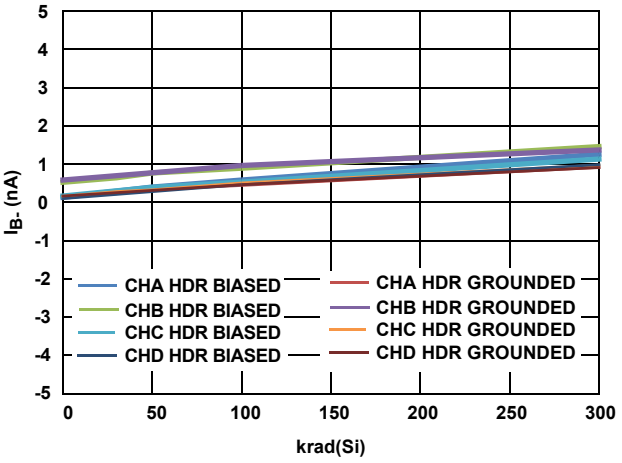


FIGURE 46. I_{B-} vs HIGH DOSE RATE RADIATION

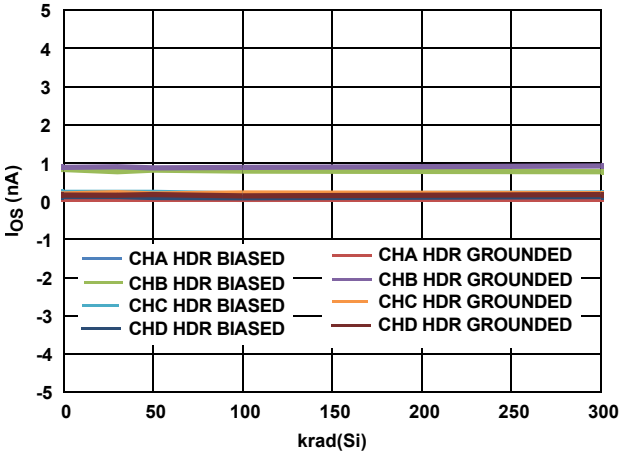


FIGURE 47. I_{OS} vs HIGH DOSE RATE RADIATION

Post Low Dose Radiation Characteristics

Unless otherwise specified, $V_S \pm 15V$, $V_{CM} = 0$, $V_O = 0V$, $T_A = +25°C$. **This data is typical mean test data post radiation exposure at a low dose rate of <10mrad(Si)/s. This data is intended to show typical parameter shifts due to low dose rate radiation. These are not limits nor are they guaranteed**

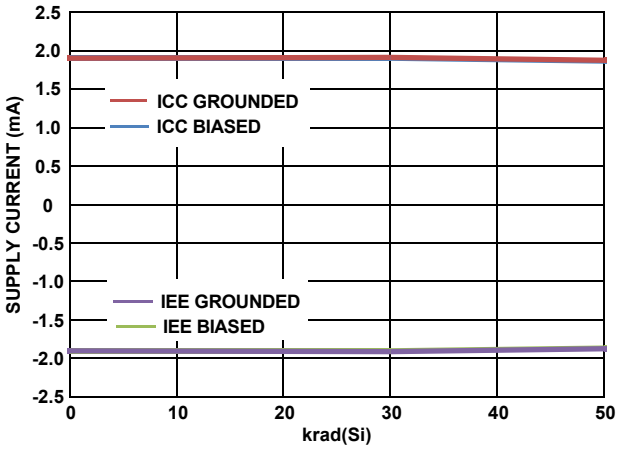


FIGURE 48. SUPPLY CURRENT vs LOW DOSE RATE RADIATION

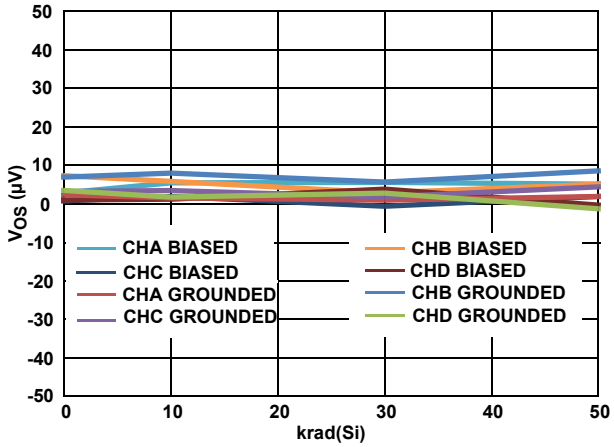


FIGURE 49. V_{OS} vs LOW DOSE RATE RADIATION

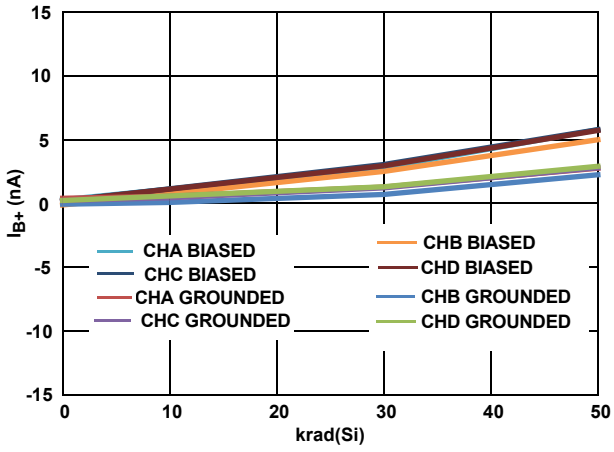


FIGURE 50. I_{B+} vs LOW DOSE RATE RADIATION

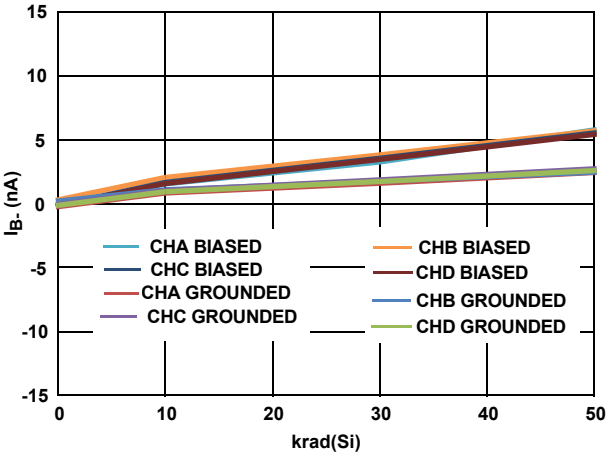


FIGURE 51. I_{B-} vs LOW DOSE RATE RADIATION

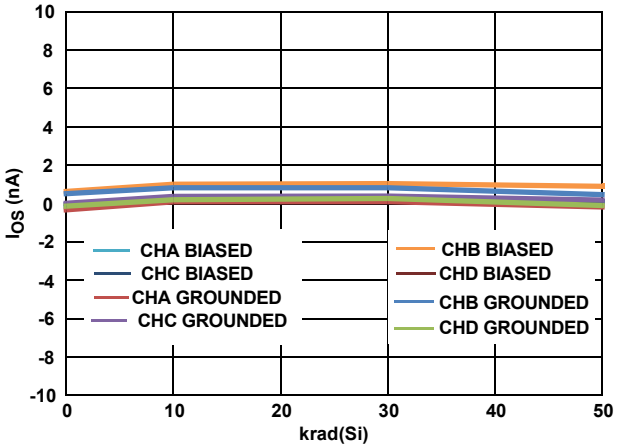


FIGURE 52. I_{OS} vs LOW DOSE RATE RADIATION

Applications Information

Functional Description

The ISL70419SEH contains four, low noise precision op amps. These devices are fabricated in a new precision 40V complementary bipolar DI process. A super-beta NPN input stage with input bias current cancellation provides low input bias current (180pA typical), low input offset voltage (13µV typical), low input noise voltage (8nV/√Hz), and low 1/f noise corner frequency (~8Hz). These amplifiers also feature high open loop gain (14kV/mV) for excellent CMRR (145dB) and THD+N performance (0.0005% at $3.5V_{RMS}$, 1kHz into 2kΩ). A complementary bipolar output stage enables high capacitive load drive without external compensation.

Operating Voltage Range

The devices are designed to operate over the 4.5V (±2.25V) to 36V (±18V) voltage range and are fully characterized at 10V (±5V) and 30V (±15V). The Power Supply Rejection Ratio typically exceeds 140dB over the full operating voltage range and 120dB minimum over the -55°C to +125°C temperature range. The worst case common mode input voltage range over-temperature is 2V to each rail. With ±15V supplies, CMRR performance is typically >130dB over-temperature. The minimum CMRR performance over the -55°C to +125°C temperature range is >120dB for power supply voltages from ±5V (10V) to ±15V (30V).

Input Performance

The super-beta NPN input pair provides excellent frequency response while maintaining high input precision. High NPN beta (>1000) reduces input bias current while maintaining good frequency response, low input bias current and low noise. Input bias cancellation circuits provide additional bias current reduction to <5nA, and excellent temperature stabilization. Figures 6 through 8 show the high degree of bias current stability at ±5V and ±15V supplies that is maintained across the -55°C to +125°C temperature range. The low bias current TC also produces very low input offset current TC, which reduces DC input offset errors in precision, high impedance amplifiers.

The +25°C maximum input offset voltage (V_{OS}) is 75µV at ±15V supplies. Input offset voltage temperature coefficients ($V_{OS}TC$) is a maximum of ±1.0µV/°C. The V_{OS} temperature behavior is smooth (Figures 3 through 4) maintaining constant TC across the entire temperature range.

Input ESD Diode Protection

The input terminals (IN+ and IN-) have internal ESD protection diodes to the positive and negative supply rails, series connected 500Ω current limiting resistors and an anti-parallel diode pair across the inputs (Figure 53).

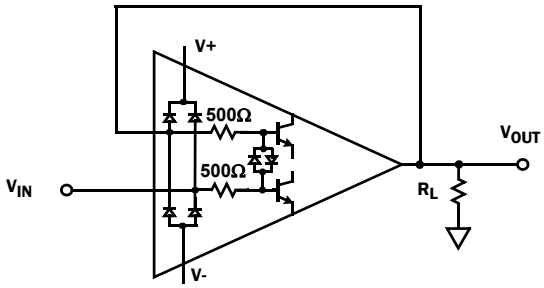


FIGURE 53. INPUT ESD DIODE CURRENT LIMITING- UNITY GAIN

The series resistors limit the high feed-through currents that can occur in pulse applications when the input dV/dT exceeds the 0.5V/µs slew rate of the amplifier. Without the series resistors, the input can forward-bias the anti-parallel diodes causing current to flow to the output resulting in severe distortion and possible diode failure.

Figure 36 provides an example of distortion free large signal response using a $4V_{P-P}$ input pulse with an input rise time of <1ns. The series resistors enable the input differential voltage to be equal to the maximum power supply voltage (36V) without damage.

In applications where one or both amplifier input terminals are at risk of exposure to high voltages beyond the power supply rails, current limiting resistors may be needed at the input terminal to limit the current through the power supply ESD diodes to 20mA max.

Output Current Limiting

The output current is internally limited to approximately ±45mA at +25°C and can withstand a short circuit to either rail as long as the power dissipation limits are not exceeded. This applies to only 1 amplifier at a time for the quad op amp. Continuous operation under these conditions may degrade long term reliability. Figures 15 and Figure 16 on page 10 show the current limit variation with temperature.

Output Phase Reversal

Output phase reversal is a change of polarity in the amplifier transfer function when the input voltage exceeds the supply voltage. The ISL70419SEH is immune to output phase reversal, even when the input voltage is 1V beyond the supplies.

Power Dissipation

It is possible to exceed the +150°C maximum junction temperatures under certain load and power supply conditions. It is therefore important to calculate the maximum junction temperature (T_{JMAX}) for all applications to determine if power supply voltages, load conditions, or package type need to be modified to remain in the safe operating area. These parameters are related using Equation 1:

$$T_{JMAX} = T_{MAX} + \theta_{JA} x PD_{MAXTOTAL} \quad \text{(EQ. 1)}$$

where:

- $P_{DMAXTOTAL}$ is the sum of the maximum power dissipation of each amplifier in the package (PD_{MAX})
- PD_{MAX} for each amplifier can be calculated using Equation 2:

$$PD_{MAX} = V_S \times I_{qMAX} + (V_S - V_{OUTMAX}) \times \frac{V_{OUTMAX}}{R_L} \quad \text{(EQ. 2)}$$

where:

- T_{MAX} = Maximum ambient temperature
- θ_{JA} = Thermal resistance of the package
- PD_{MAX} = Maximum power dissipation of 1 amplifier
- V_S = Total supply voltage
- I_{qMAX} = Maximum quiescent supply current of 1 amplifier
- V_{OUTMAX} = Maximum output voltage swing of the application

Package Characteristics

Weight of Packaged Device

0. 6043 Grams (Typical)

Lid Characteristics

Finish: Gold
Potential: Unbiased; tied to EPAD
Case Isolation to Any Lead: 20 x 10^9 Ω (min)

Die Characteristics

Die Dimensions

2406µm x 2935µm (95mils x 116mils)
Thickness: 483µm ± 25µm (19mils ± 1 mil)

Interface Materials

GLASSIVATION

Type: Nitrox
Thickness: 15kÅ

TOP METALLIZATION

Type: AlCu (99.5%/0.5%)
Thickness: 30kÅ

BACKSIDE FINISH

Silicon

PROCESS

Dielectrically Isolated Complementary Bipolar - PR40

ASSEMBLY RELATED INFORMATION

SUBSTRATE POTENTIAL

Floating

ADDITIONAL INFORMATION

WORST CASE CURRENT DENSITY

< 2 x 10^5 A/cm^2

Metallization Mask Layout

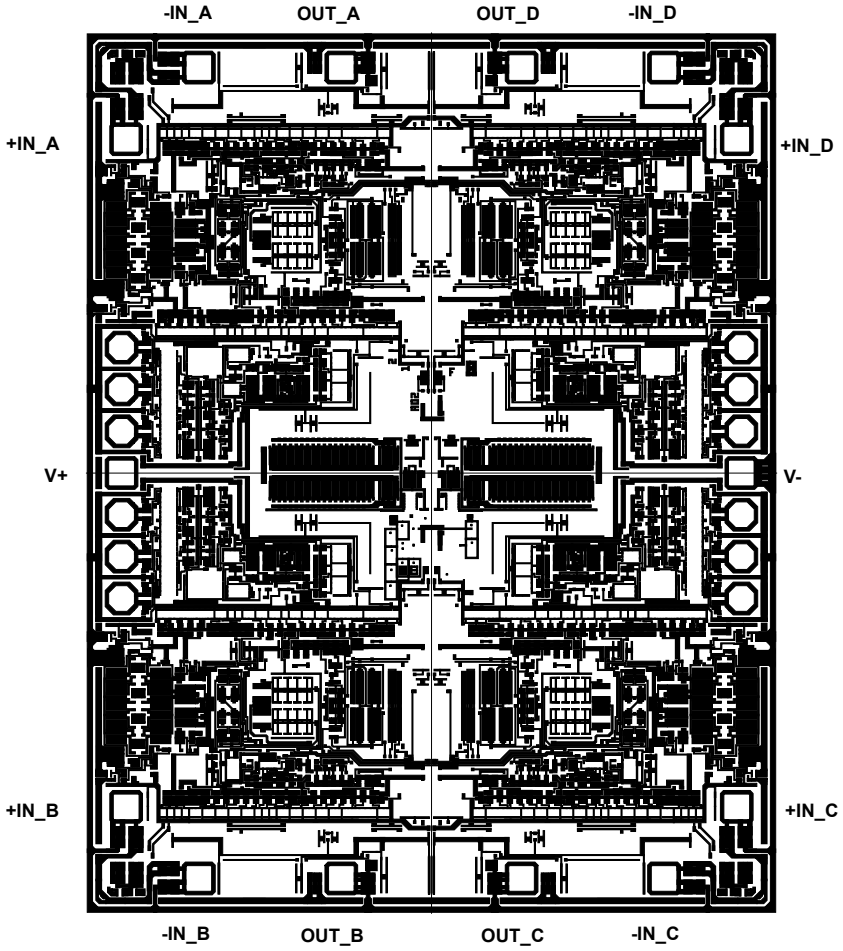


TABLE 1. DIE LAYOUT X-Y COORDINATES

PAD NAME	PAD NUMBER	X (µm)	Y (µm)	dX (µm)	dY (µm)	BOND WIRES PER PAD
OUT_A	3	-445.5	1308.5	70	70	1
-IN_A	4	-815	1308.5	70	70	1
+IN_A	5	-1040.5	1092	70	70	1
V+	9	-1044	0	70	70	1
+IN_B	13	-1040.5	-1092	70	70	1
-IN_B	14	-815	-1308.5	70	70	1
OUT_B	15	-445.5	-1308.5	70	70	1
OUT_C	16	445.5	-1308.5	70	70	1
-IN_C	17	815	-1308.5	70	70	1
+IN_C	18	1040.5	-1092	70	70	1
V-	22	1044	0	70	70	1
+IN_D	26	1040.5	1092	70	70	1
-IN_D	1	815	1308.5	70	70	1
OUT_D	2	445.5	1308.5	70	70	1

NOTE:

6. Origin of coordinates is the center of die.

Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please go to web to make sure you have the latest Revision.

DATE	REVISION	CHANGE
June 24, 2014	FN8653.0	Initial Release

About Intersil

Intersil Corporation is a leading provider of innovative power management and precision analog solutions. The company's products address some of the largest markets within the industrial and infrastructure, mobile computing and high-end consumer markets.

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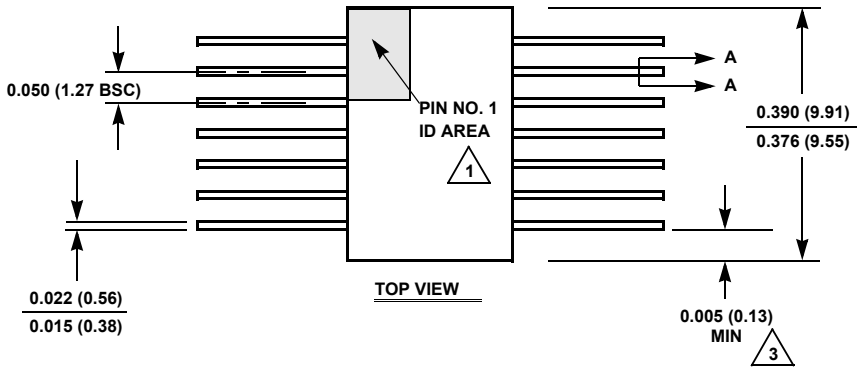
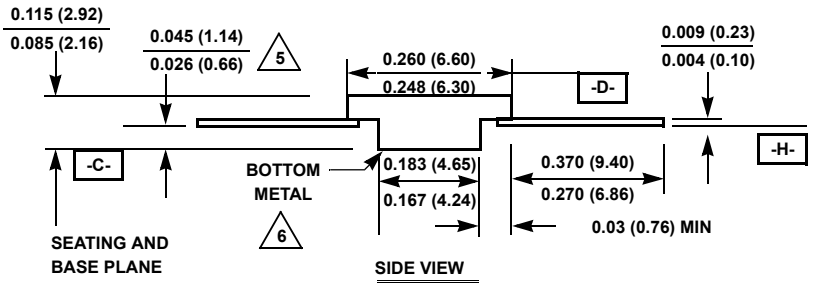
Package Outline Drawing

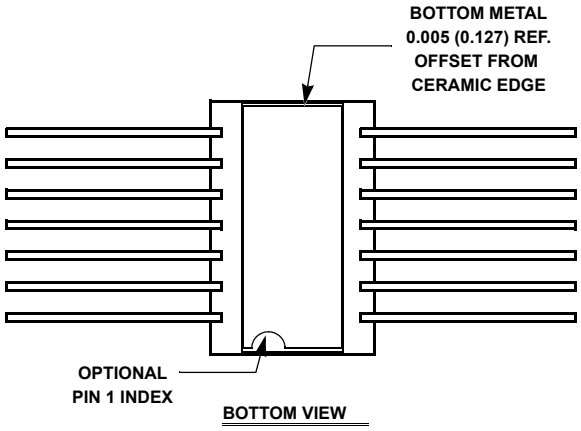
K14.C

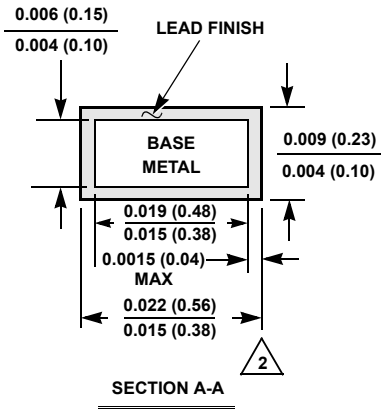
14 LEAD CERAMIC METAL SEAL FLATPACK PACKAGE

Rev 0, 9/12









NOTES:

1. Index area: A notch or a pin one identification mark shall be located adjacent to pin one and shall be located within the shaded area shown. The manufacturer's identification shall not be used as a pin one identification mark.
2. The maximum limits of lead dimensions (section A-A) shall be measured at the centroid of the finished lead surfaces, when solder dip or tin plate lead finish is applied.
3. Measure dimension at all four corners.
4. For bottom-brazed lead packages, no organic or polymeric materials shall be molded to the bottom of the package to cover the leads.
5. Dimension shall be measured at the point of exit (beyond the meniscus) of the lead from the body. Dimension minimum shall be reduced by 0.0015 inch (0.038mm) maximum when solder dip lead finish is applied.
6. The bottom of the package is a solderable metal surface.
7. Dimensioning and tolerancing per ANSI Y14.5M - 1982.
8. Dimensions: INCH (mm). Controlling dimension: INCH.