

DESCRIPTION

The RH6200 is an ultralow noise, rail-to-rail input and output unity-gain stable op amp that features 0.95nV/ $\sqrt{\text{Hz}}$ noise voltage. This amplifier combines very low noise with a 165MHz gain bandwidth, 50V/ μs slew rate and is optimized for low voltage signal conditioning systems. A shutdown pin reduces supply current during standby conditions and thermal shutdown protects the part from overload conditions. The RH6200 maintains its pre-irradiation performance for supplies from 4.5V to 12.6V and is specified pre- and post-radiation at 5V and $\pm 5\text{V}$.

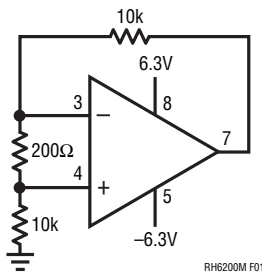
ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage (V^+ to V^-)	12.6V
Input Current (Note 2)	$\pm 40\text{mA}$
Output Short-Circuit Duration (Note 3)	Indefinite
Pin Current While Exceeding Supplies (Note 4) ...	$\pm 30\text{mA}$
Operating Junction Temperature Range	
(Note 5)	-55°C to 125°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

BURN-IN CIRCUIT



PACKAGE/ORDER INFORMATION

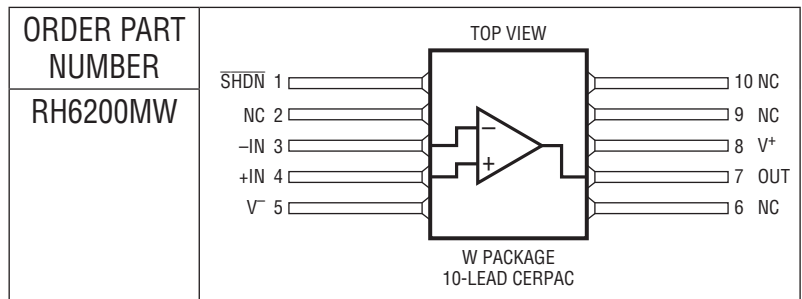


TABLE 1: ELECTRICAL CHARACTERISTICS (Preirradiation)

SYMBOL	PARAMETER	CONDITIONS	NOTES	$T_A = 25^\circ\text{C}$			SUB-GROUP	$-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$			SUB-GROUP	UNITS
				MIN	TYP	MAX		MIN	TYP	MAX		
V_{OS}	Input Offset Voltage	$V_S = 5\text{V}, 0\text{V}; V_{CM} = V^- \text{ to } V^+$		0.6	2	1		4	2,3	mV		
		$V_S = \pm 5\text{V}; V_{CM} = V^- \text{ to } V^+$		2.5	6	1		9	2,3	mV		
I_B	Input Bias Current	$V_S = 5\text{V}, 0\text{V}; V_{CM} = V^+$		8	18	1		20	2,3	μA		
		$V_S = 5\text{V}, 0\text{V}; V_{CM} = V^-$	-50	-23	1	-100	2,3	μA				
		$V_S = \pm 5\text{V}; V_{CM} = V^+$		8	18	1	20	2,3	μA			
		$V_S = \pm 5\text{V}; V_{CM} = V^-$	-50	-23	1	-200	2,3	μA				
I_{OS}	Input Offset Current	$V_S = 5\text{V}, 0\text{V}; V_{CM} = V^+$		0.02	4	1		5	2,3	μA		
		$V_S = 5\text{V}, 0\text{V}; V_{CM} = V^-$		0.4	5	1	25	2,3	μA			
		$V_S = \pm 5\text{V}; V_{CM} = V^+$		1	7	1	12	2,3	μA			
		$V_S = \pm 5\text{V}; V_{CM} = V^-$		3	12	1	50	2,3	μA			

TABLE 1: ELECTRICAL CHARACTERISTICS (Preirradiation)

SYMBOL	PARAMETER	CONDITIONS	NOTES	T _A = 25°C			SUB-GROUP	-55°C ≤ T _A ≤ 125°C			SUB-GROUP	UNITS
				MIN	TYP	MAX		MIN	TYP	MAX		
	Input Noise Voltage	0.1Hz to 10Hz	6		600							nV _{p-p}
e _n	Input Noise Voltage Density	V _S = 5V, 0V; f = 100kHz	6		1.1							nV/√Hz
		V _S = 5V, 0V; f = 10kHz			1.5	2.4						nV/√Hz
		V _S = ±5V; f = 100kHz	6		0.95							nV/√Hz
		V _S = ±5V; f = 10kHz			1.4	2.3						nV/√Hz
i _n	Input Noise Current Density	f = 10kHz Balanced Source	6		2.2							pA/√Hz
		f = 10kHz Unbalanced Source	6		3.5							pA/√Hz
A _{VOL}	Large Signal Open-Loop Voltage Gain	V _S = 5V, 0V; R _L = 1k; V _{OUT} = 0.5V to 4.5V		70	120		4	35		5,6		V/mV
		V _S = 5V, 0V; R _L = 100Ω; V _{OUT} = 1V to 4V		11	18		4					V/mV
		V _S = 5V, 0V; R _L = 100Ω; V _{OUT} = 1.5V to 3.5V						5.5		5,6		V/mV
		V _S = ±5V; R _L = 1k; V _{OUT} = ±4.5V		115	200		4	40		5,6		V/mV
CMRR	Common Mode Rejection Ratio	V _S = 5V, 0V; V _{CM} = 0V to 5V		65	90		1	58		2,3		dB
		V _S = 5V, 0V; V _{CM} = 1.5V to 3.5V		85	112		1	76		2,3		dB
		V _S = ±5V; V _{CM} = ±5V		68	96		1	63		2,3		dB
		V _S = ±5V; V _{CM} = ±2V		75	100		1	72		2,3		dB
PSRR	Power Supply Rejection Ratio	V _S = ±2.25V to ±5V		60	68		1	58		2,3		dB
V _{OL}	Output Voltage Swing Low	V _S = 5V, 0V; I _L = 0			9	50		4		100	5,6	mV
		V _S = 5V, 0V; I _L = 5mA			50	100		4		150	5,6	mV
		V _S = 5V, 0V; I _L = 20mA			150	290		4		350	5,6	mV
		V _S = ±5V; I _L = 0			12	50		4		100	5,6	mV
		V _S = ±5V; I _L = 5mA			55	110		4		150	5,6	mV
		V _S = ±5V; I _L = 20mA			150	290		4		350	5,6	mV
V _{OH}	Output Voltage Swing High	V _S = 5V, 0V; I _L = 0			55	110		4		150	5,6	mV
		V _S = 5V, 0V; I _L = 5mA			95	190		4		250	5,6	mV
		V _S = 5V, 0V; I _L = 20mA			220	400		4		500	5,6	mV
		V _S = ±5V; I _L = 0			70	130		4		200	5,6	mV
		V _S = ±5V; I _L = 5mA			110	210		4		275	5,6	mV
		V _S = ±5V; I _L = 20mA			225	420		4		550	5,6	mV
I _{SC}	Short-Circuit Current	V _S = 5V, 0V or V _S = ±5V		±60	±90		1	±45		2,3		mA
I _S	Supply Current	V _S = 5V, 0V			16.5	20		1		30	2,3	mA
		V _S = ±5V			20	23		1		35	2,3	mA
I _{S(SHDN)}	Shutdown Supply Current	V _S = 5V, 0V			1.3	1.8		1		2.2	2,3	mA
		V _S = ±5V			1.6	2.1		1		2.5	2,3	mA
I _{SHDN}	Shutdown Pin Current	V _S = 5V, 0V or V _S = ±5V; V _{SHDN} = 0.3V		-280	-200		1	-300		2,3		μA
t _{ON}	Turn-On Time	SHDN from Low to High	6		180							ns
t _{OFF}	Turn-Off Time	SHDN from High to Low	6		180							ns
GBW	Gain Bandwidth Product	V _S = 5V, 0V; at f = 1MHz	6		145							MHz
		V _S = ±5V; at f = 1MHz			110	165						MHz
SR	Slew Rate	V _S = 5V, 0V; A _V = -1; R _L = 1k; V _O = 4V		31	44		4					V/μs
		V _S = ±5V; A _V = -1; R _L = 1k; V _O = 4V		35	50		4					V/μs

TABLE 1A: ELECTRICAL CHARACTERISTICS (Postirradiation) $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	10KRAD(Si)		20KRAD(Si)		50KRAD(Si)		100KRAD(Si)		200KRAD(Si)		UNITS
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	
V_{OS}	Input Offset Voltage	$V_S = 5V, 0V; V_{CM} = V^- \text{ to } V^+$ $V_S = \pm 5V; V_{CM} = V^- \text{ to } V^+$		2.2		2.4		2.6		2.8		3	mV
				6.5		7		7.5		8		8.5	mV
I_B	Input Bias Current	$V_S = 5V, 0V; V_{CM} = V^+$ $V_S = 5V, 0V; V_{CM} = V^-$ $V_S = \pm 5V; V_{CM} = V^+$ $V_S = \pm 5V; V_{CM} = V^-$		20		22		24		26		28	μA
			-55		-60		-65		-70		-75		μA
				20		22		24		26		28	μA
			-55		-60		-65		-70		-75		μA
I_{OS}	Input Offset Current	$V_S = 5V, 0V; V_{CM} = V^+$ $V_S = 5V, 0V; V_{CM} = V^-$ $V_S = \pm 5V; V_{CM} = V^+$ $V_S = \pm 5V; V_{CM} = V^-$		5		6		7		8		9	μA
				6		7		8		9		10	μA
				8		9		10		11		12	μA
				13		14		15		16		17	μA
A_{VOL}	Large Signal Open Loop Voltage Gain	$V_S = 5V, 0V; R_L = 1k; V_{OUT} = 0.5V \text{ to } 4.5V$ $V_S = 5V, 0V; R_L = 100\Omega; V_{OUT} = 1V \text{ to } 4V$ $V_S = \pm 5V; R_L = 1k; V_{OUT} = \pm 4.5V$ $V_S = \pm 5V; R_L = 100\Omega; V_{OUT} = \pm 2V$	65		60		55		50		45		V/mV
			10		9		8		7		6		V/mV
			110		100		90		80		70		V/mV
			13.5		12		10.5		9		7.5		V/mV
CMRR	Common Mode Rejection Ratio	$V_S = 5V, 0V; V_{CM} = 0V \text{ to } 5V$ $V_S = 5V, 0V; V_{CM} = 1.5V \text{ to } 3.5V$ $V_S = \pm 5V; V_{CM} = \pm 5V$ $V_S = \pm 5V; V_{CM} = \pm 2V$	64		63		62		61		60		dB
			84		83		82		81		80		dB
			67		66		65		64		63		dB
			74		73		72		71		70		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2.25V \text{ to } \pm 5V$	59		58		57		56		55		dB
V_{OL}	Output Voltage Swing Low	$V_S = 5V, 0V; I_L = 0$ $V_S = 5V, 0V; I_L = 5mA$ $V_S = 5V, 0V; I_L = 20mA$ $V_S = \pm 5V; I_L = 0$ $V_S = \pm 5V; I_L = 5mA$ $V_S = \pm 5V; I_L = 20mA$	52		54		56		58		60		mV
			104		108		112		116		120		mV
			296		302		308		314		320		mV
			52		54		56		58		60		mV
			114		118		122		126		130		mV
			296		302		308		314		320		mV
V_{OH}	Output Voltage Swing High	$V_S = 5V, 0V; I_L = 0$ $V_S = 5V, 0V; I_L = 5mA$ $V_S = 5V, 0V; I_L = 20mA$ $V_S = \pm 5V; I_L = 0$ $V_S = \pm 5V; I_L = 5mA$ $V_S = \pm 5V; I_L = 20mA$	114		118		122		126		130		mV
			198		206		214		222		230		mV
			415		430		445		460		475		mV
			134		138		142		146		150		mV
			218		226		234		242		250		mV
			430		455		470		485		500		mV
I_{SC}	Short-Circuit Current	$V_S = 5V, 0V \text{ or } V_S = \pm 5V$	58		56		54		52		50		mA
I_S	Supply Current	$V_S = 5V, 0V$ $V_S = \pm 5V$	20.4		20.8		21.2		21.6		22		mA
			23.4		23.8		24.2		24.6		25		mA
$I_{S(SHDN)}$	Shutdown Supply Current	$V_S = 5V, 0V$ $V_S = \pm 5V$	1.84		1.88		1.92		1.96		2		mA
			2.14		2.18		2.22		2.26		2.3		mA
I_{SHDN}	Shutdown Pin Current	$V_S = 5V, 0V \text{ or } V_S = \pm 5V; V_{SHDN} = 0.3V$	-284		-288		-292		-296		-300		μA

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: Inputs are protected by back-to-back diodes. If the differential input voltage exceeds 0.7V, the input current must be limited to less than 40mA.

Note 3: A heat sink may be required to keep the junction temperature below the absolute maximum rating when the output is shorted indefinitely.

Note 4: There are reverse-biased ESD diodes from all inputs and outputs to the respective supply pins. If these pins are forced beyond either supply, unlimited current will flow through these diodes. If the current is transient in nature and limited to less than 30mA, no damage to the device will occur.

Note 5: The RH6200 is tested under pulse load conditions such that $T_J \approx T_A$. The thermal resistance of the W 10-lead CERPAC package (without heat sink) is estimated at 170°C/W. For a given application, multiply the RMS power dissipation of the RH6200 times the package thermal resistance (including any heat sinking if present) to calculate the temperature difference between the ambient temperature and the junction temperature. The RH6200 has a thermal shutdown feature that protects the part from excessive junction temperature. The amplifier will shut down to an inactive, low current condition when the junction temperature exceeds approximately 160°C. The amplifier will remain shut down until the die cools off to below approximately 150°C, at which point the amplifier will return to normal operation.

Note 6: This parameter is not production tested. Typical bench evaluation performance listed for information only.

TABLE 2: ELECTRICAL TEST REQUIREMENTS

MIL-STD-883 TEST REQUIREMENTS	SUBGROUP
Final Electrical Test Requirements (Method 5004)	1*, 2, 3, 4, 5, 6
Group A Test Requirements (Method 5005)	1*, 2, 3, 4, 5, 6
Group B and D for Class S, End Point Electrical Parameters (Method 5005)	1, 2, 3

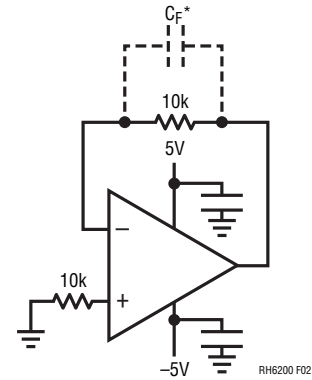
*PDA applies to subgroup 1. See PDA Test Notes.

PDA Test Notes

The PDA is specified as 5% based on failures from group A, subgroup 1, tests after cooldown as the final electrical test in accordance with method 5004 of MIL-STD-883. The verified failures of group A, subgroup 1, after burn-in divided by the total number of devices submitted for burn-in in that lot shall be used to determine the percent for the lot.

Linear Technology Corporation reserves the right to test to tighter limits than those given.

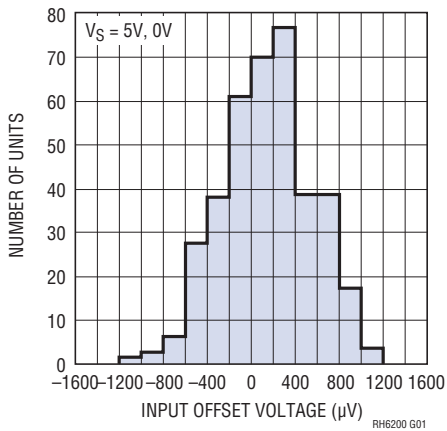
TOTAL DOSE BIAS CIRCUIT



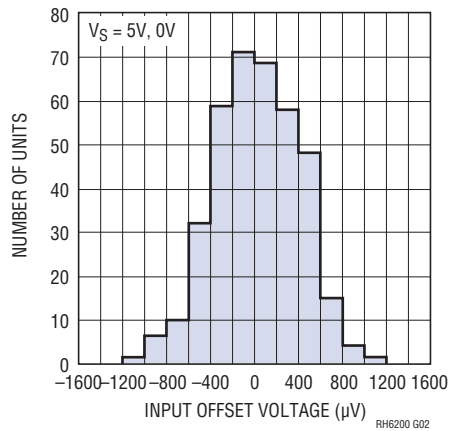
*C_F IS COMPONENT OR PARASITIC CAPACITANCE ENSURING STABILITY

TYPICAL PERFORMANCE CHARACTERISTICS

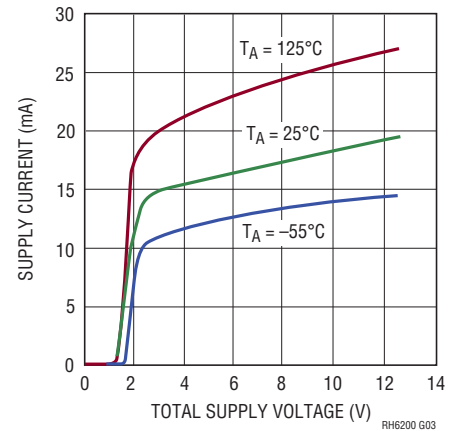
V_{OS} Distribution, V_{CM} = V⁺



V_{OS} Distribution, V_{CM} = V⁻

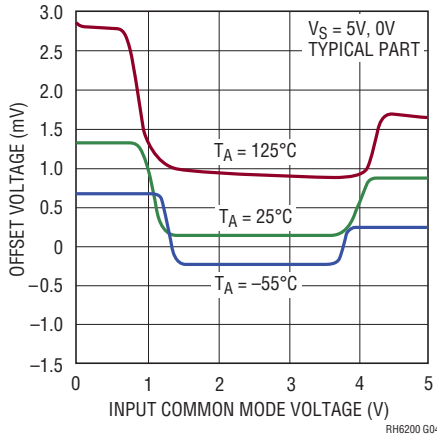


Supply Current vs Supply Voltage



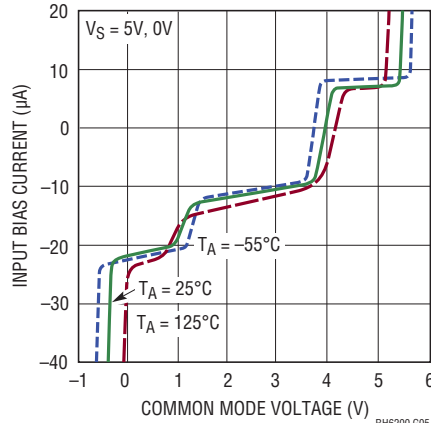
TYPICAL PERFORMANCE CHARACTERISTICS

Offset Voltage vs Input Common Mode Voltage



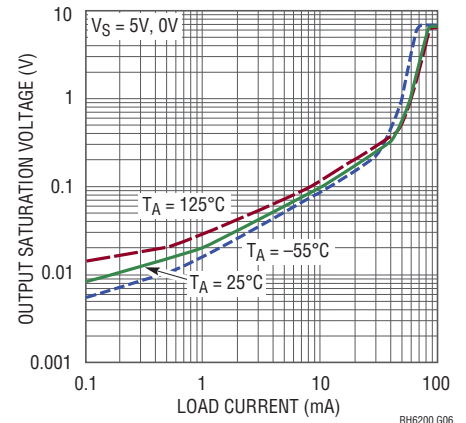
RH6200 G04

Input Bias Current vs Common Mode Voltage



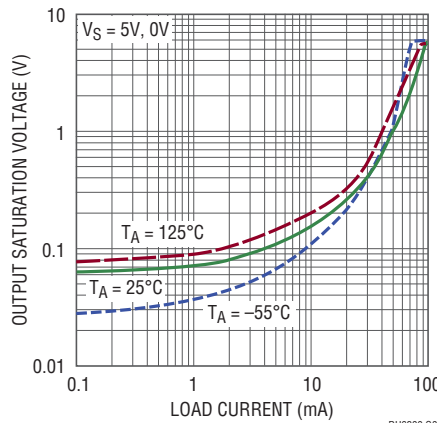
RH6200 G05

Output Saturation Voltage vs Load Current (Output Low)



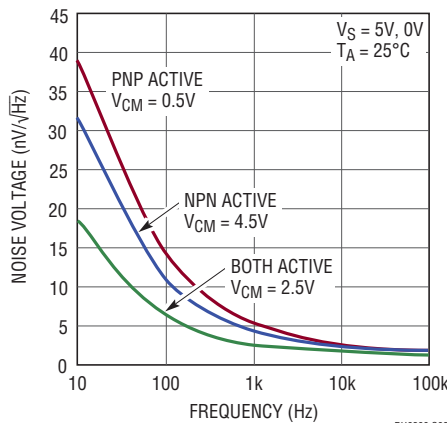
RH6200 G06

Output Saturation Voltage vs Load Current (Output High)



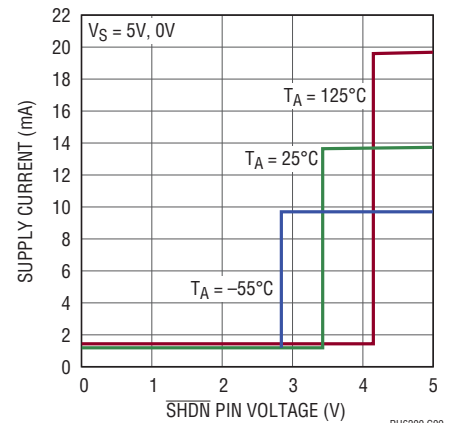
RH6200 G07

Input Noise Voltage vs Frequency



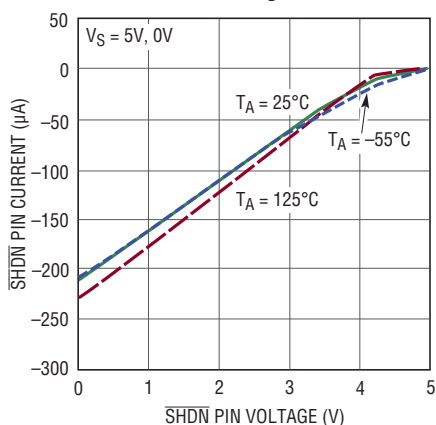
RH6200 G08

Supply Current vs SHDN Pin Voltage



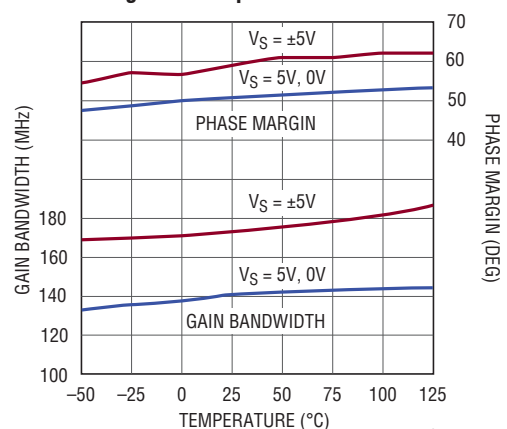
RH6200 G09

SHDN Pin Current vs SHDN Pin Voltage



RH6200 G10

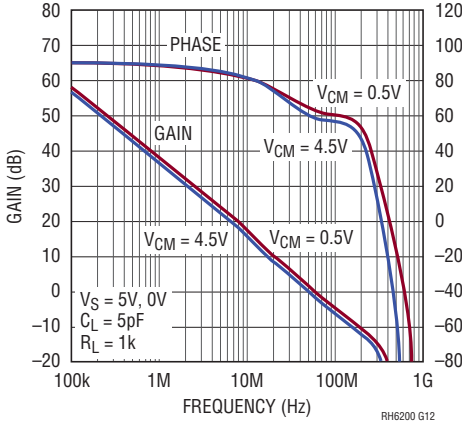
Gain Bandwidth and Phase Margin vs Temperature



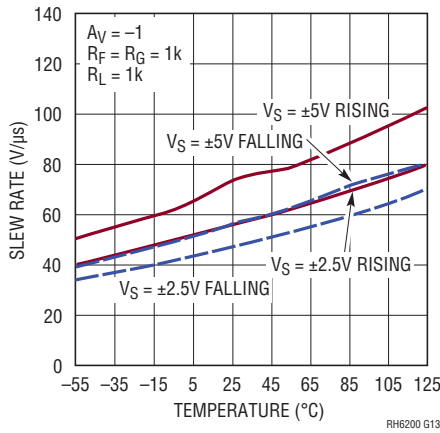
RH6200 G11

TYPICAL PERFORMANCE CHARACTERISTICS

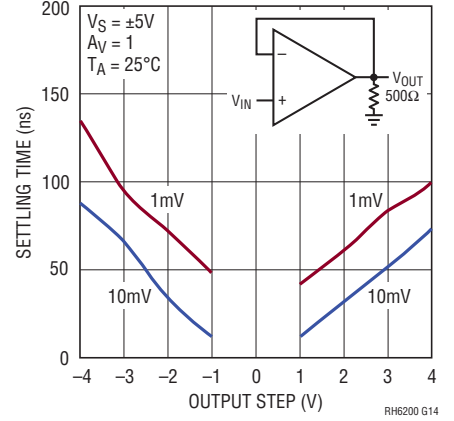
Open-Loop Gain vs Frequency



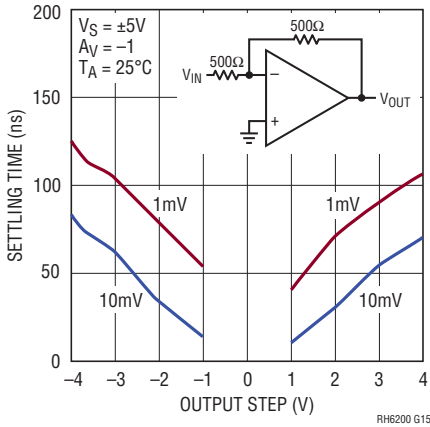
Slew Rate vs Temperature



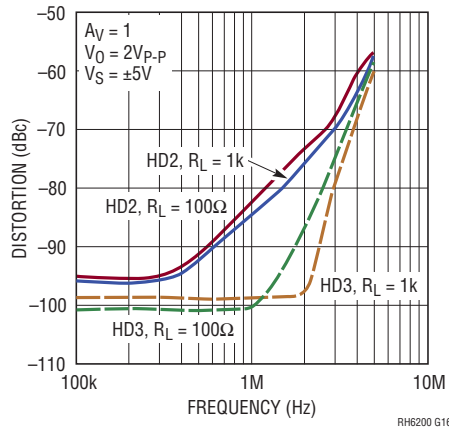
Settling Time vs Output Step (Noninverting)



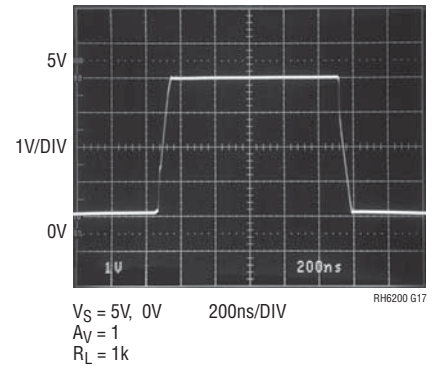
Settling Time vs Output Step (Inverting)



Distortion vs Frequency, $A_V = 1$

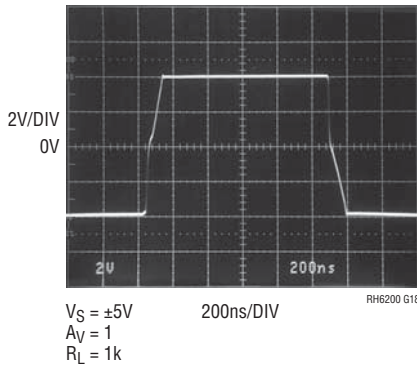


5V Large-Signal Response

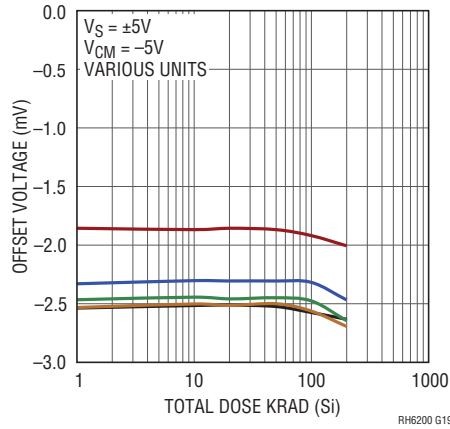


TYPICAL PERFORMANCE CHARACTERISTICS

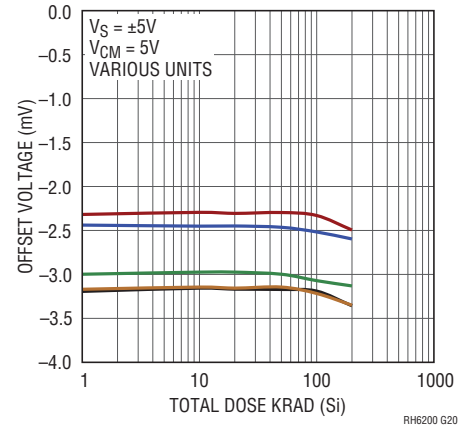
±5V Large-Signal Response



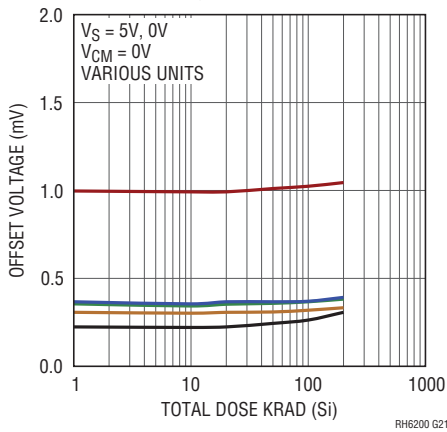
Offset Voltage



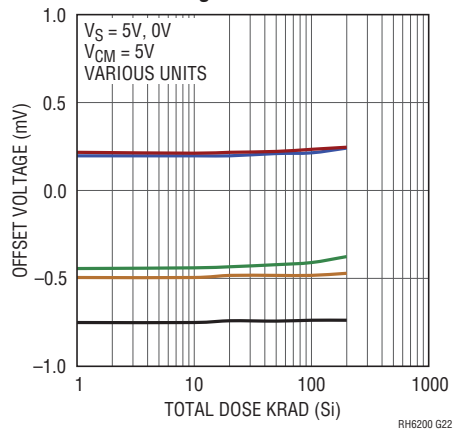
Offset Voltage



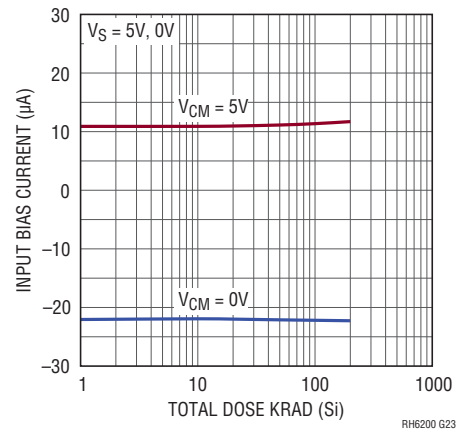
Offset Voltage



Offset Voltage

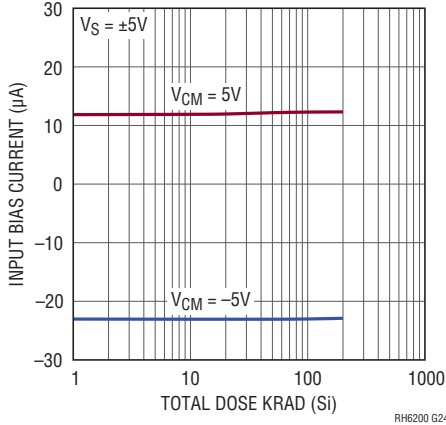


Input Bias Current

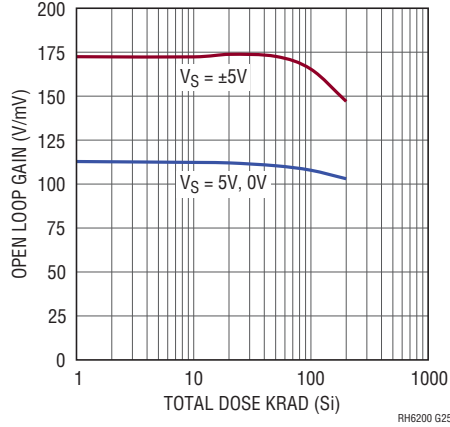


TYPICAL PERFORMANCE CHARACTERISTICS

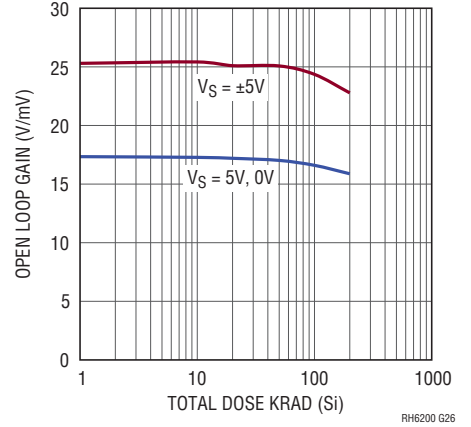
Input Bias Current



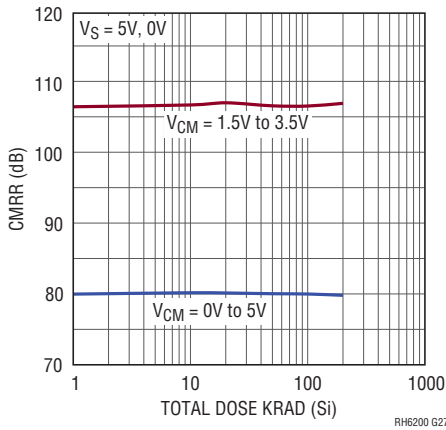
Open-Loop Voltage Gain, $R_L = 1k$



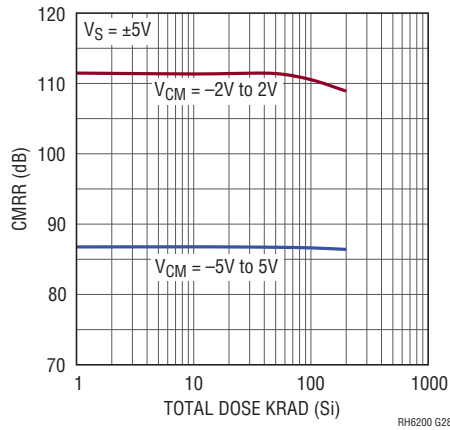
Open-Loop Voltage Gain, $R_L = 100\Omega$



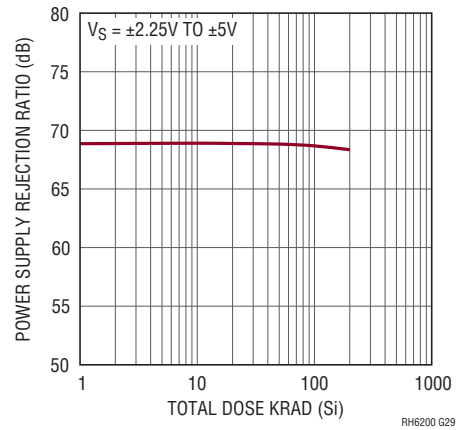
Common Mode Rejection Ratio



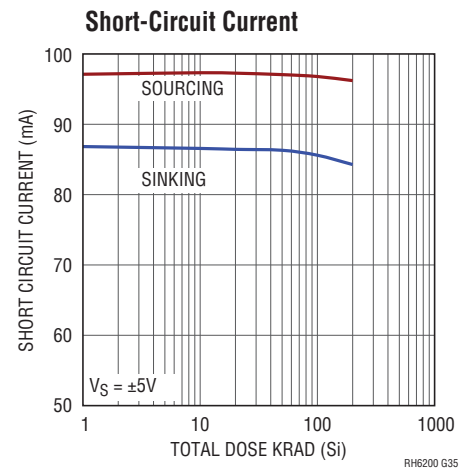
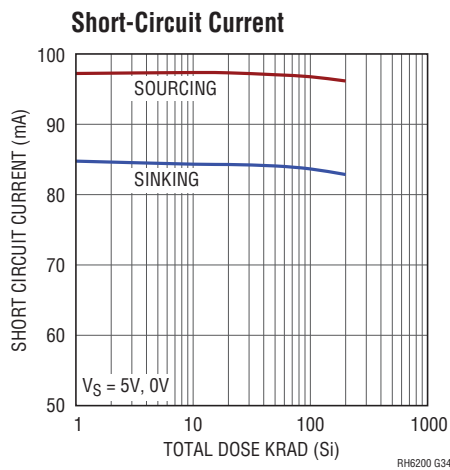
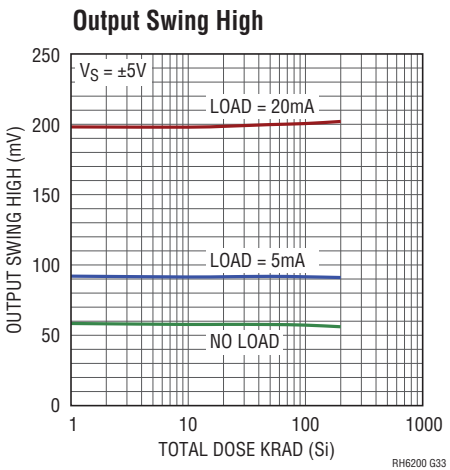
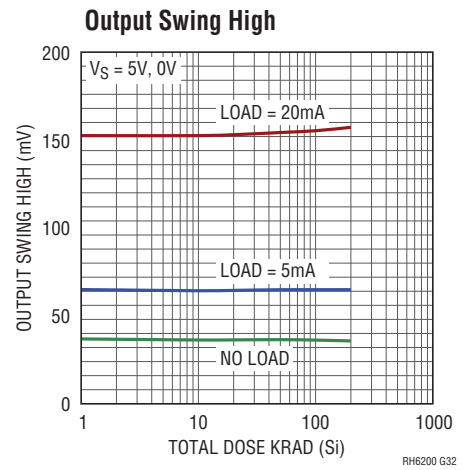
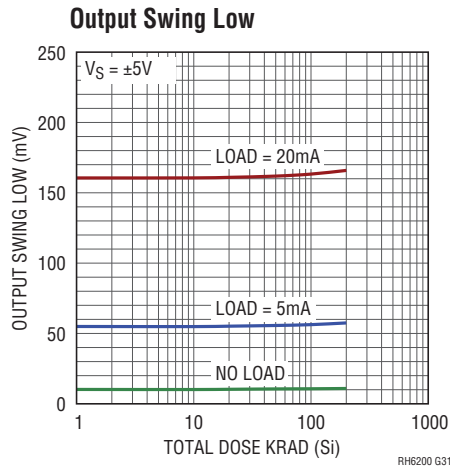
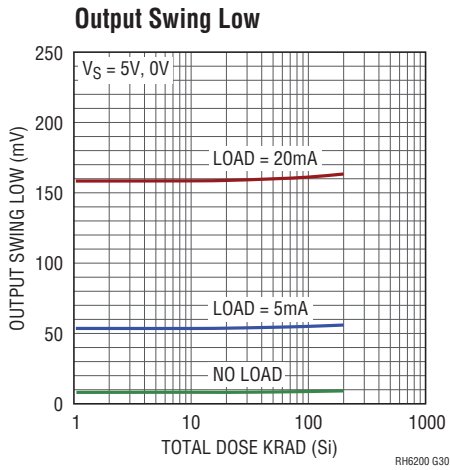
Common Mode Rejection Ratio



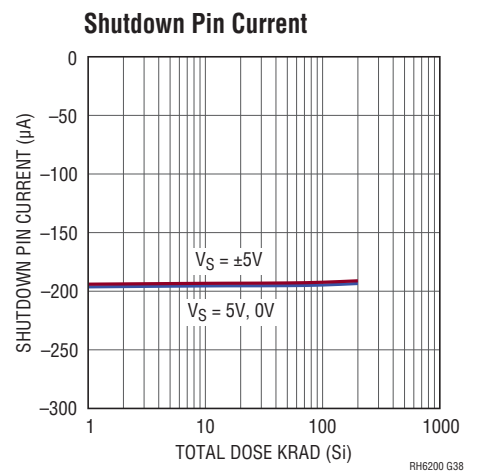
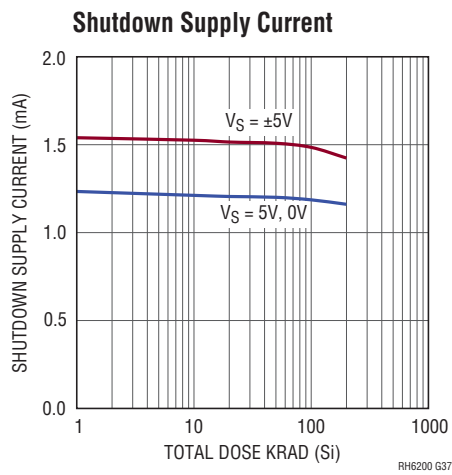
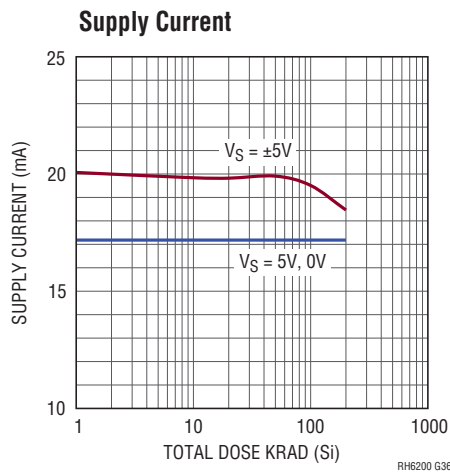
Power Supply Rejection Ratio



TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS



REVISION HISTORY

REV	DATE	DESCRIPTION	PAGE NUMBER
A	11/11	Revised Conditions for A_{VOL} in Table 1: Electrical Characteristics	2