RH6200M

Low Noise, High Speed Rail-to-Rail Op Amp

DESCRIPTION

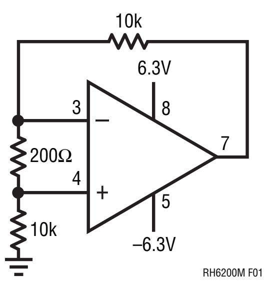
The RH6200 is an ultralow noise, rail-to-rail input and output unity-gain stable op amp that features $0.95nV/\sqrt{Hz}$ noise voltage. This amplifier combines very low noise with a 165MHz gain bandwidth, 50V/µs slew rate and is optimized for low voltage signal conditioning systems. A shutdown pin reduces 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 ±5V.

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage (V^+ to V^-) 12.6V
Input Current (Note 2) .... ±40mA
Output Short-Circuit Duration (Note 3) .... Indefinite
Pin Current While Exceeding Supplies (Note 4) ...±30mA
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

BURN-IN CIRCUIT



PACKAGE/ORDER INFORMATION

ORDER PART NUMBER
RH6200MW

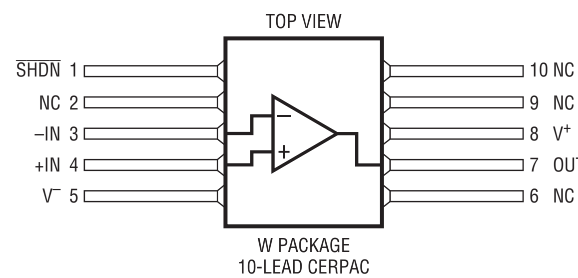


TABLE 1: ELECTRICAL CHARACTERISTICS (Preirradiation)

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

TABLE 1: ELECTRICAL CHARACTERISTICS (Preirradiation)

				T_A = 25°C			SUB-	–55°C ≤ T_A ≤ 125°C			SUB-	
SYMBOL	PARAMETER	CONDITIONS	NOTES	MIN	TYP	MAX	GROUP	MIN	TYP	MAX	GROUP	UNITS
	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
		V_S = ±5V; R_L = 100Ω; V_{OUT} = ±2V		15	26		4	7			5,6	
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	$\overline{SHDN}$ from Low to High	6		180							ns
t_{OFF}	Turn-On Time	$\overline{SHDN}$ 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) $T_A = 25°C$

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

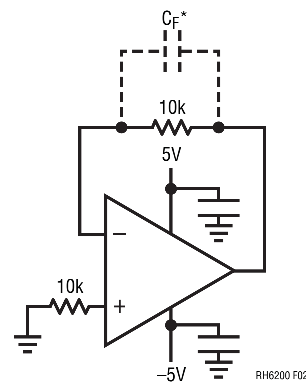
*PDA applies to subgroup 1. See PDA Test Notes.

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.

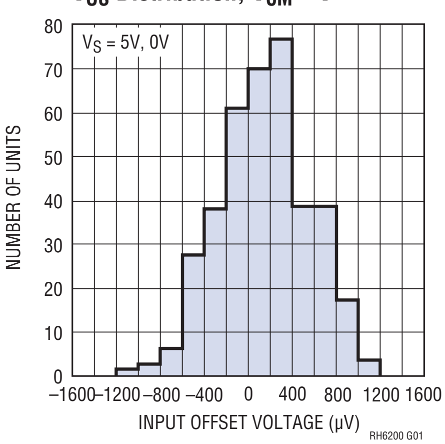
TOTAL DOSE BIAS CIRCUIT



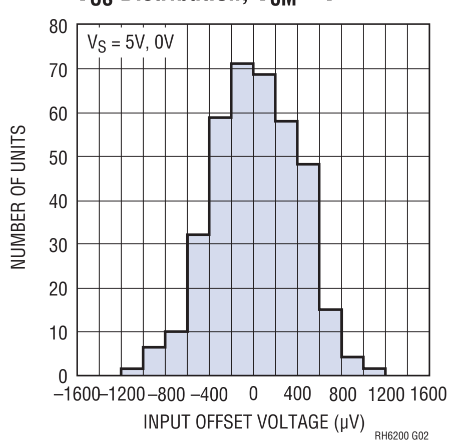
*C_F IS COMPONENT OR PARASITIC CAPACITANCE ENSURING STABILITY

TYPICAL PERFORMANCE CHARACTERISTICS

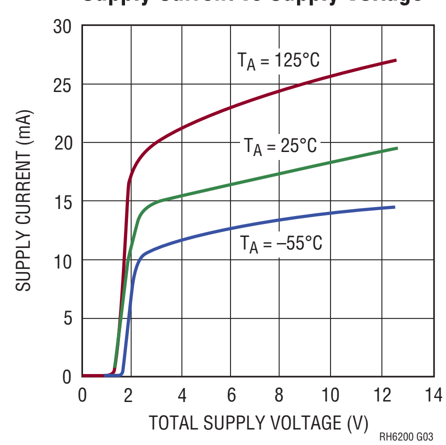
V_{OS} Distribution, $V_{CM} = V^+$



V_{OS} Distribution, $V_{CM} = V^-$

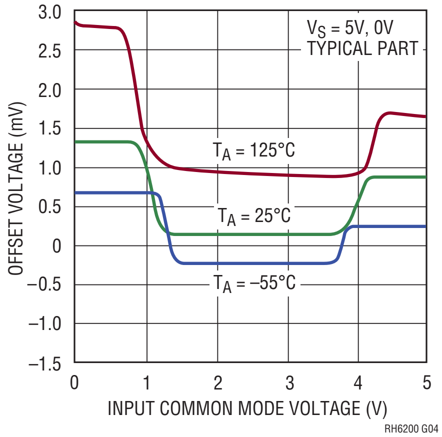


Supply Current vs Supply Voltage

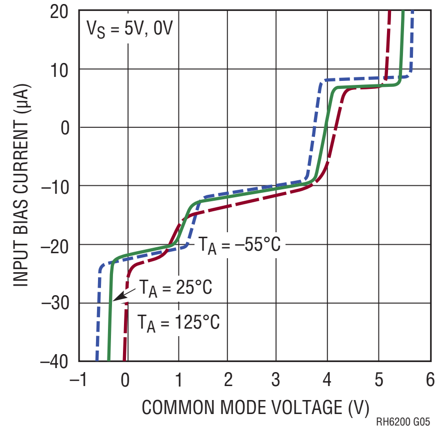


TYPICAL PERFORMANCE CHARACTERISTICS

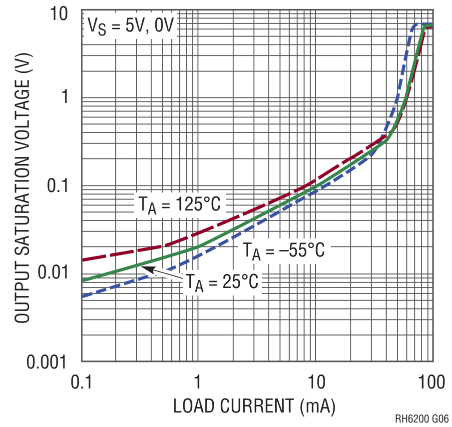
Offset Voltage vs Input Common Mode Voltage



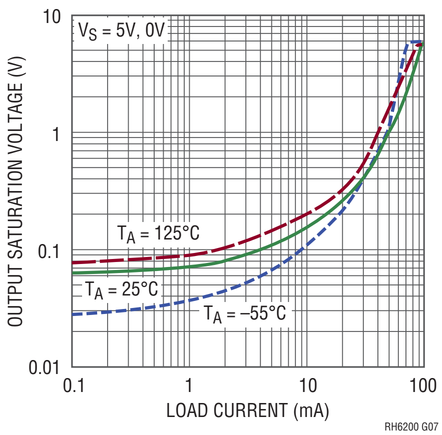
Input Bias Current vs Common Mode Voltage



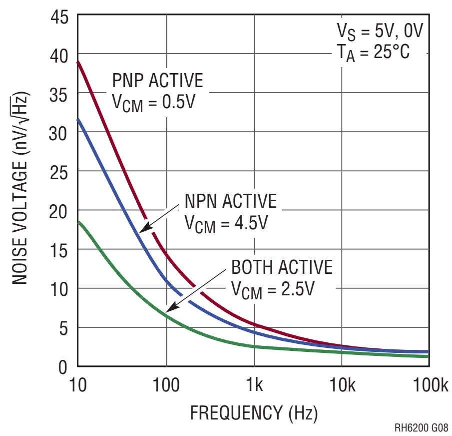
Output Saturation Voltage vs Load Current (Output Low)



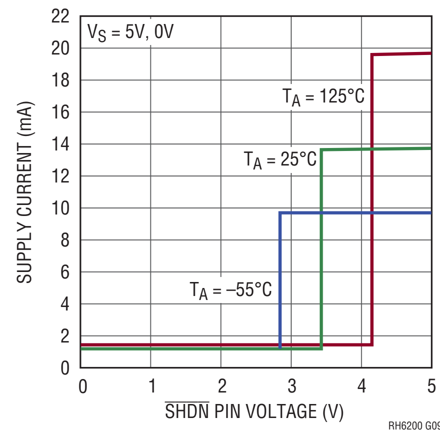
Output Saturation Voltage vs Load Current (Output High)



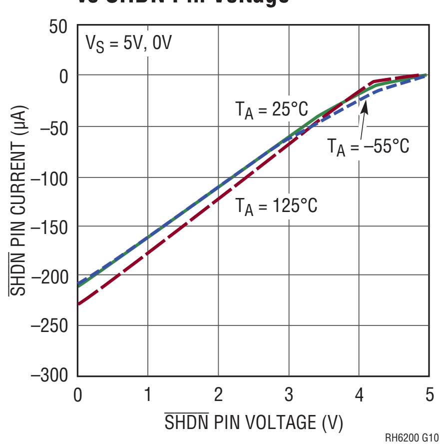
Input Noise Voltage vs Frequency



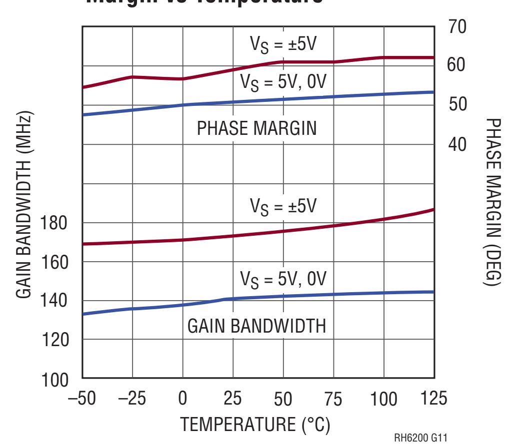
Supply Current vs $\overline{\text{SHDN}}$ Pin Voltage



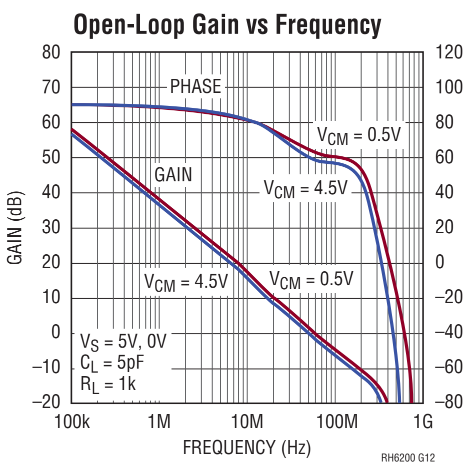
$\overline{\text{SHDN}}$ Pin Current vs $\overline{\text{SHDN}}$ Pin Voltage

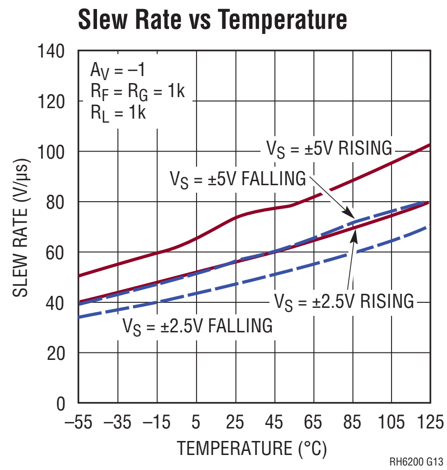


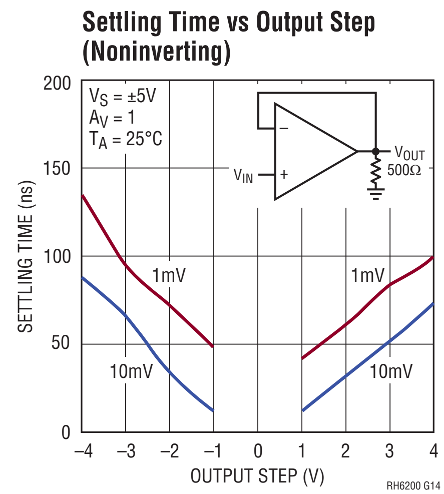
Gain Bandwidth and Phase Margin vs Temperature

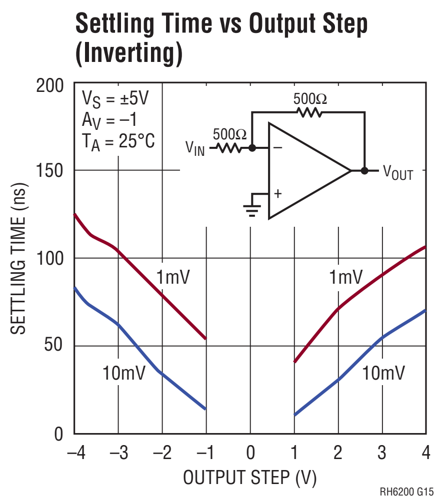


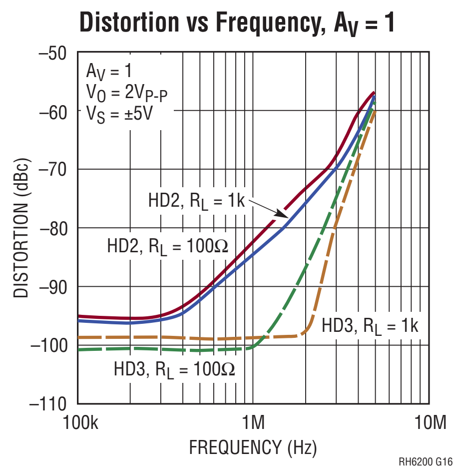
TYPICAL PERFORMANCE CHARACTERISTICS

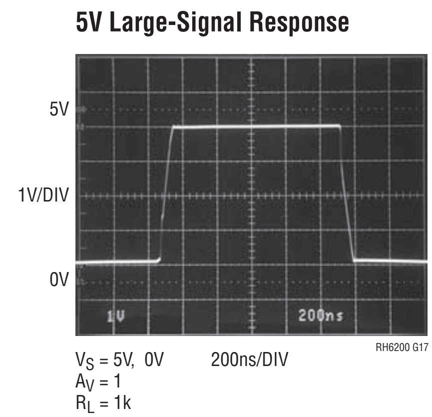






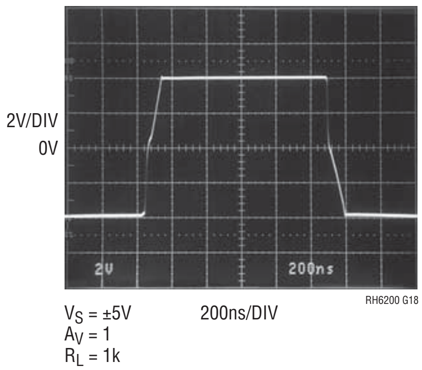




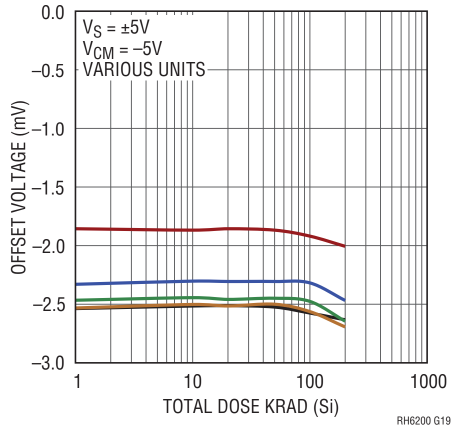


TYPICAL PERFORMANCE CHARACTERISTICS

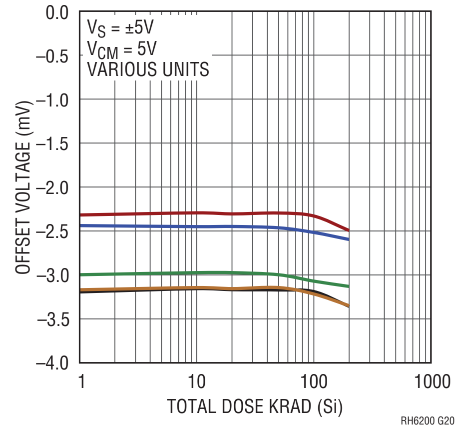
±5V Large-Signal Response



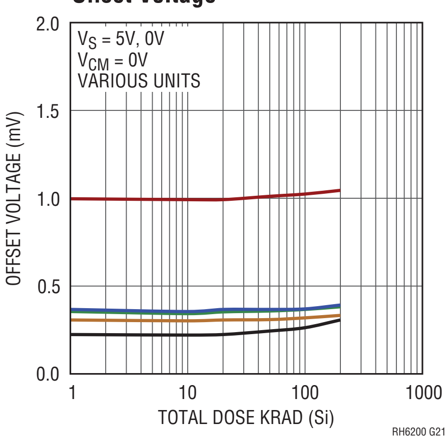
Offset Voltage



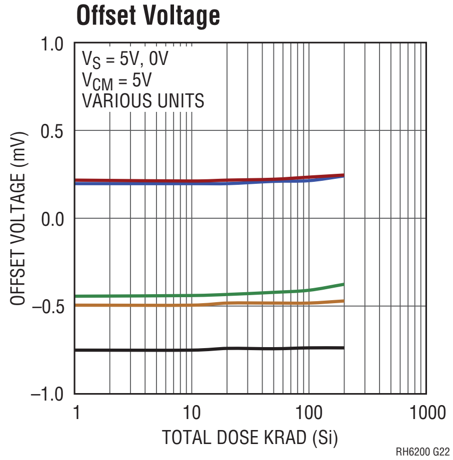
Offset Voltage



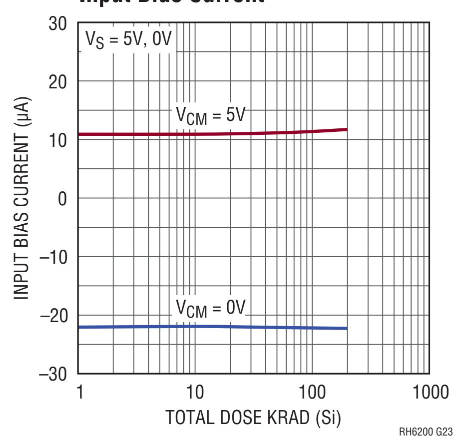
Offset Voltage



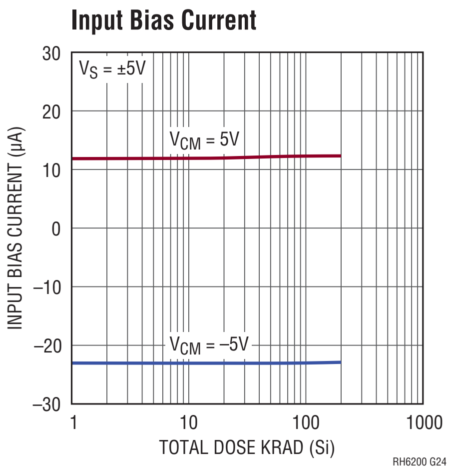
Offset Voltage

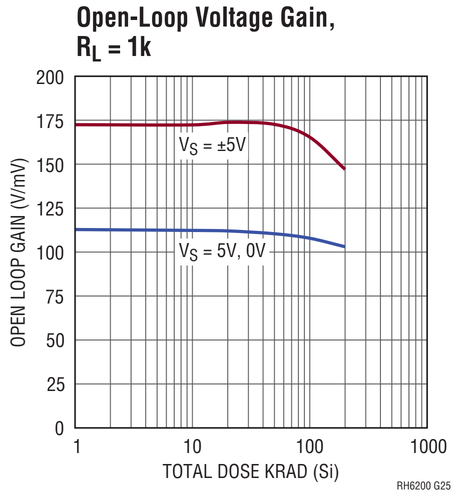


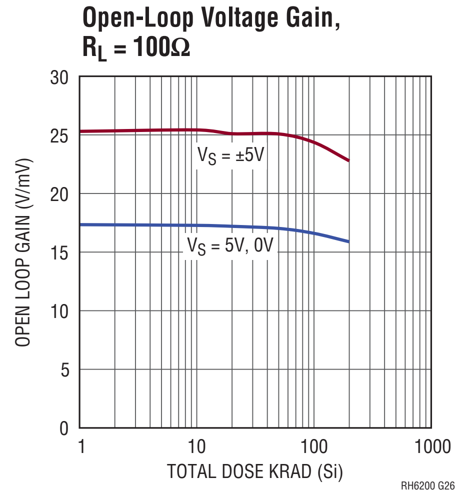
Input Bias Current

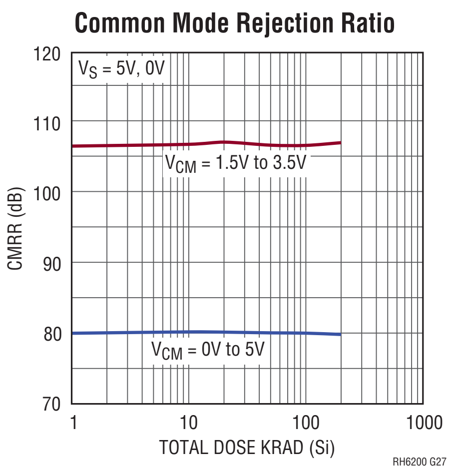


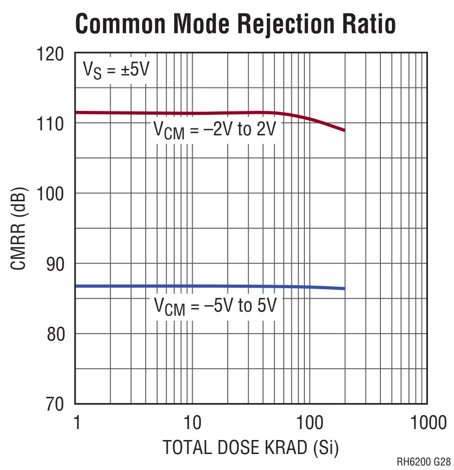
TYPICAL PERFORMANCE CHARACTERISTICS

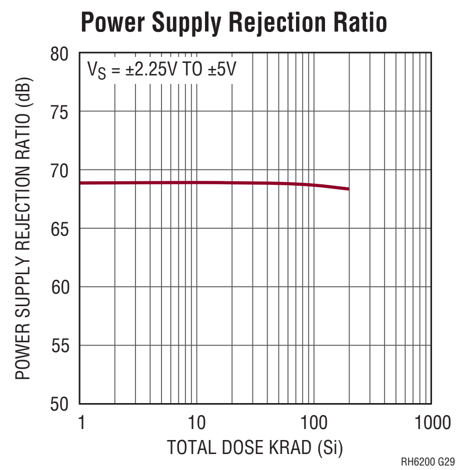




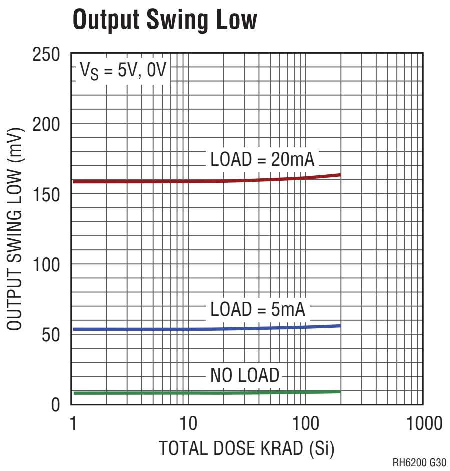


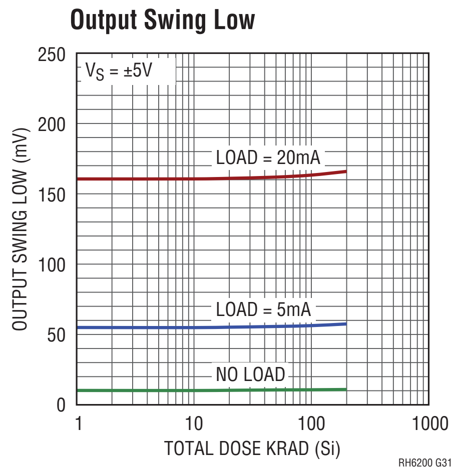


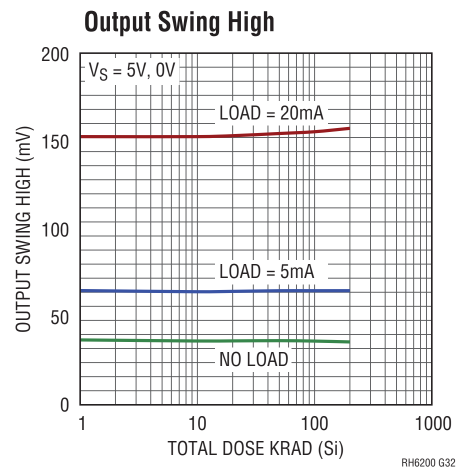


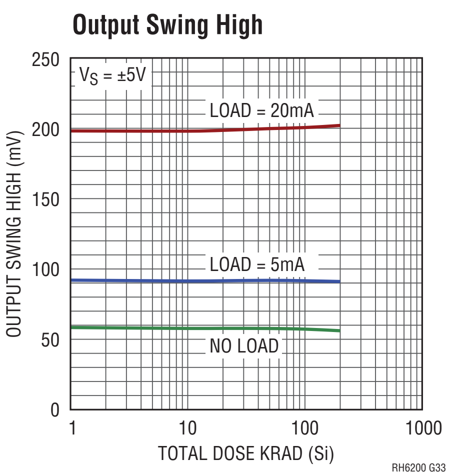


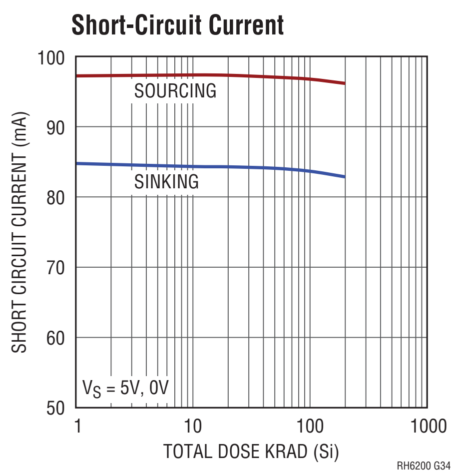
TYPICAL PERFORMANCE CHARACTERISTICS

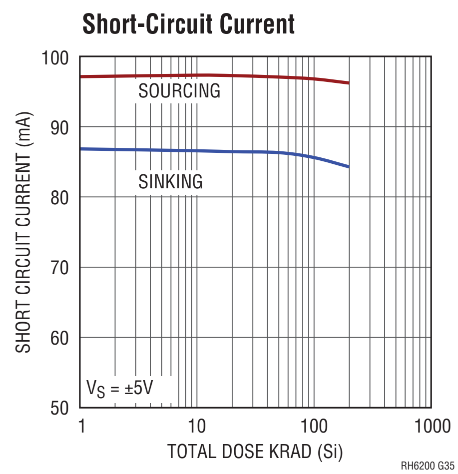






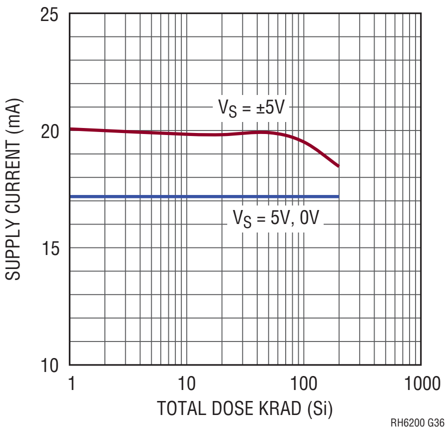




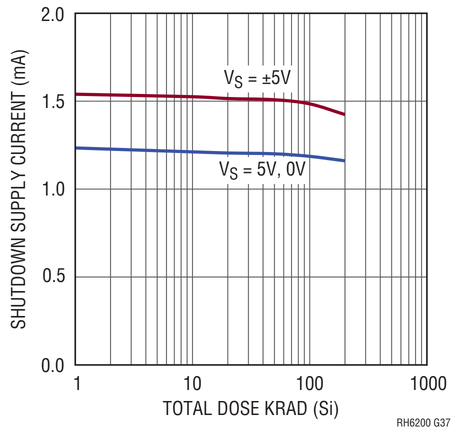


TYPICAL PERFORMANCE CHARACTERISTICS

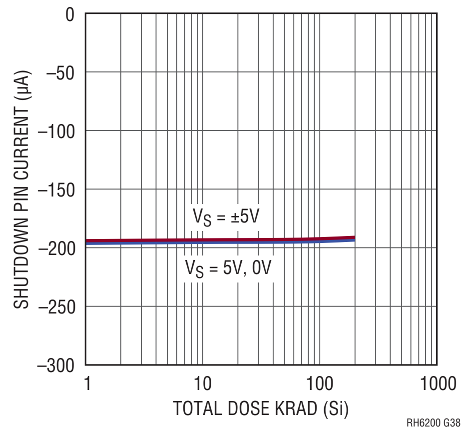
Supply Current



Shutdown Supply Current



Shutdown Pin Current



REVISION HISTORY

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

I.D. No. 66-10-1028 0807
rh6200mfa

Linear Technology Corporation
1630 McCarthy Blvd., Milpitas, CA 95035-7417
(408) 432-1900 ● FAX: (408) 434-0507 ● www.linear.com

LT 1111 REV A • PRINTED IN USA