Programmable Supply Current, Rail-to-Rail Output, Current Feedback Amplifier

August 2003

FEATURES

- **Programmable Supply Current and Bandwidth:** 10MHz at 300μA up to 200MHz at 6mA
- **High Slew Rate:** 700V/μs
- **High Output Drive:** ±75mA Minimum Output Current
- **Rail-to-Rail Output:** 0.05V to 2.85V on 3V Single Supply
- **Low Distortion:**
  –70dB HD2 at 1MHz $2V_{P-P}$
  –75dB HD3 at 1MHz $2V_{P-P}$
- **Fast Settling:** 20ns 0.1% Settling for 2V Step
- **Excellent Video Performance Into 150Ω Load:** Differential Gain of 0.20%, Differential Phase of 0.10°
- **Wide Supply Range:**
  3V to 12V Single Supply
  ±1.5V to ±6V Dual Supplies
- **Large Input Voltage Range:** ±3.8V on ±5V Dual Supplies
- **Small Size:** Low Profile (1mm) 6-Lead ThinSOT™ Package

DESCRIPTION

The LT®6210 is a current feedback amplifier with externally programmable supply current and bandwidth ranging from 10MHz at 300μA to 200MHz at 6mA. It features a low distortion rail-to-rail output stage, 700V/μs slew rate and a minimum output current drive of 75mA.

The LT6210 operates on supplies as low as a single 3V and up to either 12V or ±6V. The I_{SET} pin allows for the optimization of quiescent current for specific bandwidth, distortion or slew rate requirements. Regardless of supply voltage, the supply current is programmable from just 300μA to 6mA with an external resistor or current source.

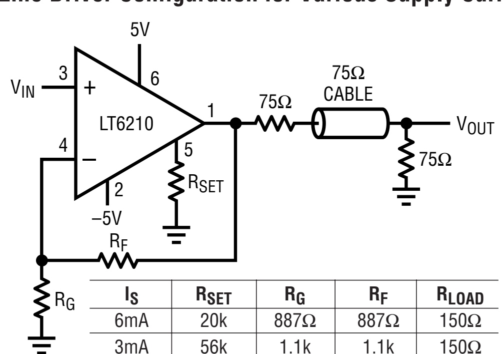
The LT6210 is manufactured on Linear Technology's proprietary low voltage complementary bipolar process and is available in the low profile (1mm) 6-lead ThinSOT package.

APPLICATIONS

- Buffers
- Video Amplifers
- Cable Drivers
- Mobile Communication
- Low Power/Battery Applications

TYPICAL APPLICATION

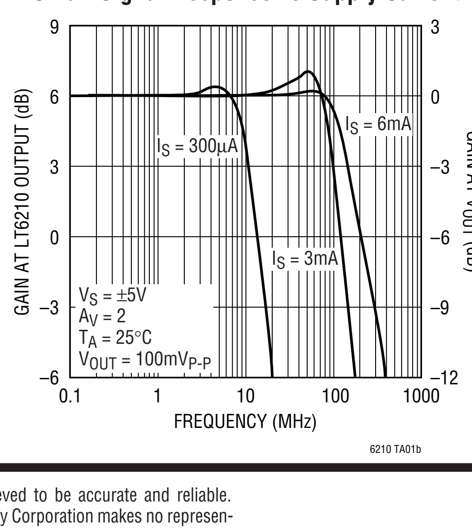
Line Driver Configuration for Various Supply Currents



I_S	R_{SET}	R_G	R_F	R_{LOAD}
6mA	20k	887Ω	887Ω	150Ω
3mA	56k	1.1k	1.1k	150Ω
300μA	1M	11k	11k	1k

6210 TA01

Small Signal Response vs Supply Current



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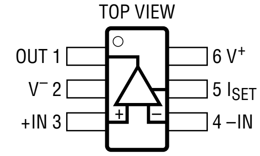
ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage (V^+ to V^-) 13.2V
Input Current .... ±10mA
Output Current .... ±80mA
Output Short-Circuit Duration (Note 2) .... Indefinite
Operating Temperature Range (Note 3) ... –40°C to 85°C
Specified Temperature Range (Note 4) .... –40°C to 85°C
Junction Temperature (Note 5) .... 150°C
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PACKAGE/ORDER INFORMATION



S6 PACKAGE
6-LEAD PLASTIC SOT-23

T_{JMAX} = 150°C, θ_{JA} = 230°C/W (NOTE 5)

ORDER PART NUMBER
LT6210CS6 LT6210IS6
S6 PART MARKING*
LTA3

*The temperature grades are identified by a label on the shipping container. Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS (I_S = 6mA)

The ● denotes specifications which apply over the specified operating temperature range, otherwise specifications are at T_A = 25°C. For V^+ = 5V, V^- = –5V: R_{SET} = 20k to ground, A_V = +2, $R_F = R_G$ = 887Ω, R_L = 150Ω; For V^+ = 3V, V^- = 0V: R_{SET} = 0Ω to V^-, A_V = +2, $R_F = R_G$ = 887Ω to 1.5V, R_L = 150Ω to 1.5V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		V_{CC} = 5V, V_{EE} = –5V, I_S = 6mA MIN	TYP	MAX	V_{CC} = 3V, V_{EE} = 0V, I_S = 6mA MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage		 ●		–1	±5.5 ±8		–1	±4.5 ±6.5	mV mV
$I_{IN}+$	Noninverting Input Current		 ●		–3.5	±7 ±9		–3	±6.5 ±8	µA µA
$I_{IN}–$	Inverting Input Current		 ●		–13.5	±30 ±45		2.5	±25 ±40	µA µA
e_n	Input Noise Voltage Density	f = 1kHz, R_F = 1k, R_G = 10Ω, R_S = 0Ω			6.5					nV/√Hz
$+i_n$	Input Noise Current Density	f = 1kHz			4.5					pA/√Hz
$-i_n$	Input Noise Current Density	f = 1kHz			25					pA/√Hz
$R_{IN}+$	Noninverting Input Resistance	V_{IN} = V^+ – 1.2V to V^- + 1.2V	●	0.5	2		0.3	1.7		MΩ
$C_{IN}+$	Noninverting Input Capacitance	f = 100kHz			2			2		pF
V_{INH}	Input Voltage Range, High	(Note 10)	●	3.8	4.2		1.8	2.2		V
V_{INL}	Input Voltage Range, Low	(Note 10)	●		–4.2	–3.8		0.8	1.2	V
V_{OUTH}	Output Voltage Swing, High	R_L = 1k, 50mV Overdrive R_L = 150Ω, 50mV Overdrive R_L = 150Ω, 50mV Overdrive	 ●	 4.4 4.2	4.8 4.6		 2.65 2.6	2.85 2.75		V V V
V_{OUTL}	Output Voltage Swing, Low	R_L = 1k, 50mV Overdrive R_L = 150Ω, 50mV Overdrive R_L = 150Ω, 50mV Overdrive	 ●		–4.95 –4.8	 –4.55 –4.4		0.05 0.1	 0.3 0.35	V V V
CMRR	Common Mode Rejection Ratio	V_{IN} = ±3.8V	 ●	47 44	50					dB dB
$-I_{CMRR}$	Inverting Input Current Common Mode Rejection	V_{IN} = ±3.8V V_{IN} = ±3.8V	 ●		0.15	±1.5 ±2				µA/V µA/V
PSRR	Power Supply Rejection Ratio	V_S = ±1.5V to ±6V (Note 6)	●	60	85		60	85		dB
$-I_{PSRR}$	Inverting Input Current Power Supply Rejection	V_S = ±1.5V to ±6V (Note 6)	 ●		2	±7 ±8				µA/V µA/V
I_S	Supply Current	V_{OUT} = 0V V_{OUT} = 0V	 ●		6	8.5 10		5.8	8.3 9	mA mA

ELECTRICAL CHARACTERISTICS (I_S = 6mA)

The ● denotes specifications which apply over the specified operating temperature range, otherwise specifications are at T_A = 25°C. For V^+ = 5V, V^- = –5V: R_{SET} = 20k to ground, A_V = +2, R_F = R_G = 887Ω, R_L = 150Ω; For V^+ = 3V, V^- = 0V: R_{SET} = 0Ω to V^-, A_V = +2, R_F = R_G = 887Ω to 1.5V, R_L = 150Ω to 1.5V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		V_{CC} = 5V, V_{EE} = –5V, I_S = 6mA MIN	TYP	MAX	V_{CC} = 3V, V_{EE} = 0V, I_S = 6mA MIN	TYP	MAX	UNITS
I_{OUT}	Maximum Output Current	R_L = 0Ω, 50mV Overdrive (Note 7)	●	±75			±45			mA
R_{OL}	Transimpedance, $\Delta V_{OUT}/\Delta I_{IN}-$	V_{OUT} = V^+ – 1.2V to V^- + 1.2V		65	115		65	115		kΩ
SR	Slew Rate	(Note 8)		500	700					V/µs
t_{pd}	Propagation Delay	50% V_{IN} to 50% V_{OUT}, 100mV_{P-P}, Larger of $t_{pd}+$, $t_{pd}-$			1.5			2.4		ns
BW	–3dB Bandwidth	<1dB Peaking, A_V = 1			200			120		MHz
t_s	Settling Time	To 0.1% of V_{FINAL}, V_{STEP} = 2V			20					ns
t_f, t_r	Small-Signal Rise and Fall Time	10% to 90%, V_{OUT} = 100mV_{P-P}			4.5					ns
dG	Differential Gain	(Note 9)			0.20			0.30		%
dP	Differential Phase	(Note 9)			0.10			0.20		Deg
HD2	2nd Harmonic Distortion	f = 1MHz, V_{OUT} = 2V_{P-P}			70			65		dB
HD3	3rd Harmonic Distortion	f = 1MHz, V_{OUT} = 2V_{P-P}			75			70		dB

(I_S = 3mA)

The ● denotes specifications which apply over the specified operating temperature range, otherwise specifications are at T_A = 25°C. For V^+ = 5V, V^- = –5V: R_{SET} = 56k to ground, A_V = +2, R_F = R_G = 1.1k, R_L = 150Ω; For V^+ = 3V, V^- = 0V: R_{SET} = 10k to V^-, A_V = +2, R_F = R_G = 1.27k to 1.5V, R_L = 150Ω to 1.5V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		V_{CC} = 5V, V_{EE} = –5V, I_S = 3mA MIN	TYP	MAX	V_{CC} = 3V, V_{EE} = 0V, I_S = 3mA MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage		 ●		–1	±4.5 ±6.5		–1.5	±4.5 ±6.5	mV mV
$I_{IN}+$	Noninverting Input Current		 ●		–1.5	±5 ±7		–1.5	±5 ±7	µA µA
$I_{IN}-$	Inverting Input Current		 ●		–12	±30 ±45		–3	±15 ±20	µA µA
e_n	Input Noise Voltage Density	f = 1kHz, R_F = 1k, R_G = 10Ω, R_S = 0Ω			7					nV/√Hz
$+i_n$	Input Noise Current Density	f = 1kHz			1.5					pA/√Hz
$-i_n$	Input Noise Current Density	f = 1kHz			15					pA/√Hz
$R_{IN}+$	Noninverting Input Resistance	V_{IN} = V^+ – 1.2V to V^- + 1.2V	●	0.5	3		1	2.5		MΩ
$C_{IN}+$	Noninverting Input Capacitance	f = 100kHz			2			2		pF
V_{INH}	Input Voltage Range, High	(Note 10)	●	3.8	4.1		1.8	2.1		V
V_{INL}	Input Voltage Range, Low	(Note 10)	●		–4.1	–3.8		0.9	1.2	V
V_{OUTH}	Output Voltage Swing, High	R_L = 1k, 50mV Overdrive R_L = 150Ω, 50mV Overdrive R_L = 150Ω, 50mV Overdrive	 ●	 4.3 4.1	4.8 4.6		 2.6 2.55	2.9 2.8		V V V
V_{OUTL}	Output Voltage Swing, Low	R_L = 1k, 50mV Overdrive R_L = 150Ω, 50mV Overdrive R_L = 150Ω, 50mV Overdrive	 ●		–4.95 –4.8	 –4.55 –4.4		0.05 0.1	 0.3 0.35	V V V
CMRR	Common Mode Rejection Ratio	V_{IN} = ±3.8V	 ●	47 44	50					dB dB
$-I_{CMRR}$	Inverting Input Current Common Mode Rejection	V_{IN} = ±3.8V V_{IN} = ±3.8V	 ●		0.3	±1.5 ±2				µA/V µA/V

ELECTRICAL CHARACTERISTICS (I_S = 3mA)

The ● denotes specifications which apply over the specified operating temperature range, otherwise specifications are at T_A = 25°C. For V^+ = 5V, V^- = –5V: R_{SET} = 56k to ground, A_V = +2, R_F = R_G = 1.1k, R_L = 150Ω; For V^+ = 3V, V^- = 0V: R_{SET} = 10k to V^-, A_V = +2, R_F = R_G = 1.27k to 1.5V, R_L = 150Ω to 1.5V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		V_{CC} = 5V, V_{EE} = –5V, I_S = 3mA MIN	TYP	MAX	V_{CC} = 3V, V_{EE} = 0V, I_S = 3mA MIN	TYP	MAX	UNITS
PSRR	Power Supply Rejection Ratio	V_S = ±1.5V to ±6V (Note 6)	●	60	85		60	85		dB
$-I_{PSRR}$	Inverting Input Current Power Supply Rejection	V_S = ±1.5V to ±6V (Note 6)			1.5	±7				μA/V
			●			±8				μA/V
I_S	Supply Current	V_{OUT} = 0V			3	4.1		3	4.1	mA
		V_{OUT} = 0V	●			4.55			4.4	mA
I_{OUT}	Maximum Output Current	R_L = 0Ω, 50mV Overdrive (Note 7)	●	±70			±45			mA
R_{OL}	Transimpedance, $\Delta V_{OUT}/\Delta I_{IN-}$	V_{OUT} = V_{CC} –1.2 to V_{CC} +1.2		65	120		65	120		kΩ
SR	Slew Rate	(Note 8)		450	600					V/μs
t_{pd}	Propagation Delay	50% V_{IN} to 50% V_{OUT}, 100mV_{P-P}, Larger of $t_{pd}+$, $t_{pd}-$			3.1			4.7		ns
BW	–3dB Bandwidth	<1dB Peaking, A_V = 1			100			70		MHz
t_s	Settling Time	To 0.1% of V_{FINAL}, V_{STEP} = 2V			20					ns
t_f, t_r	Small-Signal Rise and Fall Time	10% to 90%, V_{OUT} = 100mV_{P-P}			6					ns
dG	Differential Gain	(Note 9)			0.35			0.6		%
dP	Differential Phase	(Note 9)			0.30			0.5		Deg
HD2	2nd Harmonic Distortion	f = 1MHz, V_{OUT} = 2V_{P-P}			65			60		dB
HD3	3rd Harmonic Distortion	f = 1MHz, V_{OUT} = 2V_{P-P}			65			55		dB

(I_S = 300μA)

The ● denotes specifications which apply over the specified operating temperature range, otherwise specifications are at T_A = 25°C. For V^+ = 5V, V^- = –5V: R_{SET} = 1M to ground, A_V = +2, R_F = R_G = 11k, R_L = 1k; For V^+ = 3V, V^- = 0V: R_{SET} = 270k to V^-, A_V = +2, R_F = R_G = 9.31k to 1.5V, R_L = 1k to 1.5V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		V_{CC} = 5V, V_{EE} = –5V, I_S = 300μA MIN	TYP	MAX	V_{CC} = 3V, V_{EE} = 0V, I_S = 300μA MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage				–1	±3.5		–1.5	±3.5	mV
			●			±6			±6	mV
$I_{IN}+$	Noninverting Input Current				0.2	±1		0.2	±1	μA
			●			±2			±1.5	μA
$I_{IN}-$	Inverting Input Current				–3	±6		–0.5	±3	μA
			●			±9			±4.5	μA
e_n	Input Noise Voltage Density	f = 1kHz, R_F = 1k, R_G = 10Ω, R_S = 0Ω			13					nV/√Hz
$+i_n$	Input Noise Current Density	f = 1kHz			0.7					pA/√Hz
$-i_n$	Input Noise Current Density	f = 1kHz			5					pA/√Hz
$R_{IN}+$	Noninverting Input Resistance	V_{IN} = V^+ – 1.2V to V^- + 1.2V (Note 8)	●	1	25		1	15		MΩ
$C_{IN}+$	Noninverting Input Capacitance	f = 100kHz			2			2		pF
V_{INH}	Input Voltage Range, High	(Note 10)	●	3.8	4.1		1.8	2.1		V
V_{INL}	Input Voltage Range, Low	(Note 10)	●		–4.1	–3.8		0.9	1.2	V
V_{OUTH}	Output Voltage Swing, High	R_L = 1k, 50mV Overdrive		4.75	4.85		2.75	2.85		V
			●	4.7			2.7			V
V_{OUTL}	Output Voltage Swing, Low	R_L = 1k, 50mV Overdrive			–4.95	–4.85		0.05	0.15	V
			●			–4.8			0.2	V

ELECTRICAL CHARACTERISTICS (I_S = 300μA)

The ● denotes specifications which apply over the specified operating temperature range, otherwise specifications are at T_A = 25°C. For V^+ = 5V, V^- = –5V: R_{SET} = 1M to ground, A_V = +2, $R_F = R_G$ = 11k, R_L = 1k; For V^+ = 3V, V^- = 0V: R_{SET} = 270k to V^-, A_V = +2, $R_F = R_G$ = 9.31k to 1.5V, R_L = 1k to 1.5V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS		V_{CC} = 5V, V_{EE} = –5V, I_S = 300μA MIN	TYP	MAX	V_{CC} = 3V, V_{EE} = 0V, I_S = 300μA MIN	TYP	MAX	UNITS
CMRR	Common Mode Rejection Ratio	V_{IN} = ±3.8V		47	50					dB
			●	44						dB
$–I_{CMRR}$	Inverting Input Current Common Mode Rejection	V_{IN} = ±3.8V			0.15	±1.5				μA/V
		V_{IN} = ±3.8V	●			±2				μA/V
PSRR	Power Supply Rejection Ratio	V_S = ±1.5V to ±6V (Note 6)	●	60	85		60	85		dB
$–I_{PSRR}$	Inverting Input Current Power Supply Rejection	V_S = ±1.5V to ±6V (Note 6)			±0.4	±2.2				μA/V
			●			±4				μA/V
I_S	Supply Current	V_{OUT} = 0V			0.3	0.525		0.3	0.38	mA
		V_{OUT} = 0V	●			0.6			0.43	mA
I_{OUT}	Maximum Output Current	R_L = 0Ω, 50mV Overdrive (Note 7)	●	±30			±10			mA
R_{OL}	Transimpedance, $\Delta V_{OUT}/\Delta I_{IN}–$	V_{OUT} = V^+ – 1.2V to V^- + 1.2V		300	660		65	120		kΩ
SR	Slew Rate	(Note 8)		120	170					V/μs
t_{pd}	Propagation Delay	50% V_{IN} to 50% V_{OUT}, 100mV$_{P-P}$, Larger of t_{pd}+, t_{pd}–			30			50		ns
BW	–3dB Bandwidth	<1dB Peaking, A_V = 1			10			7.5		MHz
t_s	Settling Time	To 0.1% of V_{FINAL}, V_{STEP} = 2V			200					ns
t_f, t_r	Small-Signal Rise and Fall Time	10% to 90%, V_{OUT} = 100mV$_{P-P}$			40					ns
HD2	2nd Harmonic Distortion	f = 1MHz, V_{OUT} = 2V$_{P-P}$			40					dB
HD3	3rd Harmonic Distortion	f = 1MHz, V_{OUT} = 2V$_{P-P}$			45					dB

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: As long as output current and junction temperature are kept below the absolute maximum ratings, no damage to the part will occur. Depending on the supply voltage, a heat sink may be required.

Note 3: The LT6210C is guaranteed functional over the operating temperature range of –40°C to 85°C.

Note 4: The LT6210C is guaranteed to meet specified performance from 0°C to 70°C. The LT6210C is designed, characterized and expected to meet specified performance from –40°C and 85°C but is not tested or QA sampled at these temperatures. The LT6210I is guaranteed to meet specified performance from –40°C to 85°C.

Note 5: The LT6210 with no metal connected to the V^- pin has a θ_{JA} of 230°C/W, however, thermal resistances vary depending upon the amount of PC board metal attached to Pin 2 of the device. With the LT6210 mounted on a 2500mm^2 3/32" FR-4 board covered with 2oz copper on both sides and with just 20mm^2 of copper attached to Pin 2, θ_{JA} drops to 160°C/W. Thermal performance can be improved even further by using a 4-layer board or by attaching more metal area to Pin 2.

T_J is calculated from the ambient temperature T_A and the power dissipation P_D according to the following formula:

$$T_J = T_A + (P_D \bullet \theta_{JA})$$

The maximum power dissipation can be calculated by:

$$P_{D(MAX)} = (V_S \bullet I_{S(MAX)}) + (V_S/2)^2/R_{LOAD}$$

Note 6: For PSRR and $–I_{PSRR}$ testing, the current into the I_{SET} pin is constant, maintaining a consistent LT6210 quiescent bias point. A graph of PSRR vs Frequency is included in the Typical Performance Characteristics showing +PSRR and –PSRR with R_{SET} connecting I_{SET} to ground.

Note 7: While the LT6210 circuitry is capable of significant output currents even beyond the levels specified, sustained short-circuit currents exceeding the Absolute Maximum Rating of ±80mA may permanently damage the device.

Note 8: This parameter is guaranteed to meet specified performance through design and characterization. It has not been tested.

Note 9: Differential gain and phase are measured using a Tektronix TSG120YC/NTSC signal generator and a Tektronix 1780R Video Measurement Set. The resolution of this equipment is 0.1% and 0.1°. Five identical amplifier stages were cascaded giving an effective resolution of 0.02% and 0.02°.

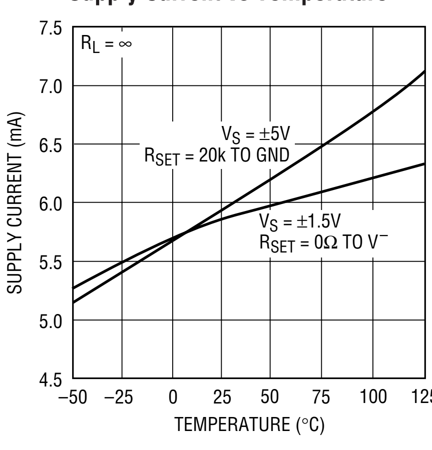
Note 10: Input voltage range on ±5V dual supplies is guaranteed by CMRR. On 3V single supply it is guaranteed by design and by correlation to the ±5V input voltage range limits.

TYPICAL AC PERFORMANCE

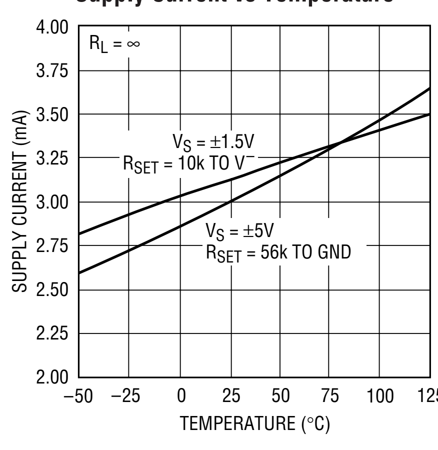
V_S (V)	I_S (mA)	R_{SET} (Ω)	A_V	R_L (Ω)	R_F (Ω)	R_G (Ω)	SMALL-SIGNAL – 3dB BW, <1dB PEAKING (MHz)	SMALL-SIGNAL ±0.1dB BW (MHz)
±5	6	20k	1	150	1200	—	200	30
±5	6	20k	2	150	887	887	160	30
±5	6	20k	–1	150	698	698	140	20
±5	3	56k	1	150	1690	—	100	15
±5	3	56k	2	150	1100	1100	100	15
±5	3	56k	–1	150	1200	1200	80	15
±5	0.3	1MEG	1	1k	13.7k	—	10	2
±5	0.3	1MEG	2	1k	11k	11k	10	2
±5	0.3	1MEG	–1	1k	10k	10k	10	1.8
3, 0	6	0	1	150	1100	—	120	20
3, 0	6	0	2	150	887	887	100	20
3, 0	6	0	–1	150	806	806	100	20
3, 0	3	10k	1	150	1540	—	70	15
3, 0	3	10k	2	150	1270	1270	60	15
3, 0	3	10k	–1	150	1200	1200	60	15
3, 0	0.3	270k	1	1k	13k	—	7.5	2
3, 0	0.3	270k	2	1k	9.31k	9.31k	7	1.5
3, 0	0.3	270k	–1	1k	10k	10k	7	1.5

TYPICAL PERFORMANCE CHARACTERISTICS

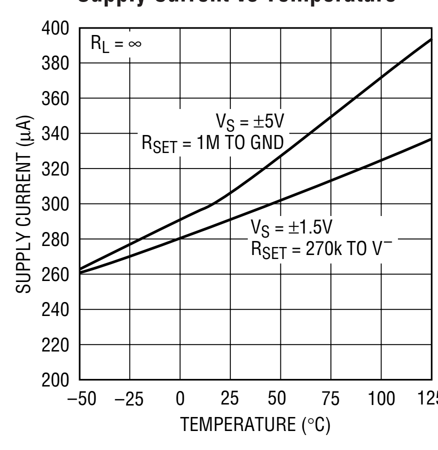
Supply Current vs Temperature



Supply Current vs Temperature

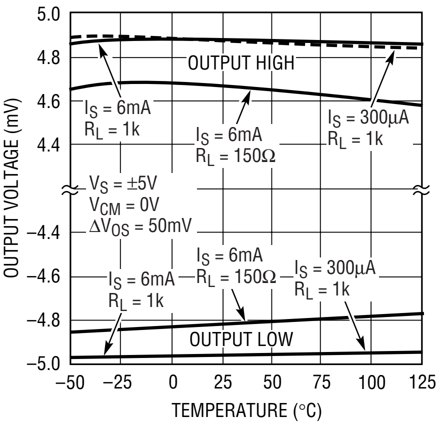


Supply Current vs Temperature



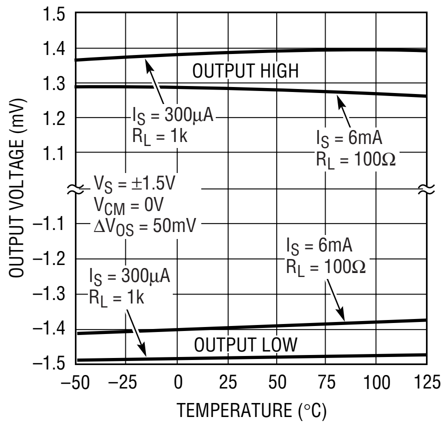
TYPICAL PERFORMANCE CHARACTERISTICS

Output Voltage Swing vs Temperature



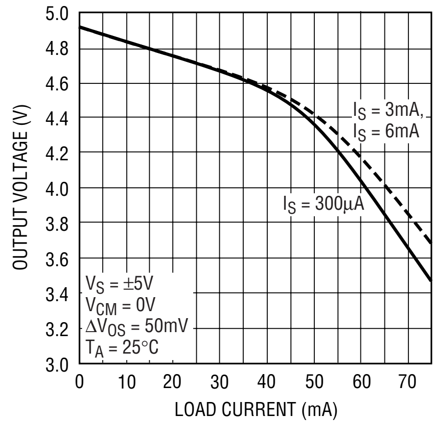
6210 G04

Output Voltage Swing vs Temperature



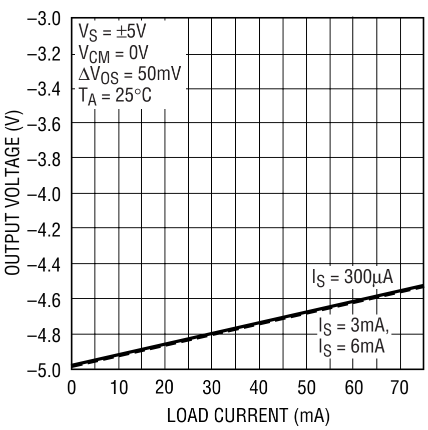
6210 G05

Output Voltage Swing vs I_{LOAD}



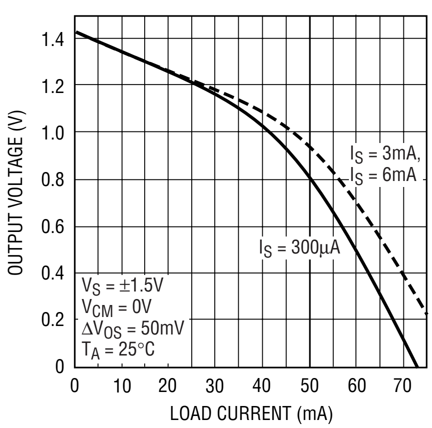
6210 G06

Output Voltage Swing vs I_{LOAD}



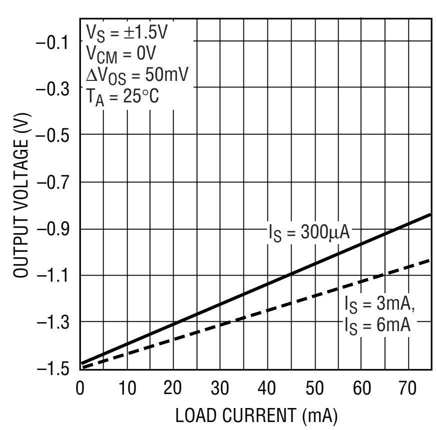
6210 G07

Output Voltage Swing vs I_{LOAD}



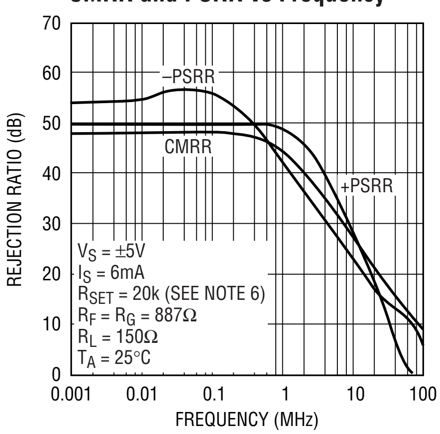
6210 G08

Output Voltage Swing vs I_{LOAD}



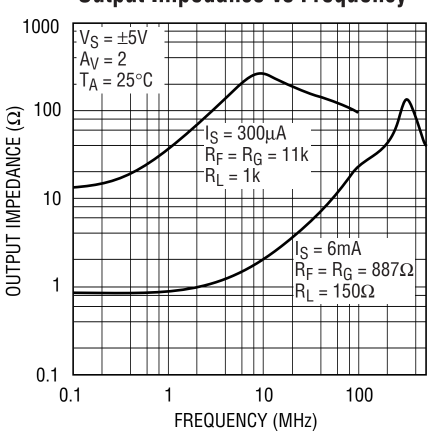
6210 G09

CMRR and PSRR vs Frequency



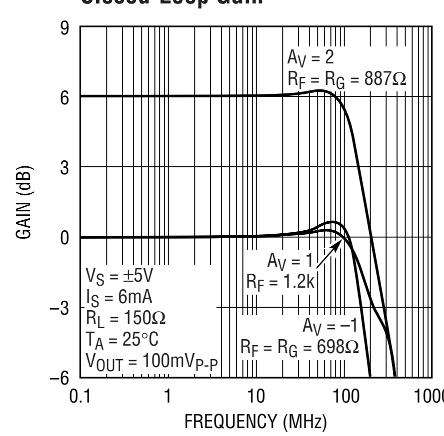
6210 G10

Output Impedance vs Frequency



6210 G11

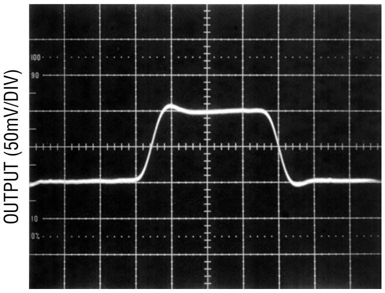
Frequency Response vs Closed-Loop Gain



6210 G12

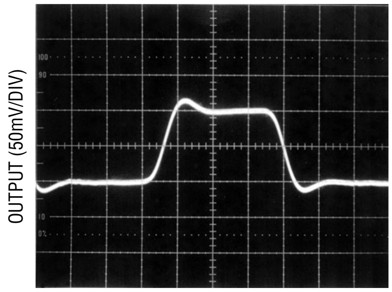
TYPICAL PERFORMANCE CHARACTERISTICS

Small-Signal Transient Response, I_S = 6mA



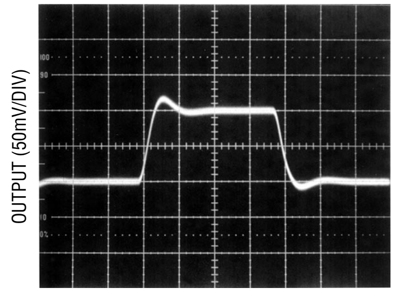
V_S = ±5V TIME (10ns/DIV)
V_{IN} = ±25mV
R_F = R_G = 887Ω
R_{SET} = 20k TO GND
R_L = 150Ω

Small-Signal Transient Response, I_S = 3mA



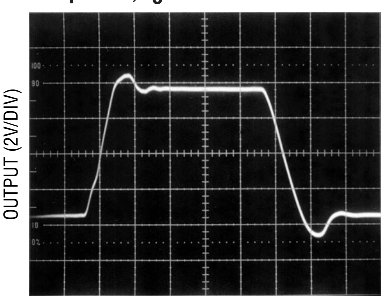
V_S = ±5V TIME (10ns/DIV)
V_{IN} = ±25mV
R_F = R_G = 1.1k
R_{SET} = 56k TO GND
R_L = 150Ω

Small-Signal Transient Response, I_S = 300μA



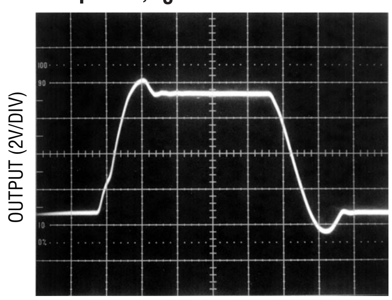
V_S = ±5V TIME (100ns/DIV)
V_{IN} = ±25mV
R_F = R_G = 11k
R_{SET} = 1M TO GND
R_L = 1k

Large-Signal Transient Response, I_S = 6mA



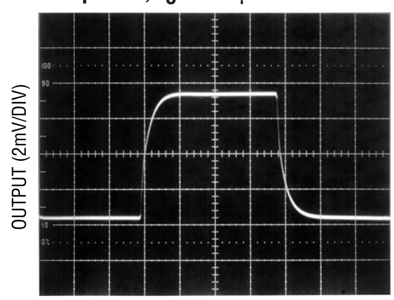
V_S = ±5V TIME (10ns/DIV)
V_{IN} = ±1.75V
R_F = R_G = 887Ω
R_{SET} = 20k TO GND
R_L = 150Ω

Large-Signal Transient Response, I_S = 3mA



V_S = ±5V TIME (10ns/DIV)
V_{IN} = ±1.75V
R_F = R_G = 1.1k
R_{SET} = 56k TO GND
R_L = 150Ω

Large-Signal Transient Response, I_S = 300μA



V_S = ±5V TIME (100ns/DIV)
V_{IN} = ±1.75V
R_F = R_G = 11k
R_{SET} = 1M TO GND
R_L = 1k

APPLICATIONS INFORMATION

Setting the Quiescent Operating Current (I_{SET} Pin)

The quiescent bias point of the LT6210 is set with either an external resistor from the I_{SET} pin to a lower potential or by drawing a current out of the I_{SET} pin. However, the I_{SET} pin is not designed to function as a shutdown. A simplified schematic of the internal biasing structure can be seen in Figure 1. Figure 2 illustrates the results of varying R_{SET} on 3V and ±5V supplies. Note that shorting the I_{SET} pin under 3V operation results in a quiescent bias of approximately 6mA. Attempting to bias the LT6210 at a current level higher than 6mA by using a smaller resistor may result in instability and decreased performance. However, internal circuitry clamps the supply current of the part at a safe level of approximately 15mA in case of accidental connection of the I_{SET} pin directly to a negative potential.

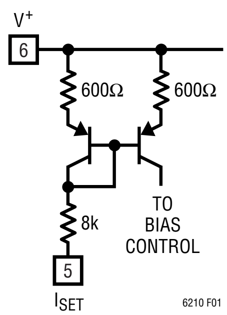


Figure 1. Internal Bias Setting Circuitry

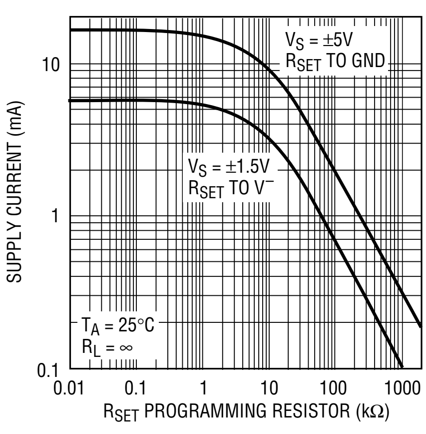


Figure 2. Setting R_{SET} to Control I_S

Input Considerations

The inputs of the LT6210 are protected by back-to-back diodes. If the differential input voltage exceeds 1.4V, the input current should be limited to less than the absolute maximum ratings of ±10mA. In normal operation, the differential voltage between the inputs is small, so the ±1.4V limit is generally not an issue. ESD diodes protect both inputs, so although the part is not guaranteed to function outside the common mode range, input voltages that exceed a diode beyond either supply will also require current limiting to keep the input current below the absolute maximum of ±10mA.

Feedback Resistor Selection

The small-signal bandwidth of the LT6210 is set by the external feedback resistors and the internal junction capacitances. As a result, the bandwidth is a function of the quiescent supply current, the supply voltage, the value of the feedback resistor, the closed-loop gain and the load resistor. Please refer to the Typical AC Performance table.

Layout and Passive Components

As with all high speed amplifiers, the LT6210 requires some attention to board layout. Low ESL/ESR bypass capacitors should be placed directly at the positive and negative supply (0.1µF ceramics are recommended). For best transient performance, additional 4.7µF tantalums should be added. A ground plane is recommended and trace lengths should be minimized, especially on the inverting input lead.

Capacitance on the Inverting Input

Current feedback amplifiers require resistive feedback from the output to the inverting input for stable operation. Capacitance on the inverting input will cause peaking in the frequency response and overshoot in the transient response. Take care to minimize the stray capacitance at the inverting input to ground and between the output and the inverting input. If significant capacitance is unavoidable in a given application, an inverting gain configuration should be considered. When configured inverting, the amplifier inputs do not slew and the effect of parasitics is greatly reduced.

Capacitive Loads

The LT6210 can drive capacitive loads directly when the proper value of feedback resistor is used. The required value for the feedback resistor will increase as load capacitance increases and as closed-loop gain decreases. Alternatively, a small resistor (5Ω to 35Ω) can be put in series

APPLICATIONS INFORMATION

with the output to isolate the capacitive load from the amplifier output. This has the advantage that the amplifier bandwidth is only reduced when the capacitive load is present. The disadvantage of this technique is that the gain is a function of the load resistance.

Power Supplies

The LT6210 will operate from single or split supplies from ±1.5V (3V total) to ±6V (12V total). It is not necessary to use equal value split supplies, however the offset voltage and inverting input bias current will change. The offset voltage changes about 2mV per volt of supply mismatch. The inverting input bias current will typically change less than 0.5μA per volt of supply mismatch.

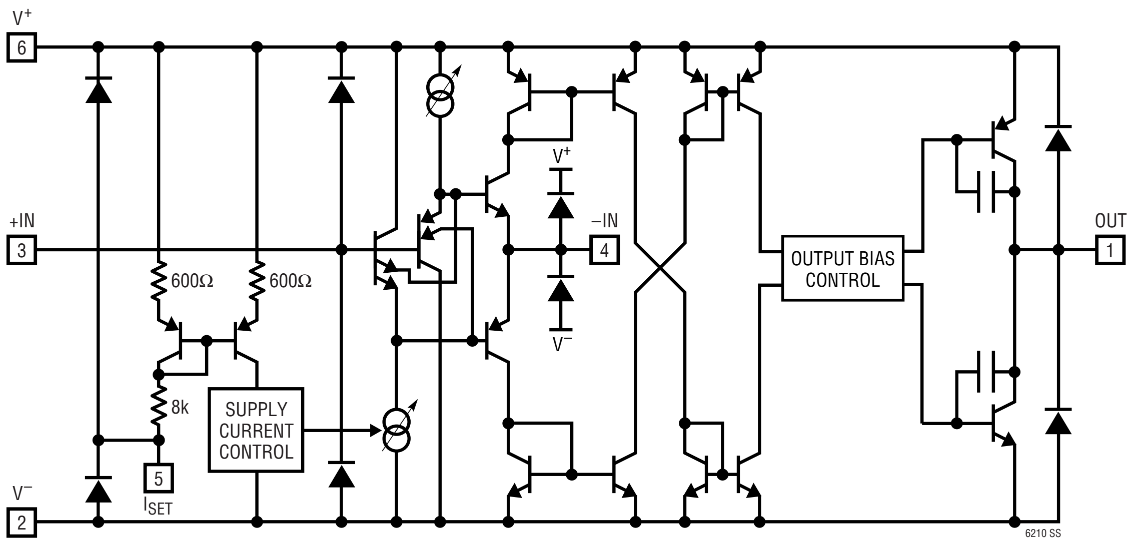
Slew Rate

Unlike a traditional voltage feedback op amp, the slew rate of a current feedback amplifier is not independent of the amplifier gain configuration. In a current feedback amplifier, both the input stage and the output stage have slew rate limitations. In the inverting mode, and for gains of 2 or more in the noninverting mode, the signal amplitude between the input pins is small and the overall slew rate is that of the output stage. For gains less than 2 in the noninverting mode, the overall slew rate is limited by the input stage. The input slew rate of the LT6210 on ±5V supplies with an R_{SET} resistor of 20k (I_S = 6mA) is approximately 700V/μs and is set by internal currents and capacitances. The output slew rate is additionally constrained by the value of the feedback resistor and internal capacitance. At a gain of 2 with 887Ω feedback and gain resistors, ±5V supplies and the same biasing as above, the output slew rate is typically 700V/μs. Larger feedback resistors, lower supply voltages and lower supply current levels will all reduce slew rate. Input slew rates significantly exceeding the output slew capability can actually decrease slew performance in a positive gain configuration; the cleanest transient response will be obtained from input slew rates slower than 1000V/μs.

Output Swing and Drive

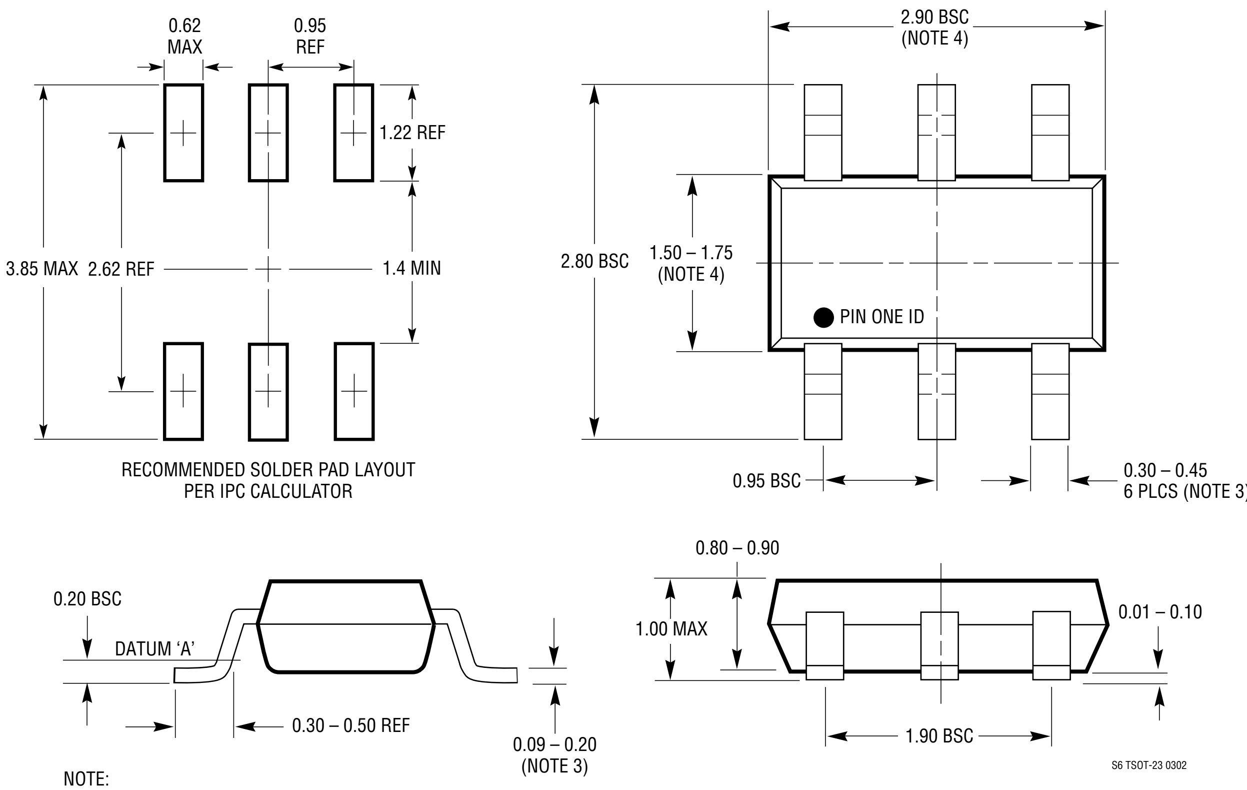
The output stage of the LT6210 consists of a pair of class-AB biased common emitters that enable the output to swing rail-to-rail. Since the LT6210 can potentially deliver output currents well beyond the specified minimum short-circuit current, care should be taken not to short the output of the device indefinitely. Attention must be paid to keep the junction temperature of the IC below the absolute maximum rating of 150°C if the output is used to drive low impedance loads. See note 5 for details. Additionally, the output of the amplifier has reverse-biased ESD diodes connected to each supply. If the output is forced beyond either supply, large currents will flow through these diodes. If the current is transient and limited to 80mA or less, no damage to the LT6210 will occur.

SIMPLIFIED SCHEMATIC



PACKAGE DESCRIPTION

S6 Package
6-Lead Plastic TSOT-23
(Reference LTC DWG # 05-08-1636)



NOTE:
1. DIMENSIONS ARE IN MILLIMETERS
2. DRAWING NOT TO SCALE
3. DIMENSIONS ARE INCLUSIVE OF PLATING
4. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH AND METAL BURR
5. MOLD FLASH SHALL NOT EXCEED 0.254mm
6. JEDEC PACKAGE REFERENCE IS MO-193

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1252/LT1253/LT1254	100MHz Low Cost Video Amplifiers	Single, Dual and Quad Current Feedback Amplifiers
LT1395/LT1396/LT1397	400MHz, 800V/µs Amplifiers	Single, Dual and Quad Current Feedback Amplifiers
LT1398/LT1399	300MHz Amplifiers with Shutdown	Dual and Triple Current Feedback Amplifiers
LT1795	50MHz, 500mA Programmable I_S Amplifier	Dual Current Feedback Amplifier
LT1806/LT1807	325MHz, 140V/µs Rail-to-Rail I/O Amplifiers	Single and Dual Voltage Feedback Amplifiers
LT1815/LT1816/LT1817	220MHz, 1500V/µs Programmable I_S Operational Amplifier	Single, Dual and Quad Voltage Feedback Amplifiers

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

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