Video Difference Amplifier

FEATURES

- Differential or Single-Ended Gain Block ±10 (20dB)
- –3dB Bandwidth 35MHz
- Slew Rate 500V/µs
- Low Cost
- Output Current ±50mA
- Settling Time 200ns to 0.1%
- CMRR @ 10MHz 45dB
- Differential Gain Error 0.2%
- Differential Phase Error 0.08°
- Input Amplitude Limiting
- Single +5V Operation
- Drives Cables Directly

APPLICATIONS

- Line Receivers
- Video Signal Processing
- Gain Limiting
- Oscillators
- Tape and Disc Drive Systems

DESCRIPTION

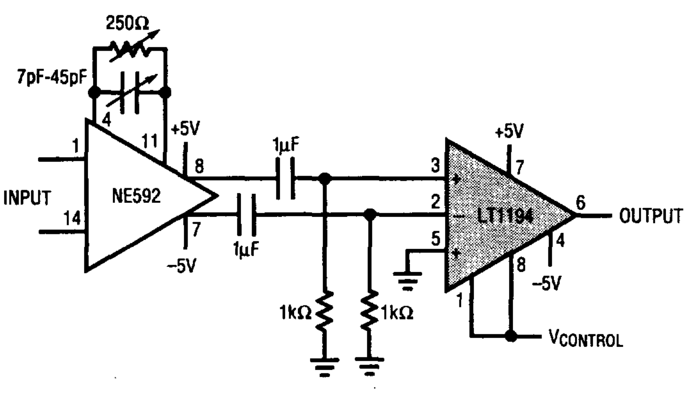
The LT1194 is a video difference amplifier optimized for operation on ±5V, and a single +5V supply. The amplifier has a fixed gain of 20dB, and features adjustable input limiting to control tough over-drive applications. It has uncommitted high input impedance (+) and (–) inputs, and can be used in differential or single-ended configurations.

The LT1194's high slew rate, 500V/µs, wide bandwidth, 35MHz, and ±50mA output current, make it ideal for driving cables directly. This versatile amplifier is easy to use for video, or applications requiring speed, accuracy, and low cost.

The LT1194 is available in 8-pin miniDIPs and SO packages.

2

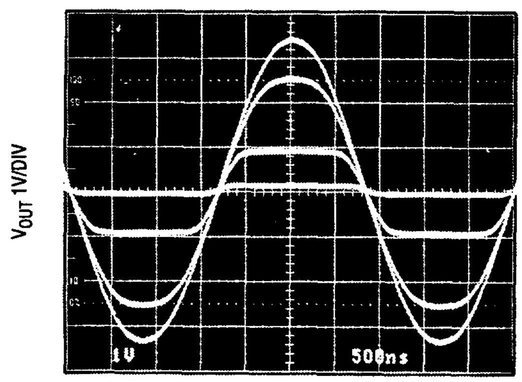
Wideband Differential Amplifier with Limiting



A_V = 1000, –3dB BW = 35MHz

LT1194 • TA01

Sine Wave Reduced by Limiting



200kHz SINE WAVE WITH $V_{CONTROL}$ = –5V, –4V, –3V, –2V

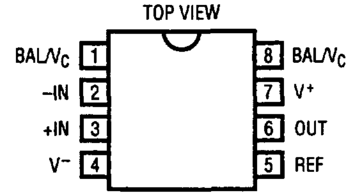
LT1194 • TA02

ABSOLUTE MAXIMUM RATINGS

Total Supply Voltage (V^+ to V^-) 18V
Differential Input Voltage .... ±6V
Input Voltage .... $\pm V_S$
Output Short Circuit Duration (Note 1) .... Continuous
Operating Junction Temperature Range
  LT1194M .... −55°C to 150°C
  LT1194C .... 0°C to 150°C
Max. Junction Temperature .... See Pkg. Descriptions
Storage Temperature Range .... −65°C to 150°C
Lead Temperature (Soldering, 10 sec.) .... 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW



J8 PACKAGE 8-LEAD HERMETIC DIP
N8 PACKAGE 8-LEAD PLASTIC DIP
S8 PACKAGE 8-LEAD PLASTIC SOIC

LT1194 • POI01

ORDER PART NUMBER
LT1194MJ8 LT1194CJ8 LT1194CN8 LT1194CS8
S8 PART MARKING
1194

ELECTRICAL CHARACTERISTICS

$V_S = \pm5V$, $V_{REF} = 0V$, Null pins 1 and 8 open circuit, $T_A = 25°C$, $C_L \le 10pF$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1194M/C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage				1.0	6.0	mV
I_{OS}	Input Offset Current				0.2	3.0	µA
I_B	Input Bias Current				±0.5	±3.5	µA
e_n	Input Noise Voltage	f_O = 10kHz			15		nV/√Hz
i_n	Input Noise Current	f_O = 10kHz			4.0		pA/√Hz
R_{IN}	Input Resistance	Either Input			30		kΩ
C_{IN}	Input Capacitance	Either Input			2.0		pF
	Input Voltage Range			−2.5		+3.5	V
CMRR	Common Mode Rejection Ratio	V_{CM} = −2.5V to +3.5V		65	80		dB
PSRR	Power Supply Rejection Ratio	V_S = ±2.375V to ±8V		65	80		dB
V_{OMAX}	Maximum Output Signal	V_S = ±8V, (Note 2)		±3.9	±4.3		V
V_{LIM}	Output Voltage Limit	V_i = ±0.5V, V_C = +2V, (Note 3)			±20	±120	mV
V_{OUT}	Output Voltage Swing	V_S = ±8V, V_{REF} = +3V	R_L = 1k	+6.6	+6.9		V
			R_L = 100Ω	+6.3	+6.7		
		V_S = ±8V, V_{REF} = −3V	R_L = 1k	−6.7	−7.4		
			R_L = 100Ω	−6.4	−6.7		
		V_S = ±5V, V_{REF} = 0V, R_L = 1k		±3.8	±4.0		
G_E	Gain Error	V_O = ±3V	R_L = 1k		0.5	3.0	%
			R_L = 100Ω		0.5	3.0	
SR	Slew Rate	V_O = ±1V, R_L = 1k, (Note 4, 8)		350	500		V/µs
FPBW	Full Power Bandwidth	V_O = 6Vp-p, (Note 5)		18.5	26.5		MHz
BW	Small Signal Bandwidth				35		MHz
t_r, t_f	Rise Time, Fall Time	R_L = 1k, V_O = ±500mV, 20% to 80%, (Note 8)		4.0	6.0	8.0	ns
t_{PD}	Propagation Delay	R_L = 1k, V_O = ±125mV, 50% to 50%			6.5		ns
	Overshoot	V_O = ±125mV			0		%

ELECTRICAL CHARACTERISTICS

$V_S = \pm 5V$, $V_{REF} = 0V$, Null pins 1 and 8 open circuit, $T_A = 25°C$, $C_L \le 10pF$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT1194M/C MIN	TYP	MAX	UNITS
t_s	Settling Time	3V Step, 0.1%, (Note 6)		200		ns
Diff A_V	Differential Gain	$R_L = 150\Omega$, (Note 7)		0.2		%
Diff Ph	Differential Phase	$R_L = 150\Omega$, (Note 7)		0.08		Deg p-p
I_S	Supply Current			35	43	mA

ELECTRICAL CHARACTERISTICS

$V_S+ = +5V$, $V_S- = 0V$, $V_{REF} = +2.5V$, Null pins 1 and 8 open circuit, $T_A = 25°C$, $C_L \le 10pF$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1194M/C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage				2.0	8.0	mV
I_{OS}	Input Offset Current				0.2	3.0	μA
I_B	Input Bias Current				±0.5	±3.0	μA
	Input Voltage Range			+2.0		+3.5	V
CMRR	Common Mode Rejection Ratio	$V_{CM} = +2.0V$ to $+3.5V$		55	70		dB
V_{LIM}	Output Voltage Limit	$V_i = \pm 0.5V$, $V_C = +2V$, (Note 3)			±20	±120	mV
V_{OUT}	Output Voltage Swing	$R_L = 100\Omega$ to Ground	V_{OUT} High	3.6	3.8		V
			V_{OUT} Low		0.25	0.4	
SR	Slew Rate	$V_O = +1V$ to $+3V$			250		V/μs
BW	Small Signal Bandwidth				32		MHz
I_S	Supply Current				32	40	mA

ELECTRICAL CHARACTERISTICS

$V_S+ = \pm 5V$, $V_{REF} = 0V$, Null pins 1 and 8 open circuit, $-55°C \le T_A \le 125°C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS			LT1194M MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage			●		1.0	9.0	mV
$\Delta V_{OS}/\Delta T$	Input V_{OS} Drift			●		6.0		μV/°C
I_{OS}	Input Offset Current			●		0.8	5.0	μA
I_B	Input Bias Current			●		±1.0	±5.5	μA
	Input Voltage Range			●	−2.5		+3.5	V
CMRR	Common Mode Rejection Ratio	$V_{CM} = -2.5V$ to $+3.5V$		●	58	80		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 2.375V$ to $\pm 5.0V$		●	60	80		dB
V_{LIM}	Output Voltage Limit	$V_i = \pm 0.5V$, $V_C = +2V$, (Note 3)		●		±20	±150	mV
V_{OUT}	Output Voltage Swing	$V_S = \pm 8V$ $V_{REF} = +3V$	$R_L = 1k$	●	+6.0	+6.6		V
			$R_L = 100\Omega$	●	+5.9	+6.5		
		$V_S = \pm 8V$ $V_{REF} = -3V$	$R_L = 1k$	●	−6.1	−6.7		
			$R_L = 100\Omega$	●	−6.0	−6.5		
G_E	Gain Error	$V_O = \pm 3V$, $R_L = 1k$		●		1.0	5.0	%
I_S	Supply Current			●		35	43	mA

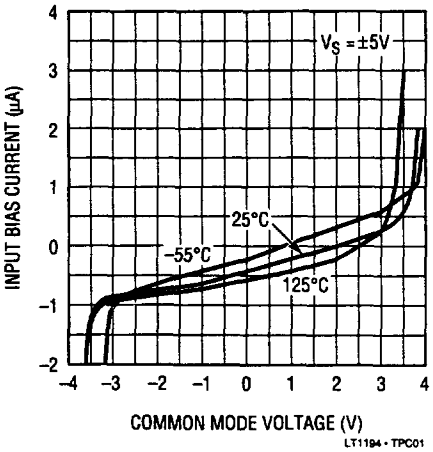
ELECTRICAL CHARACTERISTICS

V_S+ = ±5V, V_{REF} = 0V, Null pins 1 and 8 open circuit, 0°C ≤ T_A ≤ 70°C, unless otherwise noted.

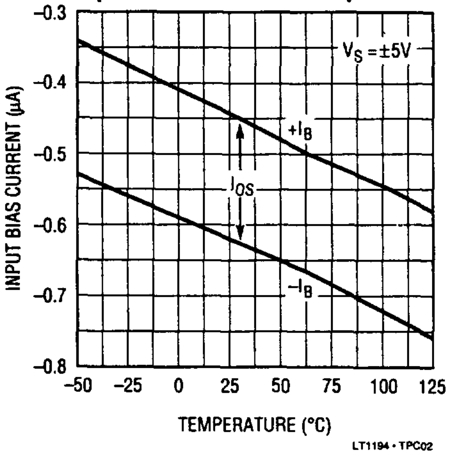
SYMBOL	PARAMETER	CONDITIONS		LT1194C MIN	LT1194C TYP	LT1194C MAX	UNITS
V_{OS}	Input Offset Voltage		●		1.0	7.0	mV
$\Delta V_{OS}/\Delta T$	Input V_{OS} Drift		●		6.0		µV/°C
I_{OS}	Input Offset Current		[illegible]		[illegible]	[illegible]	

TYPICAL PERFORMANCE CHARACTERISTICS

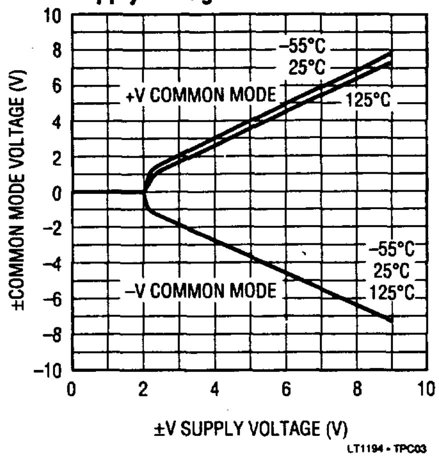
Input Bias Current vs Common Mode Voltage



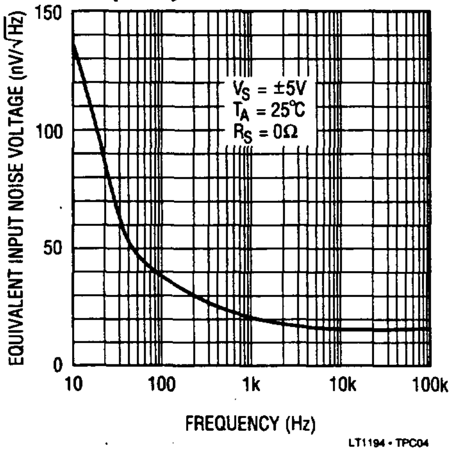
Input Bias Current vs Temperature



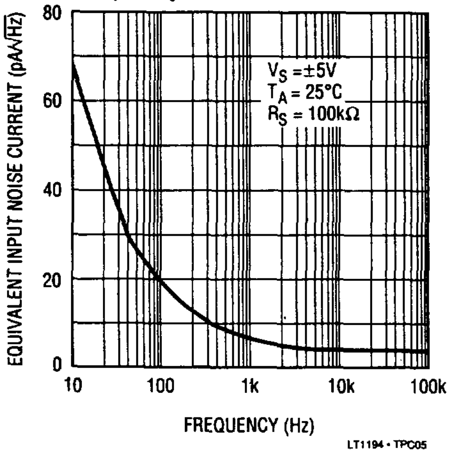
Common Mode Voltage vs Supply Voltage



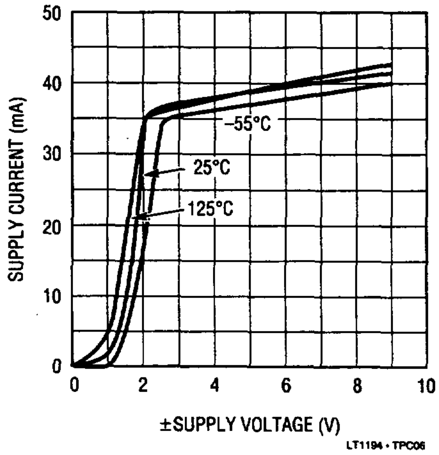
Equivalent Input Noise Voltage vs Frequency



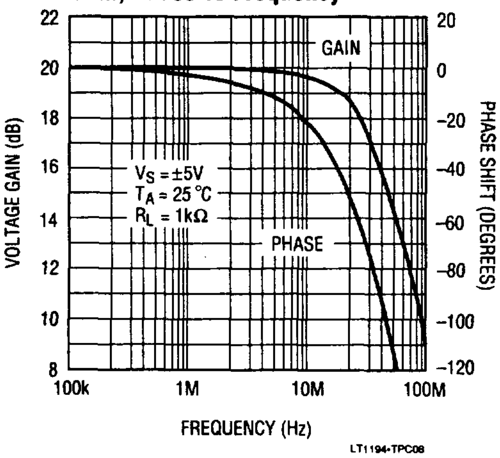
Equivalent Input Noise Current vs Frequency



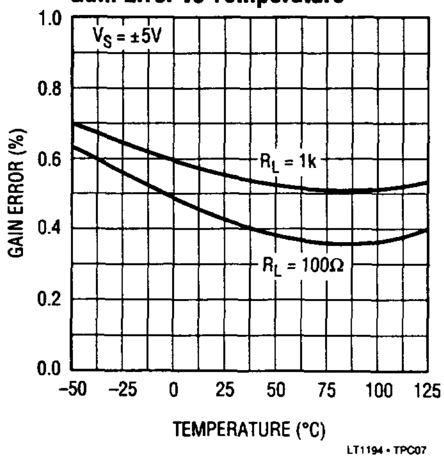
Supply Current vs Supply Voltage



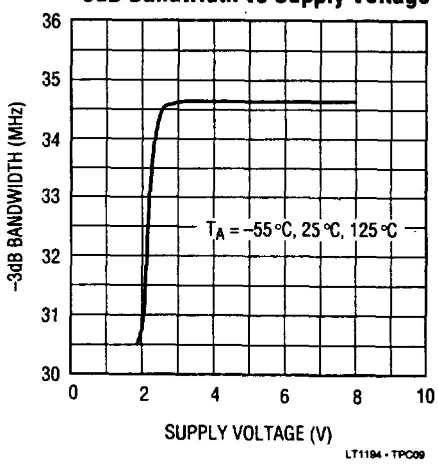
Gain, Phase vs Frequency



Gain Error vs Temperature

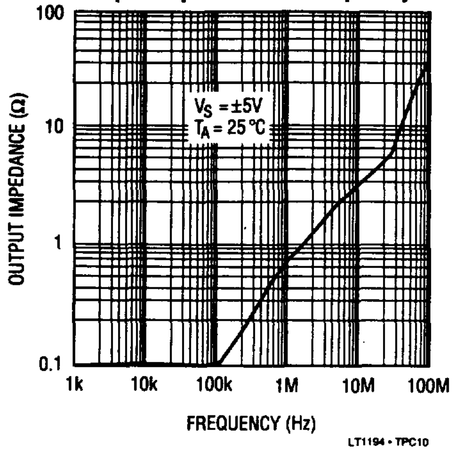


–3dB Bandwidth vs Supply Voltage

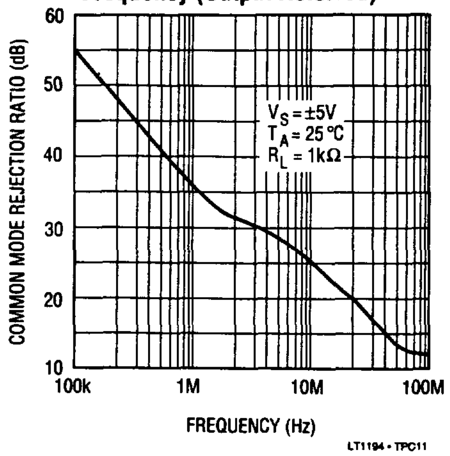


TYPICAL PERFORMANCE CHARACTERISTICS

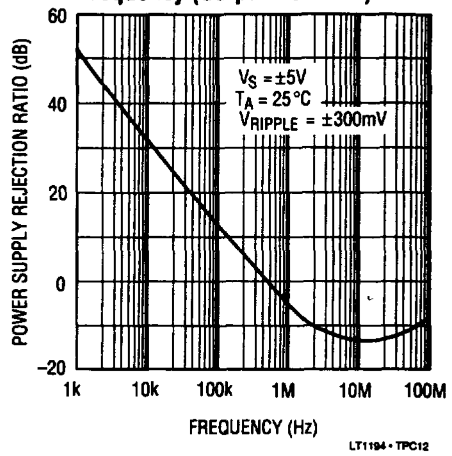
Output Impedance vs Frequency



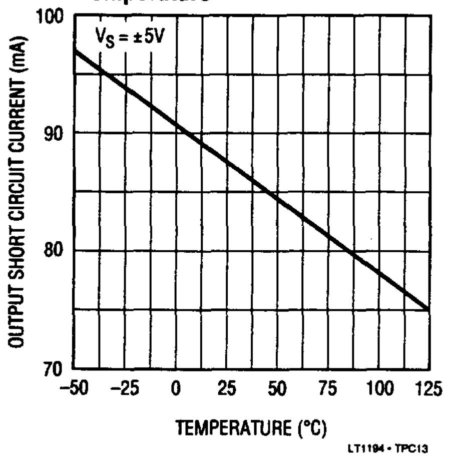
Common Mode Rejection Ratio vs Frequency (Output Referred)



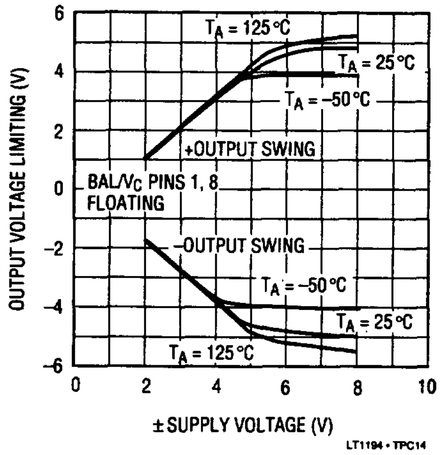
Power Supply Rejection Ratio vs Frequency (Output Referred)



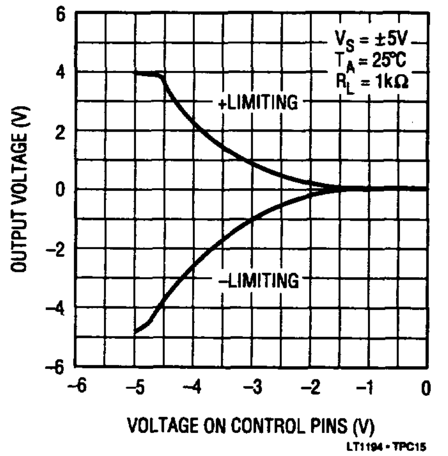
Output Short Circuit Current vs Temperature



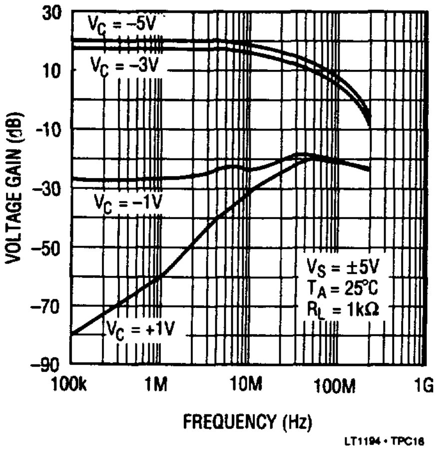
Output Voltage Limiting vs Supply Voltage



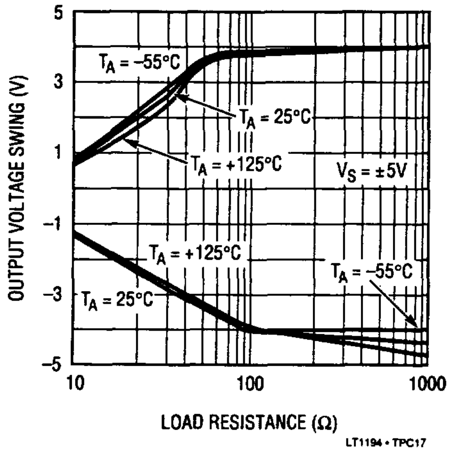
Output Voltage vs Voltage On Control Pins



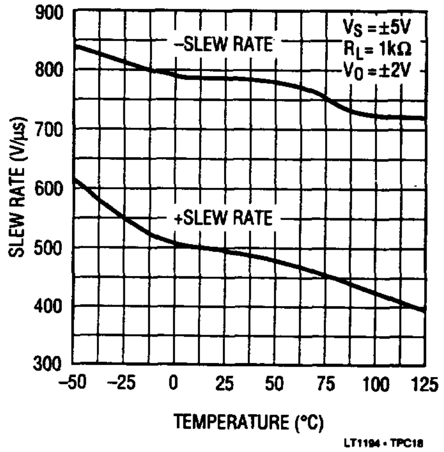
Voltage Gain vs Frequency with Control Voltage



Output Voltage Swing vs Load Resistance

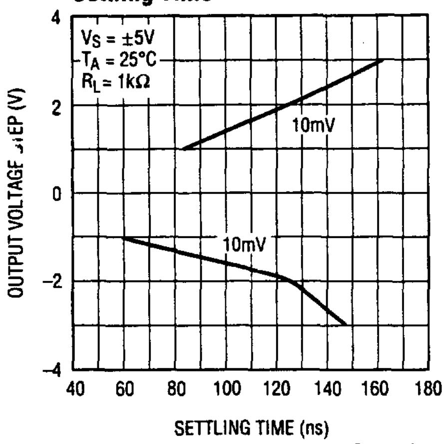


Slew Rate vs Temperature



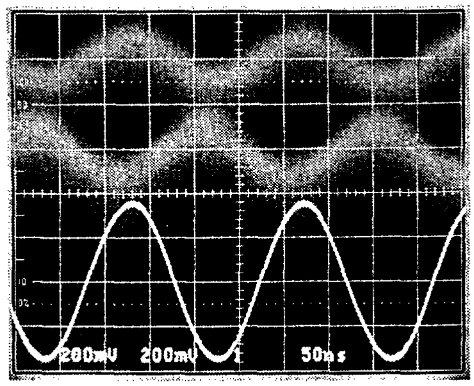
TYPICAL PERFORMANCE CHARACTERISTICS

Output Voltage Step vs Settling Time



LT1194 • TPC19

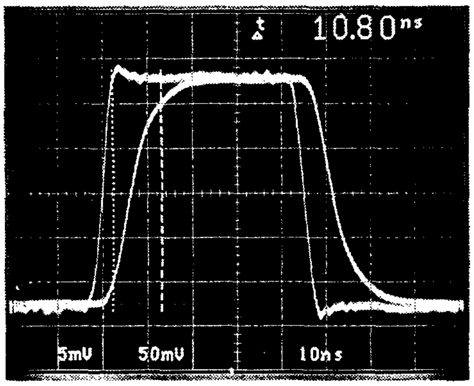
Common Mode Rejection



5MHz SINE WAVE RECOVERED FROM COMMON MODE NOISE

LT1194 • TPC22

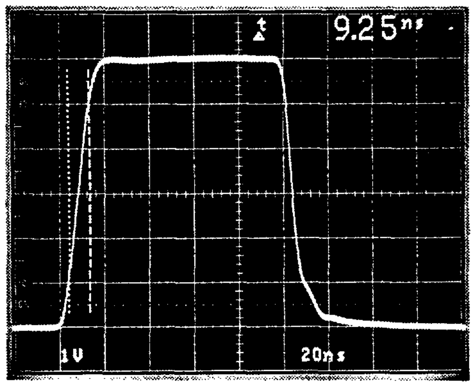
Small Signal Transient Response



RISE TIME = 10.8ns, PROPAGATION DELAY = 6ns

LT1194 • TPC21

Large Signal Transient Response



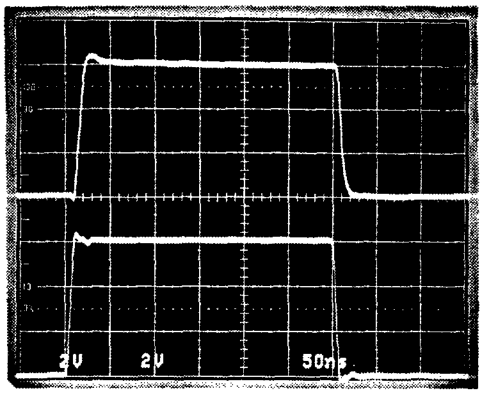
R_L = 150Ω, + SR = 430V/µs, –SR = 500V/µs

LT1194 • TPC20

APPLICATIONS INFORMATION

The LT1194 is a video difference amplifier with a fixed gain of 10 (20dB). The amplifier has two uncommitted high input impedance (+) and (–) inputs which can be used either differentially or single-ended. The LT1194 includes a Limiting feature which allows the amplifier to reduce its output as a function of DC voltage on the BAL/V_C pins. The Limiting feature uses input differential pair limiting to prevent overload in subsequent stages. This technique allows extremely fast limiting action.

Input Limiting



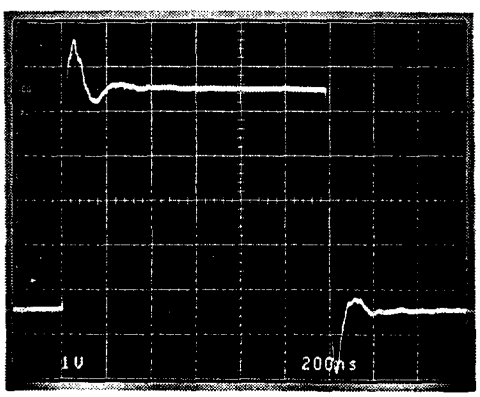
20dB INPUT OVERDRIVE V_C = –4.2V

LT1194 • TA06

Power Supply Bypassing

The LT1194 is quite tolerant of power supply bypassing. In some applications a 0.1µF ceramic disc capacitor placed 1/2 inch from the amplifier is all that is required. A scope photo of the amplifier output with no supply bypassing is used to demonstrate this bypassing tolerance, R_L = 1kΩ.

No Supply Bypass

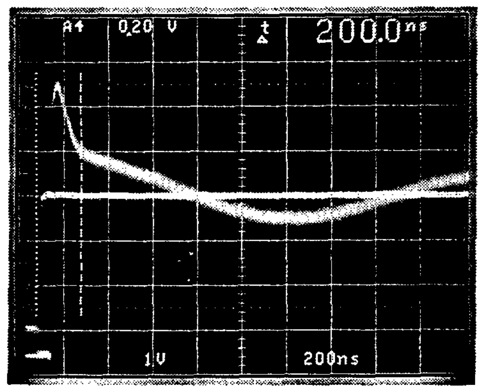


IN DEMO BOARD, R_L = 1kΩ

LT1194 • TA07

In many applications, and those requiring good settling time, it is important to use multiple bypass capacitors. A 0.1µF ceramic disc in parallel with a 4.7µF tantalum is recommended. Two oscilloscope photos with different bypass conditions are used to illustrate the settling time characteristics of the amplifier. Note that although the output waveform looks acceptable at 1V/div, when amplified to 10mV/div the settling time to 10mV is 200ns. The time drops to 162ns with multiple bypass capacitors, and does not exhibit the characteristic power supply ringing.

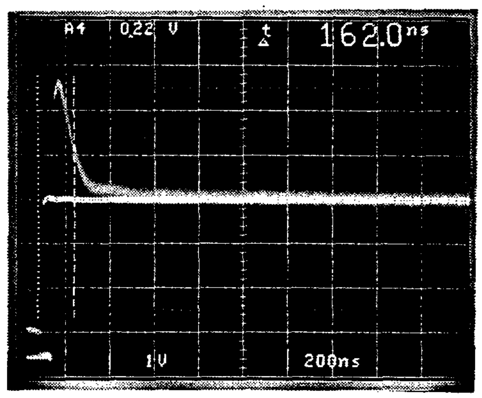
Settling Time Poor Bypass



SETTLING TIME TO 10mV, SUPPLY BYPASS CAPACITORS = 0.1µF

LT1194 • TA08

Settling Time Good Bypass



SETTLING TIME TO 10mV, SUPPLY BYPASS CAPACITORS = 0.1µF + 4.7µF TANTALUM

LT1194 • TA09

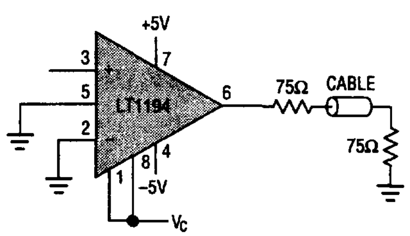
APPLICATIONS INFORMATION

Cable Terminations

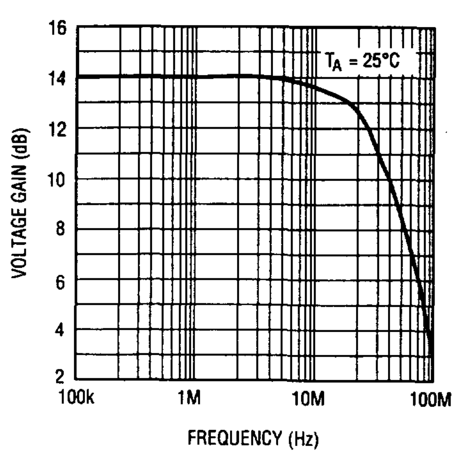
The LT1194 video difference amplifier has been optimized as a low cost cable driver. The ±50mA guaranteed output current enables the LT1194 to easily deliver 7.5Vp-p into 100Ω, while operating on ±5V supplies, or 2.6Vp-p on a single 5V supply.

When driving a cable it is important to terminate the cable to avoid unwanted reflections. This can be done in one of two ways: single termination or double termination. With single termination, the cable must be terminated at the receiving end (75Ω to ground) to absorb unwanted energy. The best performance can be obtained by double termination (75Ω in series with the output of the amplifier, and 75Ω to ground at the other end of the cable). This termination is preferred because reflected energy is absorbed at each end of the cable. When using the double termination technique it is important to note that the signal is attenuated by a factor of 2, or 6dB. For a cable driver with a gain of +5 (LT1194 gain of +10), the –3dB bandwidth is over 30MHz with no peaking.

Double Terminated Cable Driver



Voltage Gain vs Frequency



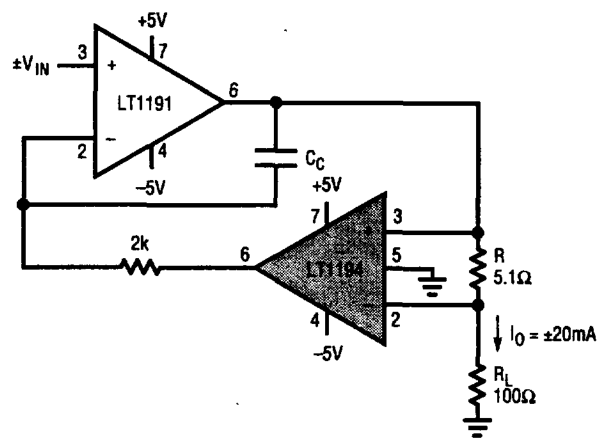
A Voltage Controlled Current Source

The LT1194 can be used to make a fast, precise, voltage controlled current source. The LT1194 high speed differential amplifier senses the current delivered to the load. The input signal V_{IN}, applied to the (+) input of the LT1191, will appear at the (–) input if the feedback loop is properly closed. In steady state the input signal appears at the output of the LT1194, and 1/10 of this signal is applied across the sense resistor. Thus the output current is simply:

$$I_O = \frac{V_{IN}}{R \times 10}$$

The compensation capacitor C_C forces the LT1191 to be the dominate pole for the loop, while the LT1194 is fast enough to be transparent in the feedback path. The ratio of the load resistor to the sense resistor should be approximately 10:1 or greater for easy compensation. For the example shown the load resistor is 100Ω, the sense resistor is 5.1Ω, and various loop compensation capacitors cause the output to exhibit an underdamped, critically, and overdamped response.

Voltage Controlled Current Source



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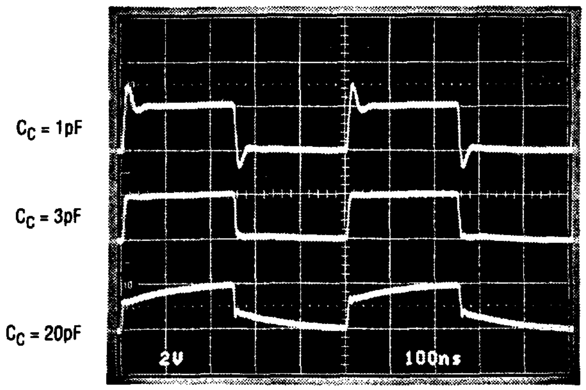
APPLICATIONS INFORMATION

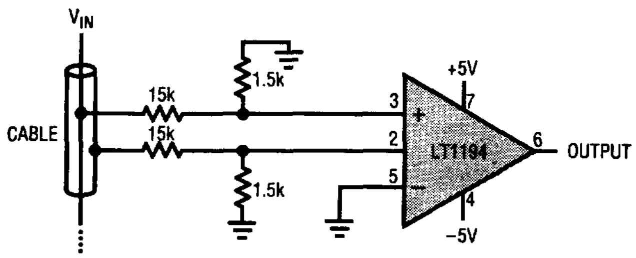
Output Current Response



±20mA CURRENT SOURCE WITH DIFFERENT COMPENSATION CAPACITORS

LT1194 • TA16

Differential Video Loop Thru Amplifier for Power Down Applications



1% RESISTOR WORST CASE CMRR = 22dB
TYPICALLY = 38dB

LT1194 • TA17

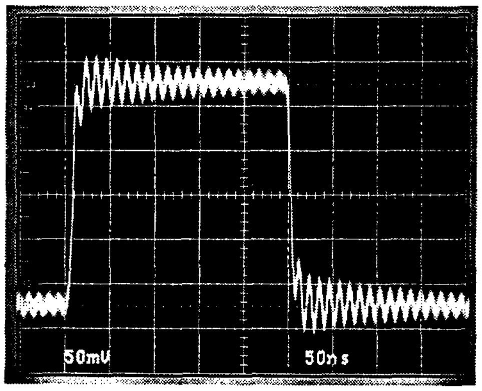
Murphy Circuits

There are several precautions the user should take when using the LT1194 in order to realize its full capability. Although the LT1194 can drive a 50pF capacitive load, isolating the capacitance with 10Ω can be helpful. Precautions primarily have to do with driving large capacitive loads.

Other precautions include:

1. Use a ground plane (see Design Note 50, High Frequency Amplifier Evaluation Board).
2. Do not use high source impedances. The input capacitance of 2pF, and R_S = 10kΩ, for instance, will give an 8MHz –3dB bandwidth.
3. PC board socket may reduce stability.

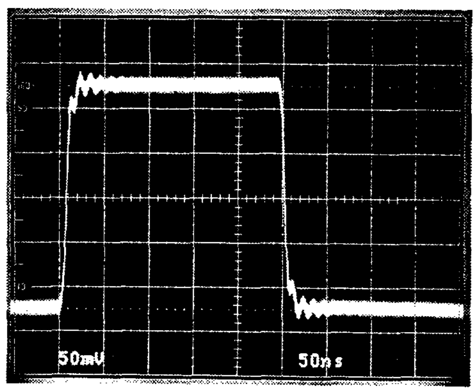
Driving Capacitive Load



LT1194 IN DEMO BOARD, C_L = 50pF

LT1194 • TA11

Driving Capacitive Load

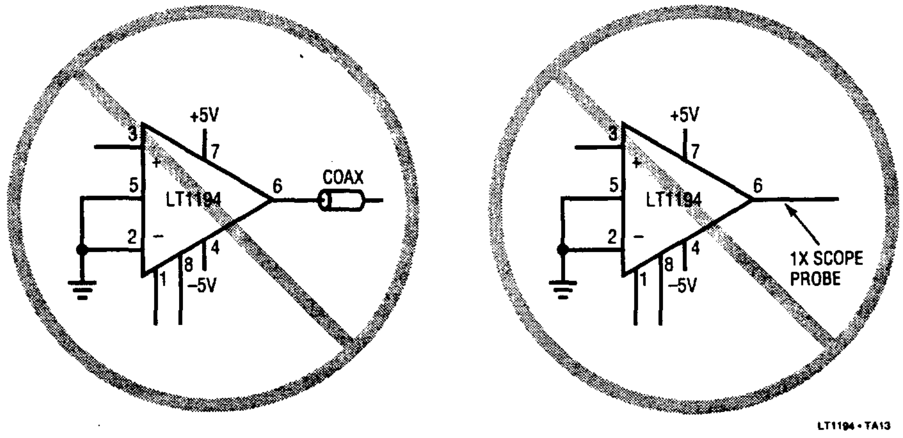


LT1194 IN DEMO BOARD, C_L = 50pF WITH 10Ω ISOLATING RESISTOR

LT1194 • TA12

APPLICATIONS INFORMATION

Murphy Circuits

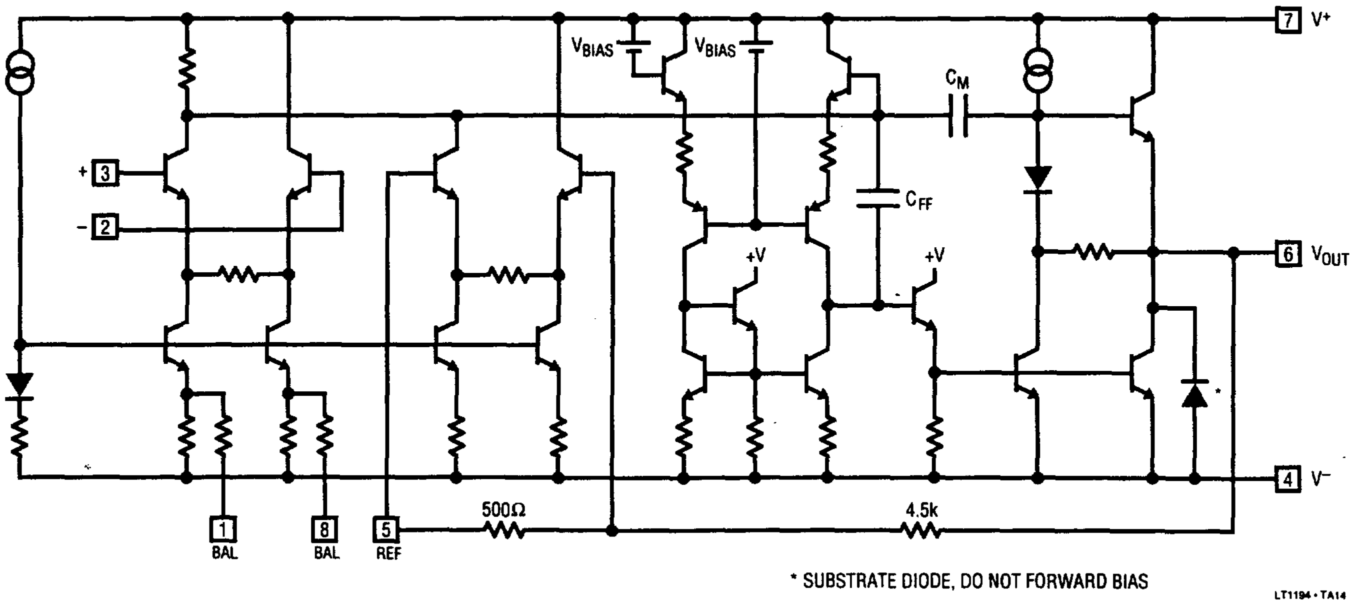


An Unterminated Cable Is a Large Capacitive Load

A 1X Scope Probe Is a Large Capacitive Load

2

SIMPLIFIED SCHEMATIC

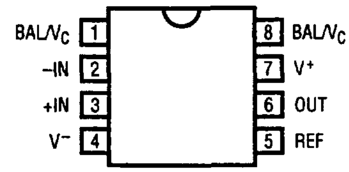


ABSOLUTE MAXIMUM RATINGS

Total Supply Voltage (V^+ to V^-) 18V
Differential Input Voltage .... ±6V
Input Voltage .... $\pm V_S$
Output Short Circuit Duration (Note 1) .... Continuous
Operating Junction Temperature Range
  LT1194M .... –55°C to 150°C
  LT1194C .... 0°C to 150°C
Max. Junction Temperature .... See Pkg. Descriptions
Storage Temperature Range .... –65°C to 150°C
Lead Temperature (Soldering, 10 sec.) .... 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW



J8 PACKAGE
8-LEAD HERMETIC DIP

N8 PACKAGE
8-LEAD PLASTIC DIP

S8 PACKAGE
8-LEAD PLASTIC SOIC

LT1194 • POI01

ORDER PART NUMBER
LT1194MJ8
LT1194CJ8
LT1194CN8
LT1194CS8
S8 PART MARKING
1194

ELECTRICAL CHARACTERISTICS

V_S = ±5V, V_{REF} = 0V, Null pins 1 and 8 open circuit, T_A = 25°C, $C_L \le$ 10pF, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1194M/C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage				1.0	6.0	mV
I_{OS}	Input Offset Current				0.2	3.0	µA
I_B	Input Bias Current				±0.5	±3.5	µA
e_n	Input Noise Voltage	f_O = 10kHz			15		nV/√Hz
i_n	Input Noise Current	f_O = 10kHz			4.0		pA/√Hz
R_{IN}	Input Resistance	Either Input			30		kΩ
C_{IN}	Input Capacitance	Either Input			2.0		pF
	Input Voltage Range			–2.5		+3.5	V
CMRR	Common Mode Rejection Ratio	V_{CM} = –2.5V to +3.5V		65	80		dB
PSRR	Power Supply Rejection Ratio	V_S = ±2.375V to ±8V		65	80		dB
V_{OMAX}	Maximum Output Signal	V_S = ±8V, (Note 2)		±3.9	±4.3		V
V_{LIM}	Output Voltage Limit	V_i = ±0.5V, V_C = +2V, (Note 3)			±20	±120	mV
V_{OUT}	Output Voltage Swing	V_S = ±8V, V_{REF} = +3V	R_L = 1k	+6.6	+6.9		V
			R_L = 100Ω	+6.3	+6.7		
		V_S = ±8V, V_{REF} = –3V	R_L = 1k	–6.7	–7.4		
			R_L = 100Ω	–6.4	–6.7		
		V_S = ±5V, V_{REF} = 0V, R_L = 1k		±3.8	±4.0		
G_E	Gain Error	V_O = ±3V	R_L = 1k		0.5	3.0	%
			R_L = 100Ω		0.5	3.0	
SR	Slew Rate	V_O = ±1V, R_L = 1k, (Note 4, 8)		350	500		V/µs
FPBW	Full Power Bandwidth	V_O = 6Vp-p, (Note 5)		18.5	26.5		MHz
BW	Small Signal Bandwidth				35		MHz
t_r, t_f	Rise Time, Fall Time	R_L = 1k, V_O = ±500mV, 20% to 80%, (Note 8)		4.0	6.0	8.0	ns
t_{PD}	Propagation Delay	R_L = 1k, V_O = ±125mV, 50% to 50%			6.5		ns
	Overshoot	V_O = ±125mV			0		%

LINEAR TECHNOLOGY

ELECTRICAL CHARACTERISTICS

$V_S = \pm5V$, $V_{REF} = 0V$, Null pins 1 and 8 open circuit, $T_A = 25°C$, $C_L \le 10pF$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	LT1194M/C MIN	TYP	MAX	UNITS
t_S	Settling Time	3V Step, 0.1%, (Note 6)		200		ns
Diff A_V	Differential Gain	$R_L = 150\Omega$, (Note 7)		0.2		%
Diff Ph	Differential Phase	$R_L = 150\Omega$, (Note 7)		0.08		Deg p-p
I_S	Supply Current			35	43	mA

ELECTRICAL CHARACTERISTICS

$V_S+ = +5V$, $V_S- = 0V$, $V_{REF} = +2.5V$, Null pins 1 and 8 open circuit, $T_A = 25°C$, $C_L \le 10pF$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS		LT1194M/C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage				2.0	8.0	mV
I_{OS}	Input Offset Current				0.2	3.0	µA
I_B	Input Bias Current				±0.5	±3.0	µA
	Input Voltage Range			+2.0		+3.5	V
CMRR	Common Mode Rejection Ratio	$V_{CM} = +2.0V$ to $+3.5V$		55	70		dB
V_{LIM}	Output Voltage Limit	$V_i = \pm0.5V$, $V_C = +2V$, (Note 3)			±20	±120	mV
V_{OUT}	Output Voltage Swing	$R_L = 100\Omega$ to Ground	V_{OUT} High	3.6	3.8		V
			V_{OUT} Low		0.25	0.4	
SR	Slew Rate	$V_O = +1V$ to $+3V$			250		V/µs
BW	Small Signal Bandwidth				32		MHz
I_S	Supply Current				32	40	mA

ELECTRICAL CHARACTERISTICS

$V_S+ = \pm5V$, $V_{REF} = 0V$, Null pins 1 and 8 open circuit, $-55°C \le T_A \le 125°C$, unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS			LT1194M MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage			●		1.0	9.0	mV
$\Delta V_{OS}/\Delta T$	Input V_{OS} Drift			●		6.0		µV/°C
I_{OS}	Input Offset Current			●		0.8	5.0	µA
I_B	Input Bias Current			●		±1.0	±5.5	µA
	Input Voltage Range			●	−2.5		+3.5	V
CMRR	Common Mode Rejection Ratio	$V_{CM} = -2.5V$ to $+3.5V$		●	58	80		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm2.375V$ to $\pm5.0V$		●	60	80		dB
V_{LIM}	Output Voltage Limit	$V_i = \pm0.5V$, $V_C = +2V$, (Note 3)		●		±20	±150	mV
V_{OUT}	Output Voltage Swing	$V_S = \pm8V$ $V_{REF} = +3V$	$R_L = 1k$	●	+6.0	+6.6		V
			$R_L = 100\Omega$	●	+5.9	+6.5		
		$V_S = \pm8V$ $V_{REF} = -3V$	$R_L = 1k$	●	−6.1	−6.7		
			$R_L = 100\Omega$	●	−6.0	−6.5		
G_E	Gain Error	$V_O = \pm3V$, $R_L = 1k$		●		1.0	5.0	%
I_S	Supply Current			●		35	43	mA

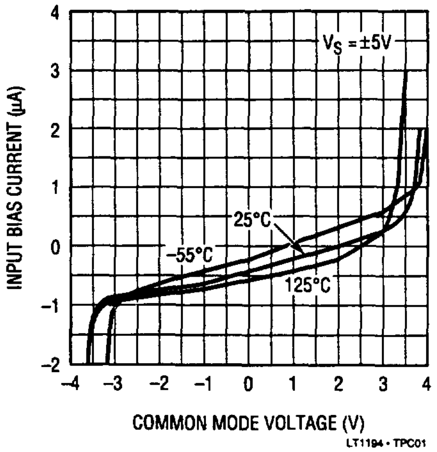
ELECTRICAL CHARACTERISTICS

V_S+ = ±5V, V_{REF} = 0V, Null pins 1 and 8 open circuit, 0°C ≤ T_A ≤ 70°C, unless otherwise noted.

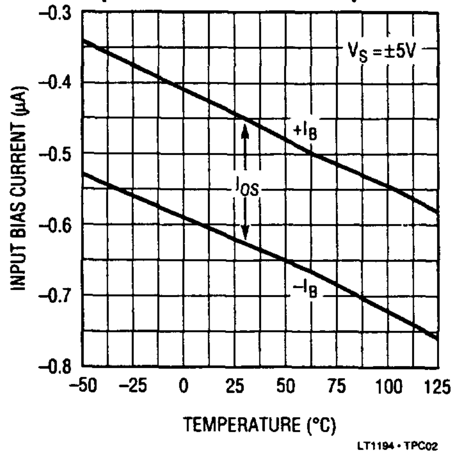
SYMBOL	PARAMETER	CONDITIONS		LT1194C MIN	TYP	MAX	UNITS
V_{OS}	Input Offset Voltage		●		1.0	7.0	mV
$\Delta V_{OS}/\Delta T$	Input V_{OS} Drift		●		6.0		μV/°C
I_{OS}	Input Offset Current		[illegible]		[illegible]	[illegible]	

TYPICAL PERFORMANCE CHARACTERISTICS

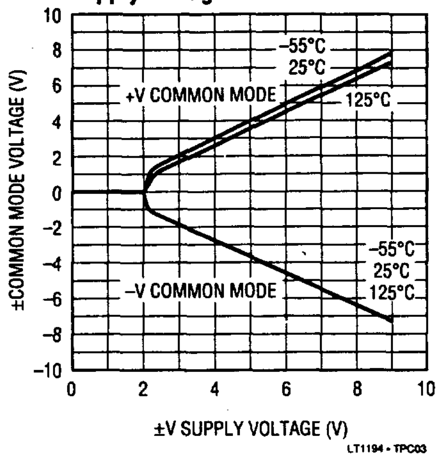
Input Bias Current vs Common Mode Voltage



Input Bias Current vs Temperature



Common Mode Voltage vs Supply Voltage



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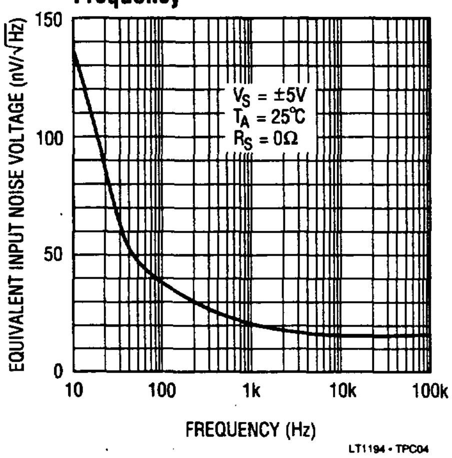
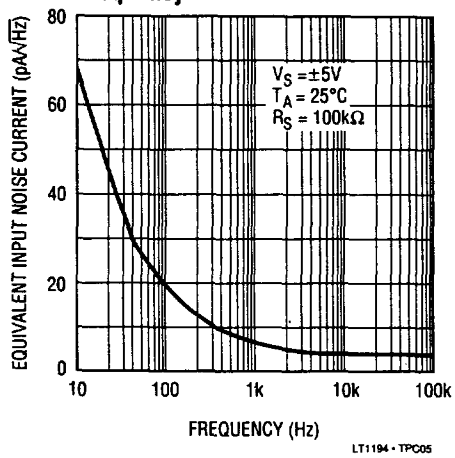
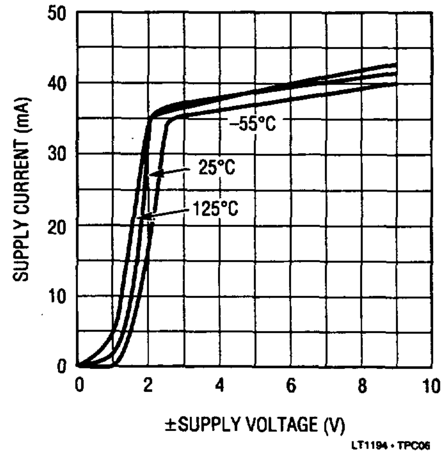
Equivalent Input Noise Voltage vs Frequency



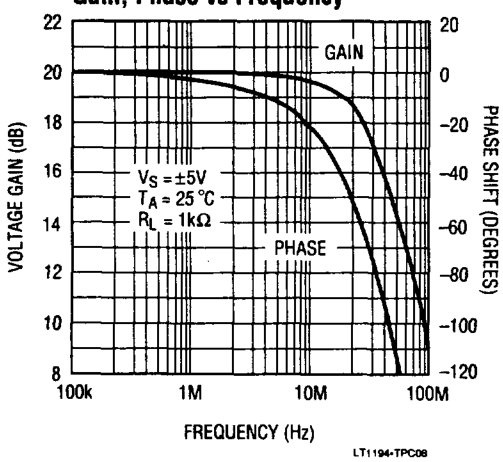
Equivalent Input Noise Current vs Frequency



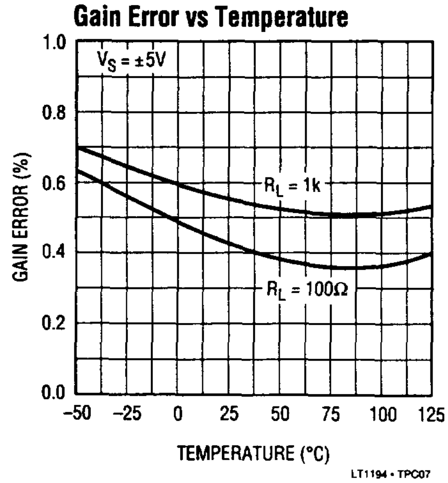
Supply Current vs Supply Voltage



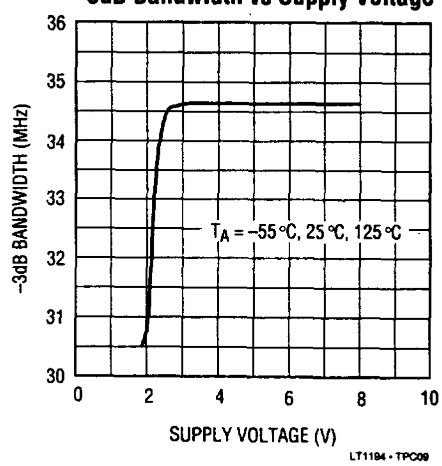
Gain, Phase vs Frequency



Gain Error vs Temperature

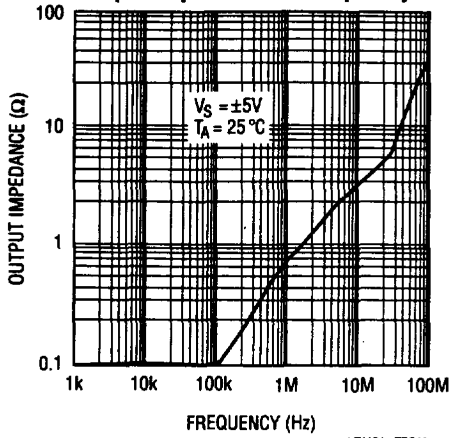


−3dB Bandwidth vs Supply Voltage



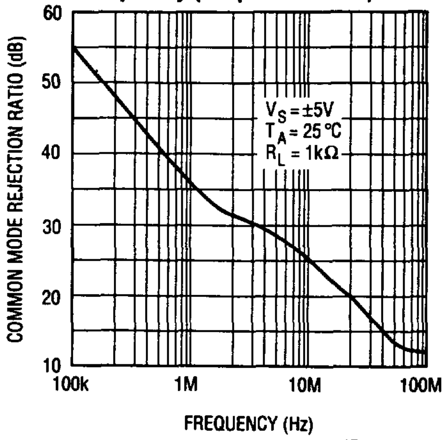
TYPICAL PERFORMANCE CHARACTERISTICS

Output Impedance vs Frequency



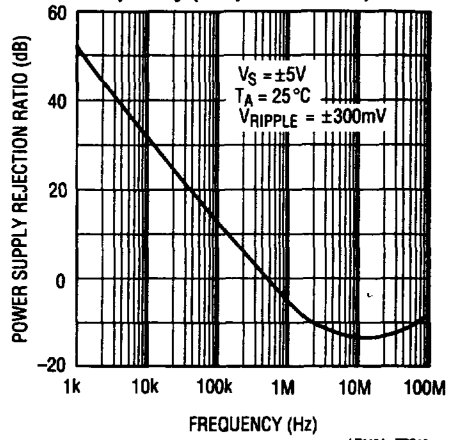
LT1194 • TPC10

Common Mode Rejection Ratio vs Frequency (Output Referred)



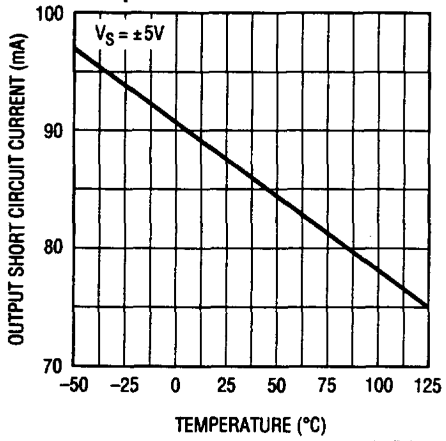
LT1194 • TPC11

Power Supply Rejection Ratio vs Frequency (Output Referred)



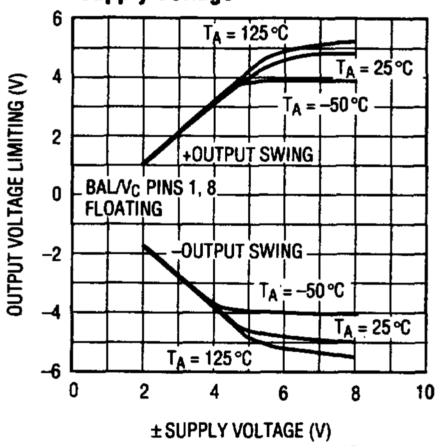
LT1194 • TPC12

Output Short Circuit Current vs Temperature



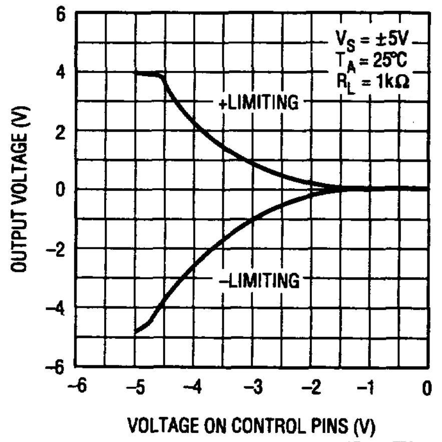
LT1194 • TPC13

Output Voltage Limiting vs Supply Voltage



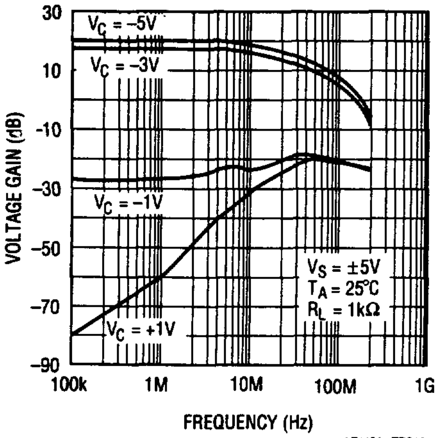
LT1194 • TPC14

Output Voltage vs Voltage On Control Pins



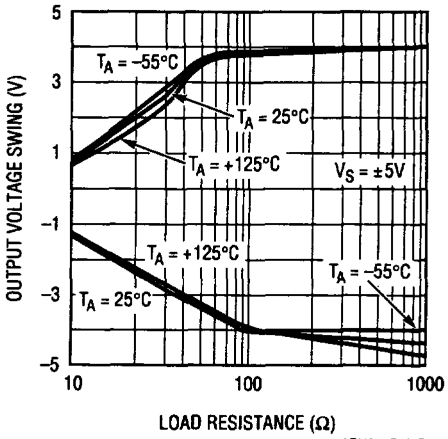
LT1194 • TPC15

Voltage Gain vs Frequency with Control Voltage



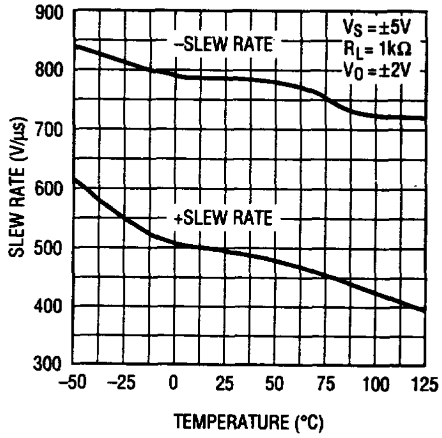
LT1194 • TPC16

Output Voltage Swing vs Load Resistance



LT1194 • TPC17

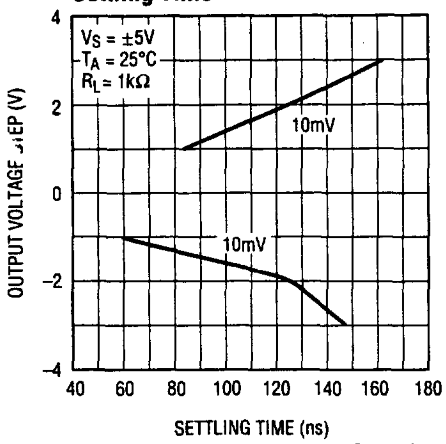
Slew Rate vs Temperature



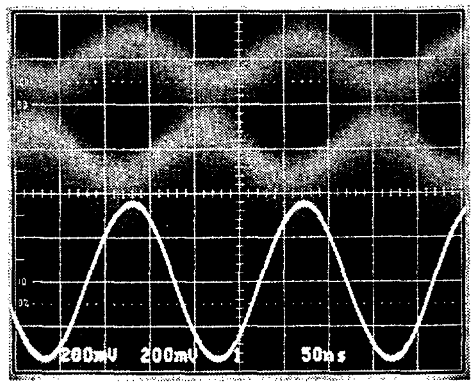
LT1194 • TPC18

TYPICAL PERFORMANCE CHARACTERISTICS

Output Voltage Step vs Settling Time



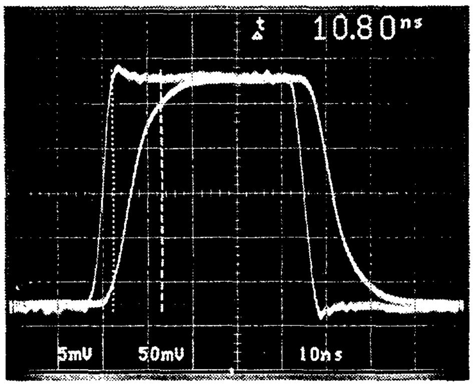
Common Mode Rejection



5MHz SINE WAVE RECOVERED FROM COMMON MODE NOISE

LT1194 • TPC22

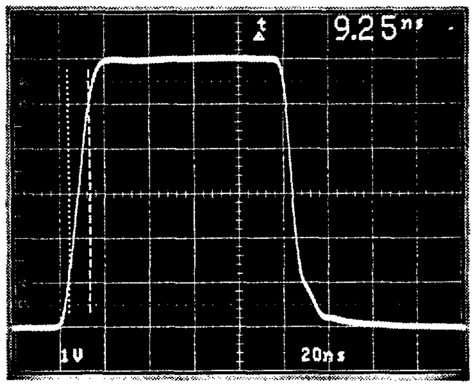
Small Signal Transient Response



RISE TIME = 10.8ns, PROPAGATION DELAY = 6ns

LT1194 • TPC21

Large Signal Transient Response



R_L = 150Ω, + SR = 430V/µs, –SR = 500V/µs

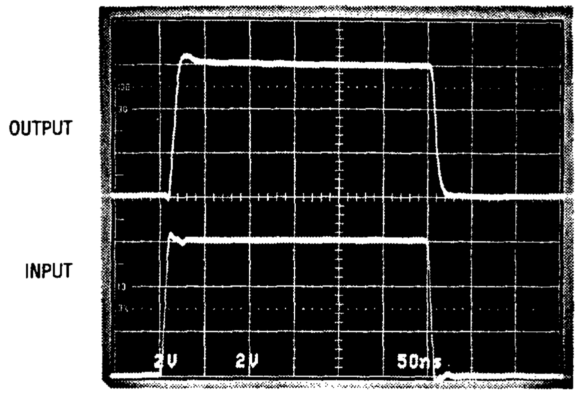
LT1194 • TPC20

2

APPLICATIONS INFORMATION

The LT1194 is a video difference amplifier with a fixed gain of 10 (20dB). The amplifier has two uncommitted high input impedance (+) and (–) inputs which can be used either differentially or single-ended. The LT1194 includes a Limiting feature which allows the amplifier to reduce its output as a function of DC voltage on the BAL/V_C pins. The Limiting feature uses input differential pair limiting to prevent overload in subsequent stages. This technique allows extremely fast limiting action.

Input Limiting



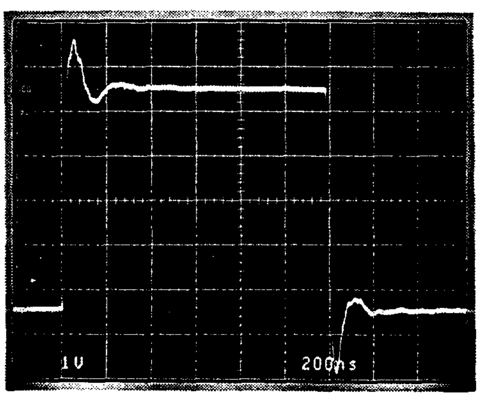
20dB INPUT OVERDRIVE V_C = –4.2V

LT1194 • TA06

Power Supply Bypassing

The LT1194 is quite tolerant of power supply bypassing. In some applications a 0.1µF ceramic disc capacitor placed 1/2 inch from the amplifier is all that is required. A scope photo of the amplifier output with no supply bypassing is used to demonstrate this bypassing tolerance, R_L = 1kΩ.

No Supply Bypass

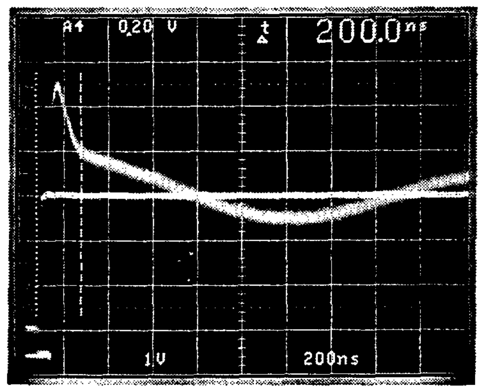


IN DEMO BOARD, R_L = 1kΩ

LT1194 • TA07

In many applications, and those requiring good settling time, it is important to use multiple bypass capacitors. A 0.1µF ceramic disc in parallel with a 4.7µF tantalum is recommended. Two oscilloscope photos with different bypass conditions are used to illustrate the settling time characteristics of the amplifier. Note that although the output waveform looks acceptable at 1V/div, when amplified to 10mV/div the settling time to 10mV is 200ns. The time drops to 162ns with multiple bypass capacitors, and does not exhibit the characteristic power supply ringing.

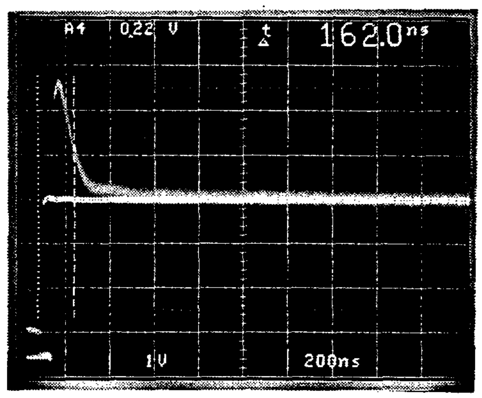
Settling Time Poor Bypass



SETTLING TIME TO 10mV,
SUPPLY BYPASS CAPACITORS = 0.1µF

LT1194 • TA08

Settling Time Good Bypass



SETTLING TIME TO 10mV, SUPPLY BYPASS CAPACITORS = 0.1µF + 4.7µF TANTALUM

LT1194 • TA09

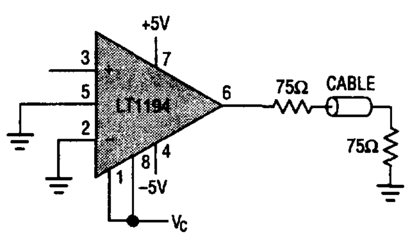
APPLICATIONS INFORMATION

Cable Terminations

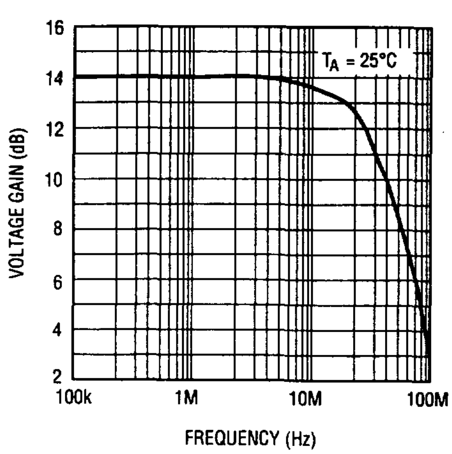
The LT1194 video difference amplifier has been optimized as a low cost cable driver. The ±50mA guaranteed output current enables the LT1194 to easily deliver 7.5Vp-p into 100Ω, while operating on ±5V supplies, or 2.6Vp-p on a single 5V supply.

When driving a cable it is important to terminate the cable to avoid unwanted reflections. This can be done in one of two ways: single termination or double termination. With single termination, the cable must be terminated at the receiving end (75Ω to ground) to absorb unwanted energy. The best performance can be obtained by double termination (75Ω in series with the output of the amplifier, and 75Ω to ground at the other end of the cable). This termination is preferred because reflected energy is absorbed at each end of the cable. When using the double termination technique it is important to note that the signal is attenuated by a factor of 2, or 6dB. For a cable driver with a gain of +5 (LT1194 gain of +10), the −3dB bandwidth is over 30MHz with no peaking.

Double Terminated Cable Driver



Voltage Gain vs Frequency



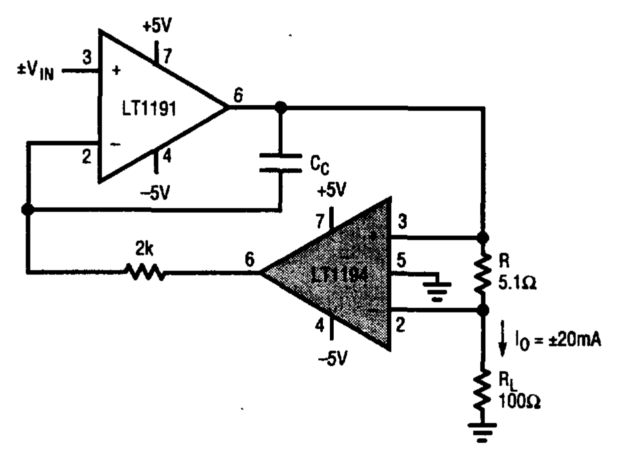
A Voltage Controlled Current Source

The LT1194 can be used to make a fast, precise, voltage controlled current source. The LT1194 high speed differential amplifier senses the current delivered to the load. The input signal V_{IN}, applied to the (+) input of the LT1191, will appear at the (−) input if the feedback loop is properly closed. In steady state the input signal appears at the output of the LT1194, and 1/10 of this signal is applied across the sense resistor. Thus the output current is simply:

$$I_O = \frac{V_{IN}}{R \times 10}$$

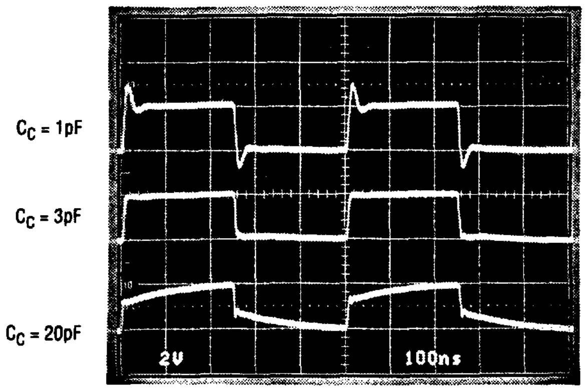
The compensation capacitor C_C forces the LT1191 to be the dominate pole for the loop, while the LT1194 is fast enough to be transparent in the feedback path. The ratio of the load resistor to the sense resistor should be approximately 10:1 or greater for easy compensation. For the example shown the load resistor is 100Ω, the sense resistor is 5.1Ω, and various loop compensation capacitors cause the output to exhibit an underdamped, critically, and overdamped response.

Voltage Controlled Current Source



APPLICATIONS INFORMATION

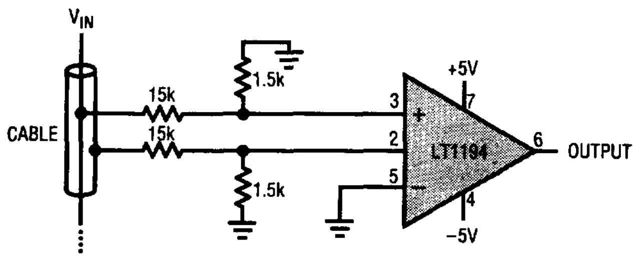
Output Current Response



±20mA CURRENT SOURCE WITH DIFFERENT COMPENSATION CAPACITORS

LT1194 • TA16

Differential Video Loop Thru Amplifier for Power Down Applications



1% RESISTOR WORST CASE CMRR = 22dB
TYPICALLY = 38dB

LT1194 • TA17

Murphy Circuits

There are several precautions the user should take when using the LT1194 in order to realize its full capability. Although the LT1194 can drive a 50pF capacitive load, isolating the capacitance with 10Ω can be helpful. Precautions primarily have to do with driving large capacitive loads.

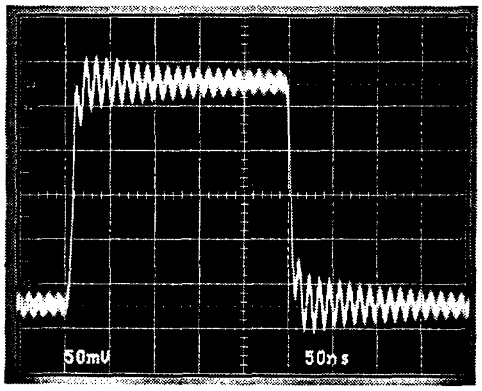
Other precautions include:

1. Use a ground plane (see Design Note 50, High Frequency Amplifier Evaluation Board).

2. Do not use high source impedances. The input capacitance of 2pF, and R_S = 10kΩ, for instance, will give an 8MHz –3dB bandwidth.

3. PC board socket may reduce stability.

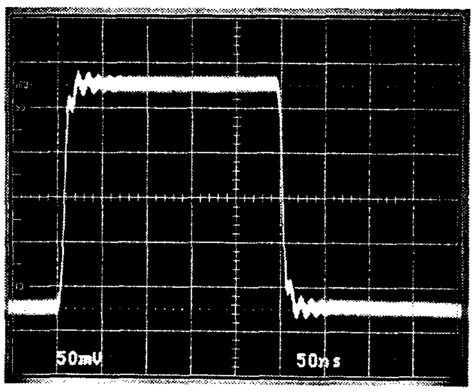
Driving Capacitive Load



LT1194 IN DEMO BOARD, C_L = 50pF

LT1194 • TA11

Driving Capacitive Load

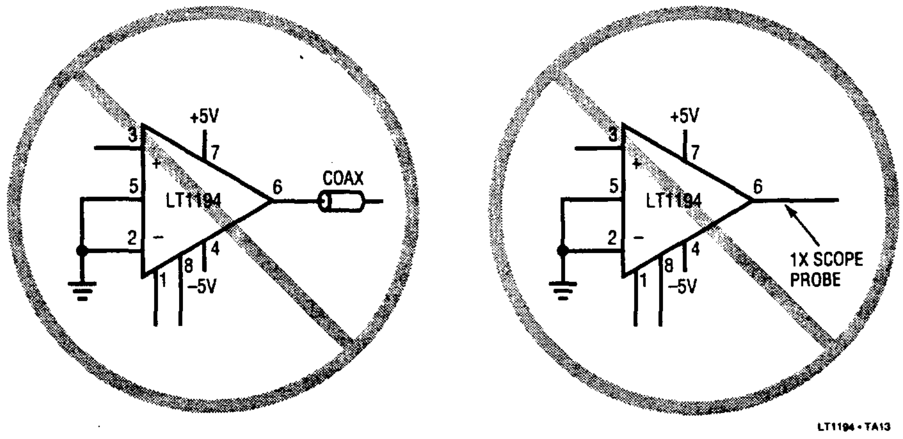


LT1194 IN DEMO BOARD, C_L = 50pF
WITH 10Ω ISOLATING RESISTOR

LT1194 • TA12

APPLICATIONS INFORMATION

Murphy Circuits



An Unterminated Cable Is a Large Capacitive Load

A 1X Scope Probe Is a Large Capacitive Load

2

SIMPLIFIED SCHEMATIC