élantec
HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

EL2099C

Video Distribution Amplifier

Features

- 50 MHz −3 dB bandwidth, $A_V = +2$
- Differential gain 0.03%
- Differential phase 0.05°
- Output short circuit current 800 mA
- Can drive six 75Ω double terminated cables ±11V
- Slew rate = 1000V/μs
- Wide supply voltage range ±5V to ±15V

Applications

- Video line driver
- ATE pin driver
- High speed data acquisition

Ordering Information

Part No.	Temp. Range	Pkg.	Outline#
EL2099CT	0°C to +75°C	5-Pin TO-220	MDP0028

General Description

The EL2099C is a high speed, monolithic operational amplifier* featuring excellent video performance and high output current capability. Built using Elantec's Complementary Bipolar process, the EL2099C uses current mode feedback to achieve wide bandwidth, and is stable in unity gain configuration.

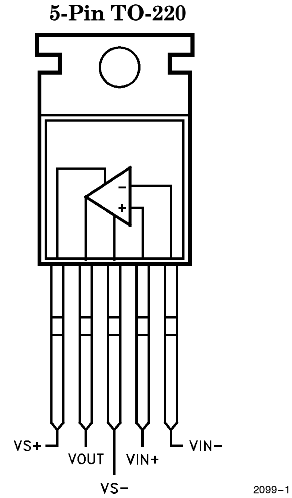
Operation from power supplies ranging from ±5V to ±15V makes the EL2099C extremely versatile. With supplies at ±15V, the EL2099C can deliver ±11V into 25Ω at slew rates of 1000V/μs. At ±5V supplies, output voltage range is ±3V into 25Ω. Its speed and output current capability make this device ideal for video line driver and automatic test equipment applications.

Differential Gain and Phase of the EL2099C are 0.03% and 0.05° respectively, and −3 dB bandwidth is 50 MHz. These features make the EL2099C especially well suited for video distribution applications.

Elantec products and facilities comply with MIL-I-45208A, and other applicable quality specifications. For information on Elantec's processing, see Elantec document, QRA-1: *Elantec's Processing, Monolithic Integrated Circuits.*

Connection Diagram

5-Pin TO-220



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Manufactured under U.S. Patent Nos. 5,179,355, 4,893,091, U.K. Patent No. 2261786.

Absolute Maximum Ratings (T_A = 25°C)

Voltage between V_S+ and V_S-	+33V
Voltage at V_S+	+16.5V
Voltage at V_S-	−16.5V
Voltage between $V_{IN}+$ and $V_{IN}-$	±6V
Current into $V_{IN}+$ or $V_{IN}-$	±10 mA
Internal Power Dissipation	See Curves
Operating Ambient Temperature Range	0°C to +75°C
Operating Junction Temperature	150°C
Storage Temperature Range	−65°C to +150°C

Important Note:
All parameters having Min/Max specifications are guaranteed. The Test Level column indicates the specific device testing actually performed during production and Quality inspection. Elantec performs most electrical tests using modern high-speed automatic test equipment, specifically the LTX77 Series system. Unless otherwise noted, all tests are pulsed tests, therefore $T_J = T_C = T_A$.

Test Level	Test Procedure
I	100% production tested and QA sample tested per QA test plan QCX0002.
II	100% production tested at T_A = 25°C and QA sample tested at T_A = 25°C, T_{MAX} and T_{MIN} per QA test plan QCX0002.
III	QA sample tested per QA test plan QCX0002.
IV	Parameter is guaranteed (but not tested) by Design and Characterization Data.
V	Parameter is typical value at T_A = 25°C for information purposes only.

Open Loop DC Electrical Characteristics

V_S = ±15V, R_L = 25Ω, T_A = 25°C unless otherwise specified

Parameter	Description	Temp	Min	Typ	Max	Test Level	Units
V_{OS}	Input Offset Voltage	25°C		5	20	I	mV
		T_{MIN}, T_{MAX}			25	IV	mV
TC V_{OS}	Average Offset Voltage Drift	Full		20		V	μV/°C
$+I_{IN}$	+Input Current	25°C		5	20	I	μA
		T_{MIN}, T_{MAX}			30	IV	μA
$-I_{IN}$	−Input Current	25°C		8	35	I	μA
		T_{MIN}, T_{MAX}			50	IV	μA
CMRR	Common Mode Rejection Ratio (Note 1)	25°C	50	60		I	dB
PSRR	Power Supply Rejection Ratio (Note 2)	25°C	60	70		I	dB
R_{OL}	Transimpedance	25°C	85	140		I	kΩ
$+R_{IN}$	+Input Resistance (Note 3)	25°C	700	1000		I	kΩ
		T_{MIN}, T_{MAX}	600			IV	kΩ
$+C_{IN}$	+Input Capacitance	25°C		3		V	pF
CMIR	Common Mode Input Range	25°C		±12.5		V	V

TD is 3.2in

Open Loop DC Electrical Characteristics — Contd.

$V_S = \pm15V$, $R_L = 25\Omega$, $T_A = 25°C$ unless otherwise specified

Parameter	Description	Temp	Min	Typ	Max	Test Level	Units
V_O	Output Voltage Swing $V_S = \pm15V$	25°C	±9	±11		I	V
	Output Voltage Swing $V_S = \pm5V$	25°C	±2.4	±3.0		I	V
I_{OUT}	Output Current	25°C	360	440		I	mA
I_{SC}	Output Short-Circuit Current	25°C	600	800		I	mA
		T_{MIN}, T_{MAX}		800		V	mA
I_S	Supply Current	25°C		32	45	I	mA

Closed Loop AC Electrical Characteristics

$V_S = \pm15V$, $A_V = +2$, $R_F = 510\Omega$, $R_L = 25\Omega$, $T_A = 25°C$ unless otherwise specified

Paremeter	Description	Min	Typ	Max	Test Level	Units
SR	Slew Rate (Notes 4, 7)	500	1000		IV	V/µs
BW	−3 dB Bandwidth (Note 7)		50		V	MHz
Peaking	(Note 7)		0.3		V	dB
t_r, t_f	Rise Time, Fall Time (Notes 5, 7)		7		V	ns
dG	Differential Gain; DC Input Offset from 0V through +0.714V, AC Amplitude 286 mV_{p-p}, f = 3.58 MHz (Notes 6, 7)		0.03		V	%
dP	Differential Phase; DC Input Offset from 0V through +0.714V, AC Amplitude 286 mV_{p-p}, f = 3.58 MHz (Notes 6, 7)		0.05		V	deg. (°)

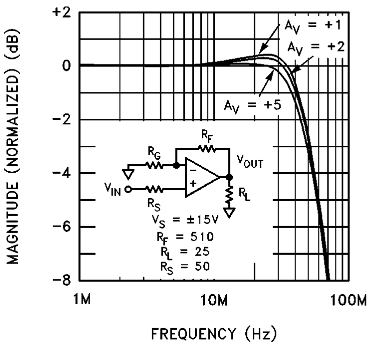
Note 1: The input is moved from −10V to +10V.
Note 2: The supplies are moved from ±5V to ±15V.
Note 3: $V_{IN} = \pm5V$. See typical performance curve for larger values of V_{IN}.
Note 4: Slew Rate is with V_{OUT} from +5V to −5V and measured at 20% and 80%.
Note 5: Rise and Fall Times are with V_{OUT} between −0.5V and +0.5V and measured at 10% and 90%.
Note 6: See typical performance curves for other conditions.
Note 7: All AC tests are performed on a "warmed up" part, except for Slew Rate, which is pulse tested.

TD is 1.7in

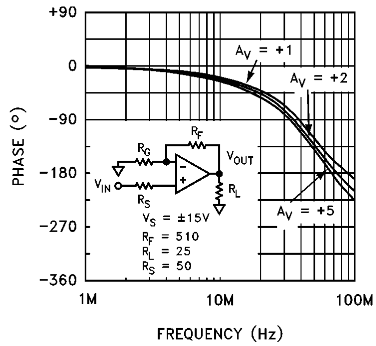
TD is 2.4in

Typical Performance Curves (T_A = 25°C, R_L = 25Ω, A_V = +2, R_F = 510 unless otherwise specified)

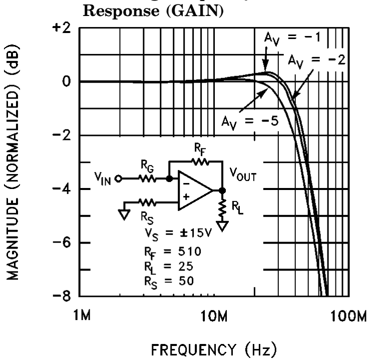
Non-Inverting Frequency Response (GAIN)



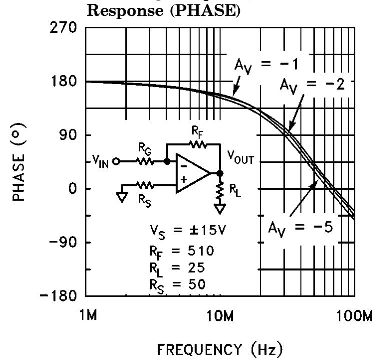
Non-Inverting Frequency Response (PHASE)



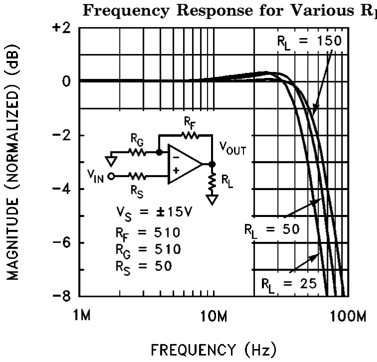
Inverting Frequency Response (GAIN)



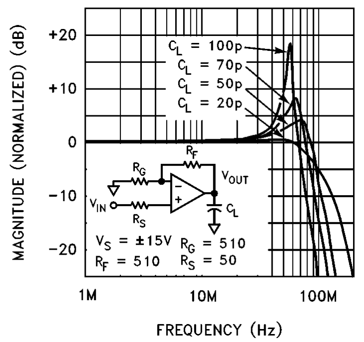
Inverting Frequency Response (PHASE)



Frequency Response for Various R_L



Frequency Response for Various C_L



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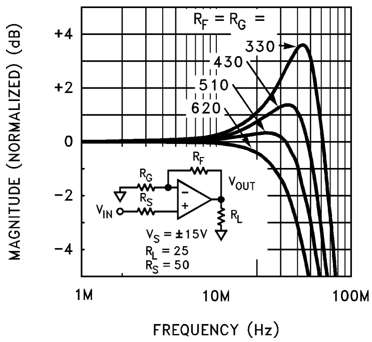
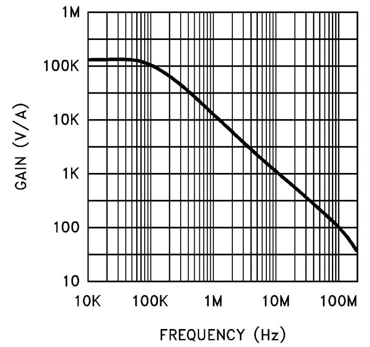
Typical Performance Curves

(T_A = 25°C, R_L = 25Ω, A_V = +2, R_F = 510 unless otherwise specified) — Contd.

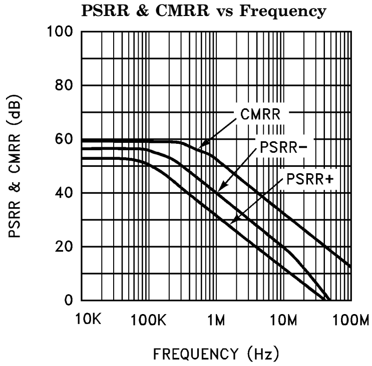
Frequency Response for Various R_F & R_G



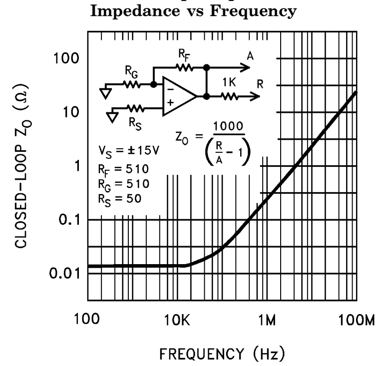
Transimpedance (R_{OL})



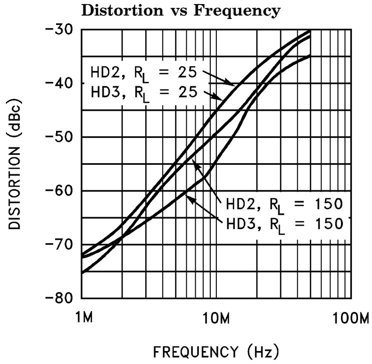
PSRR & CMRR vs Frequency



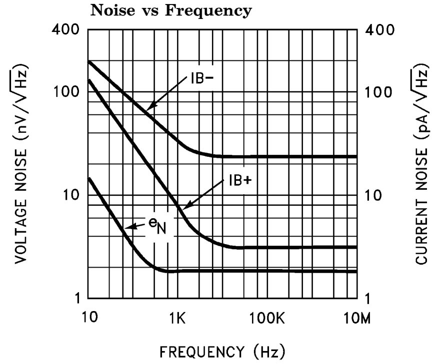
Closed-Loop Output Impedance vs Frequency



2nd and 3rd Harmonic Distortion vs Frequency



Voltage and Current Noise vs Frequency

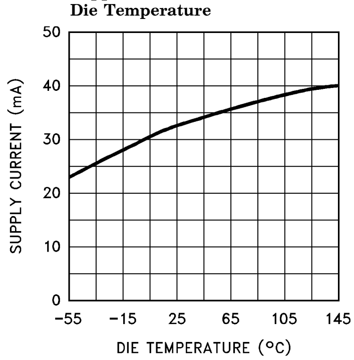


2099-3

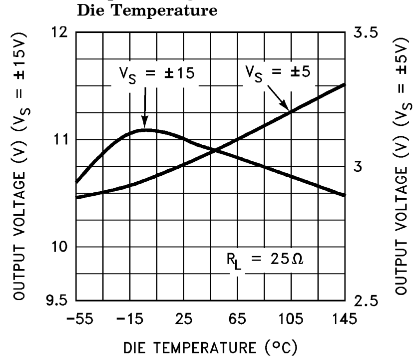
Typical Performance Curves

(T_A = 25°C, R_L = 25Ω, A_V = +2, R_F = 510 unless otherwise specified) — Contd.

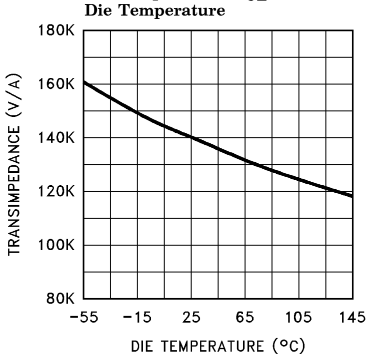
Supply Current vs Die Temperature



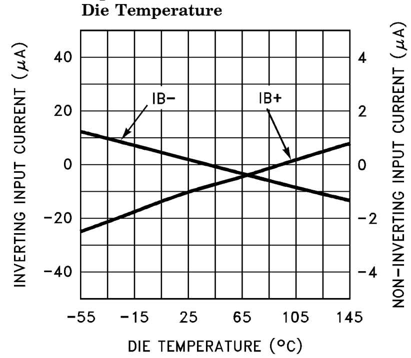
Output Voltage vs Die Temperature



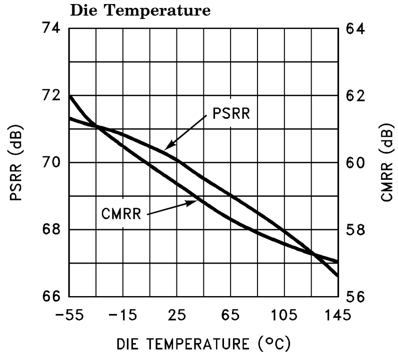
Transimpedance (R_{OL}) vs Die Temperature



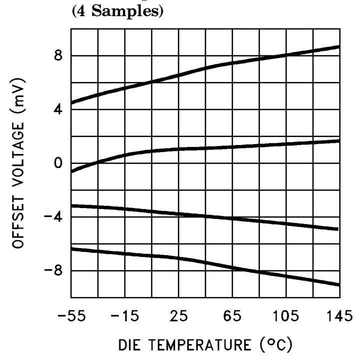
Input Current vs Die Temperature



PSRR & CMRR vs Die Temperature



Offset Voltage vs Die Temperature (4 Samples)



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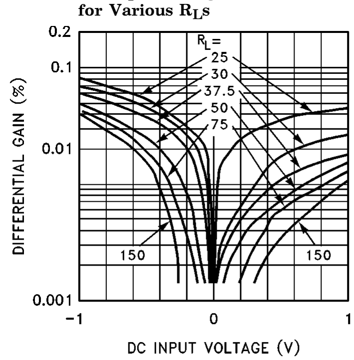
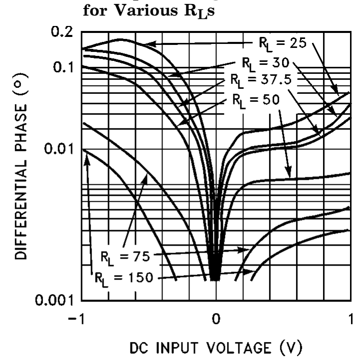
Typical Performance Curves

(T_A = 25°C, R_L = 25Ω, A_V = +2, R_F = 510 unless otherwise specified) — Contd.

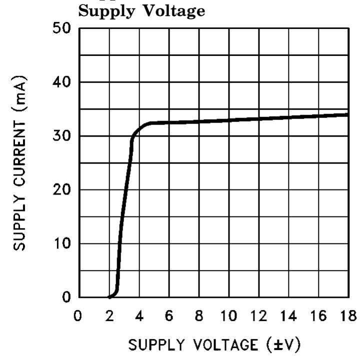
Differential Gain vs DC Input Voltage for Various R_Ls



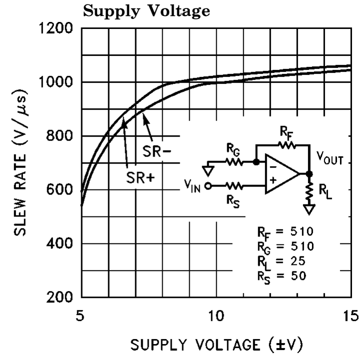
Differential Phase vs DC Input Voltage for Various R_Ls



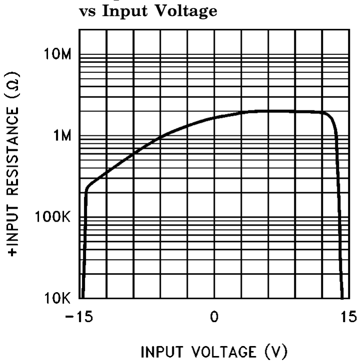
Supply Current vs Supply Voltage



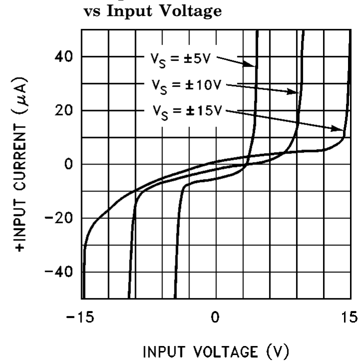
Slew Rate vs Supply Voltage



+Input Resistance vs Input Voltage



+Input Bias Current vs Input Voltage



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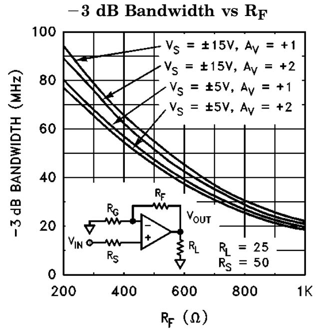
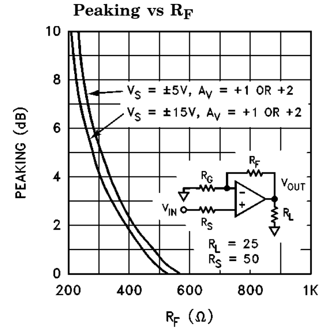
Typical Performance Curves

(T_A = 25°C, R_L = 25Ω, A_V = +2, R_F = 510 unless otherwise specified) — Contd.

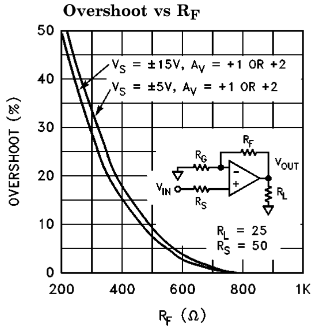
−3 dB Bandwidth vs R_F



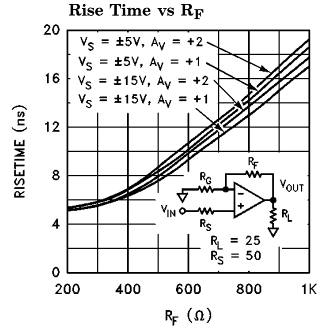
Peaking vs R_F



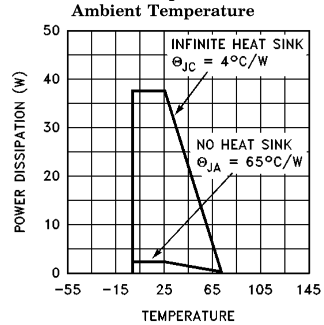
Overshoot vs R_F



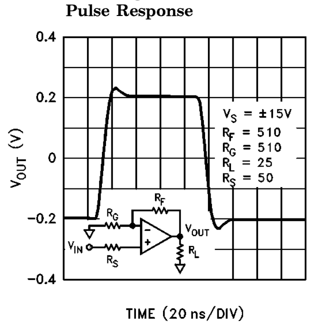
Rise Time vs R_F



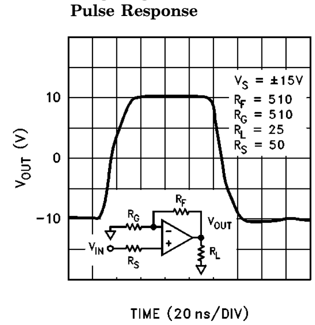
5-Lead TO-220 Maximum Power Dissipation vs Ambient Temperature



Small Signal Pulse Response



Large Signal Pulse Response



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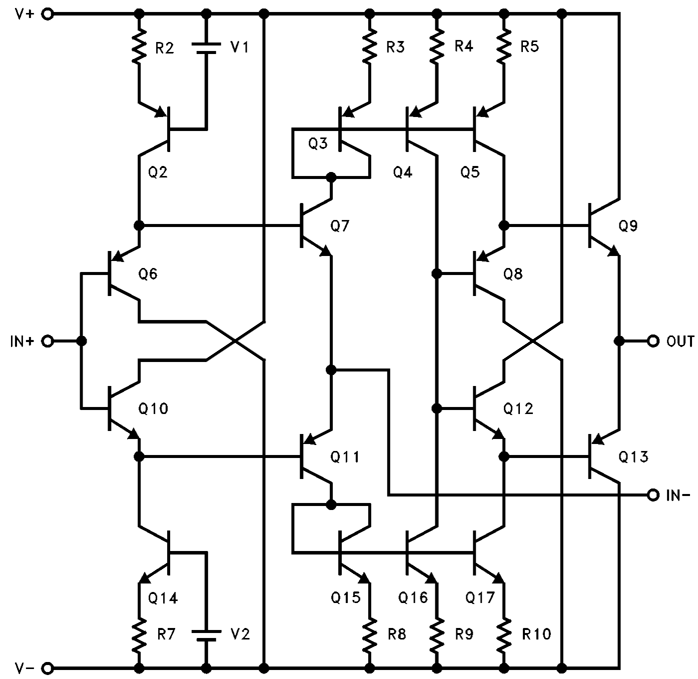
Simplified Schematic



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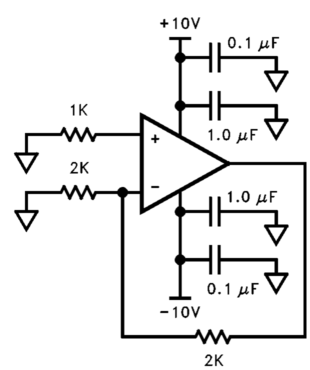
Burn-In Circuit



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Applications Information

Product Description

The EL2099C is a current mode feedback amplifier that has high output current drive capability. It is built using Elantec's proprietary dielectric isolation process that produces NPN and PNP complimentary transistors. The high output current can be useful to drive many standard video loads in parallel, as well as digital sync pulses that are 8V or greater.

+ Input Resistor Value

A small value resistor located in the + Input lead is necessary to keep the EL2099C from oscillating under certain conditions. A 50Ω resistor is recommended for all applications, although smaller values will work under some circumstances. All tests listed in this datasheet are performed with 50Ω in the + Input lead, as well as all typical performance curves. The 50Ω resistor along with the + Input bias current creates an additional typical Offset Voltage of only 250 μV at T = 25°C, and a maximum of 1.25 mV over temperature variations.

Feedback Resistor Values

The EL2099C has been designed and specified with $R_F = 510\Omega$ and $A_V = +2$. This value of feedback resistor yields extremely flat frequency response with little to no peaking. However, 3 dB bandwidth is reduced somewhat because of this. Wider bandwidth, at the expense of slight peaking, can be accomplished by reducing the value of the feedback resistor. For example, at a gain of +2, reducing the feedback resistor to 330Ω increases the −3 dB bandwidth to 70 MHz with 3 dB of peaking. Inversely, larger values of feedback resistor will cause roll off to occur at a lower frequency. There is essentially no peaking with $R_F > 510\Omega$.

Power Supplies

The EL2099C may be operated with single or split supplies as low as ±5V (10V total) to as high as ±18V (36V total). Bandwidth and slew rate are almost constant from $V_S = \pm 10V$ to ±18V, and decrease slightly as supplies are reduced to ±5V, as shown in the characteristic curves. It is not necessary to use equal value split supplies. For example, −5V and −12V would be fine for 0V to 1V video signals.

Good power supply bypassing should be used to reduce the risk of oscillation. A 1 μF to 10 μF tantalum capacitor in parallel with a 0.1 μF ceramic capacitor is recommended for bypassing each supply pin. They should be kept as close as possible to the device pins.

Due to the internal construction of the TO-220 package, the tab of the EL2099C is connected to the V_{S-} pin. Therefore, care must be taken to avoid connecting the tab to the ground plane of the system.

Printed Circuit Board Layout

As with any high frequency device, good printed circuit board layout is necessary for optimum performance. Ground plane construction is highly recommended. Lead lengths should be as short as possible. For good AC performance, parasitic capacitances should be kept to a minimum, especially at the inverting input, which is sensitive to stray capacitance. This implies keeping the ground plane away from this pin. Metal film and carbon resistors are both acceptable, while use of wire-wound resistors is not recommended because of their parasitic inductance. Similarly, capacitors should be low inductance for best performance.

Driving Cables and Capacitive Loads

The EL2099C was designed with driving multiple coaxial cables in mind. With 440 mA of output drive and low output impedance, driving six 75Ω double terminated coaxial cables to ±11V with one EL2099C is practical.

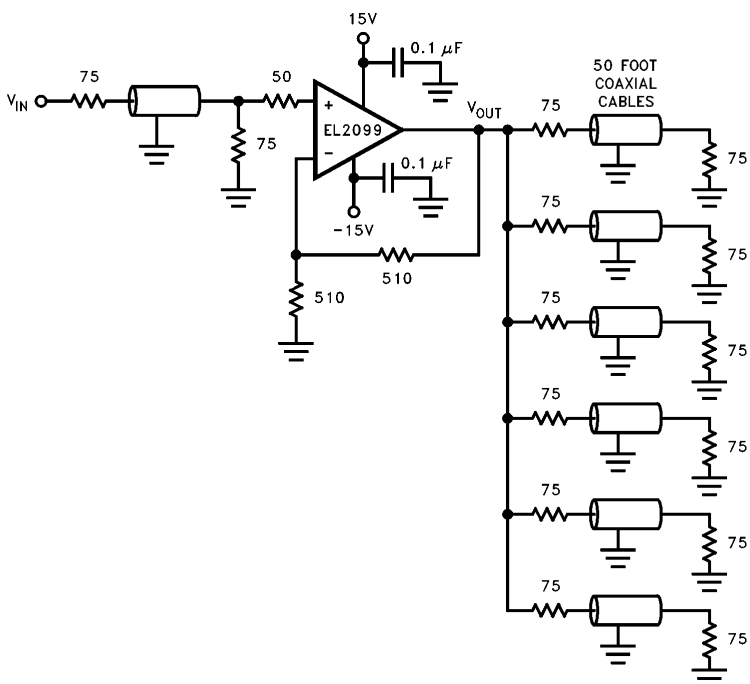
When used as a cable driver, double termination is always recommended for reflection-free performance. For those applications, the back termination series resistor will decouple the EL2099C from the capacitive cable and allow extensive capacitive drive. For a discussion on some of the other ways to drive cables, see the application section on driving cables in the EL2003 data sheet.

Applications Information — Contd.

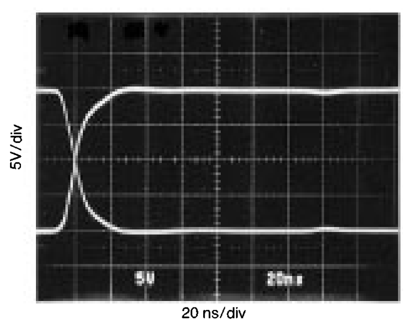
Other applications may have high capacitive loads without termination resistors. In these applications, an additional small value (5Ω–50Ω) resistor in series with the output will eliminate most peaking.

The schematic below shows the EL2099C driving 6 double terminated cables, each of average length of 50 feet.

This represents driving an effective load of 25Ω to over ±10V. The resulting performance is shown in the scope photo. Notice that double termination results in reflection free performance.



2099-10



2099-11

TAB WIDE

EL2099 Macromodel

```
* Connections:    +input
*                 |    -input
*                 |    |    +Vsupply
*                 |    |    |    -Vsupply
*                 |    |    |    |    output
*                 |    |    |    |    |
.subckt M2099     4    5    1    3    2
*
* Input Stage
*
e1 10 0 4 0 1.0
vis 10 9 0V
h2 9 12 vxx 1.0
r1 5 11 50
l1 11 12 48nH
iinp 4 0 5µA
iinm 5 0 -8µA
*
* Slew Rate Limiting
*
h1 13 0 vis 600
r2 13 14 1K
d1 14 0 dclamp
d2 0 14 dclamp
*
* High Frequency Pole
*
*e2 30 0 14 0 0.001667
13 30 17 1.5µH
c5 17 0 1pF
r5 17 0 500
*
* Transimpedance Stage
*
g1 0 18 17 0 1.0
ro1 18 0 150K
cdp 18 0 8pF
*
* Output Stage
*
q1 3 18 19 qp
q2 1 18 20 qn
q3 1 19 21 qn
q4 3 20 22 qp
r7 21 2 1
r8 22 2 1
```


TD is 6.1in

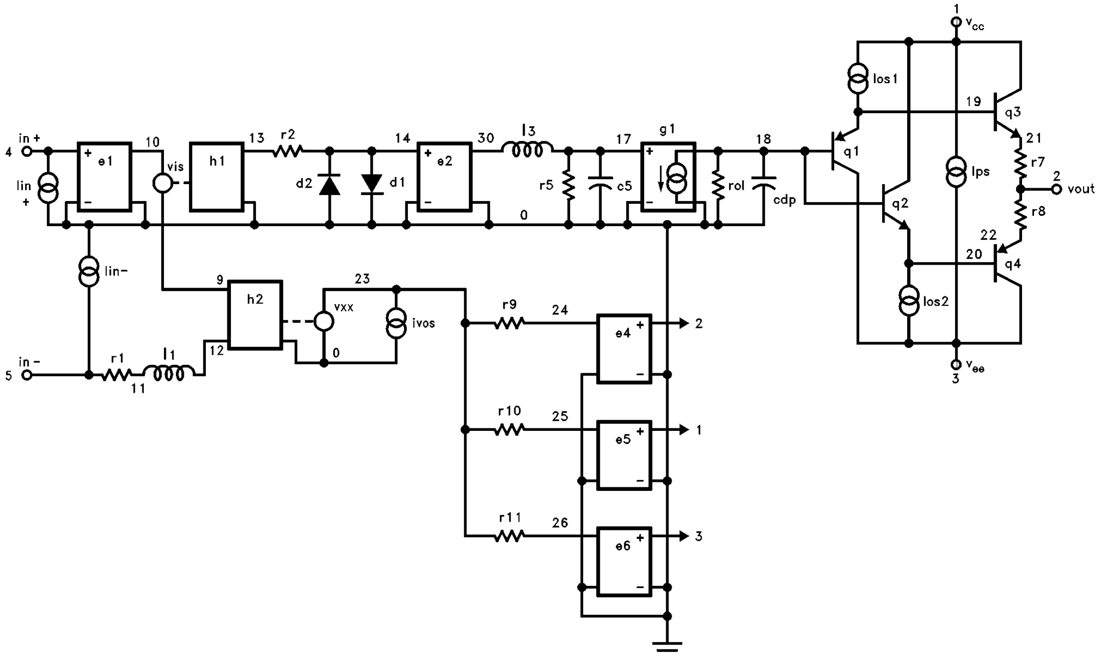
EL2099 Macromodel — Contd.

```
ios1 1 19 5mA
ios2 20 3 5mA
*
* Supply Current
*
ips 1 3 19mA
*
* Error Terms
*
ivos 0 23 5mA
vxx 23 0 0V
e4 24 0 2 0 1.0
e5 25 0 1 0 1.0
e6 26 0 3 0 1.0
r9 24 23 3K
r10 25 23 1K
r11 26 23 1K

* Models
*
.model qn npn (is=5e-15  bf=200  tf=0.1nS)
.model qp pnp (is=5e-15  bf=200  tf=0.1nS)
.model dclamp d (is=1e-30  ibv=0.266  bv=5  n=4)
.ends
```

TD is 3.1in

EL2099 Macromodel — Contd.



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EL2099C

Video Distribution Amplifier

General Disclaimer

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