élantec
HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

# EL2224/EL2224C

*Dual, 60 MHz, Unity Gain Stable, Operational Amplifier*

ELANTEC INC T-79-25



## Features

- Unity gain stable
- Wide bandwidth—60 MHz
- High slew rate—200 V/μs
- High power bandwidth ($\pm 10$ $V_{out}$) 3 MHz
- Large open loop gain 75 dB
- Low power—5 mA/amplifier
- Low input offset—1 mV typ.
- Wide supply voltage range $V_s = \pm 5V$ to $\pm 15V$
- Output short circuit protected

## Applications

- High performance active filters
- Video and pulse amplifiers
- Local area networks
- Wideband amplifiers

## Ordering Information

| Part No. | Temp. Range | Package | Outline # |
|---|---|---|---|
| EL2224CJ | 0°C to +75°C | CerDIP | MDP0010 |
| EL2224CN | 0°C to +75°C | P-DIP | MDP0031 |
| EL2224J | −55°C to +125°C | CerDIP | MDP0010 |
| EL2224J/883B | −55°C to +125°C | CerDIP | MDP0010 |
| EL2224L/883B | −55°C to +125°C | LCC | MDP0007 |
| EL2224CM | 0°C to +75°C | SOL | MDP0027 |

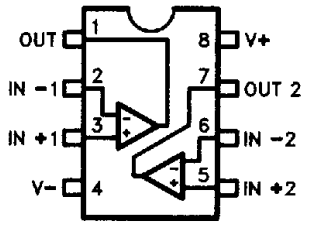
## General Description

The EL2224 monolithic dual operational amplifier is an extension of Elantec's position in high speed analog products. This amplifier features unity gain stability, high slew rate and wide bandwidth, along with an excellent speed power relationship. The dual 60 MHz EL2224 consumes only 10 mA, making it ideal for video applications. The EL2224 has short circuit protected outputs and will operate from $\pm 5V$ to $\pm 15V$. It is fabricated using Elantec's Complementary Bipolar process which allows both fast PNP and NPN transistors to be manufactured on a single chip.

Elantec's products and facilities comply with MIL-STD-883 Revision C, MIL-I-45208A, and other applicable quality specifications. For information on Elantec's military processing, see Elantec document, QRA-2: *"Elantec's Military Processing, Monolithic Integrated Circuits"*.

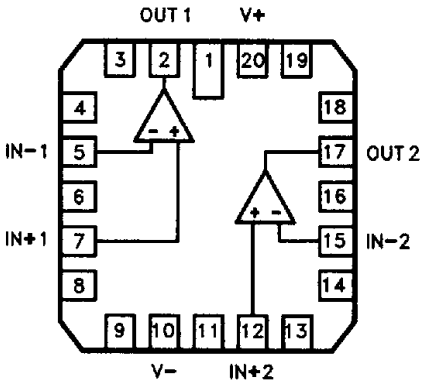
## Connection Diagrams

**EL2224J/CN**



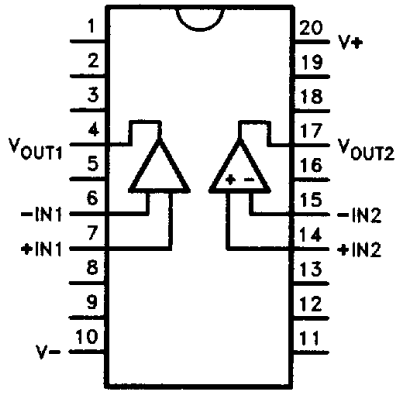

2224-1

**EL2224L**




2224-2

**EL2224CM**




2224-3

This product covered under U.S. Patent No. 4,837,523

# EL2224/EL2224C

ELANTEC INC

## Dual, 60 MHz, Unity Gain Stable, Operational Amplifier

## Absolute Maximum Ratings ($T_A$ = 25°C)

| | |
|---|---|
| Voltage Between V+ and V− | 35V |
| Differential Input Voltage | ±6V |
| Internal Power Dissipation | See Curves |
| Peak Output Current | Short Circuit Protected |
| Output Short Circuit Duration (Note 1) | Continuous |

| | |
|---|---|
| Operational Temperature Range | |
| EL2224 | −55°C to +125°C |
| EL2224C | 0°C to +75°C |
| Storage Temperature Range | −65°C to +150°C |
| Maximum Junction Temperature | |
| CerDIP, LCC | 175°C |
| Plastic DIP, SOL | 150°C |
| Lead Temperature | |
| DIP Package | 300°C |
| SOL Package | |
| Vapor Phase (60 seconds) | 215°C |
| Infrared (15 seconds) | 220°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. |

## DC Electrical Characteristics $V_S$ = ±15V; $R_L$ = 2 kΩ, unless otherwise specified

| Parameter | Description | EL2224 | | | | | EL2224C | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Temp | Min | Typ | Max | Test Level | Min | Typ | Max | Test Level | |
| $V_{OS}$ | Offset Voltage | +25°C<br>Full | | 0.5 | 5<br>8 | I<br>I | | 0.5 | 5<br>8 | I<br>III | mV<br>mV |
| $TCV_{OS}$ | Average Offset Voltage Drift | Full | | 20 | | V | | 20 | | V | µV/°C |
| $I_B$ | Bias Current | +25°C<br>Full | | 1.5 | 4<br>6 | I<br>I | | 1.5 | 4<br>6 | I<br>III | µA<br>µA |
| $I_{OS}$ | Offset Current | +25°C<br>Full | | 0.2 | 2<br>3 | I<br>I | | 0.2 | 2<br>3 | I<br>III | µA<br>µA |
| $R_{IN}$ | Input Resistance | +25°C | | 40 | | V | | 40 | | V | kΩ |
| $C_{IN}$ | Input Capacitance | +25°C | | 1 | | V | | 1 | | V | pF |
| $V_{CM}$ | Common Mode Input Range | Full | ±10 | ±12 | | I | ±10 | ±12 | | II | V |
| $e_{IN}$ | Input Noise Voltage (f = 1 kHz, $R_G$ = 0Ω) | +25°C | | 15 | | V | | 15 | | V | nV/√Hz |
| $A_{VOL}$ | Large Signal Voltage Gain (Notes 2, 3) | +25°C<br>Full | 4k<br>2.5k | 6k | | I | 4k<br>2.5k | 6k | | I<br>III | V/V<br>V/V |

## DC Electrical Characteristics $V_S = \pm 15V$; $R_L = 2\ k\Omega$, unless otherwise specified — Contd.

| Parameter | Description | EL2224 | | | | | EL2224C | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Temp | Min | Typ | Max | Test Level | Min | Typ | Max | Test Level | |
| CMRR | Common-Mode Rejection Ratio (Note 4) | Full | 70 | 80 | | I | 60 | 80 | | II | dB |
| $V_O$ | Output Voltage Swing | Full | ±11 | ±12.5 | | I | ±11 | ±12.5 | | II | V |
| $I_{SC}$ | Short Circuit Current | 25°C | | ±50 | ±70 | I | | ±50 | ±70 | I | mA |
| $R_O$ | Output Resistance | 25°C | | 40 | | V | | 40 | | V | Ω |
| $I_s$ | Supply Current | Full | | 9.5 | 13 | I | | 9.5 | 13 | II | mA |
| PSRR | Power Supply Rejection Ratio (Note 5) | Full | 60 | 75 | | I | 60 | 75 | | II | dB |

## AC Electrical Characteristics $V_S = \pm 15V$; $R_L = 2\ k\Omega$, unless otherwise specified

| Parameter | Description | EL2224 | | | | | EL2224C | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Temp | Min | Typ | Max | Test Level | Min | Typ | Max | Test Level | |
| $f_u$ | Open Loop Unity Bandwidth (Note 6) | 25°C | | 60 | | V | | 60 | | V | MHz |
| FPBW | Full Power Bandwidth (Notes 2, 7) | 25°C | 2.4 | 3.1 | | I | 2.4 | 3.1 | | I | MHz |
| $t_r$ | Rise Time (Note 8) | 25°C | | 6 | | V | | 6 | | V | ns |
| OS | Overshoot (Note 8) | 25°C | | 20 | | V | | 20 | | V | % |
| SR | Slew Rate (Note 8) | 25°C | 150 | 200 | | I | 150 | 200 | | I | V/μs |
| $t_s$ | Settling Time (Notes 9, 10) 10V Step to 0.05% | 25°C | | 120 | | V | | 120 | | V | ns |
| Ch $S_p$ | Channel Separation (f = 10 MHz) | Full | | 70 | | V | | 70 | | V | dB |

Note 1: A heat sink is required to keep the junction temperature below absolute maximum when the output is shorted.
Note 2: $V_O = \pm 10V$.
Note 3: $R_L = 2\ k\Omega$.
Note 4: Two tests are performed. $V_{CM} = 0V$ to $+10V$ and $V_{CM} = 0$ to $-10V$.
Note 5: Two tests are performed. $V+ = 15V$, and $V-$ is changed from $-5V$ to $-15V$. $V- = -15V$, and $V+$ is changed from $+5V$ to $+15V$.
Note 6: $V_O = 100\ mV$.
Note 7: Full Power Bandwidth guaranteed based on slew rate measurement using: FPBW = Slew Rate/ $2\pi V_{PEAK}$.
Note 8: Refer to Test Circuit section of data sheet.
Note 9: Settling time measurement are made with techniques in the following reference: "Take The Guesswork Out of Settling-Time Measurements," EDN September 19, 1985.
Note 10: $A_V = +1$, $R_L = 2\ k\Omega$.

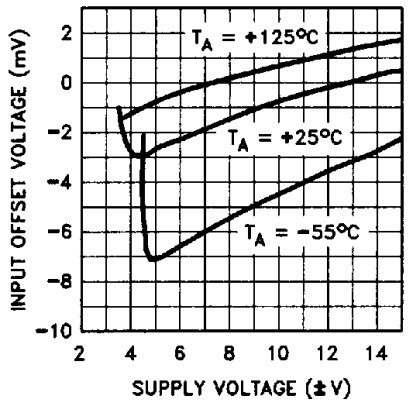
# EL2224/EL2224C

## Dual, 60 MHz, Unity Gain Stable, Operational Amplifier



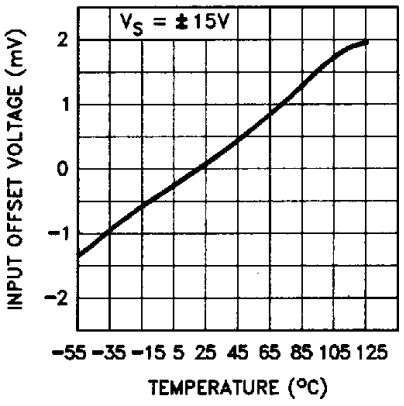
## Typical Performance Curves

**Input Offset Voltage vs Supply Voltage**



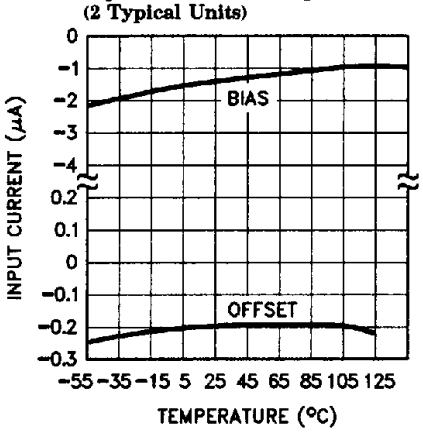

2224-4

**Normalized Input Offset Voltage vs Temperature**



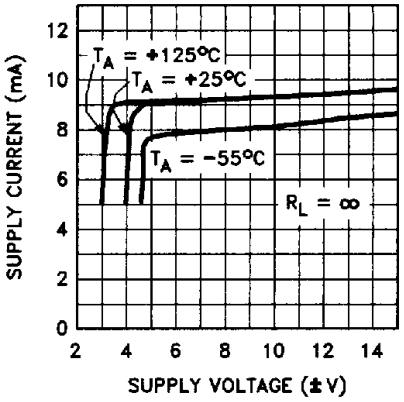

2224-5

**Input Current vs Temperature (2 Typical Units)**



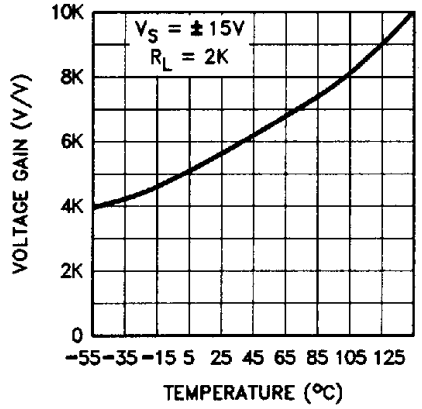

2224-6

**Supply Current vs Supply Voltage**



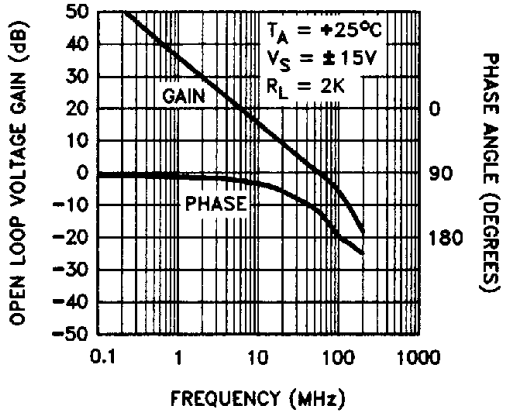

2224-7

**Voltage Gain vs Supply Voltage**




2224-8

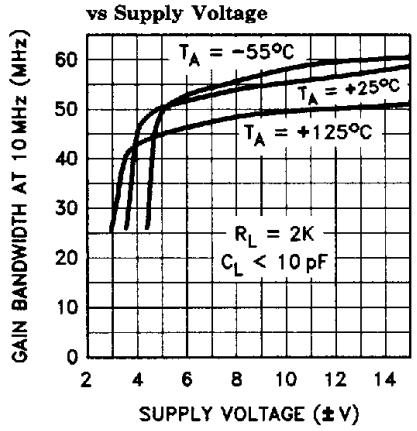
**Open Loop Voltage Gain vs Frequency**




2224-9

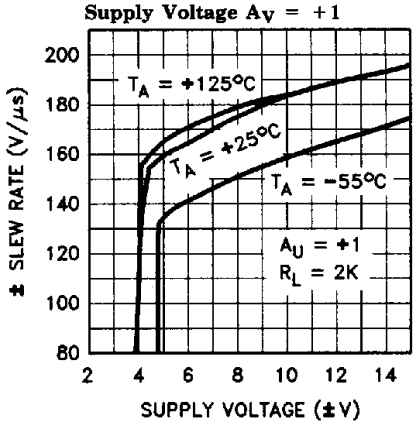
## Typical Performance Curves — Contd.

Gain Bandwidth at 10 MHz vs Supply Voltage



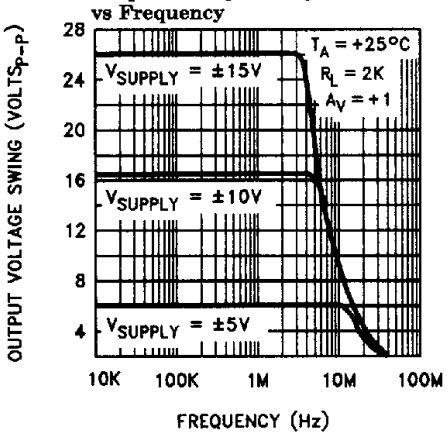

2224-10

Slew Rate vs Supply Voltage $A_V$ = +1



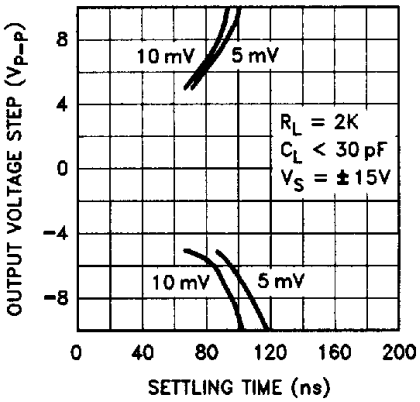

2224-11

Output Voltage Swing vs Frequency



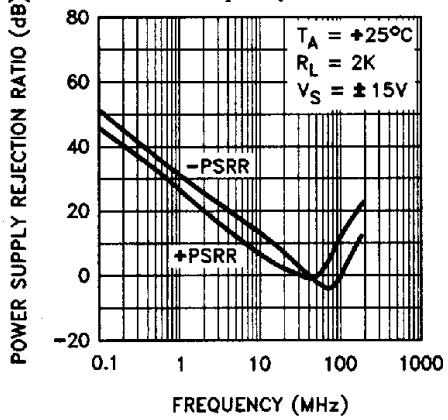

2224-12

Settling Time $A_V$ = +1



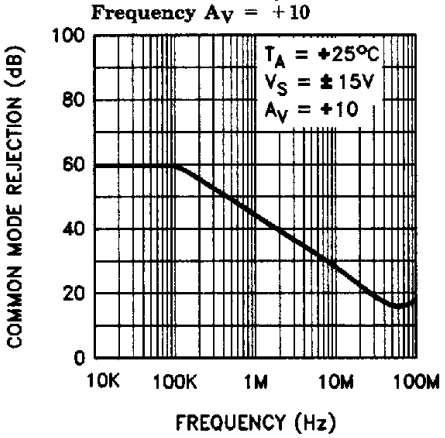

2224-13

Power Supply Rejection Ratio vs Frequency




2224-14

Common Mode Rejection vs Frequency $A_V$ = +10




2224-15

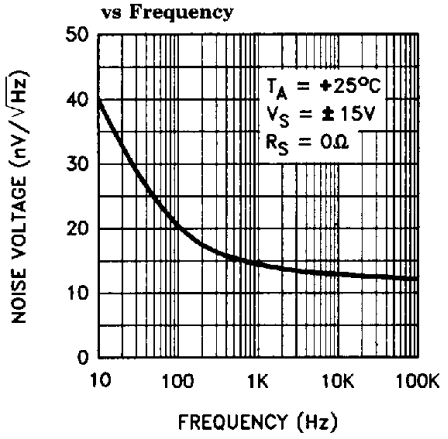
# EL2224/EL2224C



## Dual, 60 MHz, Unity Gain Stable, Operational Amplifier

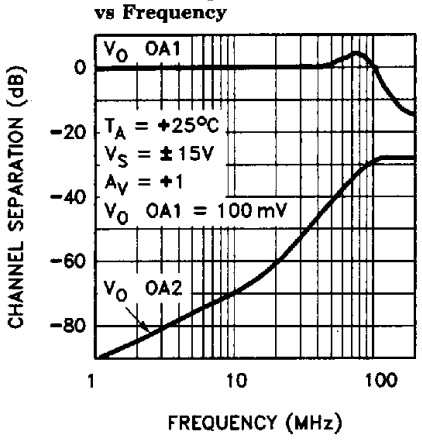
## Typical Performance Curves — Contd.

**Noise Voltage vs Frequency**



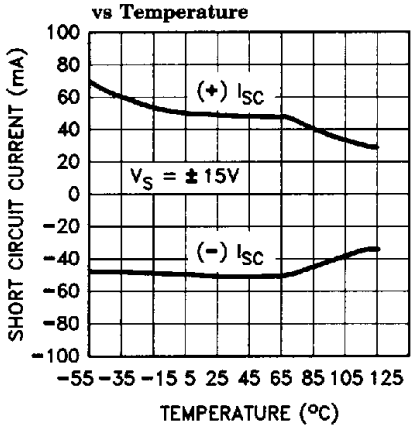

2224-16

**Channel Separation vs Frequency**



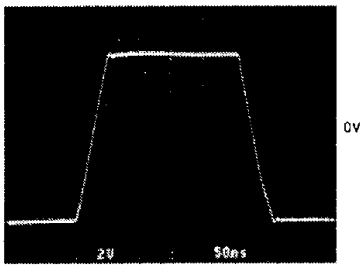

2224-17

**Short Circuit Current vs Temperature**




2224-18

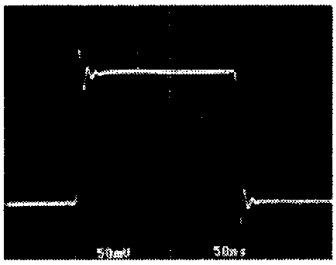
**Large Signal Response**




$A_V$ = +1
$V_{IN}$ = ±5V
$V_O$ = ±5V
$R_L$ = 2k

2224-19

**Small Signal Response**

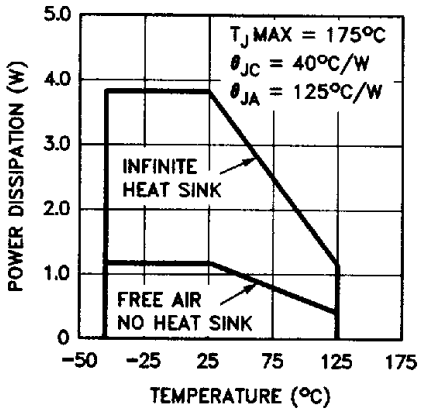



$A_V$ = +1
$V_{IN}$ = ±100 mV
$V_O$ = ±100 mV
$R_L$ = 2k

2224-20

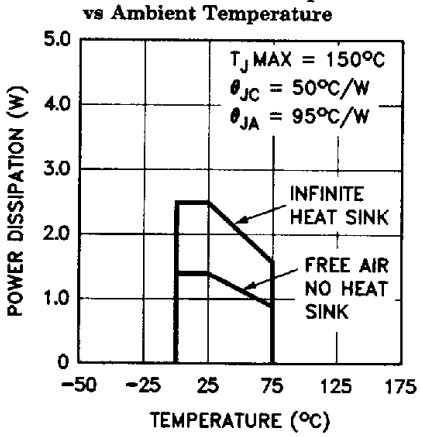
## Typical Performance Curves — Contd.

8-Lead CerDIP Maximum Power Dissipation vs Ambient Temperature



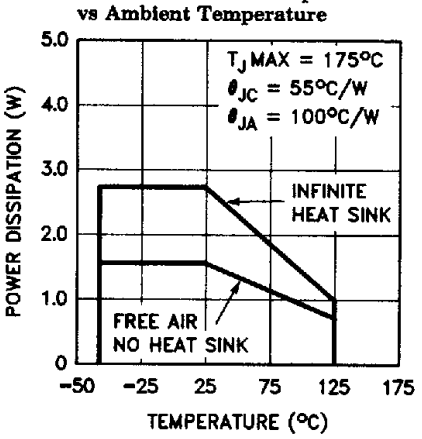

2224-21

8-Lead Plastic DIP Maximum Power Dissipation vs Ambient Temperature



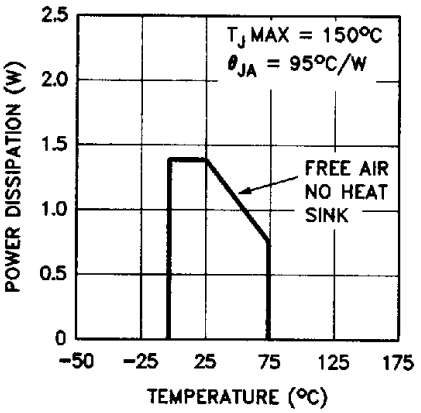

2224-22

20-Pad LCC Maximum Power Dissipation vs Ambient Temperature



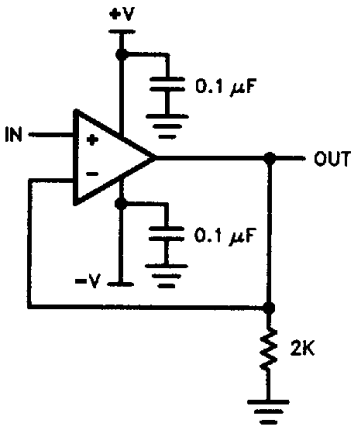

2224-23

20-Lead SOL Maximum Power Dissipation vs Ambient Temperature




2224-24

## Test Circuit

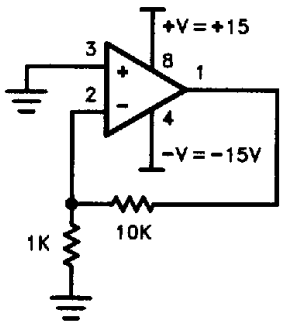



2224-27

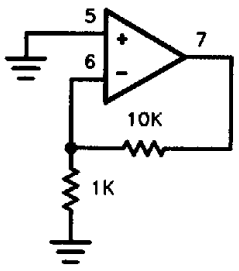
$A_V = +1$

$C_L \leq 10$ pF Scope Probe

## Burn-In Circuit




2224-28




2224-29

Pin numbers are for the 8-lead CerDIP.

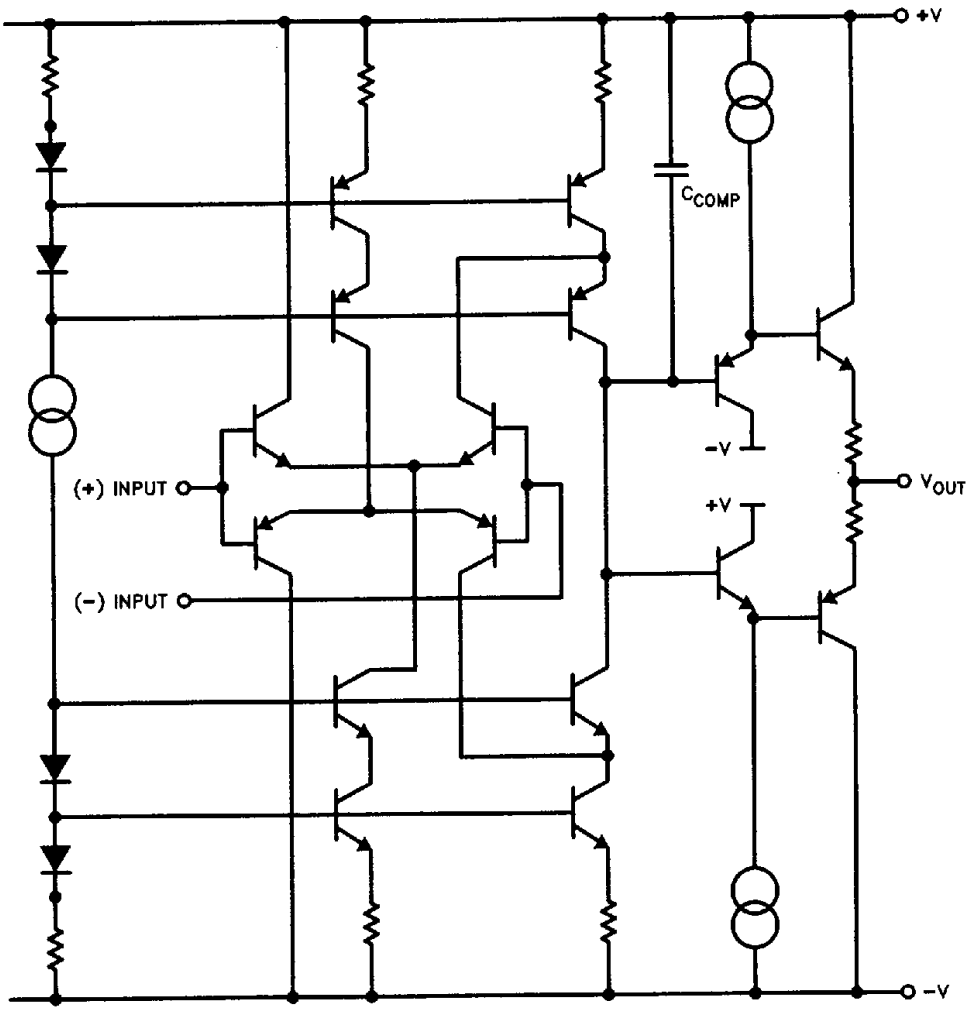
Burn-in circuit is identical for all package types.

# EL2224/EL2224C

ELANTEC INC

## Dual, 60 MHz, Unity Gain Stable, Operational Amplifier

### Simplified Schematic (one amplifier)



## EL2224 Macromodel

```
* Connections:      +input
*                   |     -input
*                   |     |     +Vsupply
*                   |     |     |     -Vsupply
*                   |     |     |     |     output
*                   |     |     |     |     |
.subckt M2224       3     2     7     4     6
* Input stage
ie 37 4 4.5mA
r6 36 37 75
r7 38 37 75
rc1 7 30 75
rc2 7 39 75
q1 30 3 36 qn
q2 39 2 38 qna
ediff 33 0 39 30 2.6
rdiff 33 0 1Meg
* Compensation Section
ga 0 34 33 0 3m
rh 34 0 1Meg
ch 34 0 15pF
rc 34 40 300
cc 40 0 1pF
* Poles
ep 41 0 40 0 1
rpa 41 42 75
cpa 42 0 3pF
rpb 42 43 50
cpb 43 0 3pF
* Output Stage
ios1 7 50 0.5mA
ios2 51 4 0.5mA
q3 4 43 50 qp
q4 7 43 51 qn
q5 7 50 52 qn
q6 4 51 53 qp
ros1 52 6 25
ros2 6 53 25
* models
.model qn npn(is=800.0E-18 bf=350 tf=0.2nS)
.model qna npn(is=864E-18 bf=400 tf=0.2nS)
.model qp pnp(is=800E-18 bf=60 tf=0.2nS)
.ends
```

# EL2224/EL2224C

## Dual, 60 MHz, Unity Gain Stable, Operational Amplifier



## EL2224 Macromodel — Contd.