

# élantec

HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

## EL2424/EL2424C

Quad 60 MHz High Speed Operational Amplifier

ELANTEC INC

T-79.07-20

EL2424/EL2424C

### Features

- Unity-gain stable
- Wide bandwidth—60 MHz
- High slew rate—200 V/ $\mu$ s
- Wide supply range— $\pm 5$ V to  $\pm 15$ V
- Output short circuit protected
- Low supply current—4 mA per amplifier

### Applications

- High frequency active filters
- Video amplifiers
- Pulse amplifiers

### Ordering Information

| Part No.     | Temp. Range     | Package | Outline # |
|--------------|-----------------|---------|-----------|
| EL2424CJ     | 0°C to +75°C    | CerDIP  | MDP0010   |
| EL2424CN     | 0°C to +75°C    | P-DIP   | MDP0031   |
| EL2424J      | -55°C to +125°C | CerDIP  | MDP0010   |
| EL2424J/883B | -55°C to +125°C | CerDIP  | MDP0010   |
| EL2424L/883B | -55°C to +125°C | LCC     | MDP0007   |
| EL2424CM     | 0°C to +75°C    | SOL     | MDP0027   |

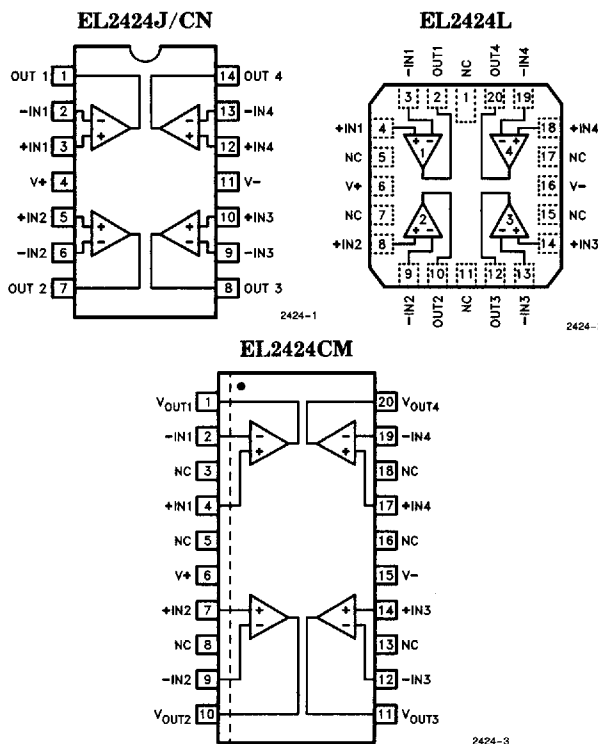
### General Description

The EL2424 monolithic quad operational amplifier is an example of Elantec's commitment to high speed low power consumption products. This amplifier is unity-gain stable, exhibits Slew Rates of 200V per microsecond, and a Gain Bandwidth of 60 MHz while drawing supply currents of 4 mA per amplifier. The output provides short circuit protection but is capable of delivering currents in excess of 50 mA. The device is manufactured using Elantec's advanced Complementary Bipolar process.

The EL2424 is available in 14-lead Plastic DIP, 14-lead CerDIP, 20-pad LCC, and 20-pad SOL.

Elantec's products and facilities comply with MIL-STD-883, Revision C, MIL-I-45082A, and other applicable quality assurance specifications. For information on Elantec's Military processing, see QRA-2, "Elantec's Military Processing, Monolithic Integrated Circuits". For information on Elantec's Commercial processing, see QRA-1, "Summary of Elantec's Reliability and Quality Assurance Policy".

### Connection Diagrams



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August 1992 Rev C

**EL2424/EL2424C**

ELANTEC INC

**Quad 60 MHz High Speed Operational Amplifier****Absolute Maximum Ratings** ( $T_A = 25^\circ\text{C}$ )

|  |                         |                              |                |
|--|-------------------------|------------------------------|----------------|
| Voltage between V+ and V-              | 35V                     | Storage Temperature Range    | -65°C to 150°C |
| Differential Input Voltage             | 6V                      | Maximum Junction Temperature |                |
| Peak Output Current                    | Short Circuit Protected | CerDIP, LCC                  | 175°C          |
| Output Short Circuit Duration (Note 1) | Continuous              | Plastic DIP, SOL             | 150°C          |
| Internal Power Dissipation             | See Curves              | Lead Temperature             |                |
| Operating Temperature Range            |                         | DIP Package                  | 300°C          |
| EL2424                                 | -55°C to +125°C         | SOL Package                  |                |
| EL2424C                                | 0°C to +75°C            | 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 $T_A = 25^\circ\text{C}$ and QA sample tested at $T_A = 25^\circ\text{C}$ , $T_{MAX}$ 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 $T_A = 25^\circ\text{C}$ for information purposes only.   |

**DC Electrical Characteristics**  $V_S = \pm 15\text{V}$ ;  $R_L = 2\text{ k}\Omega$ , unless otherwise specified

| Parameter         | Description   | Temp | EL2424   |          |     |            | EL2424C  |          |     |            | Units                        |
|-------------------|---|------|----------|----------|-----|------------|----------|----------|-----|------------|------------------------------|
|                   |   |      | Min      | Typ      | Max | Test Level | Min      | Typ      | Max | Test Level |                              |
| V <sub>OS</sub>   | Offset Voltage  | 25°C |          | 6        | 15  | I          |          | 6        | 15  | I          | mV                           |
|                   |   | Full |          |          | 20  | I          |          |          | 20  | III        | mV                           |
| TCV <sub>OS</sub> | Average Offset Voltage Drift                                    | Full |          | 50       |     | V          |          | 50       |     | V          | $\mu\text{V}/^\circ\text{C}$ |
| I <sub>B</sub>    | Bias Current  | 25°C |          | 1.0      | 4   | I          |          | 1.0      | 4   | I          | $\mu\text{A}$                |
|                   |   | Full |          |          | 6   | I          |          |          | 6   | III        | $\mu\text{A}$                |
| I <sub>OS</sub>   | Offset Current  | 25°C |          | 0.5      | 2   | I          |          | 0.5      | 2   | I          | $\mu\text{A}$                |
|                   |   | Full |          |          | 3   | I          |          |          | 3   | III        | $\mu\text{A}$                |
| R <sub>IN</sub>   | Input Resistance  | 25°C |          | 20       |     | V          |          | 20       |     | V          | k $\Omega$                   |
| C <sub>IN</sub>   | Input Capacitance   | 25°C |          | 1        |     | V          |          | 1        |     | V          | pF                           |
| V <sub>CM</sub>   | Common Mode Input Range   | Full | $\pm 10$ | $\pm 11$ |     | I          | $\pm 10$ | $\pm 11$ |     | II         | V                            |
| e <sub>IN</sub>   | Input Noise Voltage<br>( $f = 1\text{ kHz}$ , $R_G = 0\Omega$ ) | 25°C |          | 7        |     | V          |          | 7        |     | V          | $\text{nV}/\sqrt{\text{Hz}}$ |
| A <sub>VOL</sub>  | Large Signal Voltage Gain<br>(Notes 2, 3)                       | 25°C | 5k       | 13k      |     | I          | 5k       | 13k      |     | I          | V/V                          |
|                   |   | Full | 4k       |          |     | I          | 4k       |          |     | III        | V/V                          |
| CMRR              | Common-Mode Rejection Ratio<br>(Note 4)                         | Full | 70       | 87       |     | I          | 70       | 87       |     | II         | dB                           |

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## Quad 60 MHz High Speed Operational Amplifier

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

| Parameter | Description                           | Temp | EL2424   |          |          |            | EL2424C  |          |          |            | Units    |
|-----------|---------------------------------------|------|----------|----------|----------|------------|----------|----------|----------|------------|----------|
|           |                                       |      | Min      | Typ      | Max      | Test Level | Min      | Typ      | Max      | Test Level |          |
| $V_O$     | Output Voltage Swing                  | Full | $\pm 11$ | $\pm 13$ |          | I          | $\pm 11$ | $\pm 13$ |          | II         | V        |
| $I_{SC}$  | Short Circuit Current                 | 25°C | $\pm 10$ | +50      | $\pm 85$ | I          | $\pm 10$ | $\pm 50$ | $\pm 85$ | I          | mA       |
| $R_O$     | Output Resistance                     | 25°C |          | 40       |          | V          |          | 40       |          | V          | $\Omega$ |
| $I_S$     | Supply Current                        | Full |          | 14       | 18       | I          |          | 14       | 18       | II         | mA       |
| PSRR      | Power Supply Rejection Ratio (Note 5) | Full | 60       | 80       |          | I          | 60       | 80       |          | II         | dB       |

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

| Parameter | Description                                 | Temp | EL2424 |     |     |            | EL2424C |     |     |            | Units      |
|-----------|---|------|--------|-----|-----|------------|---------|-----|-----|------------|------------|
|           |   |      | 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 (Note 7)               | 25°C | 2.4    | 3.2 |     | I          | 2.4     | 3.2 |     | I          | MHz        |
| $t_r$     | Rise Time (Note 6)                          | 25°C |        | 7   |     | V          |         | 7   |     | V          | ns         |
| OS        | Overshoot (Note 6)                          | 25°C |        | 20  |     | V          |         | 20  |     | V          | %          |
| SR        | Slew Rate (Note 10)                         | 25°C | 150    | 200 |     | I          | 150     | 200 |     | I          | V/ $\mu$ s |
| $t_s$     | Settling Time (Note 9)<br>10V Step to 0.05% | 25°C |        | 330 |     | V          |         | 330 |     | V          | ns         |
| CHSp      | Channel Separation<br>$f = 1\text{ MHz}$    | 25°C |        | 65  |     | V          |         | 65  |     | 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:  $R_L = 2\text{ k}\Omega$ .

Note 4: Two tests are performed.  $V_{CM} = 0V$  to  $+10V$  and  $V_{CM} = 0V$  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:  $V_O = 100\text{ mV}$ .

Note 7: Full Power Bandwidth guaranteed based on slew rate measurement using:  $FPBW = \text{Slew Rate}/2\pi V_{peak}$ .

Note 8: Refer to Test Circuit section of data sheet.

Note 9: Settling time measurements are made with techniques in the following reference: "Take The Guesswork Out of Settling-Time Measurements," EDN September 19, 1985.

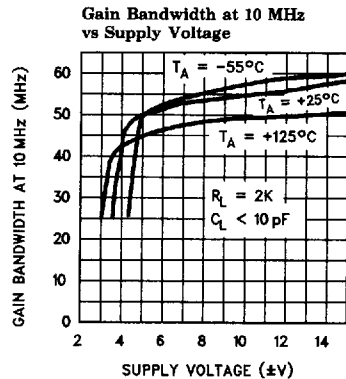
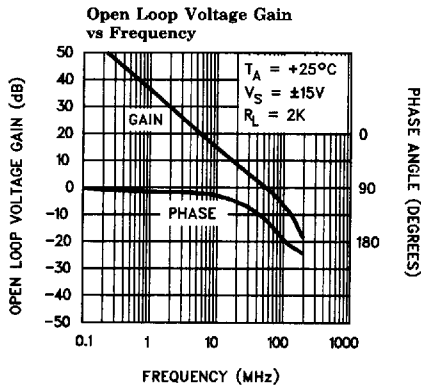
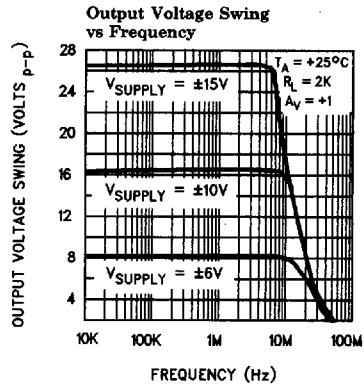
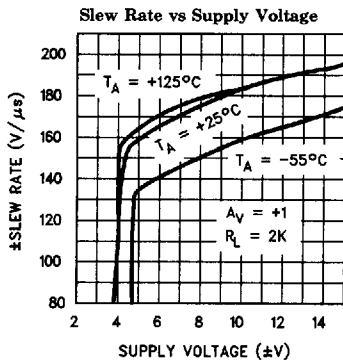
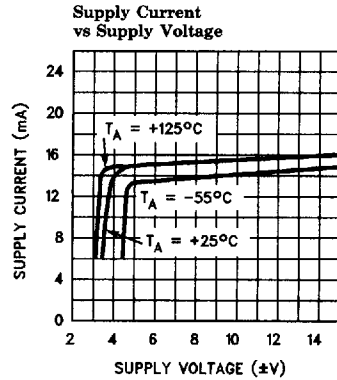
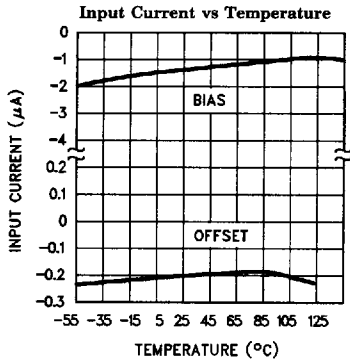
Note 10:  $V_O = \pm 10V$ .

# EL2424/EL2424C

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## Quad 60 MHz High Speed Operational Amplifier

### Typical Performance Curves



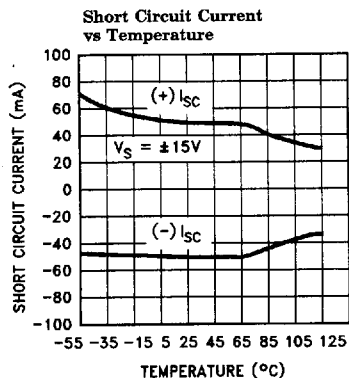
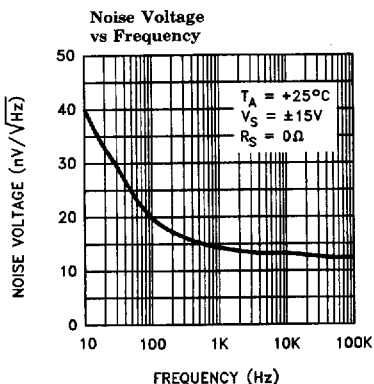
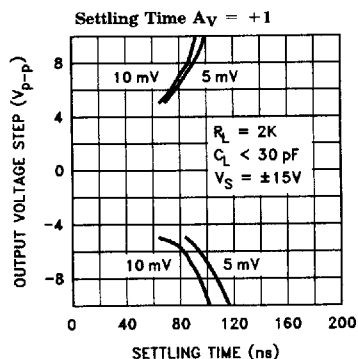
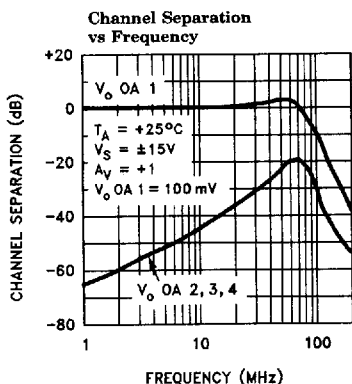
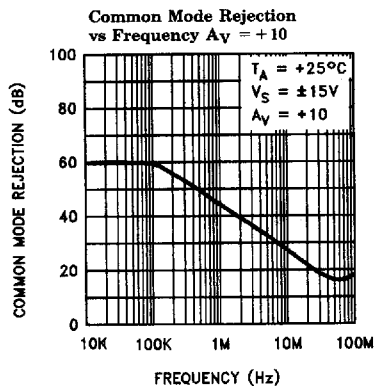
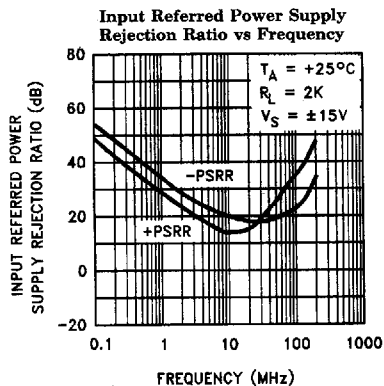
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# EL2424/EL2424C

## Quad 60 MHz High Speed Operational Amplifier

EL2424/EL2424C

### Typical Performance Curves — Contd.



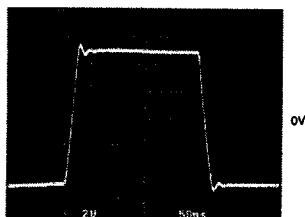
# EL2424/EL2424C

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Quad 60 MHz High Speed Operational Amplifier

## Typical Performance Curves — Contd.

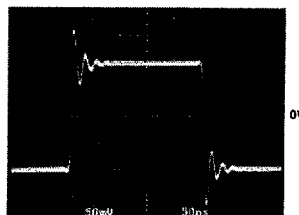
Large Signal Response



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

2424-6

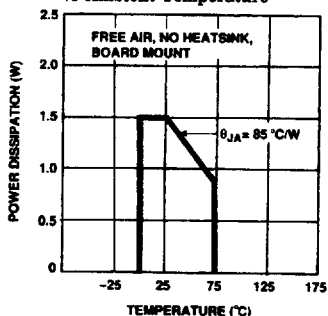
Small Signal Response



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

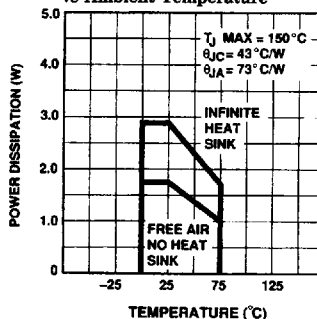
2424-7

20-Lead SOL  
 Maximum Power Dissipation  
 vs Ambient Temperature



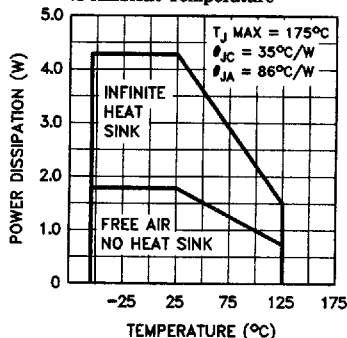
2424-8

14-Lead Plastic DIP  
 Maximum Power Dissipation  
 vs Ambient Temperature



2424-9

14-Lead CerDIP  
 Maximum Power Dissipation  
 vs Ambient Temperature



2424-10

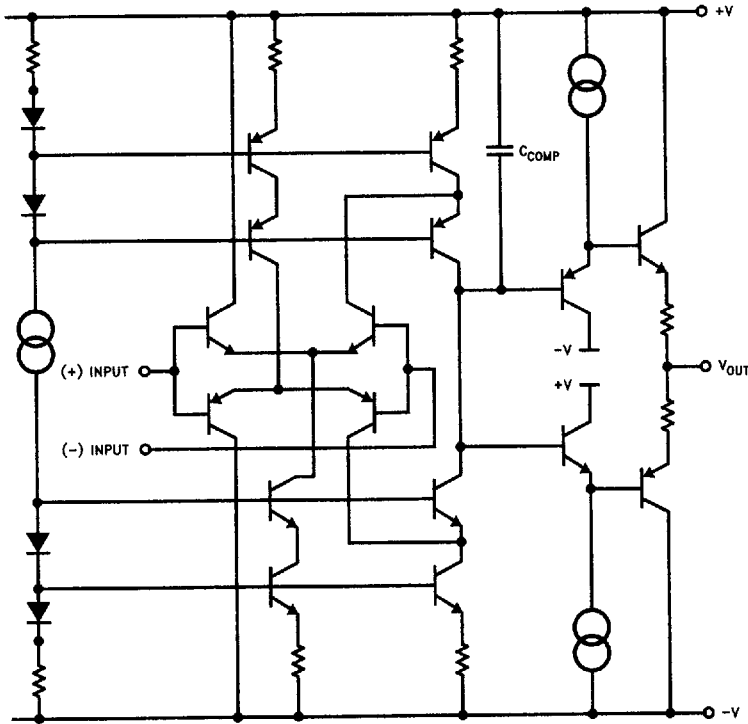
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Quad 60 MHz High Speed Operational Amplifier

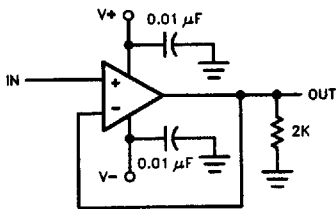
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## Simplified Schematic (One Amplifier)



2424-11

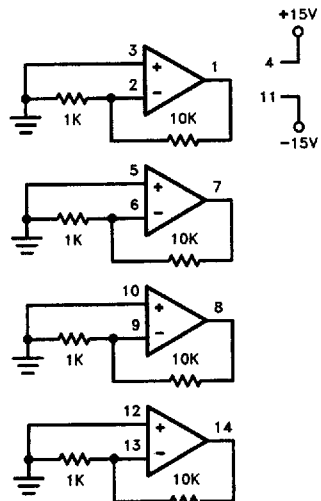
## Test Circuit



2424-12

Pin numbers indicated are for the 14-lead DIP. Circuit is identical for all package types.

## Burn In Circuit



2424-13

**EL2424/EL2424C**

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**Quad 60 MHz High Speed Operational Amplifier**

EL2424/EL2424C

**EL2424 Macromodel**

```

* Connections:
*
*
*
*
*
*
+ input
- input
+ Vsupply
- Vsupply
output
.subckt M2424 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 npn(is=800E-18 bf=60 tf=0.2nS)
.ends

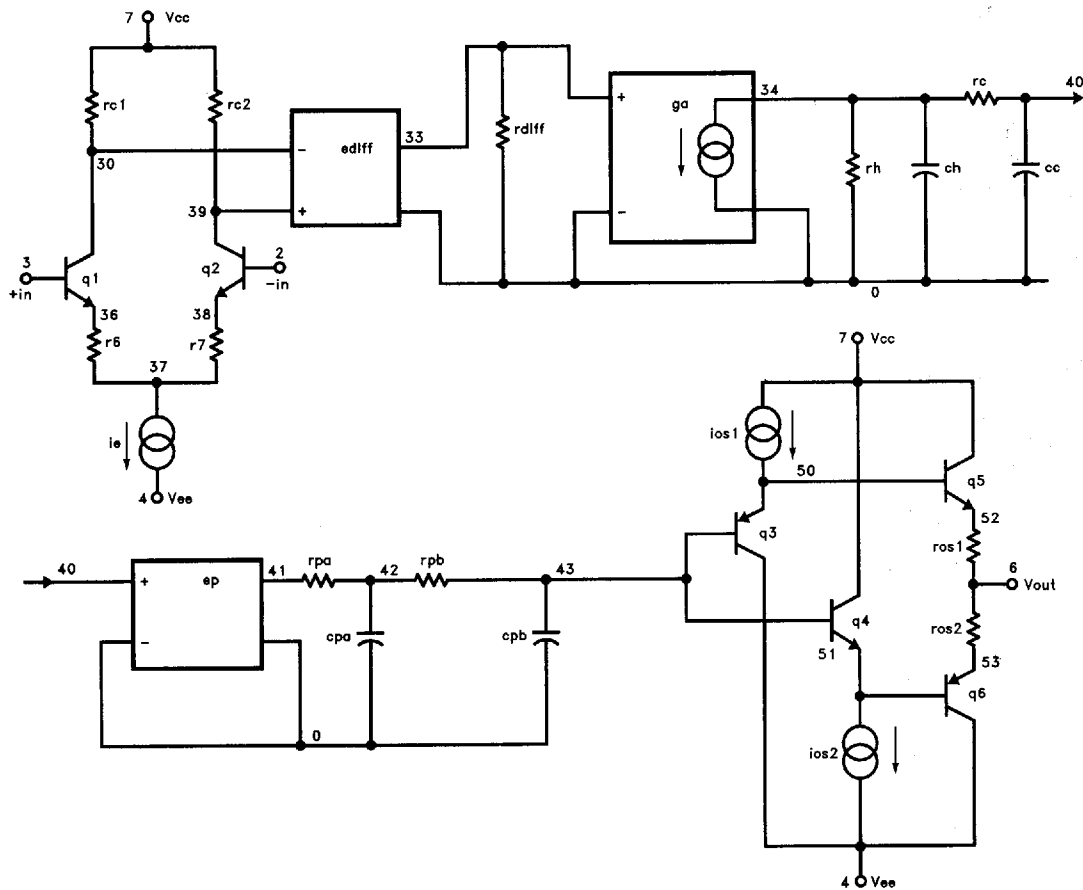
```



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**EL2424/EL2424C**  
Quad 60 MHz High Speed Operational Amplifier

EL2424/EL2424C

**EL2424 Macromodel — Contd.**

2424-14