élantec
HIGH PERFORMANCE ANALOG INTEGRATED CIRCUITS

# EL2190/EL2195

***Wideband, Fast Settling Operational Amplifier***

## Features

- Low offset voltage—0.5 mV typ., 2 mV max
- Low supply current—13 mA typ., 17 mA max
- Very high Slew Rate—200 V/μs
- Wide gain-bandwidth—150 MHz
- Power bandwidth—6.5 MHz
- Fast settling—70 ns
- Input voltage noise—6 nV/$\sqrt{Hz}$
- MIL-STD-883 Rev. C compliant
- Improved replacement for HA5190/5195

## Applications

- Fast, precise D/A converters
- High speed sample-hold circuits
- Pulse and video amplifiers
- Wideband amplifiers

## Ordering Information

| Part No. | Temp. Range | Package | Outline # |
|---|---|---|---|
| EL2190G | −55°C to + 125°C | 12-Pin TO-8 | MDP0002 |
| EL2190G/883B | 55°C to + 125°C | 12-Pin TO-8 | MDP0002 |
| EL2190J | 55°C to + 125°C | 14-Pin CerDIP | MDP0014 |
| EL2190J/883B | 55°C to + 125°C | 14-Pin CerDIP | MDP0014 |
| EL2190L/883B | 55°C to + 125°C | 20-Pad LCC | MDP0007 |
| EL2195CJ | 0°C to + 75°C | 14-Pin CerDIP | MDP0014 |
| EL2195CG | 0°C to + 75°C | 12-Pin TO-8 | MDP0002 |

59628778402 is the SMD version of this device.

## General Description

The EL2190/EL2195 are an improved design over the HA5190/HA5195 monolithic operational amplifiers. The EL2190/EL2195 feature a zener zapped trim design for tighter offset voltage, and a supply current 40% less than the previous generation devices. Employing patented circuit techniques and monolithic Complementary Bipolar construction, these devices are capable of delivering a 200 V/μs slew rate and 70 ns settling times with only 13 mA supply current. These truly differential amplifiers are designed to operate at gains ≥ 5 without the need for external compensation. Other outstanding EL2190/EL2195 features are 150 MHz gain-bandwidth product and 6.5 MHz full power bandwidth. In addition to these dynamic characteristics, these amplifiers also have excellent input characteristics such as 2 mV max offset voltage and 6.0 nV/$\sqrt{Hz}$ input voltage noise (at 1 kHz).

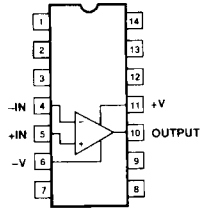
These devices make ideal output amplifiers for accurate, high speed D/A converters or the main components in high speed sample and hold circuits. 150 MHz gain-bandwidth-product, 6.5 MHz power bandwidth, and 2 mV maximum offset voltage all make the EL2190/EL2195 well suited for a variety of pulse and wideband video amplifier applications.

The EL2190 is specified over the −55°C to +125°C range while the EL2195 is specified from 0°C to +75°C.

Elantec's EL2190/883B complies with MIL-STD-883 Revision C in all aspects, including burn-in at 125°C. Elantec's facilities comply with MIL-I-45208A and other applicable quality specifications. For information on Elantec's military processing, see the Elantec document, QRA-2: *Elantec's Military Processing Monolithic Products.*

## Connection Diagrams

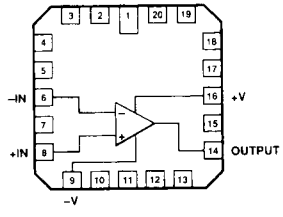
**CerDIP Package**




2190-1

**Top View**

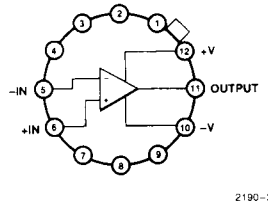
**20-Lead LCC**




2190-2

**Top View**

**12-Lead TO-8**




2190-3

**Top View**

Note: Case tied to pin 10.

Note: Non-designated pins are no connects and are not electrically connected internally.

Manufactured under U.S. Patent No. 4,837,523

# EL2190/EL2195

## Wideband, Fast Settling Operational Amplifier



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

| | |
|---|---|
| Voltage between V+ and V− | 35V |
| Differential Input Voltage | 6V |
| Output Current | 50 mA (Peak) |
| | 30 mA (Continuous) |
| Internal Power Dissipation | See Curves |

| | |
|---|---|
| Operating Temperature Range | |
| EL2190 | −55°C to +125°C |
| EL2195 | 0°C to +75°C |
| Operating Junction Temperature | |
| CerDIP, Ceramic LCC, TO-8 | 175°C |
| Lead Temperature | |
| (Soldering, 5 seconds) | 300°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. |

## DC Electrical Characteristics $V_S$ = ±15V, $R_L$ = 200Ω; unless otherwise specified

| Parameter | Description | Temp | EL2190 | | | | EL2195 | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Test Level | Min | Typ | Max | Test Level | |
| $V_{OS}$ | Offset Voltage | +25°C | | 0.5 | 2 | I | | 0.5 | 2 | I | mV |
| | | Full | | | 6 | I | | | 6 | III | mV |
| $TCV_{OS}$ | Average Offset Voltage Drift | Full | | 20 | | V | | 20 | | V | µV/°C |
| $I_B$ | Bias Current | +25°C | | 5 | 15 | I | | 5 | 15 | I | µA |
| | | Full | | | 20 | I | | | 20 | III | µA |
| $I_{OS}$ | Offset Current | +25°C | | 1 | 4 | I | | 1 | 4 | I | µA |
| | | Full | | | 6 | I | | | 6 | III | µA |
| $R_{IN}$ | Input Resistance | +25°C | | 10 | | V | | 10 | | V | kΩ |
| $C_{IN}$ | Input Capacitance | +25°C | | 1 | | V | | 1 | | V | pF |
| $V_{CM}$ | Common Mode Input Range | Full | ±6 | ±10 | | I | ±6 | ±10 | | II | V |
| $e_{IN}$ | Input Noise Voltage (f = 1 kHz, $R_G$ = 0Ω) | +25°C | | 6 | | V | | 6 | | V | nV/√Hz |
| $A_{VOL}$ | Large Signal Voltage Gain (Notes 1, 2) | +25°C | 15k | 30k | | I | 10k | 30k | | I | V/V |
| | | Full | 5k | | | I | 5k | | | III | V/V |
| CMRR | Common-Mode Rejection Ratio (Note 3) | Full | 74 | 90 | | I | 74 | 90 | | II | dB |

# EL2190/EL2195

## Wideband, Fast Settling Operational Amplifier

## DC Electrical Characteristics $V_S = \pm 15V$, $R_L = 200\Omega$; unless otherwise specified — Contd.

| Parameter | Description | Temp | EL2190 | | | | EL2195 | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Test Level | Min | Typ | Max | Test Level | |
| $V_O$ | Output Voltage Swing (Notes 1, 11) | Full | ±5 | ±8 | | I | ±5 | ±8 | | II | V |
| | | Full | ±11 | ±12 | | I | ±11 | ±12 | | II | V |
| $I_O$ | Output Current | Full | ±25 | ±50 | | I | ±25 | ±50 | | II | mA |
| $R_O$ | Output Resistance | +25°C | | 30 | | V | | 30 | | V | Ω |
| $I_S$ | Supply Current | Full | | 13 | 17 | I | | 13 | 17 | II | mA |
| PSRR | Power Supply Rejection Ratio (Note 8) | Full | 70 | 80 | | I | 70 | 80 | | II | dB |

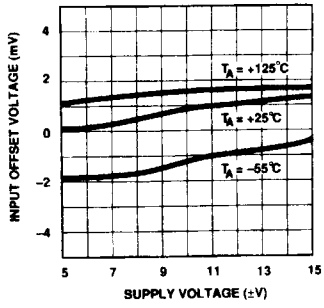
## AC Electrical Characteristics $V_S = \pm 15V$, $R_L = 200\ \Omega$; unless otherwise specified

| Parameter | Description | Test Conditions | EL2190 | | | | EL2195 | | | | Units |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | Test Level | Min | Typ | Max | Test Level | |
| GBW | Gain-Bandwidth Product (Notes 4, 5) | +25°C | | 150 | | V | | 150 | | V | MHz |
| FPBW | Full Power Bandwidth (Notes 2, 6) | +25°C | 5 | 6.5 | | I | 5 | 6.5 | | I | MHz |
| $t_r$ | Rise Time (Note 7) | +25°C | | 7 | 18 | IV | | 7 | 18 | IV | ns |
| OS | Overshoot (Note 7) | +25°C | | 25 | | V | | 25 | | V | % |
| SR | Slew Rate (Note 7) | +25°C | 160 | 200 | | I | 160 | 200 | | I | V/μs |
| $t_s$ | Settling Time (Notes 9, 10) | | | | | | | | | | |
| | 5V Step to 0.1% | +25°C | | 50 | | V | | 50 | | V | ns |
| | 5V Step to 0.05% | +25°C | | 70 | | V | | 70 | | V | ns |

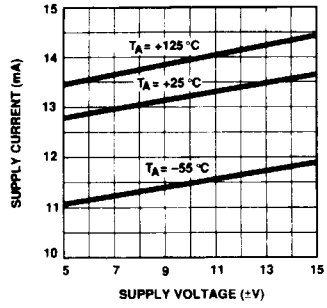
Note 1: $R_L = 200\Omega$, $C_L < 10$ pF.
Note 2: $V_O = \pm 5V$.
Note 3: Two tests are performed. $V_{CM} = 0V$ to $+5V$ and $V_{CM} = 0V$ to $-5V$.
Note 4: $V_O = 90$ mV.
Note 5: $A_V = 10$.
Note 6: Full Power Bandwidth guaranteed based on slew rate measurement using : $FPBW = \frac{\text{Slew Rate}}{2\pi V_{peak}}$.
Note 7: Refer to Test Circuits section of data sheet.
Note 8: Two tests are performed. $V+ = +15V$, and $V-$ is changed from 10V to 20V. $V- = -15V$, and $V+$ is changed from $+10V$ to $+20V$.
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: $R_L = 1k$, $A_V = -5$.
Note 11: $R_L = 1k$.

## Typical Performance Curves

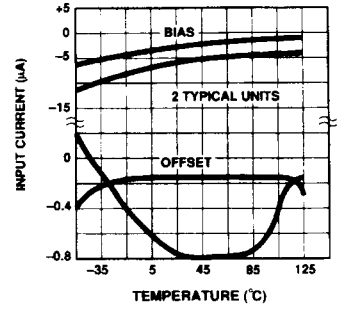
Input Offset Voltage vs Supply Voltage



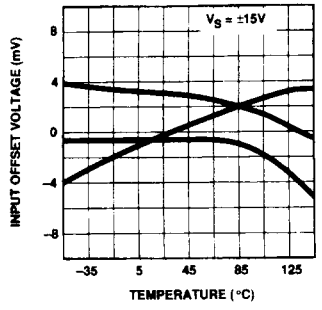

Supply Current vs Supply Voltage



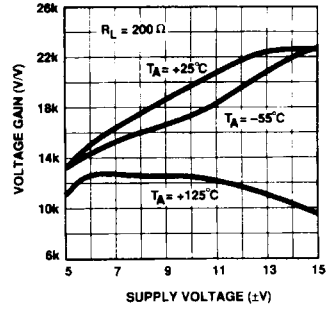

Input Currents vs Temperature



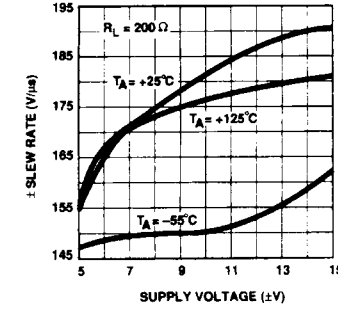

Input Offset Voltage vs Temperature (3 Typical Units)



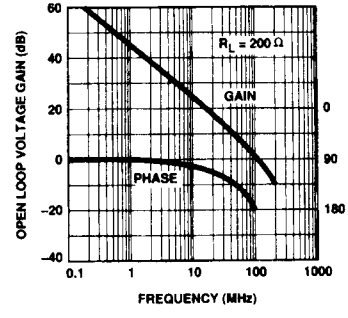

Voltage Gain vs Supply Voltage



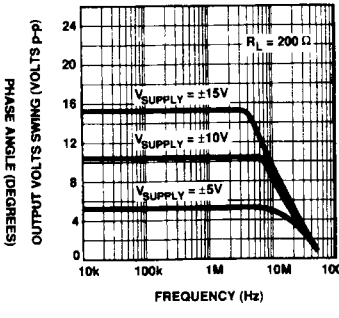

±Slew Rate vs Supply Voltage



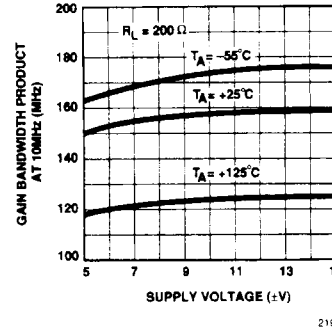

Open Loop Voltage Gain vs Frequency




Output Voltage Swing vs Frequency




Gain Bandwidth Product at 10 MHz vs Supply Voltage

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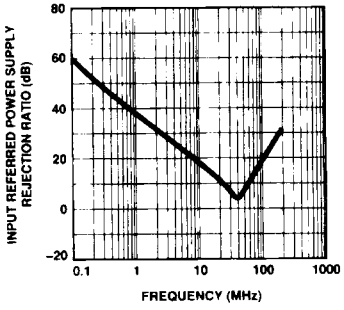
# EL2190/EL2195

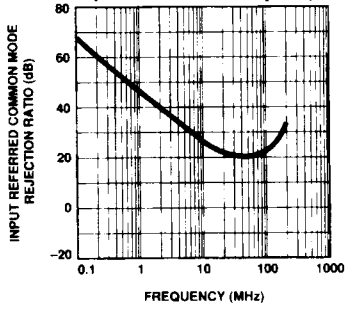
## Wideband, Fast Settling Operational Amplifier

## Typical Performance Curves — Contd.

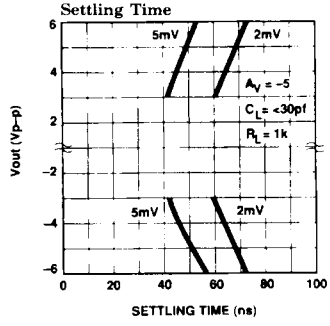
Input Referred Power Supply Rejection Ratio vs Frequency



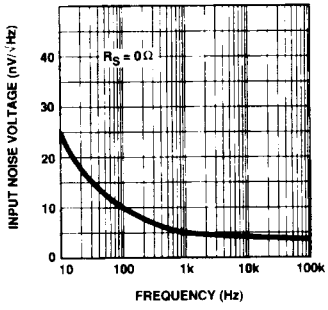

Input Referred Common Mode Rejection Ratio vs Frequency



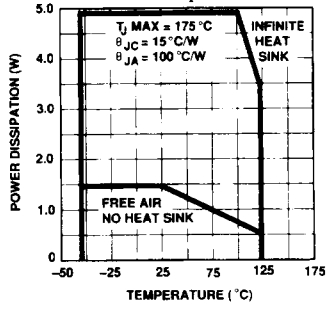

Settling Time



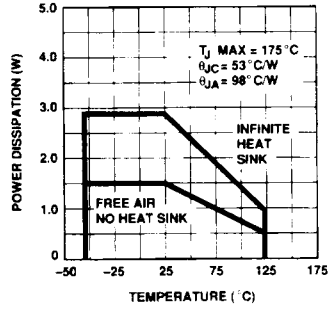

Input Noise Voltage vs Frequency



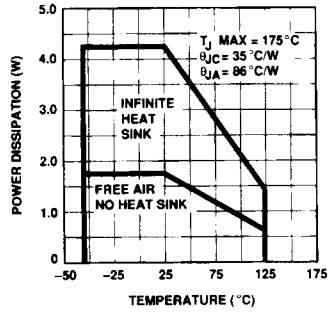

12-Lead TO-8 Maximum Power Dissipation vs Ambient Temperature




20-Lead LCC Maximum Power Dissipation vs Ambient Temperature



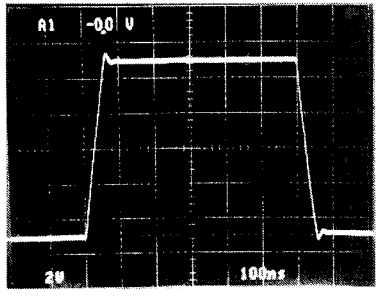

14-Lead CerDIP Maximum Power Dissipation vs Ambient Temperature




2190-5

## Typical Performance Curves — Contd.

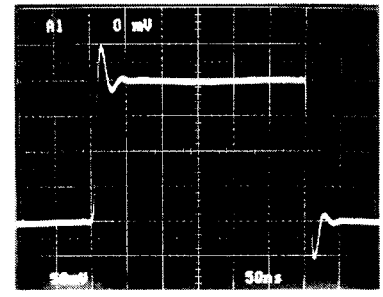
### Large Signal Response




$V_{IN}$ = ±1V
$V_O$ = ±5V

2190-6

### Small Signal Response




$V_{IN}$ = ±20 mV
$V_O$ = ±100 mV

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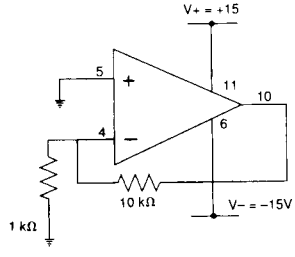
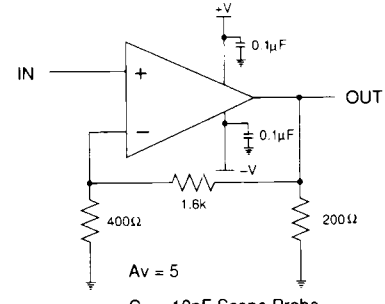
## Burn-In Circuit




2190-8

Pin numbers are for 14-lead cerDIP. Burn-in circuit is identical for all package types.

## Test Circuit

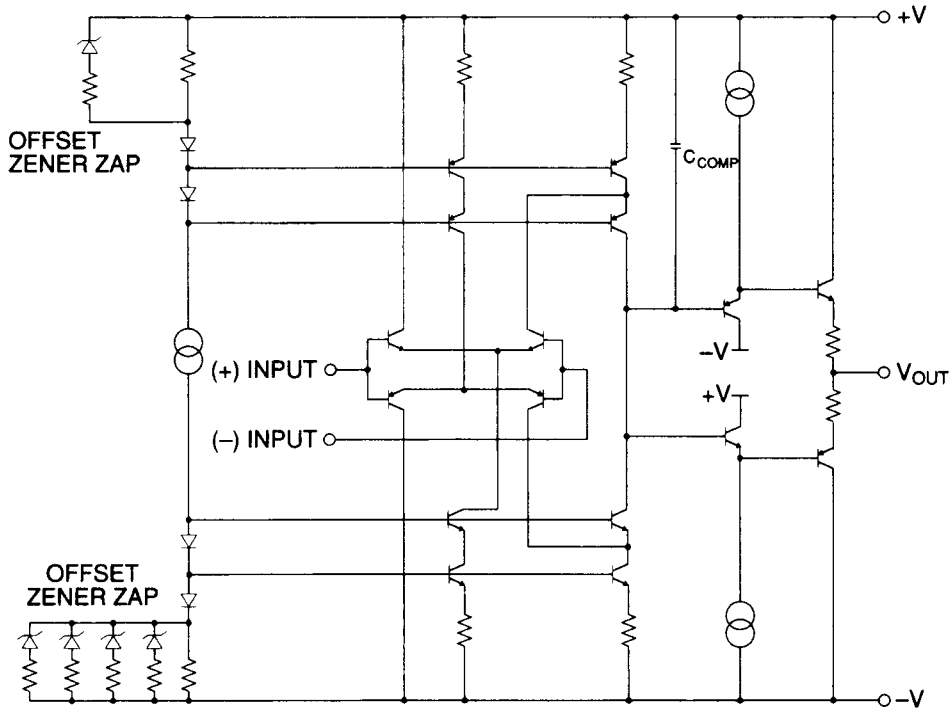



2190-9

# EL2190/EL2195

## Wideband, Fast Settling Operational Amplifier

### Schematic




2190-10

## EL2190 Macromodel

```
* Connections:      + input
*                   |     - input
*                   |     |     + Vsupply
*                   |     |     |     - Vsupply
*                   |     |     |     |     output
*                   |     |     |     |     |
.subckt M2190       5     4     11    6     10
* Input Stage
ie 37 6 2mA
r6 36 37 60
r7 38 37 60
rc1 11 30 75
rc2 11 39 75
q1 30 5 36 qn
q2 39 4 38 qna
ediff 33 0 39 30 7.25
rdiff 33 0 1Meg
* Compensation Section
ga 0 34 33 0 2.6m
rh 34 0 1.5Meg
ch 34 0 3.5pF
rc 34 40 600
cc 40 0 7pF
* Poles
ep 41 0 40 0 1
rpa 41 42 75
cpa 42 0 5pF
rpb 42 43 50
cpb 43 0 5pF
* Output Stage
ios1 11 50 1.25mA
ios2 51 6 1.25mA
q3 6 43 50 qp
q4 11 43 51 qn
q5 11 50 52 qn
q6 6 51 53 qp
ros1 52 10 25
ros2 10 53 25
* Power Supply Current
ips 11 6 8.5mA
* Models
.model qn npn(is = 800.0E - 18 bf = 200 tf = 0.2nS)
.model qna npn(is = 864E - 18 bf = 250 tf = 0.2nS)
.model qp pnp(is = 800E - 18 bf = 60 tf = 0.2nS)
.ends
```

# EL2190/EL2195

## Wideband, Fast Settling Operational Amplifier

### EL2190 Macromodel — Contd.