



## 2

# OP-21

## ABSOLUTE MAXIMUM RATINGS (Note 2)

|                                     |                 |
|-------------------------------------|-----------------|
| Supply Voltage .....                | ±18V            |
| Differential Input Voltage .....    | ±30V            |
| Input Voltage .....                 | Supply Voltage  |
| Output Short-Circuit Duration ..... | Indefinite      |
| Storage Temperature Range           |                 |
| J and Z Packages .....              | −65°C to +125°C |
| P Package .....                     | −65°C to +125°C |
| Operating Temperature Range         |                 |
| OP-21A .....                        | −55°C to +125°C |
| OP-21E, OP-21F .....                | −25°C to +85°C  |
| OP-21HS, OP-21G .....               | −40°C to +85°C  |

|                                              |                 |
|----------------------------------------------|-----------------|
| Junction Temperature (T <sub>J</sub> ) ..... | −65°C to +150°C |
| Lead Temperature (Soldering, 60 sec) .....   | 300°C           |

| PACKAGE TYPE           | θ <sub>JA</sub> (Note 1) | θ <sub>JC</sub> | UNITS |
|------------------------|--------------------------|-----------------|-------|
| TO-99 (J)              | 150                      | 18              | °C/W  |
| 8-Pin Hermetic DIP (Z) | 148                      | 16              | °C/W  |
| 8-Pin Plastic DIP (P)  | 103                      | 43              | °C/W  |
| 8-Pin SO (S)           | 158                      | 43              | °C/W  |

### NOTES:

1. θ<sub>JA</sub> is specified for worst case mounting conditions, i.e., θ<sub>JA</sub> is specified for device in socket for TO, CerDIP, P-DIP, and LCC packages; θ<sub>JA</sub> is specified for device soldered to printed circuit board for SO package.
2. Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.

## ELECTRICAL CHARACTERISTICS at V<sub>S</sub> = ±2.5V to ±15V and T<sub>A</sub> = +25°C, unless otherwise noted.

| PARAMETER                    | SYMBOL          | CONDITIONS                                                           | OP-21A/E   |      |     | OP-21F     |      |     | OP-21G/H   |      |     | UNITS |
|------------------------------|-----------------|----------------------------------------------------------------------|------------|------|-----|------------|------|-----|------------|------|-----|-------|
|                              |                 |                                                                      | MIN        | TYP  | MAX | MIN        | TYP  | MAX | MIN        | TYP  | MAX |       |
| Input Offset Voltage         | V <sub>OS</sub> | V <sub>S</sub> = ±15V                                                | —          | 40   | 100 | —          | 150  | 200 | —          | 300  | 500 | μV    |
| Input Offset Current         | I <sub>OS</sub> | V <sub>CM</sub> = 0                                                  | —          | 0.6  | 4   | —          | 0.8  | 5   | —          | 1.2  | 6   | nA    |
| Input Bias Current           | I <sub>B</sub>  | V <sub>CM</sub> = 0                                                  | —          | 50   | 100 | —          | 60   | 120 | —          | 70   | 150 | nA    |
| Input Voltage Range          | IVR             | V <sub>S</sub> = ±15V                                                | −14.5/13.5 | —    | —   | −14.5/13.5 | —    | —   | −14.5/13.5 | —    | —   | V     |
| Common-Mode Rejection Ratio  | CMRR            | V <sub>S</sub> = ±15V, No Load<br>−14.5V ≤ V <sub>CM</sub> ≤ 13.5V   | 100        | 110  | —   | 90         | 105  | —   | 84         | 100  | —   | dB    |
| Power Supply Rejection Ratio | PSRR            | V <sub>S</sub> = ±2.5V to ±15V, No Load                              | —          | 2    | 6   | —          | 4    | 10  | —          | 10   | 32  | μV/V  |
| Large-Signal Voltage Gain    | A <sub>VO</sub> | V <sub>S</sub> = ±15V,<br>R <sub>L</sub> = 10kΩ, V <sub>O</sub> ±10V | 1000       | 2000 | —   | 500        | 1500 | —   | 500        | 1000 | —   | V/mV  |
| Output Voltage Swing         | V <sub>O</sub>  | V <sub>S</sub> = ±15V,<br>R <sub>L</sub> = 10kΩ                      | −13.7/14.0 | —    | —   | −13.7/13.9 | —    | —   | −13.6/13.8 | —    | —   | V     |
| Slew Rate                    | SR              | C <sub>L</sub> = 100pF,<br>R <sub>L</sub> = 25kΩ                     | —          | 0.25 | —   | —          | 0.25 | —   | —          | 0.25 | —   | V/μs  |
| Closed-Loop Bandwidth        | BW              | A <sub>VCL</sub> = +1,<br>R <sub>L</sub> = 10kΩ                      | —          | 600  | —   | —          | 600  | —   | —          | 600  | —   | kHz   |
| Supply Current               | I <sub>SY</sub> | V <sub>S</sub> = ±2.5V,<br>No Load                                   | —          | 170  | 230 | —          | 180  | 275 | —          | 190  | 300 | μA    |
|                              |                 | V <sub>S</sub> = ±15V,<br>No Load                                    | —          | 230  | 300 | —          | 235  | 360 | —          | 250  | 420 |       |

**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 2.5V$  to  $\pm 15V$ ,  $-55^\circ C \leq T_A \leq +125^\circ C$  for OP-21A,  $-25^\circ C \leq T_A \leq +85^\circ C$  for OP-21E and OP-21F,  $-40^\circ C \leq T_A \leq +85^\circ C$  for OP-21G and OP-21H, unless otherwise noted.

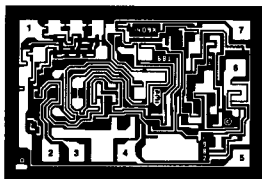
| PARAMETER                                          | SYMBOL             | CONDITIONS                                                                                 | OP-21A/E   |      |     | OP-21F     |      |     | OP-21G/H   |      |      | UNITS            |
|----------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------|------------|------|-----|------------|------|-----|------------|------|------|------------------|
|                                                    |                    |                                                                                            | MIN        | TYP  | MAX | MIN        | TYP  | MAX | MIN        | TYP  | MAX  |                  |
| Average Input Offset Voltage Drift<br>(Notes 1, 2) | TCV <sub>OS</sub>  | Unnulled                                                                                   | —          | 0.5  | 1.0 | —          | 1.0  | 2.0 | —          | 2.5  | 5.0  | $\mu V/^\circ C$ |
|                                                    | TCV <sub>OSn</sub> | Nullled                                                                                    | —          | —    | —   | —          | —    | —   | —          | —    | —    | —                |
| Input Offset Voltage                               | V <sub>OS</sub>    |                                                                                            | —          | 75   | 200 | —          | 200  | 500 | —          | 500  | 1000 | $\mu V$          |
| Input Offset Current                               | I <sub>OS</sub>    | V <sub>CM</sub> = 0                                                                        | —          | 0.7  | 5   | —          | 0.7  | 6   | —          | 0.8  | 8    | nA               |
| Input Bias Current                                 | I <sub>B</sub>     | V <sub>CM</sub> = 0                                                                        | —          | 50   | 110 | —          | 60   | 130 | —          | 70   | 165  | nA               |
| Input Voltage Range                                | IVR                |                                                                                            | -14.3/13.2 | —    | —   | -14.3/13.2 | —    | —   | -14.3/13.2 | —    | —    | V                |
| Common-Mode Rejection Ratio                        | CMRR               | No Load,<br>V <sub>S</sub> = $\pm 15V$ ,<br>-14.5V $\leq$ V <sub>CM</sub> $\leq$ 13.2V     | 96         | 105  | —   | 86         | 100  | —   | 80         | 95   | —    | dB               |
| Power Supply Rejection Ratio                       | PSRR               | V <sub>S</sub> = $\pm 2.5V$<br>to $\pm 15V$ , No Load                                      | —          | 4    | 10  | —          | 6    | 18  | —          | 18   | 57   | $\mu V/V$        |
| Large-Signal Voltage Gain                          | A <sub>VO</sub>    | V <sub>S</sub> = $\pm 15V$ ,<br>R <sub>L</sub> = 20k $\Omega$ , V <sub>O</sub> = $\pm 10V$ | 500        | 1500 | —   | 250        | 1300 | —   | 250        | 1000 | —    | V/mV             |
| Output Voltage Swing                               | V <sub>O</sub>     | V <sub>S</sub> = $\pm 15V$ ,<br>R <sub>L</sub> = 20k $\Omega$                              | -13.5/13.8 | —    | —   | -13.5/13.7 | —    | —   | -13.5/13.6 | —    | —    | V                |
| Supply Current                                     | I <sub>SY</sub>    | V <sub>S</sub> = $\pm 2.5V$ ,<br>No Load                                                   | —          | 205  | 275 | —          | 215  | 330 | —          | 230  | 360  | $\mu A$          |
|                                                    |                    | V <sub>S</sub> = $\pm 15V$ ,<br>No Load                                                    | —          | 275  | 360 | —          | 285  | 430 | —          | 300  | 500  | $\mu A$          |

**NOTES:**

1. Sample tested.
2. TCV<sub>OSn</sub> is guaranteed by unnulled TCV<sub>OS</sub> and device design.

# OP-21

## DICE CHARACTERISTICS (125°C TESTED DICE AVAILABLE)



DIE SIZE 0.069 × 0.046 inch, 3174 sq. mils  
(1.75 × 1.17 mm, 2.05 sq. mm)

1. BALANCE
2. INVERTING INPUT
3. NONINVERTING INPUT
4. V<sup>-</sup>
5. BALANCE
6. OUTPUT
7. V<sup>+</sup>

**ELECTRICAL CHARACTERISTICS** at  $V_S = \pm 15V$ ,  $T_A = +25^\circ C$  for OP-21N and OP-21G devices;  $T_A = +125^\circ C$  for OP-21NT and OP-21GT devices, unless otherwise noted.

| PARAMETER                       | SYMBOL   | CONDITIONS                               | OP-21NT<br>LIMIT | OP-21N<br>LIMIT | OP-21GT<br>LIMIT | OP-21G<br>LIMIT | UNITS         |
|---------------------------------|----------|------------------------------------------|------------------|-----------------|------------------|-----------------|---------------|
| Input Offset Voltage            | $V_{OS}$ |                                          | 200              | 100             | 500              | 200             | $\mu V$ MAX   |
| Input Offset Current            | $I_{OS}$ | $V_{CM} = 0$                             | 4                | 4               | 5                | 5               | nA MAX        |
| Input Bias Current              | $I_B$    | $V_{CM} = 0$                             | 100              | 100             | 120              | 120             | nA MAX        |
| Input Voltage Range             | IVR      |                                          | -14.3<br>+13.5   | -14.5<br>+13.5  | -14.3<br>+13.5   | -14.5<br>+13.5  | V MIN         |
| Common-Mode<br>Rejection Ratio  | CMRR     | No Load<br>CMVR = IVR                    | 96               | 100             | 86               | 90              | dB MIN        |
| Power Supply<br>Rejection Ratio | PSRR     | $V_S = \pm 2.5V$ to $\pm 15V$<br>No Load | 10               | 6               | 18               | 10              | $\mu V/V$ MAX |
| Large-Signal<br>Voltage Gain    | $A_{VO}$ | $R_L = 10k\Omega$ ,<br>$V_O = \pm 10V$   | 500              | 1000            | 250              | 500             | V/mV MIN      |
| Output Voltage Swing            | $V_O$    | $R_L = 10k\Omega$                        | -13.5<br>+13.8   | -13.7<br>+14.0  | -13.5<br>+13.8   | -13.7<br>+13.9  | V MIN         |
| Supply Current                  | $I_{SY}$ | No Load                                  | 300              | 300             | 360              | 360             | $\mu A$ MAX   |

### NOTES:

For  $25^\circ C$  characteristics of NT & GT devices, see N & G characteristics respectively.

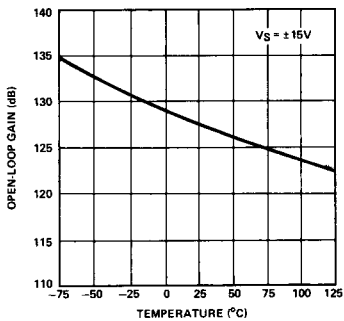
Electrical tests are performed at wafer probe to the limits shown. Due to variations in assembly methods and normal yield loss, yield after packaging is not guaranteed for standard product dice. Consult factory to negotiate specifications based on dice lot qualification through sample lot assembly and testing.

## TYPICAL ELECTRICAL CHARACTERISTICS at $V_S = \pm 15V$ , $T_A = +25^\circ C$ , unless otherwise noted.

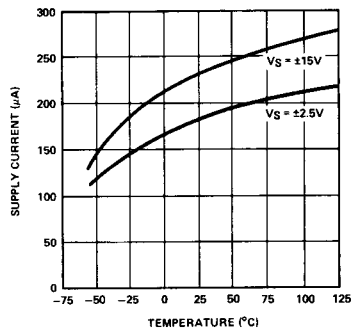
| PARAMETER                             | SYMBOL      | CONDITIONS                          | OP-21NT<br>TYPICAL | OP-21N<br>TYPICAL | OP-21GT<br>TYPICAL | OP-21G<br>TYPICAL | UNITS            |
|---------------------------------------|-------------|-------------------------------------|--------------------|-------------------|--------------------|-------------------|------------------|
| Average Input<br>Offset Voltage Drift | $TCV_{OS}$  | Unnulled                            | 0.5                | 0.5               | 1                  | 1                 | $\mu V/^\circ C$ |
| Nullled Input<br>Offset Voltage Drift | $TCV_{OSn}$ | Nullled, $R_p = 10k\Omega$          | 0.5                | 0.5               | 1                  | 1                 | $\mu V/^\circ C$ |
| Large-Signal<br>Voltage Gain          | $A_{VO}$    | $R_L = 10k\Omega$                   | 2000               | 2000              | 1500               | 1500              | V/mV             |
| Slew Rate                             | SR          | $R_L = 25k\Omega$<br>$C_L = 100pF$  | 0.25               | 0.25              | 0.25               | 0.25              | V/ $\mu s$       |
| Closed-Loop<br>Bandwidth              | BW          | $A_{VCL} = +1$<br>$R_L = 10k\Omega$ | 600                | 600               | 600                | 600               | kHz              |

TYPICAL PERFORMANCE CHARACTERISTICS

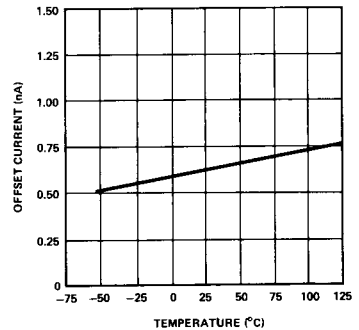
OPEN-LOOP GAIN  
vs TEMPERATURE



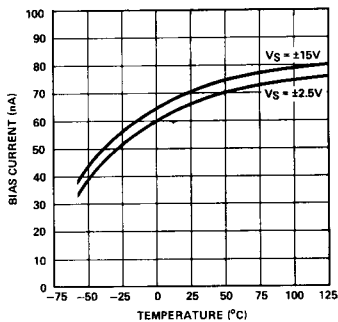
SUPPLY CURRENT  
vs TEMPERATURE



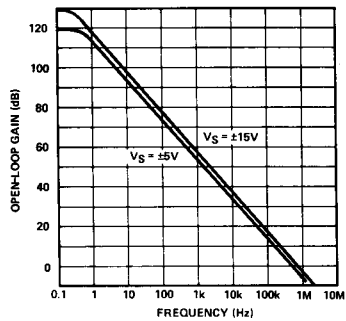
OFFSET CURRENT  
vs TEMPERATURE



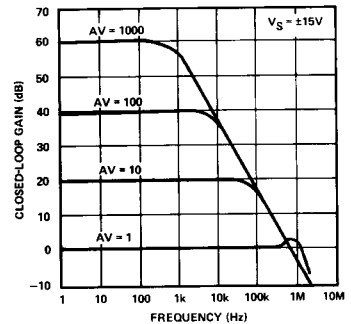
BIAS CURRENT  
vs TEMPERATURE



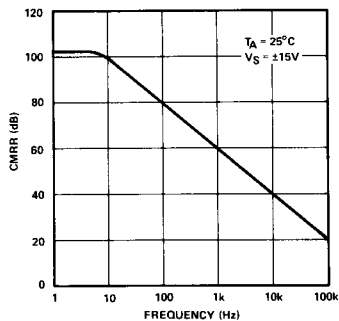
OPEN-LOOP GAIN  
vs FREQUENCY



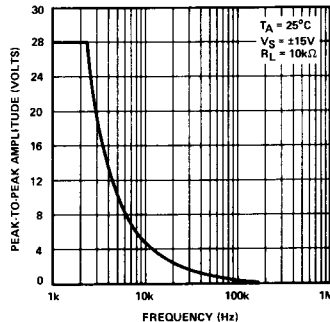
CLOSED-LOOP GAIN  
vs FREQUENCY



CMRR vs FREQUENCY



MAXIMUM OUTPUT SWING  
vs FREQUENCY



TYPICAL PERFORMANCE CHARACTERISTICS

