

FEATURES:

- RAD-PAK® technology-hardened against natural space radiation
- Package:
 - 16 pin Rad-Pak® flat package
- Low input offset voltage: 5 μV max
- Low offset voltage drift
 - 5 $\mu\text{V}/^\circ\text{C}$ max (over -55 to +125 $^\circ\text{C}$)
- Low supply current (per amplifier) 20 μA max
- High open-loop gain 700 V/me min.
- Outstanding PSRR: 5.6 $\mu\text{V}/\text{V}$ min.

DESCRIPTION:

Maxwell Technologies' OP490 micropower quad operational amplifier microcircuit features Maxwell's radiation-hardened RAD-PAK® packaging technology, the OP490 has an extremely low input offset voltage no less than 0.5 mV with a drift of under 5 $\mu\text{V}/^\circ\text{C}$, guaranteed over the full military temperature range. The OP490 features low power consumption, drawing less than 20 μA per amplifier.

Maxwell Technologies' patented RAD-PAK packaging technology incorporates radiation shielding in the microcircuit package. It eliminates the need for box shielding while providing the required radiation shielding for a lifetime in orbit or space mission. This product is available with screening up to Class S.

TABLE 1. PINOUT DESCRIPTION

| PIN | SYMBOL | DESCRIPTION |
|--------------|-----------|-----------------------|
| 1, 7, 10, 16 | OUT A - D | Output Signal |
| 2, 6, 11, 15 | -IN A - D | Negative Input Signal |
| 3, 5, 12, 14 | +IN A - D | Positive Input Signal |
| 8, 9 | NC | Not Connected |
| 4 | V+ | Positive Voltage |
| 13 | V- | Negative Voltage |

TABLE 2. OP490 ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MIN | MAX | UNIT |
|-------------------------------|---------------|------------|-----------|-----------------------------|
| Supply Voltage | V_{CC} | | ± 18 | V |
| Differential Input Voltage | | (V-) - 20 | (V+) + 20 | V |
| Common-Mode Input Voltage | | (V-) - 20 | (V+) + 20 | V |
| Output Short-Circuit Duration | | Continuous | | |
| Thermal Impedance | Θ_{JC} | -- | 3.35 | $^{\circ}\text{C}/\text{W}$ |
| Storage Temperature Range | T_S | -65 | +150 | $^{\circ}\text{C}$ |
| Operating Temperature Range | T_A | -55 | +125 | $^{\circ}\text{C}$ |

TABLE 3. DELTA LIMITS

| PARAMETER | VARIATION |
|-----------|---|
| I_{CC} | $\pm 10\%$ of specified value in Table 4. |
| | |

TABLE 4. OP490 DC ELECTRICAL CHARACTERISTICS

($V_S = \pm 15\text{V}$, $T_A = -55$ TO 125°C , UNLESS OTHERWISE SPECIFIED)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS | |
|----------------------|----------|----------------------|-------------------------------|-----|-----|-------|----|
| Input Offset Voltage | V_{OS} | | +25 $^{\circ}\text{C}$ | -- | 0.2 | 0.5 | mV |
| | | | -55 to 125 $^{\circ}\text{C}$ | -- | 0.4 | 1.0 | |
| Input Offset Current | I_{OS} | $V_{CM} = 0\text{V}$ | +25 $^{\circ}\text{C}$ | -- | 0.4 | 3 | nA |
| | | | -55 to 125 $^{\circ}\text{C}$ | -- | 1.5 | 5 | |
| Input Bias Current | I_B | $V_{CM} = 0\text{V}$ | +25 $^{\circ}\text{C}$ | -- | 4.2 | 15 | nA |
| | | | -55 to 125 $^{\circ}\text{C}$ | | 4.4 | 20 | |

TABLE 4. OP490 DC ELECTRICAL CHARACTERISTICS

(VS = ±15V, TA = -55 to 125°C, UNLESS OTHERWISE SPECIFIED)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNITS | | |
|----------------------------------|--|---|-----------------|----------|----------|-------|------|--|
| Large Signal Voltage Gain | A _{VO} | V _S = ±15V, V _O = ±10V | | | | V/mV | | |
| | | R _L = 100 kΩ | +25°C | 700 | 1200 | | -- | |
| | | | -55 to 125°C | 225 | 400 | | -- | |
| | | R _L = 10 kΩ | +25°C | 350 | 600 | | -- | |
| | | | -55 to 125°C | 125 | 240 | | -- | |
| | | R _L = 2 kΩ | +25°C | 125 | 250 | | -- | |
| | | | -55 to 125°C | 50 | 110 | | -- | |
| | | V ₊ = 5V, V ₋ = 0V, 1V < V _O < 4V | | | | | | |
| | | R _L = 100 kΩ | +25°C | -- | 400 | | -- | |
| | | | -55 to 125°C | -- | 200 | | -- | |
| R _L = 10 kΩ | +25°C | -- | 180 | -- | | | | |
| | -55 to 125°C | -- | 110 | -- | | | | |
| Input Voltage Range ¹ | IVR | V ₊ = 5V, V ₋ = 0V V _S = ±15V | 0/4 -15/13.5 | -- -- | -- -- | V | | |
| Output Voltage Swing | V _O | R _L = 10 kΩ | +25°C | ±13.5 | ±14.2 | -- | | |
| | | | -55 to 125°C | ±13 | ±14 | -- | | |
| | | R _L = 2 kΩ | +25°C | ±10.5 | ±11.5 | -- | | |
| | | | -55 to 125°C | ±10 | ±11 | -- | | |
| | V _{OH} | V ₊ = 12V, V ₋ = 0V R _L = 2 kΩ | +25°C | -- | 4.2 | -- | | |
| | | | -55 to 125°C | -- | 4.1 | -- | | |
| V _{OL} | V ₊ = 5V, V ₋ = 0V R _L = 10 kΩ | -- | 100 | -- | μV | | | |
| Common Mode Rejection | CMR | V ₊ = 5V, V ₋ = 0V, 0V < V _{CM} < 4 | +25°C | -- | 110 | -- | | |
| | | | -55 to 125°C | -- | 108 | -- | | |
| | | V ₊ = 5V, V ₋ = 0V, 0V < V _{CM} < 3.5 | +25°C | 100 | 130 | -- | | |
| | | | -55 to 125°C | 95 | 115 | -- | | |
| Power Supply Rejection Ratio | PSRR | | +25°C | -- | 1.0 | 5.6 | | |
| | | | -55 to 125°C | -- | 3.2 | 10 | | |
| Slew Rate | SR | V _S = ±15V | +25°C | -- | 12 | -- | V/ms | |
| Supply Current (All Amplifiers) | I _{SY} | V _S = ±1.5V, No Load | +25°C | -- | 40 | 60 | | |
| | | | -55 to 125°C | -- | 70 | 100 | | |
| | | V _S = ±15V, No Load | +25°C | -- | 60 | 80 | | |
| | | | -55 to 125°C | -- | 90 | 120 | | |
| Capacitive Load Stability | | AV = +1 | +25°C | -- | 650 | -- | pF | |

TABLE 4. OP490 DC ELECTRICAL CHARACTERISTICS

($V_S = \pm 15V$, $T_A = -55$ TO $125^\circ C$, UNLESS OTHERWISE SPECIFIED)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNITS |
|--------------------|--------|---|-------|-----|-----|-----|-------|
| Channel Separation | CS | $V_O = 20V_{p-p}$, $f_O = 10$ Hz, $V_S = \pm 15V^2$ | +25°C | 120 | 150 | --- | dB |

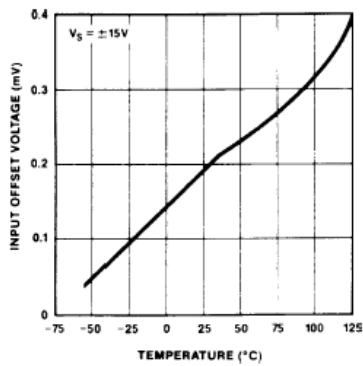
1. Guaranteed by CMR test.
2. Guaranteed but not 100% tested.

TABLE 5. OP490 AC ELECTRICAL CHARACTERISTICS

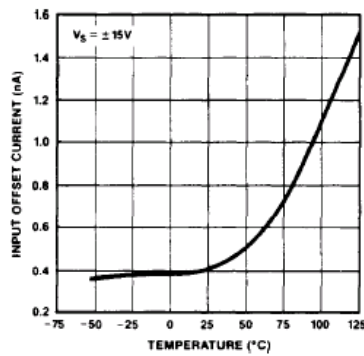
($V_S = \pm 15V$, $T_A = -55$ TO $125^\circ C$ UNLESS OTHERWISE SPECIFIED.)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|------------------------------------|-------------|-------------------------|-------|-----|-----|-----|---------------|
| Input Noise Voltage | $e_{n,p-p}$ | $f_O = 0.1$ Hz to 10 Hz | +25°C | --- | 3 | --- | μV_{p-p} |
| Input Resistance Differential Mode | R_{IN} | $V_S = \pm 15V$ | +25°C | --- | 30 | --- | $M\Omega$ |
| Input Resistance Common Mode | R_{INCM} | $V_S = \pm 15V$ | +25°C | --- | 20 | --- | $G\Omega$ |
| Gain Bandwidth Product | GBWP | $A_V = +1$ | +25°C | --- | 500 | --- | kHz |

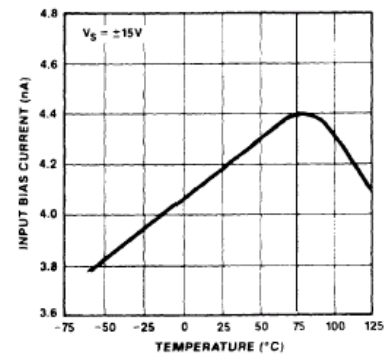
OP490RP TYPICAL OPERATING CHARACTERISTICS



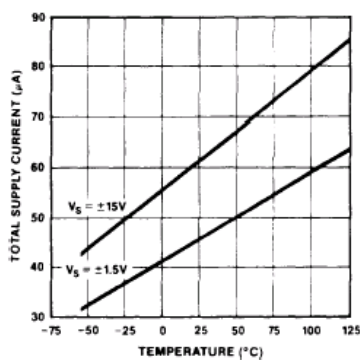
Input Offset Voltage vs. Temperature



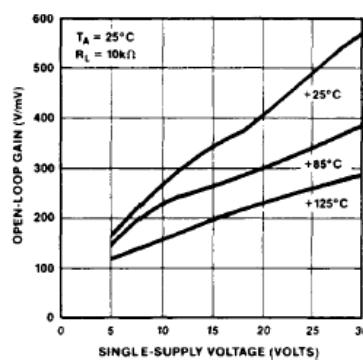
Input Offset Current vs. Temperature



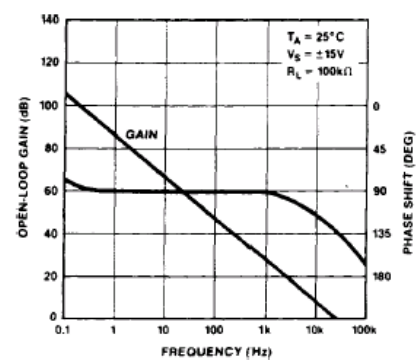
Input Bias Current vs. Temperature



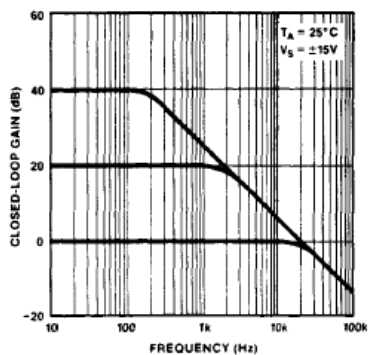
Total Supply Current vs. Temperature



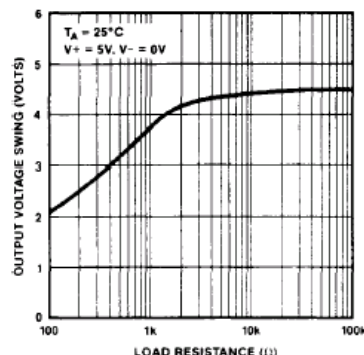
Open-Loop Gain vs. Single-Supply Voltage



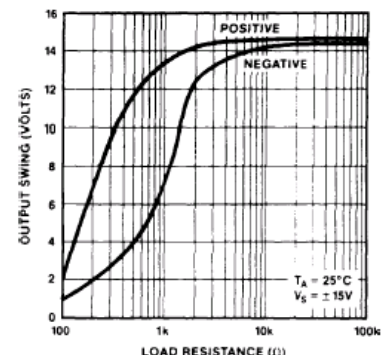
Open-Loop Gain and Phase Shift vs. Frequency



Closed-Loop Gain vs. Frequency

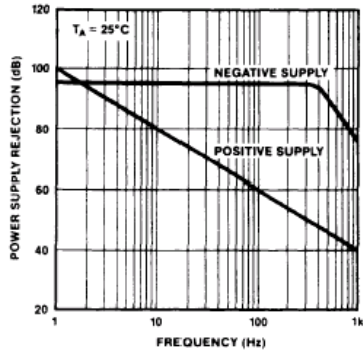


Output Voltage Swing vs. Load Resistance

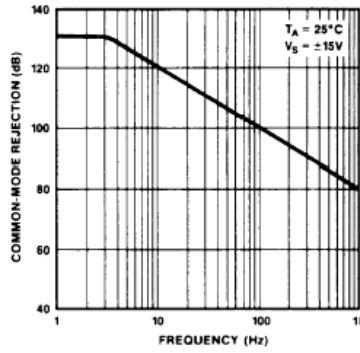


Output Voltage Swing vs. Load Resistance

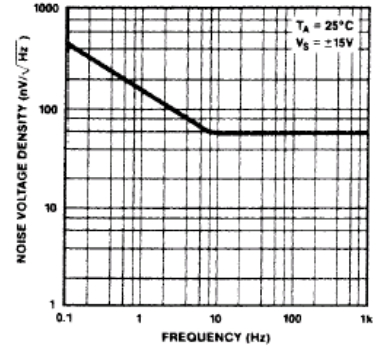
OP490RP TYPICAL OPERATING CHARACTERISTICS



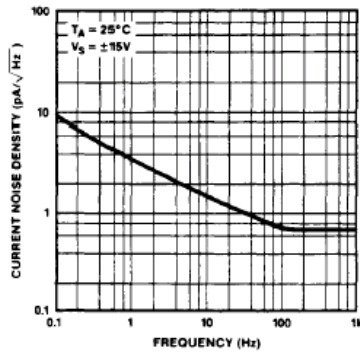
Power Supply Rejection vs. Frequency



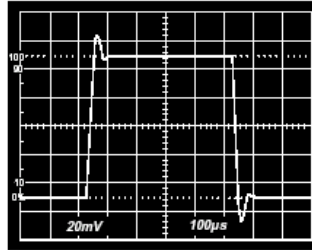
Common-Mode Rejection vs. Frequency



Noise Voltage Density vs. Frequency

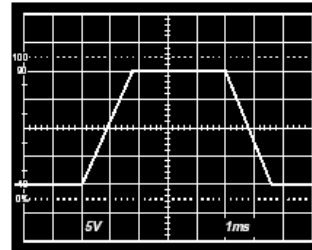


Current Noise Density vs. Frequency



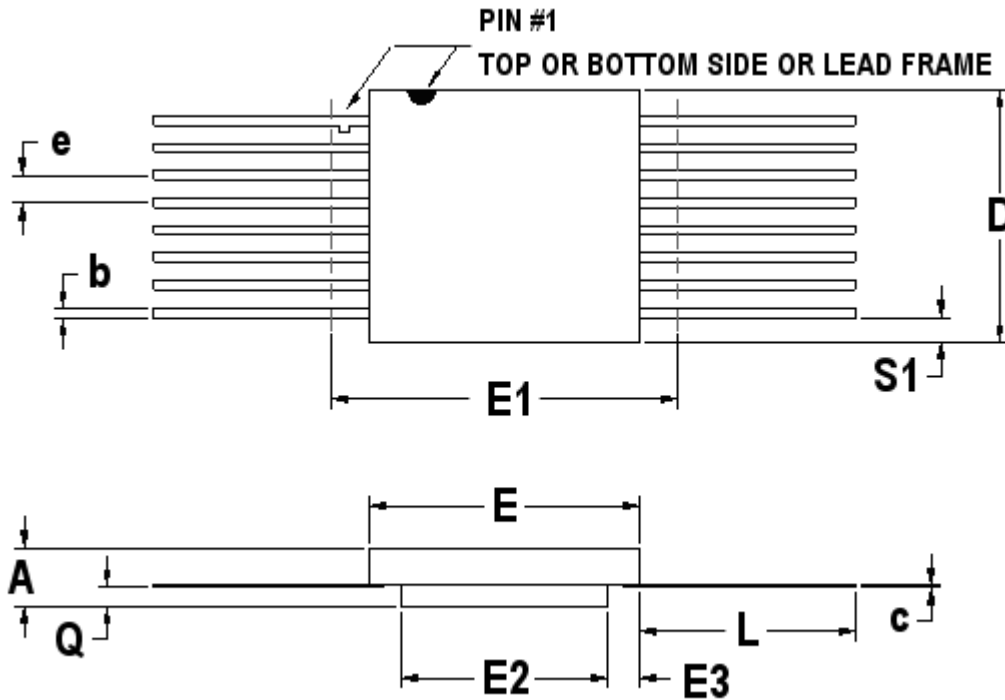
$T_A = 25^\circ\text{C}$
 $V_S = \pm 15\text{V}$
 $A_V = +1$
 $R_L = 10\text{k}\Omega$
 $C_L = 500\text{pF}$

Small-Signal Transient Response



$T_A = 25^\circ\text{C}$
 $V_S = \pm 15\text{V}$
 $A_V = +1$
 $R_L = 10\text{k}\Omega$
 $C_L = 500\text{pF}$

Large-Signal Transient Response



16-PIN RAK-PAK® FLAT PACKAGE

| SYMBOL | DIMENSION | | |
|--------|-----------|-------|-------|
| | MIN | NOM | MAX |
| A | 0.115 | 0.135 | 0.150 |
| b | 0.015 | 0.017 | 0.022 |
| c | 0.004 | 0.005 | 0.009 |
| D | -- | 0.415 | 0.440 |
| E | 0.245 | 0.280 | 0.285 |
| E1 | -- | -- | 0.315 |
| E2 | 0.120 | 0.156 | -- |
| E3 | 0.030 | 0.062 | -- |
| e | 0.050 BSC | | |
| L | 0.325 | 0.335 | 0.345 |
| Q | 0.020 | 0.033 | 0.045 |
| S1 | 0.005 | 0.024 | -- |
| N | 16 | | |

F16-01

Note: All dimensions in inches.

Important Notice:

These data sheets are created using the chip manufacturer's published specifications. Maxwell Technologies verifies functionality by testing key parameters either by 100% testing, sample testing or characterization.

The specifications presented within these data sheets represent the latest and most accurate information available to date. However, these specifications are subject to change without notice and Maxwell Technologies assumes no responsibility for the use of this information.

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Product Ordering Options

