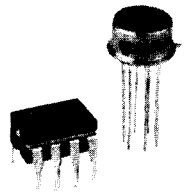
BURR-BROWN®



# OPA21

AVAILABLE IN DIE FORM

# Low-Power Precision OPERATIONAL AMPLIFIER

## FEATURES

- LOW SUPPLY CURRENT
  230μA max at $V_{CC}$ = ±15V
- WIDE SUPPLY RANGE
  ±2.5V to ±18V
- LOW OFFSET VOLTAGE
  100μV max
- LOW OFFSET VOLTAGE DRIFT
  1.0μV/°C max

## APPLICATIONS

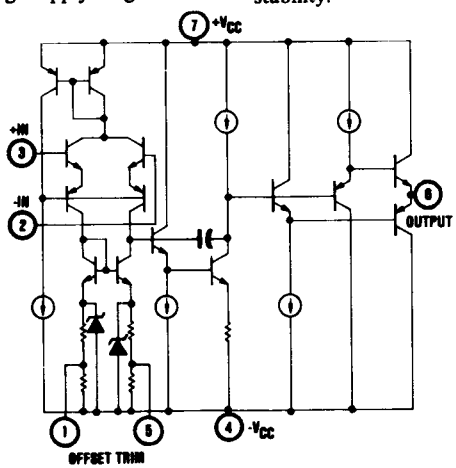
- PORTABLE EQUIPMENT
- BATTERY OPERATION
- IMPROVED REPLACEMENT FOR OP-21

## DESCRIPTION

A unique circuit design, state-of-the-art monolithic processing and advanced laser-trimming techniques are used to provide a low power amplifier with outstanding parameters—truly "instrumentation grade" performance over a wide voltage supply range.

The OPA21 consumes only 6.9mW of power at $V_{CC}$ = ±15V and 1.1mW at $V_{CC}$ = ±2.5V but offers far higher performance than MOS op-amps.

The OPA21 is internally compensated for unity-gain stability.




SIMPLIFIED CIRCUIT

International Airport Industrial Park - P.O. Box 11400 - Tucson, Arizona 85734 - Tel. (602) 746-1111 - Twx: 910-952-1111 - Cable: BBRCORP - Telex: 66-6491

PDS-482C

# SPECIFICATIONS

## ELECTRICAL

At $T_A$ = +25°C and $\pm V_{CC}$ = 2.5VDC to 15VDC, unless otherwise noted.

| PARAMETERS | CONDITIONS | OPA21E | | | OPA21G | | | UNITS |
|---|---|---|---|---|---|---|---|---|
| | | MIN | TYP | MAX | MIN | TYP | MAX | |
| **INPUT OFFSET VOLTAGE** | | | | | | | | |
| OFFSET VOLTAGE[1] | | | 40 | 100 | | 300 | 500 | µV |
| | −25°C to +85°C | | 75 | 200 | | 500 | 1000 | µV |
| Drift | −25°C to +85°C | | 0.5 | 1.0 | | 2.5 | 5.0 | µV/°C |
| Offset Adjustment Range | | | ±4 | | | * | | mV |
| **INPUT OFFSET CURRENT** | | | | | | | | |
| Offset Current | | | 0.3 | 1 | | 1.2 | 4 | nA |
| | −25°C to +85°C | | 0.5 | 2 | | 2 | 6 | nA |
| **INPUT BIAS CURRENT** | | | | | | | | |
| Bias Current | | | 7 | 25 | | 15 | 50 | nA |
| | −25°C to +85°C | | 9 | 40 | | 18 | 75 | nA |
| **INPUT NOISE** | | | | | | | | |
| Voltage | 0.1Hz to 10Hz | | 1.0 | | | * | | µV p-p |
| Voltage Density | $f_O$ = 1Hz | | 60 | | | * | | nV/√Hz |
| | $f_O$ = 10Hz | | 20 | | | * | | nV/√Hz |
| | $f_O$ = 100Hz | | 20 | | | * | | nV/√Hz |
| Current Density | $f_O$ = 1Hz | | 0.7 | | | * | | pA/√Hz |
| | $f_O$ = 10Hz | | 0.25 | | | * | | pA/√Hz |
| | $f_O$ = 100Hz | | 0.07 | | | * | | pA/√Hz |
| **INPUT RESISTANCE** | | | | | | | | |
| Differential | | | 6 | | | 4 | | MΩ |
| Common-Mode | | | $10^{10}$‖2 | | | * | | Ω‖pF |
| **INPUT VOLTAGE RANGE** | | | | | | | | |
| Input Voltage Range | | −12.5 | | | * | | | V |
| | | +14.3 | | | * | | | V |
| | −25°C to +85°C | −12.0 | | | * | | | V |
| | | +14.0 | | | * | | | V |
| **COMMON-MODE REJECTION RATIO** | | | | | | | | |
| CMRR | $V_{CM}$ = −12V to +14V, $R_L$ = 100kΩ | 100 | 110 | | 84 | 100 | | dB |
| | −25°C to +85°C | 96 | 105 | | 80 | 95 | | dB |
| **POWER SUPPLY REJECTION RATIO** | | | | | | | | |
| PSRR | $\pm V_{CC}$ = 2.5V to 18V, $R_L$ = 100kΩ | 104 | 114 | | 90 | 100 | | dB |
| | −25°C to +85°C | 100 | 108 | | 85 | 95 | | dB |
| **LARGE SIGNAL VOLTAGE GAIN** | | | | | | | | |
| Open-Loop Voltage Gain | $R_L$ = 10kΩ | 1000 | 2000 | | 500 | 1000 | | V/mV |
| | | 120 | 126 | | 114 | 120 | | dB |
| | −25°C to +85°C | 500 | 1500 | | 250 | 1000 | | V/mV |
| | | 114 | 124 | | 108 | 120 | | dB |
| **RATED OUTPUT** | | | | | | | | |
| Output Voltage Swing | $R_L$ = 10kΩ | −13.7 | −14.2 | | −13.6 | * | | V |
| | | +14.0 | +14.1 | | +13.8 | * | | V |
| Output Current | $R_L$ = 2kΩ | | 5 | | | * | | mA |
| | −25°C to +85°C, $R_L$ = 10kΩ | −13.5 | | | * | | | V |
| | | +13.8 | | | +13.6 | | | V |
| Output Resistance | Open-Loop | | 500 | | | * | | Ω |
| **DYNAMIC RESPONSE** | | | | | | | | |
| Slew Rate | $C_L$ = 100pF, $R_L$ = 25kΩ | | 0.2 | | | * | | V/µsec |
| Closed-Loop Bandwidth | $A_{CL}$ = +1, $R_L$ = 10kΩ | | 300 | | | * | | kHz |
| **POWER SUPPLY** | | | | | | | | |
| Rated Voltage | | | ±15 | | | * | | VDC |
| Voltage Range | Derated | ±2.5 | | ±18 | * | | * | VDC |
| Current Quiescent | $I_O$ = 0MA | | | | | | | |
| | $\pm V_{CC}$ = 2.5V | | 170 | 210 | | * | 250 | µA |
| | $\pm V_{CC}$ = 15V | | 200 | 230 | | * | 325 | µA |
| | $\pm V_{CC}$ = 2.5V, −25°C to +85°C | | 210 | 275 | | * | 325 | µA |
| | $\pm V_{CC}$ = 15V, −25°C to +85°C | | 230 | 325 | | * | 375 | µA |
| **TEMPERATURE RANGE** | | | | | | | | |
| Specification | Ambient | −25 | | +85 | * | | * | °C |
| Operating | Ambient | −55 | | +125 | * | | * | °C |

NOTE: (1) Guaranteed fully warmed-up.

*Specification same as OPA21E.

## ABSOLUTE MAXIMUM RATINGS

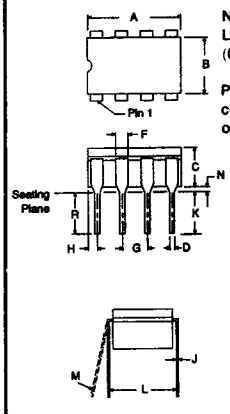
| | |
|---|---|
| Supply Voltage | ±18V |
| Internal Power Dissipation[1] | 500mW |
| Input Voltage | Supply Voltage |
| Differential Input Voltage | ±30V |
| Output Short Circuit Duration | Indefinite |
| Storage Temperature Range | −65°C to +150°C |
| Operating Temperature Range | −55°C to +125°C |
| Lead Temperature Range (soldering, 60sec) | +300°C |

NOTE: (1) Maximum package power dissipation vs ambient temperature:

| Package Type | Maximum Ambient Temperature for Rating | Derate Above Maximum Ambient Temperature |
|---|---|---|
| 8-Pin Hermetic DIP (Z) | +75°C | 6.7mW/°C |

## MECHANICAL

8-PIN HERMETIC DIP
("Z" SUFFIX)



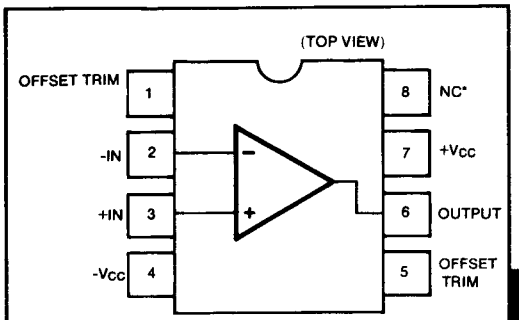

NOTE:
Leads in true position within 0.01" (0.25mm) R at MMC at seating plane.

Pin material and plating composition conform to Method 2003 (solderability) of MIL-STD-883 (except paragraph 3.2).

Pin numbers shown for reference only. Numbers may not be marked on package.

| DIM | INCHES MIN | INCHES MAX | MILLIMETERS MIN | MILLIMETERS MAX |
|---|---|---|---|---|
| A | .075 | .405 | 0.89 | 10.28 |
| B | .245 | .261 | 6.22 | 6.63 |
| C | .140 | .170 | 3.56 | 4.32 |
| D | .015 | .021 | 0.38 | 0.53 |
| F | .045 | .060 | 1.14 | 1.52 |
| G | .100 BASIC | | 2.54 BASIC | |
| H | - | .030 | - | 0.76 |
| J | .008 | .012 | 0.20 | 0.30 |
| K | .150 | - | 3.80 | - |
| L | .300 | .320 | 7.37 | 8.13 |
| M | 0° | 15° | 0° | 15° |
| N | .009 | .040 | 0.23 | 1.02 |
| R | .125 | .175 | 3.18 | 4.45 |

## PIN CONFIGURATION




*NO INTERNAL CONNECTION

## ORDERING INFORMATION

OPA21 E Z

Basic Model Number

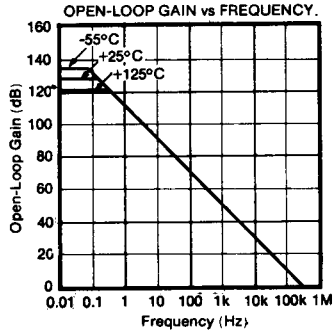
Performance Grade Code
E, G = −25°C to +85°C

Package Code
Z = 8-Pin Hermetic DIP

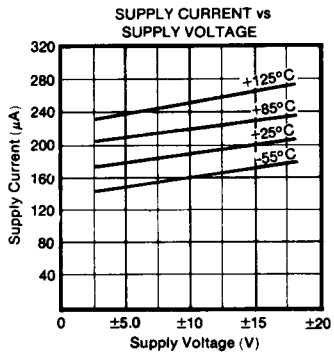
# TYPICAL PERFORMANCE CURVES

($T_A$ = +25°C, ±$V_{CC}$ = 15VDC unless otherwise noted)

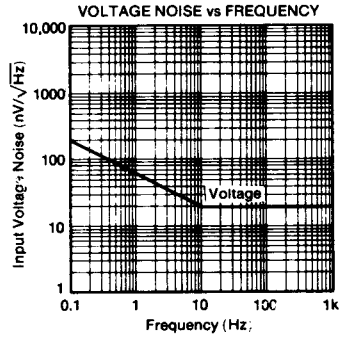
OPEN-LOOP GAIN vs FREQUENCY

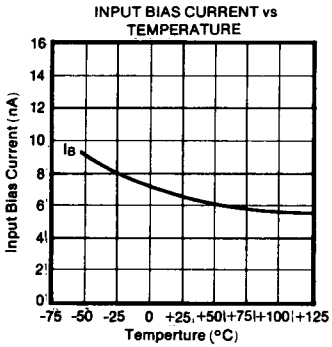


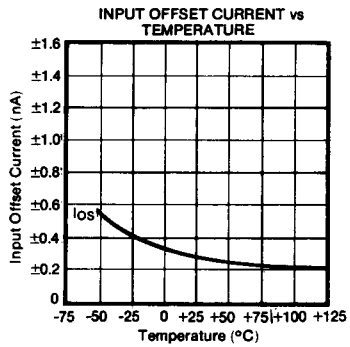

SUPPLY CURRENT vs SUPPLY VOLTAGE

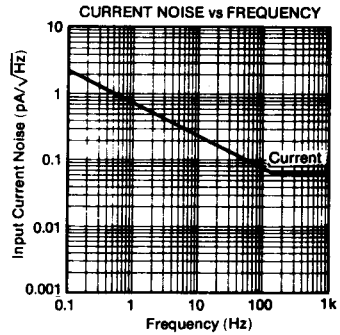


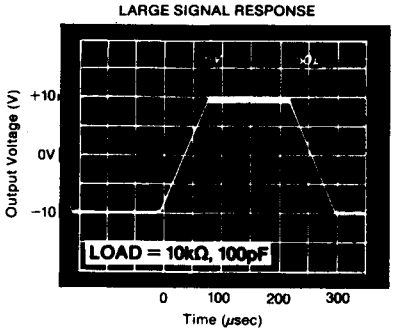

VOLTAGE NOISE vs FREQUENCY

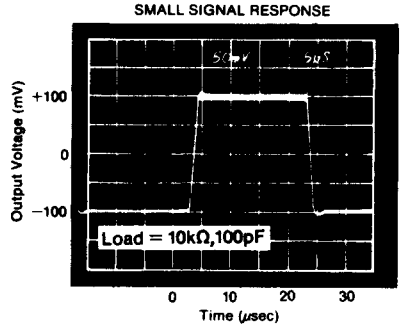


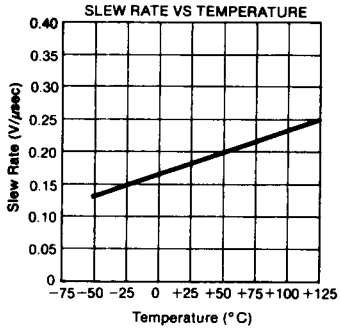

INPUT BIAS CURRENT vs TEMPERATURE
Input Bias Current (nA)
16
14
12
10
8
6
4
2
0
IB
-75 -50 -25 0 +25 +50 +75 +100 +125
Temperture (°C)

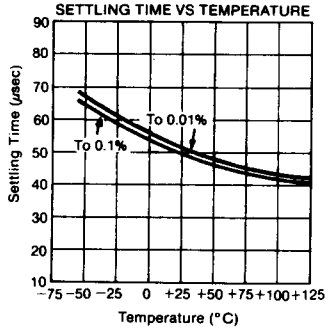

INPUT OFFSET CURRENT vs TEMPERATURE
Input Offset Current (nA)
±1.6
±1.4
±1.2
±1.0
±0.8
±0.6
±0.4
±0.2
0
IOS
-75 -50 -25 0 +25 +50 +75 +100 +125
Temperature (°C)


CURRENT NOISE vs FREQUENCY
Input Current Noise (pA/√Hz)
10
1
0.1
0.01
0.001
Current
0.1 1 10 100 1k
Frequency (Hz)


LARGE SIGNAL RESPONSE
Output Voltage (V)
+10
0V
-10
LOAD = 10kΩ, 100pF
0 100 200 300
Time (μsec)


SMALL SIGNAL RESPONSE
Output Voltage (mV)
+100
0
-100
Load = 10kΩ,100pF
0 10 20 30
Time (μsec)


SLEW RATE VS TEMPERATURE
Slew Rate (V/μsec)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
-75 -50 -25 0 +25 +50 +75 +100 +125
Temperature (°C)


SETTLING TIME VS TEMPERATURE
Settling Time (μsec)
90
80
70
60
50
40
30
20
10
To 0.01%
To 0.1%
-75 -50 -25 0 +25 +50 +75 +100 +125
Temperature (°C)

## APPLICATIONS

Figures 1 through 6 are typical applications of the OPA21.

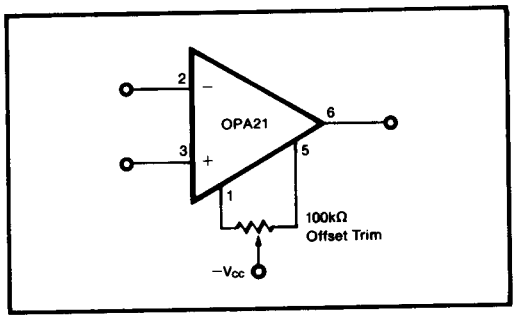



FIGURE 1. Voltage Offset Trim.

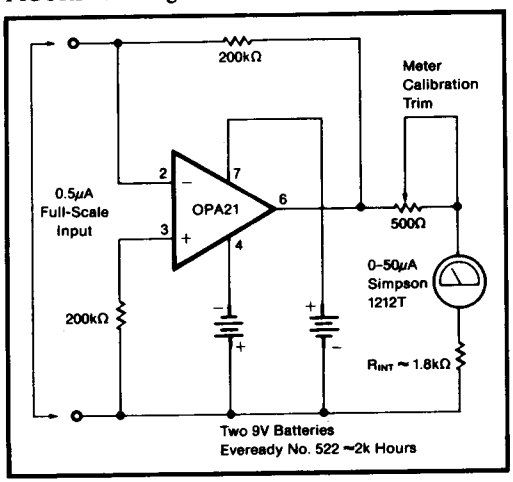



FIGURE 2. Fully-Floating Current Meter.

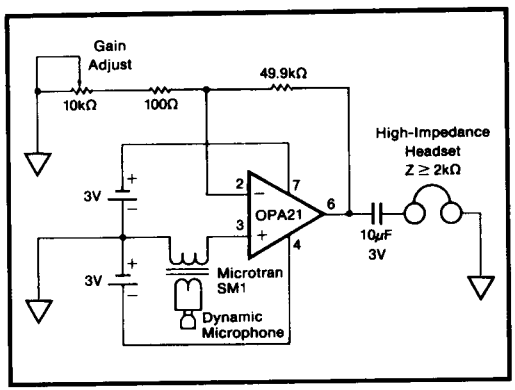



FIGURE 3. Portable Microphone Amplifier.

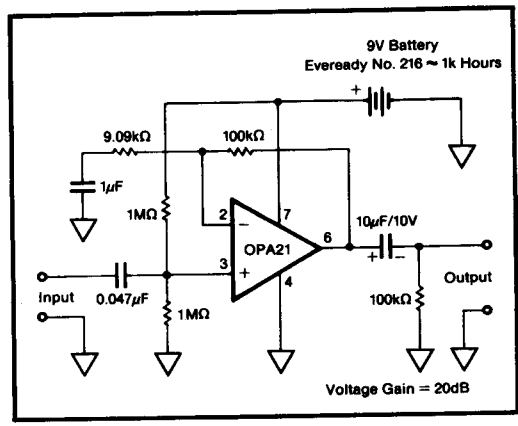



FIGURE 4. AC Amplifier.

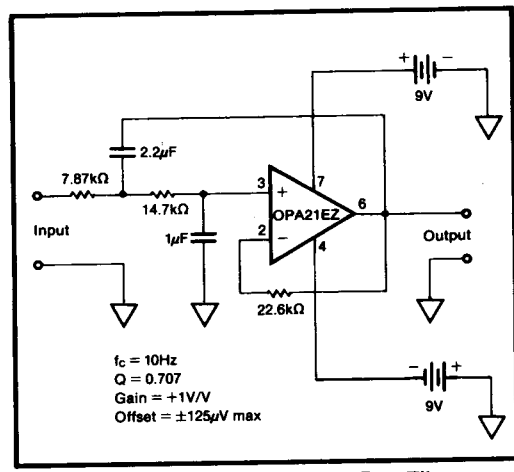



FIGURE 5. Second-Order 10Hz Low-Pass Filter.

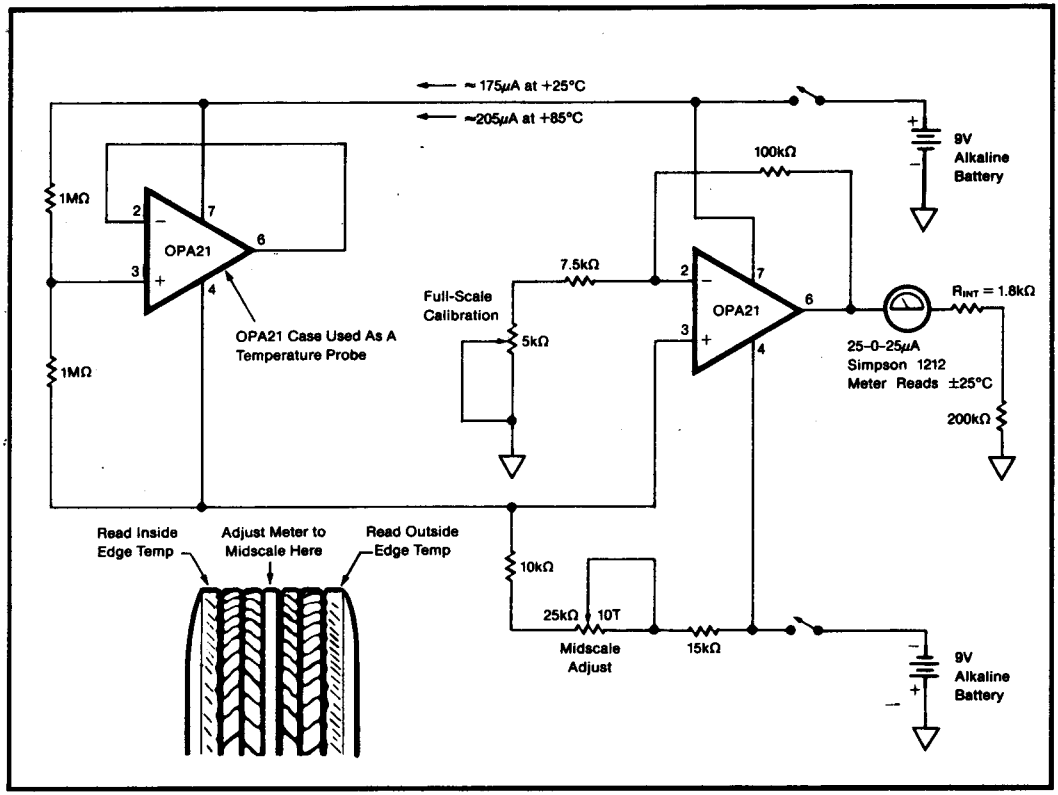



FIGURE 6. Portable Tire Pyrometer.