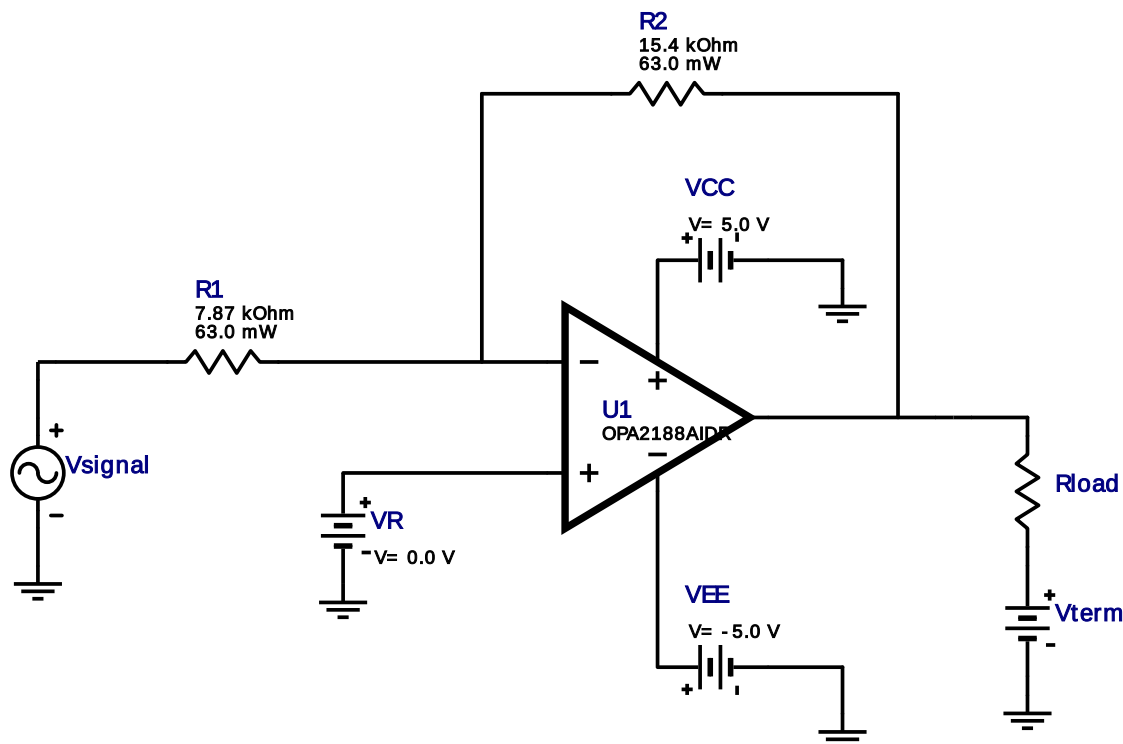


# WEBENCH® Amplifier Design Report

Design : 4077713/18 OPA2188AIDR  
Your OPA2188AIDR Inverting Amp Design

Device = OPA2188AIDR  
Topology = Inverting  
Created = Jul 17 2016 1:49AM  
BOM Cost = \$1.42  
Footprint = 62.6 mm<sup>2</sup>  
BOM Count = 3



## My Comments

No comments

## Electrical BOM

| #  | Name | Manufacturer            | Part Number                          | Properties                                          | Qty | Price  | Footprint              |
|----|------|-------------------------|--------------------------------------|-----------------------------------------------------|-----|--------|------------------------|
| 1. | R1   | Vishay-Dale             | CRCW04027K87FKED<br>Series= CRCW..e3 | Res= 7.87 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1   | \$0.01 | 0402 3 mm <sup>2</sup> |
| 2. | R2   | Vishay-Dale             | CRCW040215K4FKED<br>Series= CRCW..e3 | Res= 15.4 kOhm<br>Power= 63.0 mW<br>Tolerance= 1.0% | 1   | \$0.01 | 0402 3 mm <sup>2</sup> |
| 3. | U1   | Texas Instruments, Inc. | OPA2188AIDR                          | GbwTyp= 2.0 MHz<br>VccMin= 4.0 V<br>VccMax= 36.0 V  | 1   | \$1.40 |                        |



D0008A 57 mm<sup>2</sup>

## Design Inputs

| #  | Name                           | Value      | Description                     |
|----|--------------------------------|------------|---------------------------------|
| 1. | Topology                       | Inverting  |                                 |
| 2. | ClosedLoopGain                 | -2.0 V/V   | System Gain                     |
| 3. | SmallSignalClosedLoopBandwidth | 10000.0 Hz | Circuit Bandwidth               |
| 4. | DualSupply                     | true       | Power supply(s) to active chips |
| 5. | PositiveSupplyVoltage          | 5.0 V      |                                 |
| 6. | PositiveSupplyTolerance        | 5.0 %      |                                 |

| #   | Name                    | Value     | Description                                                 |
|-----|-------------------------|-----------|-------------------------------------------------------------|
| 7.  | NegativeSupplyVoltage   | -5.0 V    |                                                             |
| 8.  | NegativeSupplyTolerance | 5.0 %     |                                                             |
| 9.  | VinMin                  | -2.0 V    | Minimum input voltage                                       |
| 10. | VinMax                  | 2.0 V     | Maximum input voltage                                       |
| 11. | VinPkPk                 | 4.0 V     | Peak to peak input voltage (VinMax – VinMin)                |
| 12. | VinMidpointVoltage      | 0.0 V     | Midpoint of input voltage ((VinMax – VinMin)/2 + VinMin)    |
| 13. | VoutMin                 | -4.0 V    | Minimum output voltage                                      |
| 14. | VoutMax                 | 4.0 V     | Maximum output voltage                                      |
| 15. | VoutPkPk                | 8.0 V     | Peak to peak input voltage (VoutMax – VoutMin)              |
| 16. | VoutMidpointVoltage     | 0.0 V     | Midpoint of input voltage ((VoutMax – VoutMin)/2 + VoutMin) |
| 17. | VRefRecommended         | 0.0 V     | Recommended WEBENCH Voltage Reference Value                 |
| 18. | VRefUserSpec            | 0.0 V     | User override of Voltage Reference Value                    |
| 19. | TempMin                 | 0.0 degC  | Minimum Specified Temperature                               |
| 20. | TempMax                 | 70.0 degC | Maximum Specified Temperature                               |

## Performance Values - Design Criteria

| #   | Name              | Value        | Description                     |
|-----|-------------------|--------------|---------------------------------|
| 1.  | Vcc               | 5.0 V        | Positive Power Supply           |
| 2.  | Vee               | -5.0 V       | Negative Power Supply           |
| 3.  | Op Amp            | OPA2188AIDR  | Circuit's Operational Amplifier |
| 4.  | Gain              | -2.0 V/V     | Signal Gain                     |
| 5.  | Vin Min           | -2.0 V       | Input minimum voltage           |
| 6.  | Vin Max           | 2.0 V        | Input maximum voltage           |
| 7.  | Vin pk-pk         | 4.0 V        | Input peak-to-peak voltage      |
| 8.  | Vin Midpoint      | 0.0 V        | Input midpoint voltage          |
| 9.  | Vout Min          | -4.0 V       | Output minimum voltage          |
| 10. | Vout Max          | 4.0 V        | Output maximum voltage          |
| 11. | Vout pk-pk        | 8.0 V        | Output peak-to-peak voltage     |
| 12. | Vout Midpoint     | 0.0 V        | Output midpoint voltage         |
| 13. | Voltage Reference | 0.0 V        | Voltage reference               |
| 14. | R1                | 7.699 kOhms  | Gain resistor                   |
| 15. | R1 Tolerance      |              | Gain resistor tolerance         |
| 16. | R2                | 15.399 kOhms | Feedback resistor               |
| 17. | R2 Tolerance      |              | Feedback resistor tolerance     |
| 18. | SS Bandwidth      | 10.0 kHz     | Small Signal Bandwidth          |
| 19. | Temp Minimum      | 0.0 degC     | Minimum circuit temperature     |
| 20. | Temp Maximum      | 70.0 degC    | Maximum circuit temperature     |
| 21. | R1                | 7.87 kOhms   | Gain resistor                   |
| 22. | R1 Tolerance      | 1.0 %        | Gain resistor tolerance         |
| 23. | R2                | 15.4 kOhms   | Feedback resistor               |
| 24. | R2 Tolerance      | 1.0 %        | Feedback resistor tolerance     |
| 25. | SS Bandwidth      | -1.022 MHz   | Small Signal Bandwidth          |

## Performance Values - Actual Design

| #   | Name              | Value       | Description                          |
|-----|-------------------|-------------|--------------------------------------|
| 1.  | Vcc               | 5.0 V       | Positive Power Supply                |
| 2.  | Vee               | -5.0 V      | Negative Power Supply                |
| 3.  | Op Amp            | OPA2188AIDR | Actual Circuit operational amplifier |
| 4.  | Gain_target       | -1.957 V/V  | Signal gain with actual resistors    |
| 5.  | Vin Min           | -2.0 V      | Input minimum voltage                |
| 6.  | Vin Max           | 2.0 V       | Input maximum voltage                |
| 7.  | Vin pk-pk         | 4.0 V       | Input peak-to-peak voltage           |
| 8.  | Vin Midpoint      | 0.0 V       | Input midpoint voltage               |
| 9.  | Vout Min          | -3.914 V    | Actual Output minimum voltage        |
| 10. | Vout Max          | 3.914 V     | Actual Output maximum voltage        |
| 11. | Vout pk-pk        | 7.827 V     | Actual Output peak-to-peak voltage   |
| 12. | Vout Midpoint     | 0.0 V       | Actual Output midpoint voltage       |
| 13. | Voltage Reference | 0.0 V       | Actual Voltage reference             |
| 14. | Temp Minimum      | 0.0 degC    | Minimum circuit temperature          |
| 15. | Temp Maximum      | 70.0 degC   | Maximum circuit temperature          |

## Performance Values - Operating Frequency Values

| #  | Name                  | Value         | Description                      |
|----|-----------------------|---------------|----------------------------------|
| 1. | Amplifier GBWP        | 2.0 MHz       | Amplifier Gain Bandwidth Product |
| 2. | Amplifier Slew Rate   | 800.0 mV/usec | Amplifier Slew Rate              |
| 3. | Closed Loop Bandwidth | 676.407 mMHz  | System Bandwidth                 |
| 4. | FPBW                  | 12.732 mKHz   | Circuit Full-power Bandwidth     |

## Performance Values - Power Requirements

| #  | Name | Value | Description                   |
|----|------|-------|-------------------------------|
| 1. | Vcc  | 5.0 V | Positive nominal power supply |

| #  | Name        | Value   | Description                                      |
|----|-------------|---------|--------------------------------------------------|
| 2. | Vee         | -5.0 V  | Negative nominal power supply                    |
| 3. | Vsupply Max | 36.0 V  | Operational amplifier maximum power supply range |
| 4. | Vsupply Min | 4.0 V   | Operational amplifier minimum power supply range |
| 5. | Power IC    | 3.85 mW | Operational amplifier nominal power dissipation  |

### Performance Values - Vos / Ib Vout error

| #  | Name                 | Value   | Description                                             |
|----|----------------------|---------|---------------------------------------------------------|
| 1. | Vout Vos(max) error  | 74.0 mV | 25 deg C maximum offset voltage error at the output     |
| 2. | Vout Ib(max) error   | 0.0 mV  | 25 deg C maximum input bias current error at the output |
| 3. | Tot error RSS        | 74.0 mV | Root sum square of output offset errors                 |
| 4. | Tot error Worst Case | 74.0 mV | Sum of output offset errors                             |

### Performance Values - Vout Gain vs. Resistor Tolerance

No calculated performance values for this design.

### Performance Values - Error Over Temperature

| #  | Name                       | Value     | Description                                                      |
|----|----------------------------|-----------|------------------------------------------------------------------|
| 1. | Vos at maximum temperature | 21.732 mV | Maximum amplifier offset voltage drift error at high temperature |
| 2. | Vos at minimum temperature | 19.958 mV | Maximum amplifier offset voltage drift error at low temperature  |

### Performance Values - Total Output Noise

| #  | Name        | Value         | Description                                        |
|----|-------------|---------------|----------------------------------------------------|
| 1. | Noise (rms) | 38.78 uVrms   | Total output rms noise error                       |
| 2. | Noise (p-p) | 255.949 uVp-p | Total peak-to-peak output noise (3 sigma)          |
| 3. | SNR         | 97.26 dB      | Operational amplifier output Signal to Noise ratio |

### Design Assistance

1. **OPA2188** Product Folder : <http://www.ti.com/product/OPA2188> : contains the data sheet and other resources.

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