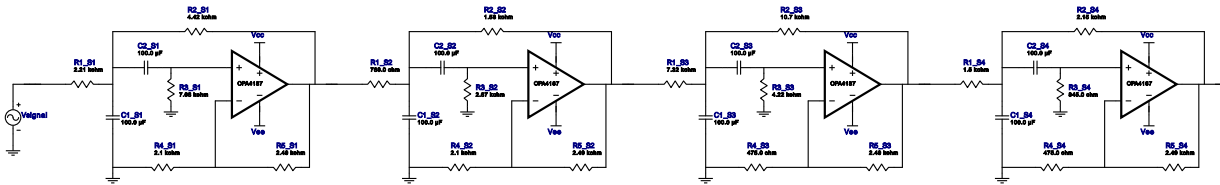


Type : Bandpass  
 Response : Butterworth  
 Order : 8  
 Number of Stages : 4

## Filter Design Report

Design : Bandpass Filter - 8th order Butterworth  
 Design ID: 22



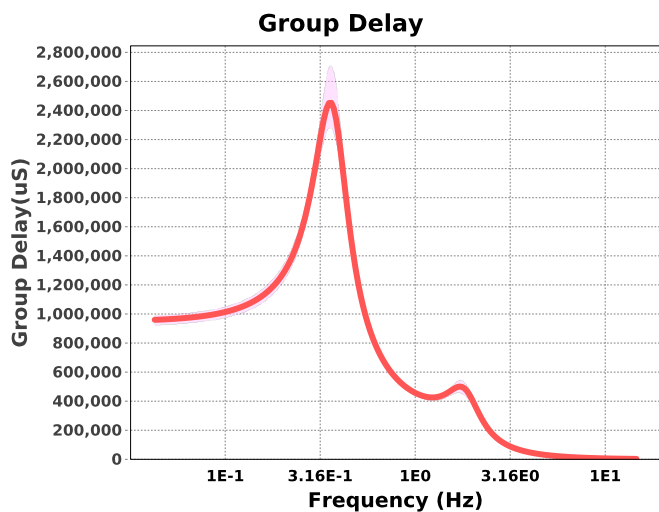
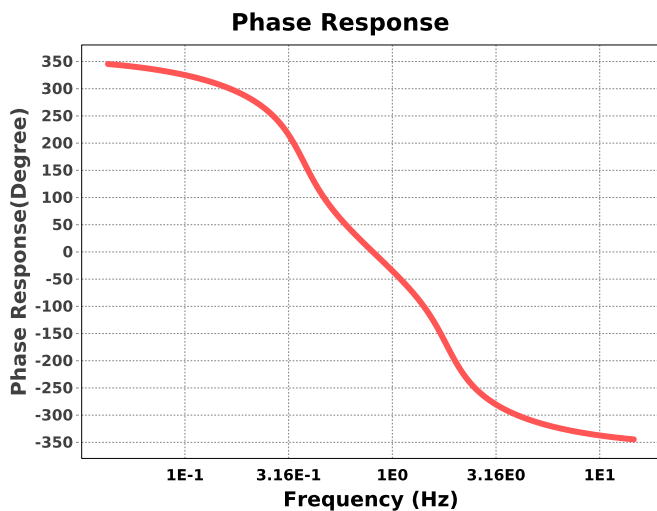
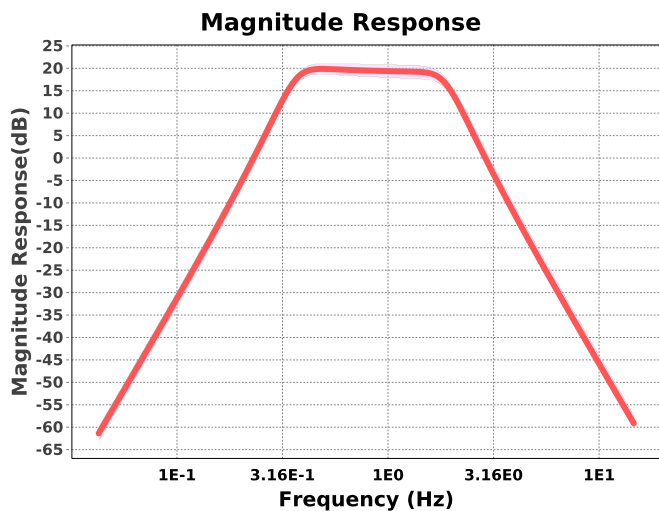
## Electrical BOM

| #   | Name  | Manufacturer           | Part Number | Properties                                     | Qty |
|-----|-------|------------------------|-------------|--|-----|
| 1.  | A1_S1 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 2.  | A1_S2 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 3.  | A1_S3 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 4.  | A1_S4 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 5.  | C1_S1 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 6.  | C1_S2 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 7.  | C1_S3 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 8.  | C1_S4 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 9.  | C2_S1 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 10. | C2_S2 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 11. | C2_S3 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 12. | C2_S4 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 13. | R1_S1 | Generic                | Ideal       | Res= 2210.0ohm<br>Tolerance= 1%                | 1   |
| 14. | R1_S2 | Generic                | Ideal       | Res= 768.0ohm<br>Tolerance= 1%                 | 1   |
| 15. | R1_S3 | Generic                | Ideal       | Res= 7320.0ohm<br>Tolerance= 1%                | 1   |
| 16. | R1_S4 | Generic                | Ideal       | Res= 1500.0ohm<br>Tolerance= 1%                | 1   |
| 17. | R2_S1 | Generic                | Ideal       | Res= 4420.0ohm<br>Tolerance= 1%                | 1   |

| #   | Name  | Manufacturer | Part Number | Properties                       | Qty |
|-----|-------|--------------|-------------|----------------------------------|-----|
| 18. | R2_S2 | Generic      | Ideal       | Res= 1580.0ohm<br>Tolerance= 1%  | 1   |
| 19. | R2_S3 | Generic      | Ideal       | Res= 10700.0ohm<br>Tolerance= 1% | 1   |
| 20. | R2_S4 | Generic      | Ideal       | Res= 2150.0ohm<br>Tolerance= 1%  | 1   |
| 21. | R3_S1 | Generic      | Ideal       | Res= 7680.0ohm<br>Tolerance= 1%  | 1   |
| 22. | R3_S2 | Generic      | Ideal       | Res= 2670.0ohm<br>Tolerance= 1%  | 1   |
| 23. | R3_S3 | Generic      | Ideal       | Res= 4220.0ohm<br>Tolerance= 1%  | 1   |
| 24. | R3_S4 | Generic      | Ideal       | Res= 845.0ohm<br>Tolerance= 1%   | 1   |
| 25. | R4_S1 | Generic      | Ideal       | Res= 2100.0ohm<br>Tolerance= 1%  | 1   |
| 26. | R4_S2 | Generic      | Ideal       | Res= 2100.0ohm<br>Tolerance= 1%  | 1   |
| 27. | R4_S3 | Generic      | Ideal       | Res= 475.0ohm<br>Tolerance= 1%   | 1   |
| 28. | R4_S4 | Generic      | Ideal       | Res= 475.0ohm<br>Tolerance= 1%   | 1   |
| 29. | R5_S1 | Generic      | Ideal       | Res= 2490.0ohm<br>Tolerance= 1%  | 1   |
| 30. | R5_S2 | Generic      | Ideal       | Res= 2490.0ohm<br>Tolerance= 1%  | 1   |
| 31. | R5_S3 | Generic      | Ideal       | Res= 2490.0ohm<br>Tolerance= 1%  | 1   |
| 32. | R5_S4 | Generic      | Ideal       | Res= 2490.0ohm<br>Tolerance= 1%  | 1   |

### Sensitivity Analysis

| #  | Name | Series | Tolerance |
|----|------|--------|-----------|
| 1. | Cap  | E48    | 2%        |
| 2. | Res  | E96    | 1%        |



## Design Inputs

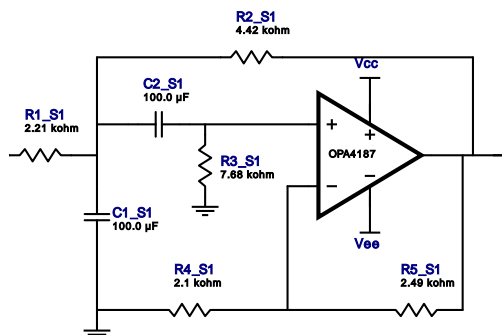
| #   | Name                | Value       | Description                                       |
|-----|---------------------|-------------|---|
| 1.  | FilterType          | bandpass    |   |
| 2.  | FilterResponse      | Butterworth |   |
| 3.  | FilterOrder         | 8.0         |   |
| 4.  | FilterTopology      | Sallen-Key  |   |
| 5.  | NumberOfStages      | 4.0         |   |
| 6.  | CenterFrequency     | 800.0 m     |   |
| 7.  | StopbandAttenuation | -65.912     |   |
| 8.  | PassbandBandwidth   | 1.5         |   |
| 9.  | StopbandBandwidth   | 10.0        |   |
| 10. | Gain                | 10.0        |   |
| 11. | DualSupply          | +/-5.00 V   | Power supply(s) to active chips                   |
| 12. | ResistorTolerance   | E96         | Resistor series - 1% Passive resistor tolerance   |
| 13. | CapacitorTolerance  | E48         | Capacitor series - 2% Passive capacitor tolerance |

## Design Assistance

1. **OPA4187** Product Folder : <http://www.ti.com/product/OPA4187> : contains the data sheet and other resources.

# Filter Stage :1

Cutoff Frequency 473.139 mHz  
 Min GBW Req'd 68.455 Hz  
 Stage Gain 2.186 V/V  
 Stage Q 668.584 m  
 Stage Topology Sallen-Key

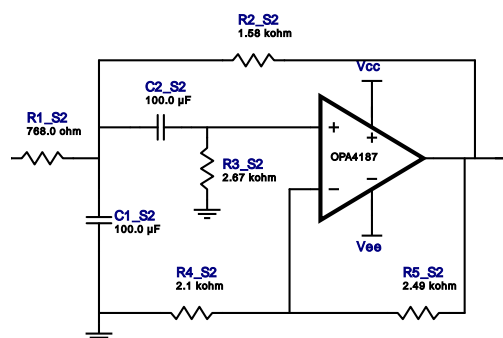


## Electrical BOM

| #  | Name  | Manufacturer           | Part Number | Properties                                     | Qty |
|----|-------|------------------------|-------------|--|-----|
| 1. | A1_S1 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 2. | C1_S1 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 3. | C2_S1 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 4. | R1_S1 | Generic                | Ideal       | Res= 2210.0ohm<br>Tolerance= 1%                | 1   |
| 5. | R2_S1 | Generic                | Ideal       | Res= 4420.0ohm<br>Tolerance= 1%                | 1   |
| 6. | R3_S1 | Generic                | Ideal       | Res= 7680.0ohm<br>Tolerance= 1%                | 1   |
| 7. | R4_S1 | Generic                | Ideal       | Res= 2100.0ohm<br>Tolerance= 1%                | 1   |
| 8. | R5_S1 | Generic                | Ideal       | Res= 2490.0ohm<br>Tolerance= 1%                | 1   |

## Filter Stage :2

|                  |            |
|------------------|------------|
| Cutoff Frequency | 1.355 Hz   |
| Min GBW Req'd    | 196.066 Hz |
| Stage Gain       | 2.186 V/V  |
| Stage Q          | 654.499 m  |
| Stage Topology   | Sallen-Key |

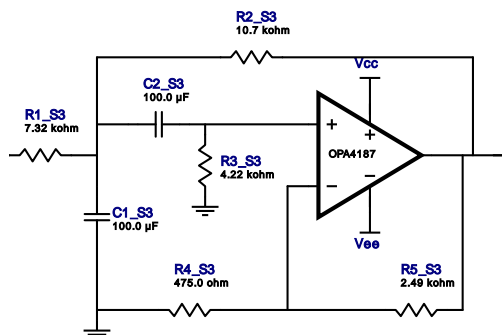


### Electrical BOM

| #  | Name  | Manufacturer           | Part Number | Properties                                     | Qty |
|----|-------|------------------------|-------------|--|-----|
| 1. | A1_S2 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 2. | C1_S2 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 3. | C2_S2 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 4. | R1_S2 | Generic                | Ideal       | Res= 768.0ohm<br>Tolerance= 1%                 | 1   |
| 5. | R2_S2 | Generic                | Ideal       | Res= 1580.0ohm<br>Tolerance= 1%                | 1   |
| 6. | R3_S2 | Generic                | Ideal       | Res= 2670.0ohm<br>Tolerance= 1%                | 1   |
| 7. | R4_S2 | Generic                | Ideal       | Res= 2100.0ohm<br>Tolerance= 1%                | 1   |
| 8. | R5_S2 | Generic                | Ideal       | Res= 2490.0ohm<br>Tolerance= 1%                | 1   |

# Filter Stage :3

Cutoff Frequency 371.616 mHz  
 Min GBW Req'd 417.482 Hz  
 Stage Gain 6.242 V/V  
 Stage Q 1.936  
 Stage Topology Sallen-Key

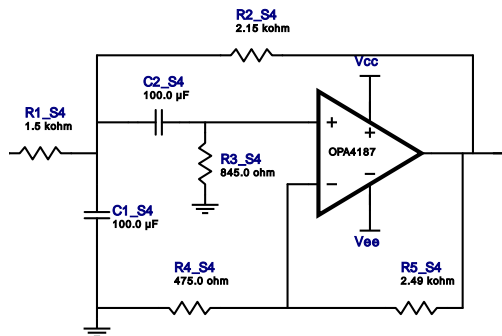


## Electrical BOM

| #  | Name  | Manufacturer           | Part Number | Properties                                     | Qty |
|----|-------|------------------------|-------------|--|-----|
| 1. | A1_S3 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 2. | C1_S3 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 3. | C2_S3 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 4. | R1_S3 | Generic                | Ideal       | Res= 7320.0ohm<br>Tolerance= 1%                | 1   |
| 5. | R2_S3 | Generic                | Ideal       | Res= 10700.0ohm<br>Tolerance= 1%               | 1   |
| 6. | R3_S3 | Generic                | Ideal       | Res= 4220.0ohm<br>Tolerance= 1%                | 1   |
| 7. | R4_S3 | Generic                | Ideal       | Res= 475.0ohm<br>Tolerance= 1%                 | 1   |
| 8. | R5_S3 | Generic                | Ideal       | Res= 2490.0ohm<br>Tolerance= 1%                | 1   |

# Filter Stage :4

Cutoff Frequency 1.842 Hz  
 Min GBW Req'd 2.101 kHz  
 Stage Gain 6.242 V/V  
 Stage Q 1.944  
 Stage Topology Sallen-Key



## Electrical BOM

| #  | Name  | Manufacturer           | Part Number | Properties                                     | Qty |
|----|-------|------------------------|-------------|--|-----|
| 1. | A1_S4 | Texas Instruments Inc. | OPA4187     | GbwTyp= 0.55MHz<br>VccMax= 36V<br>VccMin= 4.5V | 1   |
| 2. | C1_S4 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 3. | C2_S4 | Generic                | Ideal       | Cap= 100.0 uF<br>Tolerance= 2.0 %              | 1   |
| 4. | R1_S4 | Generic                | Ideal       | Res= 1500.0ohm<br>Tolerance= 1%                | 1   |
| 5. | R2_S4 | Generic                | Ideal       | Res= 2150.0ohm<br>Tolerance= 1%                | 1   |
| 6. | R3_S4 | Generic                | Ideal       | Res= 845.0ohm<br>Tolerance= 1%                 | 1   |
| 7. | R4_S4 | Generic                | Ideal       | Res= 475.0ohm<br>Tolerance= 1%                 | 1   |



| #  | Name  | Manufacturer | Part Number | Properties                      | Qty |
|----|-------|--------------|-------------|---------------------------------|-----|
| 8. | R5_S4 | Generic      | Ideal       | Res= 2490.0ohm<br>Tolerance= 1% | 1   |

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