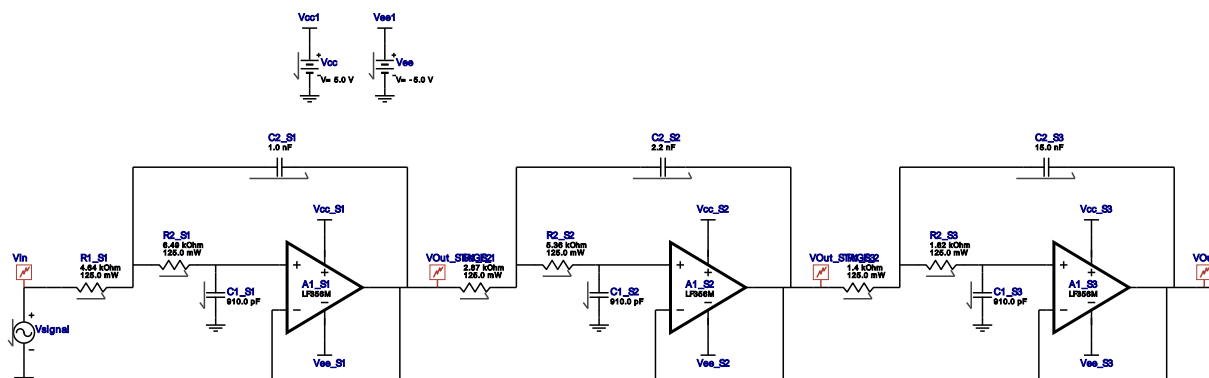


# WEBENCH® Electrical Simulation Report



Type : Lowpass  
Response : Butterworth  
Topology : Sallen\_Key  
Order : 6  
Stage Qty : 3

Device = LF356M  
Topology = Custom LP Filter  
Created = 2/3/15 4:28:23 AM  
User ID = 1198965  
Design Id = 7  
eSim Id = 1  
Simulation Type = Closed Loop Freq Response



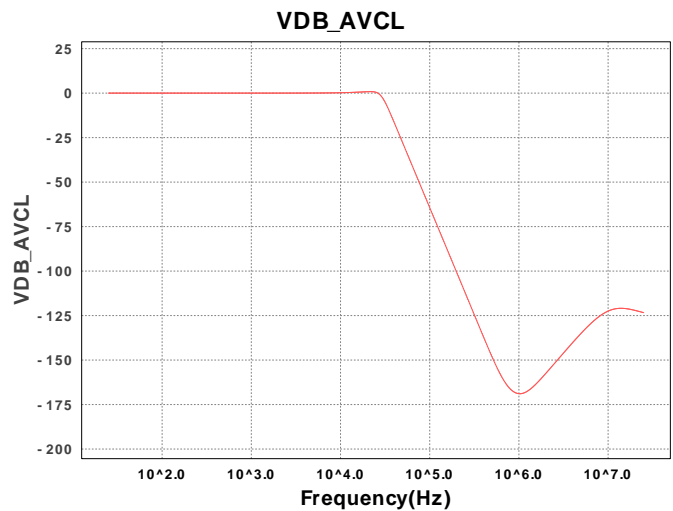
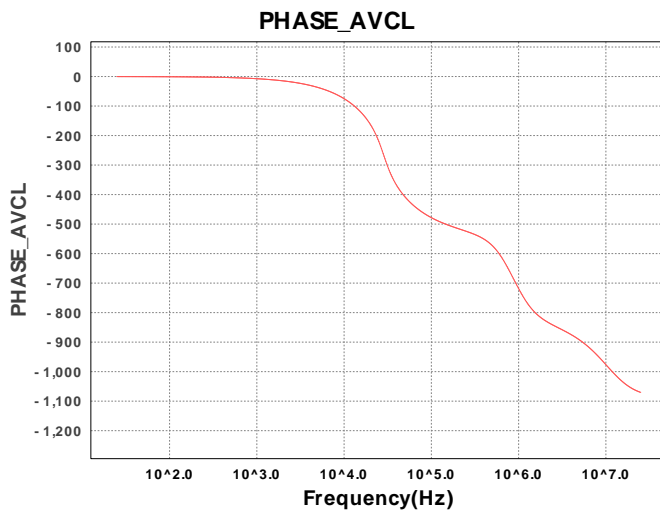
## Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S1	Texas Instruments	LF356M	GbwTyp= 5.0 MHz VccMin= 10.0 V VccMax= 36.0 V	1	\$0.30	SOIC 0 mm <sup>2</sup>
2.	A1_S2	Texas Instruments	LF356M	GbwTyp= 5.0 MHz VccMin= 10.0 V VccMax= 36.0 V	1	\$0.30	SOIC 0 mm <sup>2</sup>
3.	A1_S3	Texas Instruments	LF356M	GbwTyp= 5.0 MHz VccMin= 10.0 V VccMax= 36.0 V	1	\$0.30	SOIC 0 mm <sup>2</sup>
4.	C1_S1	MuRata	GRM1555C1E911JA01D Series= C0G/NP0	Cap= 910.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
5.	C1_S2	MuRata	GRM1555C1E911JA01D Series= C0G/NP0	Cap= 910.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
6.	C1_S3	MuRata	GRM1555C1E911JA01D Series= C0G/NP0	Cap= 910.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
7.	C2_S1	MuRata	GRM1555C1H102JA01J Series= C0G	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
8.	C2_S2	AVX	04025A221JAT2A Series= C0G	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
9.	C2_S3	Kemet	C0603C153J3GACTU Series= C0G	Cap= 15.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.07	0603 5 mm <sup>2</sup>
10.	R1_S1	Panasonic	ERJ-6ENF4641V Series= 225	Res= 4.64 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>
11.	R1_S2	Panasonic	ERJ-6ENF2871V Series= 225	Res= 2.87 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>
12.	R1_S3	Panasonic	ERJ-6ENF1401V Series= 225	Res= 1.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>
13.	R2_S1	Panasonic	ERJ-6ENF6491V Series= 225	Res= 6.49 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
14.	R2_S2	Panasonic	ERJ-6ENF5361V Series= 225	Res= 5.36 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
15.	R2_S3	Panasonic	ERJ-6ENF1621V Series= 225	Res= 1.62 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>

## Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Vsignal	AC DC	AC Voltage Source Amplitude AC Voltage Source DC Offset	1 V 0.0 V
2.	Vcc	V	Vcc Supply Rail Value	5.0 V
3.	Vee	V	Vee Supply Rail Value	-5.0 V



## Design Inputs

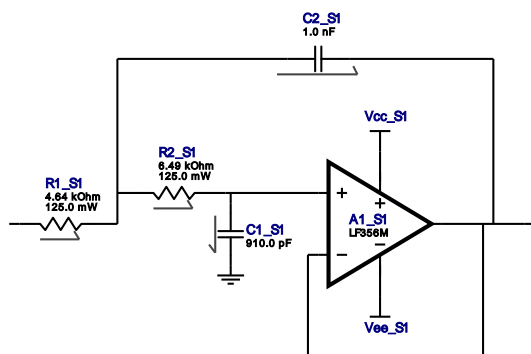
#	Name	Value	Description
1.	CapacitorTolerance	E24	Capacitor series - 5 Passive capacitance tolerance
2.	DualSupply	+/-5.0 V	Power supply(s) to active chips
3.	FilterOrder	6.0	
4.	FilterResponse	Butterworth	
5.	FilterTopology	Sallen_Key	
6.	FilterType	Lowpass	
7.	Gain	1.0 V/V	
8.	NumberOfStages	3.0	
9.	PassbandFrequency	25.0 kHz	
10.	ResistorTolerance	E96	Resistor series - 1% Passive resistor tolerance
11.	SeedCapacitance	1.0 nF	Seed Capacitance to start design of filter
12.	SettlingTimeErrorBand	100.0 m%	Settling Time Error Band
13.	SettlingTimeSpecification	100.0 µsec	Settling Time Specification
14.	StepResponseOvershootSpec	20.0 %	Step Response Overshoot
15.	StopbandAttenuation	-65.0 dB	
16.	StopbandFrequency	100.0 kHz	

## Design Assistance

1. **LF356M** Product Folder : <http://www.ti.com/product/LF356> : contains the data sheet and other resources.

## Filter Stage :1

Cutoff Frequency 25.0 kHz  
 Gain Bandwidth 1.3 MHz  
 Stage Gain 1.0 V/V  
 Stage Q 520.0 m  
 Stage Topology Sallen\_Key  
 StageNo 1.0

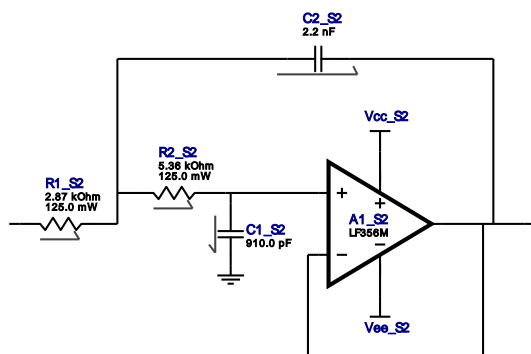


## Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S1	Texas Instruments	LF356M	GbwTyp= 5.0 MHz VccMin= 10.0 V VccMax= 36.0 V	1	\$0.30	SOIC 0 mm <sup>2</sup>
2.	C1_S1	MuRata	GRM1555C1E911JA01D Series= C0G/NP0	Cap= 910.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
3.	C2_S1	MuRata	GRM1555C1H102JA01J Series= C0G	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
4.	R1_S1	Panasonic	ERJ-6ENF4641V Series= 225	Res= 4.64 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>
5.	R2_S1	Panasonic	ERJ-6ENF6491V Series= 225	Res= 6.49 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>

## Filter Stage :2

Cutoff Frequency 25.0 kHz  
 Gain Bandwidth 1.775 MHz  
 Stage Gain 1.0 V/V  
 Stage Q 710.0 m  
 Stage Topology Sallen\_Key  
 StageNo 2.0

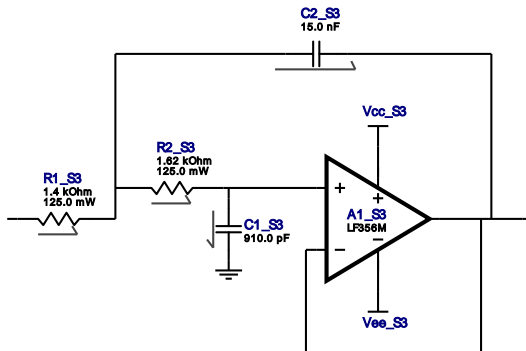


### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S2	Texas Instruments	LF356M	GbwTyp= 5.0 MHz VccMin= 10.0 V VccMax= 36.0 V	1	\$0.30	SOIC 0 mm <sup>2</sup>
2.	C1_S2	MuRata	GRM1555C1E911JA01D Series= C0G/NP0	Cap= 910.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
3.	C2_S2	AVX	04025A221JAT2A Series= C0G	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
4.	R1_S2	Panasonic	ERJ-6ENF2871V Series= 225	Res= 2.87 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>
5.	R2_S2	Panasonic	ERJ-6ENF5361V Series= 225	Res= 5.36 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>

## Filter Stage :3

Cutoff Frequency 25.0 kHz  
 Gain Bandwidth 4.825 MHz  
 Stage Gain 1.0 V/V  
 Stage Q 1.93  
 Stage Topology Sallen\_Key  
 StageNo 3.0



### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S3	Texas Instruments	LF356M	GbwTyp= 5.0 MHz VccMin= 10.0 V VccMax= 36.0 V	1	\$0.30	SOIC 0 mm <sup>2</sup>
2.	C1_S3	MuRata	GRM1555C1E911JA01D Series= C0G/NP0	Cap= 910.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
3.	C2_S3	Kemet	C0603C153J3GACTU Series= C0G	Cap= 15.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.07	0603 5 mm <sup>2</sup>
4.	R1_S3	Panasonic	ERJ-6ENF1401V Series= 225	Res= 1.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>
5.	R2_S3	Panasonic	ERJ-6ENF1621V Series= 225	Res= 1.62 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 mm <sup>2</sup>

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