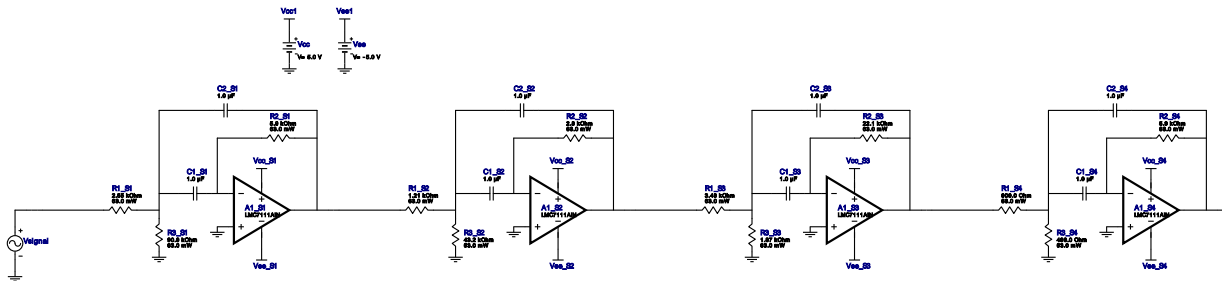


## WEBENCH<sup>®</sup> Design Report

 Design : 3989908/13 LMC7111AIN  
 Bandpass, Multiple Feedback, Butterworth


### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S1	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
2.	A1_S2	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
3.	A1_S3	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
4.	A1_S4	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
5.	C1_S1	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
6.	C1_S2	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
7.	C1_S3	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
8.	C1_S4	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
9.	C2_S1	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
10.	C2_S2	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
11.	C2_S3	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
12.	C2_S4	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
13.	R1_S1	Vishay-Dale	CRCW04022K55FKED Series= CRCW..e3	Res= 2.55 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
14.	R1_S2	Vishay-Dale	CRCW04021K21FKED Series= CRCW..e3	Res= 1.21 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
15.	R1_S3	Vishay-Dale	CRCW04023K48FKED Series= CRCW..e3	Res= 3.48 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
16.	R1_S4	Vishay-Dale	CRCW0402909RFKED Series= CRCW..e3	Res= 909.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
17.	R2_S1	Vishay-Dale	CRCW04025K90FKED Series= CRCW..e3	Res= 5.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
18.	R2_S2	Vishay-Dale	CRCW04022K80FKED Series= CRCW..e3	Res= 2.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
19.	R2_S3	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
20.	R2_S4	Vishay-Dale	CRCW04025K90FKED Series= CRCW..e3	Res= 5.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
21.	R3_S1	Vishay-Dale	CRCW040290K9FKED Series= CRCW..e3	Res= 90.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
22.	R3_S2	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
23.	R3_S3	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
24.	R3_S4	Vishay-Dale	CRCW0402499RFKED Series= CRCW..e3	Res= 499.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

## Design Inputs

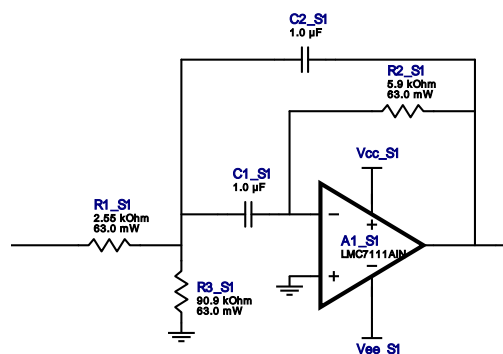
#	Name	Value	Description
1.	FilterType	Bandpass	
2.	FilterResponse	Butterworth	
3.	FilterOrder	8.0	
4.	FilterTopology	Multiple_Feedback	
5.	NumberOfStages	4.0	
6.	CenterFrequency	60.0	
7.	StopbandAttenuation	-10.0	
8.	PassbandBandwidth	90.0	
9.	StopbandBandwidth	120.0	
10.	Gain	1.0	
11.	DualSupply	+/-5.0 V	Power supply(s) to active chips
12.	ResistorTolerance	E96	Resistor series - 1% Passive resistor tolerance
13.	CapacitorTolerance	E24	Capacitor series - 5% Passive capacitance tolerance
14.	SeedCapacitance	1.0 $\mu$	Seed Capacitance to start design of filter

## Design Assistance

1. **LMC7111AIN** Product Folder : <http://www.ti.com//product/LMC7111> : contains the data sheet and other resources.

## Filter Stage :1

Cutoff Frequency 41.502 Hz  
 Min GBW Req'd 3.2 kHz  
 Stage Gain 1.0 V/V  
 Stage Q 771.0 m  
 Stage Topology Multiple\_Feedback

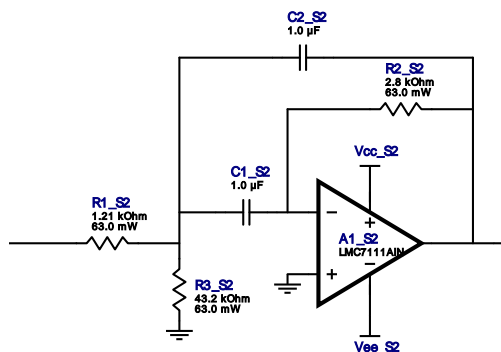


## Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S1	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
2.	C1_S1	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
3.	C2_S1	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
4.	R1_S1	Vishay-Dale	CRCW04022K55FKED Series= CRCW..e3	Res= 2.55 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
5.	R2_S1	Vishay-Dale	CRCW04025K90FKED Series= CRCW..e3	Res= 5.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
6.	R3_S1	Vishay-Dale	CRCW040290K9FKED Series= CRCW..e3	Res= 90.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

## Filter Stage :2

Cutoff Frequency 86.743 Hz  
 Min GBW Req'd 6.688 kHz  
 Stage Gain 1.0 V/V  
 Stage Q 771.0 m  
 Stage Topology Multiple\_Feedback

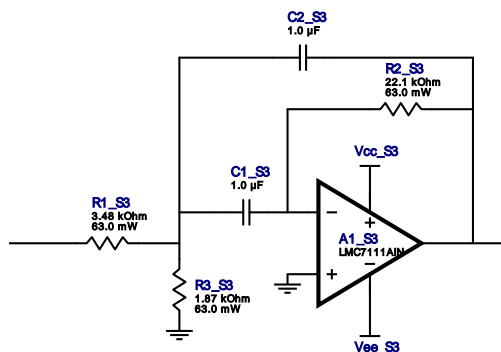


### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S2	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
2.	C1_S2	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
3.	C2_S2	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
4.	R1_S2	Vishay-Dale	CRCW04021K21FKED Series= CRCW..e3	Res= 1.21 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
5.	R2_S2	Vishay-Dale	CRCW04022K80FKED Series= CRCW..e3	Res= 2.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
6.	R3_S2	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

## Filter Stage :3

Cutoff Frequency 30.918 Hz  
 Min GBW Req'd 6.613 kHz  
 Stage Gain 1.0 V/V  
 Stage Q 2.139  
 Stage Topology Multiple\_Feedback

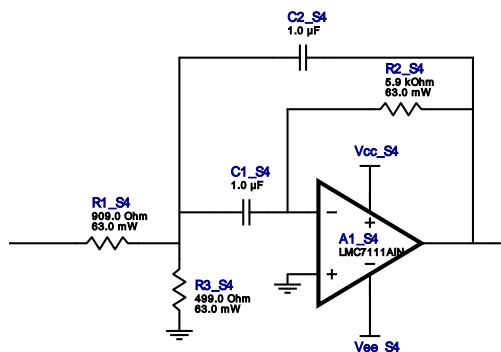


### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S3	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
2.	C1_S3	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
3.	C2_S3	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
4.	R1_S3	Vishay-Dale	CRCW04023K48FKED Series= CRCW..e3	Res= 3.48 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
5.	R2_S3	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
6.	R3_S3	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

## Filter Stage :4

Cutoff Frequency 116.438 Hz  
 Min GBW Req'd 24.906 kHz  
 Stage Gain 1.0 V/V  
 Stage Q 2.139  
 Stage Topology Multiple\_Feedback



### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	A1_S4	Texas Instruments	LMC7111AIN	GbwTyp= 50.0 mMHz VccMin= 2.7 V VccMax= 11.0 V	1	\$0.55	DIP 0 mm <sup>2</sup>
2.	C1_S4	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
3.	C2_S4	CUSTOM	CUSTOM Series= ?	Cap= 1.0 uF VDC= 0.0 V Tolerance= 0.0 %	1	NA	CUSTOM 0 mm <sup>2</sup>
4.	R1_S4	Vishay-Dale	CRCW0402909RFKED Series= CRCW..e3	Res= 909.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
5.	R2_S4	Vishay-Dale	CRCW04025K90FKED Series= CRCW..e3	Res= 5.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
6.	R3_S4	Vishay-Dale	CRCW0402499RFKED Series= CRCW..e3	Res= 499.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>

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