ANALOG DEVICES

ADP161x Coupled SEPIC-Ćuk Designer

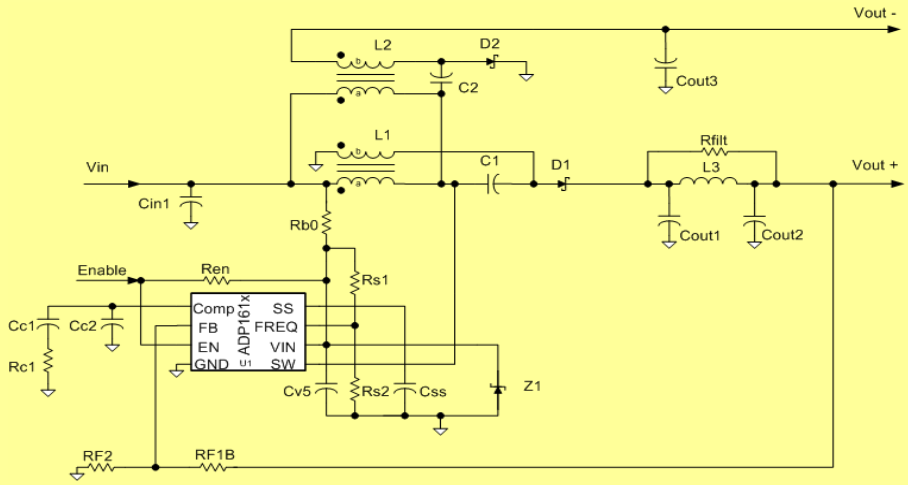
Revision v.0.21

DB20120827

Warnings and Errors:

Information: The inductor L1 will be soldered to the pads on the front of the demo board

Build Your Design!
Bill of Materials
Efficiency
Bode
Losses
Thermal Performance



Bill Of Materials

note: Parts should be modified from top to bottom because of component value dependencies

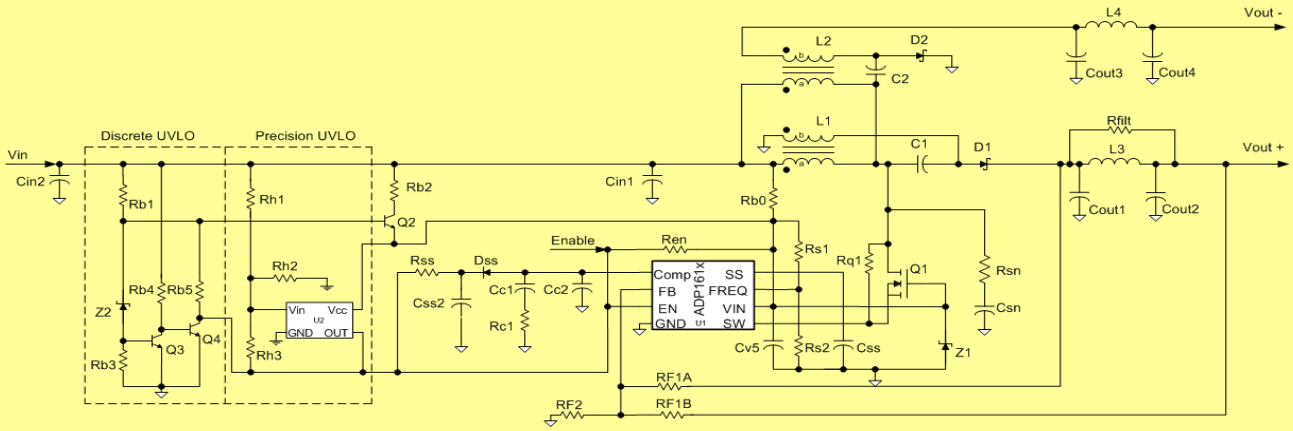
Build This Design!

Des	MFG	Component Specs	Part Number	Pkg	Qty	Area (mm²)	Height (mm)	Cost*
U1	ADI	Integrated Switching Regulator	ADP1613ARMZ	MSOP-8	1	14.7	1.1	0.700
L1	Coilcraft	47uH, 725mΩ, 0.72Apk	LPD5030-473	4.8mm x 4.8mm x 2.9mm	1	23.04	2.9	0.600
L2	Coilcraft	47uH, 725mΩ, 0.72Apk	LPD5030-473	4.8mm x 4.8mm x 2.9mm	1	23.04	2.9	0.600
D1	DiodesInc	0.2 A, 30 V	BAT54	SOT23	1	7.5	1.1	0.042
D2	DiodesInc	0.2 A, 30 V	BAT54	SOT23	1	7.5	1.1	0.042
L3	Murata	1uH, 54mΩ, 2.3Apk	LQH32PN1R0NN0	3.2mm x 2.5mm x 1.6mm	1	8	1.55	0.141
Cout1	Murata	1uF, 25V, 10mΩ	GRM188R61E105K	0603	1	1.3	0.8	0.017
Cout2	TDK	2.2uF, 25V, 4mΩ	C3216X7R1E225K	1206	3	15.4	1.6	0.139
Cout3	Murata	4.7uF, 25V, 1mΩ	GRM31CR71E475K	1206	1	5.1	1.6	0.082
Cin1	Murata	1uF, 10V, 18mΩ	GRM188R61A105K	0603	2	2.6	0.8	0.017
C1	TDK	1uF, 6.3V, 7.5mΩ	C1005X5R0J105M	0402	1	0.5	0.5	0.007
C2	TDK	1uF, 25V, 7.5mΩ	C2012X7R1E105K	0805	1	2.5	1.2	0.026
Rfilt	Vishay	1.78 Ohms, 5% tolerance	1.78 Ohms	0402	1	0.7	0.5	0.005
Rc1	Vishay	5% tolerance	100 kOhms	0402	1	0.7	0.5	0.005
Cc1	Vishay	10% tolerance	12 nF	0402	1	0.7	0.5	0.010
Cc2	Vishay	10% tolerance	10 pF	0402	1	0.7	0.5	0.010
Rf1B	Vishay	1% tolerance	47.5 kOhms	0402	1	0.7	0.5	0.005
Rf2	Vishay	1% tolerance	4.22 kOhms	0402	1	0.7	0.5	0.005
Cv5	Murata	1uF,10V,X5R	GRM188R61A105K	0603	1	1.3	0.6	0.006
Css	Murata	1uF,10V,X5R	GRM188R61A105K	0603	1	1.3	0.6	0.006
Z1			No Pop					
Rb0	Vishay	5% tolerance	1 Ohms	0402	1	0.7	0.5	0.005
Rs1	Vishay	5% tolerance	0 Ohms	0402	0	0	0	0.000
Rs2			No Pop					
				Totals	24	**118.7**	**max=2.9**	**2.47**

* All pricing is based on 1k or reel pricing and is intended for comparison purposes only

Complete BOM and Schematic for Evalutation Board (ADP161x-BL3-EVZ)

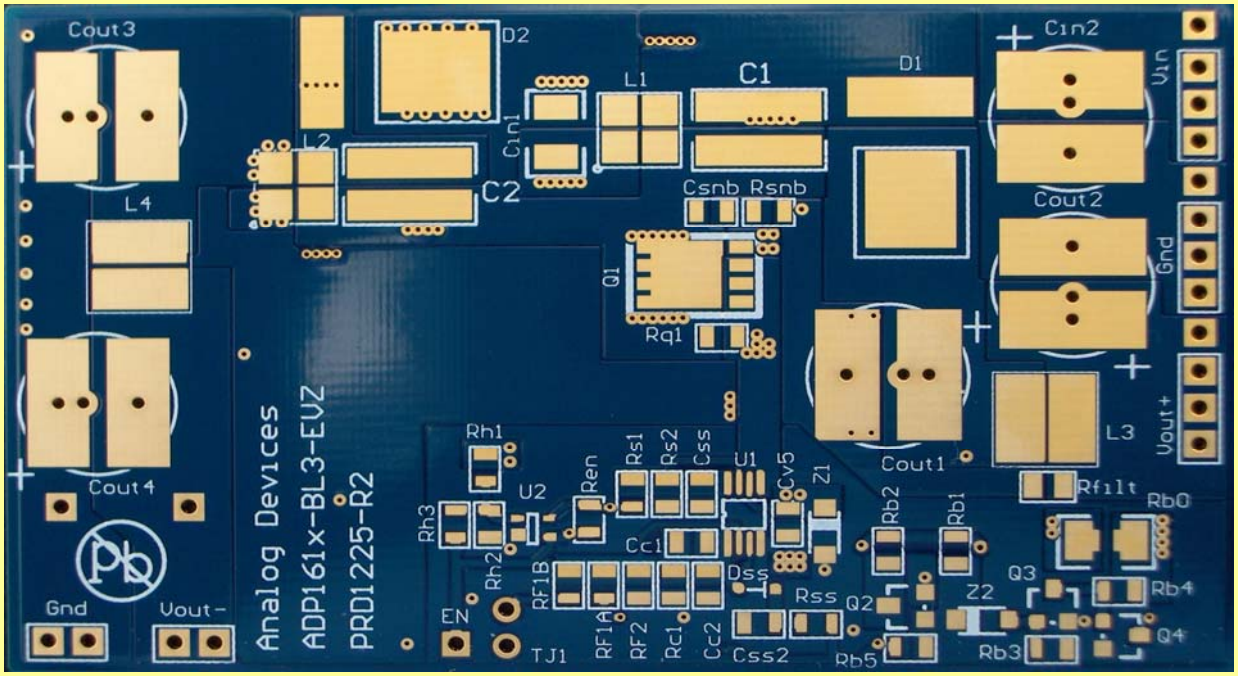
User Interface



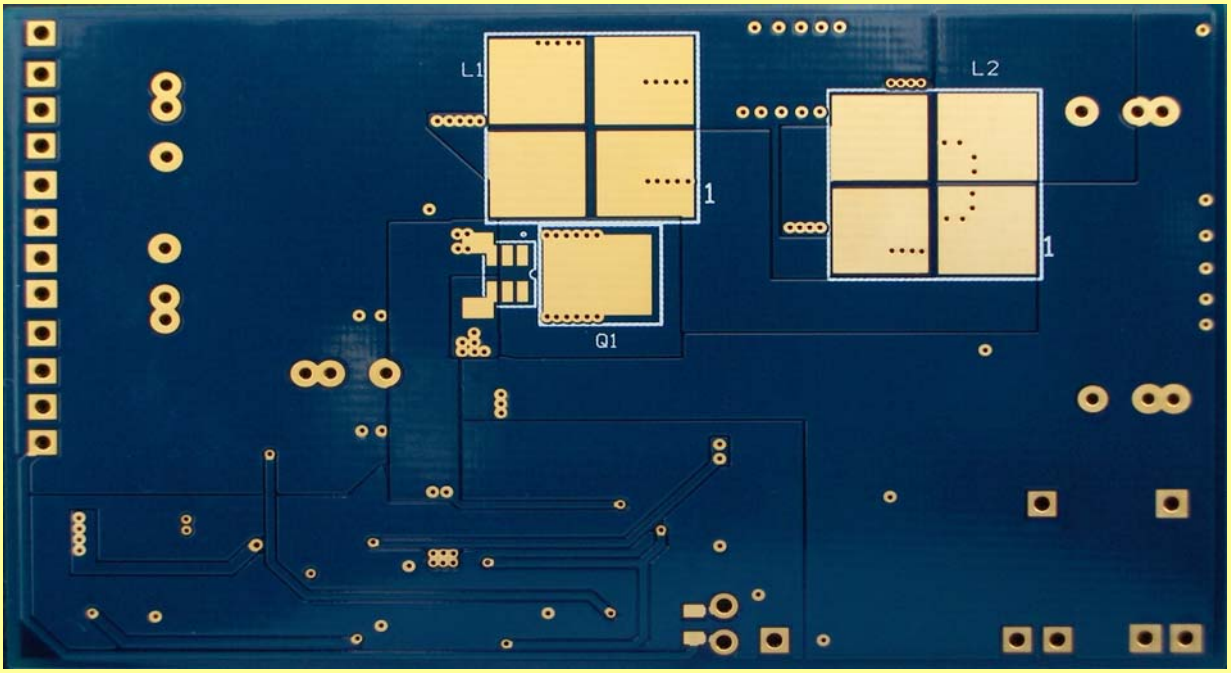
Des	MFG	Component Specs	Part Number	Pkg	Qty	Area (mm²)	Height (mm)
U1	ADI	Integrated Switching Regulator	ADP1613ARMZ	MSOP-8	1	14.7	1.1
U2			No Pop				
L1	Coilcraft	47uH, 725mΩ, 0.72Apk	LPD5030-473	4.8mm x 4.8mm x 2.9mm	1	23.04	2.9
L2	Coilcraft	47uH, 725mΩ, 0.72Apk	LPD5030-473	4.8mm x 4.8mm x 2.9mm	1	23.04	2.9
Q1			No Pop				
D1	DiodesInc	0.2 A, 30 V	BAT54	SOT23	1	7.5	1.1
D2	DiodesInc	0.2 A, 30 V	BAT54	SOT23	1	7.5	1.1
L3	Murata	1uH, 54mΩ, 2.3Apk	LQH32PN1R0NN0	3.2mm x 2.5mm x 1.6mm	1	8	1.55
Cout1	Murata	1uF, 25V, 10mΩ	GRM188R61E105K	0603	1	1.3	0.8
Cout2	TDK	2.2uF, 25V, 4mΩ	C3216X7R1E225K	1206	3	15.4	1.6
Cout3	Murata	4.7uF, 25V, 1mΩ	GRM31CR71E475K	1206	1	5.1	1.6
Cout4			No Pop				
Cin1	Murata	1uF, 10V, 18mΩ	GRM188R61A105K	0603	2	2.6	0.8
Cin2						0	
C1	TDK	1uF, 6.3V, 7.5mΩ	C1005X5R0J105M	0402	1	0.5	0.5
C2	TDK	1uF, 25V, 7.5mΩ	C2012X7R1E105K	0805	1	2.5	1.2
L4			Short Out				
Rfilt	Vishay	1.78 Ohms, 5% tolerance	1.78 Ohms	0805	1	2.5	0.5
Rc1	Vishay	5% tolerance	100 kOhms	0805	1	2.5	0.5
Cc1	Vishay	10% tolerance	12 nF	0805	1	2.5	0.5
Cc2	Vishay	10% tolerance	10 pF	0805	1	2.5	0.5
Rq1			Short Out				
Rf1A			No Pop				
Rf1B	Vishay	1% tolerance	47.5 kOhms	0805	1	2.5	0.5
Rf2	Vishay	1% tolerance	4.22 kOhms	0805	1	2.5	0.5
Rsnb			No Pop				
Csnb			No Pop				
Cv5	Murata	1uF,10V,X5R	GRM188R61A105K	0603	1	1.3	0.6
Css	Murata	1uF,10V,X5R	GRM188R61A105K	0603	1	1.3	0.6
Rss			No Pop				
Css2			No Pop				
Dss			No Pop				
Z1			No Pop				
Z2			No Pop				
Rb1			No Pop				
Rb2			No Pop				
Rb3			No Pop				
Rb4			No Pop				
Rb5			No Pop				
Rh1			No Pop				
Rh2			No Pop				
Rh3			No Pop				
Rb0	Vishay	5% tolerance	1 Ohms	0805	1	2.5	0.5
Rs1	Vishay	5% tolerance	0 Ohms	0805	1	2.5	0.5
Rs2			No Pop				
Ren	Vishay	5% tolerance	50 kOhms	0805	1	2.5	0.5
Q2			No Pop				
Q3			No Pop				
Q4			No Pop				
TJ1			Short Out				

Board Pictures (ADP161x-BL3-EVZ)

Front Side

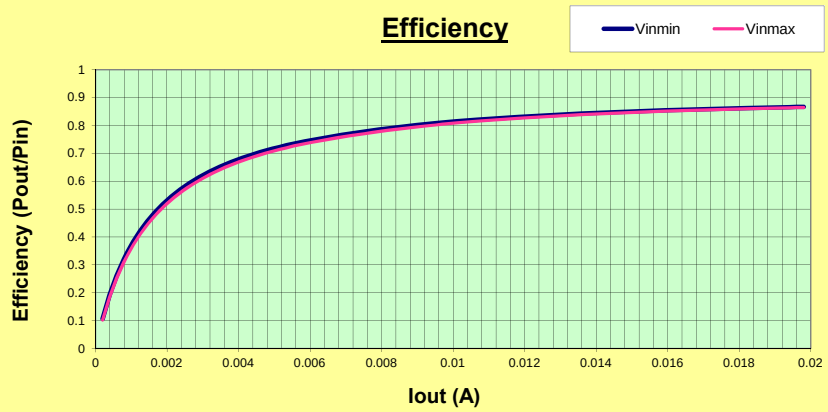


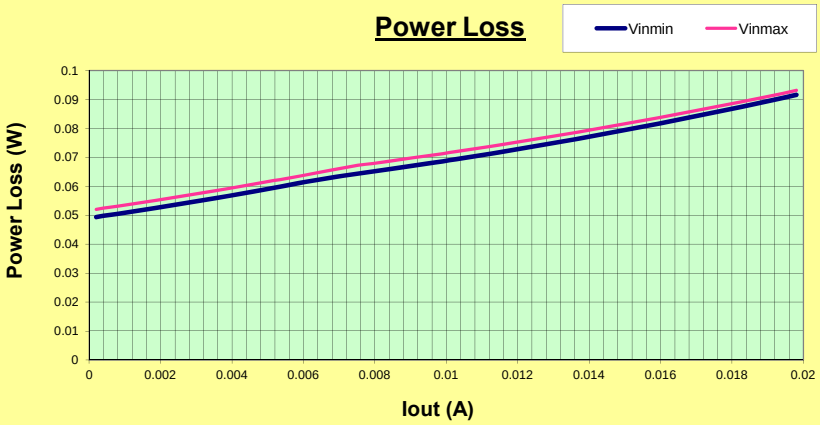
Back Side

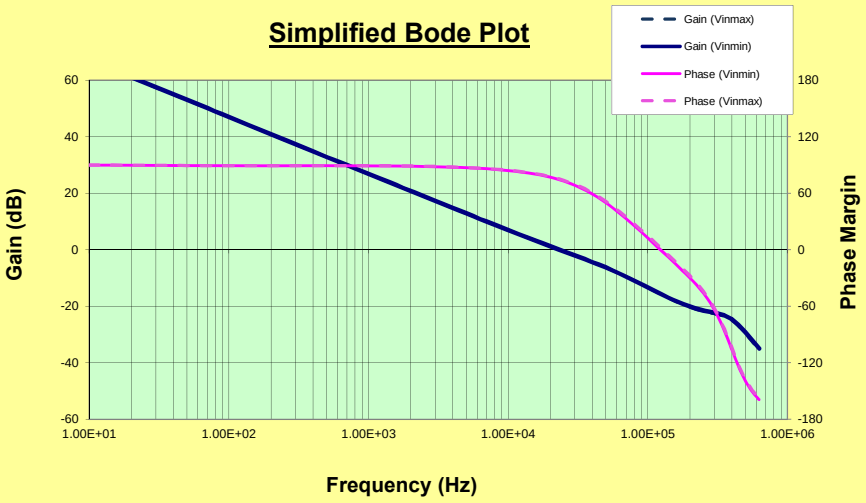


Operating Conditions

Go to top







*Unlike other ADI design tools, the bode plot for this tool does not attempt to model every aspect of the frequency response. However extensive simulation and lab test have shown that the tool reliably compensates for a stable response. In the unlikely even that a circuit built using this tool has insufficient phase margin, simply reducing Rc1 should fix the issue.

Provided Specifications

Vinmin	4.75	V
Vinmax	4.99	V
Vout	15	V
Iout	0.02	A
Ambient Temp	55	˚C
Design Optimized for	Lowest Cost	

Advanced Target Settings		Actual	Units
Height	100	2.9	mm
Frequency Select	Auto Select		
Switching Frequency	1300		kHz
Vripple (+Vout)	3	0.71	mVppk
Vripple (-Vout)	3	2.92	mVppk
Istep	0.006	0.006	A
Vstep (+Vout)	750	1	mVpk
Vstep (-Vout)	750	1	mVpk
UVLO Select	Internal UVLO		
UVLO Voltage	2.25		V
UVLO Hysteresis	0.08		V
Output Filter	Y		
All surface mount	N		

Operational Estimates

	Vinmin	Vinmax	Units
DCM at Iout max	No	No	y/n
Don (switch duty cycle)	0.770	0.761	
Doff (diode duty cycle)	0.230	0.239	
Ddead (switches off)	0.000	0.000	
Crossover Frequency	23.7	23.7	kHz
Phase Margin	74.1	74.8	Degrees

Losses (at Iout max)

	Vinmin	Vinmax	Units
U1	0.045	0.047	W
L1 (DCR+core)	0.007	0.006	W
L2 (DCR+core)	0.007	0.006	W
Diode (D1)	0.012	0.012	W
Diode (D2)	0.012	0.012	W
Cout	0.000	0.000	W
L3 (DCR+Core)	0.000	0.000	W
Rfilt	0.000	0.000	W
Bias Supply + UVLO	0.000	0.000	W
Total Converter Loss	**0.092**	**0.094**	**W**
Efficiency	**0.867**	**0.865**	**W/W**

Thermal Performance

Component	Vinmin	Vinmax	Units
ADP161x (U1)	59	60	˚C
Inductor (L1)	56	56	˚C
Inductor (L2)	56	56	˚C
Diode (D1)	61	61	˚C
Diode (D2)	61	61	˚C
Inductor (L3)	55	55	˚C

Component Stress

L1 (a) or L2 (a) (connected to input)

	Vinmin	Vinmax
Idc [I in] (A)	0.073	0.070
I peak (A)	0.088	0.085
I pp (A)	0.029	0.031
I rms (A)	0.074	0.070

L1 (b) or L2 (b) (connected to Diode)

	Vinmin	Vinmax
I peak (A)	0.029	0.029
I pp (A)	0.030	0.031
I rms (A)	0.016	0.017

Diodes (D1 and D2)	Vinmin	Vinmax
Vf (avg) (A)	0.539	0.536
I avg (A)	0.020	0.020
I peak (D1) (A)	0.233	0.228
I peak(D2) (A)	0.116	0.114

MOSFET	Vinmin	Vinmax
I peak (A)	0.233	0.228
I rms (A)	0.155	0.149

Cin	Vinmin	Vinmax
Vripple (mV)	11.0	12.0
I rms (A)	0.02	0.02

C1	Vinmin	Vinmax
Vripple (mV)	33.1	34.3
I rms (A)	0.05	0.05

C2	Vinmin	Vinmax
Vripple (mV)	33.0	33.2
I rms (A)	0.05	0.05

Go to top