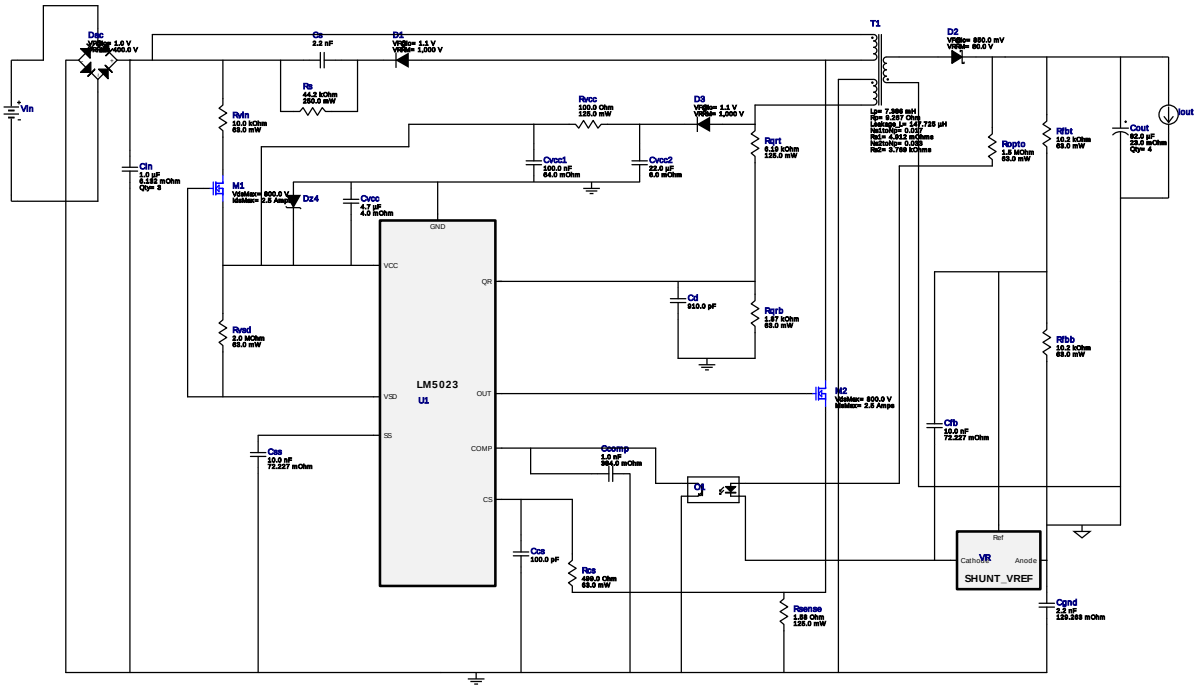
WEBENCH® Design Report

VinMin = 110.0V
VinMax = 130.0V
Vout = 5.0V
Iout = 2.0A

Device = LM5023MM-2/NOPB
Topology = Flyback
Created = 7/1/15 8:58:10 PM
BOM Cost = $0.00
Footprint = 1,108.0 mm^2
BOM Count = 2
Total Pd = 4.55W

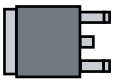
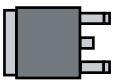
Design : 4414378/6 LM5023MM-2/NOPB
LM5023MM-2/NOPB 110.0V-130.0V to 4.99V @ 2.0A



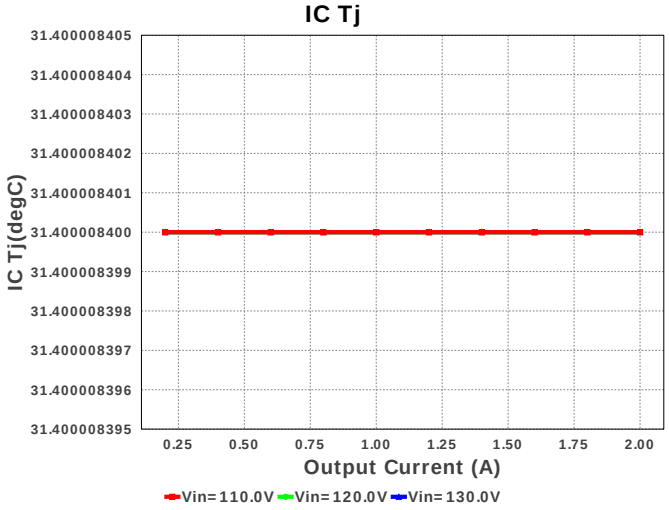
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

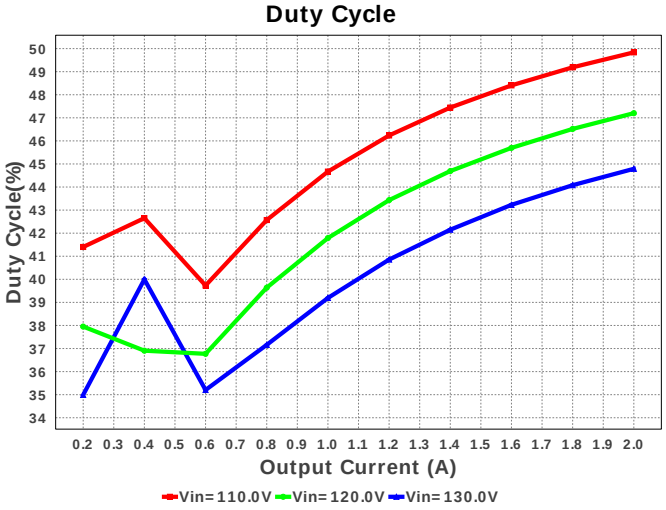
Electrical BOM

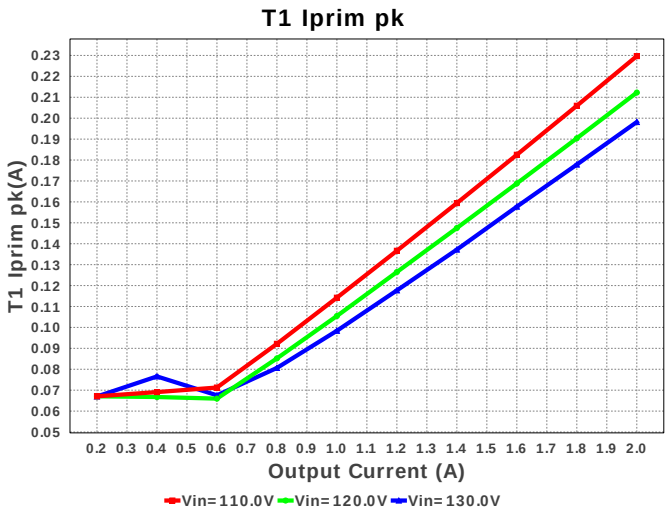
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp	Kemet	C0805C102K5RACTU Series= X7R	Cap= 1.0 nF ESR= 384.0 mOhm VDC= 50.0 V IRMS= 214.0 mA	1	$0.01	0805 7 mm^2
2.	Ccs	Kemet	C0201C101K3GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
3.	Cd	Samsung Electro-Mechanics	CL21C911JBCNNNC Series= C0G/NP0	Cap= 910.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Cfb	TDK	C1005X7R1E103K Series= X7R	Cap= 10.0 nF ESR= 72.227 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
5.	Cgnd	TDK	C4532JB3D222K Series= 274	Cap= 2.2 nF ESR= 129.263 mOhm VDC= 2.0 kV IRMS= 0.0 A	1	$0.21	1812 23 mm^2
6.	Cin	TDK	C4532X7T2E105M Series= 480	Cap= 1.0 uF ESR= 6.132 mOhm VDC= 250.0 V IRMS= 0.0 A	3	$0.40	1812 23 mm^2

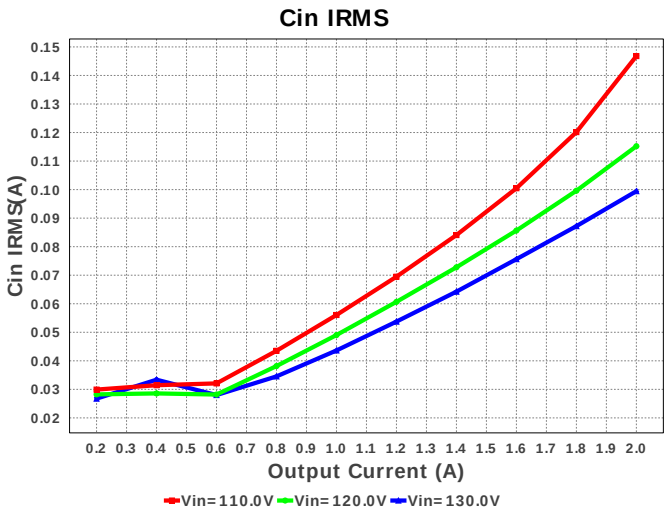
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cout	Chemi-Con	APXC100ARA820MF60G Series= PXC	Cap= 82.0 uF ESR= 23.0 mOhm VDC= 10.0 V IRMS= 2.4 A	4	$0.43	 CAPSMT_62_F60 77 mm^2
8.	Cs	MuRata	GRM155R72A222KA01D Series= X7R	Cap= 2.2 nF VDC= 100.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm^2
9.	Css	TDK	C1005X7R1E103K Series= X7R	Cap= 10.0 nF ESR= 72.227 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm^2
10.	Cvcc	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.03	 0805 7 mm^2
11.	Cvcc1	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	 0805 7 mm^2
12.	Cvcc2	MuRata	GRM31CR61C226ME15L Series= X5R	Cap= 22.0 uF ESR= 6.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.13	 1206 11 mm^2
13.	D1	Fairchild Semiconductor	1N4007	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.02	 DO-41 43 mm^2
14.	D2	Comchip Technology	CDBC580-G	VF@Io= 850.0 mV VRRM= 80.0 V	1	$0.26	 SMC 83 mm^2
15.	D3	Fairchild Semiconductor	1N4007	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.02	 DO-41 43 mm^2
16.	Dac	Diodes Inc.	HD04-T	VF@Io= 1.0 V VRRM= 400.0 V	1	$0.12	 MiniDIP 62 mm^2
17.	Dz4	Diodes Inc.	MMSZ5246B-7-F	Zener	1	$0.03	 SOD-123 13 mm^2
18.	M1	STMicroelectronics	STD3NK80ZT4	VdsMax= 800.0 V IdsMax= 2.5 Amps	1	$0.46	 DPAK 102 mm^2
19.	M2	STMicroelectronics	STD3NK80ZT4	VdsMax= 800.0 V IdsMax= 2.5 Amps	1	$0.46	 DPAK 102 mm^2
20.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.35	 SSOP-4 111 mm^2
21.	Rcs	Vishay-Dale	CRCW0402499RFKED Series= CRCW..e3	Res= 499.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
22.	Rfbb	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
23.	Rfbt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
24.	Ropto	Vishay-Dale	CRCW04021M50FKED Series= CRCW..e3	Res= 1.5 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2

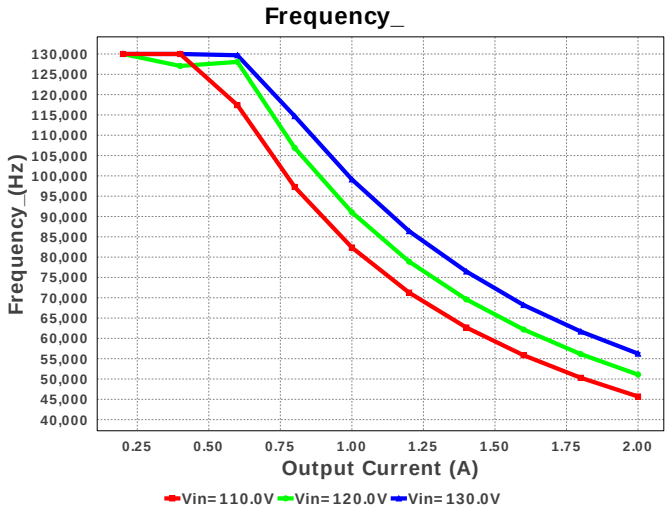
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
25.	Rqrb	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
26.	Rqrt	Panasonic	ERJ-6ENF6191V Series= 225	Res= 6.19 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
27.	Rs	Panasonic	ERJ-8ENF4422V Series= ERJ-8E	Res= 44.2 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
28.	Rsense	Vishay-Dale	CRCW08051R58FKEA Series= CRCW..e3	Res= 1.58 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
29.	Rvcc	Vishay-Dale	CRCW0805100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
30.	Rvin	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
31.	Rvsd	Vishay-Dale	CRCW04022M00FKED Series= CRCW..e3	Res= 2.0 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
32.	T1	CUSTOM	CUSTOM	Lp= 7.386 mH Rp= 9.267 Ohm Leakage_L= 147.725 µH Ns1toNp= 0.017 Rs1= 4.912 mOhms Ns2toNp= 0.033 Rs2= 3.769 kOhms	1	NA	CUSTOM 0 mm²
33.	U1	Texas Instruments	LM5023MM-2/NOPB	Switcher	1	$0.38	MUA08A 24 mm²
34.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	$0.09	R-PDSO-G3 16 mm²

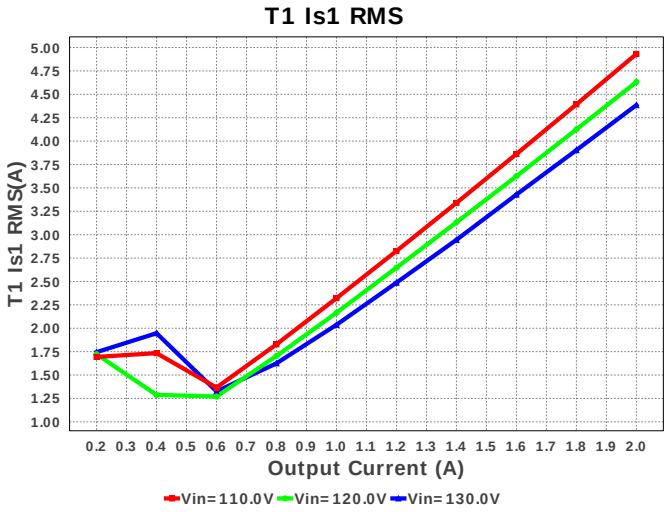


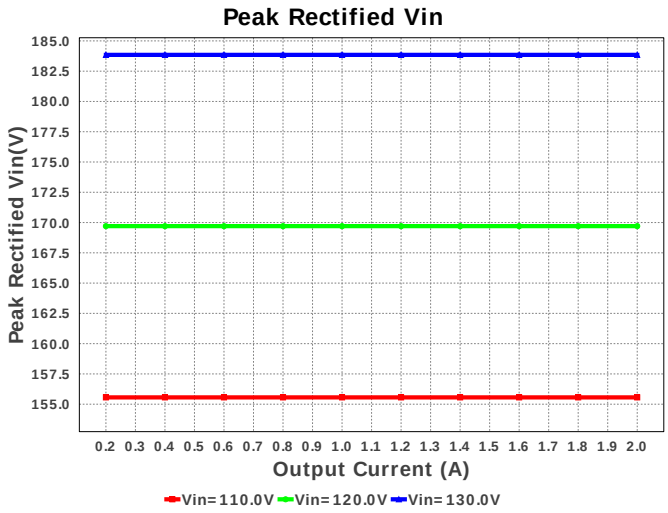


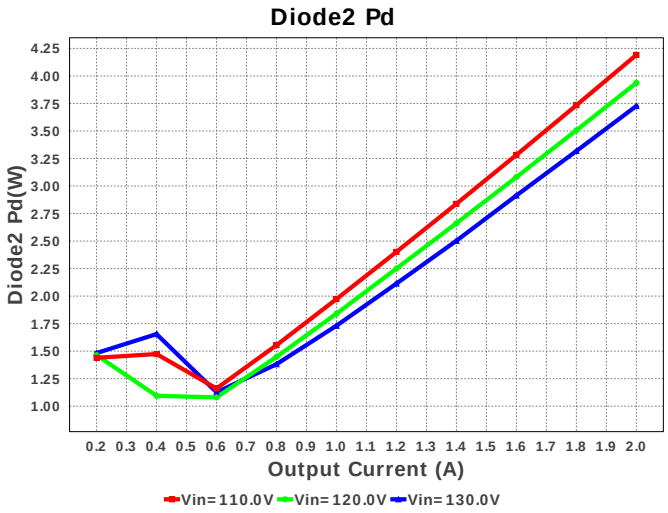


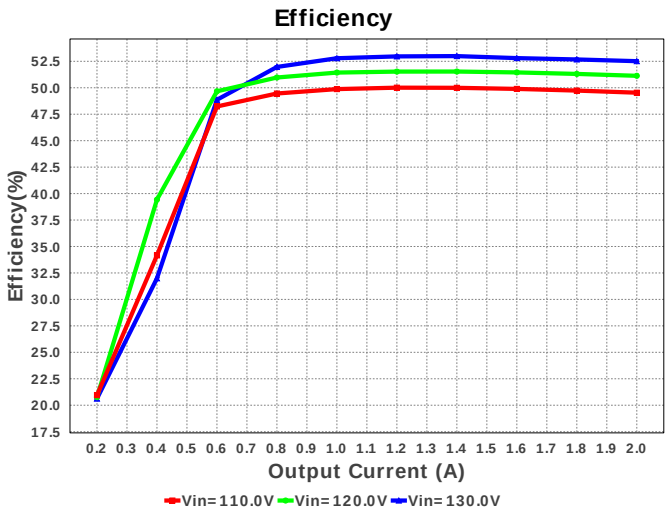


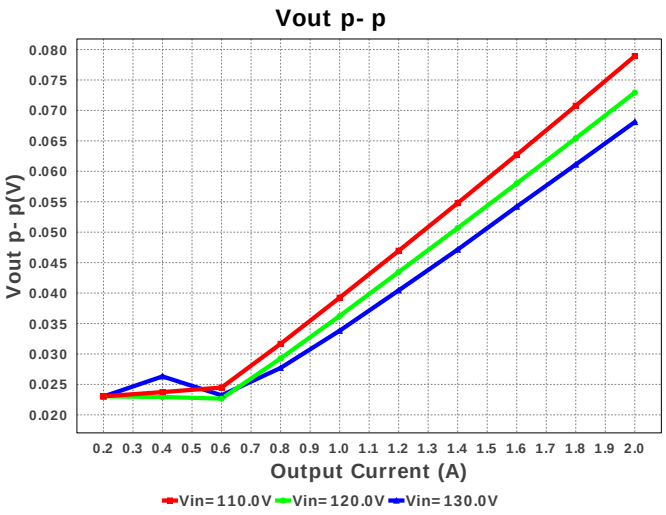


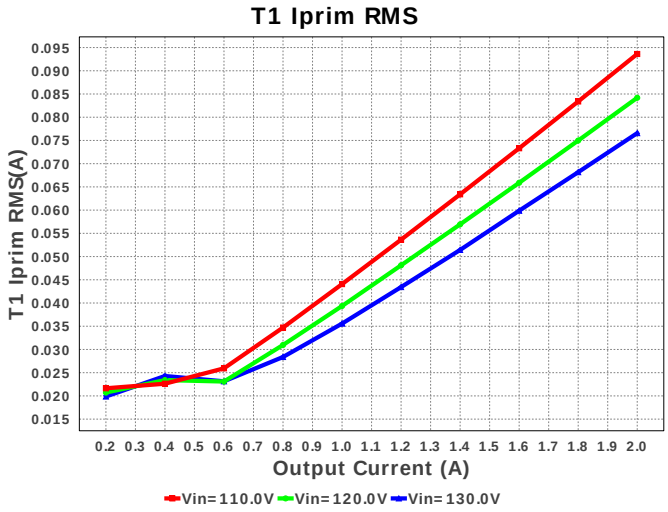


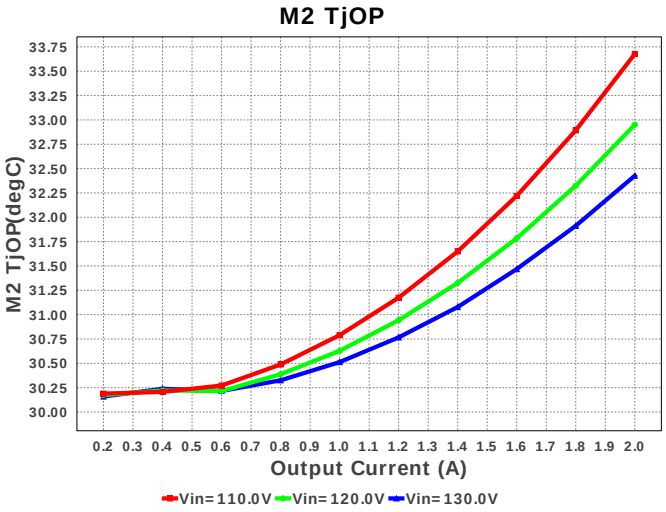


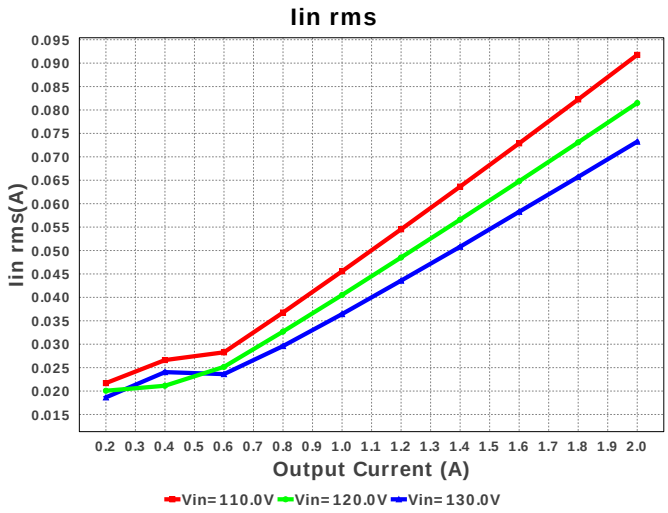


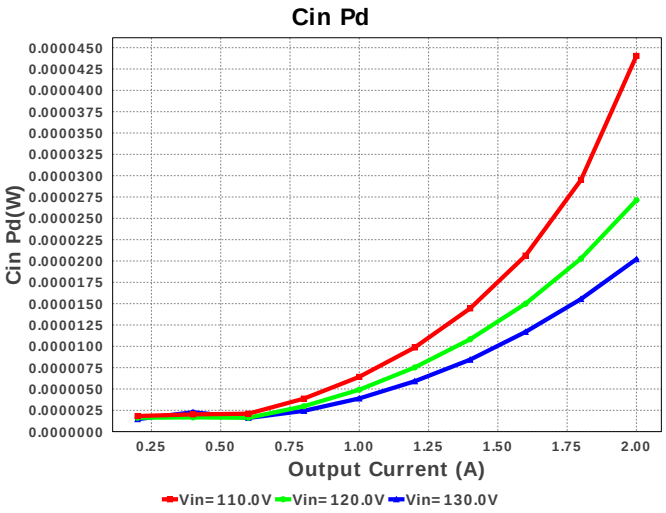


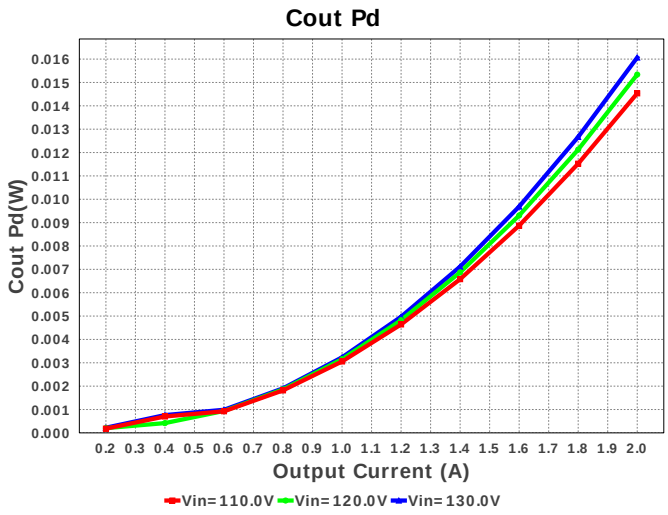


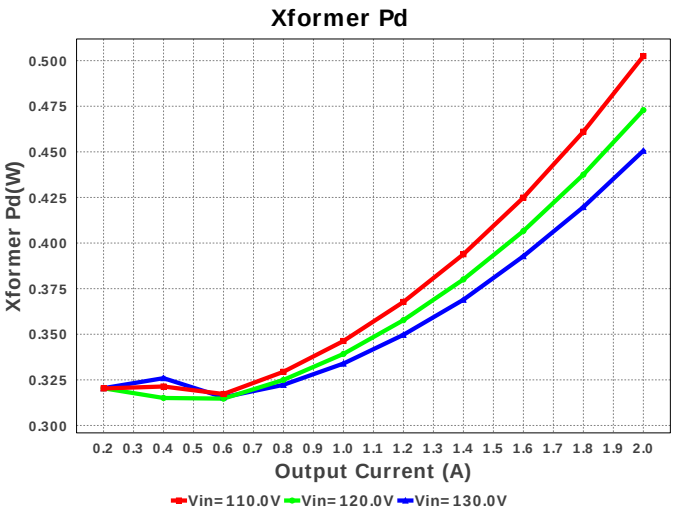


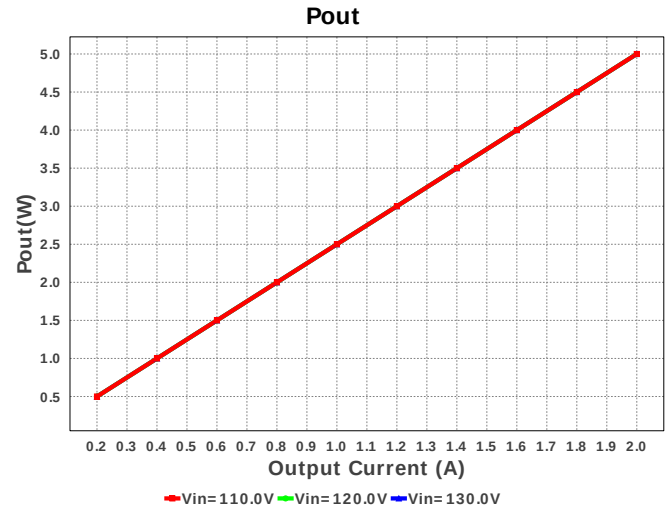


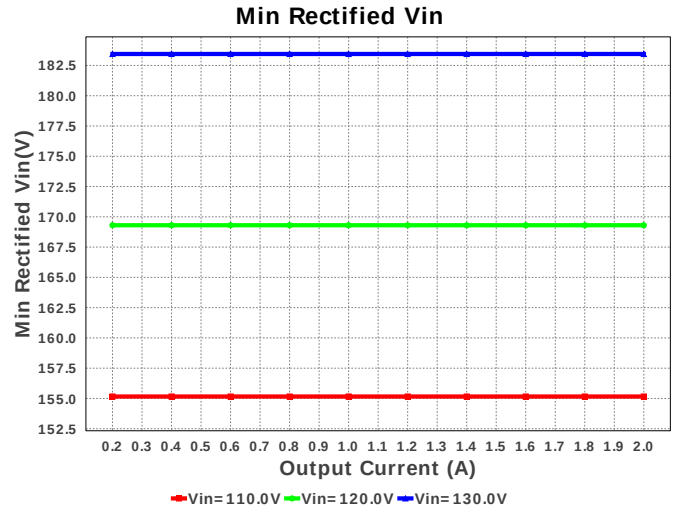


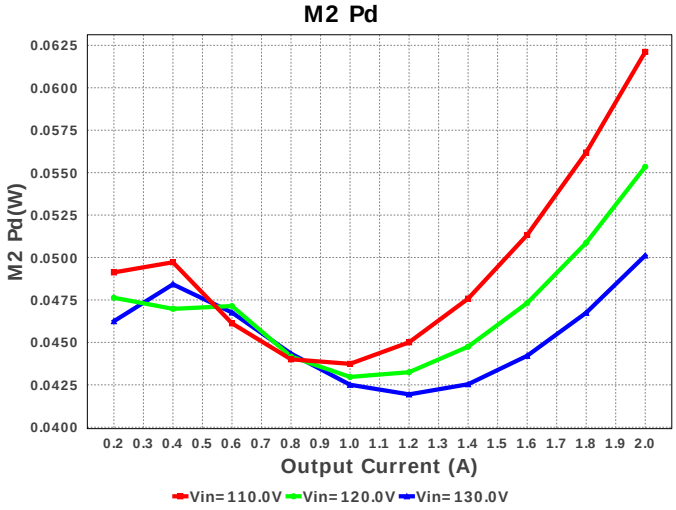


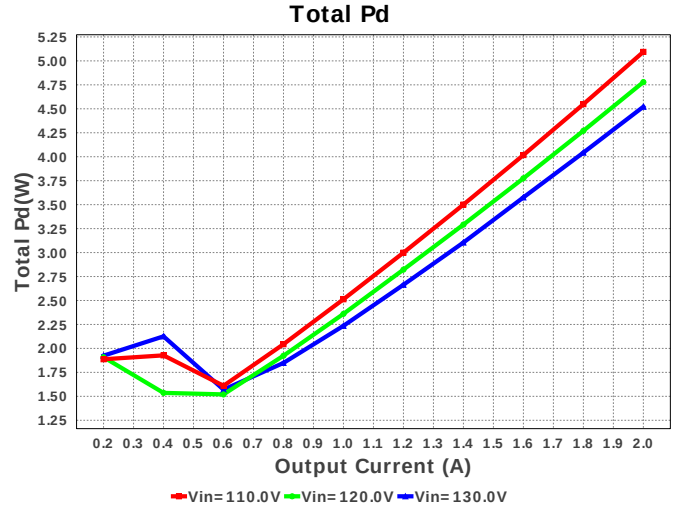


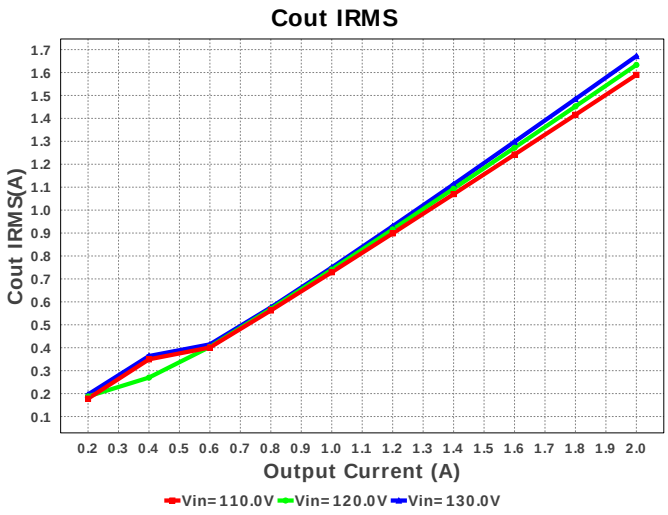


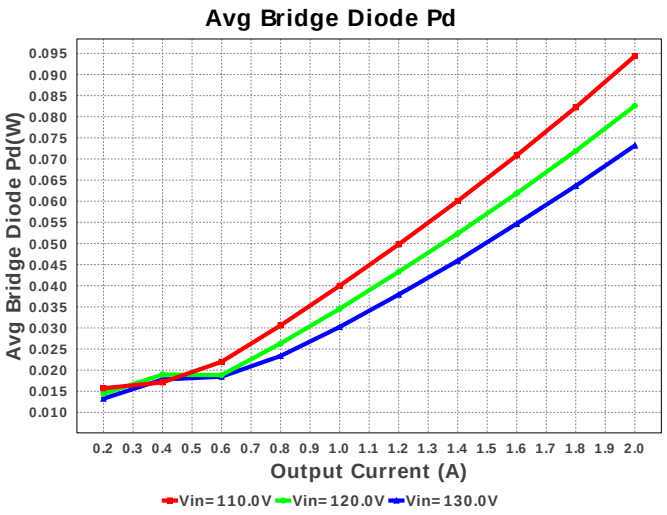


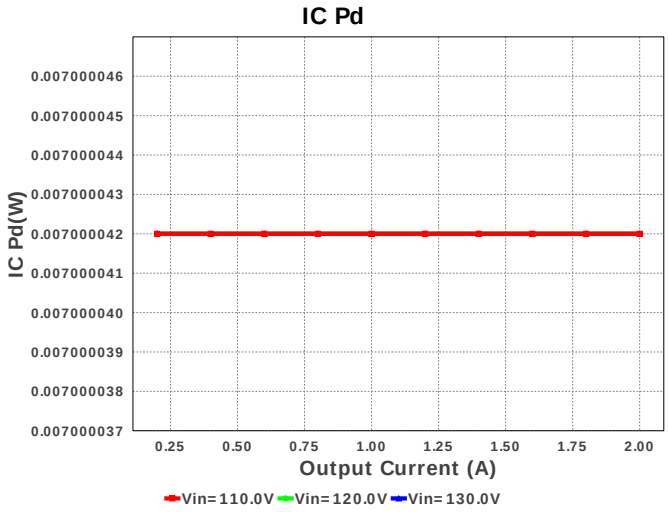


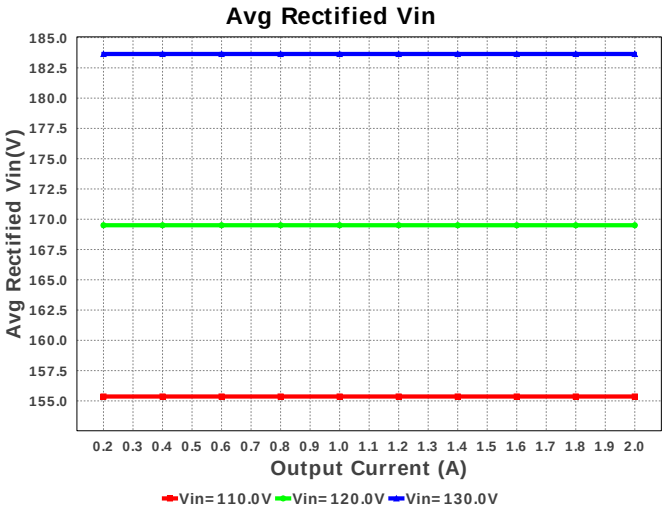


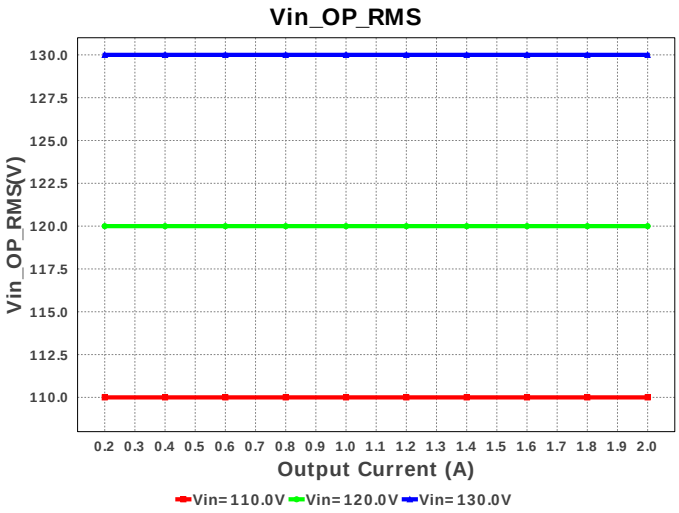


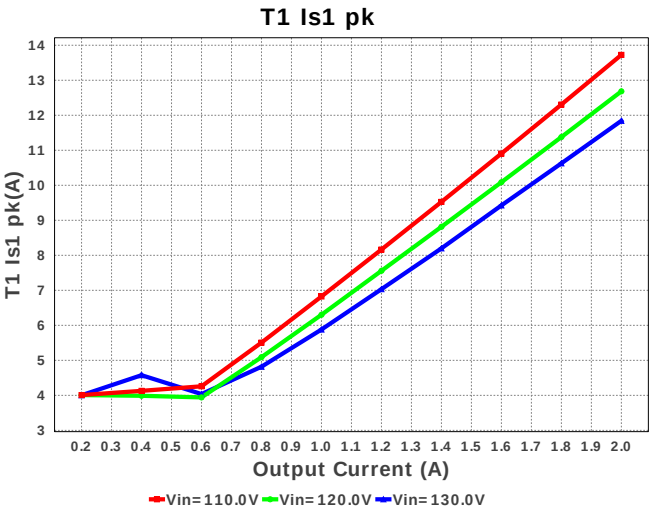












Operating Values

#	Name	Value	Category	Description
1.	Total BOM	$0.0		Total BOM Cost
2.	Cin IRMS	108.72 mA	Current	Input capacitor RMS ripple current
3.	Cout IRMS	1.567 A	Current	Output capacitor RMS ripple current
4.	Iin rms	73.461 mA	Current	RMS Input Current
5.	T1 Iprim RMS	80.297 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	198.752 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	4.398 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	11.877 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	183.646 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	2	General	Total Design BOM count
11.	FootPrint	1.108 k mm^2	General	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
12.	Pout	5.0 W	General	Total output power
13.	Vout OP	2.5 V	Op_Point	Operational Output Voltage
14.	Duty Cycle	52.955 %	Op_point	Duty cycle
15.	Efficiency	52.356 %	Op_point	Steady state efficiency
16.	Frequency	56.106 kHz	Op_point	Switching frequency
17.	IC Tj	31.4 degC	Op_point	IC junction temperature
18.	ICThetaJA	200.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	2.0 A	Op_point	Iout operating point
20.	M2 TjOP	32.676 degC	Op_point	M2 MOSFET junction temperature
21.	Min Rectified Vin	183.446 V	Op_point	Minimum voltage seen at rectified input
22.	Peak Rectified Vin	183.846 V	Op_point	Peak voltage seen at rectified input
23.	Vin_OP_RMS	130.0 V	Op_point	AC Input RMS Voltage
24.	Vout p-p	68.293 mV	Op_point	Peak-to-peak output ripple voltage
25.	Avg Bridge Diode Pd	80.225 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
26.	Cin Pd	24.16 µW	Power	Input capacitor power dissipation
27.	Cout Pd	14.123 mW	Power	Output capacitor power dissipation
28.	Diode2 Pd	3.739 W	Power	Diode2 power dissipation
29.	IC Pd	7.0 mW	Power	IC power dissipation
30.	M2 Pd	52.306 mW	Power	M2 MOSFET total power dissipation
31.	Total Pd	4.55 W	Power	Total Power Dissipation
32.	Xformer Pd	456.618 mW	Power	Transformer power dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	VinMax	130.0	Maximum input voltage
4.	VinMin	110.0	Minimum input voltage
5.	Vout	5.0	Output Voltage
6.	Vout1	5.0	Output Voltage #1
7.	line_fsw	60.0	Light Output in Lumen
8.	base_pn	LM5023	Base Product Number
9.	source	AC	Input Source Type
10.	Ta	30.0	Ambient temperature

Design Assistance

1. The feedback resistors will set the output voltage of the circuit. The values chosen may need to be fined tuned based on the final Transformer turns ratios and the voltage across the output diode at close to zero current. Please see the datasheet for further design guidance. http://www.ti.com/lit/ds/symlink/lm5023.pdf

2. **LM5023** Product Folder : http://www.ti.com/product/LM5023 : contains the data sheet and other resources.