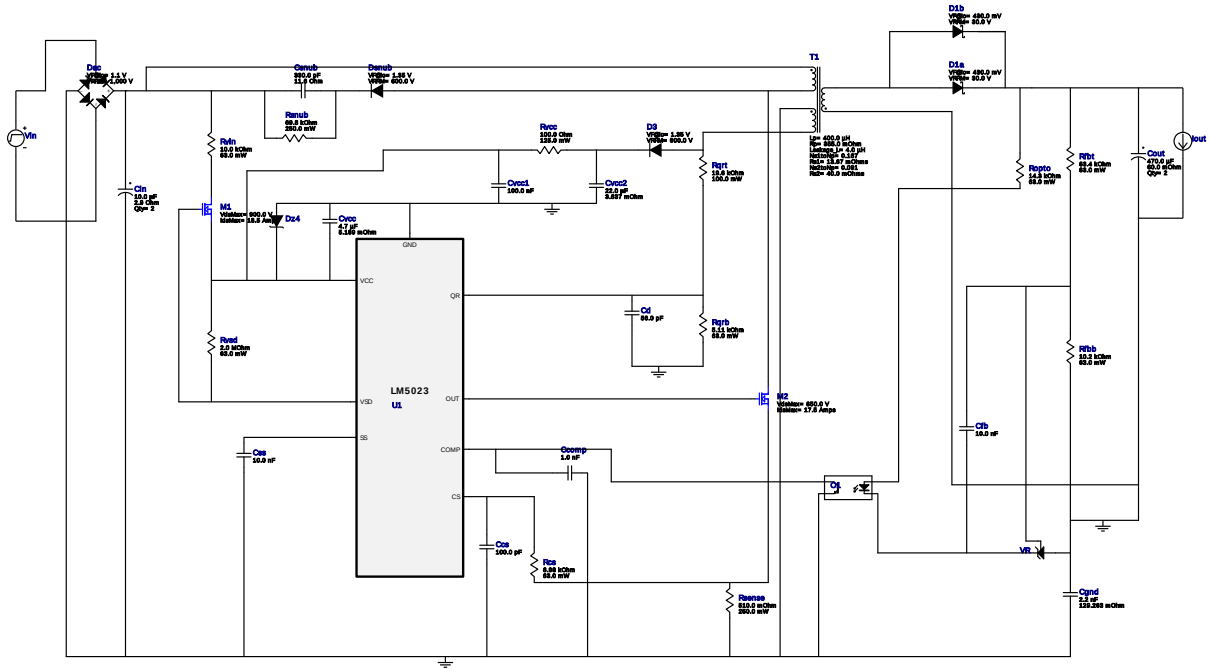
WEBENCH® Design Report

VinMin = 110.0V
VinMax = 265.0V
Vout = 18.0V
Iout = 0.9A

Device = LM5023MM-2/NOPB
Topology = Flyback
Created = 7/21/16 2:33:35 AM
BOM Cost = $0.00
BOM Count = 2
Total Pd = 1.77W

Design : 4668160/46 LM5023MM-2/NOPB
LM5023MM-2/NOPB 110.0V-265.0V to 18.00V @ 0.9A



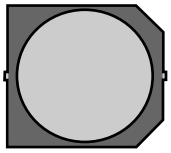
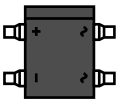
1. Rbld is a starting point, but may need to be experimented with in order to get minimum current needed to hold Vout at no load. Rlc and the feedback resistors may also need adjustment based on the actual transformer used. For more information please click the design assistance button.

My Comments

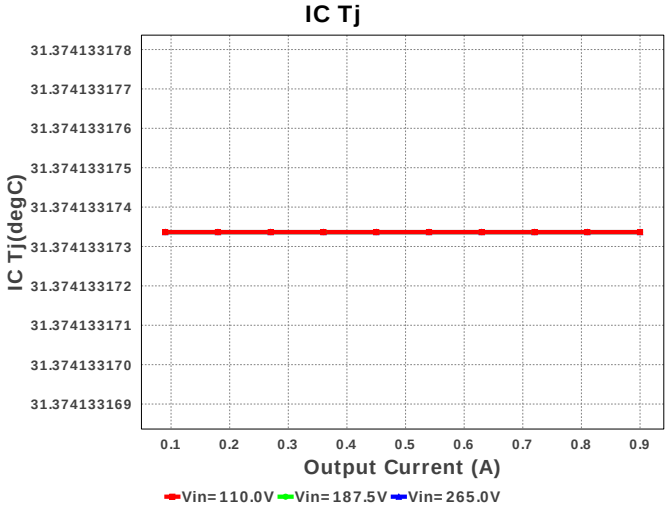
No comments

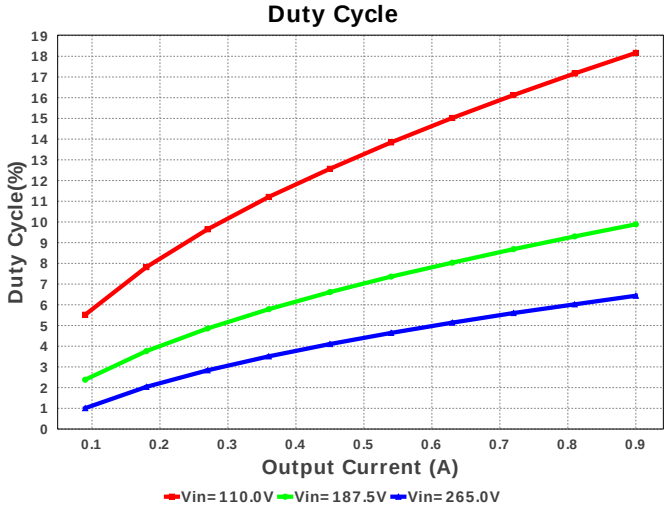
Electrical BOM

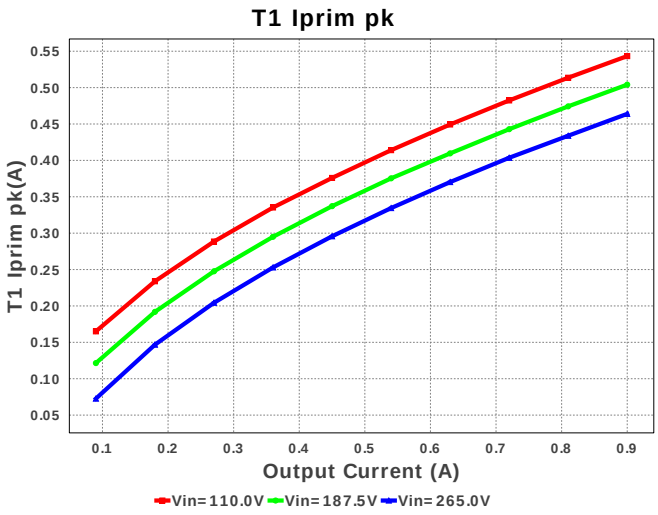
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp	MuRata	GRM033R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0201_033 2 mm²
2.	Ccs	Kemet	C0201C101K3GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
3.	Cd	TDK	C0603C0G1H560J030BA Series= C0G/NP0	Cap= 56.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
4.	Cfb	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
5.	Cgnd	TDK	C4532JB3D222K Series= JB	Cap= 2.2 nF ESR= 129.263 mOhm VDC= 2.0 kV IRMS= 0.0 A	1	$0.16	1812 23 mm²
6.	Cin	Kemet	ESG106M400AH4AA Series= 2334	Cap= 10.0 uF ESR= 2.9 Ohm VDC= 400.0 V IRMS= 100.0 mA	2	$0.19	ESG106 144 mm²

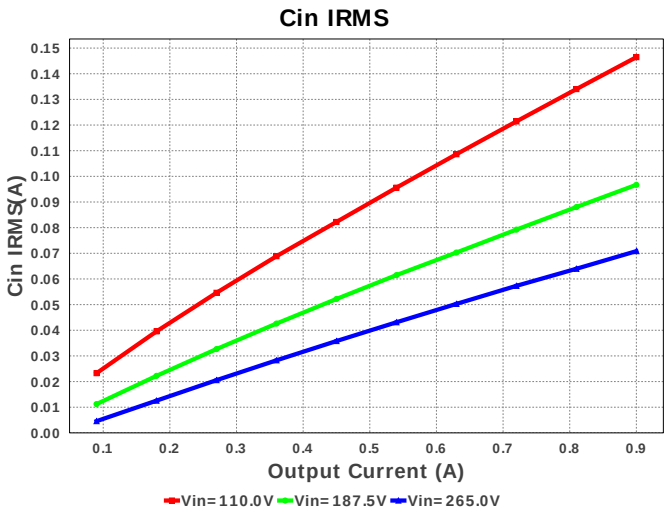
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cout	Panasonic	EEV-FK1V471Q Series= FK	Cap= 470.0 uF ESR= 60.0 mOhm VDC= 35.0 V IRMS= 1.1 A	2	$0.48	 SM_RADIAL_H13 264 mm^2
8.	Csnub	MuRata	GRM188R72E331KW07D Series= X7R	Cap= 330.0 pF ESR= 11.6 Ohm VDC= 250.0 V IRMS= 50.0 mA	1	$0.01	 0603 5 mm^2
9.	Css	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF 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= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.02	 0805 7 mm^2
11.	Cvcc1	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm^2
12.	Cvcc2	MuRata	GRM31CR61C226ME15L Series= X5R	Cap= 22.0 uF ESR= 3.637 mOhm VDC= 16.0 V IRMS= 3.4771 A	1	$0.13	 1206_190 11 mm^2
13.	D1a	ON Semiconductor	MBR0530T1G	VF@Io= 430.0 mV VRRM= 30.0 V	1	$0.06	 SOD-123 13 mm^2
14.	D1b	ON Semiconductor	MBR0530T1G	VF@Io= 430.0 mV VRRM= 30.0 V	1	$0.06	 SOD-123 13 mm^2
15.	D3	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	$0.08	 SMA 37 mm^2
16.	Dac	Vishay-Semiconductor	DF10SA	VF@Io= 1.1 V VRRM= 1,000.0 V	1	$0.24	 DF-S 99 mm^2
17.	Dsnub	Micro Commercial Components	ES1J-TP	VF@Io= 1.35 V VRRM= 600.0 V	1	$0.08	 SMA 37 mm^2
18.	Dz4	NXP Semiconductor	BZX585-C22,115	Zener	1	$0.02	 SOD-523 5 mm^2
19.	M1	STMicroelectronics	STW21N90K5	VdsMax= 900.0 V IdsMax= 18.5 Amps	1	$3.94	 TO-247 123 mm^2
20.	M2	Infineon Technologies	IPP65R190CFD	VdsMax= 650.0 V IdsMax= 17.5 Amps	1	$2.34	TO-220 0 mm^2
21.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	$0.38	 SSOP-4 111 mm^2
22.	Rcs	Vishay-Dale	CRCW04026K98FKED Series= CRCW..e3	Res= 6.98 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
23.	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
24.	Rfbt	Vishay-Dale	CRCW040263K4FKED Series= CRCW..e3	Res= 63.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
25.	Ropto	Vishay-Dale	CRCW040214K3FKED Series= CRCW..e3	Res= 14.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2

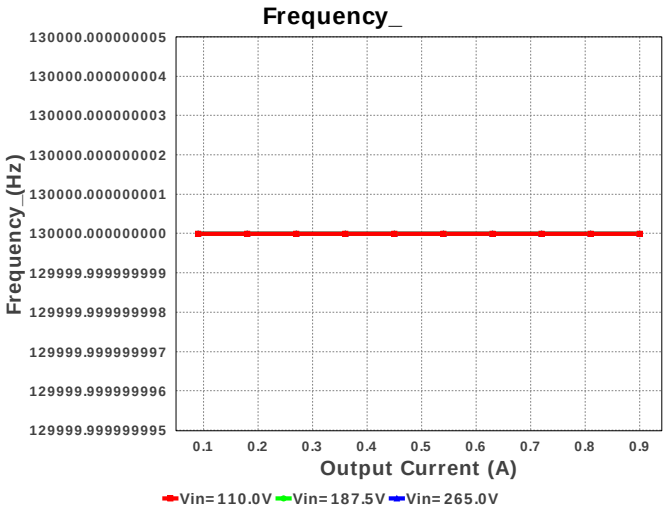
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
26.	Rqrb	Vishay-Dale	CRCW04025K11FKED Series= CRCW..e3	Res= 5.11 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
27.	Rqrt	Vishay-Dale	CRCW060319K6FKEA Series= CRCW..e3	Res= 19.6 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
28.	Rsense	Bourns	CRM0805-FX-R510ELF Series= ?	Res= 510.0 mOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.03	0805 7 mm²
29.	Rsnub	Panasonic	ERJ-8ENF6982V Series= ERJ-8E	Res= 69.8 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
30.	Rvcc	Vishay-Dale	CRCW0805100RFKEA Series= CRCW..e3	Res= 100.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
31.	Rvin	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
32.	Rvsd	Vishay-Dale	CRCW04022M00FKED Series= CRCW..e3	Res= 2.0 MOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
33.	T1	Wurth Elektronik	750313417	Lp= 400.0 µH Rp= 355.0 mOhm Leakage_L= 4.0 µH Ns1toNp= 0.167 Rs1= 13.67 mOhms Ns2toNp= 0.091 Rs2= 40.0 mOhms	1	NA	WE-DD-L 210 mm²
34.	U1	Texas Instruments	LM5023MM-2/NOPB	Switcher	1	$0.38	MUA08A 24 mm²
35.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	$0.07	R-PDSO-G3 16 mm²

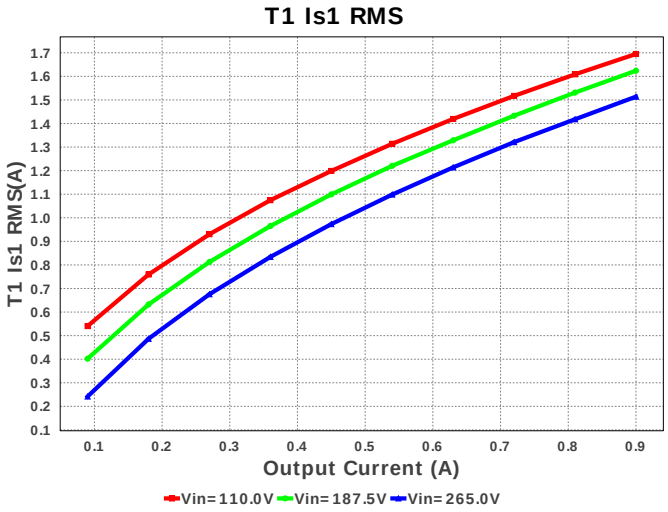


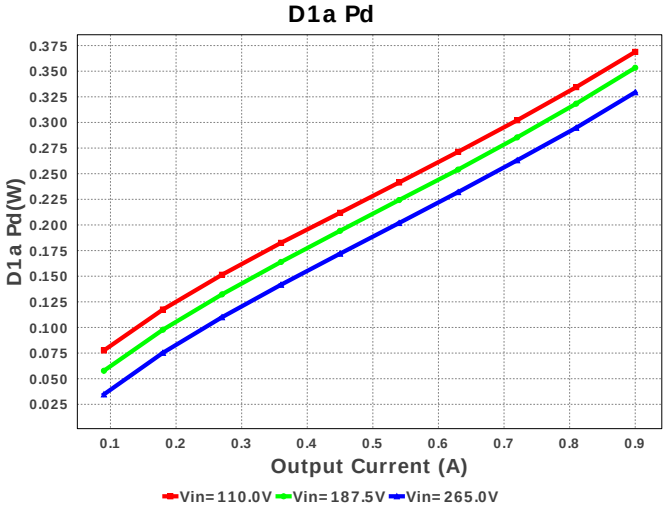


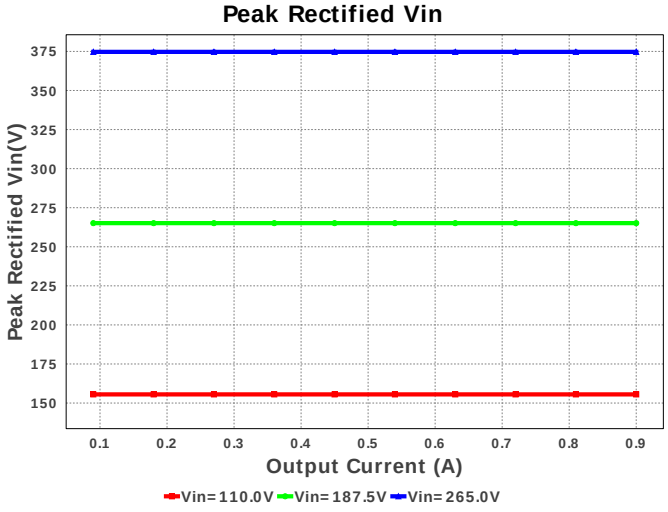


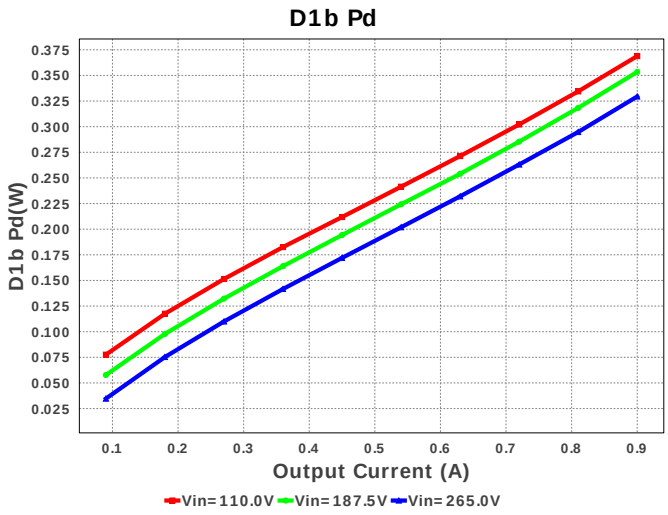


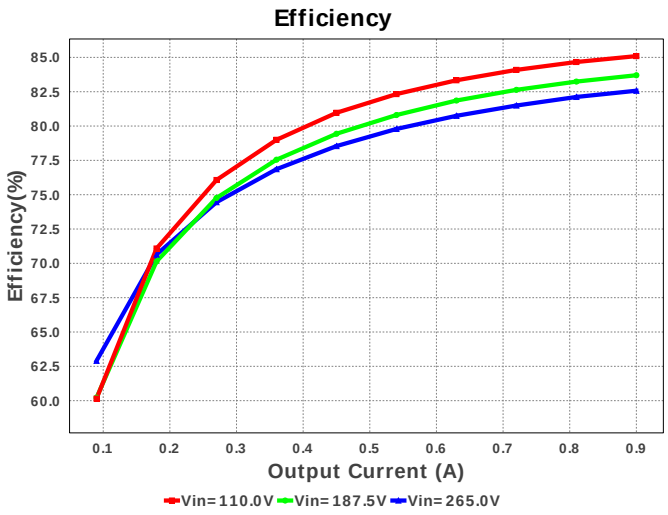


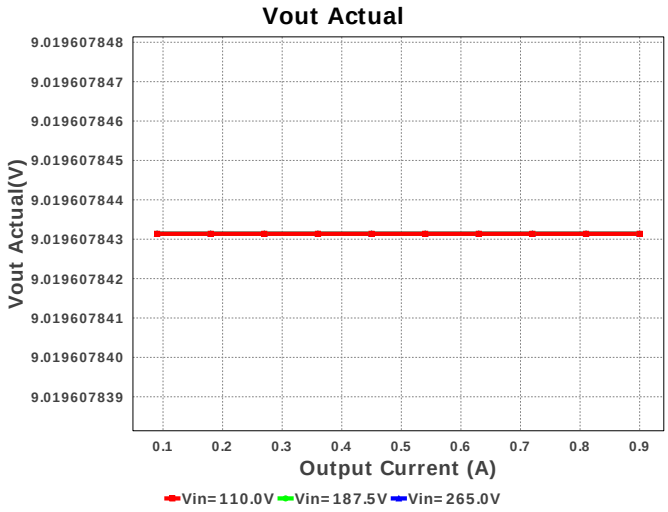


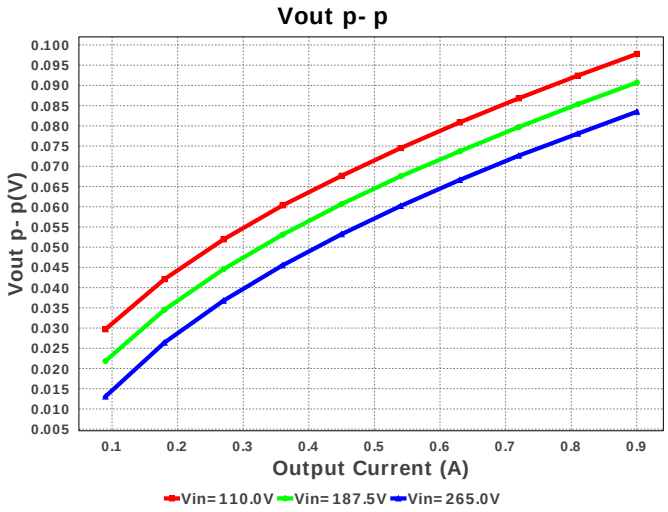


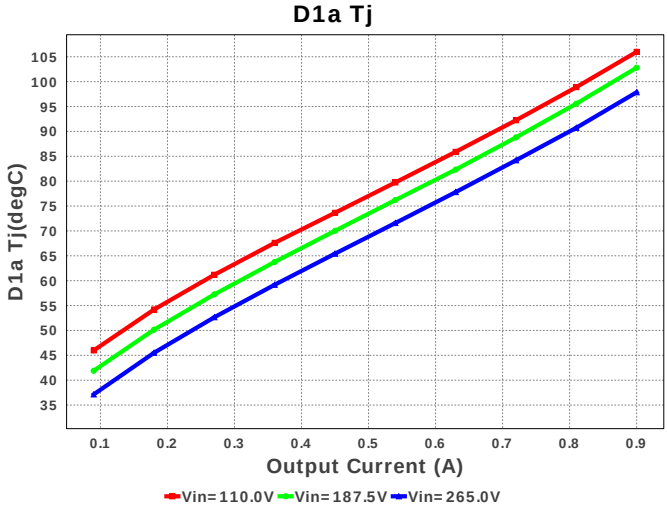


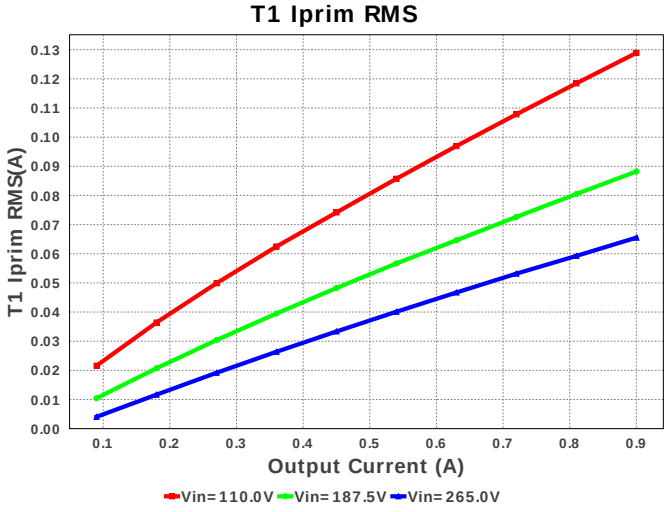


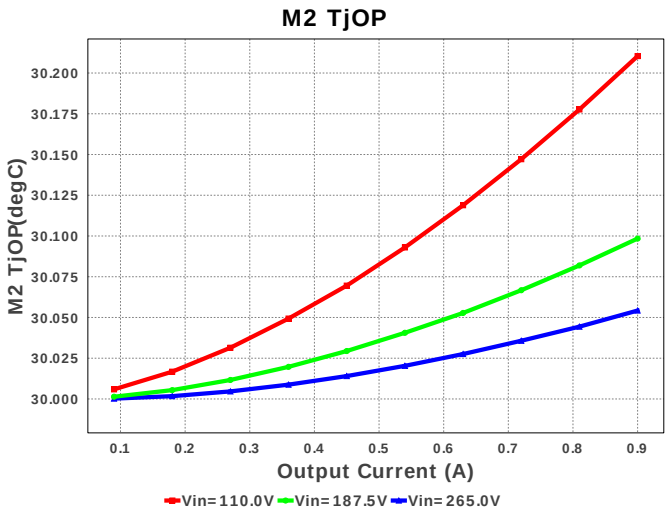


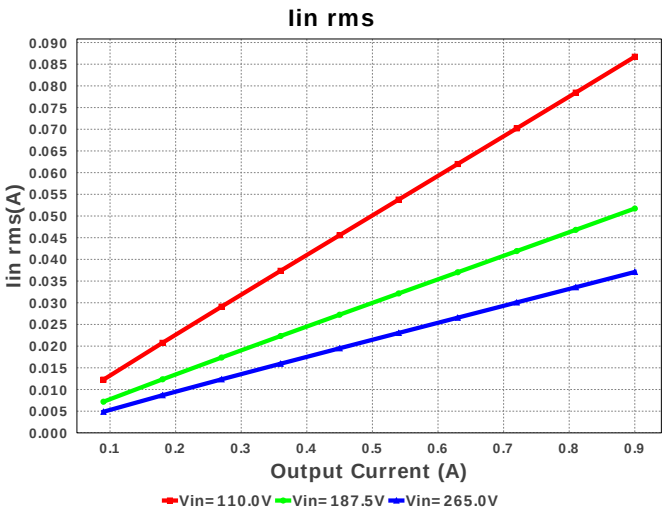


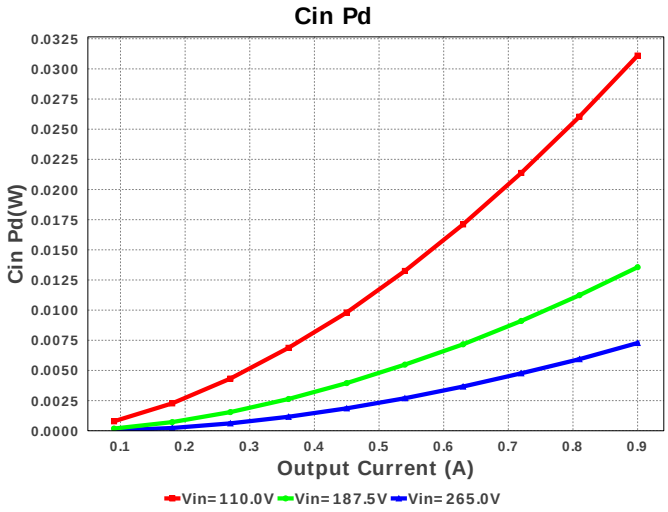


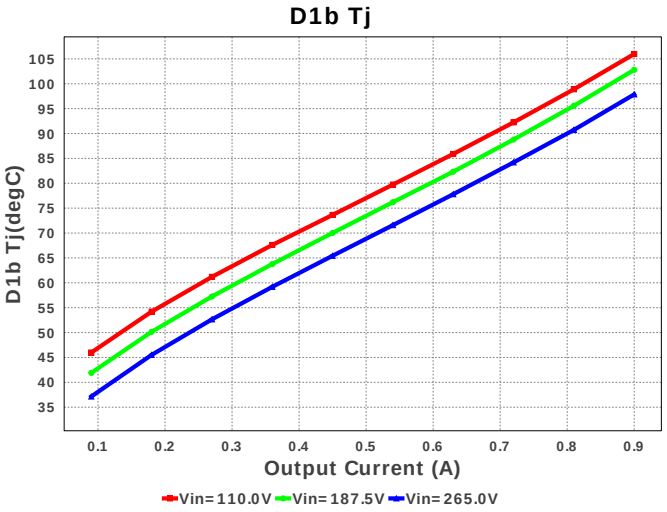


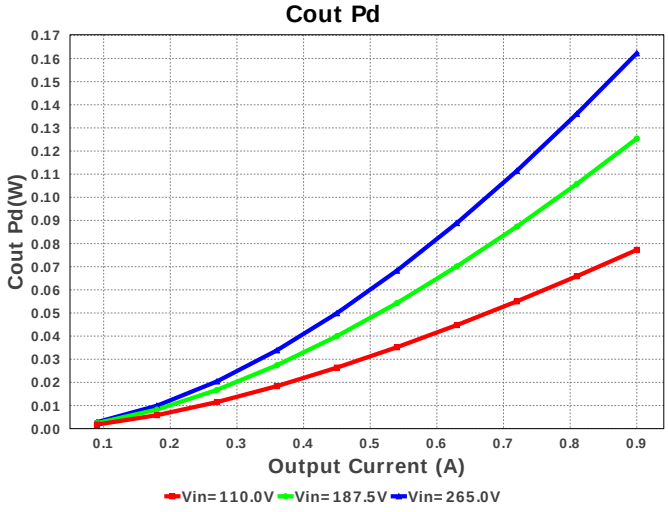


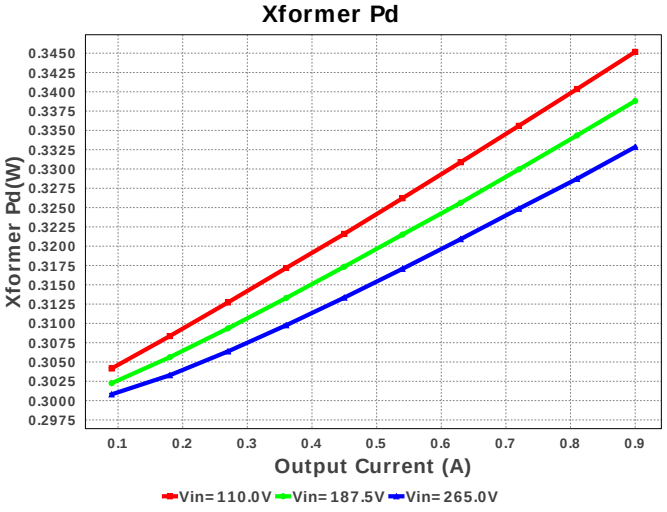


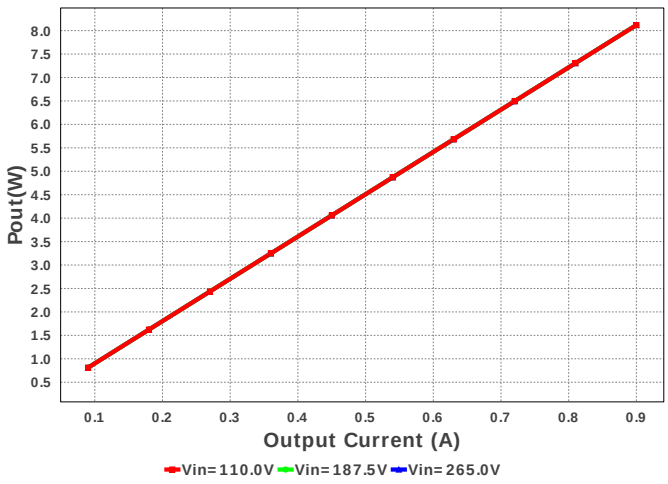


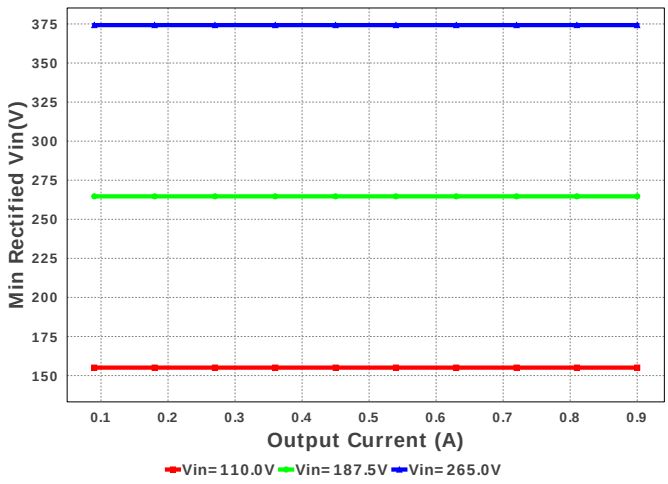


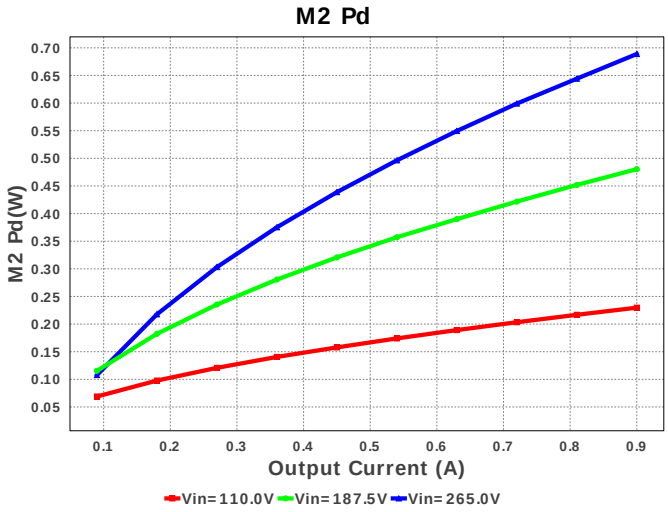


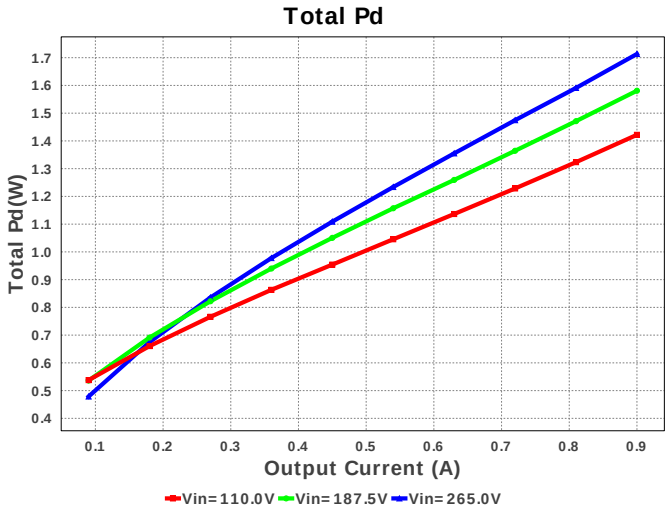


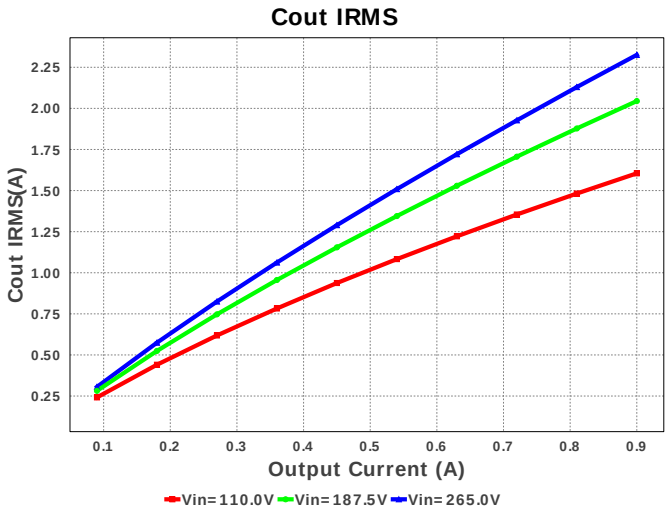


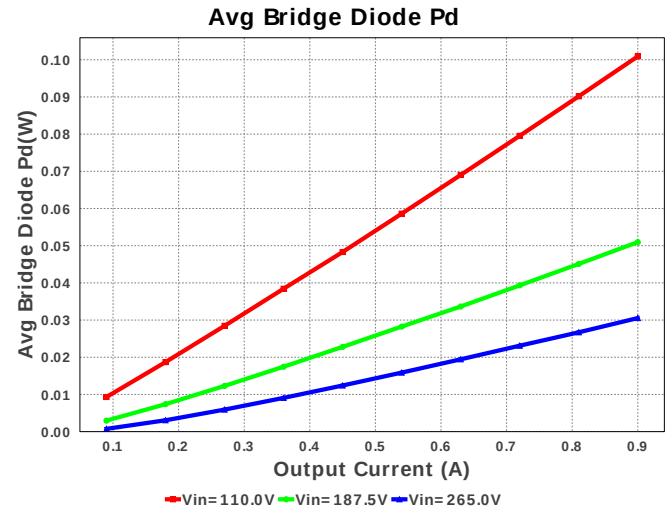


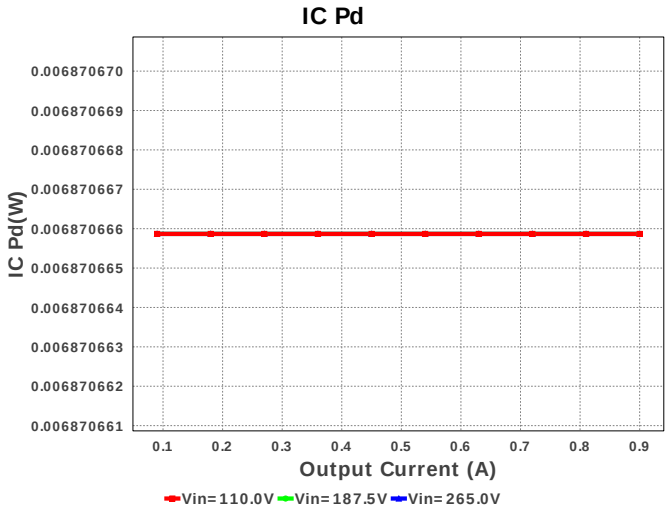


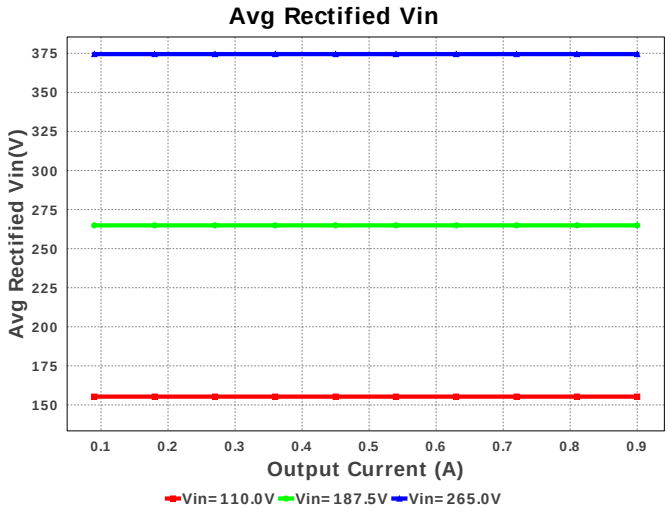


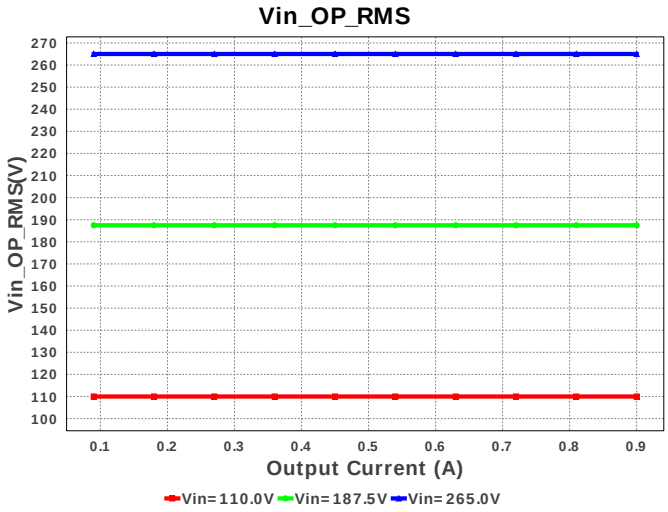


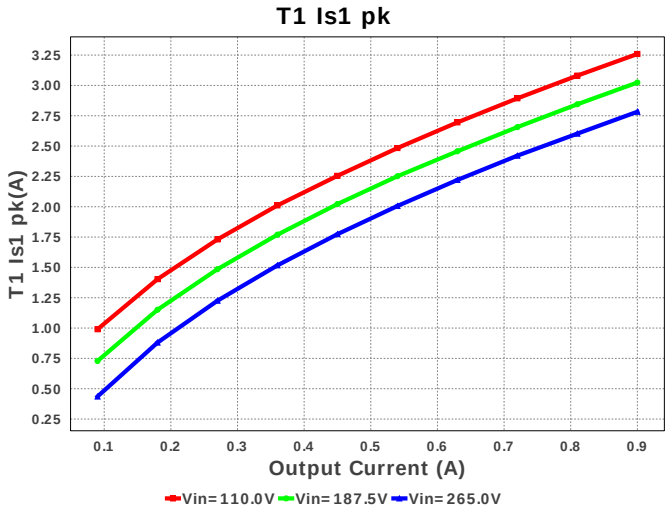












Operating Values

#	Name	Value	Category	Description
1.	Total BOM	$0.0		Total BOM Cost
2.	Cin IRMS	112.789 mA	Current	Input capacitor RMS ripple current
3.	Cout IRMS	1.719 A	Current	Output capacitor RMS ripple current
4.	Iin rms	37.303 mA	Current	RMS Input Current
5.	T1 Iprim RMS	102.182 mA	Current	Transformer Primary RMS Current
6.	T1 Iprim pk	465.379 mA	Current	Transformer Primary Peak Current
7.	T1 Is1 RMS	1.518 A	Current	Transformer Secondary1 RMS Current
8.	T1 Is1 pk	2.792 A	Current	Transformer Secondary1 Peak Current
9.	Avg Rectified Vin	374.485 V	General	Average Rectified Voltage for the AC Line Period
10.	BOM Count	2	General	Total Design BOM count
11.	FootPrint	1.615 k mm^2	General	Total Foot Print Area of BOM components
12.	Pout	8.118 W	General	Total output power
13.	D1 Tj	98.073 degC	Op_Point	D1 junction temperature
14.	D1 Tj	98.073 degC	Op_Point	D1 junction temperature
15.	Vout Actual	9.02 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	9.02 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	15.559 %	Op_point	Duty cycle
18.	Efficiency	82.118 %	Op_point	Steady state efficiency
19.	Frequency	130.0 kHz	Op_point	Switching frequency
20.	IC Tj	31.374 degC	Op_point	IC junction temperature
21.	ICThetaJA	200.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	900.0 mA	Op_point	Iout operating point
23.	M2 TjOP	30.132 degC	Op_point	M2 MOSFET junction temperature
24.	Min Rectified Vin	374.26 V	Op_point	Minimum voltage seen at rectified input
25.	Peak Rectified Vin	374.71 V	Op_point	Peak voltage seen at rectified input
26.	Vin_OP_RMS	265.0 V	Op_point	AC Input RMS Voltage
27.	Vout p-p	83.751 mV	Op_point	Peak-to-peak output ripple voltage
28.	Avg Bridge Diode Pd	74.038 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
29.	Cin Pd	18.446 mW	Power	Input capacitor power dissipation
30.	Cout Pd	88.7 mW	Power	Output capacitor power dissipation
31.	Diode1 Pd	330.449 mW	Power	Diode1 power dissipation

#	Name	Value	Category	Description
32.	Diode1 Pd	330.449 mW	Power	Diode1 power dissipation
33.	IC Pd	6.871 mW	Power	IC power dissipation
34.	M2 Pd	692.218 mW	Power	M2 MOSFET total power dissipation
35.	Total Pd	1.768 W	Power	Total Power Dissipation
36.	Xformer Pd	335.227 mW	Power	Transformer power dissipation
37.	Vout Tolerance	2.391 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	900.0 m	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	110.0	Minimum input voltage
4.	Vout	18.0	Output Voltage
5.	line_fsw	0.0	Light Output in Lumen
6.	base_pn	LM5023	Base Product Number
7.	source	AC	Input Source Type
8.	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.