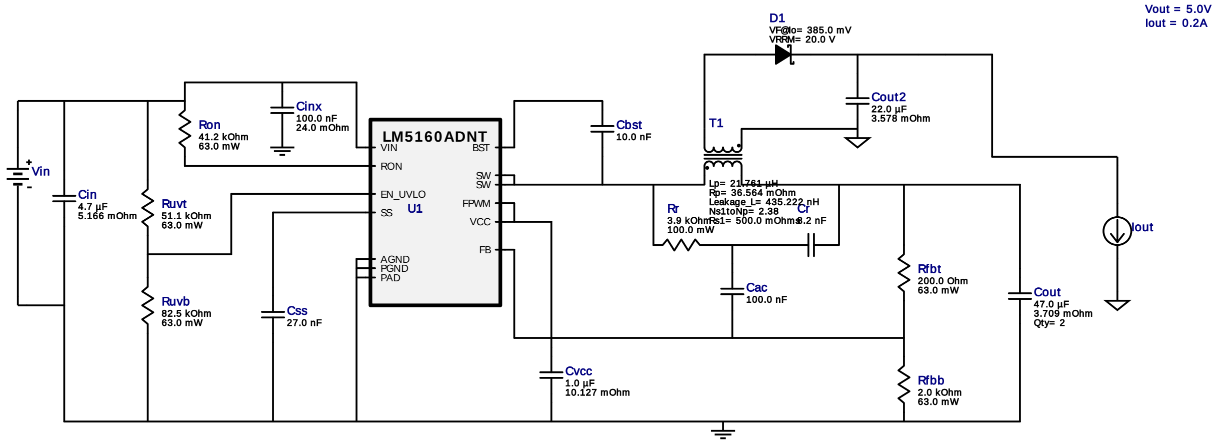
VinMin = 5.0V
VinMax = 15.0V
Vout = 5.0V
Iout = 0.2A

Device = LM5160ADNTR
Topology = Flybuck
Created = 9/25/16 12:49:50 AM
BOM Cost = $0.00
BOM Count = 19
Total Pd = 0.48W

WEBENCH ® Design Report

Design : 2425056/69 LM5160ADNTR
LM5160ADNTR 5.0V-15.0V to 5.00V @ 0.9800544619739828A

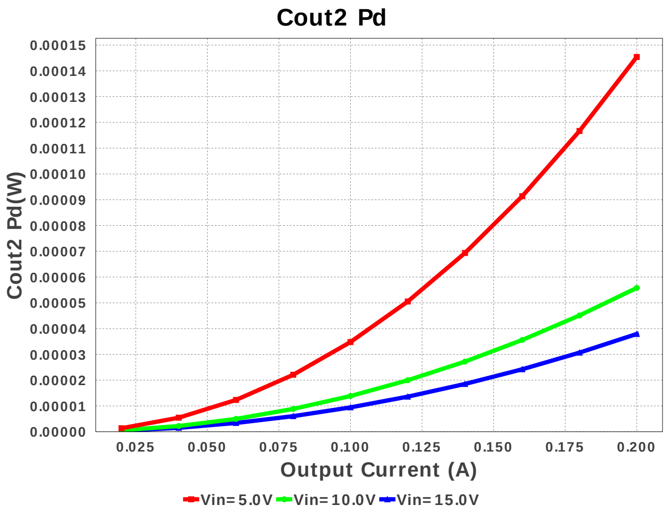


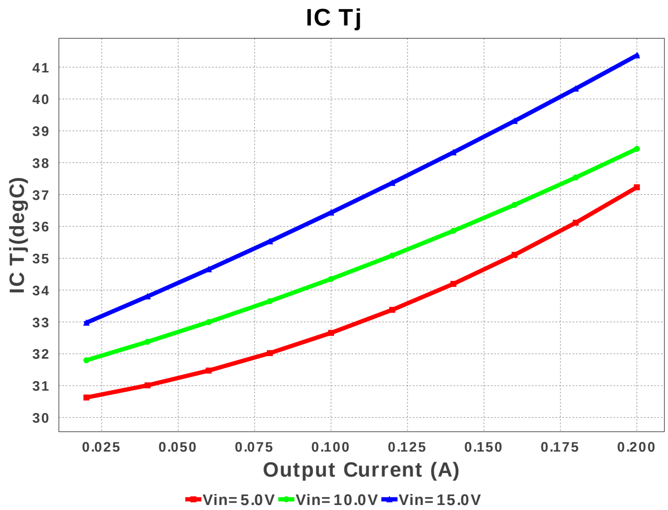
1. Feedback Resistors may need to be further adjusted to get more precise regulation as ripple injection circuit will introduce some amount of DC offset. Use simulation to help adjust.

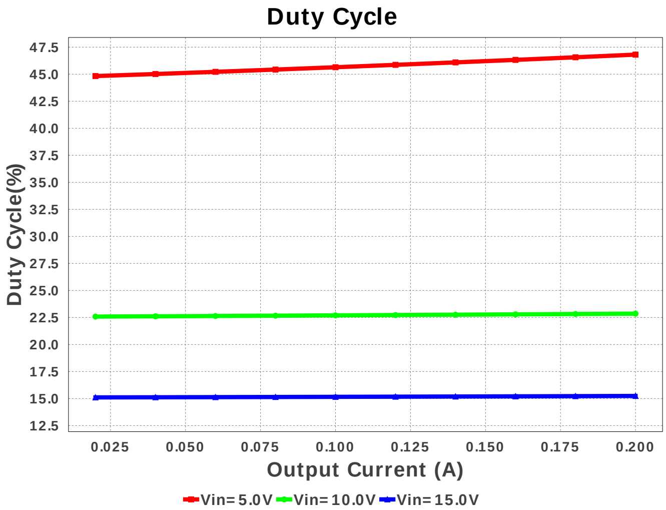
Electrical BOM

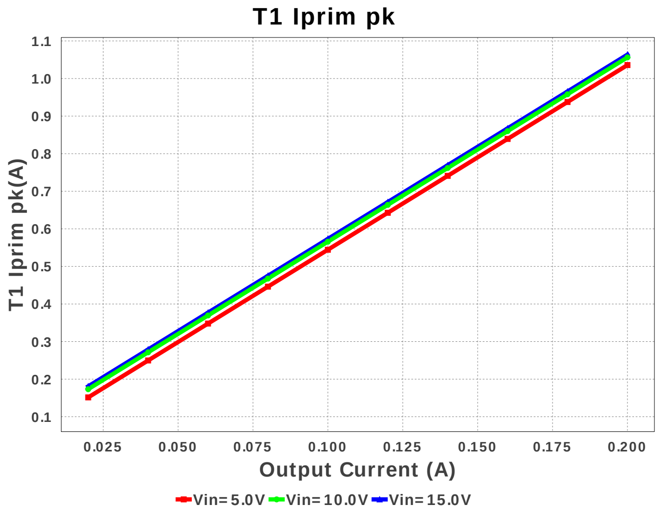
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cac	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
2.	Cbst	MuRata	GRM155R61C103KA01D Series= X5R	Cap= 10.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Cin	MuRata	GRM21BC81E475KA12L Series= X6S	Cap= 4.7 uF ESR= 5.166 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.02	0805 7 mm^2
4.	Cinx	AVX	08055C104JAT2A Series= X7R	Cap= 100.0 nF ESR= 24.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
5.	Cout	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	2	$0.15	1206_190 11 mm^2
6.	Cout2	MuRata	GRM21BC80G226ME39L Series= X6S	Cap= 22.0 uF ESR= 3.578 mOhm VDC= 4.0 V IRMS= 3.29633 A	1	$0.04	0805 7 mm^2
7.	Cr	TDK	CGA3E2C0G1H822J080AD Series= C0G/NP0	Cap= 8.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.11	0603 5 mm^2
8.	Css	MuRata	GRM155R61C273KA01D Series= X5R	Cap= 27.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
9.	Cvcc	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	$0.01	0603 5 mm^2
10.	D1	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	$0.06	SOD-123 13 mm^2

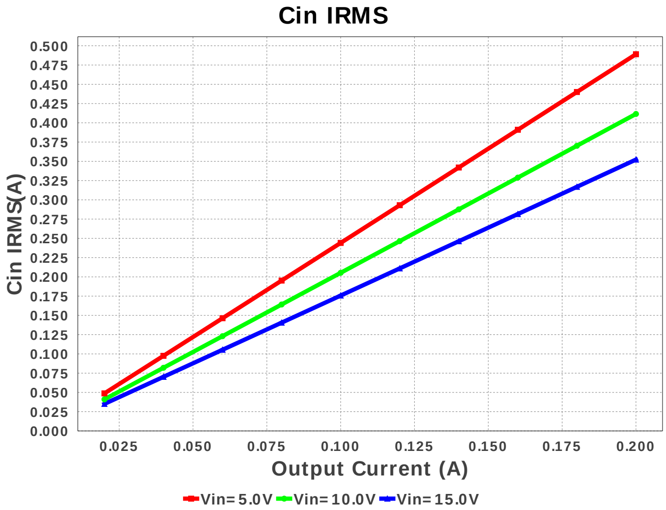
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rfbb	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
12.	Rfbt	Vishay-Dale	CRCW0402200RFKED Series= CRCW..e3	Res= 200.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
13.	Ron	Vishay-Dale	CRCW040241K2FKED Series= CRCW..e3	Res= 41.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
14.	Rr	Yageo America	RC0603FR-073K9L Series= ?	Res= 3.9 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
15.	Ruvb	Vishay-Dale	CRCW040282K5FKED Series= CRCW..e3	Res= 82.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
16.	Ruvt	Vishay-Dale	CRCW040251K1FKED Series= CRCW..e3	Res= 51.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
17.	T1	CUSTOM	CUSTOM	Lp= 21.761 µH Rp= 36.564 mOhm Leakage_L= 435.222 nH Ns1toNp= 2.38 Rs1= 500.0 mOhms	1	NA	CUSTOM 0 mm^2
18.	U1	Texas Instruments	LM5160ADNTR	Switcher	1	$1.80	DNT0012B 25 mm^2

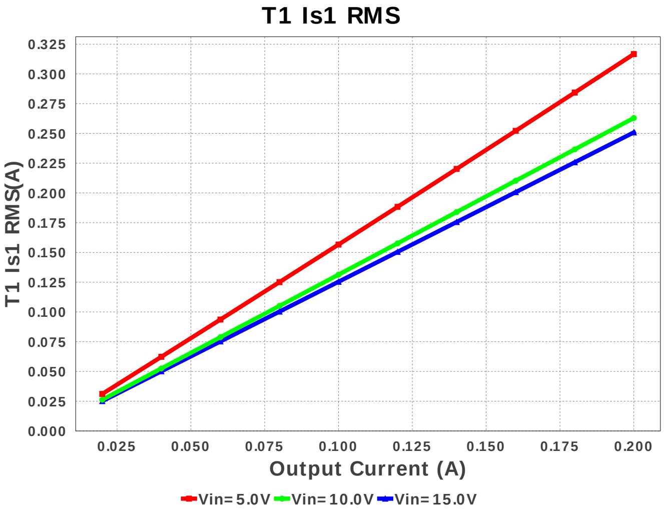


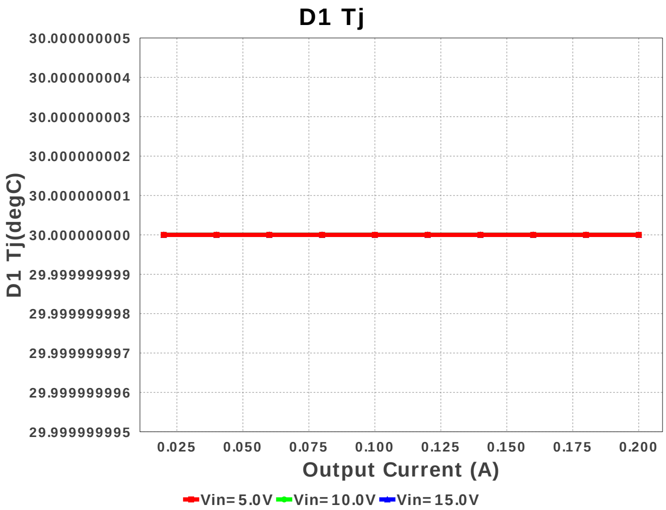


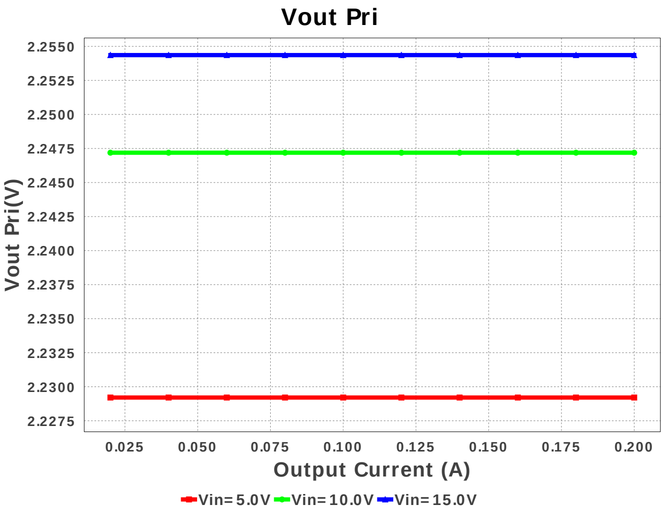

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=5.0V Vin=10.0V Vin=15.0V


T1 Iprim pk
T1 Iprim pk(A)
Output Current (A)
Vin=5.0V Vin=10.0V Vin=15.0V

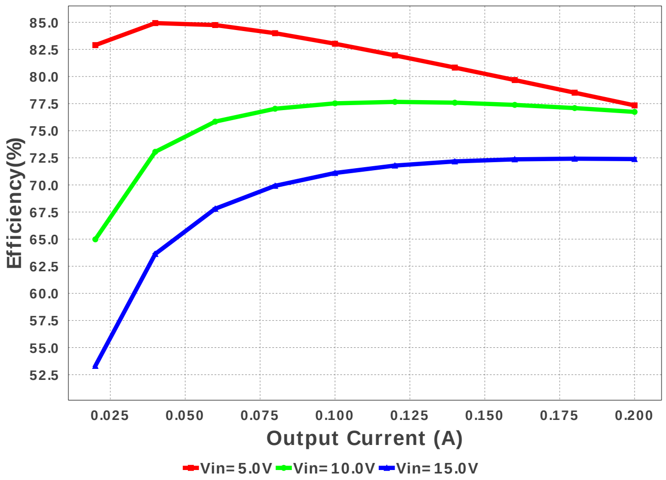

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=5.0V Vin=10.0V Vin=15.0V


T1 Is1 RMS
T1 Is1 RMS(A)
Output Current (A)
Vin=5.0V Vin=10.0V Vin=15.0V

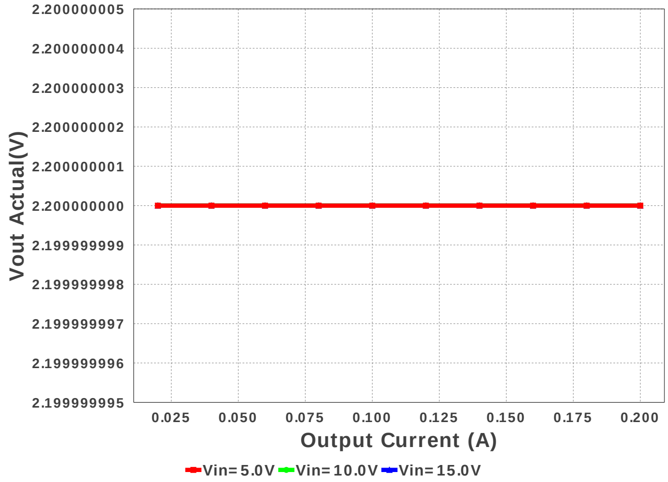

D1 Tj
D1 Tj(degC)
Output Current (A)
Vin=5.0V Vin=10.0V Vin=15.0V


Vout Pri
Vout Pri(V)
Output Current (A)
Vin=5.0V Vin=10.0V Vin=15.0V

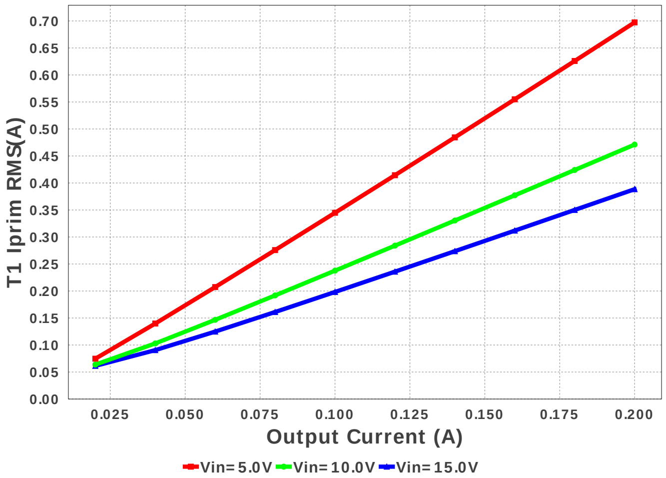
Efficiency



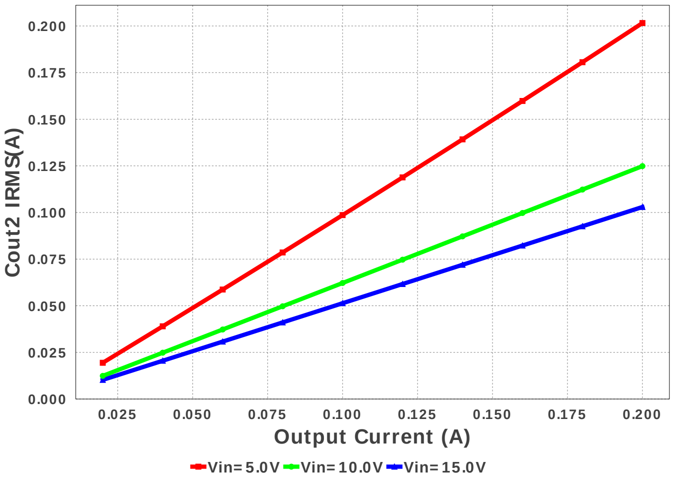
Vout Actual



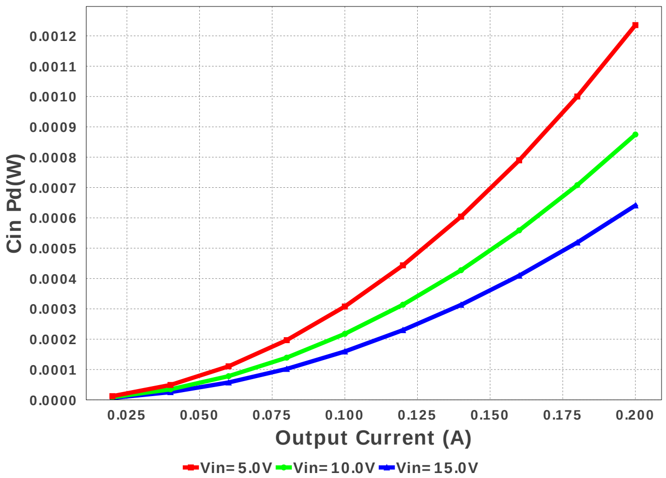
T1 Iprim RMS



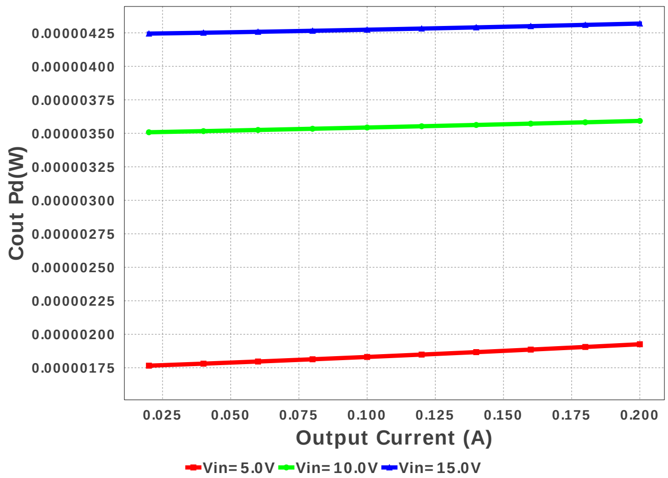
Cout2 IRMS



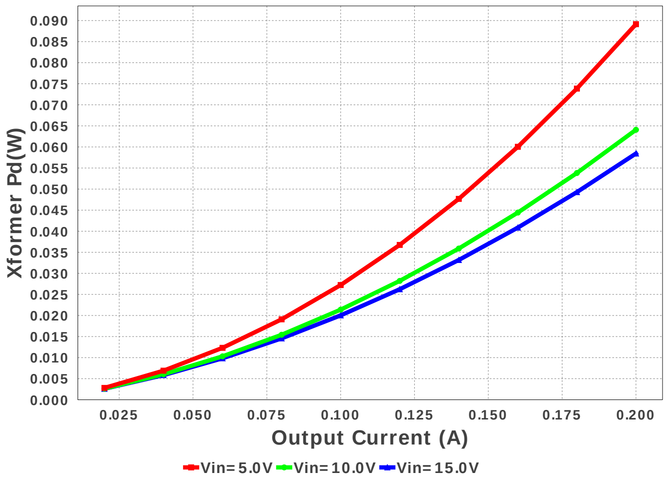
Cin Pd



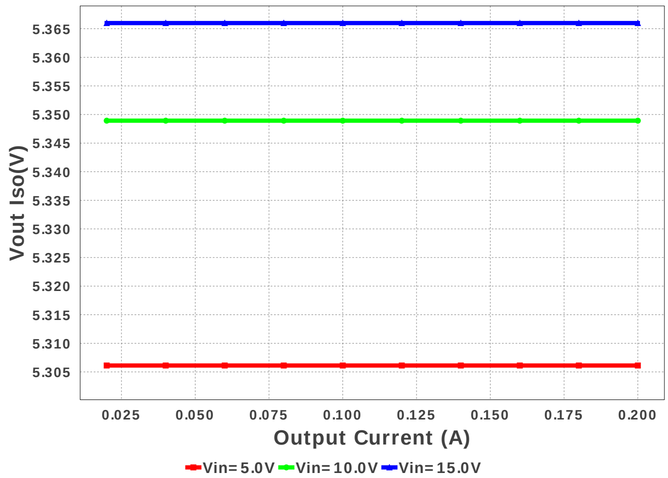
Cout Pd



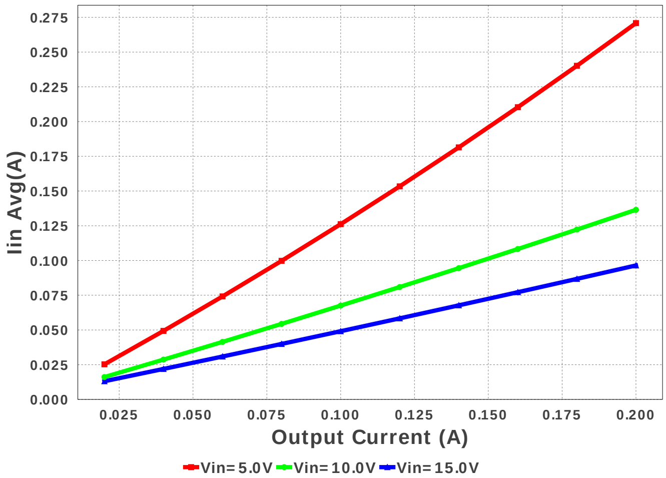
Xformer Pd



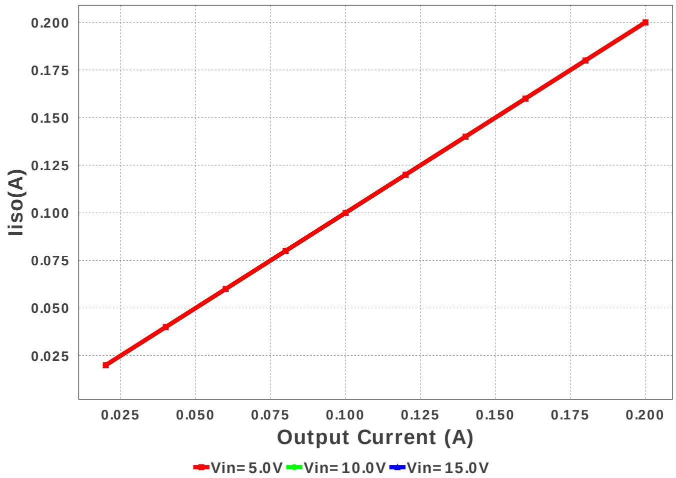
Vout Iso



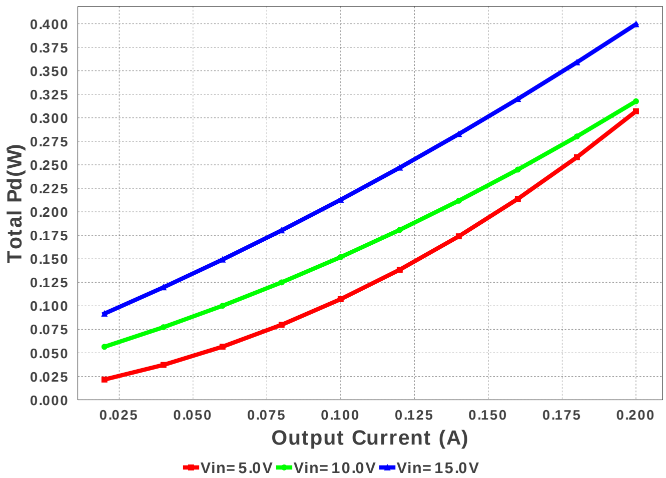
Iin Avg



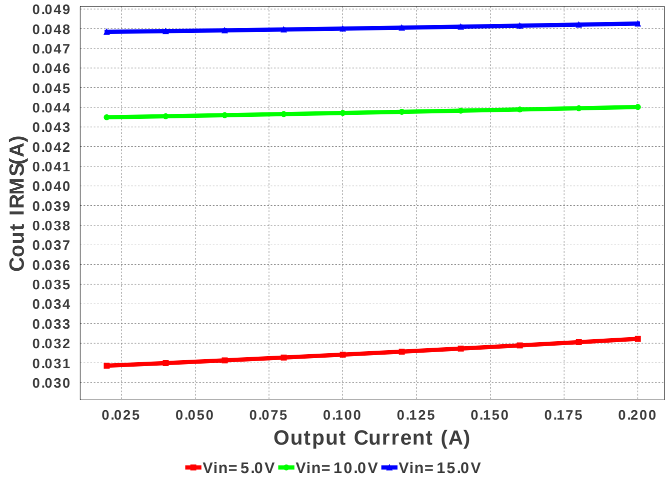
Iiso

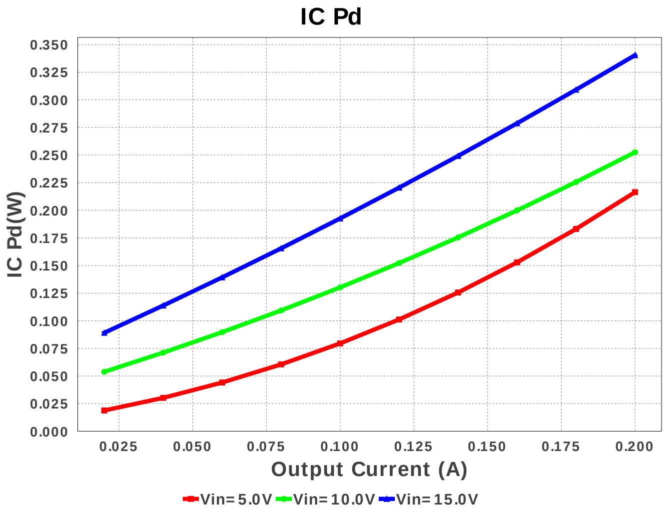


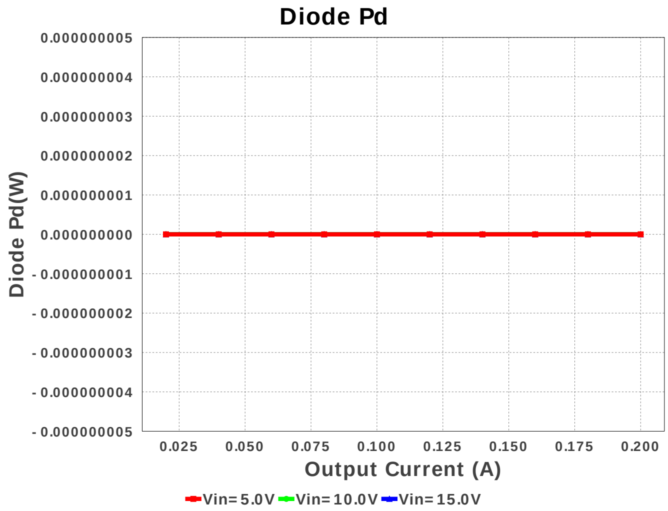
Total Pd



Cout IRMS







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	352.251 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	47.777 mA	Current	Output capacitor RMS ripple current
3.	Cout2 IRMS	102.949 mA	Current	Output capacitor2 RMS ripple current
4.	Iin Avg	101.54 mA	Current	Average input current
5.	Iiso	200.0 mA	Current	Secondary Side Output Current
6.	T1 Iprim RMS	388.391 mA	Current	Transformer Primary RMS Current
7.	T1 Iprim pk	1.063 A	Current	Transformer Primary Peak Current
8.	T1 Is1 RMS	250.846 mA	Current	Transformer Secondary1 RMS Current
9.	BOM Count	19	General	Total Design BOM count
10.	FootPrint	125.0 mm^2	General	Total Foot Print Area of BOM components
11.	Frequency	539.374 kHz	General	Switching frequency
12.	Total BOM	$0.0	General	Total BOM Cost
13.	D1 Tj	45.444 degC	Op_Point	D1 junction temperature
14.	Vout Actual	2.2 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Duty Cycle	15.241 %	Op_point	Duty cycle
16.	Efficiency	68.762 %	Op_point	Steady state efficiency
17.	IC Tj	41.462 degC	Op_point	IC junction temperature
18.	ICThetaJA	33.4 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	VIN_OP	15.0 V	Op_point	Vin operating point
20.	Vout Iso	4.991 V	Op_point	Secondary Side Output Voltage
21.	Vout Pri	2.254 V	Op_point	Primary Side Output Voltage
22.	Cin Pd	641.001 µW	Power	Input capacitor power dissipation
23.	Cout Pd	4.233 µW	Power	Output capacitor power dissipation
24.	Cout2 Pd	37.922 µW	Power	Output capacitor2 power dissipation
25.	Diode Pd	74.969 mW	Power	Diode power dissipation
26.	IC Pd	343.184 mW	Power	IC power dissipation
27.	Total Pd	475.786 mW	Power	Total Power Dissipation
28.	Xformer Pd	56.942 mW	Power	Transformer power dissipation
29.	Vout Tolerance	1.436 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	200.0 m	Maximum Output Current
2.	VinMax	15.0	Maximum input voltage
3.	VinMin	5.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	LM5160A	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. For a Constant On Time device to be stable, we need to provide a ripple at the feedback comparator. There are various methods to implement the ripple. Depending on the circuit complexity vs. the allowable ripple, we have three options to choose from. The simplest option, 'Low Complexity', would require only a high ESR cap at the output. This means that the BOM count will be small, but the output voltage ripple will be quite large. The 'Optimal Solution' would require a feed-forward cap in parallel with the upper feedback resistor to AC couple the ripple to the feedback node. This increases the BOM count slightly, but now we have more control over the output voltage ripple. If the output voltage requirement is very tight, then the best option is to go for the 'Low Output Ripple' solution. In this option we can go with very low ESR output caps and have very good control over the output voltage ripple.

2. **LM5160A** Product Folder : http://www.ti.com/product/LM5160A : contains the data sheet and other resources.