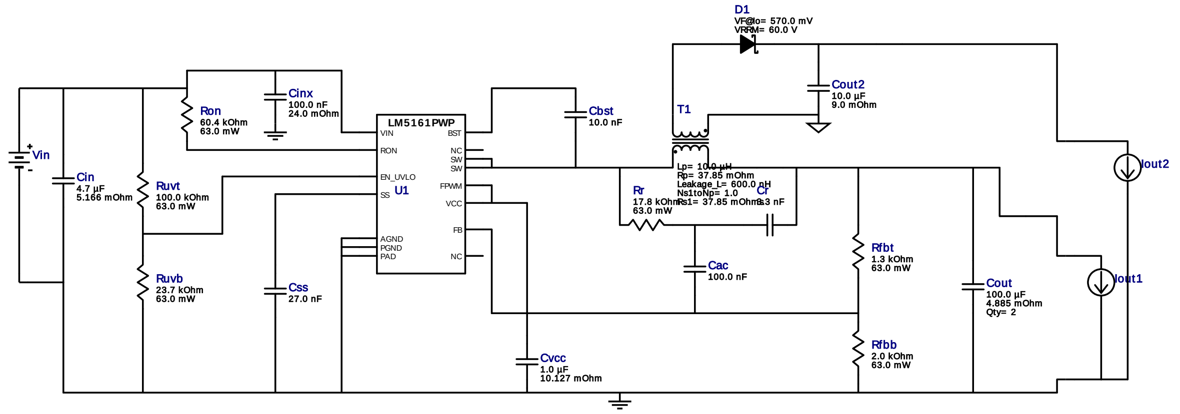
VinMin = 10.5V
VinMax = 13.0V
Vout = 3.3V
Iout = 0.3A

Device = LM5161PWPR
Topology = Flybuck
Created = 8/23/16 6:10:10 AM
BOM Cost = $3.25
BOM Count = 19
Total Pd = 0.72W

WEBENCH ® Design Report

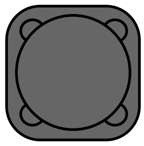
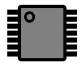
Design : 3496425/105 LM5161PWPR
LM5161PWPR 10.5V-13.0V to 3.30V @ 0.8A

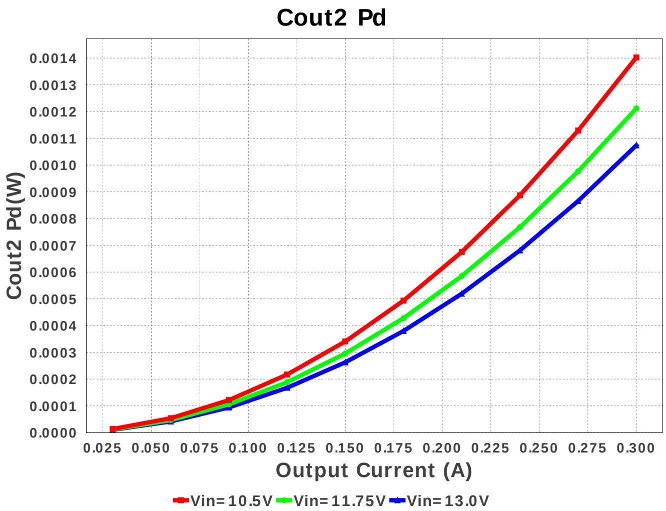


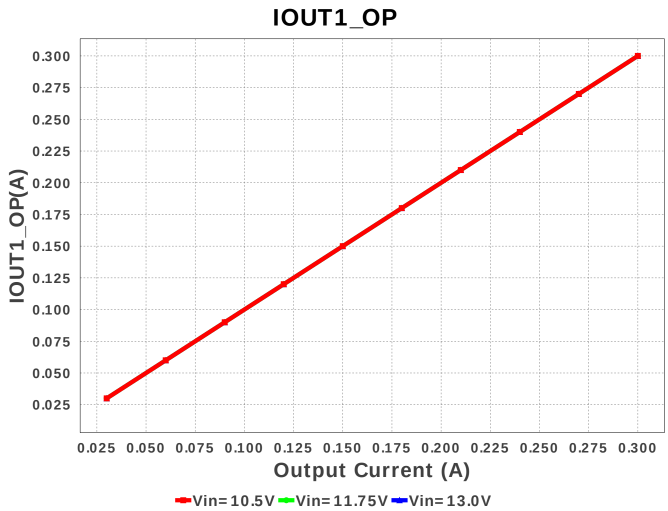
1. Feedback Resistors may need to be further adjusted to get more precise regulation as ripple injection circuit will introduce some amount of DC offset. Use simulation to help adjust.

Electrical BOM

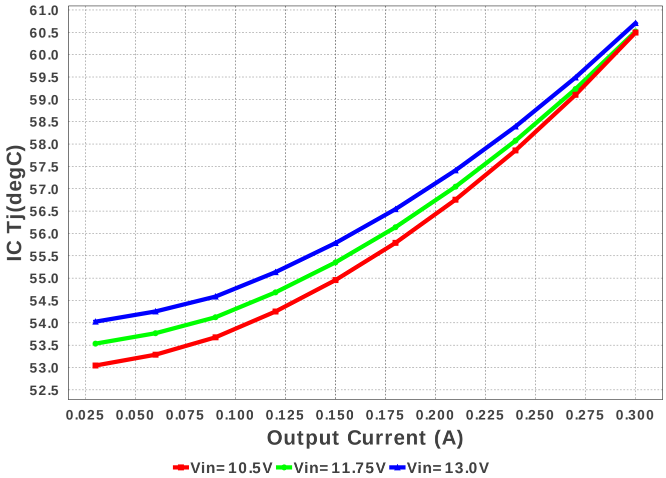
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cac	Kemet	C0603C104Z3VACTU Series= Y5V	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
2.	Cbst	MuRata	GRM155R61C103KA01D Series= X5R	Cap= 10.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Cin	MuRata	GRM21BC81E475KA12L Series= 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	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	2	$0.14	1206_190 11 mm^2
6.	Cout2	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	1	$0.02	0603 5 mm^2
7.	Cr	AVX	04023A331JAT2A Series= C0G/NP0	Cap= 3.3 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.10	0402 3 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	NXP Semiconductor	PMEG6010CEH,115	VF@Io= 570.0 mV VRRM= 60.0 V	1	$0.04	SOD-123F 12 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	CRCW04021K30FKED Series= CRCW..e3	Res= 1.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
13.	Ron	Vishay-Dale	CRCW040260K4FKED Series= CRCW..e3	Res= 60.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
14.	Rr	Vishay-Dale	CRCW040217K8FKED Series= CRCW..e3	Res= 17.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
15.	Ruvb	Vishay-Dale	CRCW040223K7FKED Series= CRCW..e3	Res= 23.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
16.	Ruvt	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
17.	T1	Coiltronics	DRQ125-100-R	Lp= 10.0 µH Rp= 37.85 mOhm Leakage_L= 600.0 nH Ns1toNp= 1.0 Rs1= 37.85 mOhms	1	$0.88	 DRQ125 210 mm^2
18.	U1	Texas Instruments	LM5161PWPR	Switcher	1	$1.80	 PWP0014A_N 59 mm^2

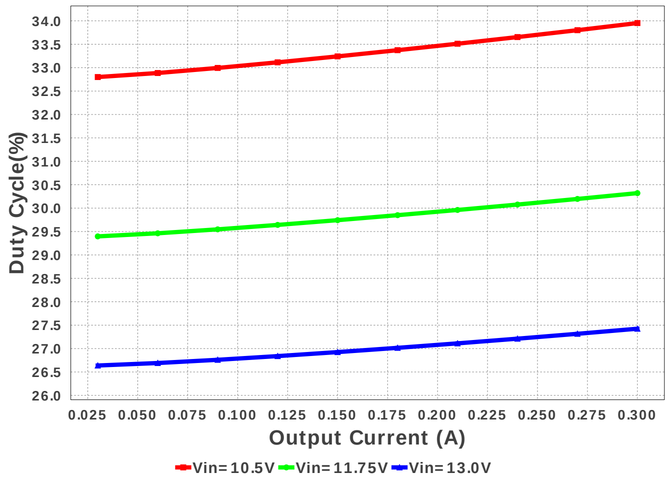




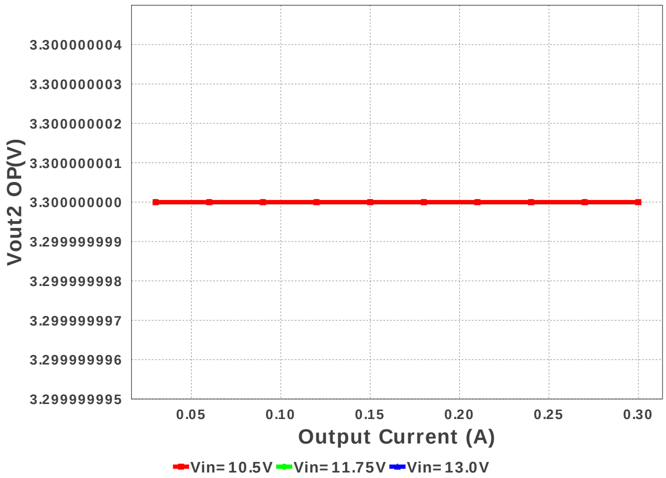
IC Tj



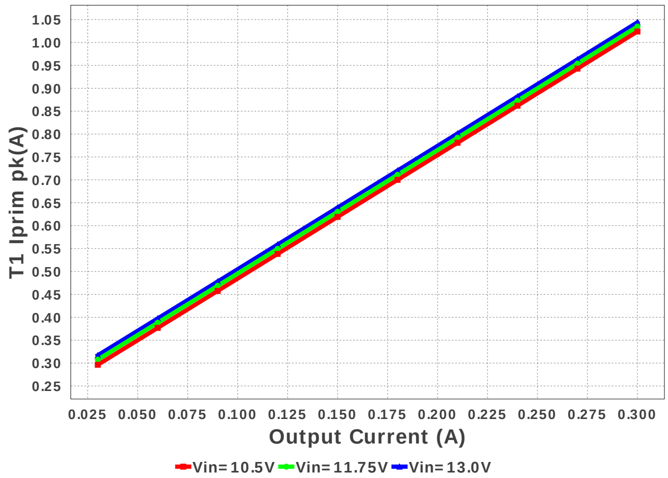
Duty Cycle



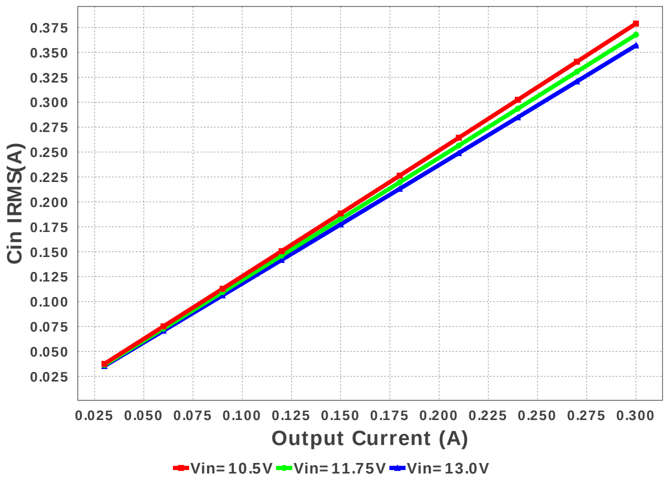
Vout2 OP



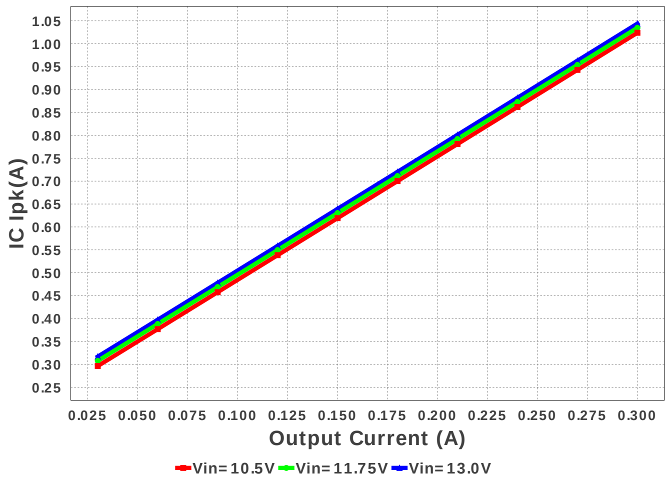
T1 Iprim pk

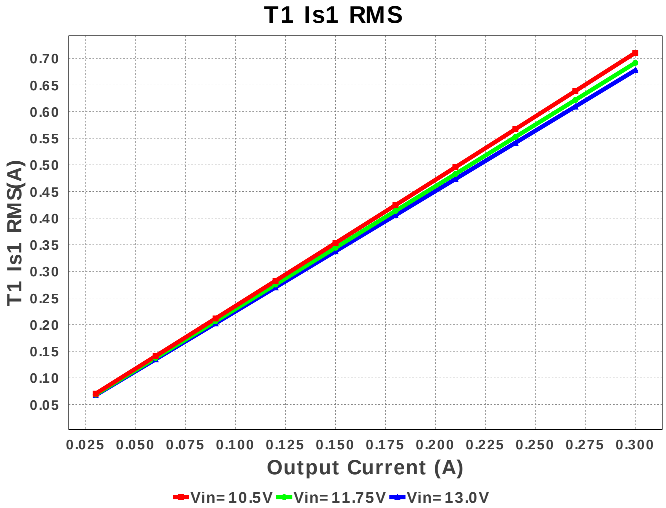


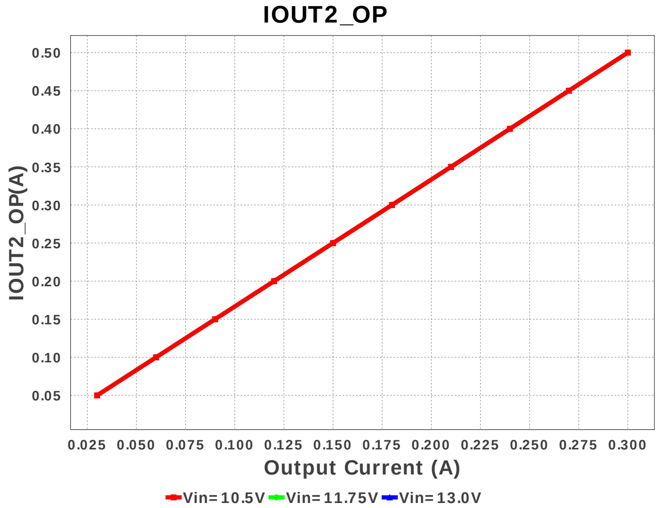
Cin IRMS

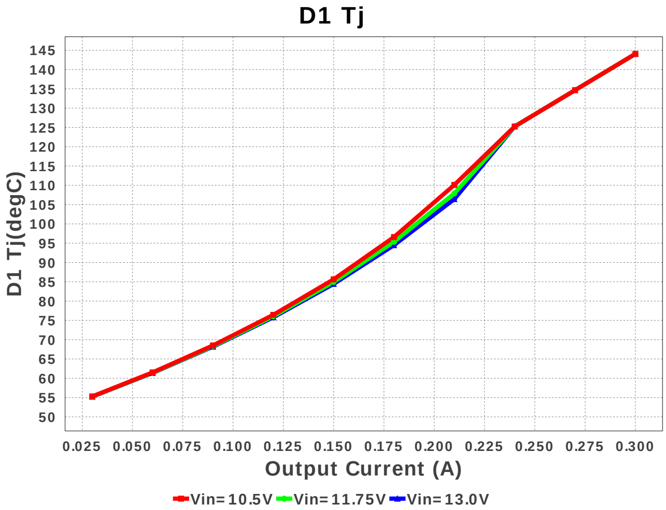


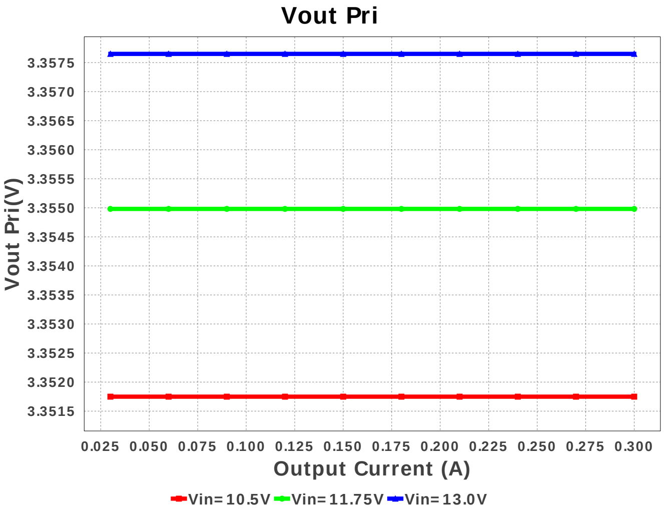
IC Ipk

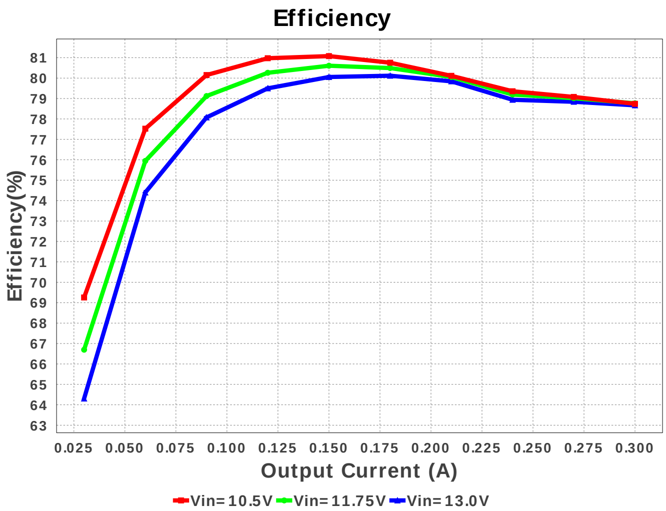


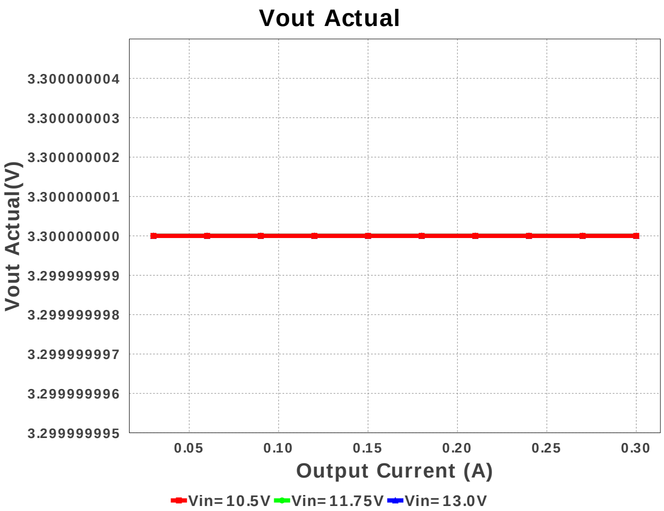

T1 Is1 RMS
T1 Is1 RMS(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

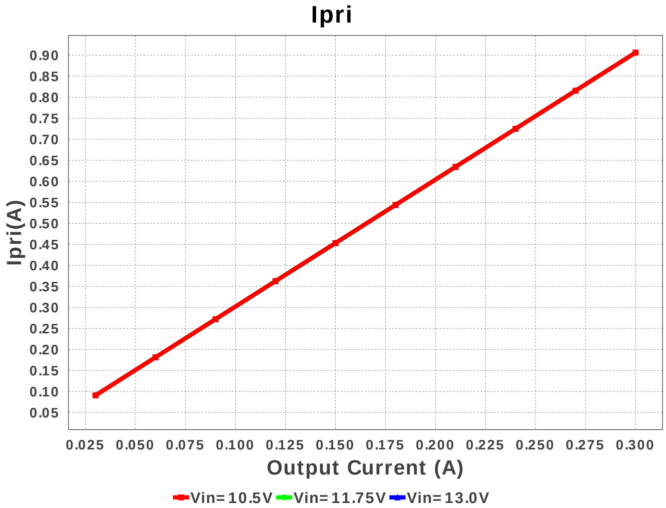

IOUT2_OP
IOUT2_OP(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

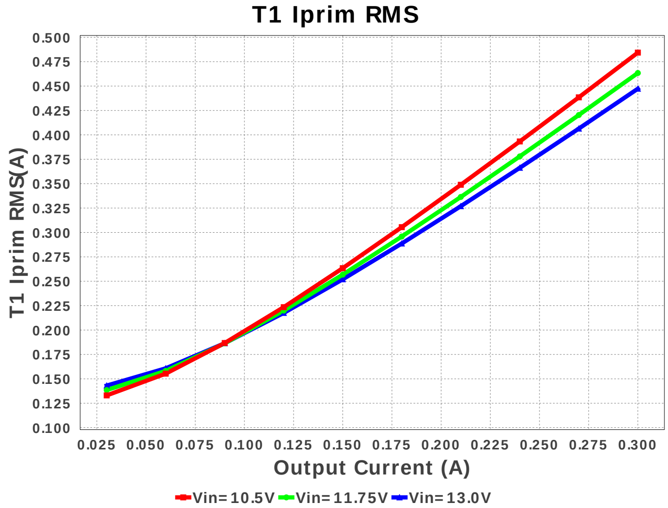

D1 Tj
D1 Tj(degC)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

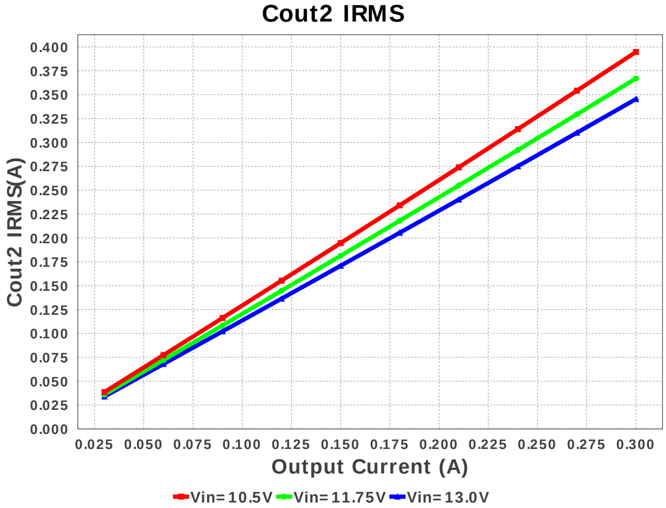

Vout Pri
Vout Pri(V)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

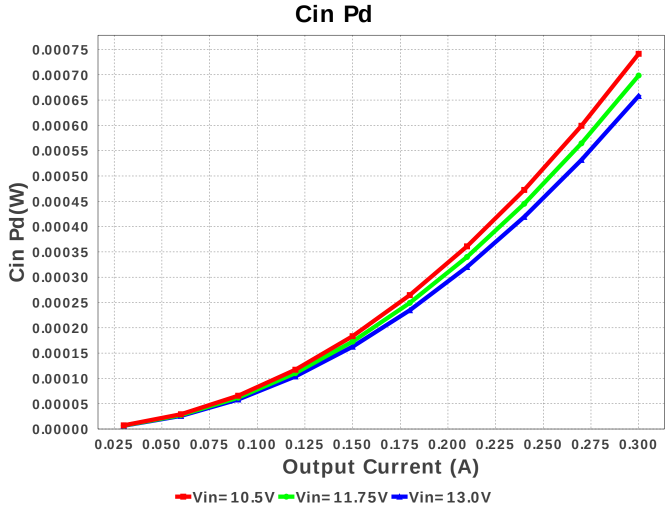

Efficiency
Efficiency(%)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

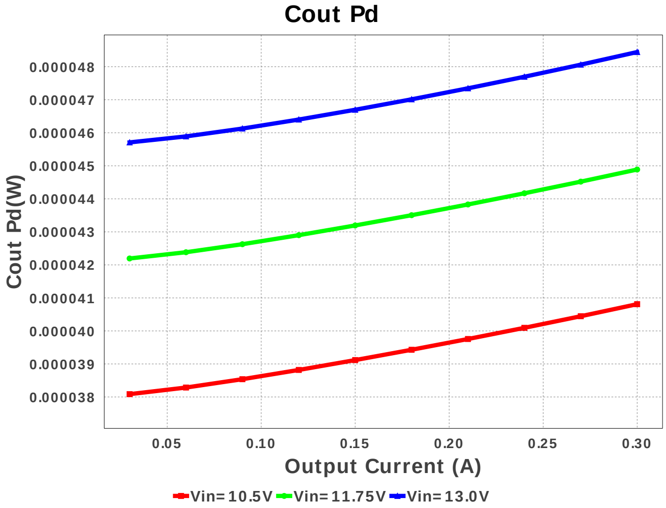

Vout Actual
Vout Actual(V)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

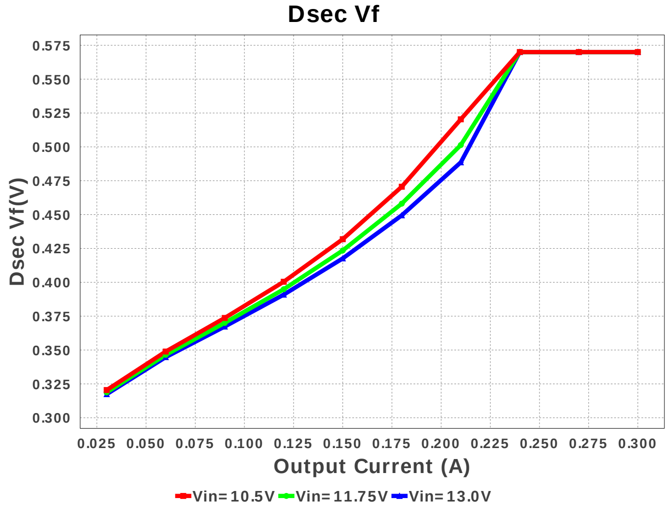

Ipri
Ipri(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

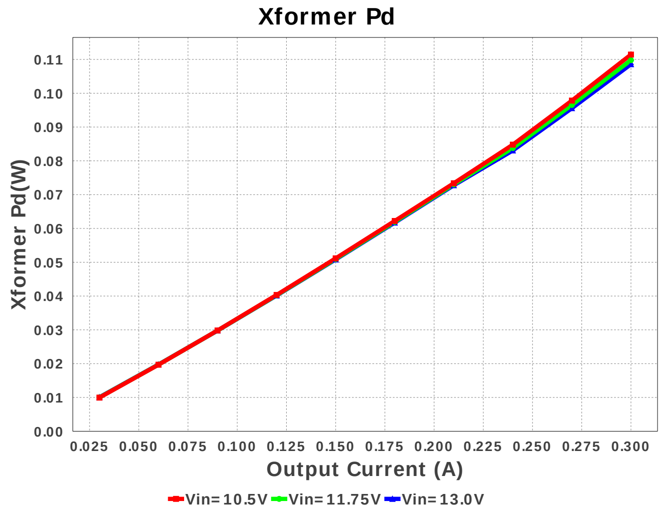

T1 Iprim RMS
T1 Iprim RMS(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

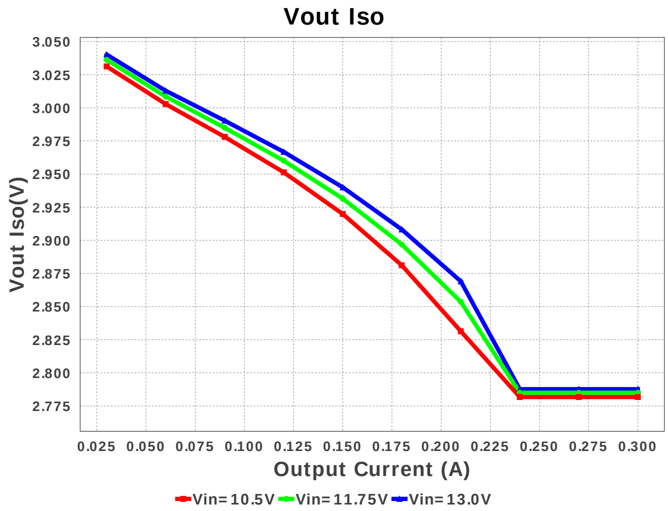

Cout2 IRMS
Cout2 IRMS(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

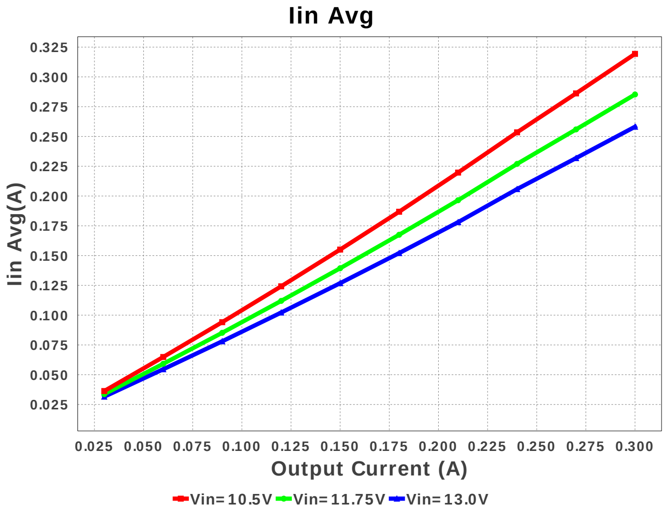

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

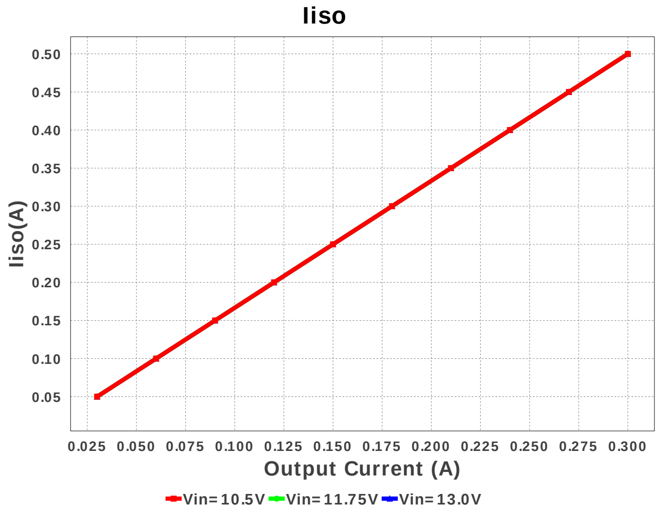

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

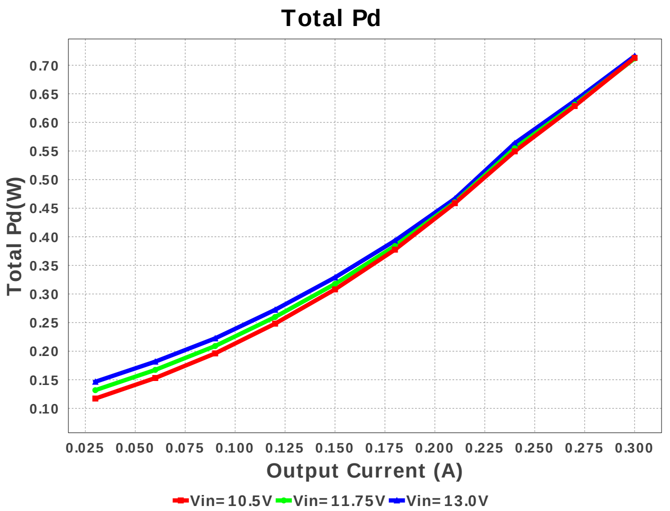

Dsec Vf
Dsec Vf(V)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

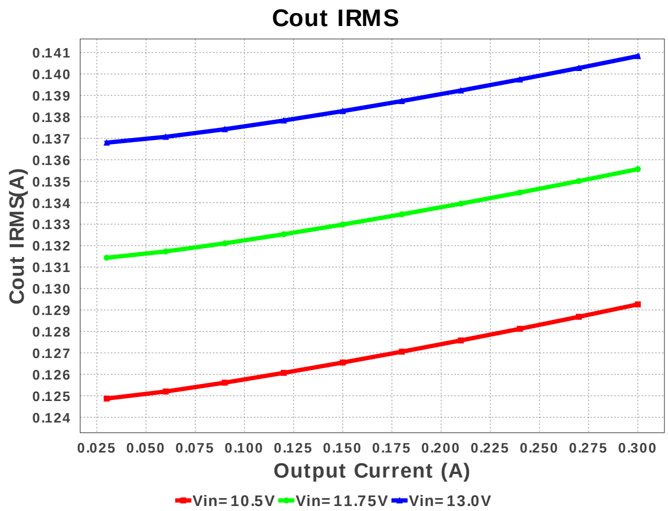

Xformer Pd
Xformer Pd(W)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

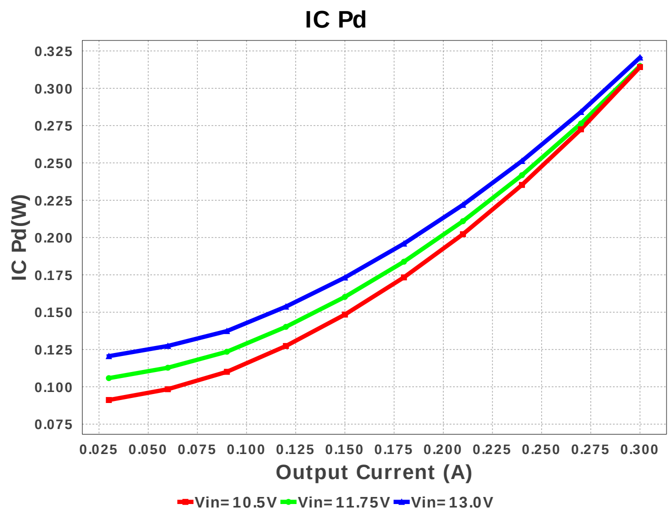

Vout Iso
Vout Iso(V)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

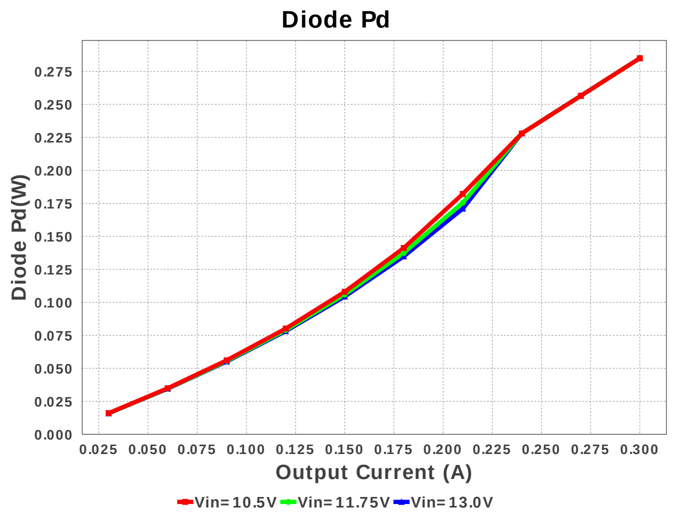

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V

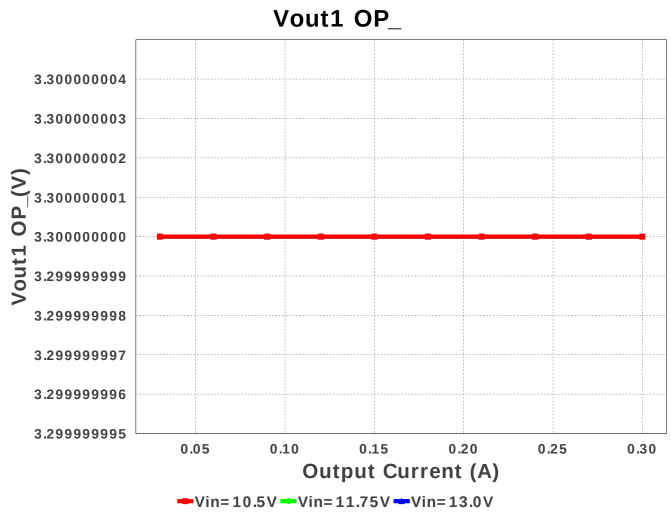

Iiso
Iiso(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V


Total Pd
Total Pd(W)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V


Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=10.5V Vin=11.75V Vin=13.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	356.905 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	140.834 mA	Current	Output capacitor RMS ripple current
3.	Cout2 IRMS	345.437 mA	Current	Output capacitor2 RMS ripple current
4.	IC Ipk	1.044 A	Current	Peak switch current in IC
5.	Iin Avg	238.86 mA	Current	Average input current
6.	Iiso	500.0 mA	Current	Secondary Side Output Current
7.	Ipri	906.061 mA	Current	Primary Side Output Current
8.	T1 Iprim RMS	447.285 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	1.044 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	677.709 mA	Current	Transformer Secondary1 RMS Current
11.	BOM Count	19	General	Total Design BOM count
12.	Dsec Vf	570.0 mV	General	Effective Forward Voltage Drop at the Operating Current
13.	FootPrint	357.0 mm^2	General	Total Foot Print Area of BOM components
14.	Frequency	542.021 kHz	General	Switching frequency
15.	Total BOM	$3.25	General	Total BOM Cost
16.	D1 Tj	144.05 degC	Op_Point	D1 junction temperature
17.	Vout Actual	3.3 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
18.	Duty Cycle	27.424 %	Op_point	Duty cycle
19.	Efficiency	76.944 %	Op_point	Steady state efficiency
20.	IC Tj	60.707 degC	Op_point	IC junction temperature
21.	ICThetaJA	33.4 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT1_OP	300.0 mA	Op_point	Iout1 operating point
23.	IOUT2_OP	500.0 mA	Op_point	Iout2 operating point
24.	VIN_OP	13.0 V	Op_point	Vin operating point
25.	Vout Iso	2.788 V	Op_point	Secondary Side Output Voltage
26.	Vout Pri	3.358 V	Op_point	Primary Side Output Voltage
27.	Vout2 OP	3.3 V	Op_point	Operational Voltage 2
28.	Cin Pd	658.05 µW	Power	Input capacitor power dissipation
29.	Cout Pd	48.445 µW	Power	Output capacitor power dissipation
30.	Cout2 Pd	1.074 mW	Power	Output capacitor2 power dissipation
31.	Diode Pd	285.0 mW	Power	Diode power dissipation

#	Name	Value	Category	Description
32.	IC Pd	320.568 mW	Power	IC power dissipation
33.	Total Pd	715.93 mW	Power	Total Power Dissipation
34.	Xformer Pd	108.586 mW	Power	Transformer power dissipation
35.	Vout Tolerance	2.056 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	Vout1 OP	3.3 V		Operational Voltage 1

Design Inputs

#	Name	Value	Description
1.	Iout	300.0 m	Maximum Output Current
2.	Iout1	300.0 m	Output Current #1
3.	Iout2	500.0 m	Output Current #2
4.	VinMax	13.0	Maximum input voltage
5.	VinMin	10.5	Minimum input voltage
6.	Vout	3.3	Output Voltage
7.	Vout1	3.3	Output Voltage #1
8.	Vout2	3.3	Output Voltage #2
9.	base_pn	LM5161	Base Product Number
10.	source	DC	Input Source Type
11.	Ta	50.0	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. **LM5161** Product Folder : http://www.ti.com/product/LM5161 : contains the data sheet and other resources.