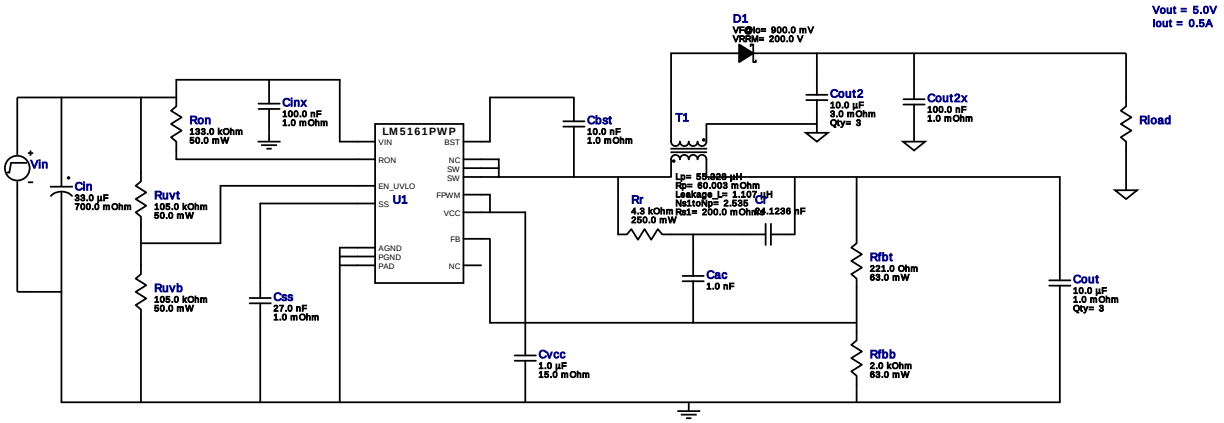
VinMin = 5.0V
VinMax = 60.0V
Vout = 5.0V
Iout = 0.5A

Device = LM5161PWPR
Topology = Flyback
Created = 2021-09-09 06:43:17.448
BOM Cost = NA
BOM Count = 23
Total Pd = 0.82W

WEBENCH® Design Report

Design : 14301 LM5161PWPR
LM5161PWPR 5V-60V to 2.22V @ 1.267728A

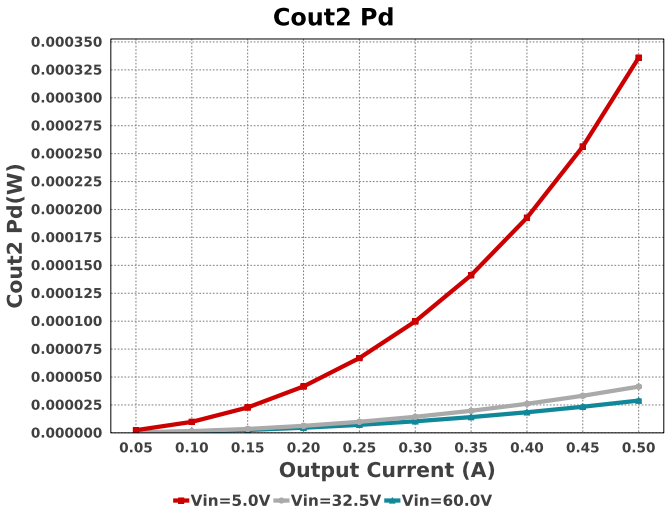


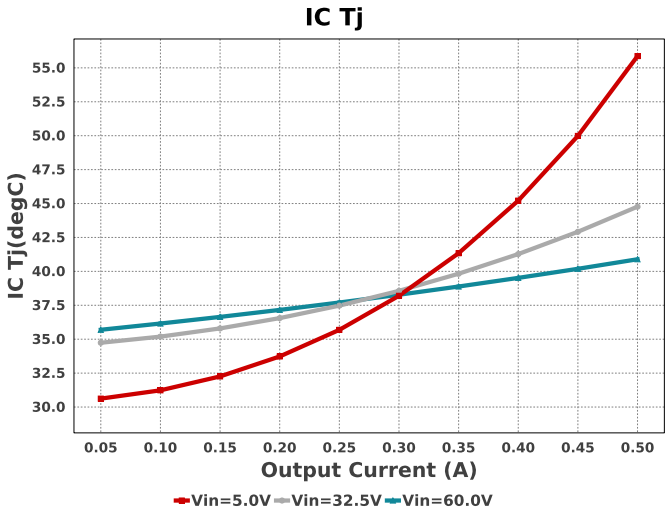
1. Feedback Resistors may need to be further adjusted to get more precise regulation as ripple injection circuit will introduce some amount of DC offset. Use simulation to help adjust.

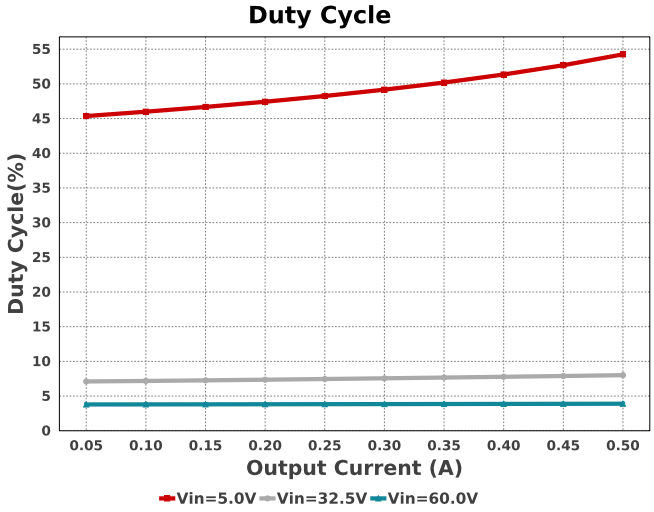
Electrical BOM

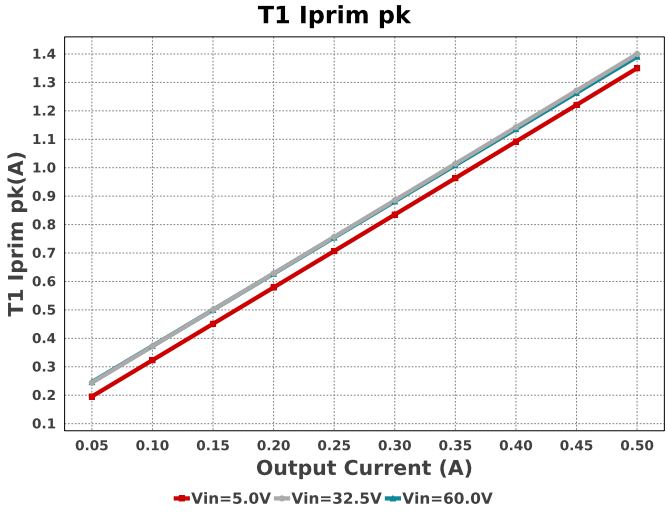
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cac	Kemet	C1812C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF VDC= 5.0 V IRMS= 0.0 A	1	$0.36	1812 23 mm²
Cac	Kemet	C1812C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF VDC= 5.0 V IRMS= 0.0 A	1	$0.36	1812 23 mm²
Cbst	MuRata	GRM155R71H103KA88D Series= X7R	Cap= 10.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	Panasonic	EEE-FK2A330P Series= FK	Cap= 33.0 uF ESR= 700.0 mOhm VDC= 100.0 V IRMS= 200.0 mA	1	$0.25	SM_RADIAL_G 172 mm²
Cinx	TDK	C2012X7T2E104K125AA Series= X7T	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 250.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm²
Cout	MuRata	GRM155R60G106ME44D Series= X5R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 4.0 V IRMS= 6.0 A	3	$0.03	0402_070 3 mm²
Cout2	Kemet	C0805C106K8PACTU Series= X5R	Cap= 10.0 uF ESR= 3.0 mOhm VDC= 10.0 V IRMS= 11.43 A	3	$0.03	0805 7 mm²
Cout2x	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cout2x	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²

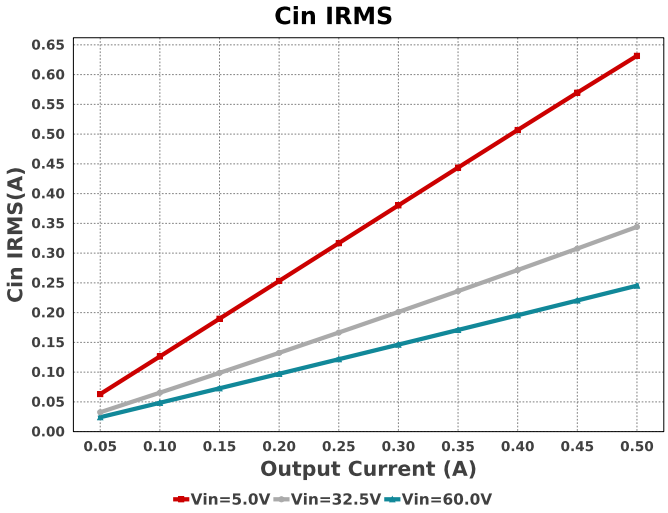
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cr	CUSTOM	CUSTOM Series= ?	Cap= 24.1236 nF VDC= 0.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
Cr	CUSTOM	CUSTOM Series= ?	Cap= 24.1236 nF VDC= 0.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm^2
Css	MuRata	GRM155R71C273KA01D Series= X7R	Cap= 27.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cvcc	Kemet	C0805C105K4RACTU Series= X7R	Cap= 1.0 uF ESR= 15.0 mOhm VDC= 16.0 V IRMS= 8.19 A	1	$0.02	0805 7 mm^2
D1	SMC Diode Solutions	SK220ATR	VF@Io= 900.0 mV VRRM= 200.0 V	1	$0.04	SMA 37 mm^2
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
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
Rfbt	Vishay-Dale	CRCW0402221RFKED Series= CRCW..e3	Res= 221.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Vishay-Dale	CRCW0402221RFKED Series= CRCW..e3	Res= 221.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Ron	Yageo	RC0201FR-07133KL Series= ?	Res= 133.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Rr	Yageo	RC1206FR-074K3L Series= ?	Res= 4.3 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm^2
Rr	Yageo	RC1206FR-074K3L Series= ?	Res= 4.3 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm^2
Ruvb	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
Ruvt	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
T1	CUSTOM	CUSTOM	Lp= 55.328 µH Rp= 60.003 mOhm Leakage_L= 1.107 µH Ns1toNp= 2.535 Rs1= 200.0 mOhms	1	NA	CUSTOM 0 mm^2
U1	Texas Instruments	LM5161PWPR	Switcher	1	$1.74	PWP0014A_N 59 mm^2

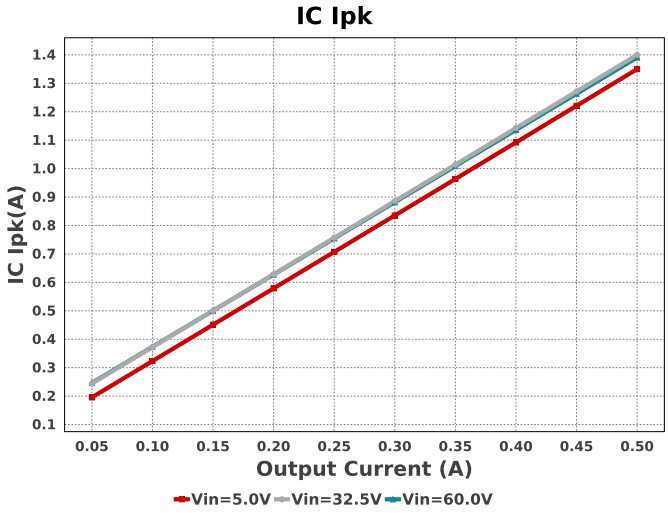


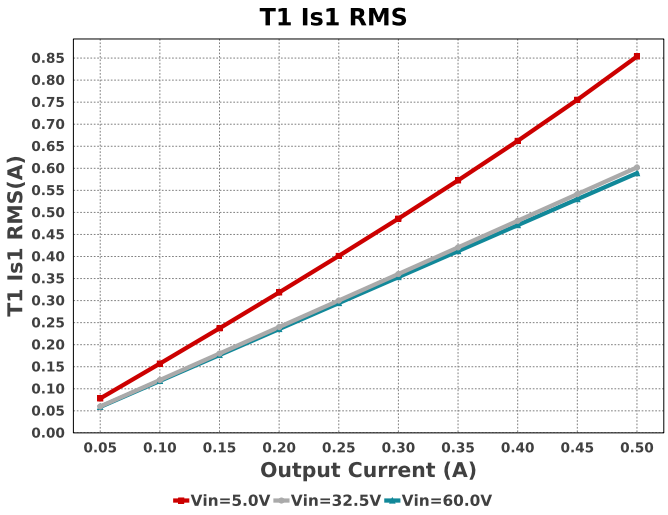


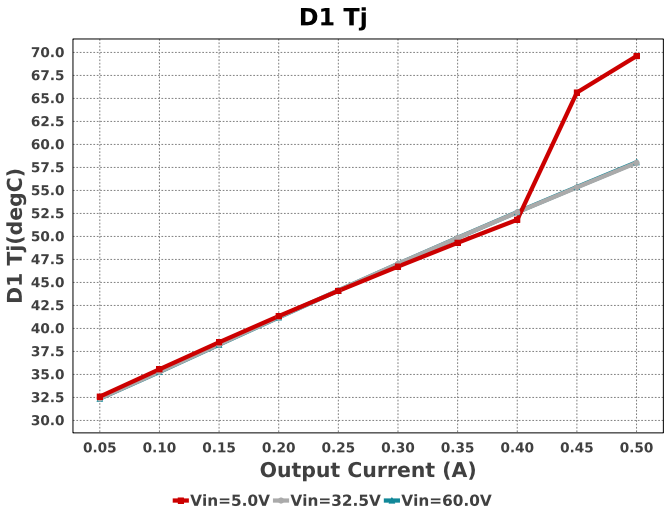


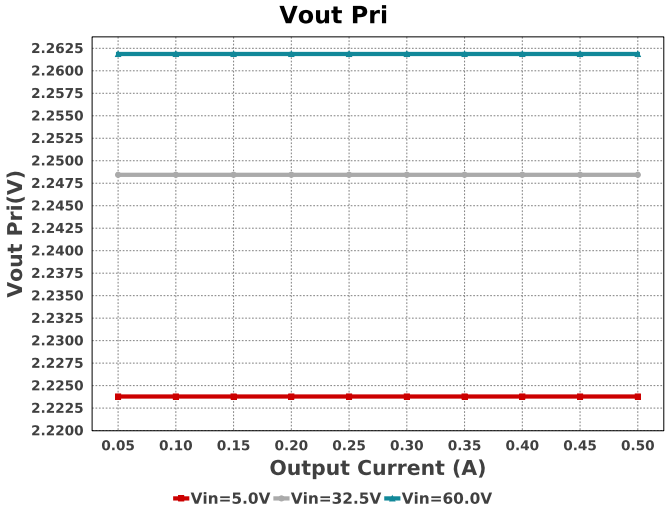


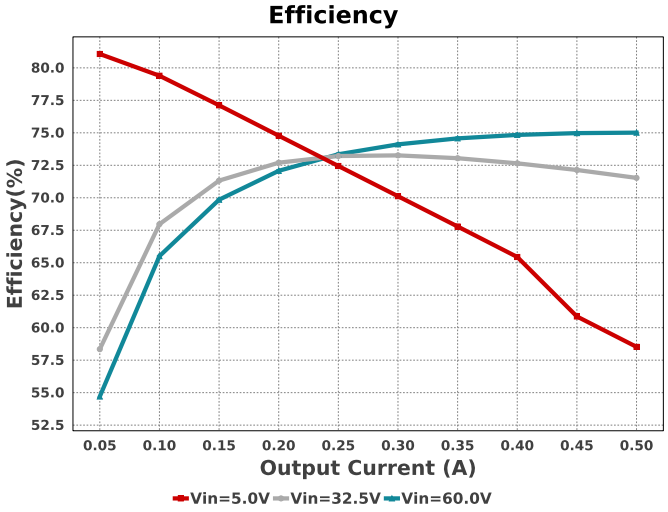


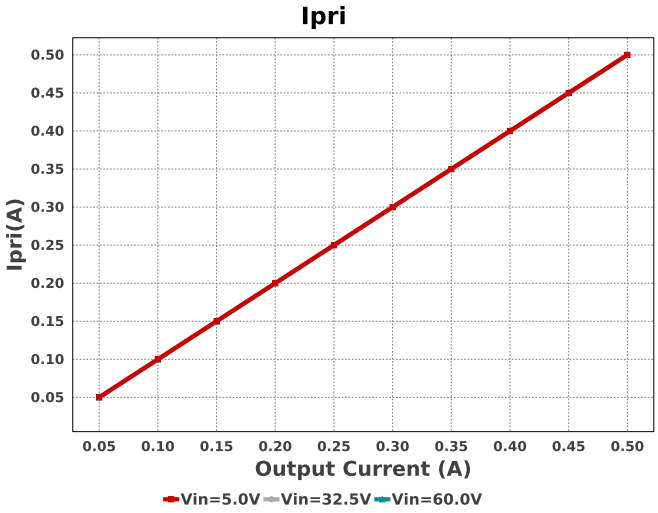


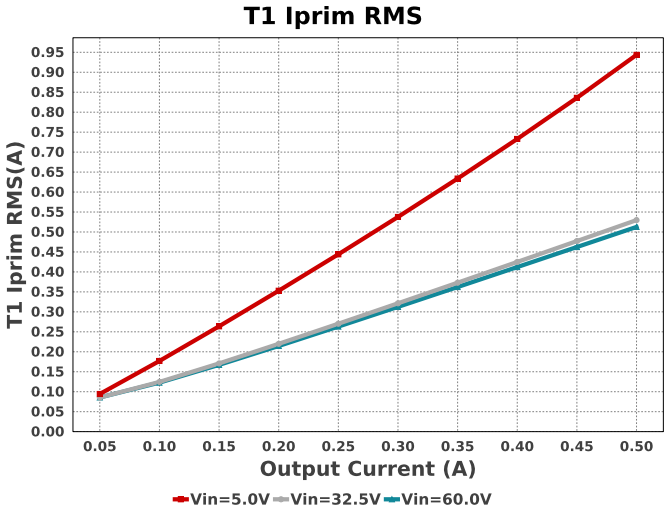


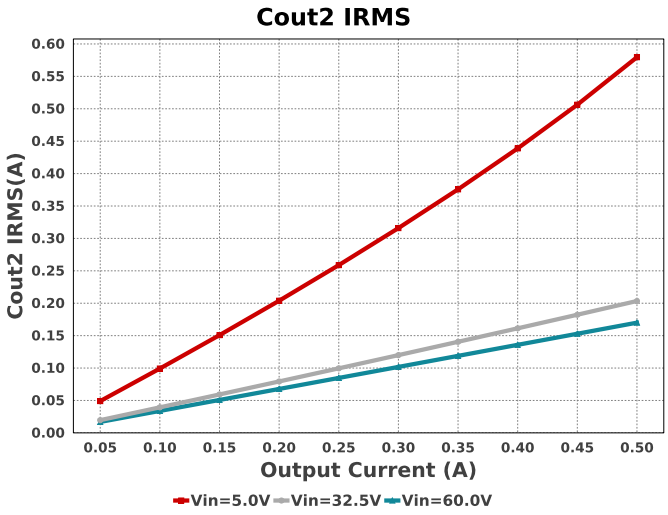


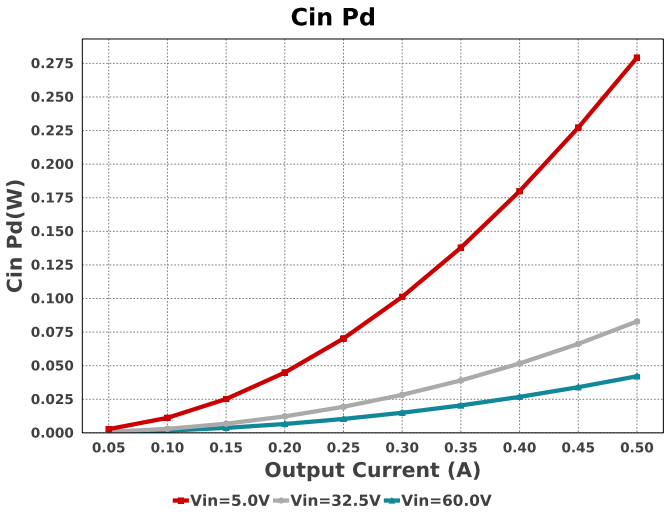


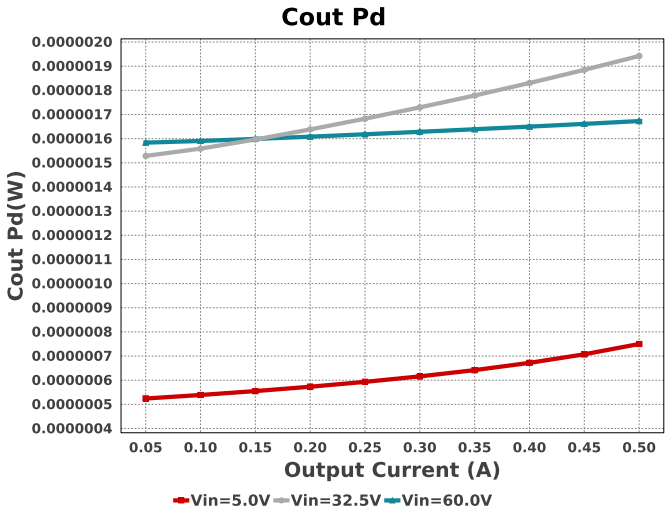


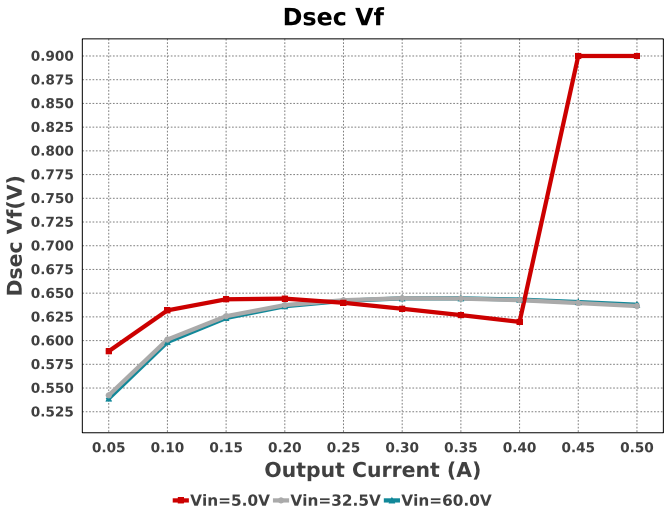


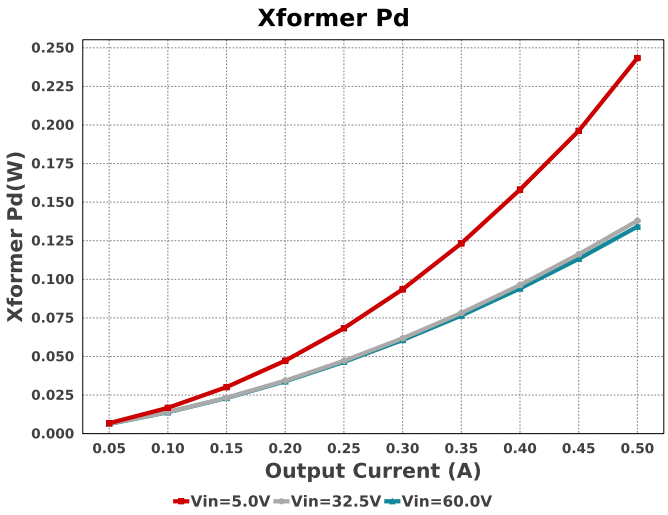


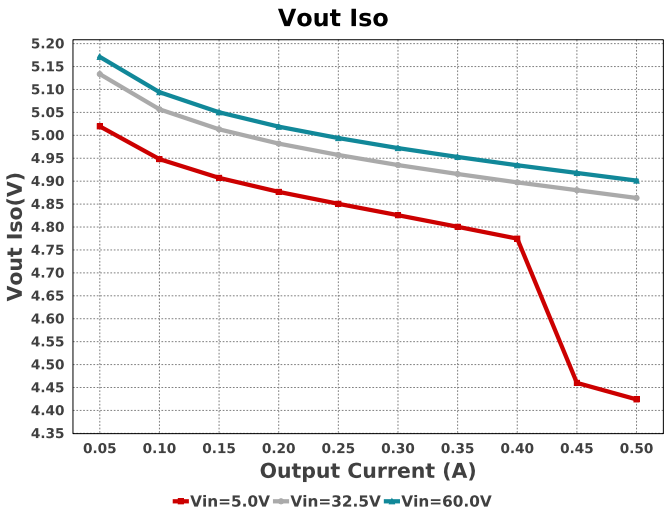


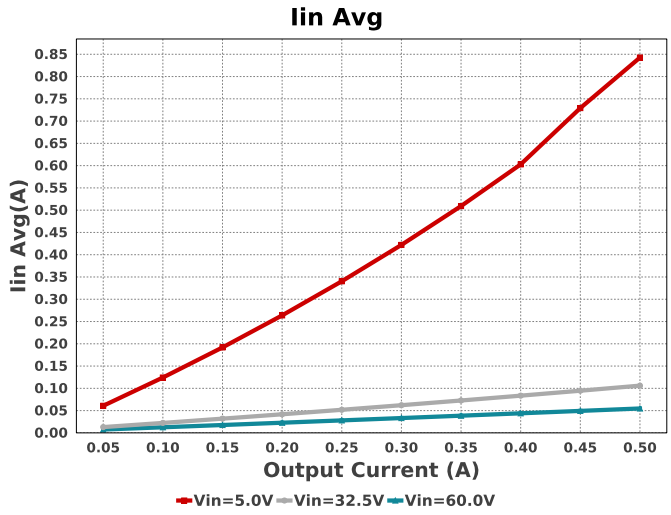


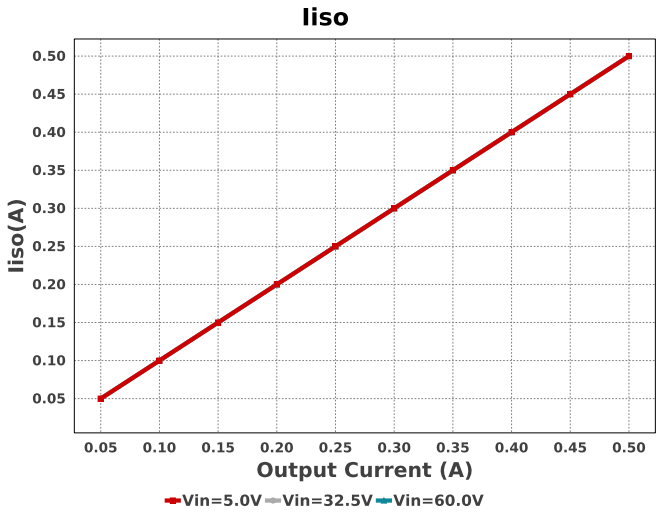


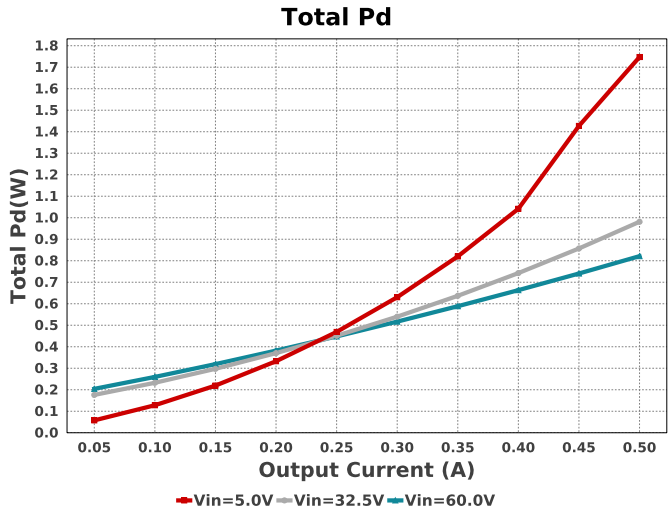


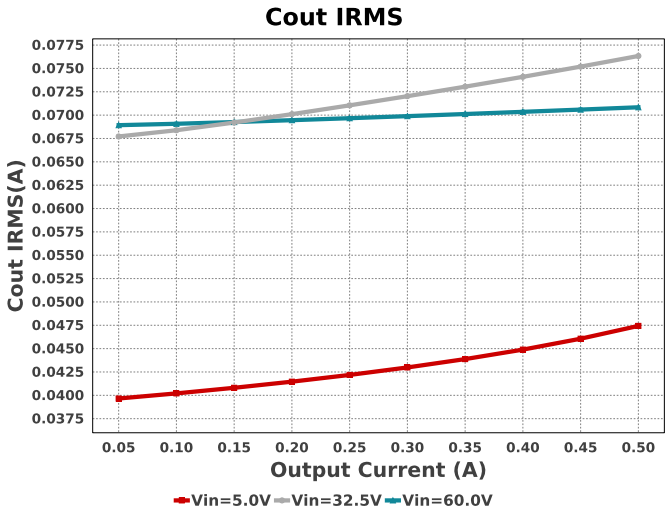


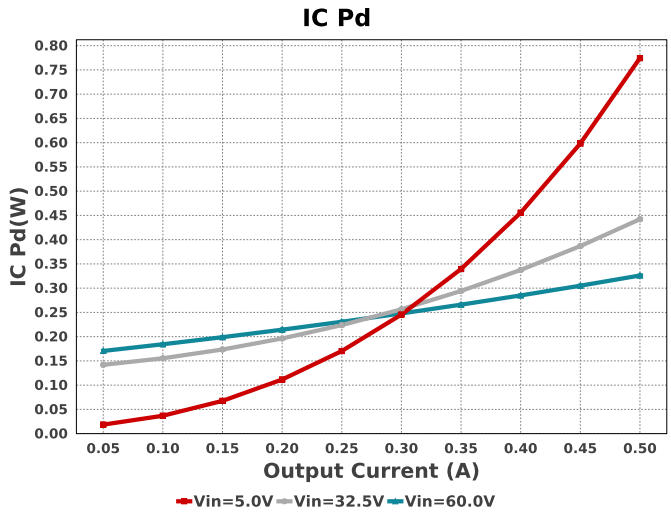


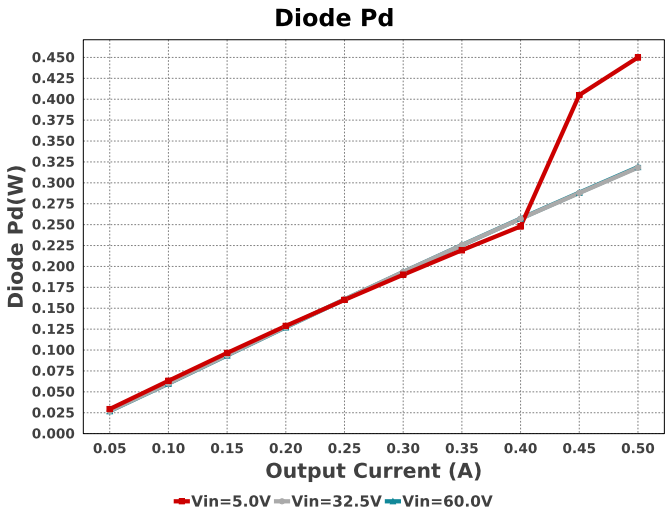












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	245.287 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	42.116 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	70.796 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	1.671 µW	Capacitor	Output capacitor power dissipation
5.	Cout2 IRMS	170.02 mA	Capacitor	Output capacitor2 RMS ripple current
6.	Cout2 Pd	28.907 µW	Capacitor	Output capacitor2 power dissipation
7.	Iiso	500.0 mA	Current	Secondary Side Output Current
8.	Ipri	500.0 mA	Current	Primary Side Output Current
9.	D1 Tj	58.063 degC	Diode	D1 junction temperature
10.	Diode Pd	318.9 mW	Diode	Diode power dissipation
11.	Dsec Vf	637.8 mV	Diode	Effective Forward Voltage Drop at the Operating Current

#	Name	Value	Category	Description
12.	IC Ipk	1.39 A	IC	Peak switch current in IC
13.	IC Pd	326.2 mW	IC	IC power dissipation
14.	IC Tj	40.895 degC	IC	IC junction temperature
15.	ICThetaJA	33.4 degC/W	IC	IC junction-to-ambient thermal resistance
16.	Iin Avg	53.719 mA	IC	Average input current
17.	Vout Iso	4.901 V	Op Point	Secondary Side Output Voltage
18.	Vout Pri	2.262 V	Op Point	Primary Side Output Voltage
19.	Cin Pd	42.116 mW	Power	Input capacitor power dissipation
20.	Cout Pd	1.671 µW	Power	Output capacitor power dissipation
21.	Cout2 Pd	28.907 µW	Power	Output capacitor2 power dissipation
22.	Diode Pd	318.9 mW	Power	Diode power dissipation
23.	IC Pd	326.2 mW	Power	IC power dissipation
24.	Total Pd	821.385 mW	Power	Total Power Dissipation
25.	Xformer Pd	134.14 mW	Power	Transformer power dissipation
26.	BOM Count	23	System Information	Total Design BOM count
27.	Duty Cycle	3.895 %	System Information	Duty cycle
28.	Efficiency	74.516 %	System Information	Steady state efficiency
29.	FootPrint	376.0 mm^2	System Information	Total Foot Print Area of BOM components
30.	Frequency	165.758 kHz	System Information	Switching frequency
31.	Iout	1.268 A	System Information	Iout operating point
32.	Total BOM	NA	System Information	Total BOM Cost
33.	Vin	60.0 V	System Information	Vin operating point
34.	Vout Actual	2.221 V	System Information	Vout Actual calculated based on selected voltage divider resistors
35.	Vout Tolerance	1.454 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
36.	T1 Iprim RMS	512.603 mA	Transformer	Transformer Primary RMS Current
37.	T1 Iprim pk	1.39 A	Transformer	Transformer Primary Peak Current
38.	T1 Is1 RMS	588.935 mA	Transformer	Transformer Secondary1 RMS Current
39.	Xformer Pd	134.14 mW	Transformer	Transformer power dissipation

Design Inputs

Name	Value	Description
Iout	500.0 m	Maximum Output Current
VinMax	60.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	5.0	Output Voltage
base_pn	LM5161	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

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. Master key : 1B0CCE6EBD53FA1F[v1]

3. **LM5161** Product Folder : http://www.ti.com/product/LM5161 : contains the data sheet and other resources.