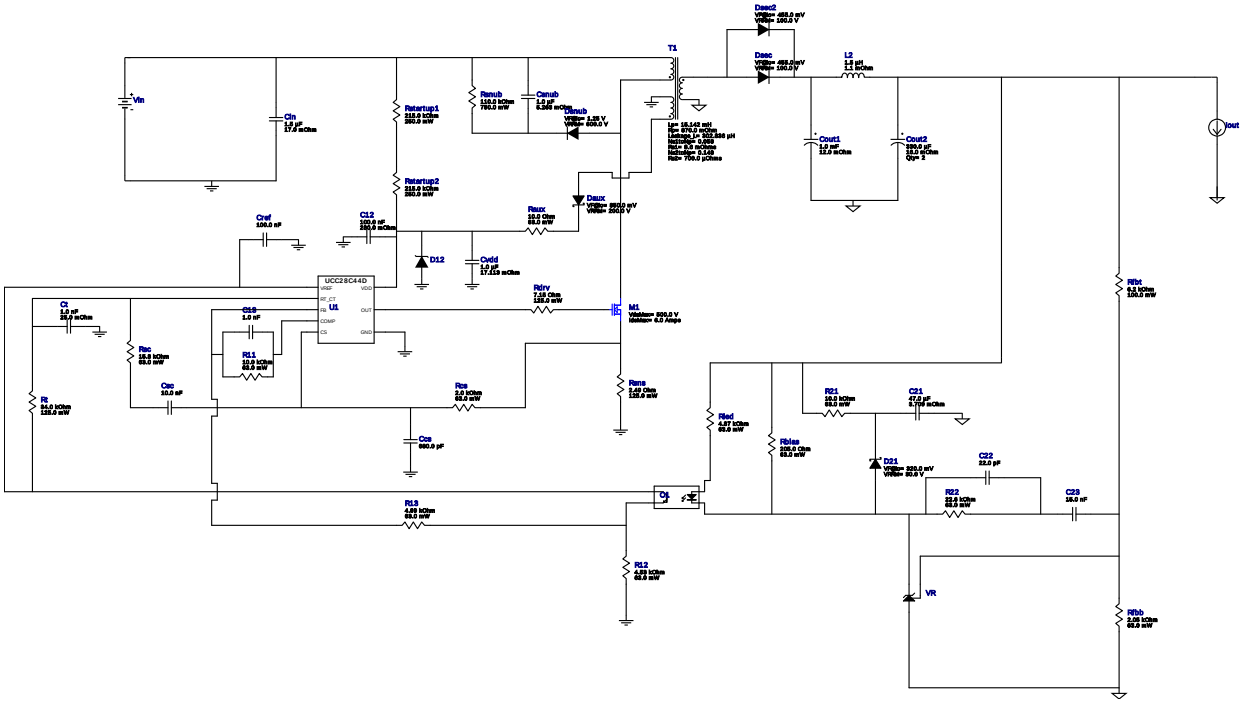
TEXAS INSTRUMENTS

WEBENCH® Design Report

VinMin = 150.0V
VinMax = 280.0V
Vout = 5.0V
Iout = 2.0A

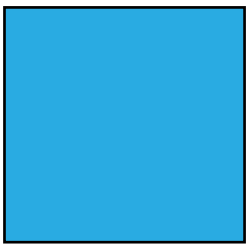
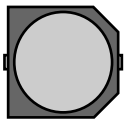
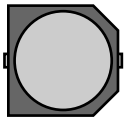
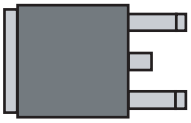
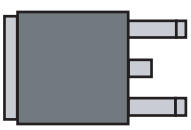
Device = UCC28C44DR
Topology = Flyback
Created = 7/12/16 12:11:41 AM
BOM Cost = $0.00
BOM Count = 45
Total Pd = 0.0W

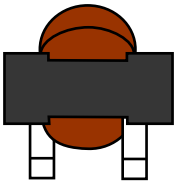
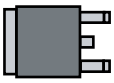
Design : 4354914/13 UCC28C44DR
UCC28C44DR 150.0V-280.0V to 5.00V @ 2.0A



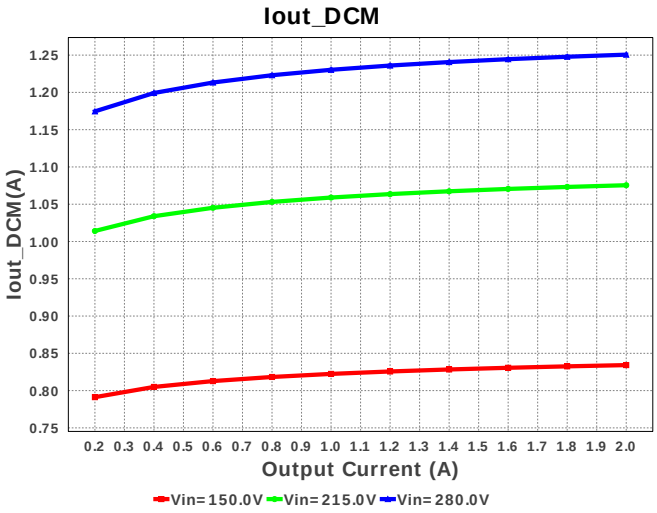
Electrical BOM

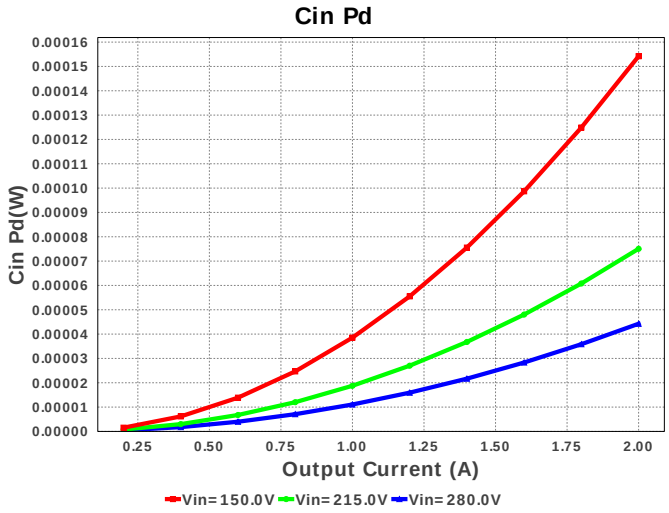
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
2.	C13	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
3.	C21	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	1	$0.15	1206_190 11 mm^2
4.	C22	Kemet	C0805C220K3GACTU Series= C0G/NP0	Cap= 22.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
5.	C23	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
6.	Ccs	MuRata	GRM033R71C681KA01D Series= X7R	Cap= 680.0 pF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2

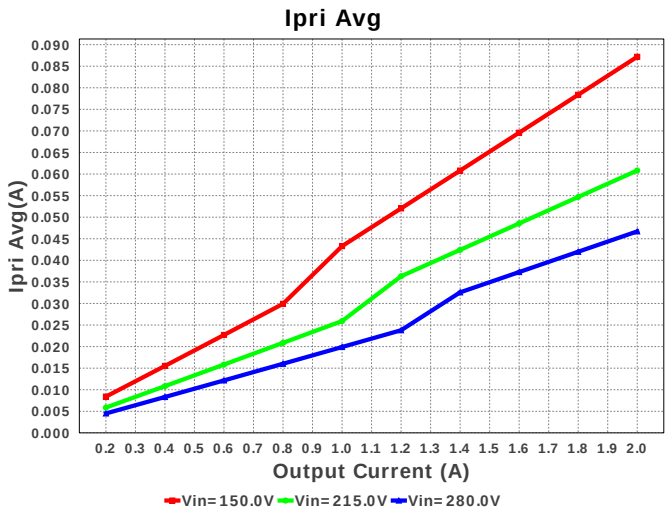
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cin	TDK	B32923C3155M Series= B32923	Cap= 1.5 uF ESR= 17.0 mOhm VDC= 630.0 V IRMS= 146.0 mA	1	$0.19	 B32923_22mm 399 mm^2
8.	Cout1	Panasonic	16SVPF1000M Series= ?	Cap= 1.0 mF ESR= 12.0 mOhm VDC= 16.0 V IRMS= 5.4 A	1	$0.74	 CAPSMT_62_F12 151 mm^2
9.	Cout2	Panasonic	16SVP330M Series= SVP	Cap= 330.0 uF ESR= 16.0 mOhm VDC= 16.0 V IRMS= 4.72 A	2	$0.39	 SM_RADIAL_10AMM 160 mm^2
10.	Cref	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm^2
11.	Csc	MuRata	GRM033R60J103KA01D Series= X5R	Cap= 10.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	 0201 2 mm^2
12.	Csnub	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	$1.19	 2220 54 mm^2
13.	Ct	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	$0.01	 0805 7 mm^2
14.	Cvdd	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	$0.01	 0603 5 mm^2
15.	D12	Diodes Inc.	DFLZ18-7	Zener	1	$0.13	 PowerDI123 13 mm^2
16.	D21	Toshiba	CMS06	VF@Io= 320.0 mV VRRM= 30.0 V	1	$0.19	 M-FLAT 19 mm^2
17.	Daux	Diodes Inc.	DFLS1200-7	VF@Io= 850.0 mV VRRM= 200.0 V	1	$0.21	 PowerDI123 13 mm^2
18.	Dsec	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.33	 DDPAK 210 mm^2
19.	Dsec2	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	$1.33	 DDPAK 210 mm^2
20.	Dsnub	Diodes Inc.	MURS160-13-F	VF@Io= 1.25 V VRRM= 600.0 V	1	$0.11	 SMB 44 mm^2

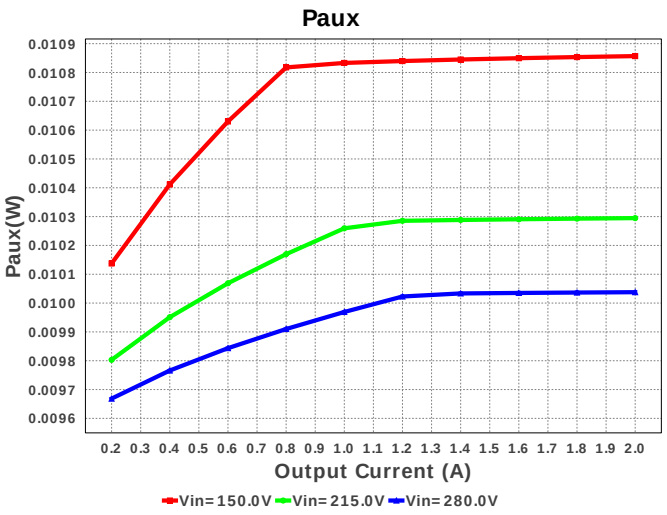
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
21.	L2	Coilcraft	SER1590-152MLB	L= 1.5 µH DCR= 1.1 mOhm	1	$1.12	 SER1590 324 mm^2
22.	M1	Fairchild Semiconductor	FDD6N50TM	VdsMax= 500.0 V IdsMax= 6.0 Amps	1	$0.47	 DPAK 102 mm^2
23.	O1	Vishay-Semiconductor	TCMT1109	Optocoupler	1	$0.21	 SOP-4 44 mm^2
24.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
25.	R12	Vishay-Dale	CRCW04024K53FKED Series= CRCW..e3	Res= 4.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
26.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
27.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
28.	R22	Vishay-Dale	CRCW040222K6FKED Series= CRCW..e3	Res= 22.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
29.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
30.	Rbias	Vishay-Dale	CRCW0402205RFKED Series= CRCW..e3	Res= 205.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
31.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
32.	Rdrv	Vishay-Dale	CRCW08057R15FKEA Series= CRCW..e3	Res= 7.15 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
33.	Rfbb	Vishay-Dale	CRCW04022K05FKED Series= CRCW..e3	Res= 2.05 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
34.	Rfbt	Yageo America	RC0603FR-076K2L Series= ?	Res= 6.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
35.	Rled	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
36.	Rsc	Vishay-Dale	CRCW040215K8FKED Series= CRCW..e3	Res= 15.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
37.	Rsns	Vishay-Dale	CRCW08052R49FKEA Series= CRCW..e3	Res= 2.49 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
38.	Rsnub	Vishay-Dale	CRCW2010110KFKEF Series= CRCW..e3	Res= 110.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	$0.03	 2010 32 mm^2
39.	Rstartup1	Panasonic	ERJ-8ENF2153V Series= ERJ-8E	Res= 215.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm^2

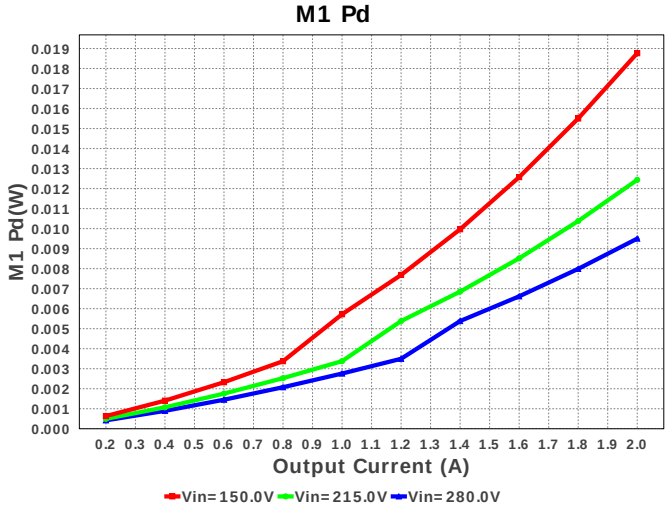
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
40.	Rstartup2	Panasonic	ERJ-8ENF2153V Series= ERJ-8E	Res= 215.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm^2
41.	Rt	Panasonic	ERJ-6ENF3402V Series= ERJ-6E	Res= 34.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
42.	T1	CUSTOM	CUSTOM	Lp= 15.142 mH Rp= 870.0 mOhm Leakage_L= 302.836 µH Ns1toNp= 0.058 Rs1= 8.6 mOhms Ns2toNp= 0.148 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm^2
43.	U1	Texas Instruments	UCC28C44DR	Switcher	1	$0.60	 D0008A 57 mm^2
44.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	$0.16	 R-PDSO-G3 16 mm^2

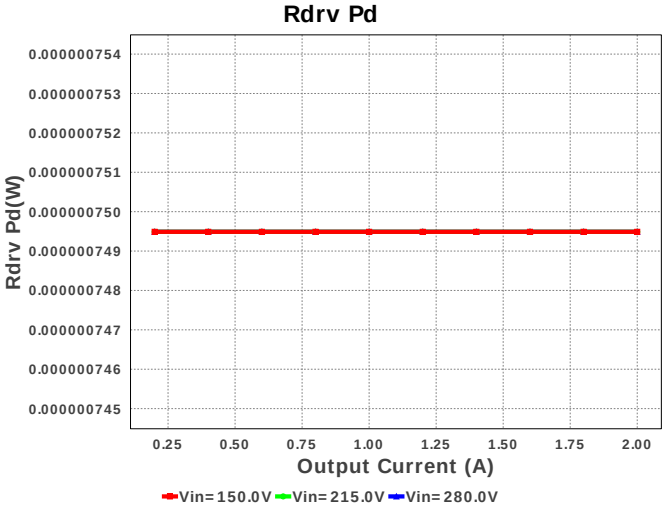


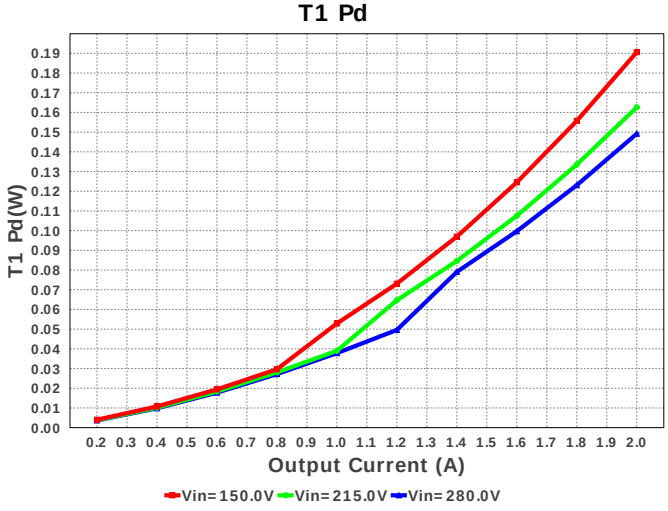


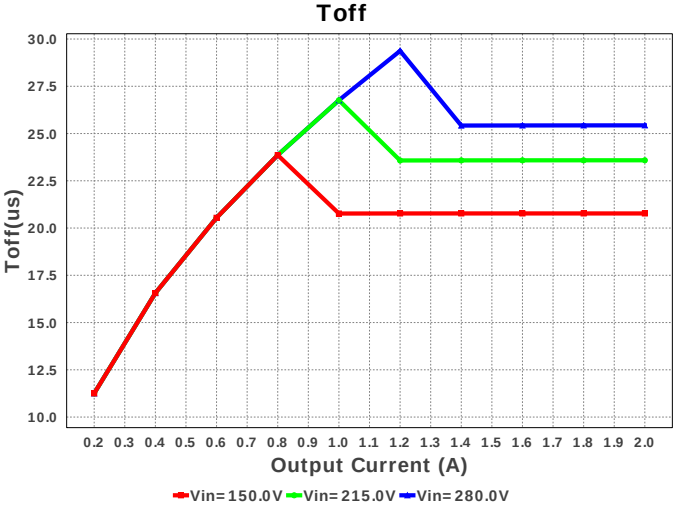


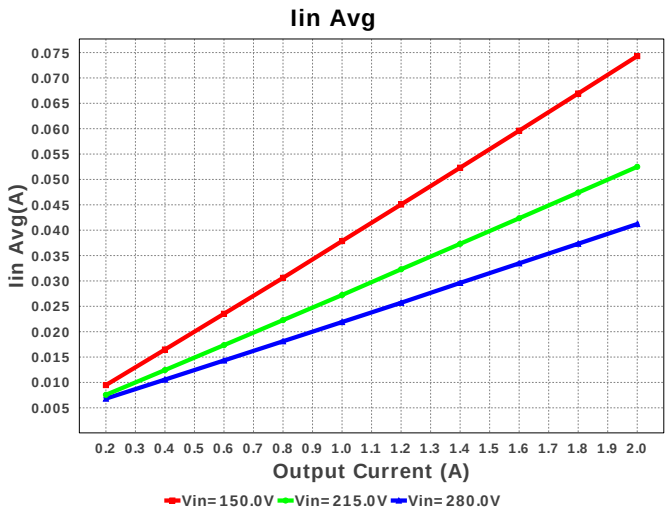


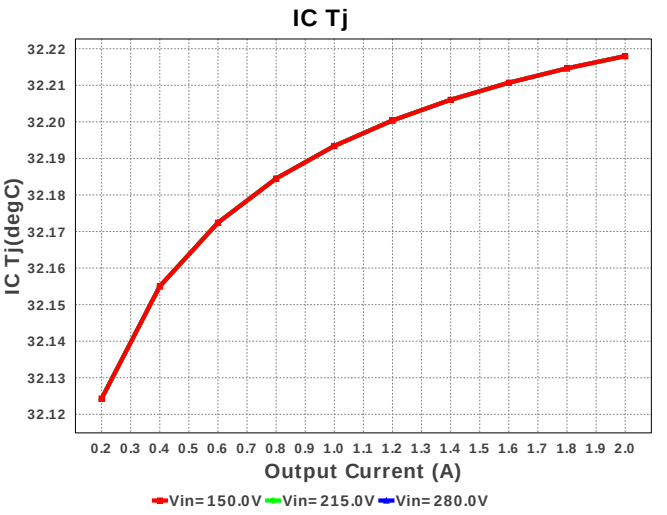


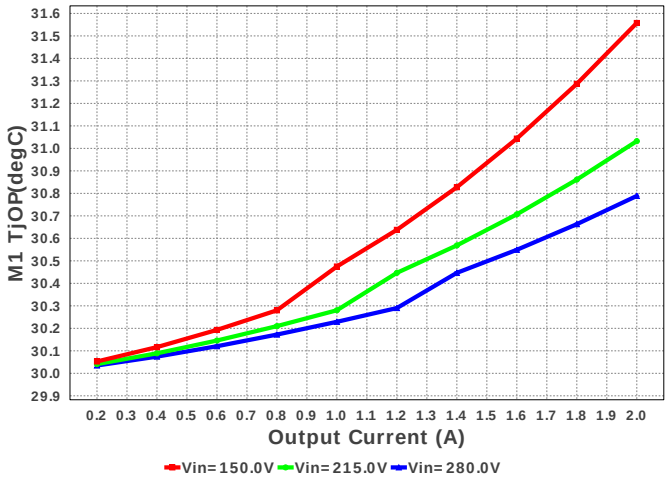


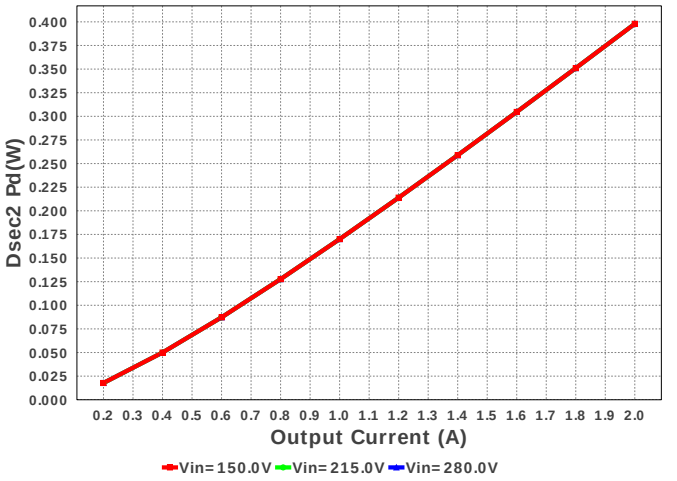


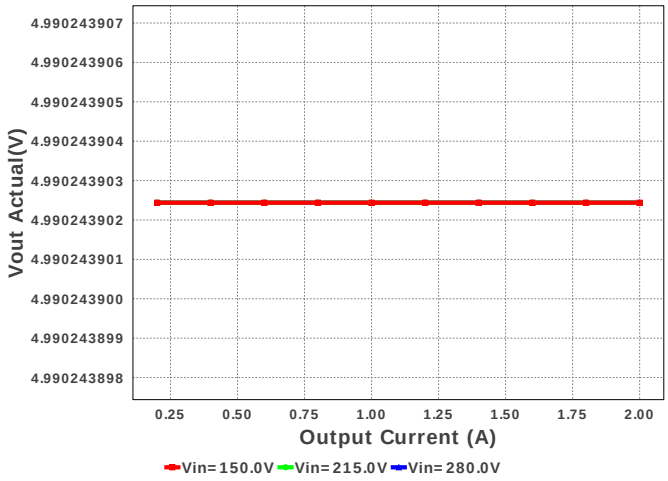


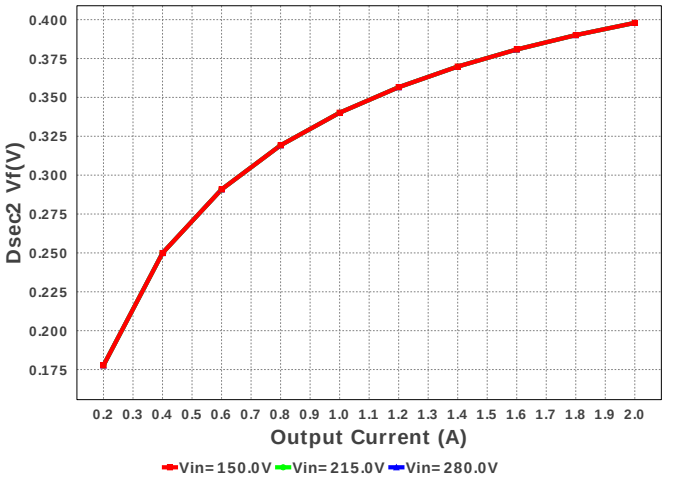


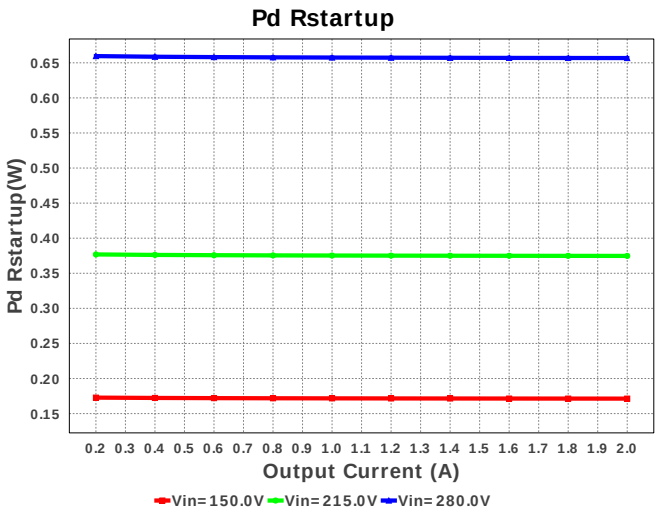


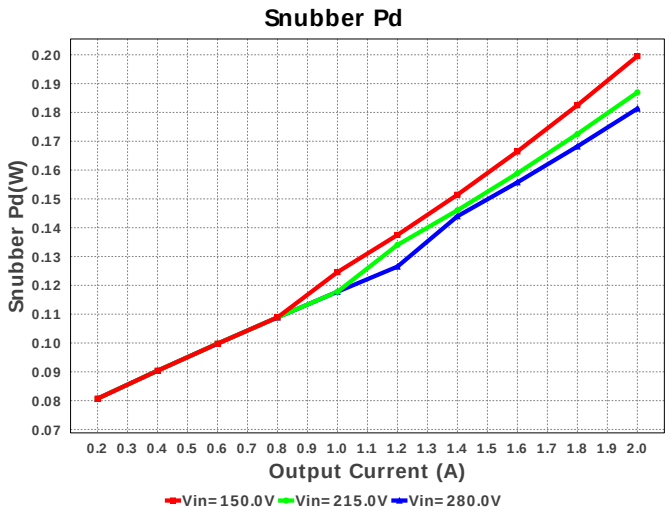


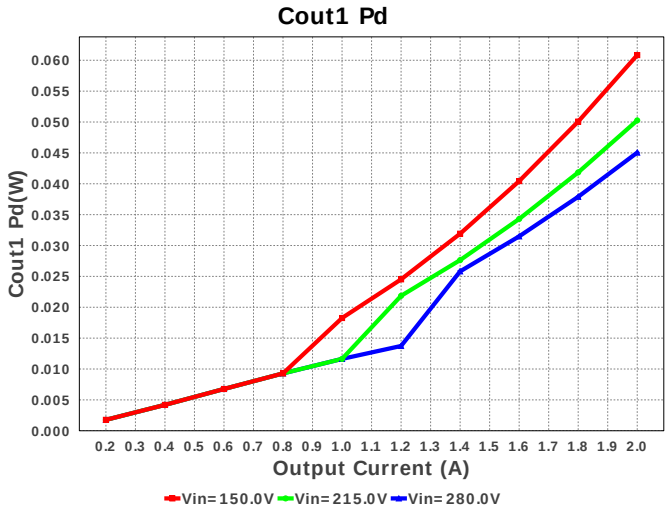


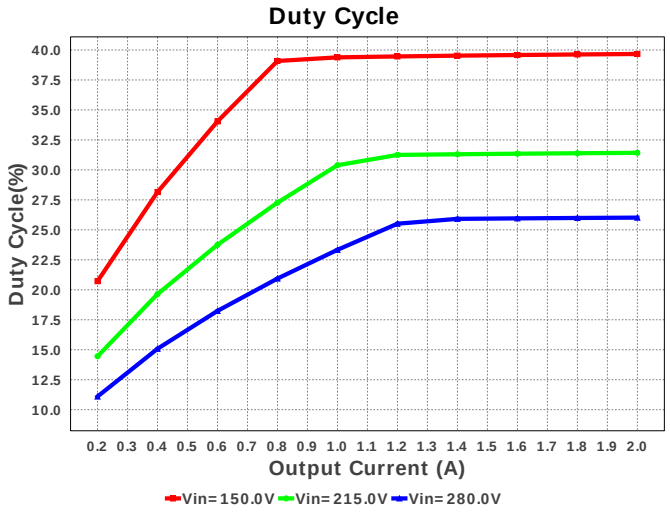


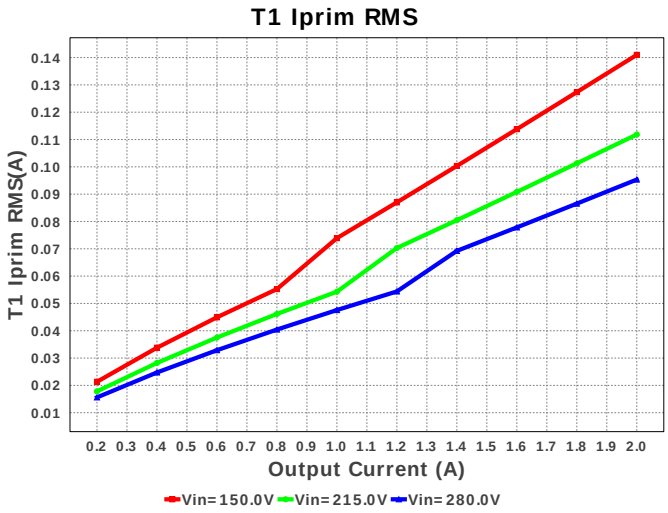


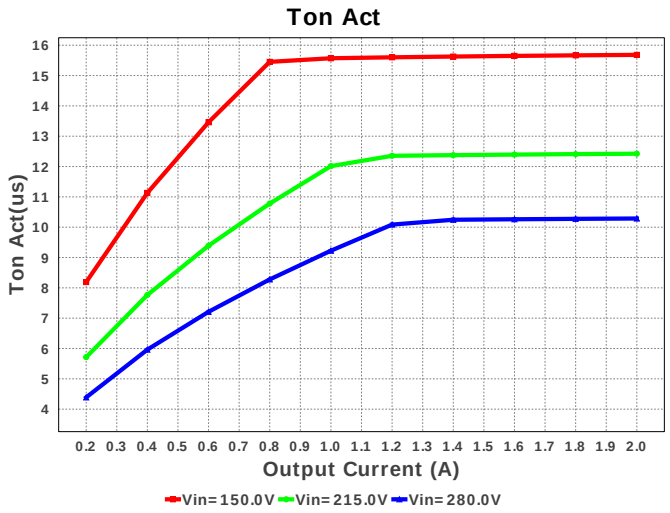


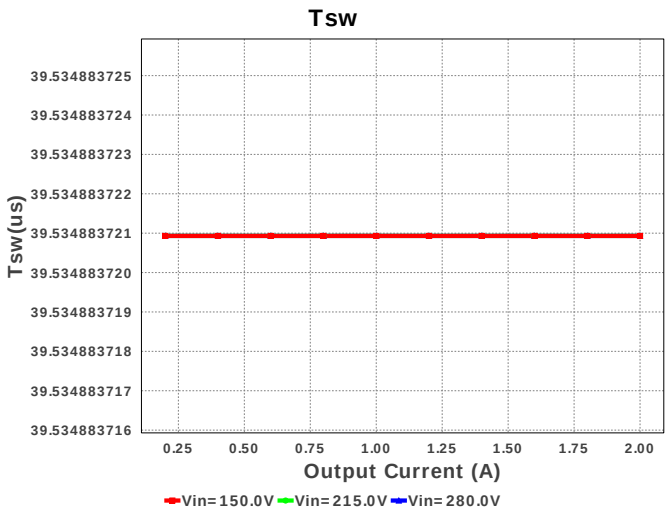


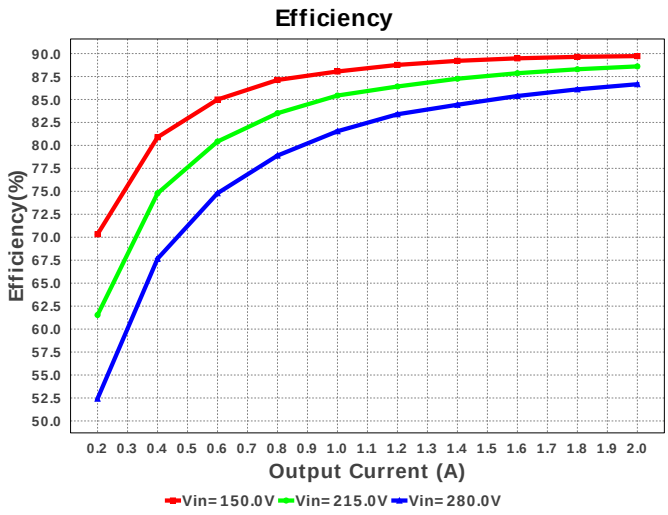


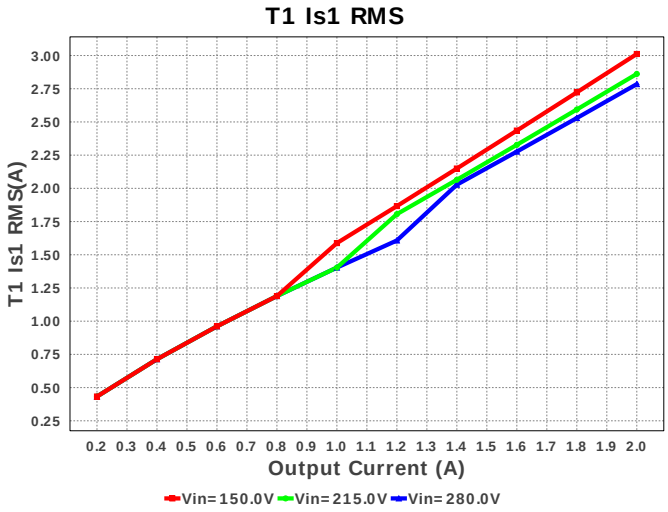


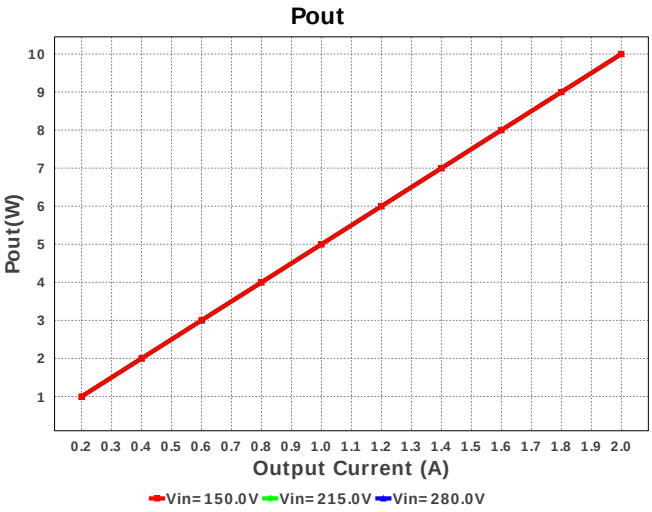


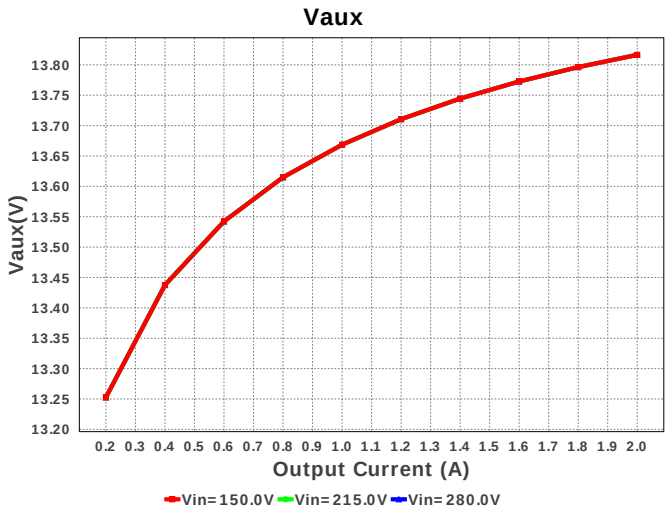


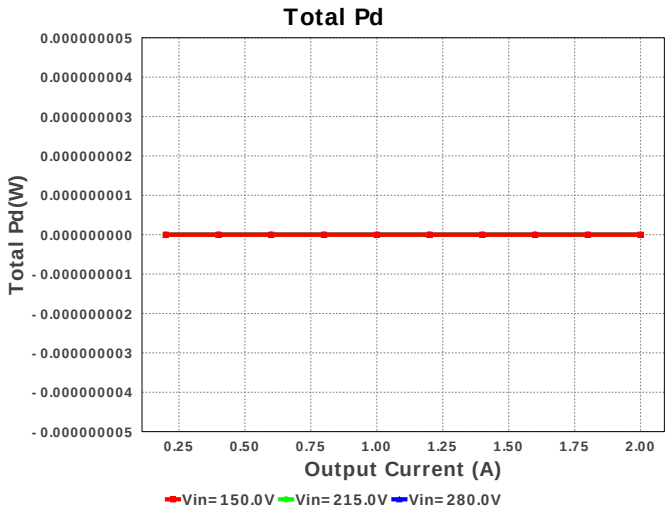


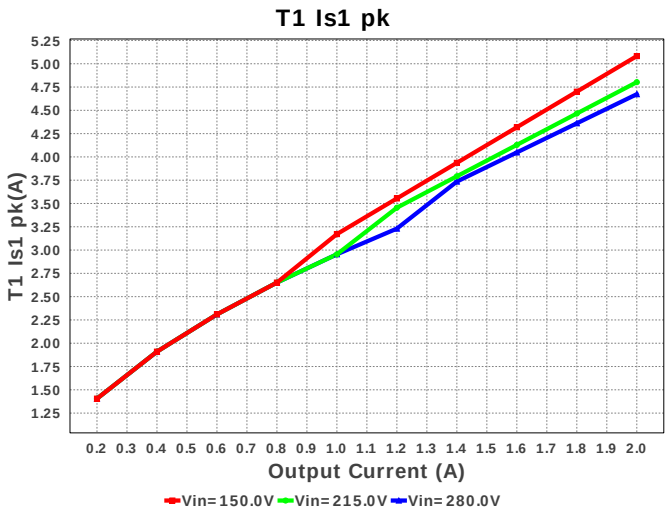


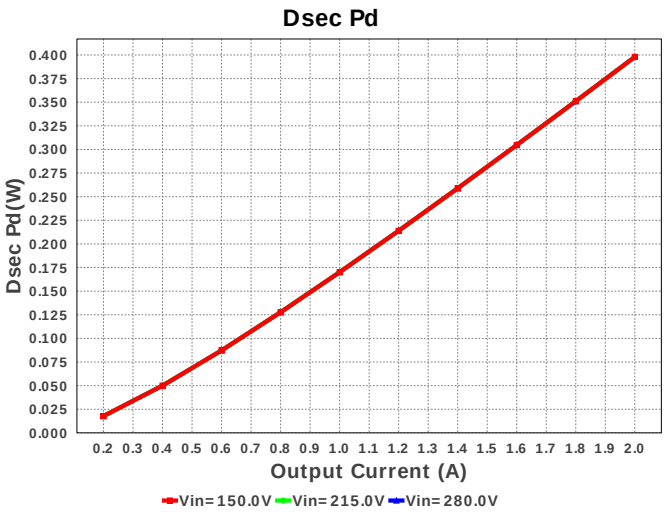


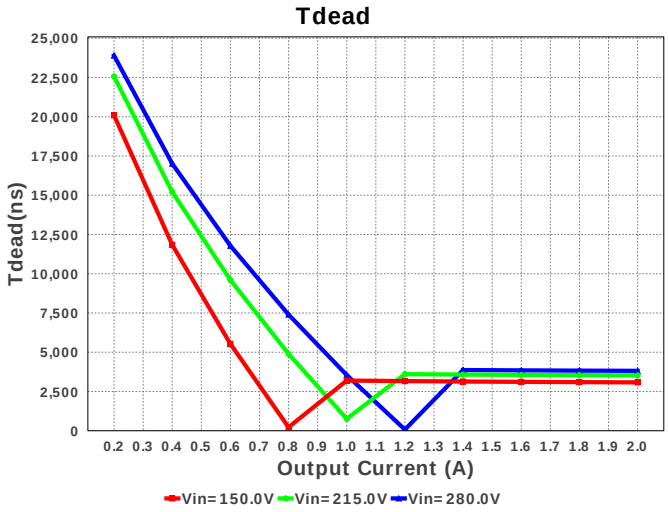


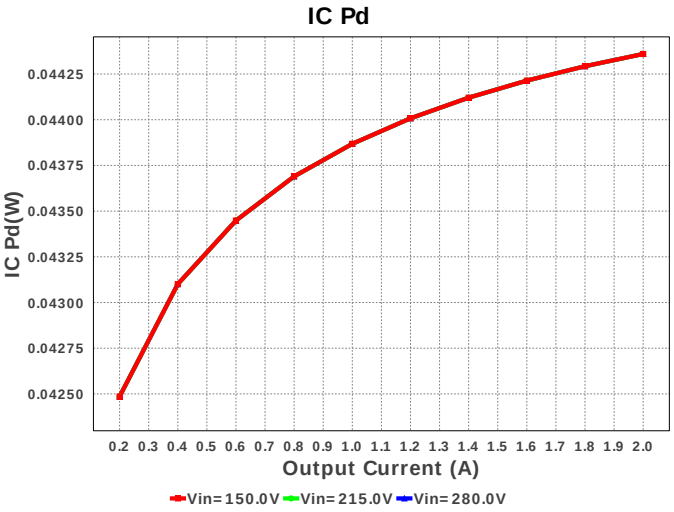


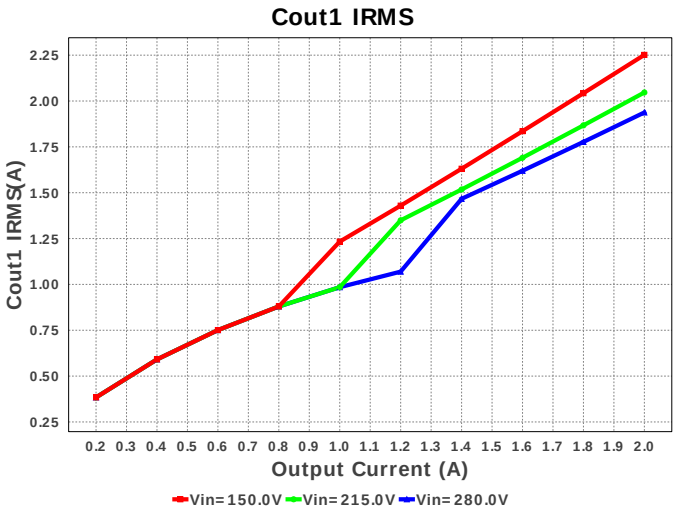


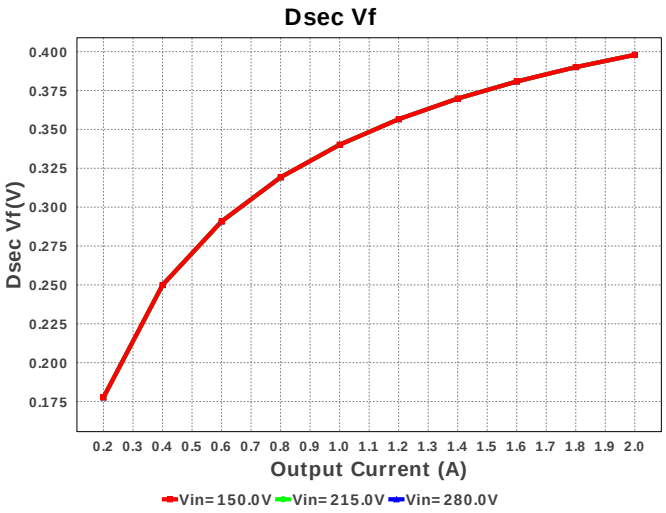


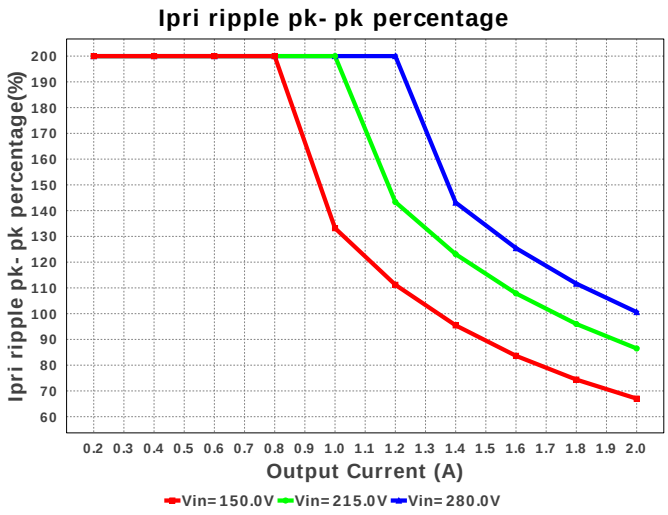


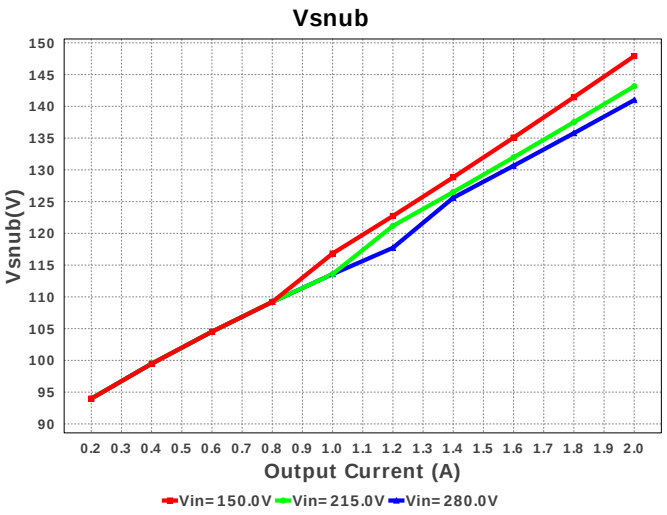


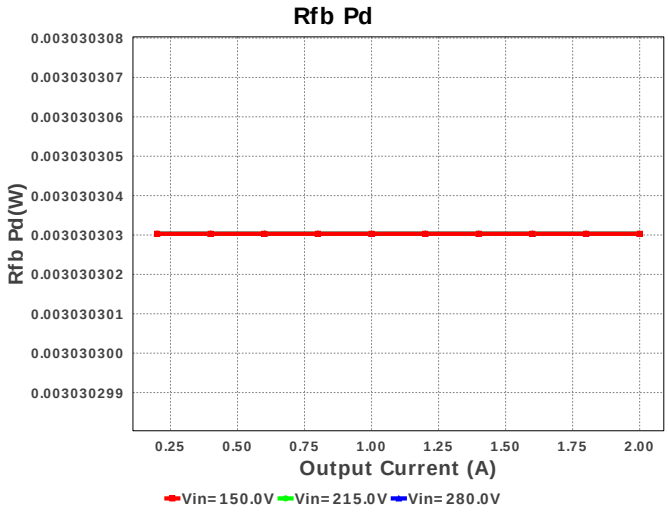


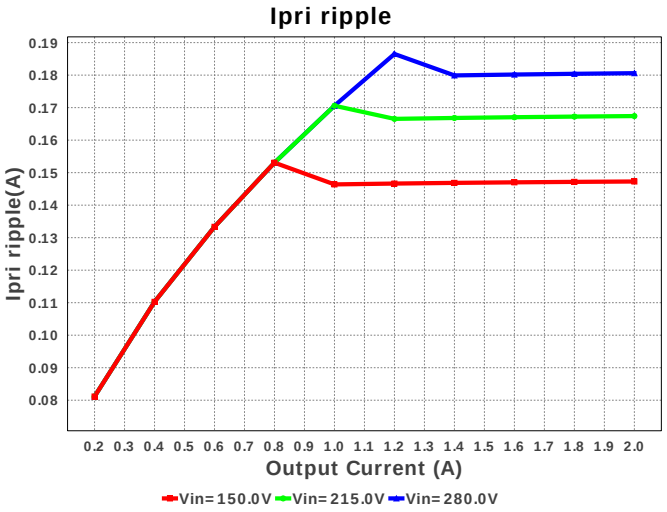


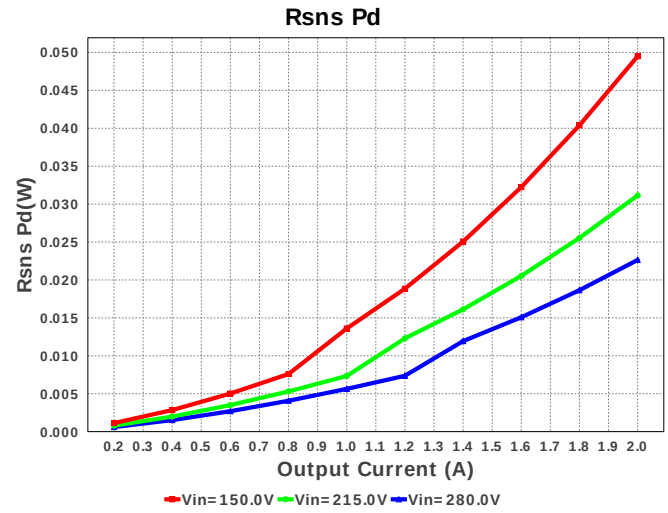


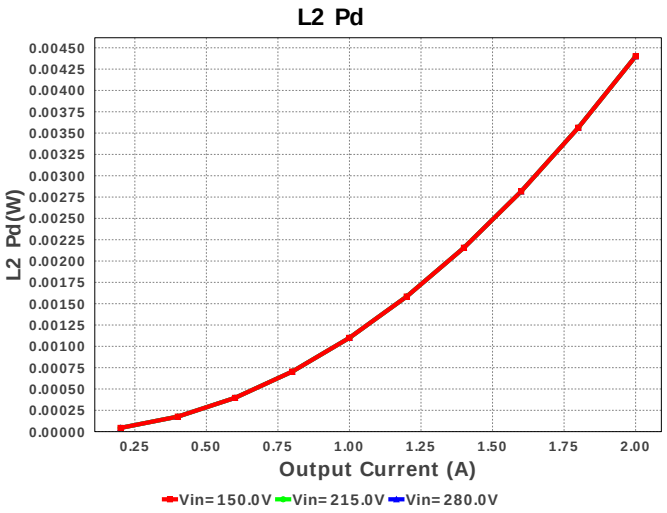


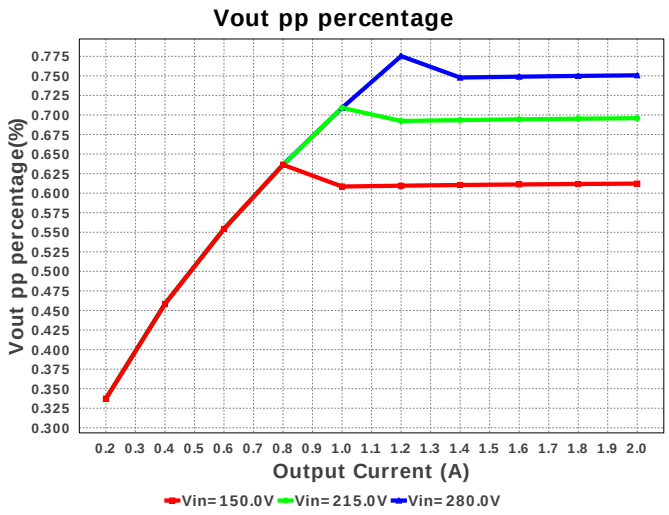


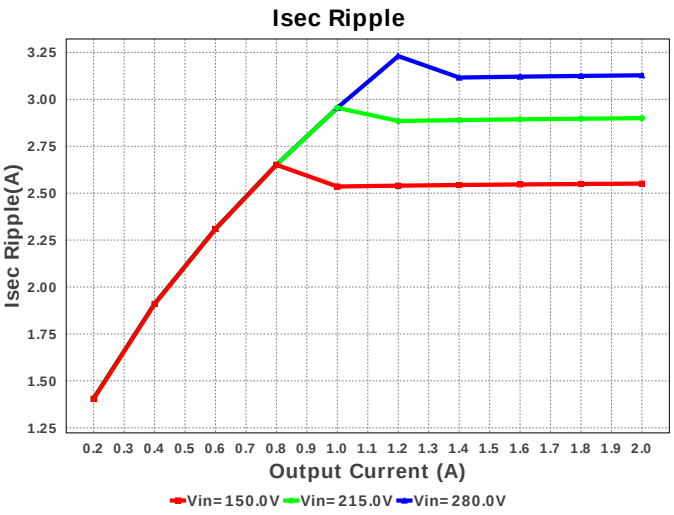


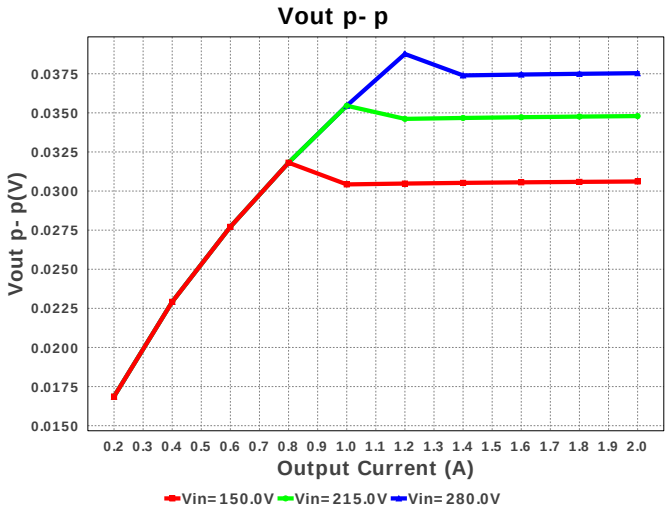


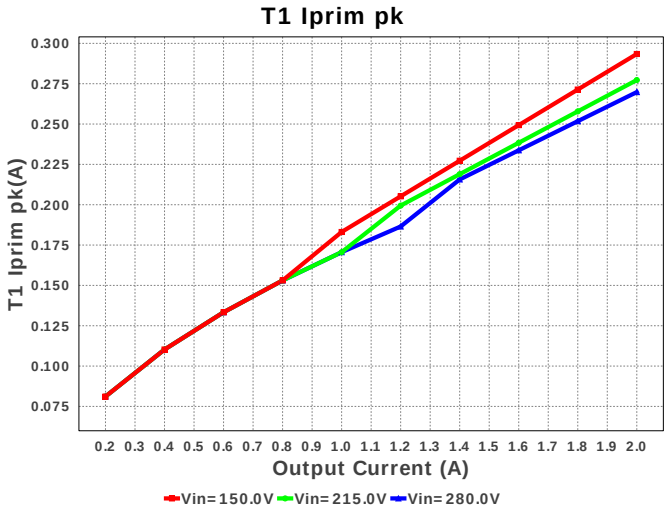












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	2.252 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	74.303 mA	Current	Average input current
3.	Iout_DCM	834.208 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	87.178 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	147.28 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	67.013 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	2.551 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	140.985 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	293.419 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	3.012 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	5.082 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	45	General	Total Design BOM count
13.	Daux trr	0.0 ns	General	Auxiliary Diode Reverse Recovery Time
14.	Dsec Vf	397.923 mV	General	Effective Forward Voltage Drop at the Operating Current
15.	Dsec trr	0.0 ns	General	Output Diode Reverse Recovery Time
16.	Dsec2 Vf	397.923 mV	General	Effective Forward Voltage Drop at the Operating Current
17.	Dsnub trr	50.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	2.144 k mm^2	General	Total Foot Print Area of BOM components
19.	Frequency	25.294 kHz	General	Switching frequency
20.	Pout	10.0 W	General	Total output power
21.	Tdead	3.081 kns	General	Approximate Dead Time of the Regulator
22.	Toff	20.772 us	General	Approximate Converter Off Time
23.	Ton Act	15.682 us	General	Approximate Converter On Time
24.	Total BOM	$0.0	General	Total BOM Cost
25.	Tsw	39.535 us	General	Switching Time Period
26.	Vaux	13.816 V	General	Auxiliary Voltage
27.	Vsnub	147.909 V	General	Voltage Across the Snubber
28.	Vout Actual	4.99 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
29.	Vout OP	5.0 V	Op_Point	Operational Output Voltage

#	Name	Value	Category	Description
30.	Duty Cycle	39.666 %	Op_point	Duty cycle
31.	Efficiency	89.723 %	Op_point	Steady state efficiency
32.	IC Tj	32.218 degC	Op_point	IC junction temperature
33.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
34.	IOUT_OP	2.0 A	Op_point	Iout operating point
35.	M1 TjOP	31.557 degC	Op_point	M1 MOSFET junction temperature
36.	Vout p-p	30.611 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	154.195 µW	Power	Input capacitor power dissipation
38.	Cout1 Pd	60.837 mW	Power	Output capacitor1 power dissipation
39.	Dsec Pd	397.923 mW	Power	Secondary Diode Power Dissipation
40.	Dsec2 Pd	397.923 mW	Power	Secondary Diode Power Dissipation
41.	IC Pd	44.36 mW	Power	IC power dissipation
42.	L2 Pd	4.4 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
43.	M1 Pd	18.765 mW	Power	M1 MOSFET total power dissipation
44.	Paux	10.857 mW	Power	Power Dissipation in Raux and Daux
45.	Pd Rstartup	171.331 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
46.	Rdrv Pd	749.489 nW	Power	Power Dissipation in Gate Drive Resistor
47.	Rfb Pd	3.03 mW	Power	Rfb Power Dissipation
48.	Rsns Pd	49.493 mW	Power	Current Limit Sense Resistor Power Dissipation
49.	Snubber Pd	199.543 mW	Power	Snubber Power Dissipation
50.	T1 Pd	190.586 mW	Power	Estimated Losses in Transformer
51.	Total Pd	0.0 W	Power	Total Power Dissipation
52.	Vout Tolerance	2.173 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout pp percentage	612.225 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	280.0	Maximum input voltage
3.	VinMin	150.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	UCC28C44	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. UCC28C44 Product Folder : http://www.ti.com/product/UCC28C44 : contains the data sheet and other resources.