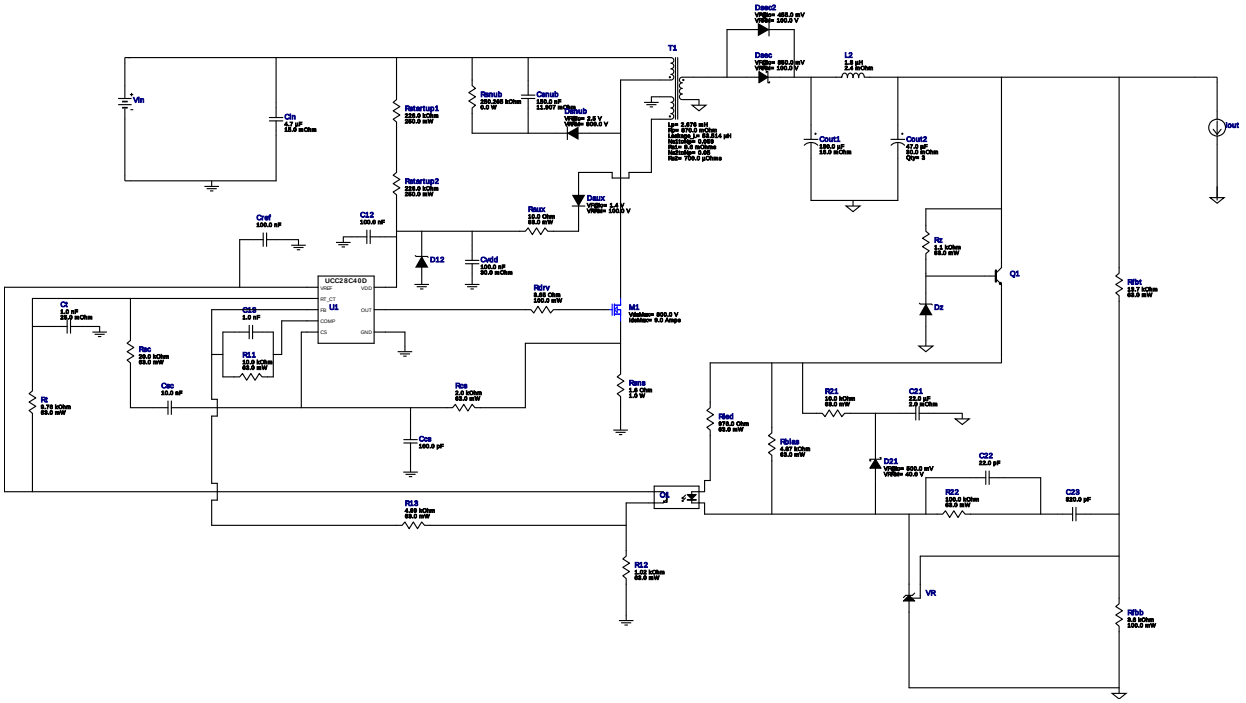
WEBENCH® Design Report

VinMin = 150.0V
VinMax = 280.0V
Vout = 12.0V
Iout = 2.0A

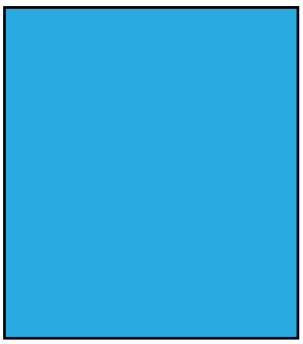
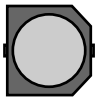
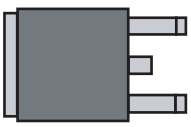
Device = UCC28C40DR
Topology = Flyback
Created = 7/12/16 12:10:09 AM
BOM Cost = $0.00
BOM Count = 49
Total Pd = 0.0W

Design : 4354914/11 UCC28C40DR
UCC28C40DR 150.0V-280.0V to 12.00V @ 2.0A



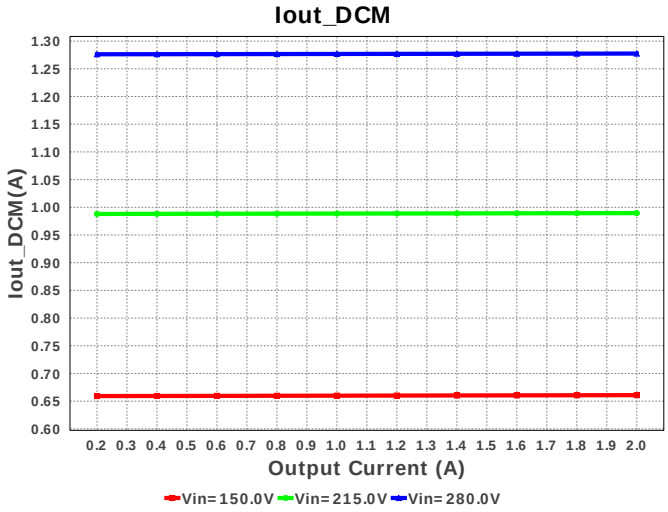
Electrical BOM

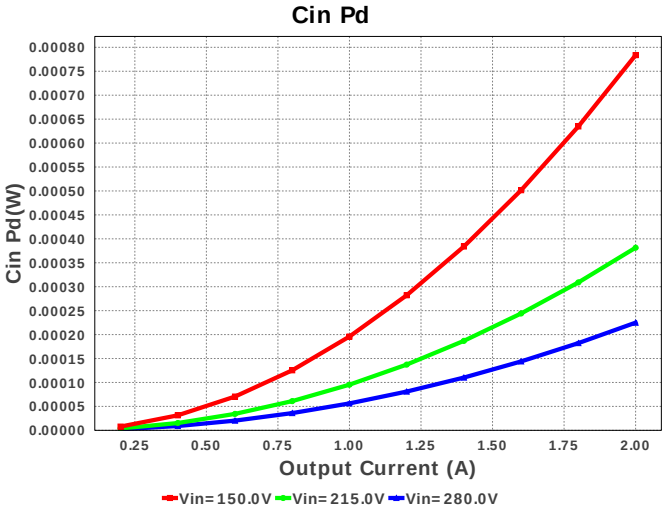
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C12	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	C13	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
3.	C21	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	$0.16	1210 15 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	MuRata	GRM033R71E821KA01D Series= X7R	Cap= 820.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
6.	Ccs	Kemet	C0201C101J3GACTU Series= C0G/NP0	Cap= 100.0 pF VDC= 5.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2

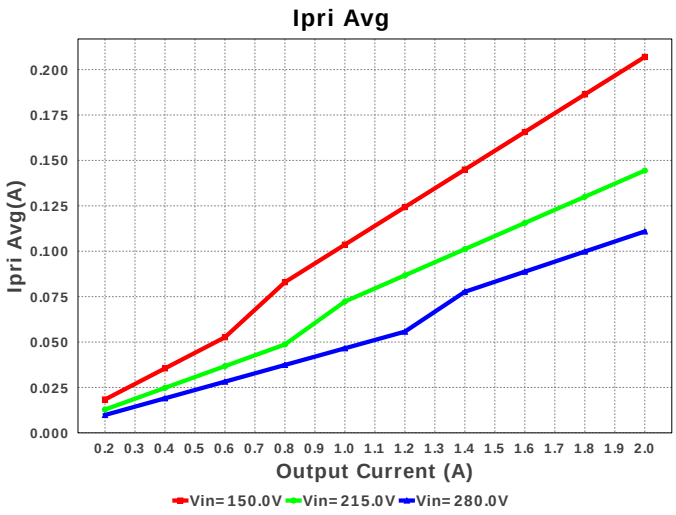
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cin	TDK	B32924D3475K Series= B32924	Cap= 4.7 uF ESR= 15.0 mOhm VDC= 630.0 V IRMS= 457.0 mA	1	$1.68	 B32924_31mm 770 mm^2
8.	Cout1	Panasonic	25SVPF180M Series= ?	Cap= 180.0 uF ESR= 16.0 mOhm VDC= 25.0 V IRMS= 4.65 A	1	$0.61	 CAPSMT_62_E12 106 mm^2
9.	Cout2	Panasonic	25SVPF47M Series= ?	Cap= 47.0 uF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 2.8 A	3	$0.43	 CAPSMT_62_F61 74 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	C3225X7T2J154K Series= X7T	Cap= 150.0 nF ESR= 11.907 mOhm VDC= 630.0 V IRMS= 0.0 A	1	$0.19	 1210 15 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	GRM188R71C104KA01D Series= X7R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 16.0 V IRMS= 1.7 A	1	$0.01	 0603 5 mm^2
15.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	$0.04	 SOD-123 13 mm^2
16.	D21	Vishay-Semiconductor	SS14-E3/61T	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.08	 SMA 37 mm^2
17.	Daux	NXP Semiconductor	BAS316,115	VF@Io= 1.4 V VRRM= 100.0 V	1	$0.02	 SOD-323 9 mm^2
18.	Dsec	Comchip Technology	CDBC5100-G	VF@Io= 850.0 mV VRRM= 100.0 V	1	$0.26	 SMC 83 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	Bourns	CD1408-FU1800	VF@Io= 2.5 V VRRM= 800.0 V	1	$0.13	 Diode_1408 13 mm^2
21.	Dz	ON Semiconductor	BZX84C9V1LT1G	Zener	1	$0.02	 SOT-23 14 mm^2

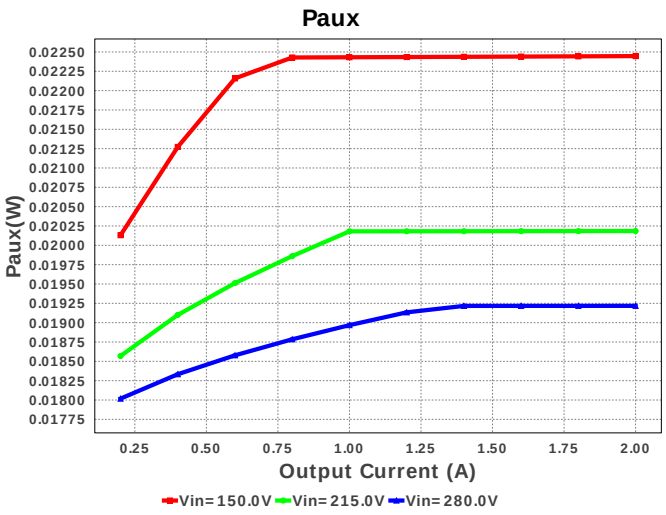
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
22.	L2	Coilcraft	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	$0.72	 SER1360 225 mm^2
23.	M1	STMicroelectronics	STF10N80K5	VdsMax= 800.0 V IdsMax= 9.0 Amps	1	$2.52	 TO-220FP 79 mm^2
24.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	$0.21	 SOP-4 44 mm^2
25.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	$0.02	 SOT-23 14 mm^2
26.	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
27.	R12	Vishay-Dale	CRCW04021K02FKED Series= CRCW..e3	Res= 1.02 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
28.	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
29.	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
30.	R22	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
31.	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
32.	Rbias	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
33.	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
34.	Rdrv	Vishay-Dale	CRCW06033R65FKEA Series= CRCW..e3	Res= 3.65 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
35.	Rfbb	Yageo America	RC0603FR-073K6L Series= ?	Res= 3.6 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
36.	Rfbt	Vishay-Dale	CRCW040213K7FKED Series= CRCW..e3	Res= 13.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
37.	Rled	Vishay-Dale	CRCW0402976RFKED Series= CRCW..e3	Res= 976.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
38.	Rsc	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
39.	Rsns	Panasonic	ERJ-1TRQF1R6U Series= ?	Res= 1.6 Ohm Power= 1.0 W Tolerance= 1.0%	1	$0.19	 2512 43 mm^2
40.	Rsnub	CUSTOM	CUSTOM Series= ?	Res= 250.265 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm^2

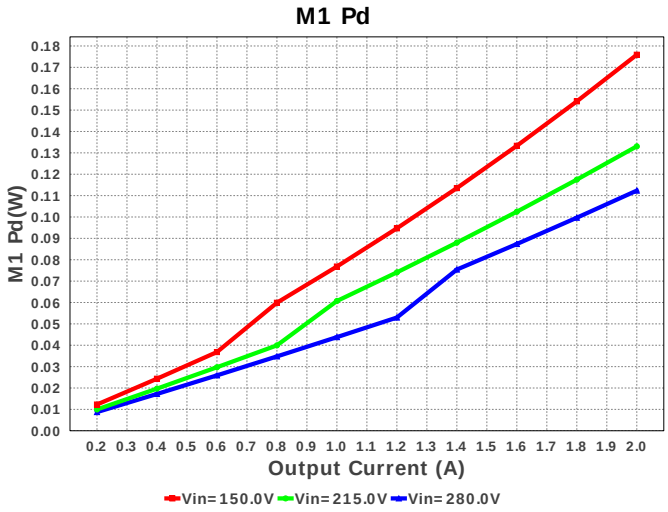
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
41.	Rstartup1	Panasonic	ERJ-8ENF2263V Series= ERJ-8E	Res= 226.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm^2
42.	Rstartup2	Panasonic	ERJ-8ENF2263V Series= ERJ-8E	Res= 226.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	 1206 11 mm^2
43.	Rt	Vishay-Dale	CRCW04029K76FKED Series= CRCW..e3	Res= 9.76 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
44.	Rz	Vishay-Dale	CRCW04021K10FKED Series= CRCW..e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
45.	T1	CUSTOM	CUSTOM	Lp= 2.676 mH Rp= 870.0 mOhm Leakage_L= 53.514 µH Ns1toNp= 0.059 Rs1= 8.6 mOhms Ns2toNp= 0.05 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm^2
46.	U1	Texas Instruments	UCC28C40DR	Switcher	1	$0.75	 D0008A 57 mm^2
47.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	$0.07	 R-PDSO-G3 16 mm^2

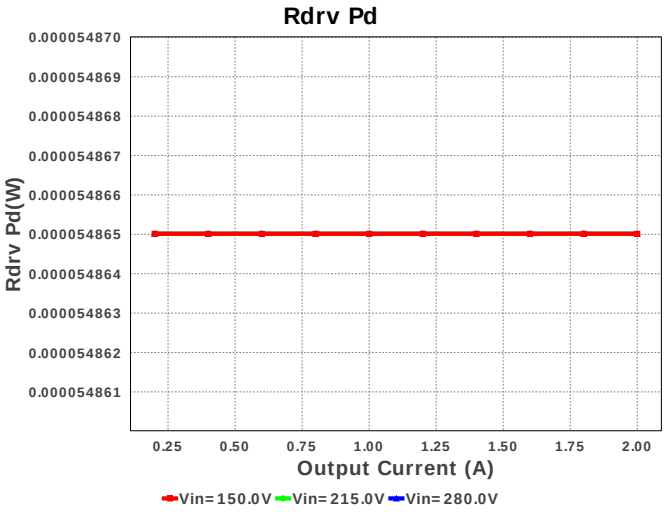


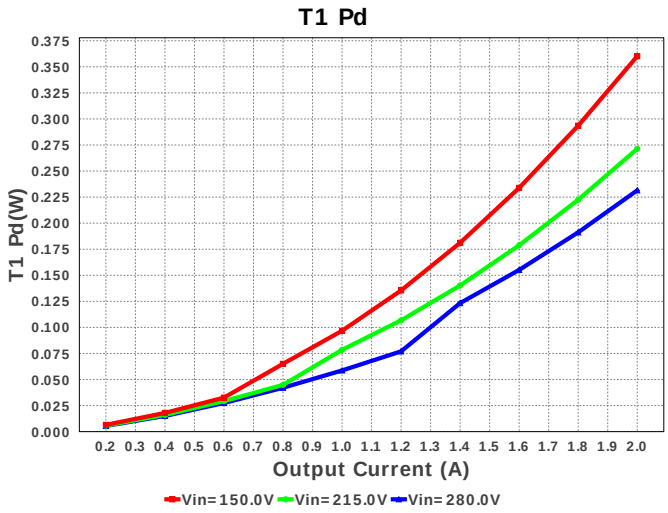


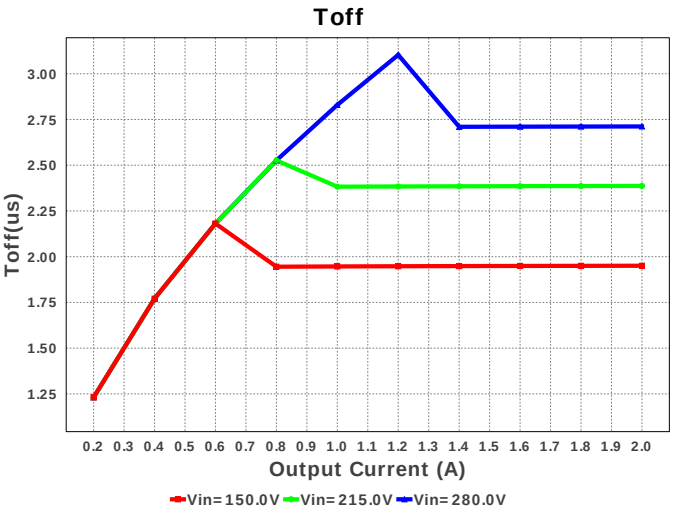


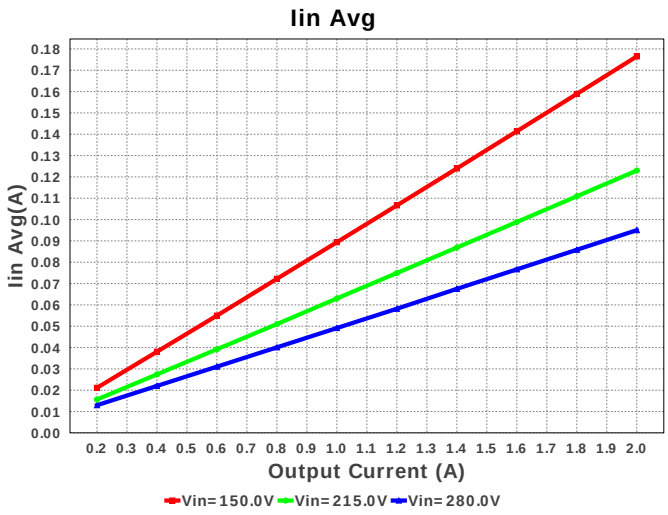


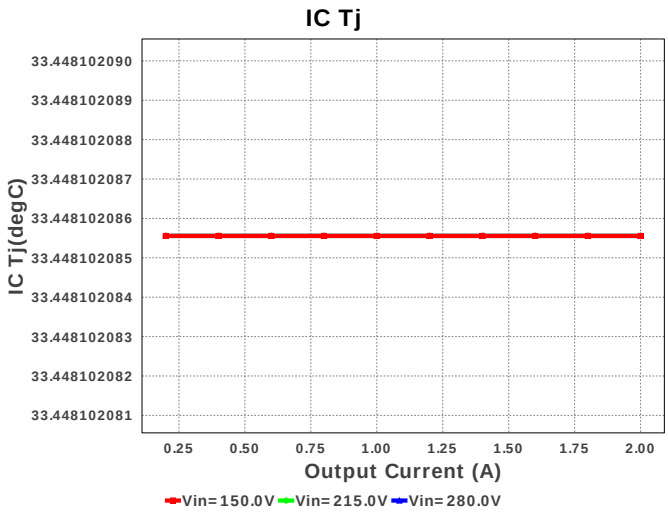


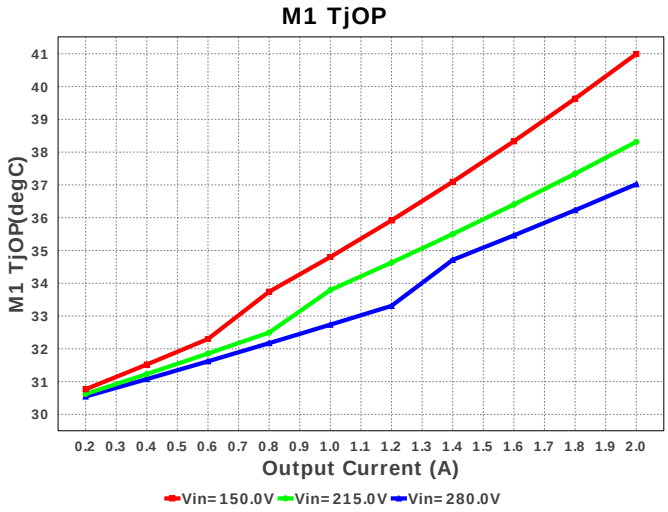


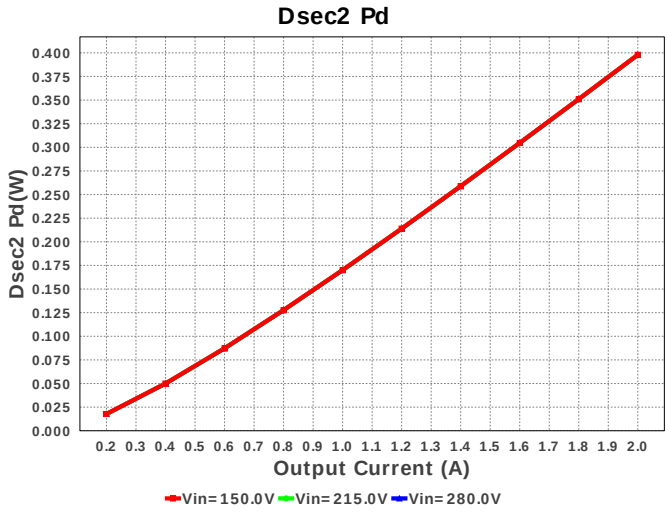


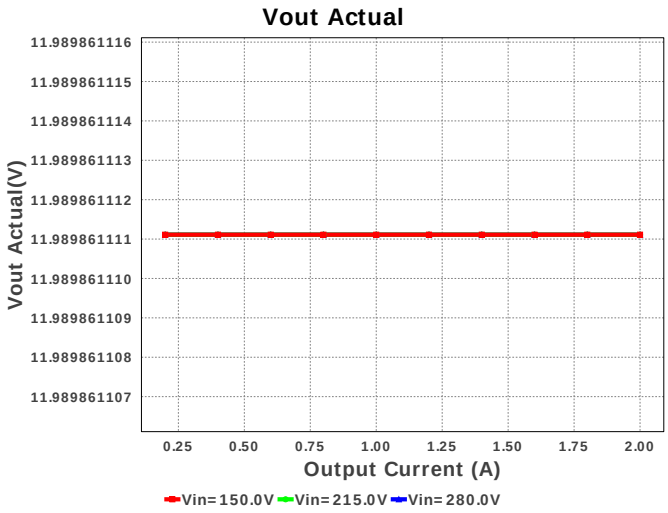


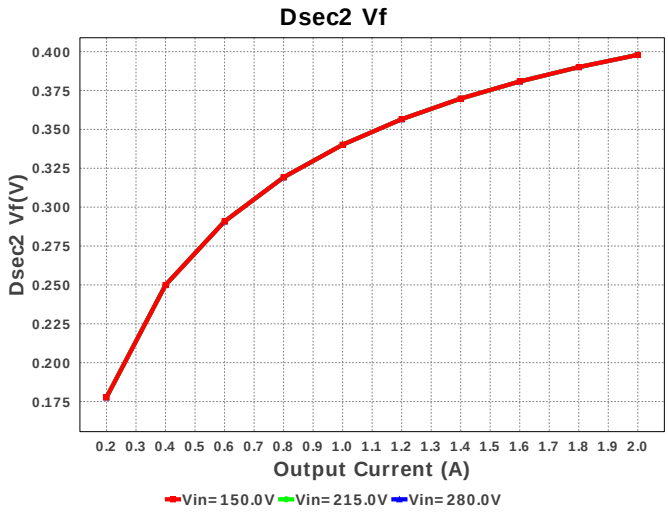


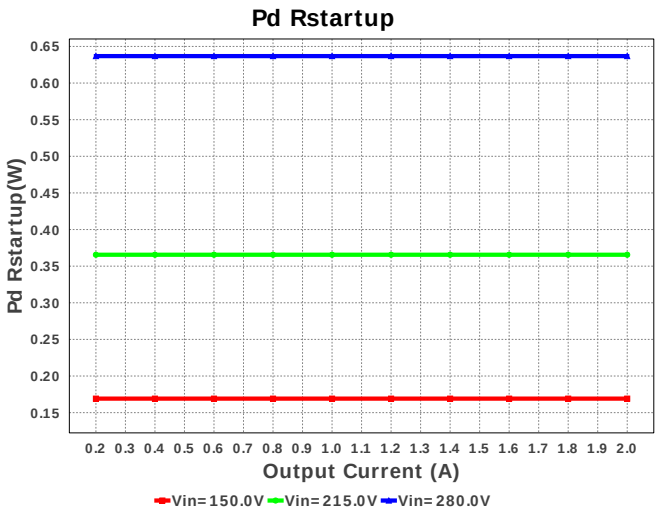


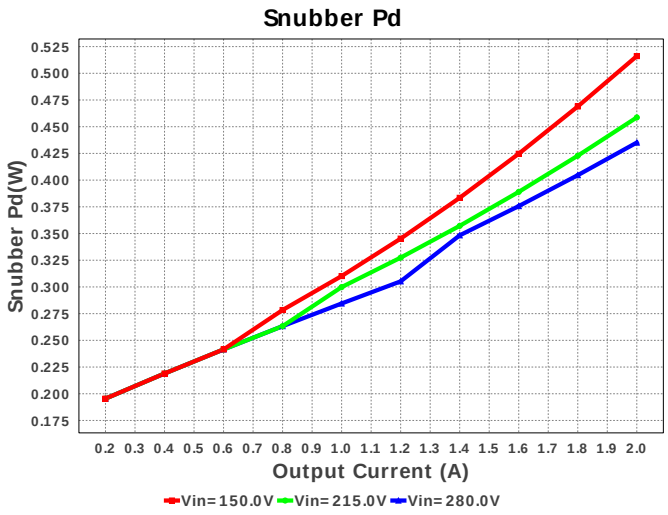


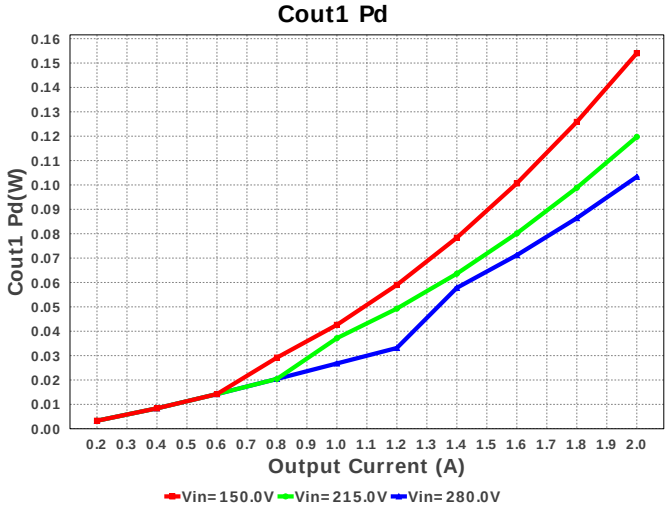


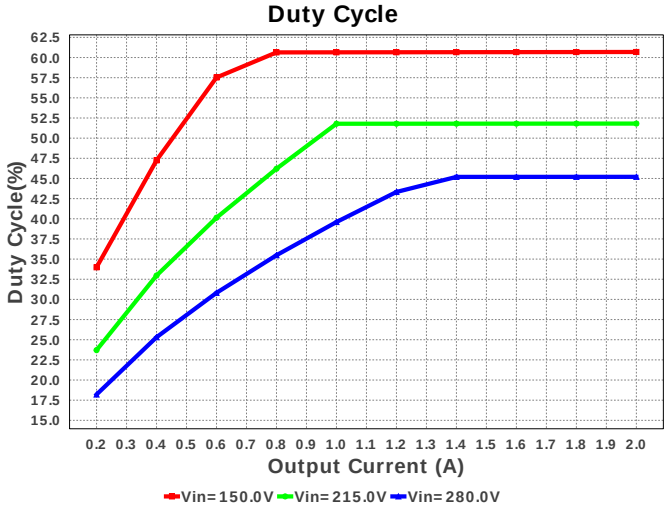


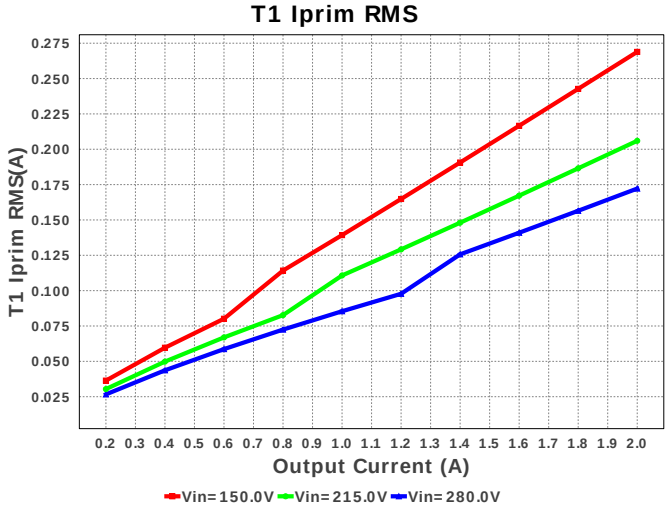


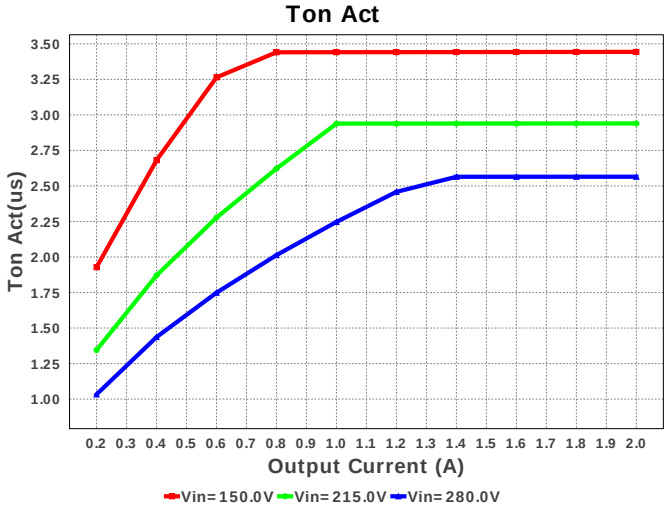


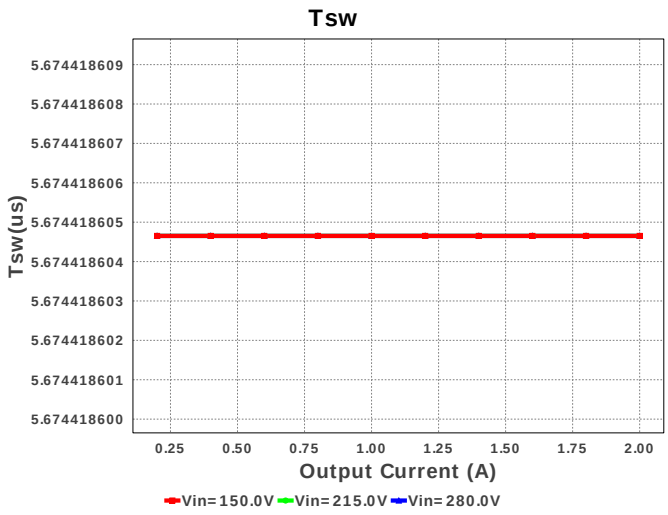


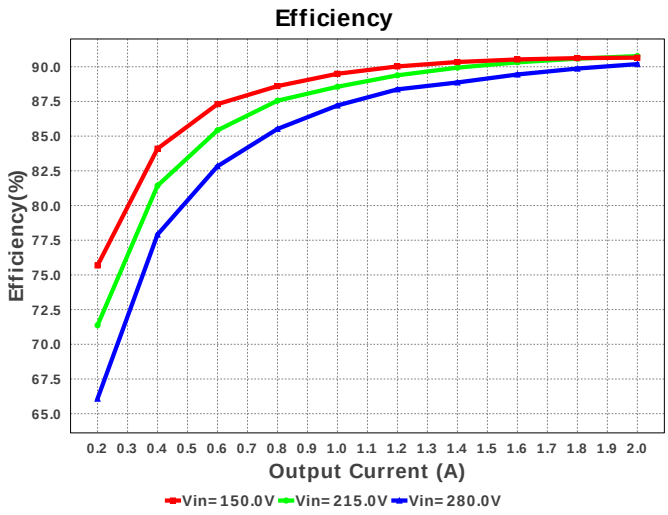


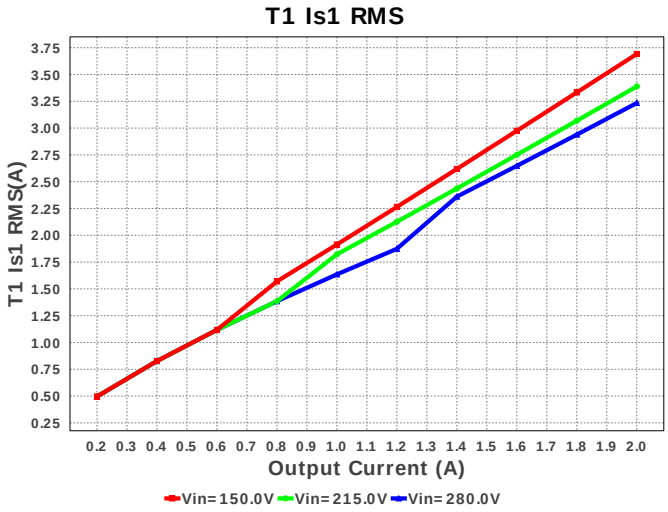


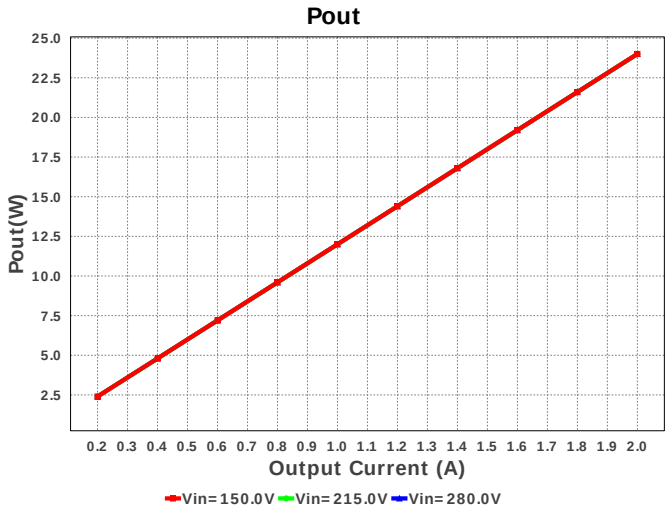


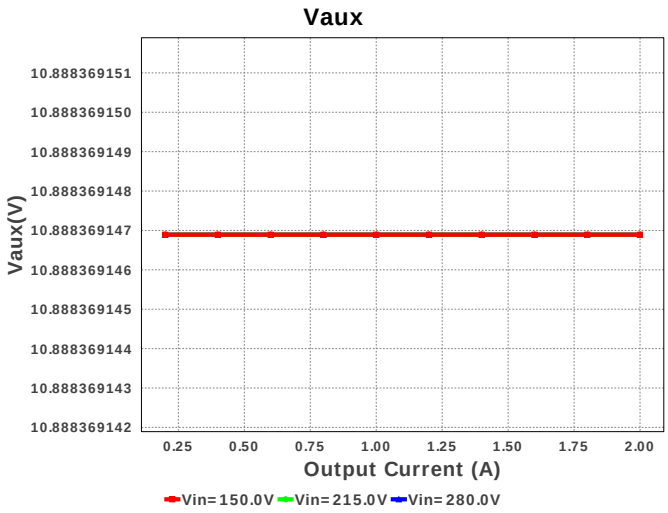


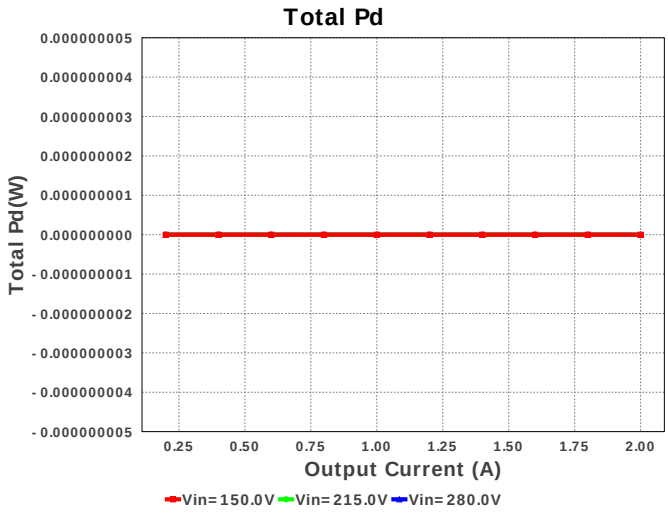


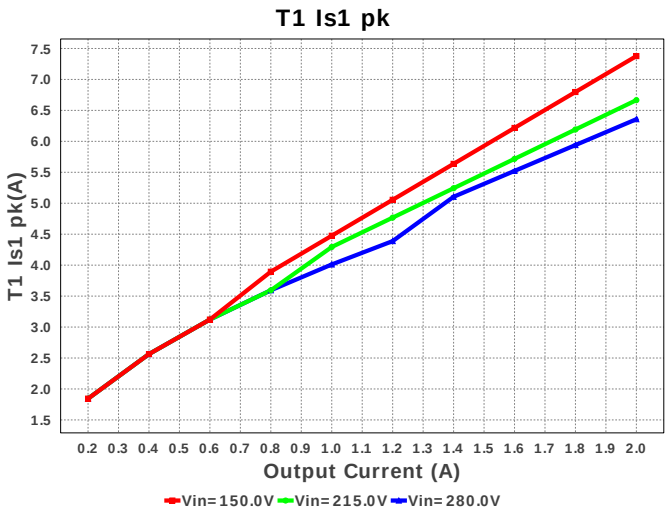


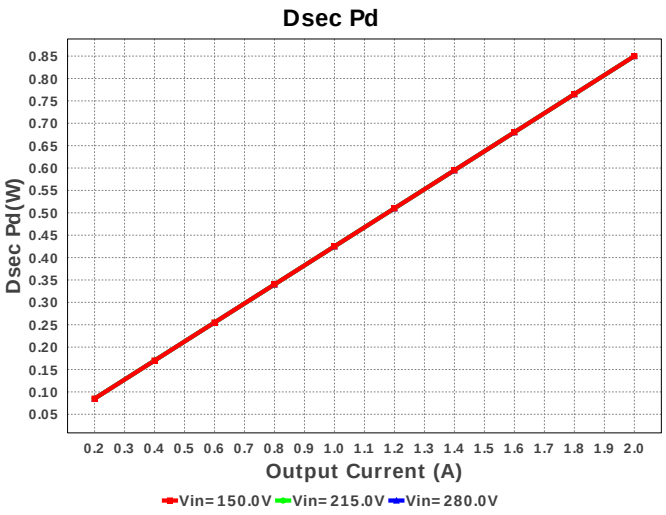


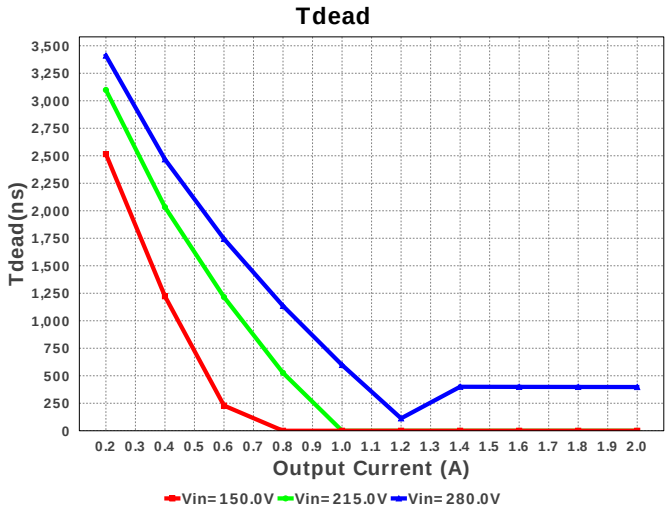


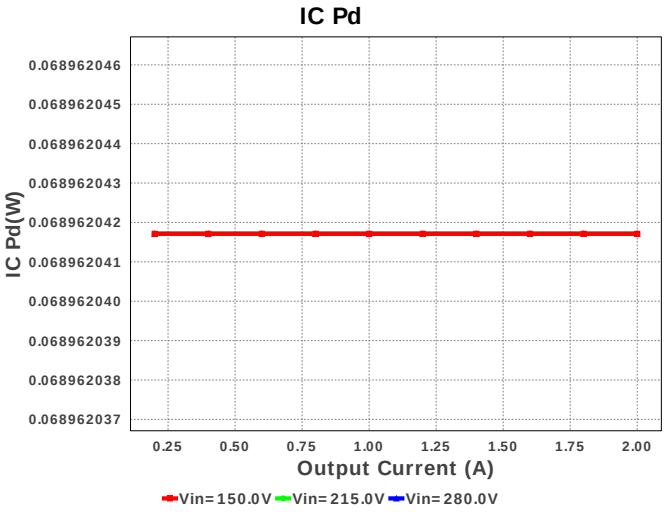


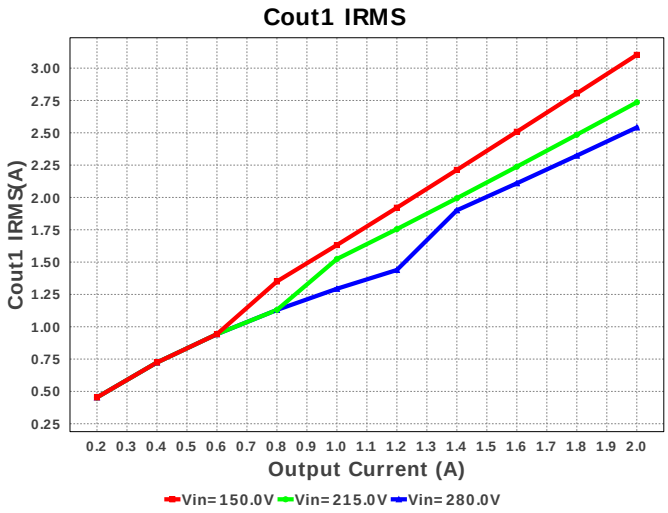


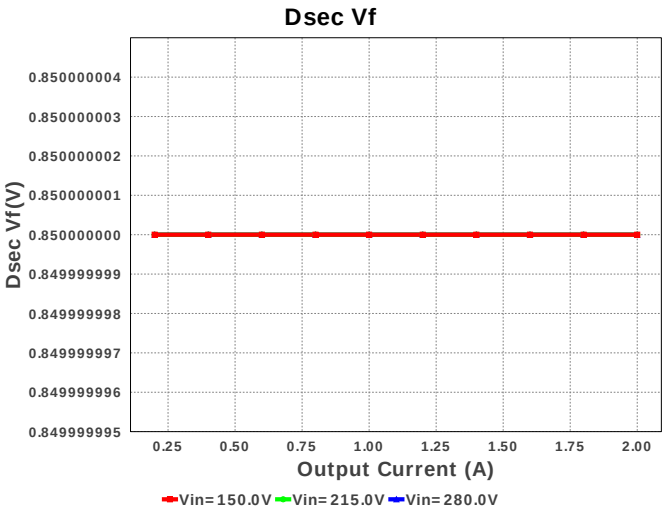


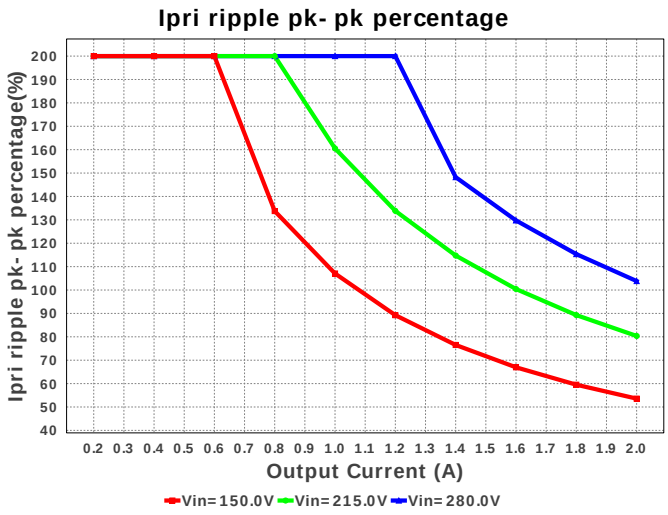


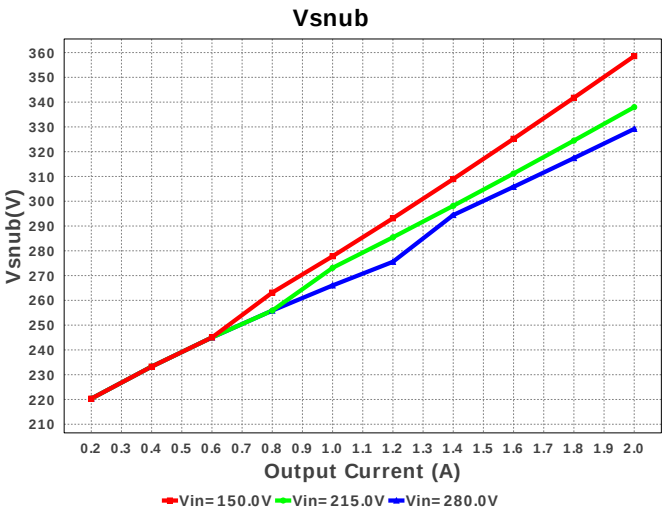


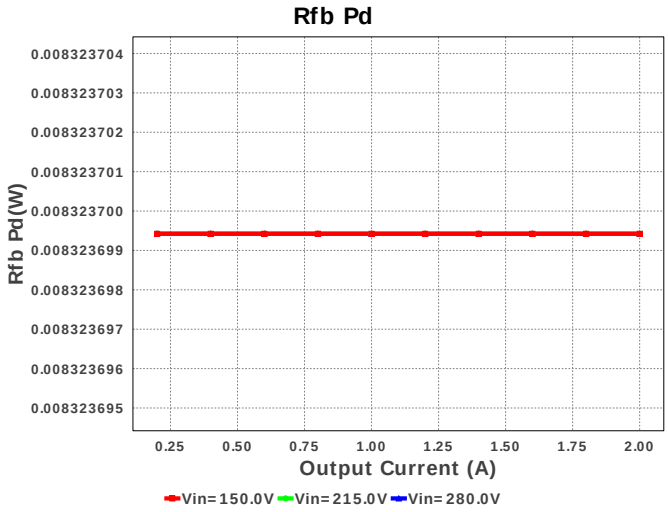


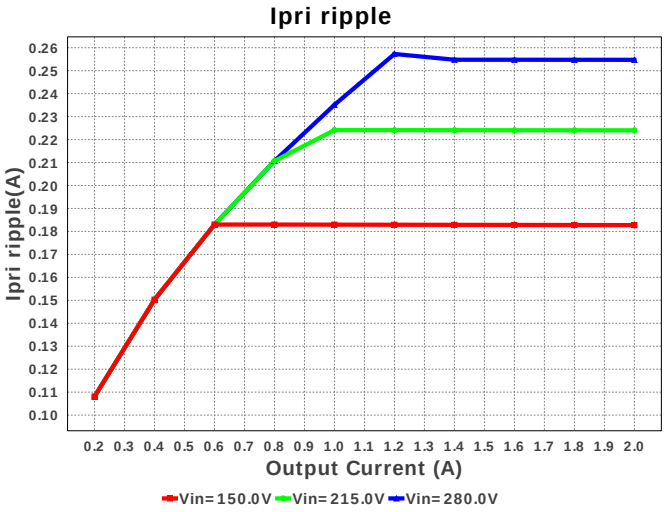


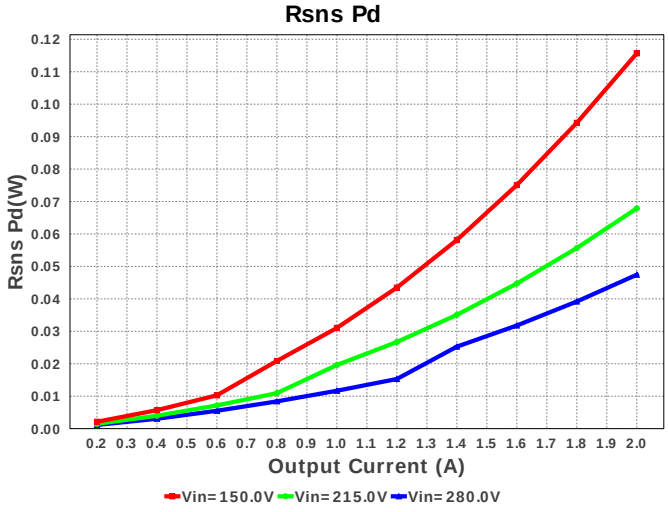


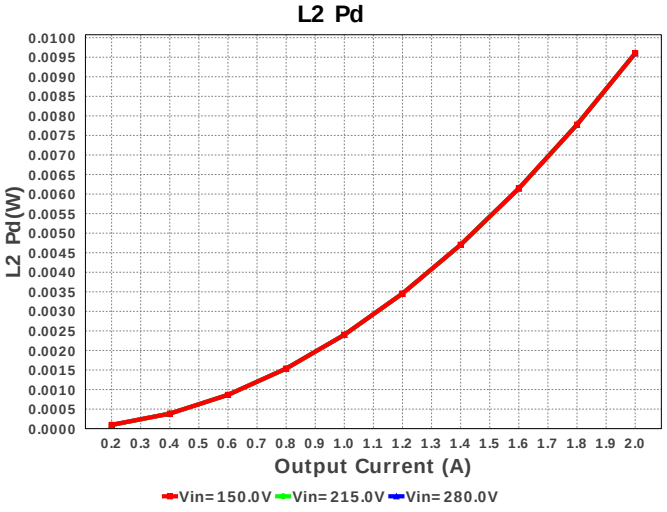


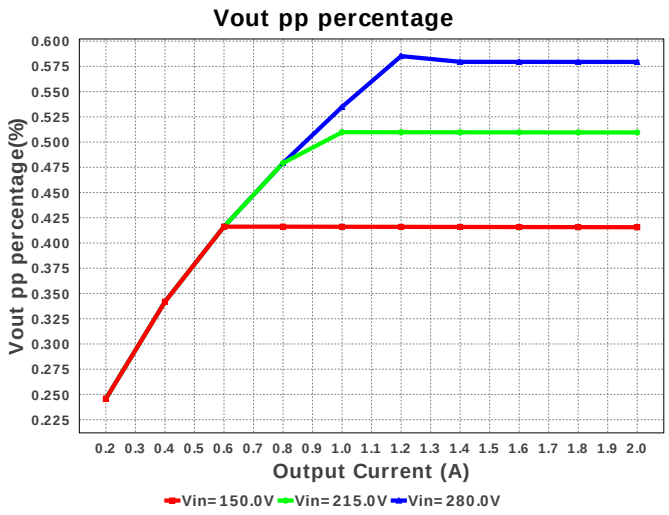


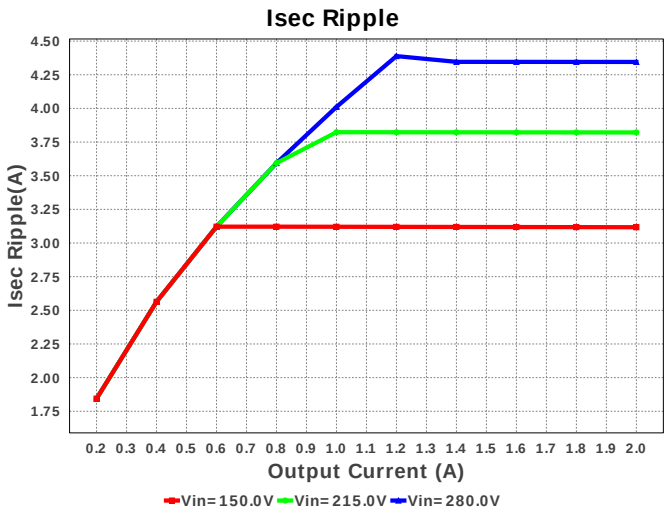


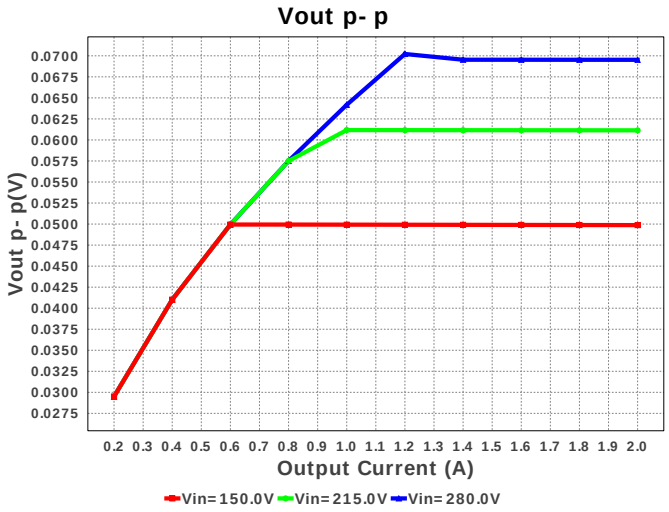


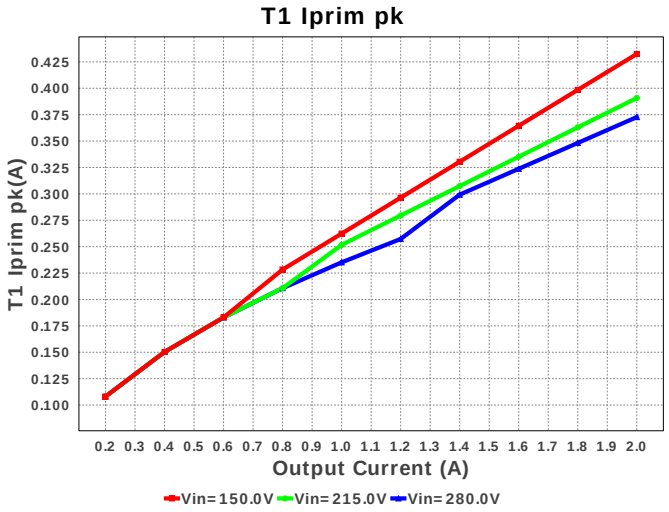












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	3.103 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	176.494 mA	Current	Average input current
3.	Iout_DCM	660.867 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	207.0 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	182.744 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	53.577 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.117 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	268.875 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	432.459 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	3.691 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	7.377 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	49	General	Total Design BOM count
13.	Daux trr	4.0 ns	General	Auxiliary Diode Reverse Recovery Time
14.	Dsec Vf	850.0 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	35.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	2.098 k mm^2	General	Total Foot Print Area of BOM components
19.	Frequency	176.23 kHz	General	Switching frequency
20.	Pout	24.0 W	General	Total output power
21.	Tdead	0.0 ns	General	Approximate Dead Time of the Regulator
22.	Toff	1.951 us	General	Approximate Converter Off Time
23.	Ton Act	3.444 us	General	Approximate Converter On Time
24.	Total BOM	$0.0	General	Total BOM Cost
25.	Tsw	5.674 us	General	Switching Time Period
26.	Vaux	10.888 V	General	Auxiliary Voltage
27.	Vsnub	358.574 V	General	Voltage Across the Snubber
28.	Vout Actual	11.99 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
29.	Vout OP	12.0 V	Op_Point	Operational Output Voltage

#	Name	Value	Category	Description
30.	Duty Cycle	60.688 %	Op_point	Duty cycle
31.	Efficiency	90.654 %	Op_point	Steady state efficiency
32.	IC Tj	33.448 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	40.994 degC	Op_point	M1 MOSFET junction temperature
36.	Vout p-p	49.877 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	783.673 µW	Power	Input capacitor power dissipation
38.	Cout1 Pd	154.025 mW	Power	Output capacitor1 power dissipation
39.	Dsec Pd	850.0 mW	Power	Secondary Diode Power Dissipation
40.	Dsec2 Pd	397.923 mW	Power	Secondary Diode Power Dissipation
41.	IC Pd	68.962 mW	Power	IC power dissipation
42.	L2 Pd	9.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
43.	M1 Pd	175.905 mW	Power	M1 MOSFET total power dissipation
44.	Paux	22.446 mW	Power	Power Dissipation in Raux and Daux
45.	Pd Rstartup	169.145 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
46.	Rdrv Pd	54.865 µW	Power	Power Dissipation in Gate Drive Resistor
47.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
48.	Rsns Pd	115.67 mW	Power	Current Limit Sense Resistor Power Dissipation
49.	Snubber Pd	516.102 mW	Power	Snubber Power Dissipation
50.	T1 Pd	360.169 mW	Power	Estimated Losses in Transformer
51.	Total Pd	0.0 W	Power	Total Power Dissipation
52.	Vout Tolerance	1.926 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout pp percentage	415.64 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	12.0	Output Voltage
5.	base_pn	UCC28C40	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. UCC28C40 Product Folder : http://www.ti.com/product/UCC28C40 : contains the data sheet and other resources.