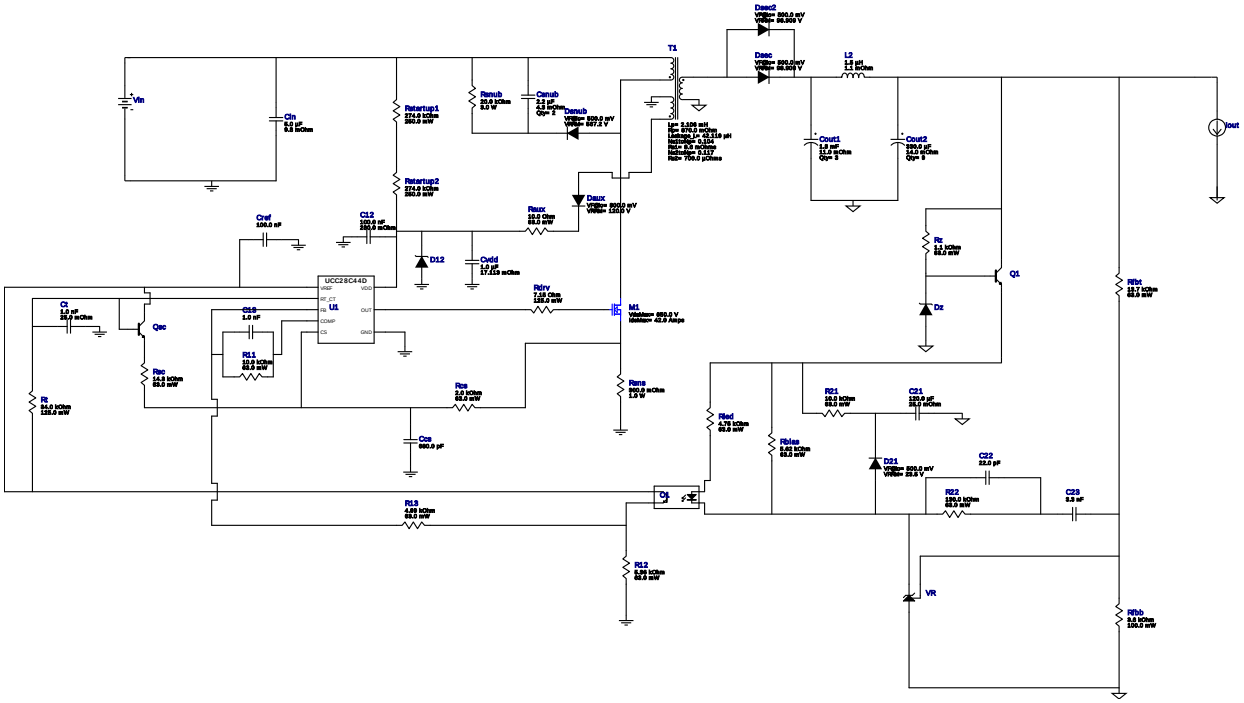
TEXAS INSTRUMENTS

WEBENCH® Design Report

VinMin = 190.0V
VinMax = 265.0V
Vout = 12.0V
Iout = 8.5A

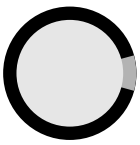
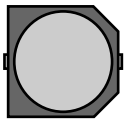
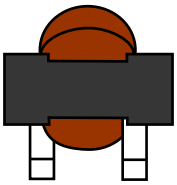
Device = UCC28C44DR
Topology = Flyback
Created = 8/21/16 7:34:49 AM
BOM Cost = $0.00
BOM Count = 58
Total Pd = 0.0W

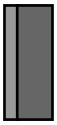
Design : 4009018/114 UCC28C44DR
UCC28C44DR 190.0V-265.0V to 12.00V @ 8.5A



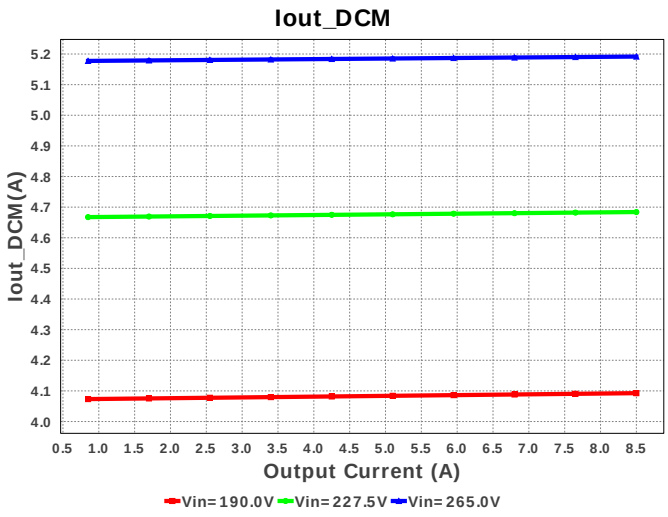
Electrical BOM

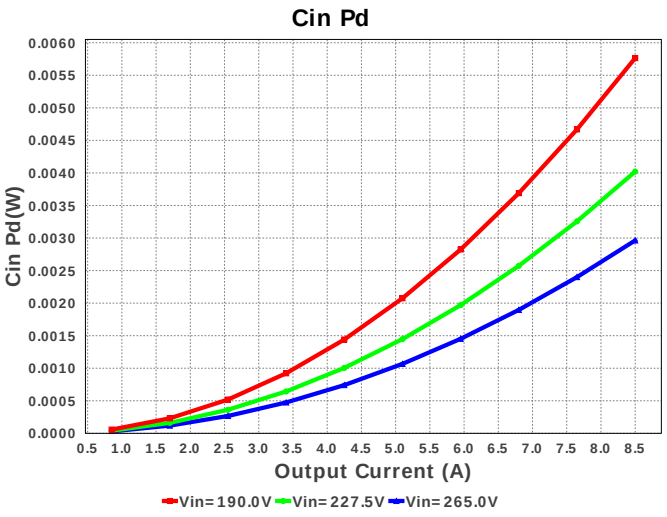
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
2.	C13	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
3.	C21	Panasonic	20SVPF120M Series= ?	Cap= 120.0 uF ESR= 25.0 mOhm VDC= 20.0 V IRMS= 3.2 A	1	$0.43	CAPSMT_62_F61 74 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	GRM216R71E332KA01D Series= X7R	Cap= 3.3 nF VDC= 25.0 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

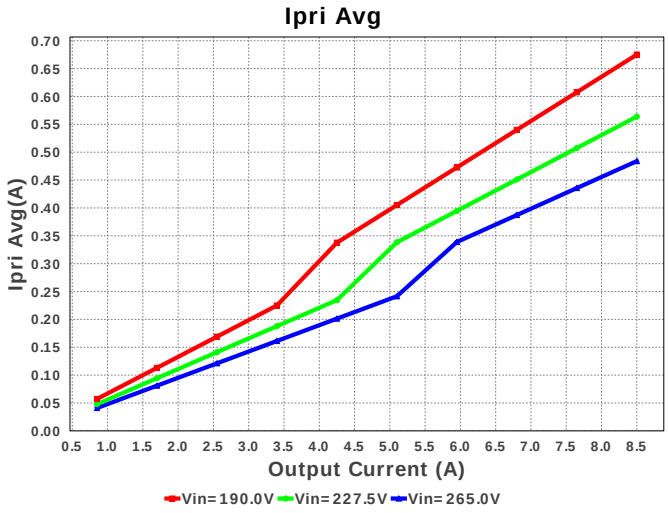
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cin	TDK	B32774D1505K Series= B32774	Cap= 5.0 uF ESR= 9.8 mOhm VDC= 1.3 kV IRMS= 10.5 A	1	$3.08	 B32774_3150x2200x3650 804 mm^2
8.	Cout1	Nichicon	UHV1V182MHD Series= HV	Cap= 1.8 mF ESR= 11.0 mOhm VDC= 35.0 V IRMS= 3.925 A	3	NA	 CAPPR5-12.5X25 210 mm^2
9.	Cout2	Panasonic	25SVPF330M Series= ?	Cap= 330.0 uF ESR= 14.0 mOhm VDC= 25.0 V IRMS= 5.0 A	9	$0.70	 CAPSMT_62_F12 151 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.	Csnub	TDK	C5750X6S2W225K Series= X6S	Cap= 2.2 uF ESR= 4.3 mOhm VDC= 400.0 V IRMS= 0.0 A	2	NA	 2220 54 mm^2
12.	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
13.	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
14.	D12	Diodes Inc.	DFLZ18-7	Zener	1	$0.13	 PowerDI123 13 mm^2
15.	D21	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 23.5 V	1	NA	CUSTOM 0 mm^2
16.	Daux	Fairchild Semiconductor	FSV10120V	VF@Io= 800.0 mV VRRM= 120.0 V	1	$0.21	 TO-277A 56 mm^2
17.	Dsec	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 98.909 V	1	NA	CUSTOM 0 mm^2
18.	Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 98.909 V	1	NA	CUSTOM 0 mm^2
19.	Dsnub	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 567.2 V	1	NA	CUSTOM 0 mm^2
20.	Dz	Diodes Inc.	DFLZ10-7	Zener	1	$0.13	 PowerDI123 13 mm^2
21.	L2	Coilcraft	SER1590-152MLB	L= 1.5 µH DCR= 1.1 mOhm	1	$1.12	 SER1590 324 mm^2

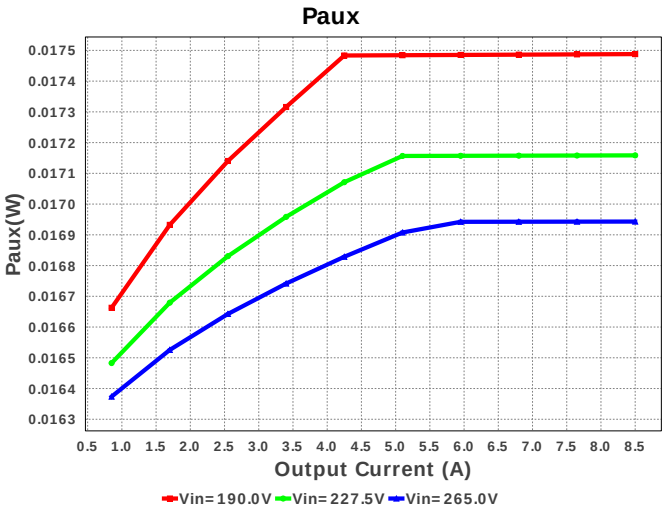
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
22.	M1	STMicroelectronics	STP57N65M5	VdsMax= 650.0 V IdsMax= 42.0 Amps	1	$7.05	 TO-220AB 397 mm^2
23.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	$0.21	 SOP-4 44 mm^2
24.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	$0.02	 SOT-23 14 mm^2
25.	Qsc	STMicroelectronics	2N2222A	Bipolar Transistor	1	NA	 TO-18 57 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	CRCW04025K36FKED Series= CRCW..e3	Res= 5.36 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	CRCW0402130KFKED Series= CRCW..e3	Res= 130.0 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	CRCW04025K62FKED Series= CRCW..e3	Res= 5.62 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	CRCW08057R15FKEA Series= CRCW..e3	Res= 7.15 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 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	CRCW04024K75FKED Series= CRCW..e3	Res= 4.75 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
38.	Rsc	Vishay-Dale	CRCW040214K3FKED Series= CRCW..e3	Res= 14.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
39.	Rsns	Stackpole Electronics Inc	CSRN2010FKR300 Series= ?	Res= 300.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.11	 2010 32 mm^2
40.	Rsnub	Vishay-Bccomponents	PR03000202002JAC00 Series= ?	Res= 20.0 kOhm Power= 3.0 W Tolerance= 5.0%	1	$0.19	 PR03 0 mm^2

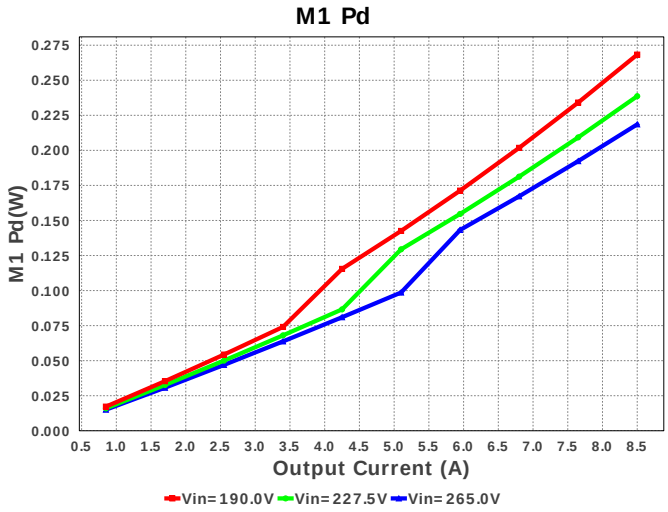
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
41.	Rstartup1	Panasonic	ERJ-8ENF2743V Series= ERJ-8E	Res= 274.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
42.	Rstartup2	Panasonic	ERJ-8ENF2743V Series= ERJ-8E	Res= 274.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	$0.01	1206 11 mm²
43.	Rt	Panasonic	ERJ-6ENF3402V Series= ERJ-6E	Res= 34.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
44.	Rz	Vishay-Dale	CRCW04021K10FKED Series= CRCW..e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
45.	T1	CUSTOM	CUSTOM	Lp= 2.106 mH Rp= 870.0 mOhm Leakage_L= 42.119 µH Ns1toNp= 0.104 Rs1= 8.6 mOhms Ns2toNp= 0.117 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
46.	U1	Texas Instruments	UCC28C44DR	Switcher	1	$0.60	D0008A 57 mm²
47.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	$0.08	DBZ0003A 14 mm²

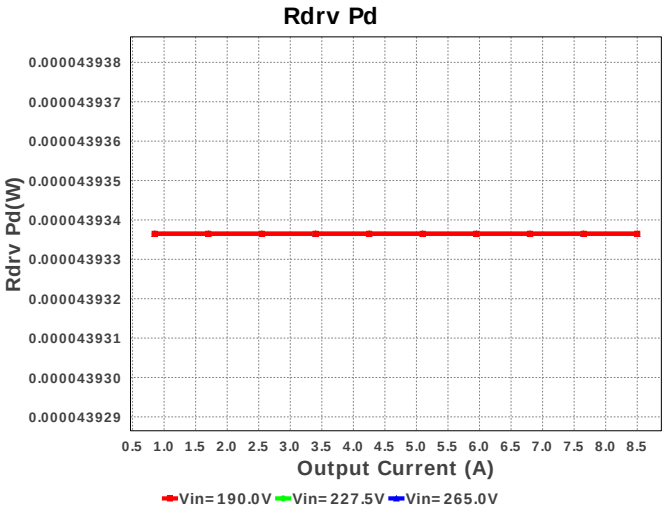


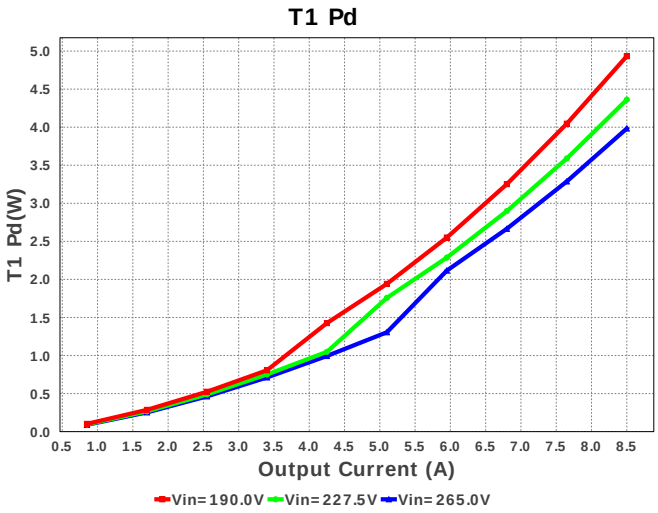


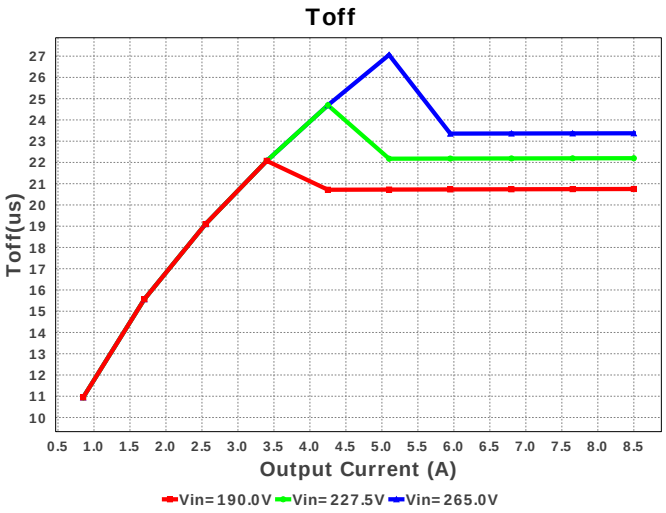


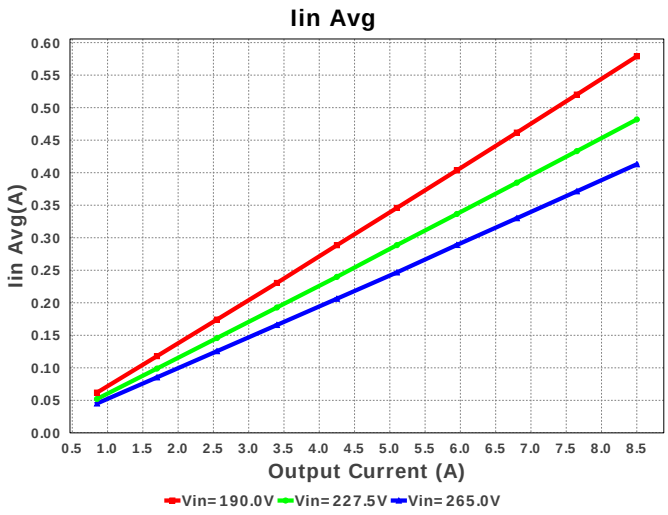


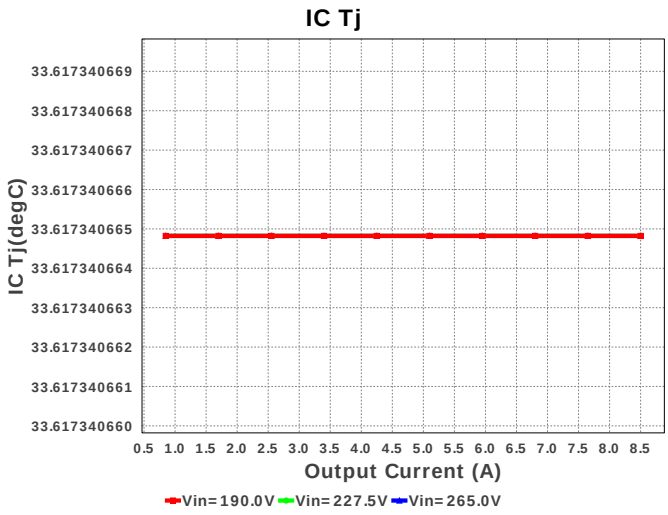


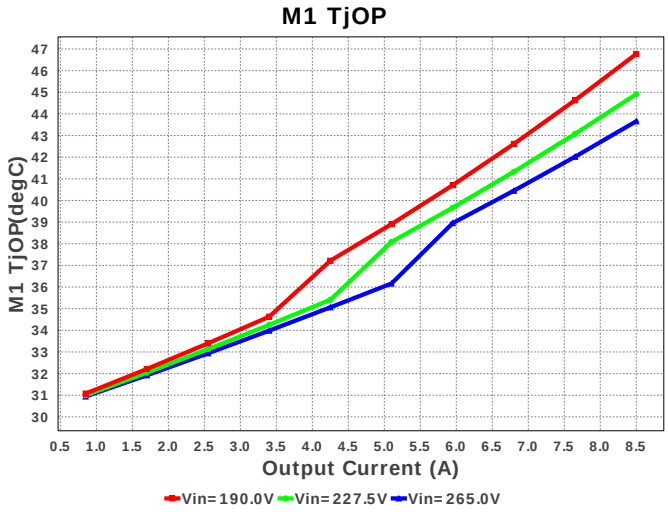


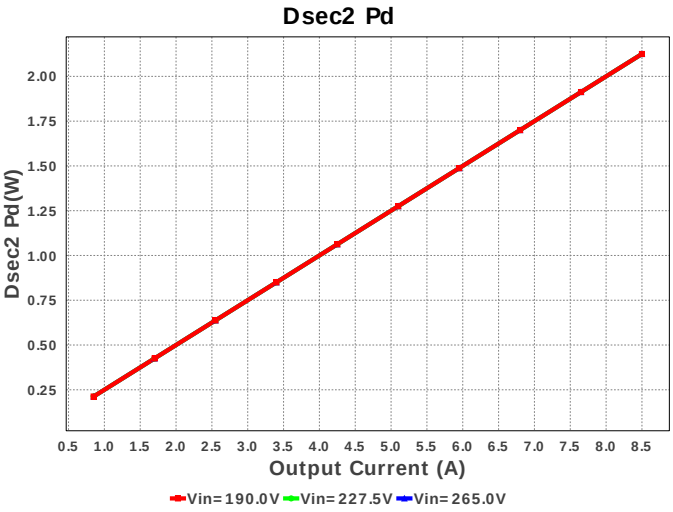


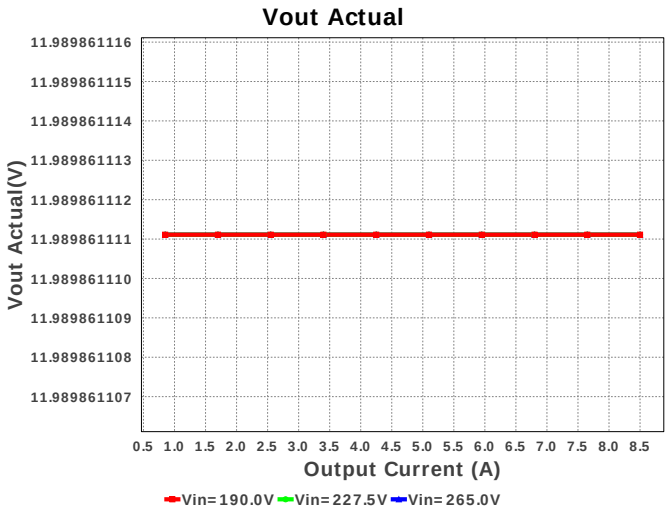


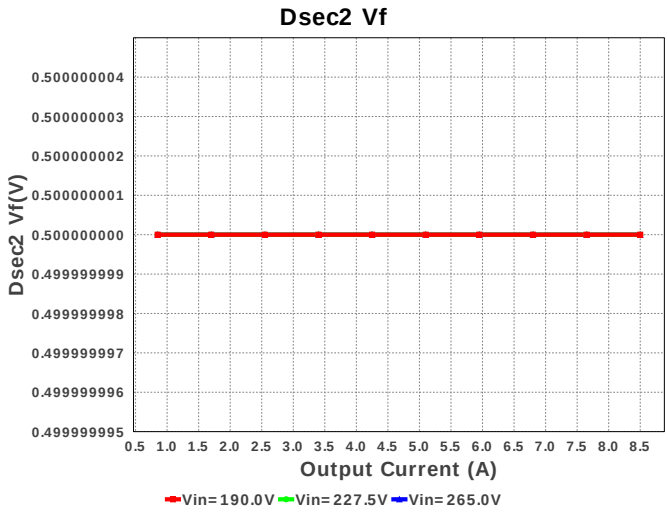


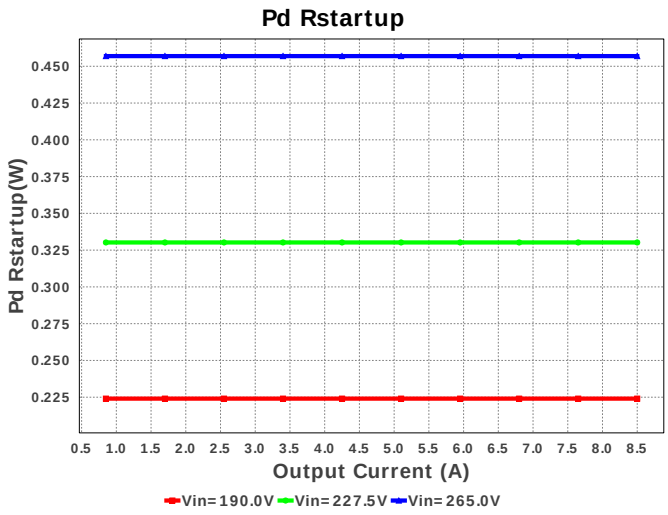


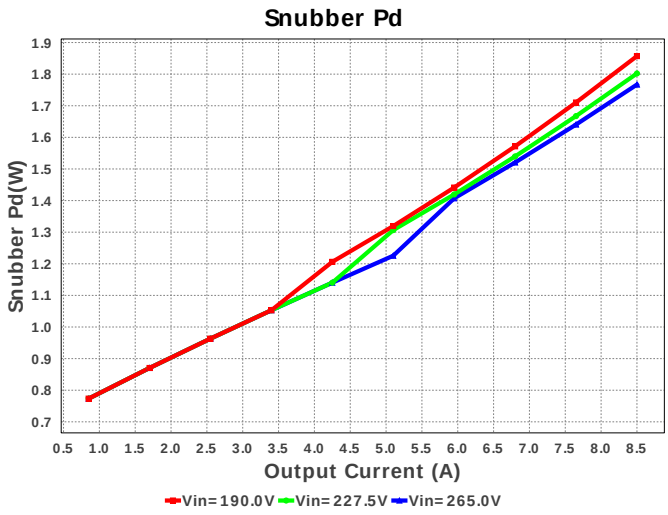


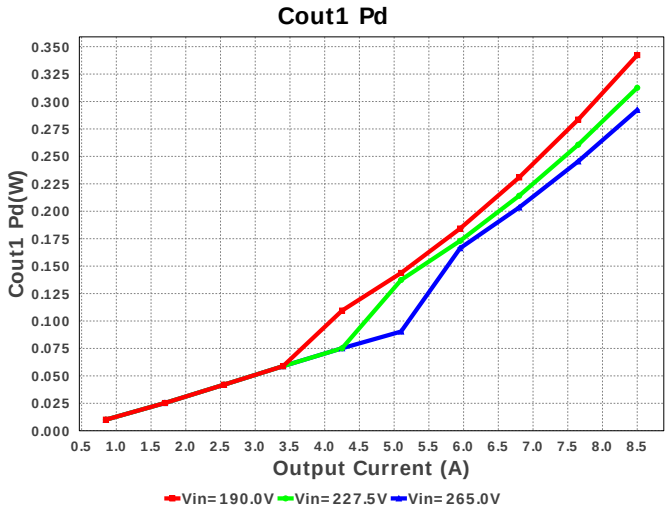


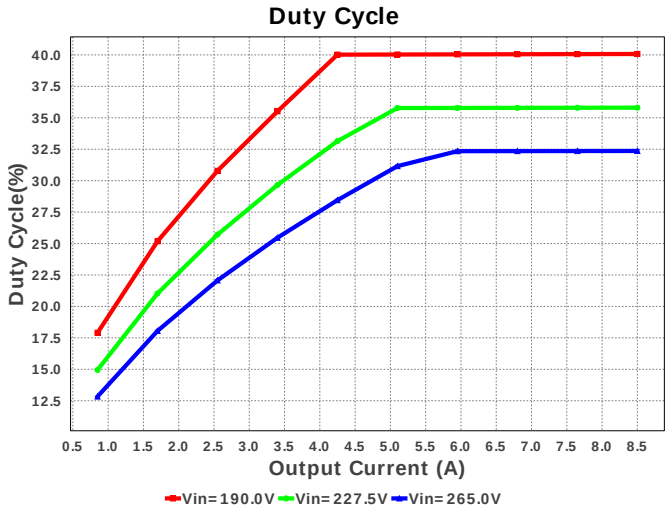


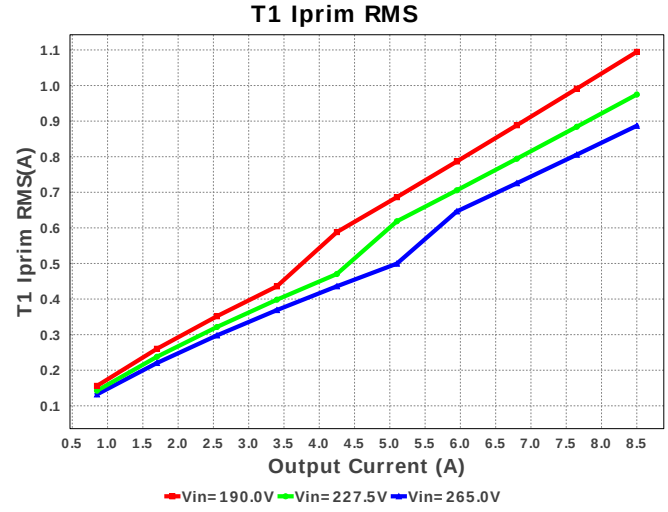


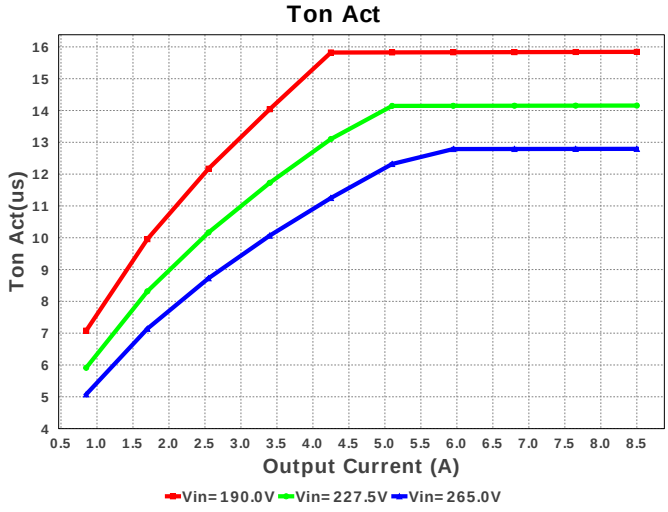


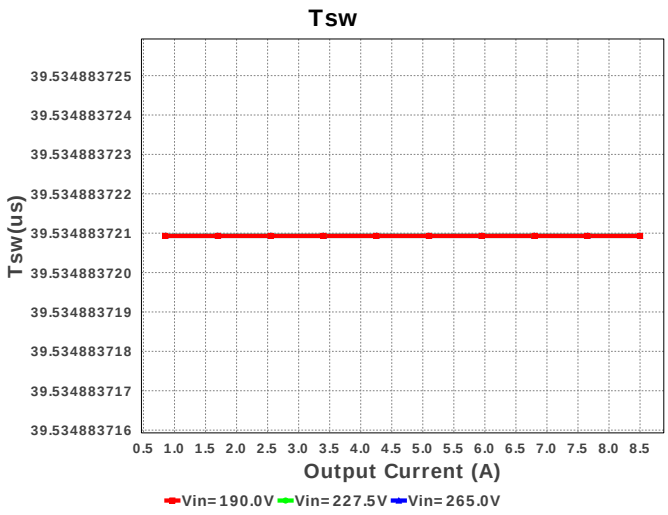


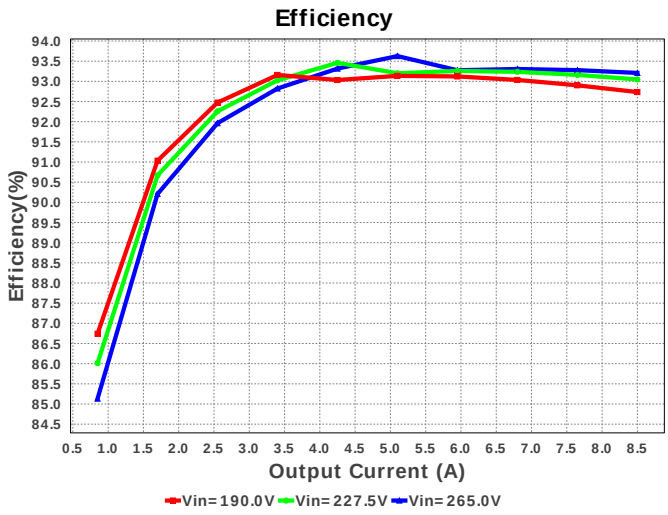


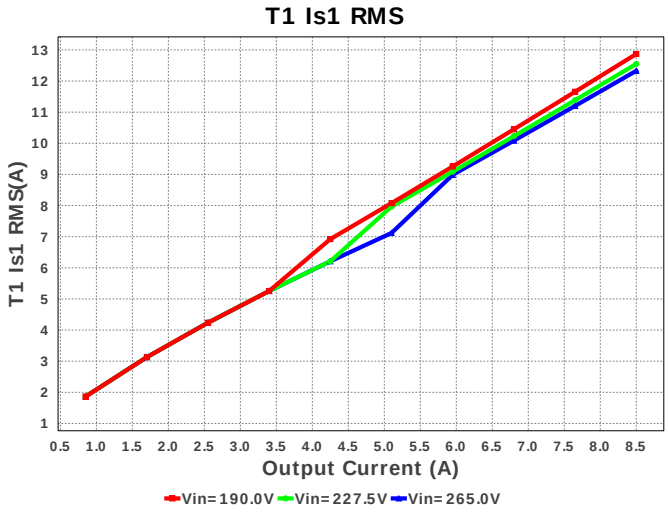


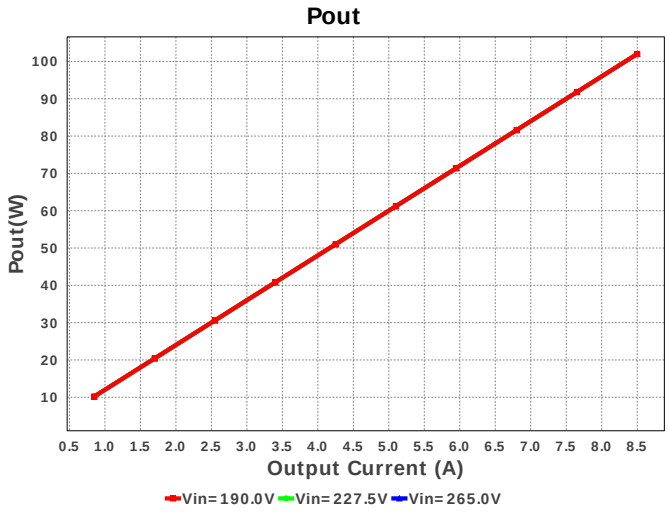


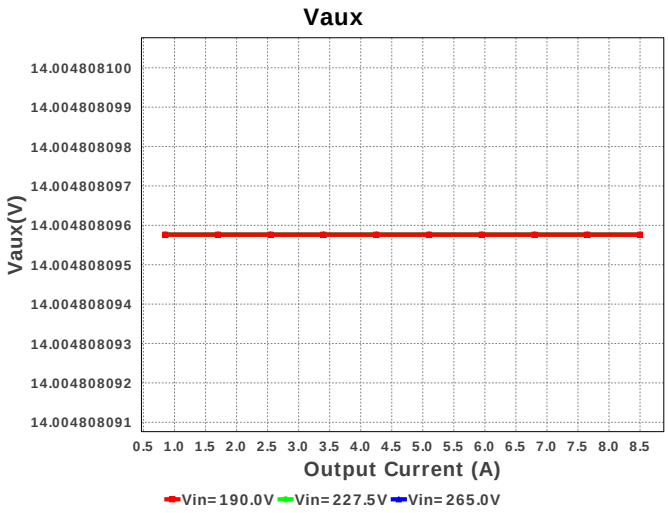


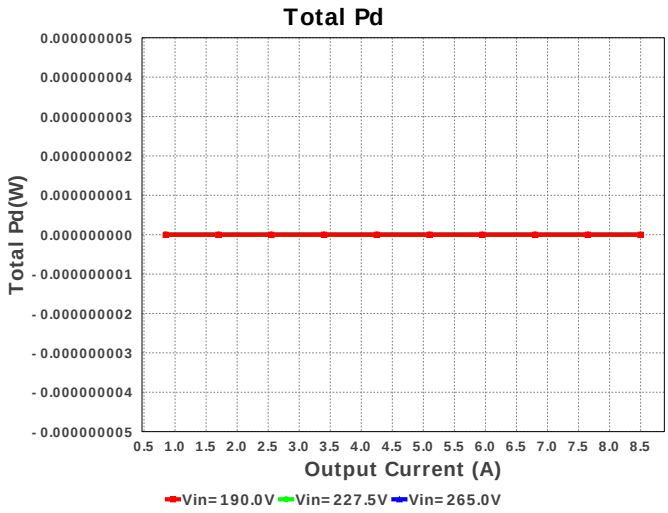


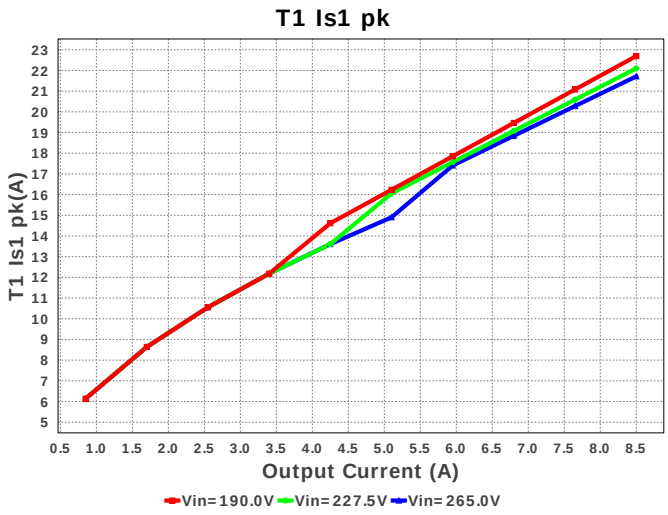


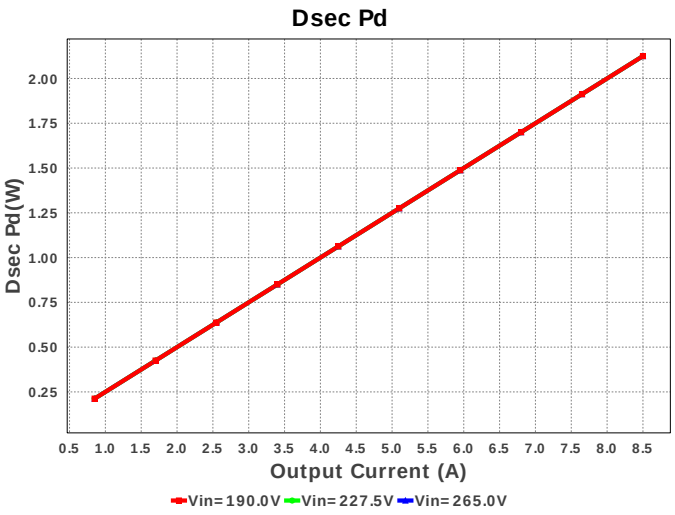


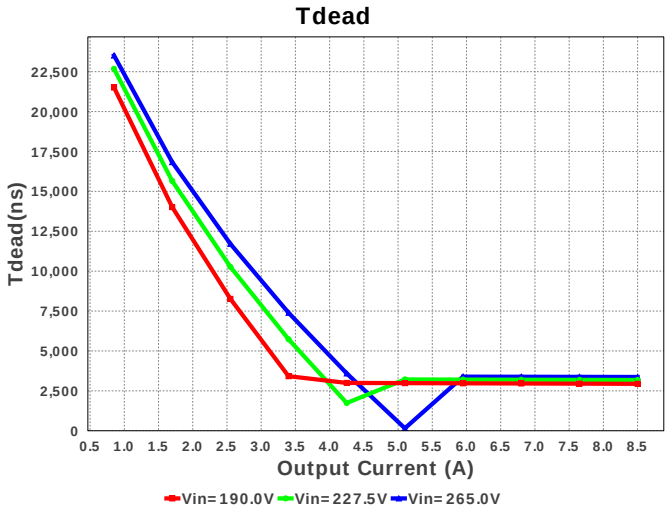


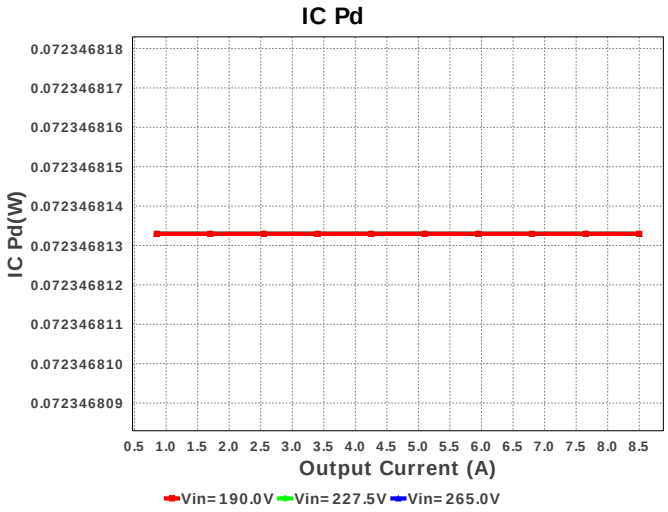


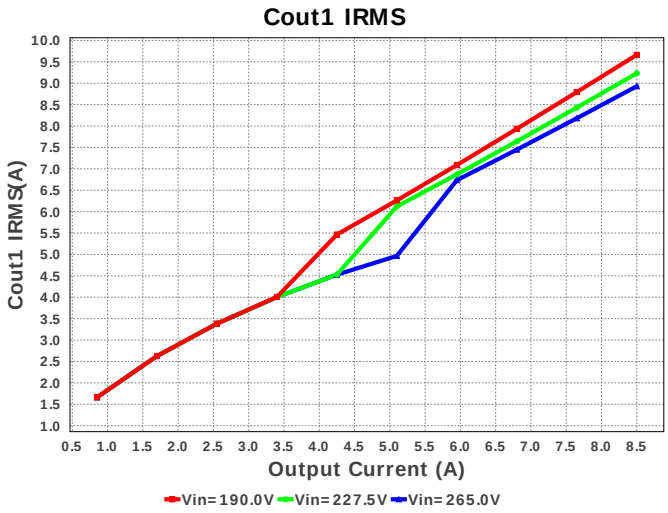


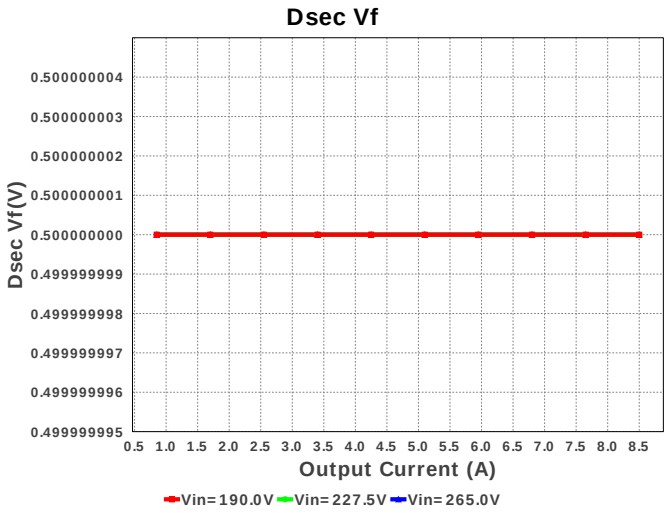


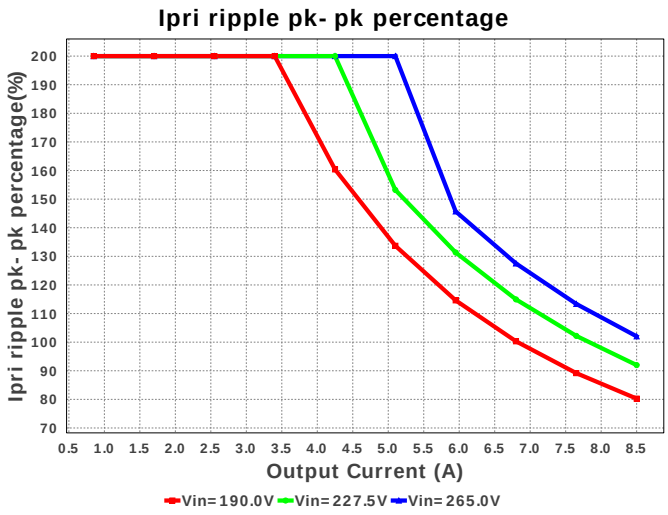


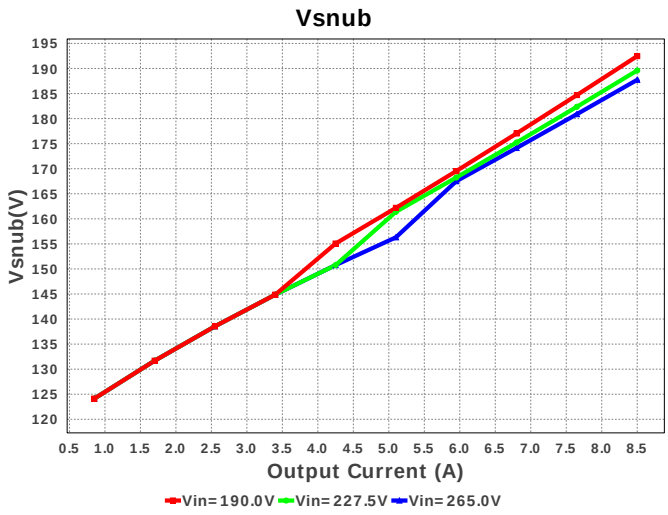


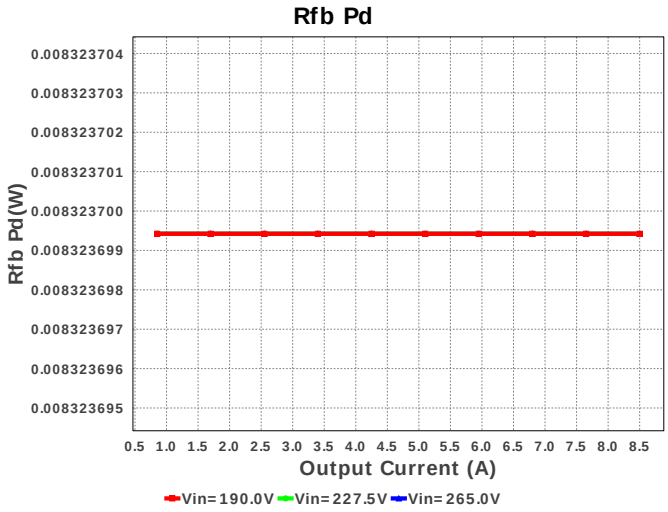


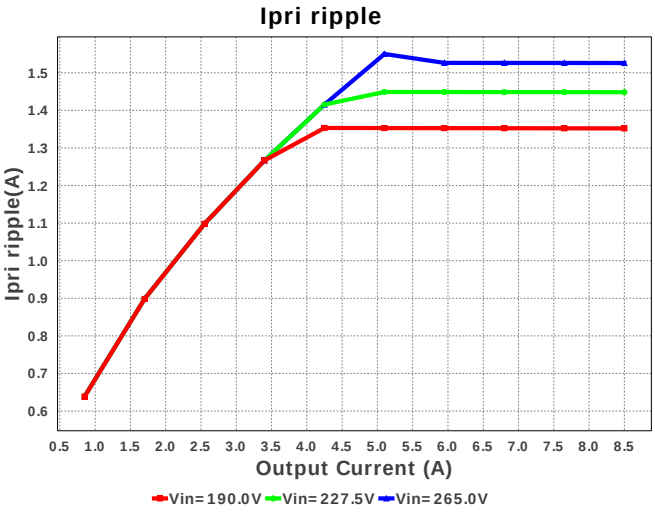


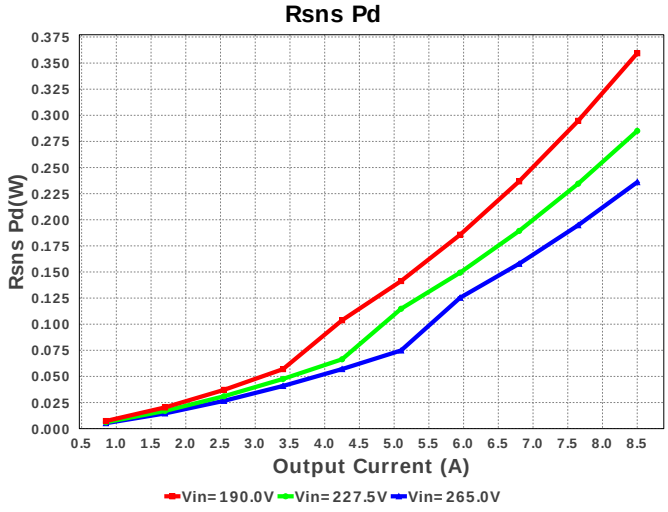


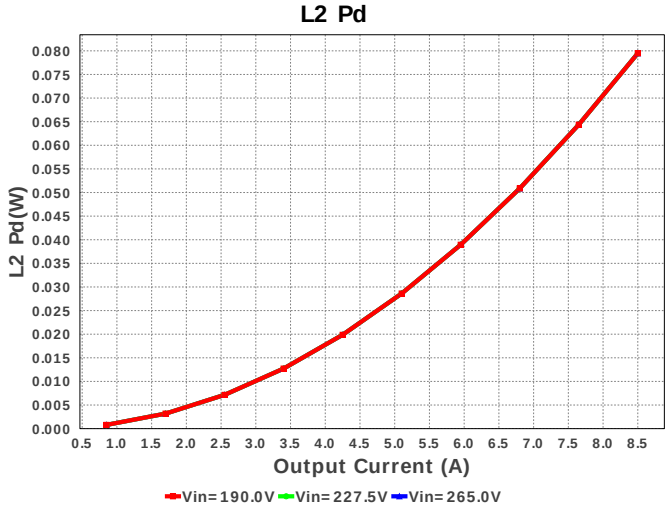


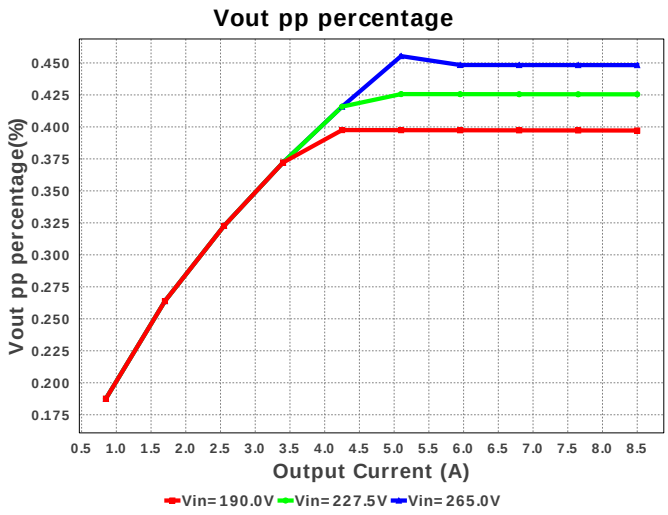


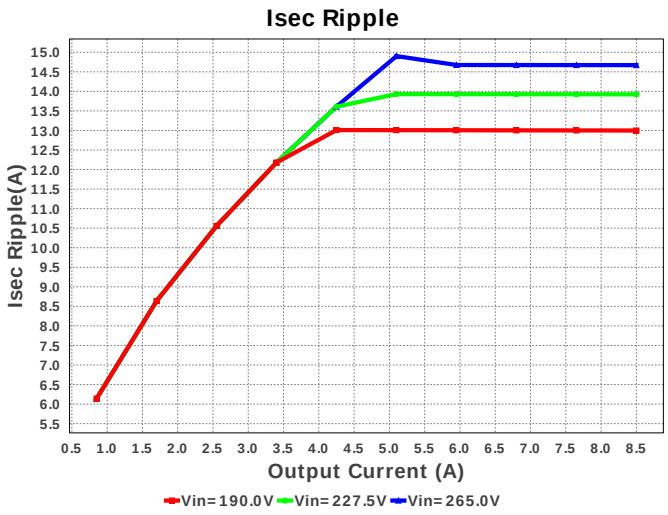


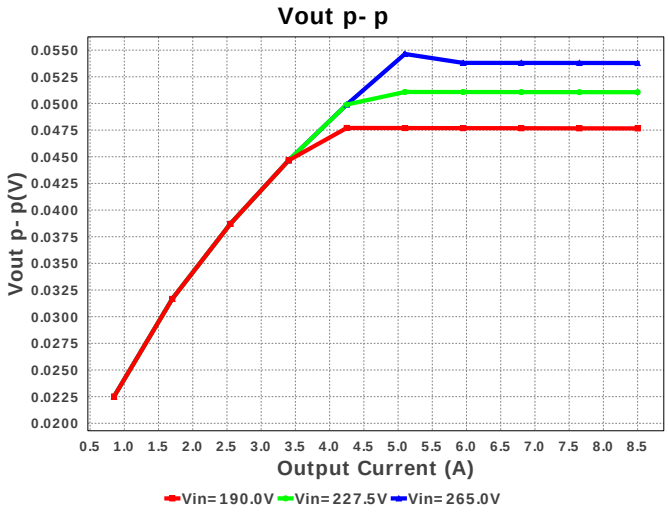


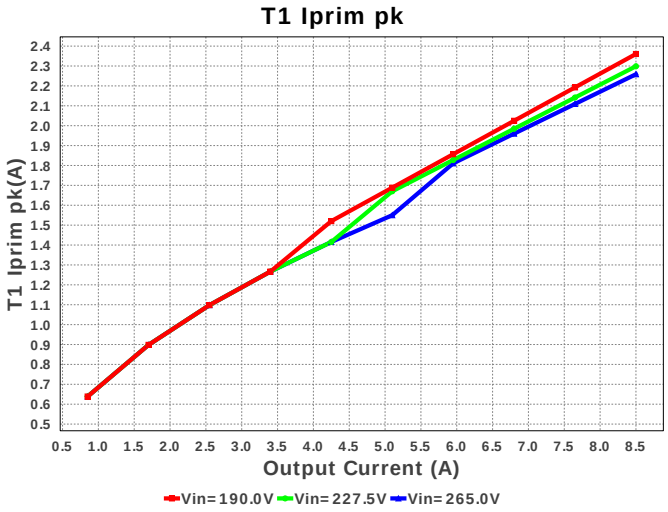












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	9.662 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	578.9 mA	Current	Average input current
3.	Iout_DCM	4.093 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	675.031 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.352 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	80.261 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	12.998 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.095 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	2.36 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	12.869 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	22.694 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	58	General	Total Design BOM count
13.	Daux trr	16.7 ns	General	Auxiliary Diode Reverse Recovery Time
14.	Dsec Vf	500.0 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	500.0 mV	General	Effective Forward Voltage Drop at the Operating Current
17.	Dsnub trr	0.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	4.238 k mm^2	General	Total Foot Print Area of BOM components
19.	Frequency	25.294 kHz	General	Switching frequency
20.	Mode	CCM	General	Conduction Mode
21.	Pout	102.0 W	General	Total output power
22.	Tdead	2.941 kns	General	Approximate Dead Time of the Regulator
23.	Toff	20.75 us	General	Approximate Converter Off Time
24.	Ton Act	15.843 us	General	Approximate Converter On Time
25.	Total BOM	$0.0	General	Total BOM Cost
26.	Tsw	39.535 us	General	Switching Time Period
27.	Vaux	14.005 V	General	Auxiliary Voltage
28.	Vsnub	192.471 V	General	Voltage Across the Snubber
29.	Vout Actual	11.99 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors

#	Name	Value	Category	Description
30.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
31.	Duty Cycle	40.074 %	Op_point	Duty cycle
32.	Efficiency	92.735 %	Op_point	Steady state efficiency
33.	IC Tj	33.617 degC	Op_point	IC junction temperature
34.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
35.	IOUT_OP	8.5 A	Op_point	Iout operating point
36.	M1 TjOP	46.769 degC	Op_point	M1 MOSFET junction temperature
37.	Vout p-p	47.659 mV	Op_point	Peak-to-peak output ripple voltage
38.	Cin Pd	5.764 mW	Power	Input capacitor power dissipation
39.	Cout1 Pd	342.294 mW	Power	Output capacitor1 power dissipation
40.	Dsec Pd	2.125 W	Power	Secondary Diode Power Dissipation
41.	Dsec2 Pd	2.125 W	Power	Secondary Diode Power Dissipation
42.	IC Pd	72.347 mW	Power	IC power dissipation
43.	L2 Pd	79.475 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
44.	M1 Pd	268.304 mW	Power	M1 MOSFET total power dissipation
45.	Paux	17.488 mW	Power	Power Dissipation in Raux and Daux
46.	Pd Rstartup	224.039 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
47.	Rdrv Pd	43.934 µW	Power	Power Dissipation in Gate Drive Resistor
48.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
49.	Rsns Pd	359.43 mW	Power	Current Limit Sense Resistor Power Dissipation
50.	Snubber Pd	1.857 W	Power	Snubber Power Dissipation
51.	T1 Pd	4.933 W	Power	Estimated Losses in Transformer
52.	Total Pd	0.0 W	Power	Total Power Dissipation
53.	Vout Tolerance	1.926 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
54.	Vout pp percentage	397.162 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	8.5	Maximum Output Current
2.	VinMax	265.0	Maximum input voltage
3.	VinMin	190.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	UCC28C44	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature
8.	userfsw	47.253 k	Customer Selected Frequency

Design Assistance

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