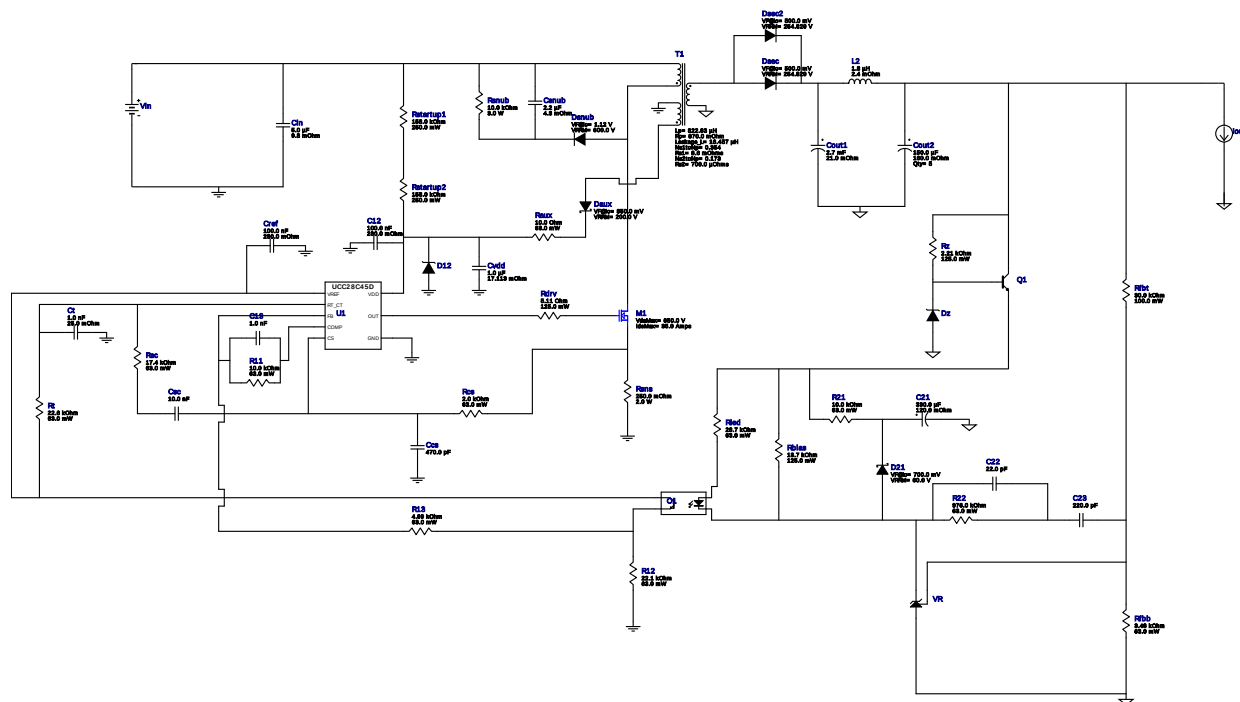
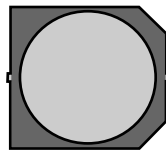


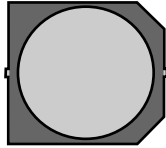
WEBENCH® Design Report

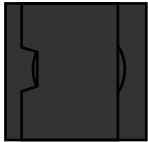
Design : 3496425/82 UCC28C45DR
UCC28C45DR 110.0V-220.0V to 24.00V @ 3.0A



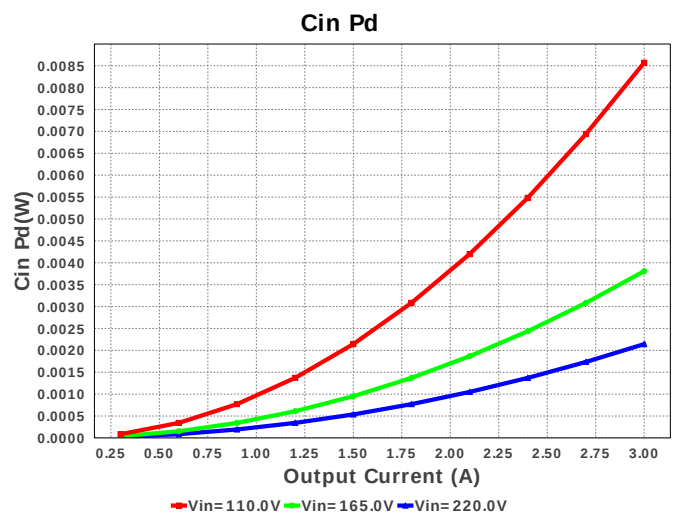
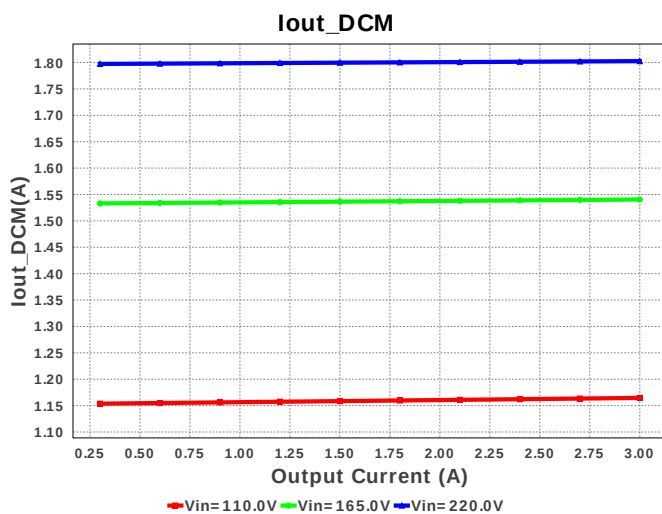
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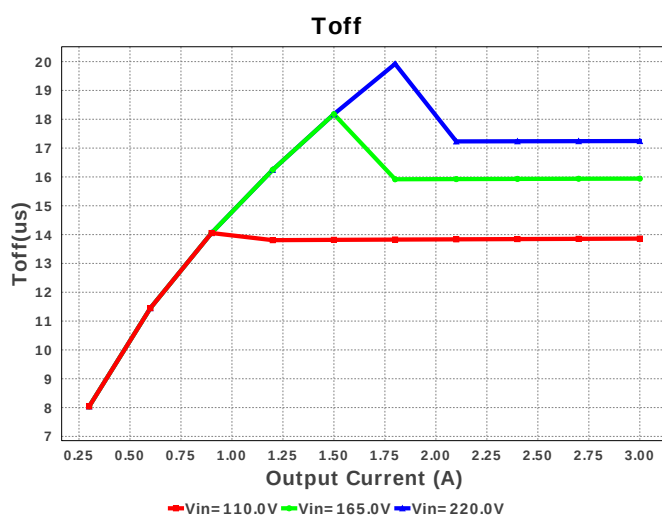
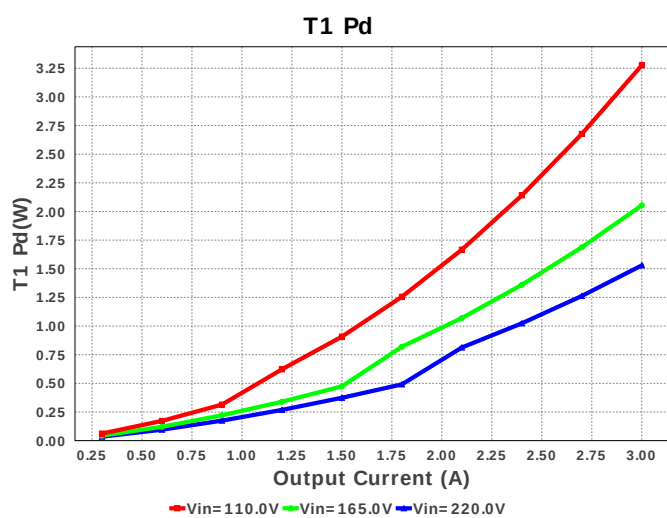
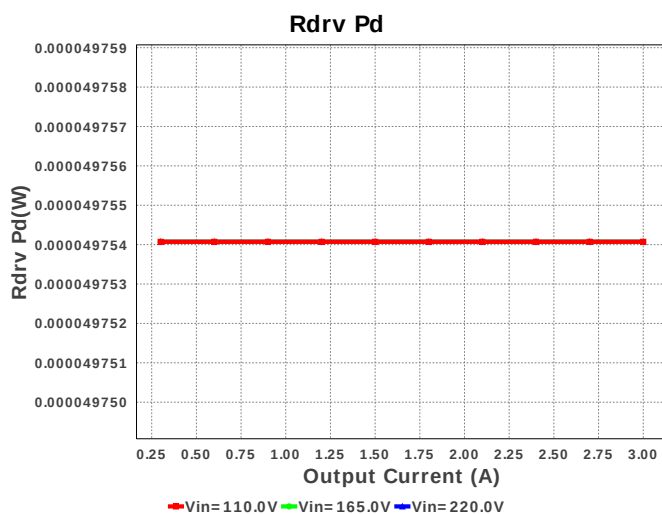
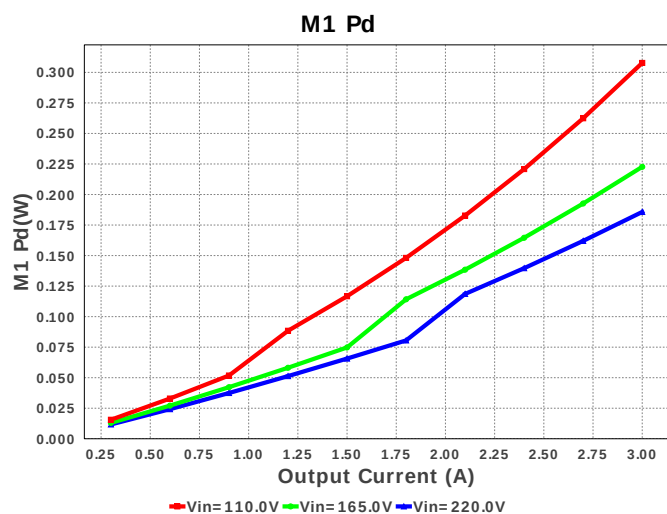
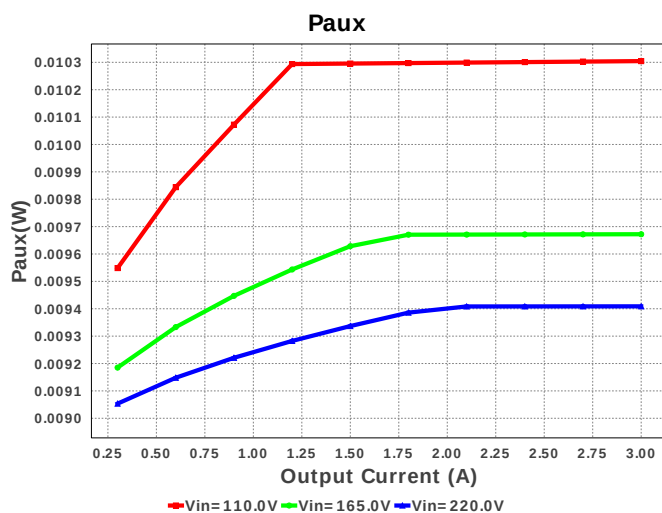
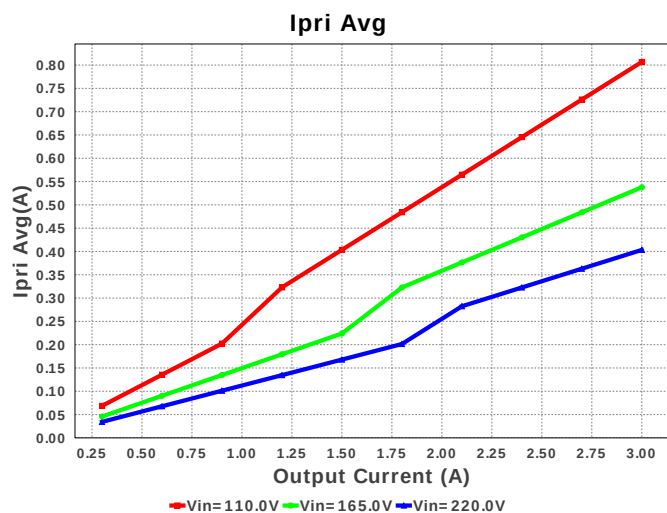
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1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
3.	C21	Panasonic	EEV-FK1H331Q Series= FK	Cap= 330.0 uF ESR= 120.0 mOhm VDC= 50.0 V IRMS= 900.0 mA	1	\$0.48	 SM_RADIAL_H13 264 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	CC0805JRNPO9BN221 Series= C0G/NP0	Cap= 220.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
6.	Ccs	Yageo America	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²

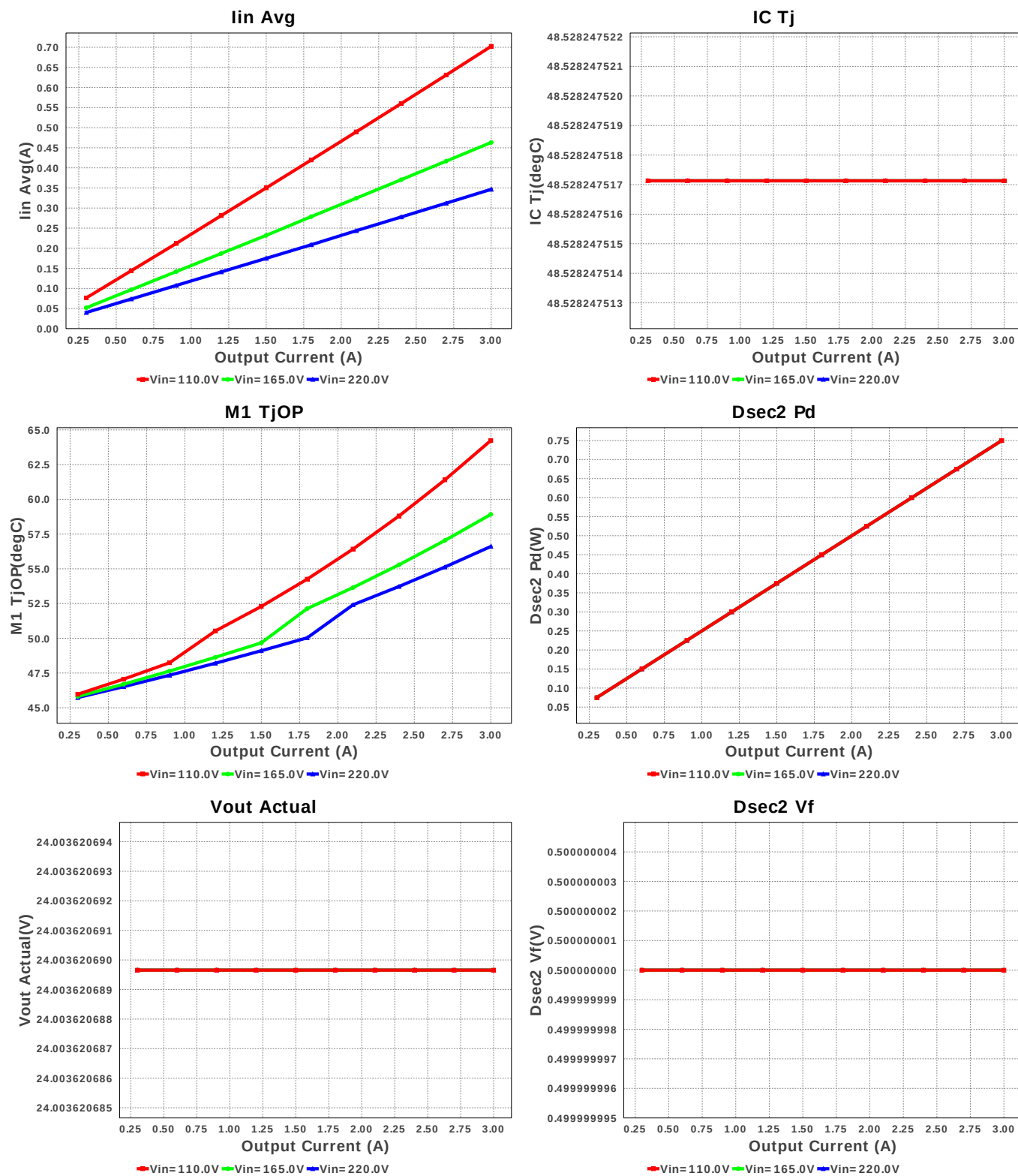
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7.	Cin	TDK	B32774D1505K Series= B32774	Cap= 5.0 uF ESR= 9.8 mOhm VDC= 1.3 kV IRMS= 10.5 A	1	\$3.08	 B32774_3150x2200x3650 804 mm ²
8.	Cout1	TDK	B41605A8278M009 Series= 2385	Cap= 2.7 mF ESR= 21.0 mOhm VDC= 63.0 V IRMS= 5.3 A	1	\$12.37	B41605_2500x4000_9 729 mm ²
9.	Cout2	Panasonic	EEV-FK1J151Q Series= FK	Cap= 150.0 uF ESR= 160.0 mOhm VDC= 63.0 V IRMS= 800.0 mA	5	\$0.51	 SM_RADIAL_H13 264 mm ²
10.	Cref	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
11.	Csc	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
12.	Csnub	TDK	C5750X6S2W225K Series= X6S	Cap= 2.2 uF ESR= 4.3 mOhm VDC= 400.0 V IRMS= 0.0 A	1	NA	 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.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
16.	D21	Diodes Inc.	B260A-13-F	VF@Io= 700.0 mV VRRM= 60.0 V	1	\$0.09	 SMA 37 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	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 254.829 V	1	NA	CUSTOM 0 mm ²
19.	Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 254.829 V	1	NA	CUSTOM 0 mm ²
20.	Dsnub	Bourns	CD214C-F3600	VF@Io= 1.12 V VRRM= 600.0 V	1	\$0.18	 SMC 83 mm ²
21.	Dz	Diodes Inc.	MMSZ5250B-7-F	Zener	1	\$0.03	 SOD-123 13 mm ²

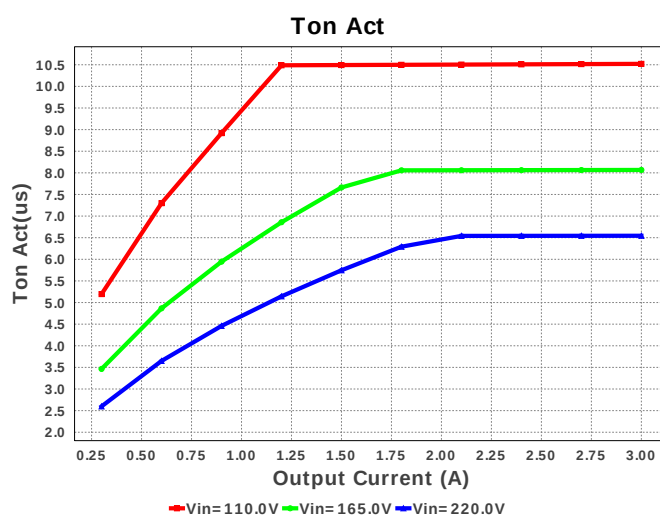
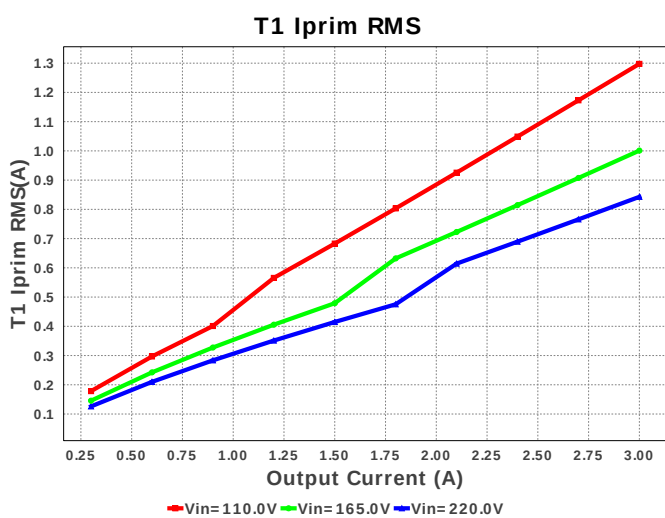
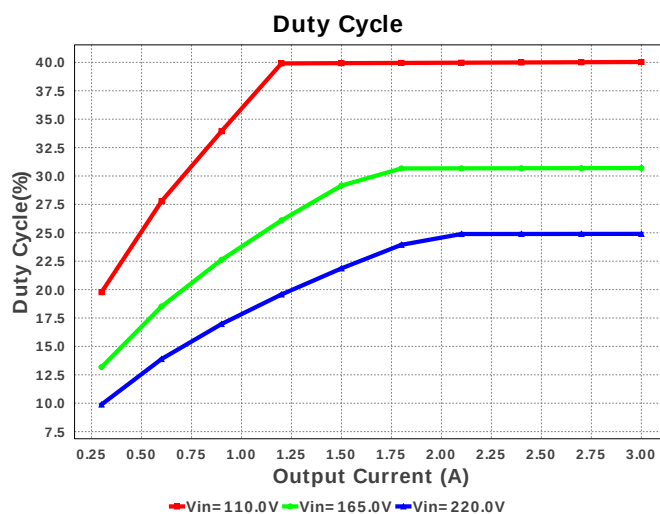
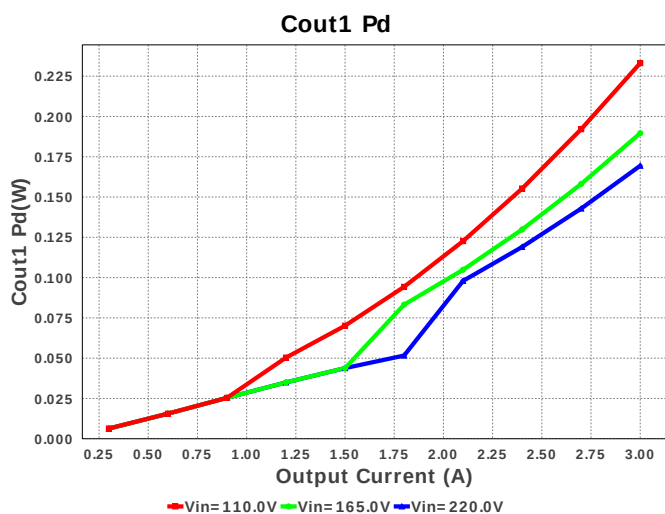
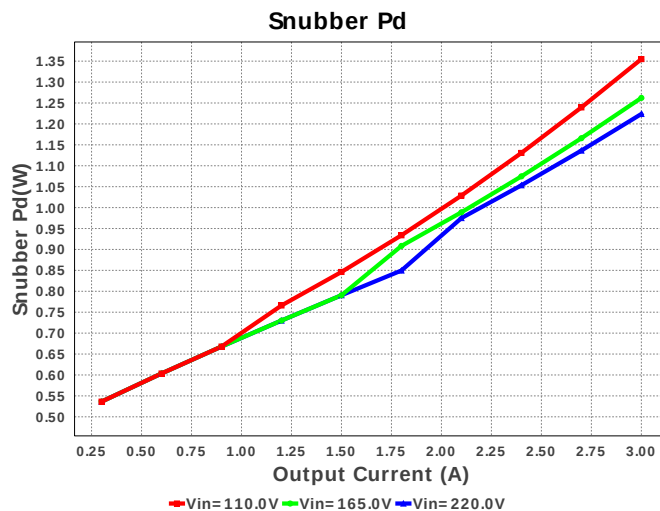
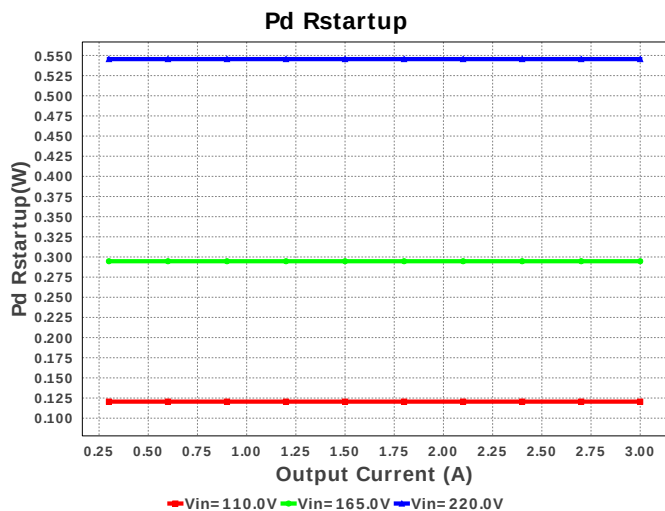
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
22.	L2	Coilcraft	SER1360-182KLB	L= 1.8 μ H DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
23.	M1	STMicroelectronics	STP45N65M5	VdsMax= 650.0 V IdsMax= 35.0 Amps	1	\$3.85	 TO-220AB 397 mm ²
24.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 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	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 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	CRCW0402976KFKED Series= CRCW..e3	Res= 976.0 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	Panasonic	ERJ-6ENF1372V Series= ERJ-6E	Res= 13.7 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 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	CRCW08055R11FKEA Series= CRCW..e3	Res= 5.11 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
35.	Rfbb	Vishay-Dale	CRCW04023K48FKED Series= CRCW..e3	Res= 3.48 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
36.	Rfbt	Yageo America	RC0603FR-0730KL Series= ?	Res= 30.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
37.	Rled	Vishay-Dale	CRCW040228K7FKED Series= CRCW..e3	Res= 28.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
38.	Rsc	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
39.	Rsns	Stackpole Electronics Inc	CSRN2512FKR250 Series= ?	Res= 250.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	\$0.13	 2512 43 mm ²

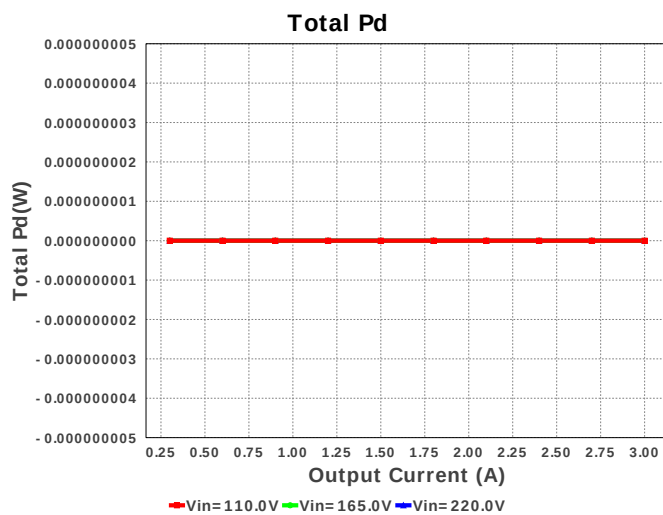
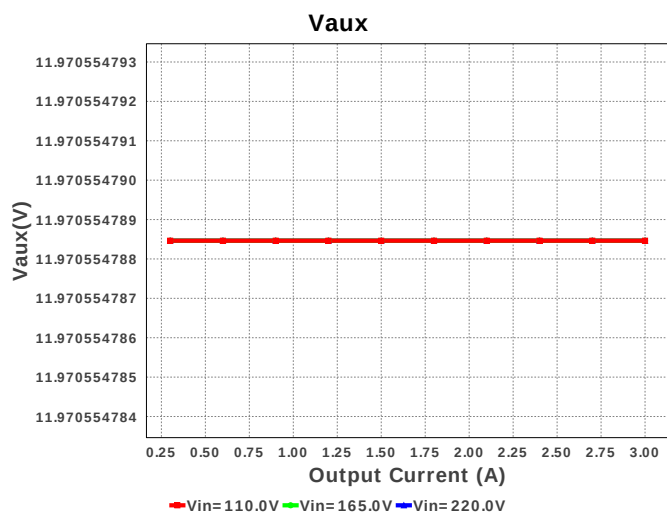
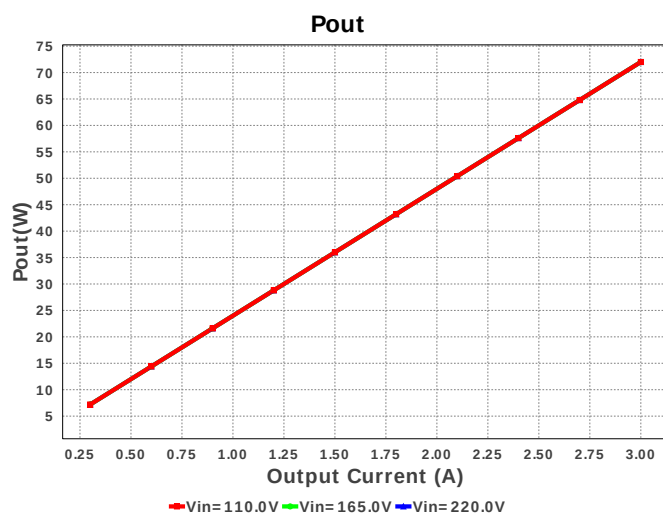
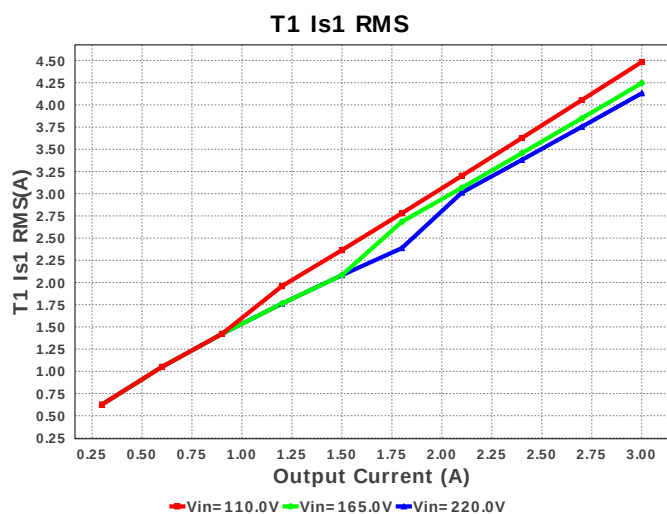
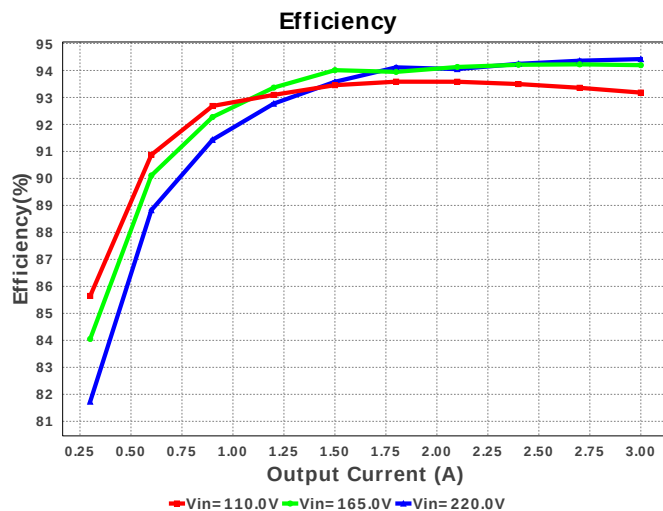
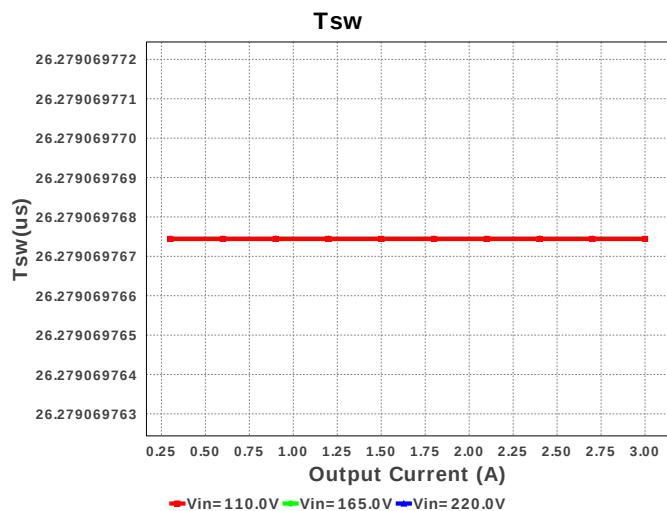
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
40.	Rsnub	Vishay-Bccomponents	PR03000201002JAC00 Series= ?	Res= 10.0 kOhm Power= 3.0 W Tolerance= 5.0%	1	\$0.19	 PR03 0 mm²
41.	Rstartup1	Panasonic	ERJ-8ENF1583V Series= ERJ-8E	Res= 158.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
42.	Rstartup2	Panasonic	ERJ-8ENF1583V Series= ERJ-8E	Res= 158.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
43.	Rt	Vishay-Dale	CRCW040222K6FKED Series= CRCW..e3	Res= 22.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
44.	Rz	Panasonic	ERJ-6ENF2211V Series= ERJ-6E	Res= 2.21 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
45.	T1	CUSTOM	CUSTOM	Lp= 822.83 µH Rp= 870.0 mOhm Leakage_L= 16.457 µH Ns1toNp= 0.354 Rs1= 8.6 mOhms Ns2toNp= 0.173 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
46.	U1	Texas Instruments	UCC28C45DR	Switcher	1	\$0.60	 D0008A 57 mm²
47.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm²

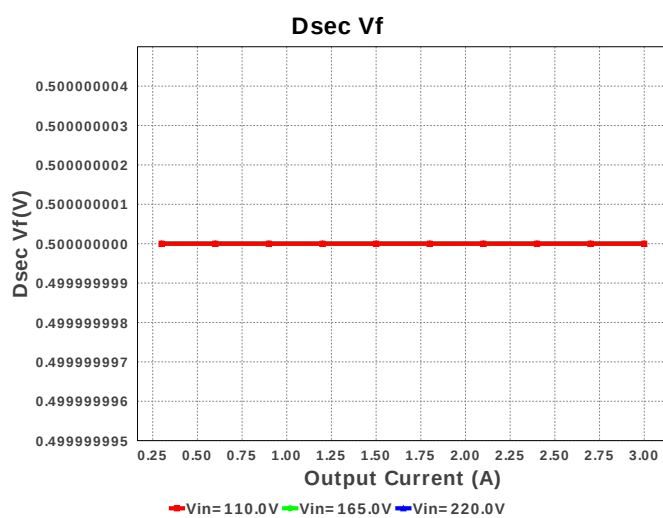
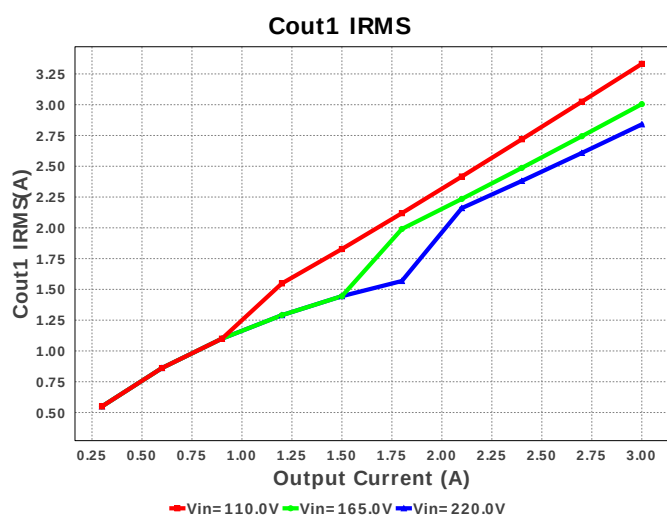
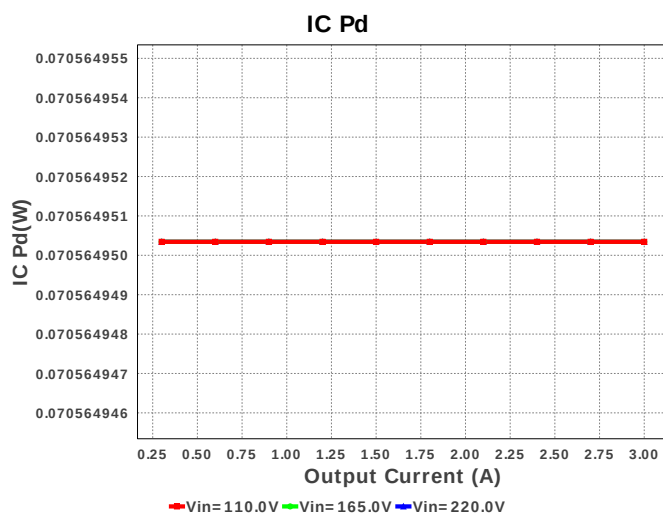
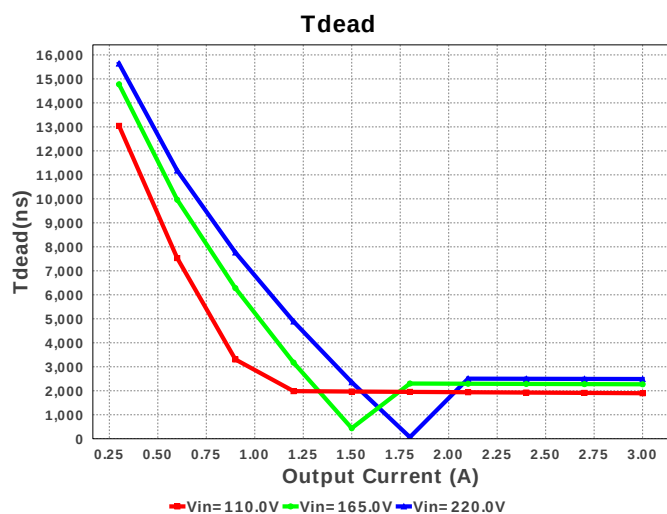
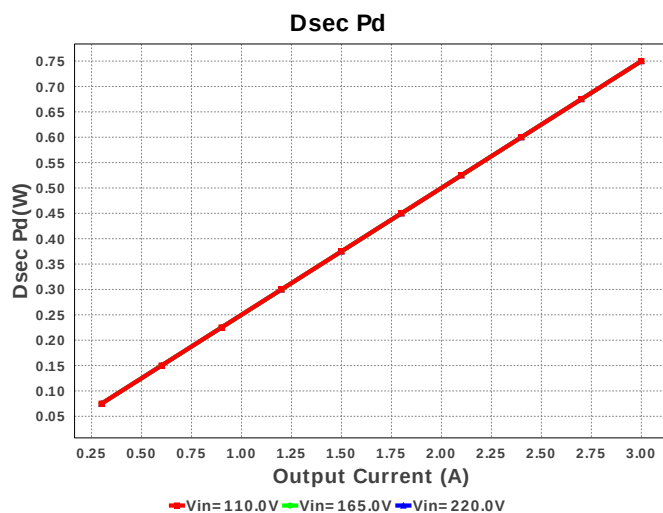
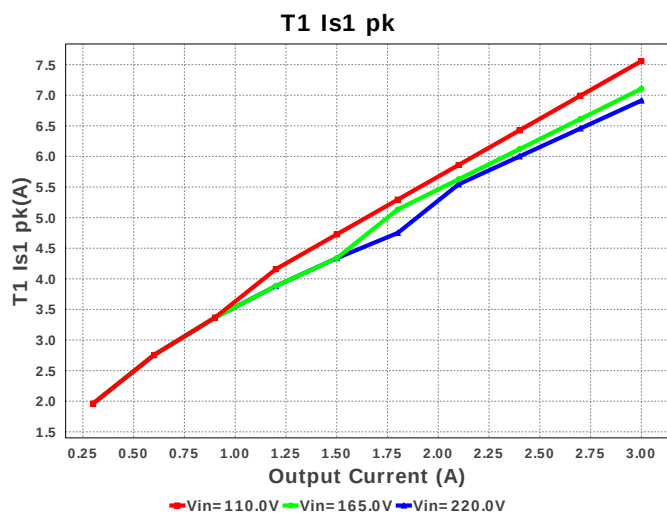


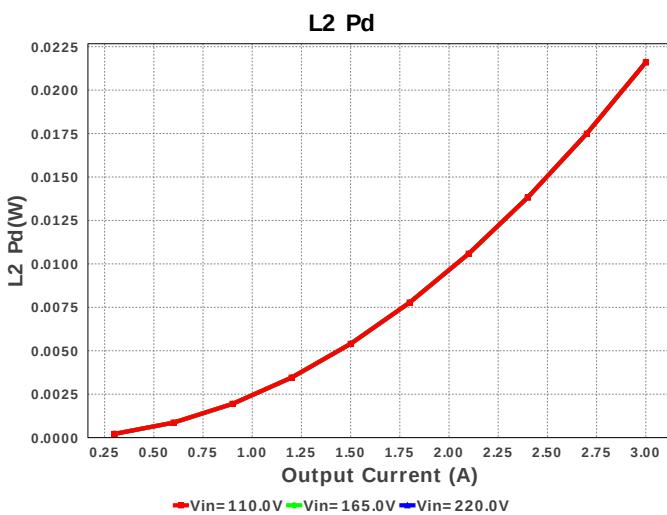
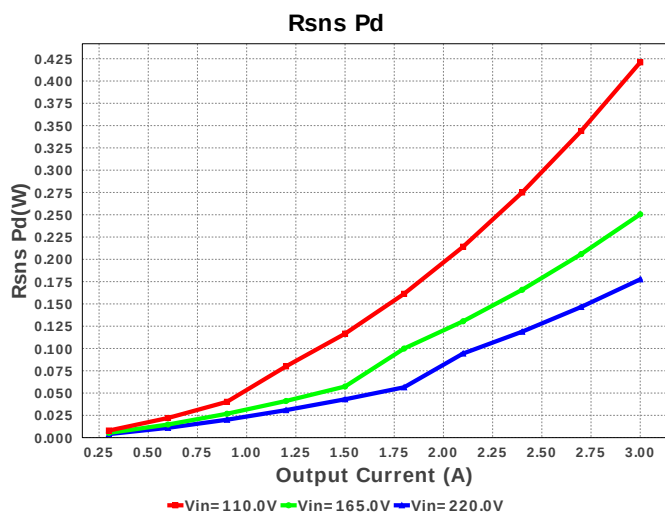
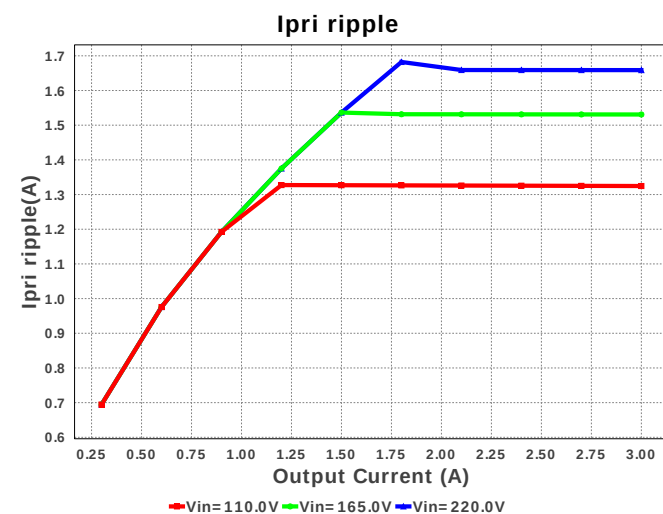
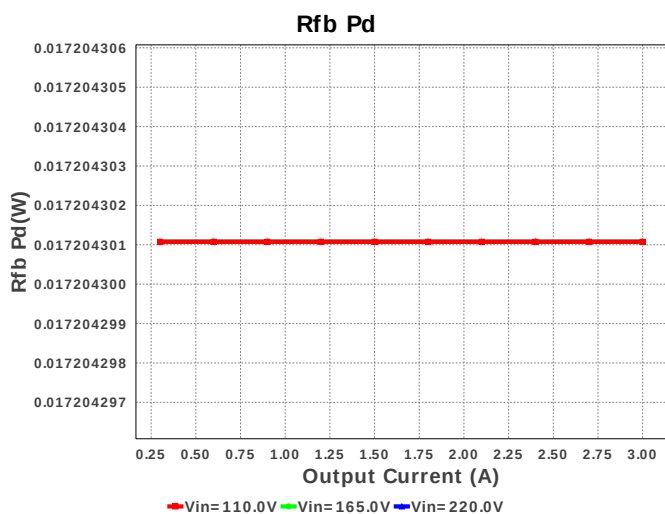
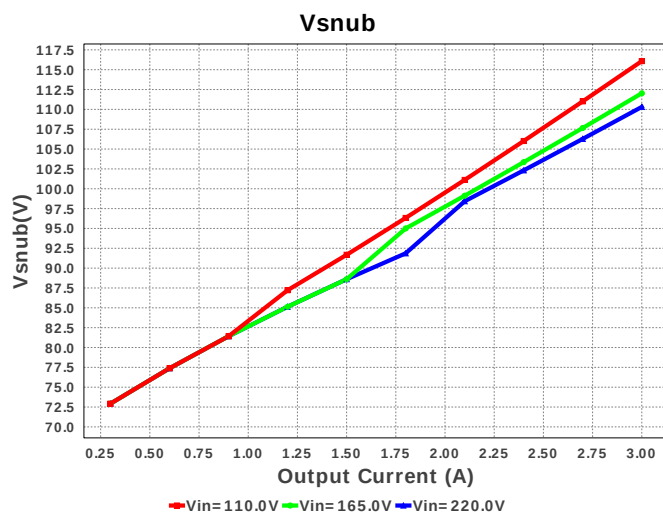
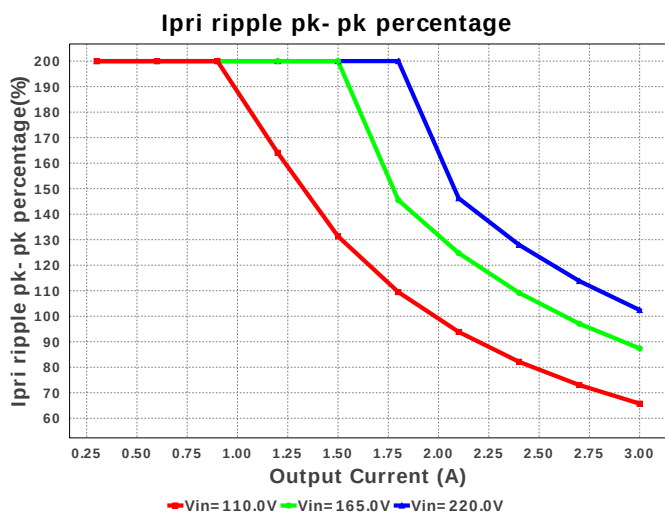


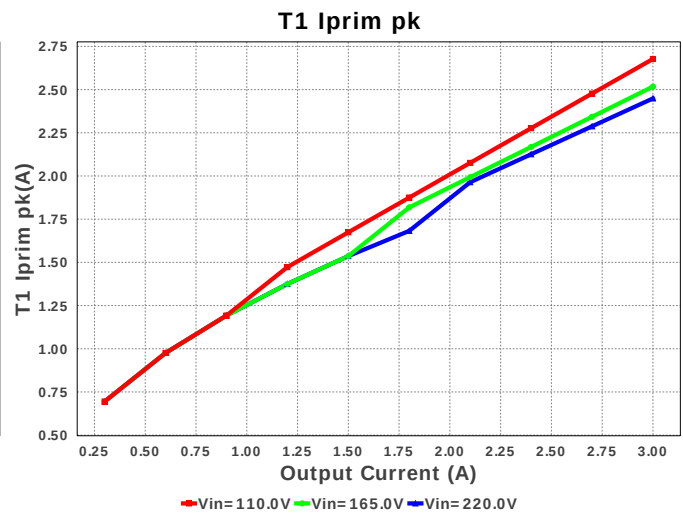
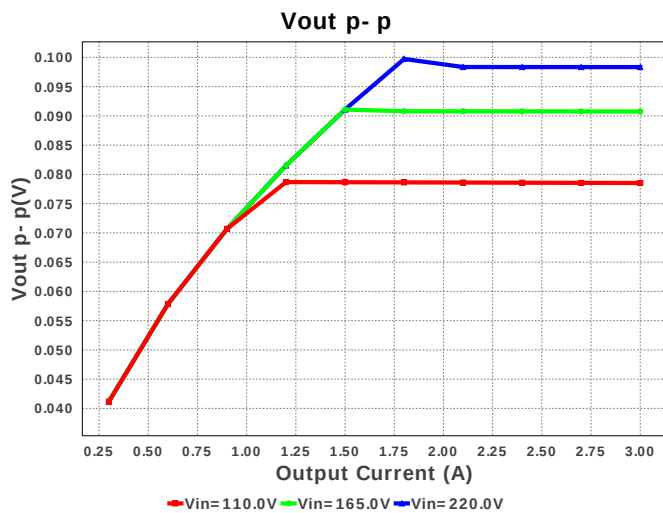
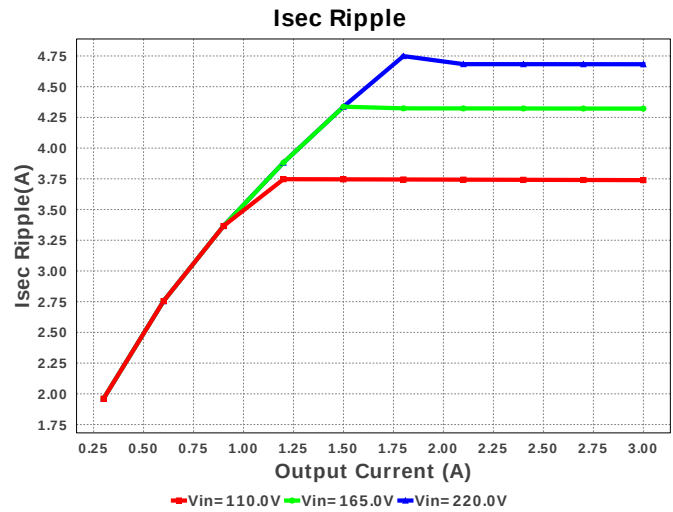
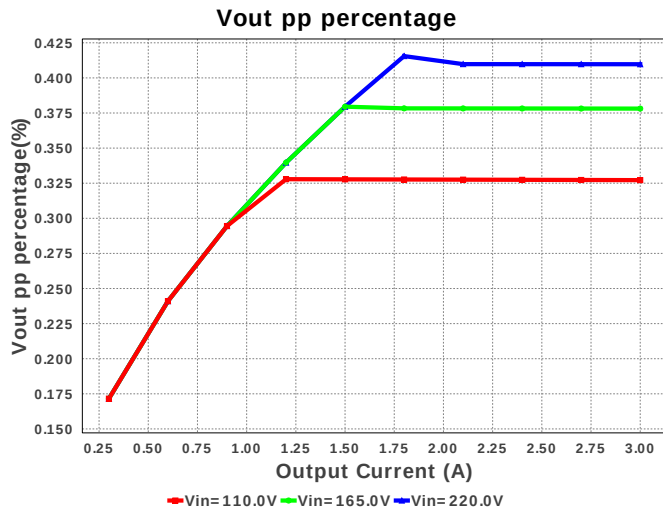












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	3.332 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	702.452 mA	Current	Average input current
3.	Iout_DCM	1.165 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	806.647 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.325 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	65.739 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.739 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.298 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	2.677 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	4.483 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	7.558 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	51	General	Total Design BOM count
13.	Daux trr	0.0 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	60.0 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	30.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	4.282 k mm ²	General	Total Foot Print Area of BOM components
19.	Frequency	38.053 kHz	General	Switching frequency
20.	Pout	72.0 W	General	Total output power
21.	Tdead	1.898 kns	General	Approximate Dead Time of the Regulator
22.	Toff	13.86 us	General	Approximate Converter Off Time
23.	Ton Act	10.521 us	General	Approximate Converter On Time
24.	Total BOM	\$0.0	General	Total BOM Cost
25.	Tsw	26.279 us	General	Switching Time Period
26.	Vaux	11.971 V	General	Auxiliary Voltage
27.	Vsnub	116.083 V	General	Voltage Across the Snubber
28.	Vout Actual	24.004 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
29.	Vout OP	24.0 V	Op_Point	Operational Output Voltage

#	Name	Value	Category	Description
30.	Duty Cycle	40.034 %	Op_point	Duty cycle
31.	Efficiency	93.18 %	Op_point	Steady state efficiency
32.	IC Tj	48.528 degC	Op_point	IC junction temperature
33.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
34.	IOUT_OP	3.0 A	Op_point	Iout operating point
35.	M1 TjOP	64.234 degC	Op_point	M1 MOSFET junction temperature
36.	Vout p-p	78.524 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	8.569 mW	Power	Input capacitor power dissipation
38.	Cout1 Pd	233.092 mW	Power	Output capacitor1 power dissipation
39.	Dsec Pd	750.0 mW	Power	Secondary Diode Power Dissipation
40.	Dsec2 Pd	750.0 mW	Power	Secondary Diode Power Dissipation
41.	IC Pd	70.565 mW	Power	IC power dissipation
42.	L2 Pd	21.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
43.	M1 Pd	307.739 mW	Power	M1 MOSFET total power dissipation
44.	Paux	10.304 mW	Power	Power Dissipation in Raux and Daux
45.	Pd Rstartup	120.551 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
46.	Rdrv Pd	49.754 μ W	Power	Power Dissipation in Gate Drive Resistor
47.	Rfb Pd	17.204 mW	Power	Rfb Power Dissipation
48.	Rsns Pd	420.959 mW	Power	Current Limit Sense Resistor Power Dissipation
49.	Snubber Pd	1.355 W	Power	Snubber Power Dissipation
50.	T1 Pd	3.276 W	Power	Estimated Losses in Transformer
51.	Total Pd	0.0 W	Power	Total Power Dissipation
52.	Vout Tolerance	2.137 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout pp percentage	327.185 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	Iout1	3.0	Output Current #1
3.	Iout2	1.0	Output Current #2
4.	Iout3	1.0	Output Current #3
5.	VinMax	220.0	Maximum input voltage
6.	VinMin	110.0	Minimum input voltage
7.	Vout	24.0	Output Voltage
8.	Vout1	24.0	Output Voltage #1
9.	Vout2	12.0	Output Voltage #2
10.	Vout3	5.0	Output Voltage #3
11.	base_pn	UCC28C45	Texas Instruments Base Part Number
12.	source	DC	Input Source Type
13.	ta	45.0	Ambient temperature

Design Assistance

1. UCC28C45 Product Folder : <http://www.ti.com/product/UCC28C45> : contains the data sheet and other resources.

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