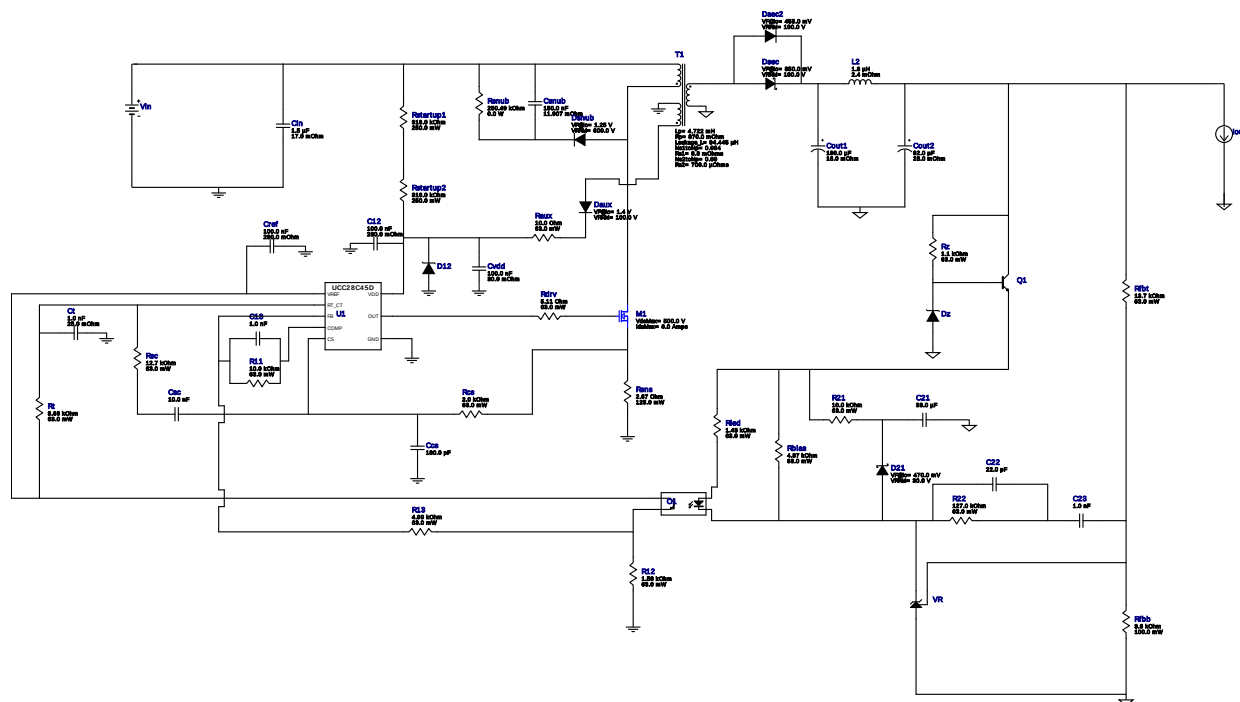


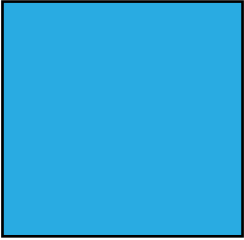
WEBENCH[®] Design Report

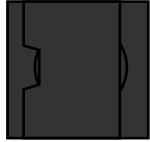
Design : 3943027/8 UCC28C45DR
UCC28C45DR 210.0V-230.0V to 12.00V @ 1.0A



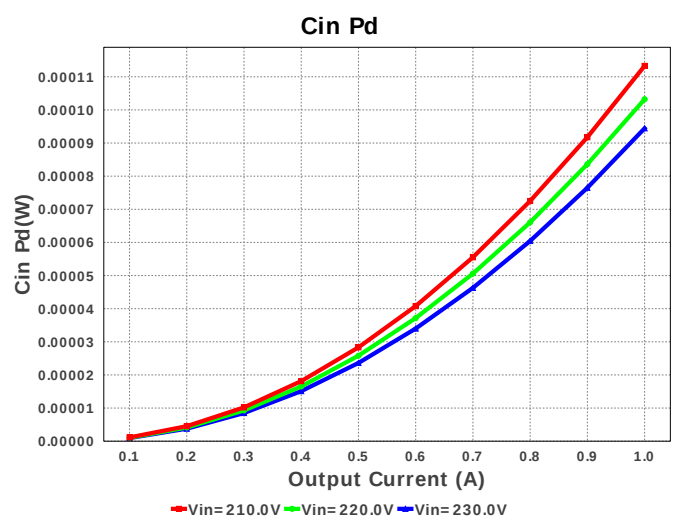
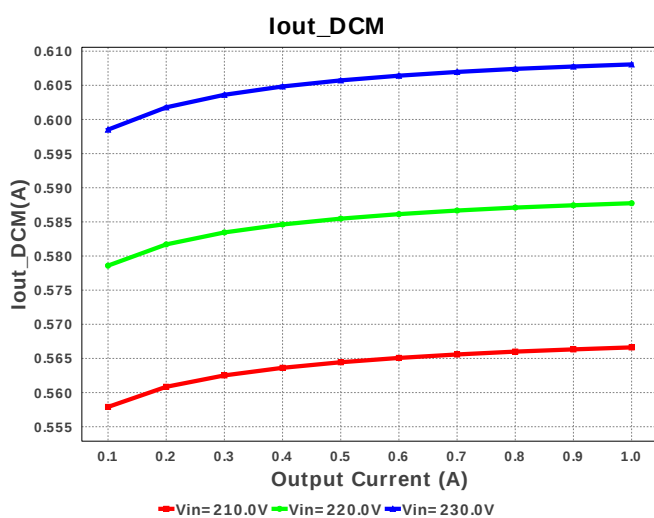
Electrical BOM

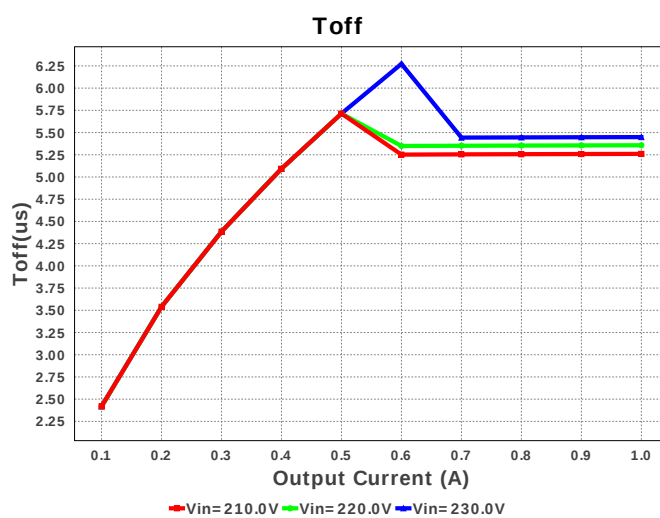
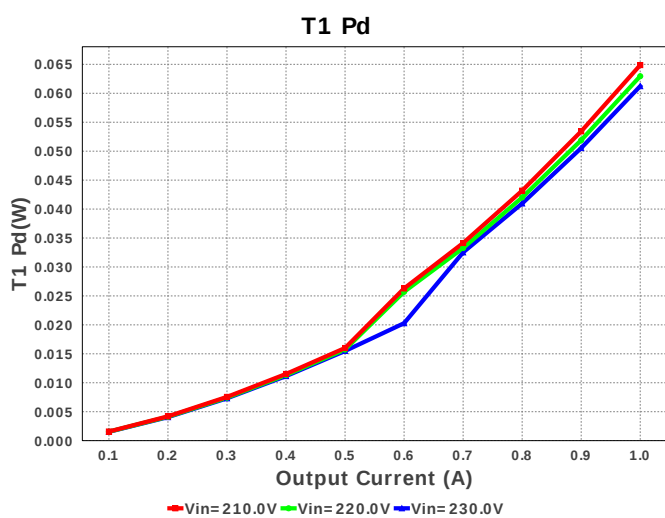
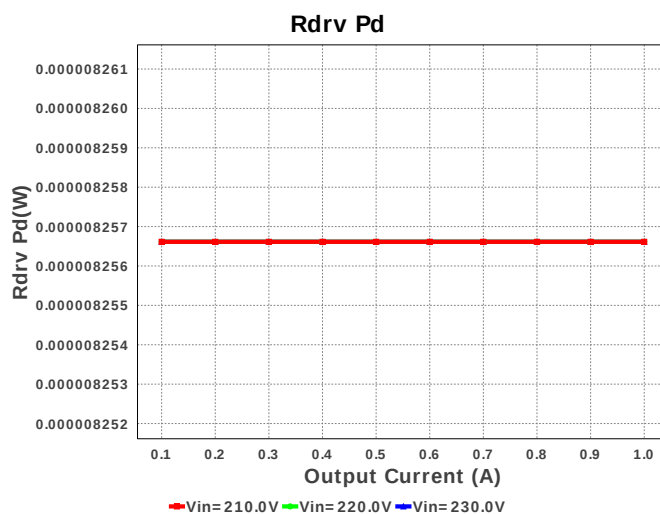
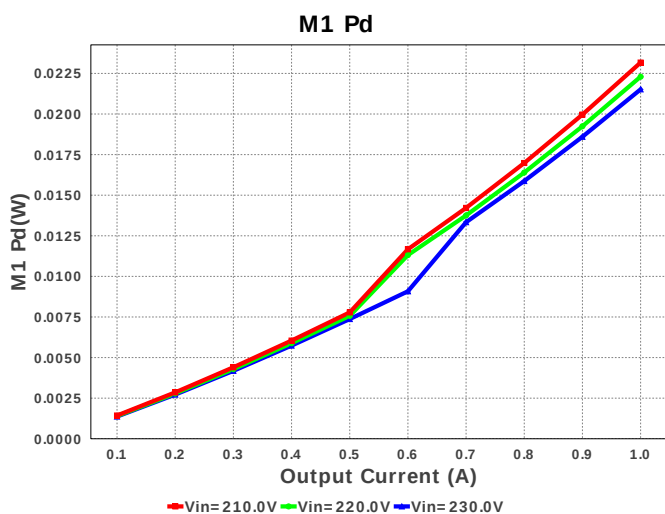
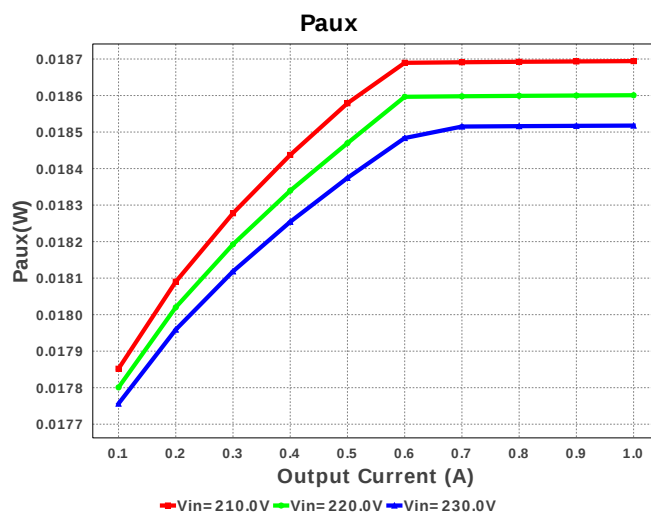
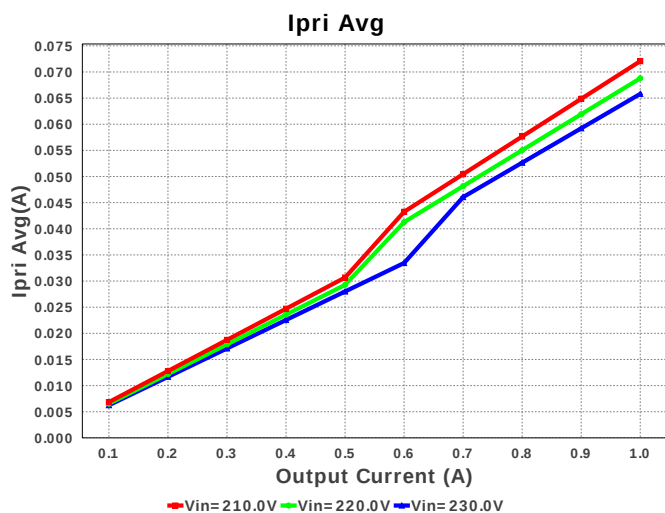
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1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
3.	C21	MuRata	KCM55WR7YA336MH01K Series= X7R	Cap= 33.0 uF VDC= 35.0 V IRMS= 0.0 A	1	\$1.51	KCM55W 59 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	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
6.	Ccs	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²

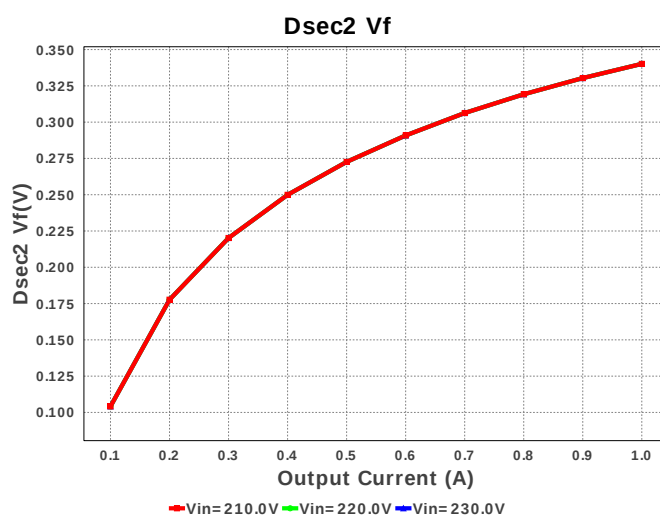
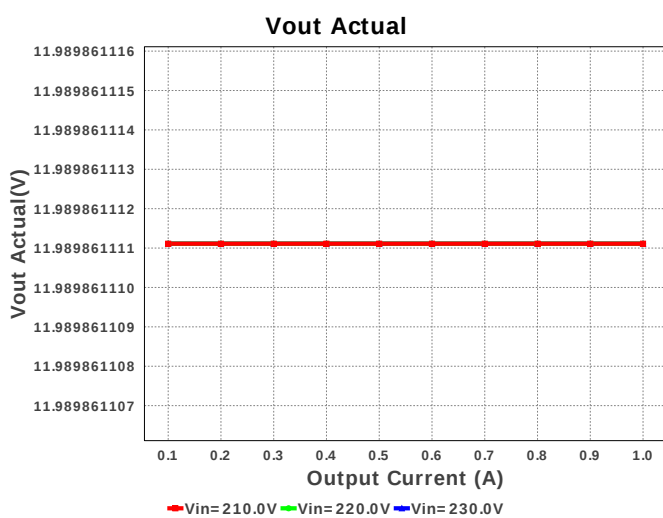
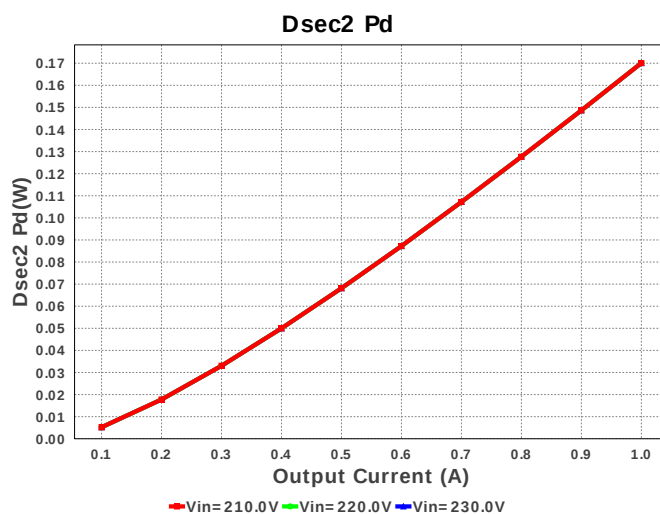
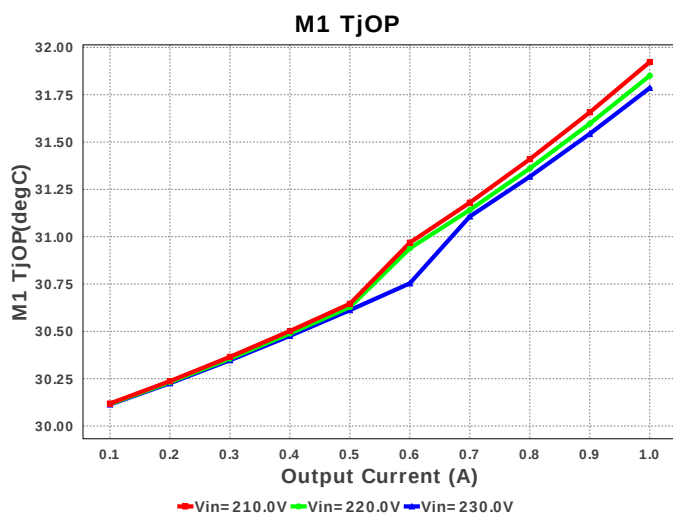
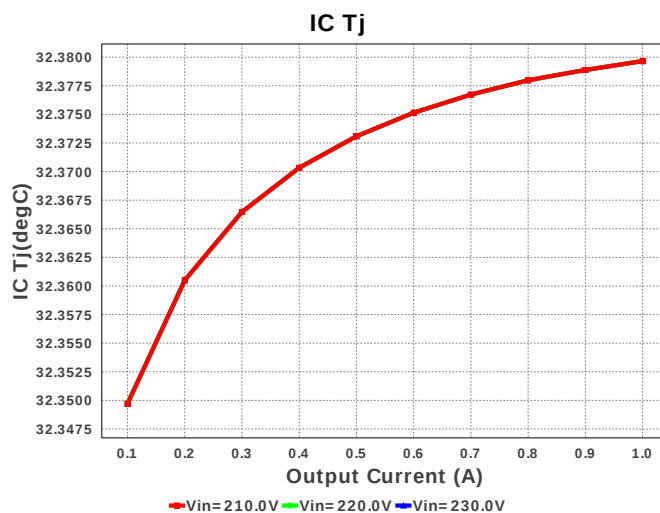
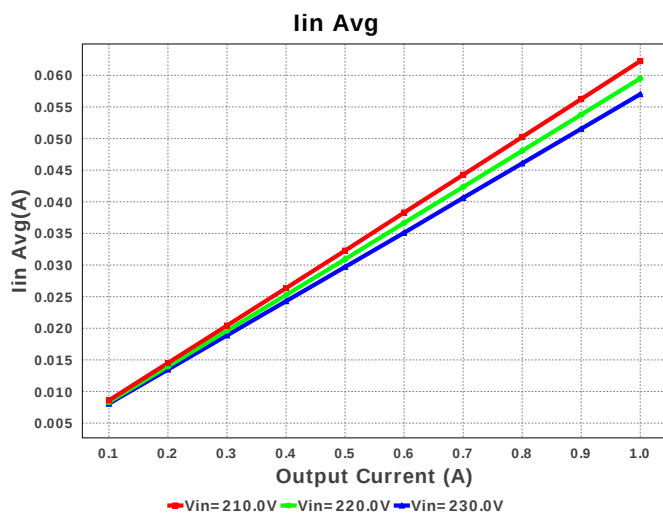
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cin	TDK	B32923C3155M Series= B32923	Cap= 1.5 uF ESR= 17.0 mOhm VDC= 630.0 V IRMS= 146.0 mA	1	\$0.19	 B32923_22mm 399 mm ²
8.	Cout1	Panasonic	25SVPF180M Series= ?	Cap= 180.0 uF ESR= 16.0 mOhm VDC= 25.0 V IRMS= 4.65 A	1	\$0.61	 CAPSMT_62_E12 106 mm ²
9.	Cout2	Panasonic	25SVPF82M Series= ?	Cap= 82.0 uF ESR= 28.0 mOhm VDC= 25.0 V IRMS= 3.0 A	1	\$0.50	 CAPSMT_62_E7 106 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	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	GRM188R71E104KA01D Series= X7R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 1.51 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	ON Semiconductor	MBR130T1G	VF@Io= 470.0 mV VRRM= 30.0 V	1	\$0.09	 SOD-123 13 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	Micro Commercial Components	SK310A-TP	VF@Io= 850.0 mV VRRM= 100.0 V	1	\$0.10	 SMA 37 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
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 mm²
23.	M1	Fairchild Semiconductor	FDD6N50TM	VdsMax= 500.0 V IdsMax= 6.0 Amps	1	\$0.47	 DPAK 102 mm²
24.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm²
25.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm²
26.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
27.	R12	Vishay-Dale	CRCW04021K58FKED Series= CRCW..e3	Res= 1.58 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
28.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
29.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
30.	R22	Vishay-Dale	CRCW0402127KFKED Series= CRCW..e3	Res= 127.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
31.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
32.	Rbias	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
33.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
34.	Rdrv	Vishay-Dale	CRCW04025R11FKED Series= CRCW..e3	Res= 5.11 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
35.	Rfbb	Yageo America	RC0603FR-073K6L Series= ?	Res= 3.6 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
36.	Rfbt	Vishay-Dale	CRCW040213K7FKED Series= CRCW..e3	Res= 13.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
37.	Rled	Vishay-Dale	CRCW04021K43FKED Series= CRCW..e3	Res= 1.43 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
38.	Rsc	Vishay-Dale	CRCW040212K7FKED Series= CRCW..e3	Res= 12.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
39.	Rsns	Vishay-Dale	CRCW08052R67FKEA Series= CRCW..e3	Res= 2.67 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
40.	Rsns	CUSTOM	CUSTOM Series= ?	Res= 250.49 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²

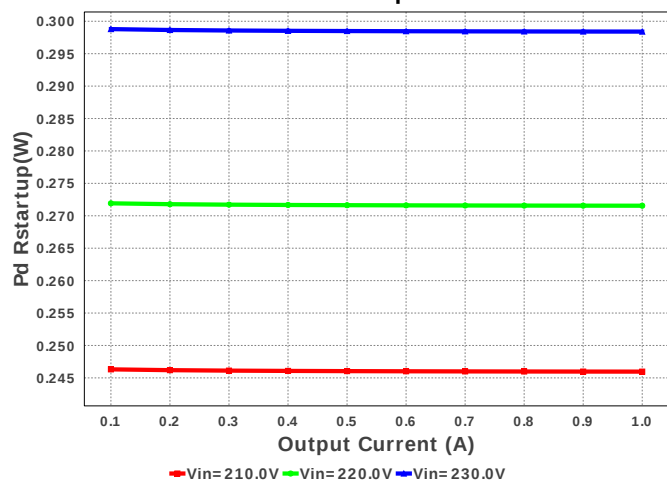
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
41.	Rstartup1	Panasonic	ERJ-8ENF3163V Series= ERJ-8E	Res= 316.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
42.	Rstartup2	Panasonic	ERJ-8ENF3163V Series= ERJ-8E	Res= 316.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
43.	Rt	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 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= 4.722 mH Rp= 870.0 mOhm Leakage_L= 94.445 μ H Ns1toNp= 0.094 Rs1= 8.6 mOhms Ns2toNp= 0.09 Rs2= 700.0 μ Ohms	1	NA	CUSTOM 0 mm ²
46.	U1	Texas Instruments	UCC28C45DR	Switcher	1	\$0.60	 D0008A 57 mm ²
47.	VR	Texas Instruments	TL431AIDBZR	Voltage References	1	\$0.08	 DBZ0003A 14 mm ²



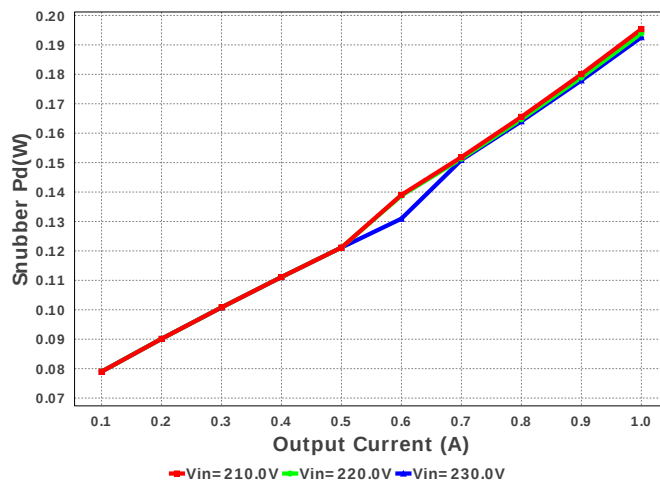




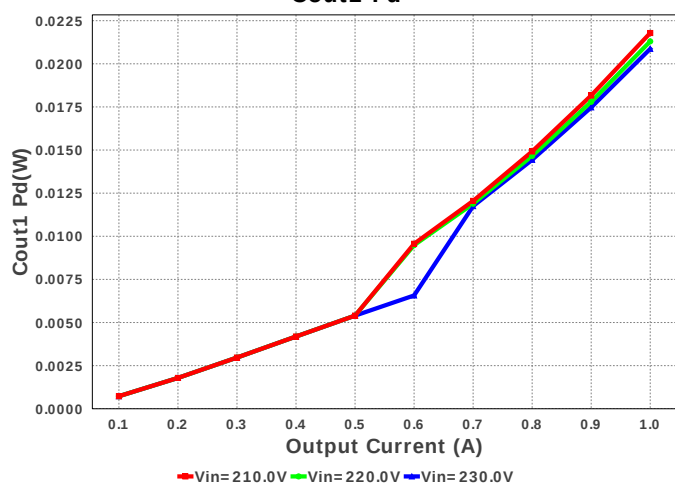
Pd Rstartup



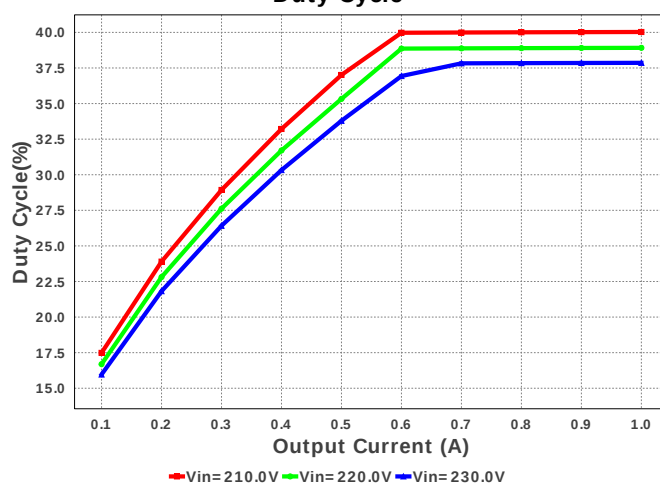
Snubber Pd



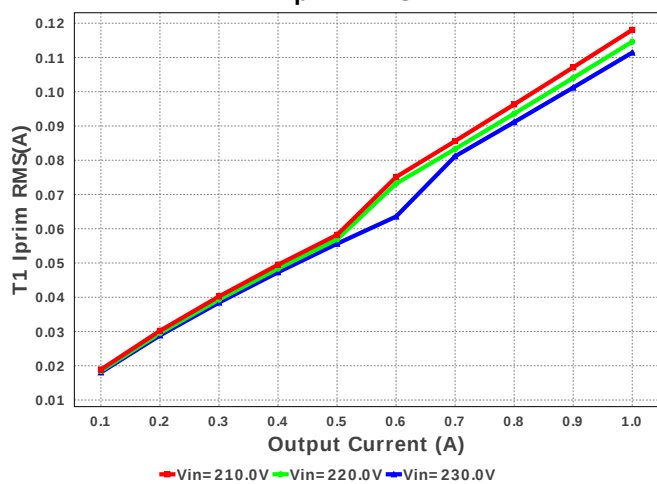
Cout1 Pd



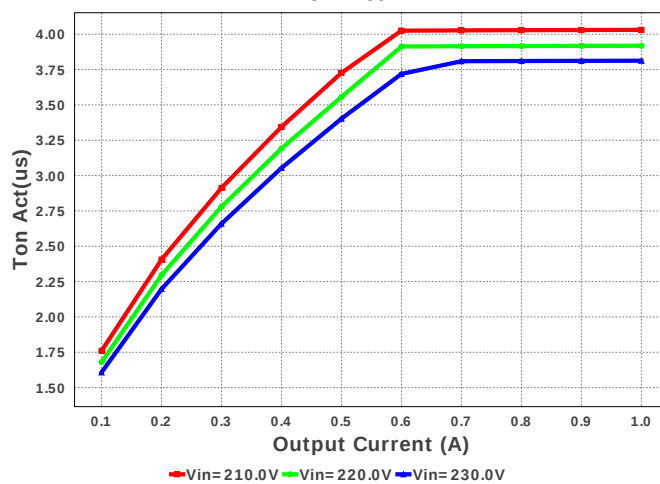
Duty Cycle

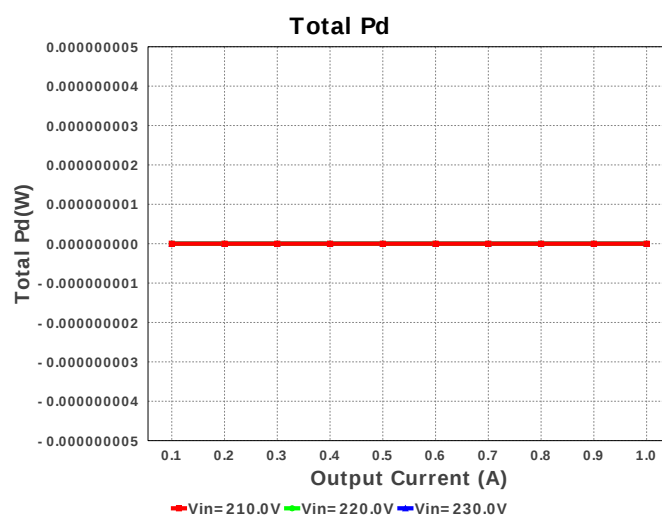
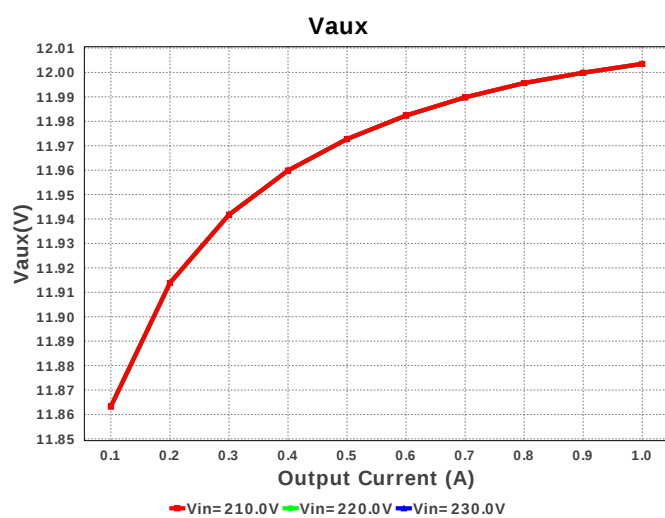
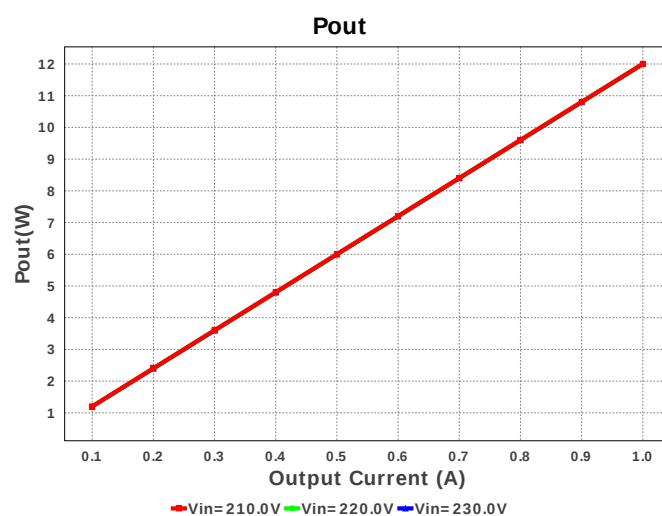
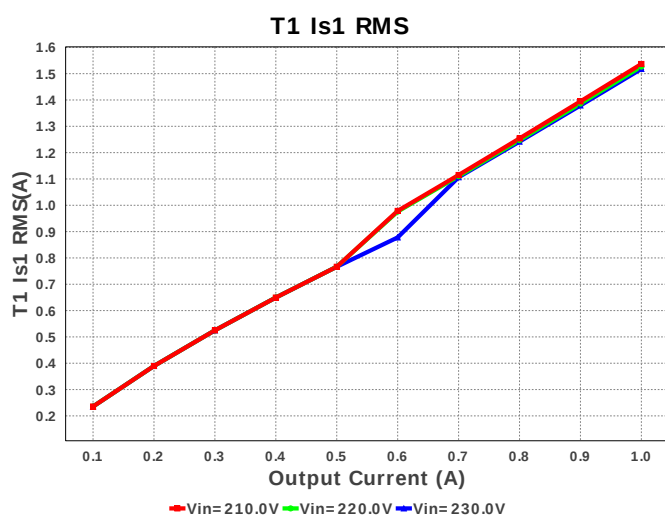
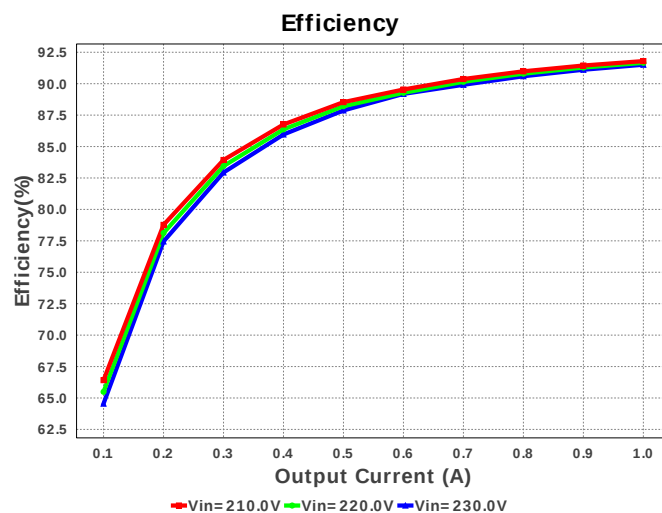
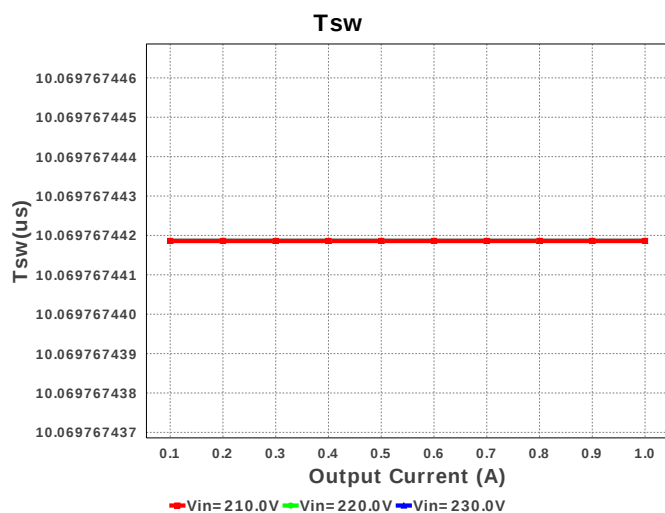


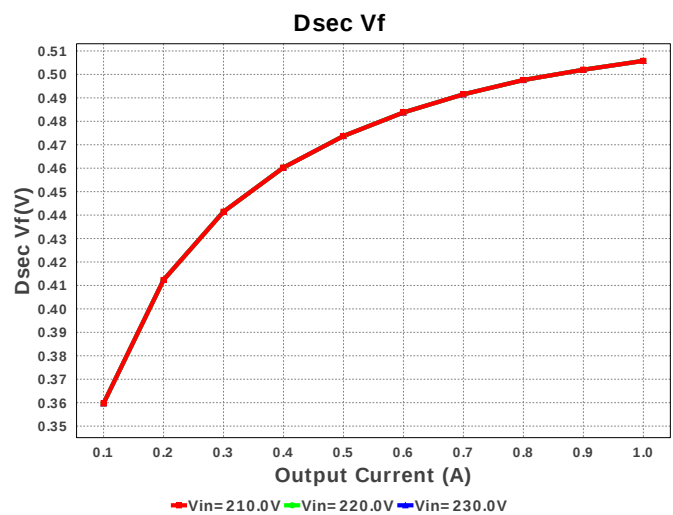
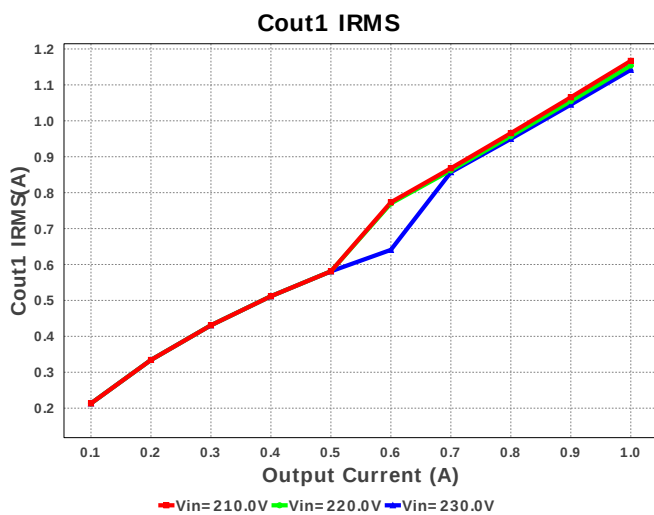
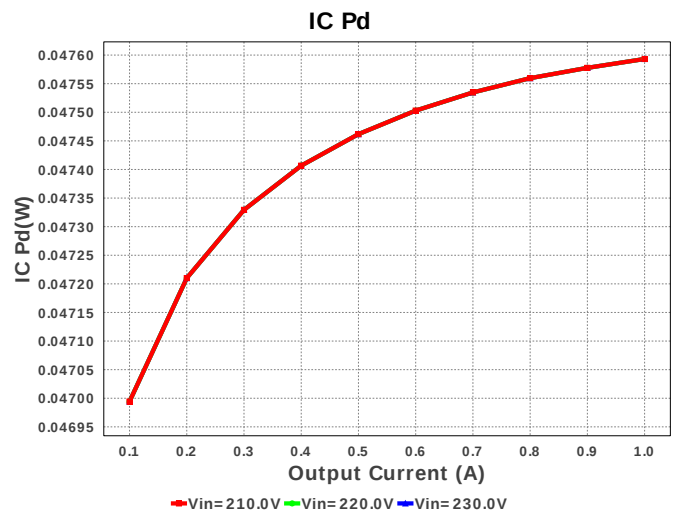
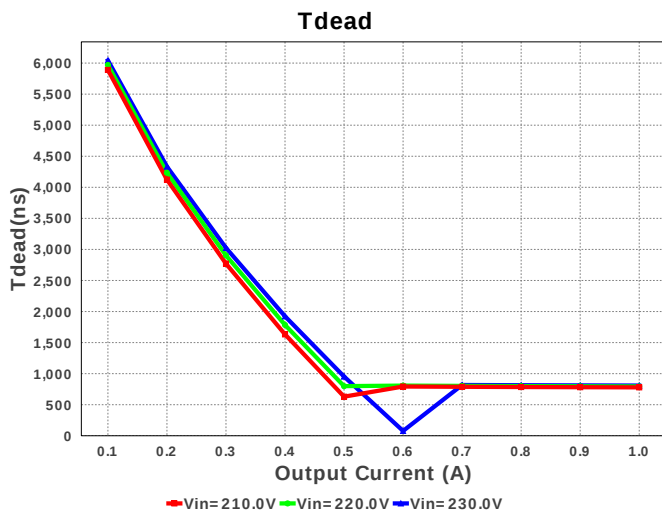
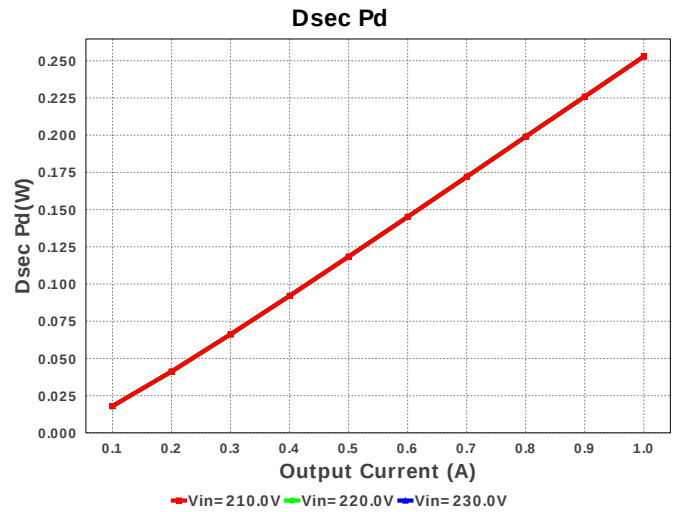
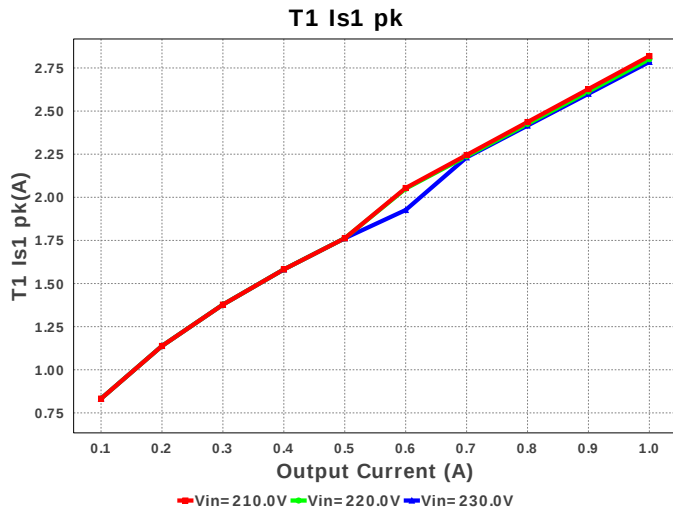
T1 Iprim RMS

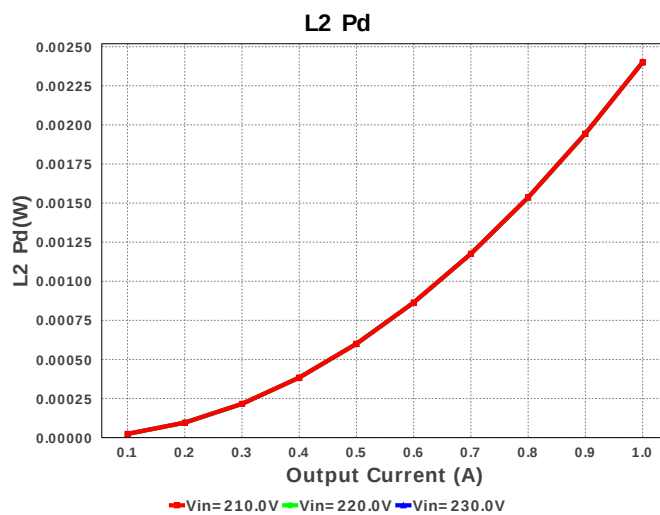
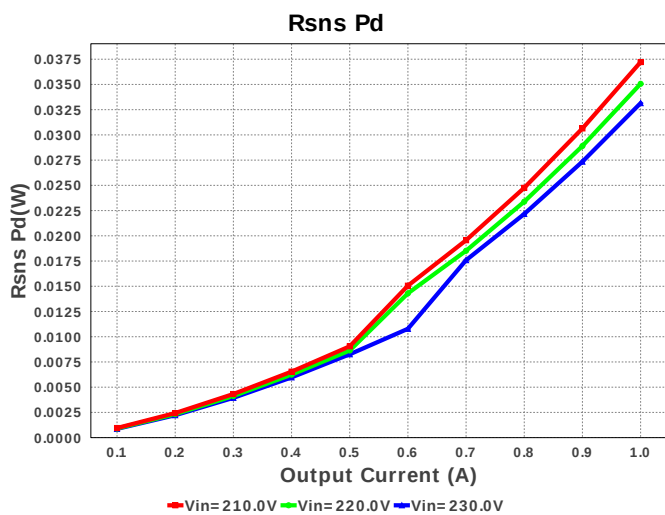
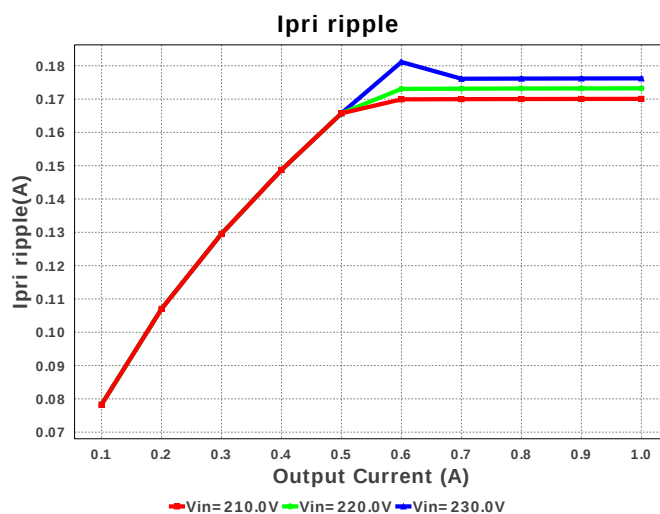
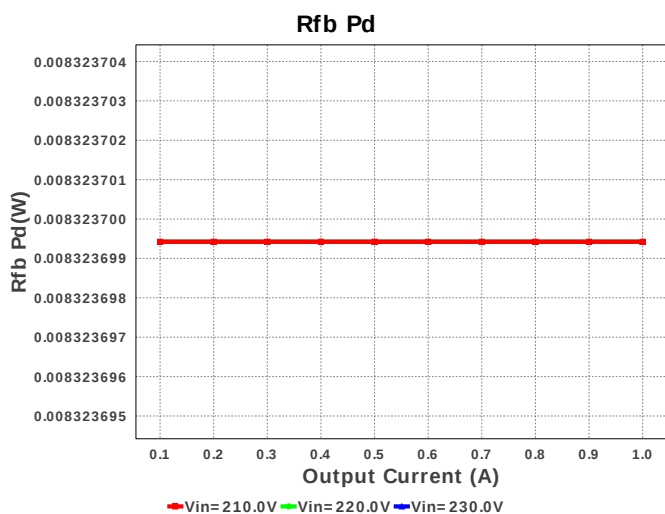
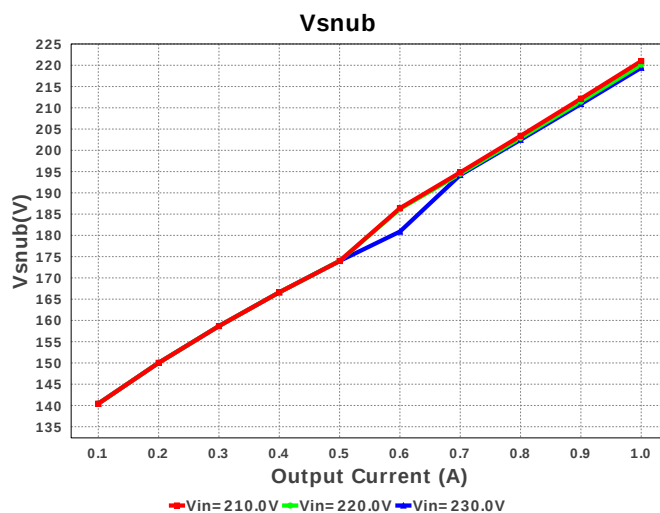
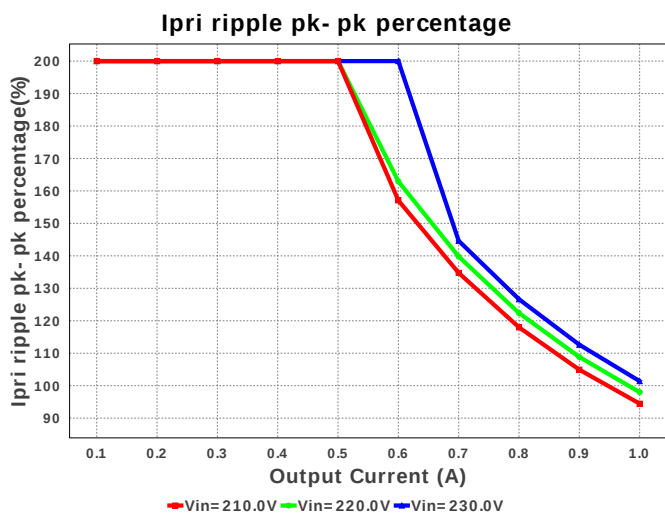


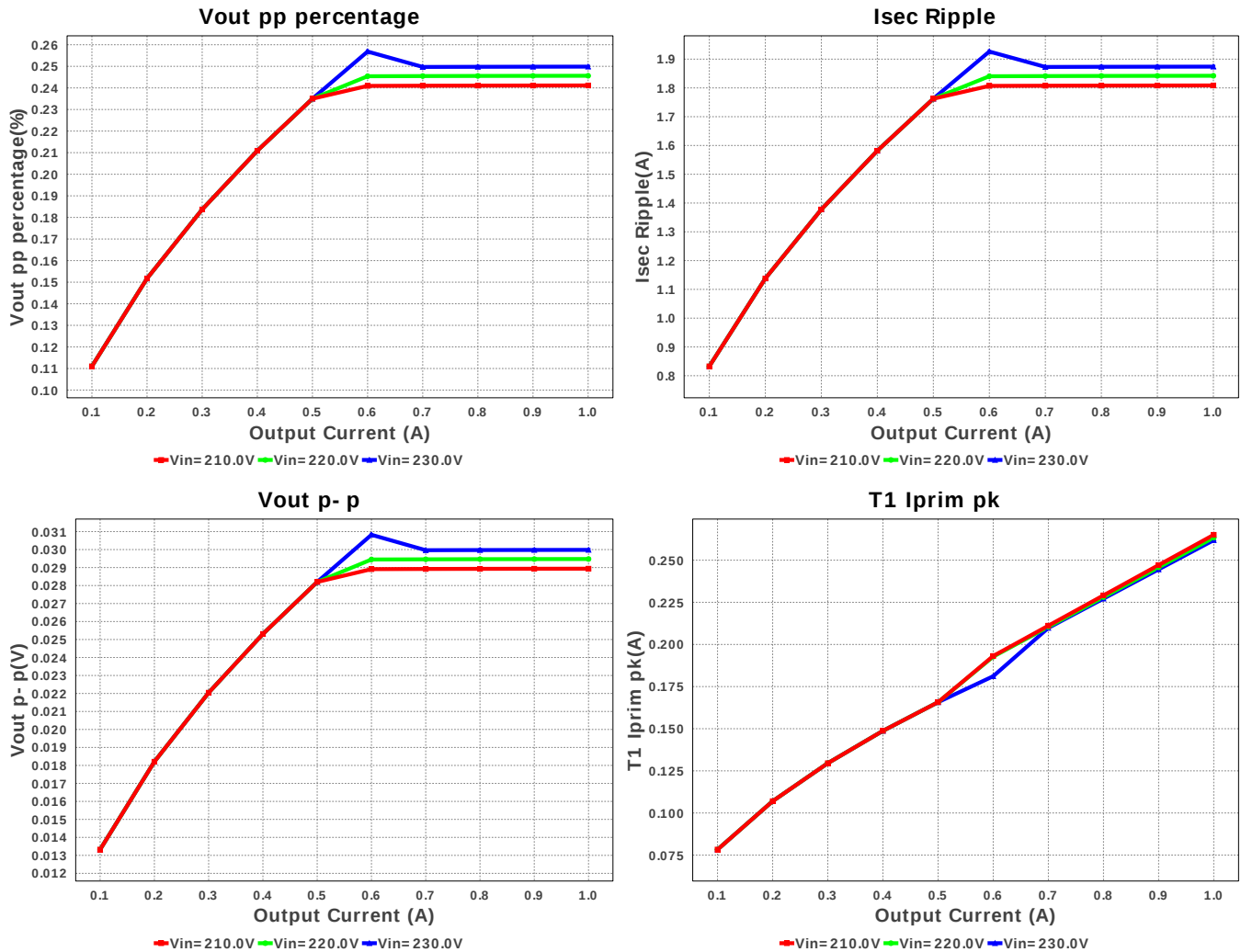
Ton Act











Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.167 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	62.249 mA	Current	Average input current
3.	Iout_DCM	566.619 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	72.064 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	170.071 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	94.468 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	1.809 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	118.061 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	265.066 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	1.537 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	2.819 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	47	General	Total Design BOM count
13.	Daux trr	4.0 ns	General	Auxiliary Diode Reverse Recovery Time
14.	Dsec Vf	505.777 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	340.147 mV	General	Effective Forward Voltage Drop at the Operating Current
17.	Dsnub trr	50.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	1.624 k mm ²	General	Total Foot Print Area of BOM components
19.	Frequency	99.307 kHz	General	Switching frequency
20.	Mode	CCM	General	Conduction Mode
21.	Pout	12.0 W	General	Total output power
22.	Tdead	779.163 ns	General	Approximate Dead Time of the Regulator
23.	Toff	5.26 us	General	Approximate Converter Off Time
24.	Ton Act	4.031 us	General	Approximate Converter On Time
25.	Total BOM	\$0.0	General	Total BOM Cost
26.	Tsw	10.07 us	General	Switching Time Period
27.	Vaux	12.004 V	General	Auxiliary Voltage
28.	Vsnub	220.982 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	40.029 %	Op_point	Duty cycle
32.	Efficiency	91.797 %	Op_point	Steady state efficiency
33.	IC Tj	32.38 degC	Op_point	IC junction temperature
34.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
35.	IOUT_OP	1.0 A	Op_point	Iout operating point
36.	M1 TjOP	31.923 degC	Op_point	M1 MOSFET junction temperature
37.	Vout p-p	28.937 mV	Op_point	Peak-to-peak output ripple voltage
38.	Cin Pd	113.286 μ W	Power	Input capacitor power dissipation
39.	Cout1 Pd	21.785 mW	Power	Output capacitor1 power dissipation
40.	Dsec Pd	252.888 mW	Power	Secondary Diode Power Dissipation
41.	Dsec2 Pd	170.073 mW	Power	Secondary Diode Power Dissipation
42.	IC Pd	47.593 mW	Power	IC power dissipation
43.	L2 Pd	2.4 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
44.	M1 Pd	23.169 mW	Power	M1 MOSFET total power dissipation
45.	Paux	18.694 mW	Power	Power Dissipation in Raux and Daux
46.	Pd Rstartup	245.966 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
47.	Rdrv Pd	8.257 μ W	Power	Power Dissipation in Gate Drive Resistor
48.	Rfb Pd	8.324 mW	Power	Rfb Power Dissipation
49.	Rsns Pd	37.216 mW	Power	Current Limit Sense Resistor Power Dissipation
50.	Snubber Pd	195.367 mW	Power	Snubber Power Dissipation
51.	T1 Pd	64.872 mW	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	241.144 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	230.0	Maximum input voltage
3.	VinMin	210.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	UCC28C45	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	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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