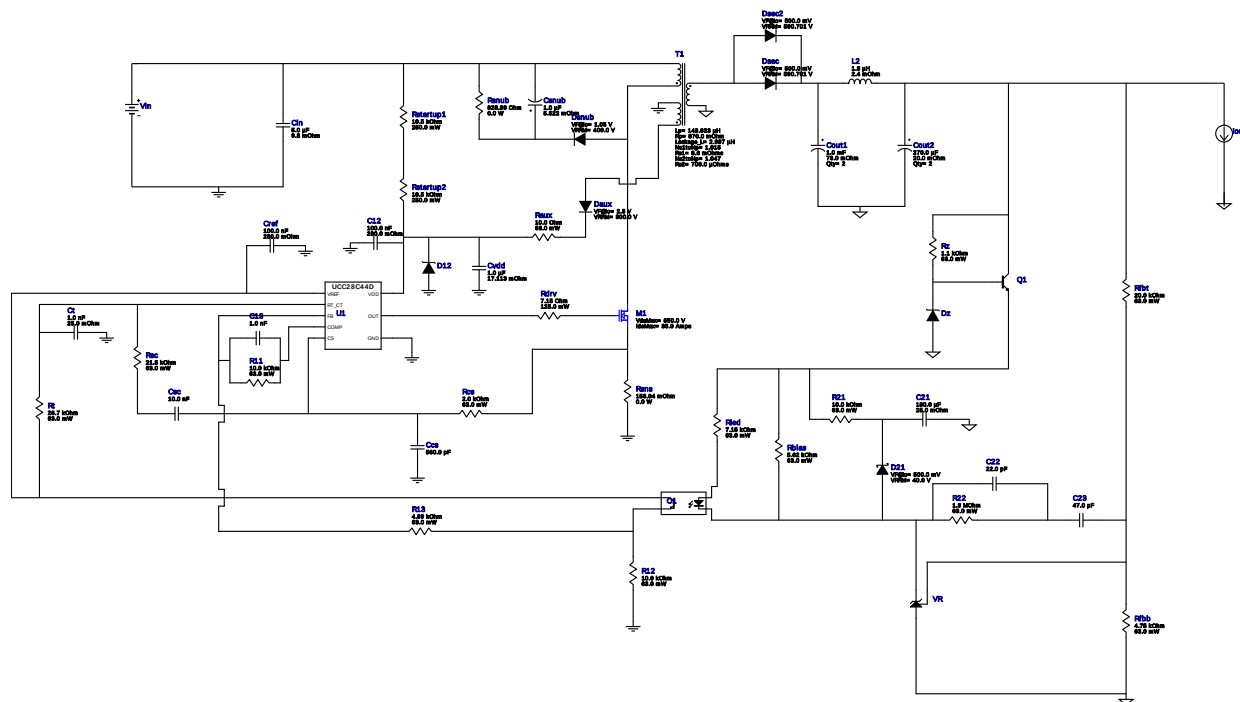
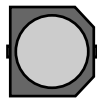


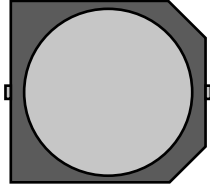
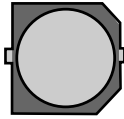
WEBENCH® Design Report

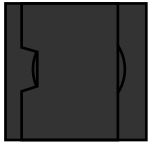
Design : 4352199/47 UCC28C44DR
UCC28C44DR 22.0V-220.0V to 13.00V @ 2.0A



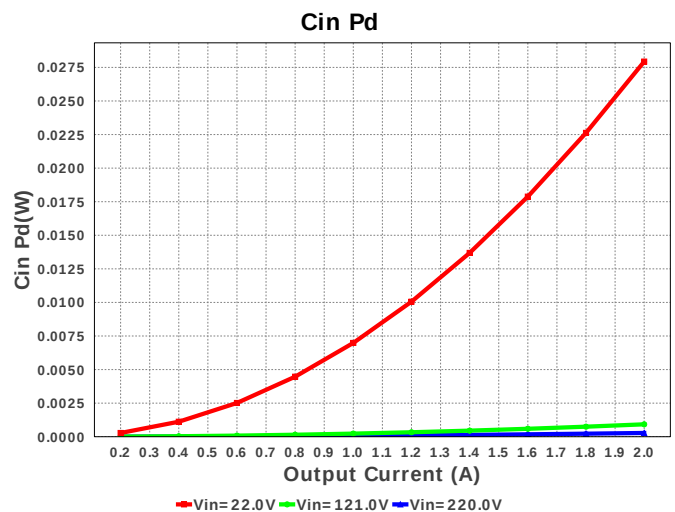
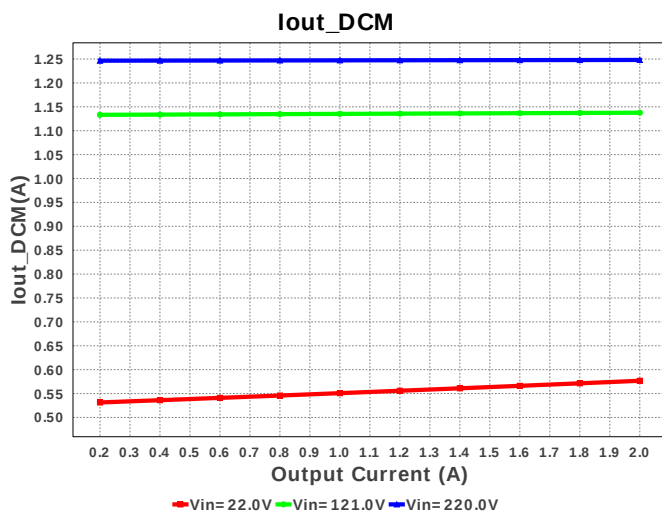
Electrical BOM

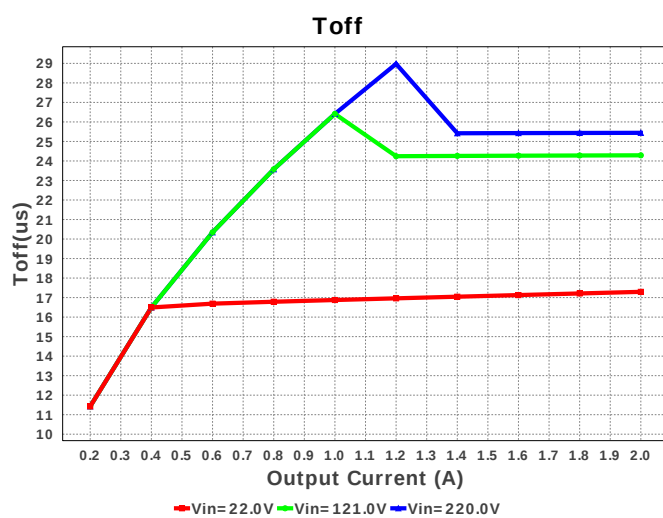
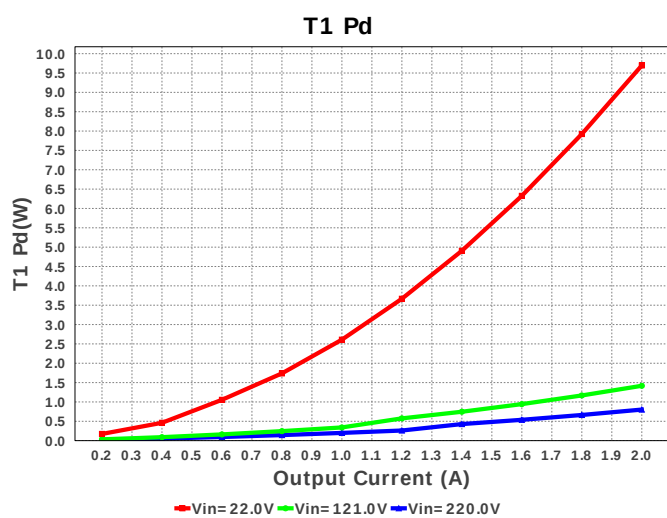
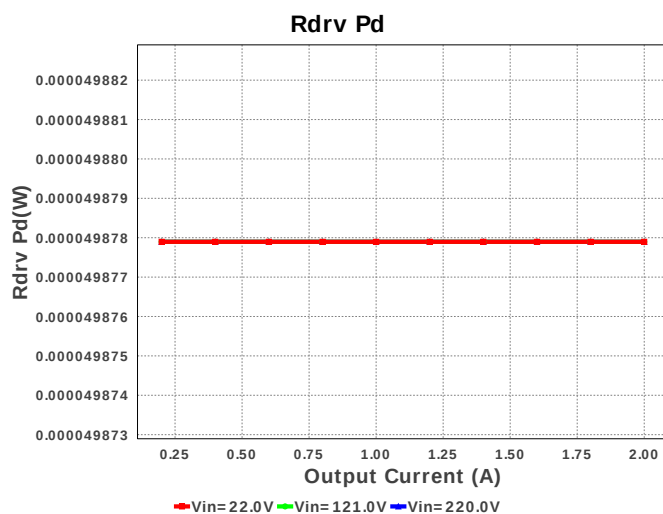
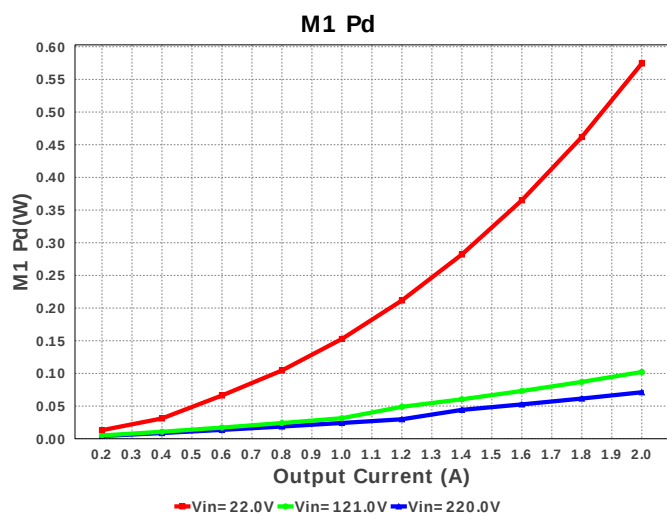
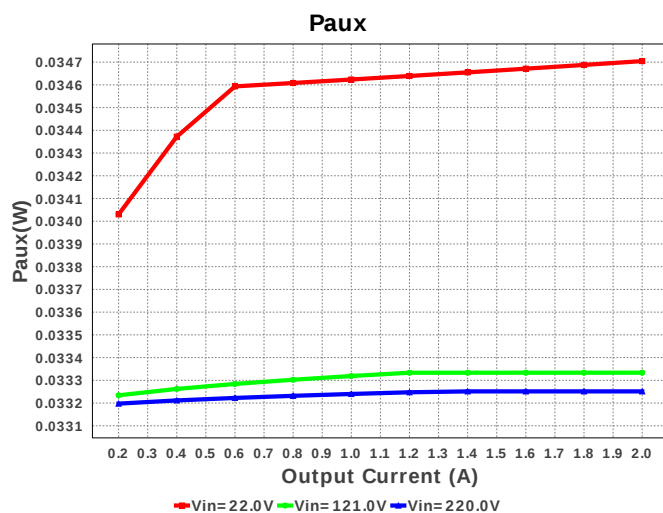
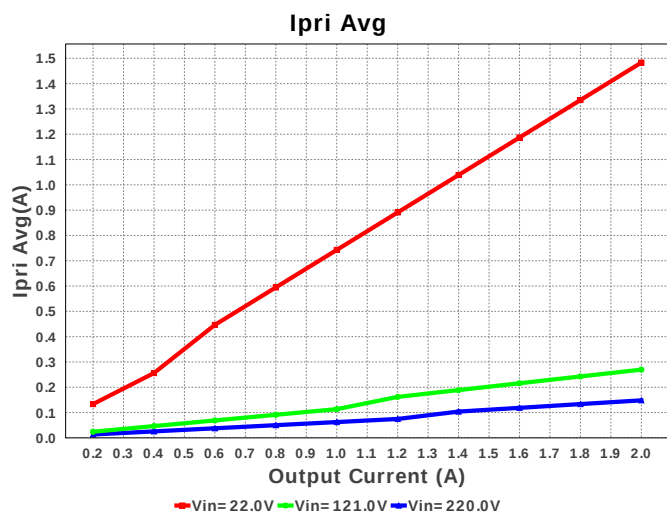
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
3.	C21	Panasonic	20SPVF180M Series= ?	Cap= 180.0 uF ESR= 25.0 mOhm VDC= 20.0 V IRMS= 3.2 A	1	\$0.50	 CAPSMT_62_E7 106 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	Kemet	C0805C470K5GACTU Series= C0G/NP0	Cap= 47.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
6.	Ccs	Yageo America	CC0805KRX7R9BB561 Series= X7R	Cap= 560.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²

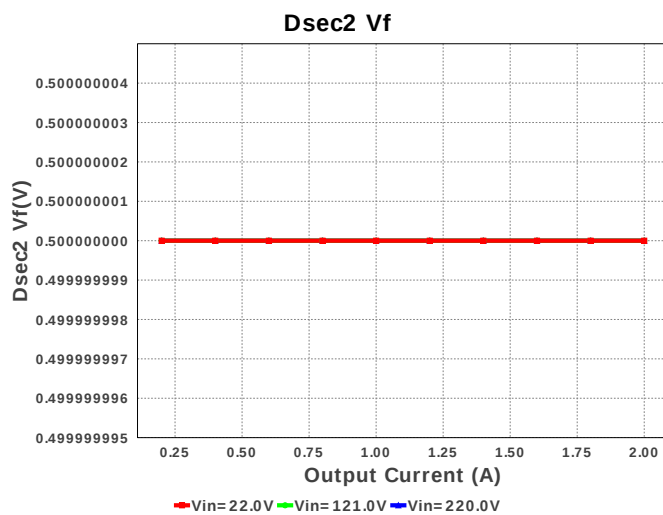
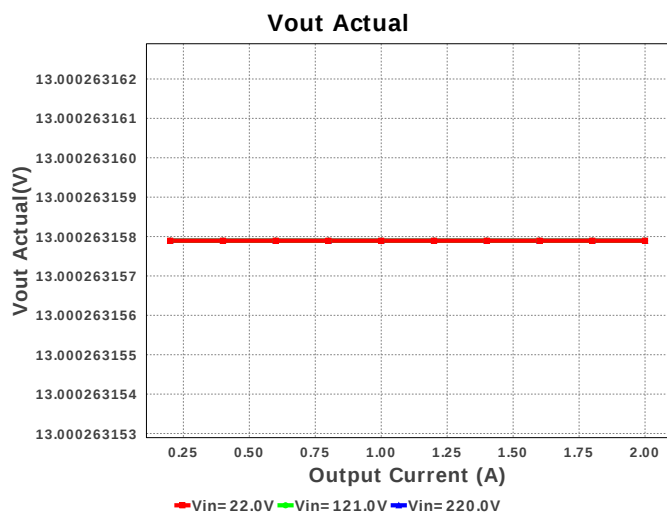
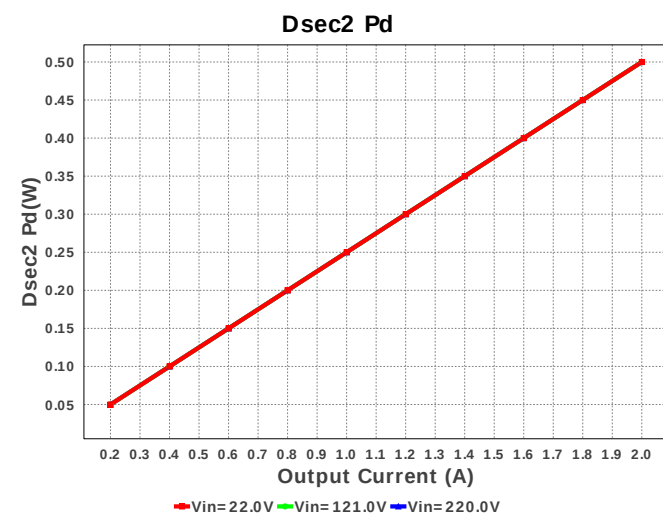
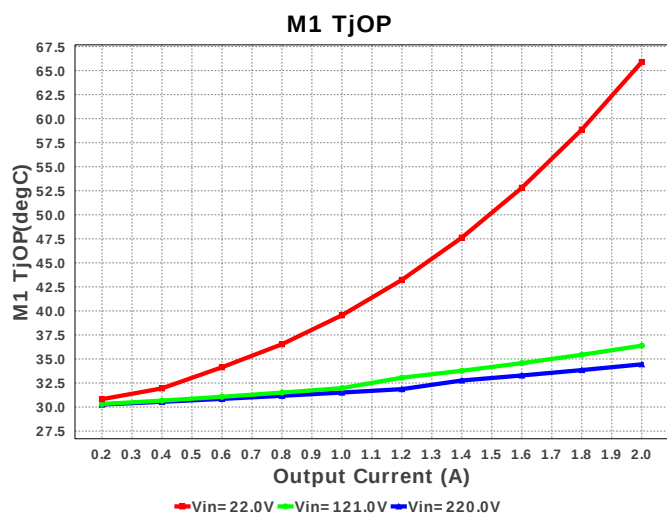
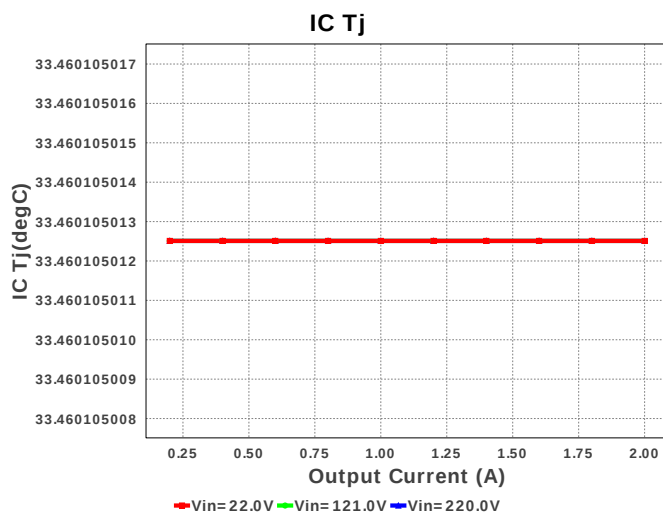
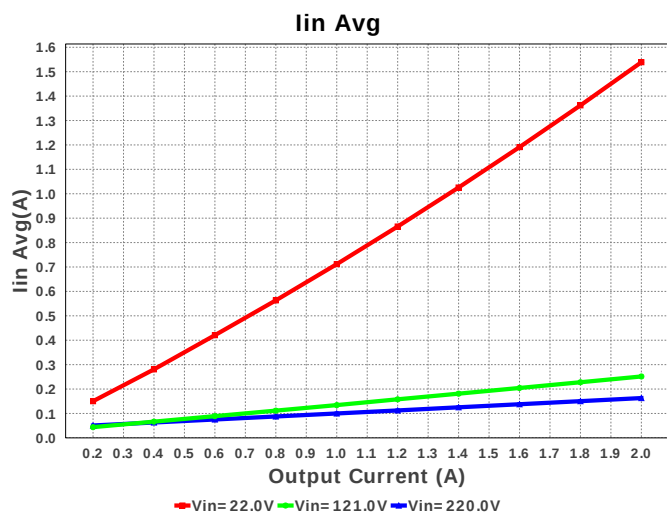
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7.	Cin	TDK	B32774D1505K Series= B32774	Cap= 5.0 uF ESR= 9.8 mOhm VDC= 1.3 kV IRMS= 10.5 A	1	\$3.08	 B32774_3150x2200x3650 804 mm ²
8.	Cout1	Panasonic	EEV-FK1H102M Series= FK	Cap= 1.0 mF ESR= 73.0 mOhm VDC= 50.0 V IRMS= 1.61 A	2	\$0.74	 SM_RADIAL_J16 399 mm ²
9.	Cout2	Panasonic	EEHZA1V271P Series= ?	Cap= 270.0 uF ESR= 20.0 mOhm VDC= 35.0 V IRMS= 2.5 A	2	\$1.02	 SM_RADIAL_10BMM 160 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	C1608X7R1V105K080AC Series= X7R	Cap= 1.0 uF ESR= 5.522 mOhm VDC= 35.0 V IRMS= 2.2162 A	1	\$0.05	 0603 5 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	Vishay-Semiconductor	SS14-E3/61T	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.08	 SMA 37 mm ²
17.	Daux	Bourns	CD1408-FU1800	VF@Io= 2.5 V VRRM= 800.0 V	1	\$0.13	 Diode_1408 13 mm ²
18.	Dsec	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 590.701 V	1	NA	CUSTOM 0 mm ²
19.	Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 590.701 V	1	NA	CUSTOM 0 mm ²
20.	Dsnub	Bourns	CD1408-FU1400	VF@Io= 1.05 V VRRM= 400.0 V	1	\$0.13	 Diode_1408 13 mm ²
21.	Dz	Diodes Inc.	MMSZ5240B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²

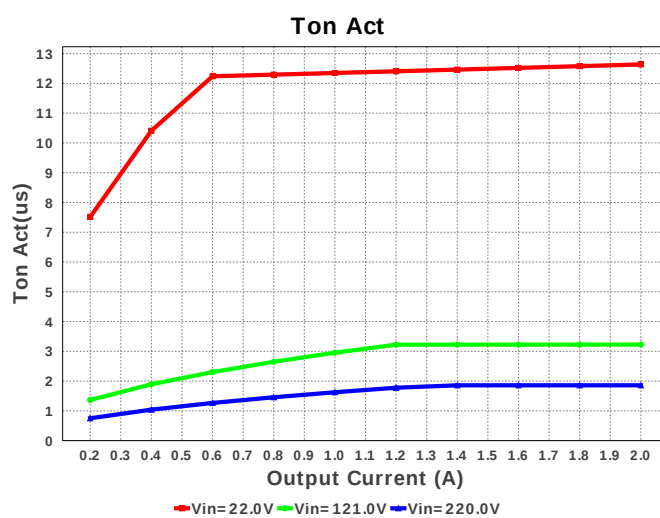
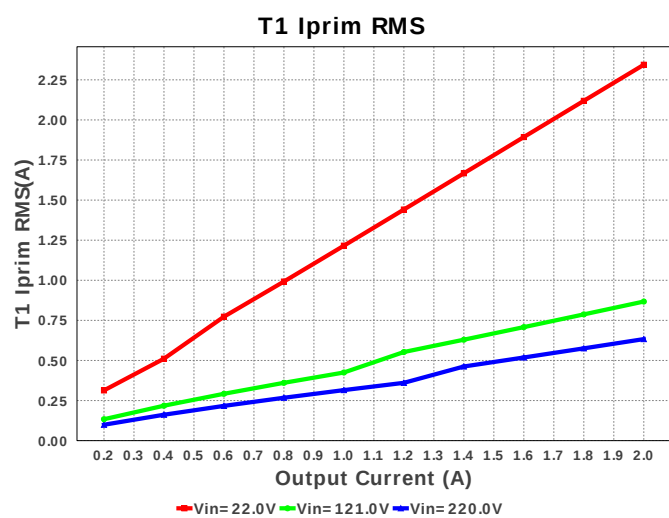
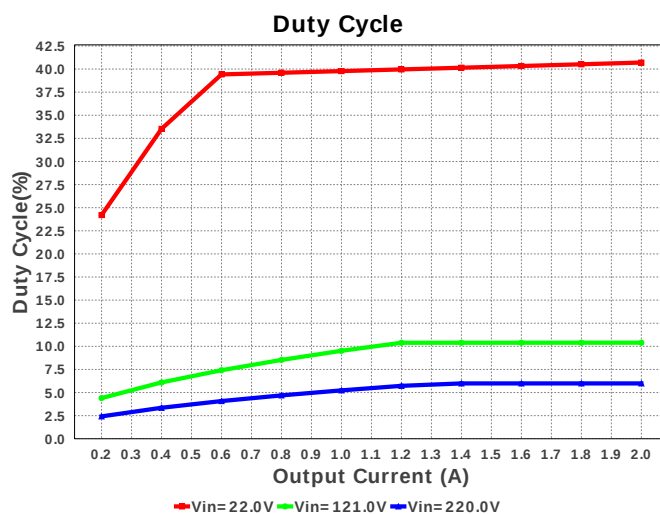
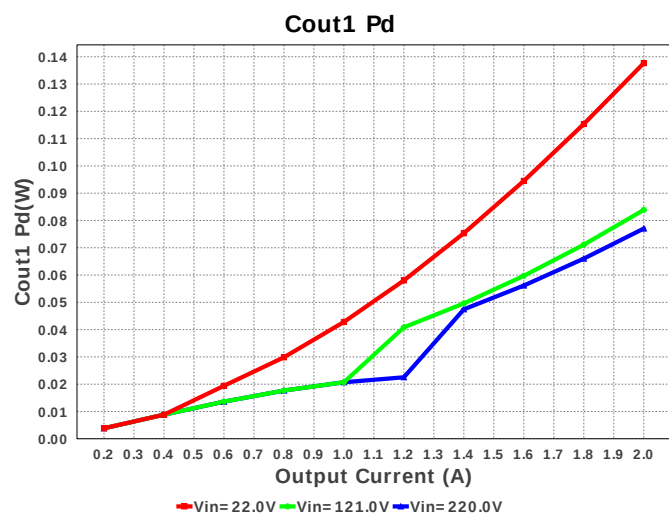
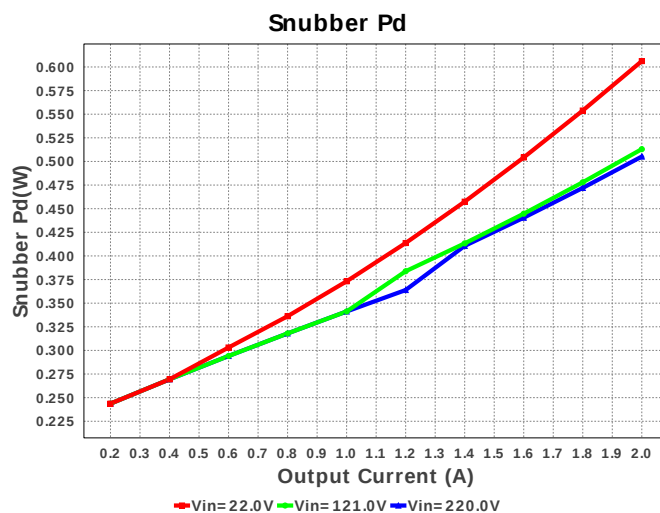
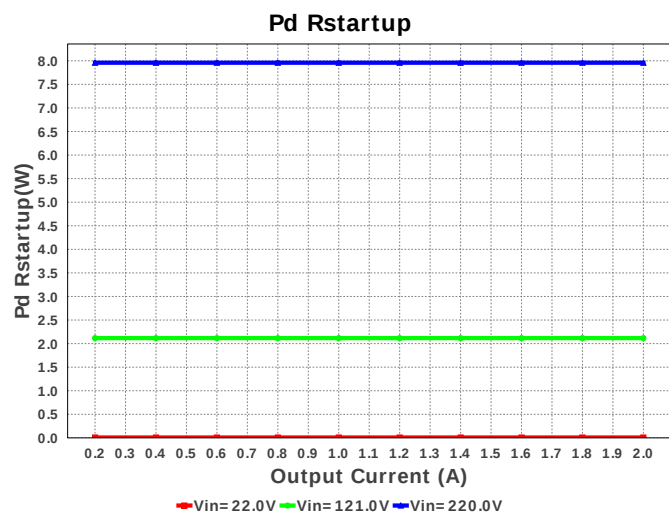
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
22.	L2	Coilcraft	SER1360-182KLB	L= 1.8 μ H DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
23.	M1	STMicroelectronics	STP45N65M5	VdsMax= 650.0 V IdsMax= 35.0 Amps	1	\$3.85	 TO-220AB 397 mm ²
24.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 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	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 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	CRCW04021M30FKED Series= CRCW..e3	Res= 1.3 MOhm 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	Vishay-Dale	CRCW04024K75FKED Series= CRCW..e3	Res= 4.75 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
36.	Rfbt	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
37.	Rled	Vishay-Dale	CRCW04027K15FKED Series= CRCW..e3	Res= 7.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
38.	Rsc	Vishay-Dale	CRCW040221K5FKED Series= CRCW..e3	Res= 21.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
39.	Rsns	CUSTOM	CUSTOM Series= ?	Res= 156.04 mOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm ²
40.	Rsnub	CUSTOM	CUSTOM Series= ?	Res= 828.99 Ohm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm ²

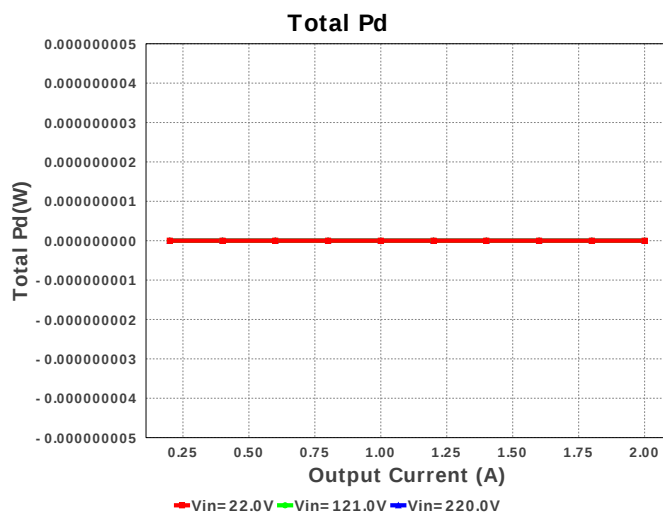
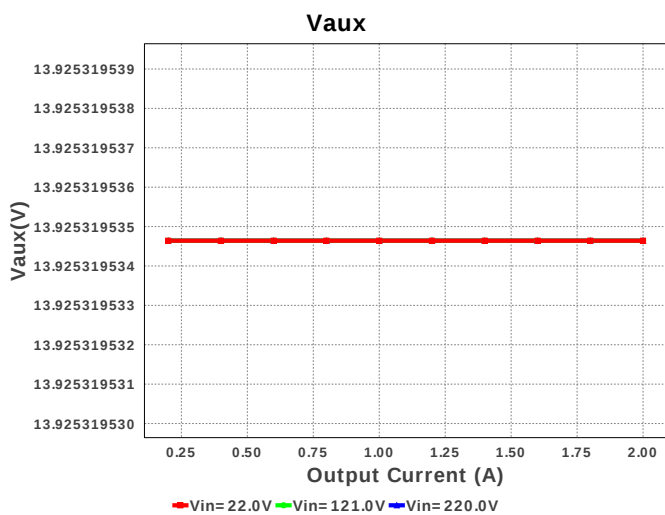
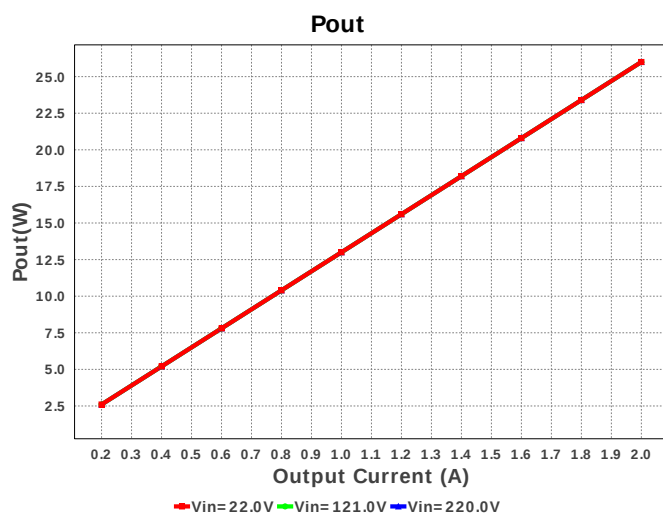
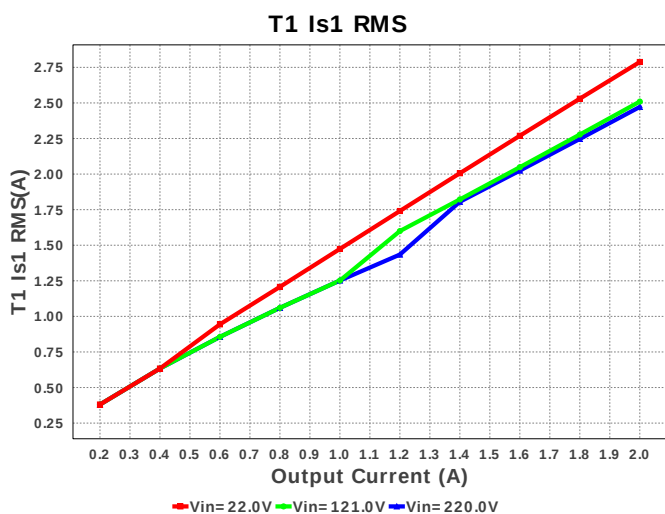
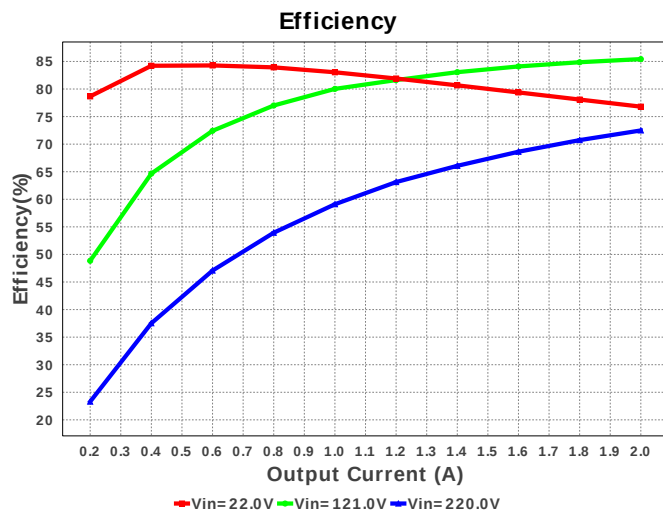
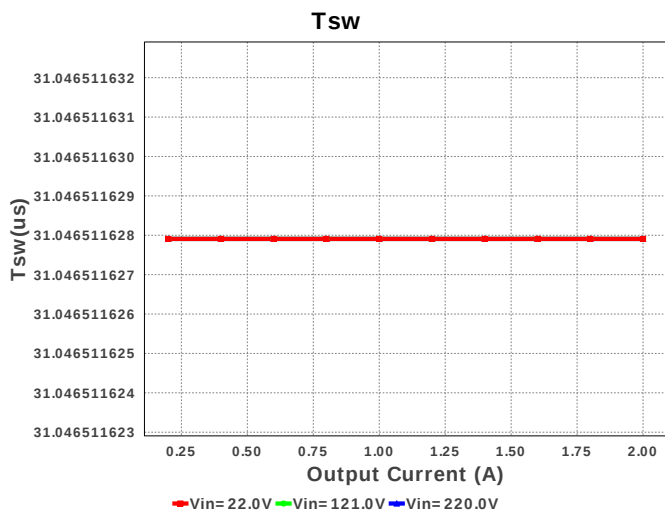
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
41.	Rstartup1	Panasonic	ERJ-8ENF1052V Series= ERJ-8E	Res= 10.5 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
42.	Rstartup2	Panasonic	ERJ-8ENF1052V Series= ERJ-8E	Res= 10.5 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
43.	Rt	Vishay-Dale	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 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= 149.833 µH Rp= 870.0 mOhm Leakage_L= 2.997 µH Ns1toNp= 1.015 Rs1= 8.6 mOhms Ns2toNp= 1.047 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm ²
46.	U1	Texas Instruments	UCC28C44DR	Switcher	1	\$0.60	 D0008A 57 mm ²
47.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm ²



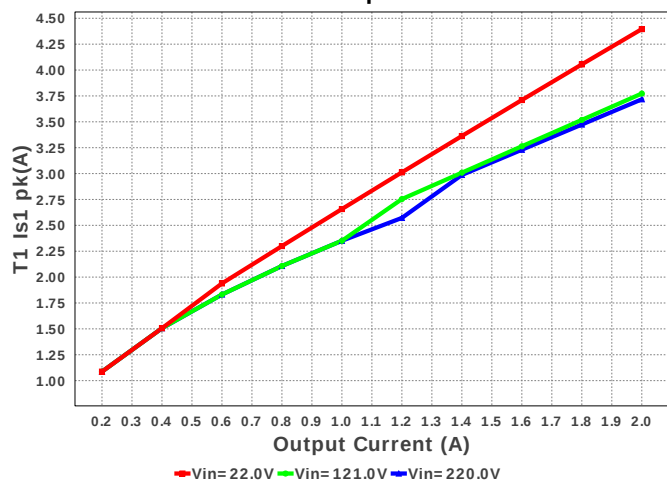




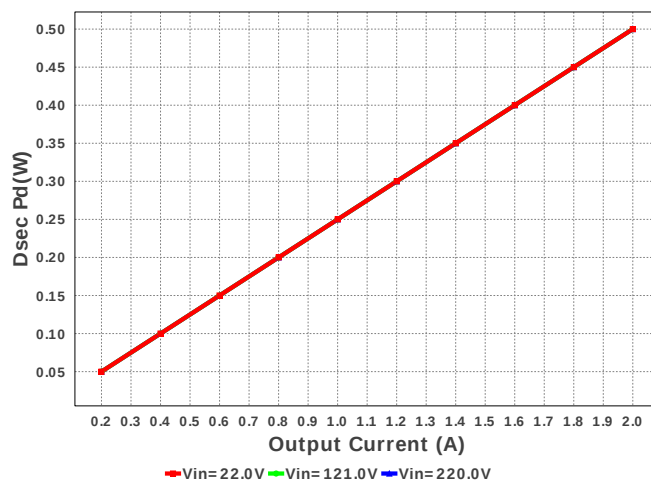




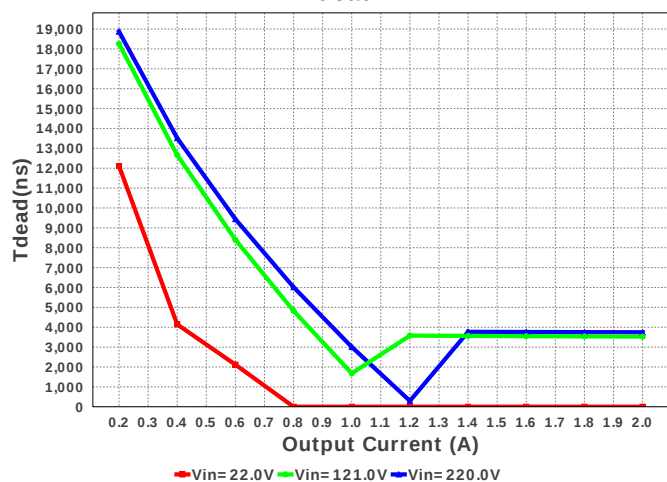
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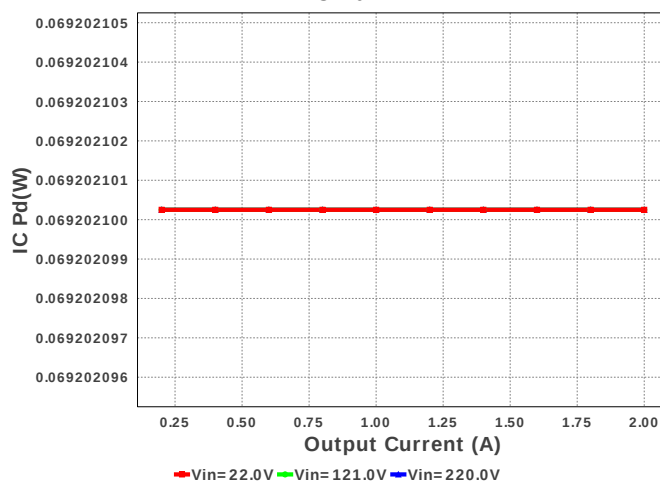
Dsec Pd



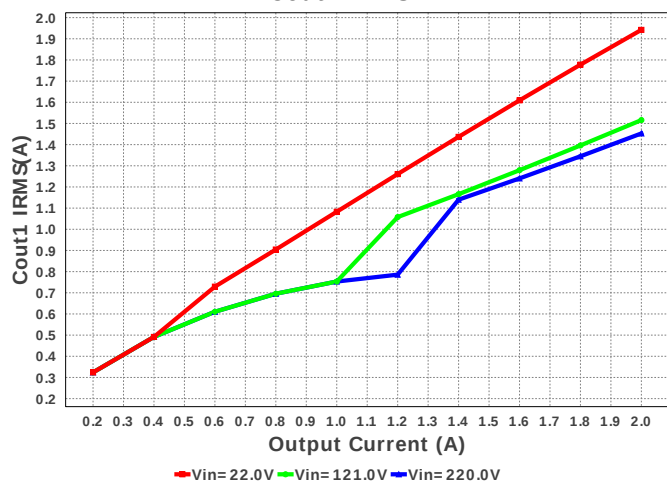
Tdead



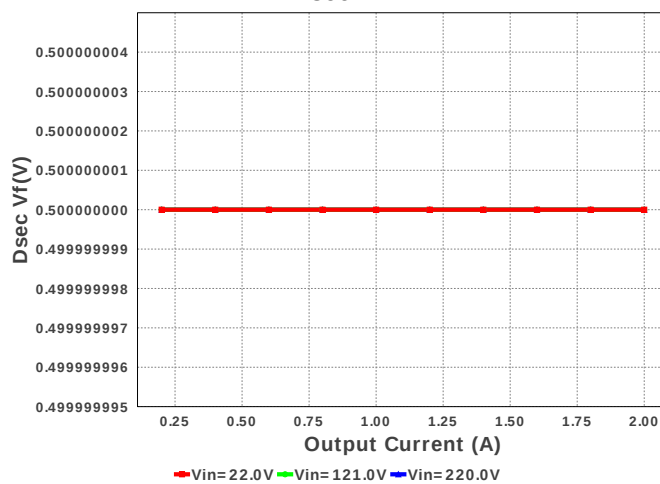
IC Pd

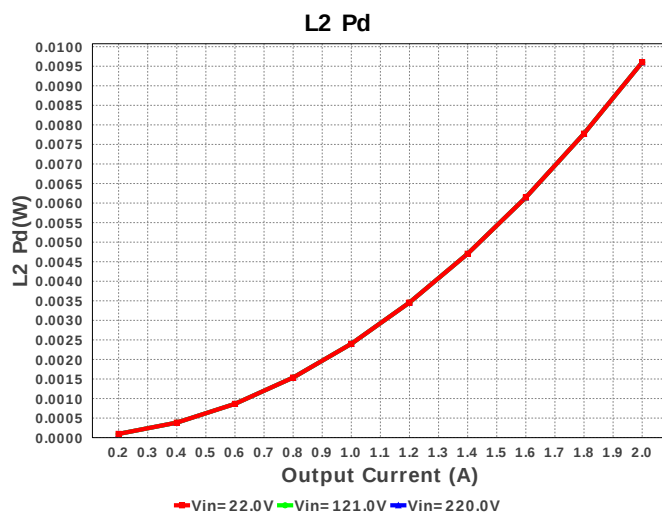
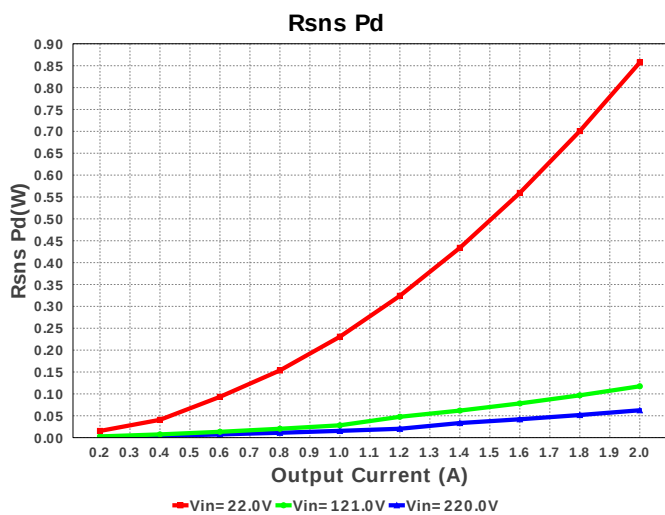
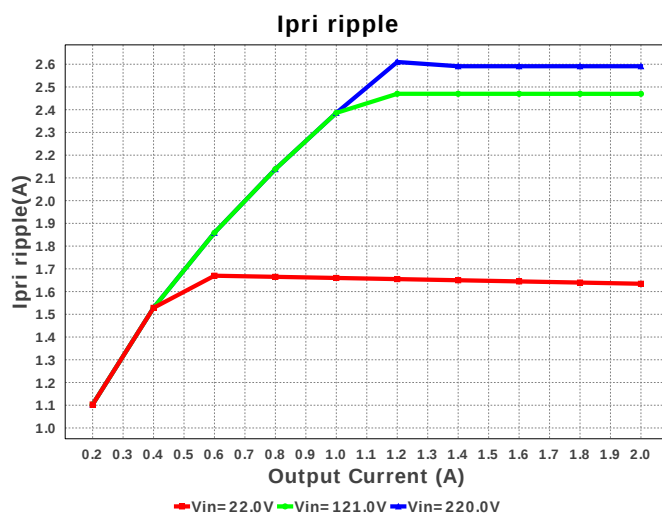
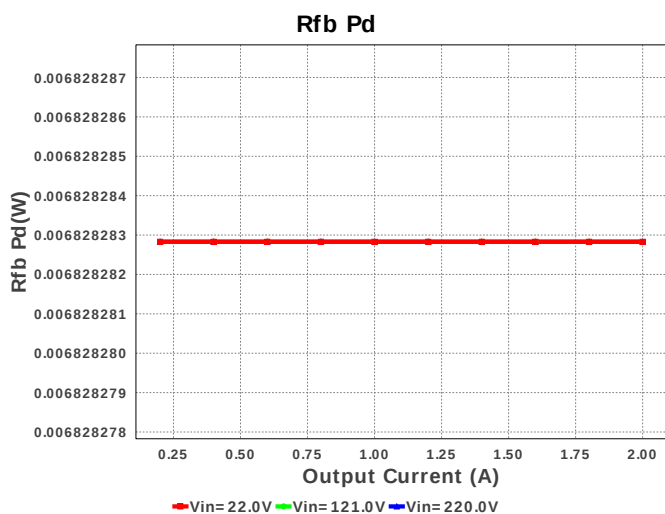
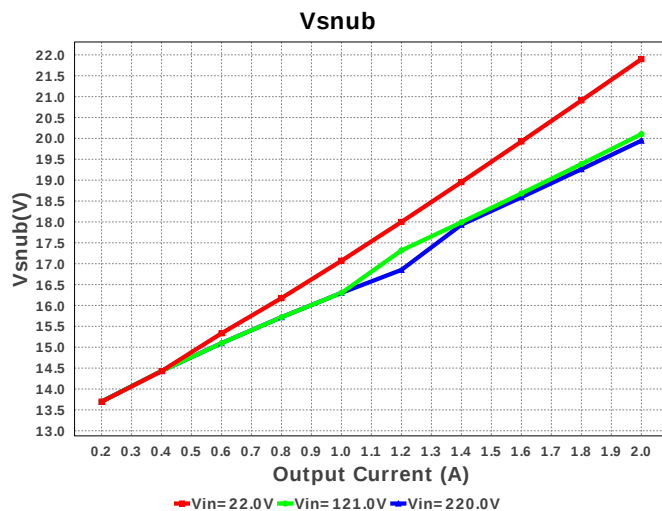
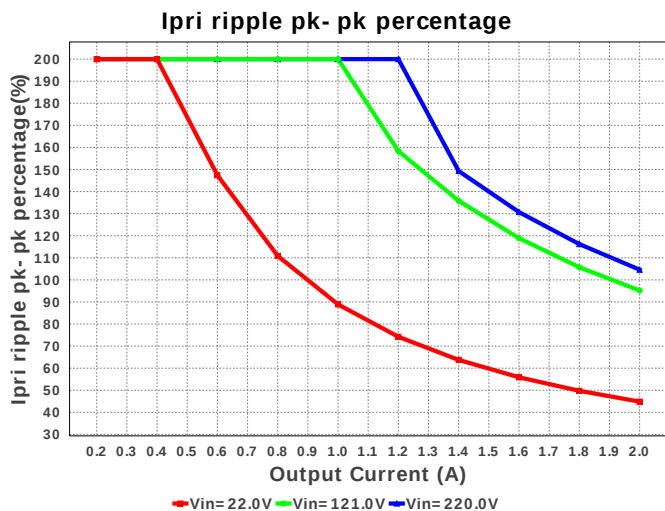


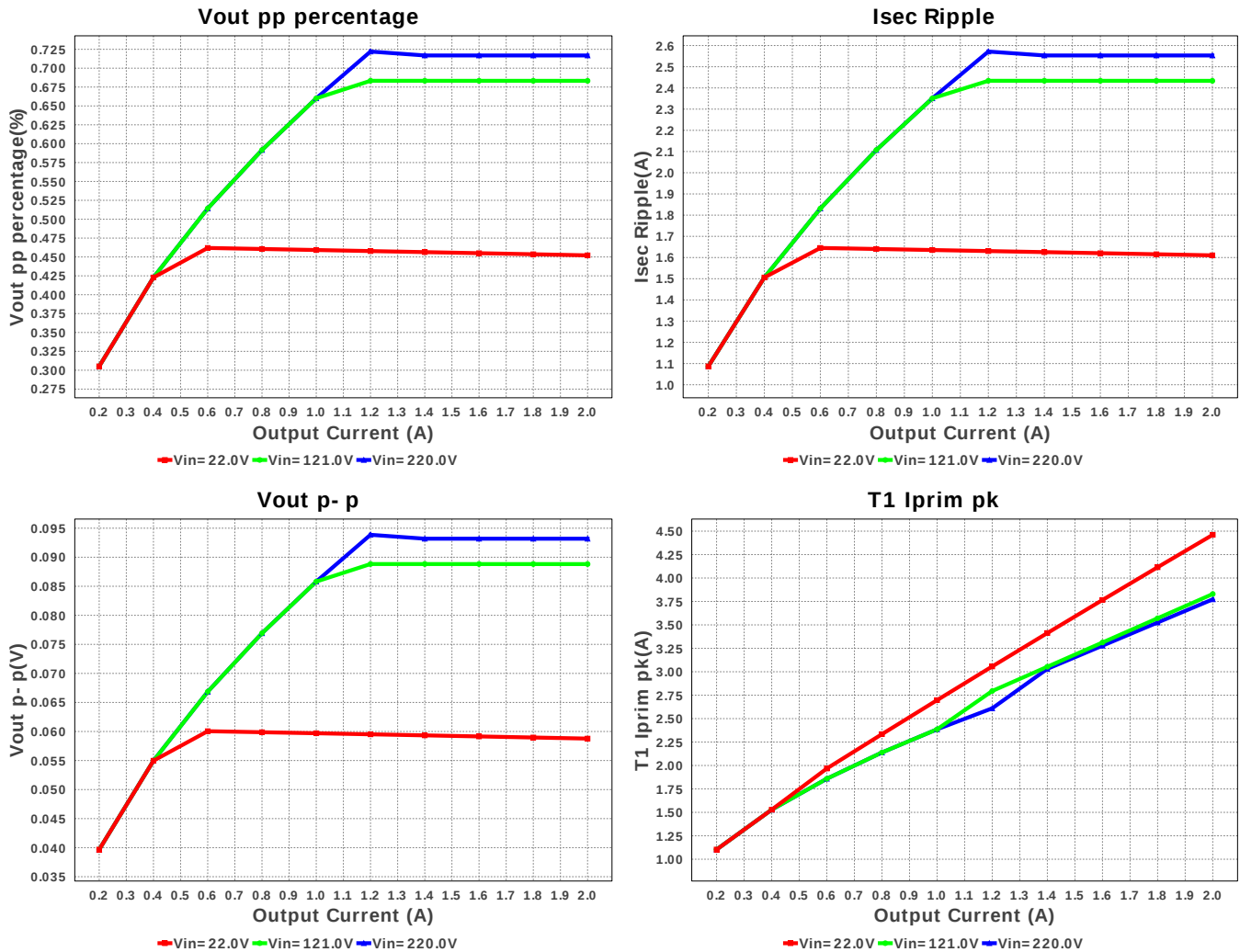
Cout1 IRMS



Dsec Vf







Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.942 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	1.539 A	Current	Average input current
3.	Iout_DCM	576.735 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	1.483 A	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.634 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	44.852 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	1.61 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	2.344 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	4.461 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	2.788 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	4.396 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	49	General	Total Design BOM count
13.	Daux trr	35.0 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	35.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	3.029 k mm ²	General	Total Foot Print Area of BOM components
19.	Frequency	32.21 kHz	General	Switching frequency
20.	Pout	26.0 W	General	Total output power
21.	Tdead	0.0 ns	General	Approximate Dead Time of the Regulator
22.	Toff	17.294 us	General	Approximate Converter Off Time
23.	Ton Act	12.637 us	General	Approximate Converter On Time
24.	Total BOM	\$0.0	General	Total BOM Cost
25.	Tsw	31.047 us	General	Switching Time Period
26.	Vaux	13.925 V	General	Auxiliary Voltage
27.	Vsnub	21.899 V	General	Voltage Across the Snubber
28.	Vout Actual	13.0 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
29.	Vout OP	13.0 V	Op_Point	Operational Output Voltage

#	Name	Value	Category	Description
30.	Duty Cycle	40.703 %	Op_point	Duty cycle
31.	Efficiency	76.801 %	Op_point	Steady state efficiency
32.	IC Tj	33.46 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	65.896 degC	Op_point	M1 MOSFET junction temperature
36.	Vout p-p	58.777 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	27.934 mW	Power	Input capacitor power dissipation
38.	Cout1 Pd	137.673 mW	Power	Output capacitor1 power dissipation
39.	Dsec Pd	500.0 mW	Power	Secondary Diode Power Dissipation
40.	Dsec2 Pd	500.0 mW	Power	Secondary Diode Power Dissipation
41.	IC Pd	69.202 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	574.33 mW	Power	M1 MOSFET total power dissipation
44.	Paux	34.704 mW	Power	Power Dissipation in Raux and Daux
45.	Pd Rstartup	7.843 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
46.	Rdrv Pd	49.878 μ W	Power	Power Dissipation in Gate Drive Resistor
47.	Rfb Pd	6.828 mW	Power	Rfb Power Dissipation
48.	Rsns Pd	857.447 mW	Power	Current Limit Sense Resistor Power Dissipation
49.	Snubber Pd	606.208 mW	Power	Snubber Power Dissipation
50.	T1 Pd	6.695 W	Power	Estimated Losses in Transformer
51.	Total Pd	0.0 W	Power	Total Power Dissipation
52.	Vout Tolerance	1.958 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout pp percentage	452.134 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	220.0	Maximum input voltage
3.	VinMin	22.0	Minimum input voltage
4.	Vout	13.0	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.

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