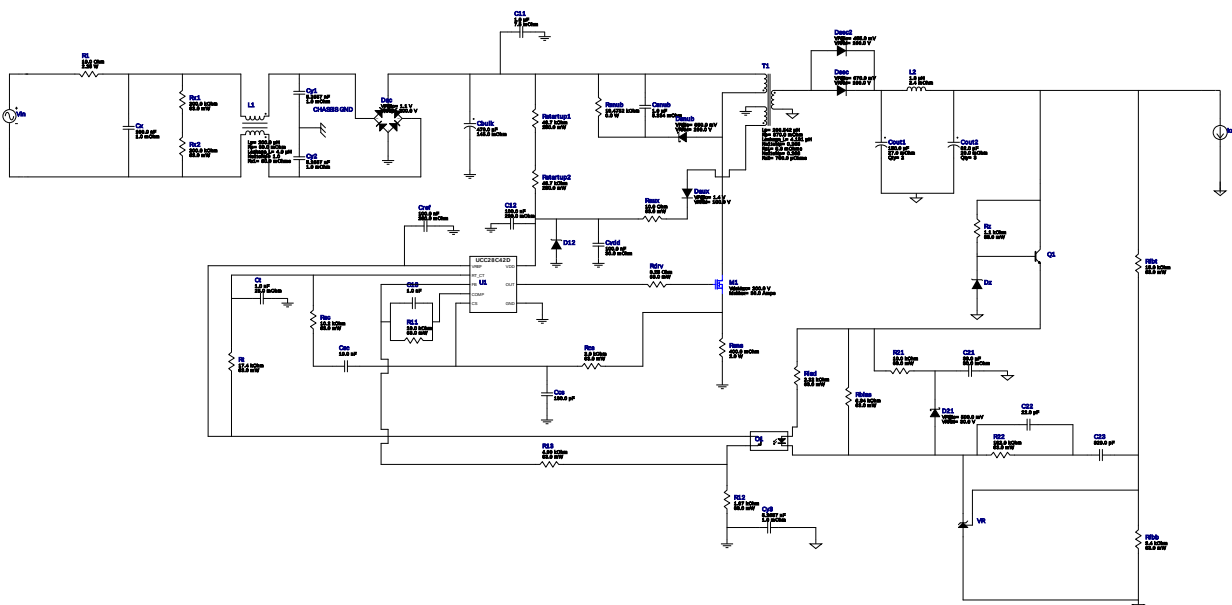


WEBENCH® Design Report

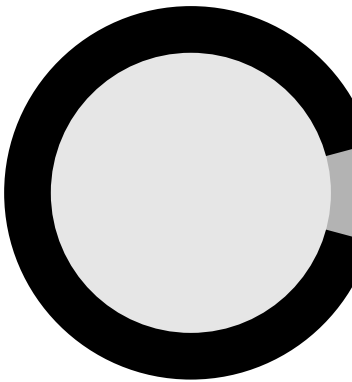
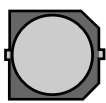
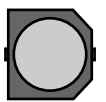
Design : 906020/2240 UCC28C42DR
UCC28C42DR 36.0V-42.0V to 13.50V @ 2.0A

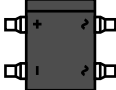
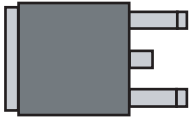
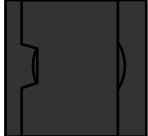


1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

Electrical BOM

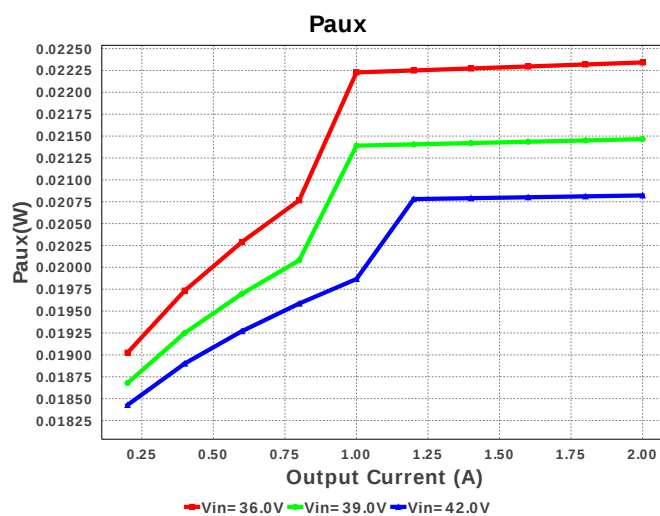
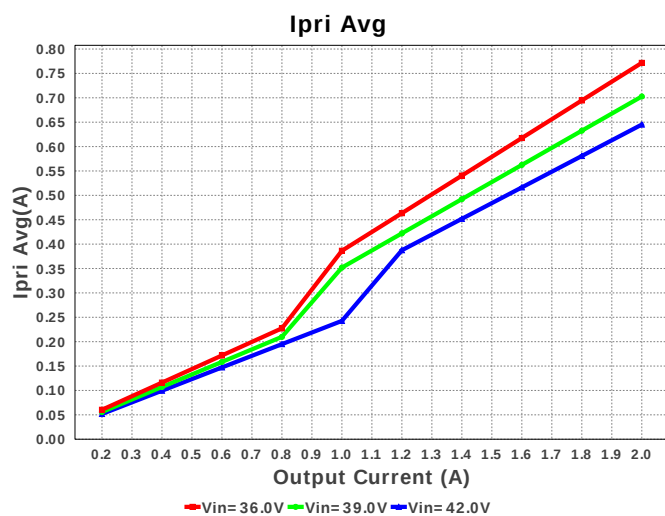
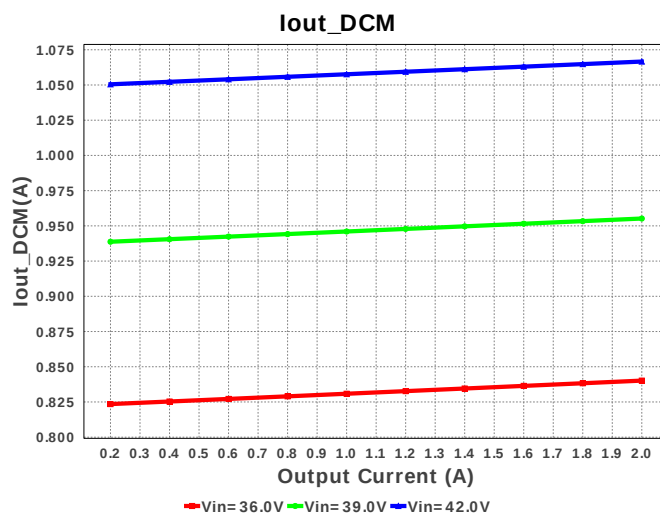
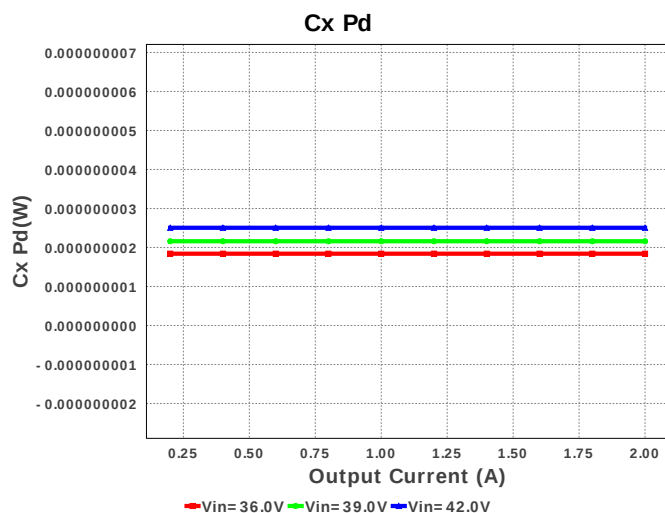
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C3216X7R2A105M160AA Series= X7R	Cap= 1.0 uF ESR= 7.5 mOhm VDC= 100.0 V IRMS= 5.9235 A	1	\$0.11	 1206 11 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	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
4.	C21	Panasonic	35SVPF39M Series= ?	Cap= 39.0 uF ESR= 30.0 mOhm VDC= 35.0 V IRMS= 2.8 A	1	\$0.50	 CAPSMT_62_E7 106 mm ²
5.	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
6.	C23	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

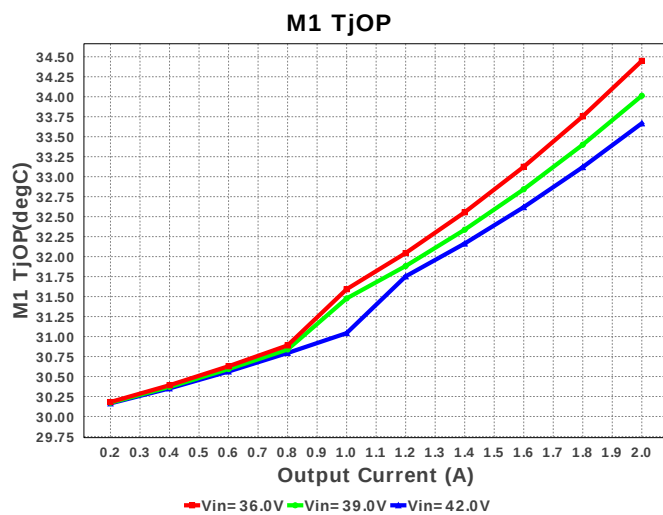
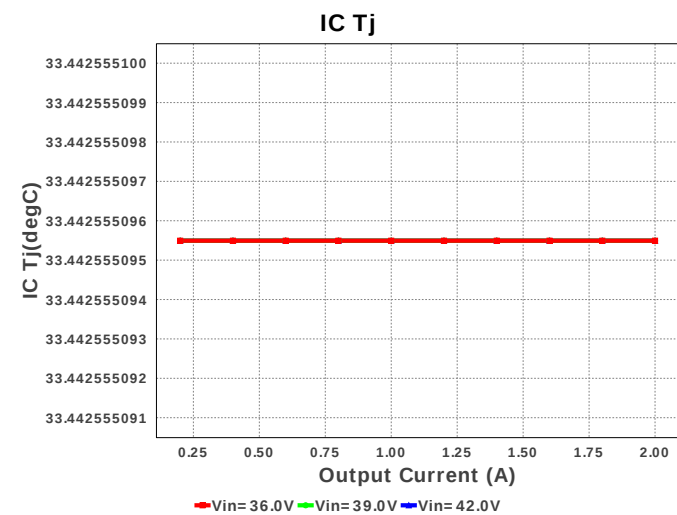
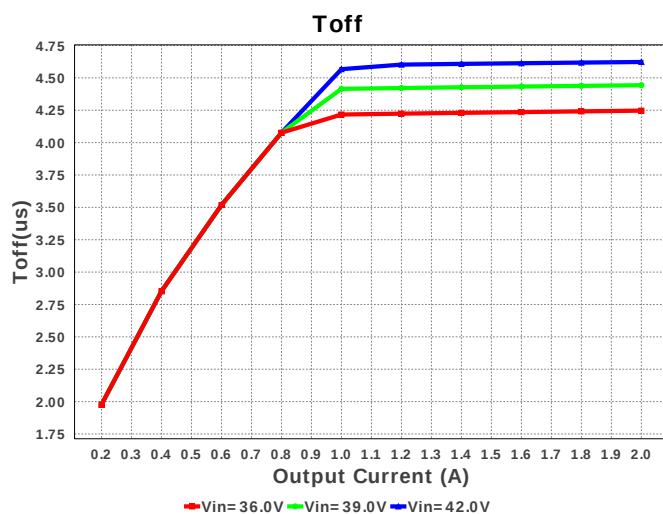
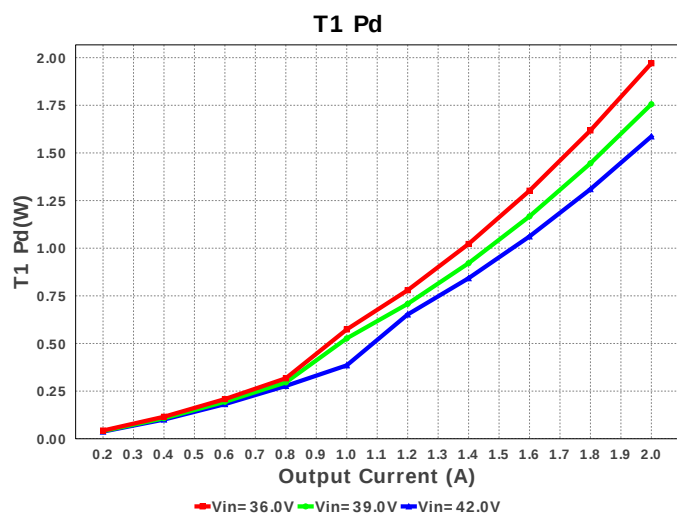
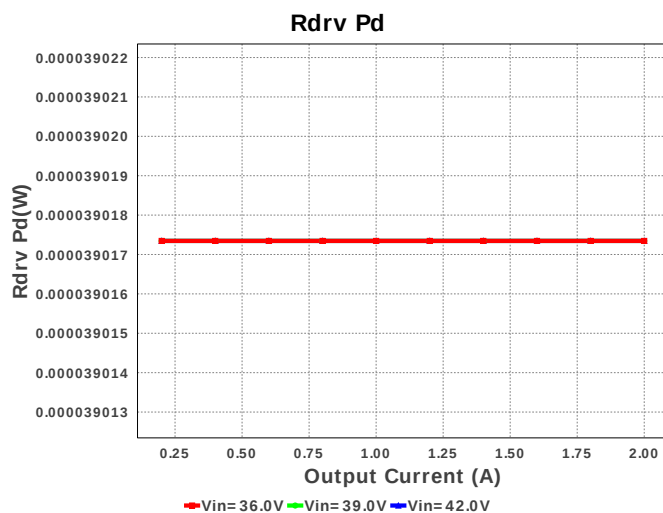
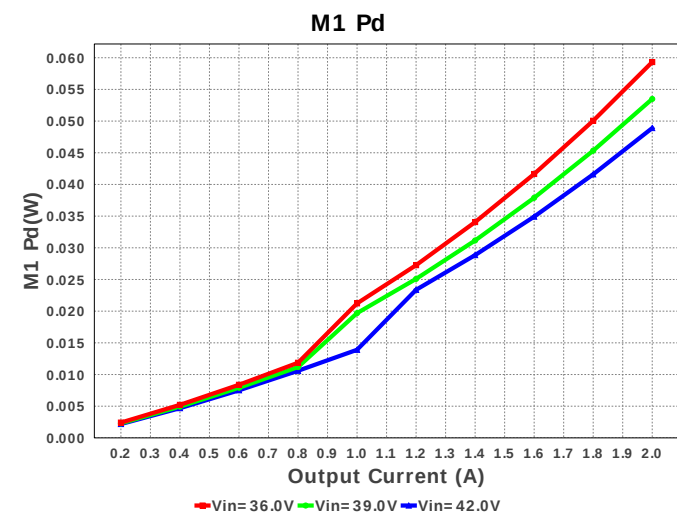
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7.	Cbulk	Kemet	ELH477M450AT6AA Series= 2333	Cap= 470.0 uF ESR= 145.0 mOhm VDC= 450.0 V IRMS= 2.5 A	1	\$4.42	 ELH_3500x5000 1369 mm ²
8.	Ccs	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
9.	Cout1	Panasonic	EEHZA1V151P Series= ?	Cap= 150.0 uF ESR= 27.0 mOhm VDC= 35.0 V IRMS= 2.3 A	2	\$0.97	 SM_RADIAL_8MM 113 mm ²
10.	Cout2	Panasonic	35SVPF82M Series= ?	Cap= 82.0 uF ESR= 20.0 mOhm VDC= 35.0 V IRMS= 4.0 A	3	\$0.61	 CAPSMT_62_E12 106 mm ²
11.	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
12.	Csc	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
13.	Csnub	MuRata	GRM31CR72A105KA01L Series= X7R	Cap= 1.0 uF ESR= 5.334 mOhm VDC= 100.0 V IRMS= 1.55432 A	1	\$0.11	 1206_190 11 mm ²
14.	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
15.	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
16.	Cx	CUSTOM	CUSTOM Series= ?	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 71.276 V IRMS= 7.9139 mA	1	NA	CUSTOM 0 mm ²
17.	Cy1	CUSTOM	CUSTOM Series= ?	Cap= 5.2657 nF ESR= 1.0 mOhm VDC= 71.276 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
18.	Cy2	CUSTOM	CUSTOM Series= ?	Cap= 5.2657 nF ESR= 1.0 mOhm VDC= 71.276 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
19.	Cy3	CUSTOM	CUSTOM Series= ?	Cap= 5.2657 nF ESR= 1.0 mOhm VDC= 71.276 V IRMS= 500.0 uA	1	NA	CUSTOM 0 mm ²
20.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²

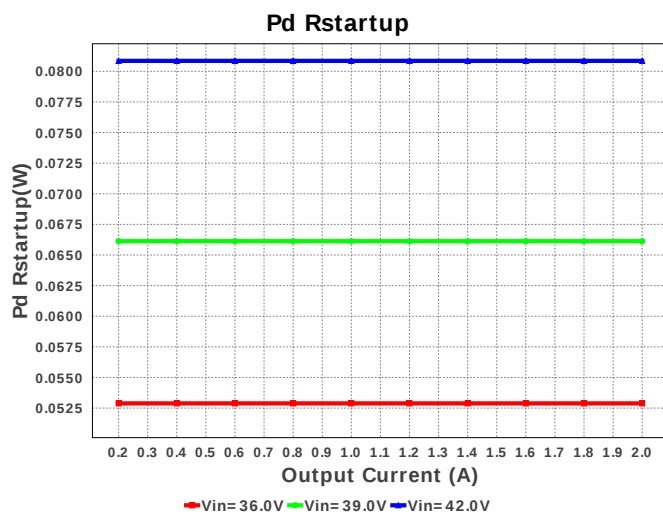
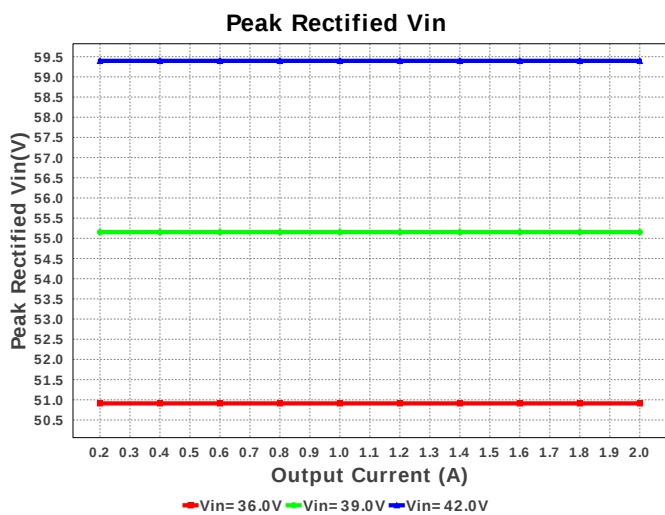
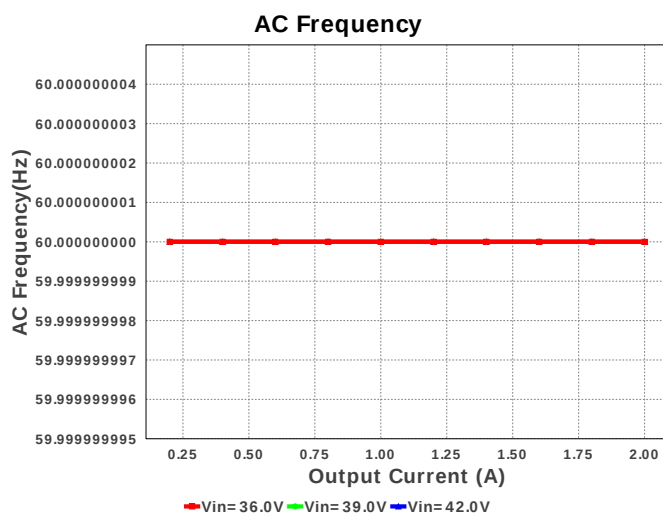
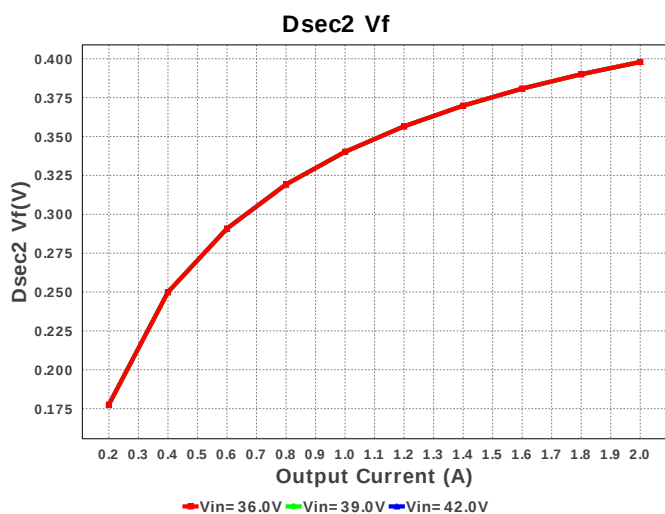
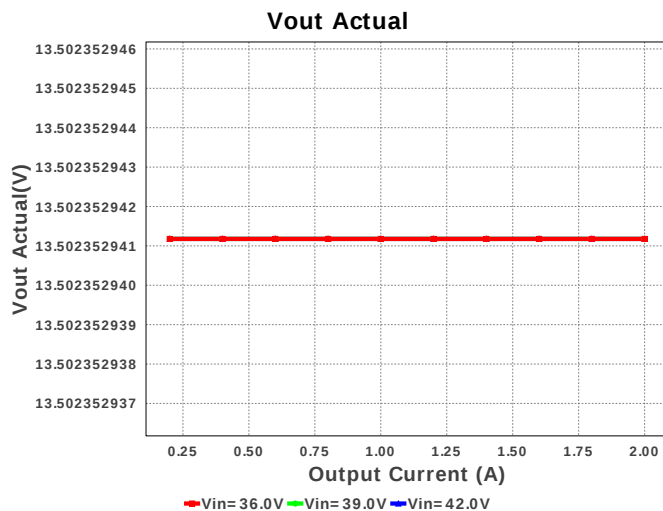
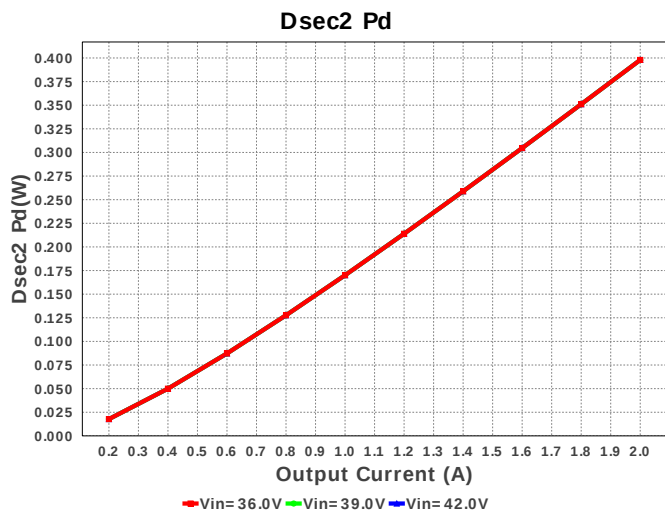
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21.	D21	Bourns	CD214A-B130LF	VF@Io= 500.0 mV VRRM= 30.0 V	1	\$0.08	 SMA 37 mm ²
22.	Dac	Diodes Inc.	DF1502S-T	VF@Io= 1.1 V VRRM= 200.0 V	1	\$0.19	 DF-S 99 mm ²
23.	Daux	NXP Semiconductor	BAS316,115	VF@Io= 1.4 V VRRM= 100.0 V	1	\$0.02	 SOD-323 9 mm ²
24.	Dsec	Fairchild Semiconductor	FSV8100V	VF@Io= 670.0 mV VRRM= 100.0 V	1	\$0.21	 TO-277A 56 mm ²
25.	Dsec2	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	\$1.33	 DDPAK 210 mm ²
26.	Dsnub	Diodes Inc.	DFLS1200-7	VF@Io= 850.0 mV VRRM= 200.0 V	1	\$0.21	 PowerDI123 13 mm ²
27.	Dz	Diodes Inc.	MMSZ5241B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
28.	L1	CUSTOM	CUSTOM	Lp= 200.0 µH Rp= 60.0 mOhm Leakage_L= 4.0 µH Ns1toNp= 1.0 Rs1= 60.0 mOhms	1	NA	CUSTOM 0 mm ²
29.	L2	Coilcraft	SER1360-182KLB	L= 1.8 µH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
30.	M1	Infineon Technologies	BSC320N20NS3 G	VdsMax= 200.0 V IdsMax= 36.0 Amps	1	\$1.32	 PG-TDSON-8 55 mm ²
31.	O1	Vishay-Semiconductor	TCMT1107	Optocoupler	1	\$0.21	 SOP-4 44 mm ²
32.	Q1	ON Semiconductor	BC846BLT1G	Bipolar Transistor	1	\$0.02	 SOT-23 14 mm ²
33.	R1	Vishay-Dale	AC03000001009JACCS Series= F_RES	Res= 10.0 Ohm Power= 2.25 W Tolerance= 5.0%	1	\$0.30	 AC03 158 mm ²
34.	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
35.	R12	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
36.	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
37.	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
38.	R22	Vishay-Dale	CRCW0402182KFKED Series= CRCW..e3	Res= 182.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

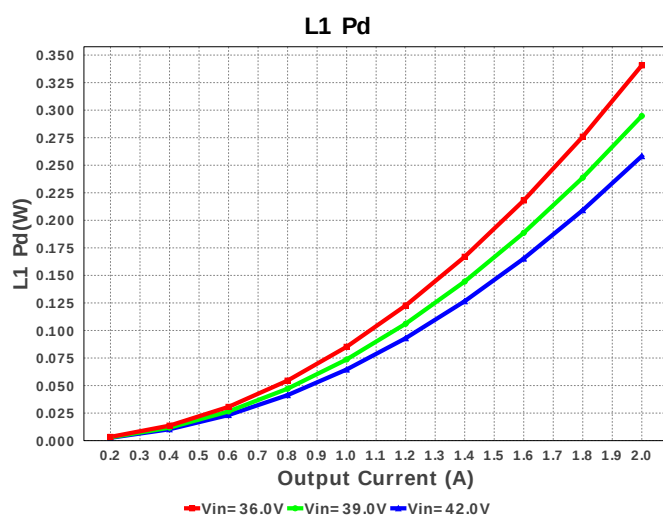
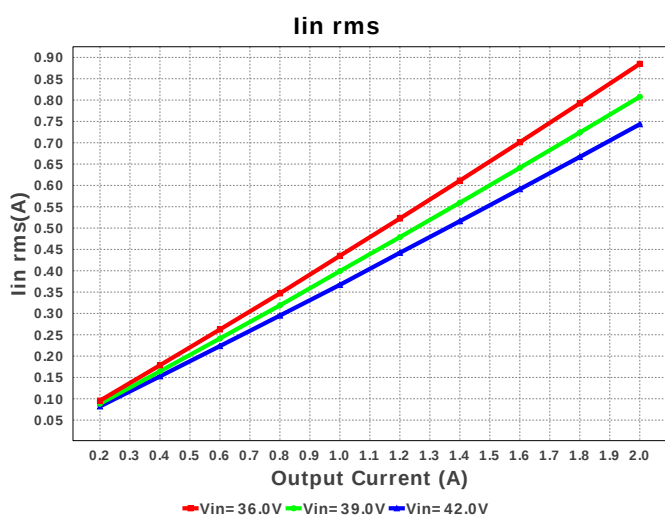
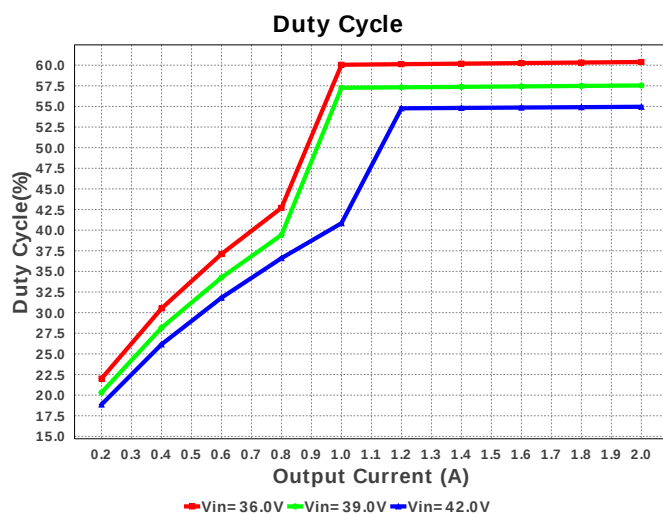
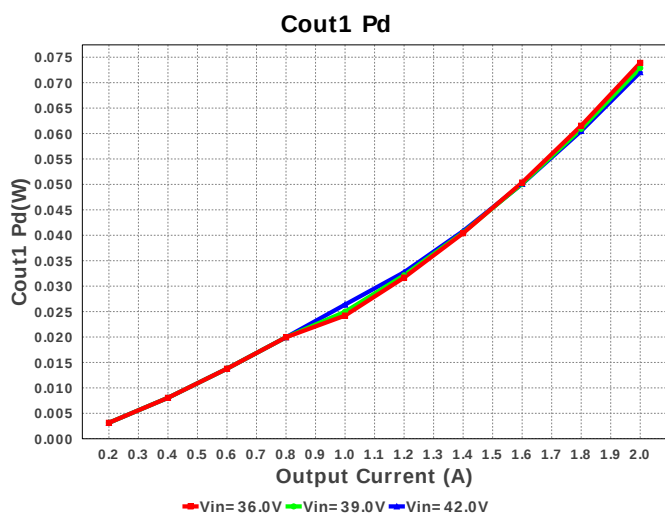
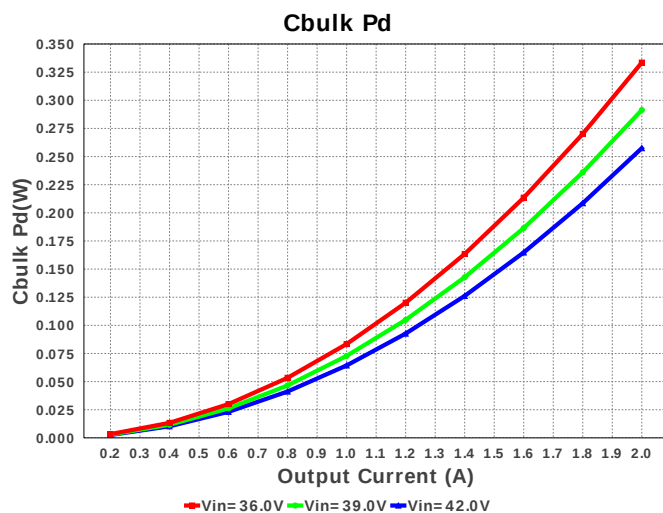
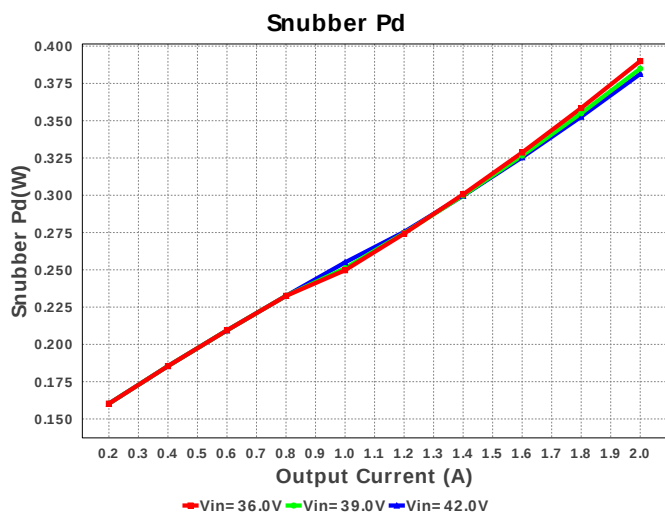
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
39.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
40.	Rbias	Vishay-Dale	CRCW04026K34FKED Series= CRCW..e3	Res= 6.34 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
41.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
42.	Rdrv	Vishay-Dale	CRCW04028R25FKED Series= CRCW..e3	Res= 8.25 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
43.	Rfbb	Vishay-Dale	CRCW04023K40FKED Series= CRCW..e3	Res= 3.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
44.	Rfbt	Vishay-Dale	CRCW040215K0FKED Series= CRCW..e3	Res= 15.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
45.	Rled	Vishay-Dale	CRCW04022K32FKED Series= CRCW..e3	Res= 2.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
46.	Rsc	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
47.	Rsns	Stackpole Electronics Inc	CSRN2512FKR400 Series= ?	Res= 400.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	\$0.13	 2512 43 mm²
48.	Rsnu	CUSTOM	CUSTOM Series= ?	Res= 19.4752 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 mm²
49.	Rstartup1	Panasonic	ERJ-8ENF4872V Series= ERJ-8E	Res= 48.7 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
50.	Rstartup2	Panasonic	ERJ-8ENF4872V Series= ERJ-8E	Res= 48.7 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
51.	Rt	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
52.	Rx1	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
53.	Rx2	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
54.	Rz	Vishay-Dale	CRCW04021K10FKED Series= CRCW..e3	Res= 1.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
55.	T1	CUSTOM	CUSTOM	Lp= 206.542 µH Rp= 870.0 mOhm Leakage_L= 4.131 µH Ns1toNp= 0.268 Rs1= 8.6 mOhms Ns2toNp= 0.268 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
56.	U1	Texas Instruments	UCC28C42DR	Switcher	1	\$0.60	 D0008A 57 mm²

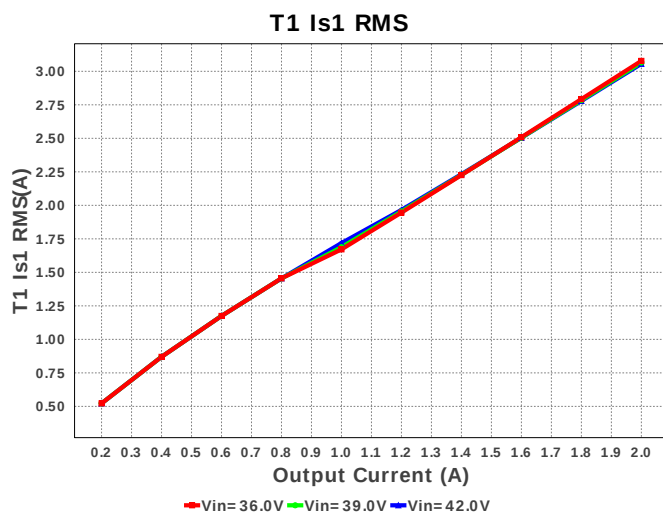
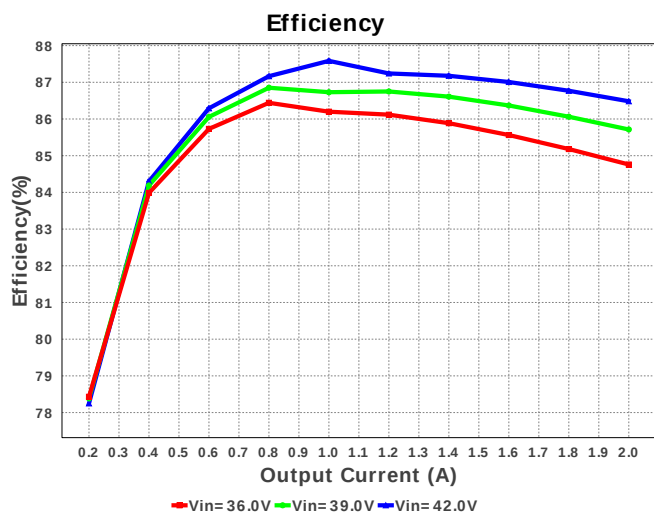
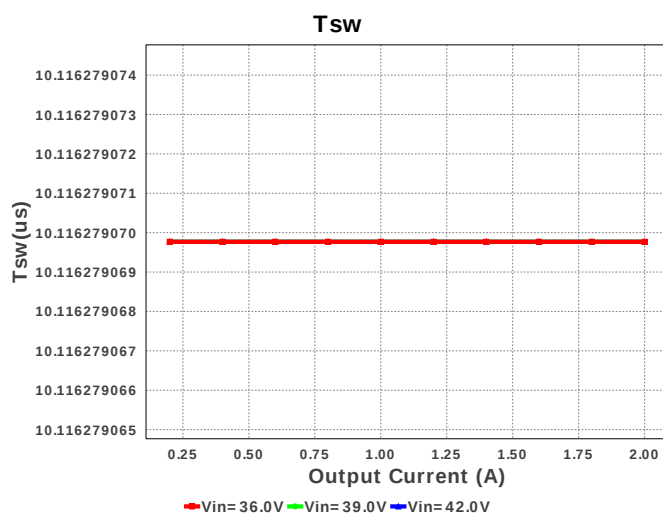
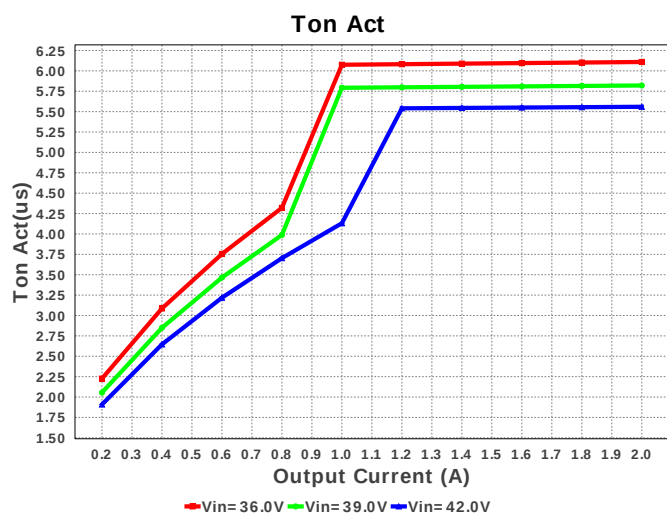
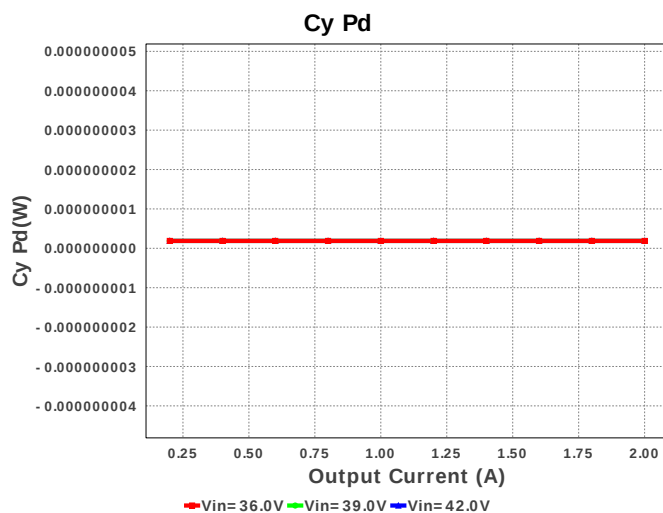
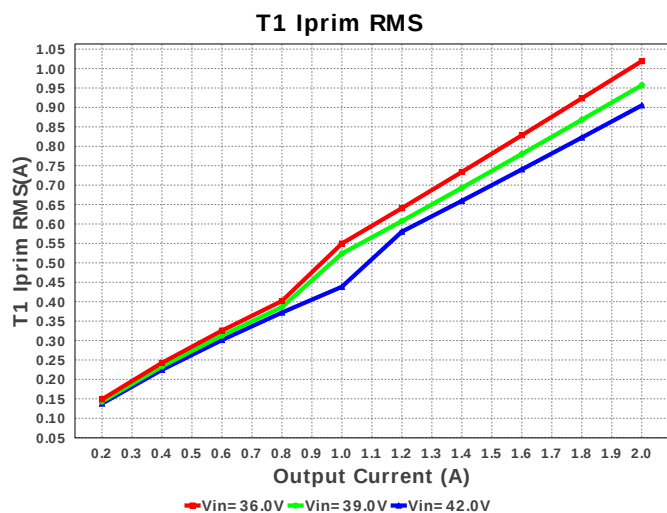
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
57.	VR	Texas Instruments	TL431AIDBVR	Voltage References	1	\$0.07	 R-PDSO-G3 16 mm ²

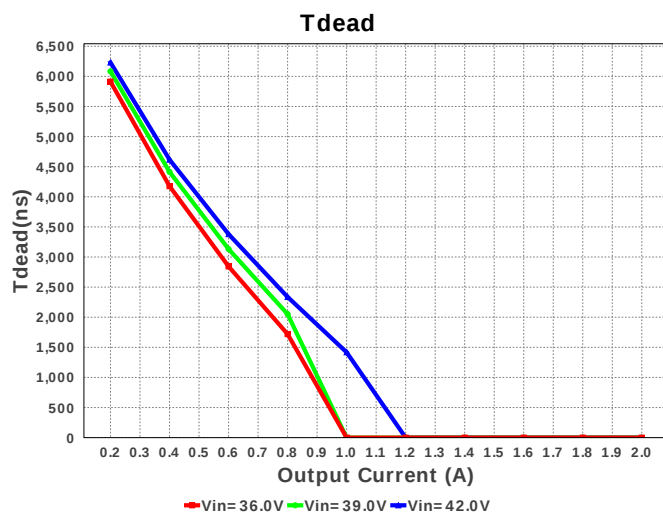
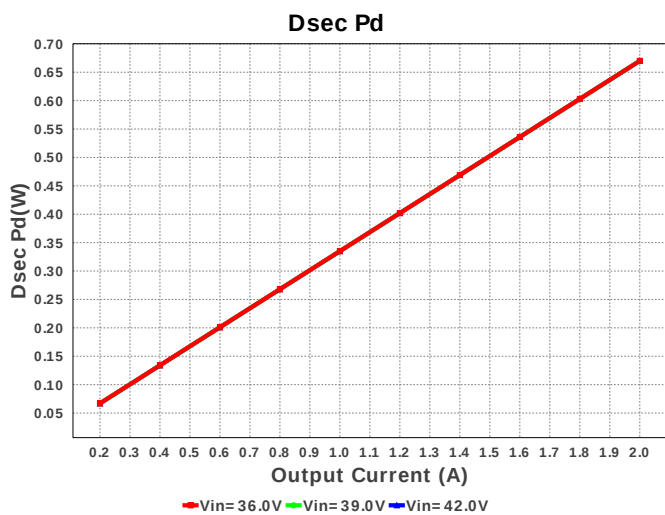
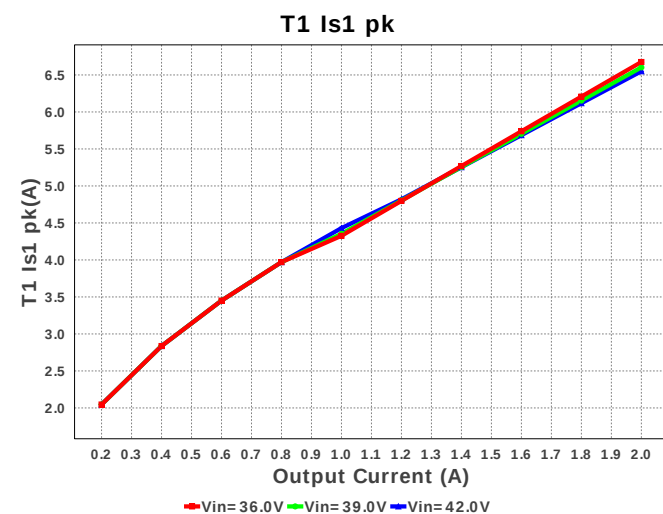
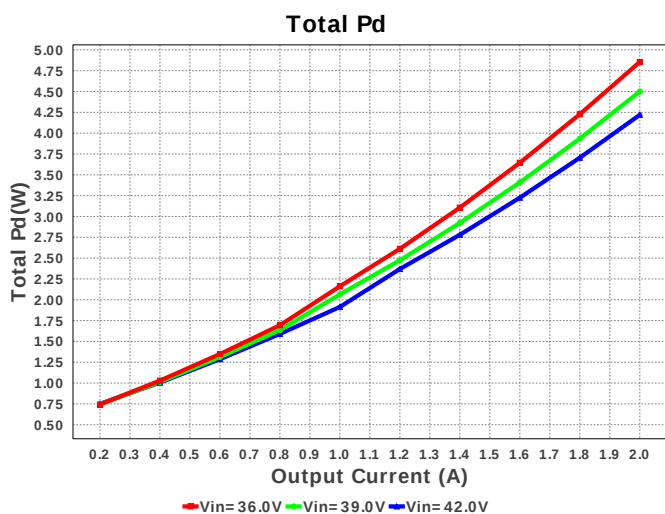
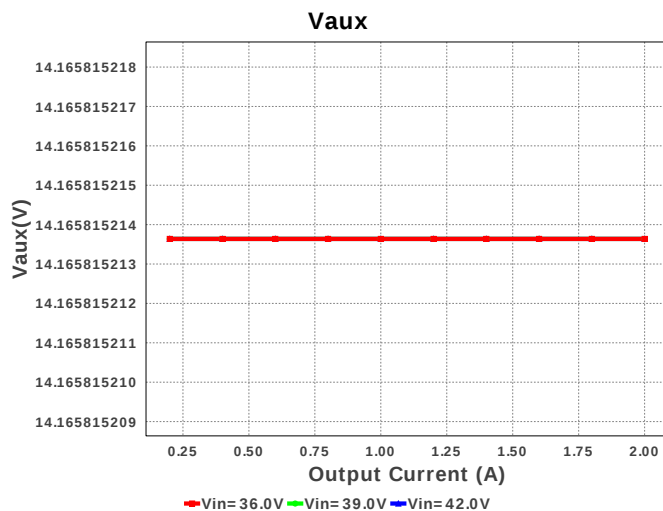
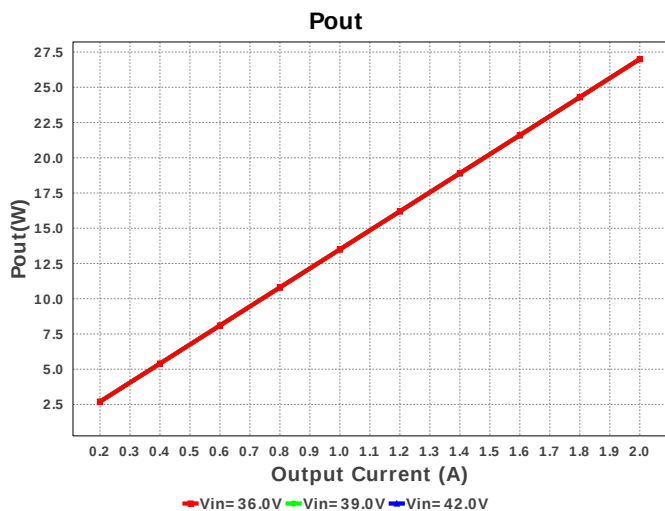


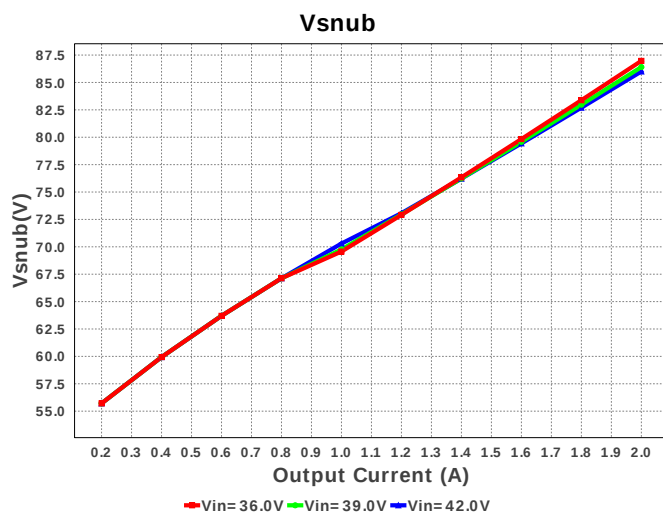
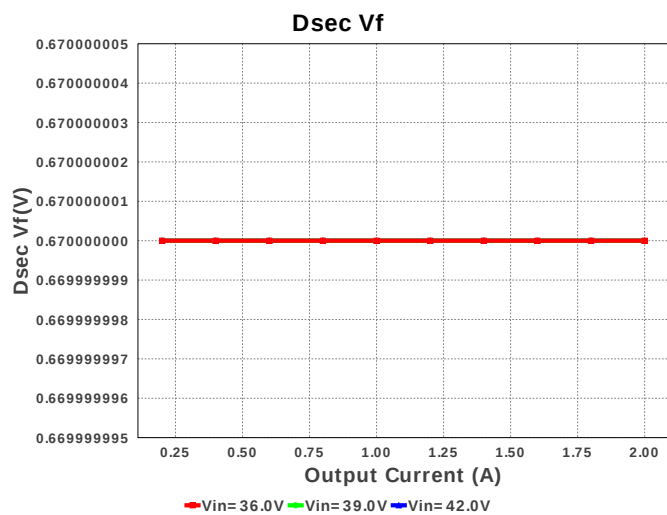
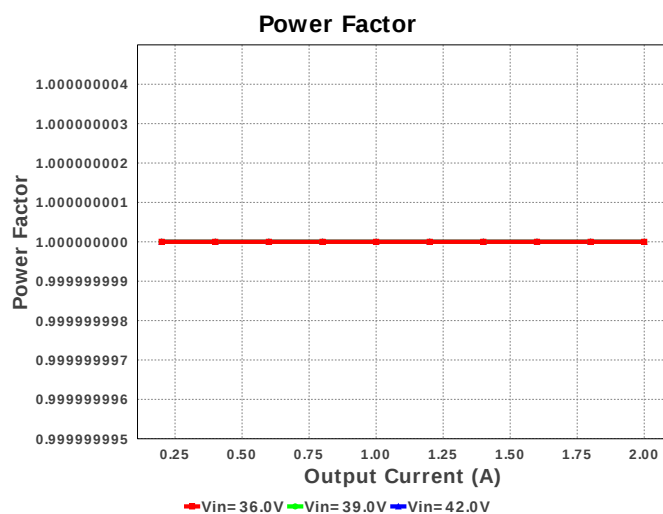
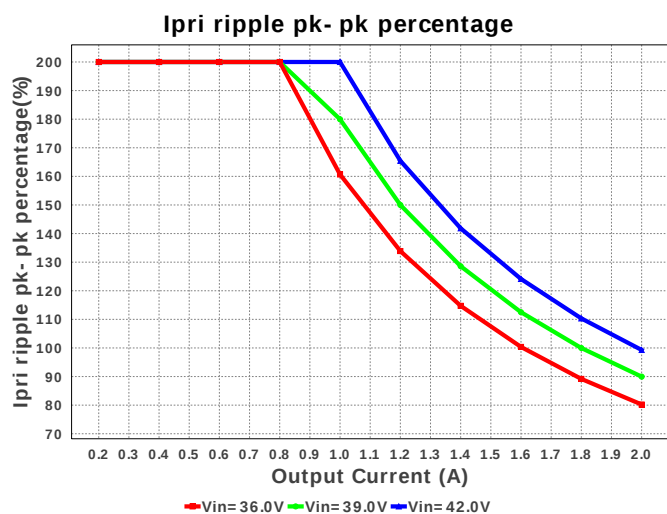
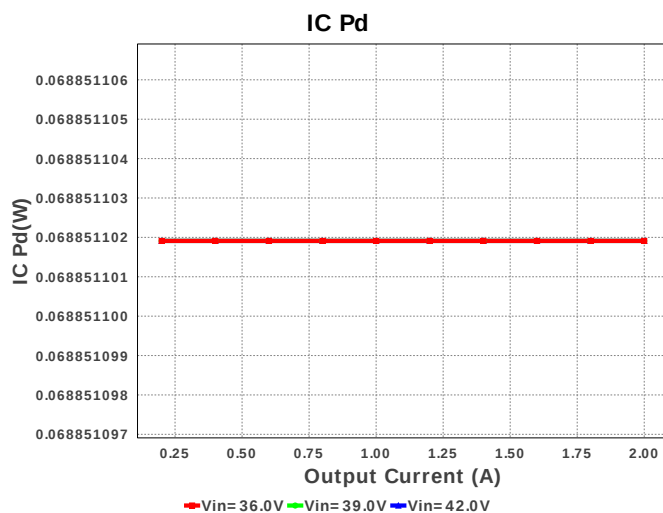
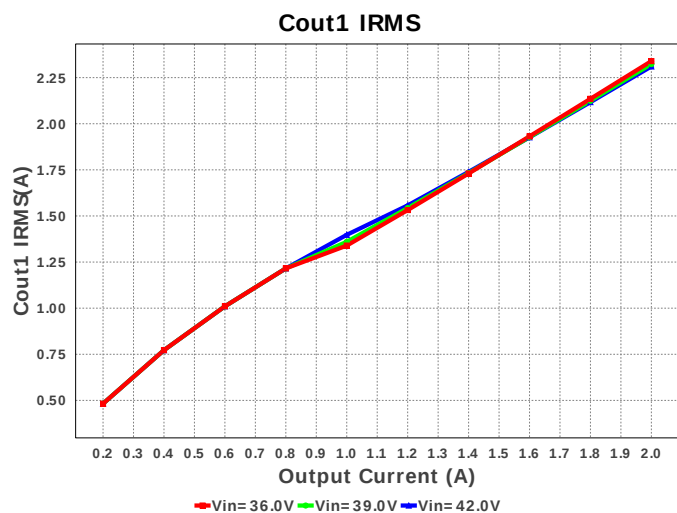


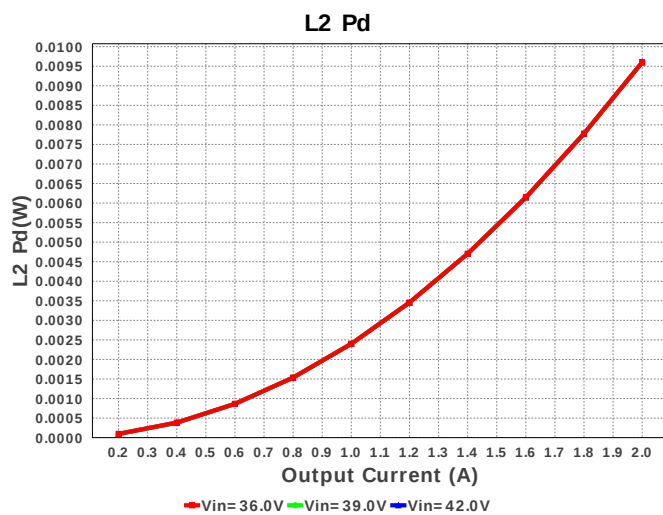
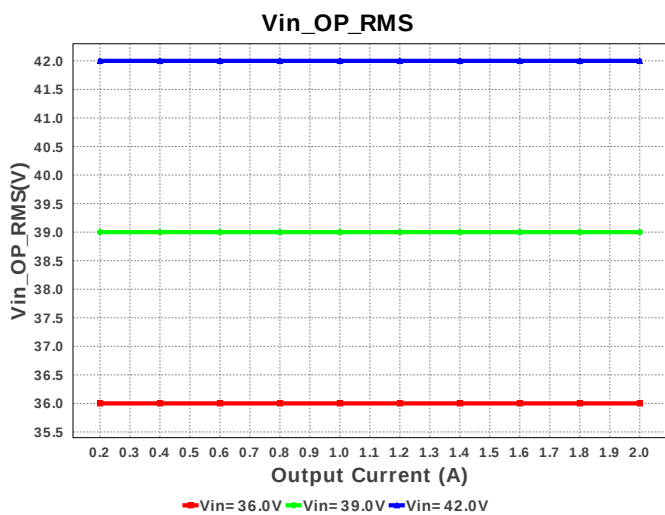
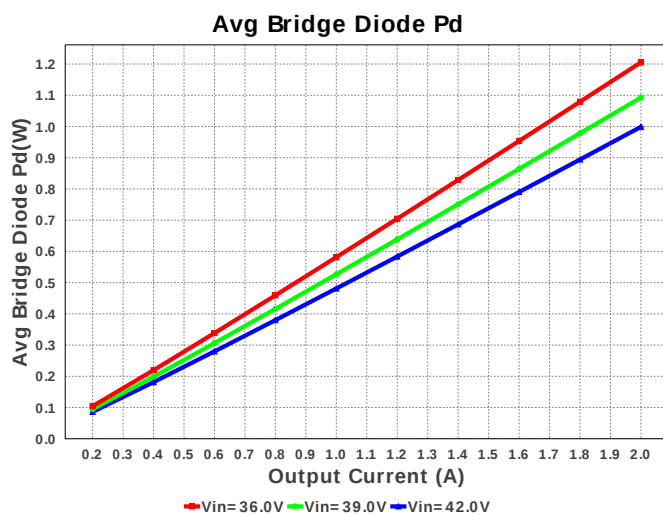
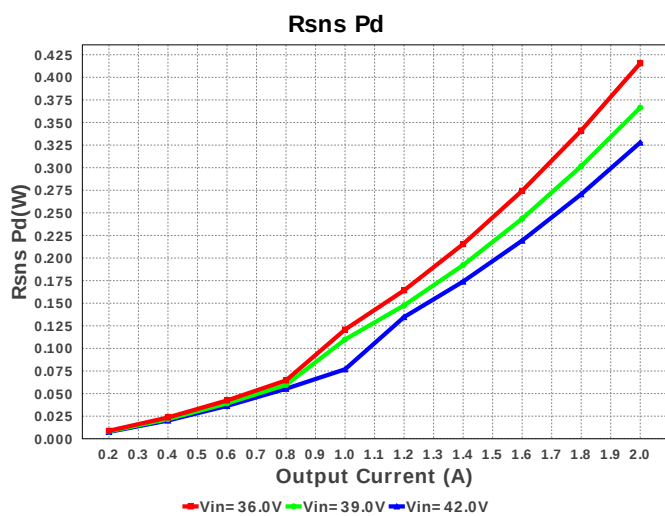
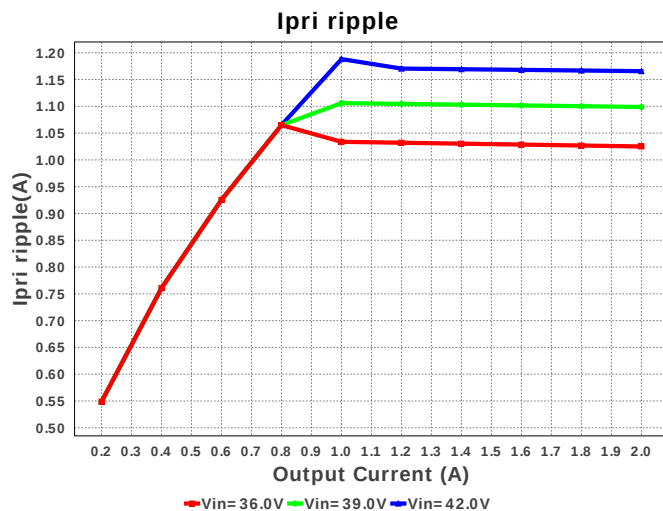
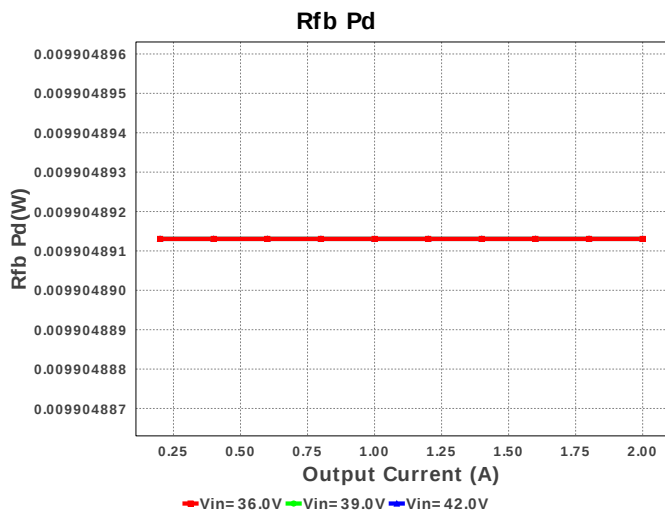


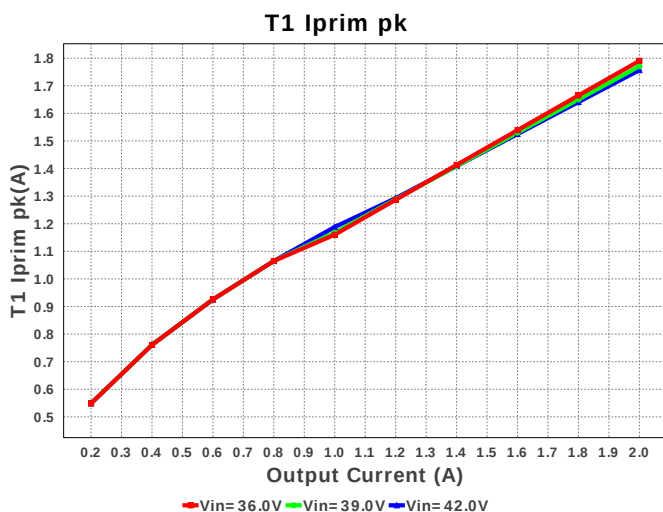
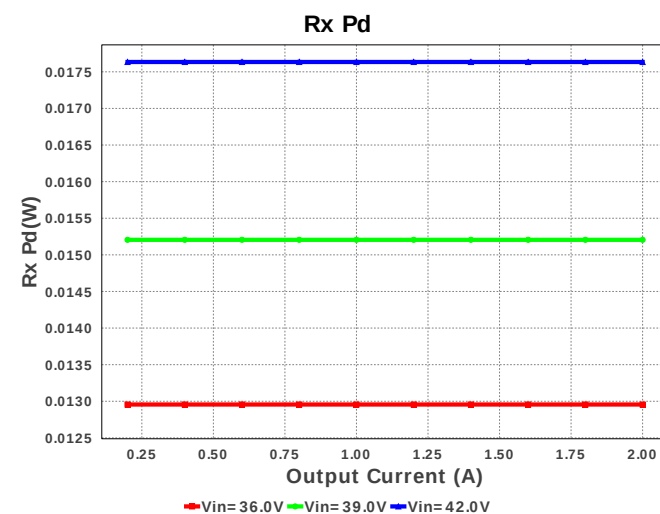
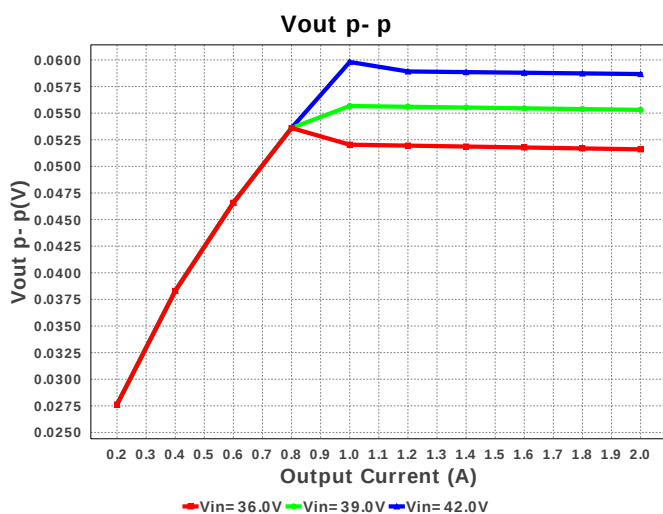
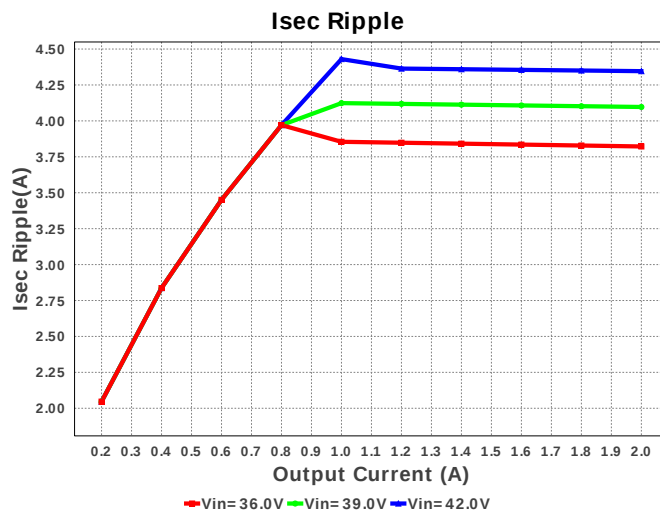
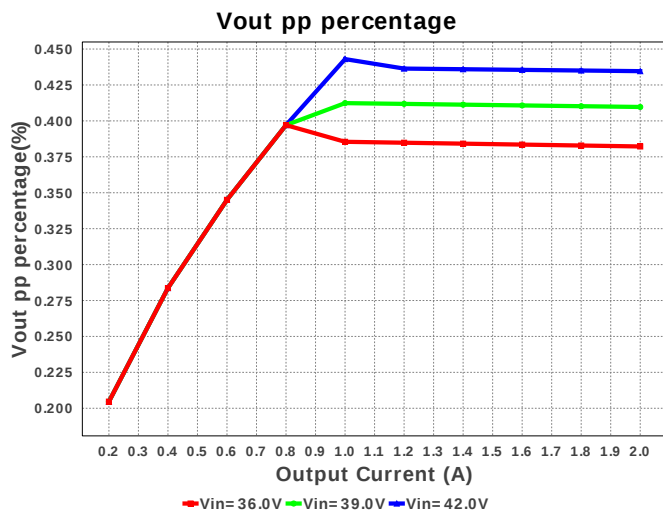












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	2.34 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	884.85 mA	Current	RMS Input Current
3.	Iout_DCM	840.153 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	771.613 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.025 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	80.224 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.822 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.019 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	1.79 A	Current	Transformer Primary Peak Current

#	Name	Value	Category	Description
10.	T1 Is1 RMS	3.078 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	6.675 A	Current	Transformer Secondary1 Peak Current
12.	AC Frequency	60.0 Hz	General	Input AC frequency
13.	BOM Count	60	General	Total Design BOM count
14.	Daux trr	4.0 ns	General	Auxiliary Diode Reverse Recovery Time
15.	Dsec Vf	670.0 mV	General	Effective Forward Voltage Drop at the Operating Current
16.	Dsec trr	19.64 ns	General	Output Diode Reverse Recovery Time
17.	Dsec2 Vf	397.923 mV	General	Effective Forward Voltage Drop at the Operating Current
18.	Dsnub trr	0.0 ns	General	Snubber Diode Reverse Recovery Time
19.	FootPrint	3.465 k mm ²	General	Total Foot Print Area of BOM components
20.	Frequency	98.851 kHz	General	Switching frequency
21.	Pout	27.0 W	General	Total output power
22.	Power Factor	1.0	General	Assumed Power Factor for the Application
23.	Tdead	0.0 ns	General	Approximate Dead Time of the Regulator
24.	Toff	4.247 us	General	Approximate Converter Off Time
25.	Ton Act	6.109 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	10.116 us	General	Switching Time Period
28.	Vaux	14.166 V	General	Auxiliary Voltage
29.	Vsnub	86.97 V	General	Voltage Across the Snubber
30.	Vout Actual	13.502 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	13.5 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	60.387 %	Op_point	Duty cycle
33.	Efficiency	84.76 %	Op_point	Steady state efficiency
34.	IC Tj	33.443 degC	Op_point	IC junction temperature
35.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
36.	IOUT_OP	2.0 A	Op_point	Iout operating point
37.	M1 TJOP	34.449 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	50.911 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	36.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	51.598 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	1.205 W	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	333.509 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	73.893 mW	Power	Output capacitor1 power dissipation
44.	Cx Pd	1.841 nW	Power	X-cap Power Dissipation
45.	Cy Pd	187.5 pW	Power	Y-caps Power Dissipation
46.	Dsec Pd	670.0 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	397.923 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	68.851 mW	Power	IC power dissipation
49.	L1 Pd	340.663 mW	Power	Power Dissipation in the Inductor
50.	L2 Pd	9.6 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
51.	M1 Pd	59.315 mW	Power	M1 MOSFET total power dissipation
52.	Paux	22.341 mW	Power	Power Dissipation in Raux and Daux
53.	Pd Rstartup	52.884 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
54.	Rdrv Pd	39.017 μW	Power	Power Dissipation in Gate Drive Resistor
55.	Rfb Pd	9.905 mW	Power	Rfb Power Dissipation
56.	Rsns Pd	415.532 mW	Power	Current Limit Sense Resistor Power Dissipation
57.	Rx Pd	12.956 mW	Power	Total Power Dissipation in Rx1 and Rx2
58.	Snubber Pd	389.971 mW	Power	Snubber Power Dissipation
59.	T1 Pd	1.971 W	Power	Estimated Losses in Transformer
60.	Total Pd	4.855 W	Power	Total Power Dissipation
61.	Vout Tolerance	1.973 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
62.	Vout pp percentage	382.205 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	42.0	Maximum input voltage
3.	VinMin	36.0	Minimum input voltage
4.	Vout	13.5	Output Voltage
5.	acFrequency	60.0	Light Output in Lumen
6.	base_pn	UCC28C42	Texas Instruments Base Part Number
7.	source	AC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. UCC28C42 Product Folder : <http://www.ti.com/product/UCC28C42> : contains the data sheet and other resources.

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