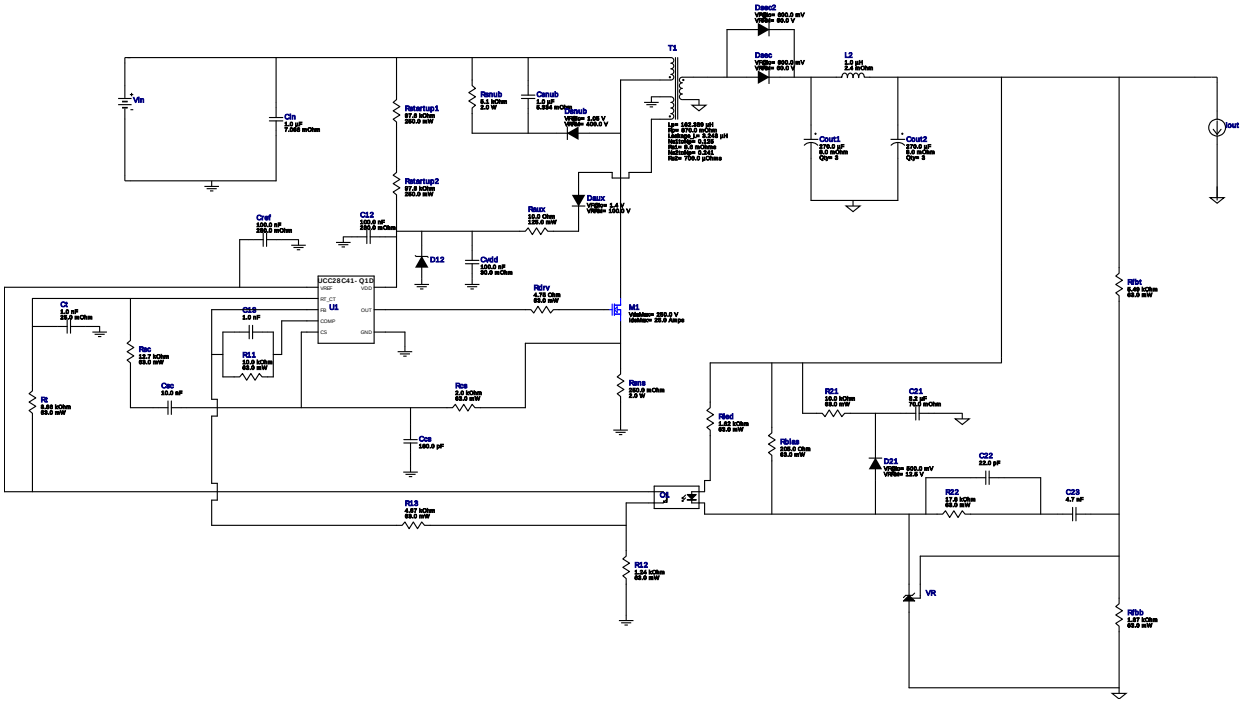
WEBENCH® Design Report

VinMin = 70.0V
VinMax = 120.0V
Vout = 5.0V
Iout = 10.0A

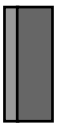
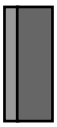
Device = UCC28C41QDRQ1
Topology = Flyback
Created = 7/2/16 5:40:16 PM
BOM Cost = $0.00
BOM Count = 48
Total Pd = 0.0W

Design : 4058737/187 UCC28C41QDRQ1
UCC28C41QDRQ1 70.0V-120.0V to 5.00V @ 10.0A



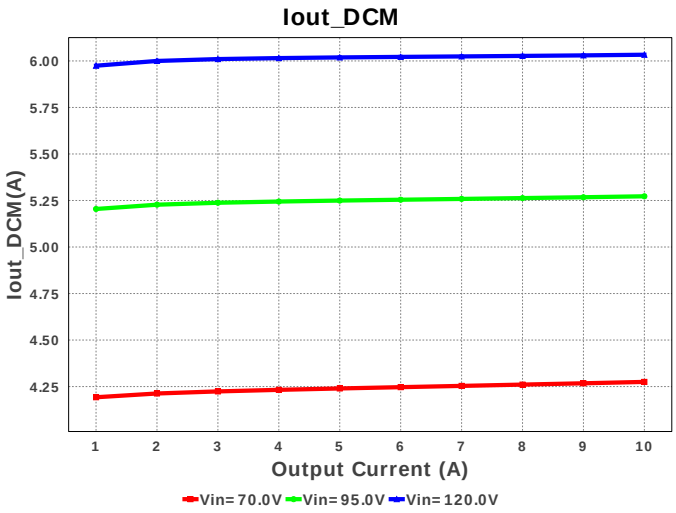
Electrical BOM

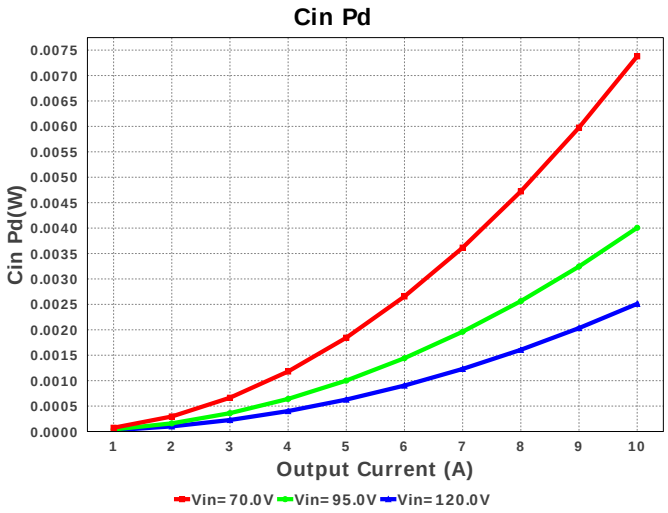
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	C21	Panasonic	35SVPD8R2M Series= SVPD	Cap= 8.2 uF ESR= 70.0 mOhm VDC= 35.0 V IRMS= 1.3 A	1	$0.60	SM_RADIAL_8MM 113 mm²
4.	C22	Kemet	C0805C220K3GACTU Series= C0G/NP0	Cap= 22.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
5.	C23	Yageo America	CC0805KRX7R9BB472 Series= X7R	Cap= 4.7 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
6.	Ccs	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
7.	Cin	MuRata	GRM55DR72E105KW01L Series= X7R	Cap= 1.0 uF ESR= 7.086 mOhm VDC= 250.0 V IRMS= 2.0605 A	1	$0.26	2220_200 54 mm²

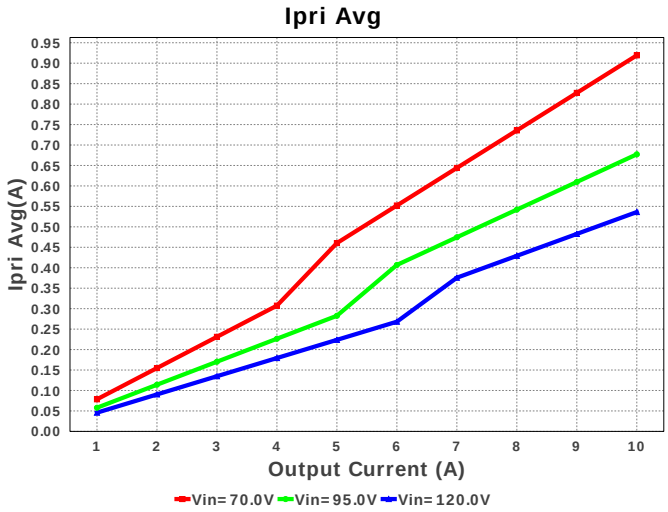
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Cout1	Panasonic	16SVPG270M Series= ?	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	3	$0.70	 CAPSMT_62_C10 74 mm^2
9.	Cout2	Panasonic	16SVPG270M Series= ?	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	3	$0.70	 CAPSMT_62_C10 74 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	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
13.	Ct	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	NA	 0805 7 mm^2
14.	Cvdd	MuRata	GRM188R71C104KA01D Series= X7R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 16.0 V IRMS= 1.7 A	1	$0.01	 0603 5 mm^2
15.	D12	Diodes Inc.	DFLZ18-7	Zener	1	NA	 PowerDI123 13 mm^2
16.	D21	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 12.5 V	1	NA	CUSTOM 0 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	Diodes Inc.	STPS30M60	VF@Io= 600.0 mV VRRM= 60.0 V	1	NA	 TO-220AB 397 mm^2
19.	Dsec2	Diodes Inc.	STPS30M60	VF@Io= 600.0 mV VRRM= 60.0 V	1	NA	 TO-220AB 397 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.	L2	Coilcraft	SER1360-102KLB	L= 1.0 µH DCR= 2.4 mOhm	1	$0.72	 SER1360 225 mm^2
22.	M1	Infineon Technologies	BSC600N25NS3 G	VdsMax= 250.0 V IdsMax= 25.0 Amps	1	$1.41	 PG-TDSON-8 55 mm^2
23.	O1	Vishay-Semiconductor	TCMT1109	Optocoupler	1	NA	 SOP-4 44 mm^2
24.	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

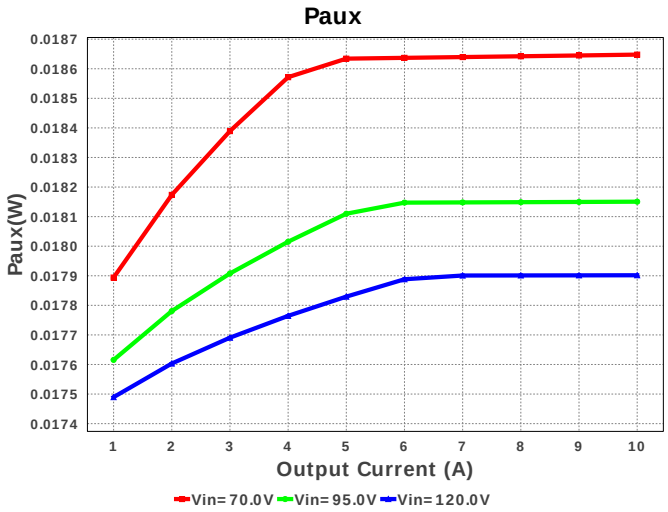
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
25.	R12	Vishay-Dale	CRCW04021K24FKED Series= CRCW..e3	Res= 1.24 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
26.	R13	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
27.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
28.	R22	Vishay-Dale	CRCW040217K8FKED Series= CRCW..e3	Res= 17.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
29.	Raux	Vishay-Dale	CRCW080510R0FKEA Series= CRCW..e3	Res= 10.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
30.	Rbias	Vishay-Dale	CRCW0402205RFKED Series= CRCW..e3	Res= 205.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 3 mm²
31.	Rcs	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
32.	Rdrv	Vishay-Dale	CRCW04024R75FKED Series= CRCW..e3	Res= 4.75 Ohm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 3 mm²
33.	Rfbb	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
34.	Rfbt	Vishay-Dale	CRCW04025K49FKED Series= CRCW..e3	Res= 5.49 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
35.	Rled	Vishay-Dale	CRCW04021K62FKED Series= CRCW..e3	Res= 1.62 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 3 mm²
36.	Rsc	Vishay-Dale	CRCW040212K7FKED Series= CRCW..e3	Res= 12.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
37.	Rsns	Stackpole Electronics Inc	CSRN2512FKR250 Series= ?	Res= 250.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	NA	2512 43 mm²
38.	Rsnub	Vishay-Bccomponents	PR02000205101JR500 Series= ?	Res= 5.1 kOhm Power= 2.0 W Tolerance= 5.0%	1	NA	PR02 113 mm²
39.	Rstartup1	Panasonic	ERJ-8ENF9762V Series= ERJ-8E	Res= 97.6 kOhm Power= 250.0 mW Tolerance= 1.0%	1	NA	1206 11 mm²
40.	Rstartup2	Panasonic	ERJ-8ENF9762V Series= ERJ-8E	Res= 97.6 kOhm Power= 250.0 mW Tolerance= 1.0%	1	NA	1206 11 mm²
41.	Rt	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	0402 3 mm²
42.	T1	CUSTOM	CUSTOM	Lp= 162.389 µH Rp= 870.0 mOhm Leakage_L= 3.248 µH Ns1toNp= 0.125 Rs1= 8.6 mOhms Ns2toNp= 0.241 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²

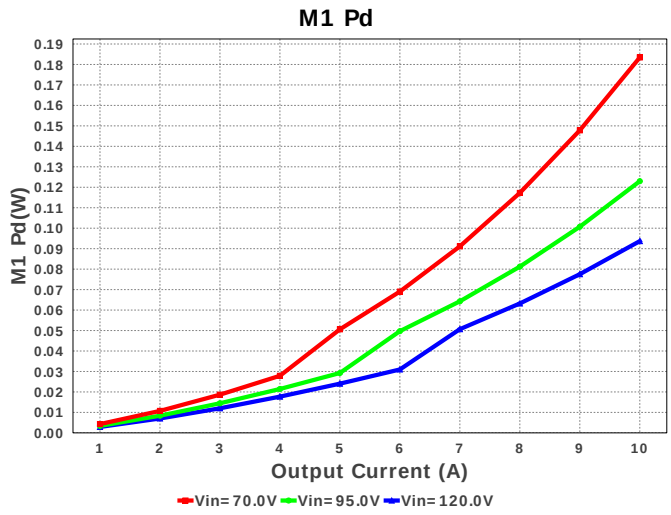
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
43.	U1	Texas Instruments	UCC28C41QDRQ1	Switcher	1	$0.80	 D0008A 57 mm^2
44.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	$0.16	 R-PDSO-G3 16 mm^2

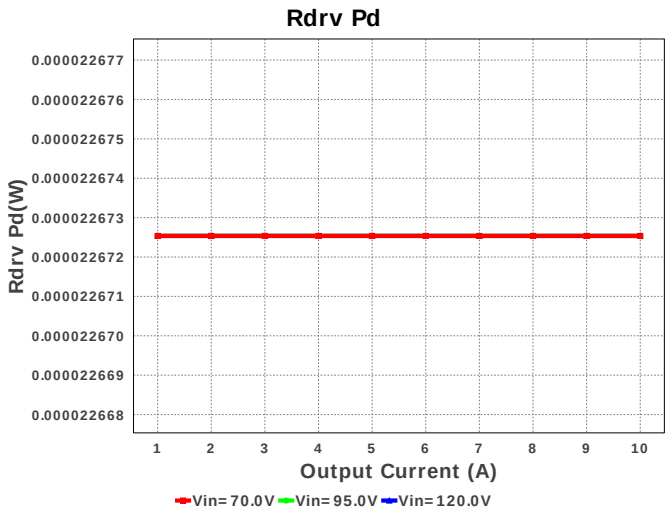


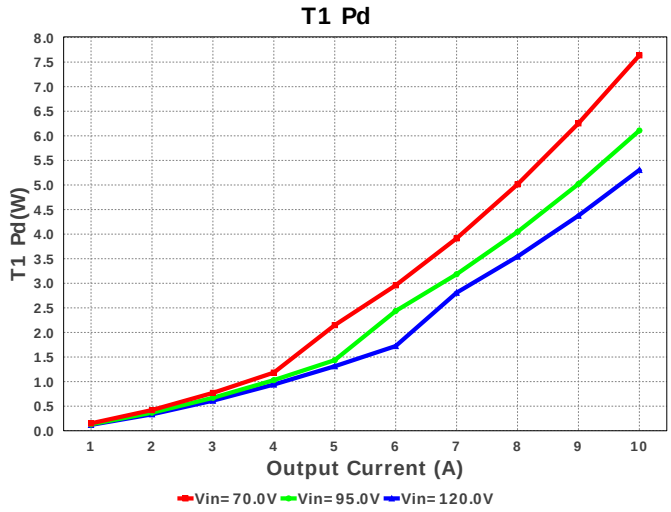


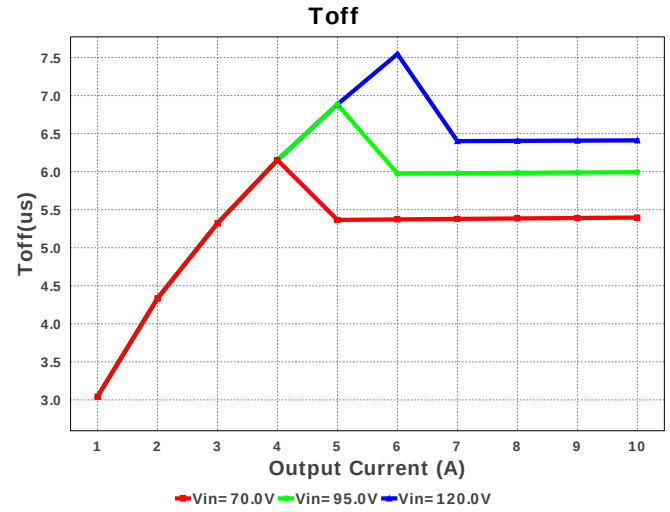


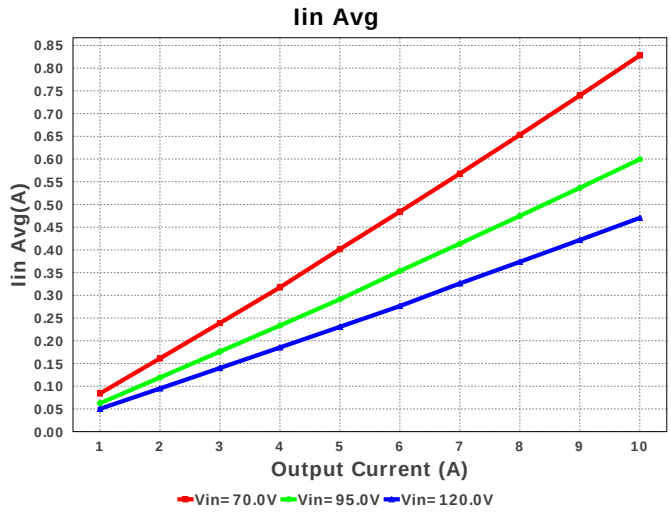


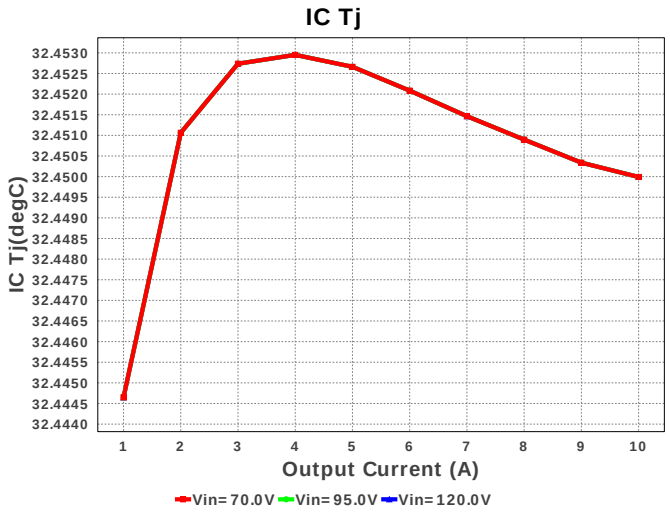


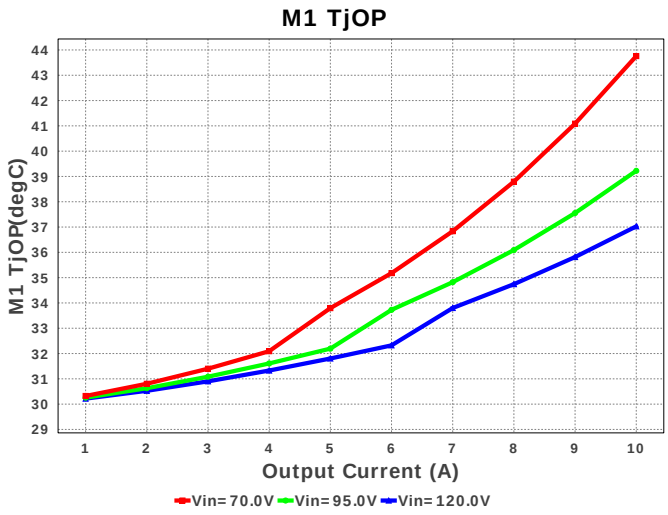


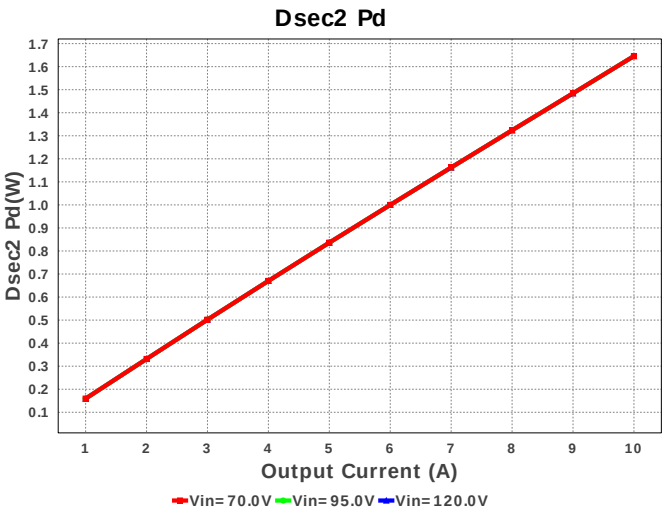


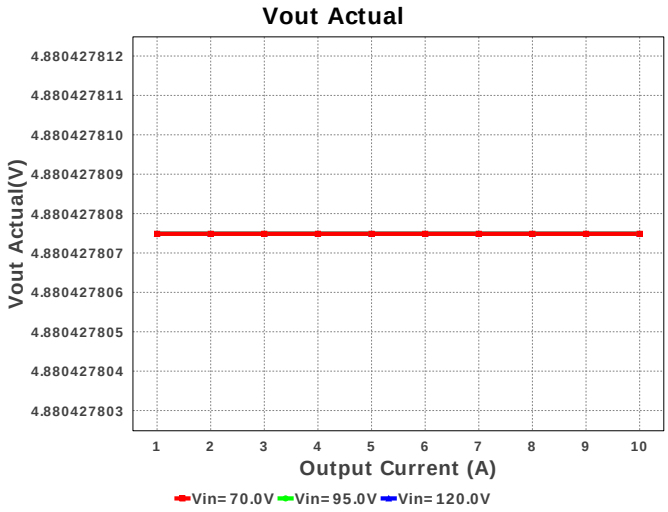


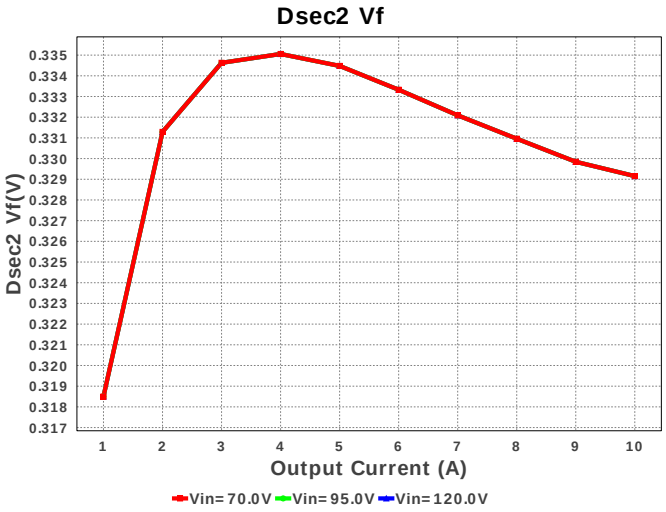


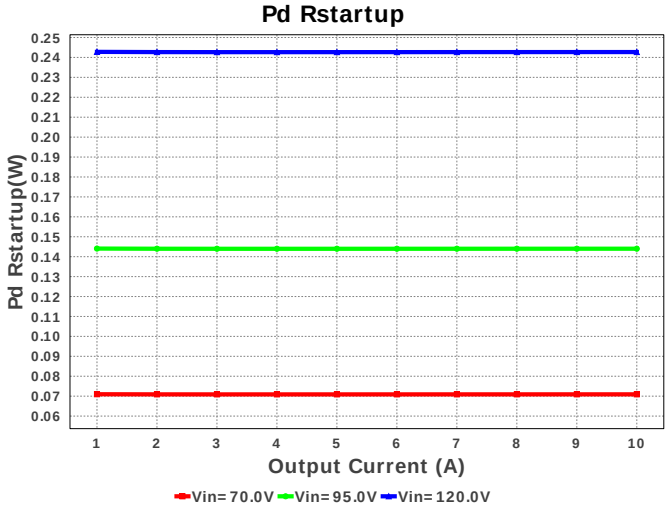


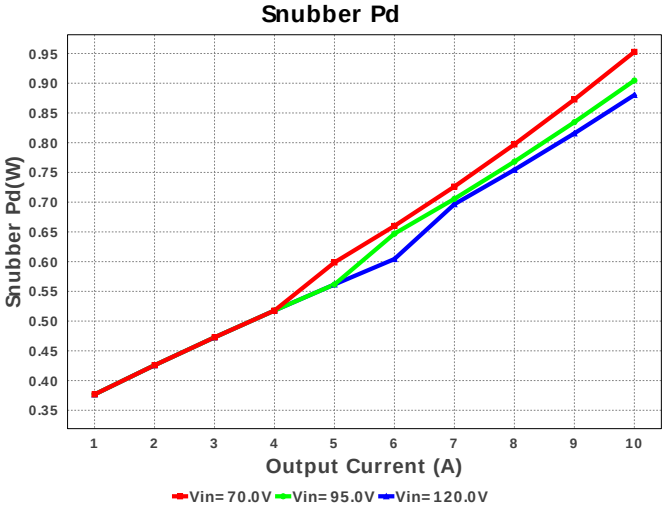


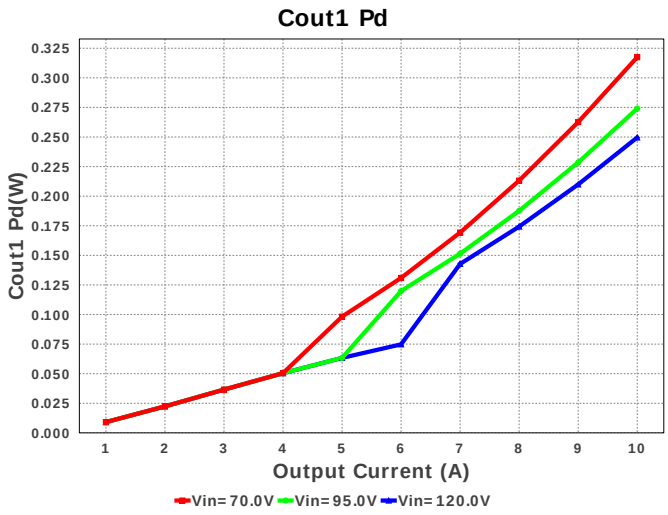


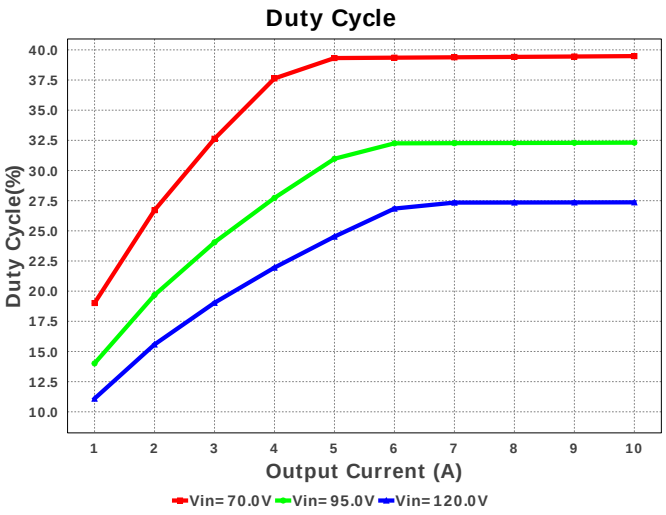


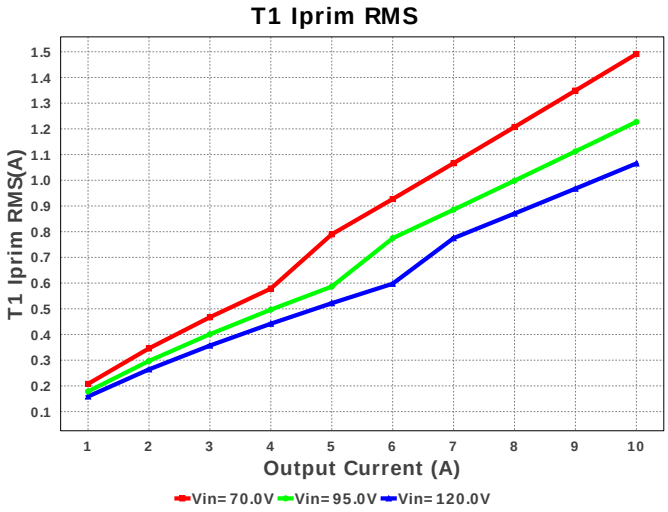


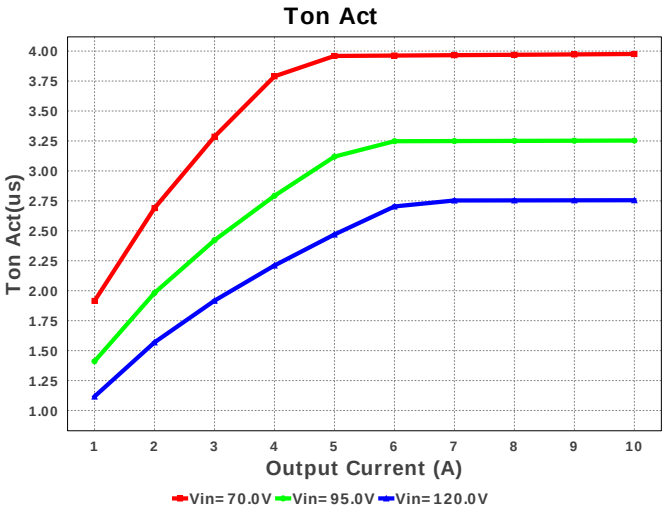


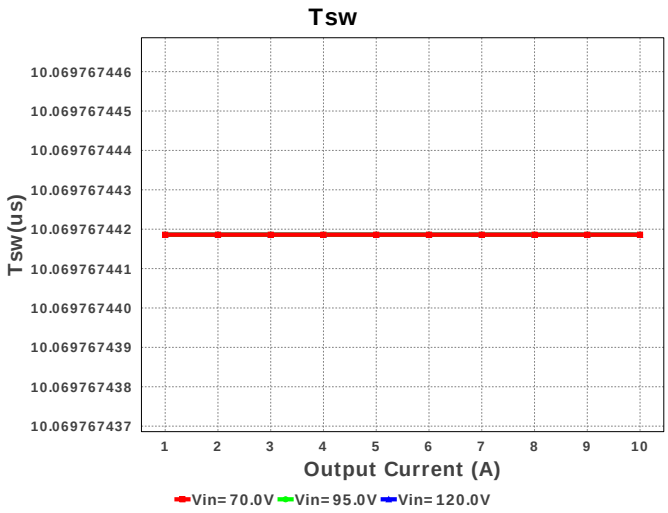


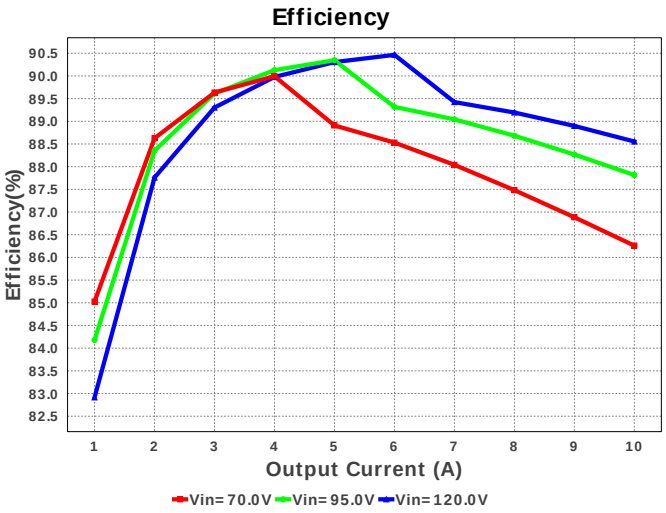


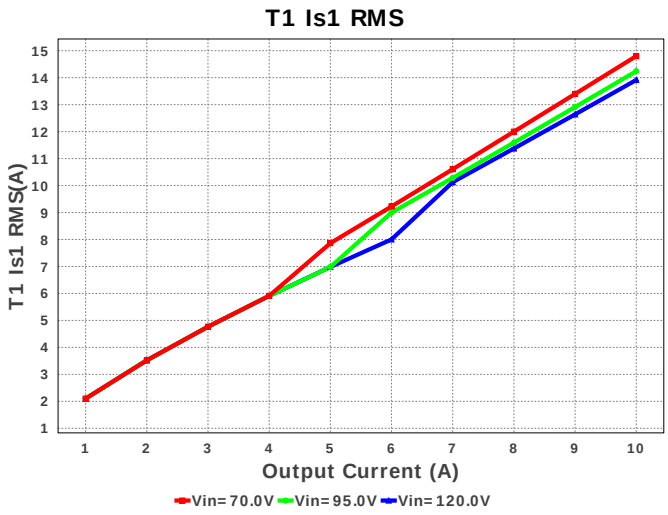


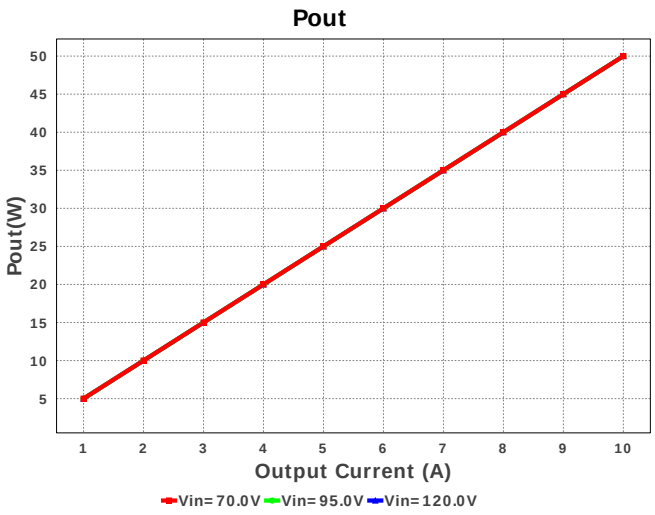


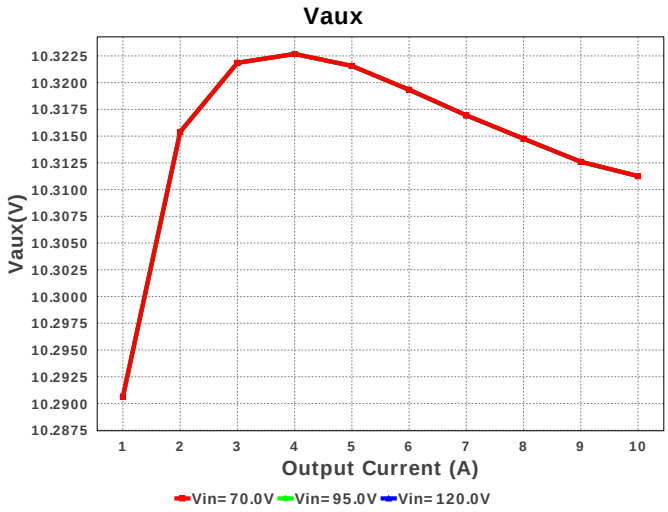


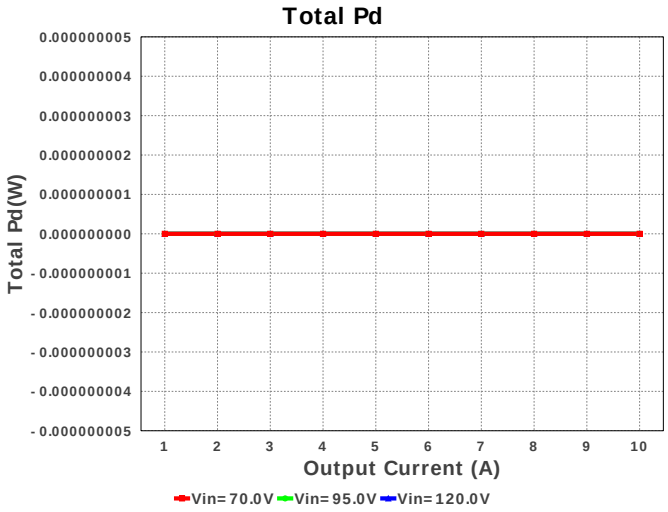


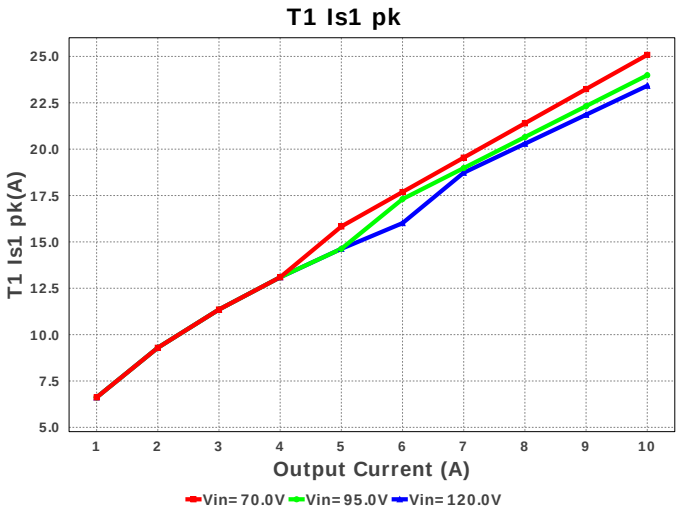


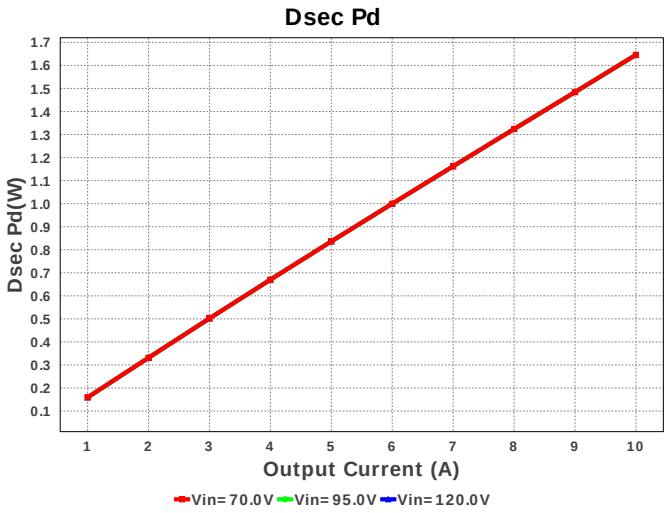


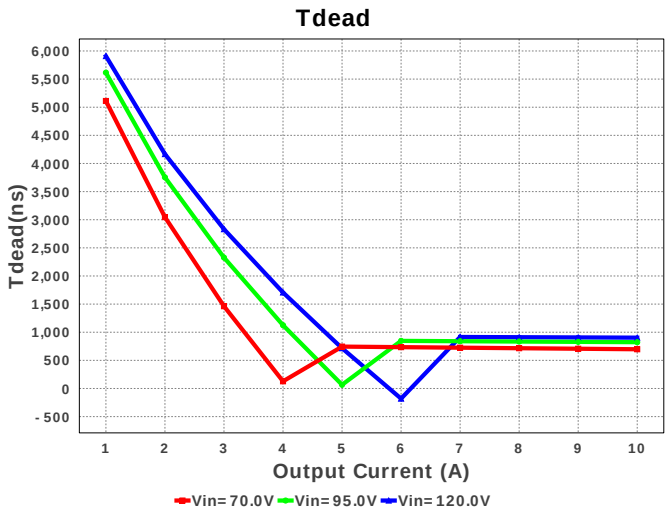


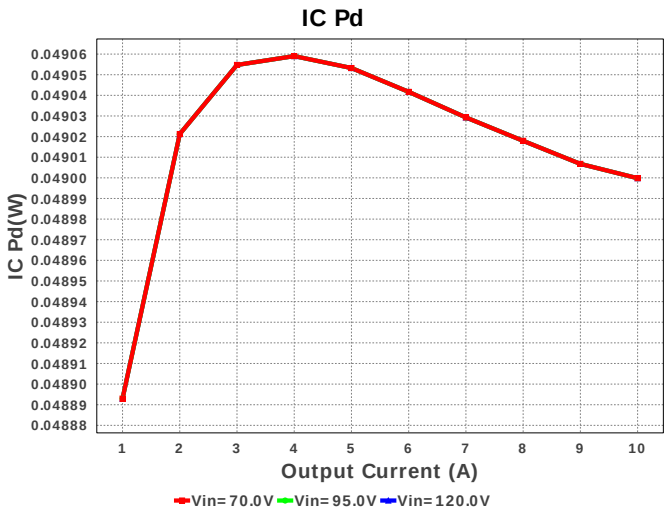


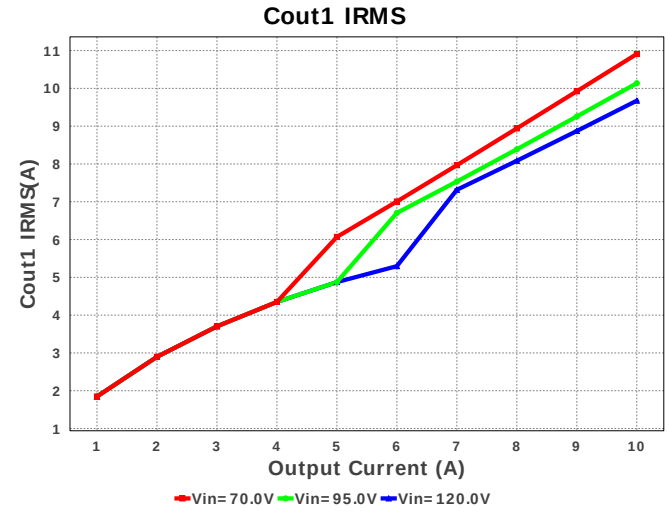


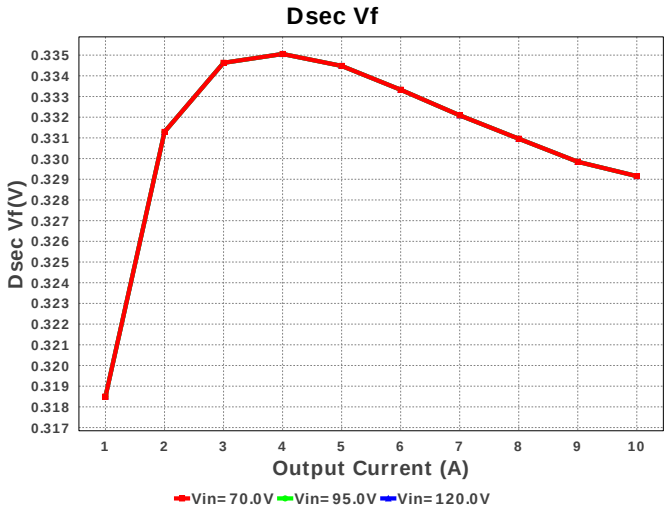


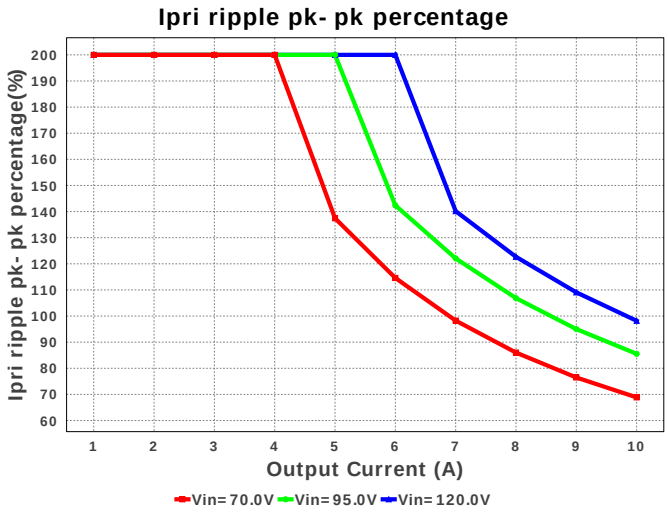


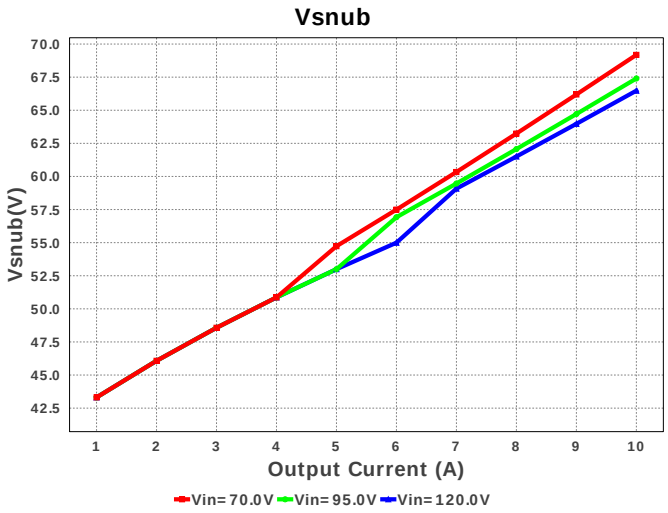


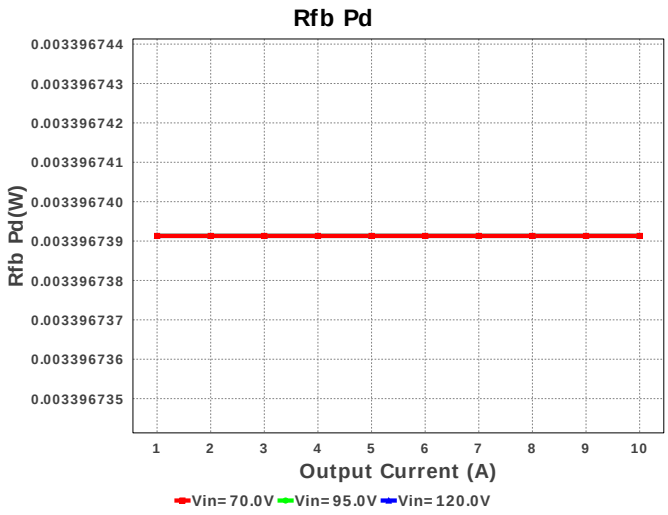


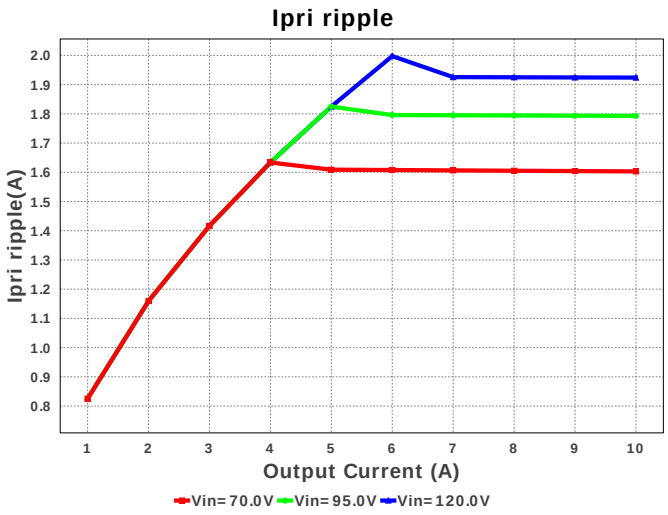


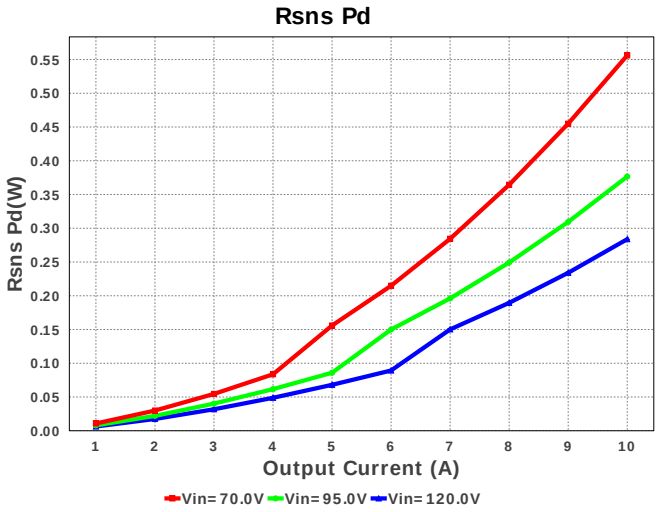


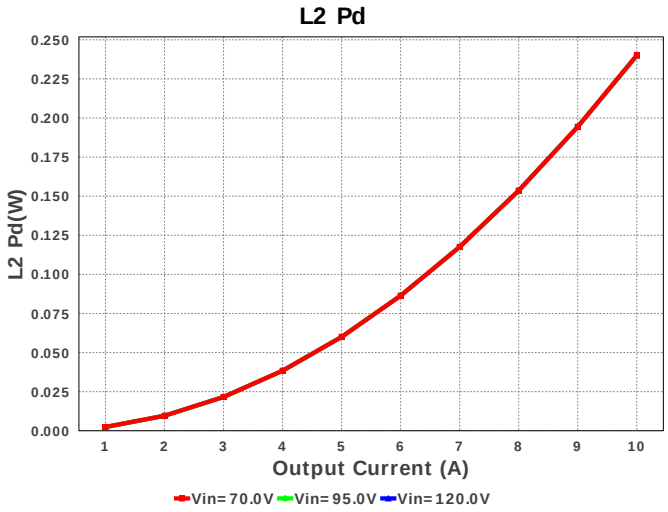


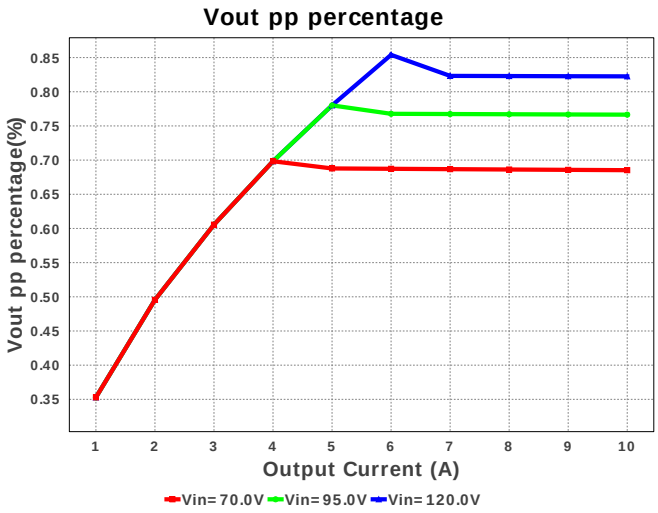


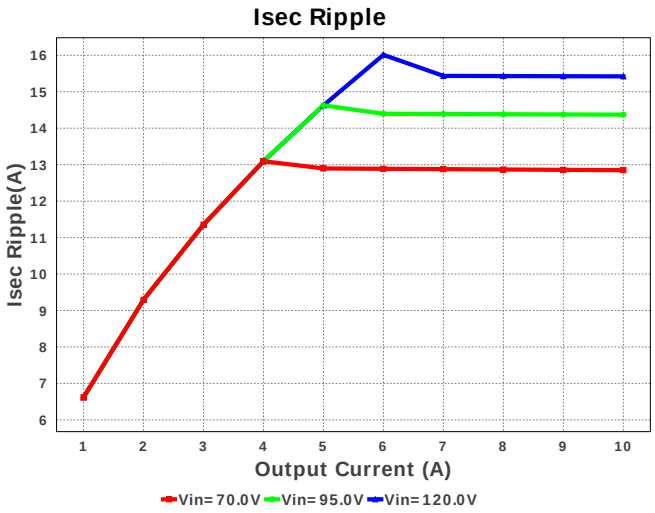


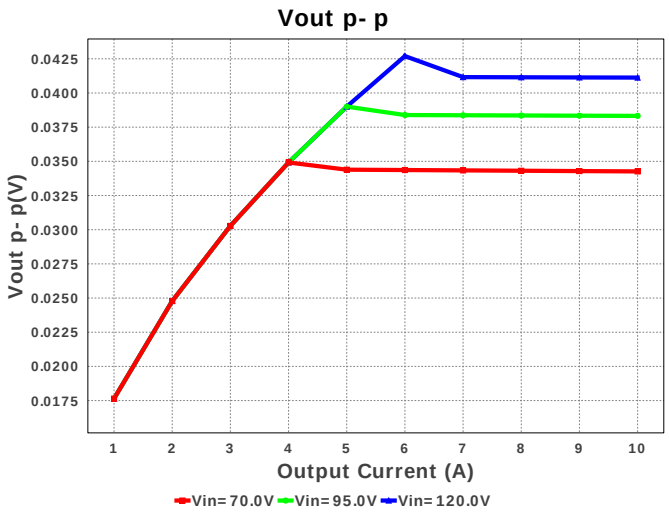


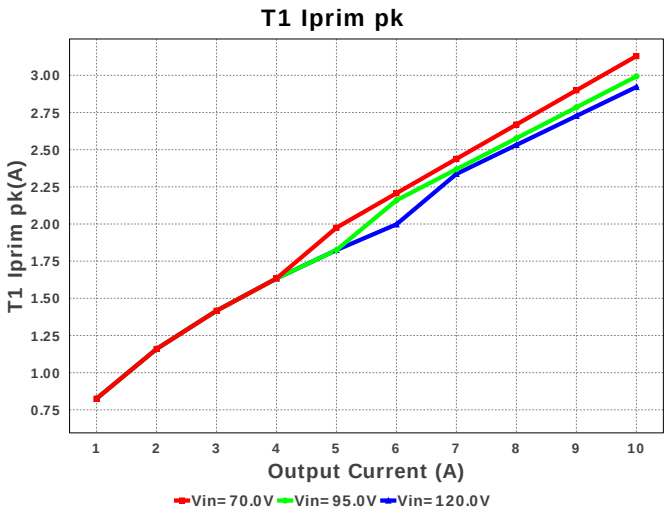












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	10.91 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	828.068 mA	Current	Average input current
3.	Iout_DCM	4.275 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	919.155 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.603 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	68.858 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	12.849 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.491 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	3.129 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	14.8 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	25.084 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	48	General	Total Design BOM count
13.	Daux trr	4.0 ns	General	Auxiliary Diode Reverse Recovery Time
14.	Dsec Vf	329.154 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	329.154 mV	General	Effective Forward Voltage Drop at the Operating Current
17.	Dsnub trr	35.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	2.234 k mm^2	General	Total Foot Print Area of BOM components
19.	Frequency	99.307 kHz	General	Switching frequency
20.	Pout	50.0 W	General	Total output power
21.	Tdead	697.312 ns	General	Approximate Dead Time of the Regulator
22.	Toff	5.397 us	General	Approximate Converter Off Time
23.	Ton Act	3.976 us	General	Approximate Converter On Time
24.	Total BOM	$0.0	General	Total BOM Cost
25.	Tsw	10.07 us	General	Switching Time Period
26.	Vaux	10.311 V	General	Auxiliary Voltage
27.	Vsnub	69.183 V	General	Voltage Across the Snubber
28.	Vout Actual	4.88 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
29.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
30.	Duty Cycle	39.484 %	Op_point	Duty cycle
31.	Efficiency	86.259 %	Op_point	Steady state efficiency
32.	IC Tj	32.45 degC	Op_point	IC junction temperature
33.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
34.	IOUT_OP	10.0 A	Op_point	Iout operating point
35.	M1 TjOP	43.757 degC	Op_point	M1 MOSFET junction temperature
36.	Vout p-p	34.263 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	7.378 mW	Power	Input capacitor power dissipation
38.	Cout1 Pd	317.42 mW	Power	Output capacitor1 power dissipation
39.	Dsec Pd	1.646 W	Power	Secondary Diode Power Dissipation
40.	Dsec2 Pd	1.646 W	Power	Secondary Diode Power Dissipation
41.	IC Pd	49.0 mW	Power	IC power dissipation
42.	L2 Pd	240.0 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
43.	M1 Pd	183.431 mW	Power	M1 MOSFET total power dissipation
44.	Paux	18.648 mW	Power	Power Dissipation in Raux and Daux
45.	Pd Rstartup	70.917 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
46.	Rdrv Pd	22.673 µW	Power	Power Dissipation in Gate Drive Resistor
47.	Rfb Pd	3.397 mW	Power	Rfb Power Dissipation
48.	Rsns Pd	556.071 mW	Power	Current Limit Sense Resistor Power Dissipation
49.	Snubber Pd	952.735 mW	Power	Snubber Power Dissipation
50.	T1 Pd	7.638 W	Power	Estimated Losses in Transformer

#	Name	Value	Category	Description
51.	Total Pd	0.0 W	Power	Total Power Dissipation
52.	Vout Tolerance	2.162 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout pp percentage	685.258 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	10.0	Maximum Output Current
2.	VinMax	120.0	Maximum input voltage
3.	VinMin	70.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	UCC28C41-Q1	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. UCC28C41-Q1 Product Folder : http://www.ti.com/product/UCC28C41%2DQ1 : contains the data sheet and other resources.