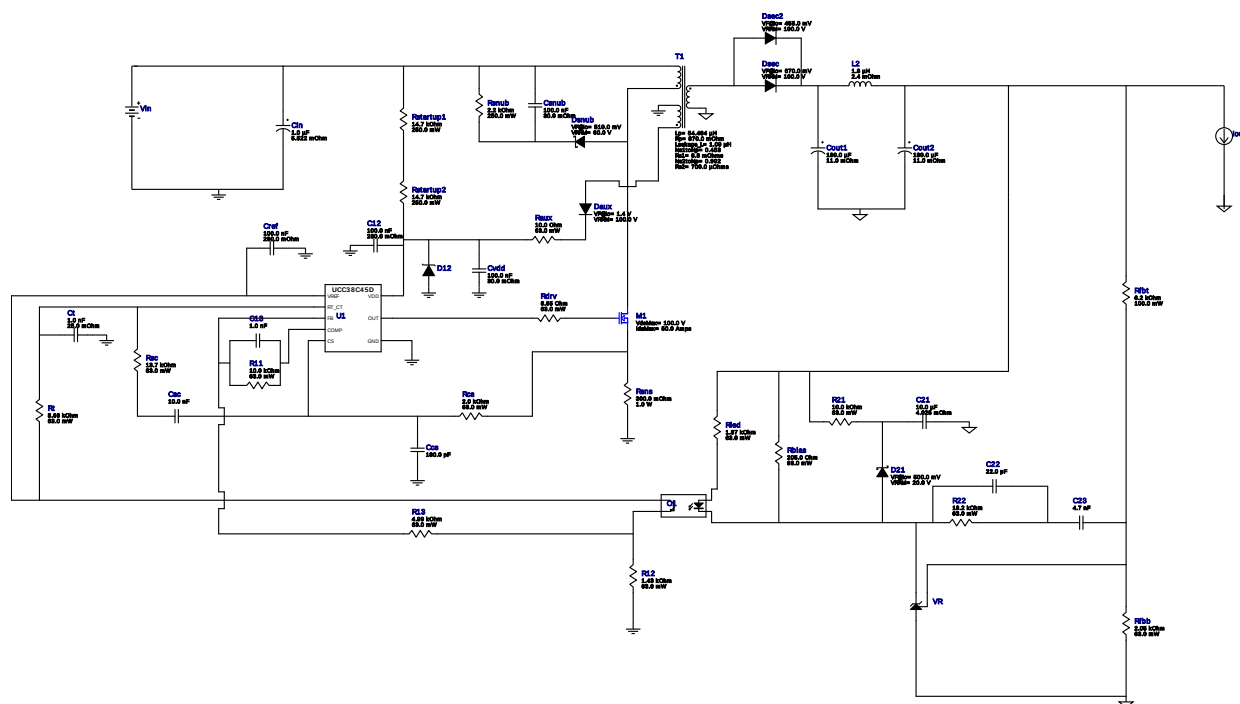


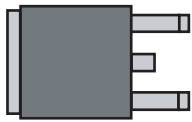
WEBENCH® Design Report

Design : 1194016/2110 UCC38C45DR
UCC38C45DR 20.0V-28.0V to 5.00V @ 2.0A



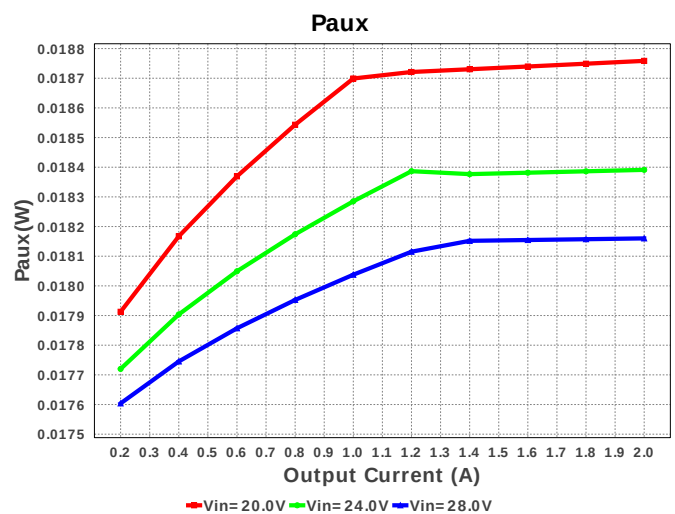
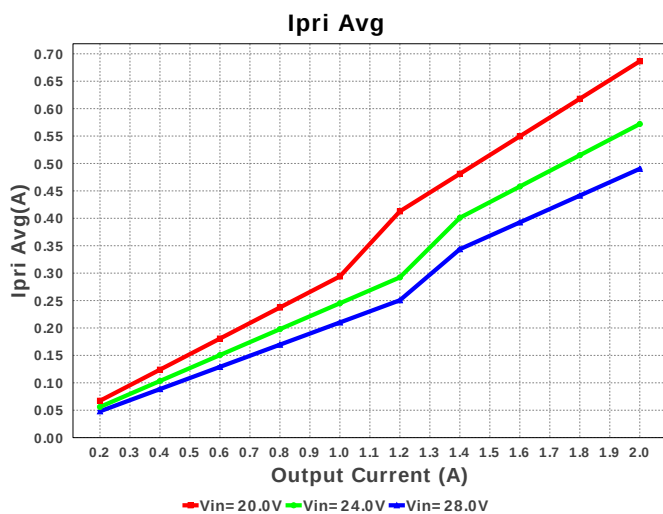
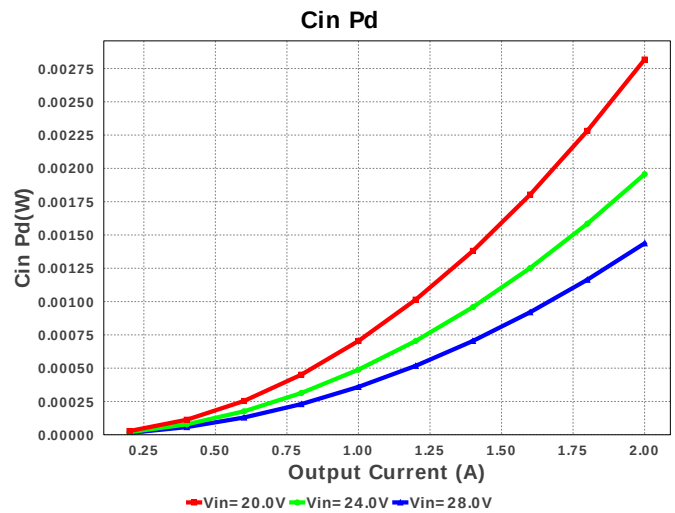
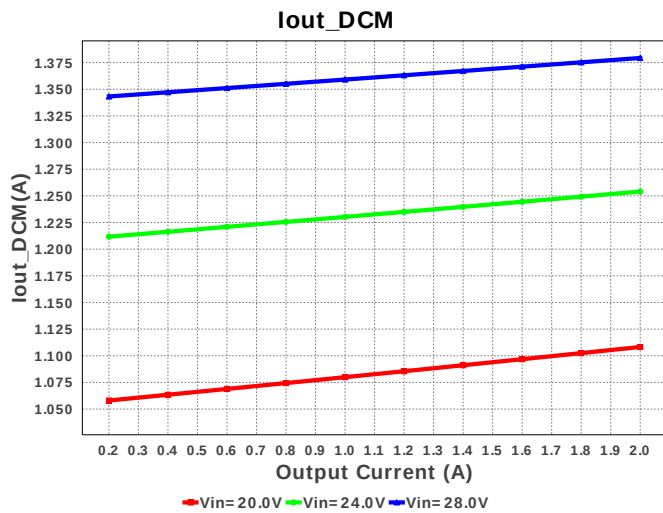
Electrical BOM

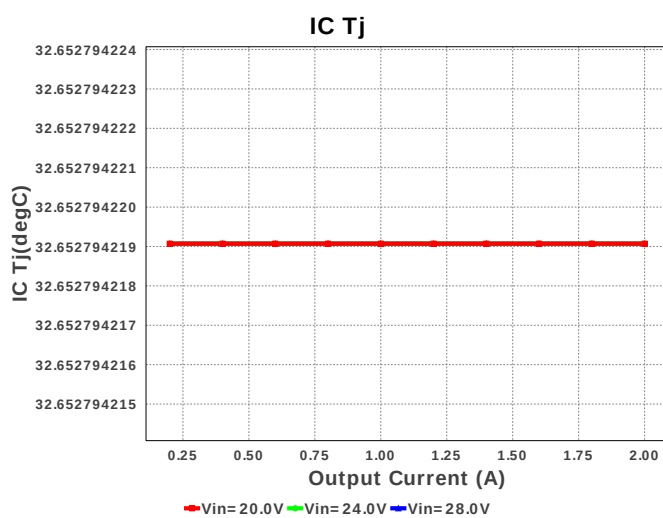
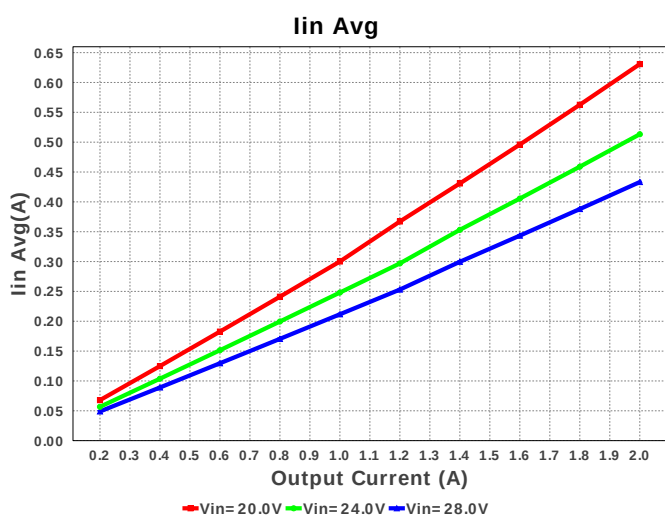
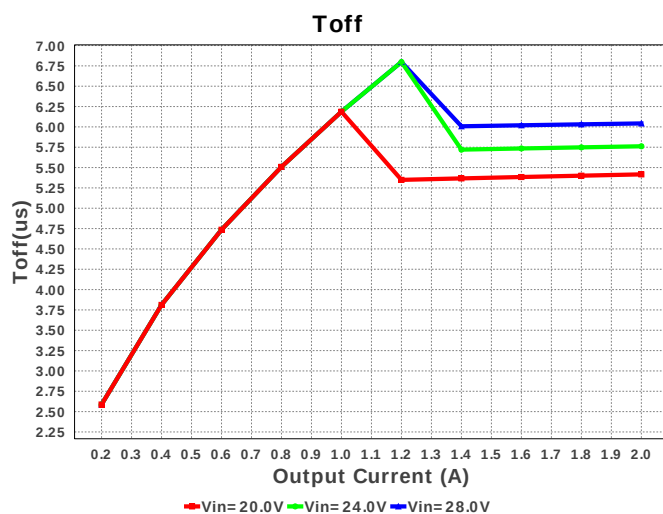
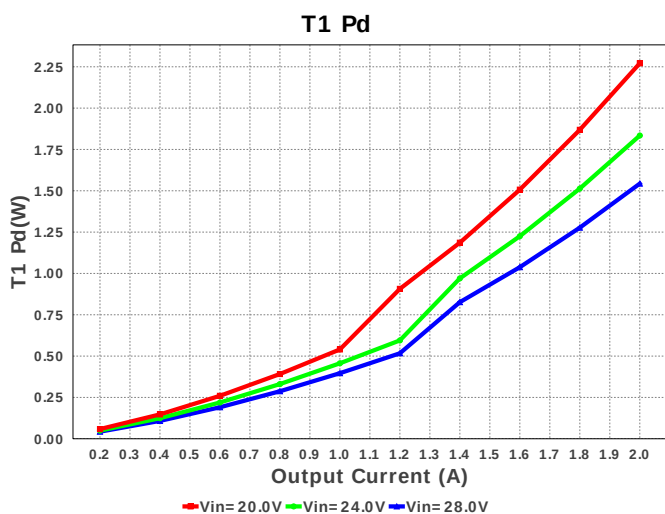
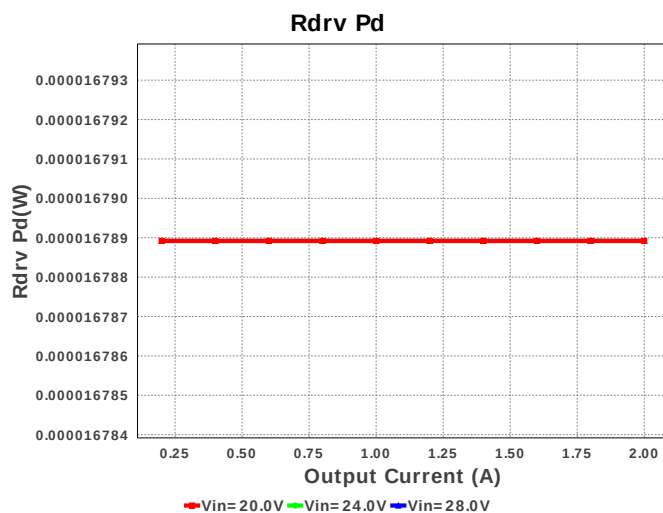
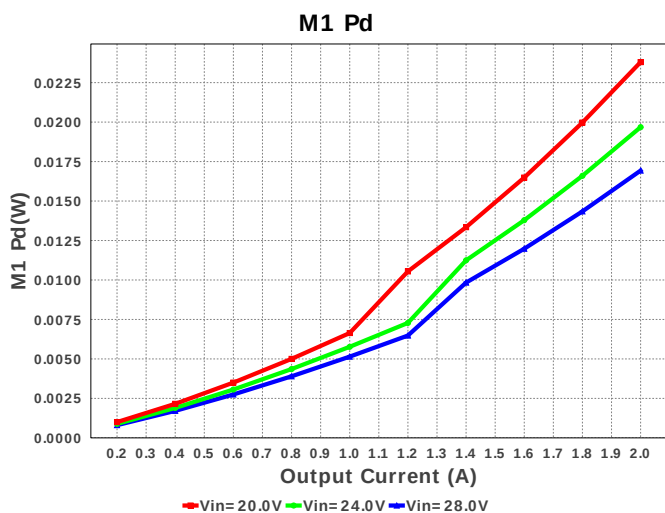
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
3.	C21	MuRata	GRM21BR61A106KE19L Series= X5R	Cap= 10.0 uF ESR= 4.025 mOhm VDC= 10.0 V IRMS= 2.445 A	1	\$0.03	0805 7 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	CC0805KRX7R9BB472 Series= X7R	Cap= 4.7 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
7.	Cin	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
8.	Cout1	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	1	\$0.49	 CAPSMT_62_C10 74 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout2	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	1	\$0.49	 CAPSMT_62_C10 74 mm²
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 mm²
11.	Csc	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
12.	Csnub	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 mm²
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 mm²
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 mm²
15.	D12	Diodes Inc.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm²
16.	D21	Vishay-Semiconductor	SS12-E3/61T	VF@Io= 500.0 mV VRRM= 20.0 V	1	\$0.08	 SMA 37 mm²
17.	Daux	NXP Semiconductor	BAS316,115	VF@Io= 1.4 V VRRM= 100.0 V	1	\$0.02	 SOD-323 9 mm²
18.	Dsec	Fairchild Semiconductor	FSV8100V	VF@Io= 670.0 mV VRRM= 100.0 V	1	\$0.21	 TO-277A 56 mm²
19.	Dsec2	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	\$1.33	 DDPAK 210 mm²
20.	Dsnub	ON Semiconductor	MBRA160T3G	VF@Io= 510.0 mV VRRM= 60.0 V	1	\$0.12	 SMA 37 mm²
21.	L2	Coilcraft	SER1360-182KLB	L= 1.8 uH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm²
22.	M1	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	\$0.75	 TRANS_NexFET_Q3 18 mm²
23.	O1	Vishay-Semiconductor	TCMT1109	Optocoupler	1	\$0.21	 SOP-4 44 mm²
24.	R11	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
25.	R12	Vishay-Dale	CRCW04021K43FKED Series= CRCW..e3	Res= 1.43 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²

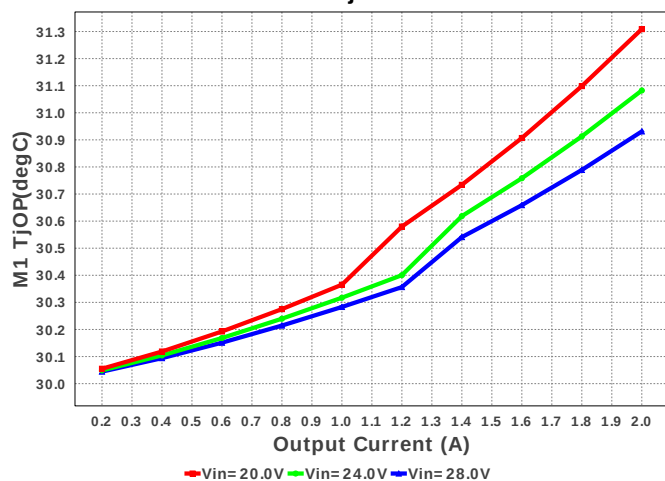
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26.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
27.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
28.	R22	Vishay-Dale	CRCW040218K2FKED Series= CRCW..e3	Res= 18.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
29.	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
30.	Rbias	Vishay-Dale	CRCW0402205RFKED Series= CRCW..e3	Res= 205.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
31.	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
32.	Rdrv	Vishay-Dale	CRCW04026R65FKED Series= CRCW..e3	Res= 6.65 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
33.	Rfbb	Vishay-Dale	CRCW04022K05FKED Series= CRCW..e3	Res= 2.05 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
34.	Rfbt	Yageo America	RC0603FR-076K2L Series= ?	Res= 6.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
35.	Rled	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.	Rsc	Vishay-Dale	CRCW040213K7FKED Series= CRCW..e3	Res= 13.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
37.	Rsns	Stackpole Electronics Inc	CSRN2010FKR300 Series= ?	Res= 300.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	\$0.11	 2010 32 mm ²
38.	Rsnu	Yageo America	RC1206FR-072K2L Series= ?	Res= 2.2 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
39.	Rstartup1	Panasonic	ERJ-8ENF1472V Series= ERJ-8E	Res= 14.7 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
40.	Rstartup2	Panasonic	ERJ-8ENF1472V Series= ERJ-8E	Res= 14.7 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
41.	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
42.	T1	CUSTOM	CUSTOM	Lp= 54.484 µH Rp= 870.0 mOhm Leakage_L= 1.09 µH Ns1toNp= 0.453 Rs1= 8.6 mOhms Ns2toNp= 0.992 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm ²
43.	U1	Texas Instruments	UCC38C45DR	Switcher	1	\$0.60	 D0008A 57 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
44.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	\$0.16	 R-PDSO-G3 16 mm²

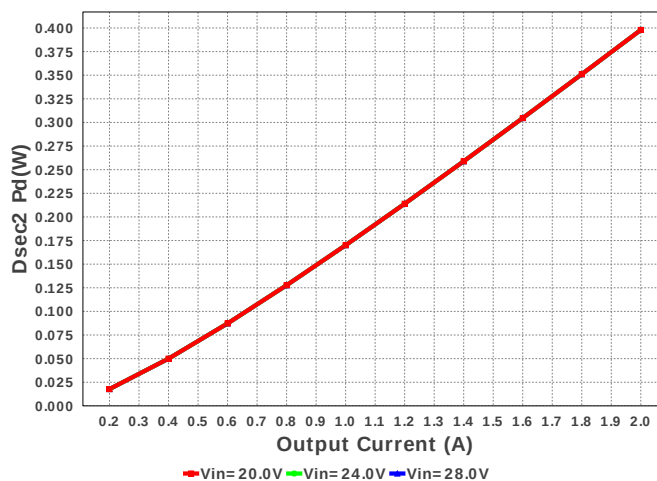




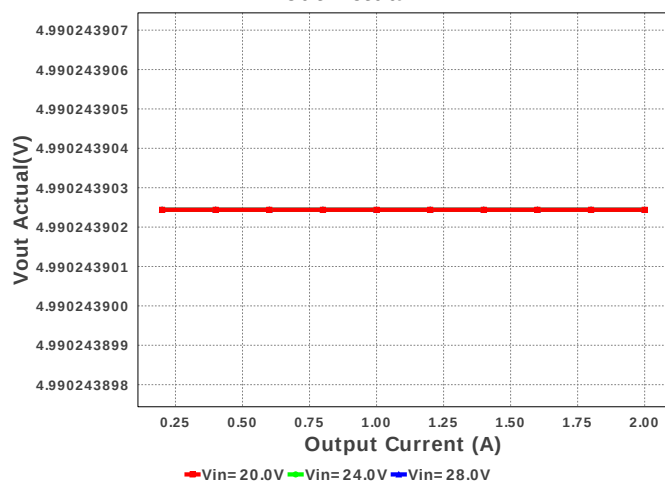
M1 TjOP



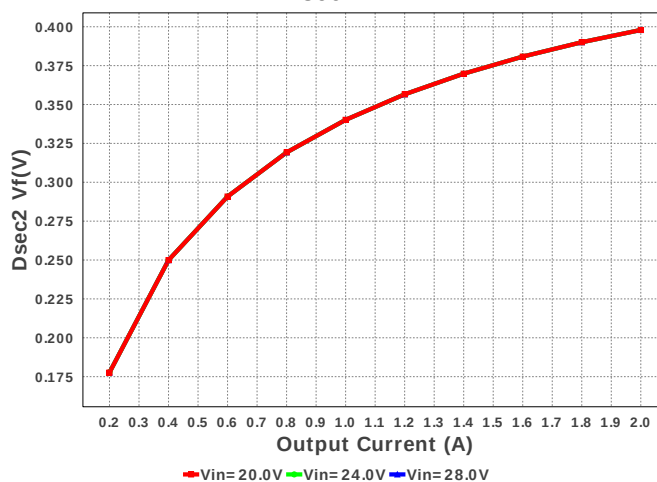
Dsec2 Pd



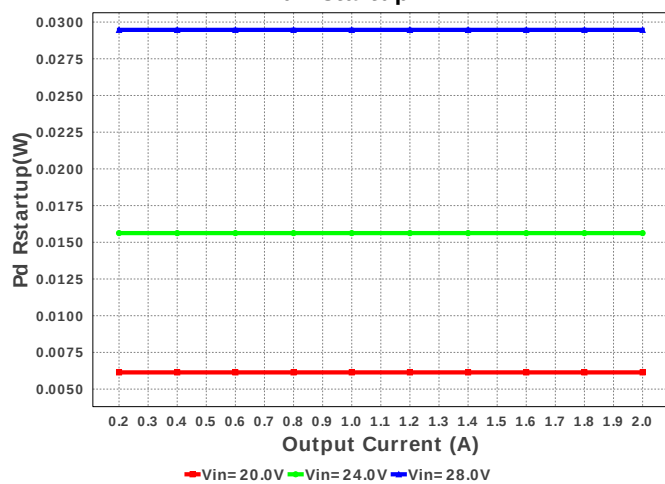
Vout Actual



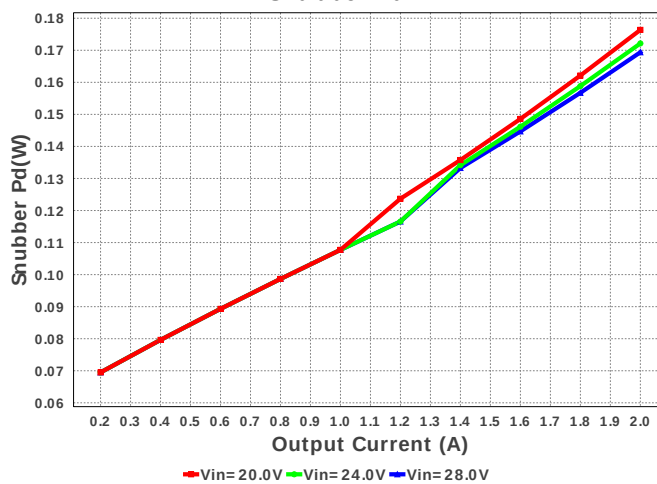
Dsec2 Vf

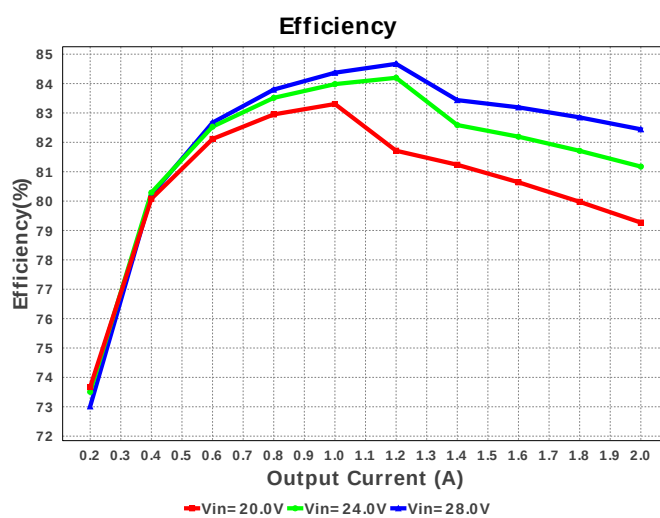
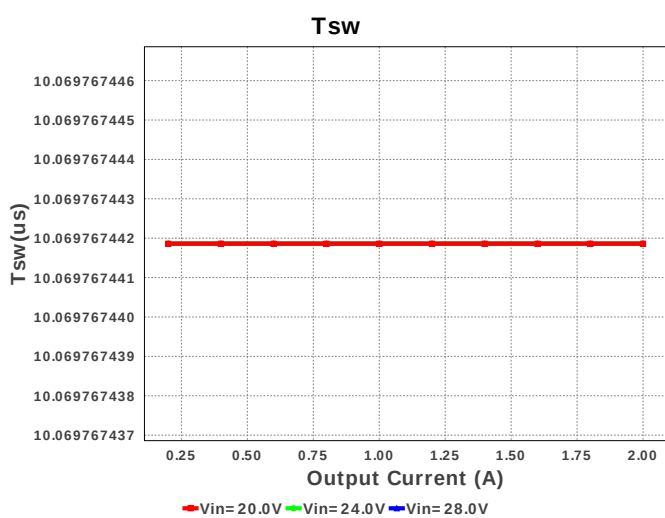
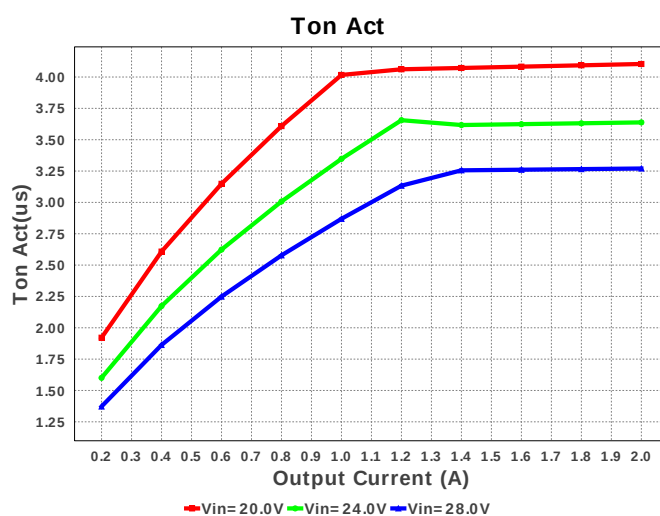
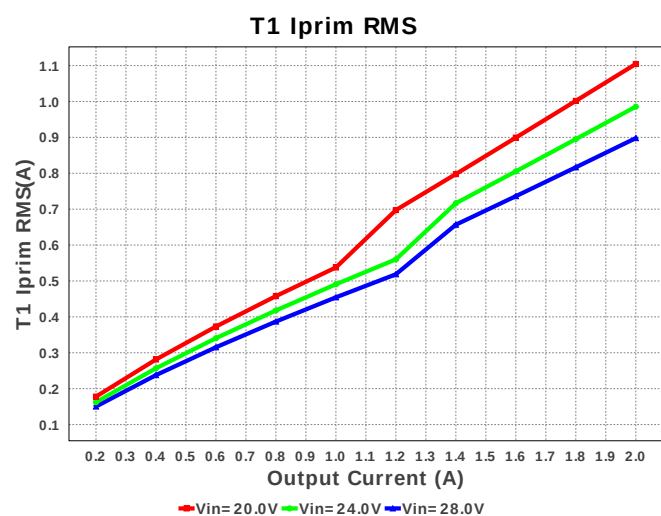
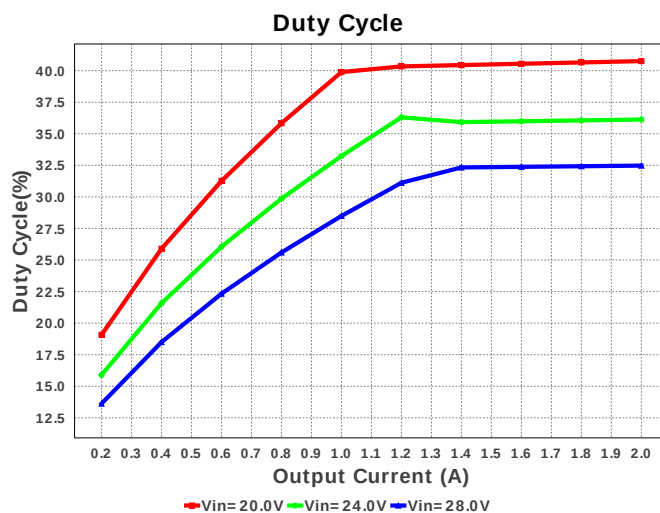
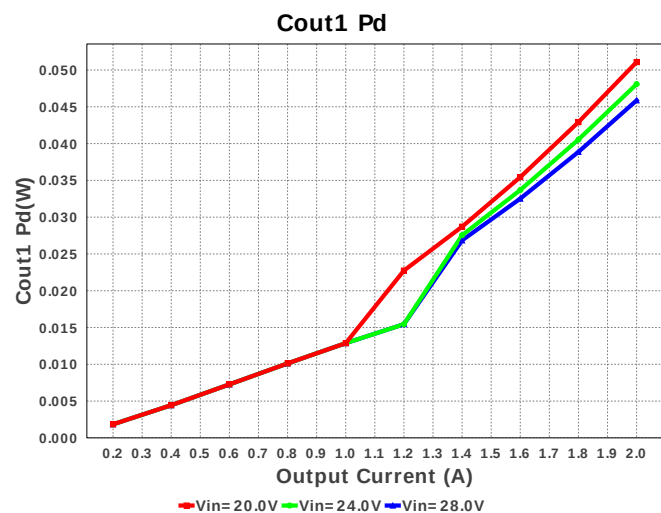


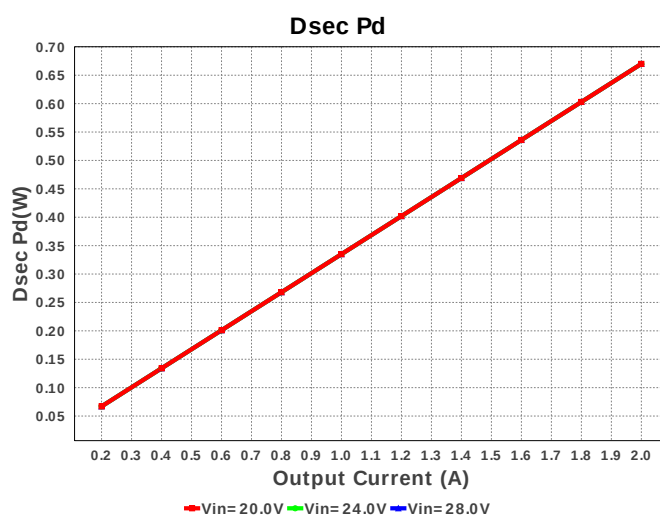
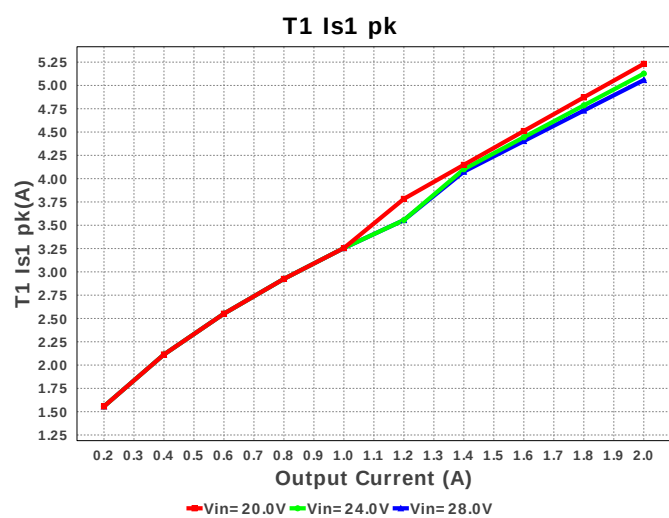
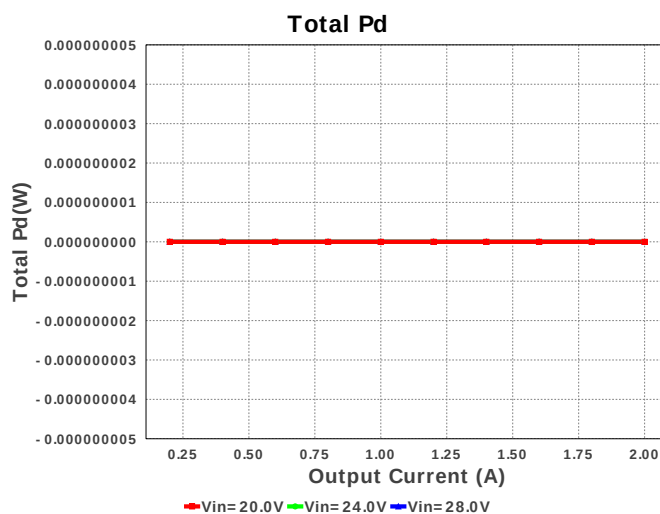
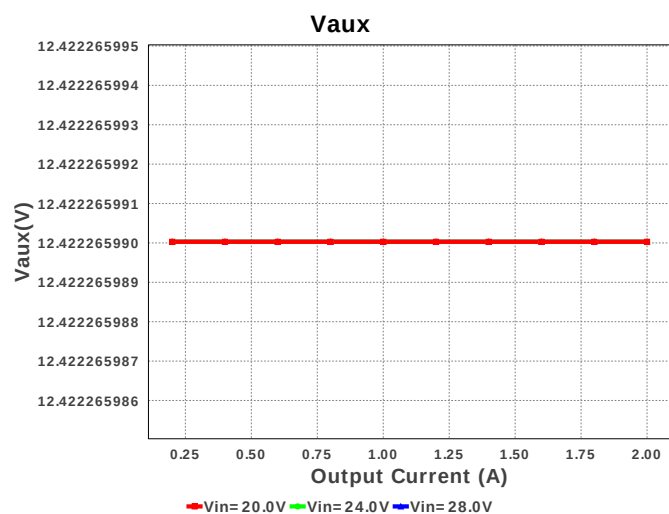
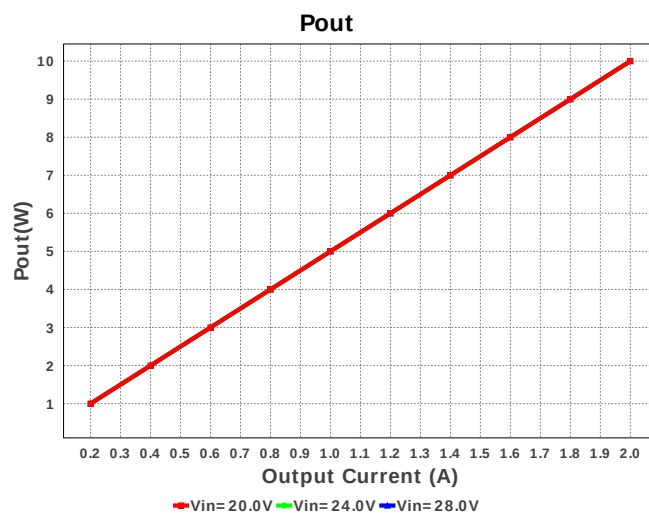
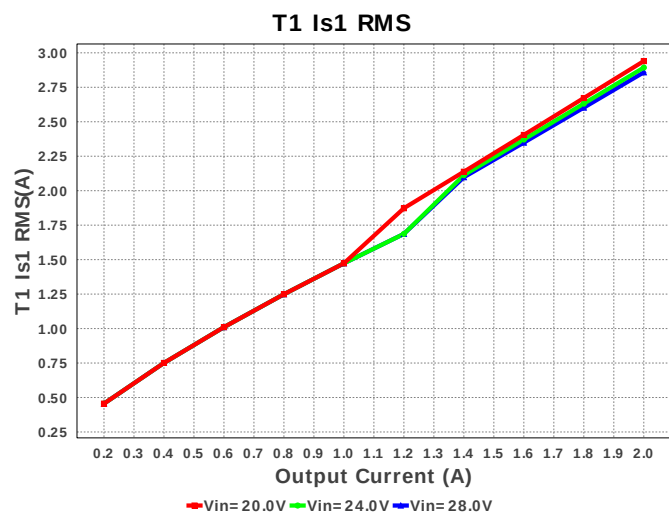
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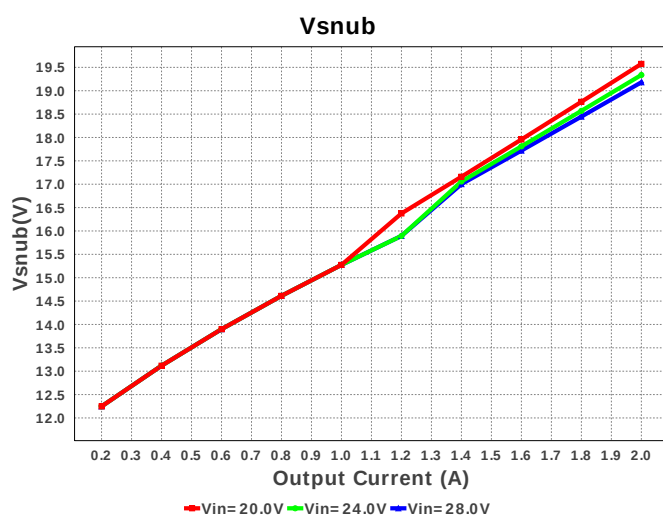
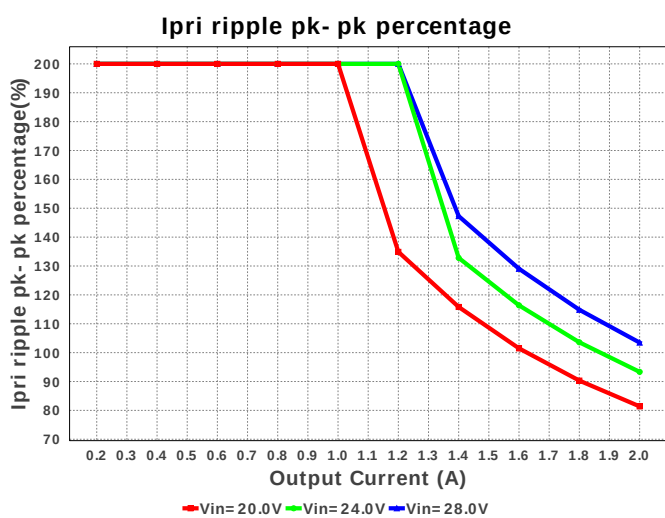
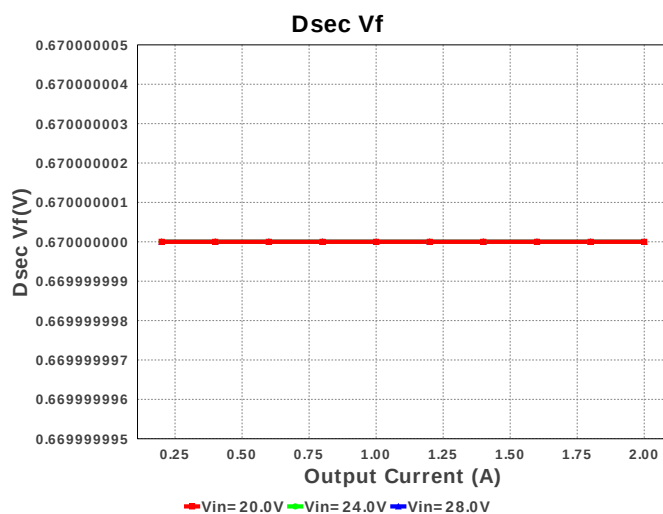
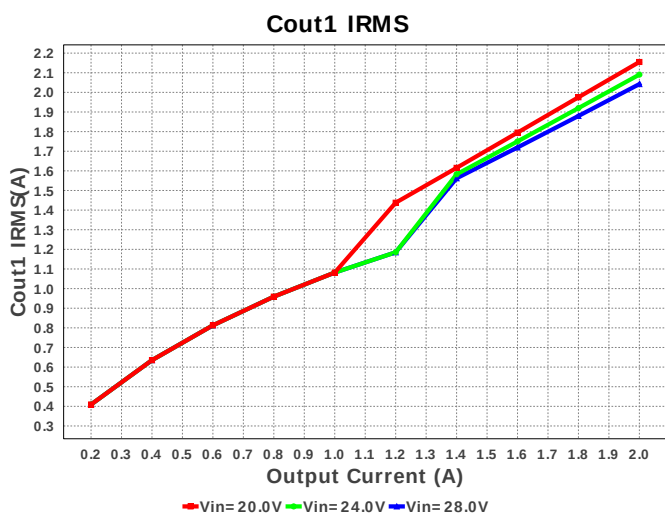
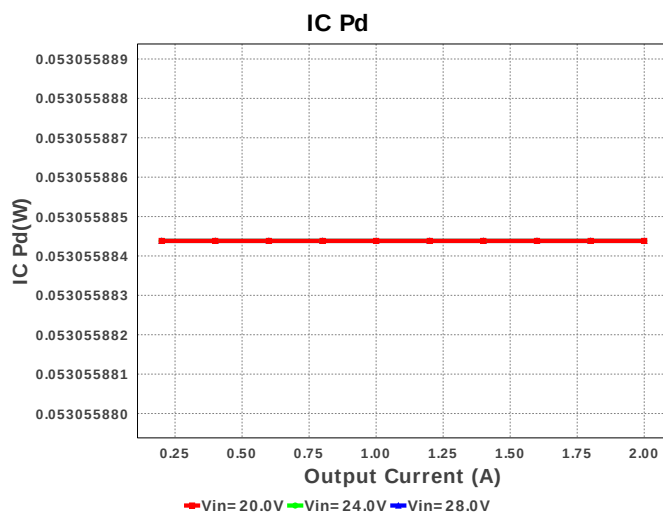
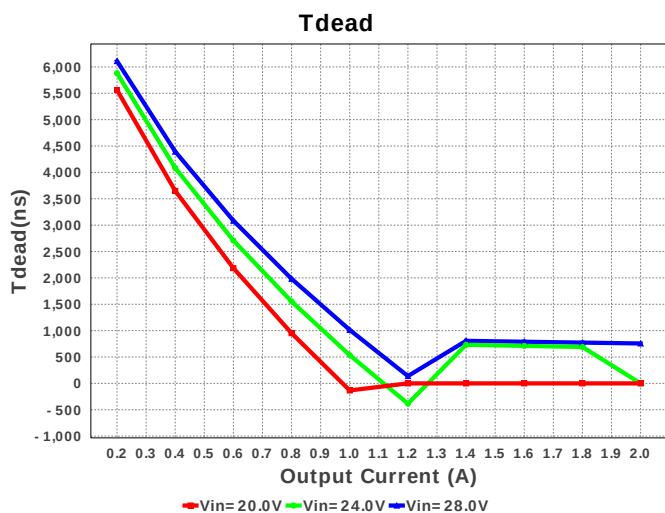


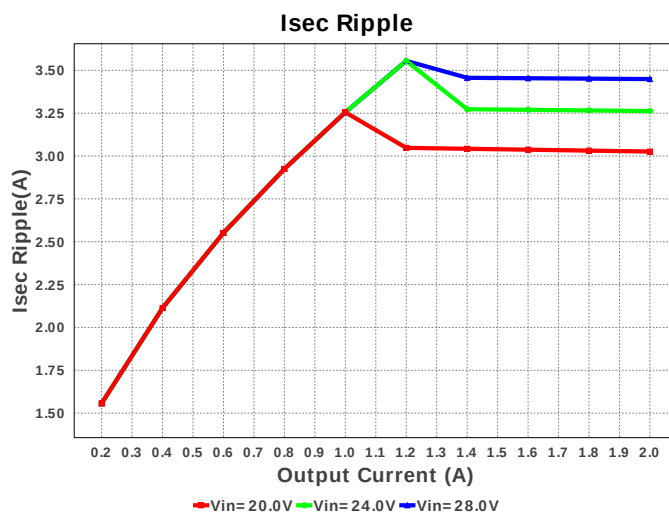
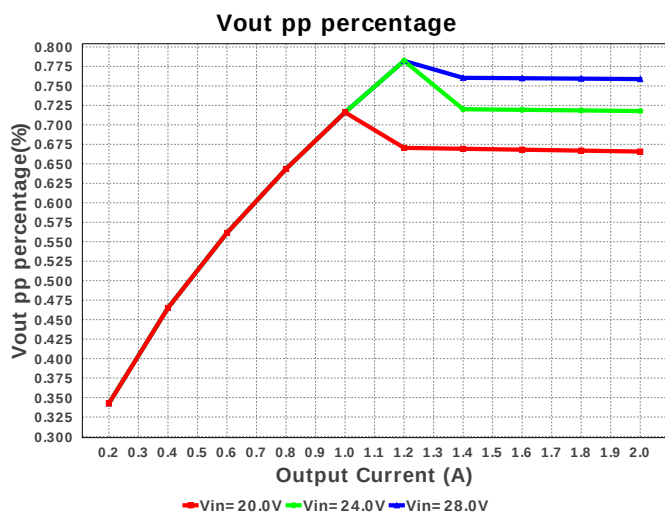
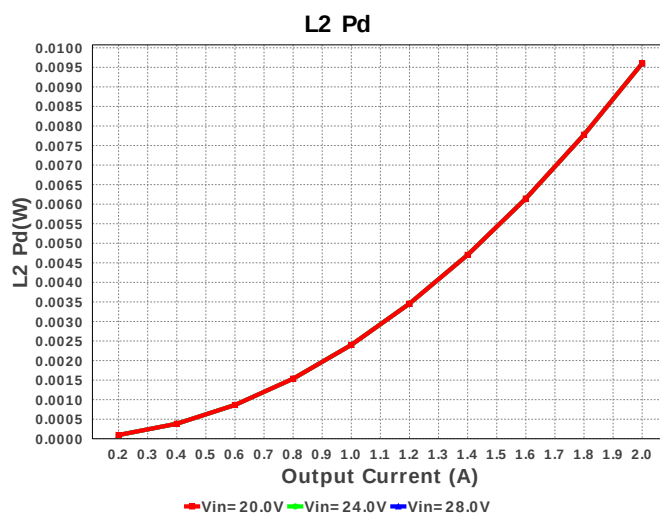
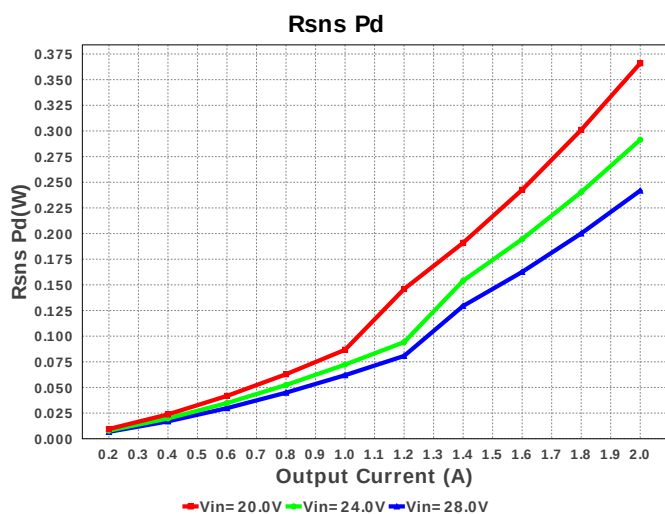
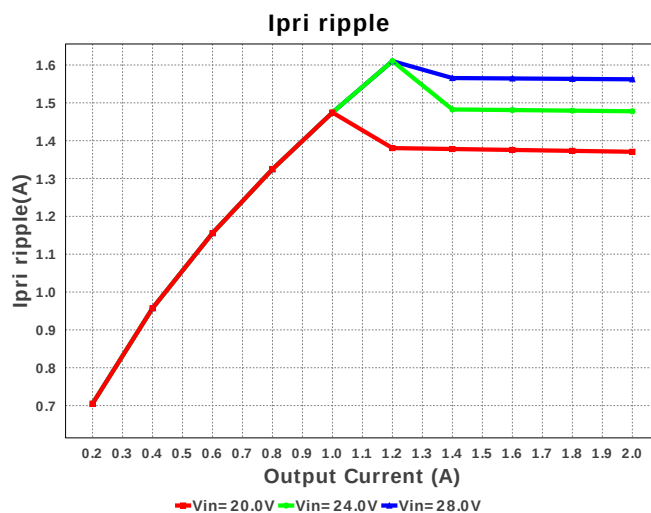
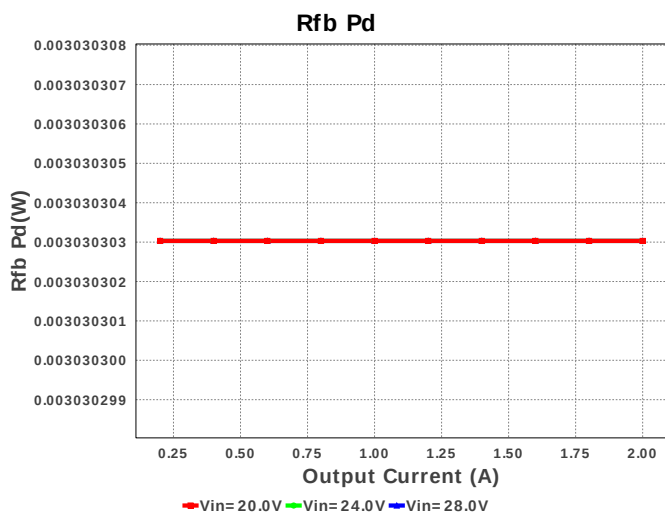
Snubber Pd

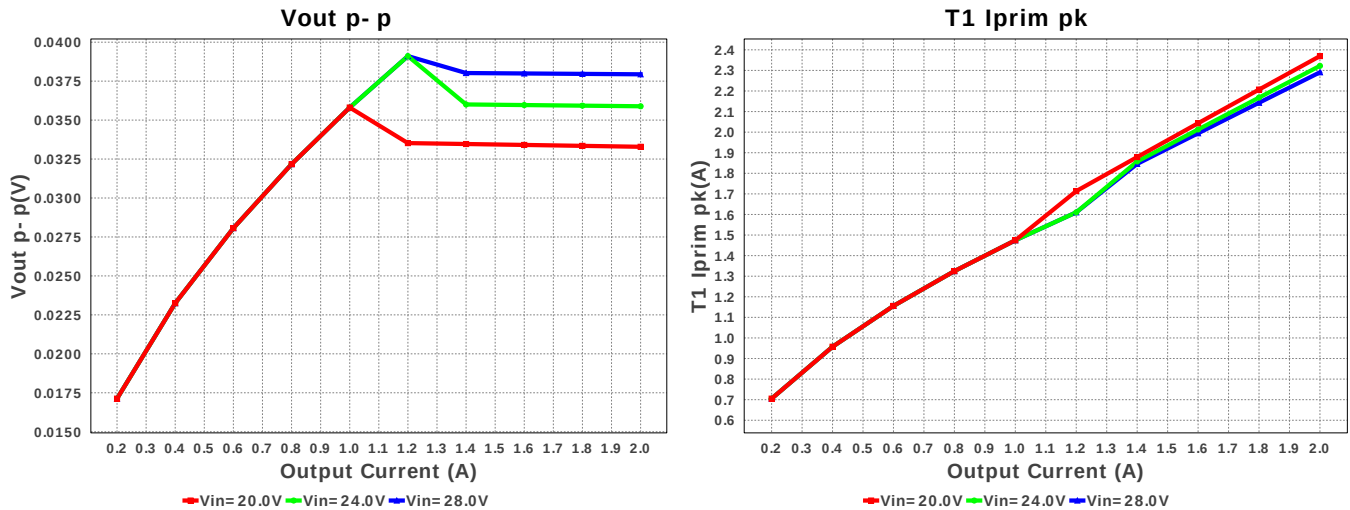












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	2.155 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	630.761 mA	Current	Average input current
3.	Iout_DCM	1.108 A	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	686.411 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	1.371 A	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	81.383 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	3.026 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	1.104 A	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	2.37 A	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	2.94 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	5.231 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	44	General	Total Design BOM count
13.	Daux trr	4.0 ns	General	Auxiliary Diode Reverse Recovery Time
14.	Dsec Vf	670.0 mV	General	Effective Forward Voltage Drop at the Operating Current
15.	Dsec trr	19.64 ns	General	Output Diode Reverse Recovery Time
16.	Dsec2 Vf	397.923 mV	General	Effective Forward Voltage Drop at the Operating Current
17.	Dsnub trr	0.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	1.058 k mm ²	General	Total Foot Print Area of BOM components
19.	Frequency	99.307 kHz	General	Switching frequency
20.	Pout	10.0 W	General	Total output power
21.	Tdead	0.0 ns	General	Approximate Dead Time of the Regulator
22.	Toff	5.416 us	General	Approximate Converter Off Time
23.	Ton Act	4.104 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	12.422 V	General	Auxiliary Voltage
27.	Vsnub	19.575 V	General	Voltage Across the Snubber
28.	Vout Actual	4.99 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	40.756 %	Op_point	Duty cycle
31.	Efficiency	79.269 %	Op_point	Steady state efficiency
32.	IC Tj	32.653 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	31.309 degC	Op_point	M1 MOSFET junction temperature
36.	Vout p-p	33.287 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	2.817 mW	Power	Input capacitor power dissipation
38.	Cout1 Pd	51.077 mW	Power	Output capacitor1 power dissipation
39.	Dsec Pd	670.0 mW	Power	Secondary Diode Power Dissipation
40.	Dsec2 Pd	397.923 mW	Power	Secondary Diode Power Dissipation
41.	IC Pd	53.056 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	23.798 mW	Power	M1 MOSFET total power dissipation
44.	Paux	18.759 mW	Power	Power Dissipation in Raux and Daux
45.	Pd Rstartup	6.139 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
46.	Rdrv Pd	16.789 μW	Power	Power Dissipation in Gate Drive Resistor
47.	Rfb Pd	3.03 mW	Power	Rfb Power Dissipation
48.	Rsns Pd	365.961 mW	Power	Current Limit Sense Resistor Power Dissipation
49.	Snubber Pd	176.369 mW	Power	Snubber Power Dissipation
50.	T1 Pd	2.271 W	Power	Estimated Losses in Transformer

#	Name	Value	Category	Description
51.	Total Pd	0.0 W	Power	Total Power Dissipation
52.	Vout Tolerance	2.173 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout pp percentage	665.746 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	Iout2	2.0	Output Current #2
4.	Iout3	1.0	Output Current #3
5.	VinMax	28.0	Maximum input voltage
6.	VinMin	20.0	Minimum input voltage
7.	Vout	5.0	Output Voltage
8.	Vout1	5.0	Output Voltage #1
9.	Vout2	12.0	Output Voltage #2
10.	Vout3	3.3	Output Voltage #3
11.	base_pn	UCC38C45	Base Product Number
12.	source	DC	Input Source Type
13.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC38C45** Product Folder : <http://www.ti.com/product/UCC38C45> : contains the data sheet and other resources.

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