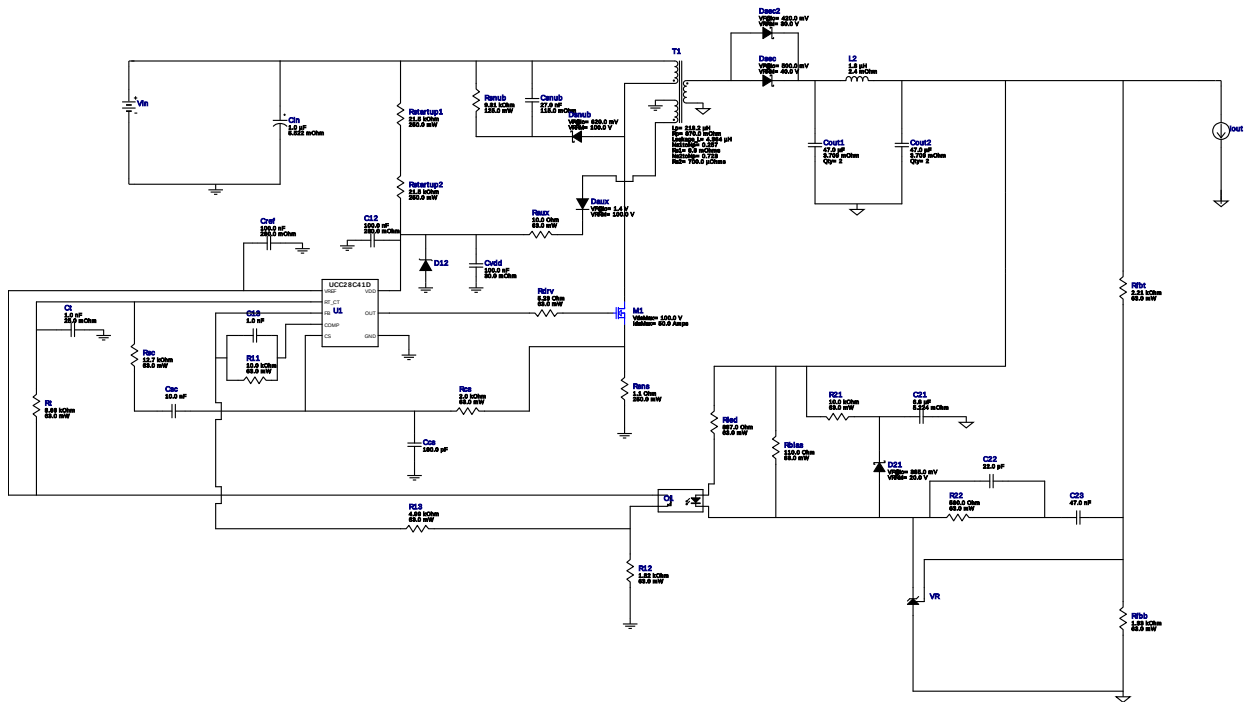


WEBENCH® Design Report

Design : 3837120/6 UCC28C41DR
UCC28C41DR 24.0V-28.0V to 3.30V @ 1.0A



My Comments

No comments

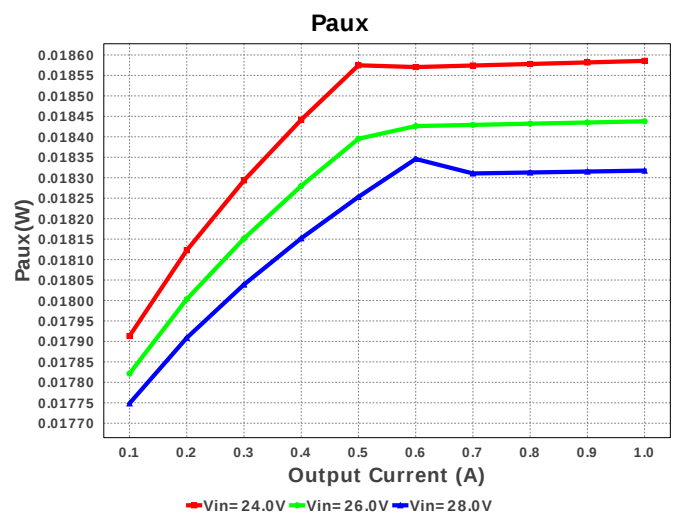
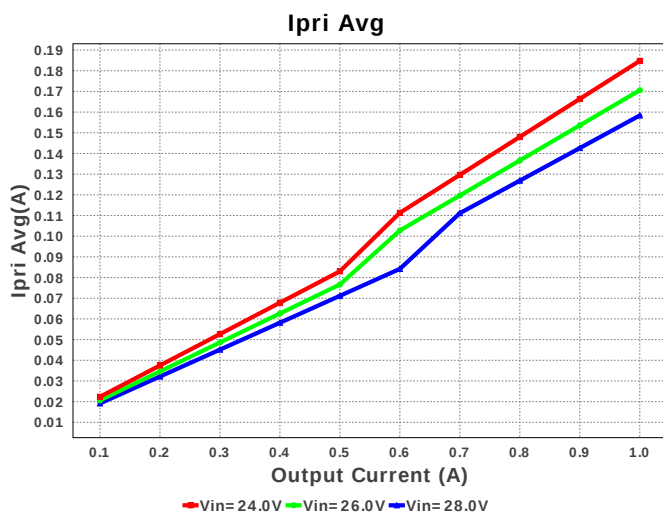
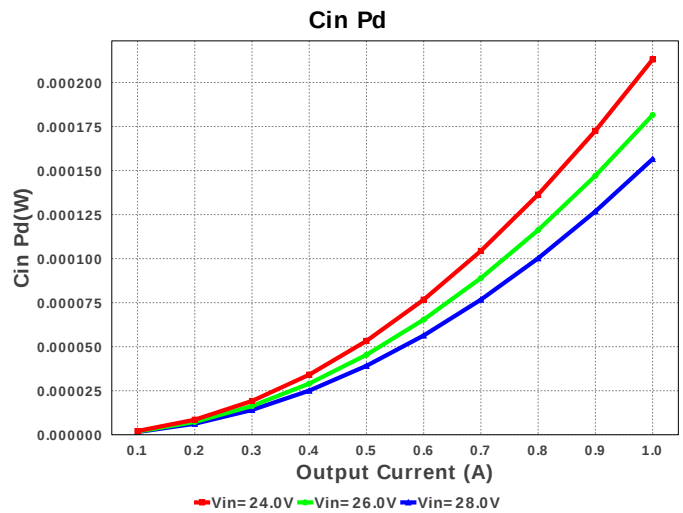
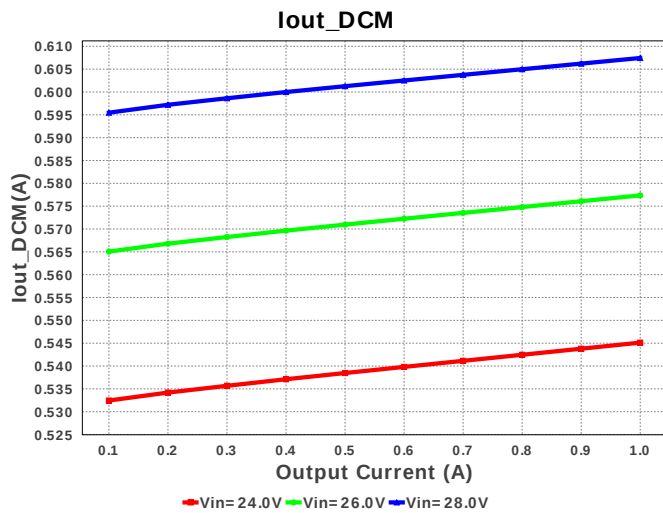
Electrical BOM

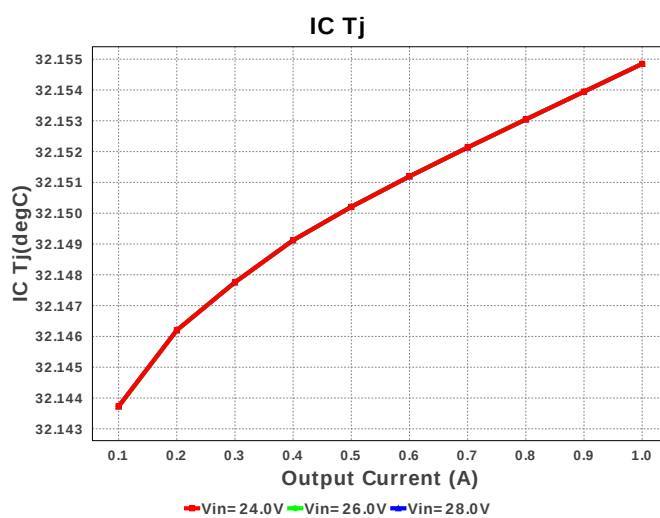
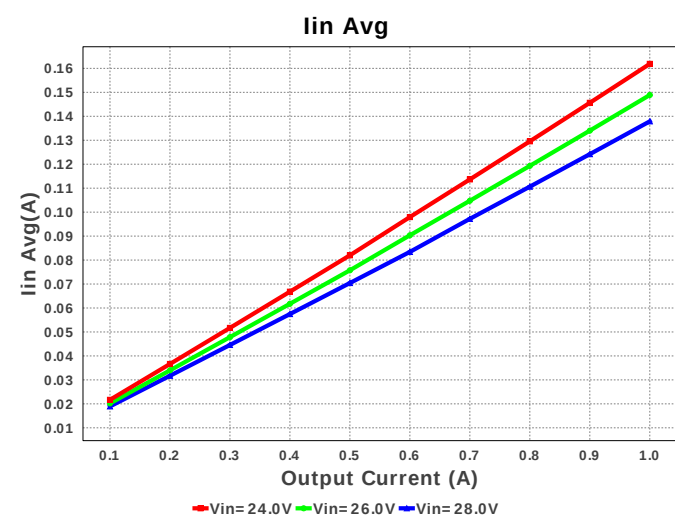
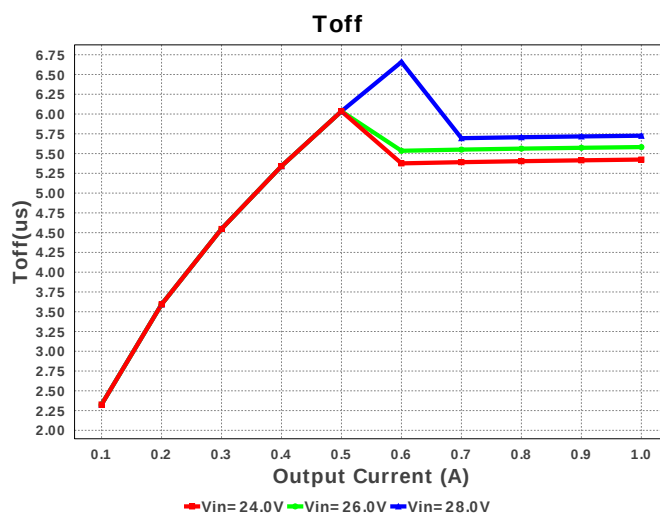
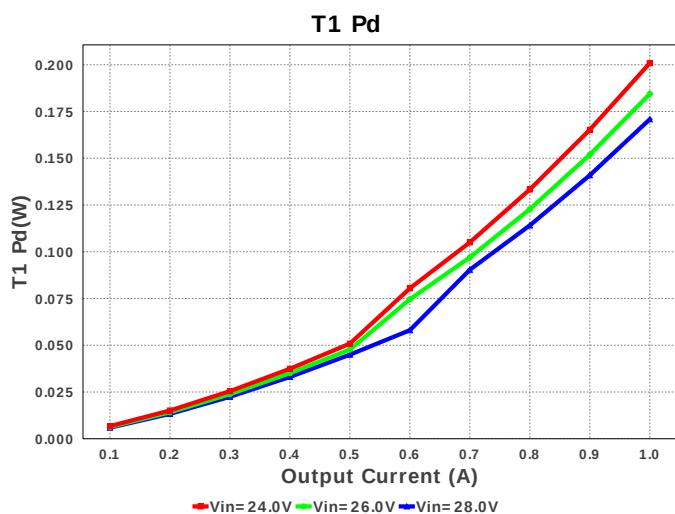
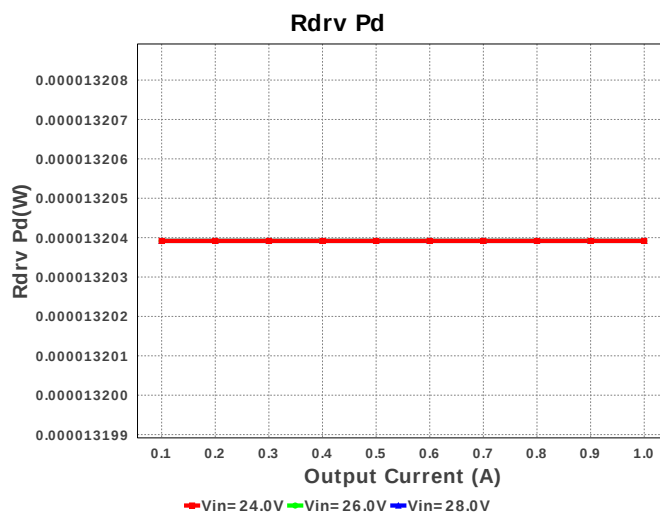
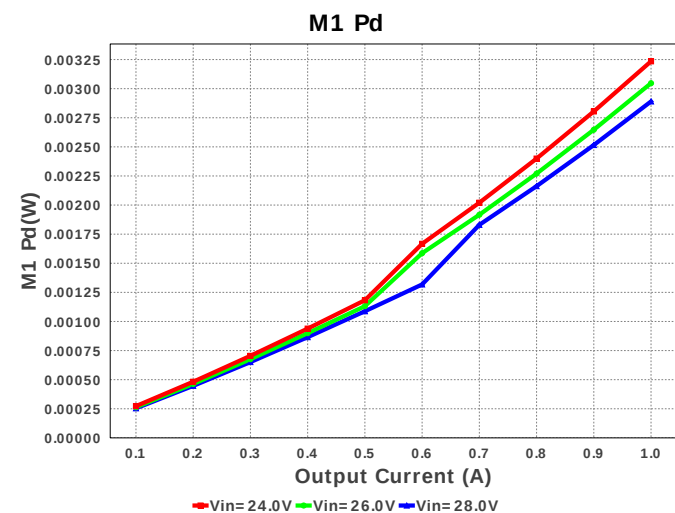
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	C13	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
3.	C21	MuRata	GRM31MR61C685KA12L Series= X5R	Cap= 6.8 uF ESR= 5.224 mOhm VDC= 16.0 V IRMS= 2.158 A	1	\$0.17	1206 11 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	Taiyo Yuden	TMK212B7473KD-T Series= X7R	Cap= 47.0 nF VDC= 25.0 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

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Cout1	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	2	\$0.15	 1206_190 11 mm ²
9.	Cout2	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	2	\$0.15	 1206_190 11 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	Kemet	C0805C273K5RACTU Series= X7R	Cap= 27.0 nF ESR= 115.0 mOhm VDC= 50.0 V IRMS= 728.0 mA	1	\$0.01	 0805 7 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	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.	MMSZ5248B-7-F	Zener	1	\$0.04	 SOD-123 13 mm ²
16.	D21	ON Semiconductor	MBR0520LT1G	VF@Io= 385.0 mV VRRM= 20.0 V	1	\$0.06	 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	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.11	 SMA 37 mm ²
19.	Dsec2	Vishay-Semiconductor	SL43-E3/57T	VF@Io= 420.0 mV VRRM= 30.0 V	1	\$0.42	 SMC 83 mm ²
20.	Dsnub	Vishay-Semiconductor	SS2PH10-M3	VF@Io= 620.0 mV VRRM= 100.0 V	1	\$0.14	DO-220AA 14 mm ²
21.	L2	Coilcraft	SER1360-182KLB	L= 1.8 uH DCR= 2.4 mOhm	1	\$0.72	 SER1360 225 mm ²
22.	M1	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	\$0.75	 TRANS_NexFET_Q3 18 mm ²
23.	O1	Vishay-Semiconductor	TCMT1109	Optocoupler	1	\$0.21	 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
25.	R12	Vishay-Dale	CRCW04021K82FKED Series= CRCW..e3	Res= 1.82 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

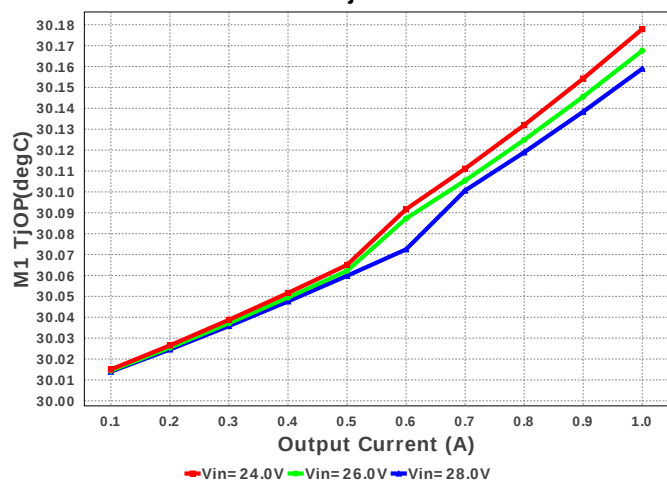
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
26.	R13	Vishay-Dale	CRCW04024K99FKED Series= CRCW..e3	Res= 4.99 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
27.	R21	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
28.	R22	Vishay-Dale	CRCW0402590RFKED Series= CRCW..e3	Res= 590.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
29.	Raux	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
30.	Rbias	Vishay-Dale	CRCW0402110RFKED Series= CRCW..e3	Res= 110.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 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	CRCW04025R23FKED Series= CRCW..e3	Res= 5.23 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
33.	Rfbb	Vishay-Dale	CRCW04021K33FKED Series= CRCW..e3	Res= 1.33 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
34.	Rfbt	Vishay-Dale	CRCW04022K21FKED Series= CRCW..e3	Res= 2.21 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
35.	Rled	Vishay-Dale	CRCW0402887RFKED Series= CRCW..e3	Res= 887.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 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	Vishay-Dale	CRCW12061R10FKEA Series= CRCW..e3	Res= 1.1 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
38.	Rsnu	Panasonic	ERJ-6ENF9311V Series= ERJ-6E	Res= 9.31 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm²
39.	Rstartup1	Panasonic	ERJ-8ENF2152V Series= ERJ-8E	Res= 21.5 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
40.	Rstartup2	Panasonic	ERJ-8ENF2152V Series= ERJ-8E	Res= 21.5 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm²
41.	Rt	Vishay-Dale	CRCW04028K66FKED Series= CRCW..e3	Res= 8.66 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
42.	T1	CUSTOM	CUSTOM	Lp= 218.2 µH Rp= 870.0 mOhm Leakage_L= 4.364 µH Ns1toNp= 0.257 Rs1= 8.6 mOhms Ns2toNp= 0.723 Rs2= 700.0 µOhms	1	NA	CUSTOM 0 mm²
43.	U1	Texas Instruments	UCC28C41DR	Switcher	1	\$0.75	 D0008A 57 mm²

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

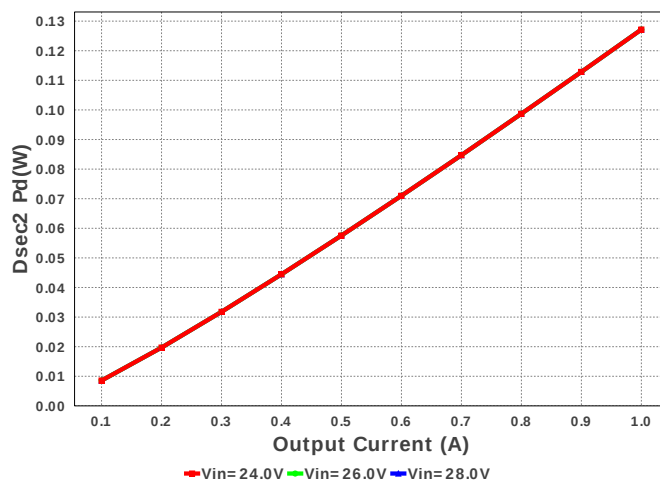




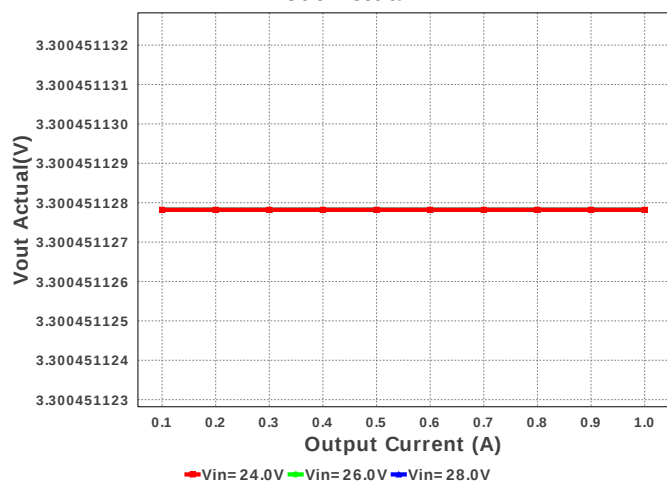
M1 TjOP



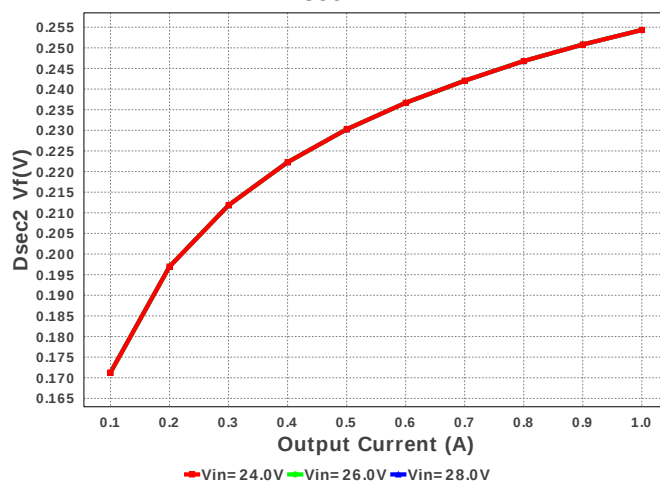
Dsec2 Pd



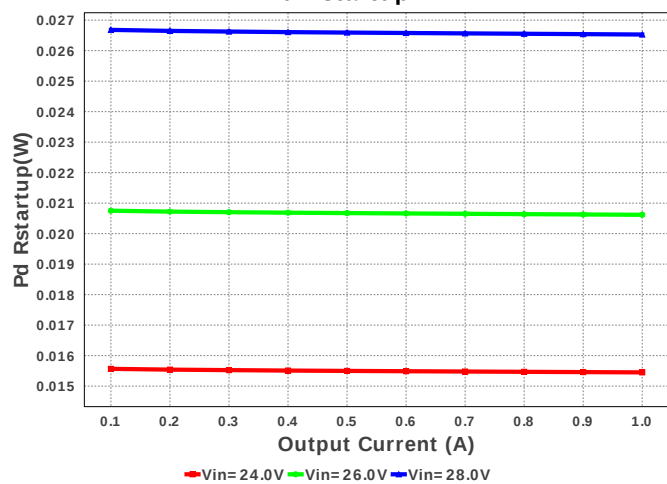
Vout Actual



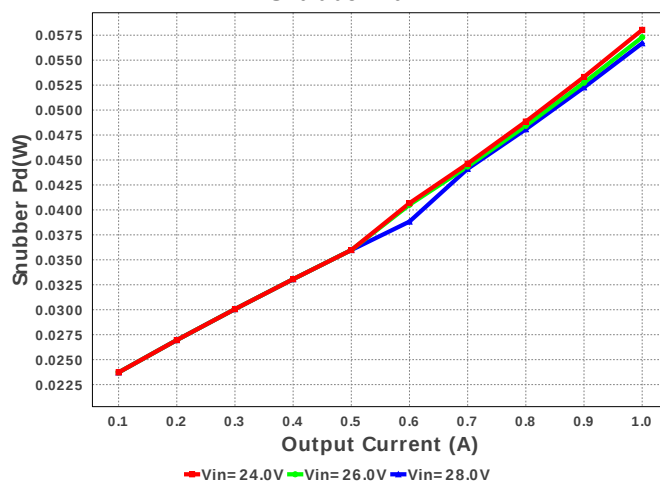
Dsec2 Vf

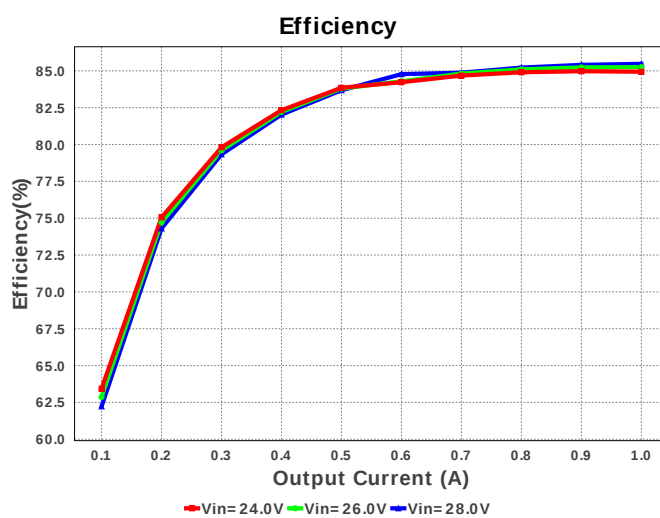
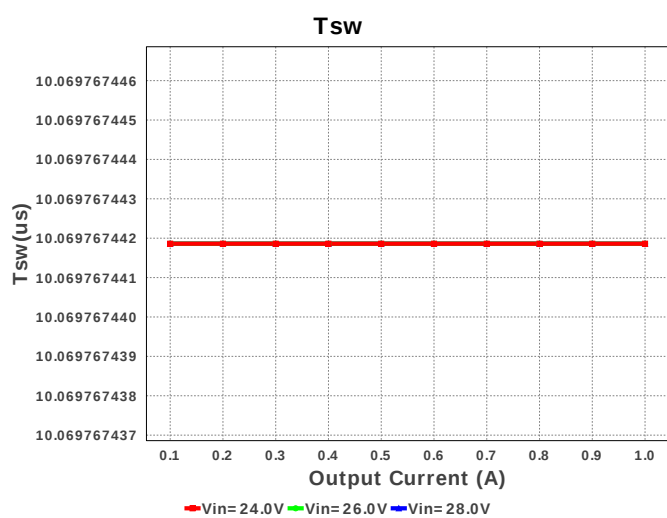
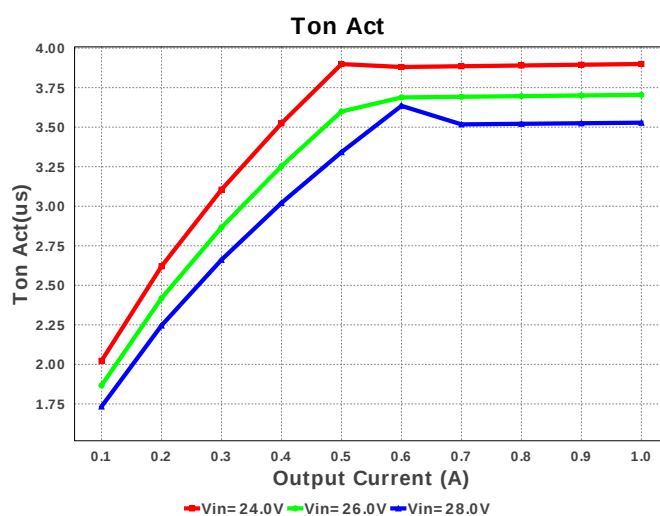
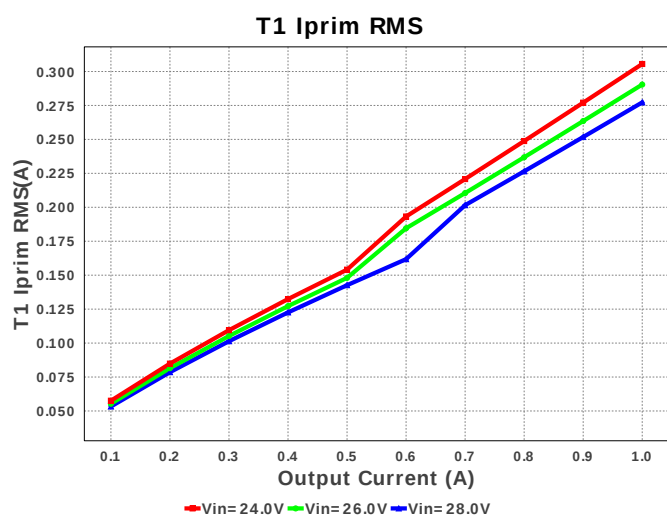
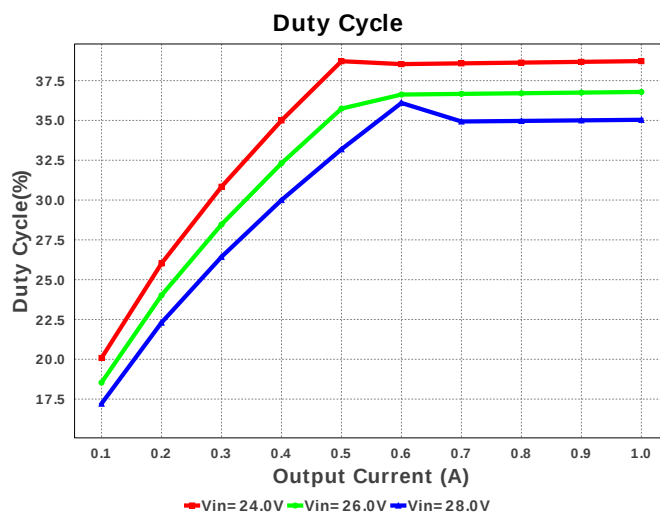
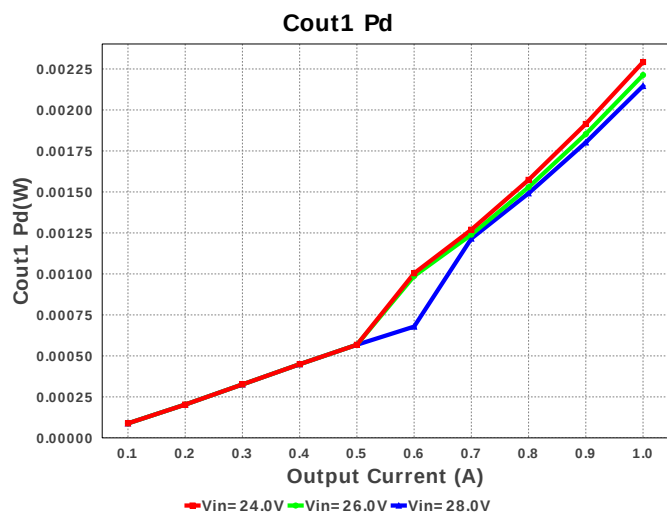


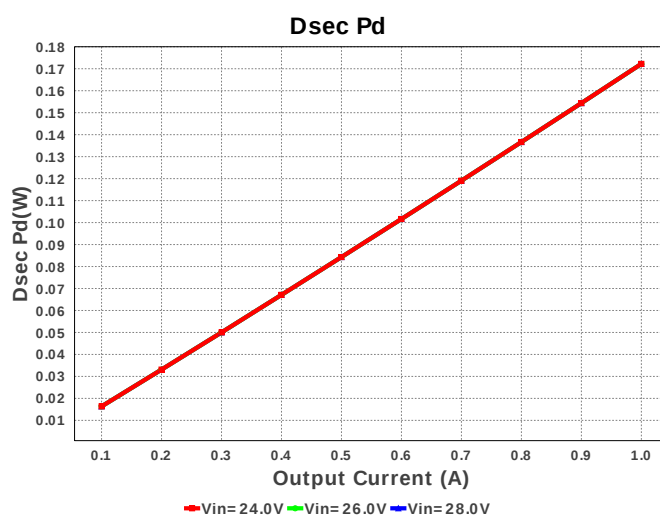
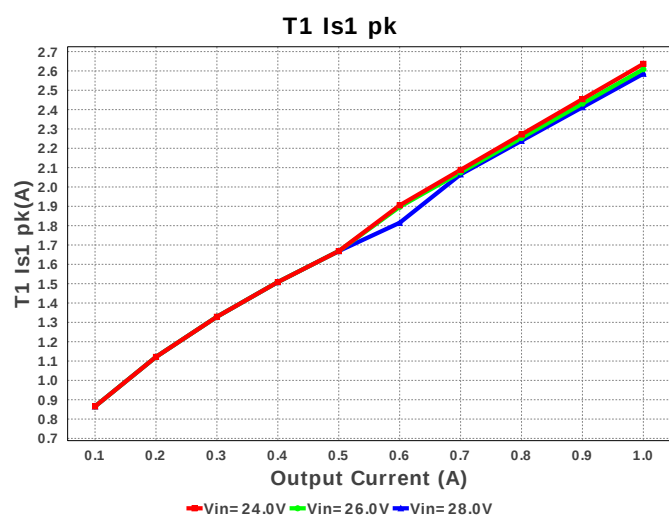
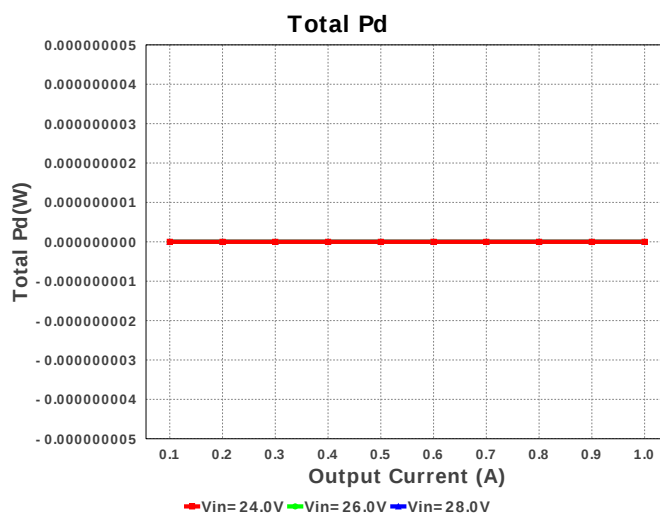
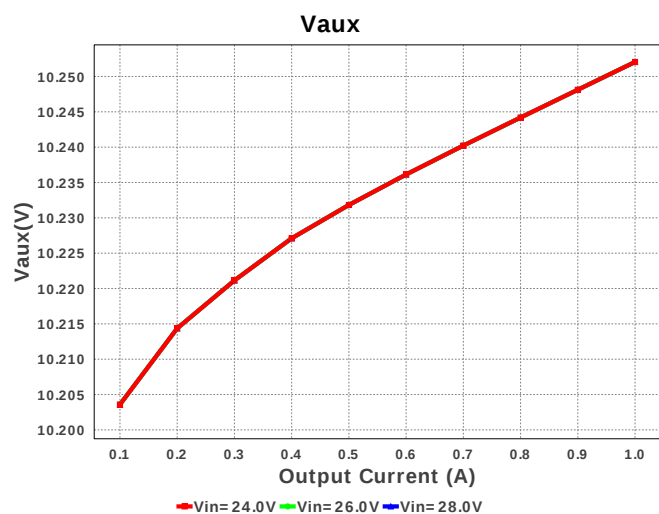
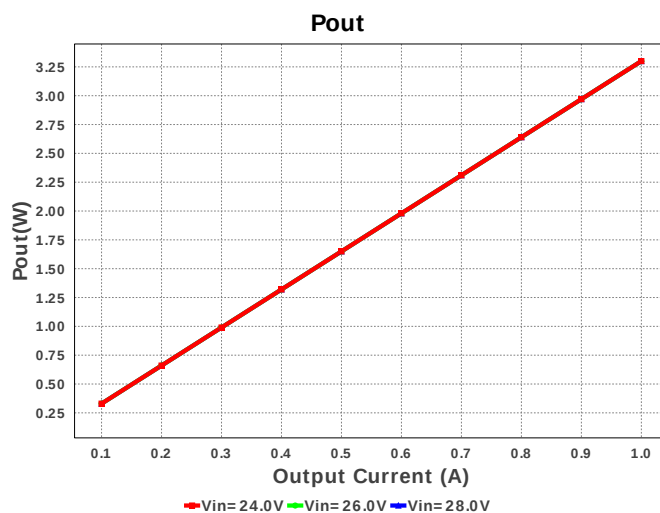
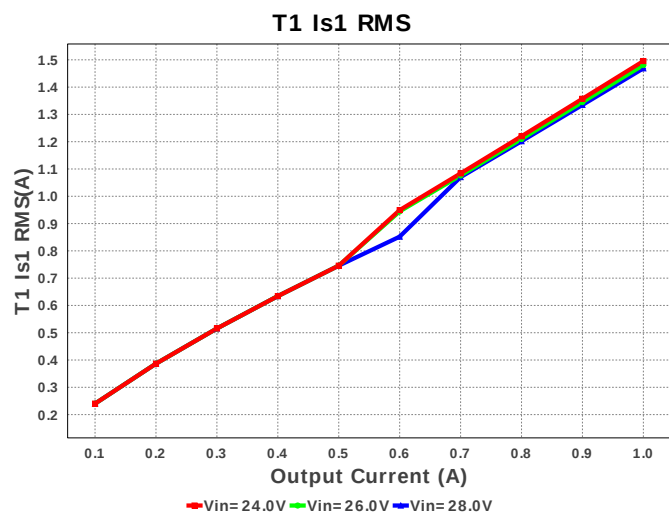
Pd Rstartup

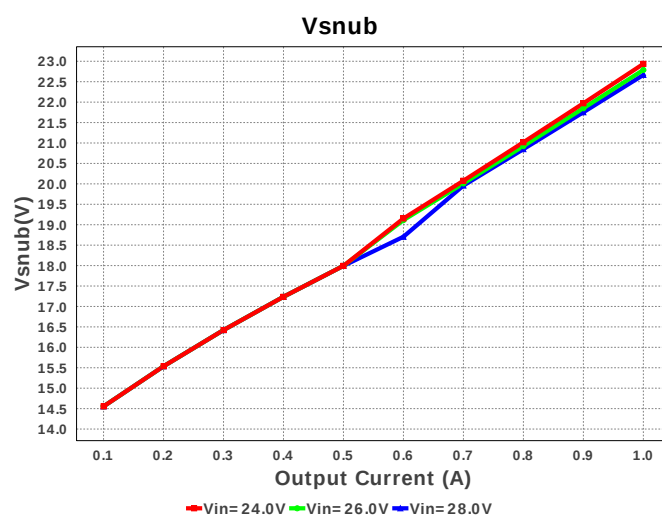
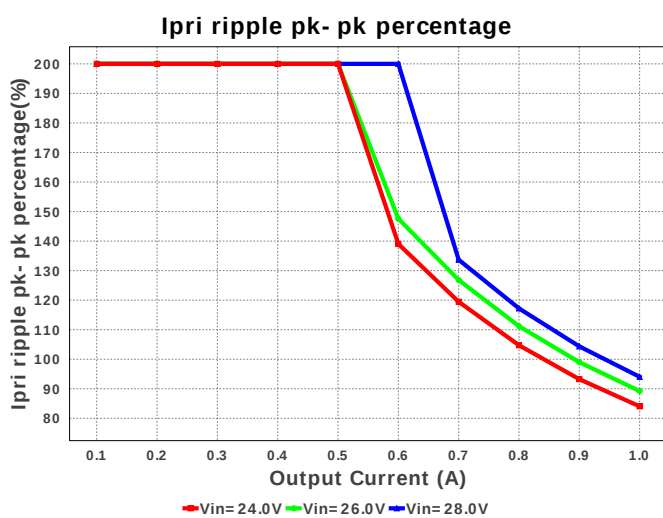
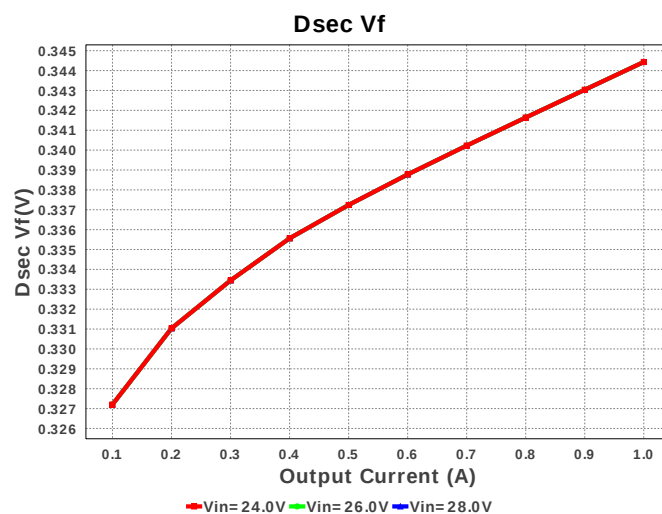
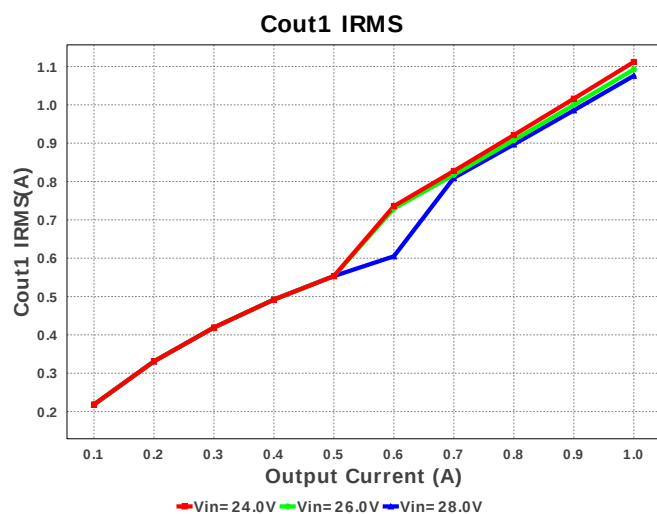
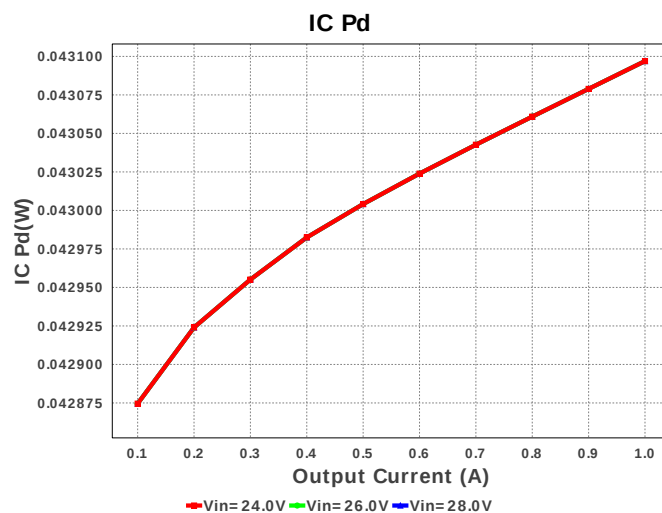
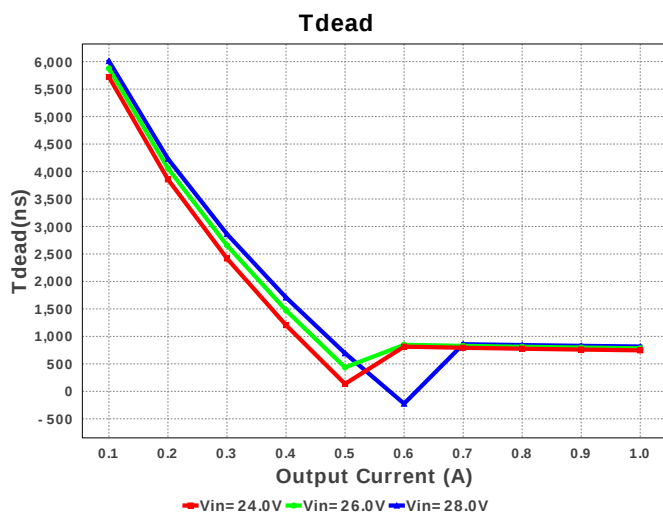


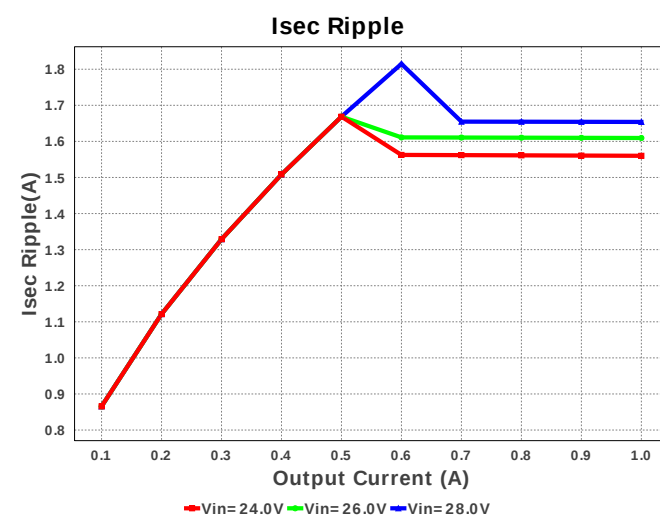
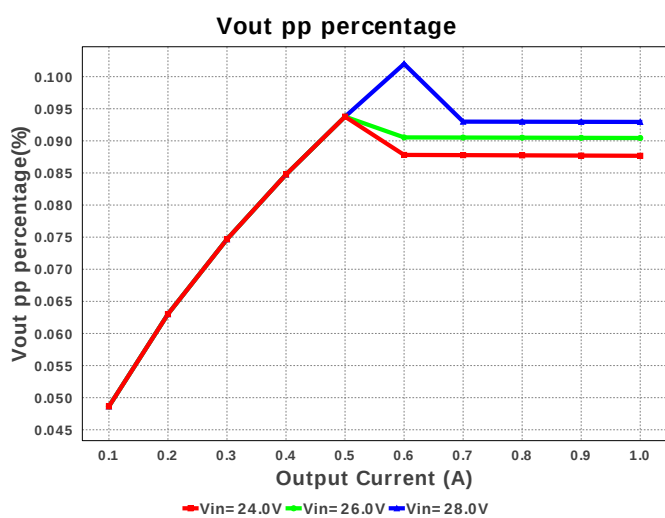
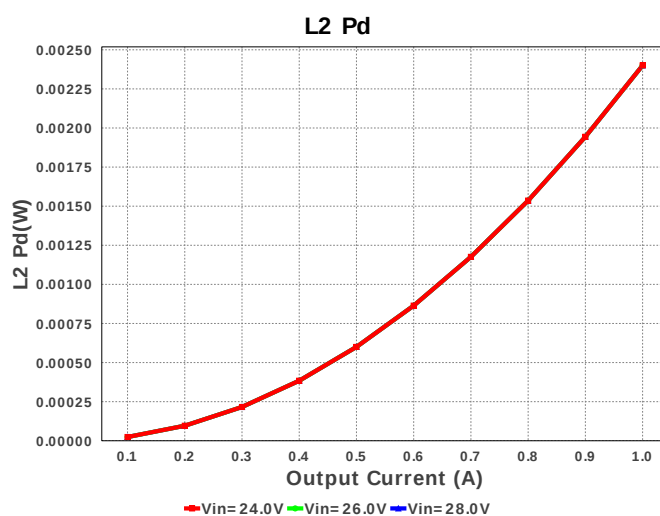
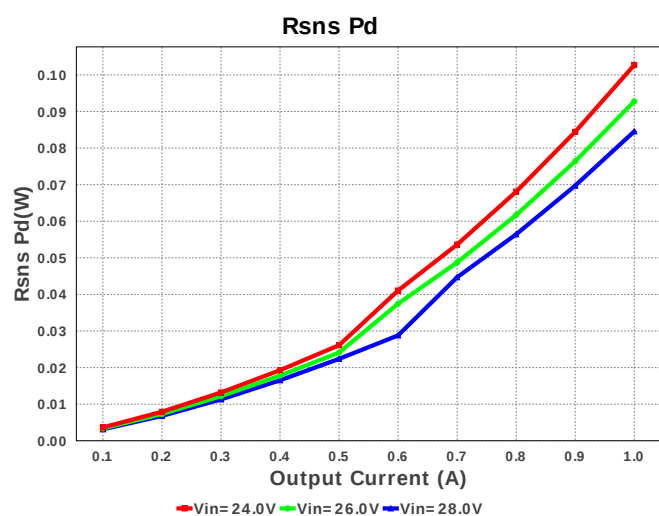
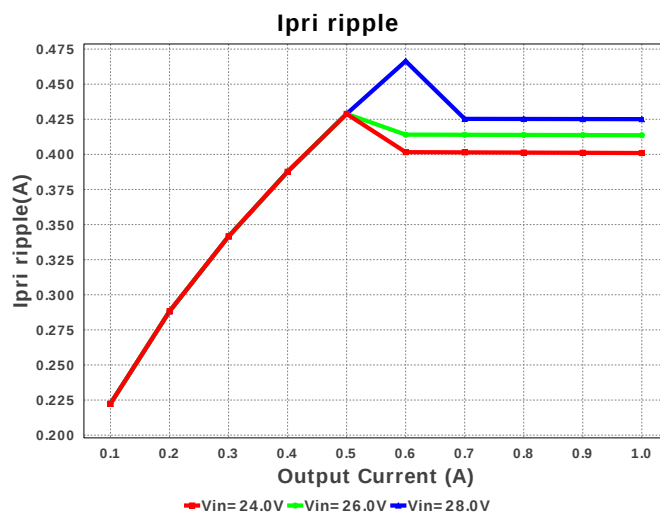
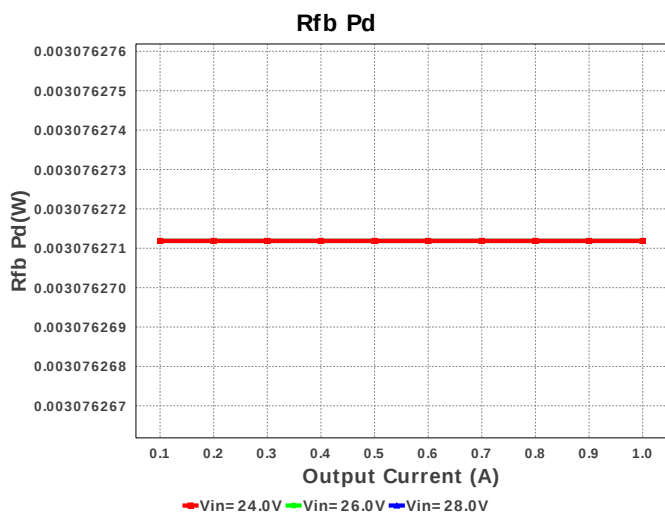
Snubber Pd

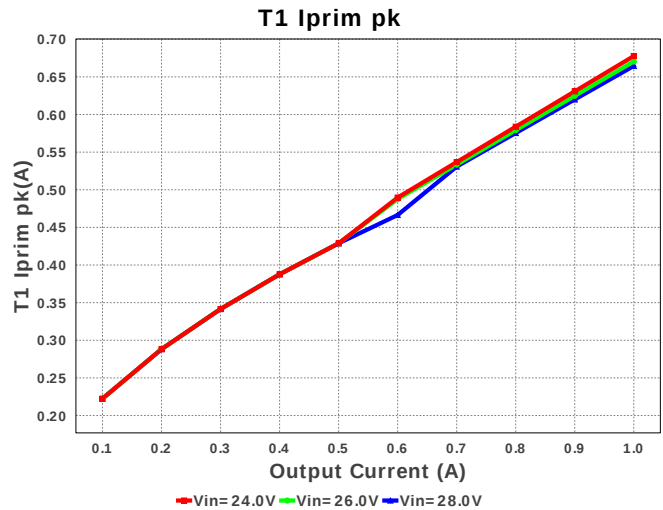
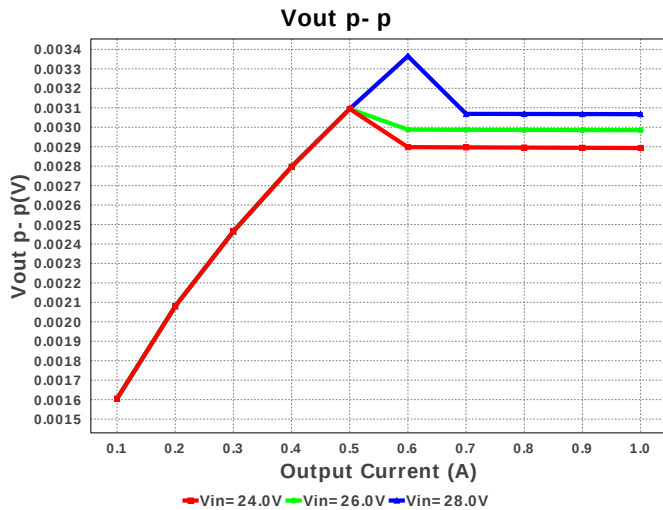












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.112 A	Current	Output capacitor1 RMS ripple current
2.	Iin Avg	161.879 mA	Current	Average input current
3.	Iout_DCM	545.121 mA	Current	Approximate Current below which DCM mode of operation will begin
4.	Ipri Avg	184.776 mA	Current	Average Current in Primary Winding over the complete Switching Period
5.	Ipri ripple	400.97 mA	Current	Ripple Current in the Primary Winding
6.	Ipri ripple pk-pk percentage	84.036 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
7.	Isec Ripple	1.56 A	Current	Ripple Current in the Secondary Winding
8.	T1 Iprim RMS	305.536 mA	Current	Transformer Primary RMS Current
9.	T1 Iprim pk	677.623 mA	Current	Transformer Primary Peak Current
10.	T1 Is1 RMS	1.495 A	Current	Transformer Secondary1 RMS Current
11.	T1 Is1 pk	2.636 A	Current	Transformer Secondary1 Peak Current
12.	BOM Count	46	General	Total Design BOM count
13.	Daux trr	4.0 ns	General	Auxiliary Diode Reverse Recovery Time
14.	Dsec Vf	344.432 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	254.33 mV	General	Effective Forward Voltage Drop at the Operating Current
17.	Dsnub trr	0.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	741.0 mm ²	General	Total Foot Print Area of BOM components
19.	Frequency	99.307 kHz	General	Switching frequency
20.	Pout	3.3 W	General	Total output power
21.	Tdead	745.954 ns	General	Approximate Dead Time of the Regulator
22.	Toff	5.424 us	General	Approximate Converter Off Time
23.	Ton Act	3.9 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	10.252 V	General	Auxiliary Voltage
27.	Vsnub	22.936 V	General	Voltage Across the Snubber
28.	Vout Actual	3.3 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
29.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
30.	Duty Cycle	38.726 %	Op_point	Duty cycle
31.	Efficiency	84.94 %	Op_point	Steady state efficiency
32.	IC Tj	32.155 degC	Op_point	IC junction temperature
33.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
34.	IOUT_OP	1.0 A	Op_point	Iout operating point
35.	M1 TJOP	30.178 degC	Op_point	M1 MOSFET junction temperature
36.	Vout p-p	2.893 mV	Op_point	Peak-to-peak output ripple voltage
37.	Cin Pd	213.062 μW	Power	Input capacitor power dissipation
38.	Cout1 Pd	2.292 mW	Power	Output capacitor1 power dissipation
39.	Dsec Pd	172.216 mW	Power	Secondary Diode Power Dissipation
40.	Dsec2 Pd	127.165 mW	Power	Secondary Diode Power Dissipation
41.	IC Pd	43.097 mW	Power	IC power dissipation
42.	L2 Pd	2.4 mW	Power	Average Power Dissipation in the Inductor Over the AC Line Period
43.	M1 Pd	3.235 mW	Power	M1 MOSFET total power dissipation
44.	Paux	18.586 mW	Power	Power Dissipation in Raux and Daux
45.	Pd Rstartup	15.45 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
46.	Rdrv Pd	13.204 μW	Power	Power Dissipation in Gate Drive Resistor
47.	Rfb Pd	3.076 mW	Power	Rfb Power Dissipation
48.	Rsns Pd	102.687 mW	Power	Current Limit Sense Resistor Power Dissipation
49.	Snubber Pd	58.034 mW	Power	Snubber Power Dissipation
50.	T1 Pd	200.892 mW	Power	Estimated Losses in Transformer

#	Name	Value	Category	Description
51.	Total Pd	0.0 W	Power	Total Power Dissipation
52.	Vout Tolerance	1.914 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
53.	Vout pp percentage	87.673 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	Iout1	1.0	Output Current #1
3.	Iout2	1.0	Output Current #2
4.	Iout3	1.0	Output Current #3
5.	VinMax	28.0	Maximum input voltage
6.	VinMin	24.0	Minimum input voltage
7.	Vout	3.3	Output Voltage
8.	Vout1	3.3	Output Voltage #1
9.	Vout2	5.0	Output Voltage #2
10.	Vout3	12.0	Output Voltage #3
11.	base_pn	UCC28C41	Base Product Number
12.	source	DC	Input Source Type
13.	Ta	30.0	Ambient temperature

Design Assistance

1. **UCC28C41** Product Folder : <http://www.ti.com/product/UCC28C41> : contains the data sheet and other resources.

Texas Instruments' WEBENCH simulation tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Simulations are created using Texas Instruments' published specifications as well as the published specifications of other device manufacturers. While Texas Instruments does update this information periodically, this information may not be current at the time the simulation is built. Texas Instruments does not warrant the accuracy or completeness of the specifications or any information contained therein. Texas Instruments does not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. Texas Instruments does not warrant that the designs are production worthy.

You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.

Use of Texas Instruments' WEBENCH simulation tools is subject to [Texas Instruments' Site Terms and Conditions of Use](#). Prototype boards based on WEBENCH created designs are provided AS IS without warranty of any kind for evaluation and testing purposes and are subject to the terms of the [Evaluation License Agreement](#).