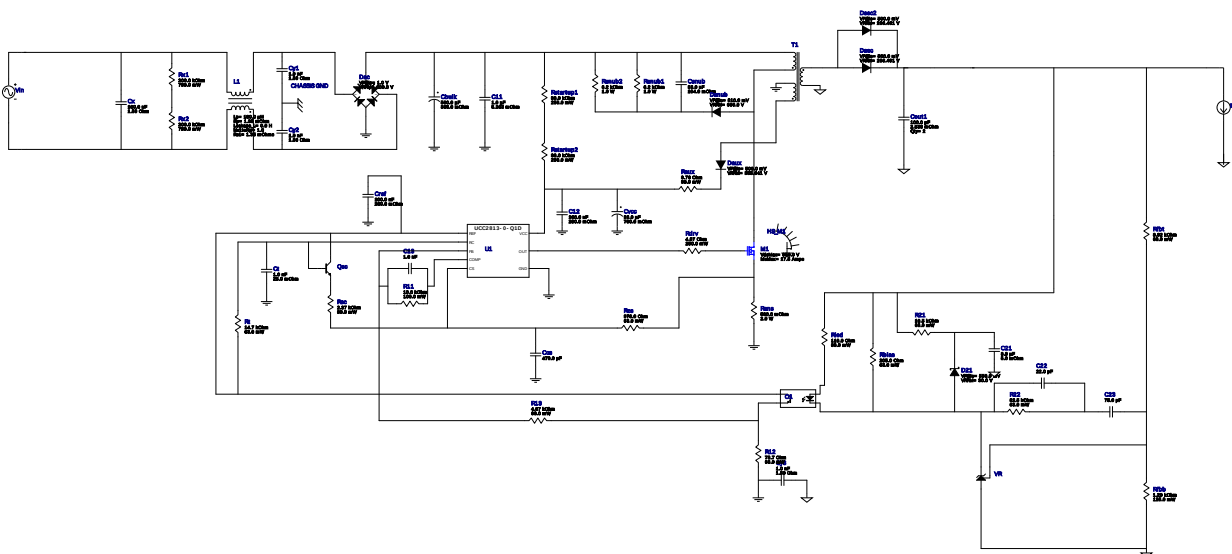


WEBENCH® Design Report

Design : 916945/925 UCC2813QDR-0Q1
UCC2813QDR-0Q1 17.0V-240.0V to 5.00V @ 1.5A



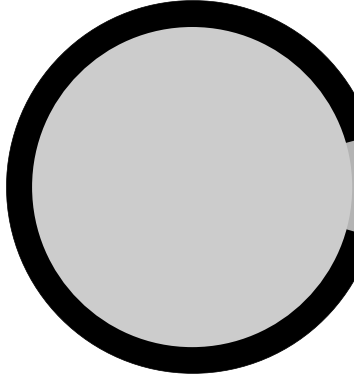
1. The EMI filter selected here contains the estimated values. The real numbers will depend on the attenuation needed at a particular frequency.

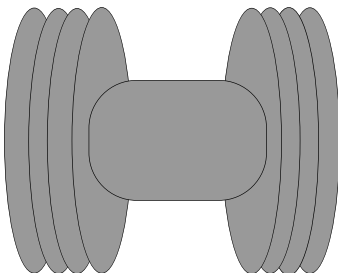
My Comments

No comments

Electrical BOM

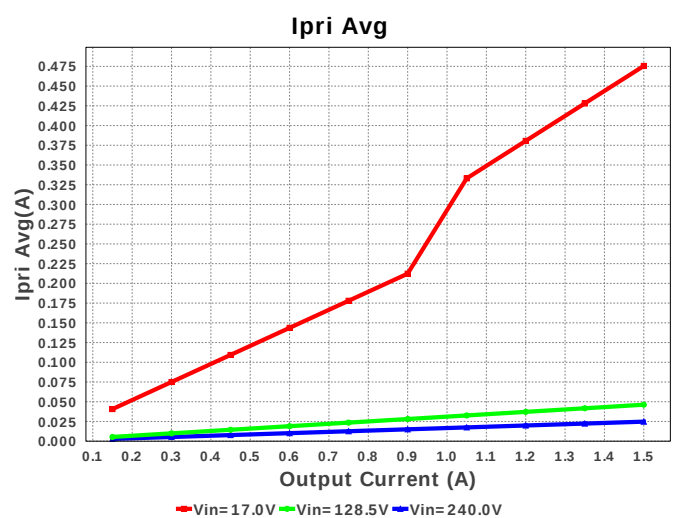
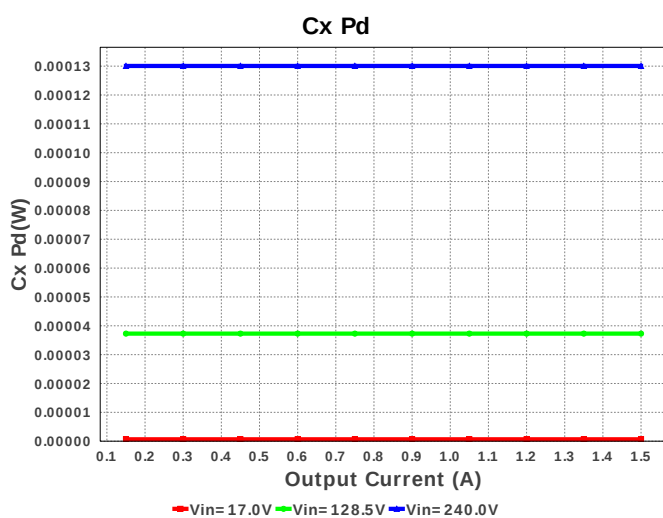
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	C11	TDK	C5750X6S2W105K Series= X6S	Cap= 1.0 uF ESR= 5.263 mOhm VDC= 400.0 V IRMS= 0.0 A	1	\$1.31	 2220 54 mm ²
2.	C12	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
3.	C13	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
4.	C21	Kemet	C0805C335K8PACTU Series= X5R	Cap= 3.3 uF ESR= 5.0 mOhm VDC= 10.0 V IRMS= 8.13 A	1	\$0.06	 0805 7 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	Samsung Electro-Mechanics	CL21C750JBANNNC Series= C0G/NP0	Cap= 75.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²

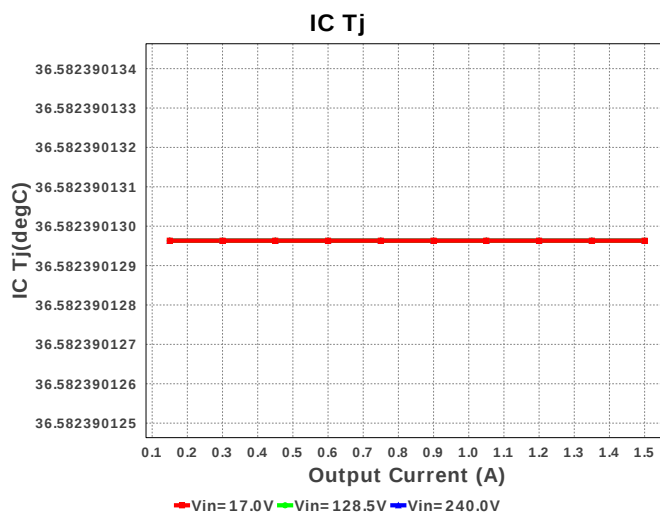
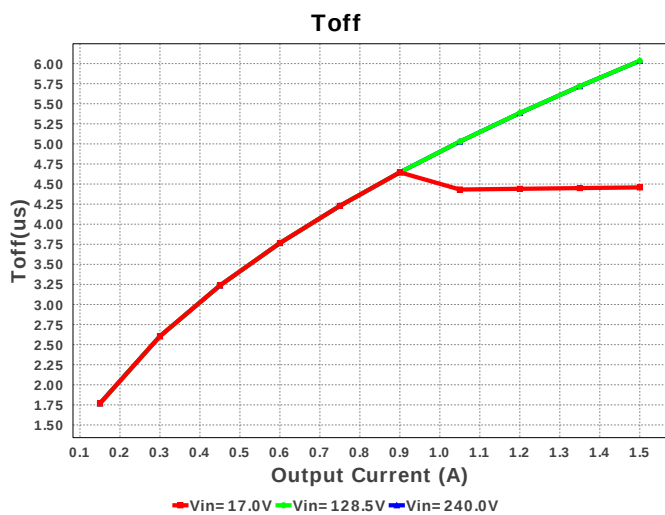
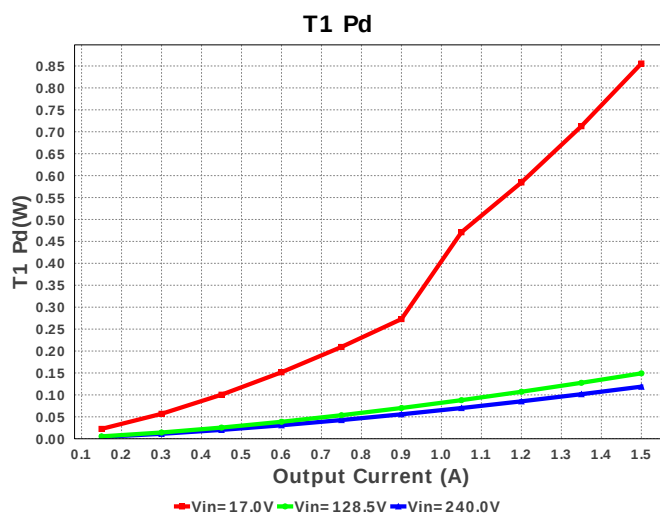
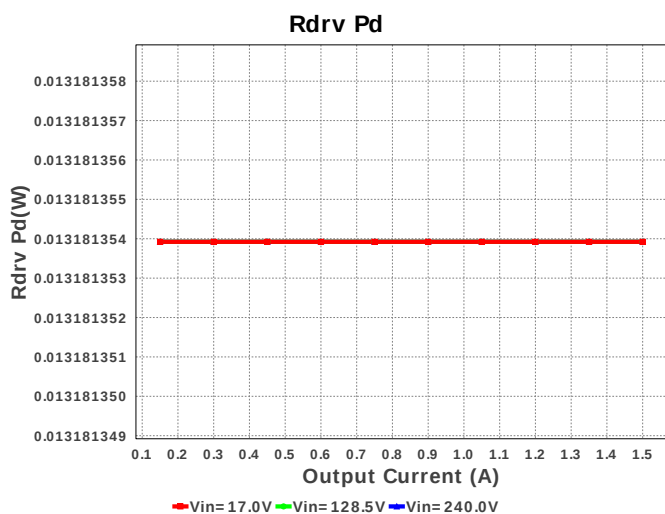
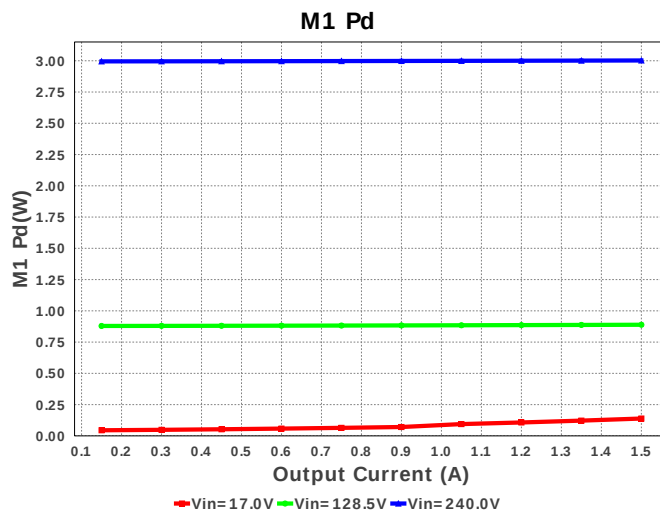
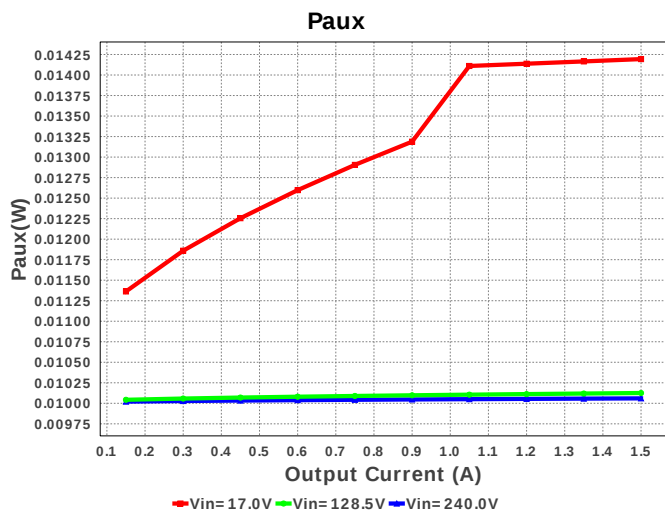
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7.	Cbulk	Nichicon	LLS2G561MELC Series= 2387	Cap= 560.0 uF ESR= 355.0 mOhm VDC= 400.0 V IRMS= 2.85 A	1	\$3.27	 Nichicon_3500x4000_Snap 1369 mm ²
8.	Ccs	Yageo America	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
9.	Cout1	TDK	C3216X5R1A107M160AC Series= X5R	Cap= 100.0 uF ESR= 2.838 mOhm VDC= 10.0 V IRMS= 4.3069 A	2	\$0.51	 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.	Csnub	Kemet	C0805C333K5RACTU Series= X7R	Cap= 33.0 nF ESR= 104.0 mOhm VDC= 50.0 V IRMS= 831.0 mA	1	\$0.01	 0805 7 mm ²
12.	Ct	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	\$0.02	 0805 7 mm ²
13.	Cvcc	Panasonic	EEE-FK1E330UR Series= FK	Cap= 33.0 uF ESR= 700.0 mOhm VDC= 25.0 V IRMS= 160.0 mA	1	\$0.10	 SM_RADIAL_C 62 mm ²
14.	Cx	Kemet	PHE844RD6100MR30L2 Series= 2231	Cap= 100.0 nF ESR= 1.59 Ohm VDC= 1000.0 V IRMS= 0.0 A	1	\$0.38	 PHE844_D14 280 mm ²
15.	Cy1	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF ESR= 1.59 Ohm VDC= 3.0 kV IRMS= 0.0 A	1	\$0.24	 B81123_1800x500x1050 140 mm ²

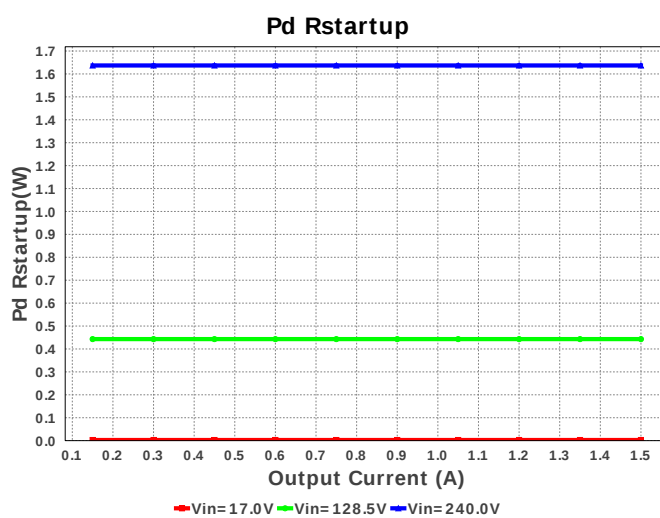
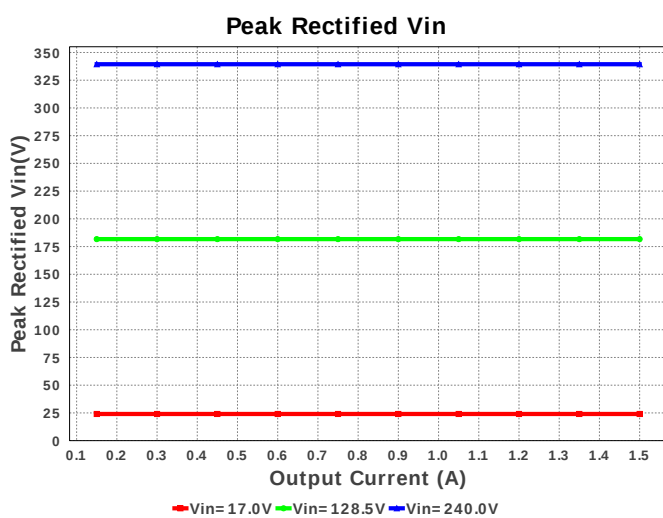
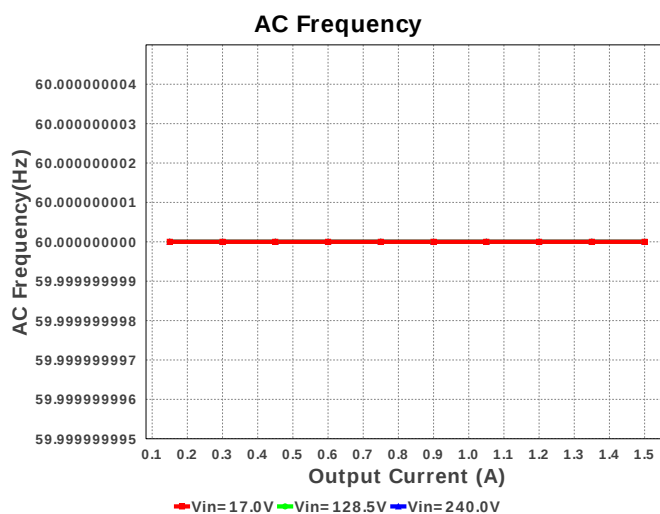
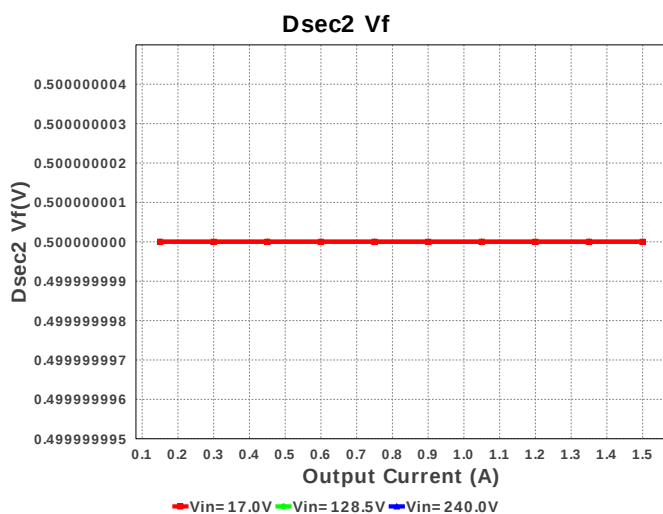
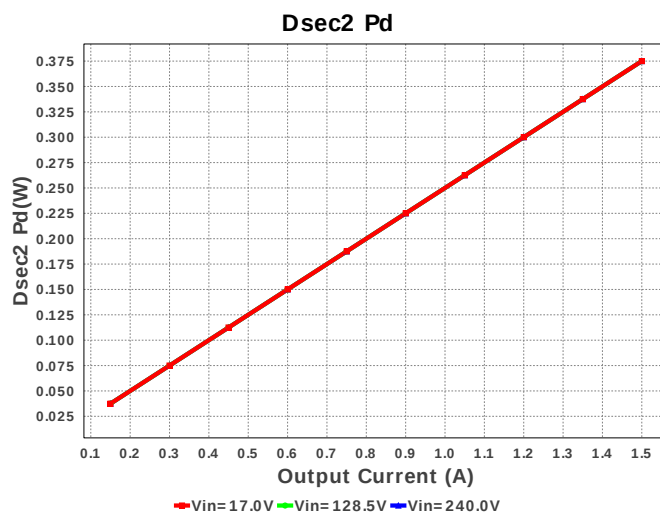
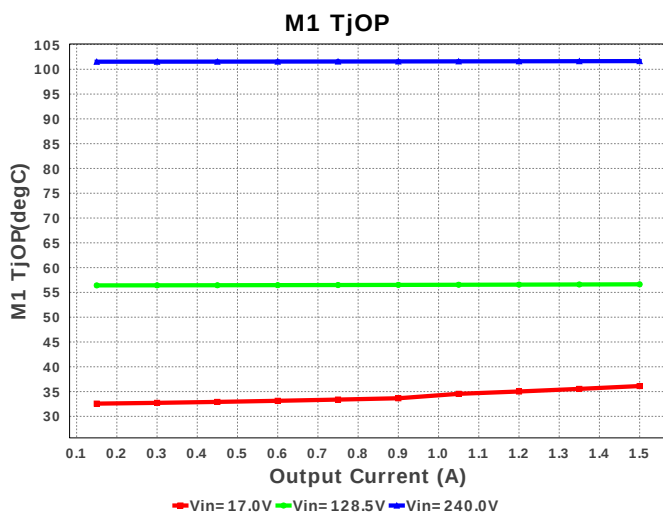
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
16.	Cy2	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF ESR= 1.59 Ohm VDC= 3.0 kV IRMS= 0.0 A	1	\$0.24	 B81123_1800x500x1050 140 mm ²
17.	Cy3	TDK	B81123C1102M Series= B81123	Cap= 1.0 nF ESR= 1.59 Ohm VDC= 3.0 kV IRMS= 0.0 A	1	\$0.24	 B81123_1800x500x1050 140 mm ²
18.	D21	Panasonic	DB2S31600L	VF@Io= 550.0 mV VRRM= 30.0 V	1	\$0.04	 SOD-523 5 mm ²
19.	Dac	Diodes Inc.	HD06-T	VF@Io= 1.0 V VRRM= 600.0 V	1	\$0.15	 MiniDIP 62 mm ²
20.	Daux	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 355.641 V	1	NA	CUSTOM 0 mm ²
21.	Dsec	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 206.491 V	1	NA	CUSTOM 0 mm ²
22.	Dsec2	CUSTOM	CUSTOM	VF@Io= 500.0 mV VRRM= 206.491 V	1	NA	CUSTOM 0 mm ²
23.	Dsnub	ON Semiconductor	MURS360T3	VF@Io= 810.0 mV VRRM= 600.0 V	1	\$1.18	 SMC 83 mm ²
24.	HS_M1	Aavid	563002B00000G	Heatsink	1	\$0.46	 563002 403 mm ²
25.	L1	Laird-Signal Integrity Products	CMX1211Z181B-10	Lp= 180.0 µH Rp= 1.35 mOhm Leakage_L= 0.0 H Ns1toNp= 1.0 Rs1= 1.35 mOhms	1	\$3.58	 CMX1211Z181B 904 mm ²

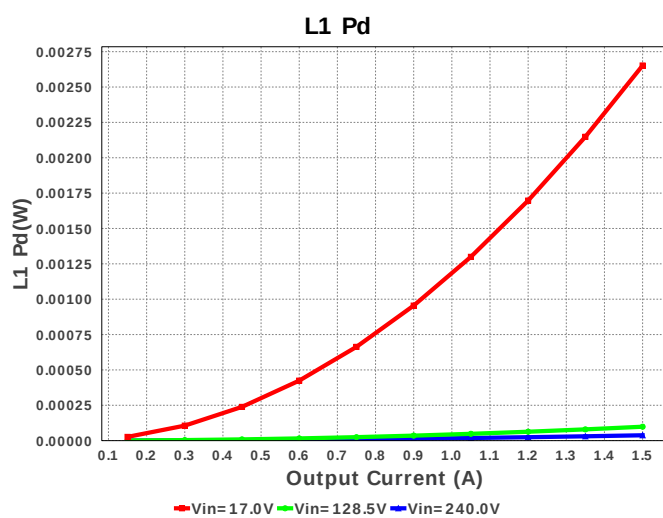
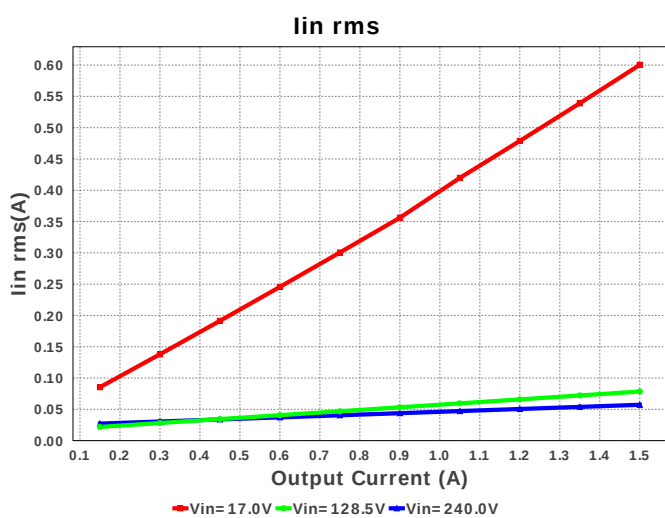
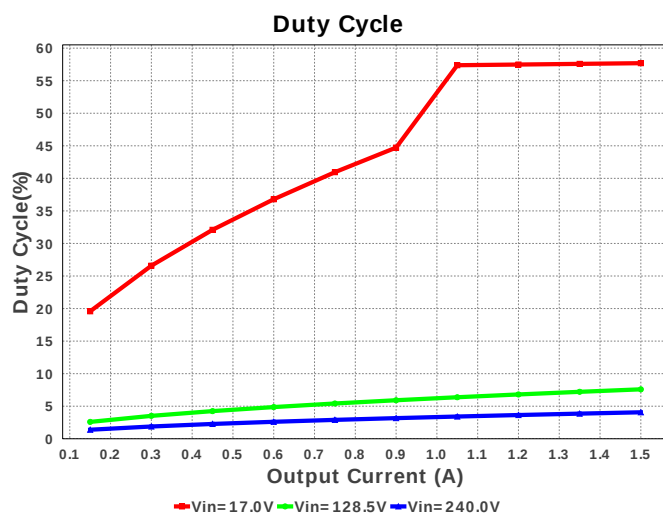
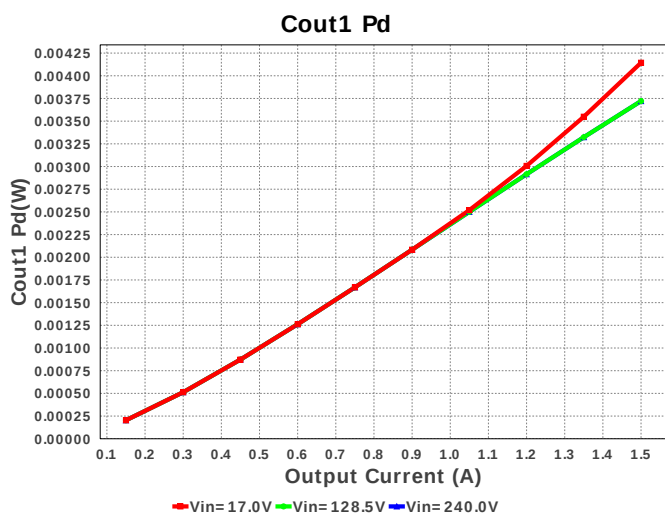
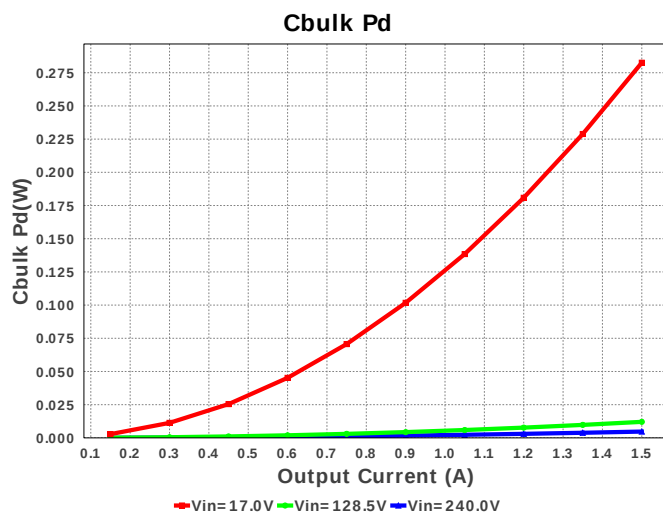
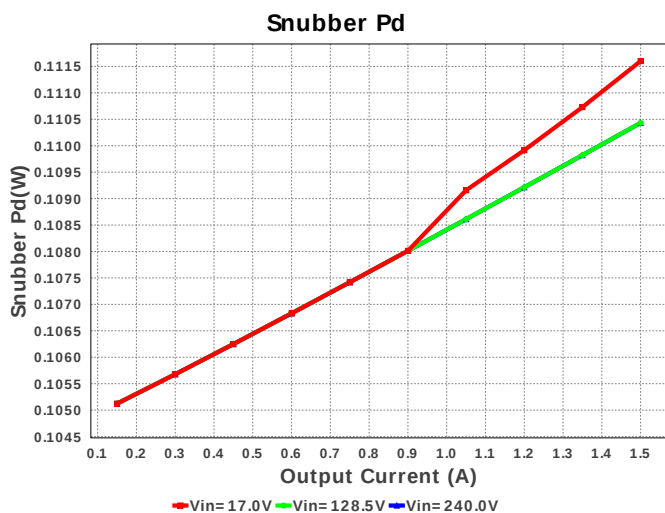
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
26.	M1	Infineon Technologies	IPP65R190CFD	VdsMax= 650.0 V IdsMax= 17.5 Amps	1	\$2.34	 TO-220AB 79 mm ²
27.	O1	Vishay-Semiconductor	TCMT1109	Optocoupler	1	\$0.21	 SOP-4 44 mm ²
28.	Qsc	STMicroelectronics	2N2222A	Bipolar Transistor	1	\$1.02	 TO-18 57 mm ²
29.	R11	Susumu Co Ltd	RR1220P-103-D Series= RR12	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 0.5%	1	\$0.01	 0805 7 mm ²
30.	R12	Vishay-Dale	CRCW040278R7FKED Series= CRCW..e3	Res= 78.7 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
31.	R13	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
32.	R21	Vishay-Dale	CRCW040210K5FKED Series= CRCW..e3	Res= 10.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
33.	R22	Vishay-Dale	CRCW040282K5FKED Series= CRCW..e3	Res= 82.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
34.	Raux	Vishay-Dale	CRCW04029R76FKED Series= CRCW..e3	Res= 9.76 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
35.	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
36.	Rcs	Vishay-Dale	CRCW0402976RFKED Series= CRCW..e3	Res= 976.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
37.	Rdrv	Vishay-Dale	CRCW12064R87FKEA Series= CRCW..e3	Res= 4.87 Ohm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
38.	Rfbb	Yageo America	RT0805BRD071K29L Series= RT0805	Res= 1.29 kOhm Power= 125.0 mW Tolerance= 0.1%	1	\$0.05	 0805 7 mm ²
39.	Rfbt	Vishay-Dale	CRCW04023K92FKED Series= CRCW..e3	Res= 3.92 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
40.	Rled	Vishay-Dale	CRCW0402110RFKED Series= CRCW..e3	Res= 110.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
41.	Rsc	Vishay-Dale	CRCW04022K37FKED Series= CRCW..e3	Res= 2.37 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
42.	Rsns	Vishay-Dale	RSMF2FTR590 Series= ?	Res= 590.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	\$0.06	 CMF55 63 mm ²
43.	Rsub1	Vishay-Bccomponents	PR01000106201JR500 Series= ?	Res= 6.2 kOhm Power= 1.0 W Tolerance= 5.0%	1	\$0.03	 PR01 89 mm ²
44.	Rsub2	Vishay-Bccomponents	PR01000106201JR500 Series= ?	Res= 6.2 kOhm Power= 1.0 W Tolerance= 5.0%	1	\$0.03	 PR01 89 mm ²
45.	Rstartup1	Yageo America	RC1206FR-0733KL Series= ?	Res= 33.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²

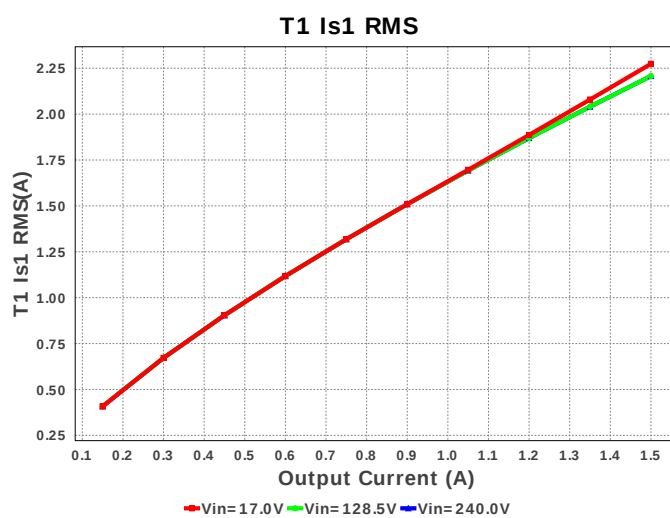
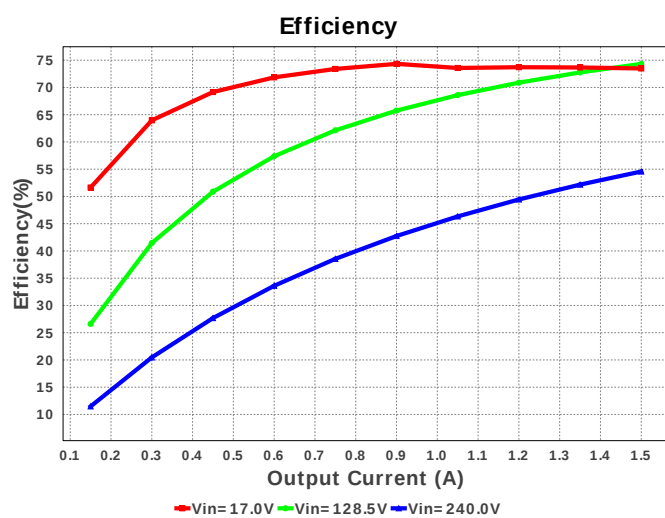
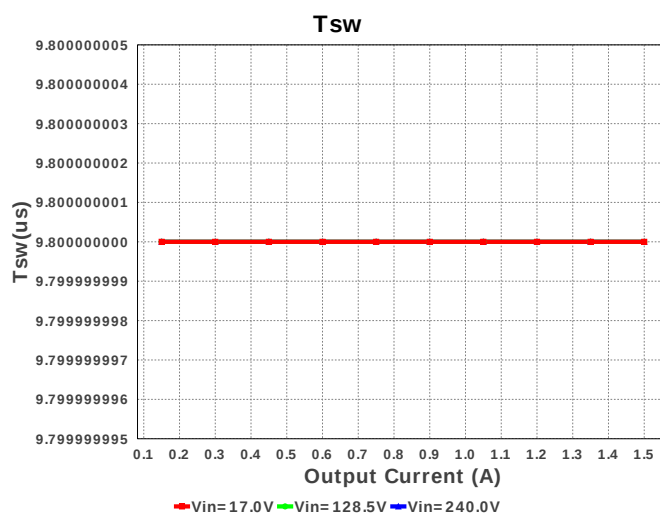
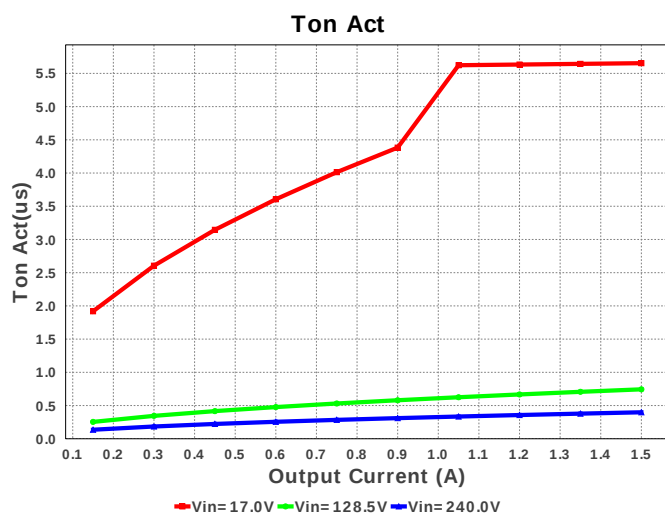
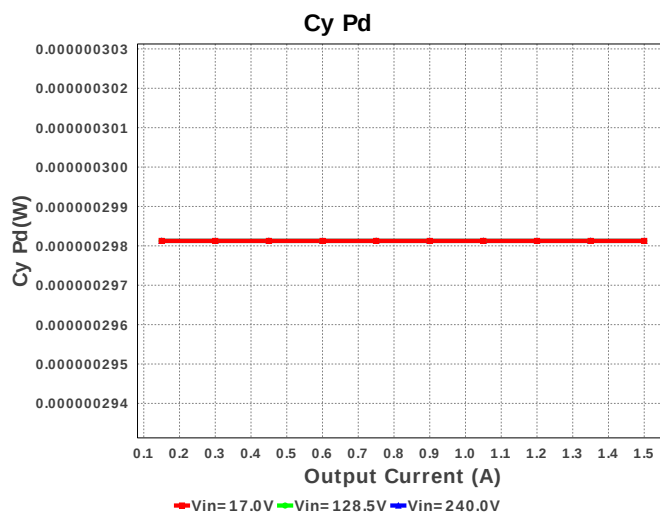
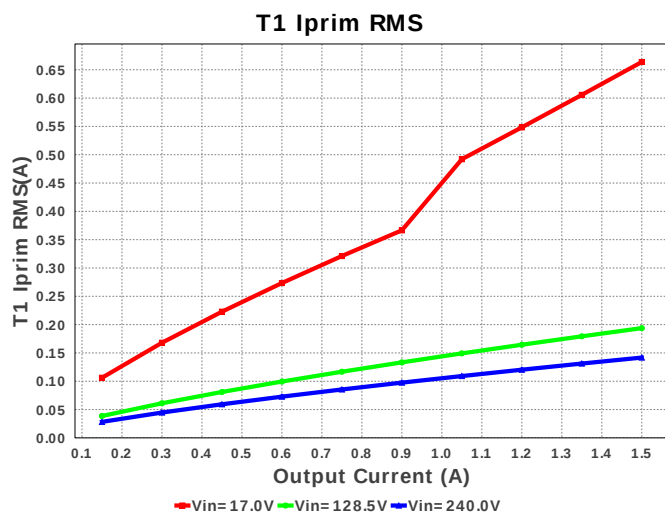
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
46.	Rstartup2	Yageo America	RC1206FR-0733KL Series= ?	Res= 33.0 kOhm Power= 250.0 mW Tolerance= 1.0%	1	\$0.01	 1206 11 mm ²
47.	Rt	Vishay-Dale	CRCW040214K7FKED Series= CRCW...e3	Res= 14.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
48.	Rx1	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.04	 2010 32 mm ²
49.	Rx2	Vishay-Semiconductor	CRCW2010200KFKEF Series= ?	Res= 200.0 kOhm Power= 750.0 mW Tolerance= 1.0%	1	\$0.04	 2010 32 mm ²
50.	T1	Core=TDK , CoilFormer=TDK	Core=B66307G0000X127 , CoilFormer=B66308B1108T001	Lp= 111.0 µH Turns Ratio(Nas)= 13:7 Turns Ratio(Nps)= 28:7 Npri= 28.0 Naux= 13.0 Nsec= 7.0	1	\$0.63	 TDK_B66305 200 mm ²
51.	U1	Texas Instruments	UCC2813QDR-0Q1	Switcher	1	\$1.20	 D0008A 57 mm ²
52.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	\$0.16	 R-PDSO-G3 16 mm ²

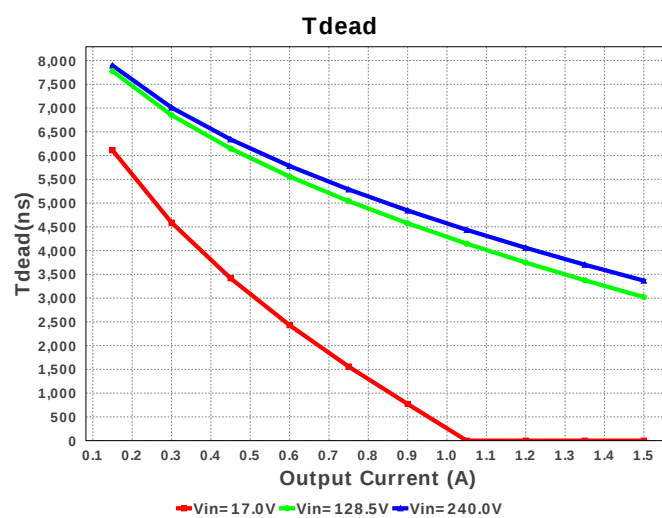
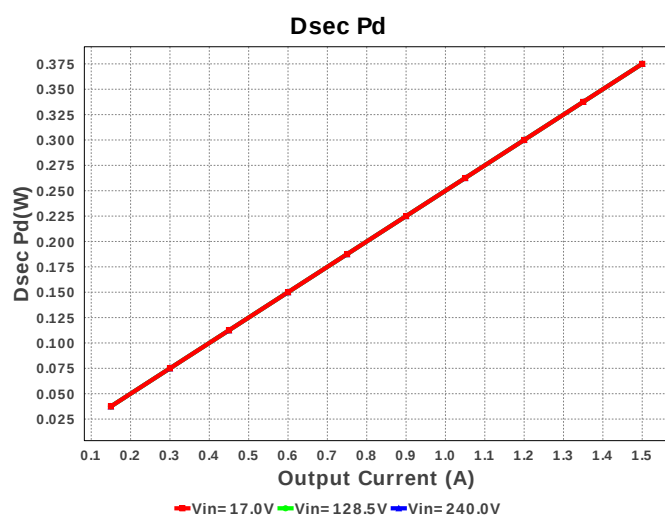
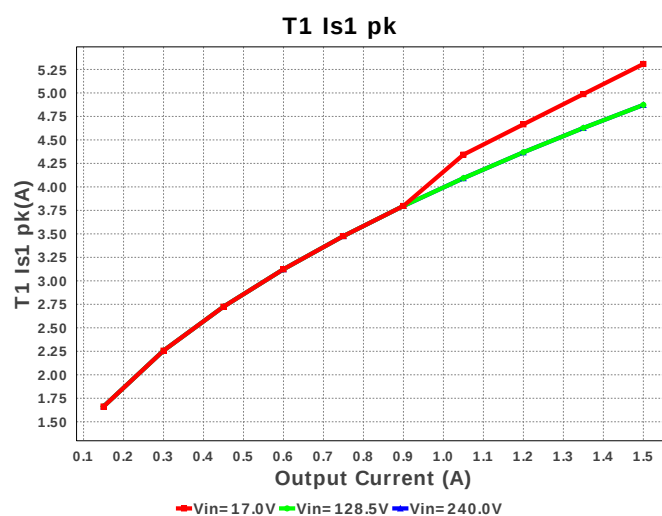
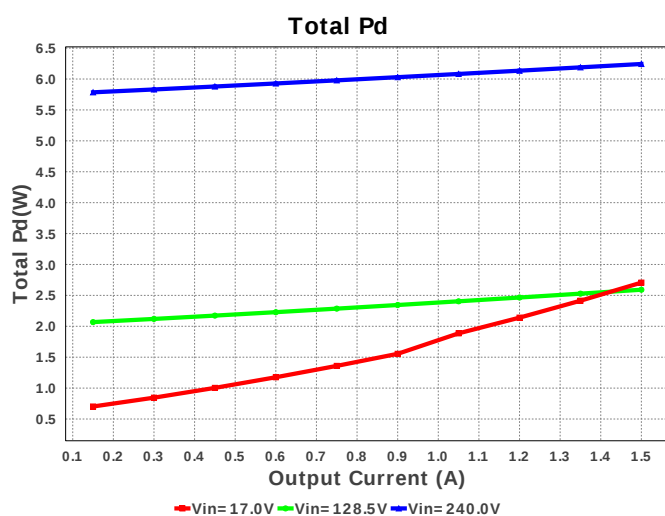
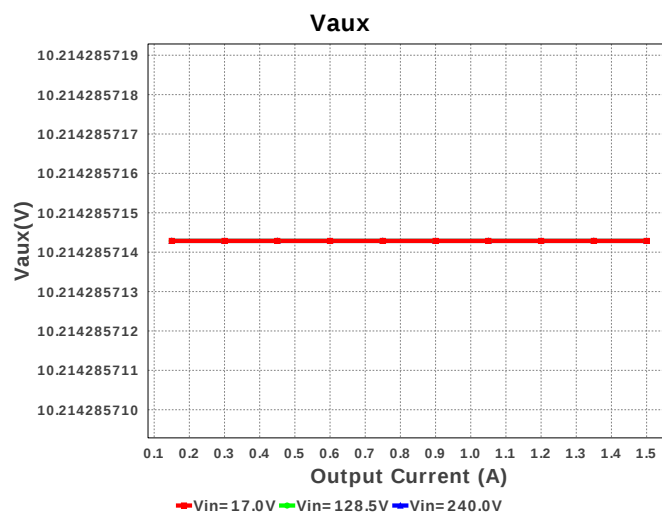
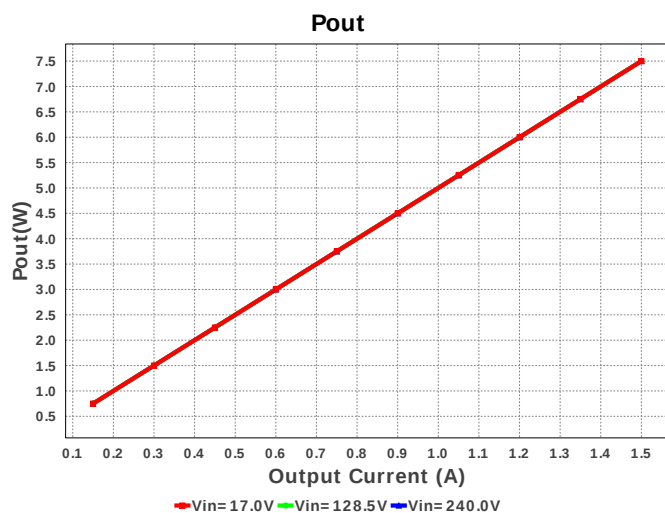


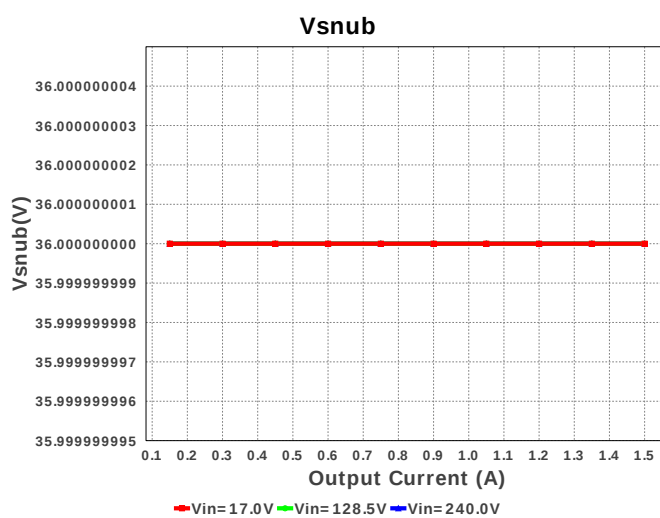
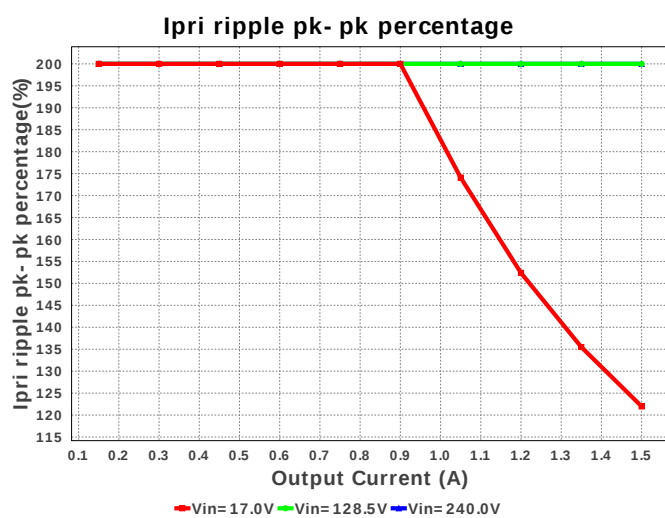
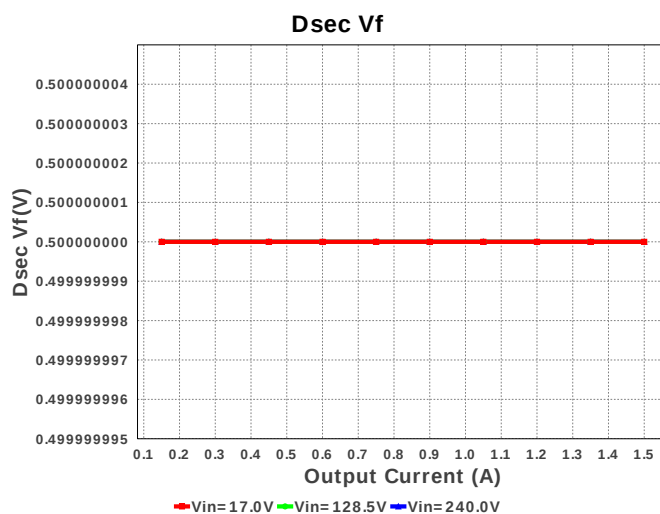
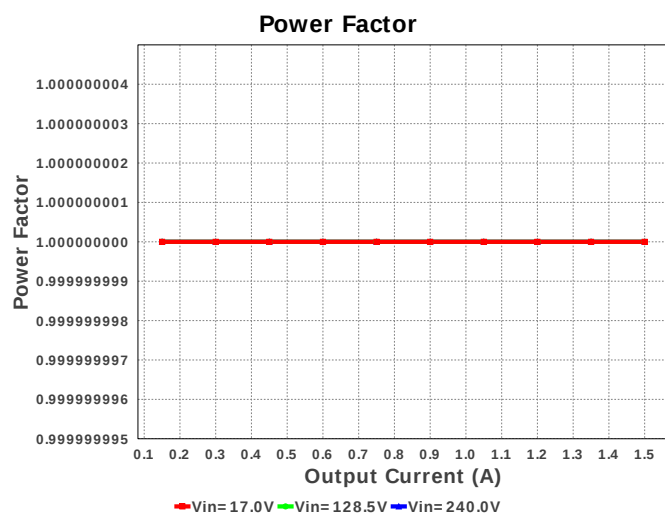
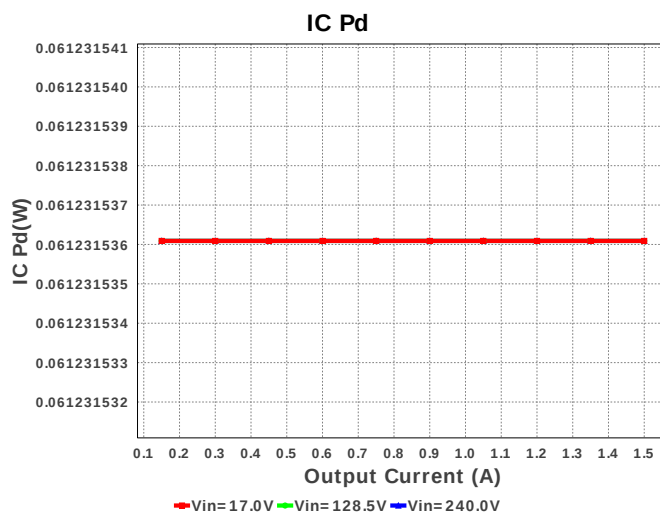
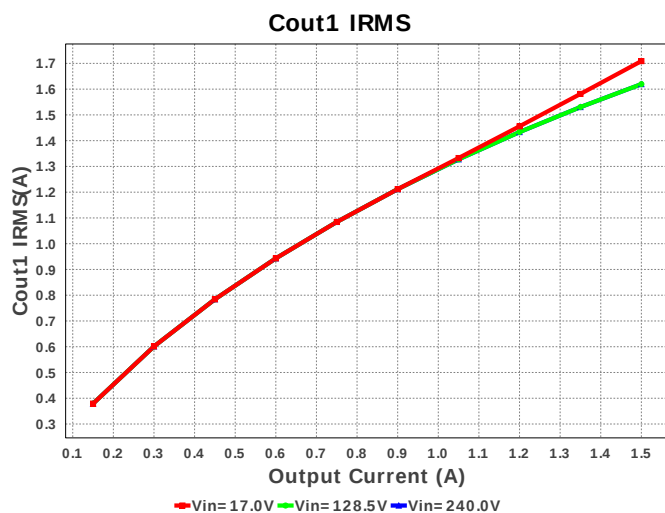


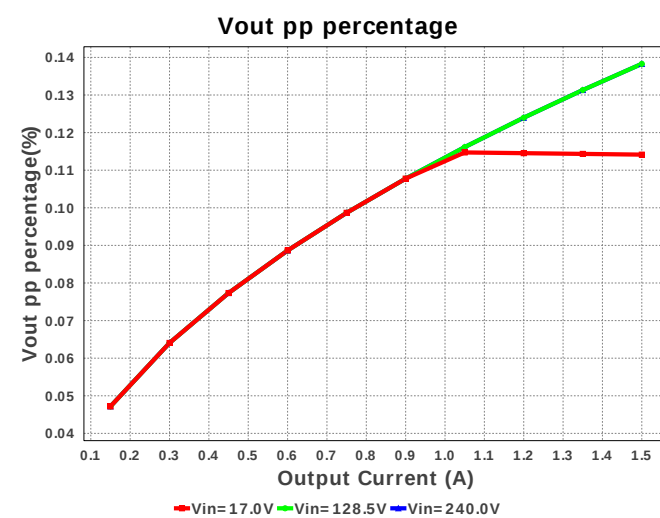
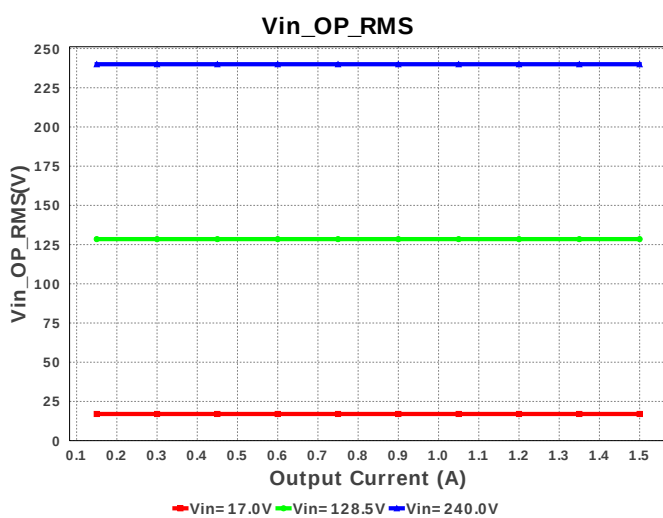
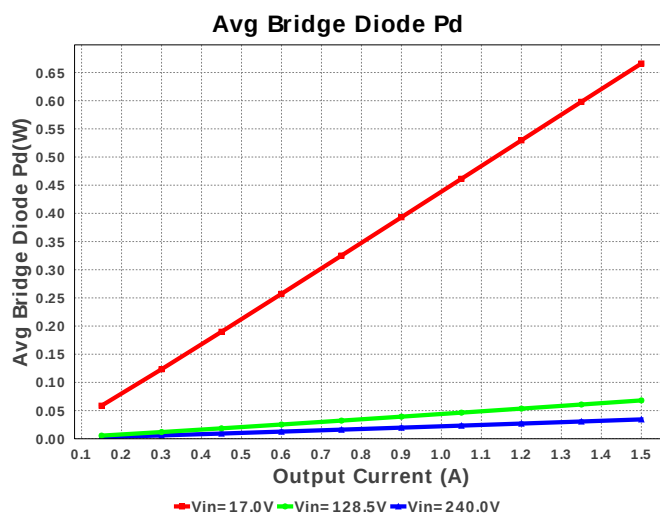
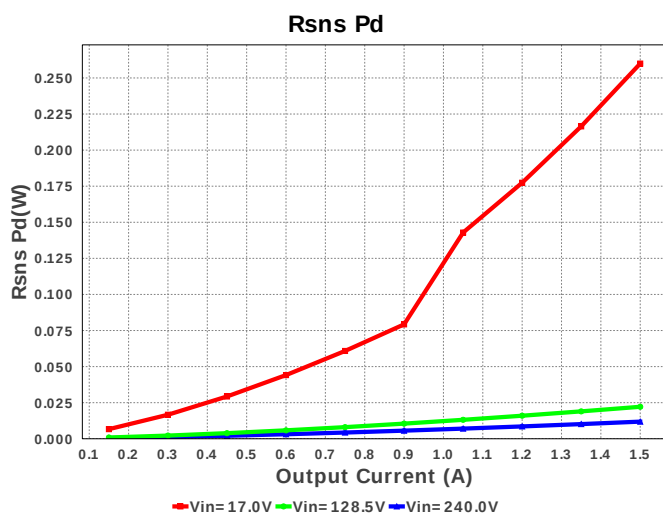
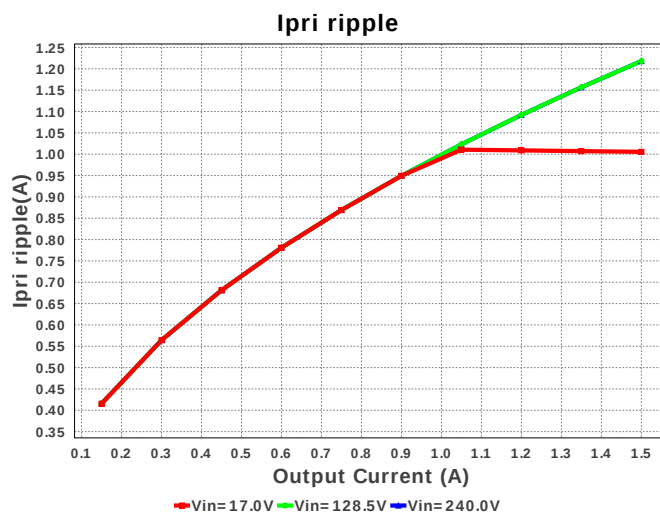
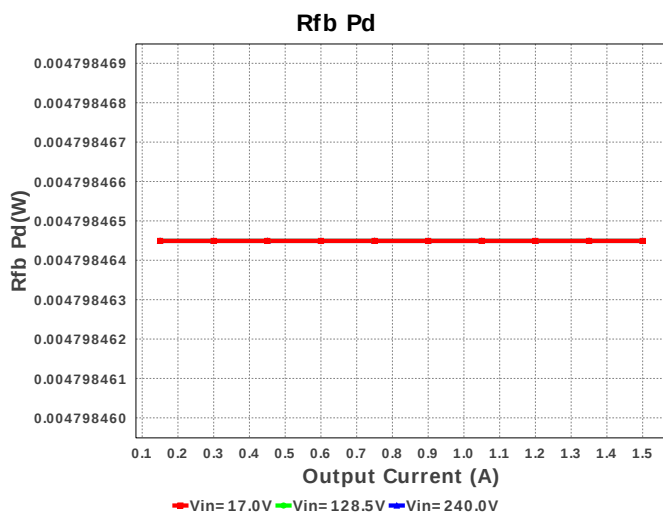


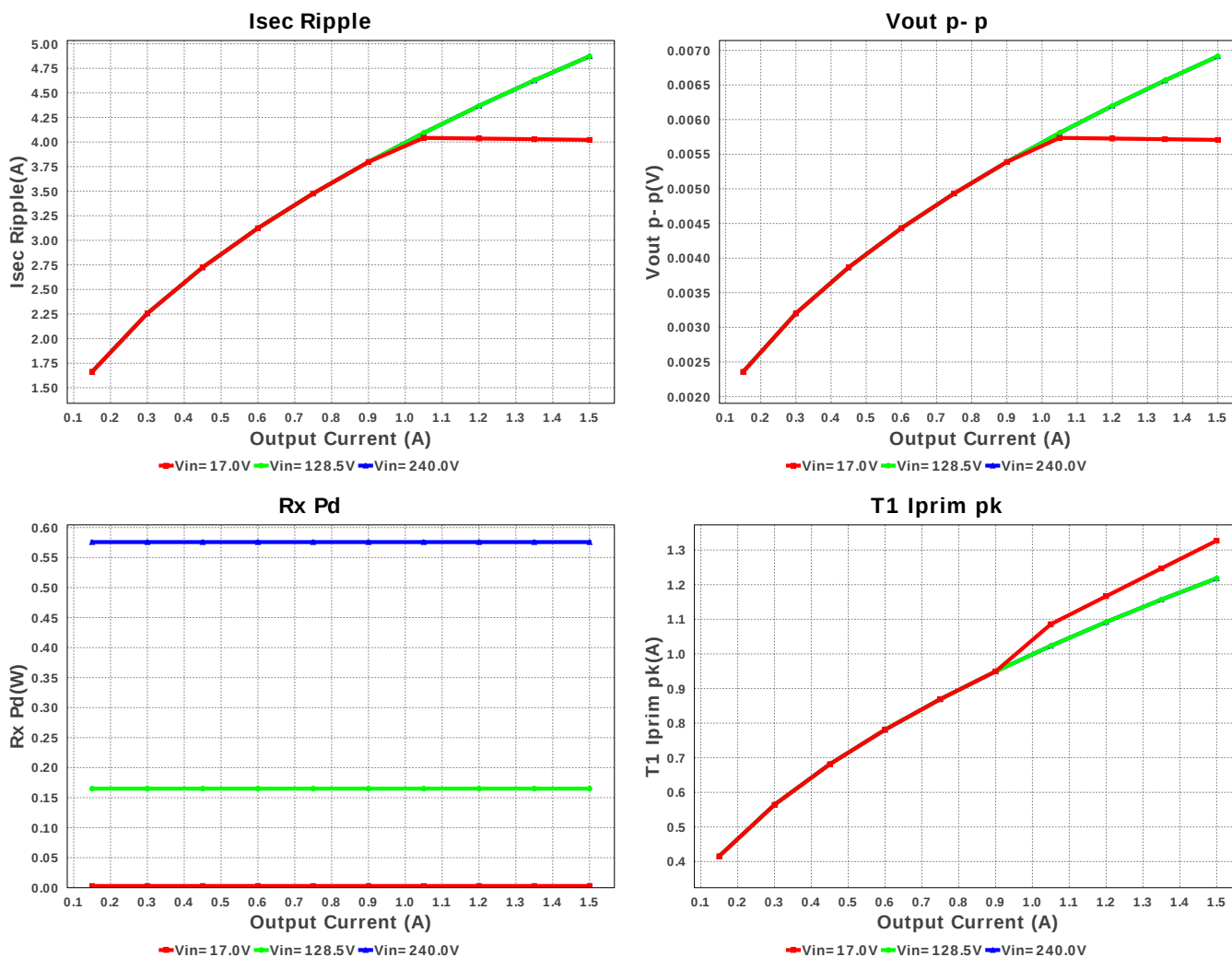












Operating Values

#	Name	Value	Category	Description
1.	Cout1 IRMS	1.708 A	Current	Output capacitor1 RMS ripple current
2.	Iin rms	600.36 mA	Current	RMS Input Current
3.	Ipri Avg	475.547 mA	Current	Average Current in Primary Winding over the complete Switching Period
4.	Ipri ripple	1.004 A	Current	Ripple Current in the Primary Winding
5.	Ipri ripple pk-pk percentage	121.766 %	Current	Primary Current pk-pk ripple percentage(of Ipri avg during ton only)
6.	Isec Ripple	4.015 A	Current	Ripple Current in the Secondary Winding
7.	T1 Iprim RMS	663.652 mA	Current	Transformer Primary RMS Current
8.	T1 Iprim pk	1.326 A	Current	Transformer Primary Peak Current
9.	T1 Is1 RMS	2.273 A	Current	Transformer Secondary1 RMS Current
10.	T1 Is1 pk	5.305 A	Current	Transformer Secondary1 Peak Current
11.	AC Frequency	60.0 Hz	General	Input AC frequency
12.	BOM Count	53	General	Total Design BOM count
13.	Daux trr	0.0 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	0.0 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	75.0 ns	General	Snubber Diode Reverse Recovery Time
18.	FootPrint	4.577 k mm ²	General	Total Foot Print Area of BOM components
19.	Frequency	102.041 kHz	General	Switching frequency
20.	Mode	CCM	General	Conduction Mode
21.	Pout	7.5 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	4.458 us	General	Approximate Converter Off Time
25.	Ton Act	5.654 us	General	Approximate Converter On Time
26.	Total BOM	\$0.0	General	Total BOM Cost
27.	Tsw	9.8 us	General	Switching Time Period
28.	Vaux	10.214 V	General	Auxiliary Voltage
29.	Vsnub	36.0 V	General	Voltage Across the Snubber

#	Name	Value	Category	Description
30.	Vout Actual	5.008 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
31.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
32.	Duty Cycle	57.69 %	Op_point	Duty cycle
33.	Efficiency	73.486 %	Op_point	Steady state efficiency
34.	IC Tj	36.582 degC	Op_point	IC junction temperature
35.	ICThetaJA	107.5 degC/W	Op_point	IC junction-to-ambient thermal resistance
36.	IOUT_OP	1.5 A	Op_point	Iout operating point
37.	M1 TJOP	36.109 degC	Op_point	M1 MOSFET junction temperature
38.	Peak Rectified Vin	24.041 V	Op_point	Peak voltage seen at rectified input
39.	Vin_OP_RMS	17.0 V	Op_point	AC Input RMS Voltage
40.	Vout p-p	5.697 mV	Op_point	Peak-to-peak output ripple voltage
41.	Avg Bridge Diode Pd	665.909 mW	Power	Average Power Dissipation in the Bridge Diode over the AC Line Period
42.	Cbulk Pd	282.533 mW	Power	Bulk capacitor power dissipation
43.	Cout1 Pd	4.141 mW	Power	Output capacitor1 power dissipation
44.	Cx Pd	652.589 nW	Power	X-cap Power Dissipation
45.	Cy Pd	298.125 nW	Power	Y-caps Power Dissipation
46.	Dsec Pd	375.0 mW	Power	Secondary Diode Power Dissipation
47.	Dsec2 Pd	375.0 mW	Power	Secondary Diode Power Dissipation
48.	IC Pd	61.232 mW	Power	IC power dissipation
49.	L1 Pd	2.652 mW	Power	Power Dissipation in the Inductor
50.	M1 Pd	138.608 mW	Power	M1 MOSFET total power dissipation
51.	Paux	14.194 mW	Power	Power Dissipation in Raux and Daux
52.	Pd Rstartup	2.691 mW	Power	Power Dissipation in Rstartup1 and Rstartup2
53.	Rdrv Pd	13.181 mW	Power	Power Dissipation in Gate Drive Resistor
54.	Rfb Pd	4.798 mW	Power	Rfb Power Dissipation
55.	Rsns Pd	259.856 mW	Power	Current Limit Sense Resistor Power Dissipation
56.	Rx Pd	2.889 mW	Power	Total Power Dissipation in Rx1 and Rx2
57.	Snubber Pd	111.604 mW	Power	Snubber Power Dissipation
58.	T1 Pd	855.247 mW	Power	Estimated Losses in Transformer
59.	Total Pd	2.706 W	Power	Total Power Dissipation
60.	Vout Tolerance	1.479 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
61.	Vout pp percentage	113.943 m%		Output Voltage ripple percentage

Design Inputs

#	Name	Value	Description
1.	Iout	1.5	Maximum Output Current
2.	VinMax	240.0	Maximum input voltage
3.	VinMin	17.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	line_fsw	60.0	Light Output in Lumen
6.	base_pn	UCC2813-0-Q1	Base Product Number
7.	source	AC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

1. Feature Highlights: This device provides the features that are necessary to implement off-line or dc-to-dc fixed-frequency current-mode control schemes, with a minimum number of external components.

2. The UCC2813-0-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application

3. **UCC2813-0-Q1** Product Folder : <http://www.ti.com/product/UCC2813%2D0%2DQ1> : contains the data sheet and other resources.

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