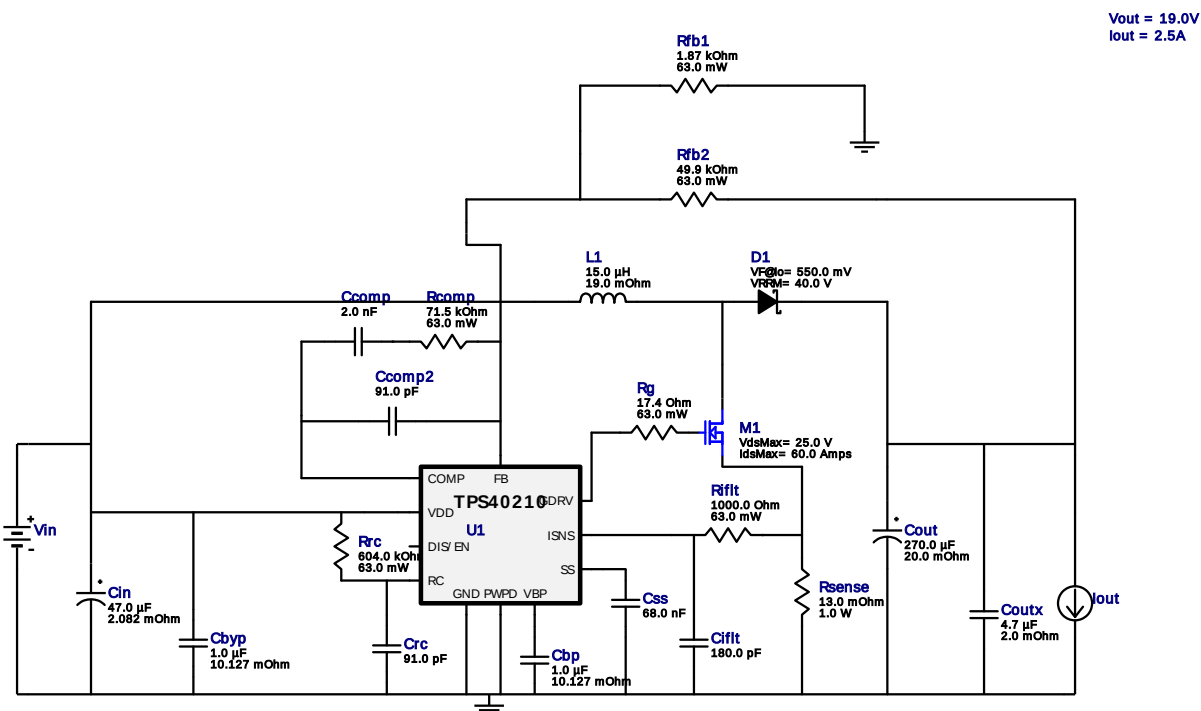


WEBENCH® Design Report

Design : 1641152/96 TPS40210DGQR
TPS40210DGQR 10.0V-14.4V to 19.38V @ 2.5A

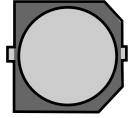
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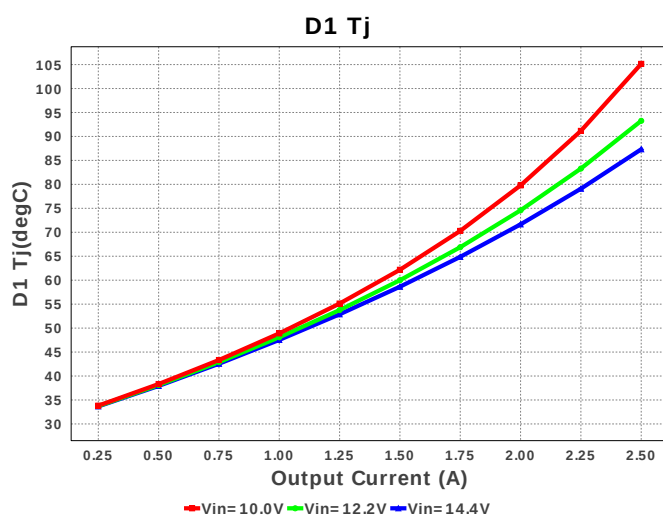
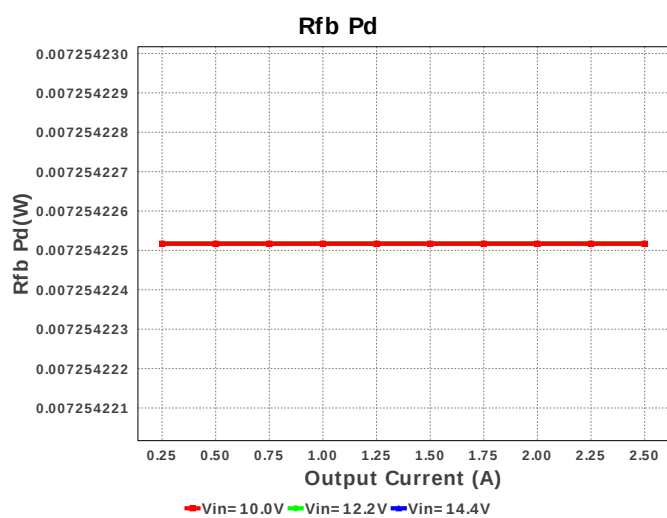
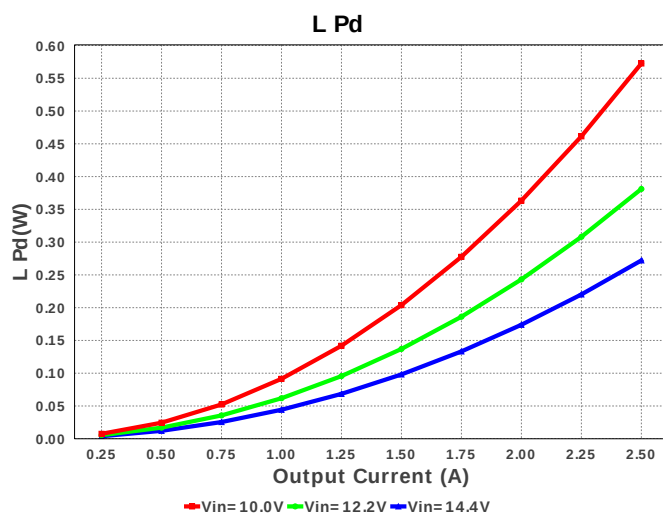
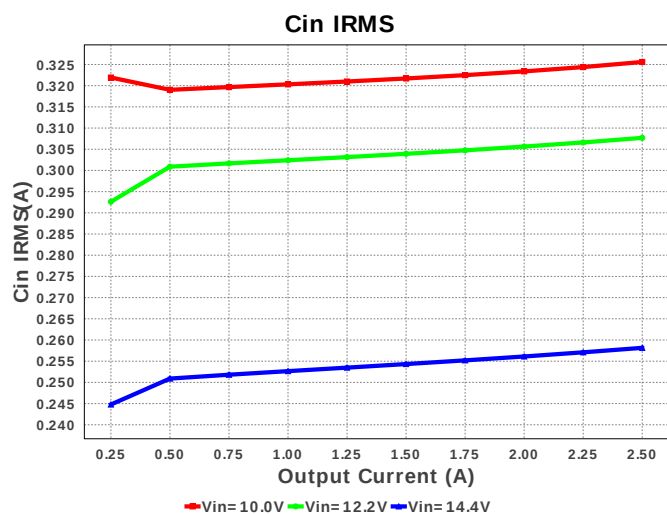
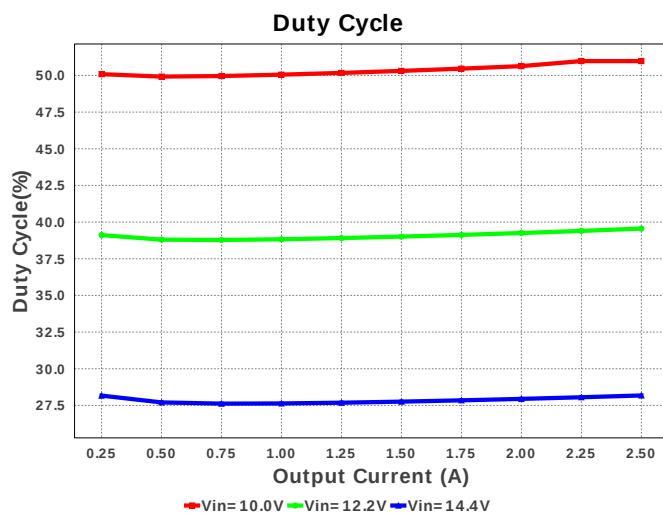
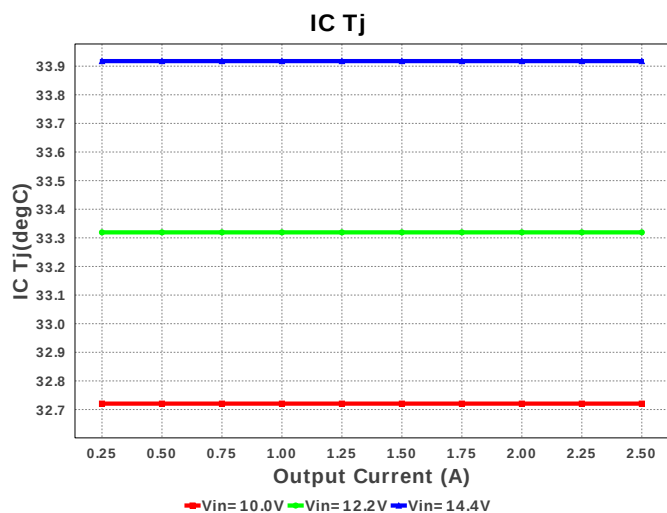
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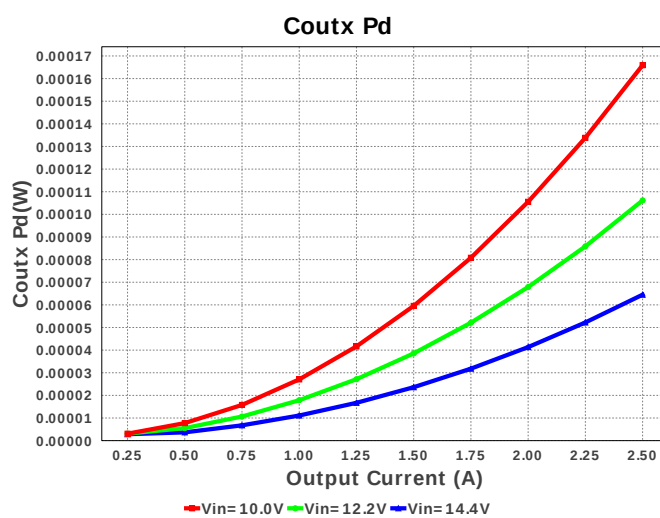
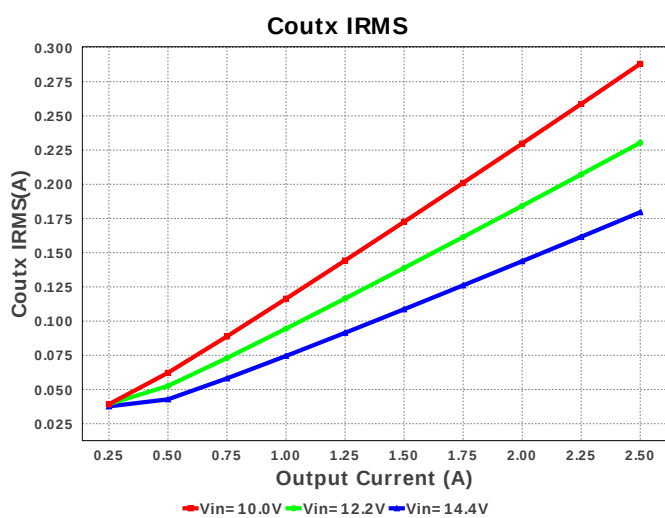
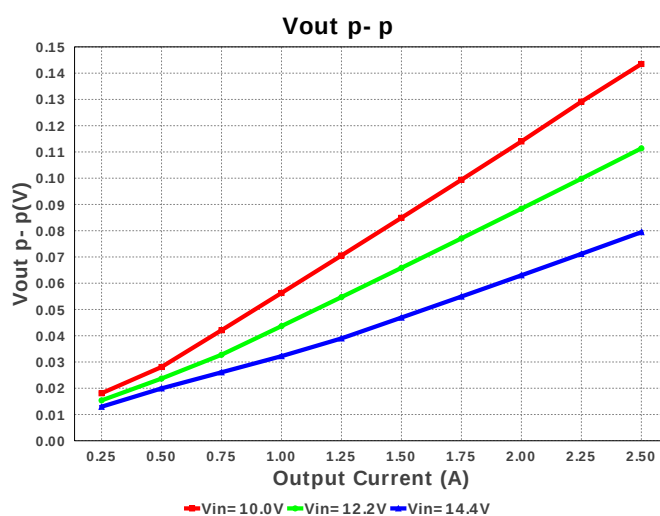
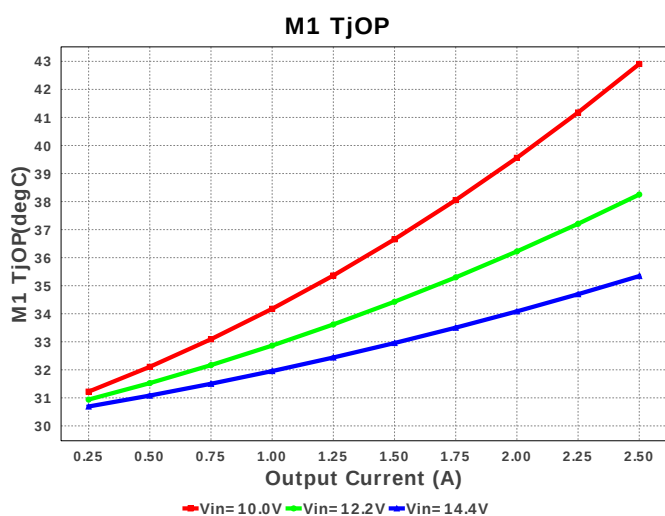
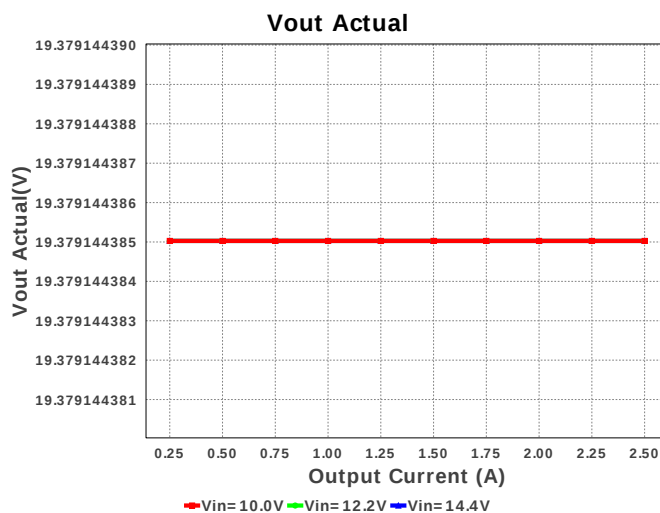
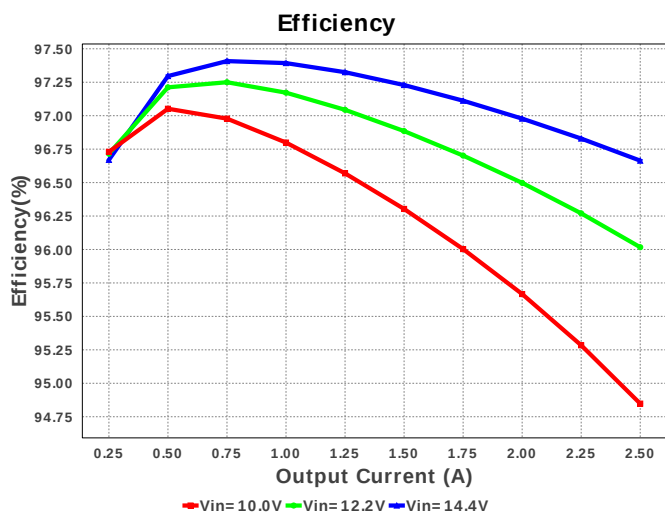


Electrical BOM

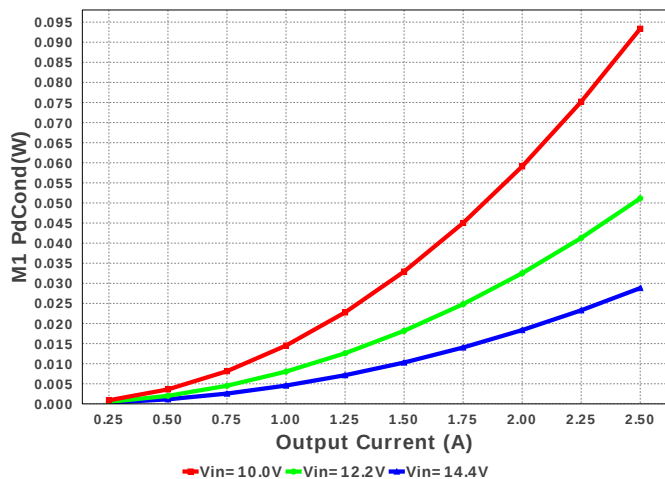
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1.	Cbp	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	\$0.01	0603 5 mm ²
2.	Cbyp	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	\$0.01	0603 5 mm ²
3.	Ccomp	Kemet	C0805C202J3GACTU Series= C0G/NP0	Cap= 2.0 nF VDC= 5.0 V IRMS= 0.0 A	1	NA	0805 7 mm ²
4.	Ccomp2	Samsung Electro-Mechanics	CL21C910JBANNNC Series= C0G/NP0	Cap= 91.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
5.	Ciflt	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
6.	Cin	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	1	\$0.35	1206 11 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cout	Panasonic	EEHZA1V271P Series= ?	Cap= 270.0 uF ESR= 20.0 mOhm VDC= 35.0 V IRMS= 2.5 A	1	\$1.02	 SM_RADIAL_10BMM 160 mm²
8.	Coutx	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	1	\$0.02	 0805 7 mm²
9.	Crc	Samsung Electro-Mechanics	CL21C910JBANNNC Series= C0G/NP0	Cap= 91.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
10.	Css	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
11.	D1	Diodes Inc.	B540C-13-F	VF@Io= 550.0 mV VRRM= 40.0 V	1	\$0.17	 SMC 83 mm²
12.	L1	Coilcraft	MSS1210-153MEB	L= 15.0 µH DCR= 19.0 mOhm	1	\$0.81	 MSS1210 204 mm²
13.	M1	Texas Instruments	CSD16327Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	\$0.44	 TRANS_NexFET_Q3 18 mm²
14.	Rcomp	Vishay-Dale	CRCW040271K5FKED Series= CRCW..e3	Res= 71.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
15.	Rfb1	Vishay-Dale	CRCW04021K87FKED Series= CRCW..e3	Res= 1.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
16.	Rfb2	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
17.	Rg	Vishay-Dale	CRCW040217R4FKED Series= CRCW..e3	Res= 17.4 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
18.	Riflt	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
19.	Rrc	Vishay-Dale	CRCW0402604KFKED Series= CRCW..e3	Res= 604.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	NA	 0402 3 mm²
20.	Rsense	Susumu Co Ltd	PRL1632-R013-F-T1 Series= PRL1632	Res= 13.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	NA	 0612 11 mm²
21.	U1	Texas Instruments	TPS40210DGQR	Switcher	1	\$0.80	 S-PDSO-G10 24 mm²

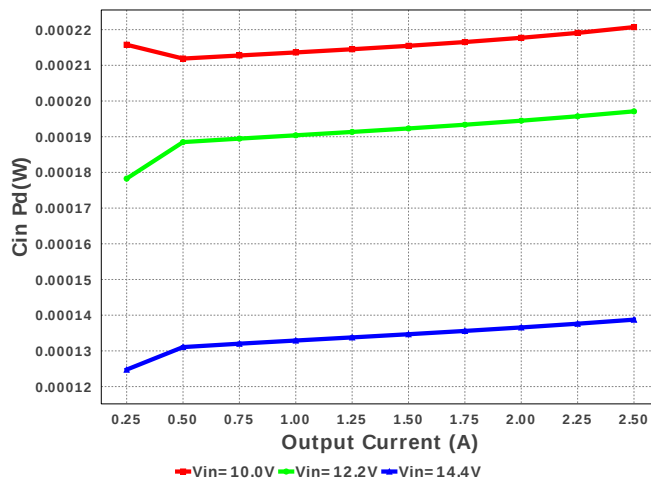




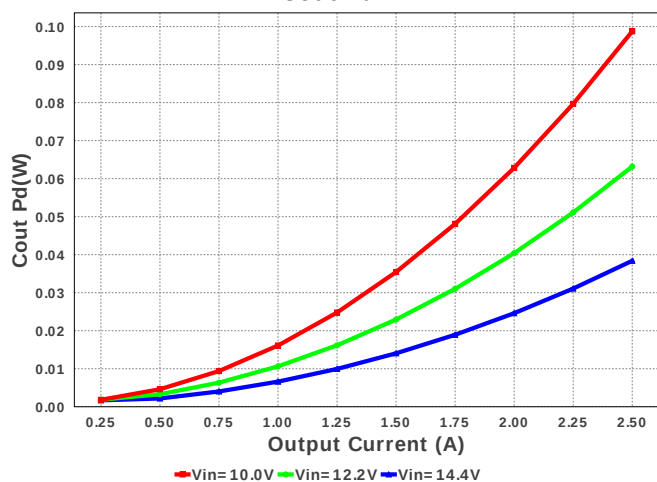
M1 PdCond



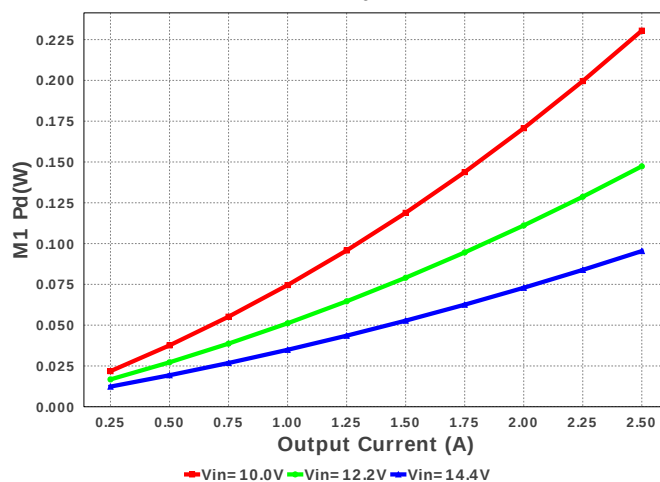
Cin Pd



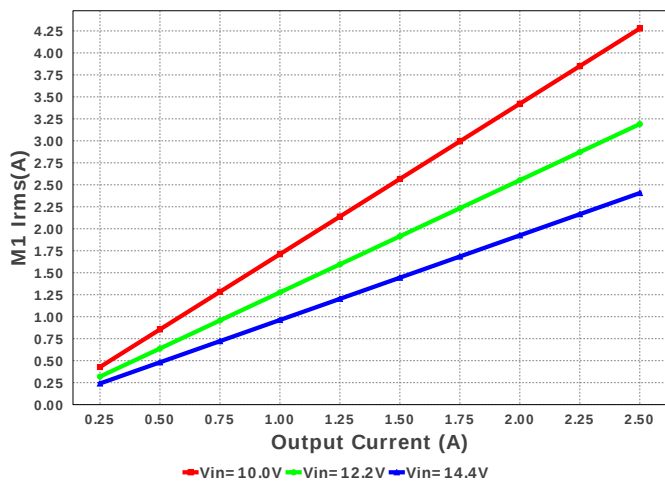
Cout Pd



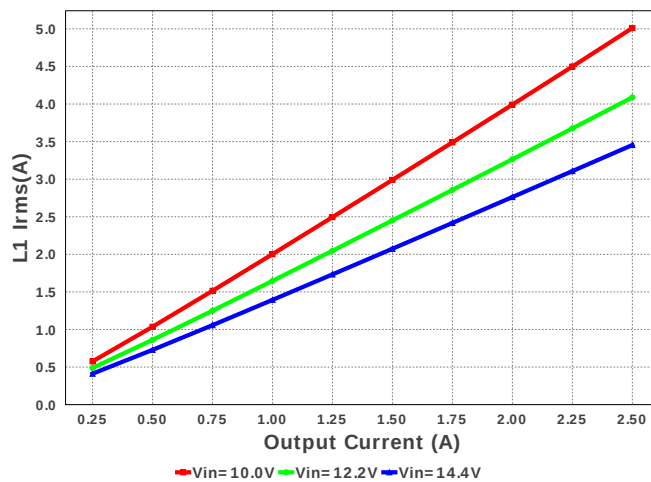
M1 Pd

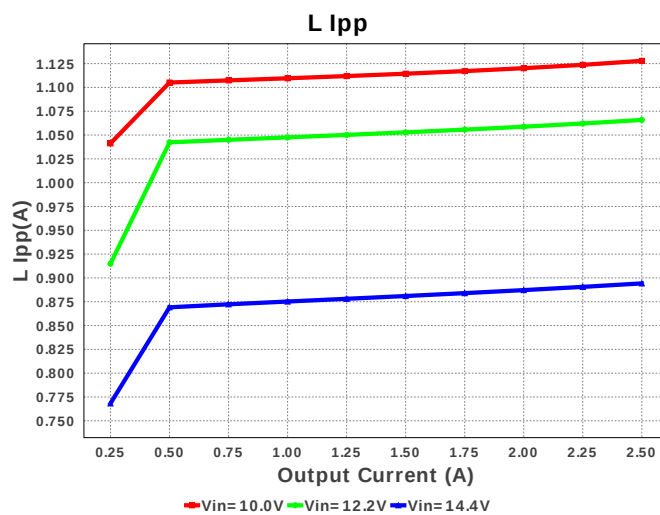
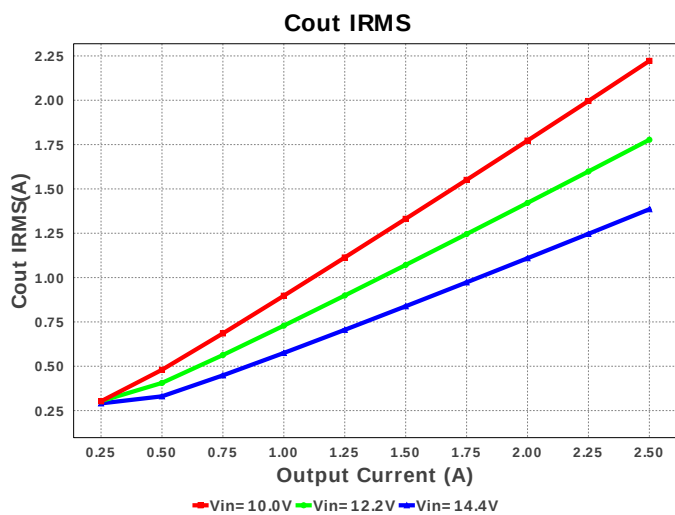
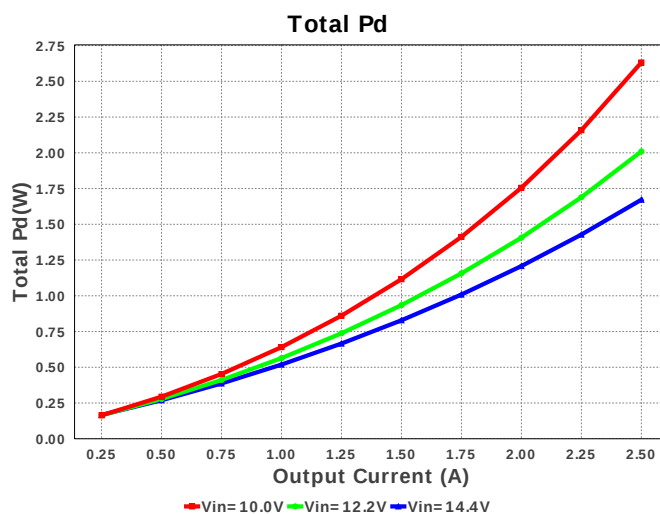
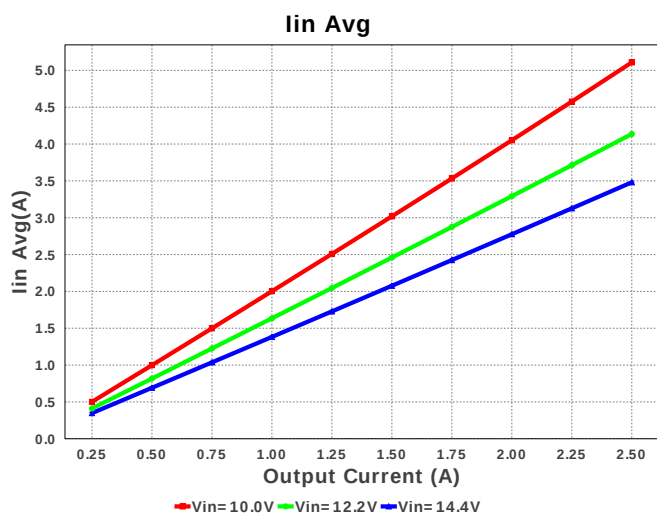
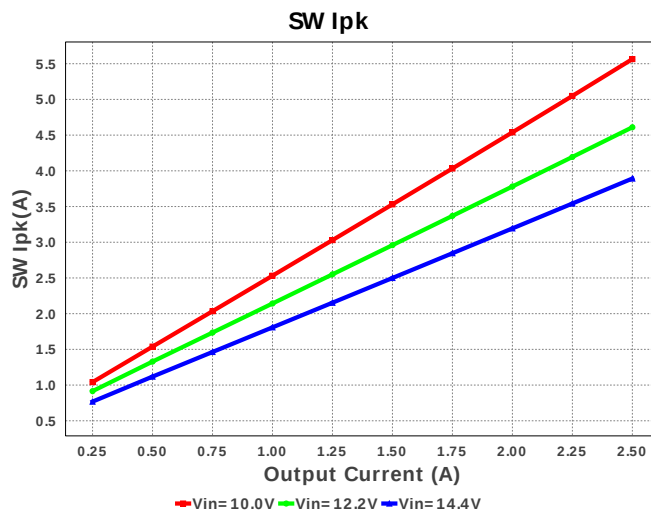
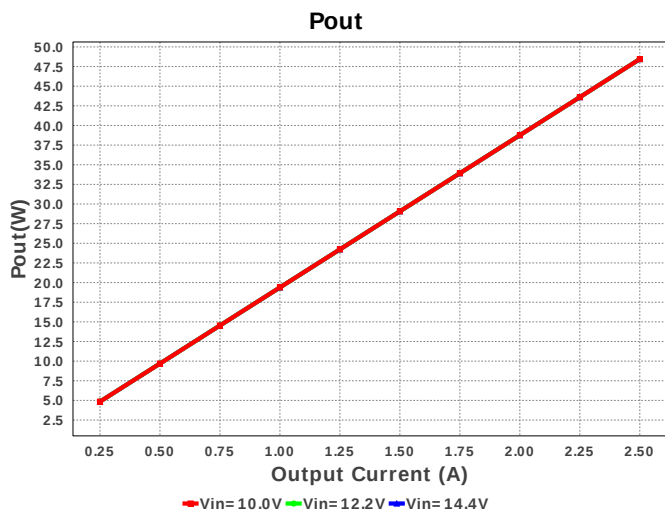


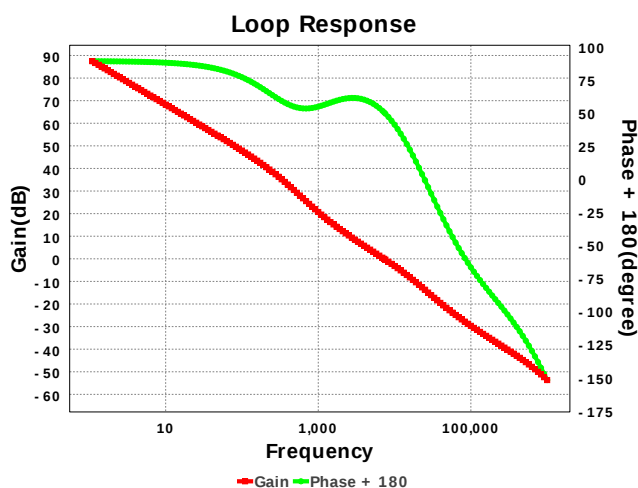
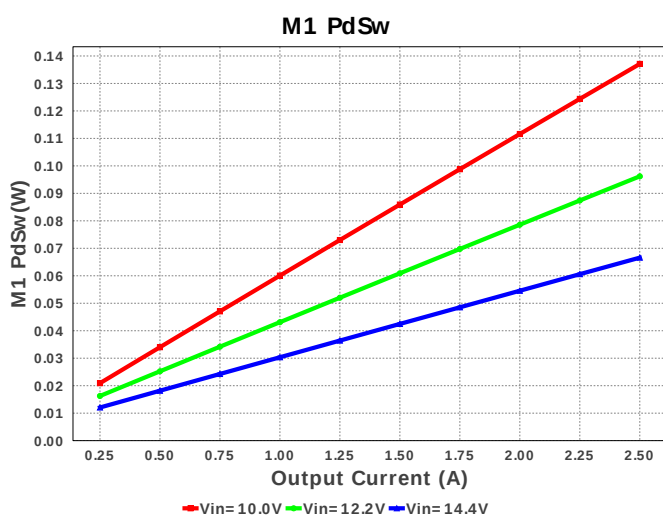
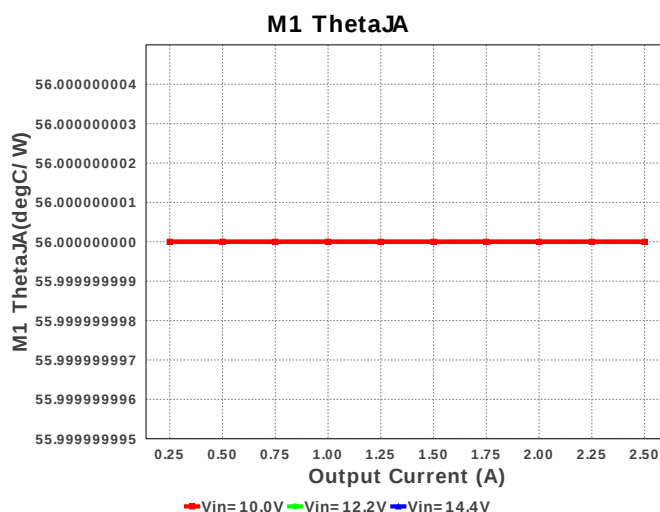
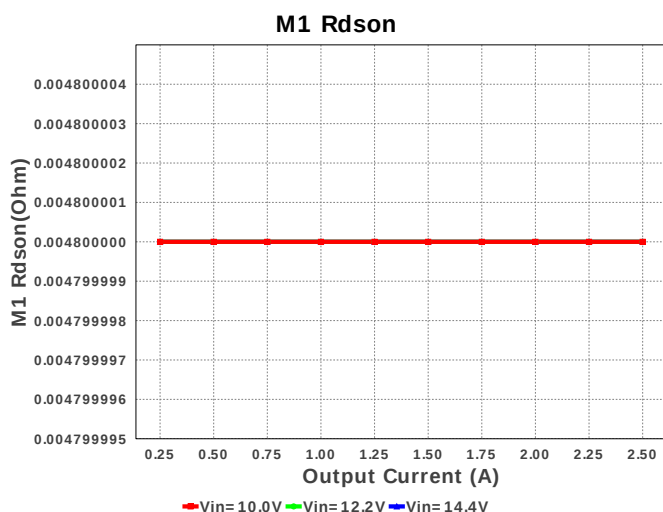
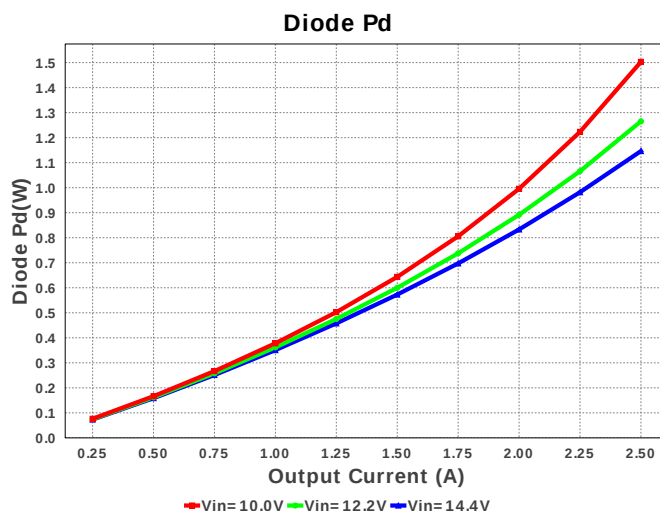
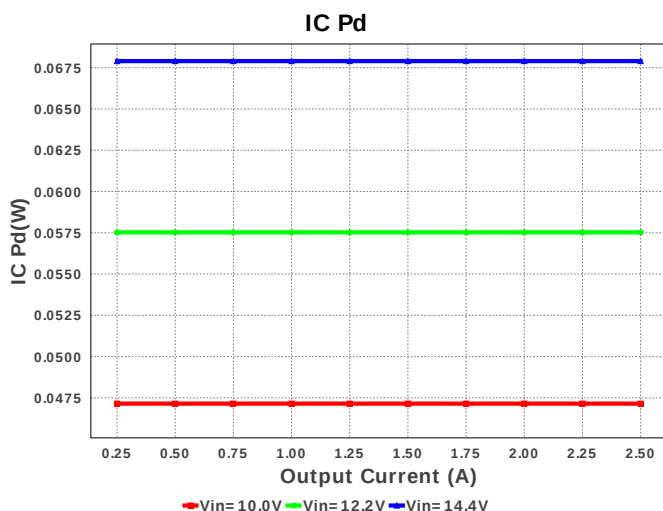
M1 Irms



L1 Irms







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	348.833 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	2.193 A	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	262.944 mA	Current	Output capacitor _x RMS ripple current
4.	Iin Avg	4.973 A	Current	Average input current
5.	L Ipp	1.208 A	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	4.9 A	Current	Inductor ripple current
7.	M1 Irms	4.161 A	Current	M1 MOSFET Irms
8.	SW Ipk	5.492 A	Current	Peak switch current
9.	BOM Count	21	General	Total Design BOM count
10.	FootPrint	576.0 mm ²	General	Total Foot Print Area of BOM components
11.	Frequency	272.12 kHz	General	Switching frequency

#	Name	Value	Category	Description
12.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
13.	M1 Rdson	4.8 mOhm	General	Drain-Source On-resistance
14.	M1 ThetaJA	56.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
15.	Pout	47.5 W	General	Total output power
16.	Total BOM	\$0.0	General	Total BOM Cost
17.	D1 Tj	98.75 degC	Op_Point	D1 junction temperature
18.	Low Freq Gain	88.224 dB	Op_Point	Gain at 10Hz
19.	Vout Actual	19.379 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
20.	Vout OP	19.379 V	Op_Point	Operational Output Voltage
21.	Cross Freq	5.526 kHz	Op_point	Bode plot crossover frequency
22.	Duty Cycle	49.733 %	Op_point	Duty cycle
23.	Efficiency	95.513 %	Op_point	Steady state efficiency
24.	Gain Marg	-11.184 dB	Op_point	Bode Plot Gain Margin
25.	IC Tj	32.624 degC	Op_point	IC junction temperature
26.	ICThetaJA	57.7 degC/W	Op_point	IC junction-to-ambient thermal resistance
27.	IOUT_OP	2.5 A	Op_point	Iout operating point
28.	M1 TjOP	41.641 degC	Op_point	M1 MOSFET junction temperature
29.	Phase Marg	53.963 deg	Op_point	Bode Plot Phase Margin
30.	VIN_OP	10.0 V	Op_point	Vin operating point
31.	Vout p-p	141.255 mV	Op_point	Peak-to-peak output ripple voltage
32.	Cin Pd	253.347 μW	Power	Input capacitor power dissipation
33.	Cout Pd	96.207 mW	Power	Output capacitor power dissipation
34.	Coutx Pd	138.279 μW	Power	Output capacitor_x power loss
35.	Diode Pd	1.375 W	Power	Diode power dissipation
36.	IC Pd	45.477 mW	Power	IC power dissipation
37.	L Pd	547.413 mW	Power	Inductor power dissipation
38.	M1 Pd	207.873 mW	Power	M1 MOSFET total power dissipation
39.	M1 PdCond	87.982 mW	Power	M1 MOSFET conduction losses
40.	M1 PdSw	119.892 mW	Power	M1 MOSFET switching losses
41.	Rfb Pd	6.973 mW	Power	Rfb Power Dissipation
42.	Total Pd	2.231 W	Power	Total Power Dissipation
43.	Vout Tolerance	3.404 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.5	Maximum Output Current
2.	VinMax	14.4	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	19.0	Output Voltage
5.	base_pn	TPS40210	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS40210** Product Folder : <http://www.ti.com/product/TPS40210> : contains the data sheet and other resources.

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