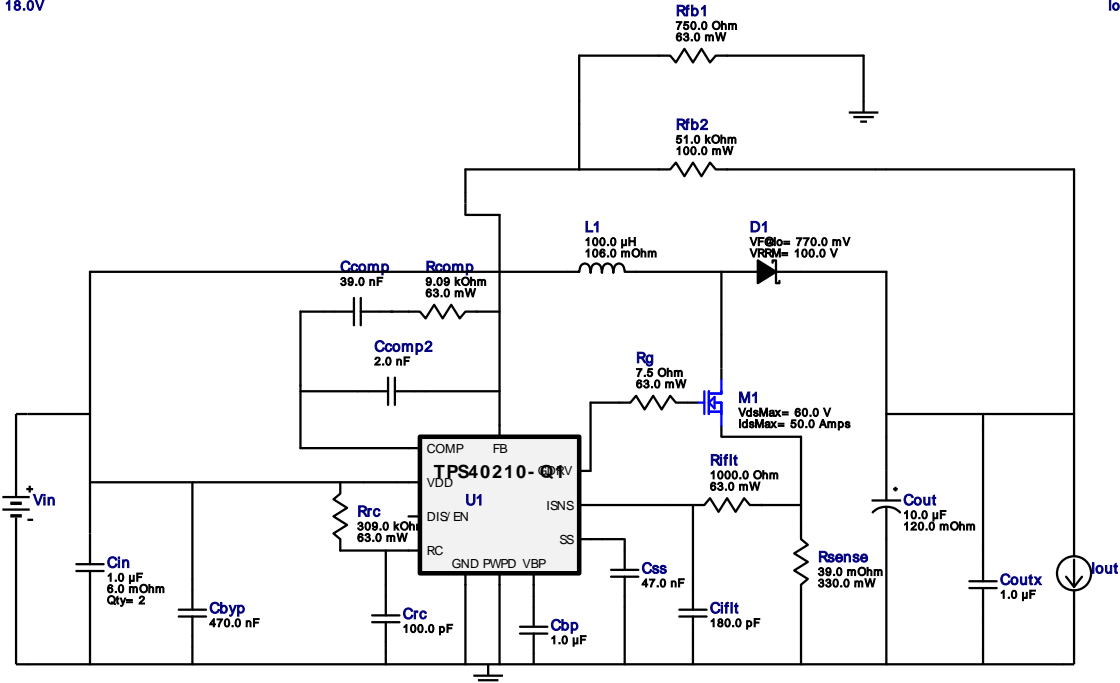


## WEBENCH<sup>®</sup> Design Report

 Design : 4410573/13 TPS40210QDGQRQ1  
 TPS40210QDGQRQ1 9.0V-18.0V to 48.30V @ 0.3A

 VinMin = 9.0V  
 VinMax = 18.0V

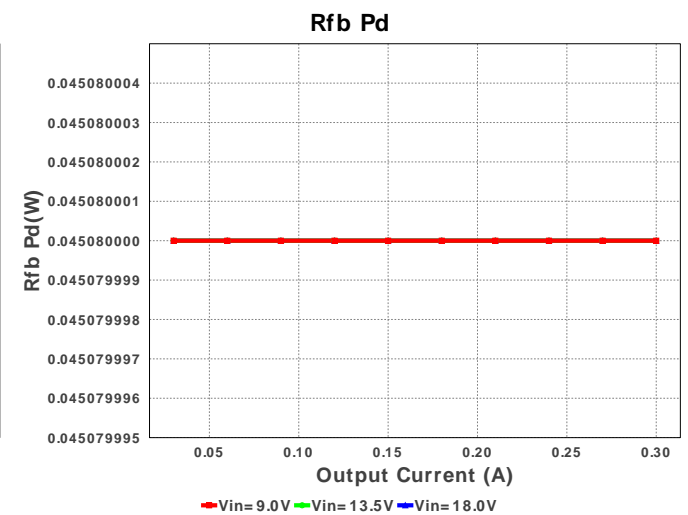
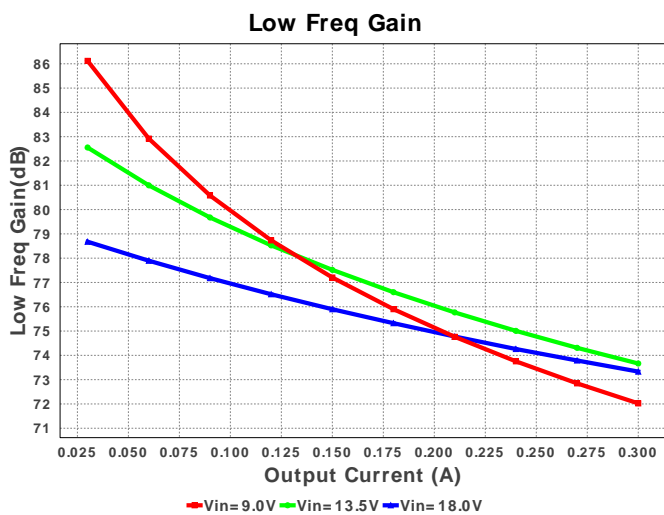
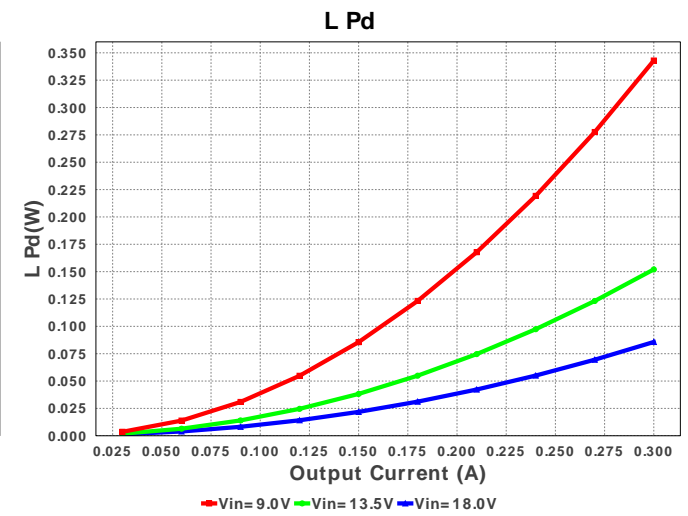
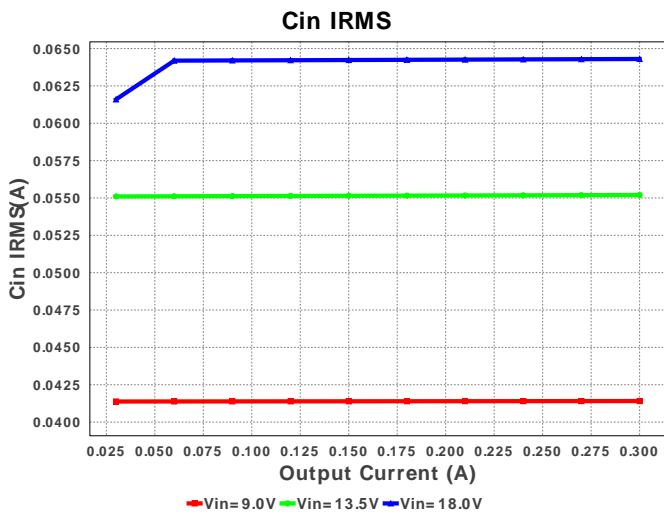
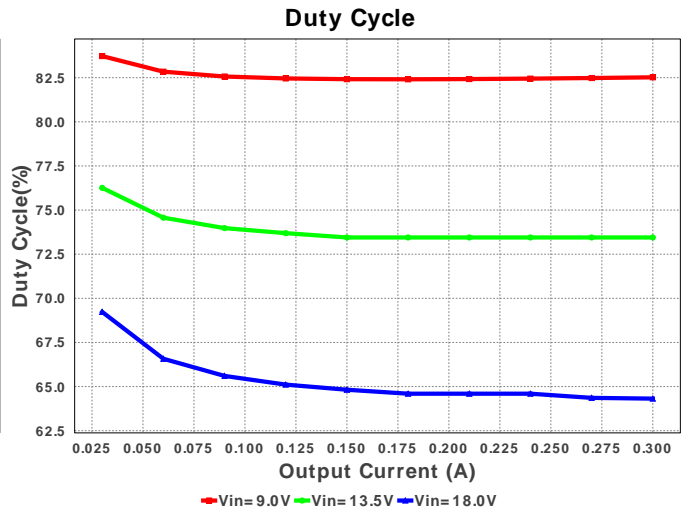
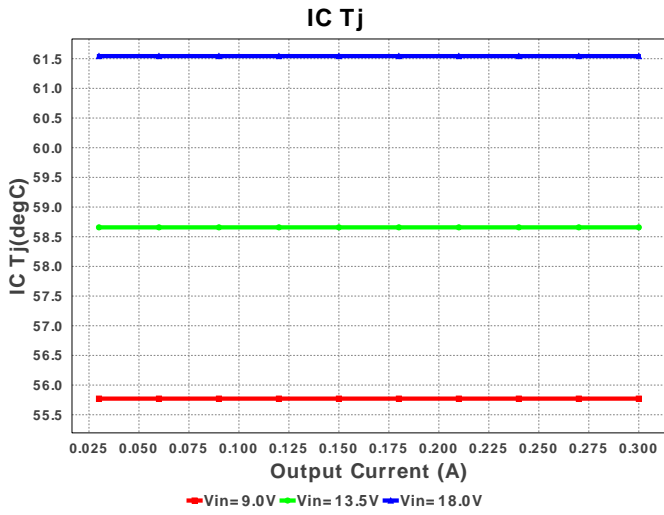
 Vout = 48.0V  
 Iout = 0.3A


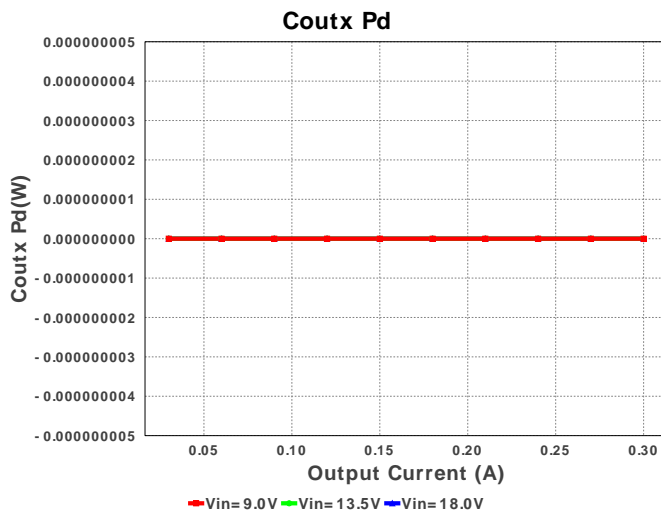
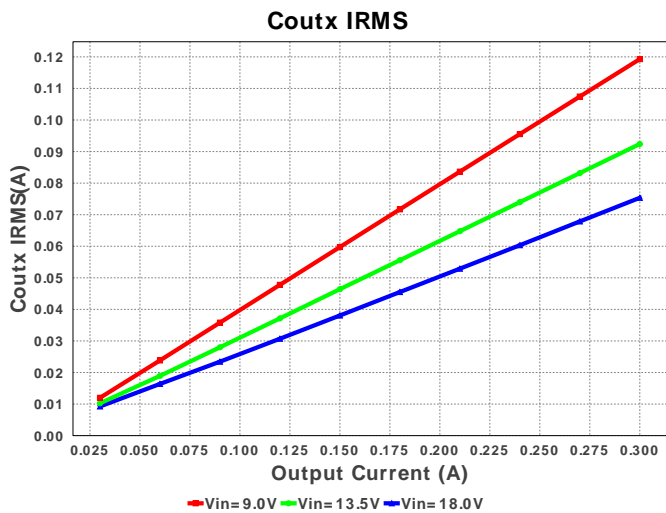
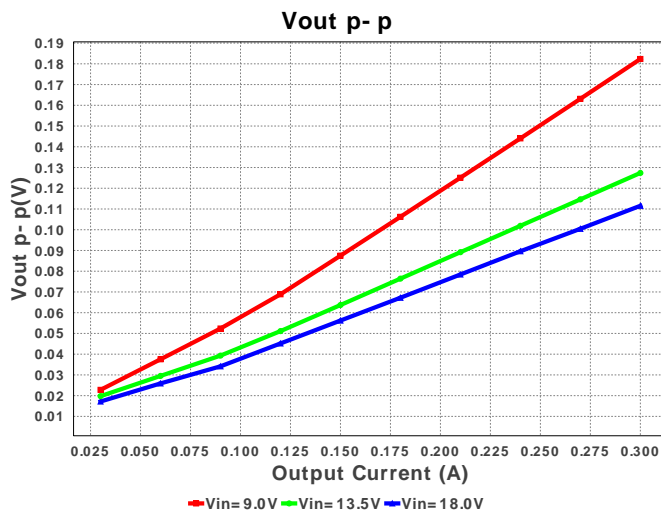
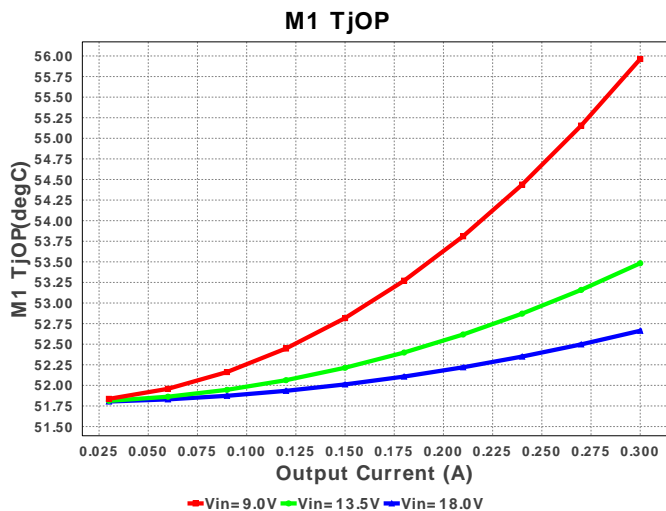
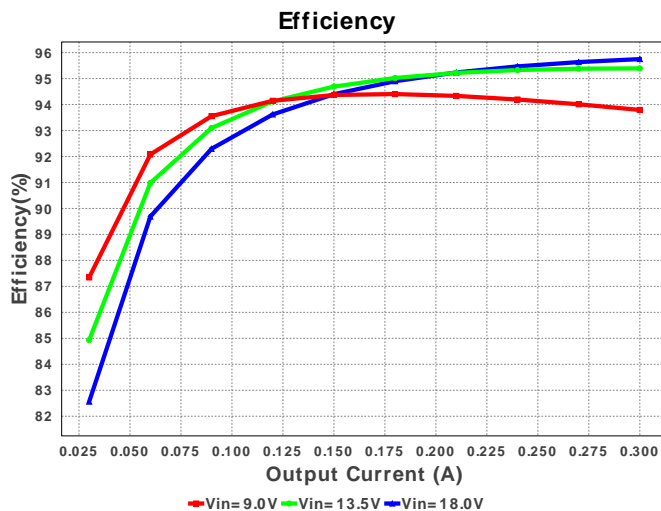
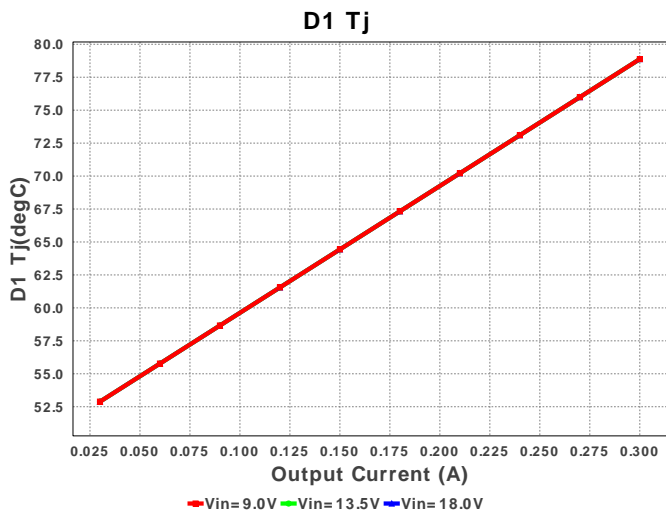
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. View WEBENCH(R) Disclaimer.

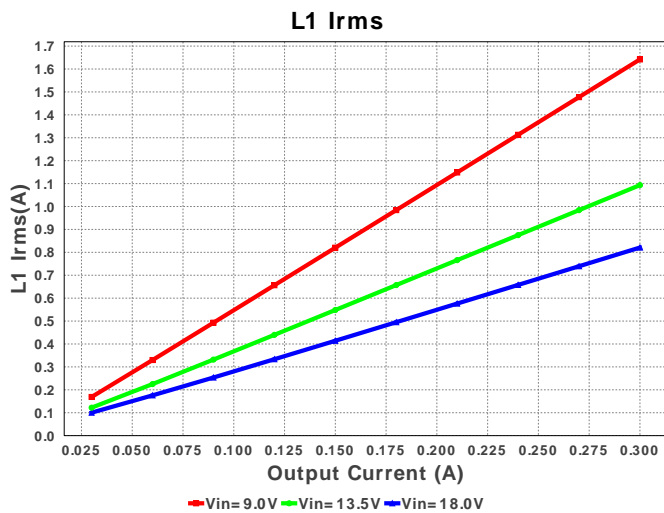
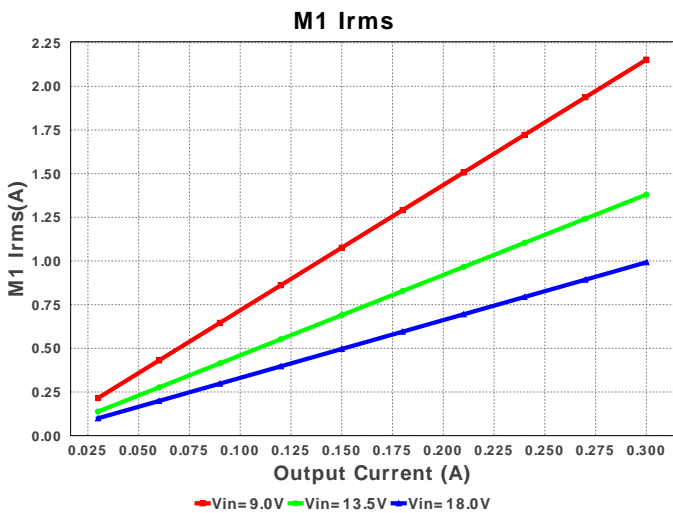
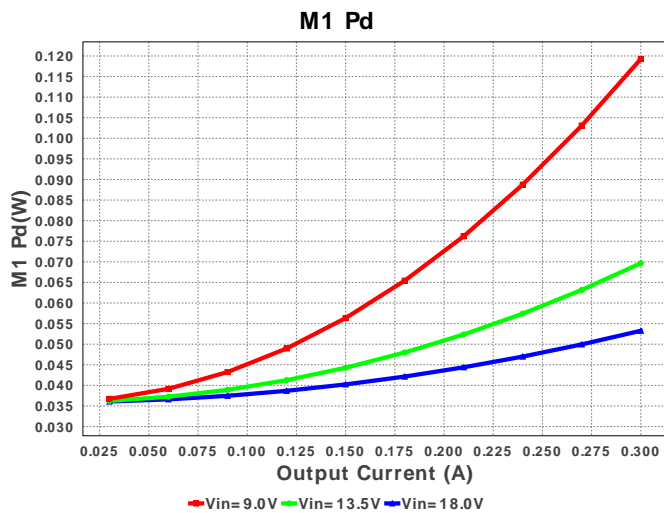
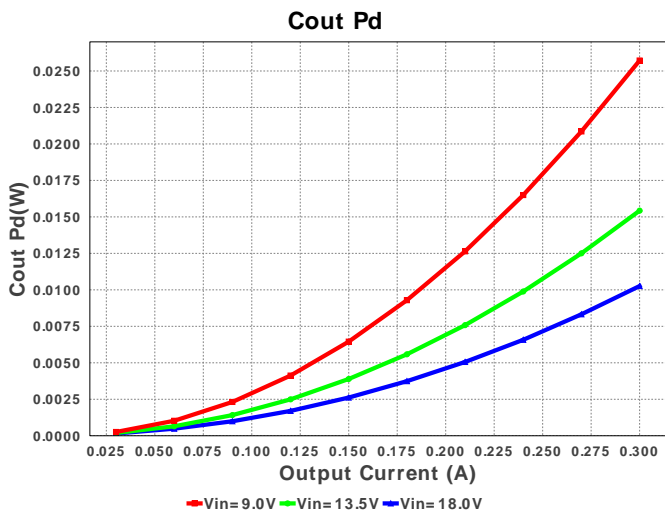
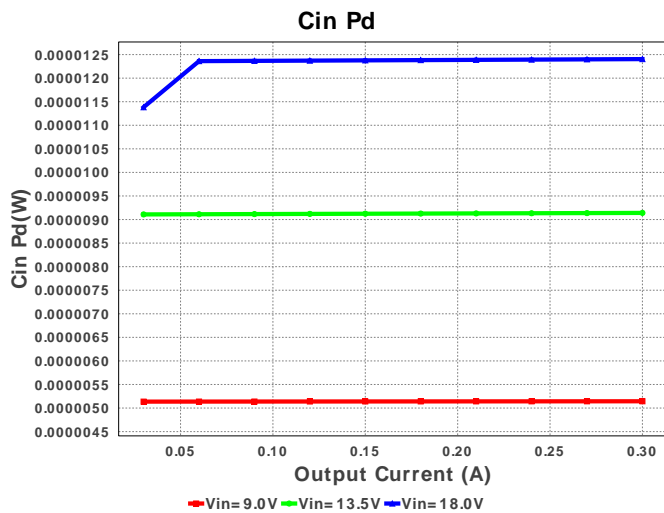
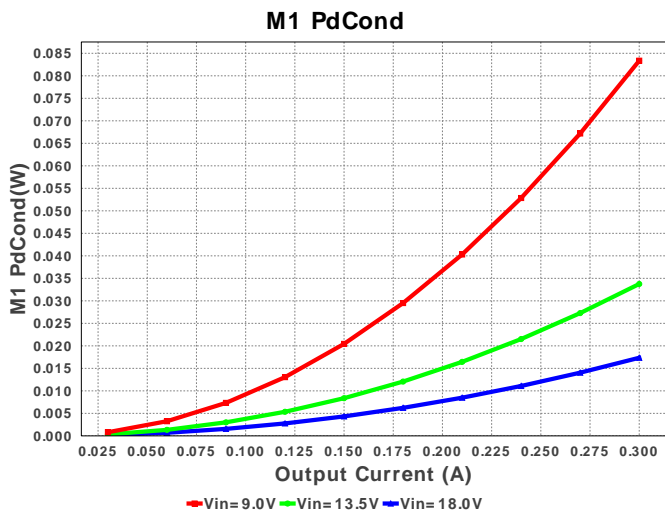
### Electrical BOM

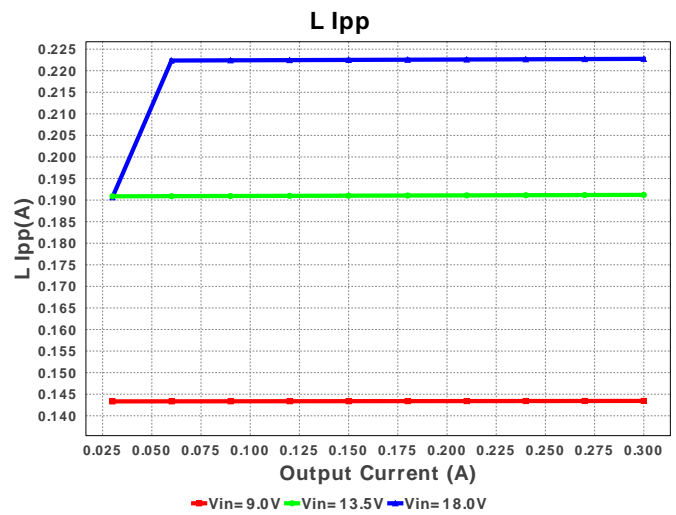
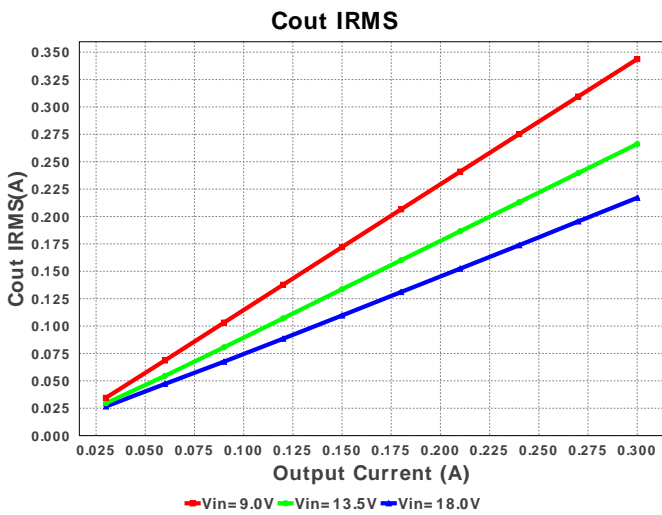
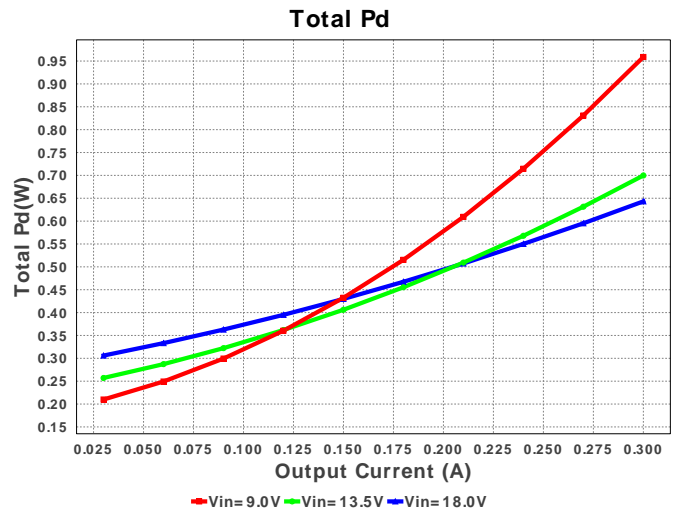
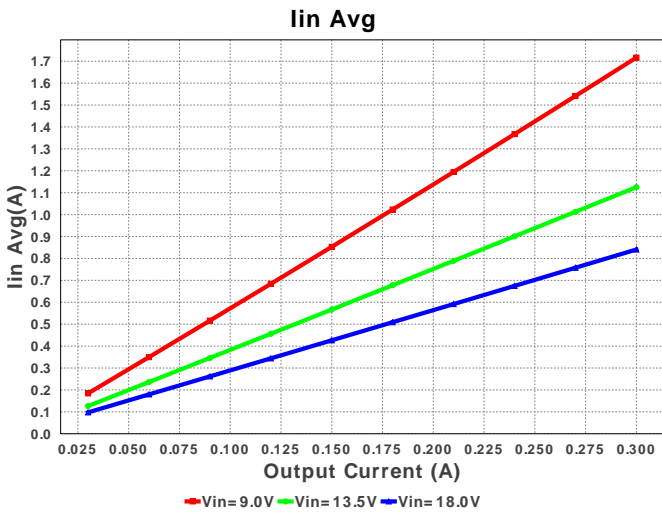
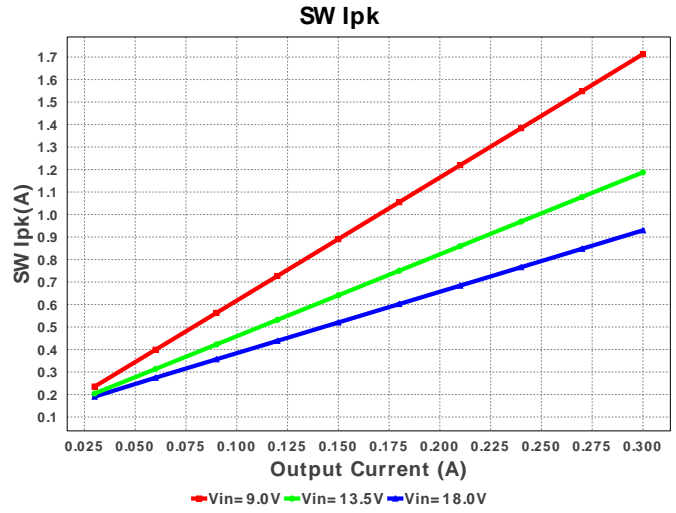
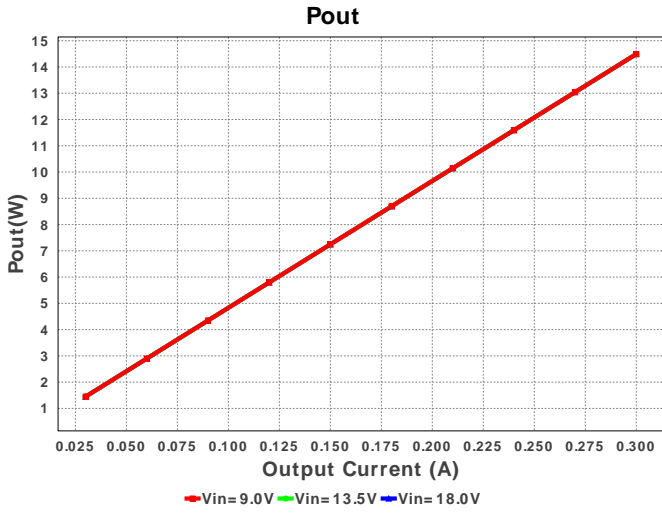
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbp	MuRata	GRM21BR61C105KA01L Series= X5R	Cap= 1.0 uF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm <sup>2</sup>
2.	Cbyp	Taiyo Yuden	TMK212BJ474KD-T Series= X5R	Cap= 470.0 nF VDC= 20.0 V IRMS= 0.0 A	1	\$0.02	0805 7 mm <sup>2</sup>
3.	Ccomp	MuRata	GRM155R61A393KA01D Series= X5R	Cap= 39.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
4.	Ccomp2	MuRata	GRM2165C1H202JA01D Series= C0G/NP0	Cap= 2.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.03	0805 7 mm <sup>2</sup>
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 <sup>2</sup>
6.	Cin	MuRata	GRM219R71E105KA88D Series= X7R	Cap= 1.0 uF ESR= 6.0 mOhm VDC= 25.0 V IRMS= 3.87 A	2	\$0.04	0805 7 mm <sup>2</sup>

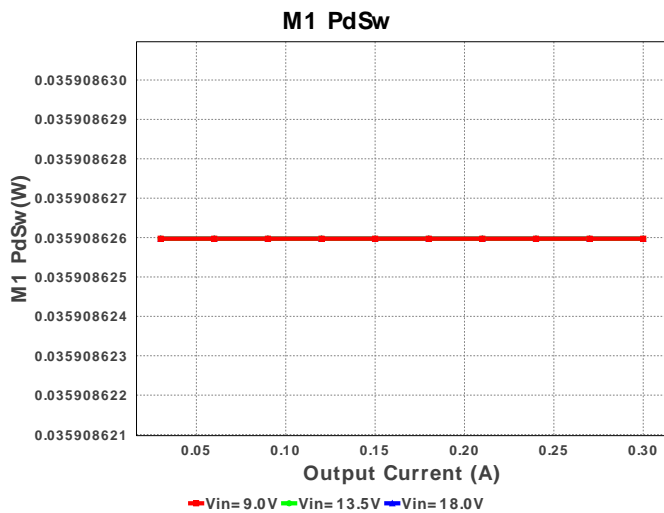
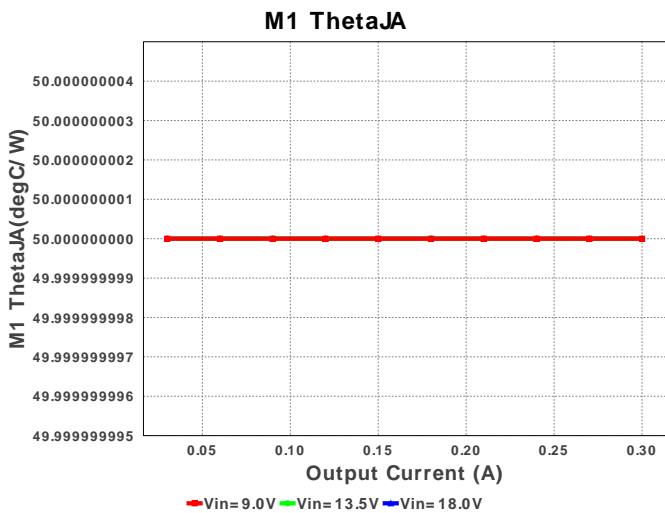
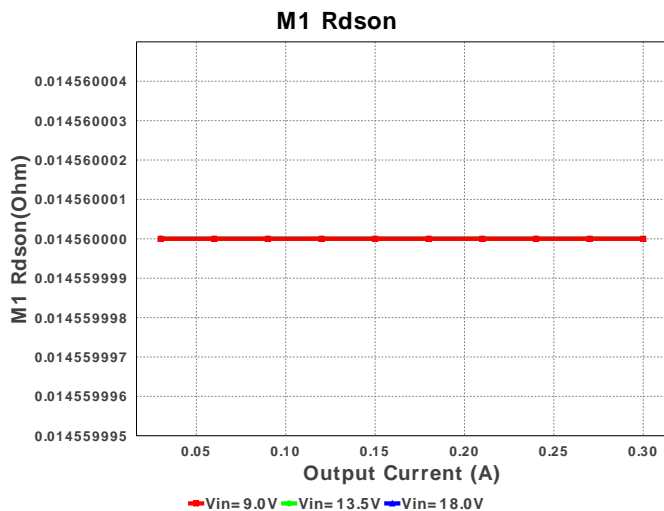
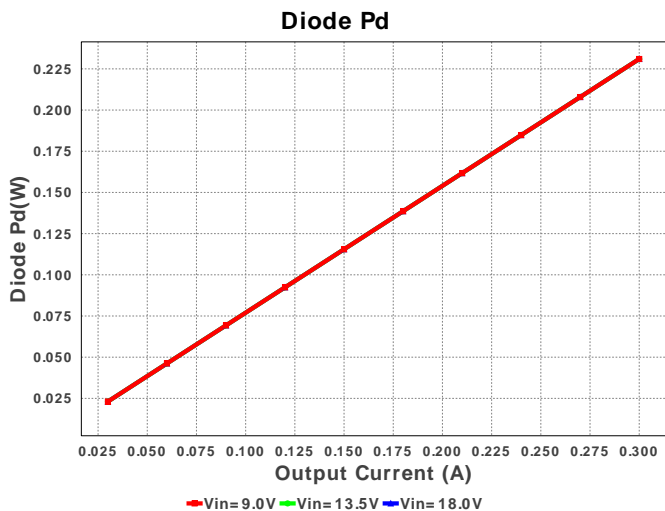
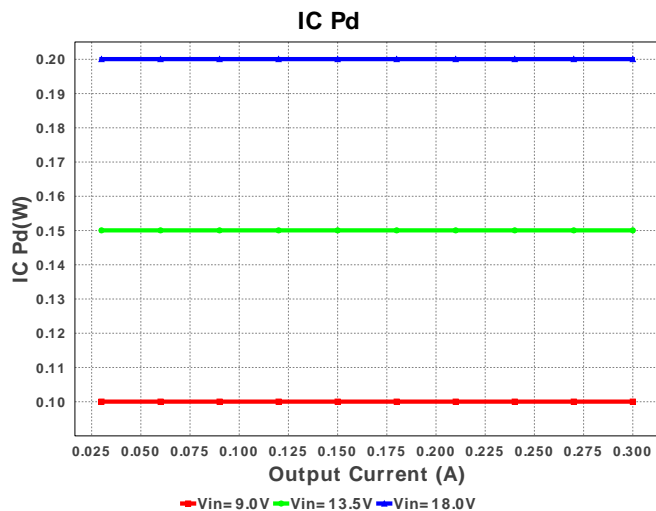
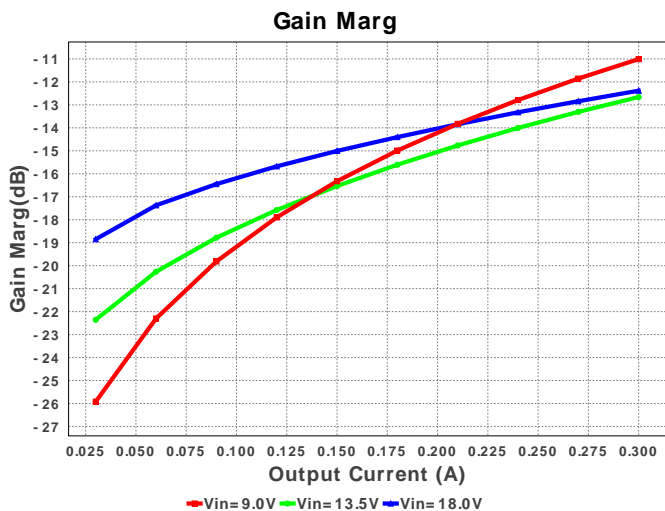
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cout	Panasonic	EEHZA1J100P Series= 1267	Cap= 10.0 uF ESR= 120.0 mOhm VDC= 63.0 V IRMS= 1.0 A	1	\$0.56	 SM_RADIAL_6.3AMM 80 mm²
8.	Coutx	MuRata	GRM31CR72A105KA01L Series= X7R	Cap= 1.0 uF VDC= 100.0 V IRMS= 0.0 A	1	\$0.12	 1206 11 mm²
9.	Crc	Samsung Electro-Mechanics	CL21C101JBANNNC Series= C0G/NP0	Cap= 100.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
10.	Css	MuRata	GRM155R61A473KA01D Series= X5R	Cap= 47.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
11.	D1	Diodes Inc.	DFLS1100-7	VF@Io= 770.0 mV VRRM= 100.0 V	1	\$0.14	 PowerD1123 13 mm²
12.	L1	Coilcraft	MSS1210-104KEB	L= 100.0 uH DCR= 106.0 mOhm	1	\$0.81	 MSS1210 204 mm²
13.	M1	Texas Instruments	CSD18537NQ5A	VdsMax= 60.0 V IdsMax= 50.0 Amps	1	\$0.46	 TRANS_NexFET_Q5A 55 mm²
14.	Rcomp	Vishay-Dale	CRCW04029K09FKED Series= CRCW..e3	Res= 9.09 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
15.	Rfb1	Vishay-Dale	CRCW0402750RFKED Series= CRCW..e3	Res= 750.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
16.	Rfb2	Susumu Co Ltd	RR1220P-513-D Series= 264	Res= 51.0 kOhm Power= 100.0 mW Tolerance= 0.5%	1	\$0.01	 0805 7 mm²
17.	Rg	Vishay-Dale	CRCW04027R50FKED Series= CRCW..e3	Res= 7.5 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
18.	Rift	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	CRCW0402309KFKED Series= CRCW..e3	Res= 309.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
20.	Rsense	Panasonic	ERJ-L14KF39MU Series= 232	Res= 39.0 mOhm Power= 330.0 mW Tolerance= 1.0%	1	\$0.11	 1210 15 mm²
21.	U1	Texas Instruments	TPS40210QDGQRQ1	Switcher	1	\$0.94	 S-PDSO-G10 24 mm²

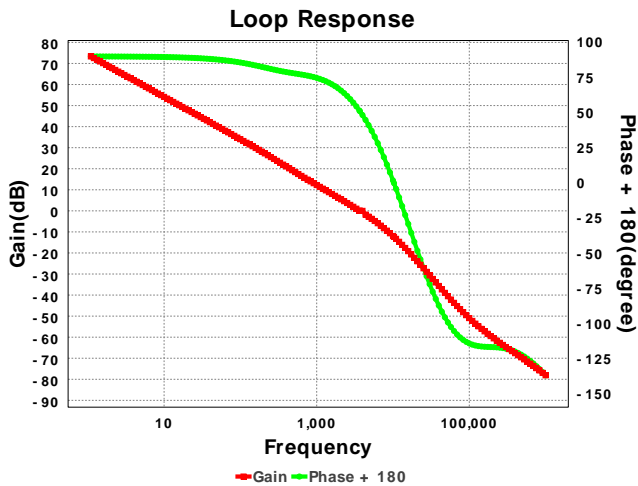












## Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	41.496 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	342.646 mA	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	119.104 mA	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	1.692 A	Current	Average input current
5.	L Ipp	143.75 mA	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	1.626 A	Current	Inductor ripple current
7.	M1 Irms	2.134 A	Current	M1 MOSFET Irms
8.	SW Ipk	1.698 A	Current	Peak switch current
9.	BOM Count	22	General	Total Design BOM count
10.	FootPrint	477.0 mm <sup>2</sup>	General	Total Foot Print Area of BOM components
11.	Frequency	512.777 kHz	General	Switching frequency
12.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
13.	M1 Rdson	14.56 mOhm	General	Drain-Source On-resistance
14.	M1 ThetaJA	50.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
15.	Pout	14.4 W	General	Total output power
16.	Total BOM	\$3.38	General	Total BOM Cost
17.	D1 Tj	78.875 degC	Op_Point	D1 junction temperature
18.	Low Freq Gain	72.098 dB	Op_Point	Gain at 10Hz
19.	Vout OP	48.3 V	Op_Point	Operational Output Voltage
20.	Cross Freq	2.034 kHz	Op_point	Bode plot crossover frequency
21.	Duty Cycle	82.188 %	Op_point	Duty cycle
22.	Efficiency	94.555 %	Op_point	Steady state efficiency
23.	Gain Marg	-11.145 dB	Op_point	Bode Plot Gain Margin
24.	IC Tj	55.813 degC	Op_point	IC junction temperature
25.	ICThetaJA	57.7 degC/W	Op_point	IC junction-to-ambient thermal resistance
26.	IOUT_OP	300.0 mA	Op_point	Iout operating point
27.	M1 TjOP	55.896 degC	Op_point	M1 MOSFET junction temperature
28.	Phase Marg	54.917 deg	Op_point	Bode Plot Phase Margin
29.	VIN_OP	9.0 V	Op_point	Vin operating point
30.	Vout p-p	179.255 mV	Op_point	Peak-to-peak output ripple voltage
31.	Cin Pd	5.166 μW	Power	Input capacitor power dissipation
32.	Cout Pd	25.586 mW	Power	Output capacitor power dissipation
33.	Coutx Pd	0.0 W	Power	Output capacitor_x power loss
34.	Diode Pd	231.0 mW	Power	Diode power dissipation
35.	IC Pd	100.746 mW	Power	IC power dissipation
36.	L Pd	336.382 mW	Power	Inductor power dissipation
37.	M1 Pd	117.926 mW	Power	M1 MOSFET total power dissipation
38.	M1 PdCond	81.874 mW	Power	M1 MOSFET conduction losses
39.	M1 PdSw	36.052 mW	Power	M1 MOSFET switching losses
40.	Rfb Pd	44.522 mW	Power	Rfb Power Dissipation
41.	Total Pd	829.214 mW	Power	Total Power Dissipation

## Design Inputs

#	Name	Value	Description
1.	Iout	300.0 m	Maximum Output Current
2.	Iout1	300.0 m	Output Current #1
3.	VinMax	18.0	Maximum input voltage
4.	VinMin	9.0	Minimum input voltage
5.	Vout	48.0	Output Voltage
6.	Vout1	48.0	Output Voltage #1
7.	base_pn	TPS40210-Q1	Base Product Number



#	Name	Value	Description
8.	source	DC	Input Source Type
9.	Ta	50.0	Ambient temperature

## Design Assistance

1. The TPS40210-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

2. **TPS40210-Q1** Product Folder : <http://www.ti.com/product/TPS40210%2DQ1> : 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](#).