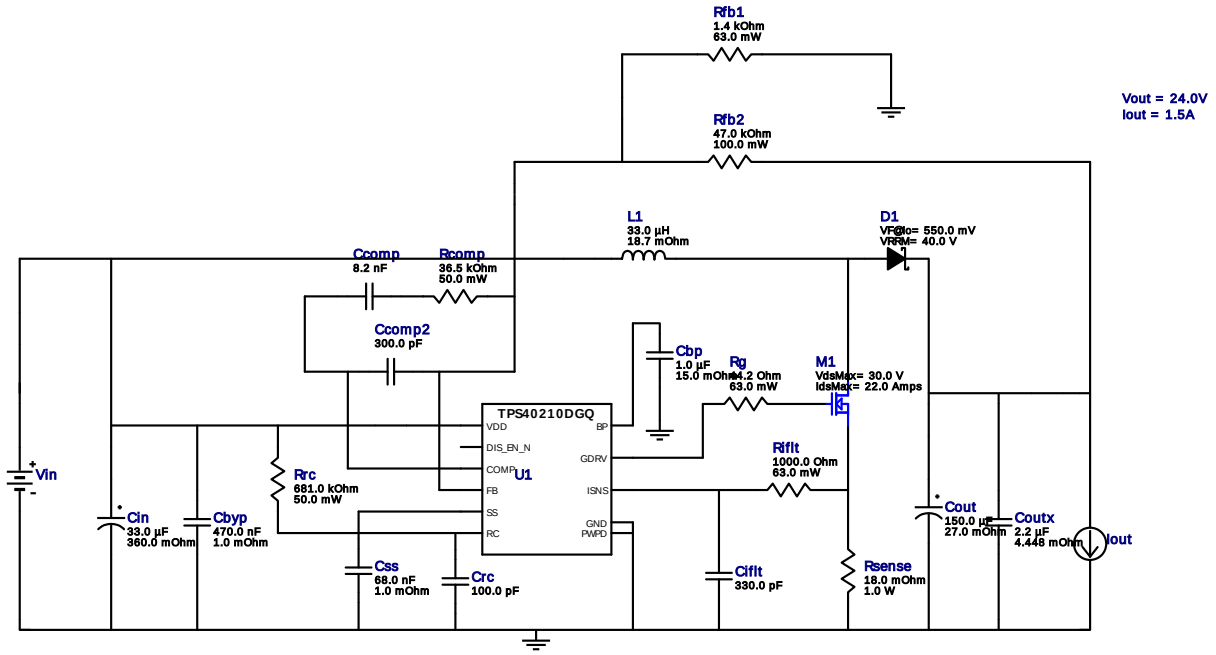
WEBENCH® Design Report

VinMin = 10.0V
VinMax = 19.0V
Vout = 24.0V
Iout = 1.5A

Device = TPS40210DGQR
Topology = Boost
Created = 2020-02-22 11:18:43.595
BOM Cost = $4.88
BOM Count = 21
Total Pd = 2.1W

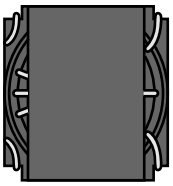
TPS40210DGQR 10V-19V to 24.00V @ 1.5A



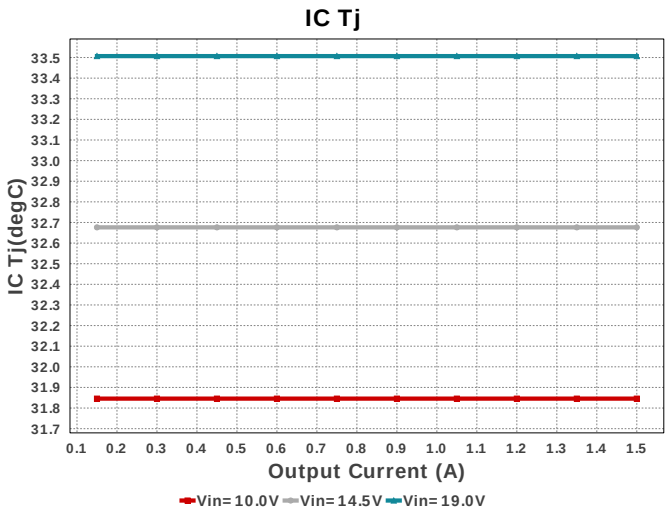
Electrical BOM

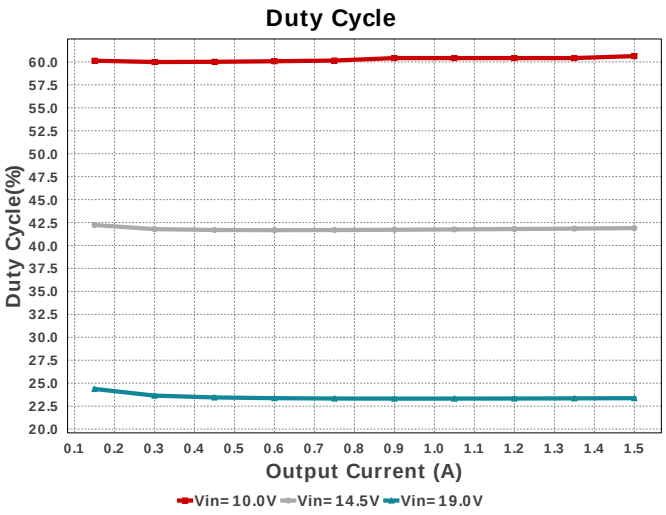
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbp	Kemet	C0805C105K4RACTU Series= X7R	Cap= 1.0 uF ESR= 15.0 mOhm VDC= 16.0 V IRMS= 8.19 A	1	$0.02	0805 7 mm²
2.	Cbyp	Taiyo Yuden	TMK212BJ474KD-T Series= X5R	Cap= 470.0 nF ESR= 1.0 mOhm VDC= 20.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
3.	Ccomp	TDK	C2012C0G1H822K060AA Series= C0G/NP0	Cap= 8.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm²
4.	Ccomp2	Samsung Electro-Mechanics	CL10C301JB8NNNC Series= C0G/NP0	Cap= 300.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
5.	Cifit	Samsung Electro-Mechanics	CL21C331JBANNNC Series= C0G/NP0	Cap= 330.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
6.	Cin	Panasonic	EEE-FK1V330P Series= FK	Cap= 33.0 uF ESR= 360.0 mOhm VDC= 35.0 V IRMS= 240.0 mA	1	$0.11	SM_RADIAL_D 84 mm²
7.	Cout	Panasonic	EEHZA1V151P Series= ZA	Cap= 150.0 uF ESR= 27.0 mOhm VDC= 35.0 V IRMS= 2.3 A	1	$1.08	SM_RADIAL_8MM 113 mm²
8.	Coutx	MuRata	GRM31CR61H225KA88L Series= X5R	Cap= 2.2 uF ESR= 4.448 mOhm VDC= 50.0 V IRMS= 2.2252 A	1	$0.10	1206_190 11 mm²

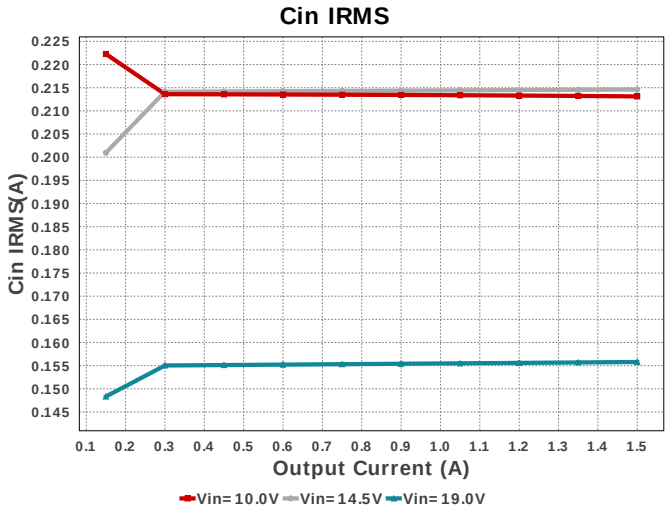
Copyright © 2020, Texas Instruments Incorporated

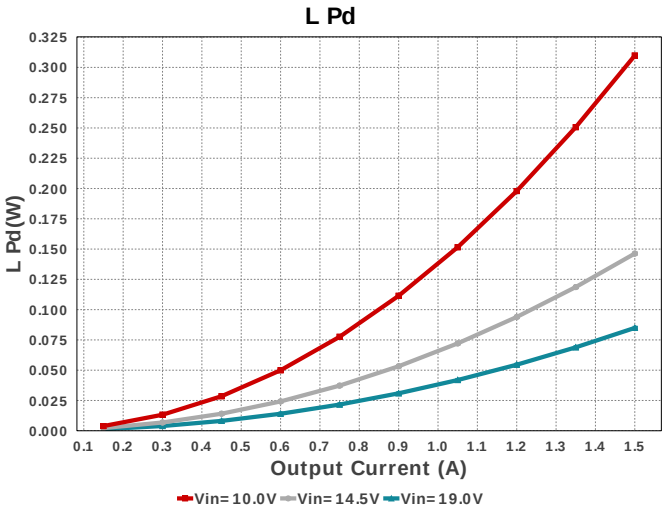
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Crc	Samsung Electro-Mechanics	CL21C101JBANNNC Series= C0G/NP0	Cap= 100.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm^2
10.	Css	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm^2
11.	D1	Fairchild Semiconductor	SS24FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.05	 SOD-123F 12 mm^2
12.	L1	Coilcraft	XAL1510-333MEB	L= 33.0 µH DCR= 18.7 mOhm	1	$2.27	 XAL1510 320 mm^2
13.	M1	Texas Instruments	CSD17571Q2	VdsMax= 30.0 V IdsMax= 22.0 Amps	1	$0.13	DQK0006C 9 mm^2
14.	Rcomp	Yageo	RC0201FR-0736K5L Series= ?	Res= 36500.0Ohm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	 0201 2 mm^2
15.	Rfb1	Vishay-Dale	CRCW04021K40FKED Series= CRCW..e3	Res= 1400.0Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
16.	Rfb2	Yageo	RC0603FR-0747KL Series= ?	Res= 47000.0Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm^2
17.	Rg	Vishay-Dale	CRCW040244R2FKED Series= CRCW..e3	Res= 44.2Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
18.	Riflt	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
19.	Rrc	Yageo	RC0201FR-07681KL Series= ?	Res= 681000.0Ohm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	 0201 2 mm^2
20.	Rsense	Susumu Co Ltd	PRL1632-R018-F-T1 Series= PRL1632	Res= 0.018Ohm Power= 1.0 W Tolerance= 1.0%	1	$0.20	 0612 11 mm^2
21.	U1	Texas Instruments	TPS40210DGQR	Switcher	1	$0.75	 S-PDSO-G10 24 mm^2

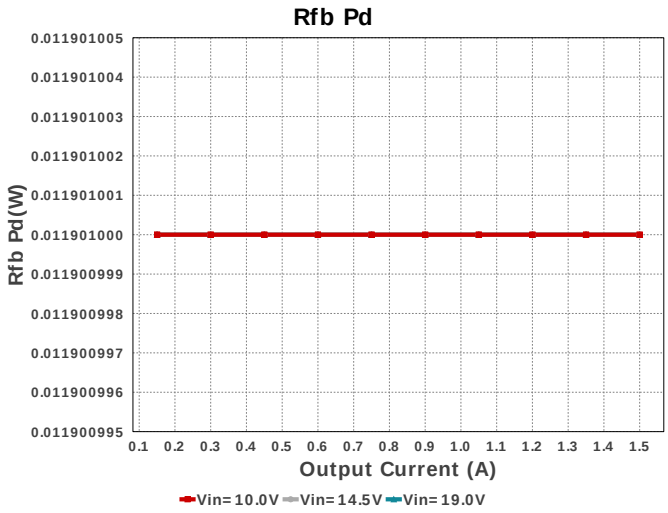
Copyright © 2020, Texas Instruments Incorporated

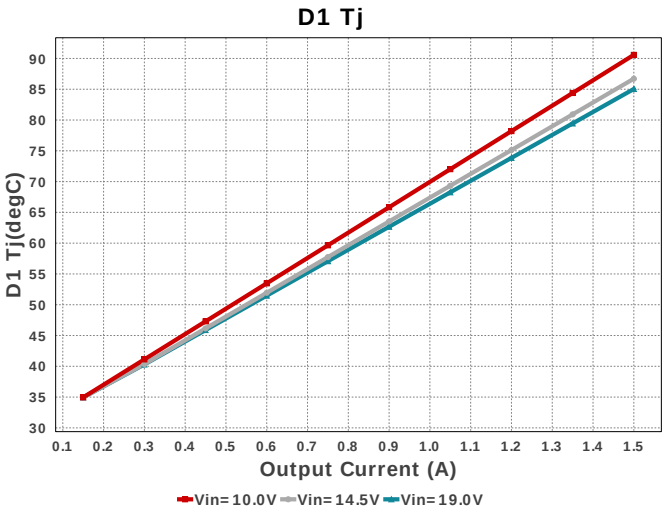






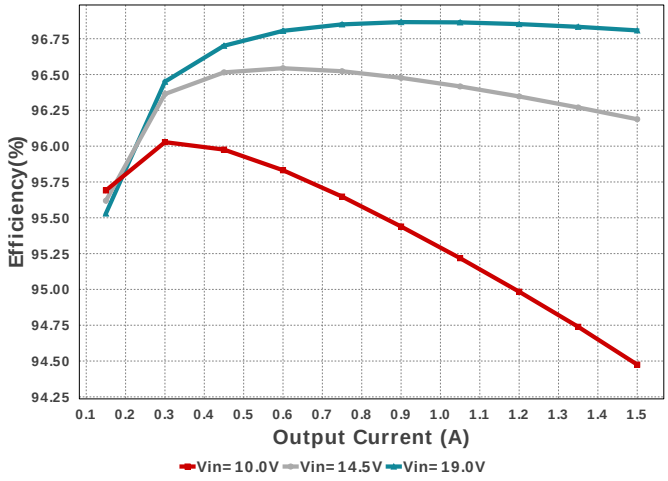




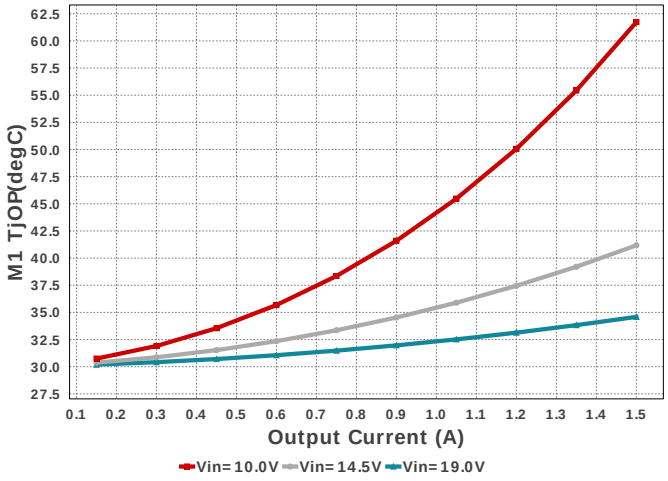


Copyright © 2020, Texas Instruments Incorporated

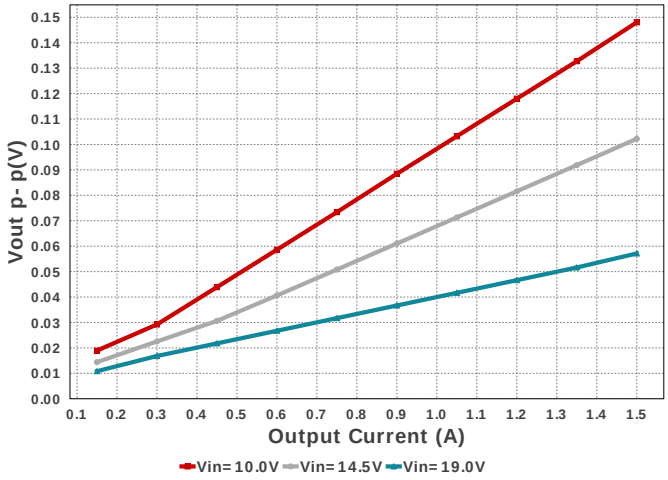
Efficiency



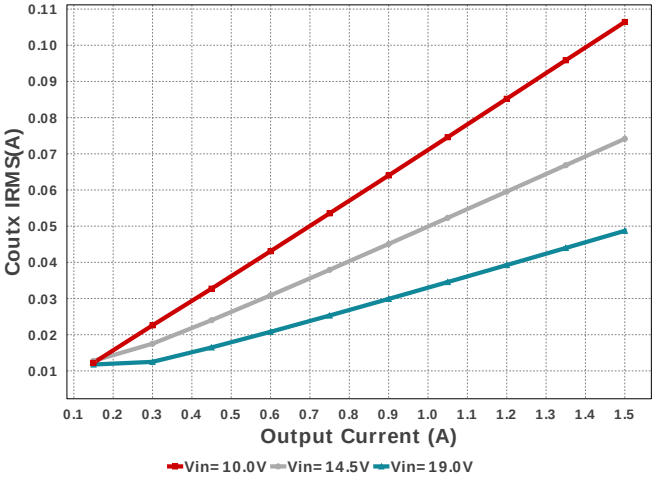
M1 TjOP



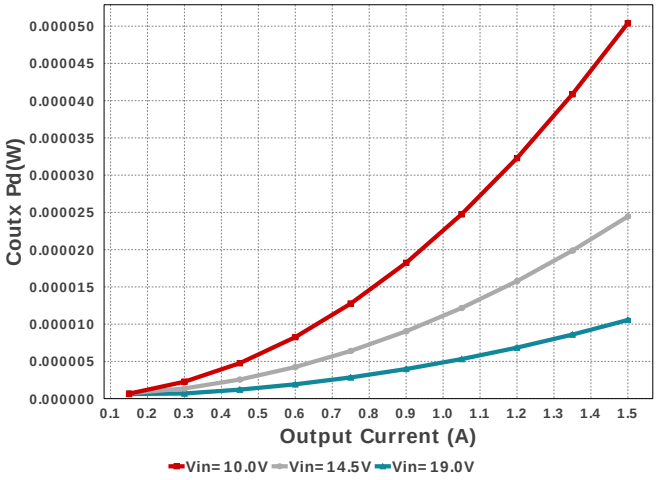
Vout p- p



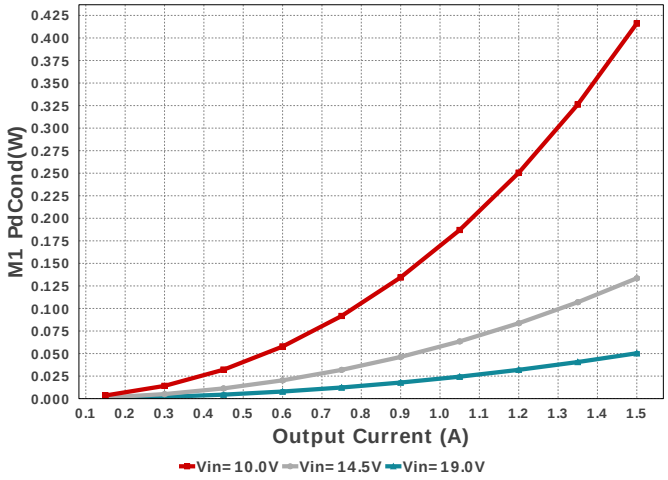
Coutx IRMS



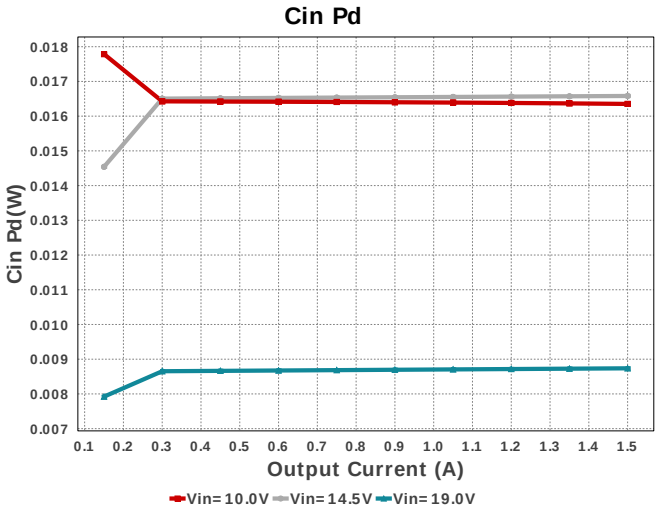
Coutx Pd

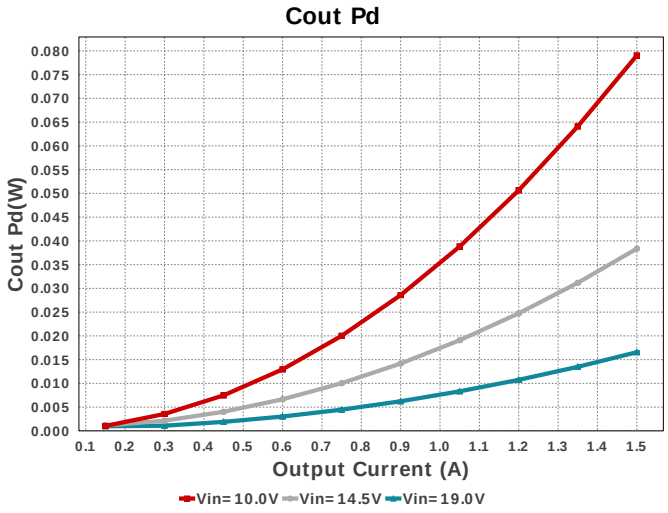


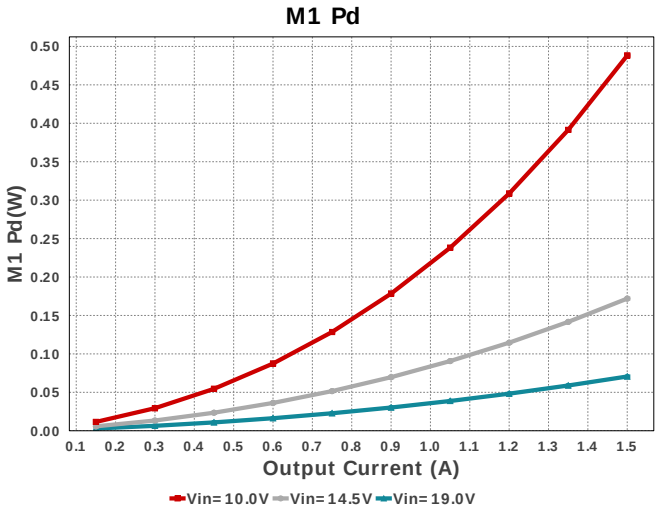
M1 PdCond

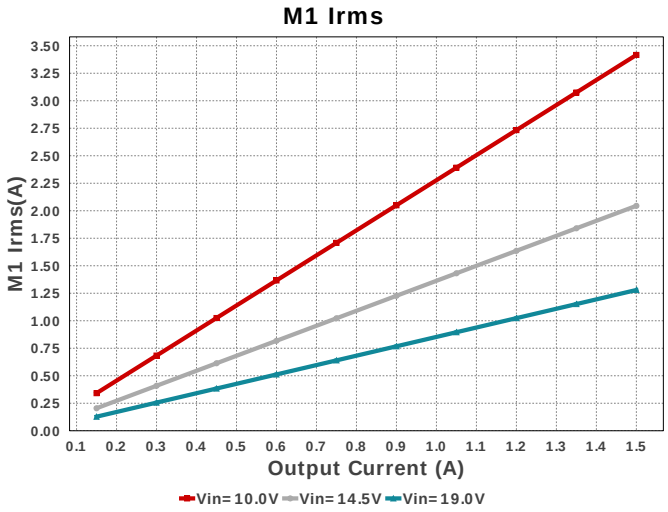


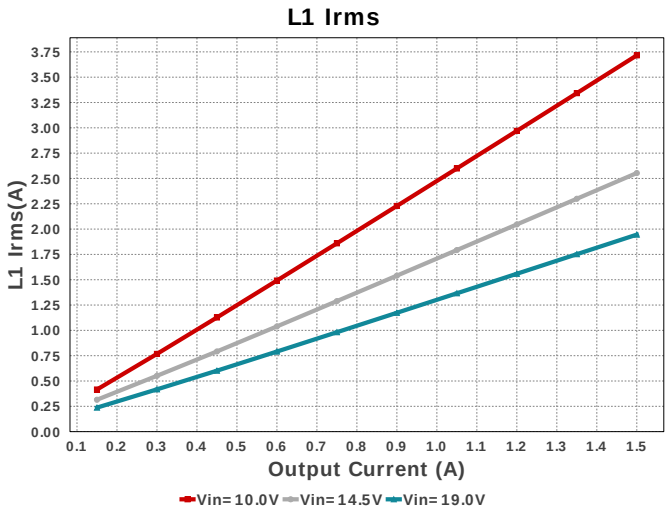
Copyright © 2020, Texas Instruments Incorporated

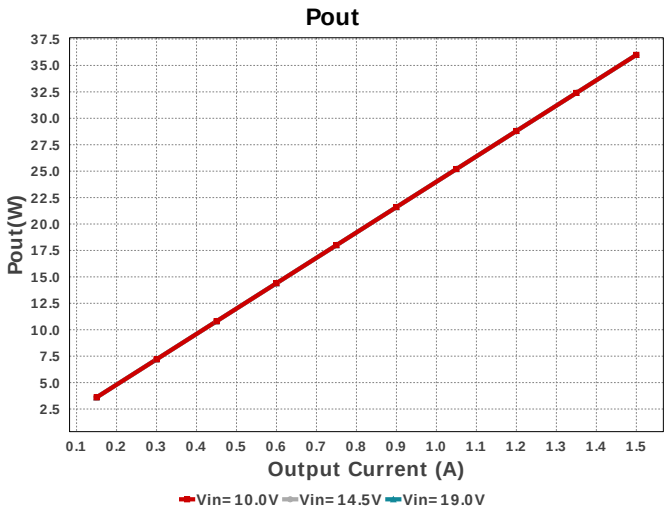




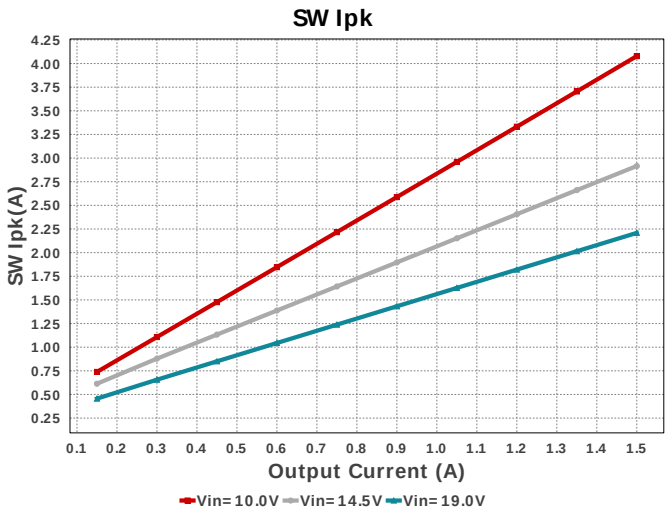


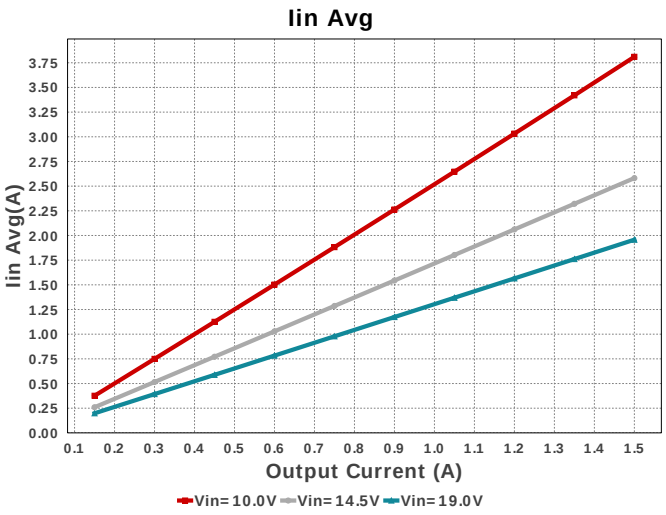


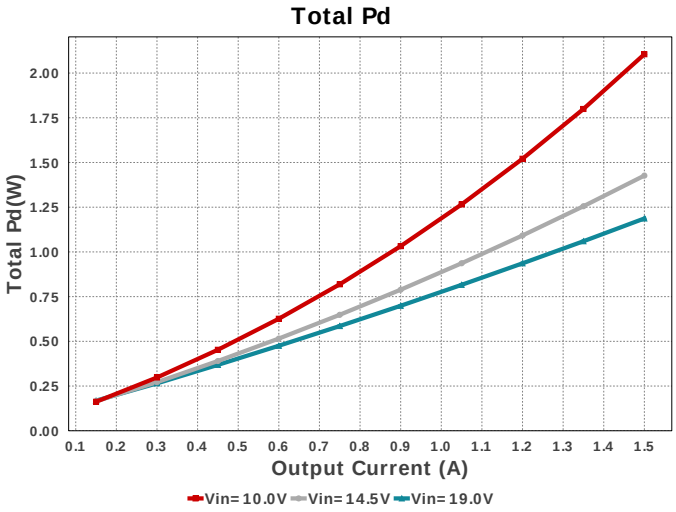


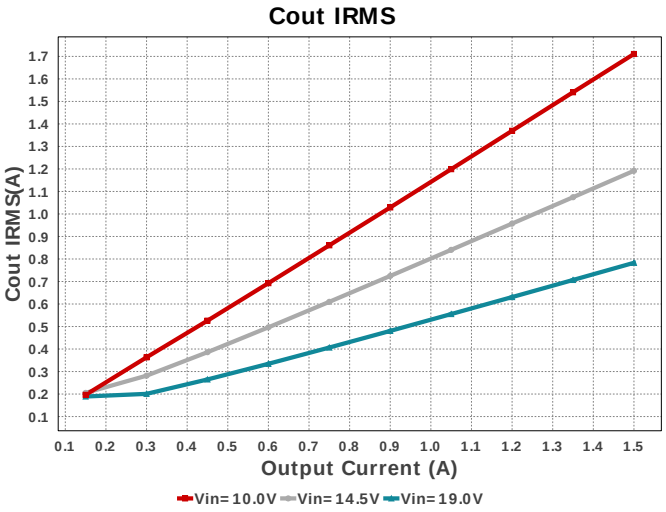


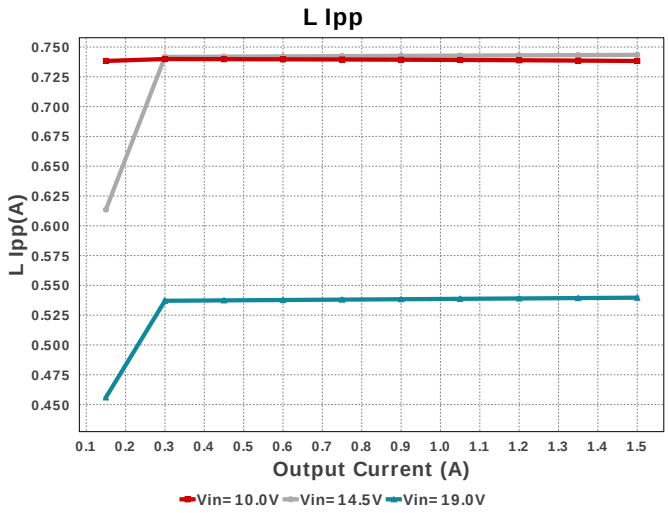
Copyright © 2020, Texas Instruments Incorporated

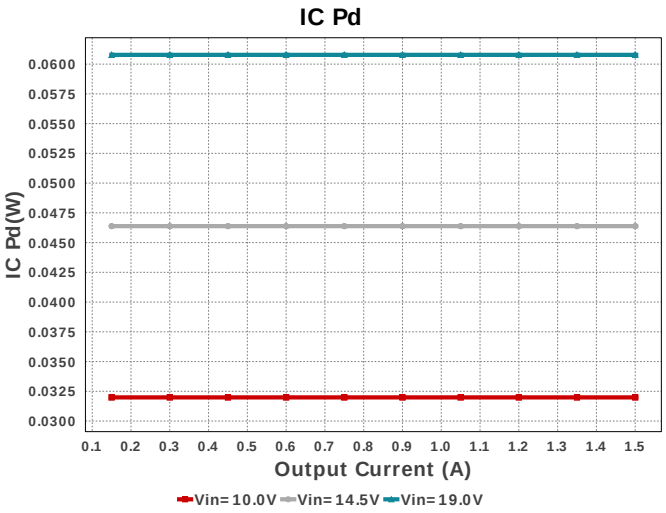




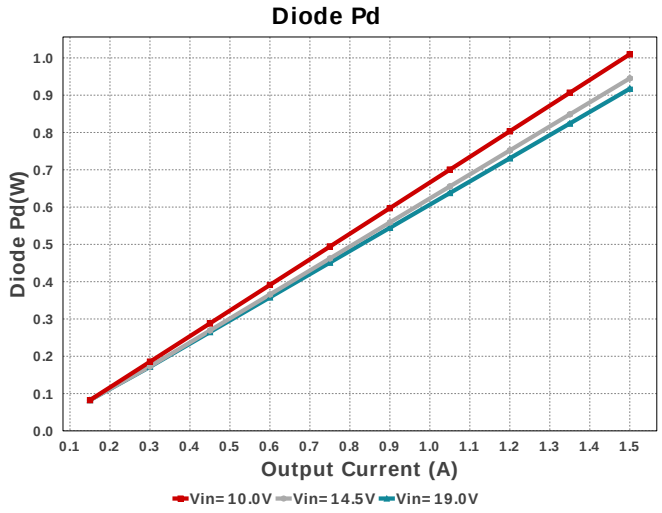


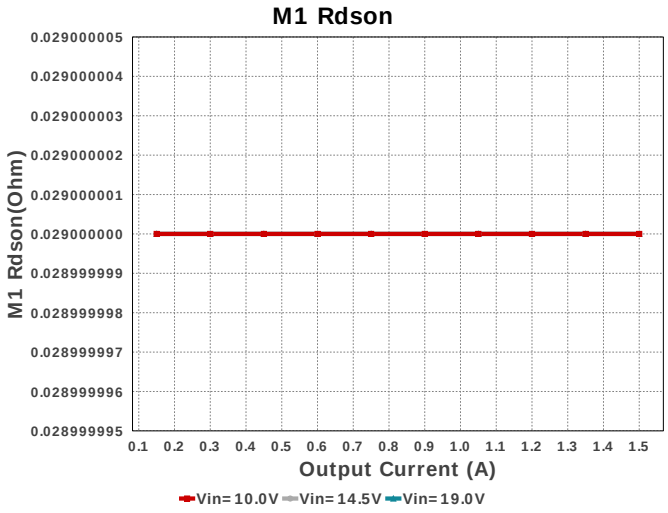


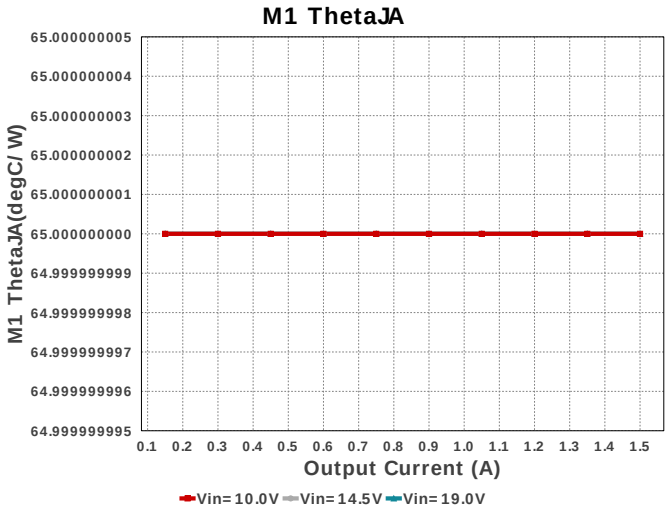


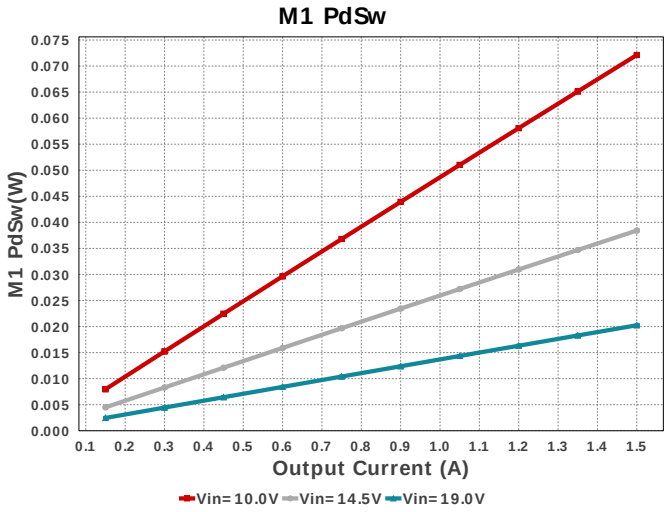


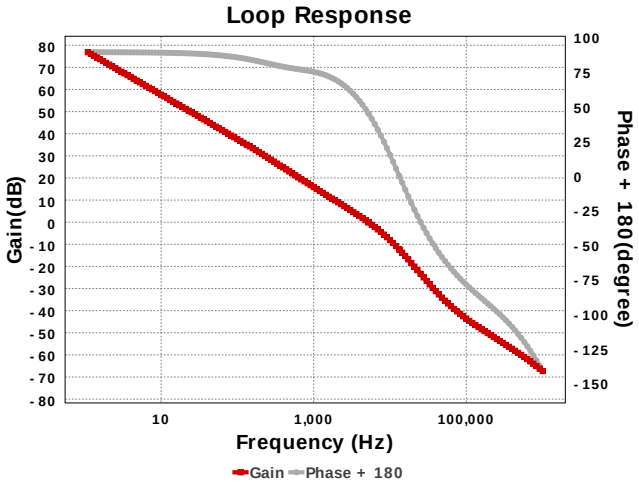
Copyright © 2020, Texas Instruments Incorporated











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	213.13 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	16.353 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	1.711 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	79.021 mW	Capacitor	Output capacitor power dissipation
5.	Coutx IRMS	106.435 mA	Capacitor	Output capacitor_x RMS ripple current
6.	Coutx Pd	50.388 µW	Capacitor	Output capacitor_x power loss
7.	D1 Tj	90.582 degC	Diode	D1 junction temperature
8.	Diode Pd	1.01 W	Diode	Diode power dissipation
9.	IC Pd	31.988 mW	IC	IC power dissipation
10.	IC Tj	31.846 degC	IC	IC junction temperature
11.	IC Tolerance	14.0 mV	IC	IC Feedback Tolerance

Copyright © 2020, Texas Instruments Incorporated

#	Name	Value	Category	Description
12.	ICThetaJA	57.7 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	3.81 A	IC	Average input current
14.	L Ipp	738.31 mA	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	309.77 mW	Inductor	Inductor power dissipation
16.	L1 Irms	3.715 A	Inductor	Inductor ripple current
17.	M1 Irms	3.409 A	Mosfet	M1 MOSFET Irms
18.	M1 Pd	484.45 mW	Mosfet	M1 MOSFET total power dissipation
19.	M1 PdCond	413.83 mW	Mosfet	M1 MOSFET conduction losses
20.	M1 PdSw	70.623 mW	Mosfet	M1 MOSFET switching losses
21.	M1 Rdson	29.0 mOhm	Mosfet	Drain-Source On-resistance
22.	M1 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
23.	M1 TjOP	61.489 degC	Mosfet	M1 MOSFET junction temperature
24.	Cin Pd	16.353 mW	Power	Input capacitor power dissipation
25.	Cout Pd	79.021 mW	Power	Output capacitor power dissipation
26.	Coutx Pd	50.388 µW	Power	Output capacitor_x power loss
27.	Diode Pd	1.01 W	Power	Diode power dissipation
28.	IC Pd	31.988 mW	Power	IC power dissipation
29.	L Pd	309.77 mW	Power	Inductor power dissipation
30.	M1 Pd	484.45 mW	Power	M1 MOSFET total power dissipation
31.	M1 PdCond	413.83 mW	Power	M1 MOSFET conduction losses
32.	M1 PdSw	70.623 mW	Power	M1 MOSFET switching losses
33.	Rfb Pd	11.901 mW	Power	Rfb Power Dissipation
34.	Total Pd	2.102 W	Power	Total Power Dissipation
35.	Rfb Pd	11.901 mW	Resistor	Rfb Power Dissipation
36.	BOM Count	21	System Information	Total Design BOM count
37.	Cross Freq	3.059 kHz	System Information	Bode plot crossover frequency
38.	Duty Cycle	60.629 %	System Information	Duty cycle
39.	Efficiency	94.484 %	System Information	Steady state efficiency
40.	FootPrint	643.0 mm^2	System Information	Total Foot Print Area of BOM components
41.	Frequency	242.648 kHz	System Information	Switching frequency
42.	Gain Marg	-11.028 dB	System Information	Bode Plot Gain Margin
43.	Iout	1.5 A	System Information	Iout operating point
44.	Low Freq Gain	78.731 dB	System Information	Gain at 1Hz
45.	Mode	CCM	System Information	Conduction Mode
46.	Phase Marg	54.992 deg	System Information	Bode Plot Phase Margin
47.	Pout	36.0 W	System Information	Total output power
48.	SW Ipk	4.078 A	System Information	Peak switch current
49.	Total BOM	$4.88	System Information	Total BOM Cost
50.	Vin	10.0 V	System Information	Vin operating point
51.	Vout	24.0 V	System Information	Operational Output Voltage
52.	Vout Actual	24.2 V	System Information	Vout Actual calculated based on selected voltage divider resistors
53.	Vout Tolerance	4.001 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
54.	Vout p-p	148.028 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

#	Name	Value	Description
1.	Iout	1.5	Maximum Output Current
2.	VinMax	19.0	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	24.0	Output Voltage
5.	acFrequency	60.0	AC Frequency
6.	base_pn	TPS40210	Base Product Number
7.	source	DC	Input Source Type
8.	Ta	30.0	Ambient temperature

Copyright © 2020, Texas Instruments Incorporated

Design Assistance

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

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.

Copyright © 2020, Texas Instruments Incorporated