TEXAS INSTRUMENTS

VinMin = 6.5V
VinMax = 22.0V
Vout = 5.0V
Iout = 2.5A

Device = TPS54331QDRQ1
Topology = Buck
Created = 2019-02-12 01:25:49.278
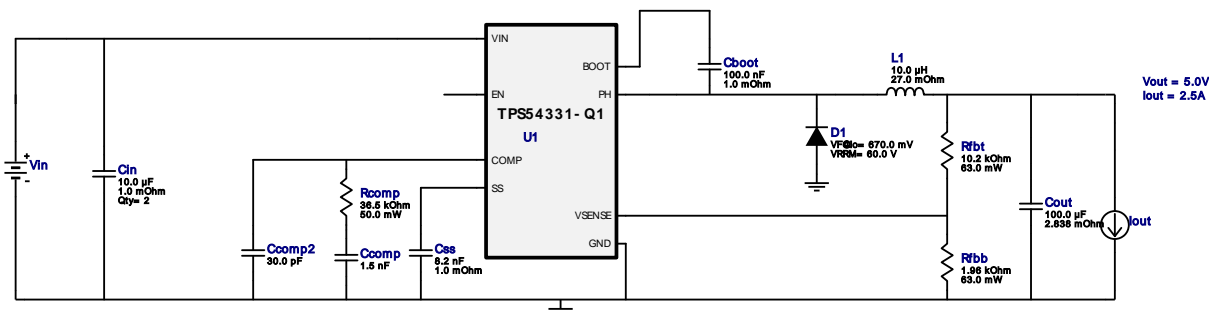BOM Cost = $4.41
BOM Count = 13
Total Pd = 1.83W

WEBENCH ® Design Report
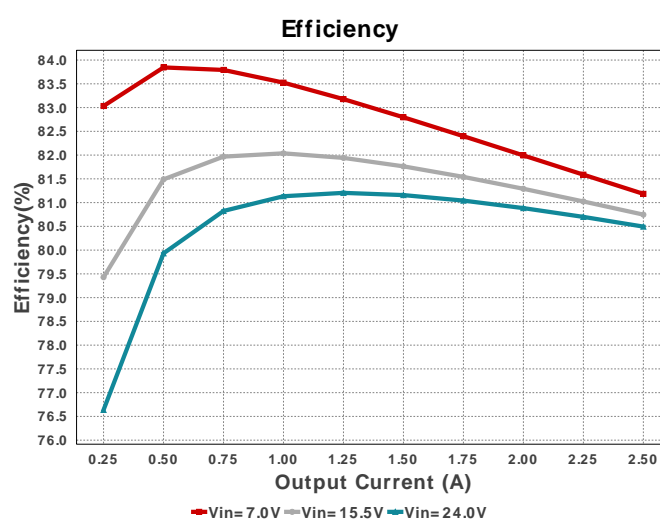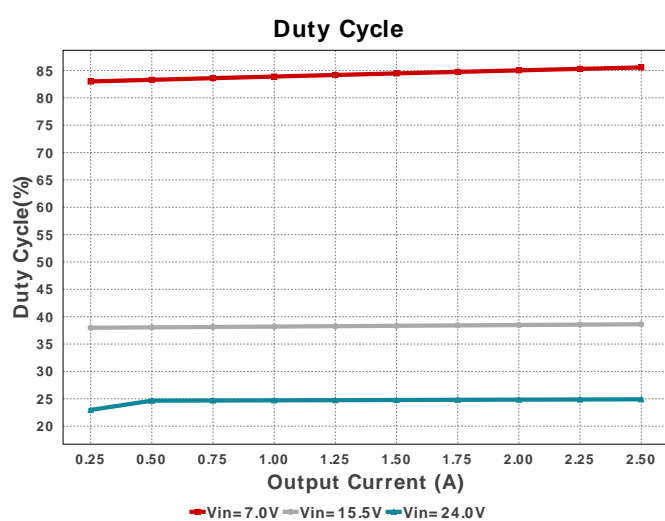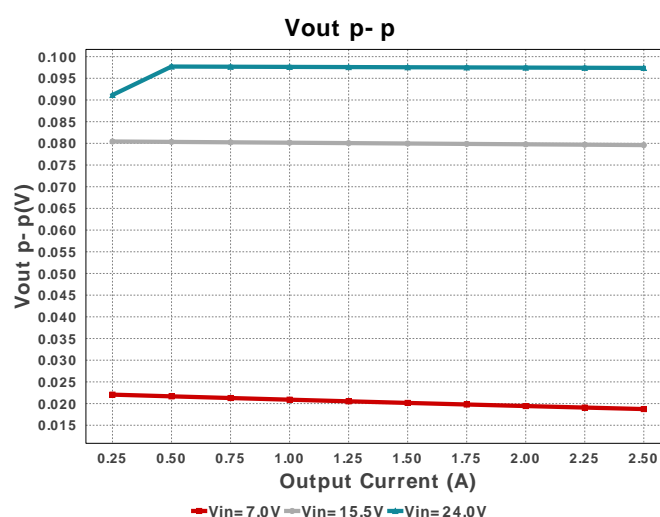
TPS54331QDRQ1 6.5V-22V to 5.00V @ 2.5A

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

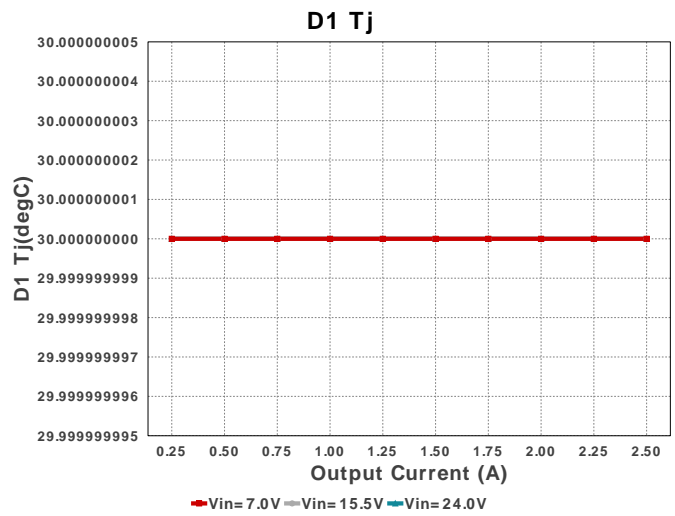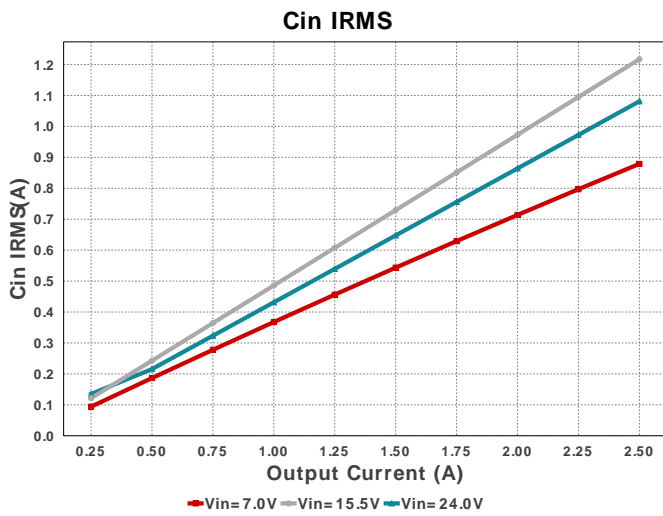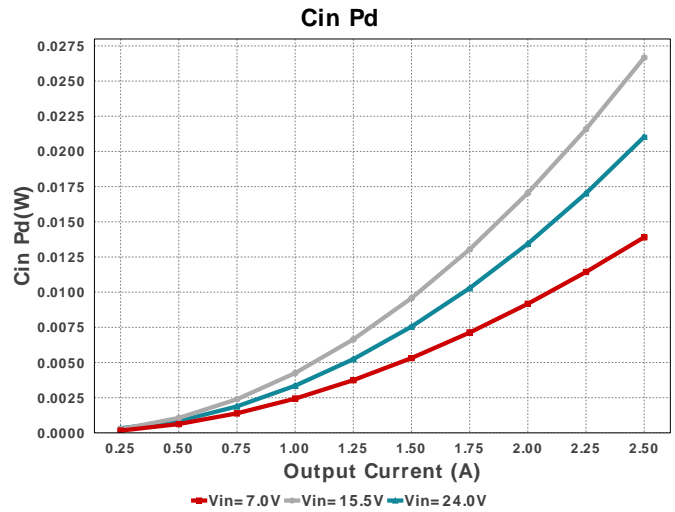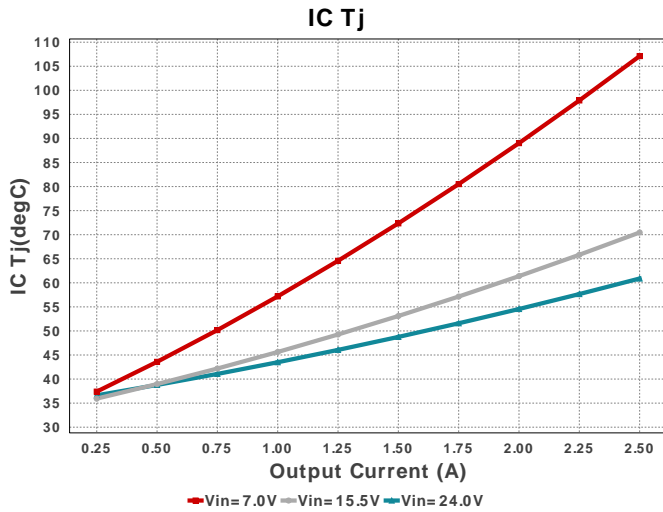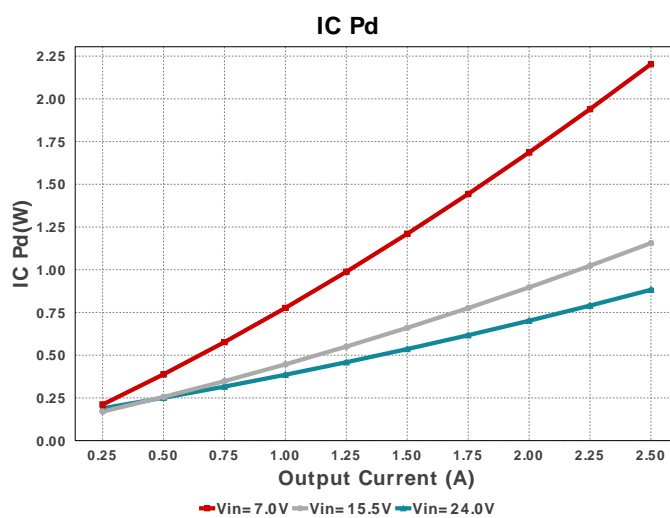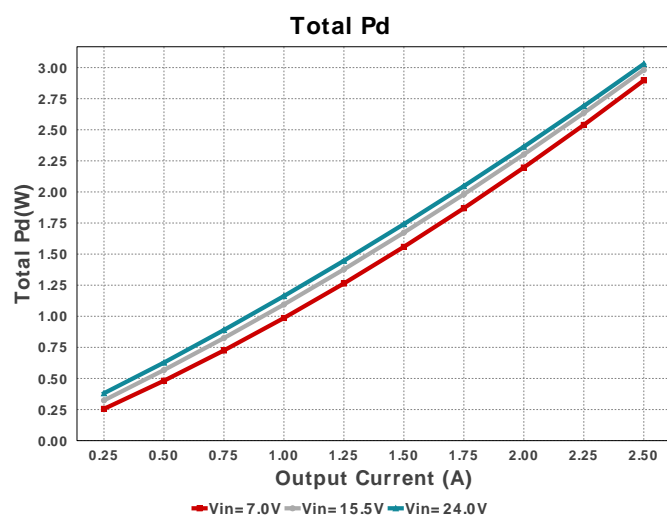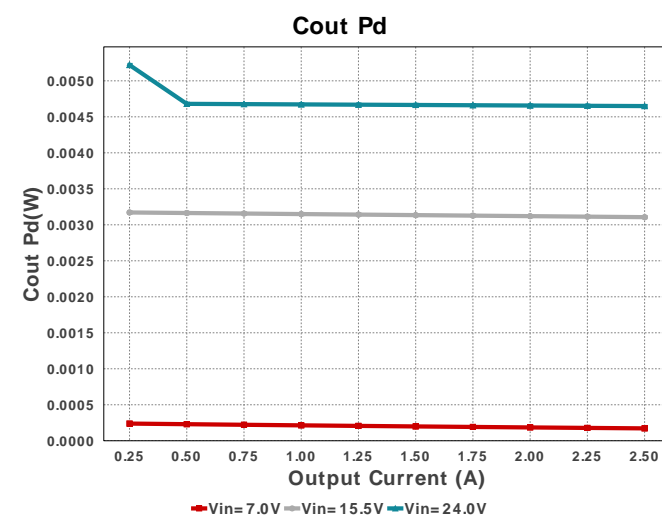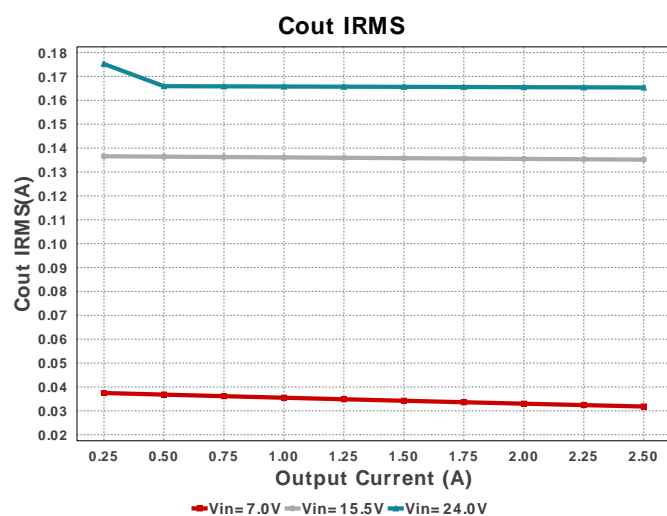| #	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R71A104KA01D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	Ccomp	MuRata	GCM1885C1H152JA16D Series= C0G/NP0	Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0603 5 mm^2
3.	Ccomp2	Johanson Technology	250R05L300JV4T Series= C0G/NP0	Cap= 30.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.02	0201 2 mm^2
4.	Cin	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	2	$0.56	1210 15 mm^2
5.	Cout	TDK	C3216X5R1A107M160AC Series= X5R	Cap= 100.0 uF ESR= 2.838 mOhm VDC= 10.0 V IRMS= 4.3069 A	1	$0.58	1206_190 11 mm^2
6.	Css	MuRata	GRM033R71A822KA01D Series= X7R	Cap= 8.2 nF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
7.	D1	Diodes Inc.	PDS560-13	VF@Io= 670.0 mV VRRM= 60.0 V	1	$0.44	PowerDI5 50 mm^2
8.	L1	Coilcraft	XAL6060-103MEB	L= 10.0 µH DCR= 27.0 mOhm	1	$0.82	XAL6060 72 mm^2
9.	Rcomp	Yageo	RC0201FR-0736K5L Series= ?	Res= 36500.0Ohm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
10.	Rfbb	Vishay-Dale	CRCW04021K96FKED Series= CRCW..e3	Res= 1960.0Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rfbt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10200.0Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
12.	U1	Texas Instruments	TPS54331QDRQ1	Switcher	1	$1.35	

D0008A 57 mm²

L Ipp

Vout p- p

Duty Cycle

Efficiency

2

IC Tj

Cin Pd

Cin IRMS

D1 Tj

Iin Avg

Pout

3

IC Ipk

Vin= 7.0V Vin= 15.5V Vin= 24.0V

Diode Pd

Vin= 7.0V Vin= 15.5V Vin= 24.0V

Cout IRMS

Vin= 7.0V Vin= 15.5V Vin= 24.0V

Cout Pd

Vin= 7.0V Vin= 15.5V Vin= 24.0V

Total Pd

Vin= 7.0V Vin= 15.5V Vin= 24.0V

IC Pd

Vin= 7.0V Vin= 15.5V Vin= 24.0V

L Pd
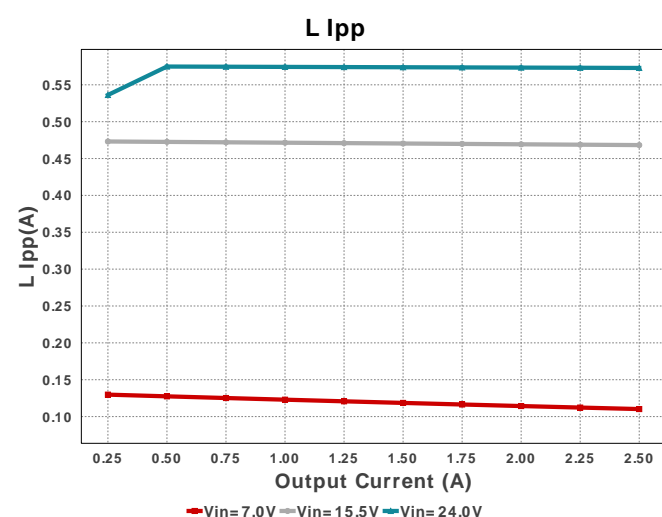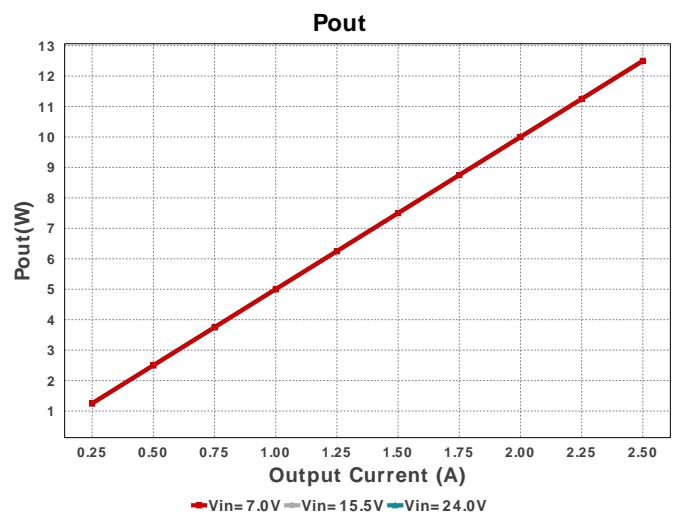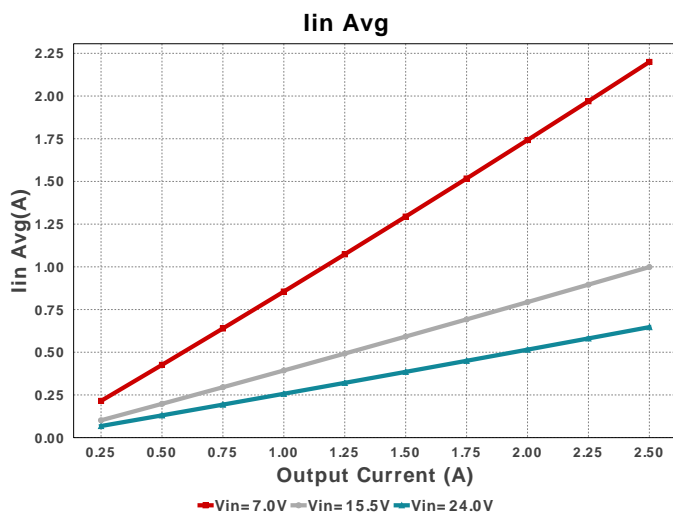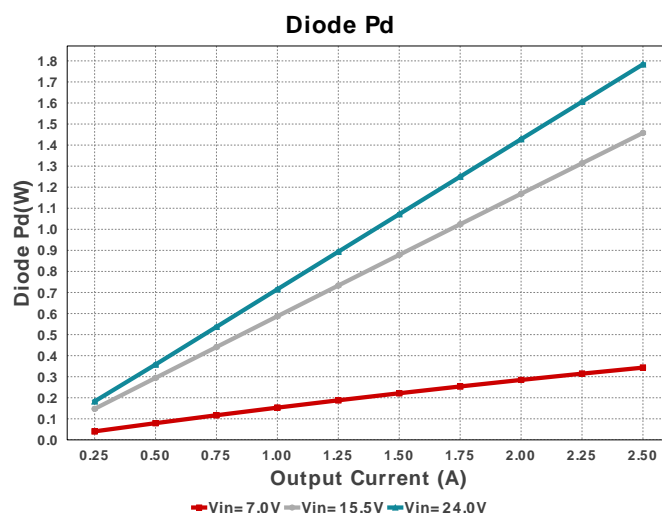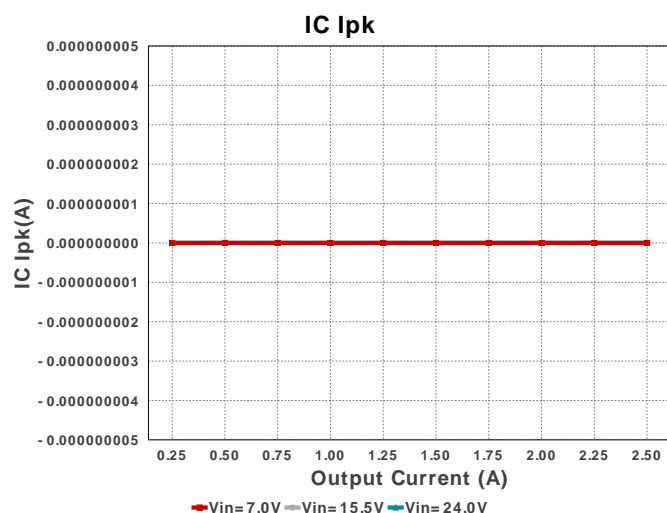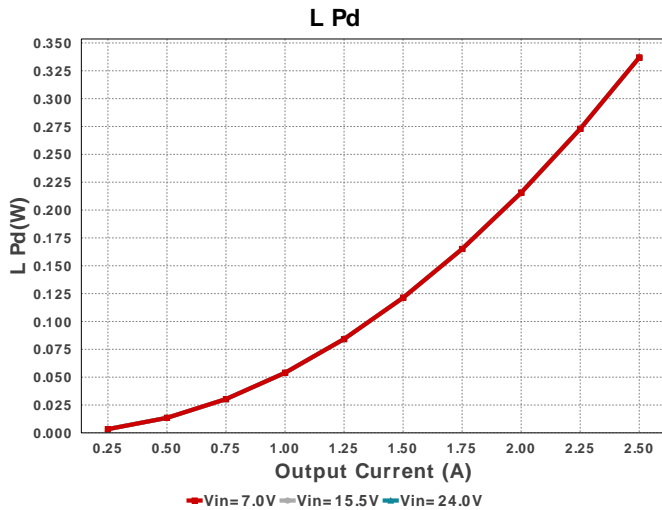
Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	554.475 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	153.72 µW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	210.088 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	125.26 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	110.26 degC	Diode	D1 junction temperature
6.	Diode Pd	844.8 mW	Diode	Diode power dissipation
7.	IC Ipk	0.0 A	IC	Peak switch current in IC
8.	IC Pd	799.1 mW	IC	IC power dissipation
9.	IC Tj	109.91 degC	IC	IC junction temperature
10.	ICThetaJA	100.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	651.35 mA	IC	Average input current
12.	L Ipp	727.77 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	185.63 mW	Inductor	Inductor power dissipation
14.	M Irms	1.235 A	Mosfet	MOSFET RMS ripple current
15.	M Vds Act	124.706 mV	Mosfet	Voltage drop across the MosFET
16.	Cin Pd	153.72 µW	Power	Input capacitor power dissipation
17.	Cout Pd	125.26 µW	Power	Output capacitor power dissipation
18.	Diode Pd	844.8 mW	Power	Diode power dissipation
19.	IC Pd	799.1 mW	Power	IC power dissipation
20.	L Pd	185.63 mW	Power	Inductor power dissipation
21.	Total Pd	1.83 W	Power	Total Power Dissipation
22.	BOM Count	13	System Information	Total Design BOM count
23.	Cross Freq	19.844 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	24.402 %	System Information	Duty cycle
25.	Efficiency	87.231 %	System Information	Steady state efficiency
26.	FootPrint	238.0 mm²	System Information	Total Foot Print Area of BOM components
27.	Frequency	570.0 kHz	System Information	Switching frequency
28.	Gain Marg	-18.999 dB	System Information	Bode Plot Gain Margin
29.	Iout	2.5 A	System Information	Iout operating point
30.	Low Freq Gain	66.188 dB	System Information	Gain at 1Hz
31.	Mode	CCM	System Information	Conduction Mode
32.	Phase Marg	61.232 deg	System Information	Bode Plot Phase Margin
33.	Pout	12.5 W	System Information	Total output power
34.	Total BOM	$4.41	System Information	Total BOM Cost
35.	Vin	22.0 V	System Information	Vin operating point
36.	Vout	5.0 V	System Information	Operational Output Voltage

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#	Name	Value	Category	Description
37.	Vout Actual	4.963 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	5.254 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	3.645 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

#	Name	Value	Description
1.	Iout	2.5	Maximum Output Current
2.	VinMax	22.0	Maximum input voltage
3.	VinMin	6.5	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	acFrequency	60.0	AC Frequency
6.	base_pn	TPS54331-Q1	Base Product Number
7.	source	DC	Input Source Type
8.	Ta	30.0	Ambient temperature

Design Assistance

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2. **TPS54331-Q1** Product Folder : http://www.ti.com/product/TPS54331%2DQ1 : contains the data sheet and other resources.