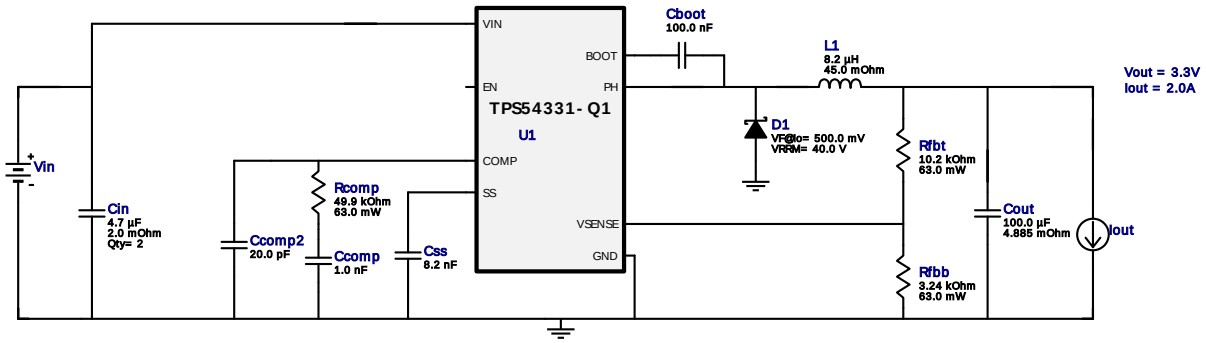
WEBENCH® Design Report

VinMin = 14.0V
VinMax = 22.0V
Vout = 3.3V
Iout = 2.0A

Device = TPS54331QDRQ1
Topology = Buck
Created = 7/12/16 1:37:43 AM
BOM Cost = $2.27
BOM Count = 13
Total Pd = 1.49W

Design : 4737567/49 TPS54331QDRQ1
TPS54331QDRQ1 14.0V-22.0V to 3.30V @ 2.0A

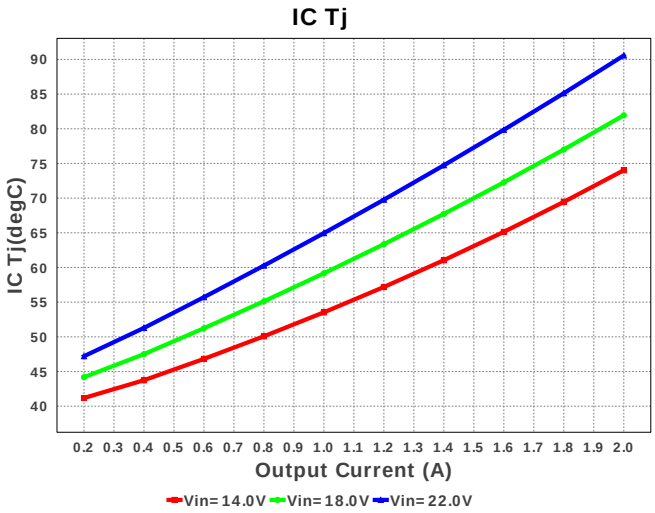


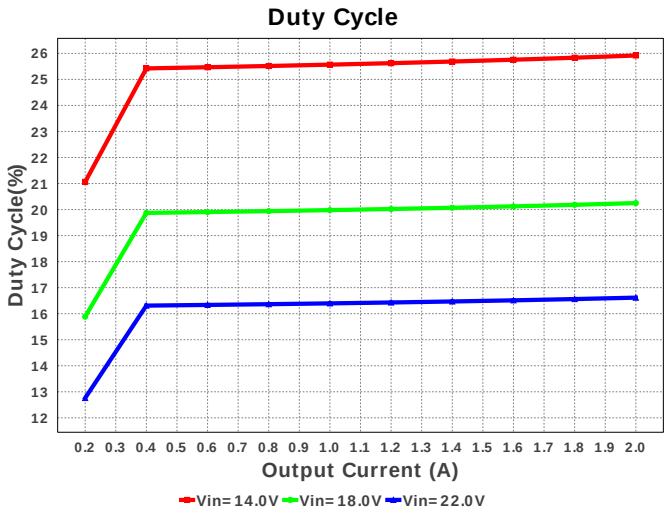
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

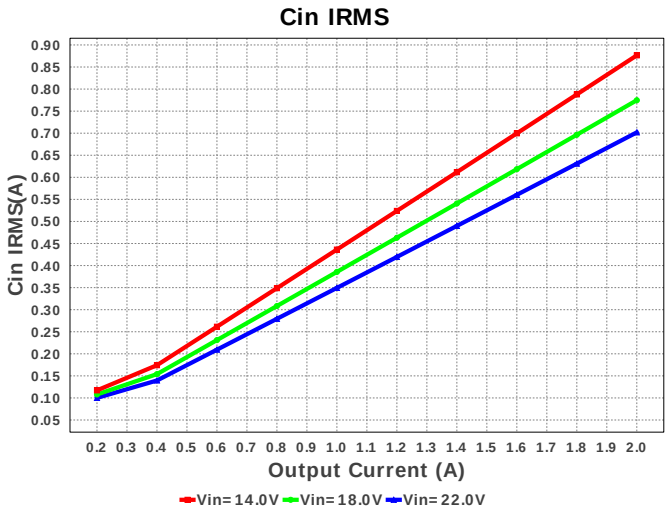
Electrical BOM

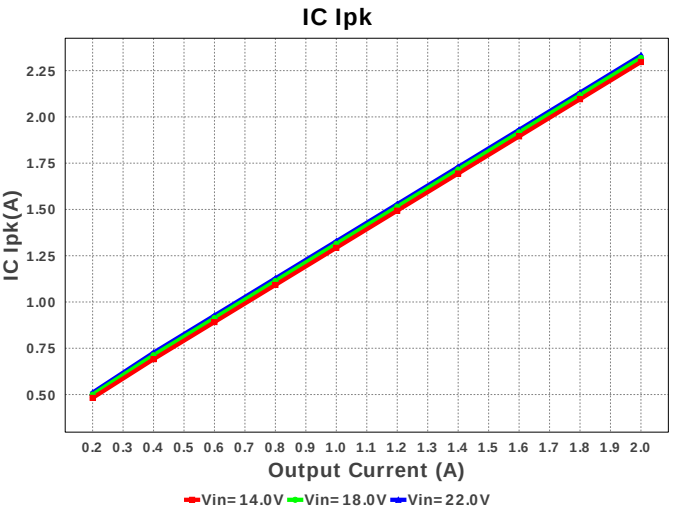
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Ccomp	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	Ccomp2	Samsung Electro-Mechanics	CL21C200JBANNNC Series= C0G/NP0	Cap= 20.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Cin	MuRata	GRM32ER71H475KA88L Series= X7R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 50.0 V IRMS= 5.35 A	2	$0.19	1210 15 mm²
5.	Cout	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	1	$0.14	1206_190 11 mm²
6.	Css	MuRata	GRM033R61A822KA01D Series= X5R	Cap= 8.2 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
7.	D1	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	$0.11	SMA 37 mm²
8.	L1	Bourns	SRN8040-8R2Y	L= 8.2 µH DCR= 45.0 mOhm	1	$0.22	SRN8040 100 mm²
9.	Rcomp	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
10.	Rfbb	Vishay-Dale	CRCW04023K24FKED Series= CRCW..e3	Res= 3.24 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rfbt	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
12.	U1	Texas Instruments	TPS54331QDRQ1	Switcher	1	$1.35	D0008A 57 mm^2

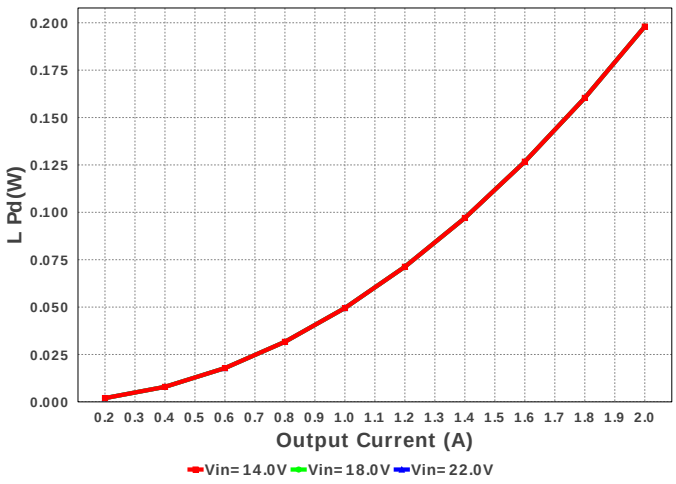




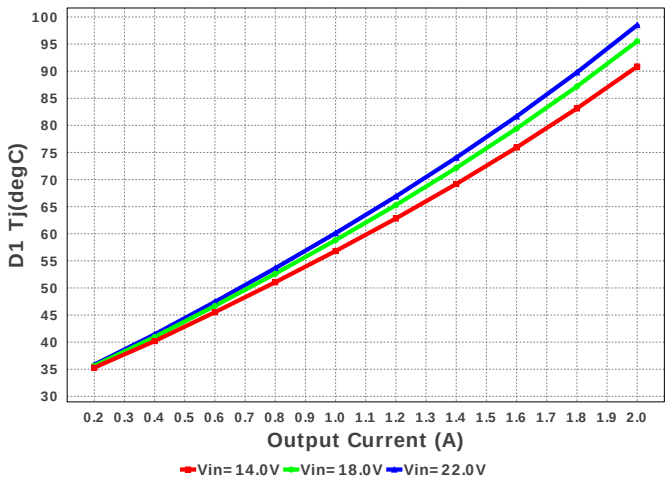




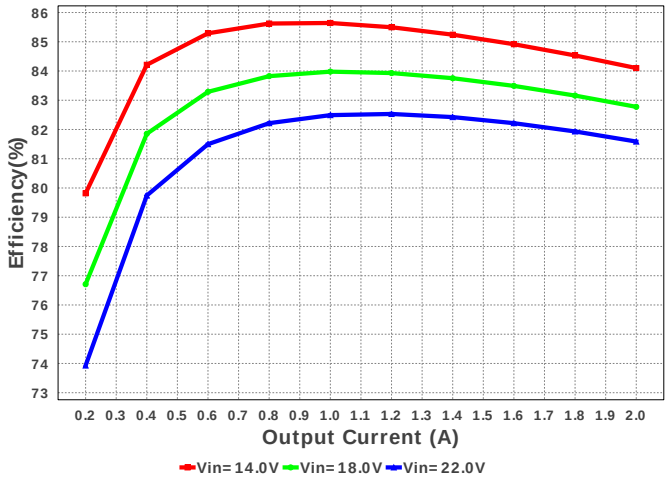
L Pd



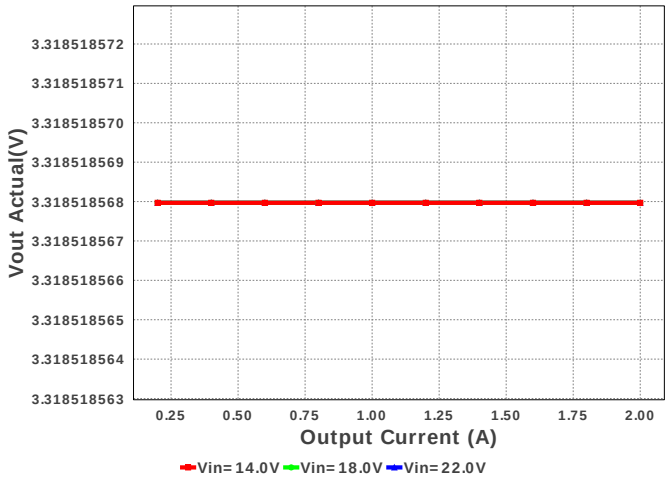
D1 Tj



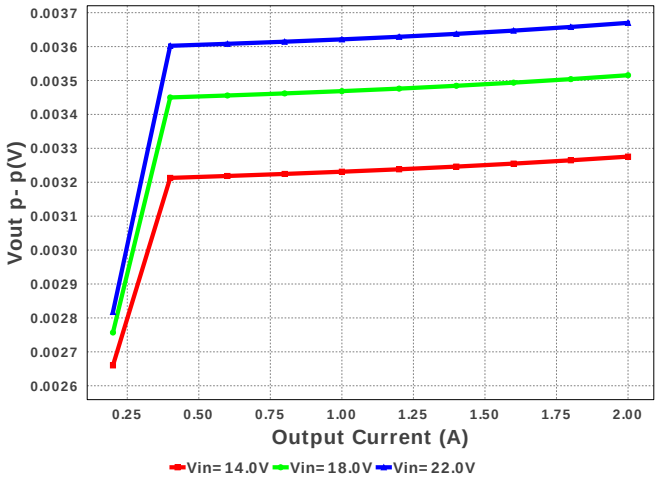
Efficiency



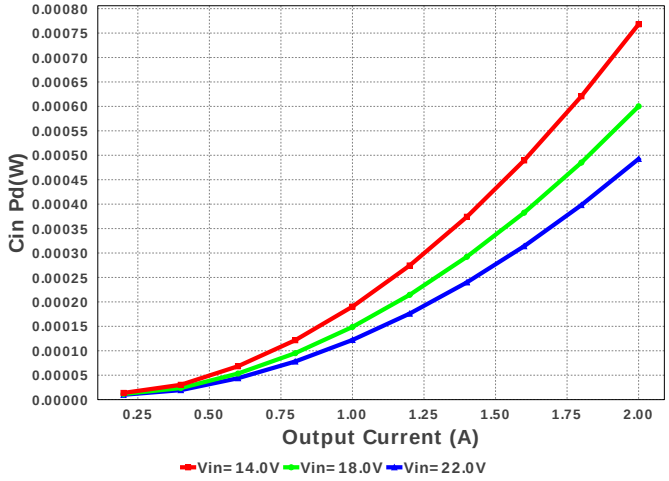
Vout Actual

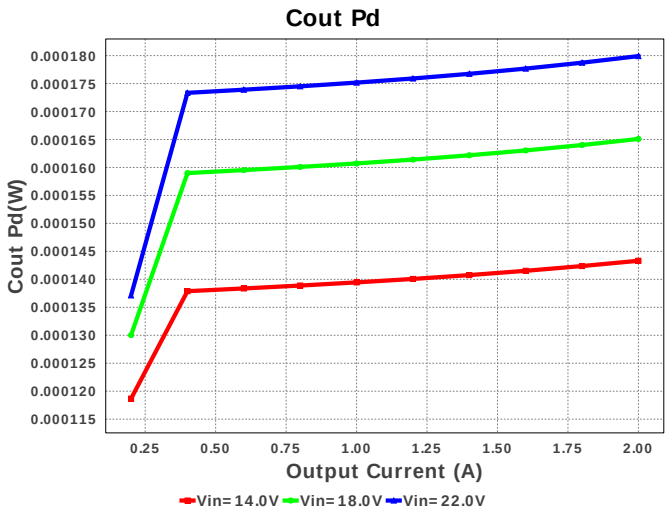


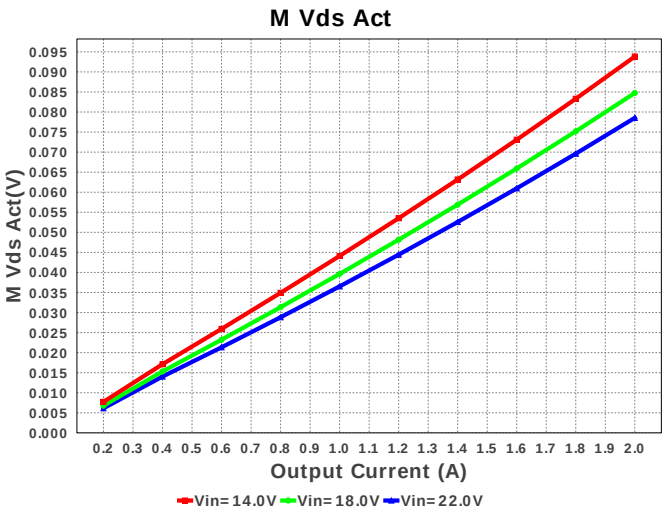
Vout p- p

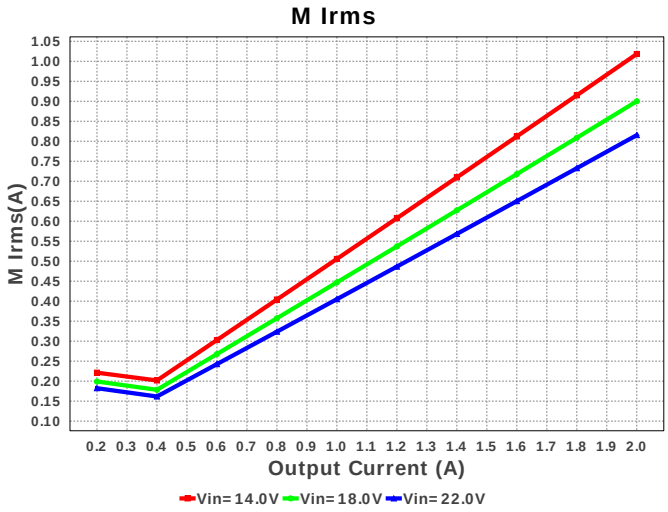


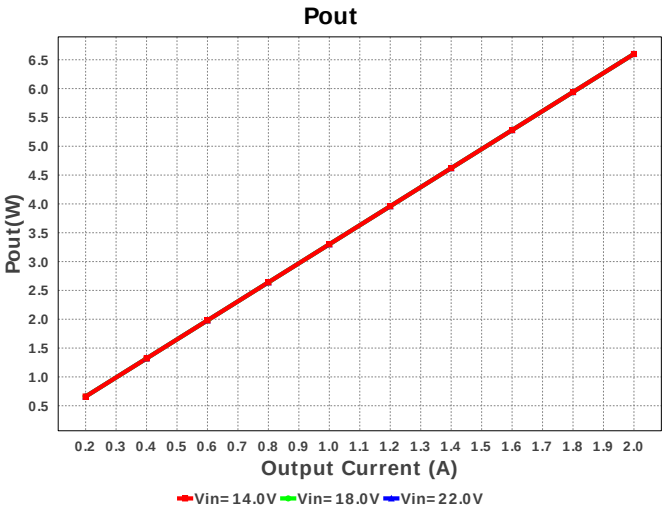
Cin Pd

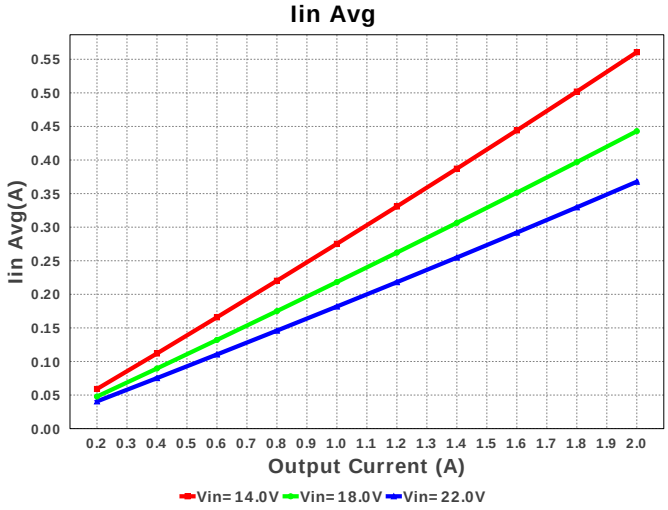


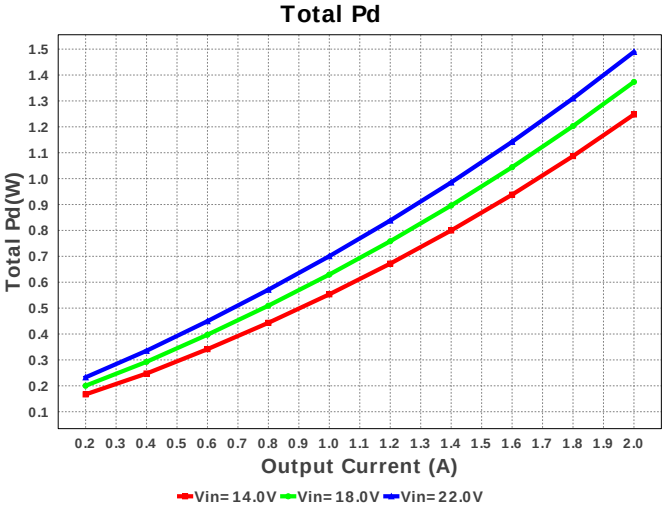


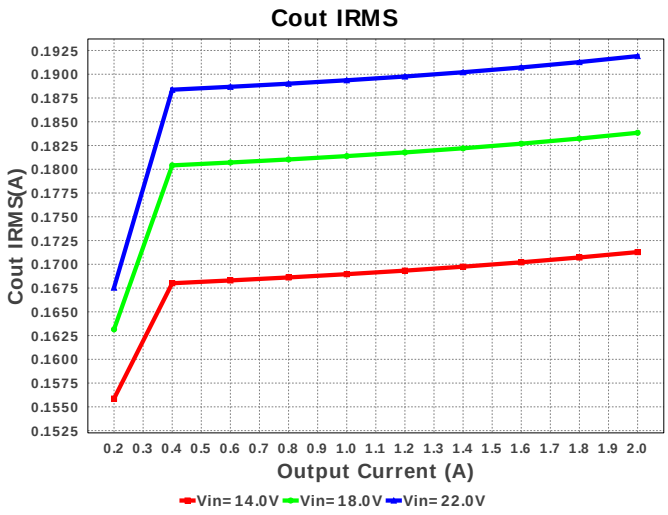


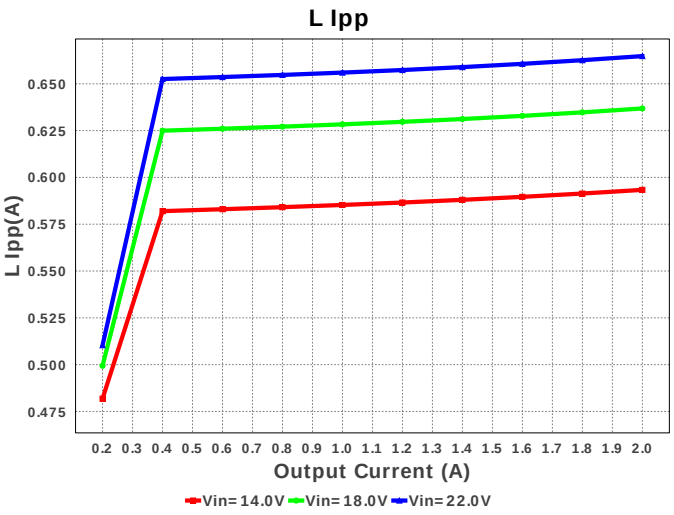


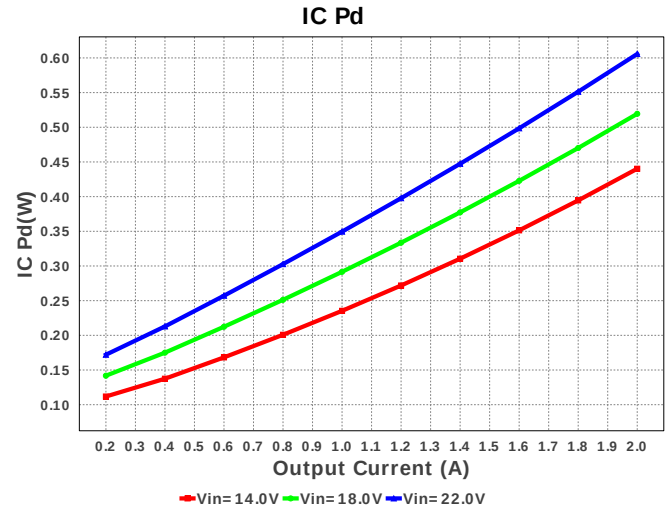


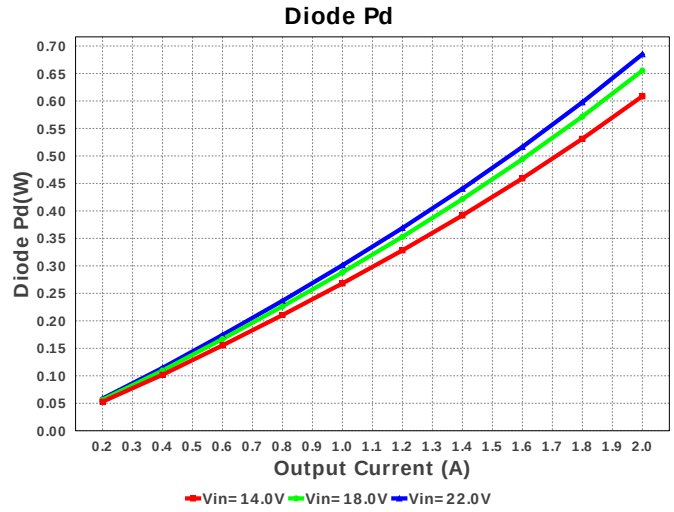


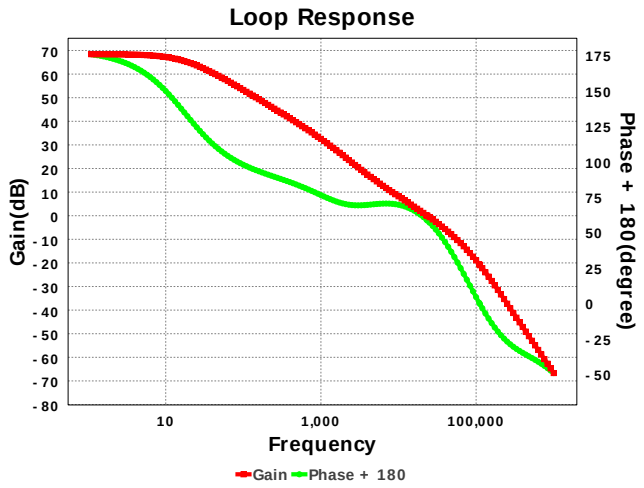












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	701.829 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	191.909 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	2.332 A	Current	Peak switch current in IC
4.	Iin Avg	367.7 mA	Current	Average input current
5.	L Ipp	664.79 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	815.26 mA	Current	MOSFET RMS current
7.	BOM Count	13	General	Total Design BOM count
8.	FootPrint	262.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	570.0 kHz	General	Switching frequency
10.	M Vds Act	78.541 mV	General	Voltage drop across the MosFET
11.	Pout	6.6 W	General	Total output power

#	Name	Value	Category	Description
12.	Total BOM	$2.27	General	Total BOM Cost
13.	D1 Tj	98.504 degC	Op_Point	D1 junction temperature
14.	Low Freq Gain	68.426 dB	Op_Point	Gain at 10Hz
15.	Vout Actual	3.319 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
17.	Cross Freq	23.573 kHz	Op_point	Bode plot crossover frequency
18.	Duty Cycle	16.616 %	Op_point	Duty cycle
19.	Efficiency	81.588 %	Op_point	Steady state efficiency
20.	Gain Marg	-20.979 dB	Op_point	Bode Plot Gain Margin
21.	IC Tj	90.567 degC	Op_point	IC junction temperature
22.	ICThetaJA	100.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
23.	IOUT_OP	2.0 A	Op_point	Iout operating point
24.	Phase Marg	58.927 deg	Op_point	Bode Plot Phase Margin
25.	VIN_OP	22.0 V	Op_point	Vin operating point
26.	Vout p-p	3.67 mV	Op_point	Peak-to-peak output ripple voltage
27.	Cin Pd	492.564 µW	Power	Input capacitor power dissipation
28.	Cout Pd	179.91 µW	Power	Output capacitor power dissipation
29.	Diode Pd	685.041 mW	Power	Diode power dissipation
30.	IC Pd	605.671 mW	Power	IC power dissipation
31.	L Pd	198.0 mW	Power	Inductor power dissipation
32.	Total Pd	1.489 W	Power	Total Power Dissipation
33.	Vout Tolerance	5.087 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	22.0	Maximum input voltage
3.	VinMin	14.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS54331-Q1	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

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