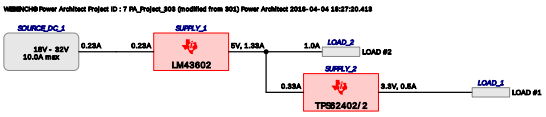


WEBENCH® Power Architect

Project Report

Project : 3747628/7 : PA_Project_303 (modified from 301)
Created : 2016-04-04 18:27:20.413
Optimize project optFactor=3

Project Summary

1.	Total System Efficiency	89.936 %
2.	Total System BOM Count	14.0
3.	Total System Footprint	303.0 mm2
4.	Total System BOM Cost	$3.59
5.	Total System Power Dissipation	744.2 mW

--> Launch WEBENCH Power Architect.

My Comments

?????????

Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_1	0	LOAD_2	LOAD #2
SUPPLY_2	0	LOAD_1	LOAD #1

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	LM43602	Switcher : SIMPLE SWITCHER Buck Regulator	5 V	1.326 A	91.7%	267	$2.69	25	9
2.	SUPPLY_2	TPS62402/2	Switcher : 2.25-MHz 400-mA and 600-mA Dual Step-Down Converter	3.3 V	0.5 A	92.1%	36	$0.90	24	4

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD #2	5 V	1 A	VoutRipple=10%
2.	LOAD #1	3.3 V	0.5 A	VoutRipple=10%

Project Diagram

Electrical Procurement BOM

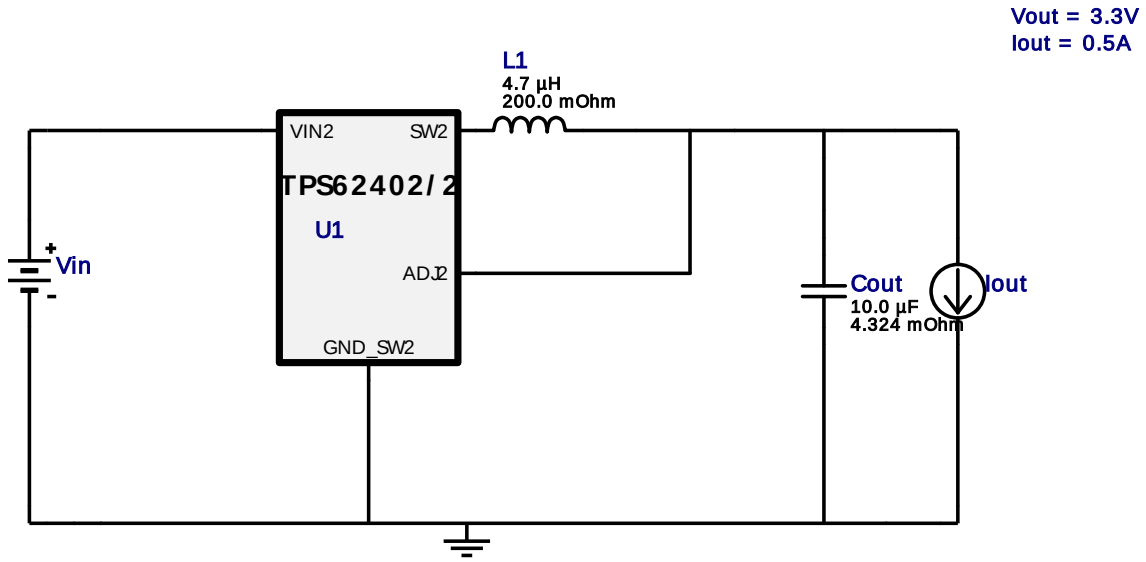
Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm^2)
Kemet	C0805C180M3GACTU	0805	1	$0.01	7
Kemet	C0805C475K8PACTU	0805	1	$0.03	7
TDK	C3216X5R1H105K	1206	1	$0.02	11
Vishay-Dale	CRCW04021M00FKED	0402	1	$0.01	3
Vishay-Dale	CRCW0402255KFKED	0402	1	$0.01	3
MuRata	GRM155C80J474KE19D	0402	1	$0.01	3
MuRata	GRM188R60J225KE19D	0603	1	$0.02	5
MuRata	GRM219R60J106KE19D	0805	1	$0.02	7
MuRata	GRM31CR61A476KE15L	1206_190	1	$0.21	11
MuRata	GRM32ER71H475KA88L	1210	1	$0.29	15
Texas Instruments	LM43602PWPR	PWP0016F	1	$1.75	59
TDK	NLCV32T-4R7M-PFR	NLCV32	1	$0.10	13
Bourns	SRU1048-150Y	SRU1048	1	$0.33	144
Texas Instruments	TPS62402DRCR	DRC0010J	1	$0.78	16
Total			14	$3.02971000000000004	

WEBENCH® Design Report

Vout = 3.3V
Iout = 0.5A

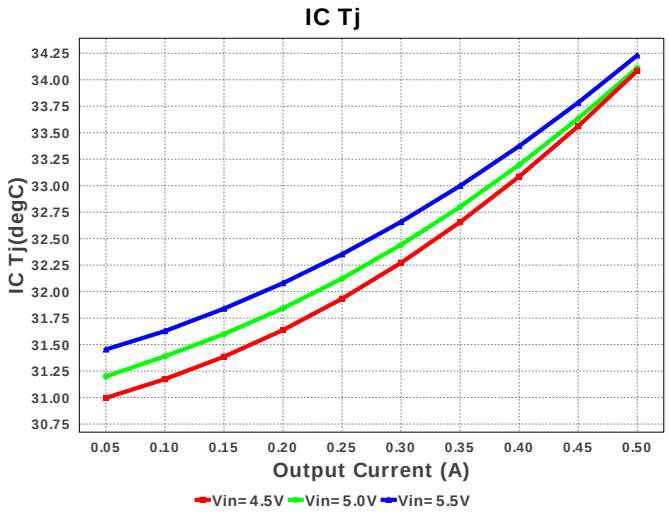
Device = TPS62402DRCR
Topology = Buck
Created = 4/4/16 6:27:19 PM
BOM Cost = $0.90
BOM Count = 3
Total Pd = 0.14W

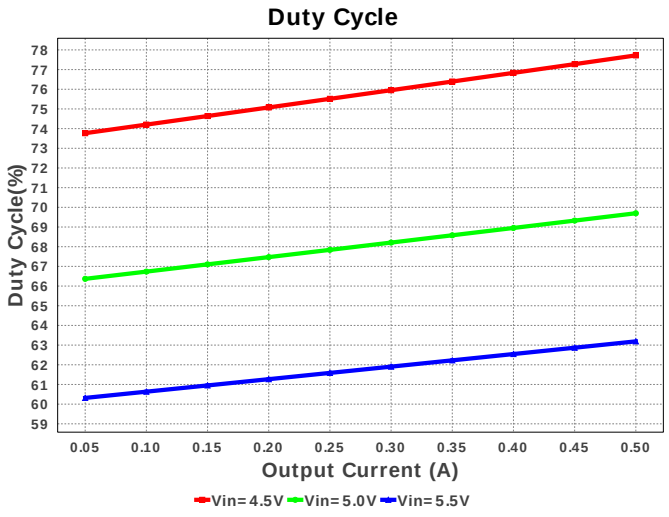
Design : 3747628/24 TPS62402DRCR
TPS62402DRCR 4.5V-5.5V to 3.30V @ 0.5A



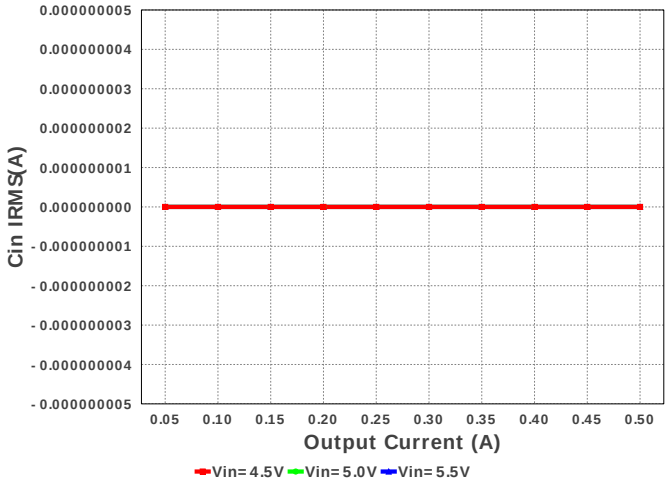
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cout	MuRata	GRM219R60J106KE19D Series= X5R	Cap= 10.0 uF ESR= 4.324 mOhm VDC= 6.3 V IRMS= 2.8728 A	1	$0.02	0805 7 mm²
2.	L1	TDK	NLCV32T-4R7M-PFR	L= 4.7 µH DCR= 200.0 mOhm	1	$0.10	NLCV32 13 mm²
3.	U1	Texas Instruments	TPS62402DRCR	Switcher	1	$0.78	DRC0010J 16 mm²

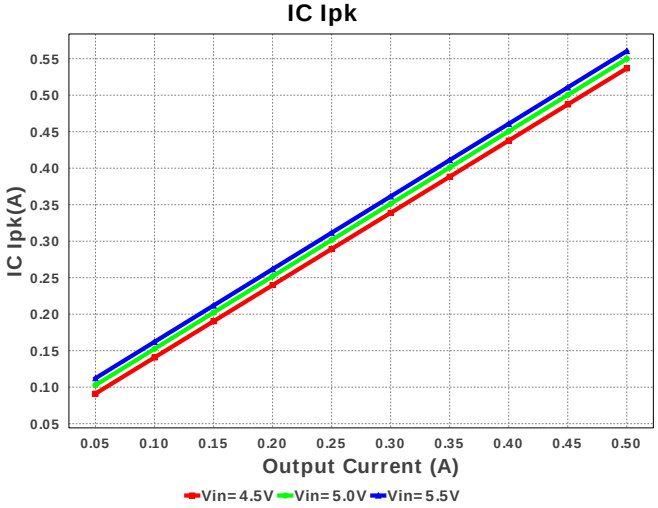




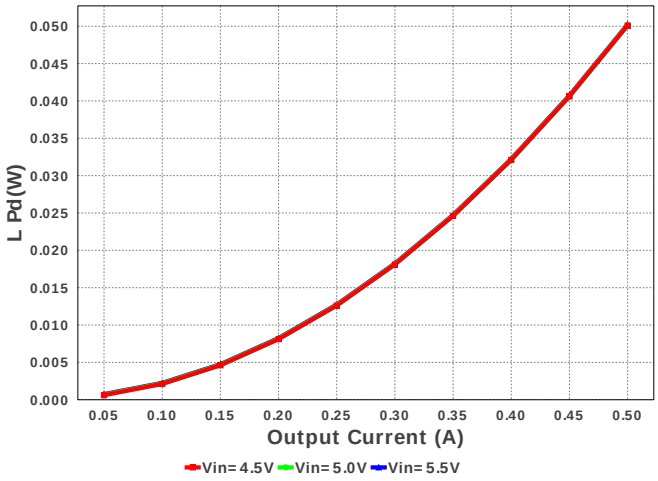
Cin IRMS



IC Ipk



L Pd



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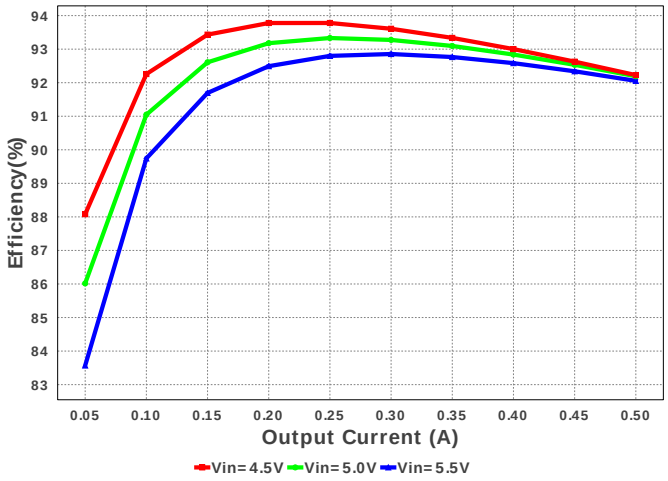
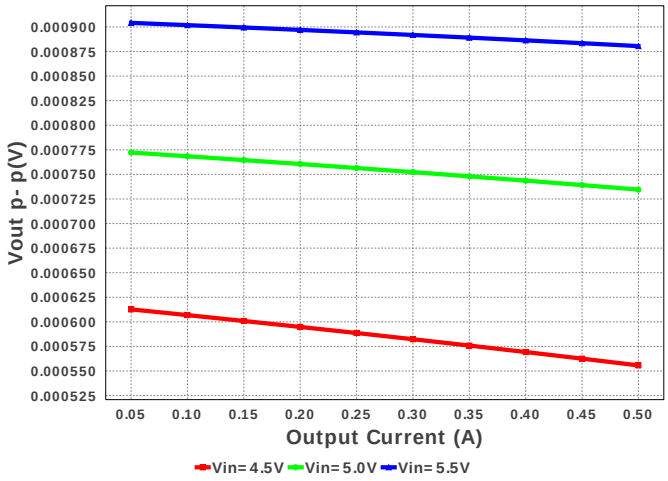
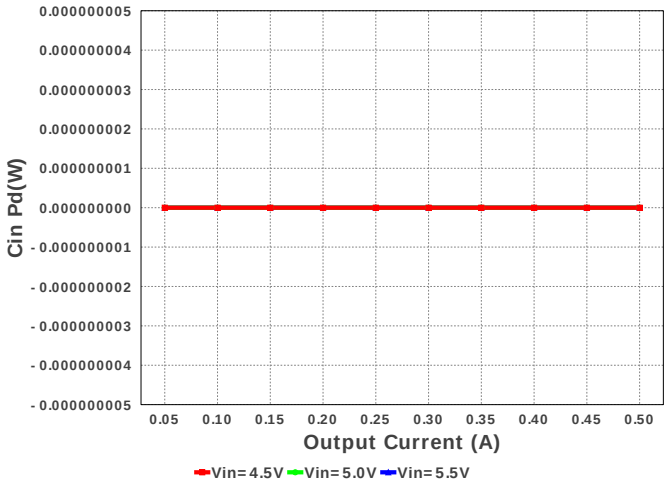
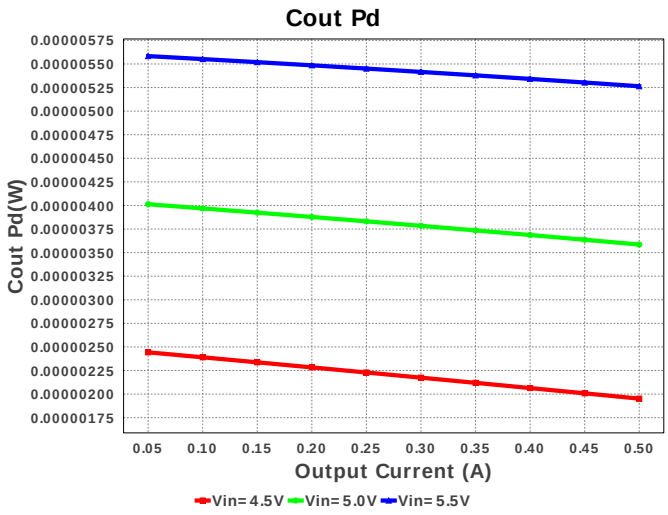


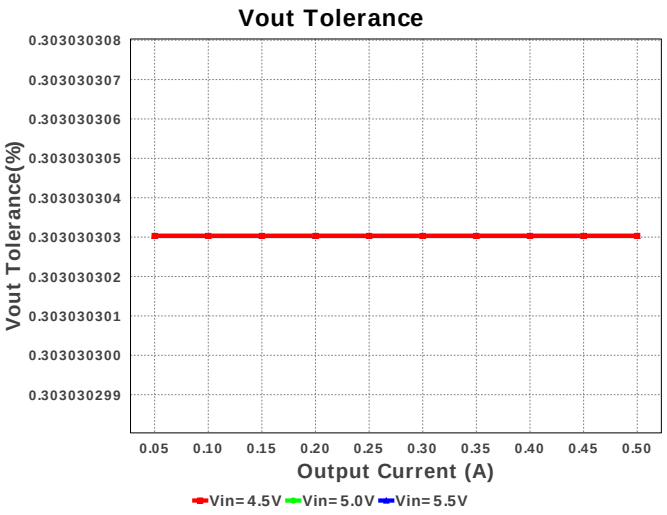
Vout p- p

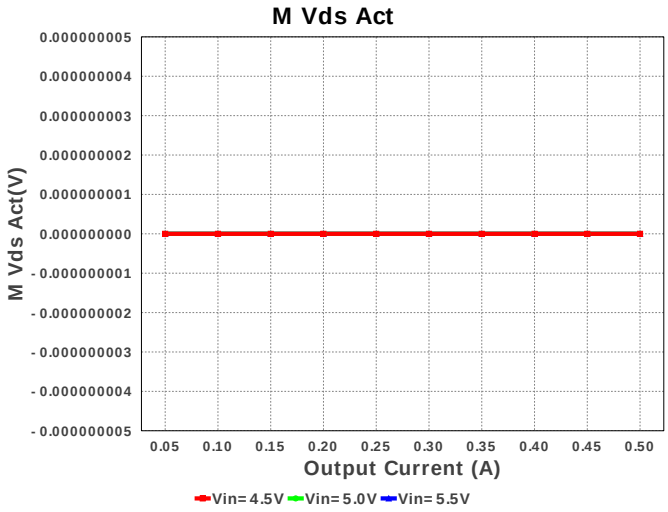


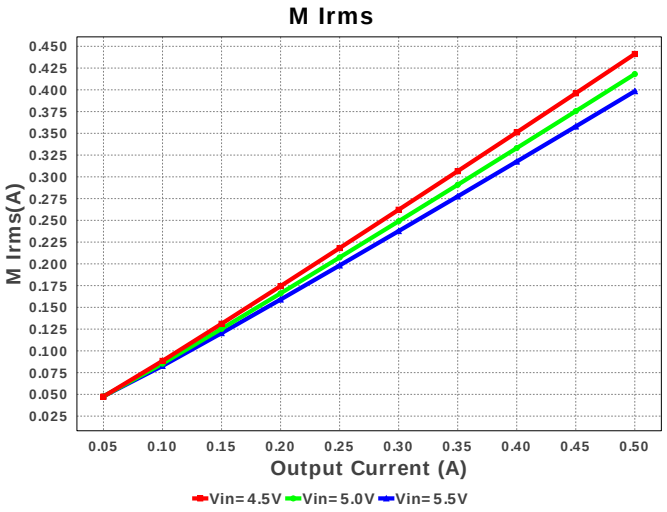
Cin Pd

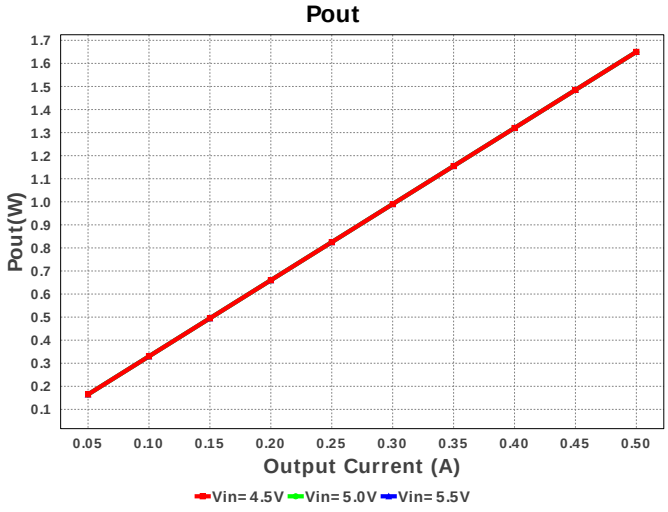


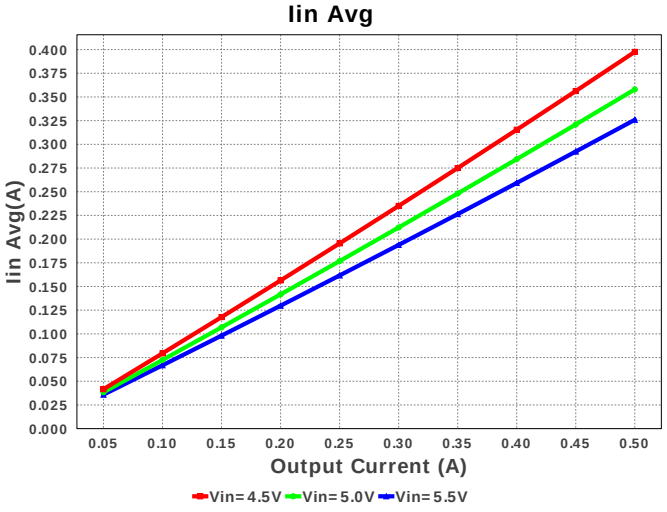


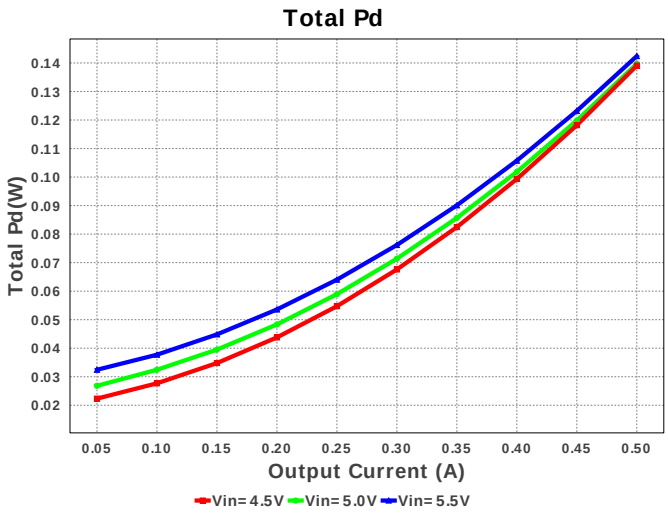


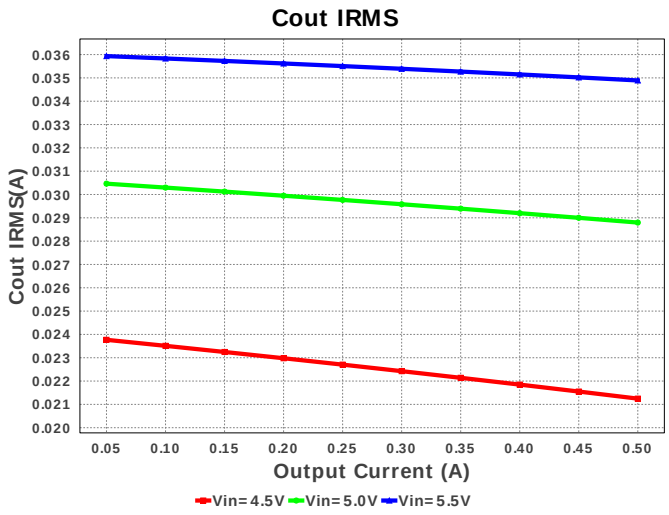


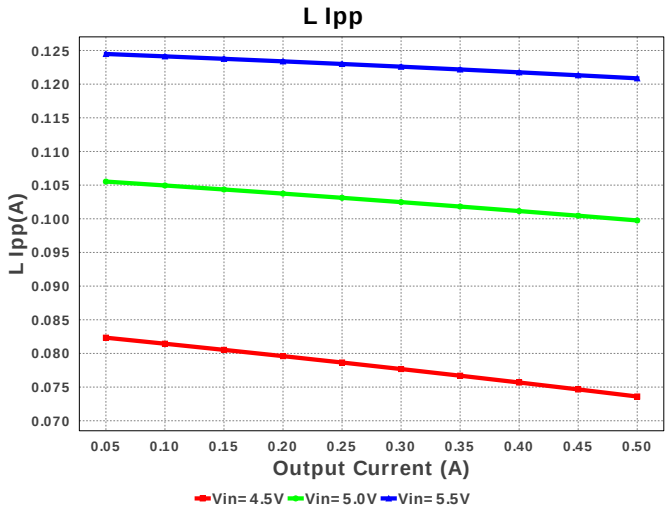


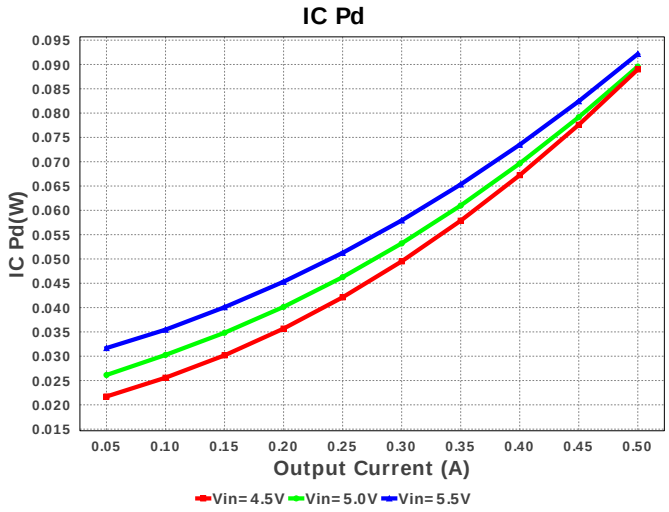


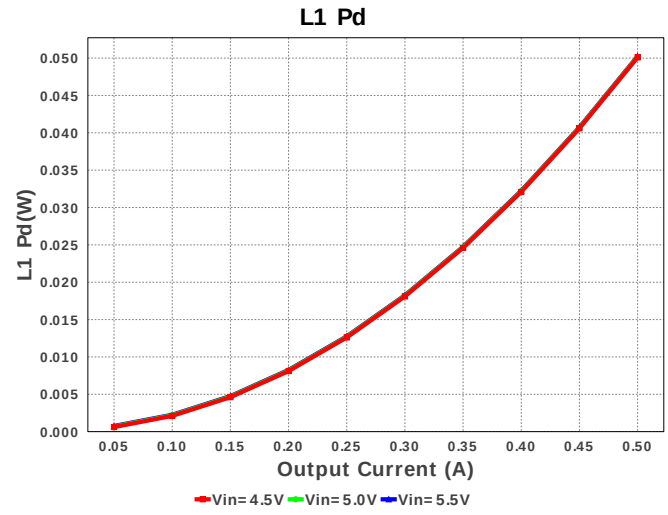


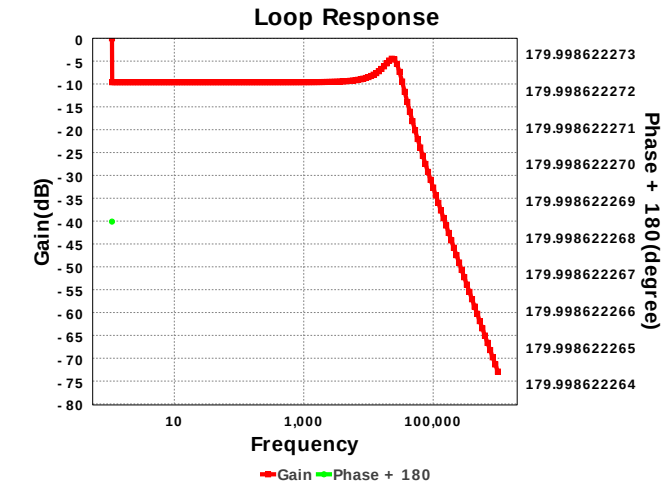












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	0.0 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	34.89 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	560.432 mA	Current	Peak switch current in IC
4.	Iin Avg	325.89 mA	Current	Average input current
5.	L Ipp	120.86 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	398.426 mA	Current	Q Iavg
7.	BOM Count	3	General	Total Design BOM count
8.	FootPrint	36.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	2.25 MHz	General	Switching frequency
10.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	0.0 V	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Pout	1.65 W	General	Total output power
13.	Total BOM	$0.9	General	Total BOM Cost
14.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	63.19 %	Op_point	Duty cycle
16.	Efficiency	92.055 %	Op_point	Steady state efficiency
17.	IC Tj	34.23 degC	Op_point	IC junction temperature
18.	ICThetaJA	45.9 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	500.0 mA	Op_point	Iout operating point
20.	VIN_OP	5.5 V	Op_point	Vin operating point
21.	Vout p-p	880.525 µV	Op_point	Peak-to-peak output ripple voltage
22.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
23.	Cout Pd	5.264 µW	Power	Output capacitor power dissipation
24.	IC Pd	92.158 mW	Power	IC power dissipation
25.	L Pd	50.243 mW	Power	Inductor power dissipation
26.	L1 Pd	50.243 mW	Power	Power Dissipation in the Inductor
27.	Total Pd	142.406 mW	Power	Total Power Dissipation
28.	Vout Tolerance	303.03 m%		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	VinMax	5.5	Maximum input voltage
3.	VinMin	4.5	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS62402/2	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS62402/2** Product Folder : http://www.ti.com/product/tps62402 : contains the data sheet and other resources.

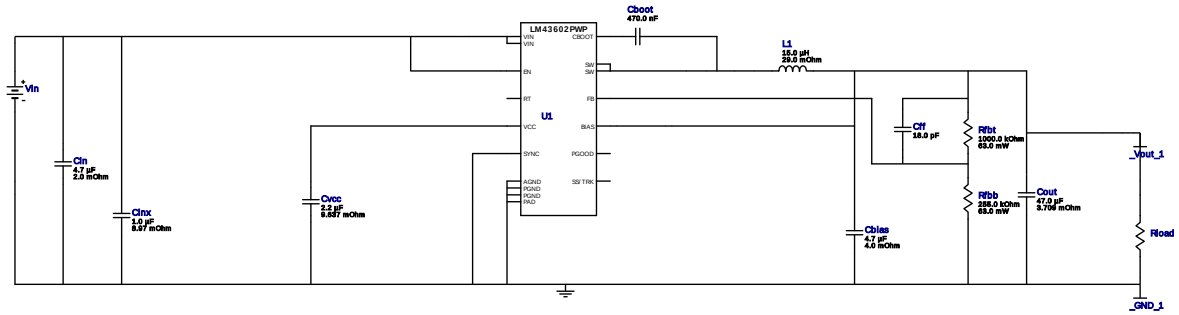
TEXAS INSTRUMENTS

WEBENCH® Design Report

Vout = 5.0V
Iout = 1.33A

Device = LM43602PWPR
Topology = Buck
Created = 4/4/16 6:27:19 PM
BOM Cost = $2.69
BOM Count = 11
Total Pd = 0.6W

Design : 3747628/25 LM43602PWPR
LM43602PWPR 18.0V-32.0V to 5.00V @ 1.32589A

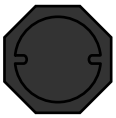


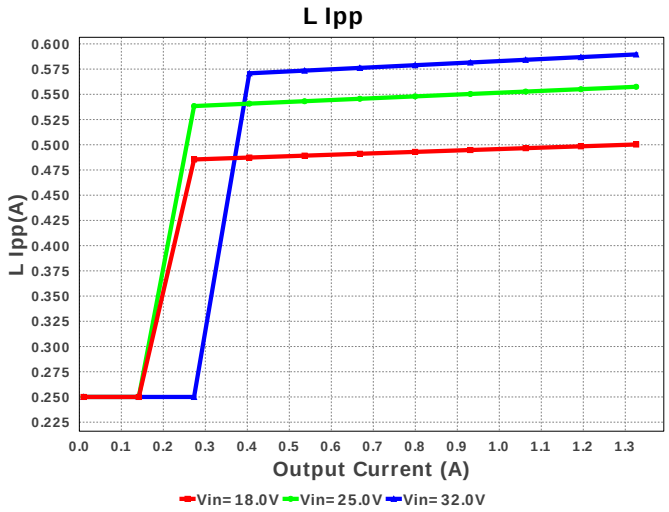
1. The input capacitor included in the BOM only contains a small filter capacitor that should be placed near the IC. Depending on where the power supply is laid out in the system additional bulk capacitance may need to be added to filter the line ripple.

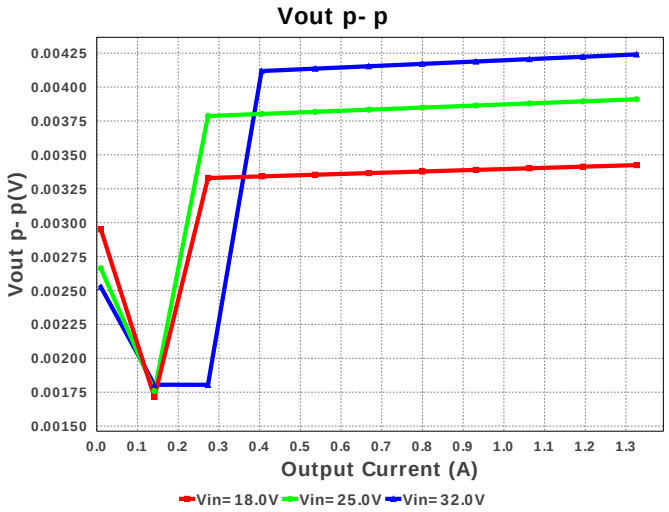
2. If there is no VinTyp specified, WEBENCH will use the VinMax value. To change the VinTyp value, click on the "Change Design Inputs" button under the Optimization Tuning knob. In some applications, while the design requires the input voltage to be a wide range, for a majority of the time, it is operating at a much lower voltage than the maximum input voltage. Sizing the inductor based on the maximum input voltage may yield an inductance much larger than typically needed, causing a larger footprint for the overall design. At the same time, components such as the input capacitor must be rated based on the maximum input voltage. WEBENCH now supports the use of this additional input voltage specification.

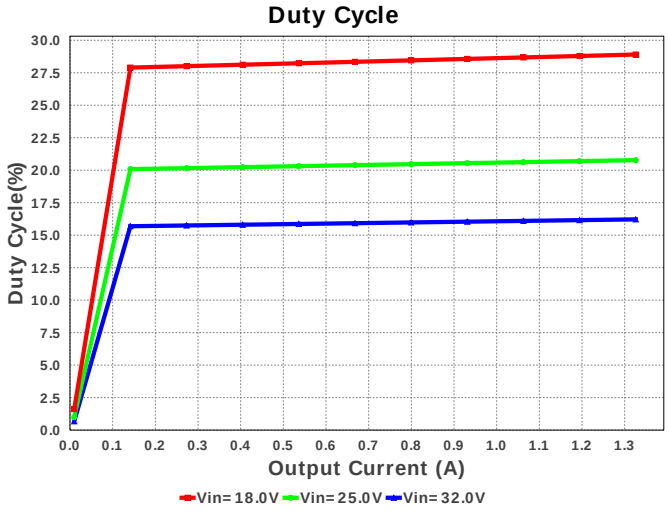
Electrical BOM

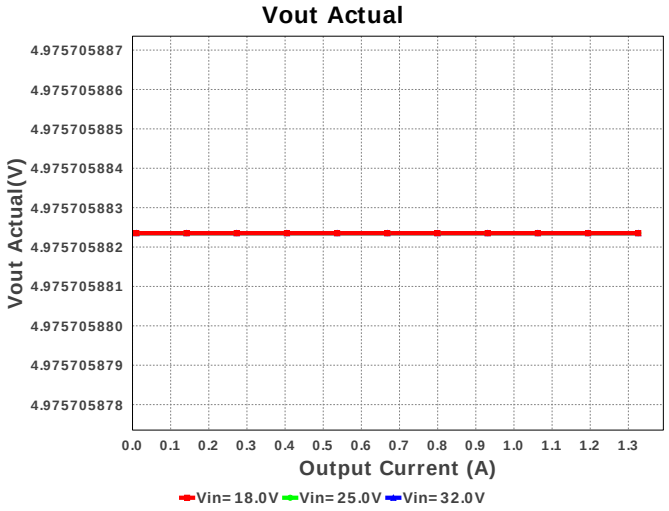
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbias	Kemet	C0805C475K8PACTU Series= X5R	Cap= 4.7 uF ESR= 4.0 mOhm VDC= 10.0 V IRMS= 9.89 A	1	$0.03	0805 7 mm^2
2.	Cboot	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Cff	Kemet	C0805C180M3GACTU Series= C0G/NP0	Cap= 18.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Cin	MuRata	GRM32ER71H475KA88L Series= X7R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 50.0 V IRMS= 5.35 A	1	$0.29	1210 15 mm^2
5.	Cinx	TDK	C3216X5R1H105K Series= X5R	Cap= 1.0 uF ESR= 8.97 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.02	1206 11 mm^2
6.	Cout	MuRata	GRM31CR61A476KE15L Series= X5R	Cap= 47.0 uF ESR= 3.709 mOhm VDC= 10.0 V IRMS= 4.2862 A	1	$0.21	1206_190 11 mm^2

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	Cvcc	MuRata	GRM188R60J225KE19D Series= X5R	Cap= 2.2 uF ESR= 9.637 mOhm VDC= 6.3 V IRMS= 1.32271 A	1	$0.02	 0603 5 mm^2
8.	L1	Bourns	SRU1048-150Y	L= 15.0 µH DCR= 29.0 mOhm	1	$0.33	 SRU1048 144 mm^2
9.	Rfbb	Vishay-Dale	CRCW0402255KFKED Series= CRCW..e3	Res= 255.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
10.	Rfbt	Vishay-Dale	CRCW04021M00FKED Series= CRCW..e3	Res= 1000.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
11.	U1	Texas Instruments	LM43602PWPR	Switcher	1	$1.75	 PWP0016F 59 mm^2

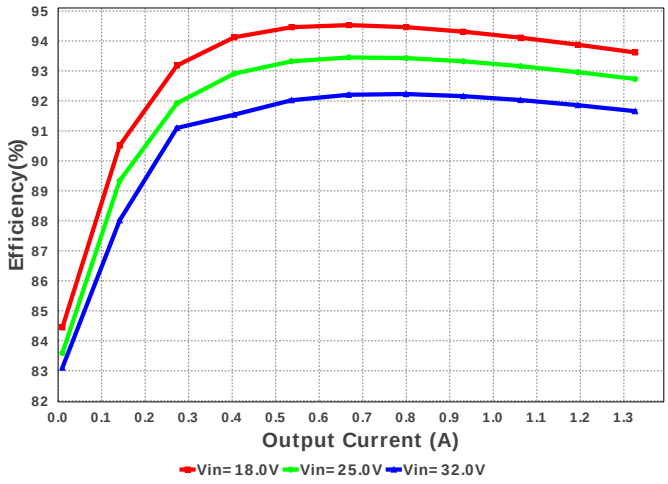




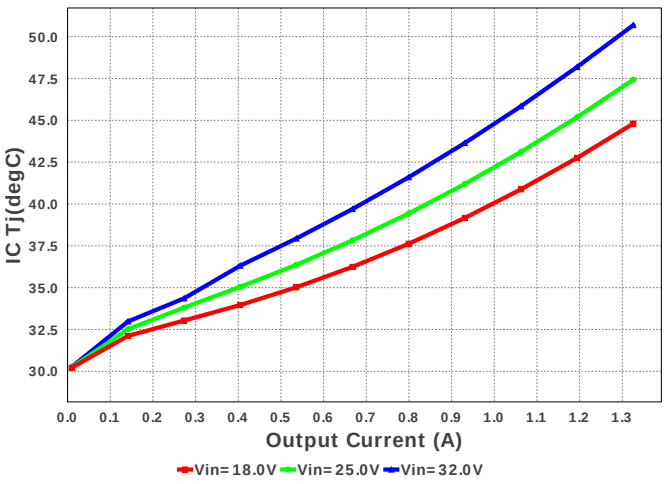




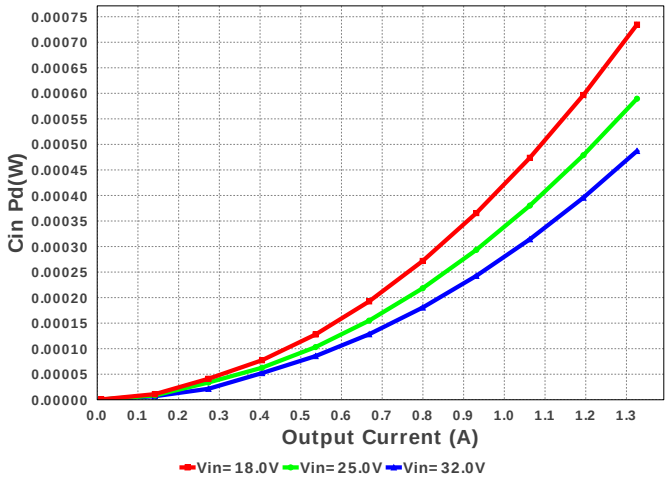
Efficiency



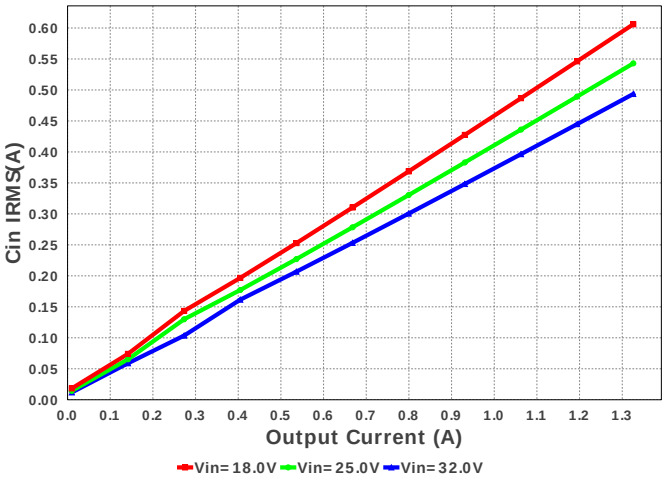
IC Tj



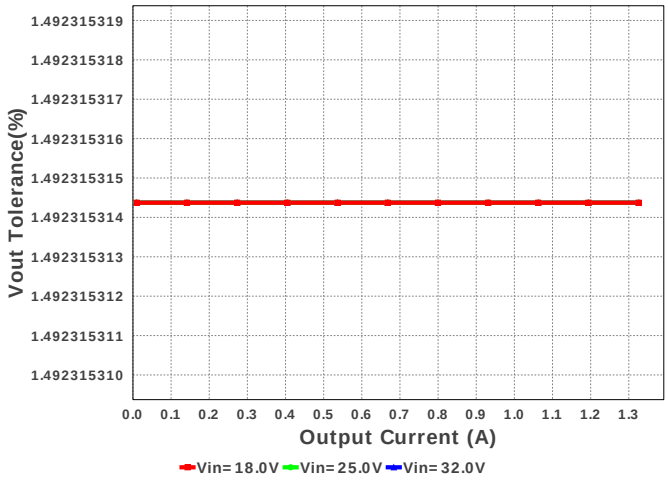
Cin Pd



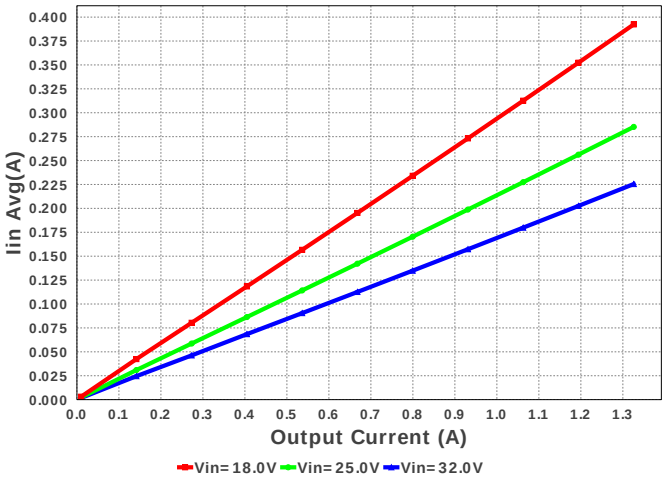
Cin IRMS

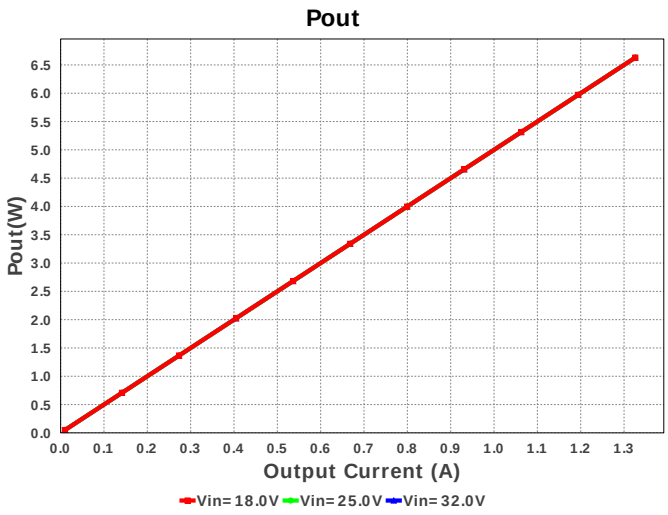


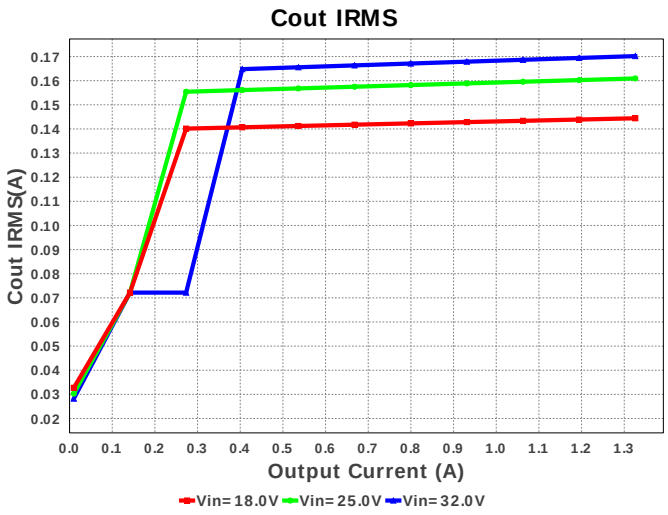
Vout Tolerance

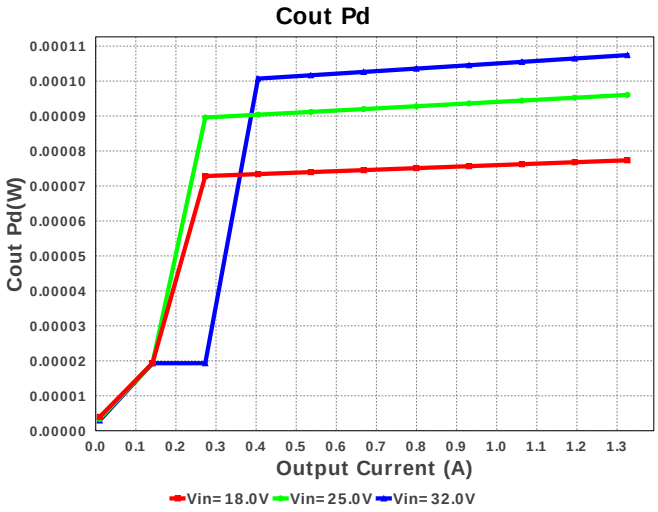


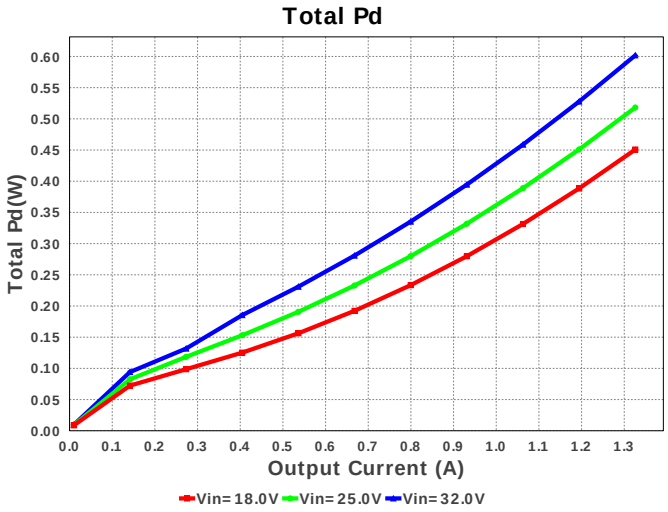
Iin Avg

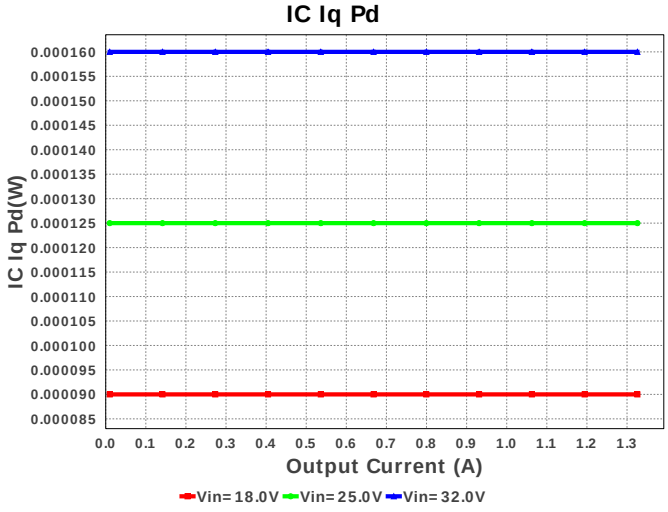


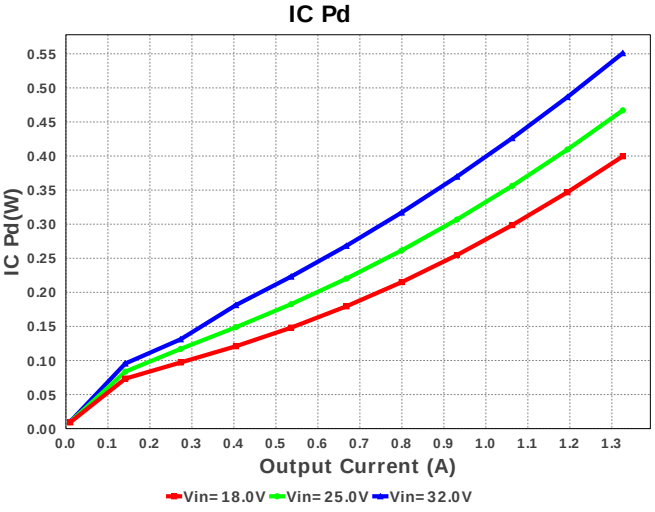


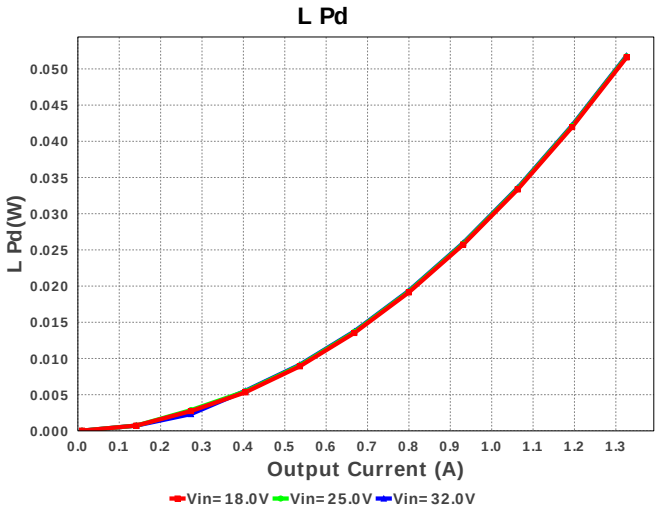


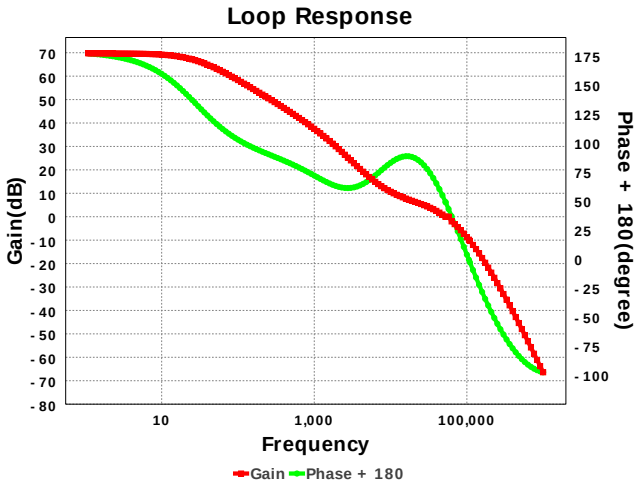


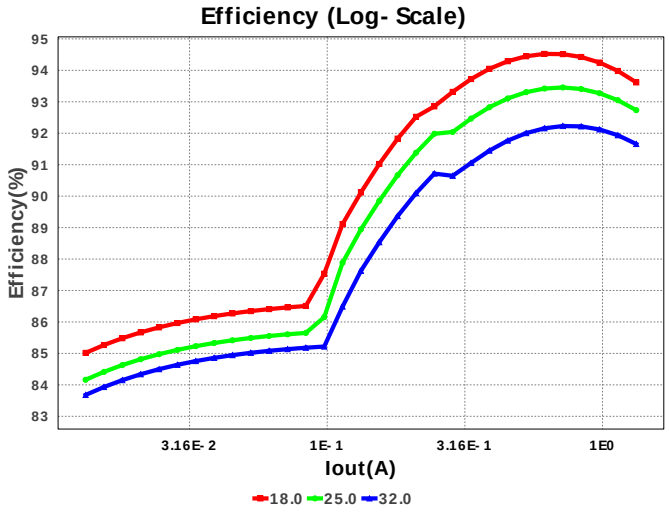












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	493.507 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	170.184 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	225.43 mA	Current	Average input current
4.	L Ipp	589.54 mA	Current	Peak-to-peak inductor ripple current
5.	BOM Count	11	General	Total Design BOM count
6.	FootPrint	267.0 mm^2	General	Total Foot Print Area of BOM components
7.	Frequency	500.0 kHz	General	Switching frequency
8.	Pout	6.629 W	General	Total output power
9.	Total BOM	$2.69	General	Total BOM Cost
10.	Low Freq Gain	69.694 dB	Op_Point	Gain at 10Hz
11.	Vout Actual	4.976 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
12.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
13.	Cross Freq	52.7 kHz	Op_point	Bode plot crossover frequency
14.	Duty Cycle	16.216 %	Op_point	Duty cycle
15.	Efficiency	91.658 %	Op_point	Steady state efficiency
16.	Gain Marg	-9.799 dB	Op_point	Bode Plot Gain Margin
17.	IC Tj	50.691 degC	Op_point	IC junction temperature
18.	ICThetaJA	38.9 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	1.326 A	Op_point	Iout operating point
20.	Phase Marg	49.487 deg	Op_point	Bode Plot Phase Margin
21.	VIN_OP	32.0 V	Op_point	Vin operating point
22.	Vout p-p	4.241 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	487.098 µW	Power	Input capacitor power dissipation
24.	Cout Pd	107.423 µW	Power	Output capacitor power dissipation
25.	IC Iq Pd	160.0 µW	Power	IC Iq Pd
26.	IC Pd	550.904 mW	Power	IC power dissipation
27.	L Pd	51.821 mW	Power	Inductor power dissipation
28.	Total Pd	601.772 mW	Power	Total Power Dissipation
29.	Vout Tolerance	1.492 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.326	Maximum Output Current
2.	VinMax	32.0	Maximum input voltage
3.	VinMin	18.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	LM43602	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **LM43602** Product Folder : http://www.ti.com/product/LM43602 : contains the data sheet and other resources.