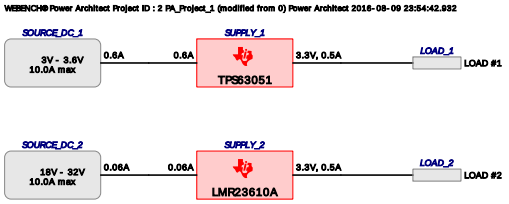
WEBENCH® Power Architect



Project Report

Project : 1783693/2 : PA_Project_1 (modified from 0)
Created : 2016-08-09 23:54:42.932
Optimize project optFactor=3

Project Summary

1.	Total System Efficiency	89.032 %
2.	Total System BOM Count	16.0
3.	Total System Footprint	219.0 mm2
4.	Total System BOM Cost	$2.87
5.	Total System Power Dissipation	408.3 mW

--> Launch WEBENCH Power Architect.

Sequencer Flag Table

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

Power Supplies

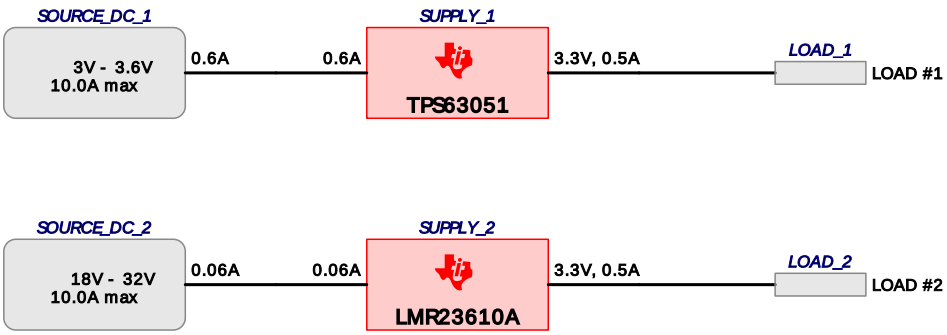
#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	TPS63051	Switcher : 1A Single Inductor Buck Boost with adjustable soft start	3.3 V	0.5 A	91%	44	$0.98	6	4
2.	SUPPLY_2	LMR23610A	Switcher : SIMPLE SWITCHER Step-Down Converter	3.3 V	0.5 A	87.1%	175	$1.89	7	9

Power Loads

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

Project Diagram

WEBENCH® Power Architect Project ID : 2 PA_Project_1 (modified from 0) Power Architect 2016-08-09 23:54:42.932



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm^2)
AVX	0402YC132KAT2A	0402	1	$0.05	3
Kemet	C0603C151K3GACTU	0603	1	$0.01	5
Vishay-Dale	CRCW0603100KFKEA	0603	1	$0.01	5
Panasonic	ERJ-6ENF2212V	0805	1	$0.01	7
MuRata	GRM188R60J106ME47D	0603	3	$0.02	14
MuRata	GRM188R60J225KE19D	0603	1	$0.02	5
MuRata	GRM31CR60J107ME39L	1206_190	1	$0.14	11
MuRata	GRM32ER71H475KA88L	1210	1	$0.19	15
Texas Instruments	LMR23610ADDAR	DDA0008E_N	1	$1.30	57
MuRata	LQM2HPN1R5MG0L	1008	1	$0.12	10
Yageo America	RC0603FR-0751KL	0603	1	$0.01	5
Bourns	SRN6045-220M	SRN6045	1	$0.16	64
Texas Instruments	TPS63051RMWR	RMW0012A	1	$0.74	12
Taiyo Yuden	UMK212B7474KG-T	0805	1	$0.05	7
Total			16	$2.87	219.03

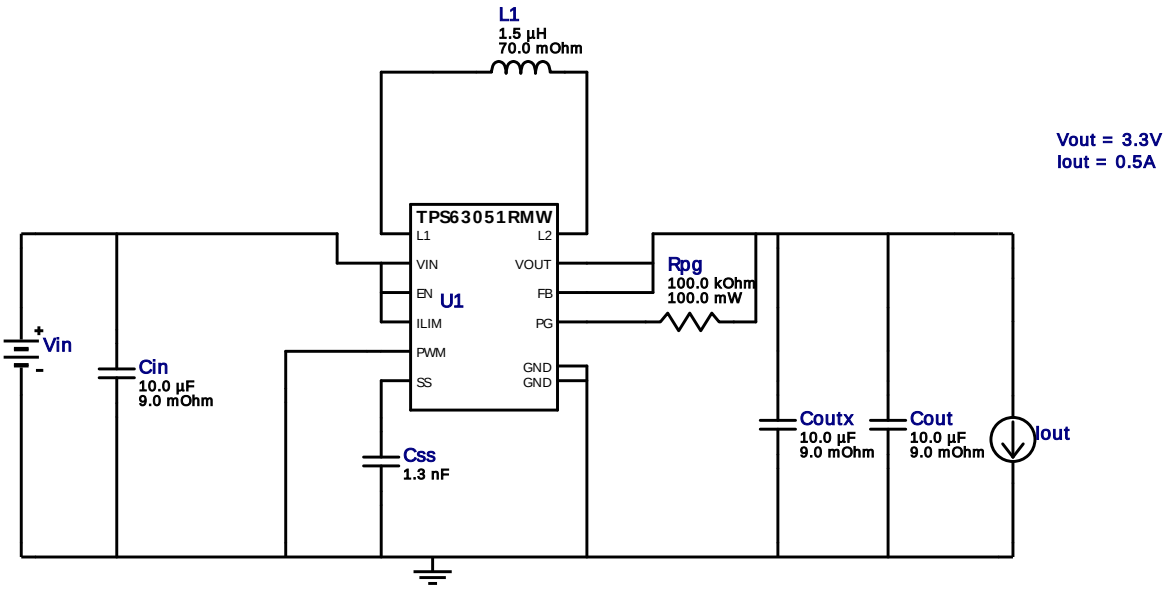
TEXAS INSTRUMENTS

WEBENCH® Design Report

Vout = 3.3V
Iout = 0.5A

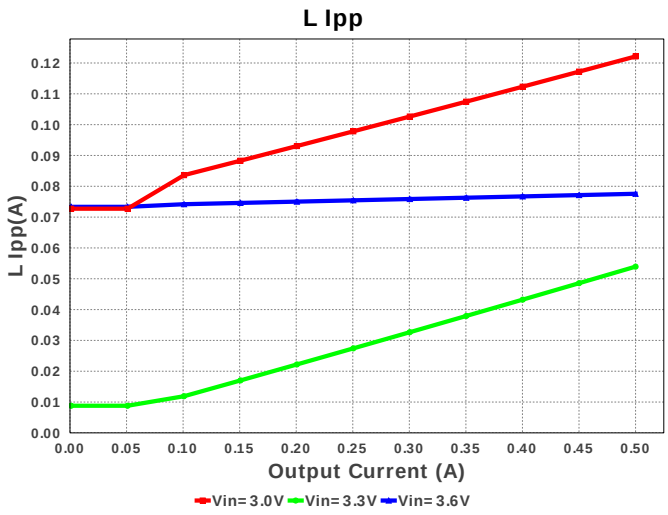
Device = TPS63051RMWR
Topology = Buck_Boost
Created = 8/9/16 11:54:42 PM
BOM Cost = $0.98
BOM Count = 7
Total Pd = 0.16W

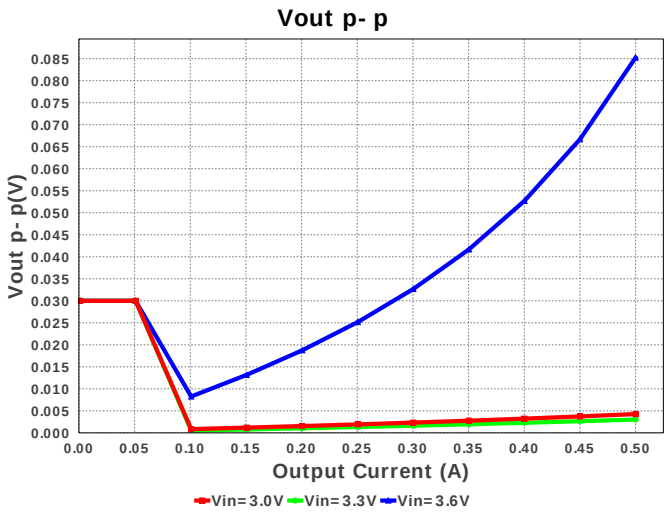
Design : 1783693/6 TPS63051RMWR
TPS63051RMWR 3.0V-3.6V to 3.30V @ 0.5A

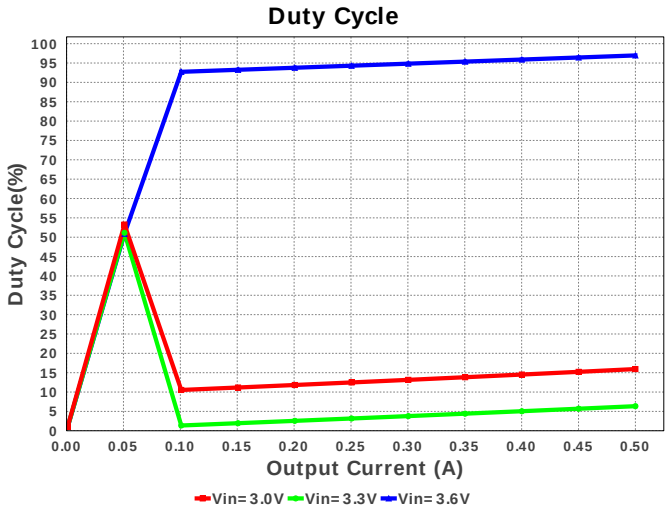


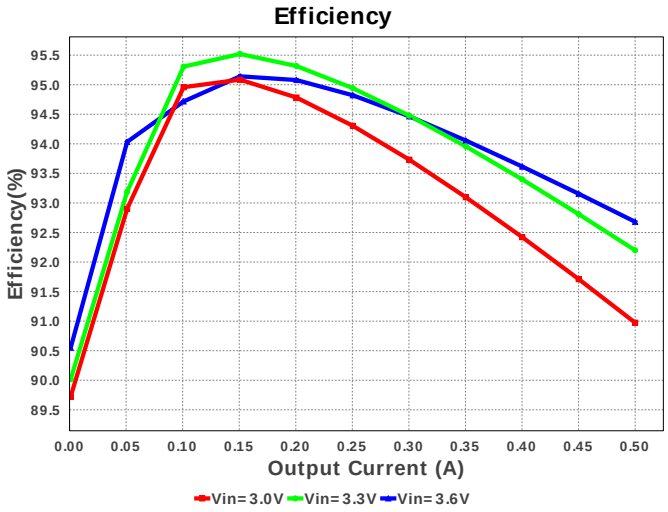
Electrical BOM

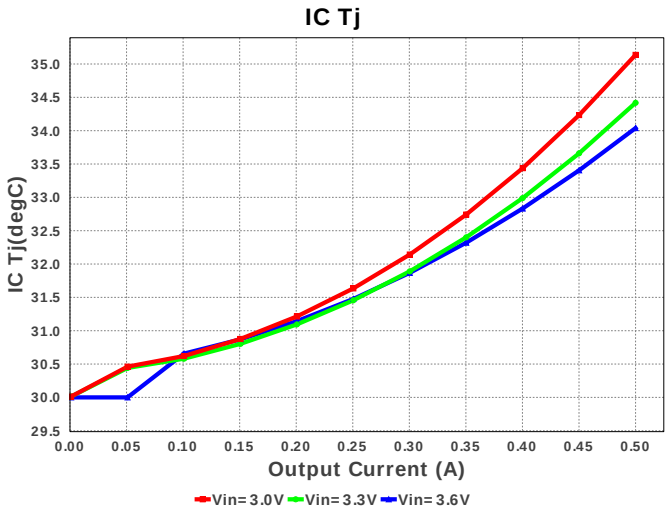
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	1	$0.02	0603 5 mm²
2.	Cout	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	1	$0.02	0603 5 mm²
3.	Coutx	MuRata	GRM188R60J106ME47D Series= X5R	Cap= 10.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 2.74 A	1	$0.02	0603 5 mm²
4.	Css	AVX	0402YC132KAT2A Series= X7R	Cap= 1.3 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.05	0402 3 mm²
5.	L1	MuRata	LQM2HPN1R5MG0L	L= 1.5 µH DCR= 70.0 mOhm	1	$0.12	1008 10 mm²
6.	Rpg	Vishay-Dale	CRCW0603100KFKEA Series= CRCW..e3	Res= 100.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
7.	U1	Texas Instruments	TPS63051RMWR	Switcher	1	$0.74	RMW0012A 12 mm²

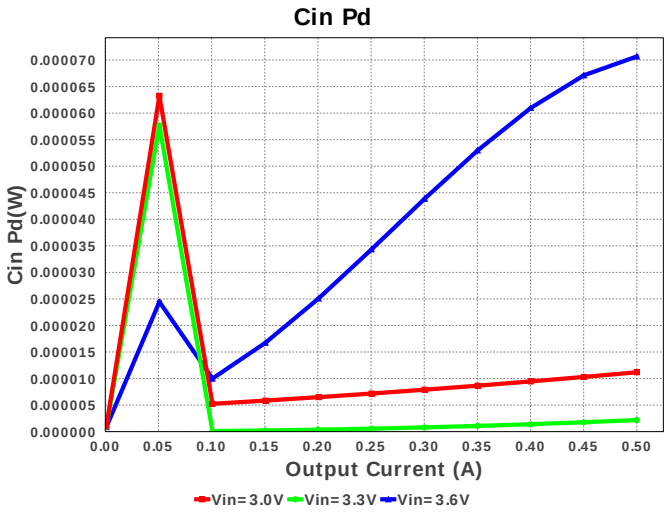




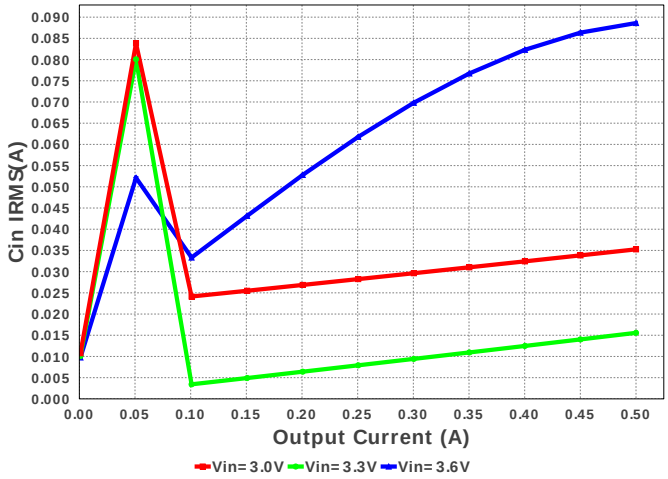




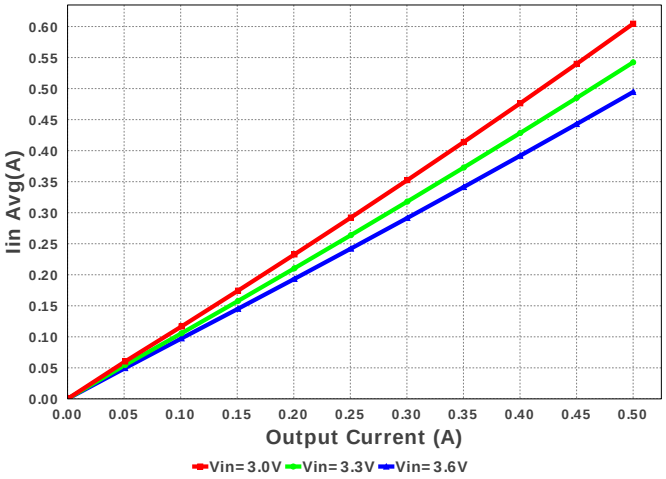




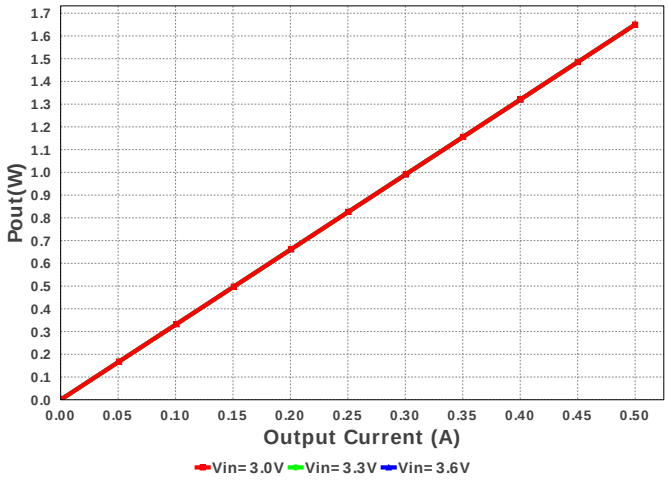
Cin IRMS



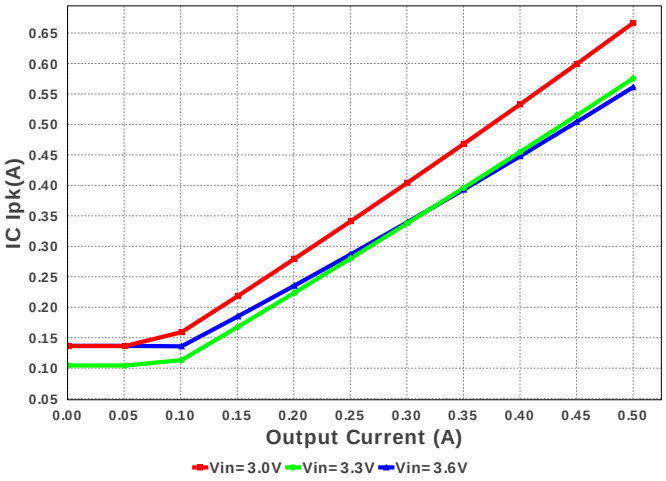
Iin Avg



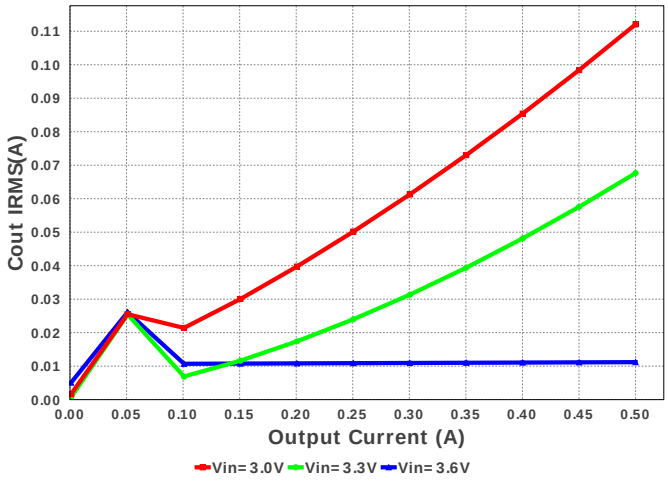
Pout



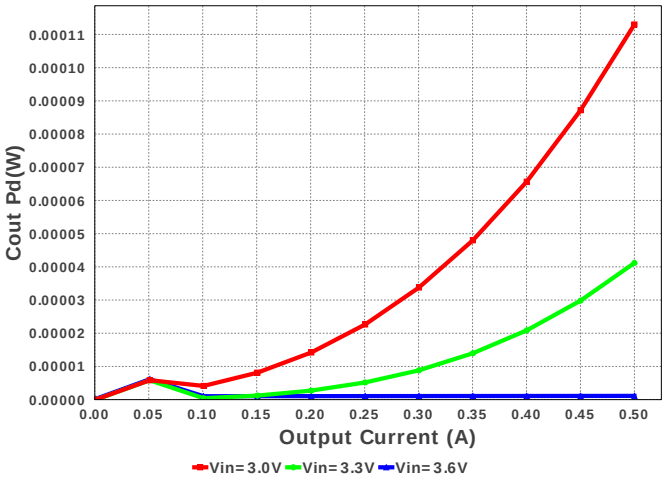
IC Ipk

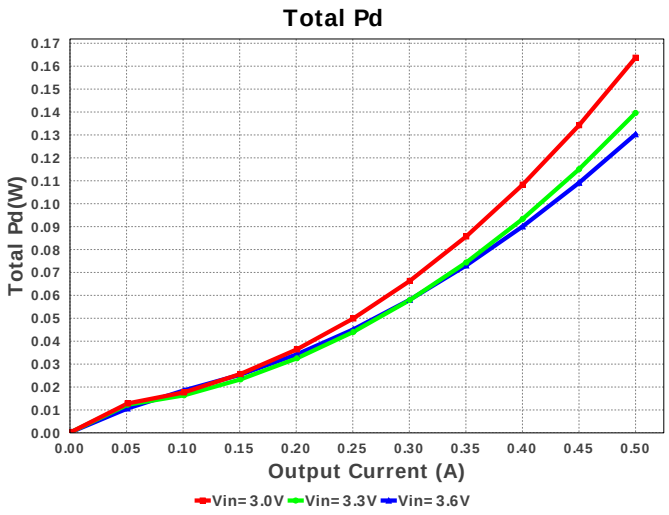


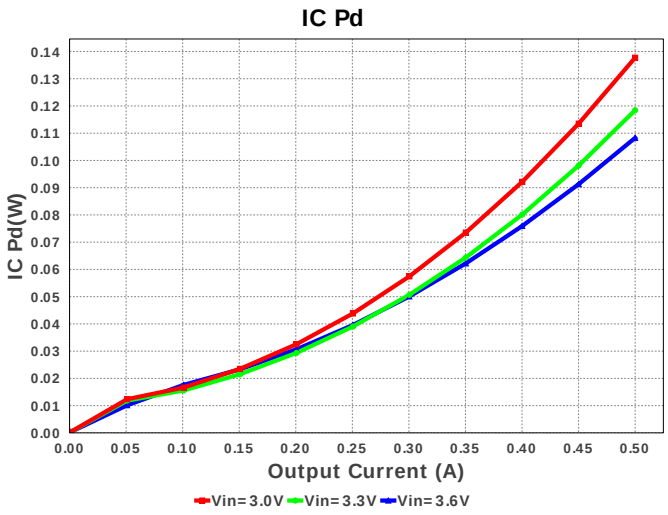
Cout IRMS

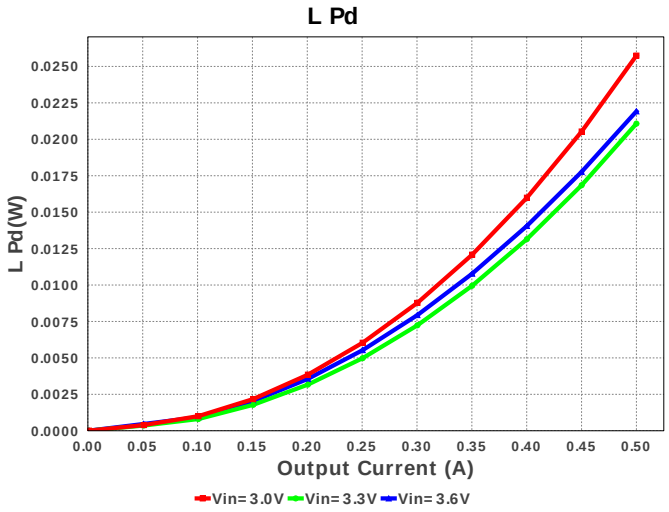


Cout Pd









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	35.253 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	112.031 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	666.365 mA	Current	Peak switch current in IC
4.	Iin Avg	604.48 mA	Current	Average input current
5.	L Ipp	122.12 mA	Current	Peak-to-peak inductor ripple current
6.	BOM Count	7	General	Total Design BOM count
7.	FootPrint	44.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	2.5 MHz	General	Switching frequency
9.	Mode	BOOST PWM CCM	General	PWM/PFM Mode
10.	Pout	1.65 W	General	Total output power
11.	Total BOM	$0.98	General	Total BOM Cost
12.	Duty Cycle	15.935 %	Op_point	Duty cycle
13.	Efficiency	90.987 %	Op_point	Steady state efficiency
14.	IC Tj	35.136 degC	Op_point	IC junction temperature
15.	ICThetaJA	37.3 degC/W	Op_point	IC junction-to-ambient thermal resistance
16.	IOUT_OP	500.0 mA	Op_point	Iout operating point
17.	VIN_OP	3.0 V	Op_point	Vin operating point
18.	Vout p-p	1.868 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	11.185 µW	Power	Input capacitor power dissipation
20.	Cout Pd	0.0 W	Power	Output capacitor power dissipation
21.	IC Pd	137.685 mW	Power	IC power dissipation
22.	L Pd	25.735 mW	Power	Inductor power dissipation
23.	Total Pd	163.445 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	VinMax	3.6	Maximum input voltage
3.	VinMin	3.0	Minimum input voltage
4.	Vout	3.3	Output Voltage

#	Name	Value	Description
5.	base_pn	TPS63051	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. TPS63051 Product Folder : http://www.ti.com/product/TPS63051 : contains the data sheet and other resources.

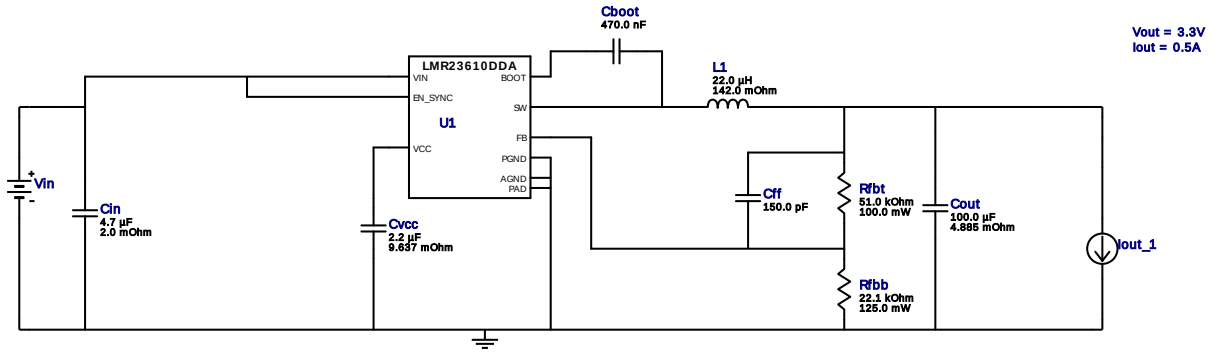
TEXAS INSTRUMENTS

WEBENCH® Design Report

Vout = 3.3V
Iout = 0.5A

Device = LMR23610ADDAR
Topology = Buck
Created = 8/9/16 11:54:42 PM
BOM Cost = $1.89
BOM Count = 9
Total Pd = 0.24W

Design : 1783693/7 LMR23610ADDAR
LMR23610ADDAR 18.0V-32.0V to 3.30V @ 0.5A



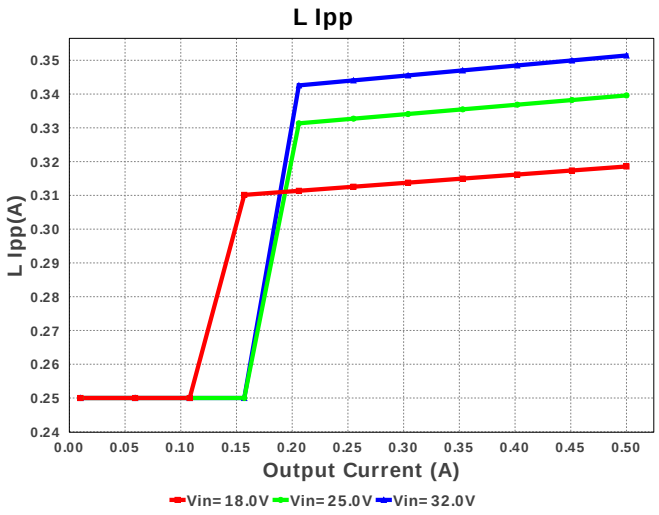
1. The input capacitor included in the BOM only contains a small filter capacitor that should be placed near the IC. Depending on where the power supply is laid out in the system additional bulk capacitance may need to be added to filter the line ripple.

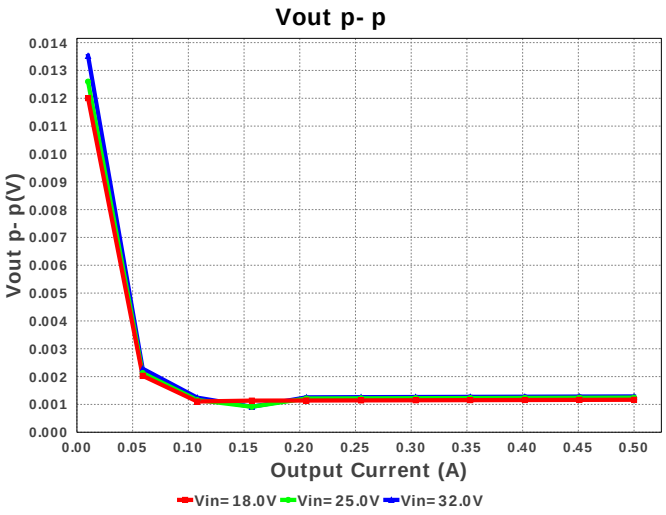
2. If there is no VinTyp specified, WEBENCH will use the VinMax value. To change the VinTyp value, click on the "Change Design Inputs" button under the Optimization Tuning knob. In some applications, while the design requires the input voltage to be a wide range, for a majority of the time, it is operating 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.

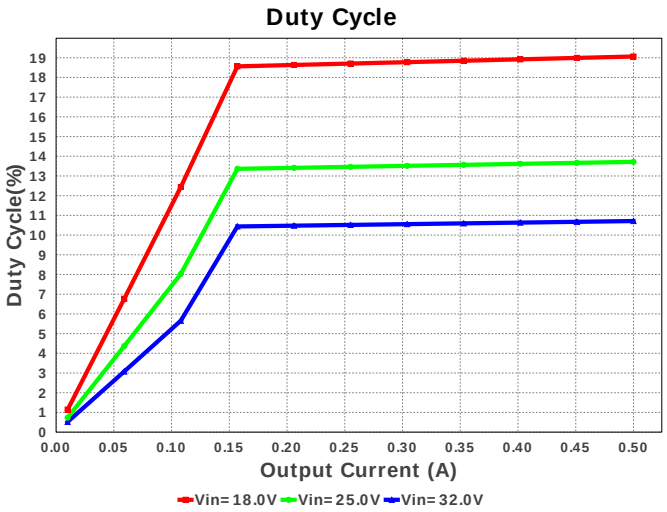
Electrical BOM

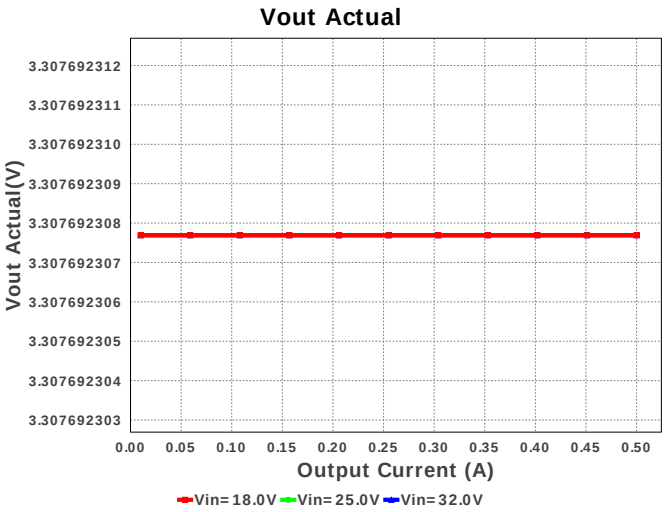
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	Taiyo Yuden	UMK212B7474KG-T Series= X7R	Cap= 470.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.05	0805 7 mm²
2.	Cff	Kemet	C0603C151K3GACTU Series= C0G/NP0	Cap= 150.0 pF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
3.	Cin	MuRata	GRM32ER71H475KA88L Series= X7R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 50.0 V IRMS= 5.35 A	1	$0.19	1210 15 mm²
4.	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
5.	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 mm²
6.	L1	Bourns	SRN6045-220M	L= 22.0 µH DCR= 142.0 mOhm	1	$0.16	SRN6045 64 mm²
7.	Rfbb	Panasonic	ERJ-6ENF2212V Series= ERJ-6E	Res= 22.1 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	0805 7 mm²
8.	Rfbt	Yageo America	RC0603FR-0751KL Series= ?	Res= 51.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²

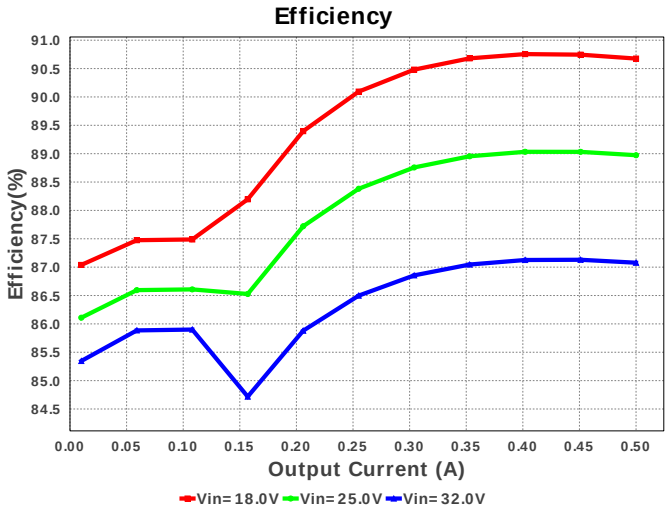
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	U1	Texas Instruments	LMR23610ADDAR	Switcher	1	$1.30	DDA0008E_N 57 mm^2

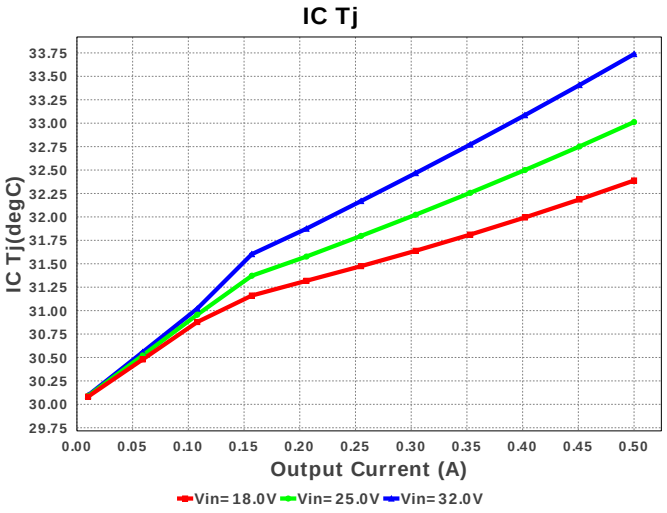


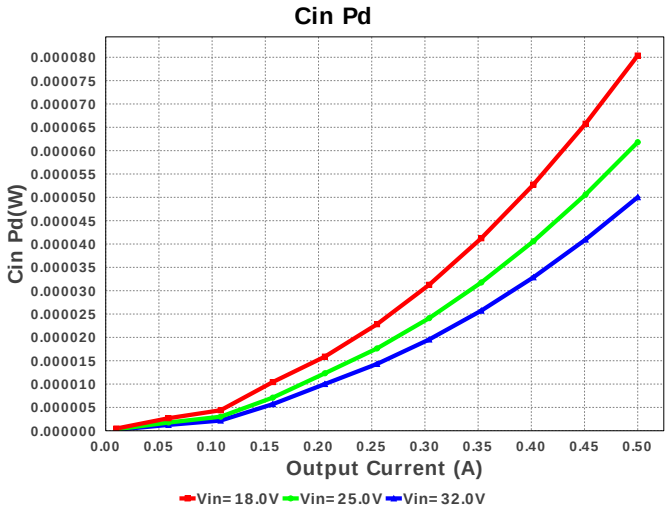


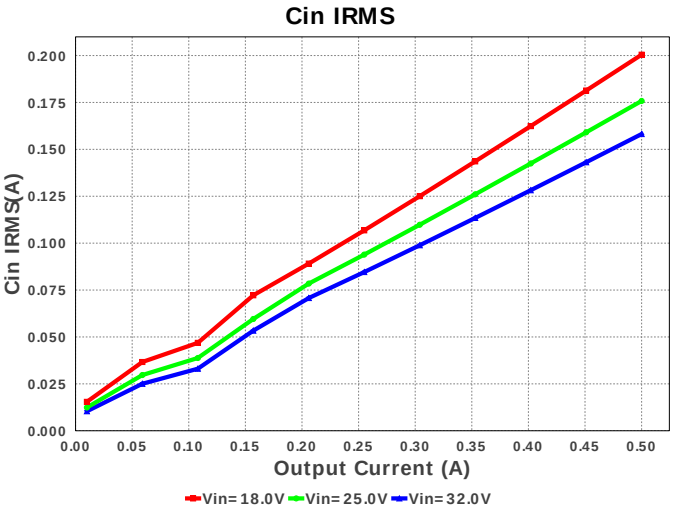


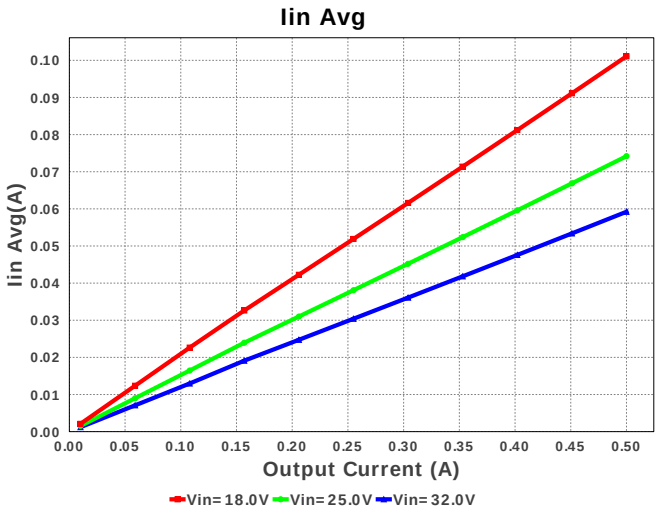


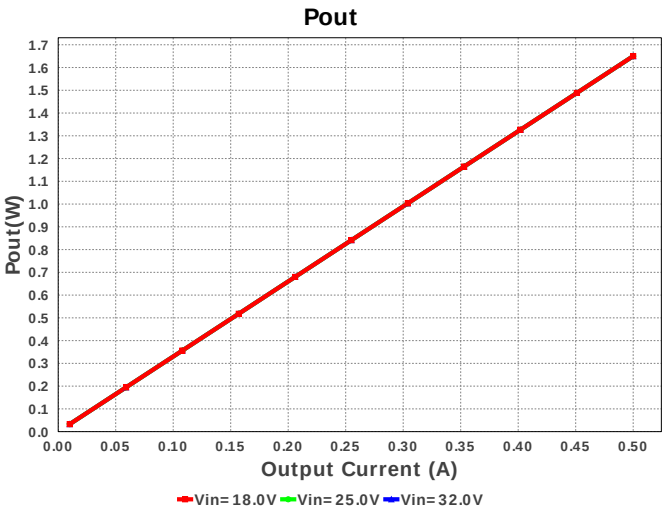


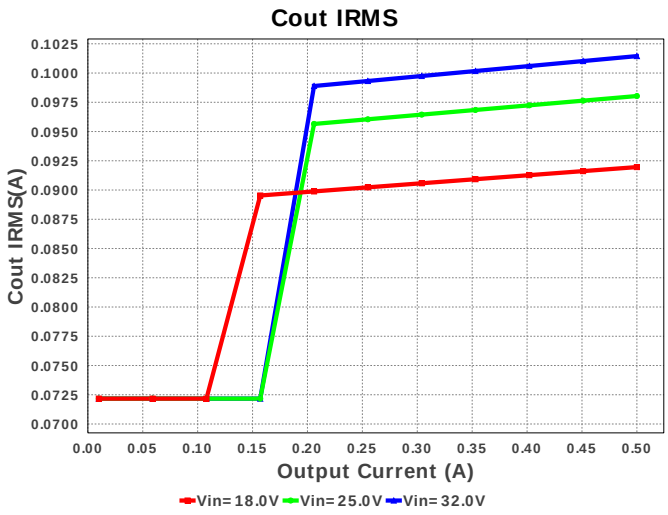


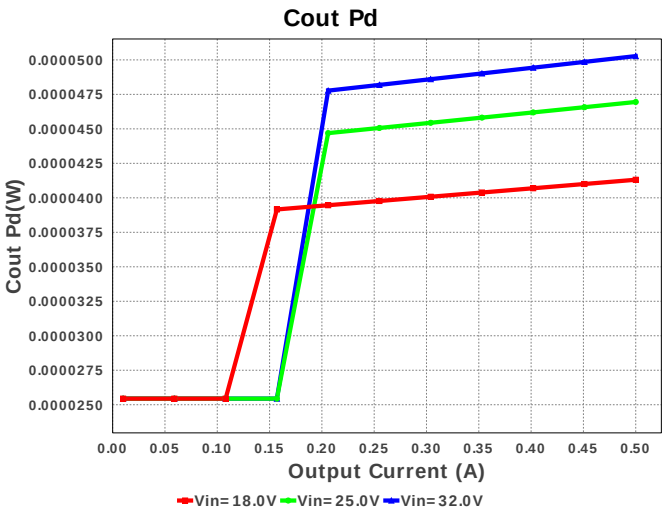


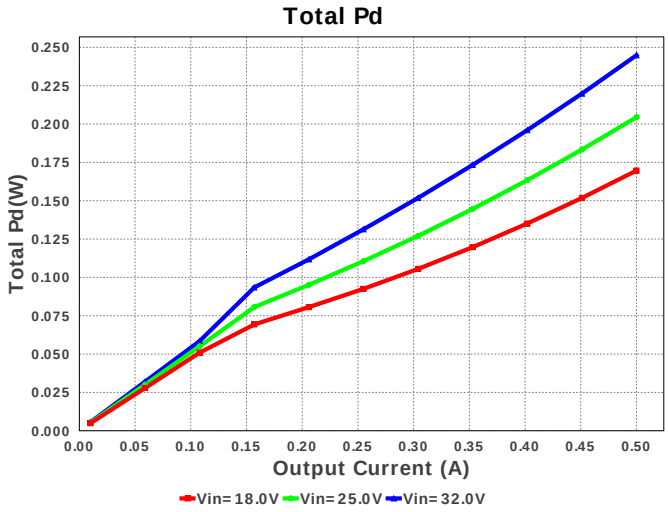


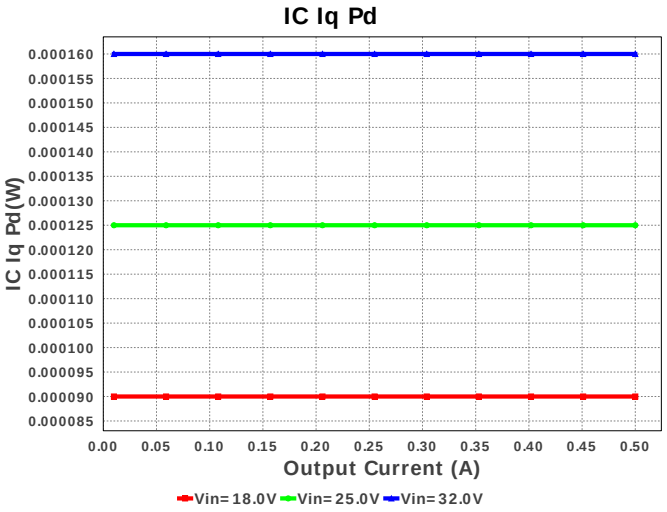


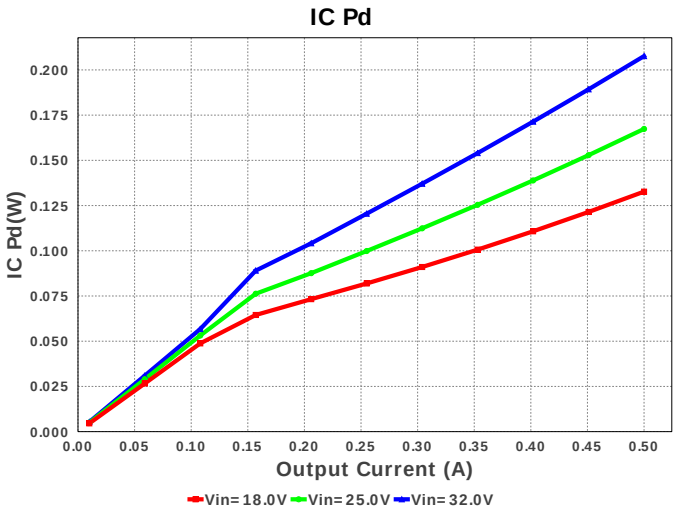


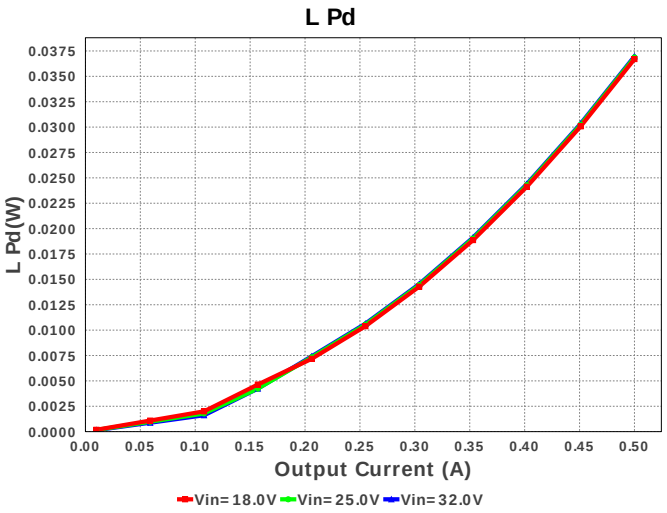


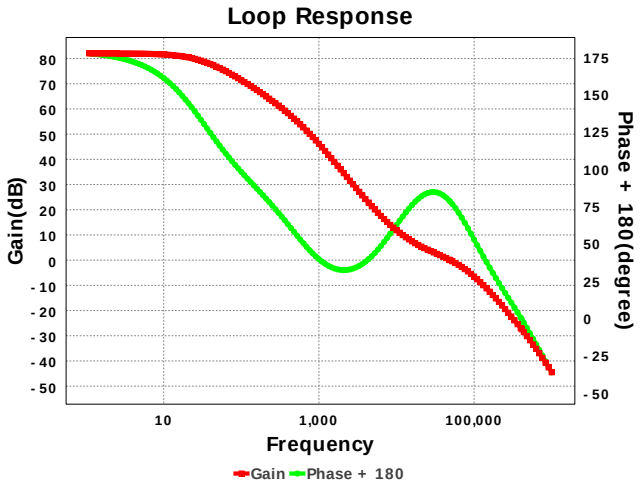


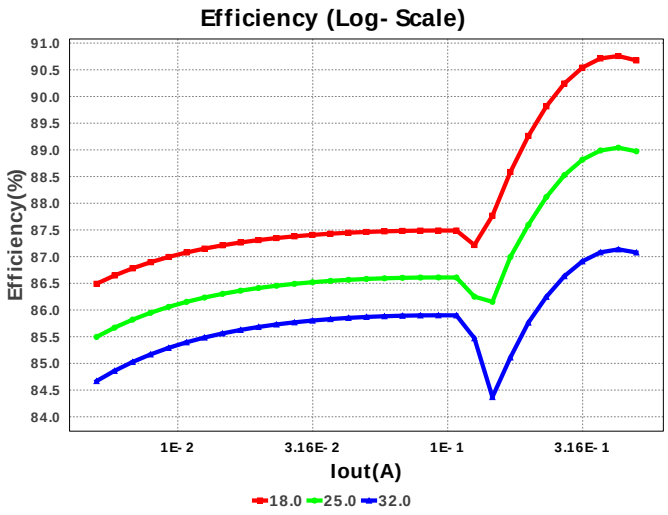












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	158.159 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	101.448 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	59.214 mA	Current	Average input current
4.	L Ipp	351.43 mA	Current	Peak-to-peak inductor ripple current
5.	BOM Count	9	General	Total Design BOM count
6.	FootPrint	175.0 mm^2	General	Total Foot Print Area of BOM components
7.	Frequency	400.0 kHz	General	Switching frequency
8.	Mode	CCM	General	Conduction Mode
9.	Pout	1.65 W	General	Total output power
10.	Total BOM	$1.89	General	Total BOM Cost
11.	ICThetaJA Effective	18.0 degC/W	Op_Point	Effective IC Junction-to-Ambient Thermal Resistance
12.	Low Freq Gain	82.023 dB	Op_Point	Gain at 10Hz
13.	Vout Actual	3.308 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
14.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
15.	Cross Freq	49.216 kHz	Op_point	Bode plot crossover frequency
16.	Duty Cycle	10.712 %	Op_point	Duty cycle
17.	Efficiency	87.078 %	Op_point	Steady state efficiency
18.	Gain Marg	-27.436 dB	Op_point	Bode Plot Gain Margin
19.	IC Tj	33.737 degC	Op_point	IC junction temperature
20.	IOUT_OP	500.0 mA	Op_point	Iout operating point
21.	Phase Marg	78.676 deg	Op_point	Bode Plot Phase Margin
22.	VIN_OP	32.0 V	Op_point	Vin operating point
23.	Vout p-p	1.288 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	50.029 µW	Power	Input capacitor power dissipation
25.	Cout Pd	50.275 µW	Power	Output capacitor power dissipation
26.	IC Iq Pd	160.0 µW	Power	IC Iq Pd
27.	IC Pd	207.635 mW	Power	IC power dissipation
28.	L Pd	36.961 mW	Power	Inductor power dissipation
29.	Total Pd	244.852 mW	Power	Total Power Dissipation
30.	Vout Tolerance	3.438 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	VinMax	32.0	Maximum input voltage
3.	VinMin	18.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	LMR23610A	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. LMR23610A Product Folder : http://www.ti.com/product/LMR23610 : contains the data sheet and other resources.