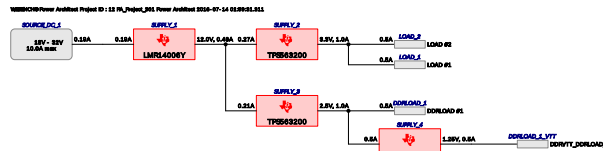


WEBENCH® Power Architect



Project Report

Project : 4354344/12 : PA_Project_301

Created : 2016-07-14 01:59:31.311

Optimize project optFactor=3

Project Summary

1. Total System Efficiency	76.388 %
2. Total System BOM Count	27.0
3. Total System Footprint	549.0 mm2
4. Total System BOM Cost	\$5.51
5. Total System Power Dissipation	1.6 W

--> Launch WEBENCH Power Architect.

My Comments

No comments

Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_2	0	LOAD_2	LOAD #2
SUPPLY_2	0	LOAD_1	LOAD #1
SUPPLY_3	0	DDRLOAD_1	DDRLOAD #1
SUPPLY_4	0	DDRLOAD_1_VTT	DDRVTT_DDRLOAD_1
SUPPLY_1	NA		

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	LMR14006Y	Switcher : Wide Vin device	12.0 V	0.48 A	93.1%	117	\$1.56	57	16
2.	SUPPLY_2	TPS563200	Switcher : 17V, 3A,6-pin, Low Iq Synchronous buck converter with Advanced Eco-mode	3.3 V	1.0 A	92.3%	149	\$1.27	54	4
3.	SUPPLY_3	TPS563200	Switcher : 17V, 3A,6-pin, Low Iq Synchronous buck converter with Advanced Eco-mode	2.5 V	1.0 A	90.8%	149	\$1.06	56	11
4.	SUPPLY_4	LP2996-N	DDRLDO : DDR1,DDR2	1.25 V	0.5 A	99.9%	87	\$1.21	55	9

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD #2	3.3 V	0.5 A	VoutRipple=10%
2.	LOAD #1	3.3 V	0.5 A	VoutRipple=10%
3.	DDRLOAD #1	2.5 V	0.5 A	VoutRipple=10%
4.	DDRVTT_DDRLOAD_1	1.25 V	0.5 A	VoutRipple=10%

Project Diagram



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
AVX	08053C104KAT2A	0805	2	\$0.01	14
Panasonic	25SVPG15M	CAPSMT_62_B45	1	\$0.43	53
Panasonic	2R5TPE220MAFB	CAPSMT_6_B2S	1	\$0.50	17
Kemet	C0805C104K5RACTU	0805	1	\$0.01	7
TDK	C3216JB1A476M	1206	1	\$0.34	11
TDK	C3216X6S0G476M	1206	1	\$0.13	11
TDK	C3225X7R2A225K230AB	1210_250	1	\$0.19	15
Vishay-Dale	CRCW040210K0FKED	0402	2	\$0.01	6
Vishay-Dale	CRCW040222K6FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040233K2FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04026K04FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040288K7FKED	0402	1	\$0.01	3
MuRata	GRM155R60J103KA01D	0402	1	\$0.01	3
MuRata	GRM155R60J104KA01D	0402	1	\$0.01	3
MuRata	GRM32ER61E226KE15L	1210	2	\$0.16	29
Taiyo Yuden	JMK212BJ476MG-T	0805	1	\$0.14	7
Texas Instruments	LMR14006YDDCR	MK06A	1	\$1.10	11
Texas Instruments	LP2996MRX/NOPB	DDA0008A	1	\$0.55	57
NXP Semiconductor	PMEG6010CEH,115	SOD-123F	1	\$0.04	12
Bourns	SDR0604-390KL	SDR0604	1	\$0.18	61
Bourns	SRN8040-2R2Y	SRN8040	2	\$0.22	200
Texas Instruments	TPS563200DDCR	DDC0006A	2	\$0.52	21
Total			27	\$558.7254999999999	

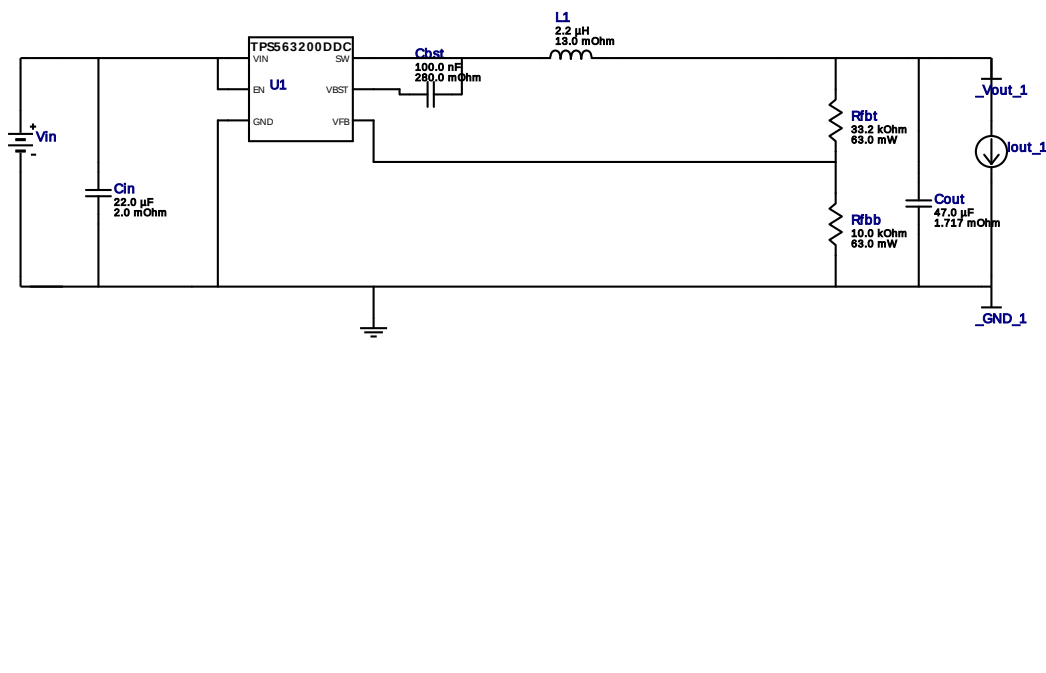


Vout = 3.3V
Iout = 1.0A

Device = TPS563200DDCR
Topology = Buck
Created = 7/14/16 1:59:29 AM
BOM Cost = \$1.27
BOM Count = 7
Total Pd = 0.28W

WEBENCH® Design Report

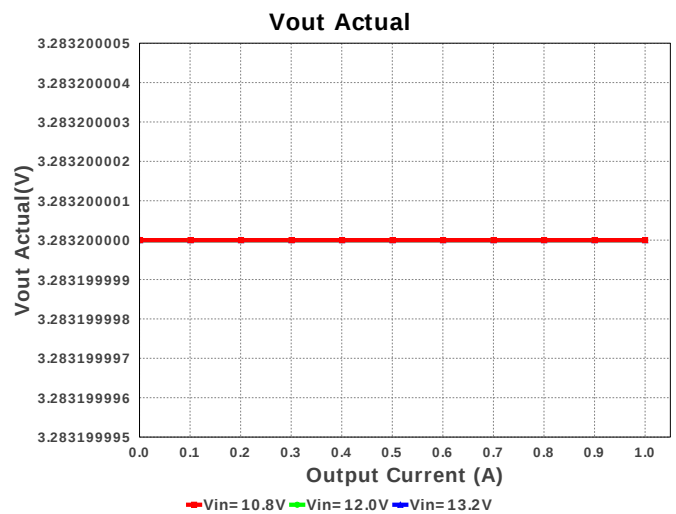
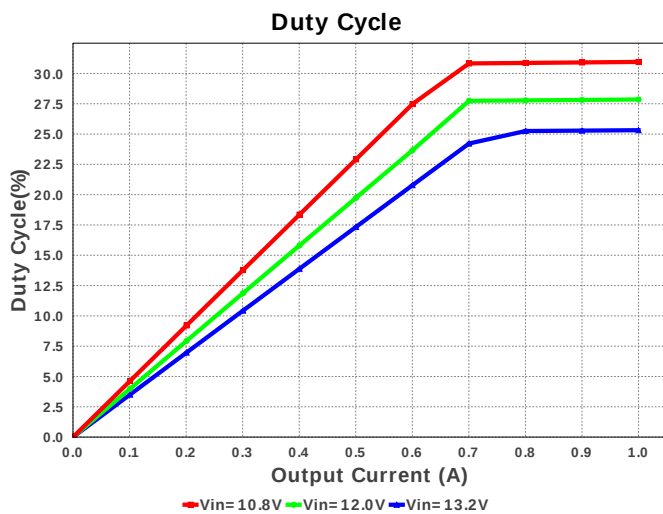
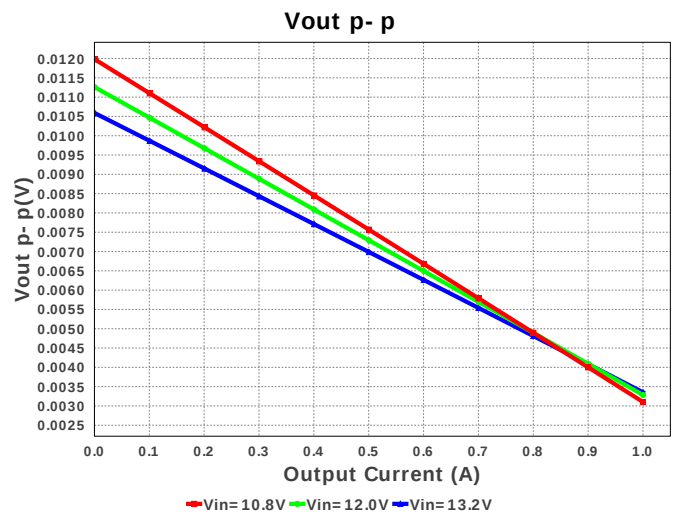
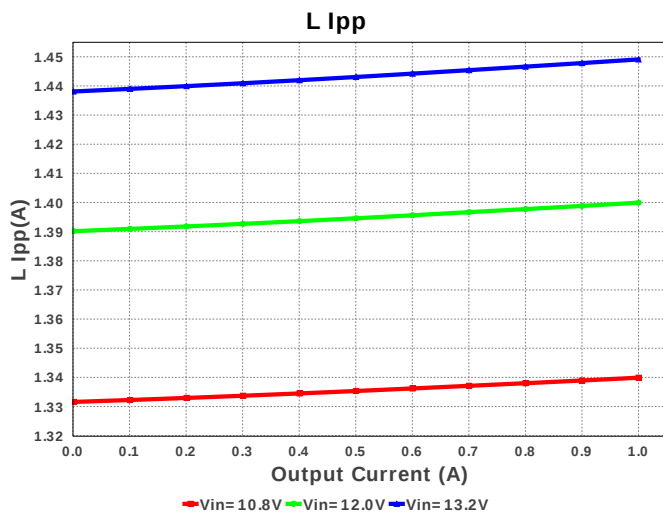
Design : 4354344/54 TPS563200DDCR
TPS563200DDCR 10.8V-13.2V to 3.30V @ 1.0A

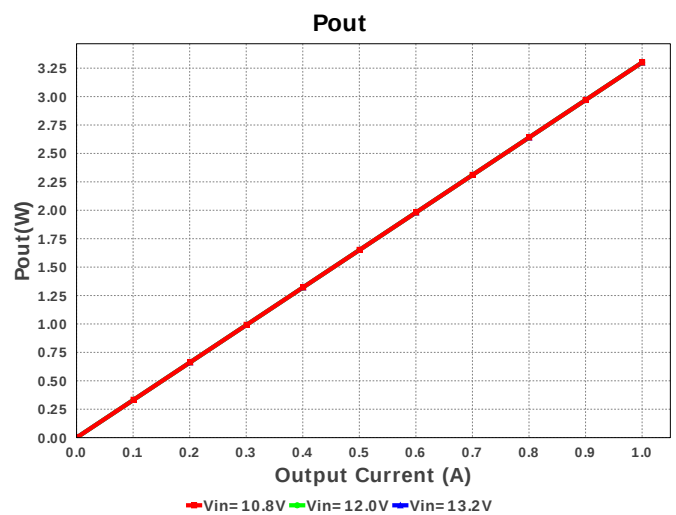
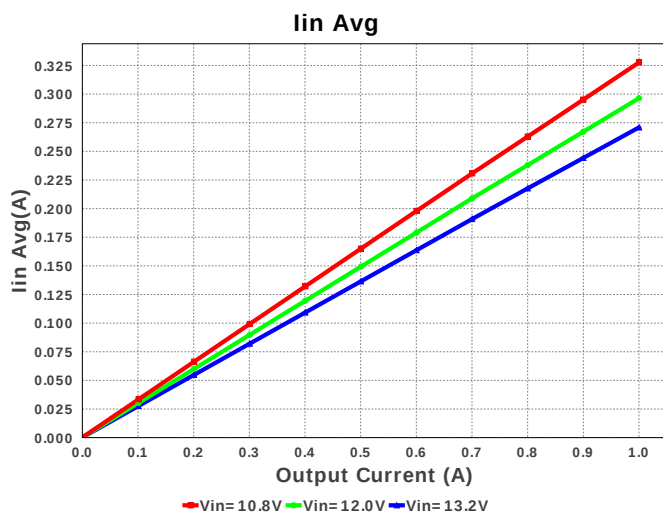
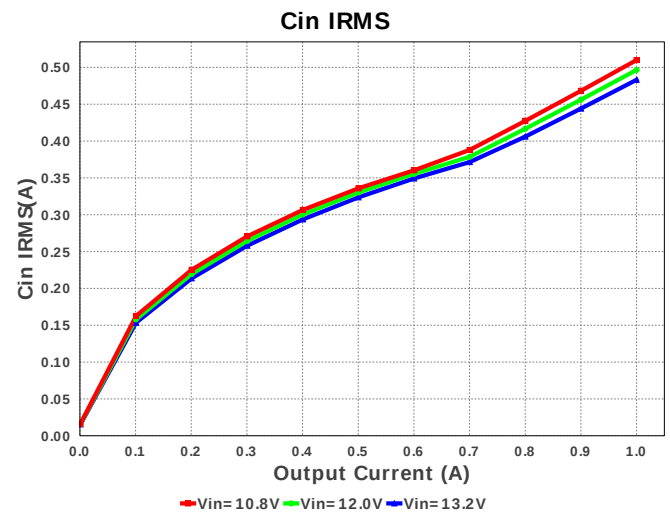
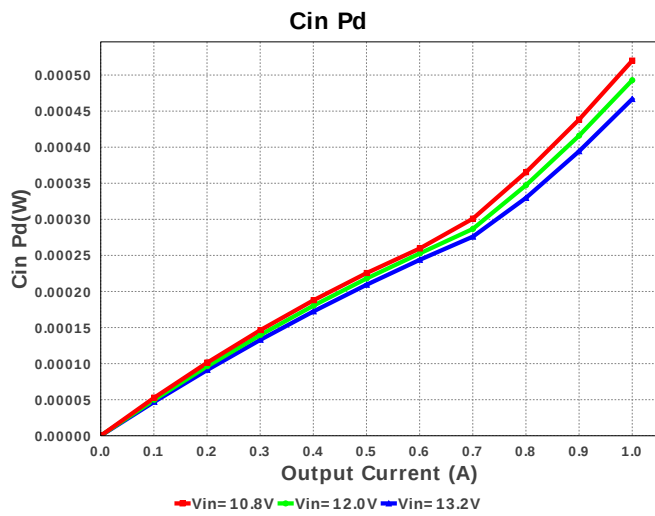
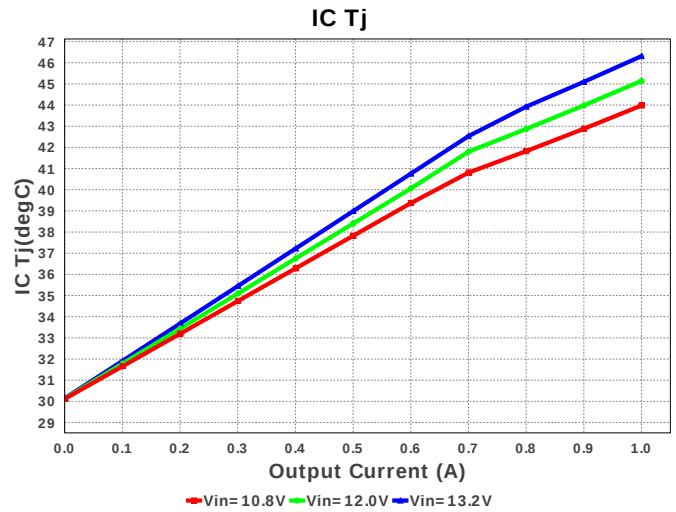
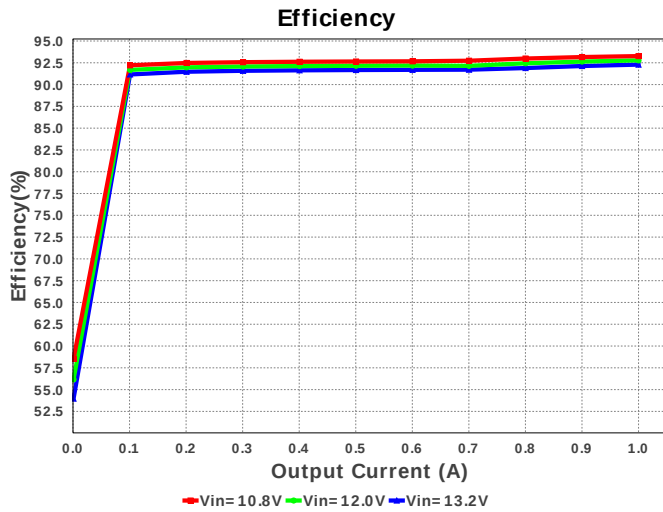


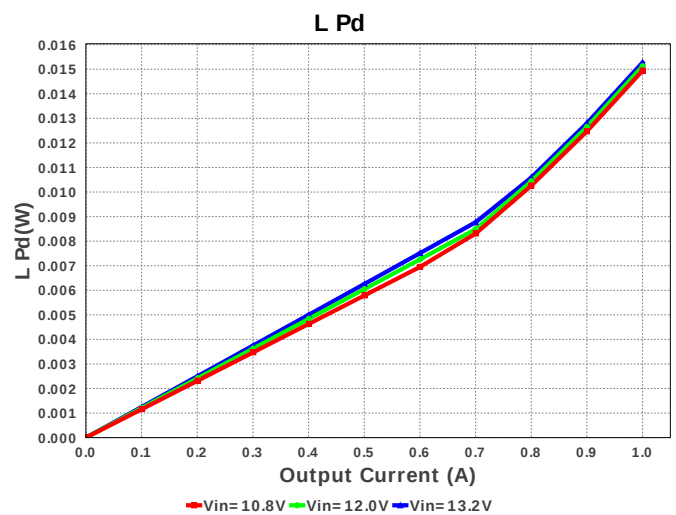
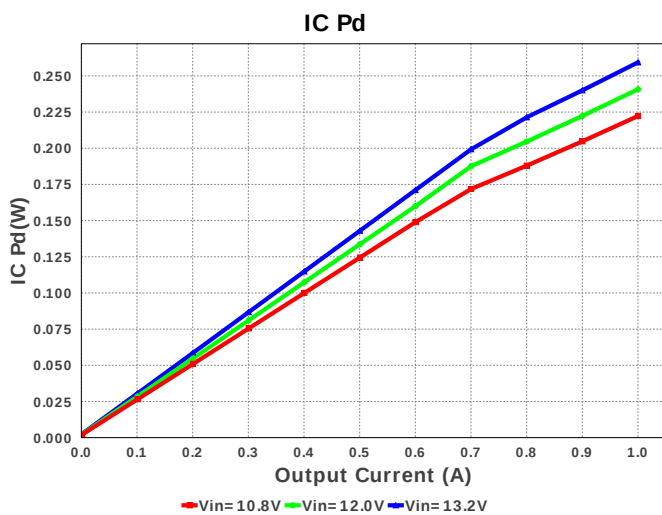
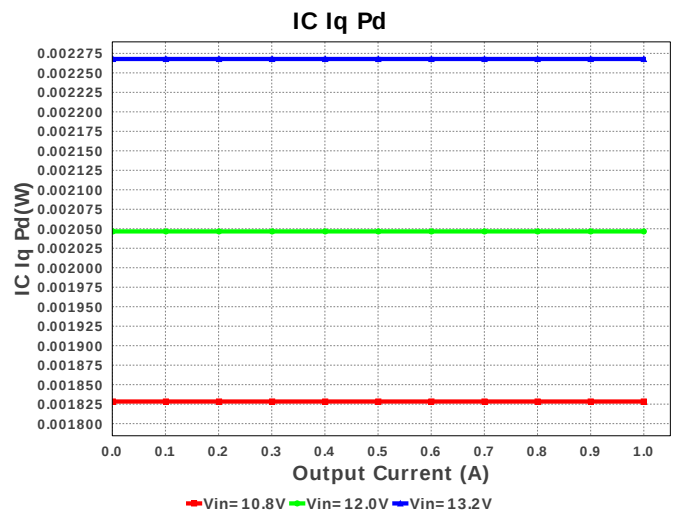
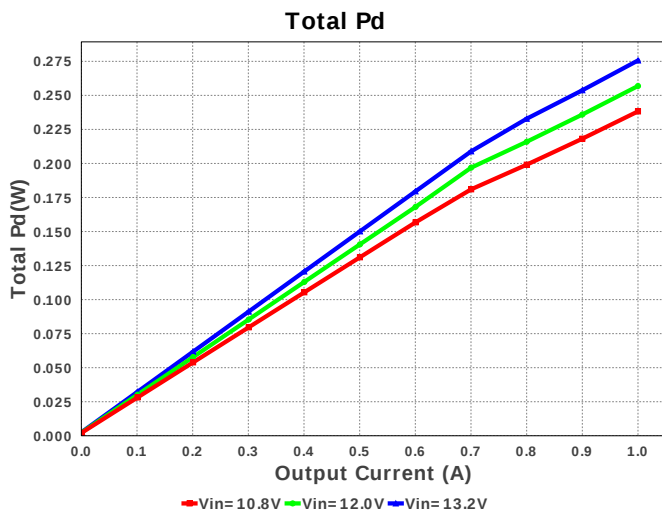
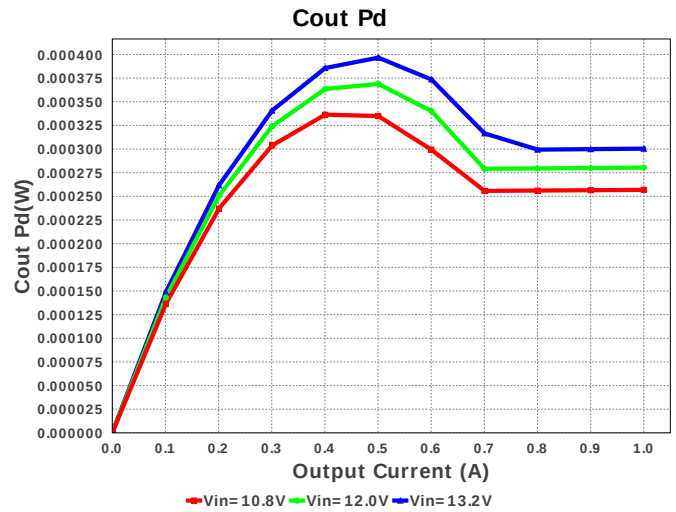
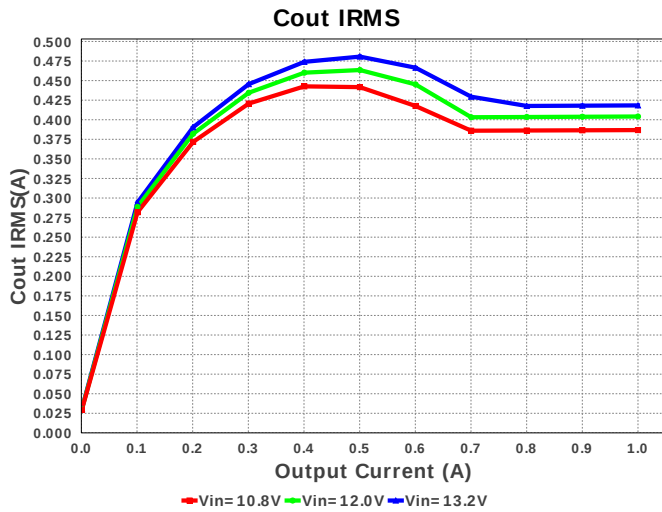
Electrical BOM

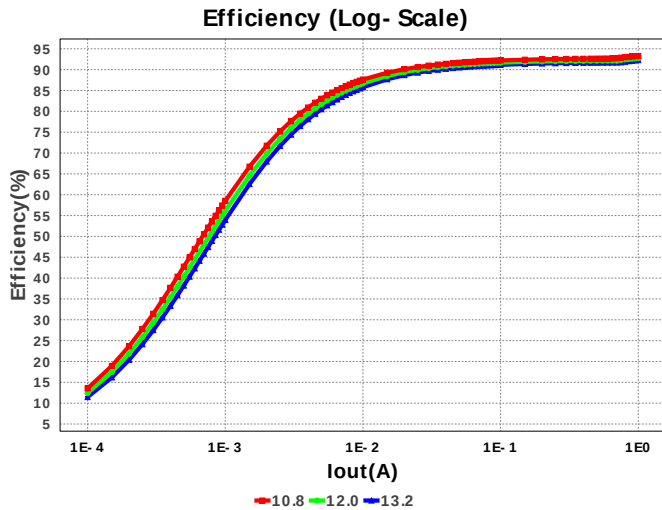
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
2.	Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.16	 1210 15 mm²
3.	Cout	TDK	C3216JB1A476M Series= JB	Cap= 47.0 uF ESR= 1.717 mOhm VDC= 10.0 V IRMS= 0.0 A	1	\$0.34	 1206 11 mm²
4.	L1	Bourns	SRN8040-2R2Y	L= 2.2 µH DCR= 13.0 mOhm	1	\$0.22	 SRN8040 100 mm²
5.	Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
6.	Rfbb	Vishay-Dale	CRCW040233K2FKED Series= CRCW..e3	Res= 33.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	U1	Texas Instruments	TPS563200DDCR	Switcher	1	\$0.52	 DDC0006A 10 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	483.097 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	418.317 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	270.88 mA	Current	Average input current
4.	L Ipp	1.449 A	Current	Peak-to-peak inductor ripple current
5.	BOM Count	7	General	Total Design BOM count
6.	FootPrint	149.0 mm ²	General	Total Foot Print Area of BOM components
7.	Frequency	781.495 kHz	General	Switching frequency
8.	Pout	3.3 W	General	Total output power
9.	Total BOM	\$1.27	General	Total BOM Cost
10.	Vout Actual	3.283 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
11.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
12.	Duty Cycle	25.318 %	Op_point	Duty cycle
13.	Efficiency	92.291 %	Op_point	Steady state efficiency
14.	IC Tj	46.313 degC	Op_point	IC junction temperature
15.	ICThetaJA	62.9 degC/W	Op_point	IC junction-to-ambient thermal resistance
16.	IOUT_OP	1.0 A	Op_point	Iout operating point
17.	VIN_OP	13.2 V	Op_point	Vin operating point
18.	Vout p-p	5.724 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	466.766 μ W	Power	Input capacitor power dissipation
20.	Cout Pd	300.456 μ W	Power	Output capacitor power dissipation
21.	IC Iq Pd	2.268 mW	Power	IC Iq Pd
22.	IC Pd	259.355 mW	Power	IC power dissipation
23.	L Pd	15.275 mW	Power	Inductor power dissipation
24.	Total Pd	275.644 mW	Power	Total Power Dissipation
25.	Vout Tolerance	2.889 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	13.2	Maximum input voltage
3.	VinMin	10.8	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS563200	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS563200** Product Folder : <http://www.ti.com/product/TPS563200> : contains the data sheet and other resources.

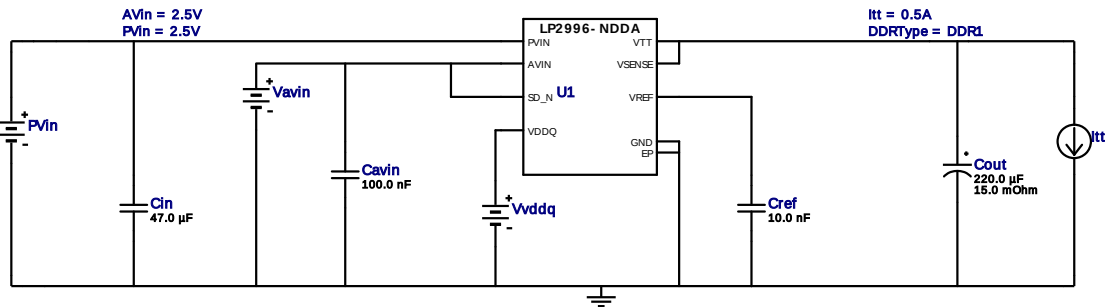


WEBENCH® Design Report

Design : 4354344/55 LP2996MRX/NOPB
Design 55 - LP2996MRX/NOPB

DDRTYPE = DDR1
PVin = 2.5V
AVin = 2.5V
I_{tt} = 0.5A
Ta = 30.0degC

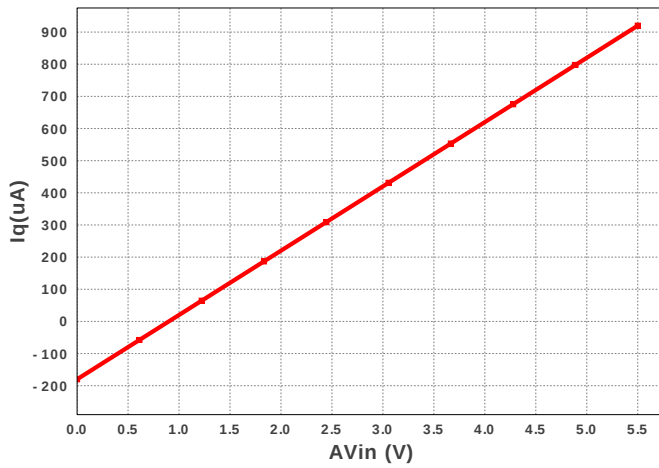
Device = LP2996MRX/NOPB
Topology = DDRLDO
Created = 7/14/16 1:59:30 AM
BOM Cost = \$1.21
BOM Count = 5
Total Pd = 0.63W



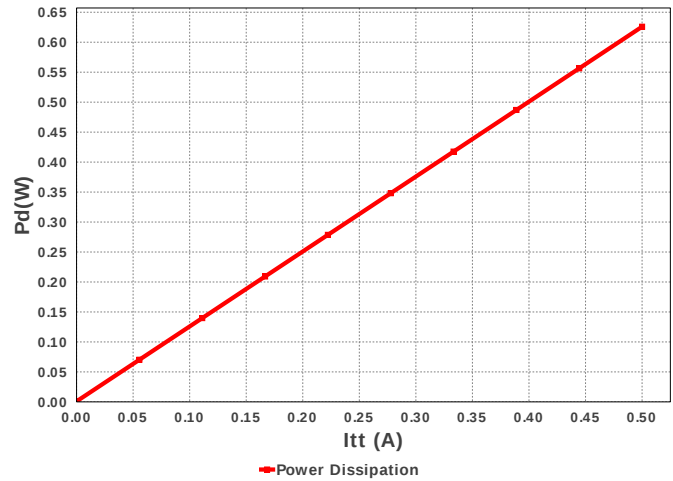
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cavin	MuRata	GRM155R60J104KA01D Series= X5R	Cap= 100.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Cin	Taiyo Yuden	JMK212BJ476MG-T Series= X5R	Cap= 47.0 uF VDC= 6.3 V IRMS= 0.0 A	1	\$0.14	0805 7 mm ²
3.	Cout	Panasonic	2R5TPE220MAFB Series= ?	Cap= 220.0 uF ESR= 15.0 mOhm VDC= 2.5 V IRMS= 2.0 A	1	\$0.50	CAPSMT_6_B2S 17 mm ²
4.	Cref	MuRata	GRM155R60J103KA01D Series= X5R	Cap= 10.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
5.	U1	Texas Instruments	LP2996MRX/NOPB	Switcher	1	\$0.55	DAA0008A 57 mm ²

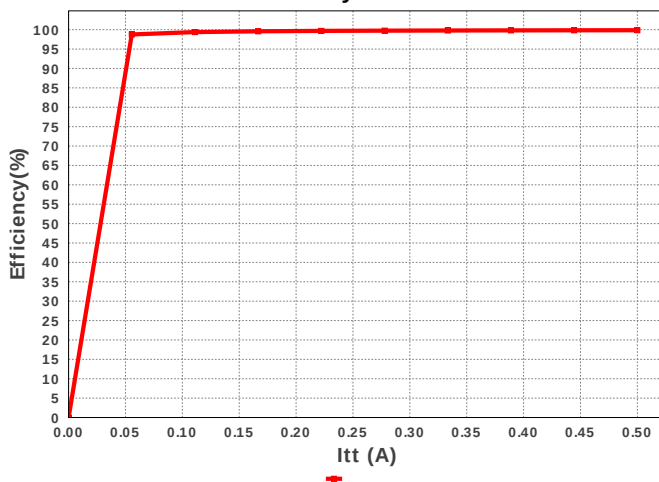
Quiescent Current Iq Vs. AVin



Power Dissipation Vs. Itt



Efficiency Vs. Itt



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	5	General	Total Design BOM count
2.	FootPrint	87.0 mm ²	General	Total Foot Print Area of BOM components
3.	Total BOM	\$1.21	General	Total BOM Cost
4.	AVin_OP	2.5 V	Op_Point	Pvin operating point
5.	Itt_OP	500.0 mA	Op_Point	Itt Operating Point
6.	PVin_OP	2.5 V	Op_Point	Pvin operating point
7.	Ta_OP	30.0 degC	Op_Point	Operating Ambient Temperature
8.	Vddq_OP	2.5 V	Op_Point	Vddq operating point
9.	Vtt_OP	1.25 V	Op_Point	Vtt operating point
10.	Efficiency	99.862 %	Op_point	Steady state efficiency
11.	IC TJ	56.912 degC	Op_point	IC junction temperature
12.	ICThetaJA	43.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
13.	Total Pd	625.862 mW	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	AVin	2.5 A	AVin
2.	DDRTYPE	DDR1	DDRTYPE
3.	Itt	500.0 mA	Itt
4.	PVin	2.5 A	PVin
5.	application	DDRPower	application
6.	base_pn	LP2996-N	Base Product Number
7.	Ta	30.0 A	Ambient temperature

Design Assistance

1. **LP2996-N** Product Folder : <http://www.ti.com/product/lp2996-n/description> : contains the data sheet and other resources.

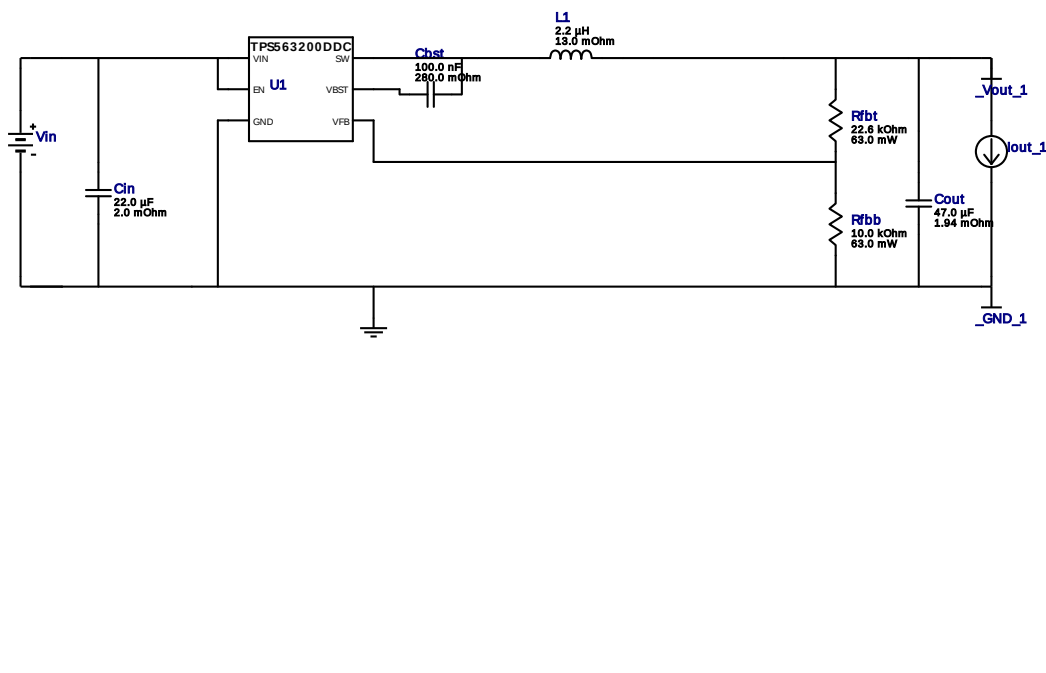


Vout = 2.5V
Iout = 1.0A

Device = TPS563200DDCR
Topology = Buck
Created = 7/14/16 1:59:30 AM
BOM Cost = \$1.06
BOM Count = 7
Total Pd = 0.25W

WEBENCH® Design Report

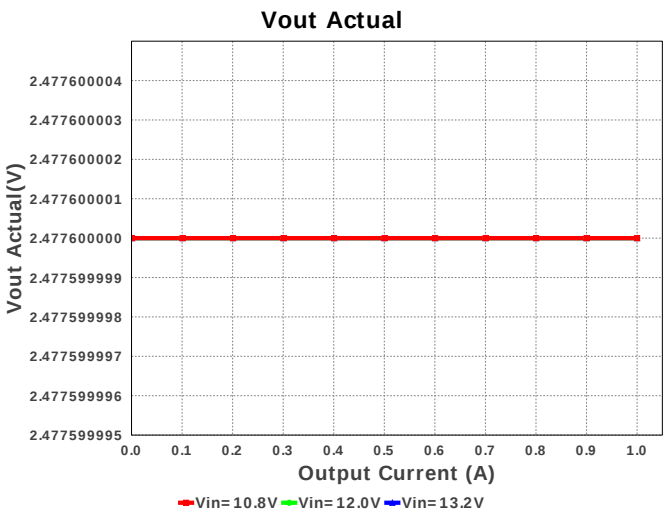
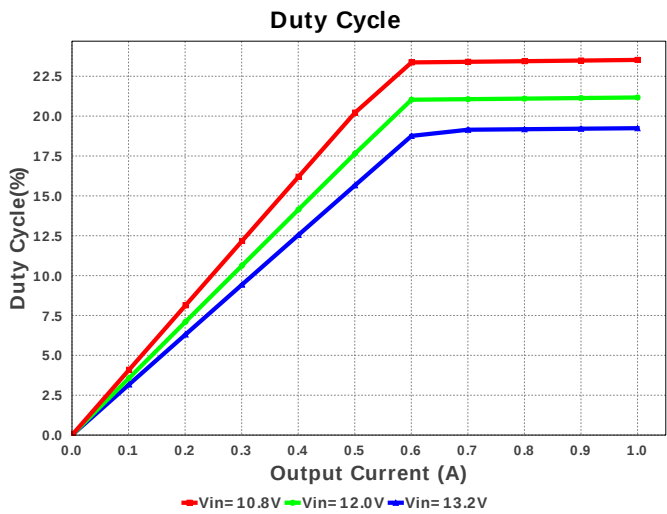
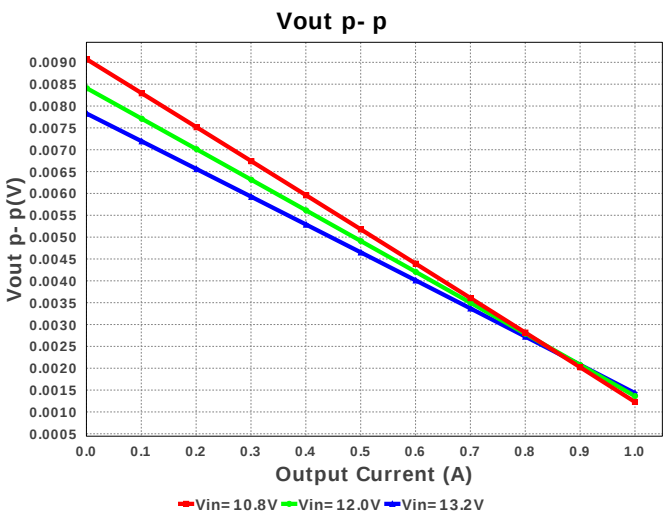
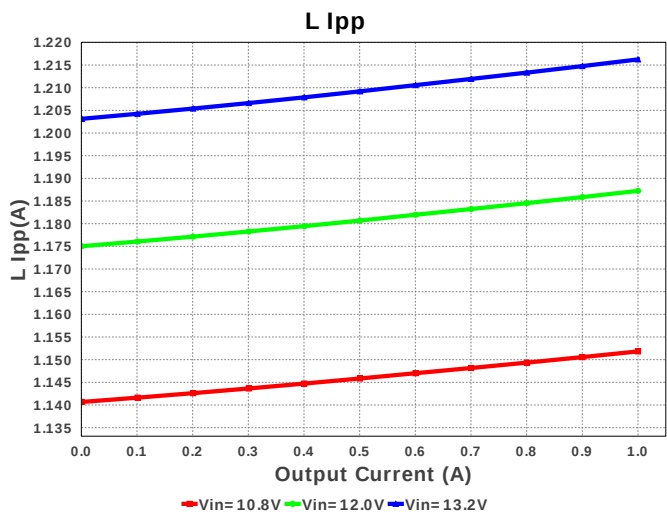
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TPS563200DDCR 10.8V-13.2V to 2.50V @ 1.0A

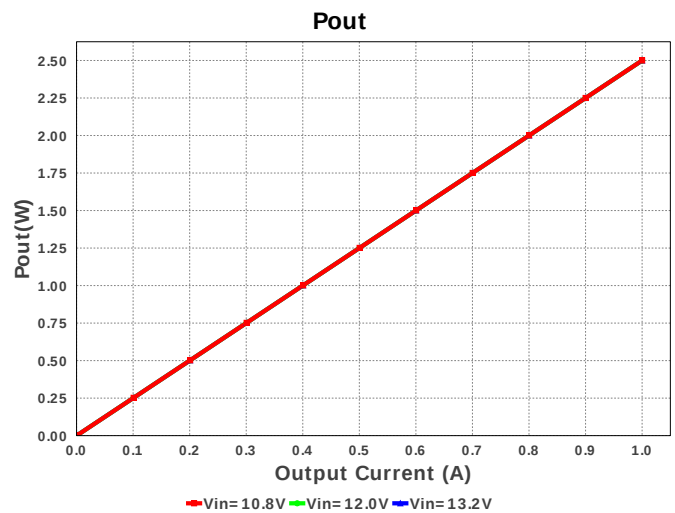
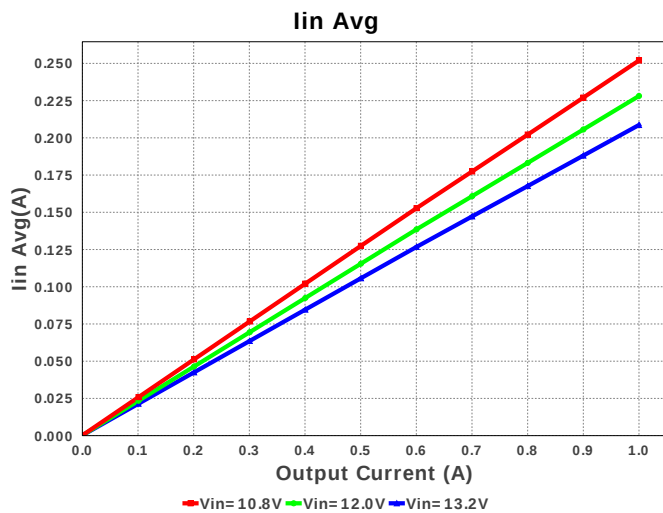
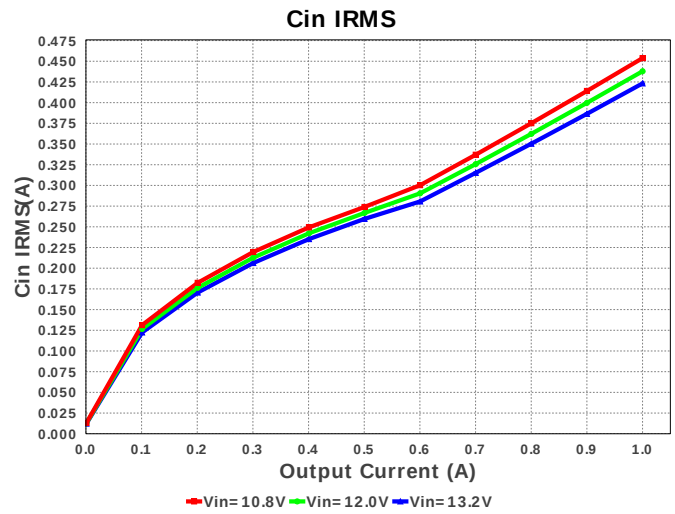
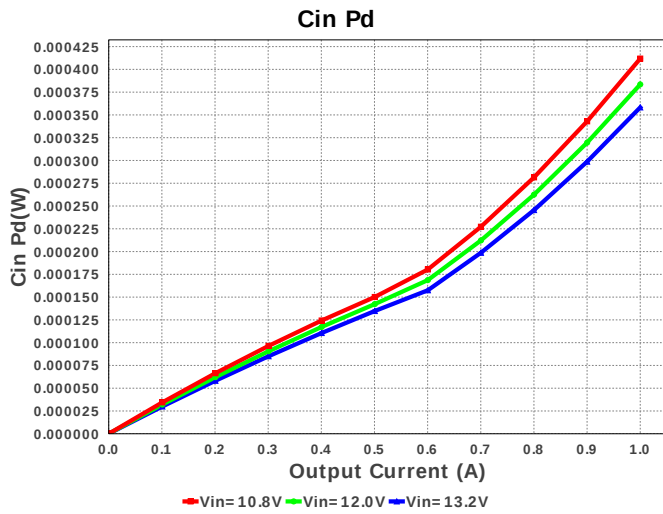
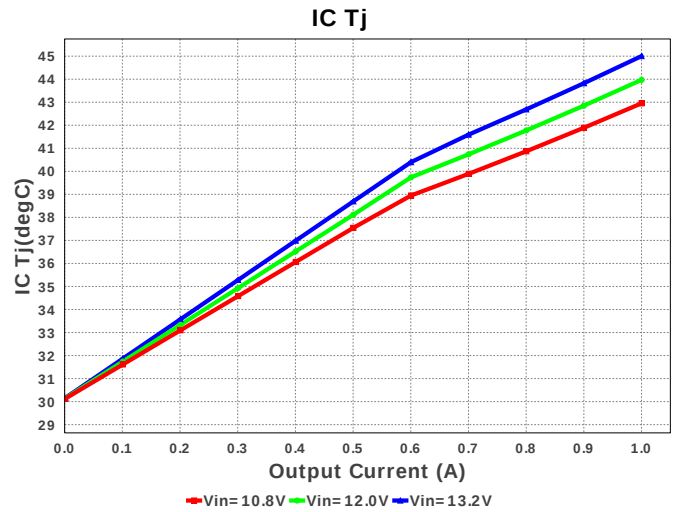
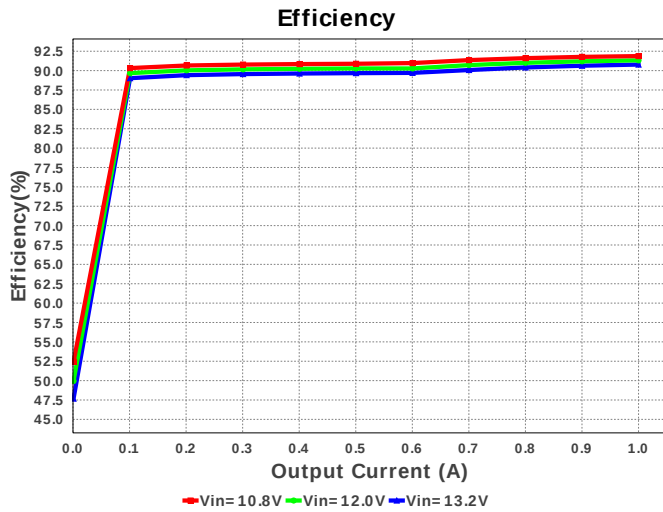


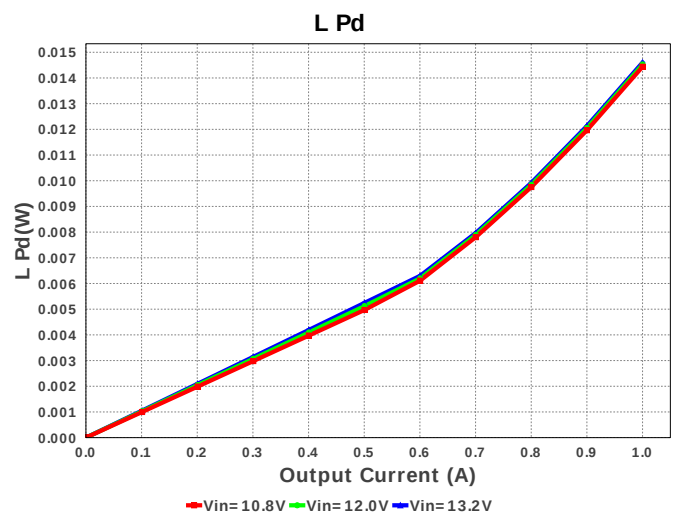
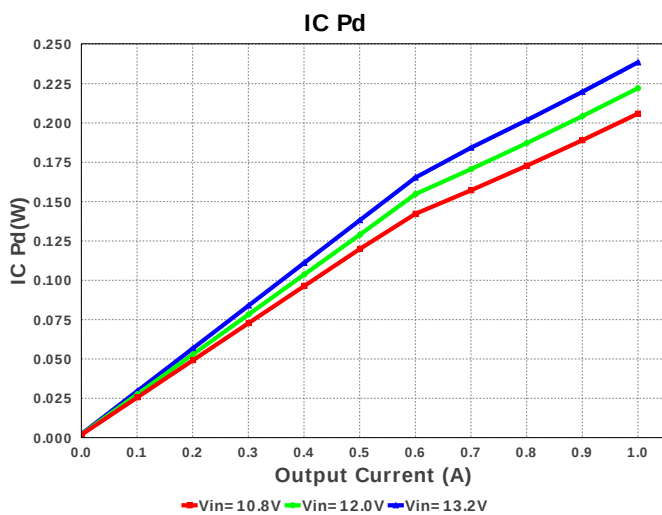
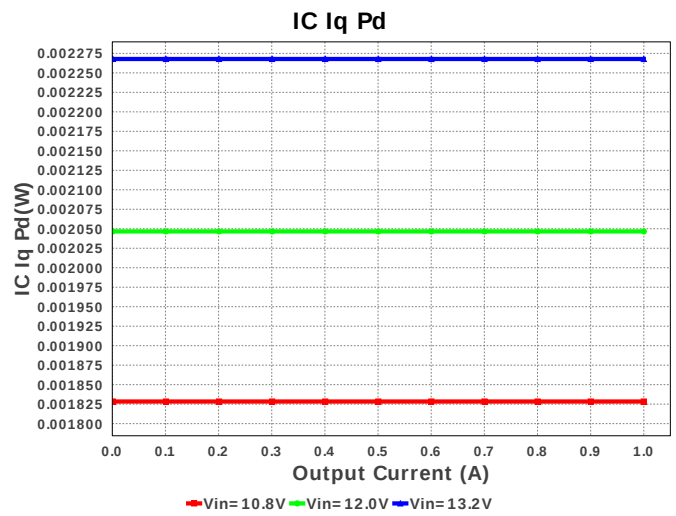
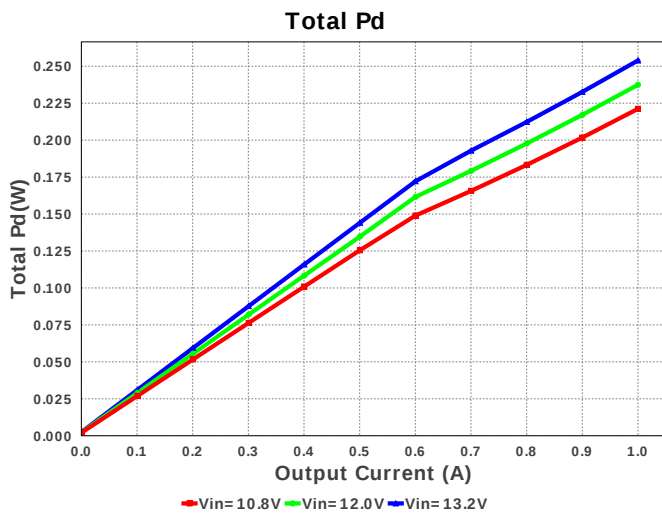
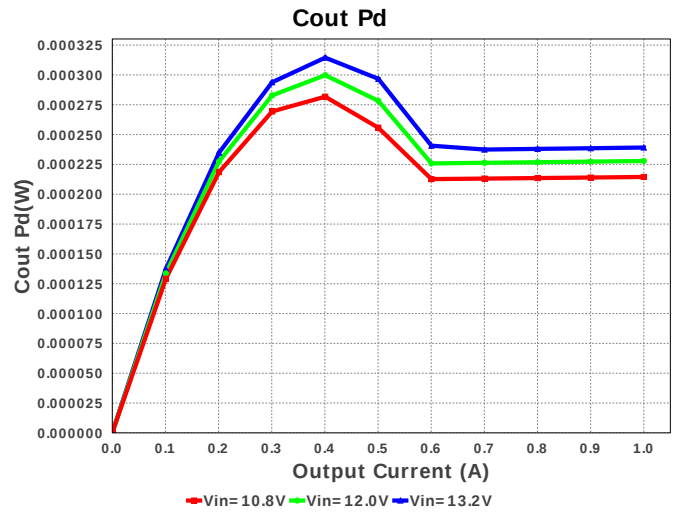
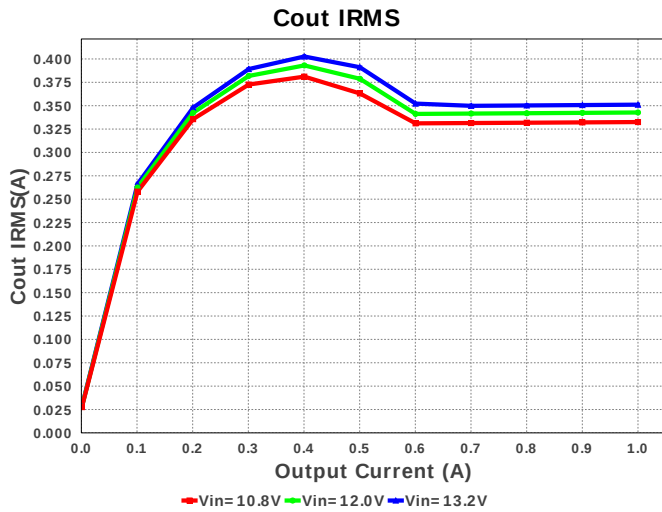
Electrical BOM

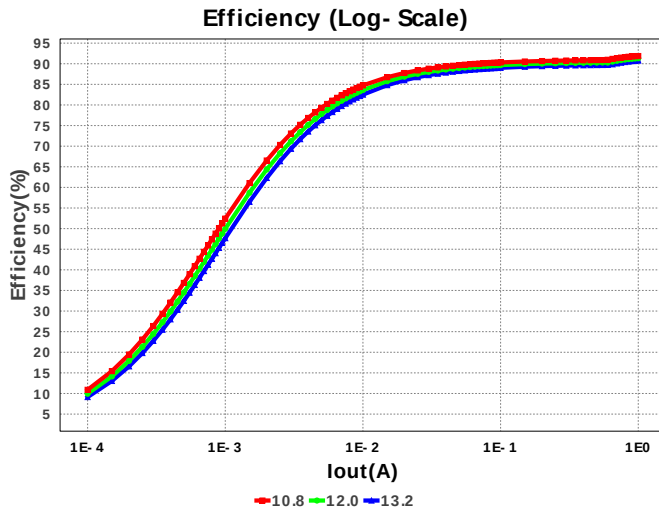
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1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm²
2.	Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.16	 1210 15 mm²
3.	Cout	TDK	C3216X6S0G476M Series= X6S	Cap= 47.0 uF ESR= 1.94 mOhm VDC= 4.0 V IRMS= 0.0 A	1	\$0.13	 1206 11 mm²
4.	L1	Bourns	SRN8040-2R2Y	L= 2.2 uH DCR= 13.0 mOhm	1	\$0.22	 SRN8040 100 mm²
5.	Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
6.	Rfbb	Vishay-Dale	CRCW040222K6FKED Series= CRCW..e3	Res= 22.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	U1	Texas Instruments	TPS563200DDCR	Switcher	1	\$0.52	 DDC0006A 10 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	423.232 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	351.098 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	208.63 mA	Current	Average input current
4.	L Ipp	1.216 A	Current	Peak-to-peak inductor ripple current
5.	BOM Count	7	General	Total Design BOM count
6.	FootPrint	149.0 mm ²	General	Total Foot Print Area of BOM components
7.	Frequency	765.255 kHz	General	Switching frequency
8.	Pout	2.5 W	General	Total output power
9.	Total BOM	\$1.06	General	Total BOM Cost
10.	Vout Actual	2.478 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
11.	Vout OP	2.5 V	Op_Point	Operational Output Voltage
12.	Duty Cycle	19.244 %	Op_point	Duty cycle
13.	Efficiency	90.78 %	Op_point	Steady state efficiency
14.	IC Tj	45.003 degC	Op_point	IC junction temperature
15.	ICThetaJA	62.9 degC/W	Op_point	IC junction-to-ambient thermal resistance
16.	IOUT_OP	1.0 A	Op_point	Iout operating point
17.	VIN_OP	13.2 V	Op_point	Vin operating point
18.	Vout p-p	5.656 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	358.251 μW	Power	Input capacitor power dissipation
20.	Cout Pd	239.143 μW	Power	Output capacitor power dissipation
21.	IC Iq Pd	2.268 mW	Power	IC Iq Pd
22.	IC Pd	238.528 mW	Power	IC power dissipation
23.	L Pd	14.603 mW	Power	Inductor power dissipation
24.	Total Pd	253.911 mW	Power	Total Power Dissipation
25.	Vout Tolerance	2.735 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	13.2	Maximum input voltage
3.	VinMin	10.8	Minimum input voltage
4.	Vout	2.5	Output Voltage
5.	base_pn	TPS563200	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS563200** Product Folder : <http://www.ti.com/product/TPS563200> : contains the data sheet and other resources.

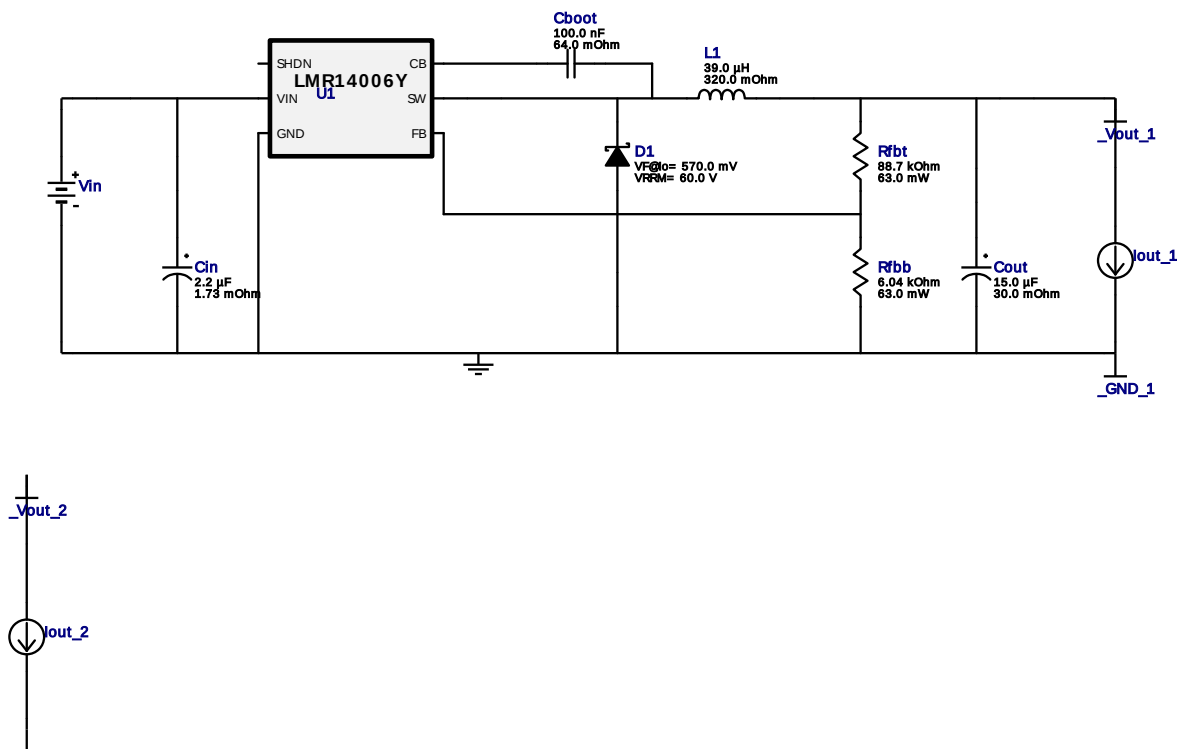


Vout = 12.0V
Iout = 0.48A

Device = LMR14006YDDCR
Topology = Buck
Created = 7/14/16 1:59:30 AM
BOM Cost = \$1.97
BOM Count = 8
Total Pd = 0.44W

WEBENCH® Design Report

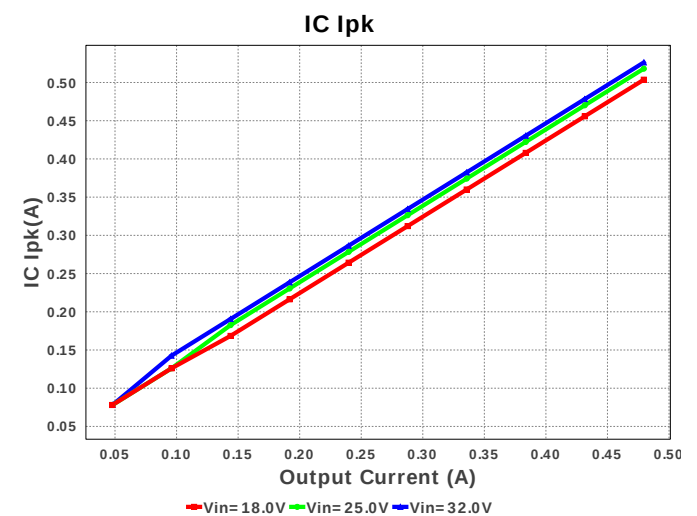
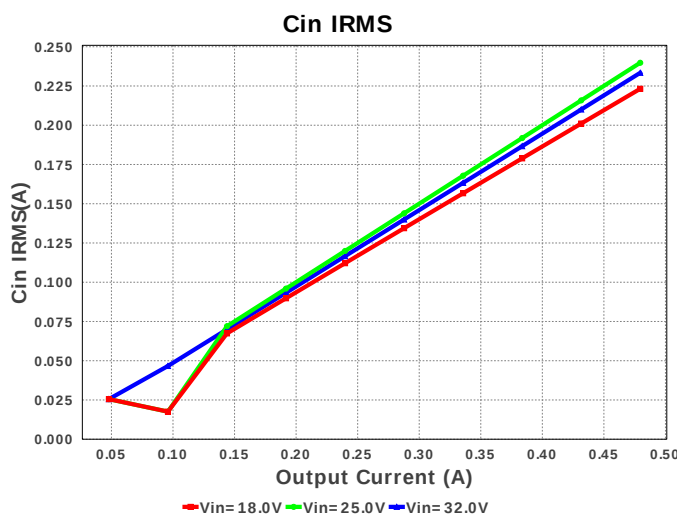
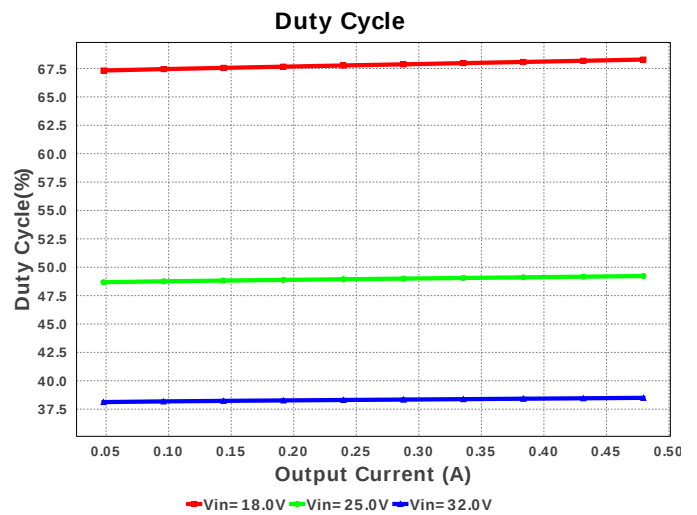
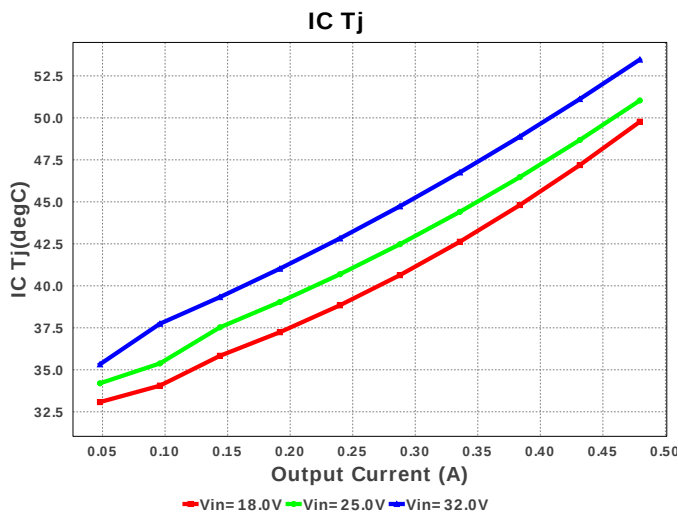
Design : 4354344/57 LMR14006YDDCR
LMR14006YDDCR 18.0V-32.0V to 12.00V @ 0.47951A

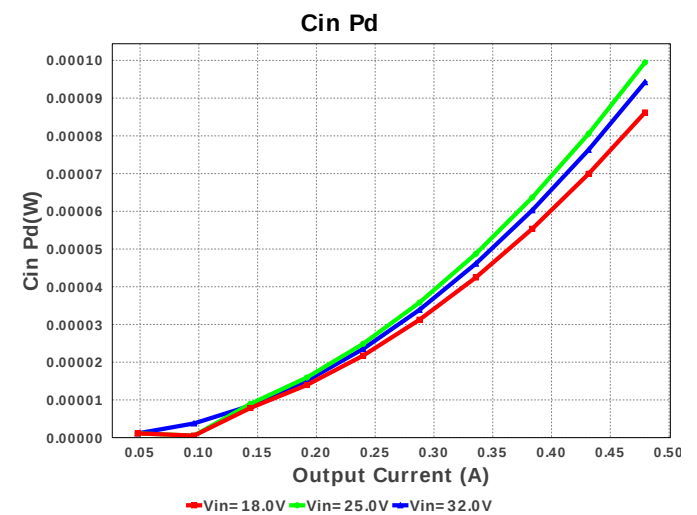
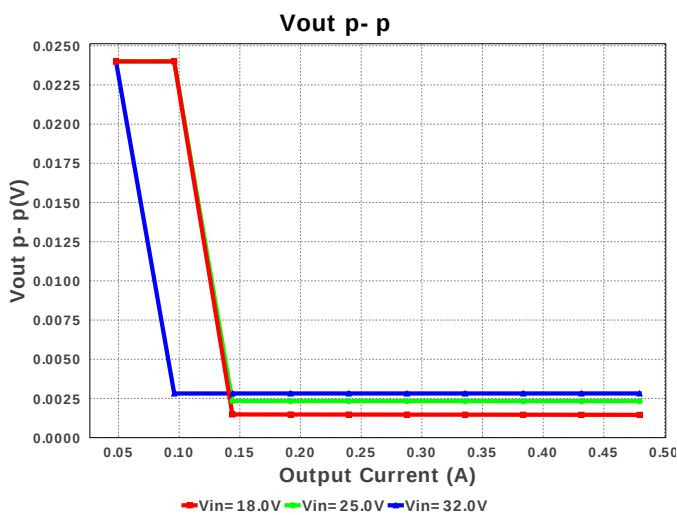
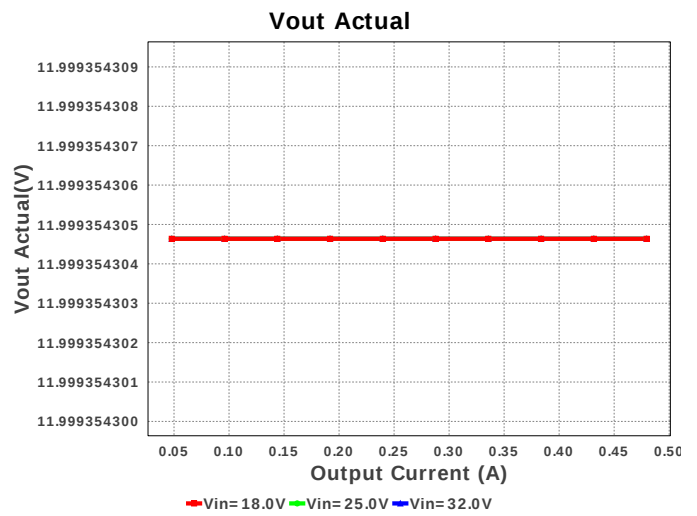
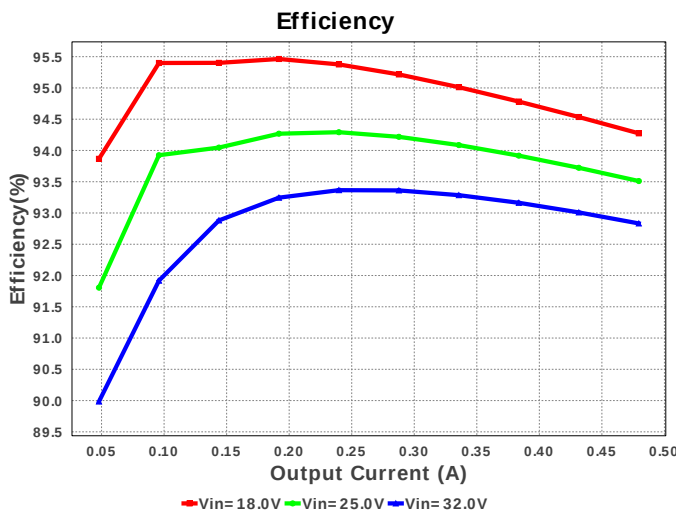
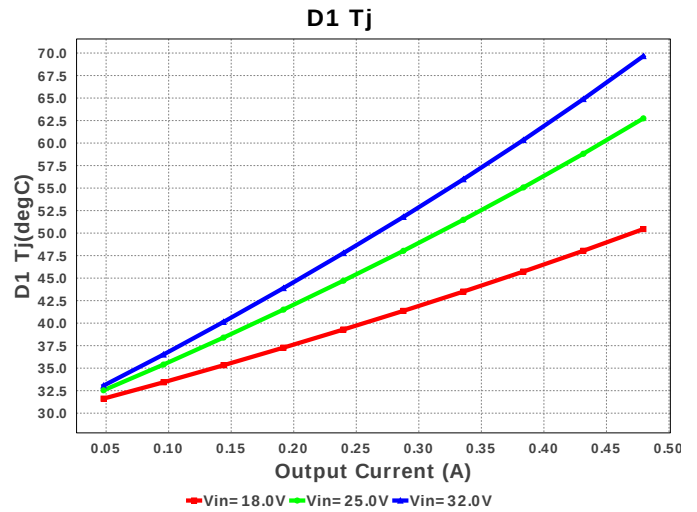
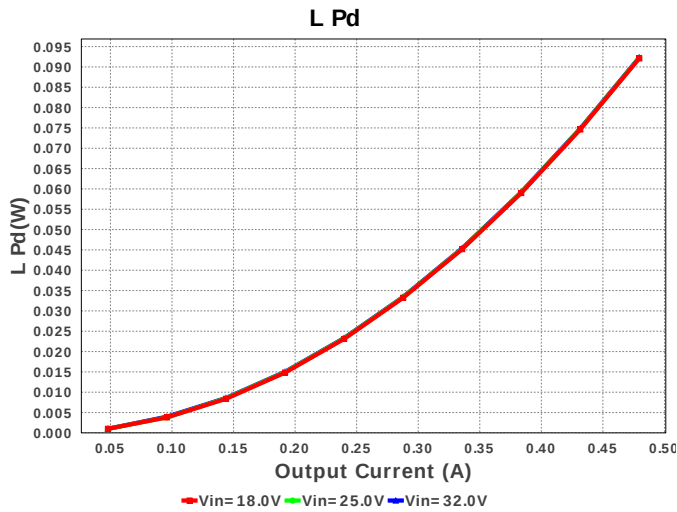


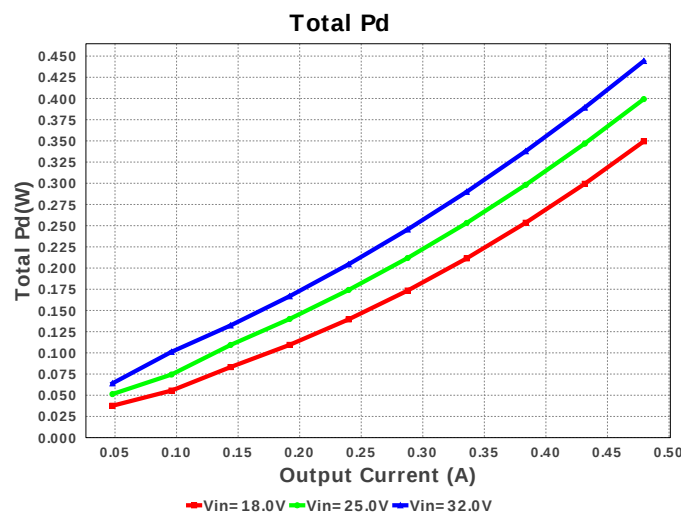
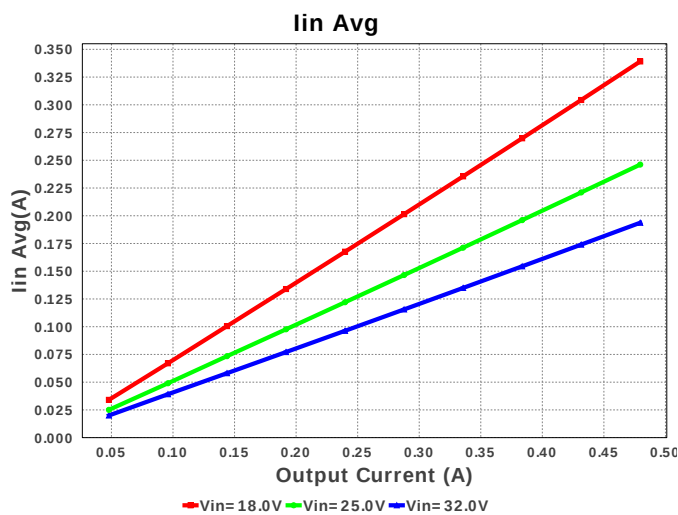
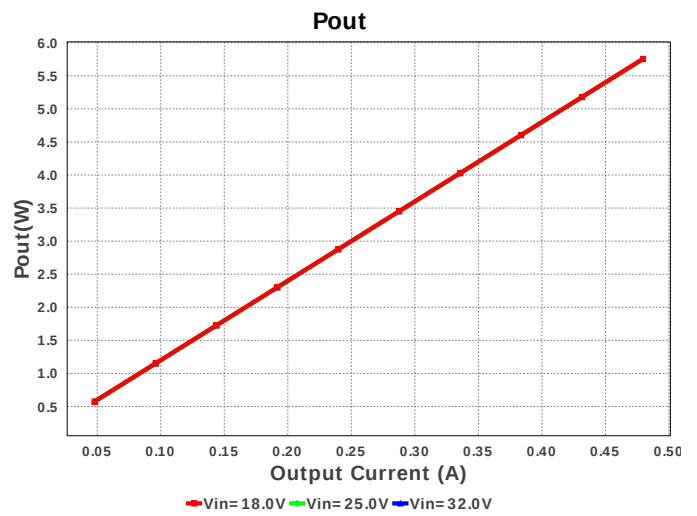
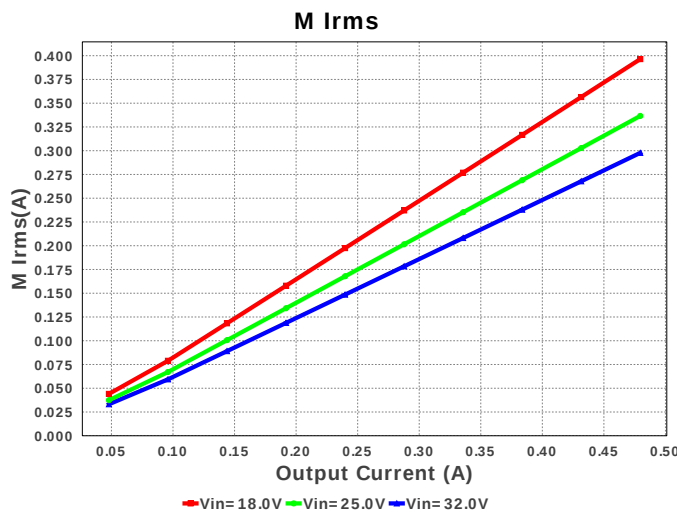
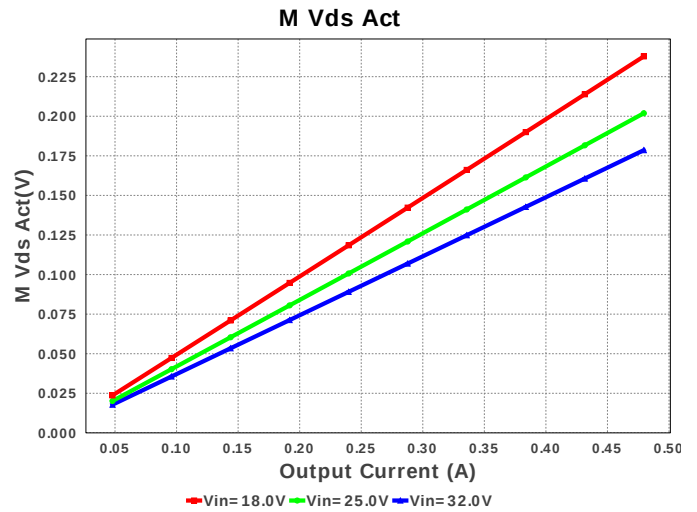
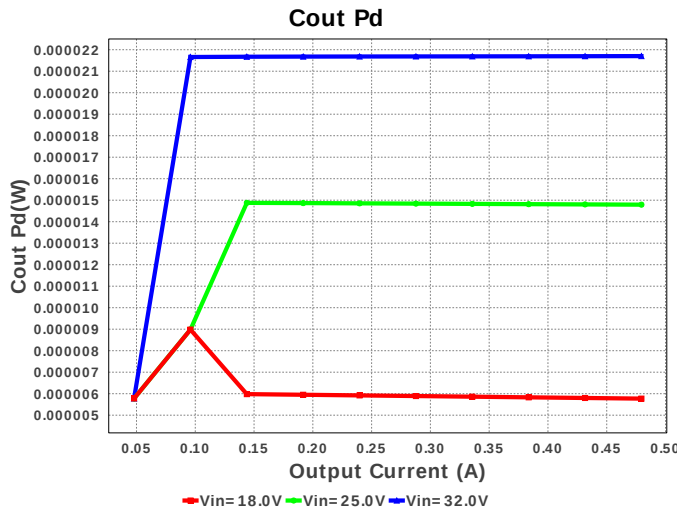
Electrical BOM

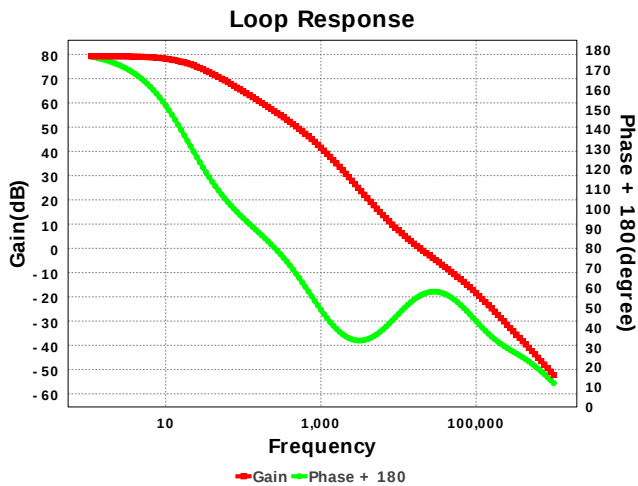
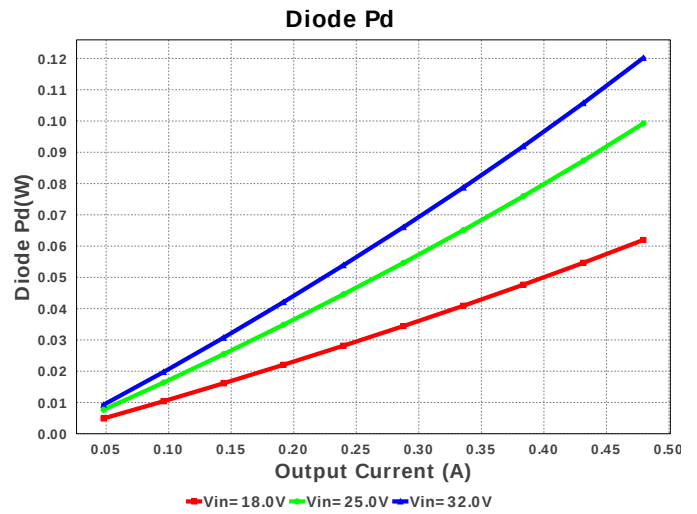
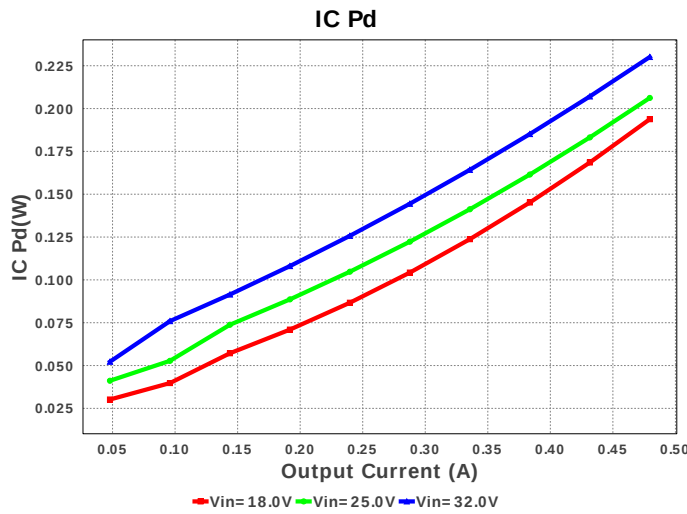
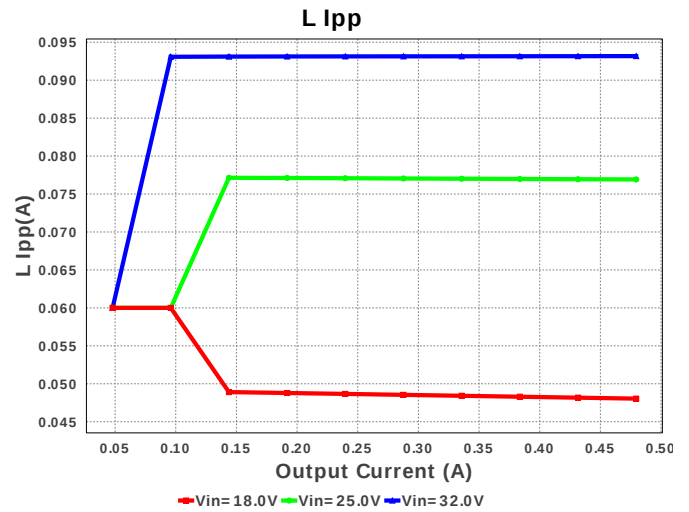
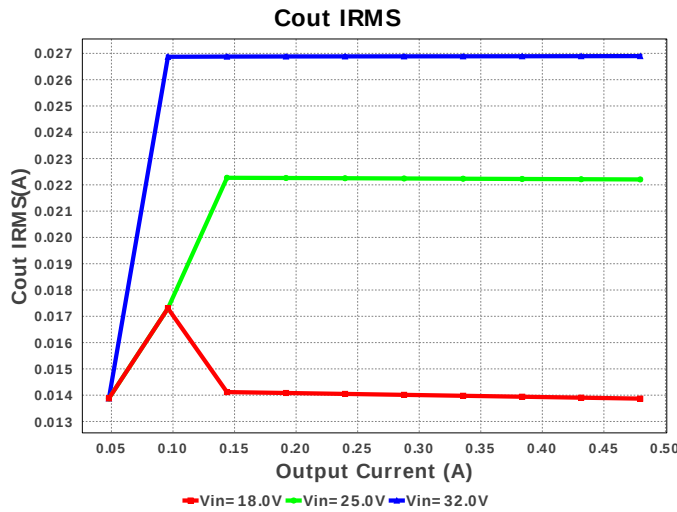
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	\$0.01	 0805 7 mm ²
2.	Cin	TDK	C3225X7R2A225K230AB Series= X7R	Cap= 2.2 uF ESR= 1.73 mOhm VDC= 100.0 V IRMS= 5.5932 A	1	\$0.19	 1210_250 15 mm ²
3.	Cout	Panasonic	25SVPG15M Series= ?	Cap= 15.0 uF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 2.8 A	1	\$0.43	 CAPSMT_62_B45 53 mm ²
4.	D1	NXP Semiconductor	PMEG6010CEH,115	Vf@Io= 570.0 mV VRRM= 60.0 V	1	\$0.04	 SOD-123F 12 mm ²
5.	L1	Bourns	SDR0604-390KL	L= 39.0 uH DCR= 320.0 mOhm	1	\$0.18	 SDR0604 61 mm ²
6.	Rfbb	Vishay-Dale	CRCW04026K04FKED Series= CRCW..e3	Res= 6.04 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
7.	Rfbb	Vishay-Dale	CRCW040288K7FKED Series= CRCW..e3	Res= 88.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	U1	Texas Instruments	LMR14006YDDCR	Switcher	1	\$1.10	 MK06A 11 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	233.387 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	26.897 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	526.223 mA	Current	Peak switch current in IC
4.	Iin Avg	193.7 mA	Current	Average input current
5.	L Ipp	93.172 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	297.706 mA	Current	Q Iavg
7.	BOM Count	8	General	Total Design BOM count
8.	FootPrint	164.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	2.1 MHz	General	Switching frequency
10.	IC Tolerance	18.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	178.559 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Pout	5.754 W	General	Total output power
13.	Total BOM	\$1.97	General	Total BOM Cost
14.	D1 Tj	69.66 degC	Op_Point	D1 junction temperature
15.	Vout Actual	11.999 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
17.	Cross Freq	18.956 kHz	Op_point	Bode plot crossover frequency
18.	Duty Cycle	38.498 %	Op_point	Duty cycle
19.	Efficiency	92.833 %	Op_point	Steady state efficiency
20.	IC Tj	53.471 degC	Op_point	IC junction temperature
21.	ICThetaJA	102.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
22.	IOUT_OP	479.51 mA	Op_point	Iout operating point
23.	Phase Marg	56.137 deg	Op_point	Bode Plot Phase Margin
24.	VIN_OP	32.0 V	Op_point	Vin operating point
25.	Vout p-p	2.82 mV	Op_point	Peak-to-peak output ripple voltage
26.	Cin Pd	94.232 μW	Power	Input capacitor power dissipation
27.	Cout Pd	21.703 μW	Power	Output capacitor power dissipation
28.	Diode Pd	120.182 mW	Power	Diode power dissipation
29.	IC Pd	230.104 mW	Power	IC power dissipation
30.	L Pd	92.31 mW	Power	Inductor power dissipation
31.	Total Pd	444.239 mW	Power	Total Power Dissipation
32.	Vout Tolerance	4.289 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	479.51 m	Maximum Output Current
2.	VinMax	32.0	Maximum input voltage
3.	VinMin	18.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	LMR14006Y	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **LMR14006Y** Product Folder : <http://www.ti.com/product/LMR14006> : contains the data sheet and other resources.

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