

WEBENCH® Power Architect

Project Report

Project : 4790845/11 : PA_Project_504 (modified from 501)

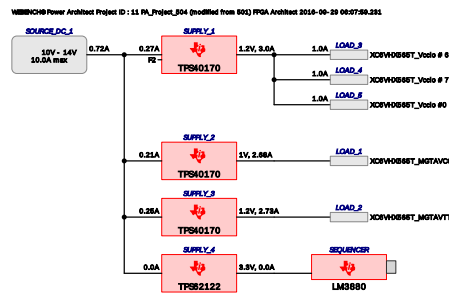
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Optimize project optFactor=5

Project Summary

1. Total System Efficiency	94.229 %
2. Total System BOM Count	99.0
3. Total System Footprint	2.891 kmm2
4. Total System BOM Cost	\$19.26
5. Total System Power Dissipation	585.2 mW

--> Launch WEBENCH Power Architect.



Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_1	2	LOAD_3	XC6VHX565T_Vccio # 6
SUPPLY_1	2	LOAD_4	XC6VHX565T_Vccio # 7
SUPPLY_1	2	LOAD_5	XC6VHX565T_Vccio # 0
SUPPLY_2	1	LOAD_1	XC6VHX565T_MGTAVCC
SUPPLY_3	1	LOAD_2	XC6VHX565T_MGTAVTT
SUPPLY_4	NA		
SEQUENCER	NA		

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	TPS40170	Switcher : 4.5V to 60V Input Synch. PWM Buck Controller	1.2 V	3.0 A	94.7%	863	\$6.39	63	4
2.	SUPPLY_2	TPS40170	Switcher : 4.5V to 60V Input Synch. PWM Buck Controller	1 V	2.68 A	93.4%	962	\$5.52	64	12
3.	SUPPLY_3	TPS40170	Switcher : 4.5V to 60V Input Synch. PWM Buck Controller	1.2 V	2.73 A	94.5%	868	\$5.96	65	20
4.	SUPPLY_4	TPS62122	Switcher : 2V-15V,75mA, Buck Converter with DCS-Control	3.3 V	0.001 A	83.9%	179	\$0.91	67	30
5.	SEQUENCER	LM3880	Sequencer : Power Sequencer	3.3 V	0.001 A	0%	19	\$0.48	66	28

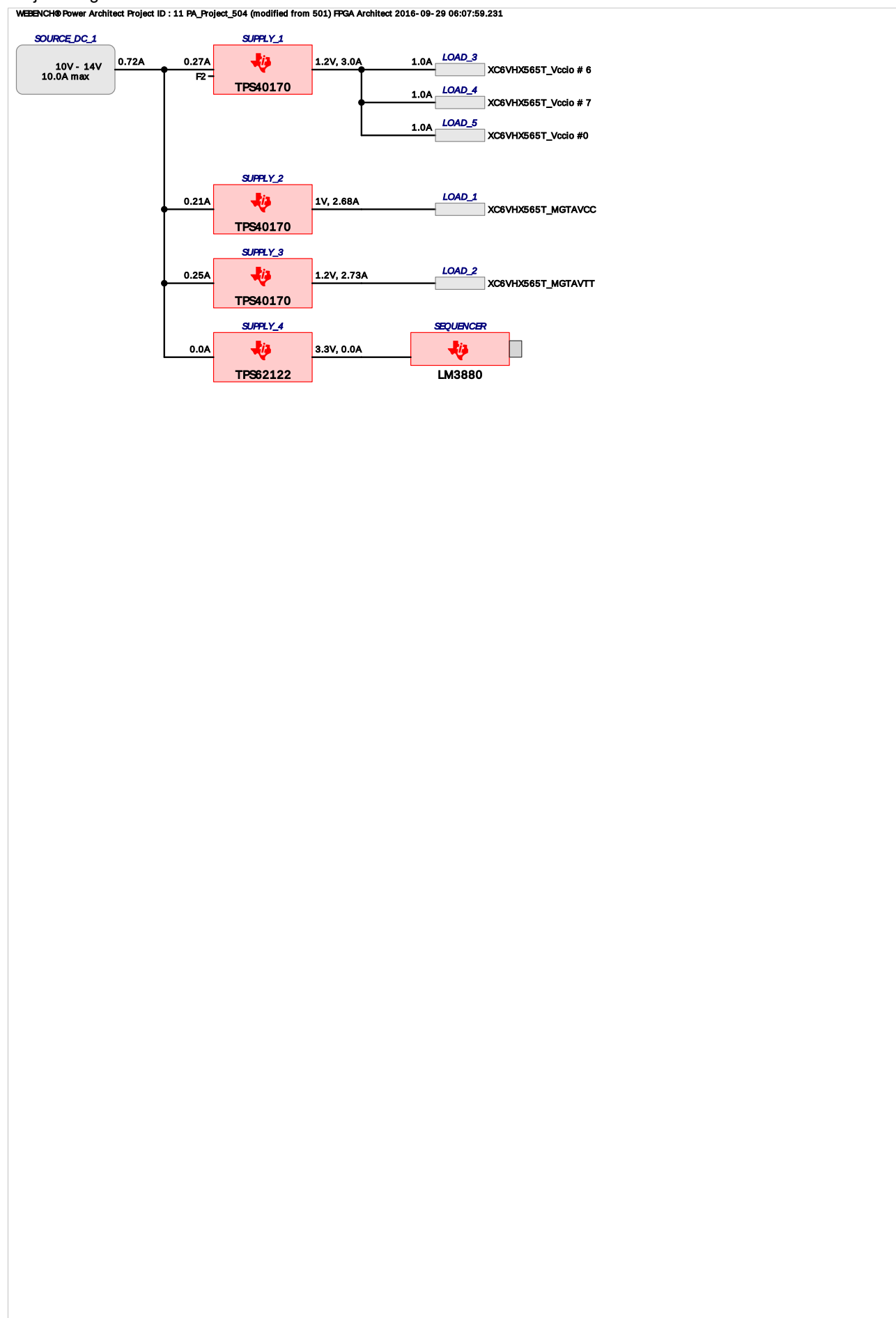
Power Loads

#	Name	VLoad	ILoad	Description
1.	XC6VHX565T_Vccio # 6	1.2 V	1 A	VoutRipple=10%, SoftStart delay=1.0 mSec, Up Sequence Order=1 delay=2.0 mSec, Down Sequence Order=0 delay=2.0 mSec
2.	XC6VHX565T_Vccio # 7	1.2 V	1 A	VoutRipple=10%, SoftStart delay=1.0 mSec, Up Sequence Order=1 delay=2.0 mSec, Down Sequence Order=0 delay=2.0 mSec
3.	XC6VHX565T_Vccio # 0	1.2 V	1 A	VoutRipple=10%, SoftStart delay=1.0 mSec, Up Sequence Order=1 delay=2.0 mSec, Down Sequence Order=0 delay=2.0 mSec
4.	XC6VHX565T_MGTAVCC	1 V	2.68 A	VoutRipple=6%, Group=Tx, Up Sequence Order=0 delay=2.0 mSec, Down Sequence Order=1 delay=2.0 mSec
5.	XC6VHX565T_MGTAVTT	1.2 V	2.73 A	VoutRipple=10%, Group=Tx, Up Sequence Order=0 delay=2.0 mSec, Down Sequence Order=1 delay=2.0 mSec

FPGAs, Processors

#	Manufacturer	Part Number	Name	Series	Description
1.	Actel	A3P015	FPGA_1	ProASIC3	FPGA Actel ProASIC3 A3P015
2.	Xilinx	XC6VHX565T	FPGA_1	Virtex-6 HXT	FPGA Xilinx Virtex-6 HXT XC6VHX565T

Project Diagram



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
Panasonic	2R5SVPC560M	SM_RADIAL_6.3AMM	1	\$0.32	80
Panasonic	2R5SVPE330MY	CAPSMT_62_E61	1	\$0.22	53
Panasonic	2TPE470MAJGB	CAPSMT_6_B2S	4	\$0.70	34
Samsung Electro-Mechanics	CL21C250JBANNNC	0805	1	\$0.01	7
Vishay-Dale	CRCW0402100KFKED	0402	6	\$0.01	18
Vishay-Dale	CRCW040210K0FKED	0402	11	\$0.01	33
Vishay-Dale	CRCW040210M0FKED	0402	3	\$0.01	9
Vishay-Dale	CRCW040215K0FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04021K05FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04021K33FKED	0402	2	\$0.01	6
Vishay-Dale	CRCW04021K43FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402255KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402316RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402324RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402383RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04027K50FKED	0402	3	\$0.01	9
Vishay-Dale	CRCW0402931RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402976RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040297K6FKED	0402	3	\$0.01	9
Texas Instruments	CSD16323Q3	DQG0008A	3	\$0.41	55
Texas Instruments	CSD17312Q5	TRANS_NexFET_Q5	3	\$0.93	165
MuRata	GRM033C80J223KE01D	0201	3	\$0.01	6
MuRata	GRM033R61A472KA01D	0201	1	\$0.01	2
MuRata	GRM033R61A562KA01D	0201	2	\$0.01	4
MuRata	GRM033R70J222KA01D	0201	3	\$0.01	6
MuRata	GRM033R71C102KA01D	0201	6	\$0.01	12
MuRata	GRM155R60J154KE01D	0402	2	\$0.01	6
MuRata	GRM155R61A184KE19D	0402	1	\$0.02	3
MuRata	GRM155R61C104KA88D	0402	3	\$0.01	9
MuRata	GRM188R60J475KE19D	0603	1	\$0.01	5
MuRata	GRM188R61C105KA93D	0603	3	\$0.01	14
MuRata	GRM188R61E105KA12D	0603	3	\$0.01	14
MuRata	GRM21BR61E475KA12L	0805	3	\$0.02	20
MuRata	GRM21BR61E475MA12L	0805	6	\$0.02	20
MuRata	GRM31CD80G107ME39L	1206_190	2	\$0.14	11
Texas Instruments	LM3880MF-1AE/NOPB	R-PDSO-G6	1	\$0.45	10
Yageo America	RC0603FR-0782KL	0603	1	\$0.01	5
Coilcraft	SER2915L-223KL	SER2915L	3	\$1.88	1,955
Bourns	SRU1048-220Y	SRU1048	1	\$0.33	144
Taiyo Yuden	TMK212BJ475KG-T	0805	1	\$0.05	7
Texas Instruments	TPS40170RGYR	RGY0020A	3	\$1.50	74
Texas Instruments	TPS62122DRVR	S-PWSON-N6	1	\$0.49	9
Total			100	\$1299.21	2999999997

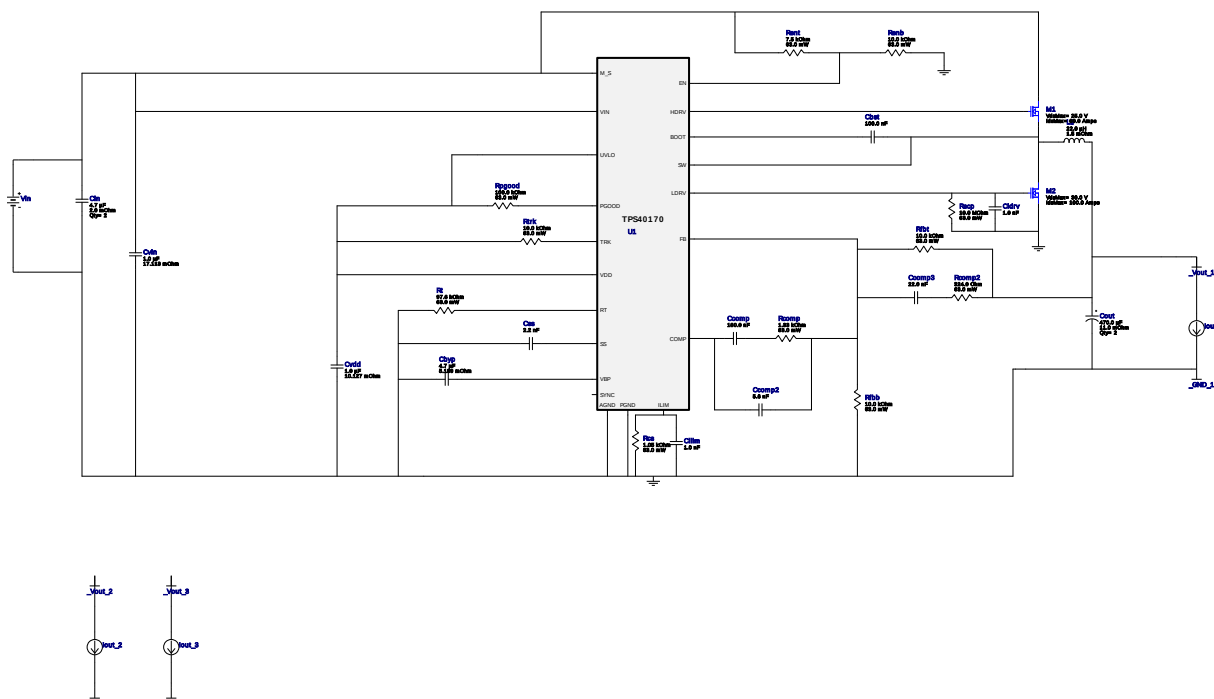


Vout = 1.2V
Iout = 3.0A

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Topology = Buck
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BOM Count = 29
Total Pd = 0.2W

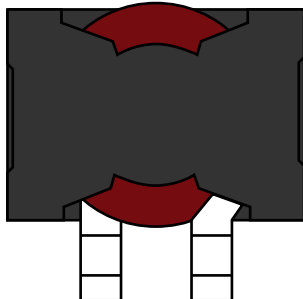
WEBENCH® Design Report

Design : 4790845/63 TPS40170RGYR
TPS40170RGYR 10.0V-14.0V to 1.20V @ 3.0A

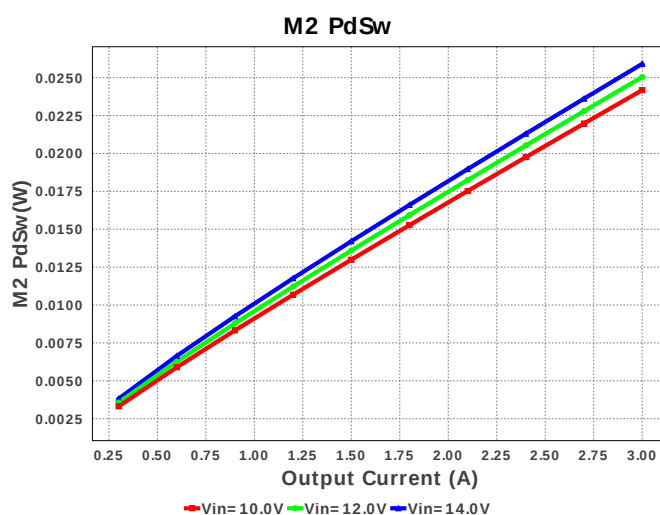
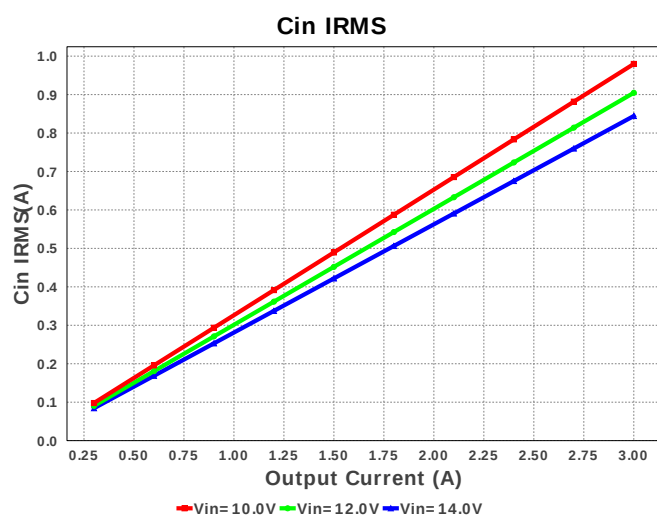
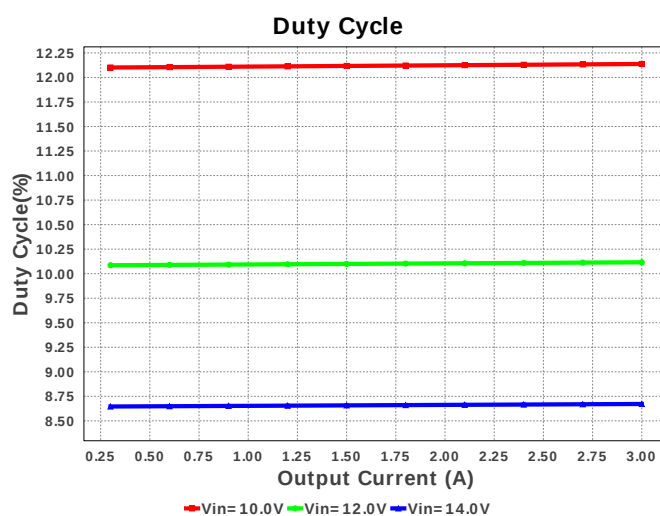
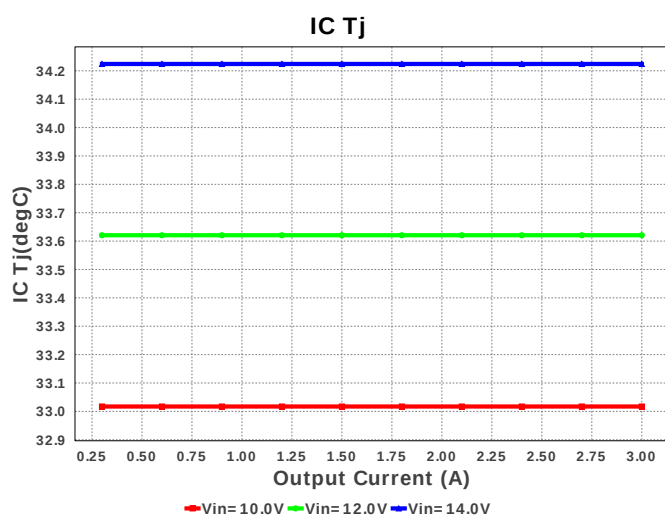


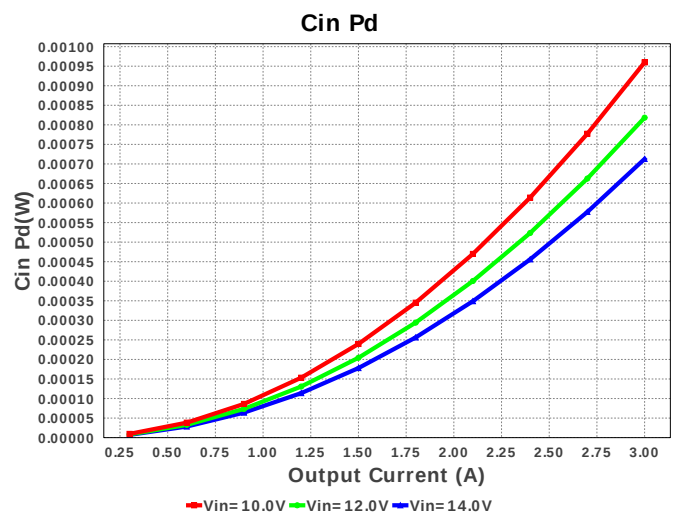
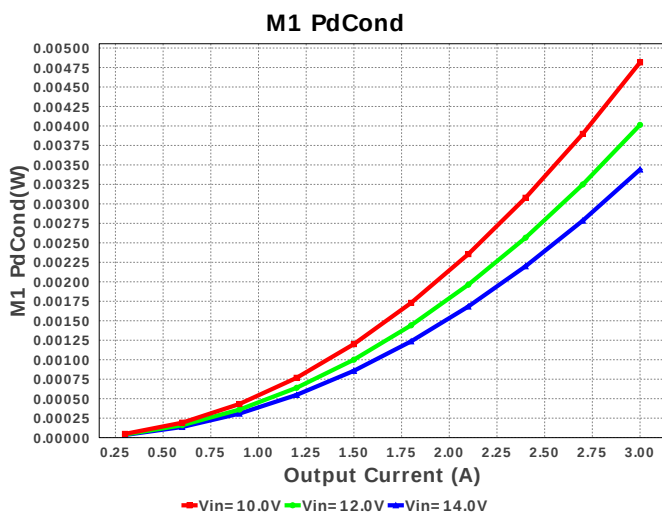
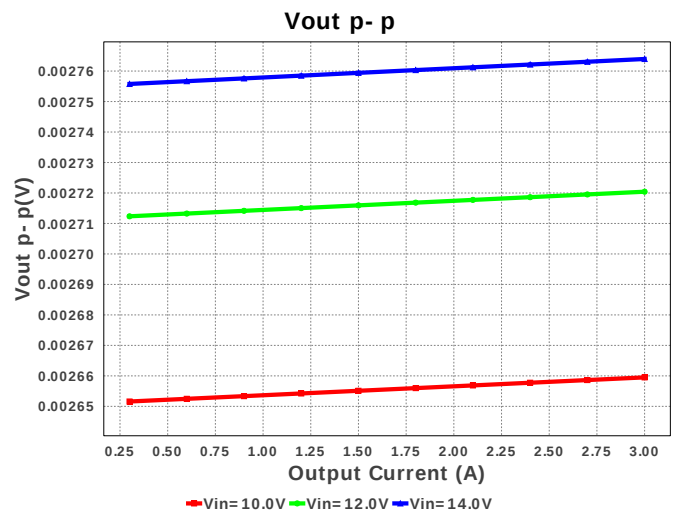
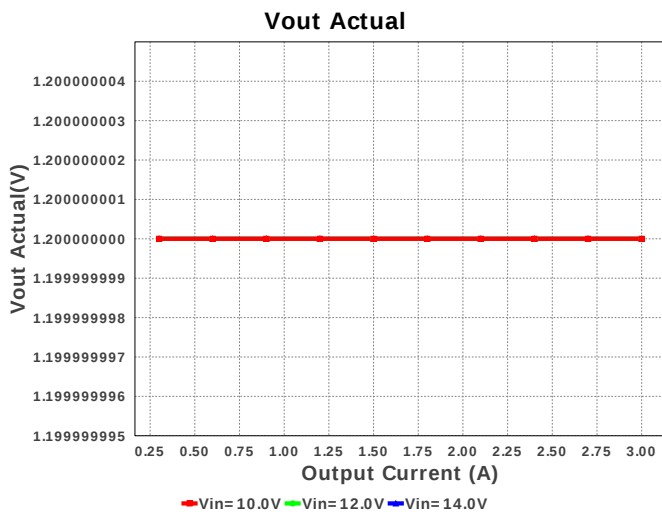
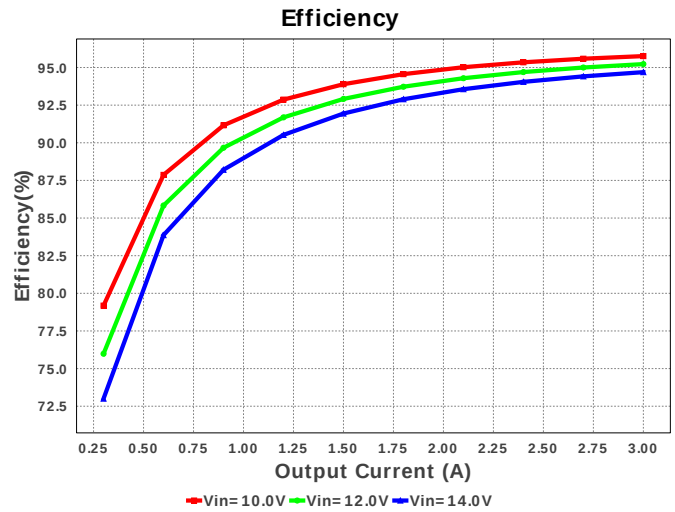
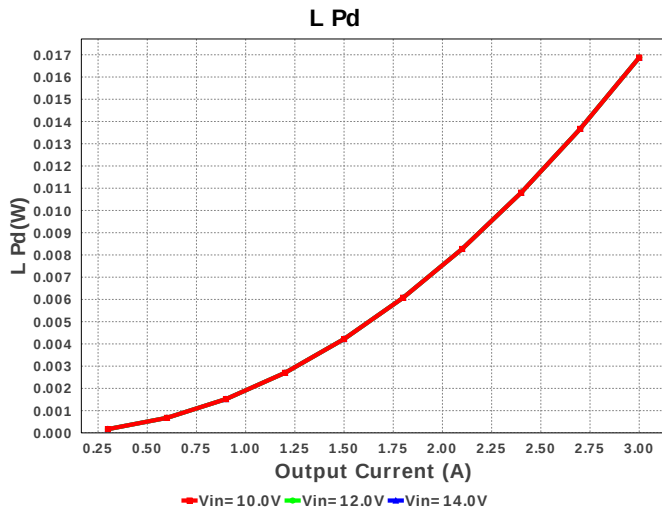
Electrical BOM

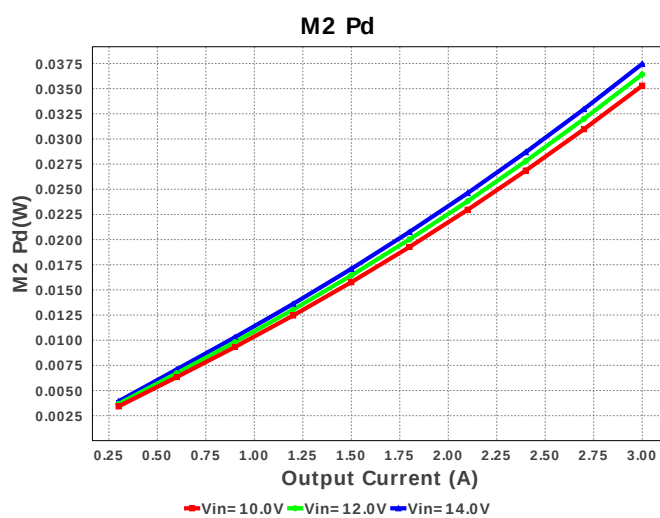
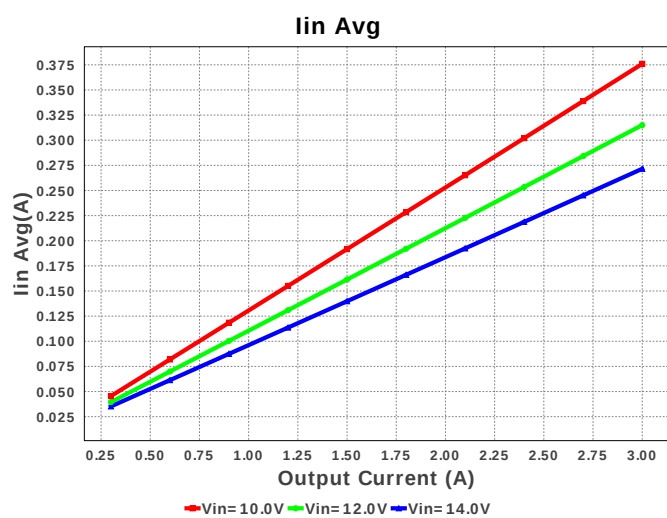
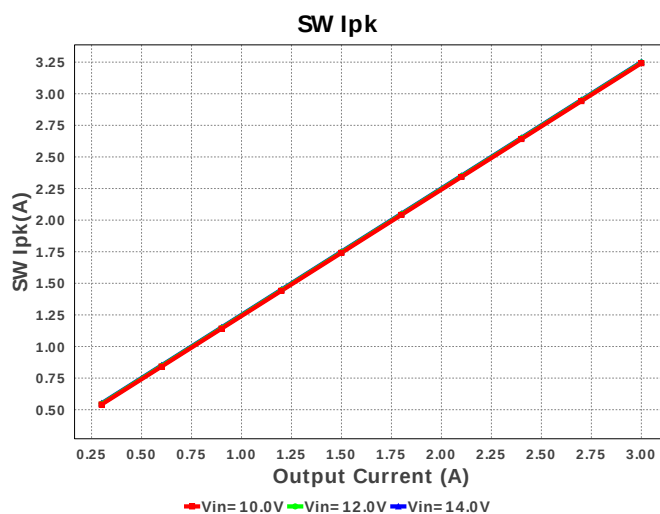
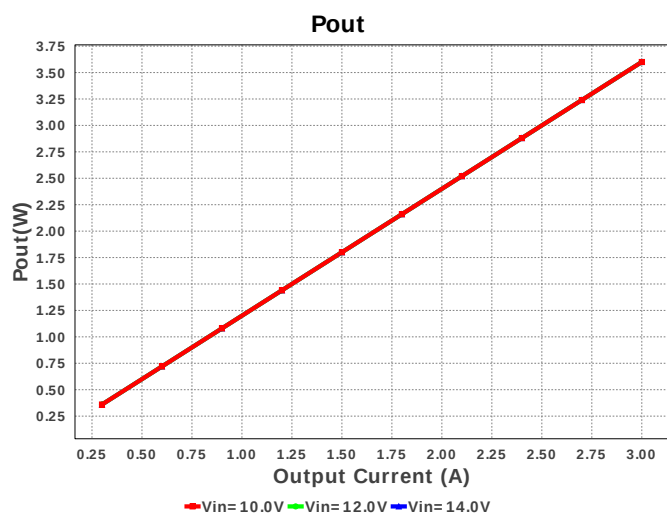
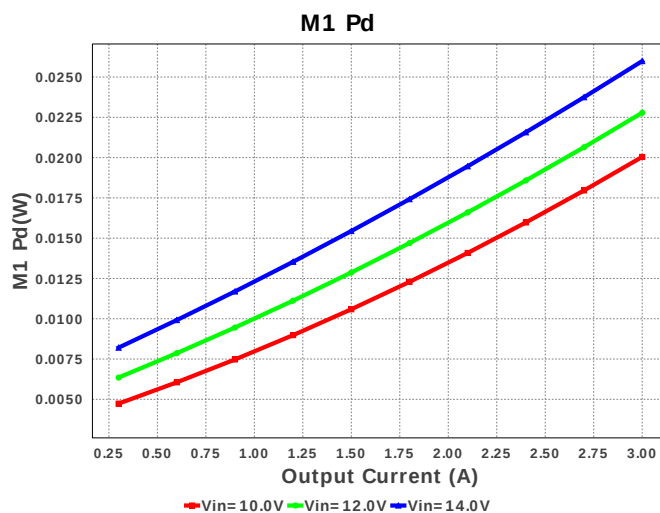
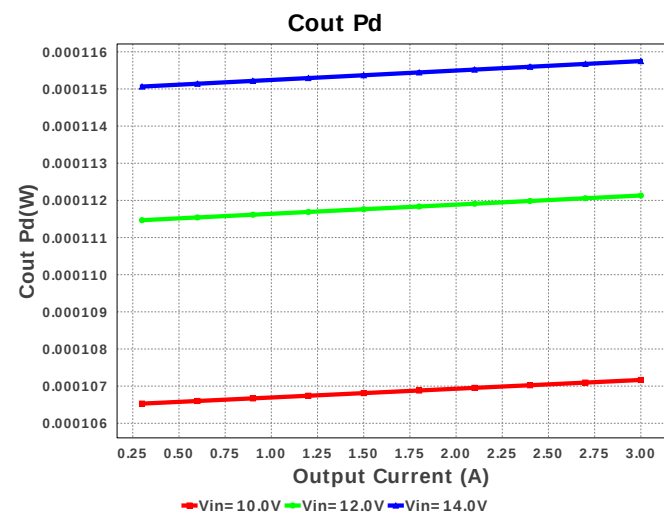
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1.	Cbst	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Cbyp	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	\$0.02	0805 7 mm ²
3.	Ccomp	MuRata	GRM155R61A184KE19D Series= X5R	Cap= 180.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.02	0402 3 mm ²
4.	Ccomp2	MuRata	GRM033R61A562KA01D Series= X5R	Cap= 5.6 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
5.	Ccomp3	MuRata	GRM033C80J223KE01D Series= X6S	Cap= 22.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
6.	Cilim	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
7.	Cin	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	2	\$0.02	0805 7 mm ²
8.	Cdrv	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²

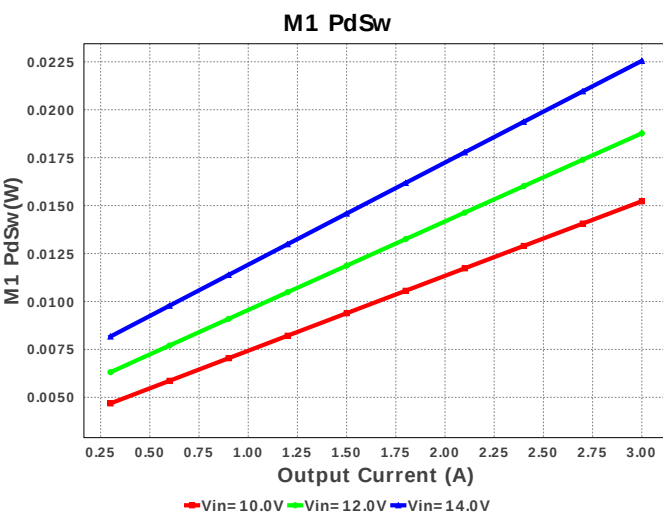
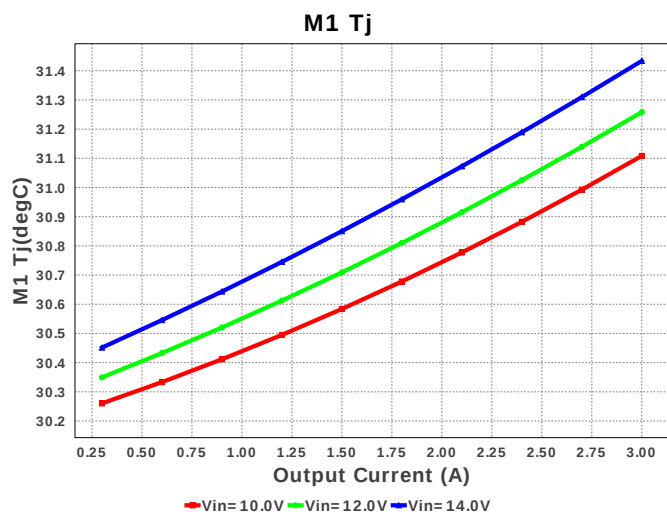
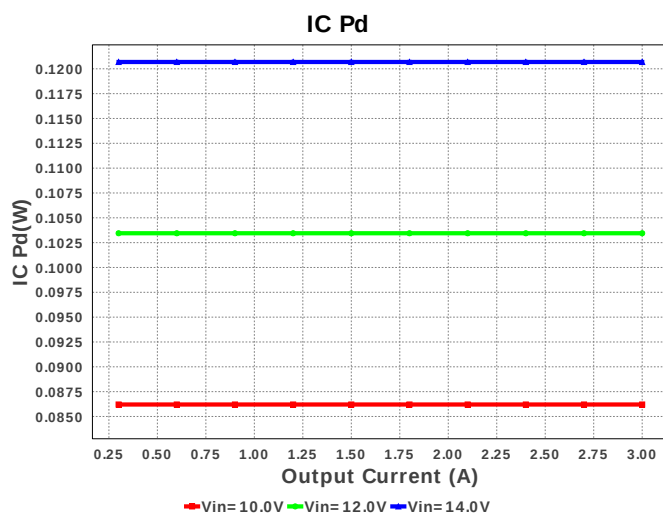
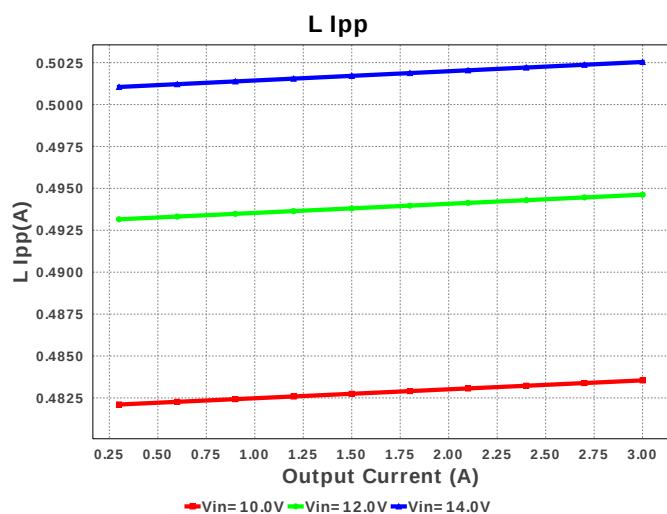
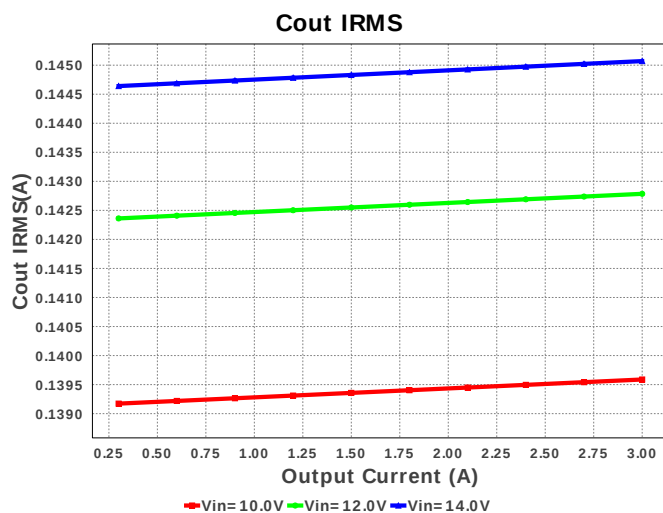
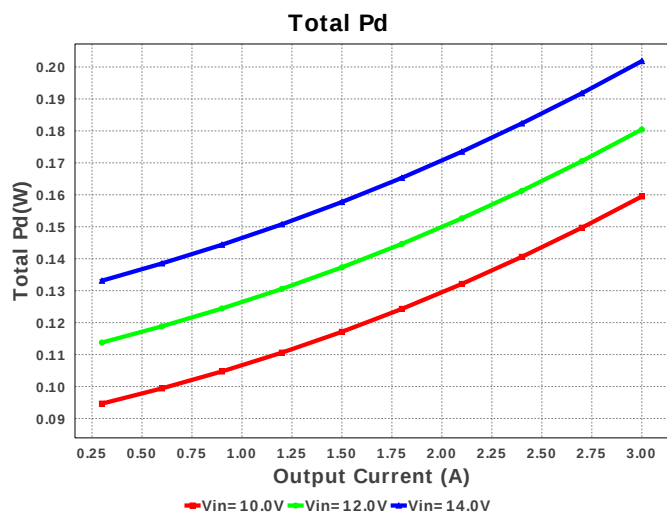
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout	Panasonic	2TPE470MAJGB Series= ?	Cap= 470.0 uF ESR= 11.0 mOhm VDC= 2.0 V IRMS= 2.3 A	2	\$0.70	 CAPSMT_6_B2S 17 mm²
10.	Css	MuRata	GRM033R70J222KA01D Series= X7R	Cap= 2.2 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm²
11.	Cvdd	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	\$0.01	 0603 5 mm²
12.	Cvin	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	\$0.01	 0603 5 mm²
13.	L1	Coilcraft	SER2915L-223KL	L= 22.0 µH DCR= 1.5 mOhm	1	\$1.88	 SER2915L 652 mm²
14.	M1	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	\$0.41	 DQG0008A 18 mm²
15.	M2	Texas Instruments	CSD17312Q5	VdsMax= 30.0 V IdsMax= 100.0 Amps	1	\$0.93	 TRANS_NexFET_Q5 55 mm²
16.	Rcomp	Vishay-Dale	CRCW04021K33FKED Series= CRCW..e3	Res= 1.33 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
17.	Rcomp2	Vishay-Dale	CRCW0402324RFKED Series= CRCW..e3	Res= 324.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
18.	Rcs	Vishay-Dale	CRCW04021K05FKED Series= CRCW..e3	Res= 1.05 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
19.	Renb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
20.	Rent	Vishay-Dale	CRCW04027K50FKED Series= CRCW..e3	Res= 7.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
21.	Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
22.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
23.	Rpgood	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
24.	Rscp	Vishay-Dale	CRCW040210M0FKED Series= CRCW..e3	Res= 10.0 MOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²

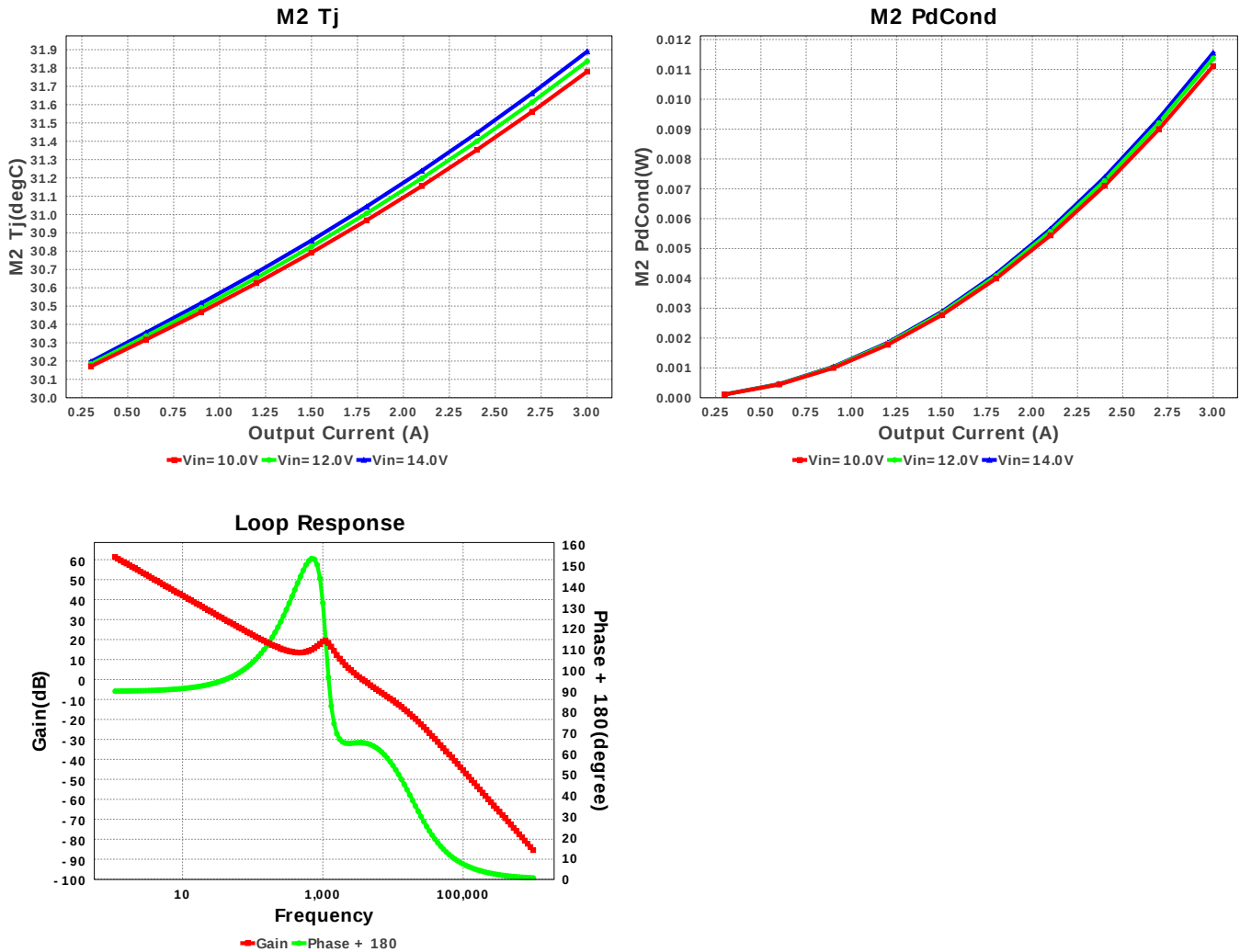
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25.	Rt	Vishay-Dale	CRCW040297K6FKED Series= CRCW..e3	Res= 97.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
26.	Rtrk	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
27.	U1	Texas Instruments	TPS40170RGYR	Switcher	1	\$1.50	 RGY0020A 25 mm ²











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	844.276 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	145.07 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	271.54 mA	Current	Average input current
4.	L Ipp	502.54 mA	Current	Peak-to-peak inductor ripple current
5.	SW Ipk	3.251 A	Current	Peak switch current
6.	BOM Count	29	General	Total Design BOM count
7.	FootPrint	863.0 mm ²	General	Total Foot Print Area of BOM components
8.	Frequency	100.402 kHz	General	Switching frequency
9.	IC Tolerance	6.0 μ V	General	IC Feedback Tolerance
10.	Mode	CCM	General	Conduction Mode
11.	Pout	3.6 W	General	Total output power
12.	Total BOM	\$6.39	General	Total BOM Cost
13.	Low Freq Gain	61.26 dB	Op_Point	Gain at 10Hz
14.	Vout Actual	1.2 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Cross Freq	3.681 kHz	Op_point	Bode plot crossover frequency
16.	Duty Cycle	8.672 %	Op_point	Duty cycle
17.	Efficiency	94.696 %	Op_point	Steady state efficiency
18.	Gain Marg	-96.719 dB	Op_point	Bode Plot Gain Margin
19.	IC Tj	34.224 degC	Op_point	IC junction temperature
20.	IOUT_OP	3.0 A	Op_point	Iout operating point
21.	M1 Tj	31.434 degC	Op_point	M1 MOSFET junction temperature
22.	M2 Tj	31.879 degC	Op_point	M2 MOSFET junction temperature
23.	Phase Marg	65.442 deg	Op_point	Bode Plot Phase Margin
24.	VIN_OP	14.0 V	Op_point	Vin operating point
25.	Vout p-p	2.764 mV	Op_point	Peak-to-peak output ripple voltage
26.	Cin Pd	712.802 μ W	Power	Input capacitor power dissipation
27.	Cout Pd	115.75 μ W	Power	Output capacitor power dissipation
28.	IC Pd	120.687 mW	Power	IC power dissipation
29.	L Pd	16.875 mW	Power	Inductor power dissipation
30.	M1 Pd	25.989 mW	Power	M1 MOSFET total power dissipation
31.	M1 PdCond	3.441 mW	Power	M1 MOSFET conduction losses

#	Name	Value	Category	Description
32.	M1 PdSw	22.548 mW	Power	M1 MOSFET switching losses
33.	M2 Pd	37.244 mW	Power	M2 MOSFET total power dissipation
34.	M2 PdCond	11.552 mW	Power	M2 MOSFET conduction losses
35.	M2 PdSw	25.692 mW	Power	M2 MOSFET switching losses
36.	Total Pd	201.635 mW	Power	Total Power Dissipation
37.	Vout Tolerance	1.011 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	SoftStart	1.0 ms	Soft Start Time (ms)
3.	VinMax	14.0	Maximum input voltage
4.	VinMin	10.0	Minimum input voltage
5.	Vout	1.2	Output Voltage
6.	base_pn	TPS40170	Texas Instruments Base Part Number
7.	source	DC	Input Source Type
8.	ta	30.0	Ambient temperature

Design Assistance

1. TPS40170 Product Folder : <http://www.ti.com/product/TPS40170> : contains the data sheet and other resources.

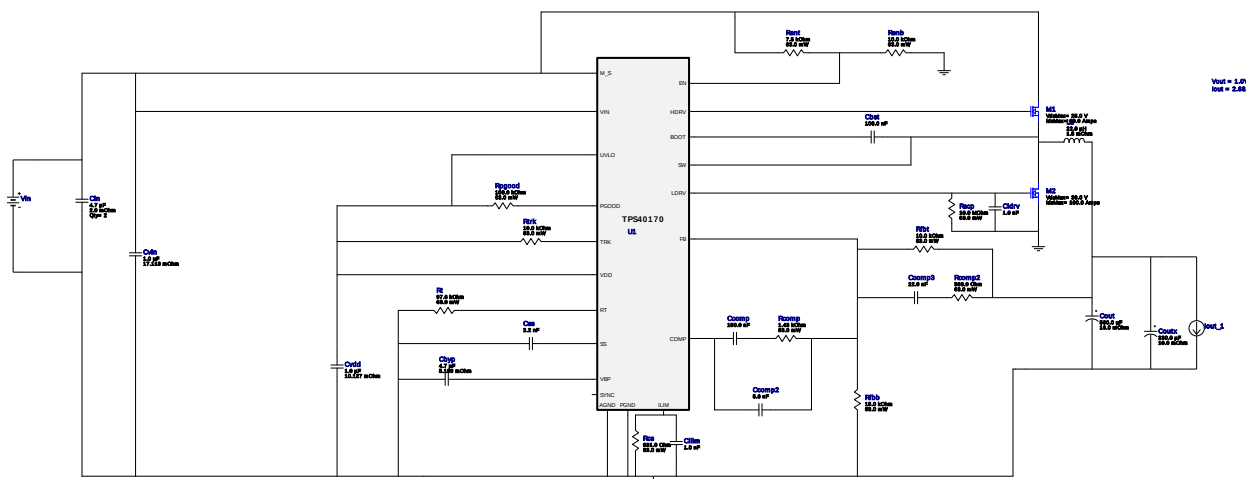


Vout = 1.0V
Iout = 2.68A

Device = TPS40170RGYR
Topology = Buck
Created = 9/29/16 6:07:56 AM
BOM Cost = \$5.52
BOM Count = 29
Total Pd = 0.19W

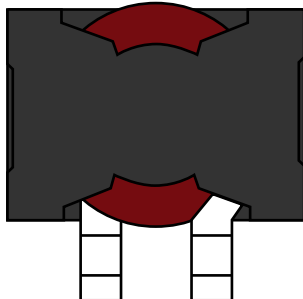
WEBENCH® Design Report

Design : 4790845/64 TPS40170RGYR
TPS40170RGYR 10.0V-14.0V to 1.00V @ 2.68A

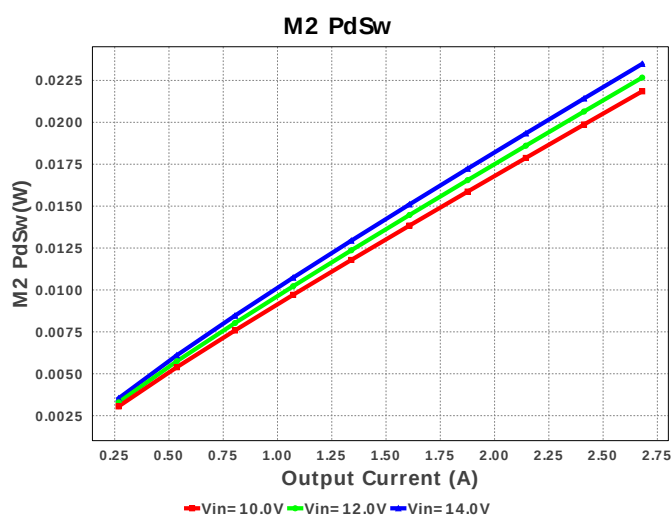
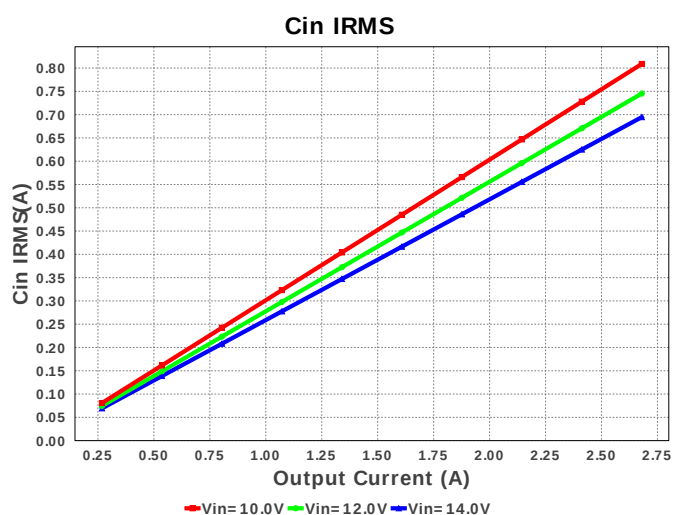
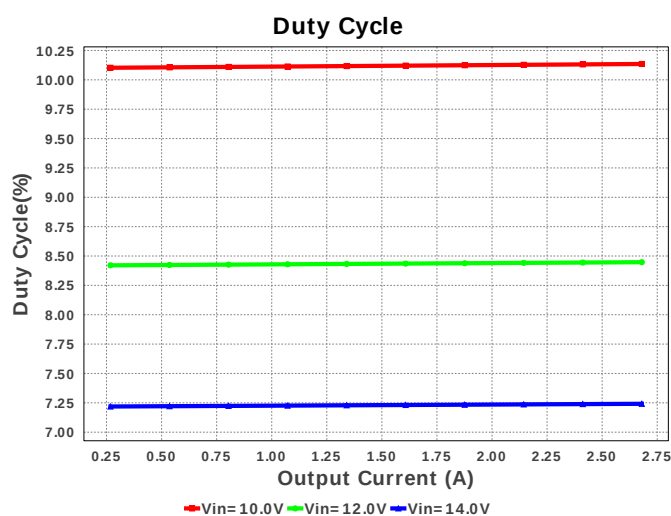
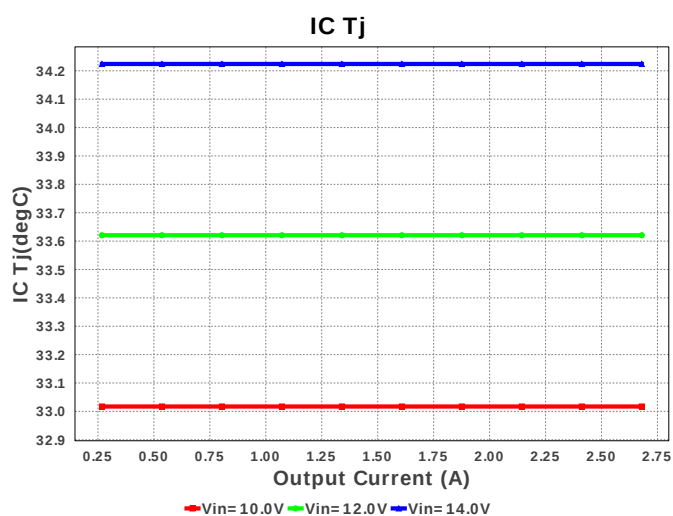


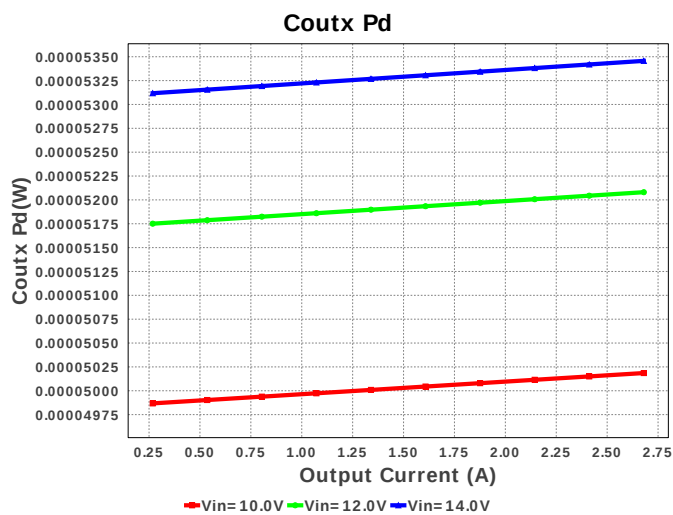
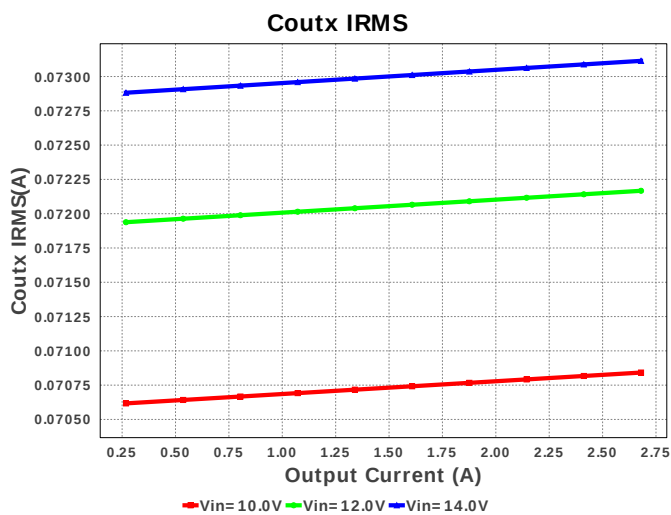
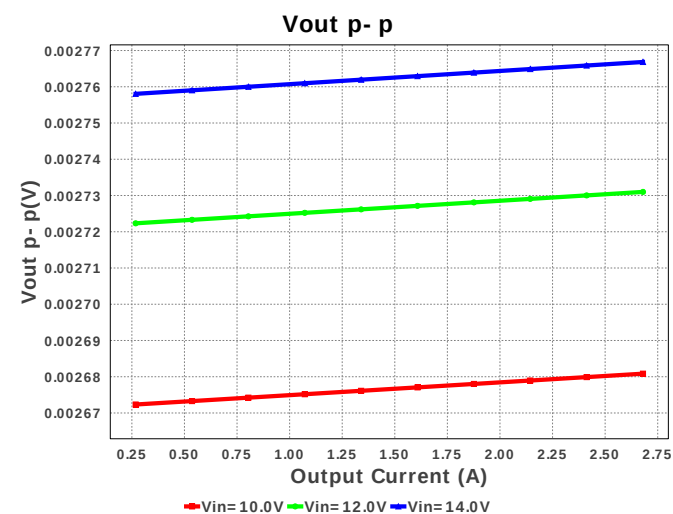
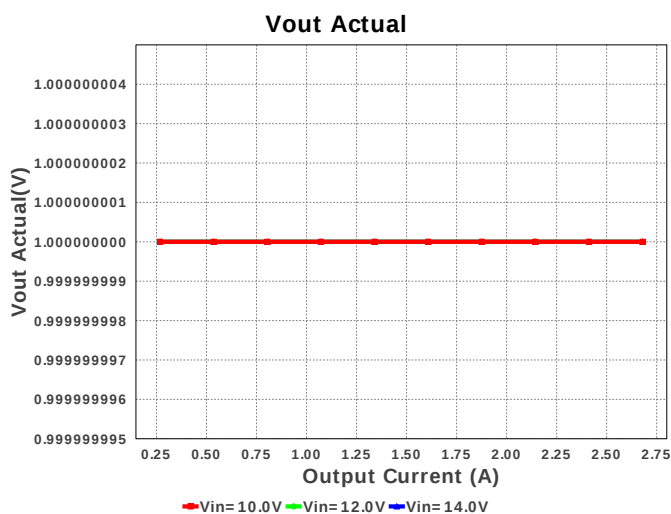
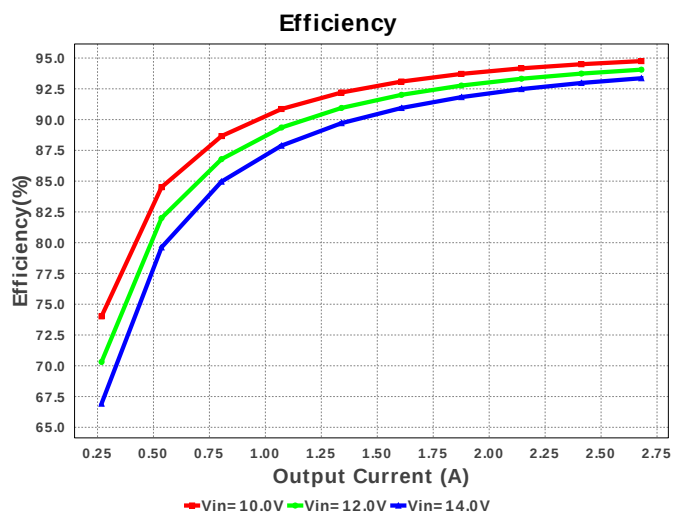
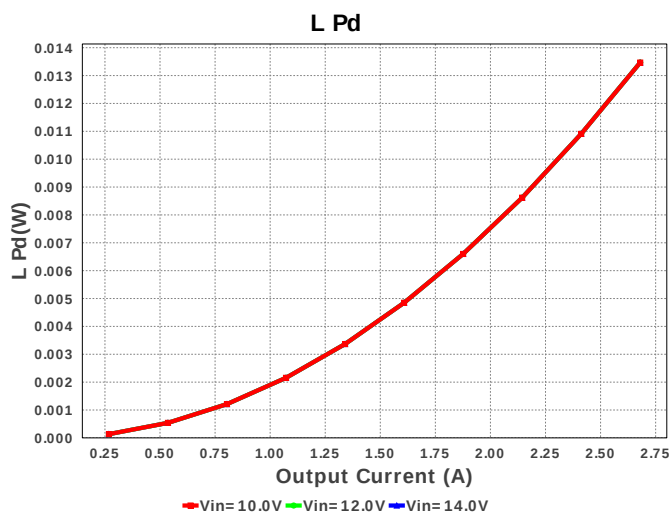
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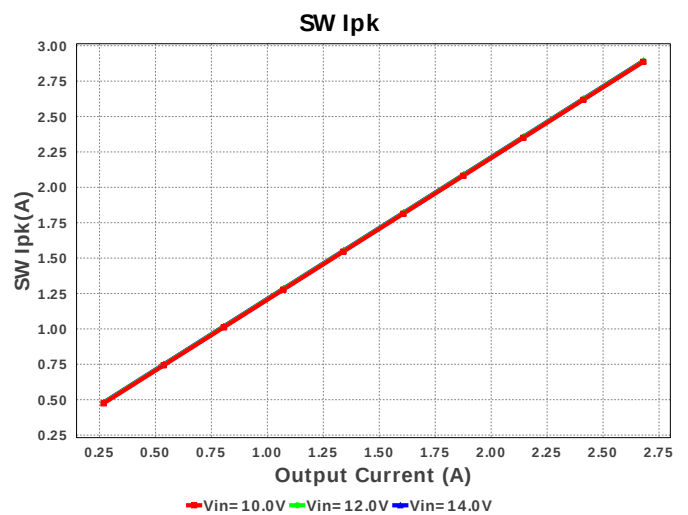
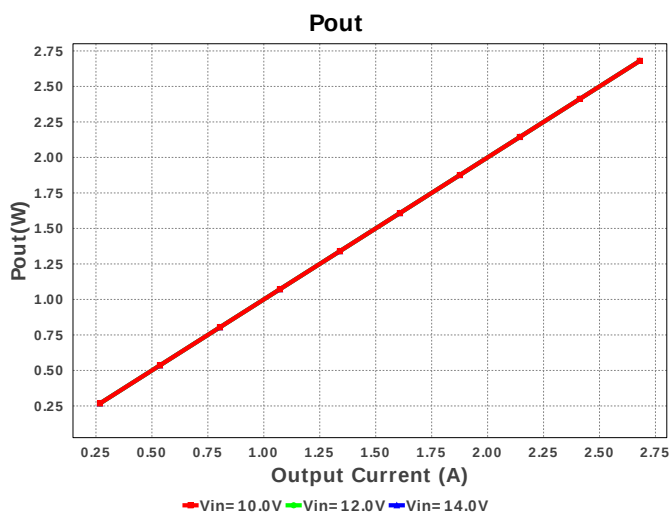
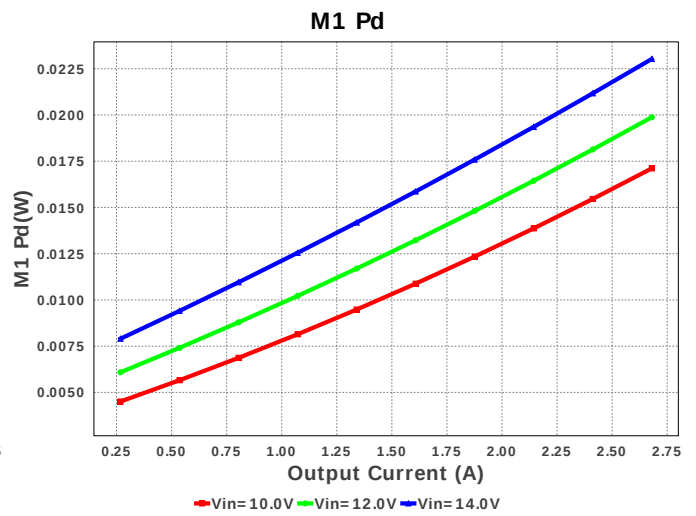
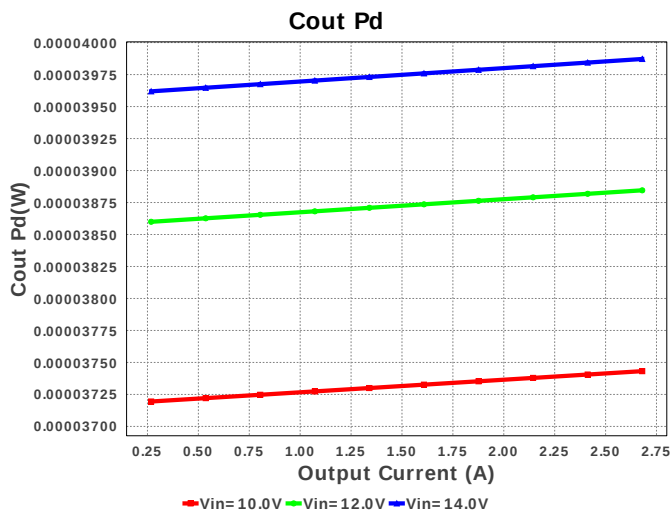
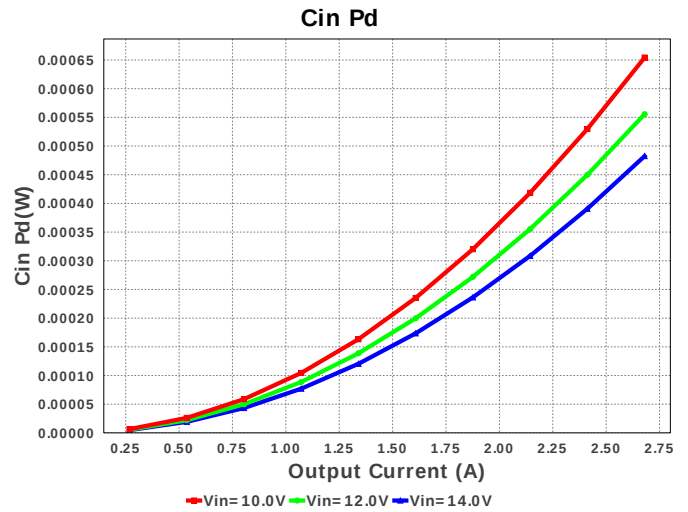
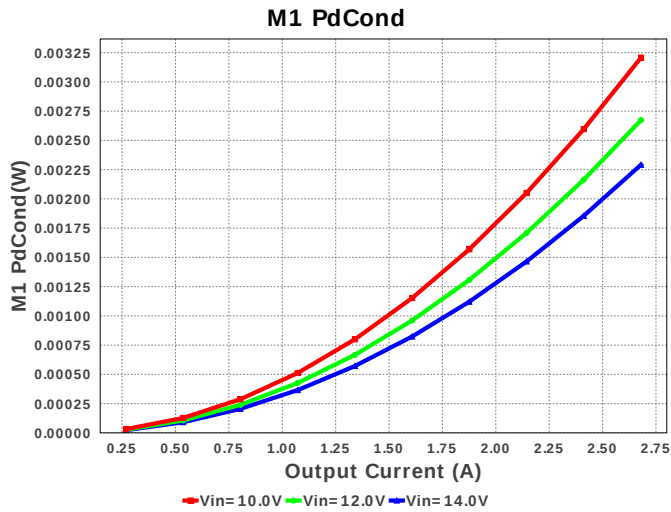
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2.	Cbyp	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	\$0.02	0805 7 mm ²
3.	Ccomp	MuRata	GRM155R60J154KE01D Series= X5R	Cap= 150.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
4.	Ccomp2	MuRata	GRM033R61A562KA01D Series= X5R	Cap= 5.6 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
5.	Ccomp3	MuRata	GRM033C80J223KE01D Series= X6S	Cap= 22.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
6.	Cilim	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
7.	Cin	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	2	\$0.02	0805 7 mm ²
8.	Cldr	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
9.	Cout	Panasonic	2R5SVPC560M Series= SVPC	Cap= 560.0 uF ESR= 16.0 mOhm VDC= 2.5 V IRMS= 3.5 A	1	\$0.32	SM_RADIAL_6.3AMM 80 mm ²

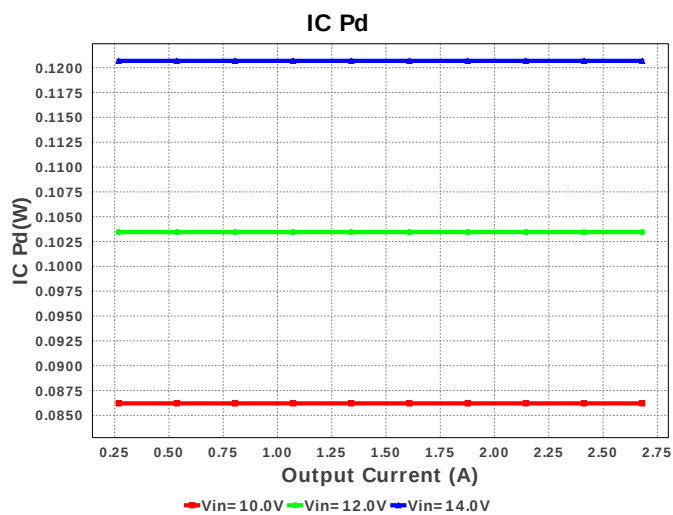
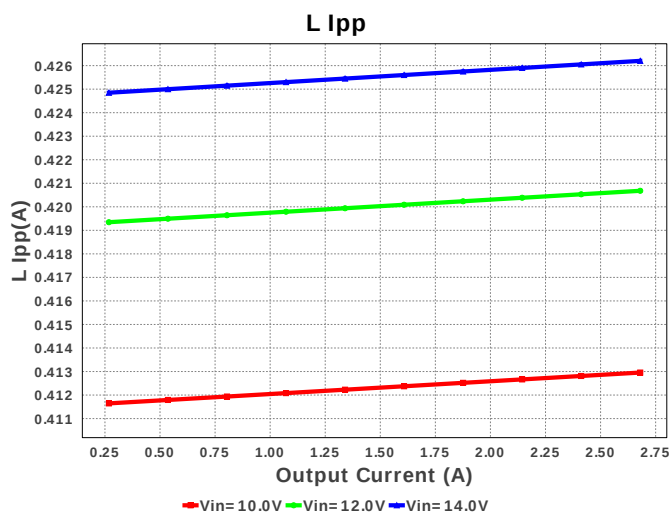
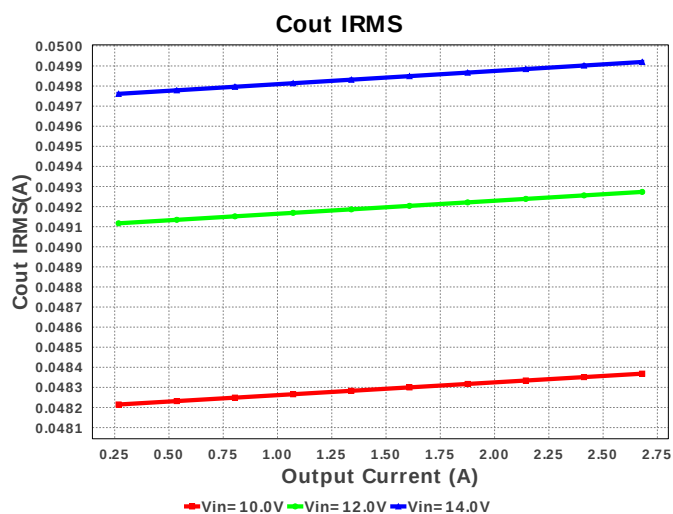
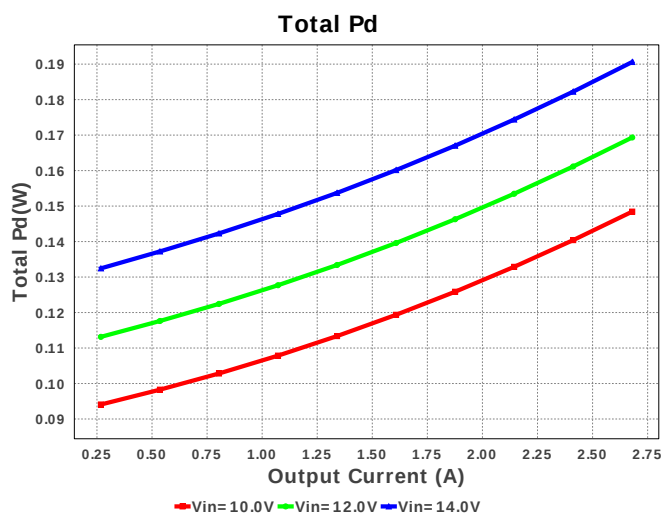
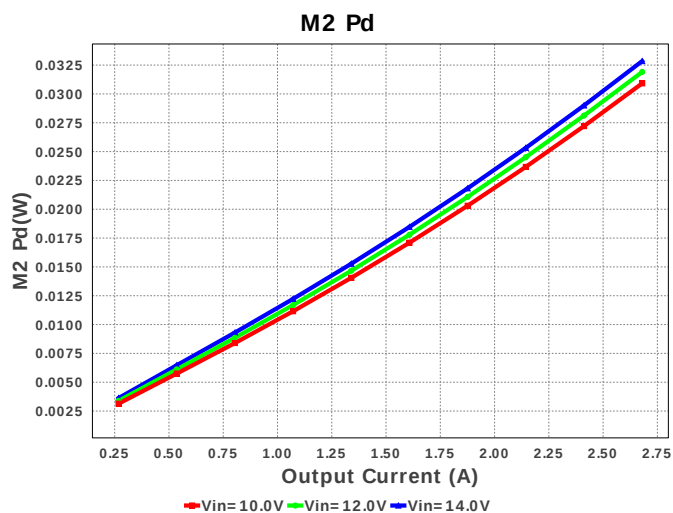
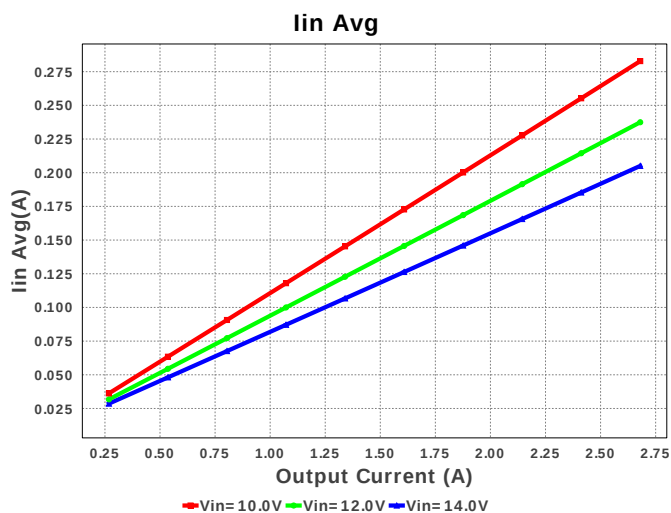
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10.	Coutx	Panasonic	2R5SVPE330MY Series= SVPE	Cap= 330.0 uF ESR= 10.0 mOhm VDC= 2.5 V IRMS= 3.86 A	1	\$0.22	 CAPSMT_62_E61 53 mm ²
11.	Css	MuRata	GRM033R70J222KA01D Series= X7R	Cap= 2.2 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
12.	Cvdd	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	\$0.01	 0603 5 mm ²
13.	Cvin	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	\$0.01	 0603 5 mm ²
14.	L1	Coilcraft	SER2915L-223KL	L= 22.0 uH DCR= 1.5 mOhm	1	\$1.88	 SER2915L 652 mm ²
15.	M1	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	\$0.41	 DQG0008A 18 mm ²
16.	M2	Texas Instruments	CSD17312Q5	VdsMax= 30.0 V IdsMax= 100.0 Amps	1	\$0.93	 TRANS_NexFET_Q5 55 mm ²
17.	Rcomp	Vishay-Dale	CRCW04021K43FKED Series= CRCW..e3	Res= 1.43 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
18.	Rcomp2	Vishay-Dale	CRCW0402383RFKED Series= CRCW..e3	Res= 383.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
19.	Rcs	Vishay-Dale	CRCW0402931RFKED Series= CRCW..e3	Res= 931.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
20.	Renb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
21.	Rent	Vishay-Dale	CRCW04027K50FKED Series= CRCW..e3	Res= 7.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
22.	Rfbb	Vishay-Dale	CRCW040215K0FKED Series= CRCW..e3	Res= 15.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
23.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
24.	Rpgood	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
25.	Rscp	Vishay-Dale	CRCW040210M0FKED Series= CRCW..e3	Res= 10.0 MOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

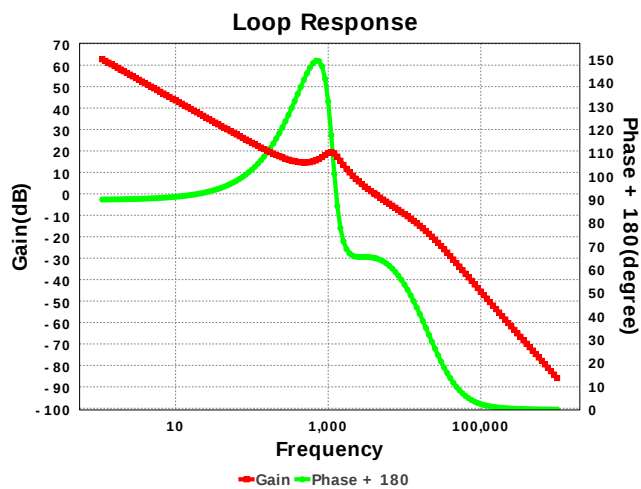
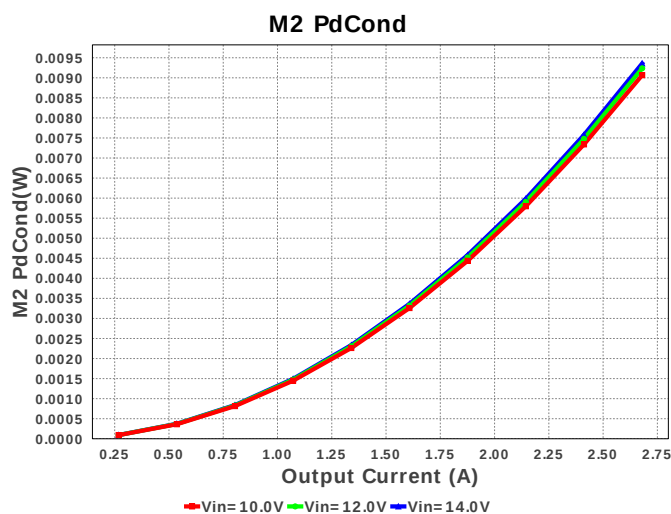
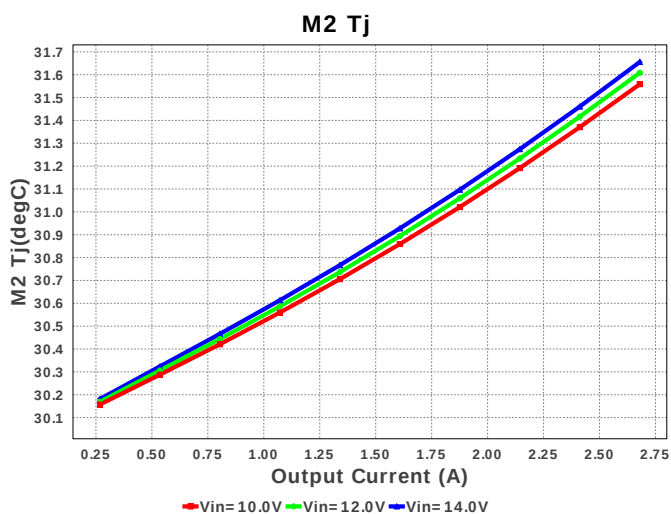
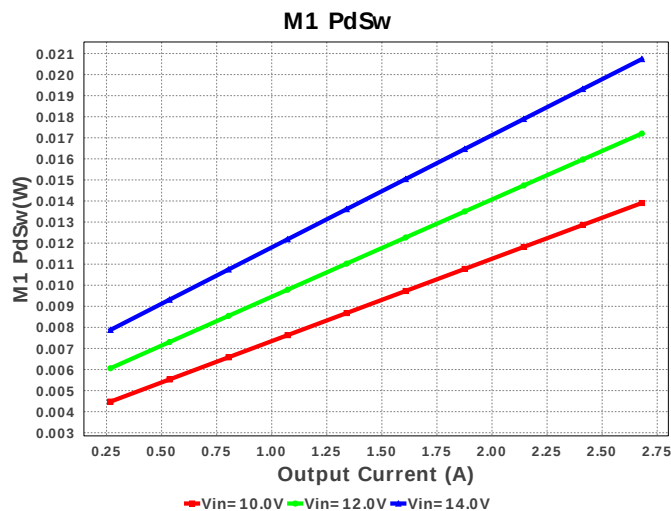
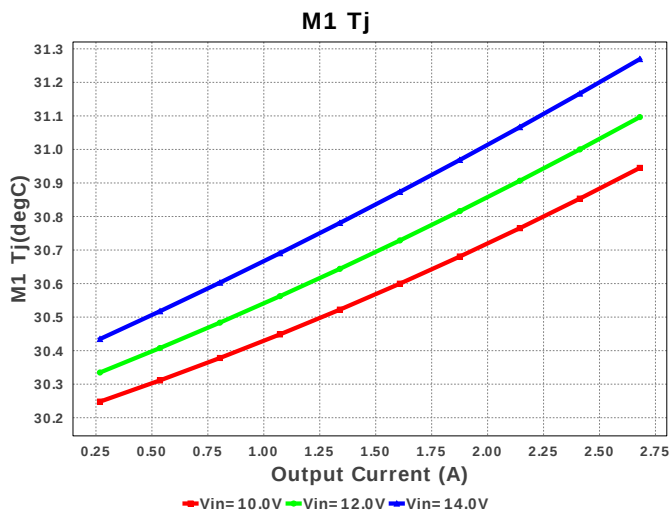
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
26.	Rt	Vishay-Dale	CRCW040297K6FKED Series= CRCW..e3	Res= 97.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
27.	Rtrk	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
28.	U1	Texas Instruments	TPS40170RGYR	Switcher	1	\$1.50	 RGY0020A 25 mm ²











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	694.591 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	49.92 mA	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	73.114 mA	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	205.03 mA	Current	Average input current
5.	L Ipp	426.2 mA	Current	Peak-to-peak inductor ripple current
6.	SW Ipk	2.893 A	Current	Peak switch current
7.	BOM Count	29	General	Total Design BOM count
8.	FootPrint	962.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	100.402 kHz	General	Switching frequency
10.	IC Tolerance	6.0 μ V	General	IC Feedback Tolerance
11.	Mode	CCM	General	Conduction Mode

#	Name	Value	Category	Description
12.	Pout	2.68 W	General	Total output power
13.	Total BOM	\$5.52	General	Total BOM Cost
14.	Low Freq Gain	62.782 dB	Op_Point	Gain at 10Hz
15.	Vout Actual	1000.0 mV	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Cross Freq	4.074 kHz	Op_point	Bode plot crossover frequency
17.	Duty Cycle	7.242 %	Op_point	Duty cycle
18.	Efficiency	93.367 %	Op_point	Steady state efficiency
19.	Gain Marg	-96.963 dB	Op_point	Bode Plot Gain Margin
20.	IC Tj	34.224 degC	Op_point	IC junction temperature
21.	IOUT_OP	2.68 A	Op_point	Iout operating point
22.	M1 Tj	31.269 degC	Op_point	M1 MOSFET junction temperature
23.	M2 Tj	31.646 degC	Op_point	M2 MOSFET junction temperature
24.	Phase Marg	65.115 deg	Op_point	Bode Plot Phase Margin
25.	VIN_OP	14.0 V	Op_point	Vin operating point
26.	Vout p-p	2.767 mV	Op_point	Peak-to-peak output ripple voltage
27.	Cin Pd	482.457 μ W	Power	Input capacitor power dissipation
28.	Cout Pd	39.872 μ W	Power	Output capacitor power dissipation
29.	Coutx Pd	53.457 μ W	Power	Output capacitor_x power loss
30.	IC Pd	120.687 mW	Power	IC power dissipation
31.	L Pd	13.467 mW	Power	Inductor power dissipation
32.	M1 Pd	23.027 mW	Power	M1 MOSFET total power dissipation
33.	M1 PdCond	2.292 mW	Power	M1 MOSFET conduction losses
34.	M1 PdSw	20.735 mW	Power	M1 MOSFET switching losses
35.	M2 Pd	32.651 mW	Power	M2 MOSFET total power dissipation
36.	M2 PdCond	9.358 mW	Power	M2 MOSFET conduction losses
37.	M2 PdSw	23.293 mW	Power	M2 MOSFET switching losses
38.	Total Pd	190.395 mW	Power	Total Power Dissipation
39.	Vout Tolerance	809.09 m%		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.68	Maximum Output Current
2.	VinMax	14.0	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	1.0	Output Voltage
5.	base_pn	TPS40170	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. TPS40170 Product Folder : <http://www.ti.com/product/TPS40170> : contains the data sheet and other resources.

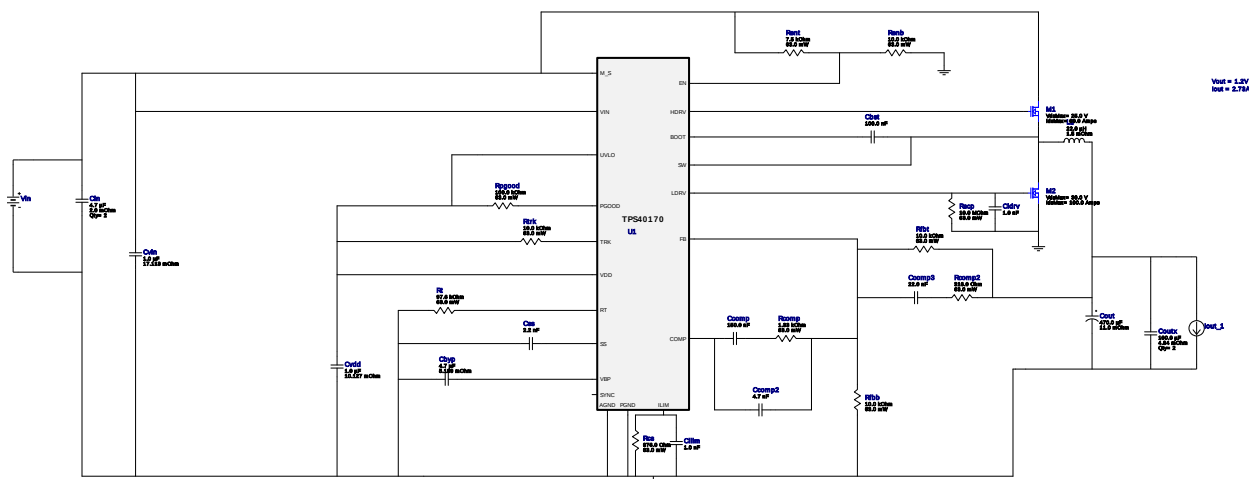


Vout = 1.2V
Iout = 2.73A

Device = TPS40170RGYR
Topology = Buck
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BOM Count = 30
Total Pd = 0.19W

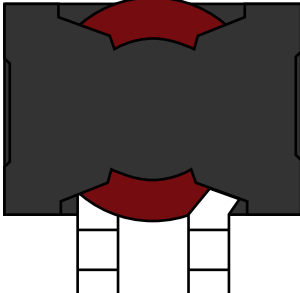
WEBENCH® Design Report

Design : 4790845/65 TPS40170RGYR
TPS40170RGYR 10.0V-14.0V to 1.20V @ 2.73A

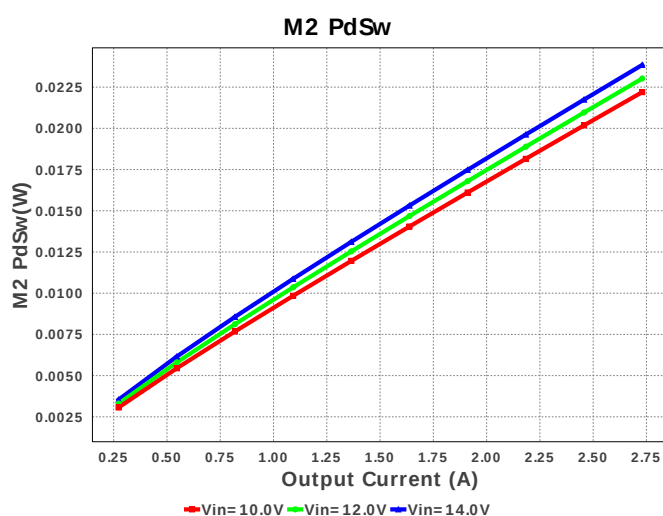
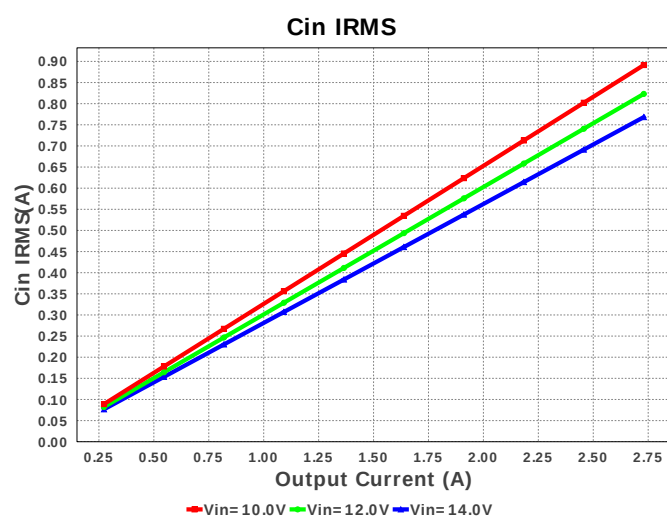
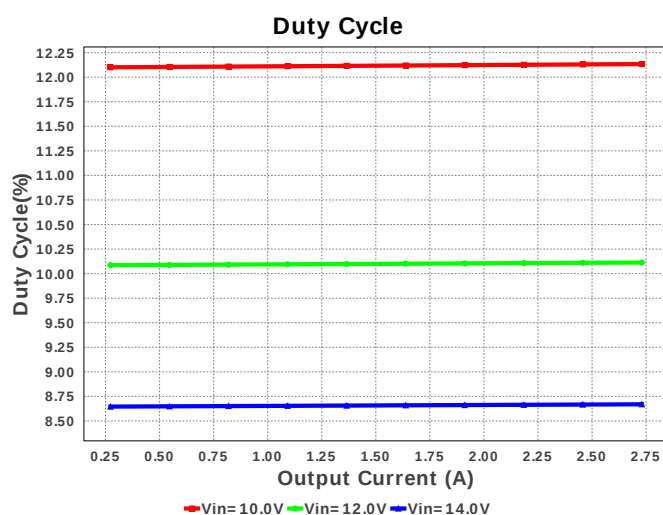
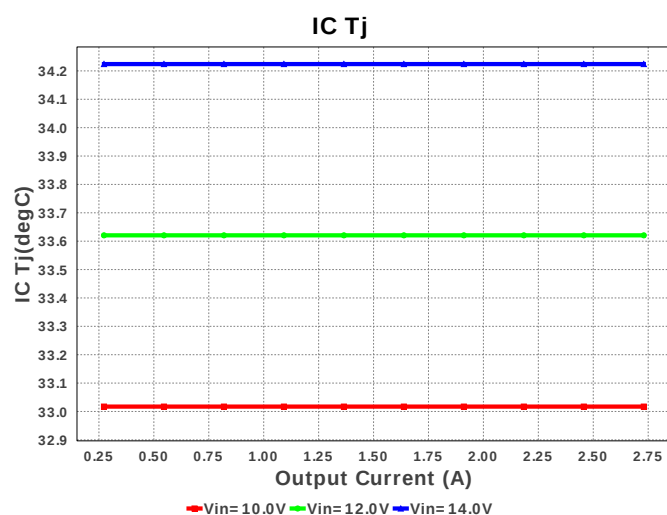


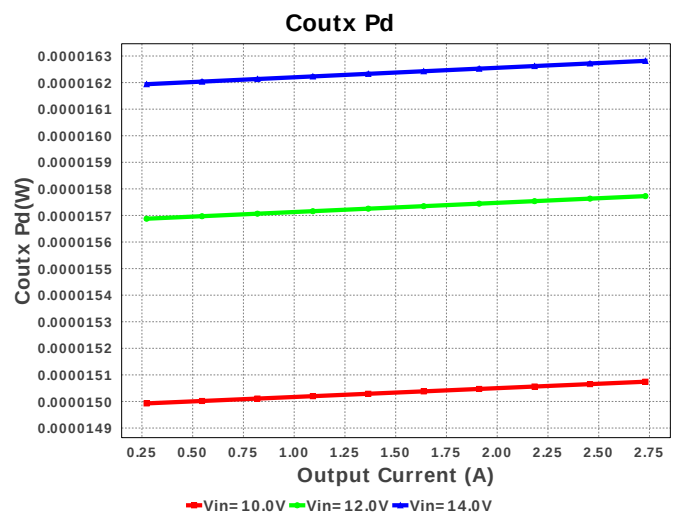
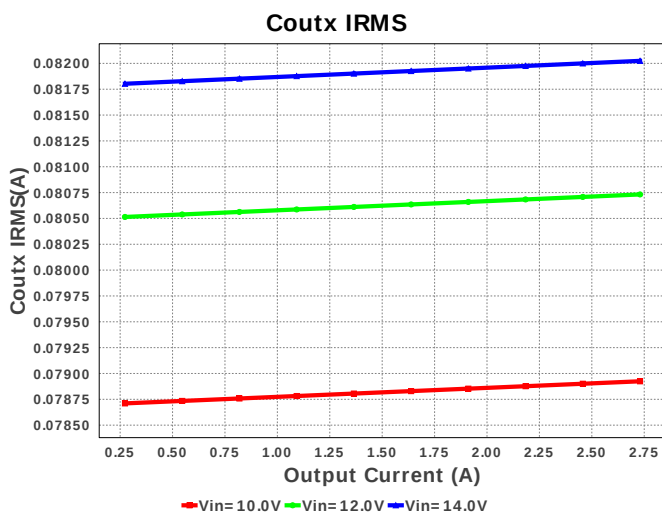
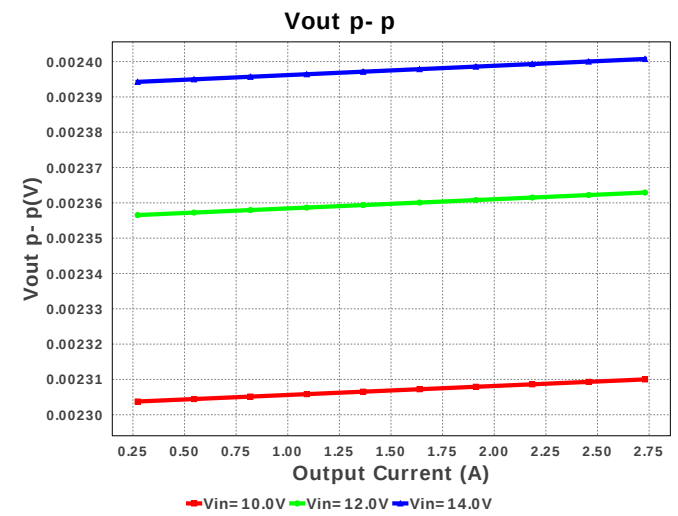
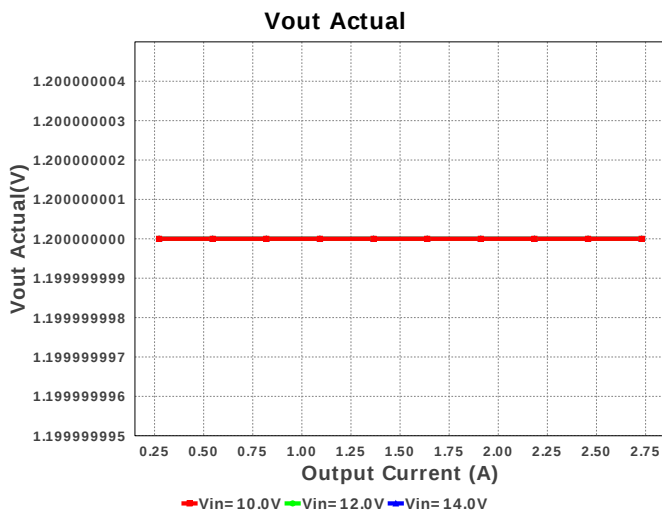
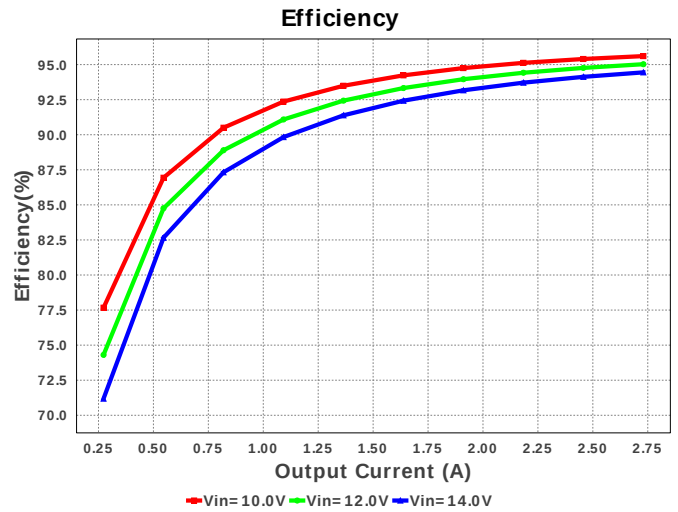
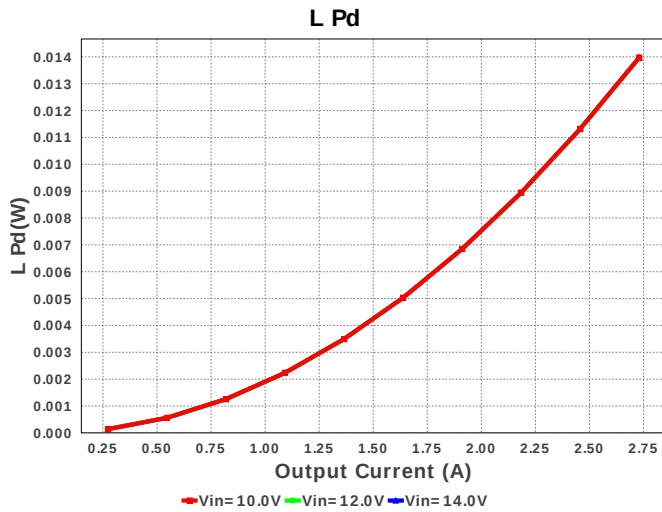
Electrical BOM

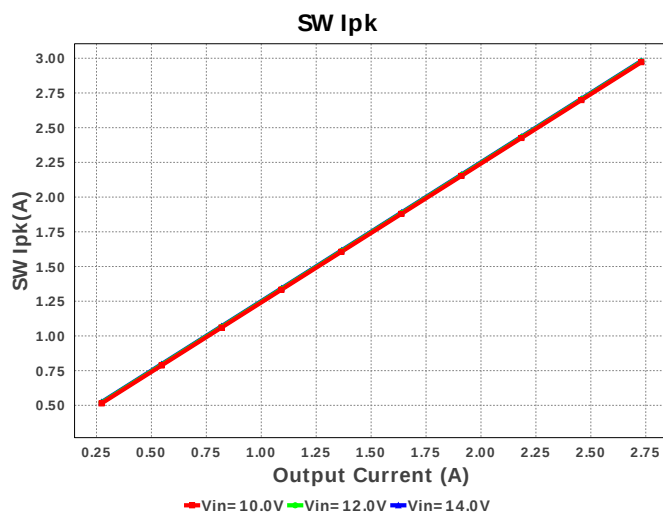
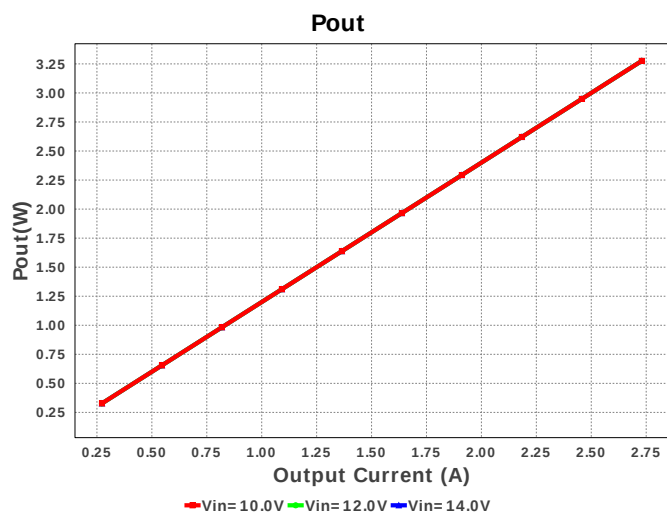
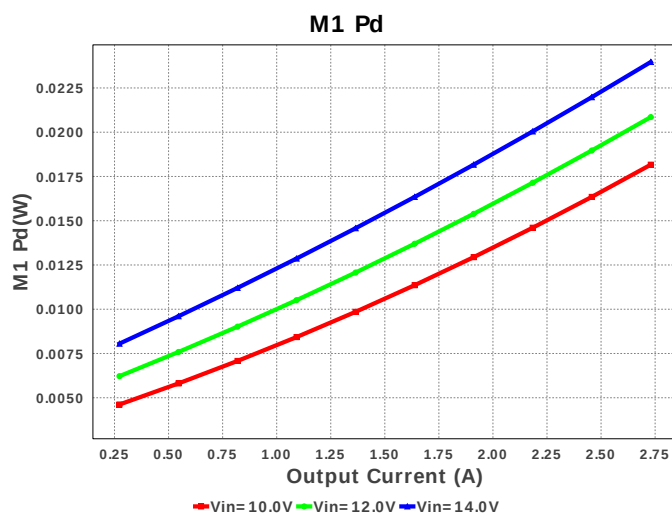
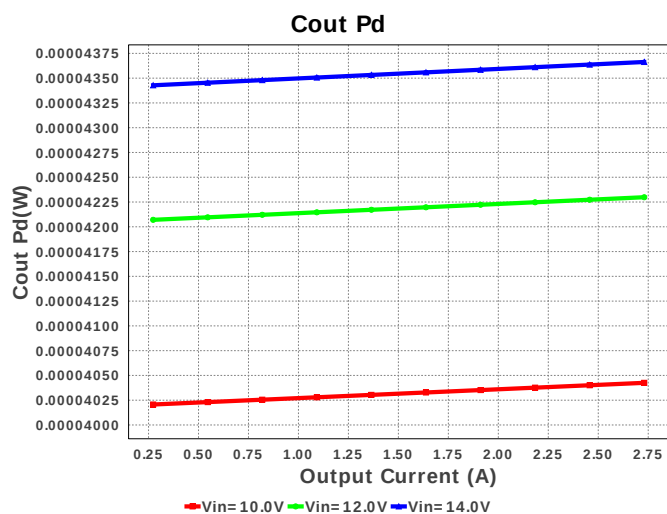
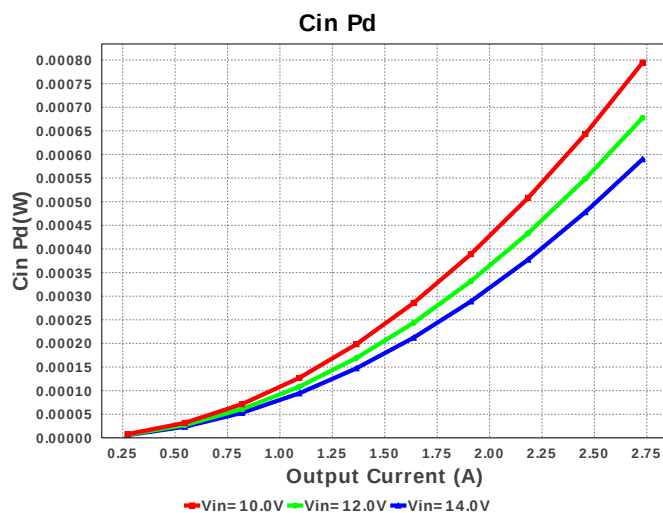
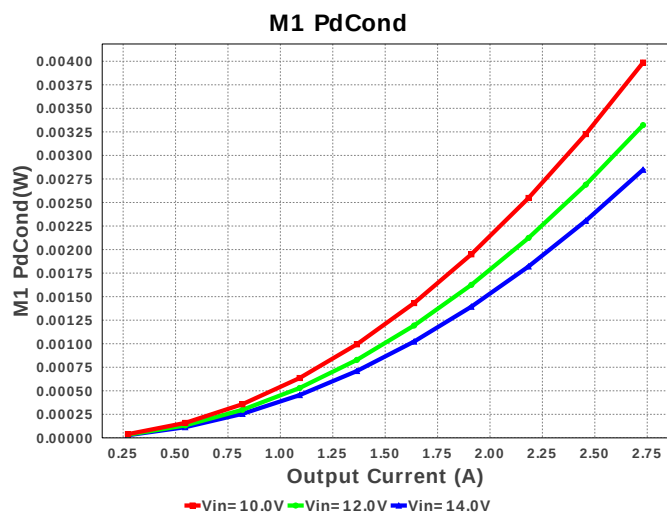
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1.	Cbst	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Cbyp	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	\$0.02	0805 7 mm ²
3.	Ccomp	MuRata	GRM155R60J154KE01D Series= X5R	Cap= 150.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
4.	Ccomp2	MuRata	GRM033R61A472KA01D Series= X5R	Cap= 4.7 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
5.	Ccomp3	MuRata	GRM033C80J223KE01D Series= X6S	Cap= 22.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
6.	Cilim	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
7.	Cin	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	2	\$0.02	0805 7 mm ²
8.	Cldr	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
9.	Cout	Panasonic	2TPE470MAJGB Series= ?	Cap= 470.0 uF ESR= 11.0 mOhm VDC= 2.0 V IRMS= 2.3 A	1	\$0.70	CAPSMT_6_B2S 17 mm ²
10.	Coutx	MuRata	GRM31CD80G107ME39L Series= X6T	Cap= 100.0 uF ESR= 4.84 mOhm VDC= 4.0 V IRMS= 4.3381 A	2	\$0.14	1206_190 11 mm ²

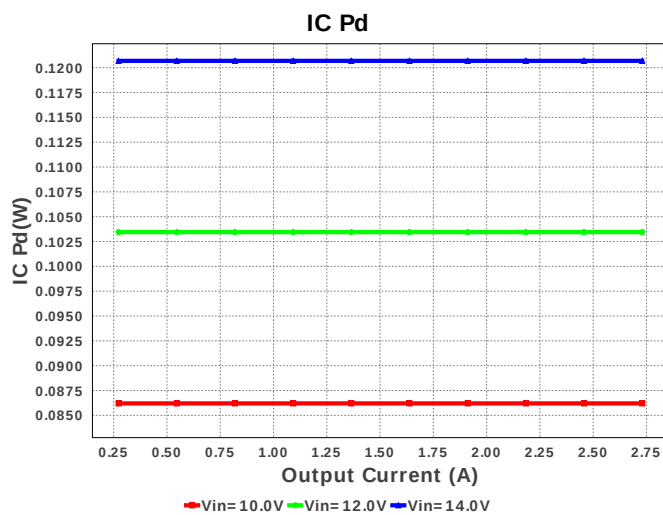
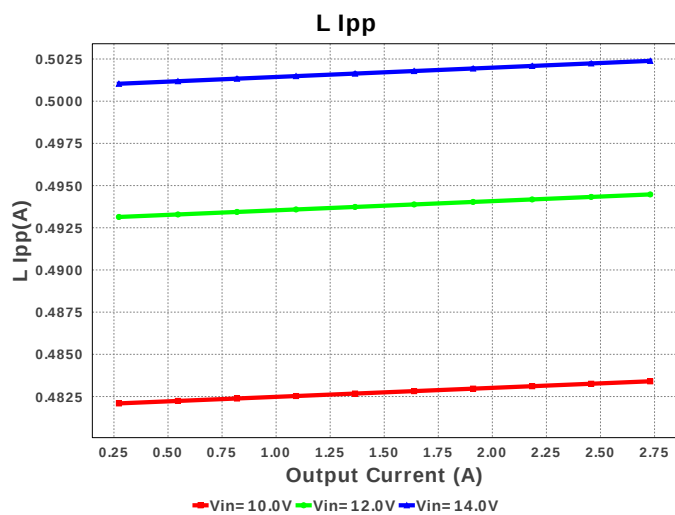
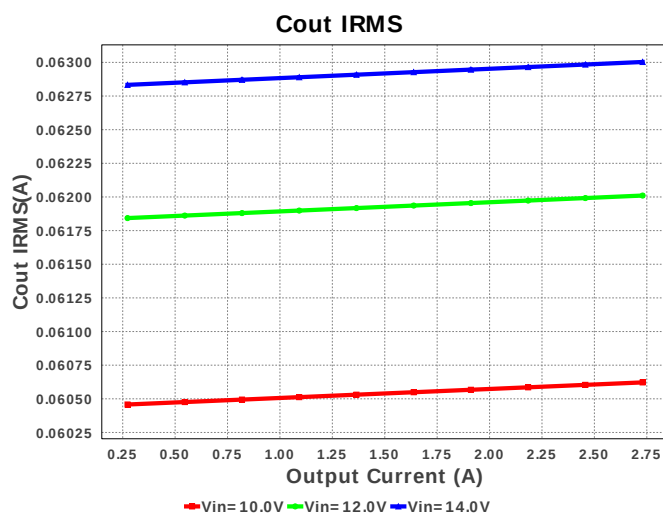
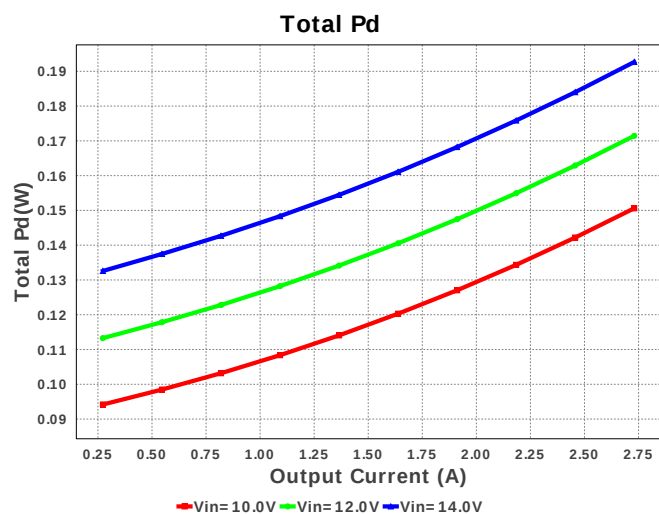
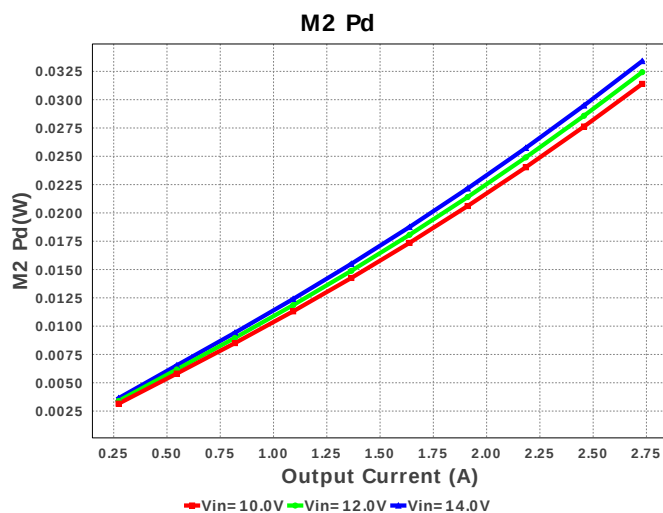
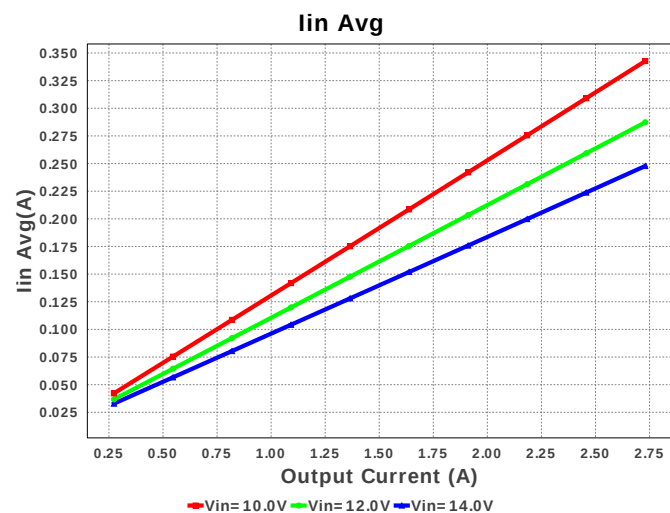
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Css	MuRata	GRM033R70J222KA01D Series= X7R	Cap= 2.2 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
12.	Cvdd	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	\$0.01	 0603 5 mm ²
13.	Cvin	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	\$0.01	 0603 5 mm ²
14.	L1	Coilcraft	SER2915L-223KL	L= 22.0 uH DCR= 1.5 mOhm	1	\$1.88	 SER2915L 652 mm ²
15.	M1	Texas Instruments	CSD16323Q3	VdsMax= 25.0 V IdsMax= 60.0 Amps	1	\$0.41	 DQG0008A 18 mm ²
16.	M2	Texas Instruments	CSD17312Q5	VdsMax= 30.0 V IdsMax= 100.0 Amps	1	\$0.93	 TRANS_NexFET_Q5 55 mm ²
17.	Rcomp	Vishay-Dale	CRCW04021K33FKED Series= CRCW..e3	Res= 1.33 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
18.	Rcomp2	Vishay-Dale	CRCW0402316RFKED Series= CRCW..e3	Res= 316.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
19.	Rcs	Vishay-Dale	CRCW0402976RFKED Series= CRCW..e3	Res= 976.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
20.	Renb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
21.	Rent	Vishay-Dale	CRCW04027K50FKED Series= CRCW..e3	Res= 7.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
22.	Rfbb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
23.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
24.	Rpgood	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
25.	Rscp	Vishay-Dale	CRCW040210M0FKED Series= CRCW..e3	Res= 10.0 MOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
26.	Rt	Vishay-Dale	CRCW040297K6FKED Series= CRCW..e3	Res= 97.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
27.	Rtrk	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

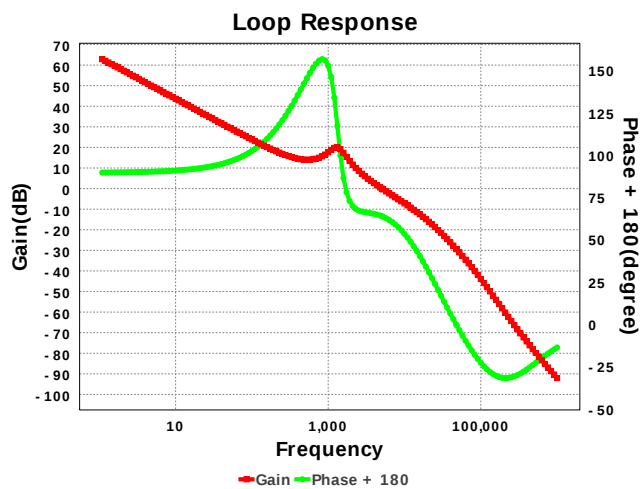
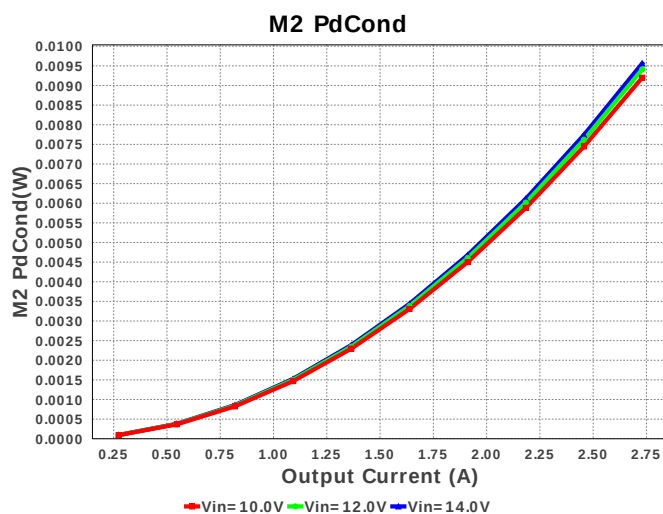
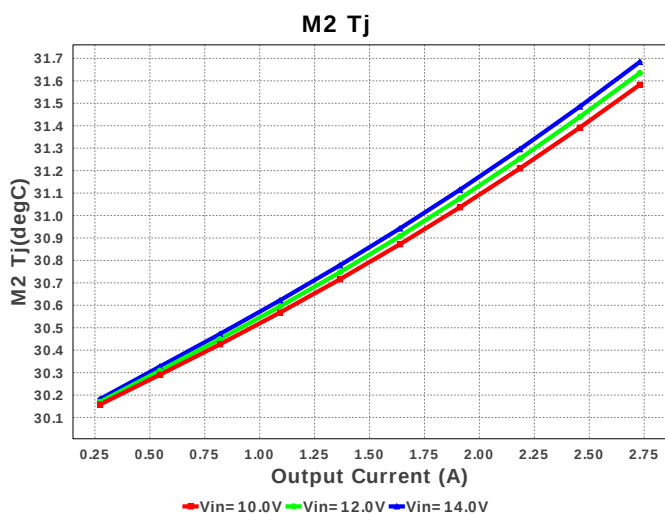
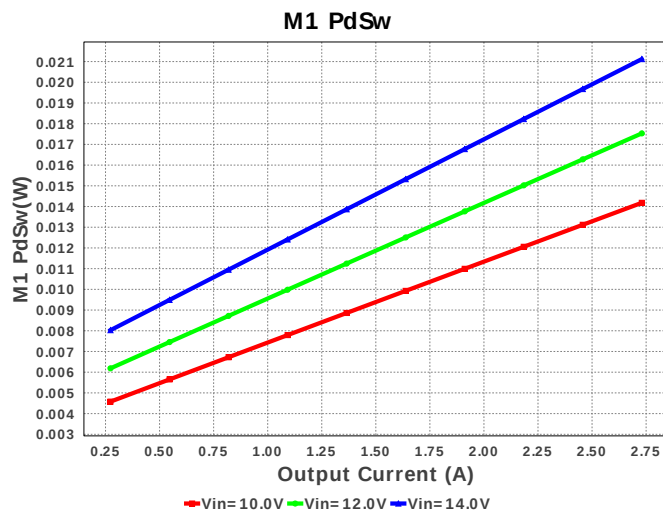
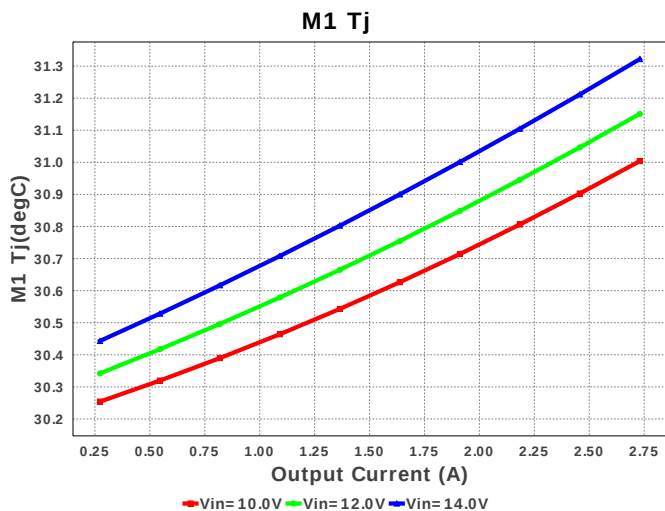
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
28. U1		Texas Instruments	TPS40170RGYR	Switcher	1	\$1.50	 RGY0020A 25 mm ²











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	768.188 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	63.003 mA	Current	Output capacitor RMS ripple current
3.	Coutx IRMS	82.024 mA	Current	Output capacitor_x RMS ripple current
4.	Iin Avg	247.75 mA	Current	Average input current
5.	L Ipp	502.39 mA	Current	Peak-to-peak inductor ripple current
6.	SW Ipk	2.981 A	Current	Peak switch current
7.	BOM Count	30	General	Total Design BOM count
8.	FootPrint	868.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	100.402 kHz	General	Switching frequency
10.	IC Tolerance	6.0 μ V	General	IC Feedback Tolerance
11.	Mode	CCM	General	Conduction Mode

#	Name	Value	Category	Description
12.	Pout	3.276 W	General	Total output power
13.	Total BOM	\$5.96	General	Total BOM Cost
14.	Low Freq Gain	62.853 dB	Op_Point	Gain at 10Hz
15.	Vout Actual	1.2 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Cross Freq	5.049 kHz	Op_point	Bode plot crossover frequency
17.	Duty Cycle	8.669 %	Op_point	Duty cycle
18.	Efficiency	94.451 %	Op_point	Steady state efficiency
19.	Gain Marg	-29.417 dB	Op_point	Bode Plot Gain Margin
20.	IC Tj	34.224 degC	Op_point	IC junction temperature
21.	IOUT_OP	2.73 A	Op_point	Iout operating point
22.	M1 Tj	31.322 degC	Op_point	M1 MOSFET junction temperature
23.	M2 Tj	31.673 degC	Op_point	M2 MOSFET junction temperature
24.	Phase Marg	64.32 deg	Op_point	Bode Plot Phase Margin
25.	VIN_OP	14.0 V	Op_point	Vin operating point
26.	Vout p-p	2.401 mV	Op_point	Peak-to-peak output ripple voltage
27.	Cin Pd	590.113 µW	Power	Input capacitor power dissipation
28.	Cout Pd	43.663 µW	Power	Output capacitor power dissipation
29.	Coutx Pd	16.282 µW	Power	Output capacitor_x power loss
30.	IC Pd	120.687 mW	Power	IC power dissipation
31.	L Pd	13.974 mW	Power	Inductor power dissipation
32.	M1 Pd	23.967 mW	Power	M1 MOSFET total power dissipation
33.	M1 PdCond	2.848 mW	Power	M1 MOSFET conduction losses
34.	M1 PdSw	21.119 mW	Power	M1 MOSFET switching losses
35.	M2 Pd	33.178 mW	Power	M2 MOSFET total power dissipation
36.	M2 PdCond	9.561 mW	Power	M2 MOSFET conduction losses
37.	M2 PdSw	23.617 mW	Power	M2 MOSFET switching losses
38.	Total Pd	192.467 mW	Power	Total Power Dissipation
39.	Vout Tolerance	1.011 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.73	Maximum Output Current
2.	VinMax	14.0	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	1.2	Output Voltage
5.	base_pn	TPS40170	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. TPS40170 Product Folder : <http://www.ti.com/product/TPS40170> : contains the data sheet and other resources.

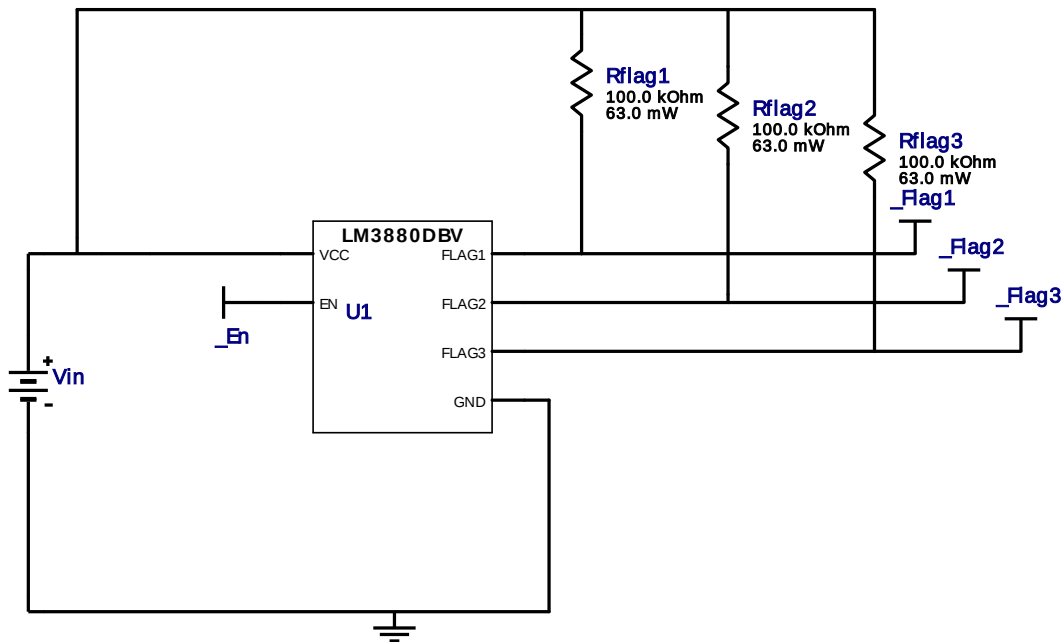


Vout = 3.3V
Iout = 0.0A

Device = LM3880MF-1AE/NOPB
Topology = SEQUENCER
Created = 9/29/16 6:07:58 AM
BOM Cost = \$0.48
BOM Count = 4
Total Pd = 0.0W

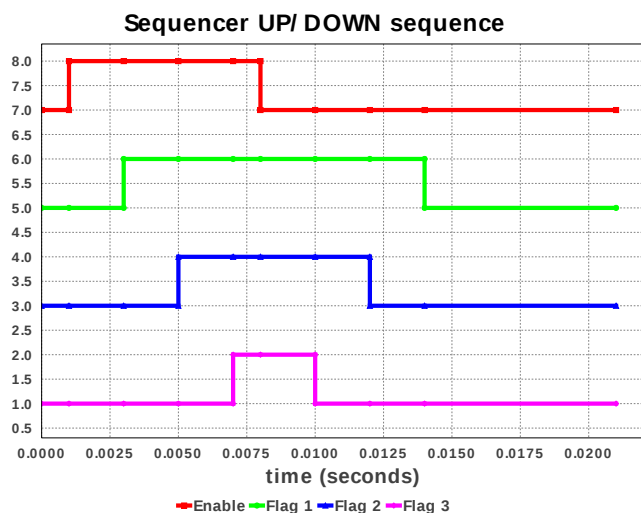
WEBENCH® Design Report

Design : 4790845/66 LM3880MF-1AE/NOPB
Design 66 - LM3880MF-1AE/NOPB



Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Rflag1	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
2.	Rflag2	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
3.	Rflag3	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
4.	U1	Texas Instruments	LM3880MF-1AE/NOPB	Switcher	1	\$0.45	R-PDSO-G6 10 mm ²



Operating Values

#	Name	Value	Category	Description
1.	BOM Count	4	General	Total Design BOM count
2.	FootPrint	19.0 mm ²	General	Total Foot Print Area of BOM components
3.	Total BOM	\$0.48	General	Total BOM Cost
4.	Total Pd	82.5 μ W	Power	Total Power Dissipation
5.	Flag Voltage	3.3 V		Flag Voltage
6.	Flag1 Down delay (From EN high to low)	6.0 ms		Flag Delay
7.	Flag1 Up delay (From EN low to high)	2.0 ms		Flag Delay
8.	Flag2 Down delay (From EN high to low)	4.0 ms		Flag Delay
9.	Flag2 Up delay (From EN low to high)	4.0 ms		Flag Delay
10.	Flag3 Down delay (From EN high to low)	2.0 ms		Flag Delay
11.	Flag3 Up delay (From EN low to high)	6.0 ms		Flag Delay
12.	Flags Used	2.0		Flags Used
13.	Total Flags	3.0		Total Flags
14.	Vcc	3.3 V		Vcc

Design Inputs

#	Name	Value	Description
1.	Iout	1.0 μ	Maximum Output Current
2.	VinMax	3.3	Maximum input voltage
3.	VinMin	3.3	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	LM3880	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. LM3880 Product Folder : <http://www.ti.com/product/LM3880> : contains the data sheet and other resources.

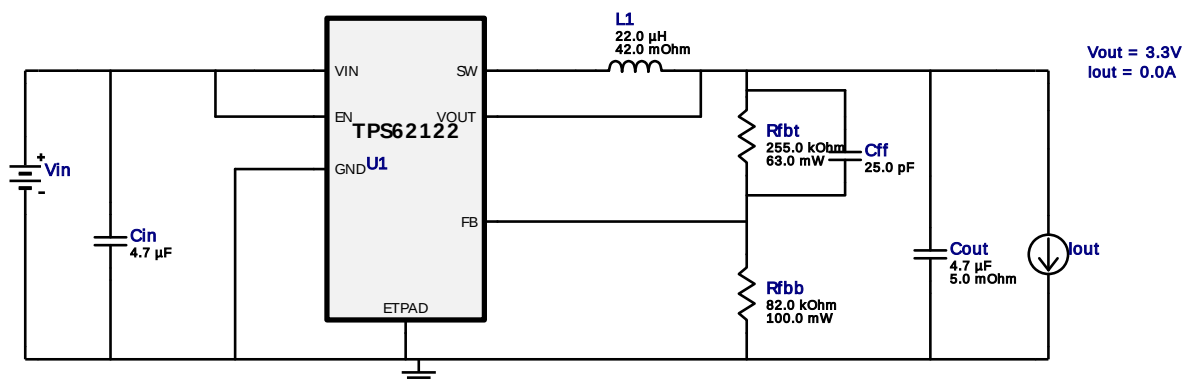


Vout = 3.3V
Iout = 0.0A

Device = TPS62122DRVR
Topology = Buck
Created = 9/29/16 6:07:58 AM
BOM Cost = \$0.91
BOM Count = 7
Total Pd = 0.0W

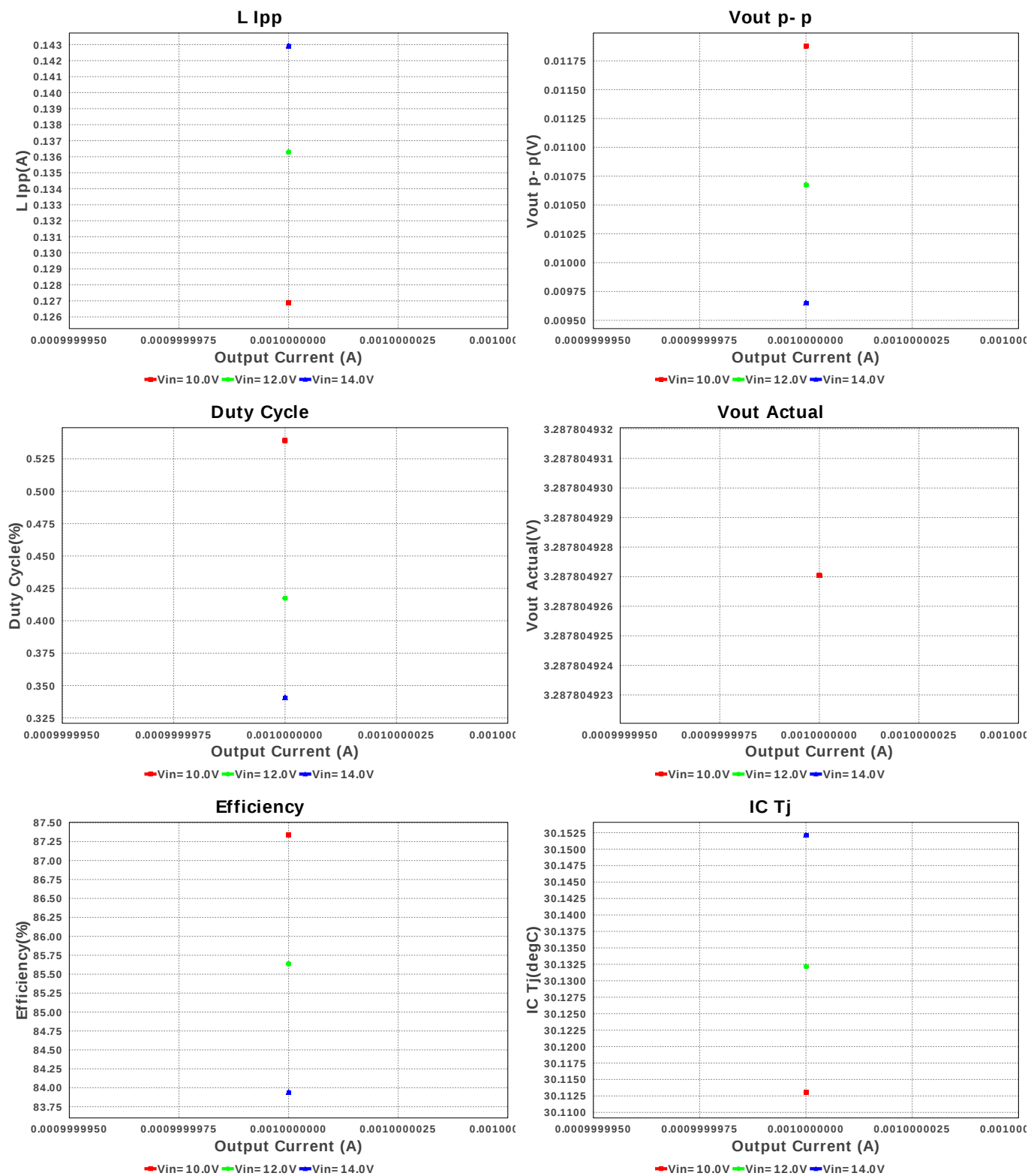
WEBENCH® Design Report

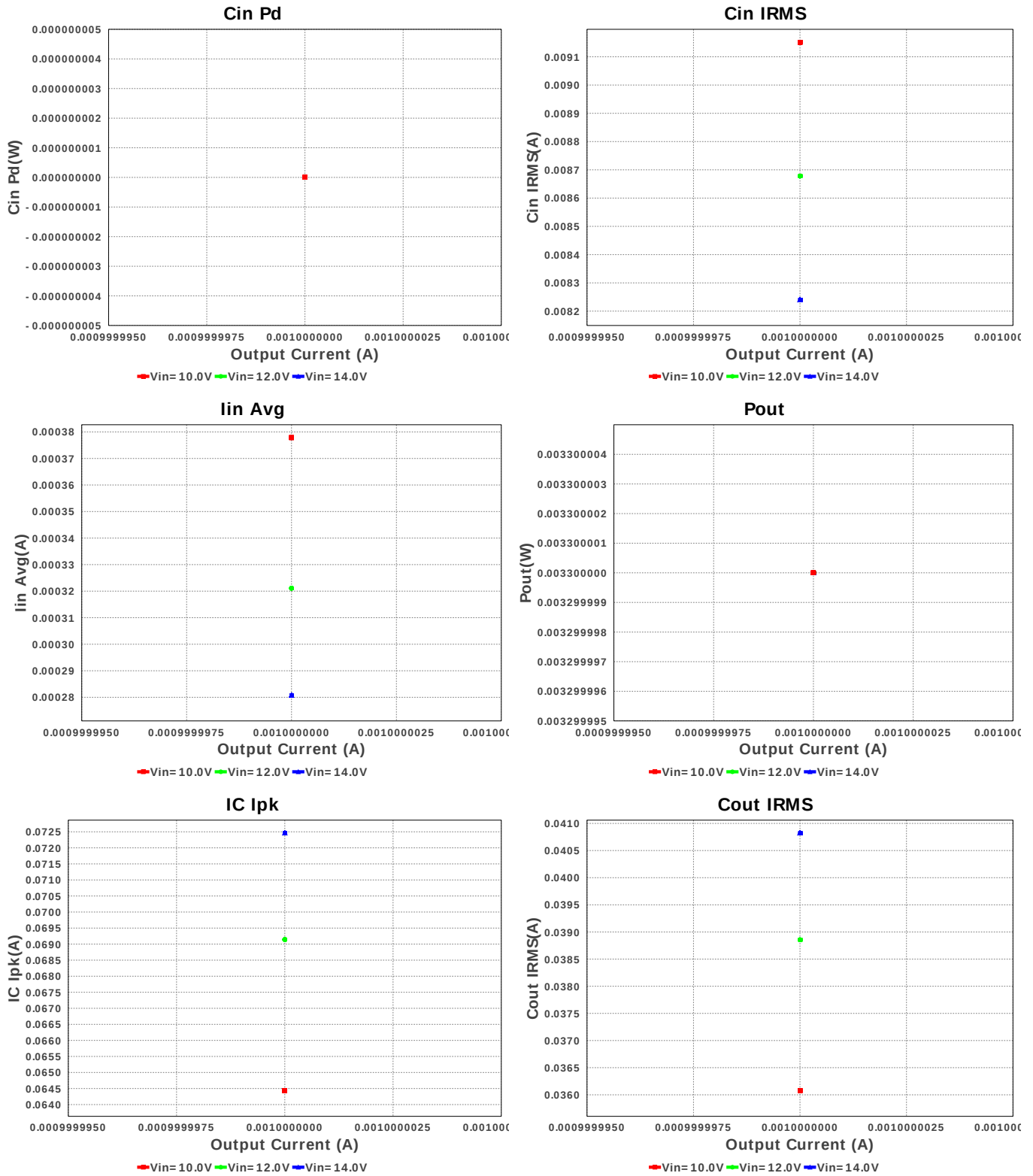
Design : 4790845/67 TPS62122DRVR
TPS62122DRVR 10.0V-14.0V to 3.30V @ 0.001A

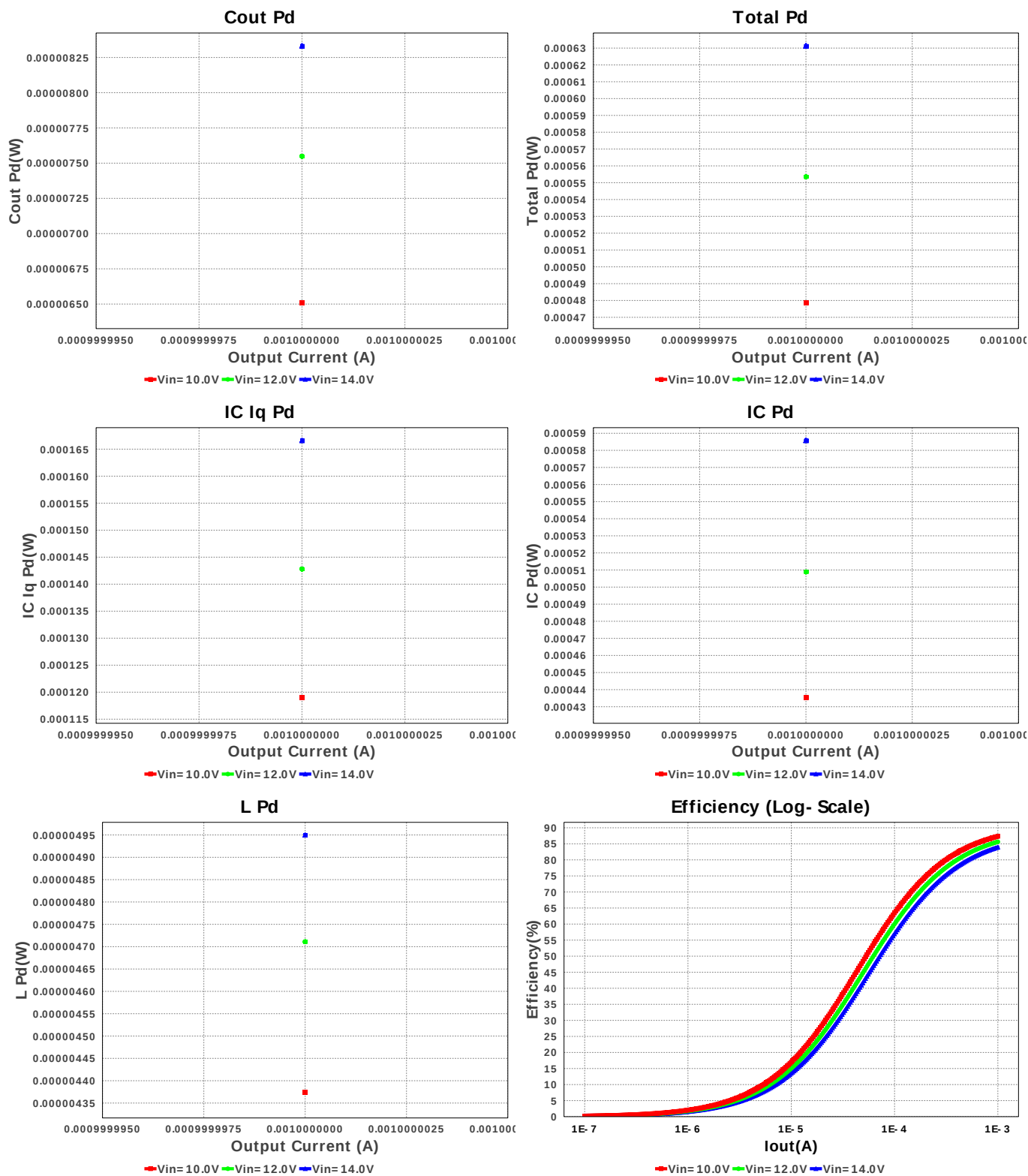


Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cff	Samsung Electro-Mechanics	CL21C250JBANNNC Series= C0G/NP0	Cap= 25.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	Cin	Taiyo Yuden	TMK212BJ475KG-T Series= X5R	Cap= 4.7 uF VDC= 25.0 V IRMS= 0.0 A	1	\$0.05	0805 7 mm ²
3.	Cout	MuRata	GRM188R60J475KE19D Series= X5R	Cap= 4.7 uF ESR= 5.0 mOhm VDC= 6.3 V IRMS= 2.0 A	1	\$0.01	0603 5 mm ²
4.	L1	Bourns	SRU1048-220Y	L= 22.0 µH DCR= 42.0 mOhm	1	\$0.33	SRU1048 144 mm ²
5.	Rfbb	Yageo America	RC0603FR-0782KL Series= ?	Res= 82.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²
6.	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
7.	U1	Texas Instruments	TPS62122DRVR	Switcher	1	\$0.49	S-PWSON-N6 9 mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	8.24 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	40.823 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	72.462 mA	Current	Peak switch current in IC
4.	Iin Avg	280.81 μ A	Current	Average input current
5.	L Ipp	142.92 mA	Current	Peak-to-peak inductor ripple current
6.	BOM Count	7	General	Total Design BOM count
7.	FootPrint	179.0 mm ²	General	Total Foot Print Area of BOM components
8.	Frequency	11.594 kHz	General	Switching frequency
9.	Mode	DCM	General	Conduction Mode
10.	Pout	3.3 mW	General	Total output power
11.	Total BOM	\$0.91	General	Total BOM Cost

#	Name	Value	Category	Description
12.	Vout Actual	3.288 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
13.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
14.	Duty Cycle	340.712 m%	Op_point	Duty cycle
15.	Efficiency	83.941 %	Op_point	Steady state efficiency
16.	IC Tj	30.152 degC	Op_point	IC junction temperature
17.	ICThetaJA	259.7 degC/W	Op_point	IC junction-to-ambient thermal resistance
18.	IOUT_OP	1.0 mA	Op_point	Iout operating point
19.	VIN_OP	14.0 V	Op_point	Vin operating point
20.	Vout p-p	9.651 mV	Op_point	Peak-to-peak output ripple voltage
21.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
22.	Cout Pd	8.332 µW	Power	Output capacitor power dissipation
23.	IC Iq Pd	166.6 µW	Power	IC Iq Pd
24.	IC Pd	585.75 µW	Power	IC power dissipation
25.	L Pd	4.949 µW	Power	Inductor power dissipation
26.	Total Pd	631.334 µW	Power	Total Power Dissipation
27.	Vout Tolerance	4.067 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0 m	Maximum Output Current
2.	VinMax	14.0	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS62122	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. [TPS62122 Product Folder](http://www.ti.com/product/TPS62122) : <http://www.ti.com/product/TPS62122> : contains the data sheet and other resources.

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