

WEBENCH® Power Architect

Project Report

Project : 4790845/7 : PA_Project_301

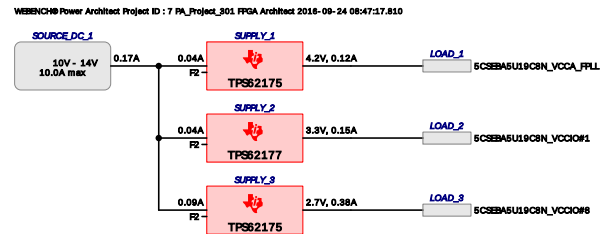
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Optimize project optFactor=3

Project Summary

1. Total System Efficiency	84.6 %
2. Total System BOM Count	19.0
3. Total System Footprint	164.0 mm2
4. Total System BOM Cost	\$3.04
5. Total System Power Dissipation	368.6 mW

--> Launch WEBENCH Power Architect.



Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_1	2	LOAD_1	5CSEBA5U19C8N_VCCA_FPLL
SUPPLY_2	2	LOAD_2	5CSEBA5U19C8N_VCCIO#1
SUPPLY_3	2	LOAD_3	5CSEBA5U19C8N_VCCIO#8

Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	TPS62175	Switcher : High Light-Load Efficiency Buck Converter	4.2 V	0.12 A	86.2%	56	\$1.02	42	4
2.	SUPPLY_2	TPS62177	Switcher : Fixed 3.3Vout, High Light-Load Efficiency Buck Converter	3.3 V	0.15 A	84.1%	50	\$1.00	43	9
3.	SUPPLY_3	TPS62175	Switcher : High Light-Load Efficiency Buck Converter	2.7 V	0.38 A	84%	58	\$1.02	44	14

Power Loads

#	Name	VLoad	ILoad	Description
1.	5CSEBA5U19C8N_VCCA_FPLL	4.2 V	0.12 A	VoutRipple=10%, Down Sequence Order=0 delay=2.0 mSec
2.	5CSEBA5U19C8N_VCCIO#1	3.3 V	0.15 A	VoutRipple=10%, Down Sequence Order=0 delay=2.0 mSec
3.	5CSEBA5U19C8N_VCCIO#8	2.7 V	0.38 A	VoutRipple=10%, Down Sequence Order=0 delay=2.0 mSec

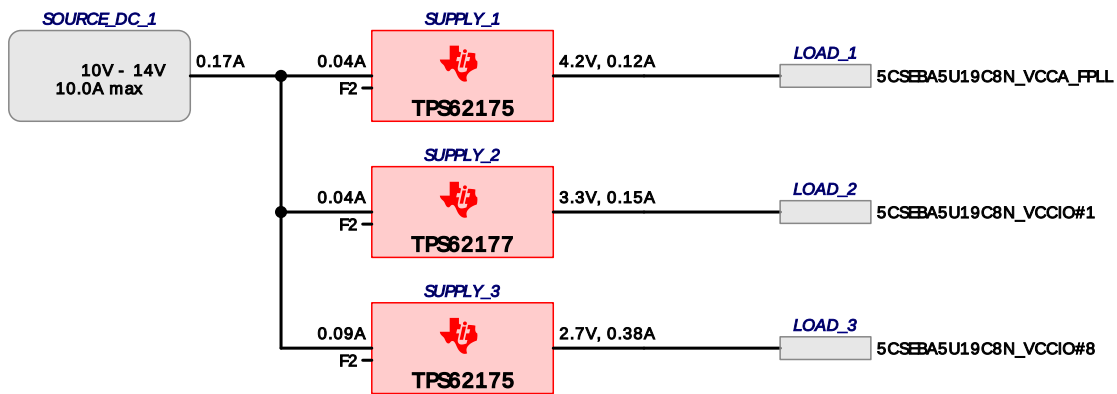
FPGAs, Processors

#	Manufacturer	Part Number	Name	Series	Description
1.	Altera	5CSEBA5U19C8N	FPGA_1	Cyclone V SE	FPGA Altera Cyclone V SE 5CSEBA5U19C8N

http://www.altera.com/literature/hb/cyclone-v/cv_51002.pdf

Project Diagram

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Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
Vishay-Dale	CRCW0402100KFKED	0402	3	\$0.01	9
Vishay-Dale	CRCW04021M62FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402383KFKED	0402	2	\$0.01	6
MuRata	GRM188R61C225KE15D	0603	3	\$0.02	14
MuRata	GRM21BC80G226ME39L	0805	1	\$0.04	7
MuRata	GRM21BR60J226ME39L	0805	2	\$0.04	14
Coilcraft	LPS4018-103MRB	LPS4018	3	\$0.35	72
Yageo America	RC0603FR-07910KL	0603	1	\$0.01	5
Texas Instruments	TPS62175DQCR	R- PWSN- N10	2	\$0.58	24
Texas Instruments	TPS62177DQCR	R- PWSN- N10	1	\$0.58	12
Total			19	\$365.40	0000000000000003

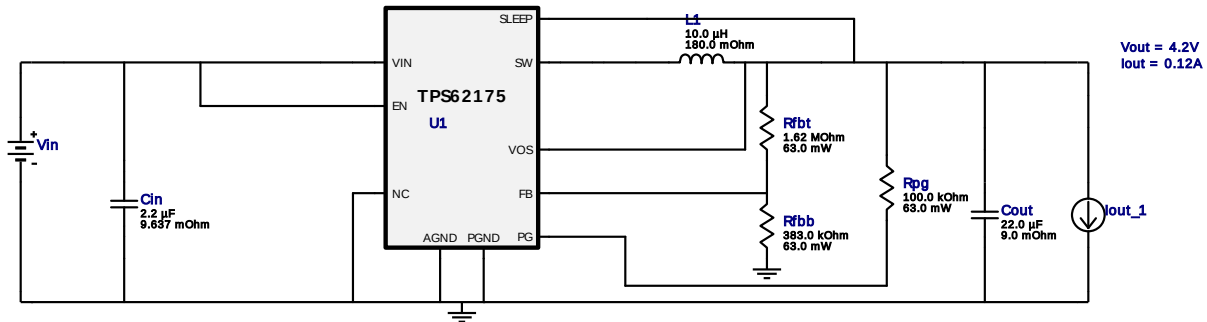


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Iout = 0.12A

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BOM Count = 7
Total Pd = 0.08W

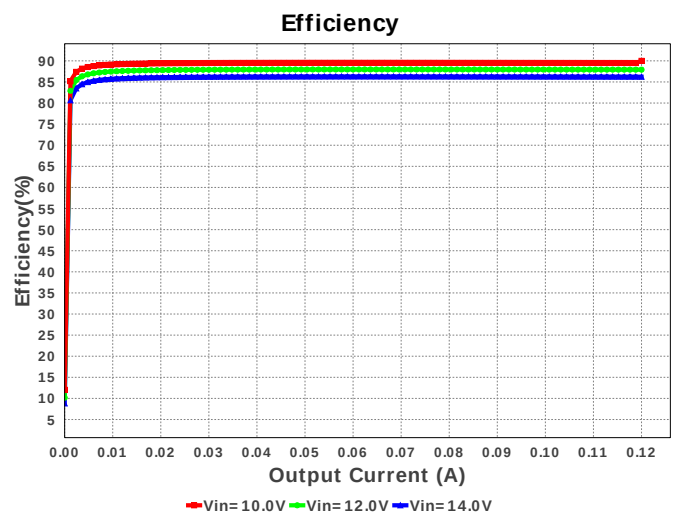
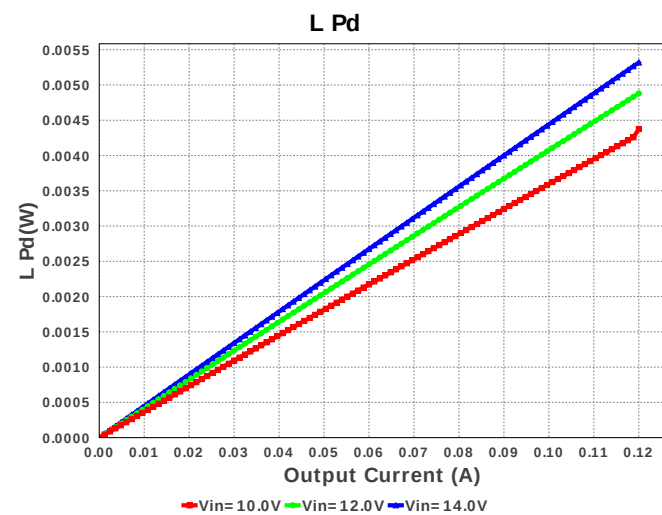
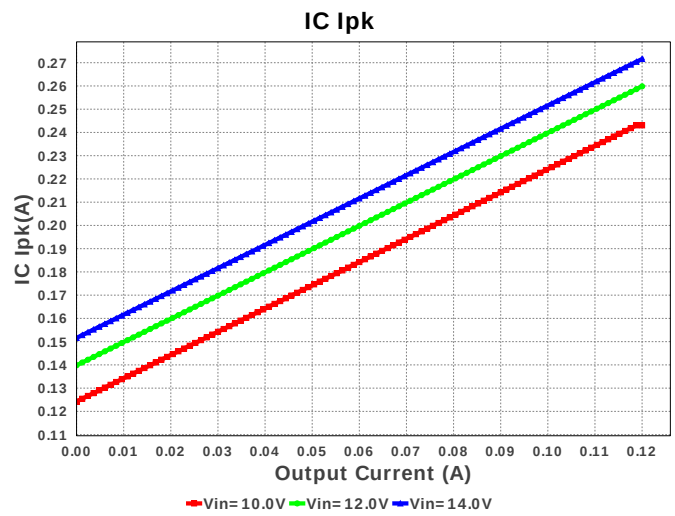
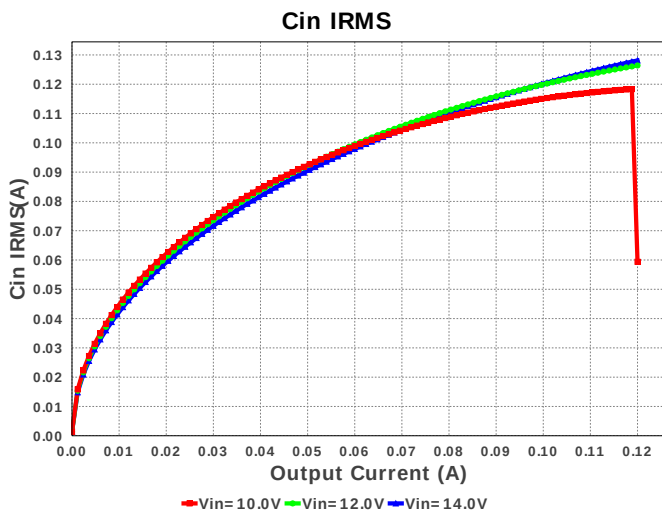
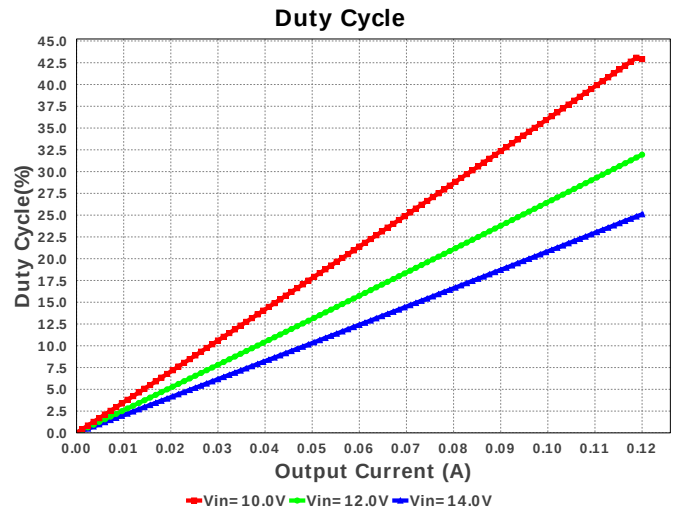
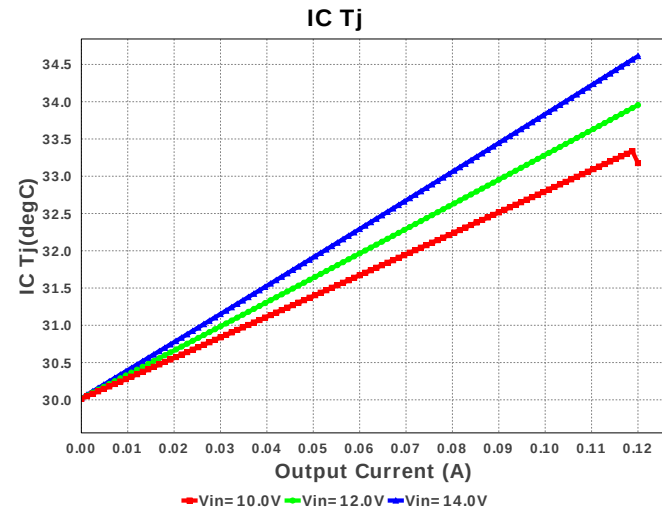
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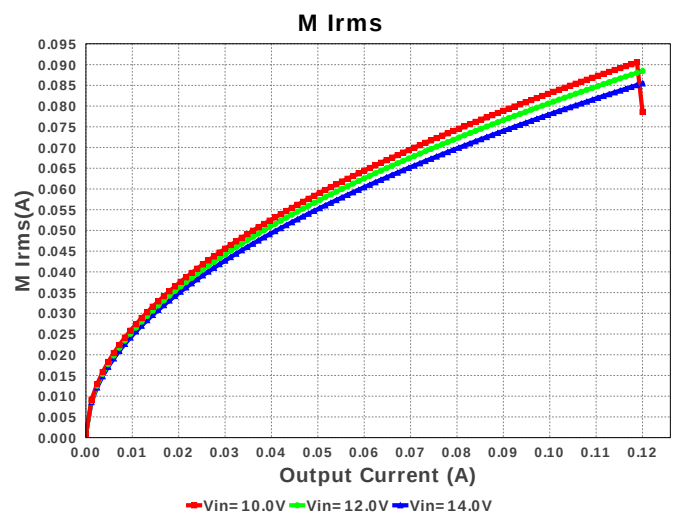
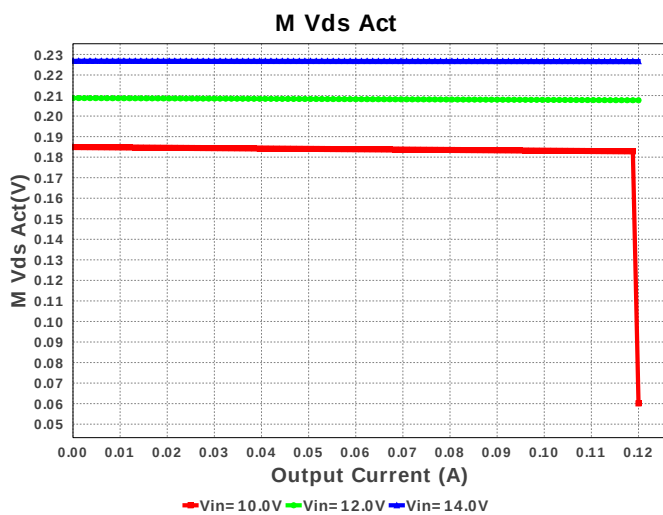
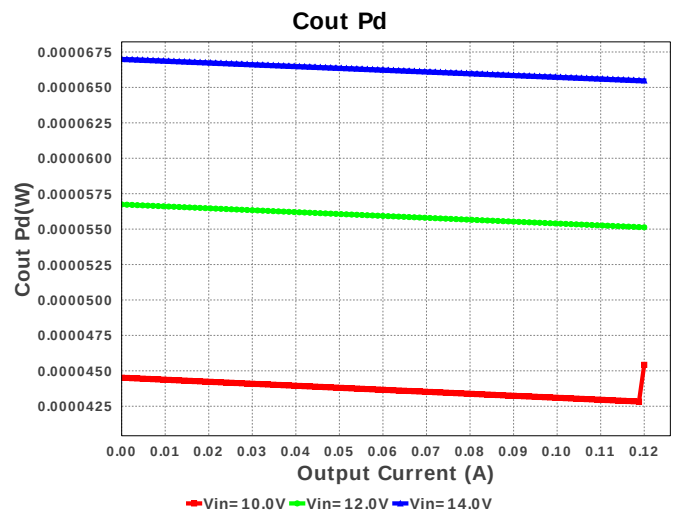
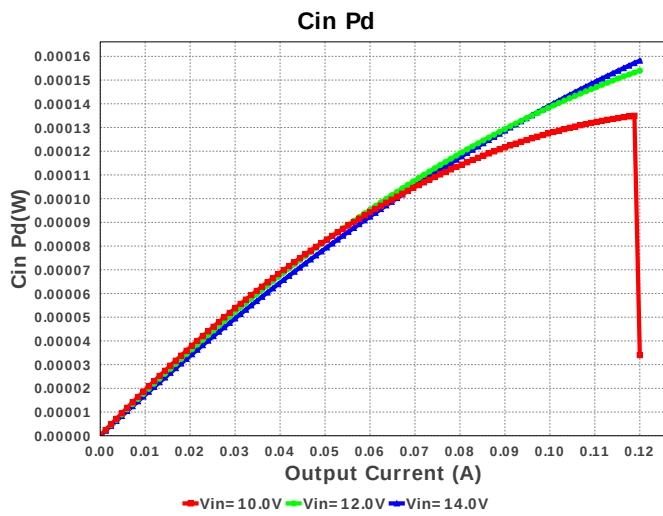
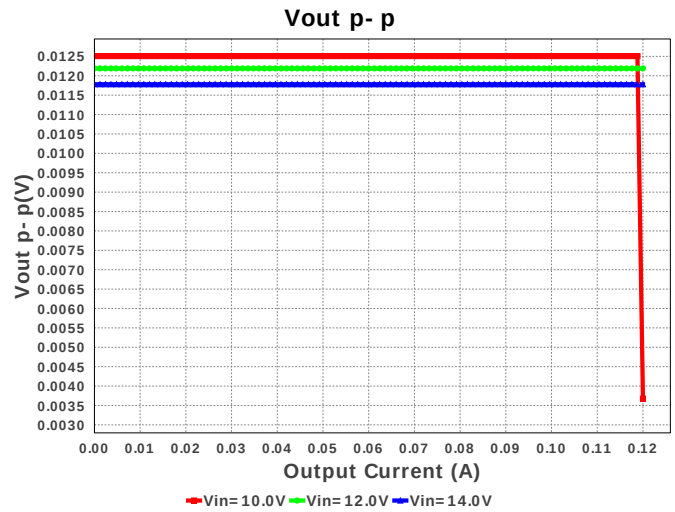
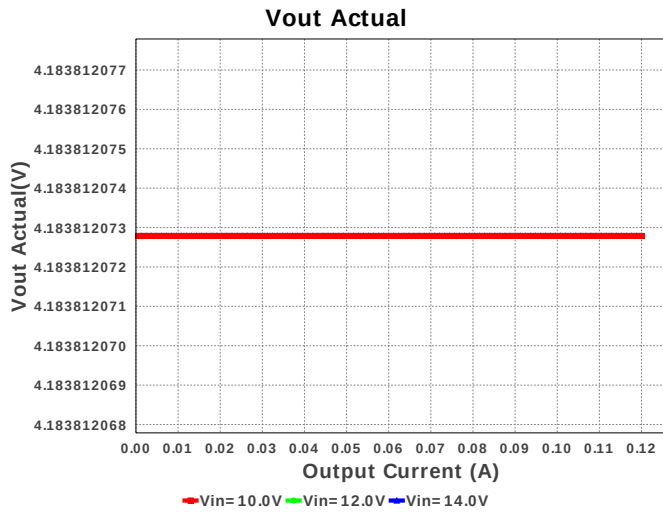
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TPS62175DQCR 10.0V-14.0V to 4.20V @ 0.12A

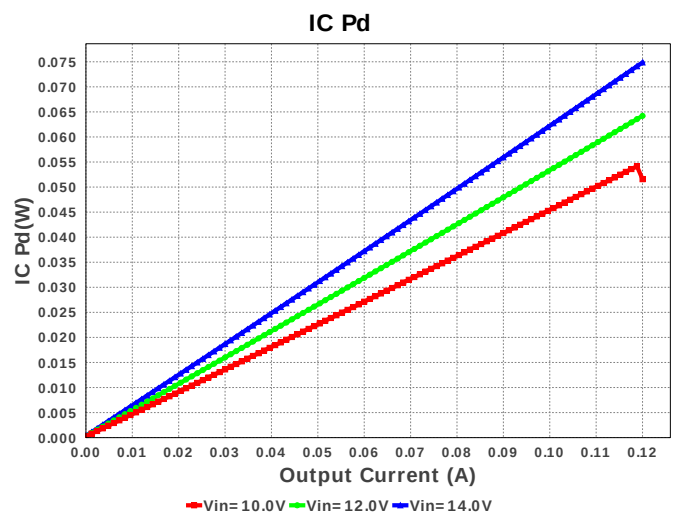
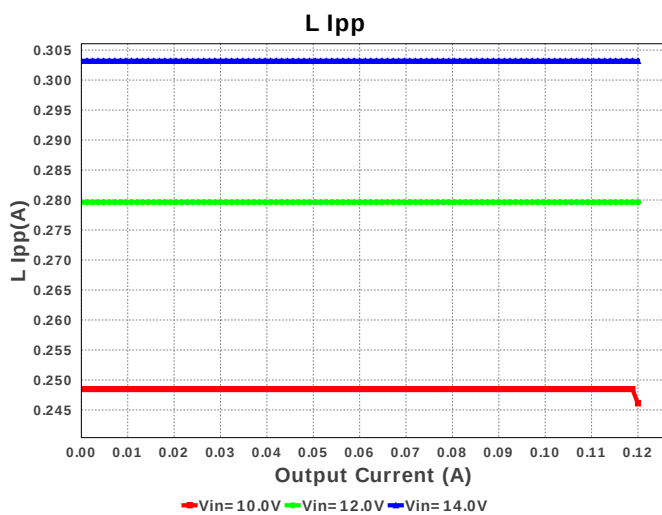
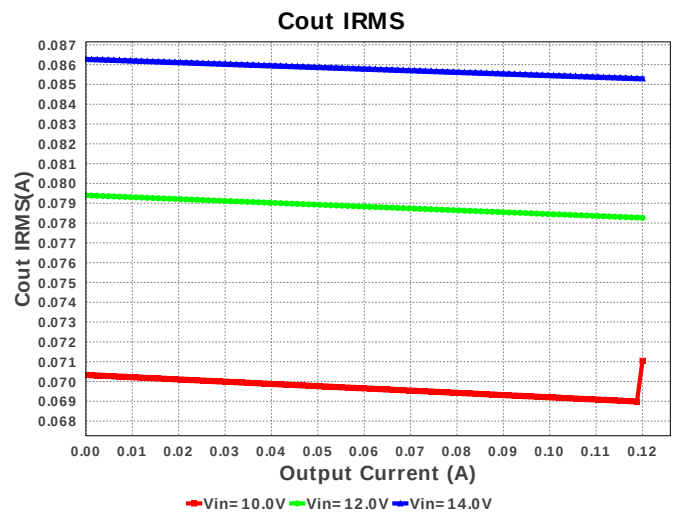
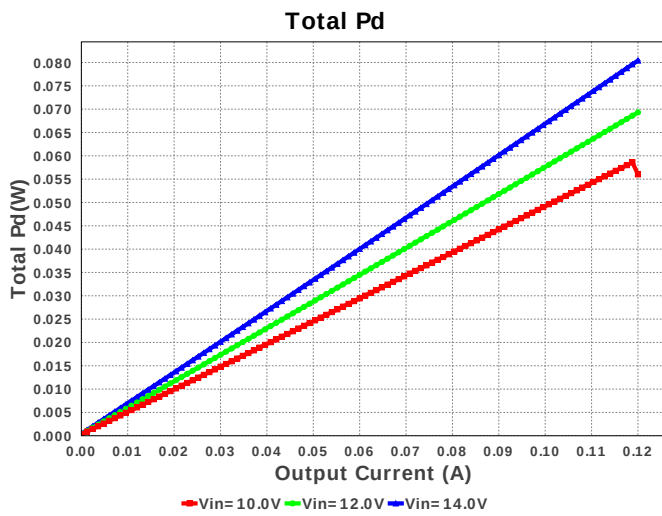
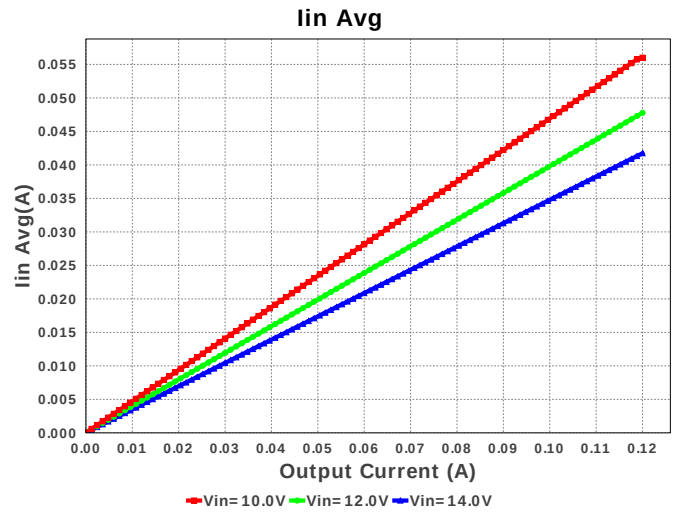
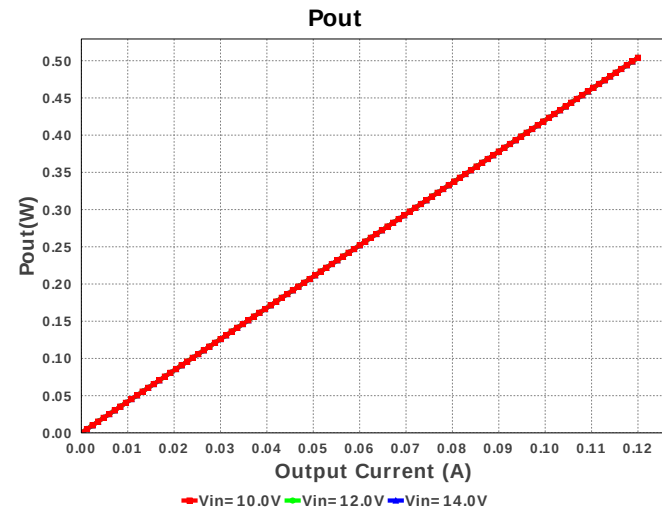


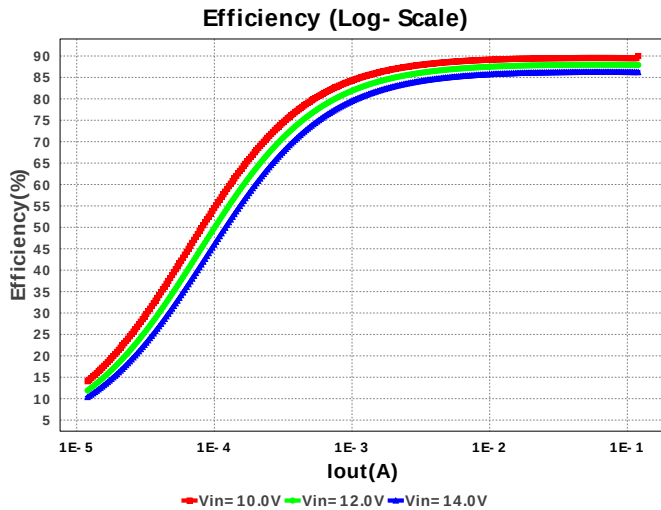
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM188R61C225KE15D Series= X5R	Cap= 2.2 uF ESR= 9.637 mOhm VDC= 16.0 V IRMS= 1.20373 A	1	\$0.02	0603 5 mm ²
2.	Cout	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	1	\$0.04	0805 7 mm ²
3.	L1	Coilcraft	LPS4018-103MRB	L= 10.0 uH DCR= 180.0 mOhm	1	\$0.35	LPS4018 24 mm ²
4.	Rfbb	Vishay-Dale	CRCW0402383KFKED Series= CRCW..e3	Res= 383.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
5.	Rfbt	Vishay-Dale	CRCW04021M62FKED Series= CRCW..e3	Res= 1.62 MOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
6.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
7.	U1	Texas Instruments	TPS62175DQCR	Switcher	1	\$0.58	R-PWSON-N10 12 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	128.128 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	85.303 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	271.601 mA	Current	Peak switch current in IC
4.	Iin Avg	41.744 mA	Current	Average input current
5.	L Ipp	303.2 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	85.476 mA	Current	Q Iavg
7.	BOM Count	7	General	Total Design BOM count
8.	FootPrint	56.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	811.339 kHz	General	Switching frequency
10.	IC Tolerance	24.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	226.735 mV	General	Voltage drop across the MosFET
12.	Mode	DCM	General	Conduction Mode
13.	Pout	504.0 mW	General	Total output power
14.	Total BOM	\$1.02	General	Total BOM Cost
15.	Vout Actual	4.184 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	4.2 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	25.102 %	Op_point	Duty cycle
18.	Efficiency	86.24 %	Op_point	Steady state efficiency
19.	IC Tj	34.612 degC	Op_point	IC junction temperature
20.	ICThetaJA	61.6 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	120.0 mA	Op_point	Iout operating point
22.	VIN_OP	14.0 V	Op_point	Vin operating point
23.	Vout p-p	11.78 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	158.207 μW	Power	Input capacitor power dissipation
25.	Cout Pd	65.489 μW	Power	Output capacitor power dissipation
26.	IC Pd	74.87 mW	Power	IC power dissipation
27.	L Pd	5.319 mW	Power	Inductor power dissipation
28.	Total Pd	80.416 mW	Power	Total Power Dissipation
29.	Vout Tolerance	4.683 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	120.0 m	Maximum Output Current
2.	VinMax	14.0	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	4.2	Output Voltage
5.	base_pn	TPS62175	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS62175** Product Folder : <http://www.ti.com/product/TPS62175> : contains the data sheet and other resources.

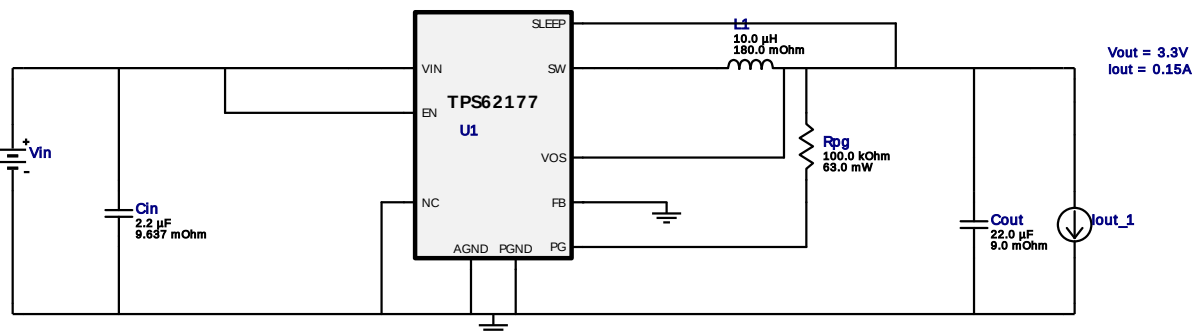


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Iout = 0.15A

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Topology = Buck
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BOM Count = 5
Total Pd = 0.09W

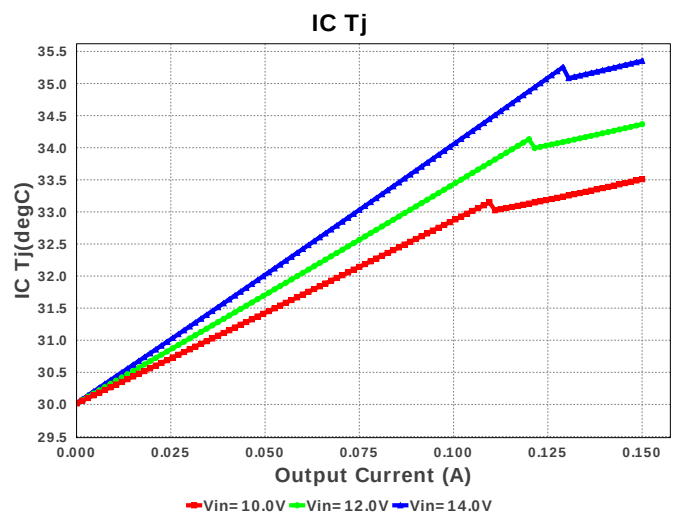
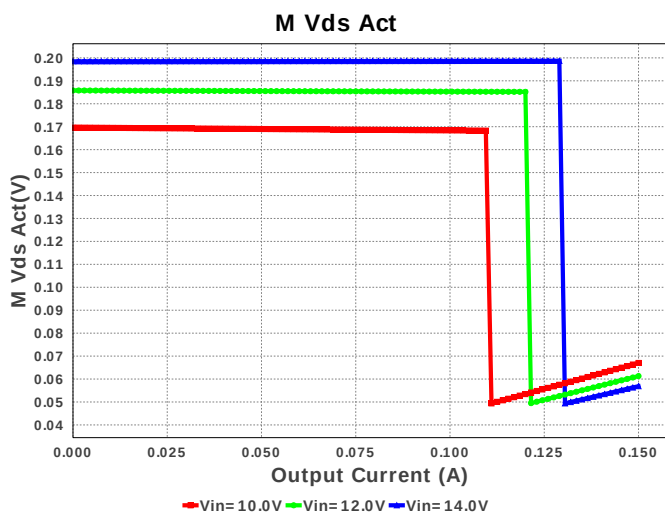
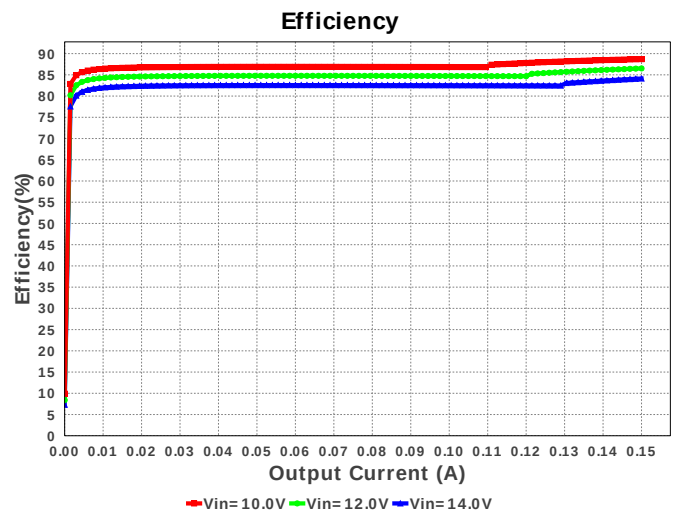
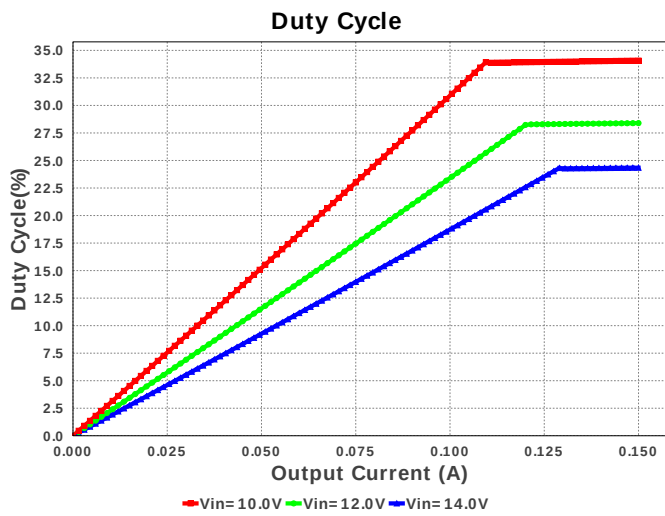
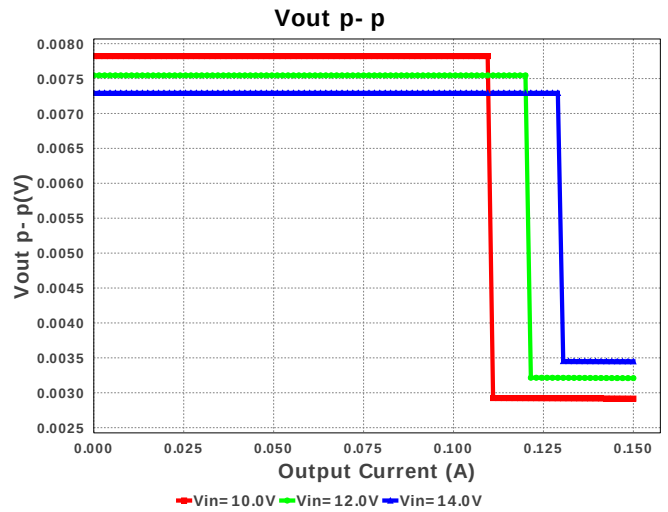
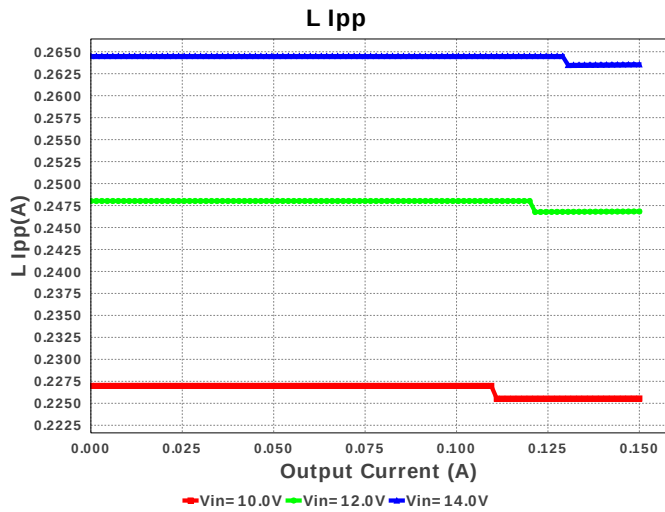
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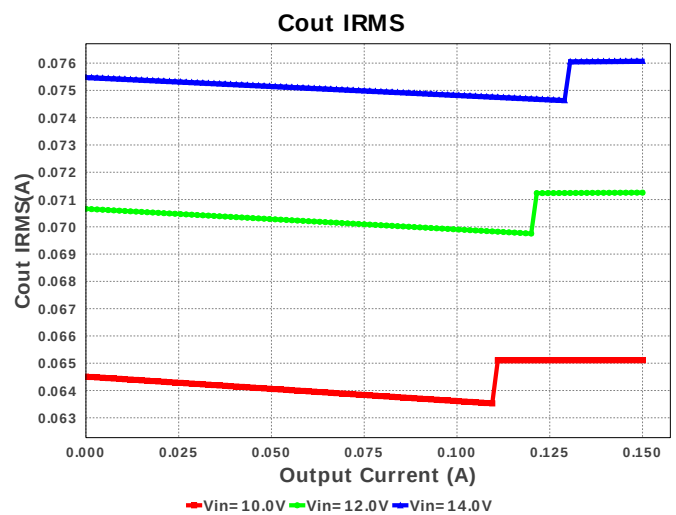
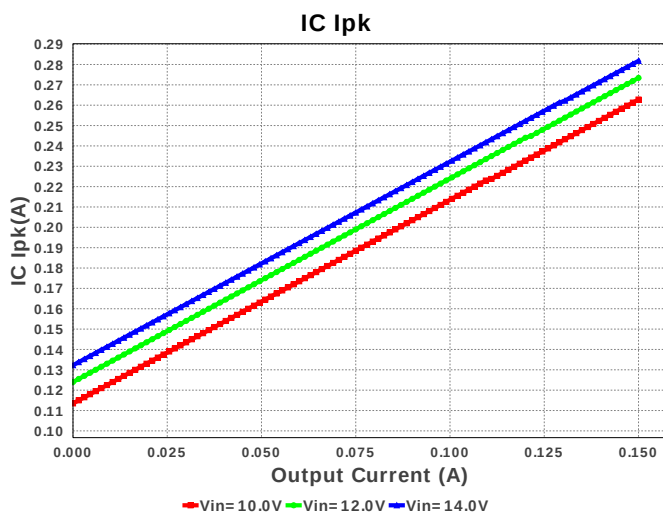
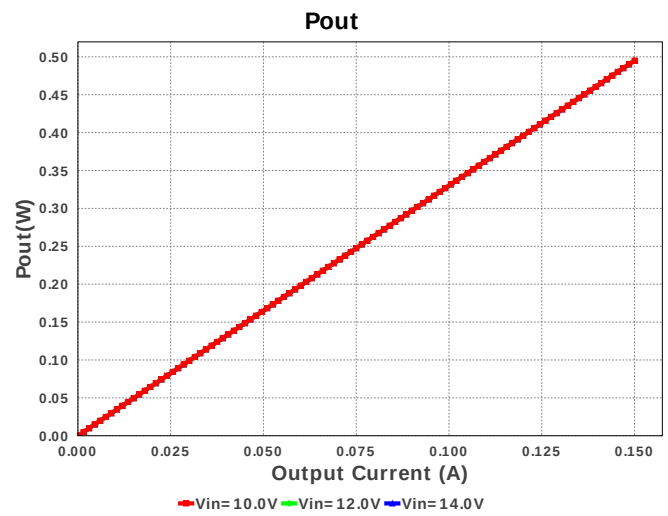
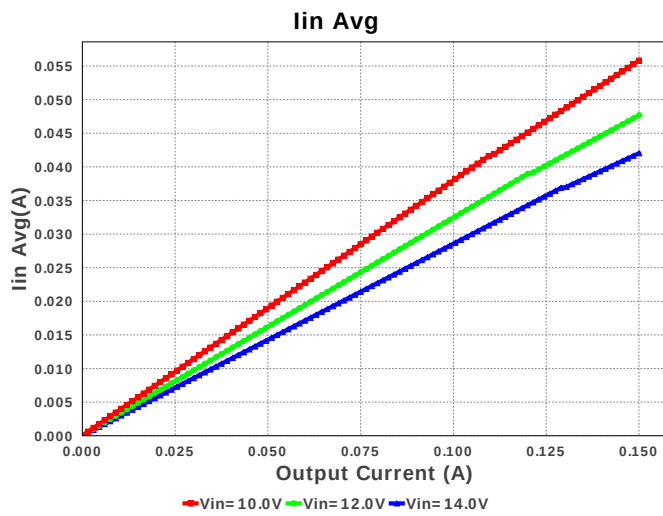
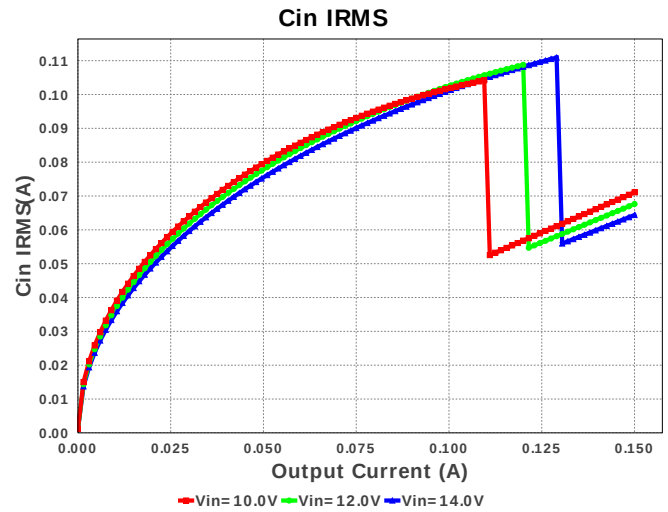
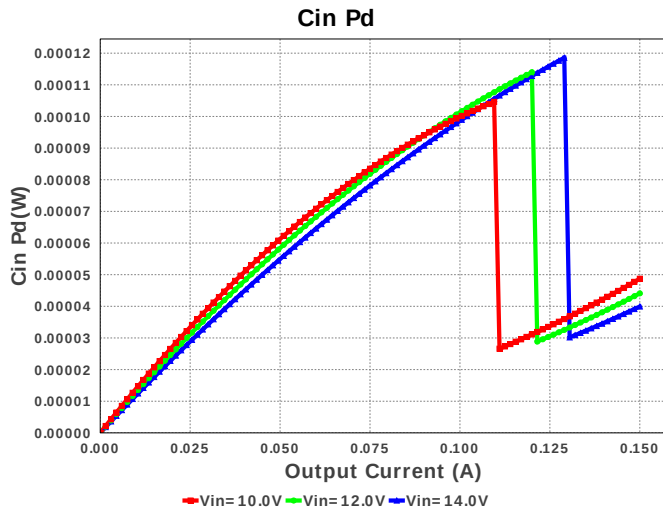
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TPS62177DQCR 10.0V-14.0V to 3.30V @ 0.15A

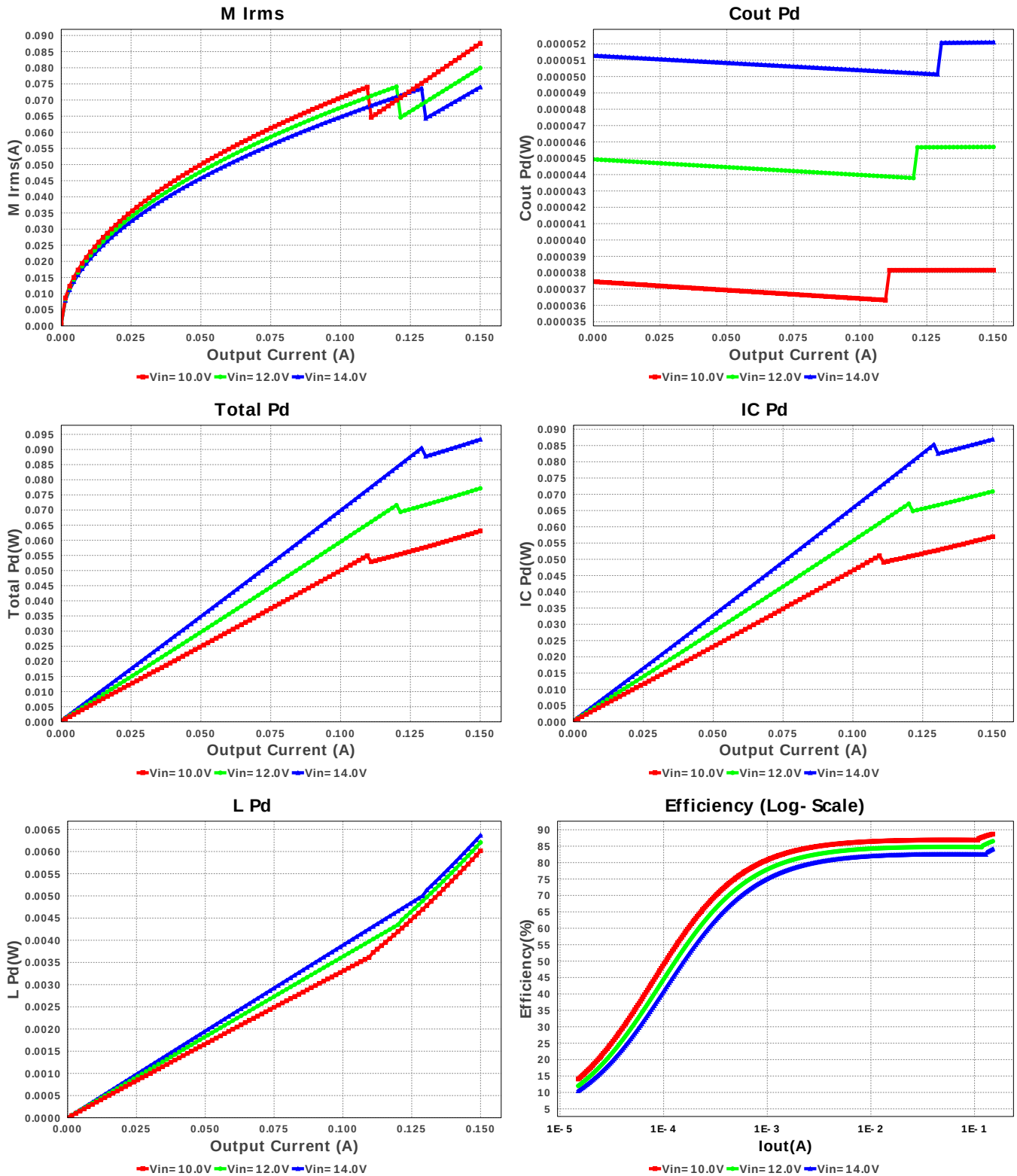


Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM188R61C225KE15D Series= X5R	Cap= 2.2 uF ESR= 9.637 mOhm VDC= 16.0 V IRMS= 1.20373 A	1	\$0.02	0603 5 mm ²
2.	Cout	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	1	\$0.04	0805 7 mm ²
3.	L1	Coilcraft	LPS4018-103MRB	L= 10.0 µH DCR= 180.0 mOhm	1	\$0.35	LPS4018 24 mm ²
4.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
5.	U1	Texas Instruments	TPS62177DQCR	Switcher	1	\$0.58	R-PWSON-N10 12 mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	64.374 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	76.083 mA	Current	Output capacitor RMS ripple current
3.	IC IpK	281.779 mA	Current	Peak switch current in IC
4.	Iin Avg	42.026 mA	Current	Average input current
5.	L Ipp	263.56 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	74.009 mA	Current	Q lavg
7.	BOM Count	5	General	Total Design BOM count
8.	FootPrint	50.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	988.322 kHz	General	Switching frequency
10.	IC Tolerance	24.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	56.885 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Mode	CCM	General	Conduction Mode
13.	Pout	495.0 mW	General	Total output power
14.	Total BOM	\$1.0	General	Total BOM Cost
15.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	24.344 %	Op_point	Duty cycle
17.	Efficiency	84.133 %	Op_point	Steady state efficiency
18.	IC Tj	35.353 degC	Op_point	IC junction temperature
19.	ICThetaJA	61.6 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	150.0 mA	Op_point	Iout operating point
21.	VIN_OP	14.0 V	Op_point	Vin operating point
22.	Vout p-p	3.45 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	39.936 μ W	Power	Input capacitor power dissipation
24.	Cout Pd	52.097 μ W	Power	Output capacitor power dissipation
25.	IC Pd	86.9 mW	Power	IC power dissipation
26.	L Pd	6.365 mW	Power	Inductor power dissipation
27.	Total Pd	93.356 mW	Power	Total Power Dissipation
28.	Vout Tolerance	727.27 m%		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	150.0 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	TPS62177	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS62177** Product Folder : <http://www.ti.com/product/TPS62177> : contains the data sheet and other resources.

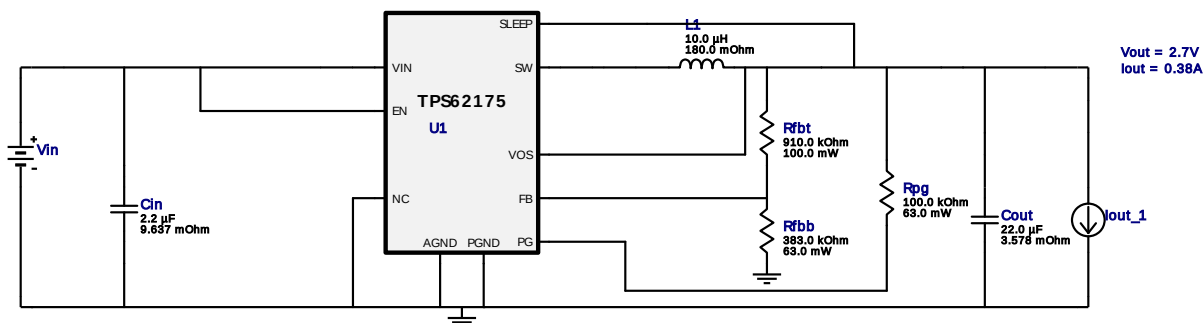


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Iout = 0.38A

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Topology = Buck
Created = 9/24/16 8:47:13 AM
BOM Cost = \$1.02
BOM Count = 7
Total Pd = 0.19W

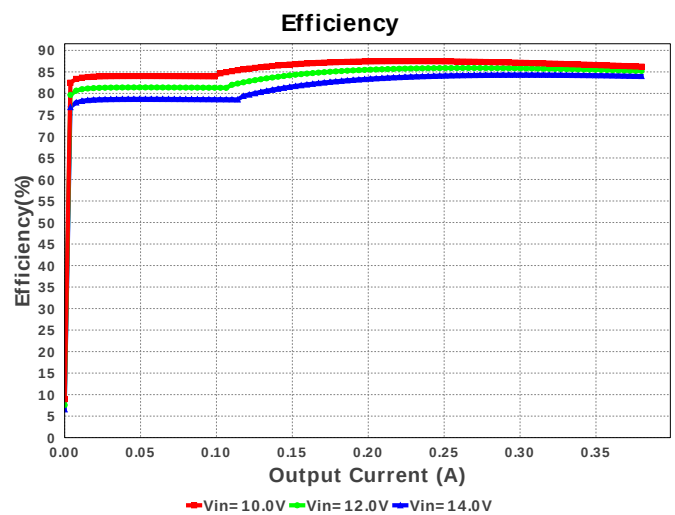
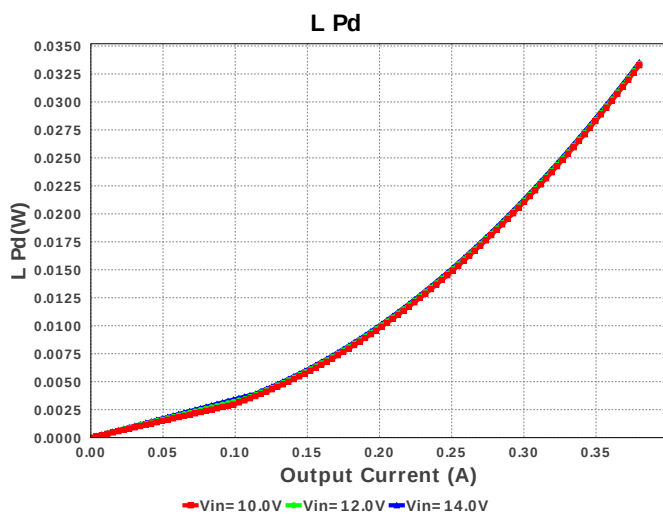
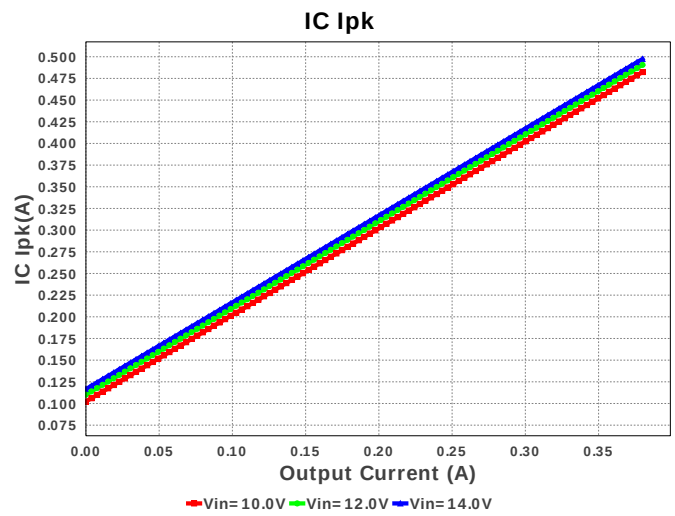
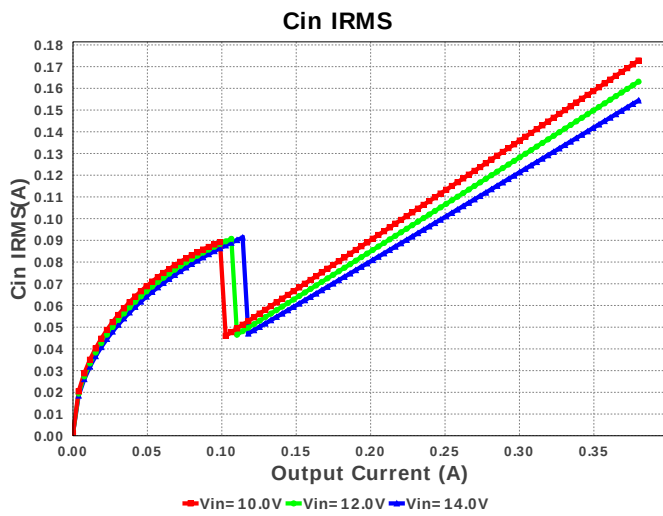
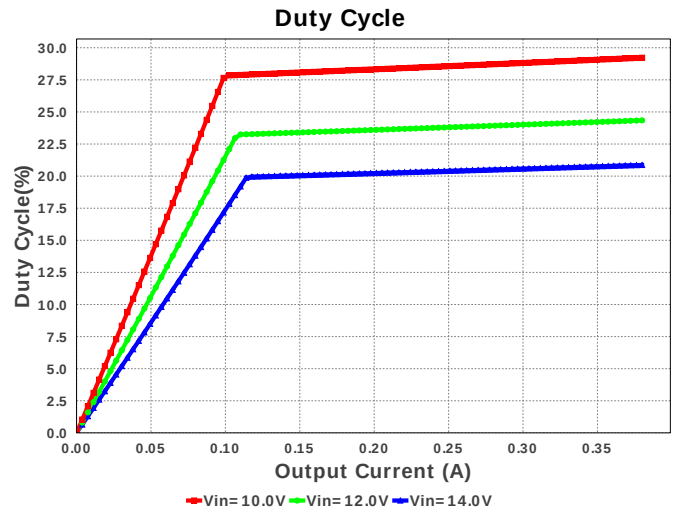
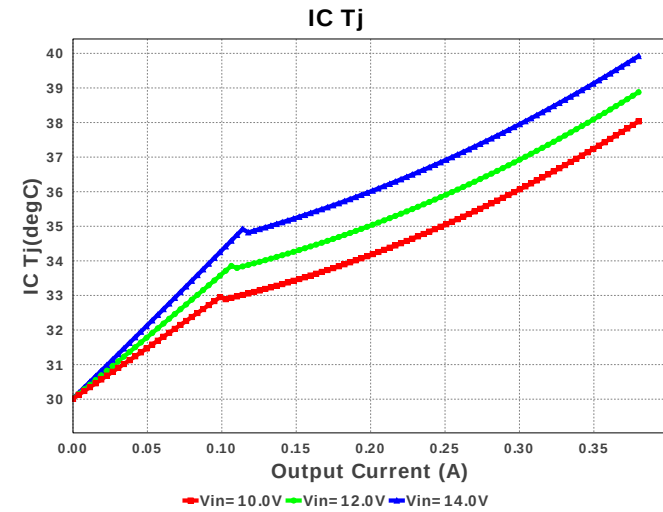
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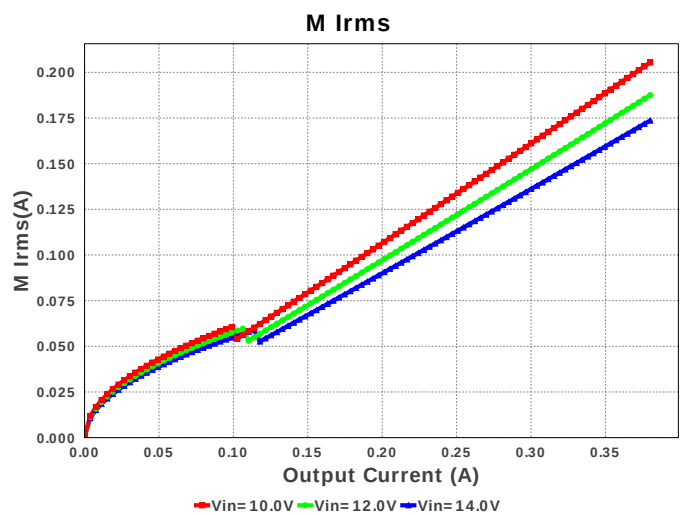
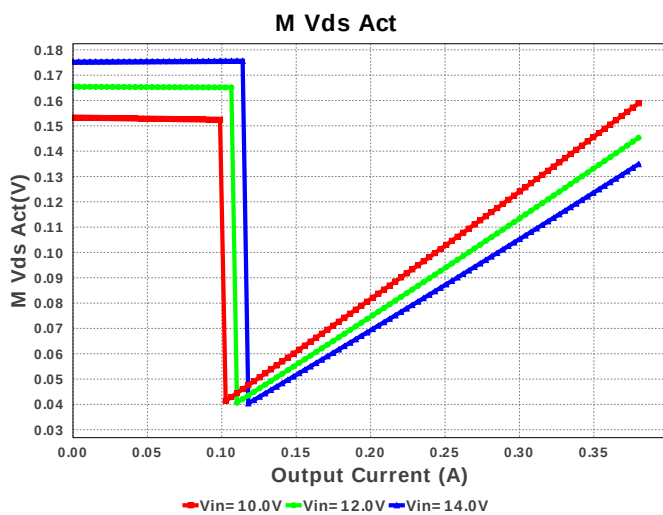
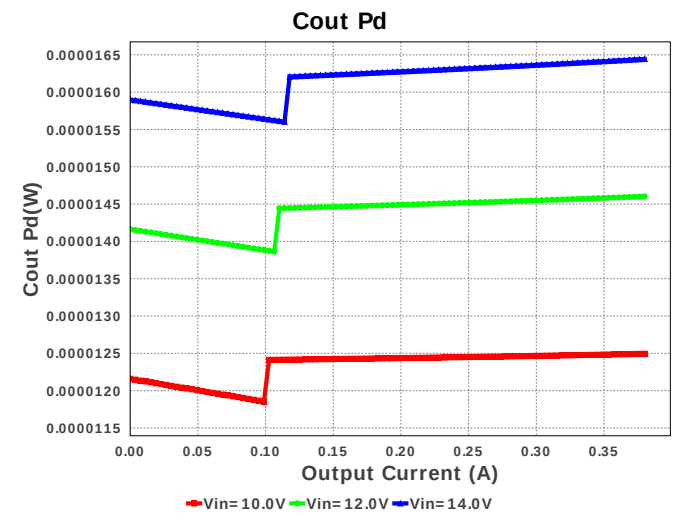
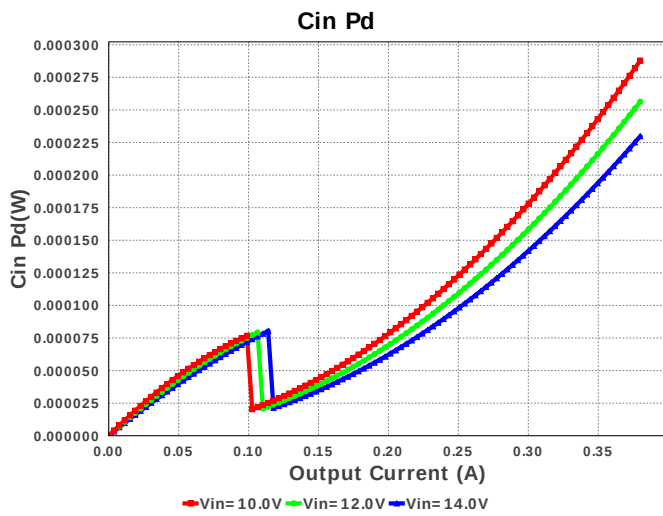
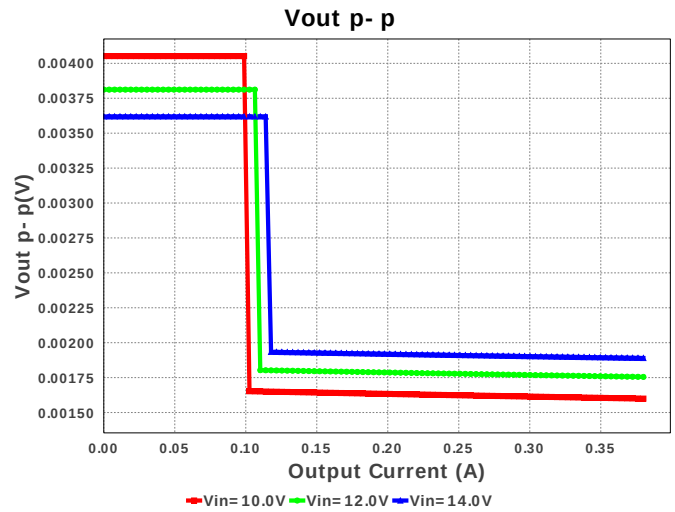
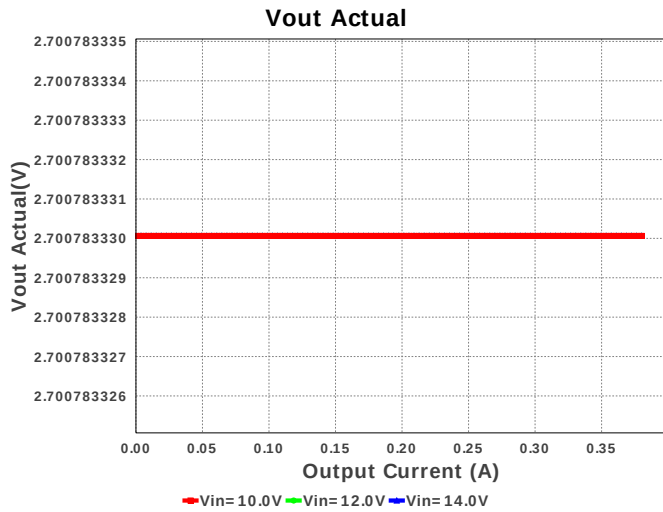
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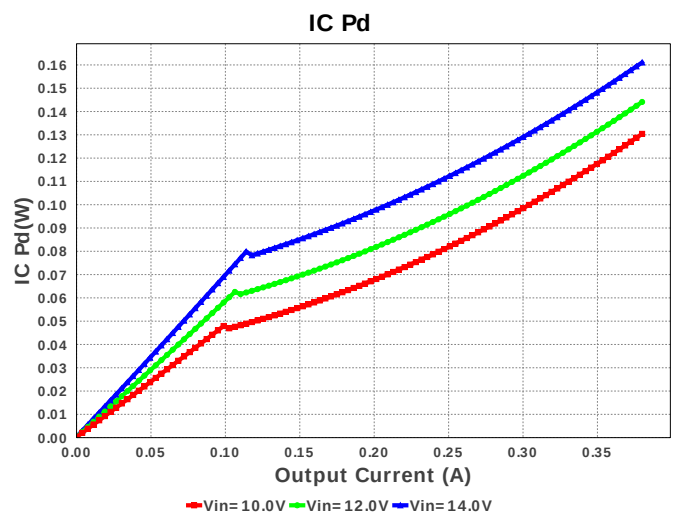
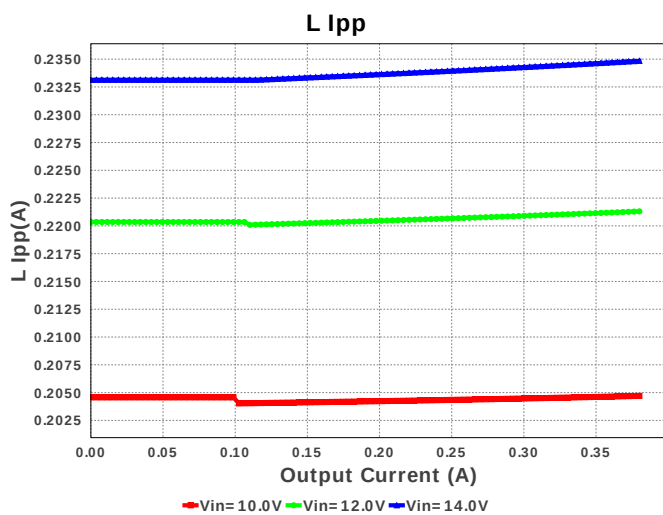
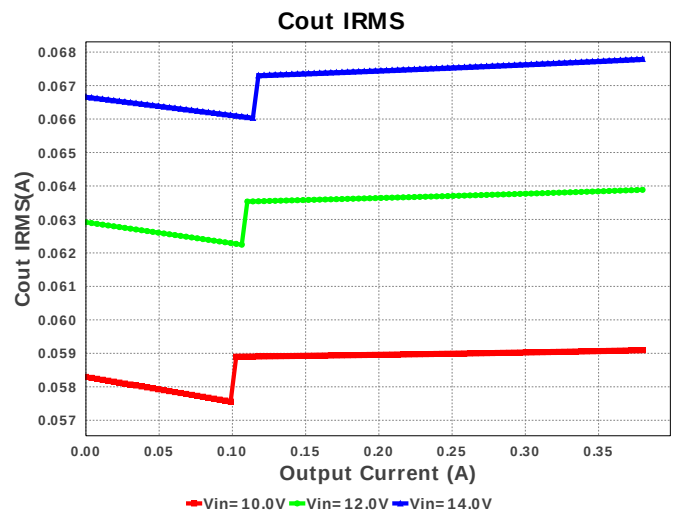
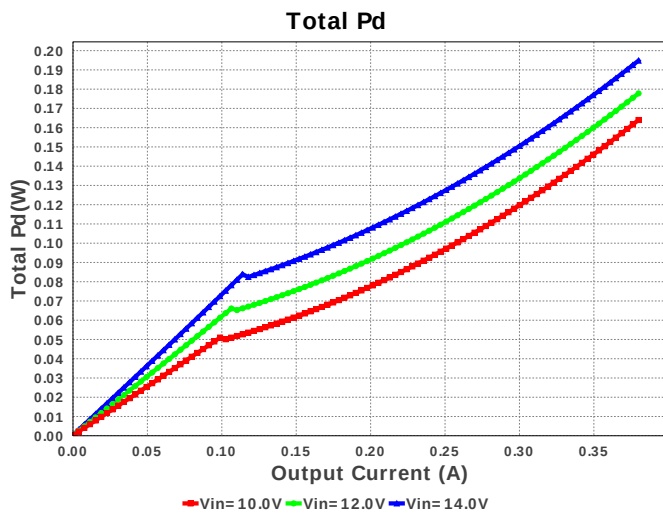
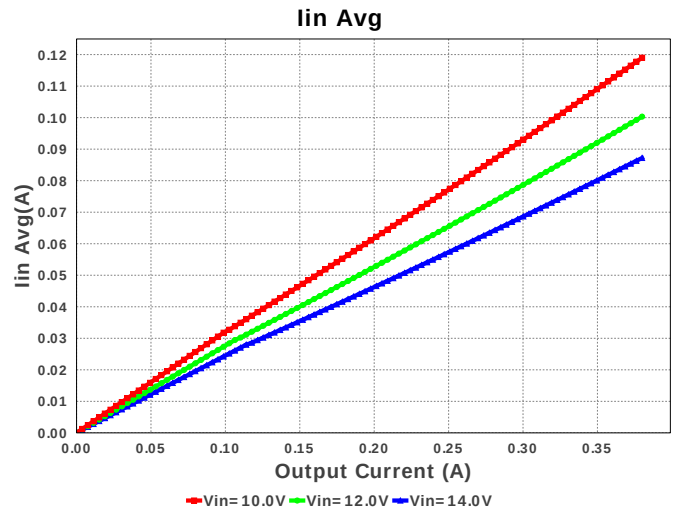
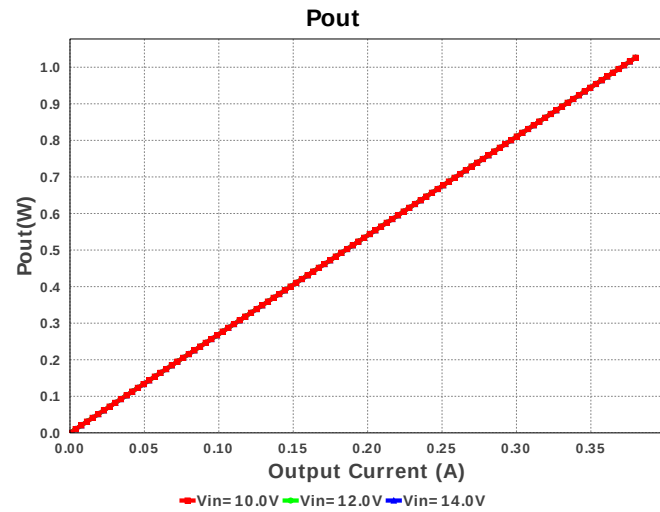


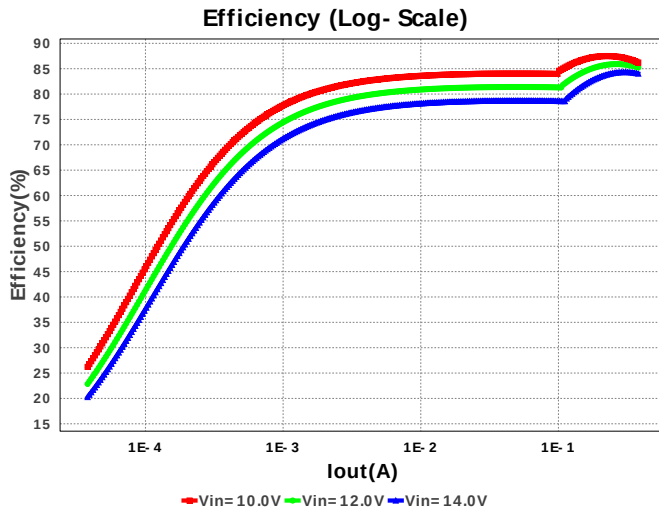
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM188R61C225KE15D Series= X5R	Cap= 2.2 uF ESR= 9.637 mOhm VDC= 16.0 V IRMS= 1.20373 A	1	\$0.02	0603 5 mm ²
2.	Cout	MuRata	GRM21BC80G226ME39L Series= X6S	Cap= 22.0 uF ESR= 3.578 mOhm VDC= 4.0 V IRMS= 3.29633 A	1	\$0.04	0805 7 mm ²
3.	L1	Coilcraft	LPS4018-103MRB	L= 10.0 uH DCR= 180.0 mOhm	1	\$0.35	LPS4018 24 mm ²
4.	Rfbb	Vishay-Dale	CRCW0402383KFKED Series= CRCW..e3	Res= 383.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
5.	Rfbb	Yageo America	RC0603FR-07910KL Series= ?	Res= 910.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²
6.	Rpg	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
7.	U1	Texas Instruments	TPS62175DQCR	Switcher	1	\$0.58	R-PWSON-N10 12 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	154.414 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	67.794 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	497.423 mA	Current	Peak switch current in IC
4.	Iin Avg	87.202 mA	Current	Average input current
5.	L Ipp	234.85 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	173.582 mA	Current	Q Iavg
7.	BOM Count	7	General	Total Design BOM count
8.	FootPrint	58.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	1.004 MHz	General	Switching frequency
10.	IC Tolerance	24.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	134.847 mV	General	Voltage drop across the MosFET
12.	Mode	CCM	General	Conduction Mode
13.	Pout	1.026 W	General	Total output power
14.	Total BOM	\$1.02	General	Total BOM Cost
15.	Vout Actual	2.701 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	2.7 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	20.866 %	Op_point	Duty cycle
18.	Efficiency	84.041 %	Op_point	Steady state efficiency
19.	IC Tj	39.921 degC	Op_point	IC junction temperature
20.	ICThetaJA	61.6 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	380.0 mA	Op_point	Iout operating point
22.	VIN_OP	14.0 V	Op_point	Vin operating point
23.	Vout p-p	1.89 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	229.781 μW	Power	Input capacitor power dissipation
25.	Cout Pd	16.445 μW	Power	Output capacitor power dissipation
26.	IC Pd	161.056 mW	Power	IC power dissipation
27.	L Pd	33.524 mW	Power	Inductor power dissipation
28.	Total Pd	194.832 mW	Power	Total Power Dissipation
29.	Vout Tolerance	4.464 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	380.0 m	Maximum Output Current
2.	VinMax	14.0	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	2.7	Output Voltage
5.	base_pn	TPS62175	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS62175** Product Folder : <http://www.ti.com/product/TPS62175> : contains the data sheet and other resources.

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