

WEBENCH® Power Architect

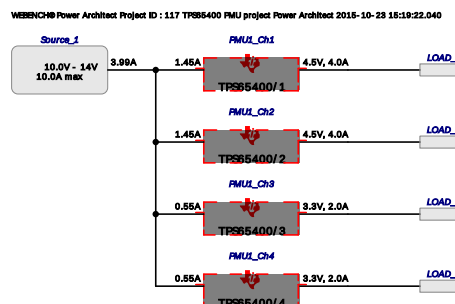
Project Report

Project : 1222857/117 : TPS65400 PMU project
Created : 2015-10-23 15:19:22.040

Project Summary

1. Total System Efficiency	88.072 %
2. Total System BOM Count	57.0
3. Total System Footprint	585.0 mm ²
4. Total System BOM Cost	\$5.96
5. Total System Power Dissipation	6.664 W

--> Launch WEBENCH Power Architect.



Power Supplies

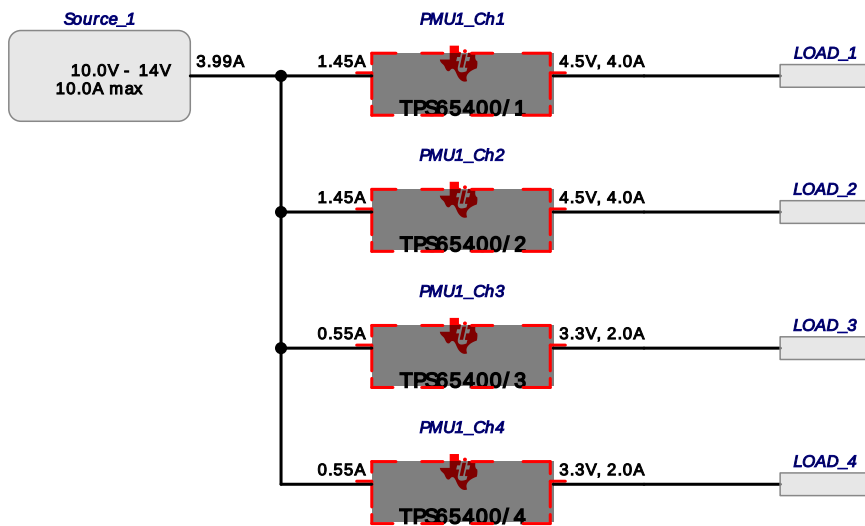
#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	PMU1_Ch1	TPS65400/1	Buck : 4.5V to 18V input, 4A/4A/2A/2A synchronous quad converter with PMBus/I2C Interface	4.5 V	4.0 A	88.7%	215	\$0.00	5759	8
2.	PMU1_Ch2	TPS65400/2	Buck : 4.5V to 18V input, 4A/4A/2A/2A synchronous quad converter with PMBus/I2C Interface	4.5 V	4.0 A	88.7%	215	\$0.00	5760	14
3.	PMU1_Ch3	TPS65400/3	Buck : 4.5V to 18V input, 4A/4A/2A/2A synchronous quad converter with PMBus/I2C Interface	3.3 V	2.0 A	86.4%	219	\$0.00	5761	19
4.	PMU1_Ch4	TPS65400/4	Buck : 4.5V to 18V input, 4A/4A/2A/2A synchronous quad converter with PMBus/I2C Interface	3.3 V	2.0 A	86.4%	219	\$0.00	5762	25
5.	PMU1	TPS65400	PMU : TPS65400 4.5- to 18-V Input Flexible Power Management Unit With PMBus/I2C Interface	V	NaN A	88.1%	585	\$5.96	5758	4

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD_1	4.5 V	4.0 A	VoutRipple=10%
2.	LOAD_2	4.5 V	4.0 A	VoutRipple=10%
3.	LOAD_3	3.3 V	2.0 A	VoutRipple=10%
4.	LOAD_4	3.3 V	2.0 A	VoutRipple=10%

Project Diagram

WEBENCH® Power Architect Project ID : 117 TPS65400 PMU project Power Architect 2015-10-23 15:19:22.040



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
AVX	08053C104KAT2A	0805	8	\$0.01	54
Kemet	C0603C100K3GACTU	0603	4	\$0.01	19
Yageo America	CC0603MRX5R5BB106	0603	8	\$0.02	19
Yageo America	CC0805DRNP09BN7R0	0805	4	\$0.01	27
Vishay-Dale	CRCW040210K0FKED	0402	3	\$0.01	9
Vishay-Dale	CRCW040210K5FKED	0402	4	\$0.01	12
Vishay-Dale	CRCW040214K7FKED	0402	4	\$0.01	12
Vishay-Dale	CRCW040216K9FKED	0402	4	\$0.01	12
Vishay-Dale	CRCW0402187RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040222K1FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04023K01FKED	0402	2	\$0.01	6
Vishay-Dale	CRCW040275K0FKED	0402	4	\$0.01	12
MuRata	GRM155R61A683KA01D	0402	8	\$0.01	24
MuRata	GRM1885C1E122JA01D	0603	4	\$0.01	19
MuRata	GRM188R71H182KA01D	0603	4	\$0.01	19
MuRata	GRM219R61E106KA12	0805	8	\$0.05	27
MuRata	GRM21BR61A106KE19L	0805	8	\$0.03	27
MuRata	GRM21BR61C106KE15L	0805	5	\$0.04	34
MuRata	GRM21BR61C475KA88L	0805	5	\$0.03	34
MuRata	GRM21BR71E335KA73L	0805	5	\$0.04	34
MuRata	GRM32ER61E226KE15L	1210	4	\$0.16	59
Yageo America	RC0603FR-0724KL	0603	4	\$0.01	19
Yageo America	RC0603FR-0768KL	0603	4	\$0.01	19
Bourns	SRN6045-8R2Y	SRN6045	4	\$0.16	256
Texas Instruments	TPS65400RGZR	RGZ0048B	5	\$3.20	405
Coilcraft	XAL5030-472MEB	XAL5030	4	\$0.63	218
Total			119	\$21.78	1382

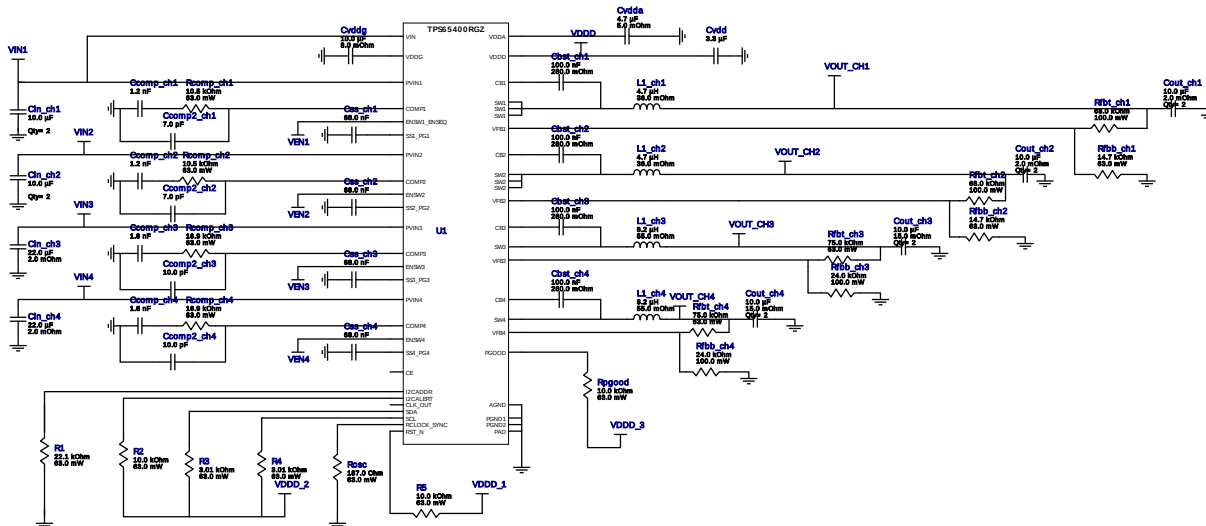


WEBENCH® Design Report

Design : 1222857/5758 TPS65400RGZR
Design 5758 - TPS65400RGZR

VinMin = NaNV
VinMax = NaNV
Vout = 4.5V
Iout = 4.0A

Device = TPS65400RGZR
Topology = PMU
Created = 10/23/15 3:19:18 PM
BOM Cost = \$5.96
BOM Count = 57
Total Pd = 6.66W



1. This schematic shows all the components for this Power Management Unit. The block diagram on the left shows how the channels are connected. Use the drop down PMU Options selector below the optimization dial on the summary page to get the details for each channel. Or click on the block diagram on the left to select a specific channel.

Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst_ch1	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 mm ²
2.	Cbst_ch2	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 mm ²
3.	Cbst_ch3	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 mm ²
4.	Cbst_ch4	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 mm ²
5.	Ccomp2_ch1	Taiyo Yuden	CC0805DRNP09BN7R0 Series= C0G/NP0	Cap= 7.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
6.	Ccomp2_ch2	Taiyo Yuden	CC0805DRNP09BN7R0 Series= C0G/NP0	Cap= 7.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
7.	Ccomp2_ch3	Kemet	C0603C100K3GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
8.	Ccomp2_ch4	Kemet	C0603C100K3GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Ccomp_ch1	MuRata	GRM1885C1E122JA01D Series= C0G/NP0	Cap= 1.2 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm²
10.	Ccomp_ch2	MuRata	GRM1885C1E122JA01D Series= C0G/NP0	Cap= 1.2 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm²
11.	Ccomp_ch3	MuRata	GRM188R71H182KA01D Series= X7R	Cap= 1.8 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm²
12.	Ccomp_ch4	MuRata	GRM188R71H182KA01D Series= X7R	Cap= 1.8 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm²
13.	Cin_ch1	MuRata	GRM219R61E106KA12 Series= X5R	Cap= 10.0 uF VDC= 25.0 V IRMS= 0.0 A	2	\$0.05	 0805 7 mm²
14.	Cin_ch2	MuRata	GRM219R61E106KA12 Series= X5R	Cap= 10.0 uF VDC= 25.0 V IRMS= 0.0 A	2	\$0.05	 0805 7 mm²
15.	Cin_ch3	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
16.	Cin_ch4	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
17.	Cout_ch1	MuRata	GRM21BR61A106KE19L Series= X5R	Cap= 10.0 uF ESR= 2.0 mOhm VDC= 10.0 V IRMS= 0.0 A	2	\$0.03	 0805 7 mm²
18.	Cout_ch2	MuRata	GRM21BR61A106KE19L Series= X5R	Cap= 10.0 uF ESR= 2.0 mOhm VDC= 10.0 V IRMS= 0.0 A	2	\$0.03	 0805 7 mm²
19.	Cout_ch3	Yageo America	CC0603MRX5R5BB106 Series= X5R	Cap= 10.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 0.0 A	2	\$0.02	 0603 5 mm²
20.	Cout_ch4	Yageo America	CC0603MRX5R5BB106 Series= X5R	Cap= 10.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 0.0 A	2	\$0.02	 0603 5 mm²
21.	Css_ch1	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
22.	Css_ch2	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
23.	Css_ch3	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
24.	Css_ch4	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm²
25.	Cvdd	MuRata	GRM21BR71E335KA73L Series= X7R	Cap= 3.3 uF VDC= 25.0 V IRMS= 0.0 A	1	\$0.04	 0805 7 mm²
26.	Cvdda	MuRata	GRM21BR61C475KA88L Series= X5R	Cap= 4.7 uF ESR= 5.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.03	 0805 7 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Cvddg	MuRata	GRM21BR61C106KE15L Series= X5R	Cap= 10.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.04	 0805 7 mm ²
28.	L1_ch1	Coilcraft	XAL5030-472MEB	L= 4.7 µH DCR= 36.0 mOhm	1	\$0.63	 XAL5030 54 mm ²
29.	L1_ch2	Coilcraft	XAL5030-472MEB	L= 4.7 µH DCR= 36.0 mOhm	1	\$0.63	 XAL5030 54 mm ²
30.	L1_ch3	Bourns	SRN6045-8R2Y	L= 8.2 µH DCR= 55.0 mOhm	1	\$0.16	 SRN6045 64 mm ²
31.	L1_ch4	Bourns	SRN6045-8R2Y	L= 8.2 µH DCR= 55.0 mOhm	1	\$0.16	 SRN6045 64 mm ²
32.	R1	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
33.	R2	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
34.	R3	Vishay-Dale	CRCW04023K01FKED Series= CRCW..e3	Res= 3.01 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
35.	R4	Vishay-Dale	CRCW04023K01FKED Series= CRCW..e3	Res= 3.01 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
36.	R5	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
37.	Rcomp_ch1	Vishay-Dale	CRCW040210K5FKED Series= CRCW..e3	Res= 10.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
38.	Rcomp_ch2	Vishay-Dale	CRCW040210K5FKED Series= CRCW..e3	Res= 10.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
39.	Rcomp_ch3	Vishay-Dale	CRCW040216K9FKED Series= CRCW..e3	Res= 16.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
40.	Rcomp_ch4	Vishay-Dale	CRCW040216K9FKED Series= CRCW..e3	Res= 16.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
41.	Rfbb_ch1	Vishay-Dale	CRCW040214K7FKED Series= CRCW..e3	Res= 14.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
42.	Rfbb_ch2	Vishay-Dale	CRCW040214K7FKED Series= CRCW..e3	Res= 14.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
43.	Rfbb_ch3	Yageo America	RC0603FR-0724KL Series= ?	Res= 24.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
44.	Rfbb_ch4	Yageo America	RC0603FR-0724KL Series= ?	Res= 24.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
45.	Rfbbt_ch1	Yageo America	RC0603FR-0768KL Series= ?	Res= 68.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
46.	Rfbt_ch2	Yageo America	RC0603FR-0768KL Series= ?	Res= 68.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
47.	Rfbt_ch3	Vishay-Dale	CRCW040275K0FKED Series= CRCW..e3	Res= 75.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
48.	Rfbt_ch4	Vishay-Dale	CRCW040275K0FKED Series= CRCW..e3	Res= 75.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
49.	Rosc	Vishay-Dale	CRCW0402187RFKED Series= CRCW..e3	Res= 187.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
50.	Rpgood	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
51.	U1	Texas Instruments	TPS65400RGZR	Switcher	1	\$3.20	 RGZ0048B 81 mm ²

Operating Values

#	Name	Value	Category	Description
1.	BOM Count	57	General	Total Design BOM count
2.	FootPrint	585.0 mm ²	General	Total PMU footprint area of BOM components
3.	Pout	49.2 W	General	Total PMU output power
4.	Total BOM	\$5.96	General	Total BOM Cost
5.	Efficiency	88.072 %	Op_point	PMU steady state efficiency
6.	IC Tj	122.996 degC	Op_point	PMU IC junction temperature
7.	ICThetaJA	18.4 degC/W	Op_point	IC junction-to-ambient thermal resistance
8.	Cin_ch1 Pd	0.0 W	Power	Input capacitor power dissipation
9.	Cin_ch2 Pd	0.0 W	Power	Input capacitor power dissipation
10.	Cin_ch3 Pd	1.536 mW	Power	Input capacitor power dissipation
11.	Cin_ch4 Pd	1.536 mW	Power	Input capacitor power dissipation
12.	Cout_ch1 Pd	132.549 µW	Power	Output capacitor power dissipation
13.	Cout_ch2 Pd	132.549 µW	Power	Output capacitor power dissipation
14.	Cout_ch3 Pd	231.38 µW	Power	Output capacitor power dissipation
15.	Cout_ch4 Pd	231.38 µW	Power	Output capacitor power dissipation
16.	IC Pd	5.054 W	Power	IC Pd
17.	L1_ch1 Pd	580.772 mW	Power	Inductor power dissipation
18.	L1_ch2 Pd	580.772 mW	Power	Inductor power dissipation
19.	L1_ch3 Pd	221.697 mW	Power	Inductor power dissipation
20.	L1_ch4 Pd	221.697 mW	Power	Inductor power dissipation
21.	Module ICPd	5.054 W	Power	IC Pd
22.	Total Pd	6.663 W	Power	PMU total power dissipation
23.	Total Pd	6.663 W	Power	PMU total power dissipation

Design Inputs

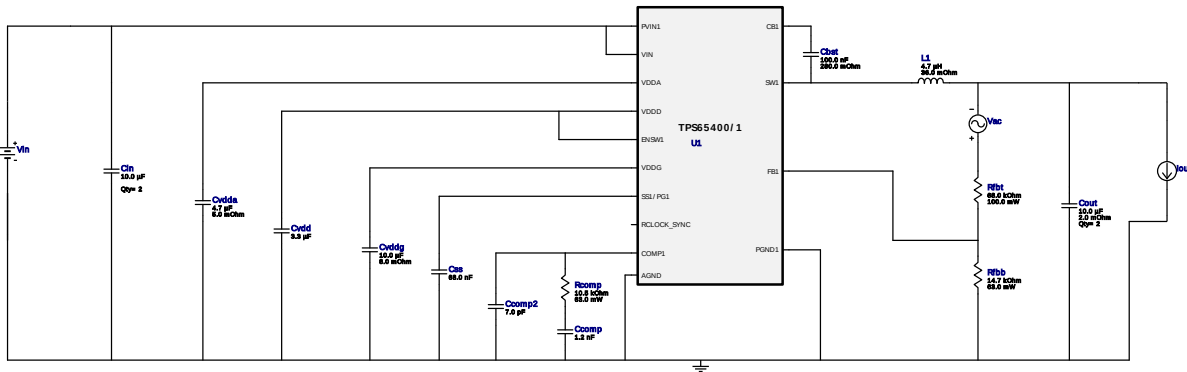
#	Name	Value	Description
1.	Iout	4.0	Maximum Output Current
2.	Iout1	4.0	Output Current #1
3.	Iout2	4.0	Output Current #2
4.	Iout3	2.0	Output Current #3
5.	Iout4	2.0	Output Current #4
6.	Vout	4.5	Output Voltage
7.	Vout1	4.5	Output Voltage #1
8.	Vout2	4.5	Output Voltage #2
9.	Vout3	3.3	Output Voltage #3
10.	Vout4	3.3	Output Voltage #4
11.	base_pn	TPS65400	Base Product Number
12.	source	DC	Input Source Type
13.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS65400** Product Folder : <http://www.ti.com/product/TPS65400> : contains the data sheet and other resources.

Device = TPS65400RGZR
Topology = Buck
Created = 10/23/15 3:19:18 PM
BOM Cost = \$NaN
BOM Count = NaN
Total Pd = 2.29W

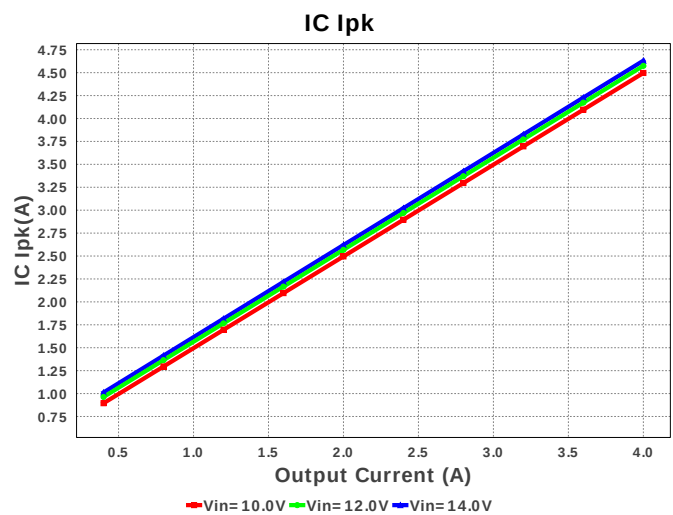
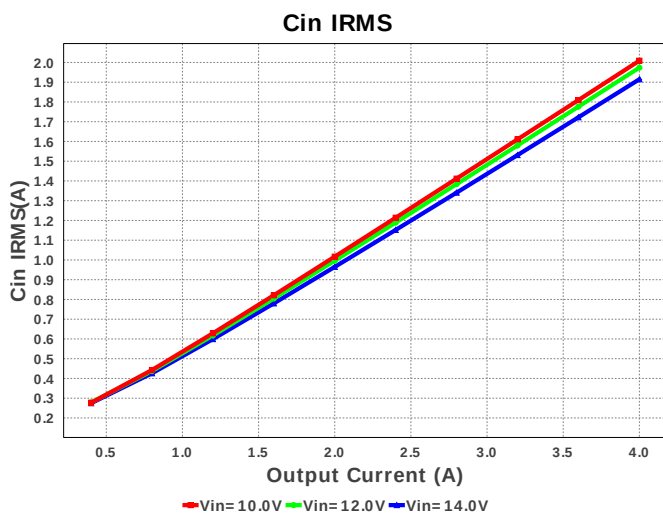
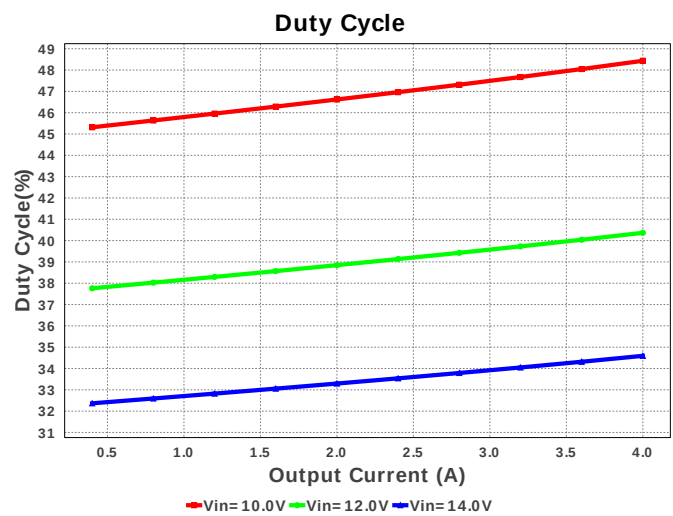
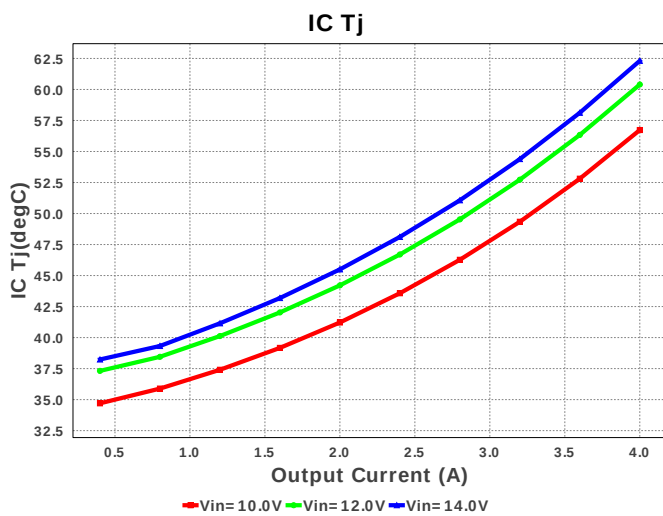
Design : 1222857/5759 TPS65400RGZR
TPS65400RGZR 10.0V-14.0V to 4.50V @ 4.0A

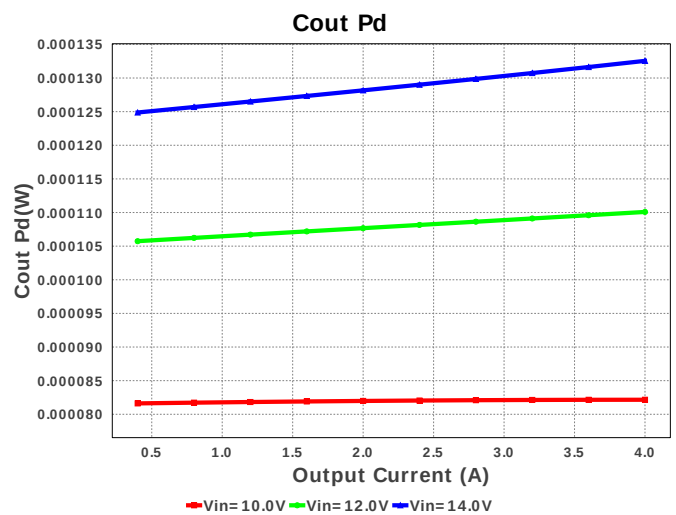
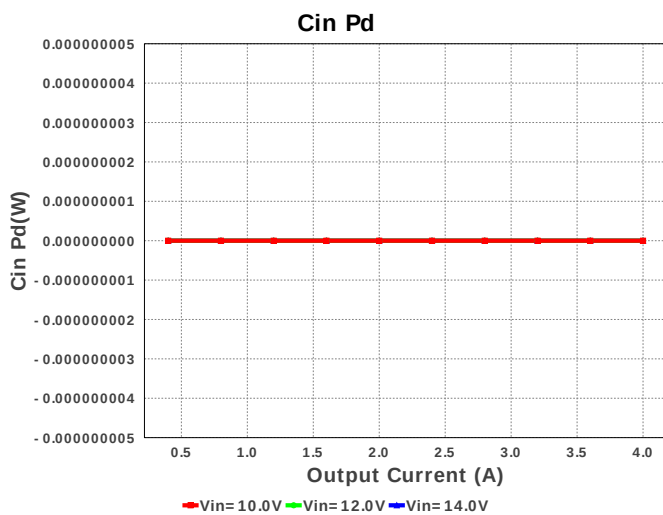
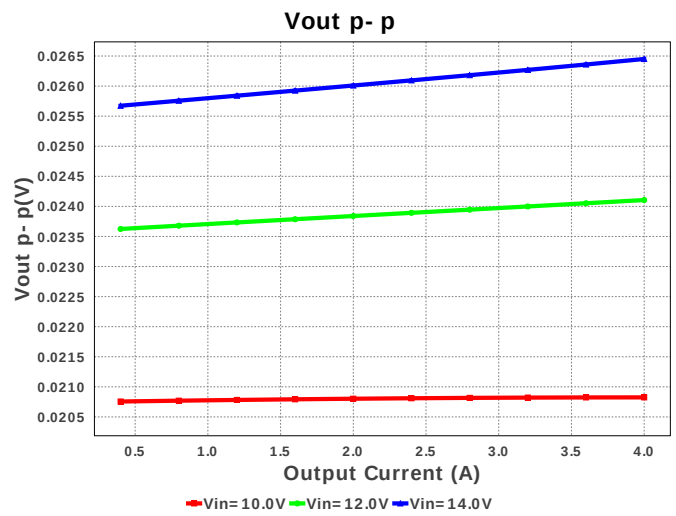
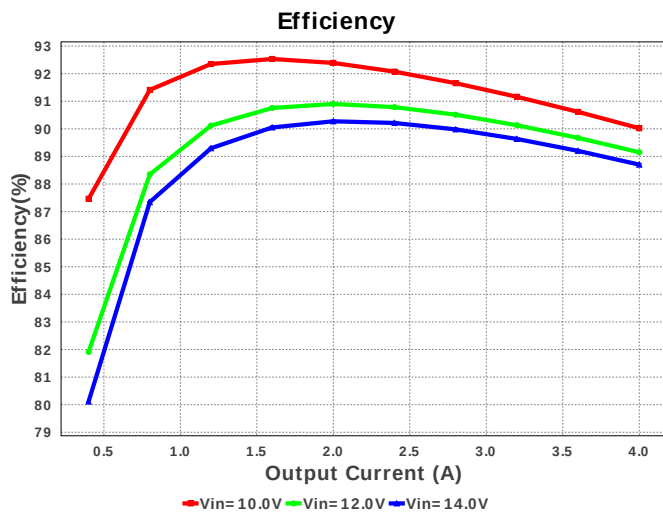
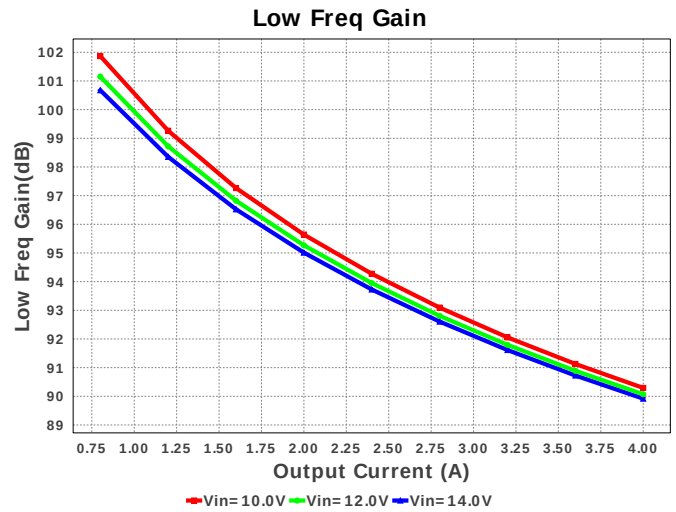
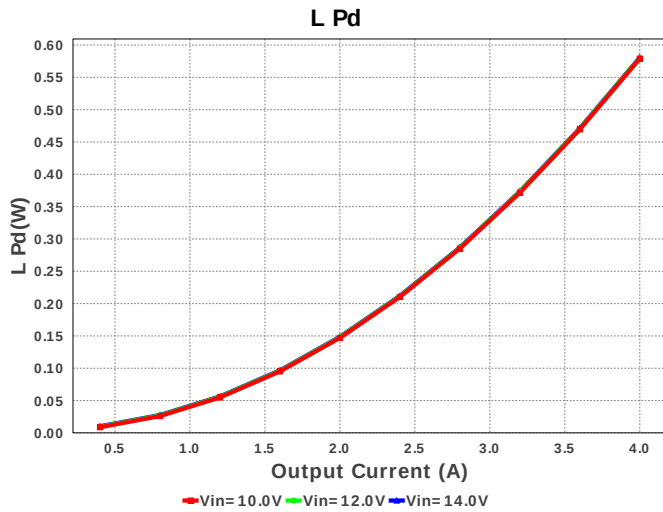


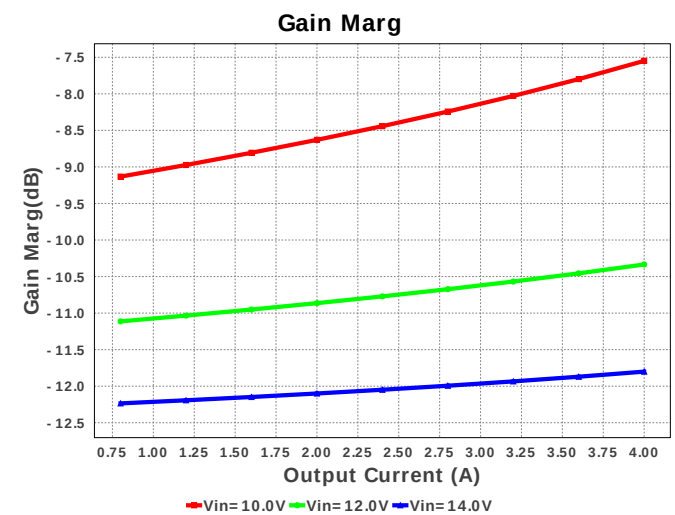
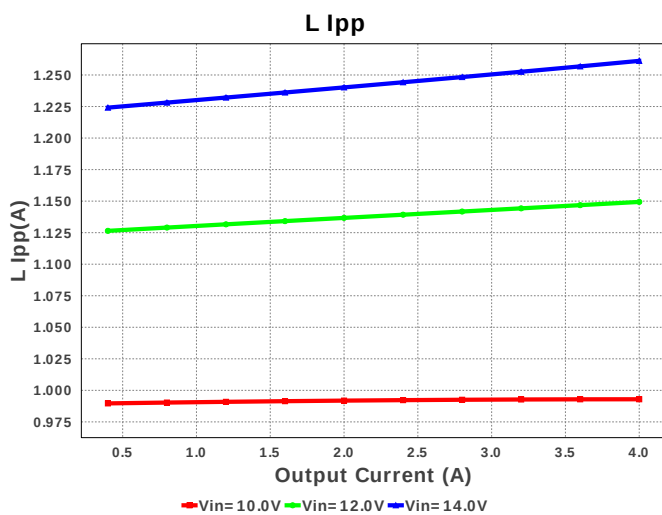
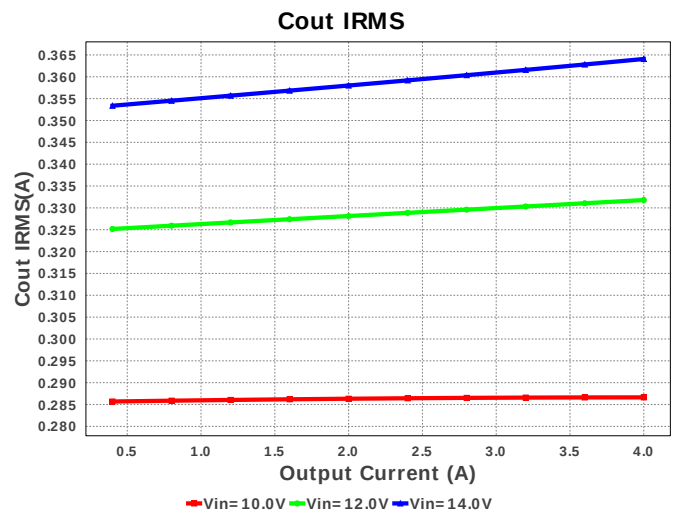
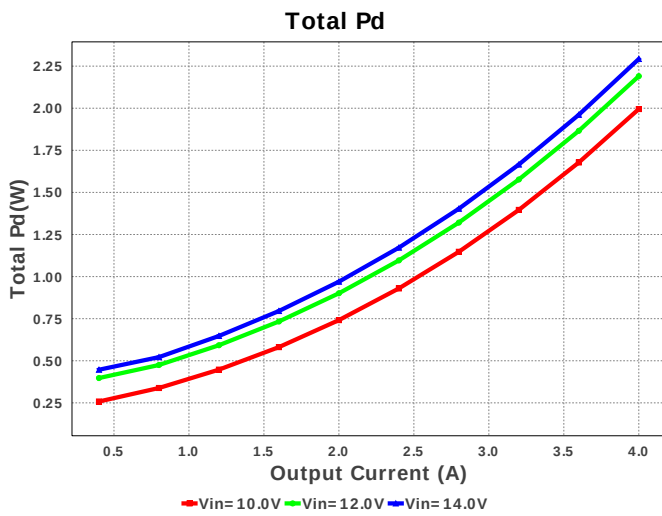
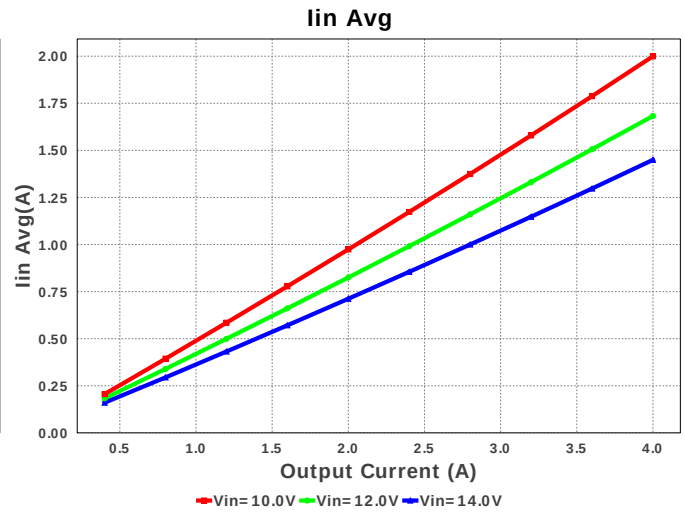
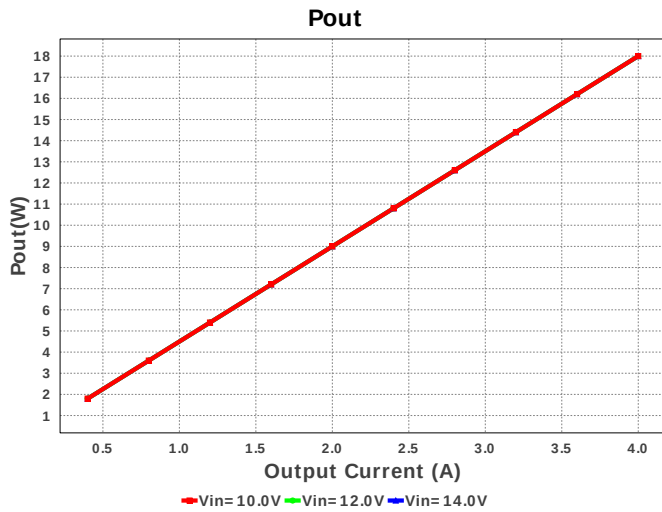
Electrical BOM

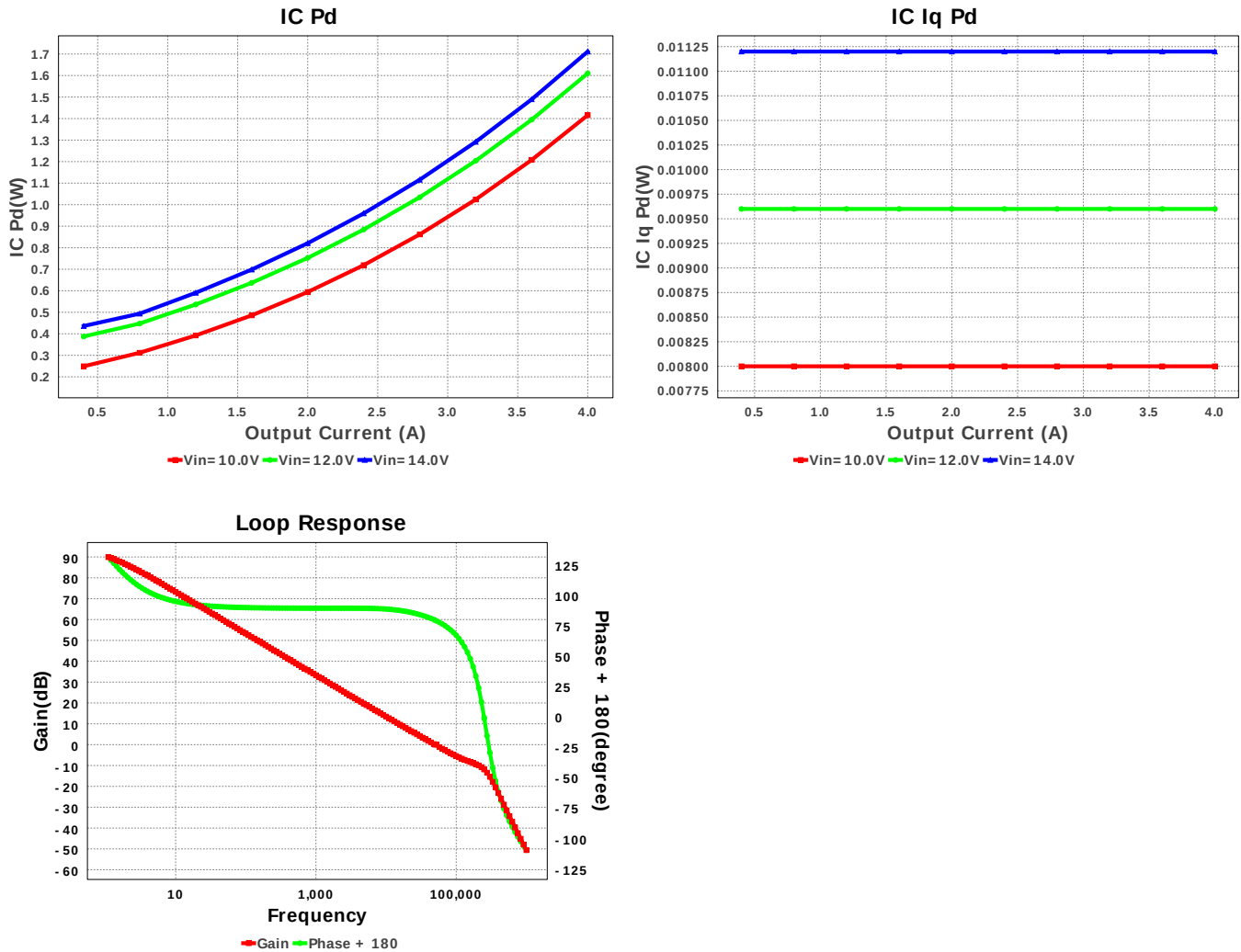
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
2.	Ccomp	MuRata	GRM1885C1E122JA01D Series= C0G/NP0	Cap= 1.2 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
3.	Ccomp2	Yageo America	CC0805DRNP09BN7R0 Series= C0G/NP0	Cap= 7.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
4.	Cin	MuRata	GRM219R61E106KA12 Series= X5R	Cap= 10.0 uF VDC= 25.0 V IRMS= 0.0 A	2	\$0.05	 0805 7 mm ²
5.	Cout	MuRata	GRM21BR61A106KE19L Series= X5R	Cap= 10.0 uF ESR= 2.0 mOhm VDC= 10.0 V IRMS= 0.0 A	2	\$0.03	 0805 7 mm ²
6.	Css	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
7.	Cvdd	MuRata	GRM21BR71E335KA73L Series= X7R	Cap= 3.3 uF VDC= 25.0 V IRMS= 0.0 A	0	\$0.04	 0805 7 mm ²
8.	Cvdda	MuRata	GRM21BR61C475KA88L Series= X5R	Cap= 4.7 uF ESR= 5.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.03	 0805 7 mm ²
9.	Cvddg	MuRata	GRM21BR61C106KE15L Series= X5R	Cap= 10.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.04	 0805 7 mm ²
10.	L1	Coilcraft	XAL5030-472MEB	L= 4.7 uH DCR= 36.0 mOhm	1	\$0.63	 XAL5030 54 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rcomp	Vishay-Dale	CRCW040210K5FKED Series= CRCW..e3	Res= 10.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
12.	Rfbb	Vishay-Dale	CRCW040214K7FKED Series= CRCW..e3	Res= 14.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
13.	Rfbt	Yageo America	RC0603FR-0768KL Series= ?	Res= 68.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
14.	U1	Texas Instruments	TPS65400RGZR	Switcher	0	\$3.20	 RGZ0048B 81 mm²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.915 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	364.073 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	4.631 A	Current	Peak switch current in IC
4.	Iin Avg	1.45 A	Current	Average input current
5.	L Ipp	1.261 A	Current	Peak-to-peak inductor ripple current
6.	Frequency	532.485 kHz	General	Switching frequency
7.	Pout	18.0 W	General	Total output power
8.	Low Freq Gain	89.919 dB	Op_Point	Gain at 10Hz
9.	Vout OP	4.5 V	Op_Point	Operational Output Voltage
10.	Cross Freq	49.736 kHz	Op_point	Bode plot crossover frequency
11.	Duty Cycle	34.594 %	Op_point	Duty cycle
12.	Efficiency	88.703 %	Op_point	PMU channel steady state efficiency
13.	Gain Marg	-11.801 dB	Op_point	Bode Plot Gain Margin
14.	ICThetaJA	18.88 degC/W	Op_point	IC junction-to-ambient thermal resistance
15.	IOUT_OP	4.0 A	Op_point	Iout operating point
16.	Phase Marg	80.267 deg	Op_point	Bode Plot Phase Margin
17.	VIN_OP	14.0 V	Op_point	Vin operating point
18.	Vout p-p	25.207 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
20.	Cout Pd	132.549 μ W	Power	Output capacitor power dissipation
21.	IC Iq Pd	11.2 mW	Power	IC Iq Pd
22.	IC Pd	1.711 W	Power	IC power dissipation
23.	L Pd	580.772 mW	Power	Inductor power dissipation
24.	Total Pd	2.293 W	Power	PMU channel power dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	4.0	Maximum Output Current
2.	Iout1	4.0	Output Current #1
3.	VinMax	14.0	Maximum input voltage

#	Name	Value	Description
4.	VinMin	10.0	Minimum input voltage
5.	Vout	4.5	Output Voltage
6.	Vout1	4.5	Output Voltage #1
7.	base_pn	TPS65400/1	Base Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS65400/1** Product Folder : <http://www.ti.com/product/TPS65400> : contains the data sheet and other resources.

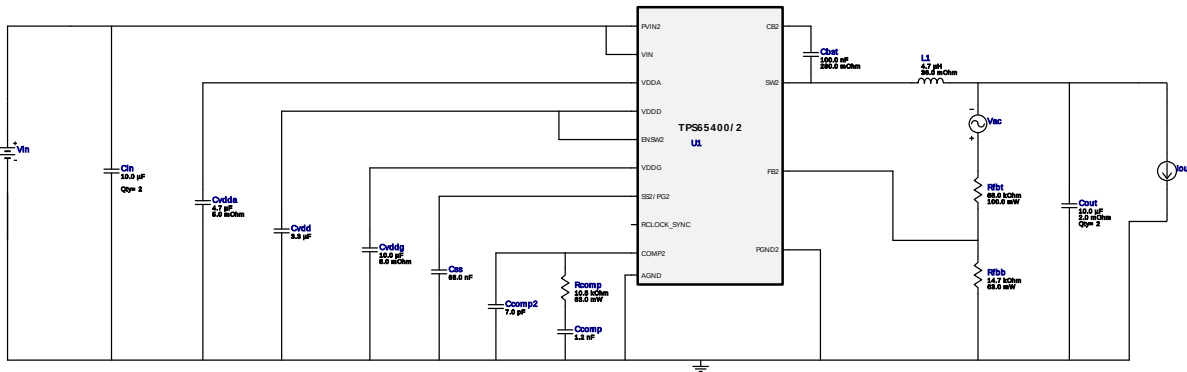


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WEBENCH® Design Report

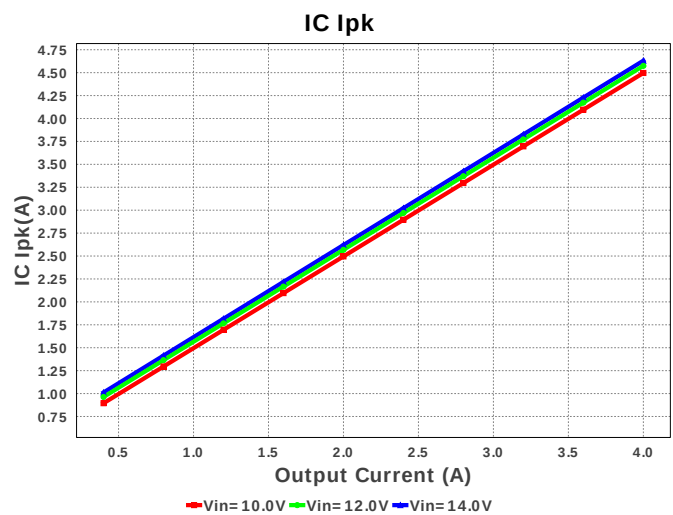
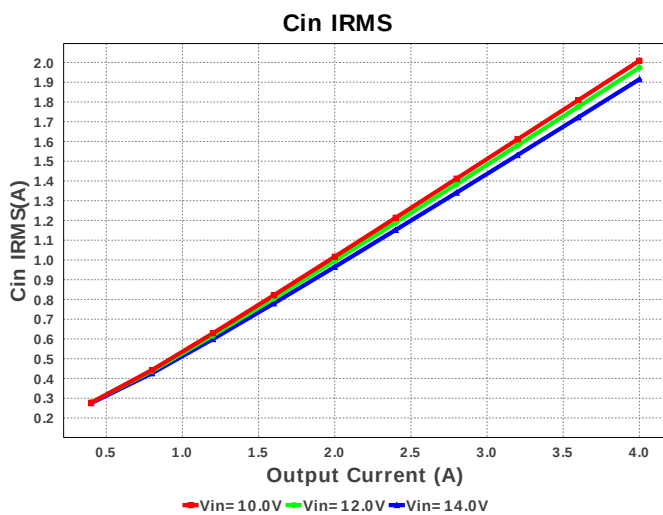
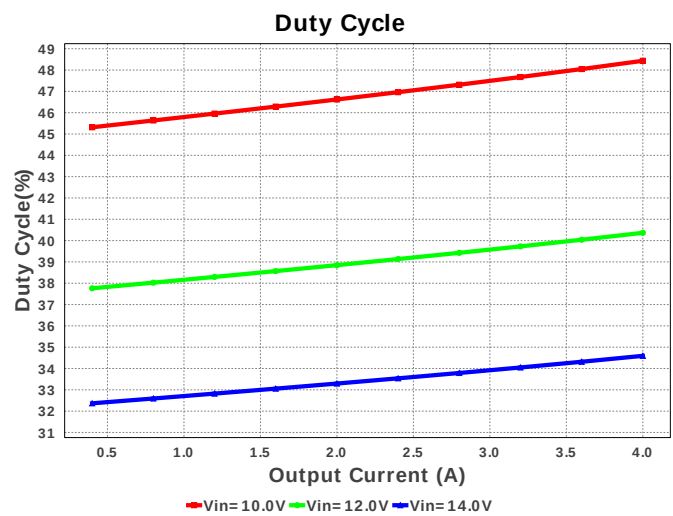
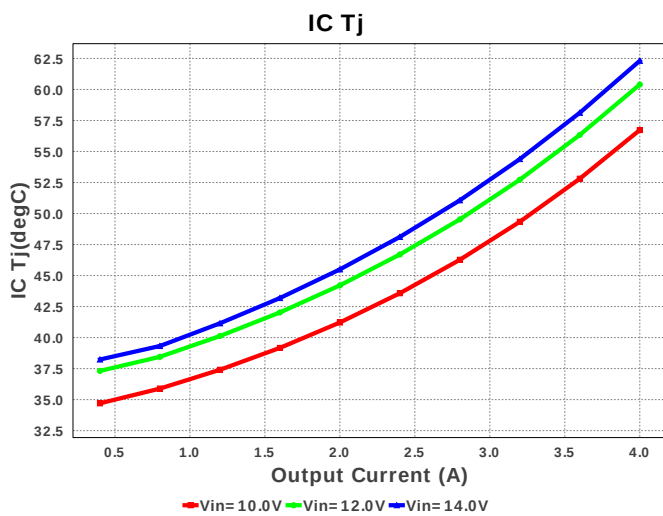
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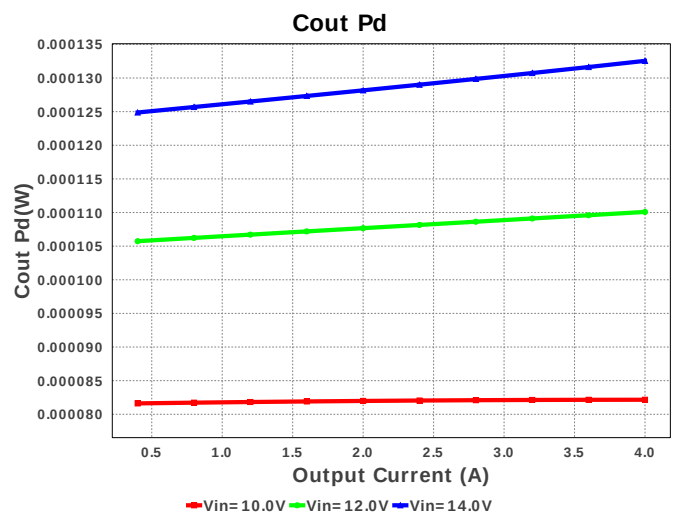
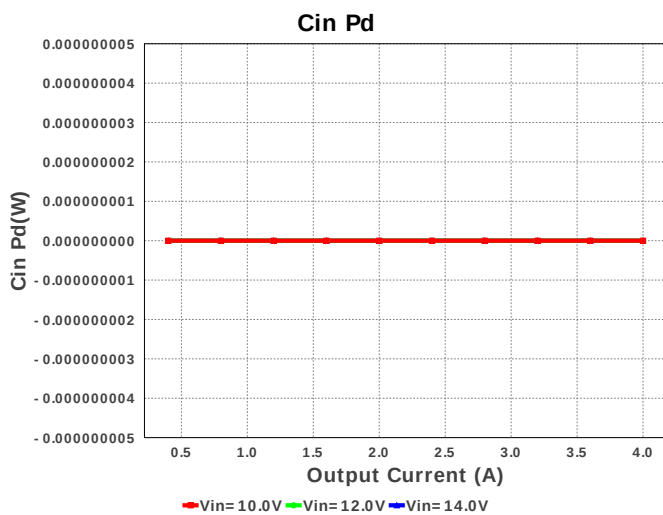
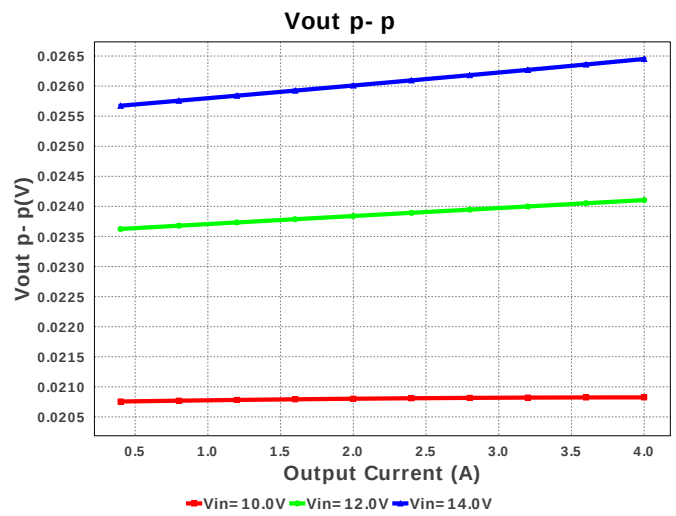
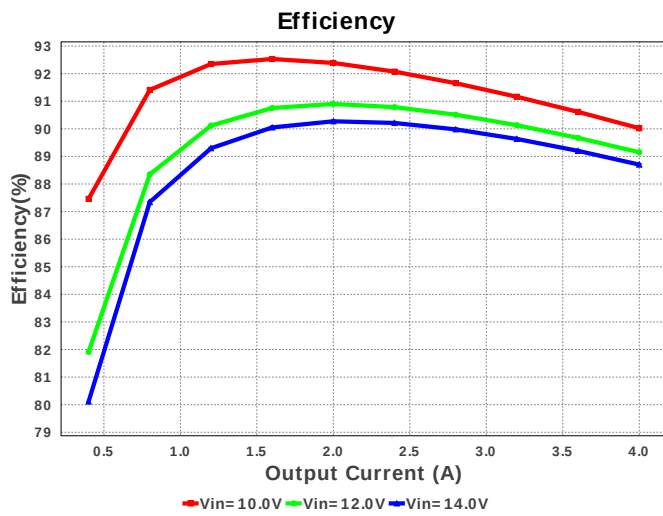
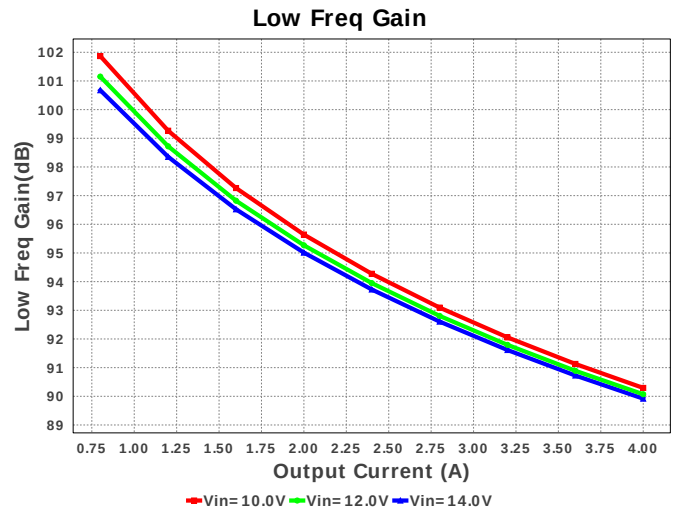
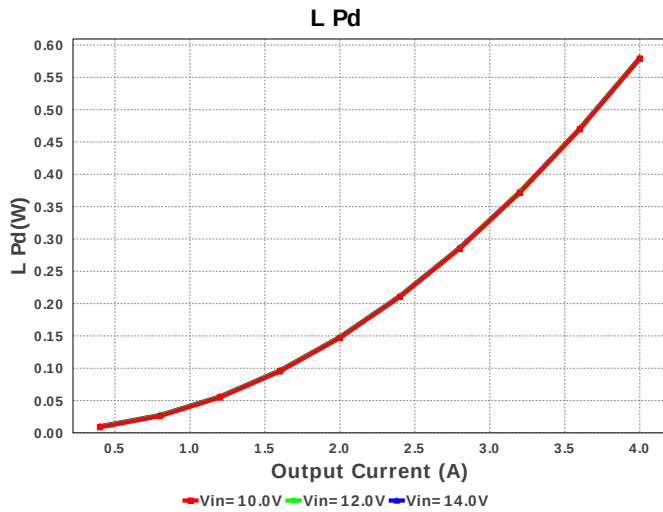


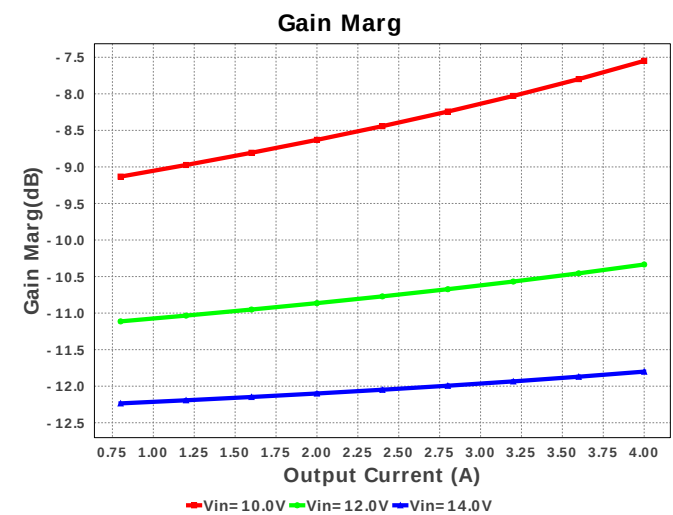
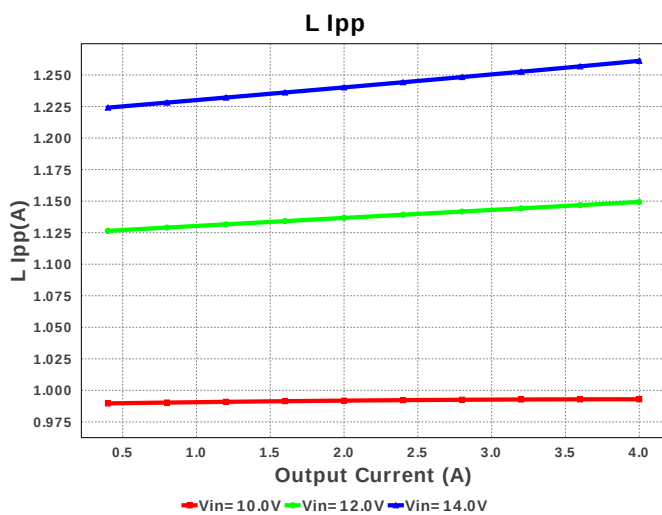
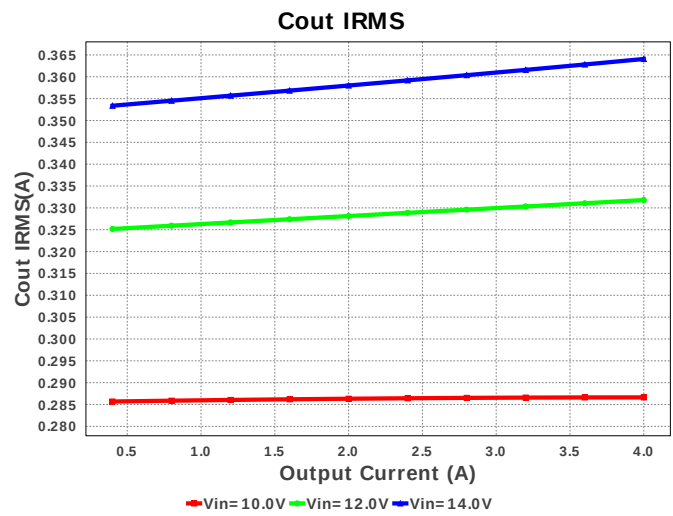
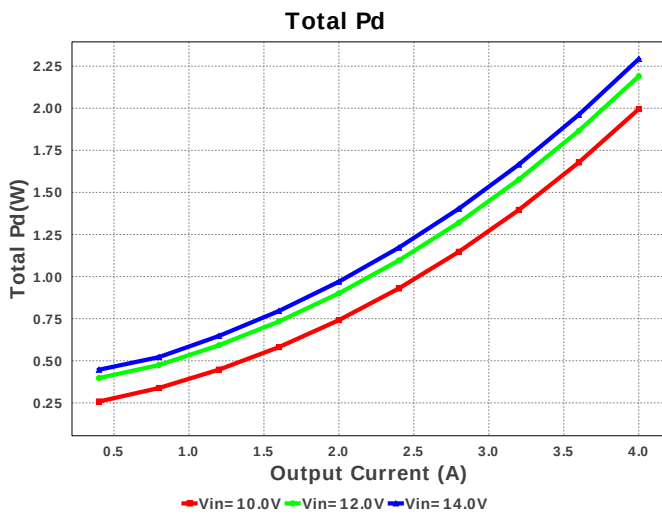
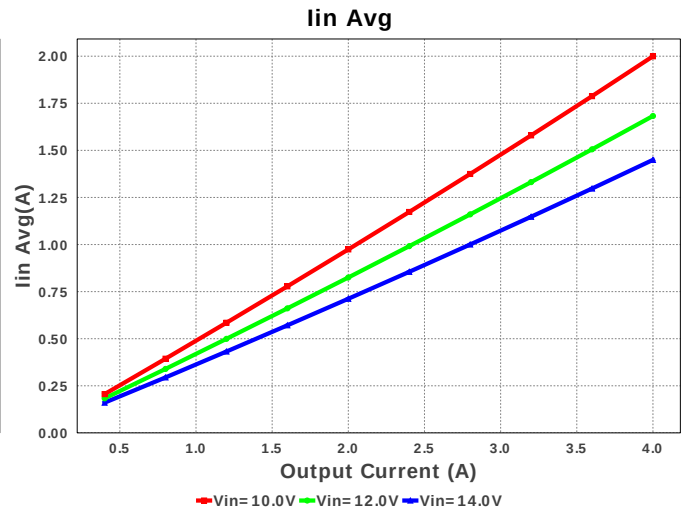
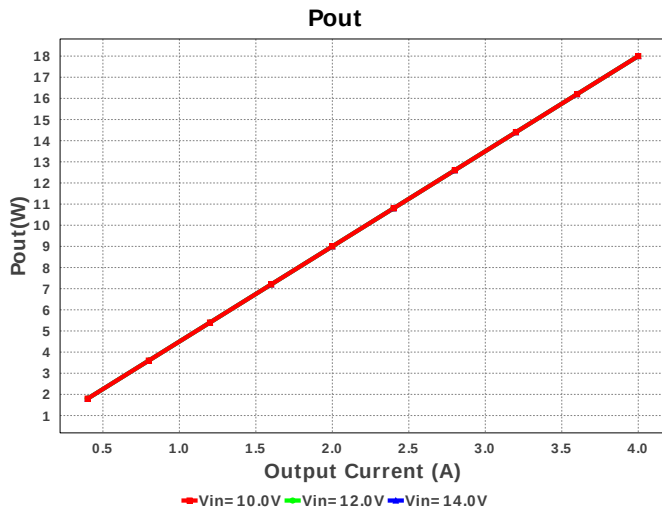
Electrical BOM

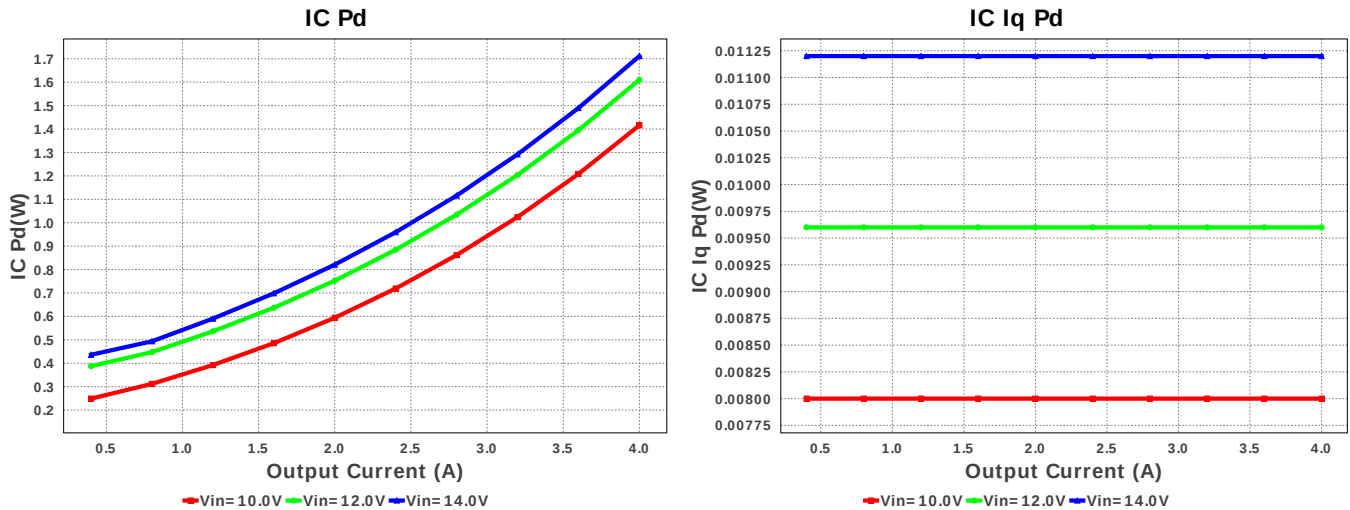
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	Ccomp	MuRata	GRM1885C1E122JA01D Series= C0G/NP0	Cap= 1.2 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
3.	Ccomp2	Yageo America	CC0805DRNP09BN7R0 Series= C0G/NP0	Cap= 7.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
4.	Cin	MuRata	GRM219R61E106KA12 Series= X5R	Cap= 10.0 uF VDC= 25.0 V IRMS= 0.0 A	2	\$0.05	0805 7 mm ²
5.	Cout	MuRata	GRM21BR61A106KE19L Series= X5R	Cap= 10.0 uF ESR= 2.0 mOhm VDC= 10.0 V IRMS= 0.0 A	2	\$0.03	0805 7 mm ²
6.	Css	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
7.	Cvdd	MuRata	GRM21BR71E335KA73L Series= X7R	Cap= 3.3 uF VDC= 25.0 V IRMS= 0.0 A	0	\$0.04	0805 7 mm ²
8.	Cvdda	MuRata	GRM21BR61C475KA88L Series= X5R	Cap= 4.7 uF ESR= 5.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.03	0805 7 mm ²
9.	Cvddg	MuRata	GRM21BR61C106KE15L Series= X5R	Cap= 10.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.04	0805 7 mm ²
10.	L1	Coilcraft	XAL5030-472MEB	L= 4.7 uH DCR= 36.0 mOhm	1	\$0.63	XAL5030 54 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rcomp	Vishay-Dale	CRCW040210K5FKED Series= CRCW..e3	Res= 10.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
12.	Rfbb	Vishay-Dale	CRCW040214K7FKED Series= CRCW..e3	Res= 14.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
13.	Rfbt	Yageo America	RC0603FR-0768KL Series= ?	Res= 68.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
14.	U1	Texas Instruments	TPS65400RGZR	Switcher	0	\$3.20	 RGZ0048B 81 mm²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.915 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	364.073 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	4.631 A	Current	Peak switch current in IC
4.	Iin Avg	1.45 A	Current	Average input current
5.	L Ipp	1.261 A	Current	Peak-to-peak inductor ripple current
6.	Frequency	532.485 kHz	General	Switching frequency
7.	Pout	18.0 W	General	Total output power
8.	Low Freq Gain	89.919 dB	Op_Point	Gain at 10Hz
9.	Vout OP	4.5 V	Op_Point	Operational Output Voltage
10.	Cross Freq	49.736 kHz	Op_point	Bode plot crossover frequency
11.	Duty Cycle	34.594 %	Op_point	Duty cycle
12.	Efficiency	88.703 %	Op_point	PMU channel steady state efficiency
13.	Gain Marg	-11.801 dB	Op_point	Bode Plot Gain Margin
14.	ICThetaJA	18.88 degC/W	Op_point	IC junction-to-ambient thermal resistance
15.	IOUT_OP	4.0 A	Op_point	Iout operating point
16.	Phase Marg	80.267 deg	Op_point	Bode Plot Phase Margin
17.	VIN_OP	14.0 V	Op_point	Vin operating point
18.	Vout p-p	25.207 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
20.	Cout Pd	132.549 μ W	Power	Output capacitor power dissipation
21.	IC Iq Pd	11.2 mW	Power	IC Iq Pd
22.	IC Pd	1.711 W	Power	IC power dissipation
23.	L Pd	580.772 mW	Power	Inductor power dissipation
24.	Total Pd	2.293 W	Power	PMU channel power dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	4.0	Maximum Output Current
2.	Iout1	4.0	Output Current #1
3.	VinMax	14.0	Maximum input voltage
4.	VinMin	10.0	Minimum input voltage
5.	Vout	4.5	Output Voltage
6.	Vout1	4.5	Output Voltage #1
7.	base_pn	TPS65400/2	Base Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS65400/2** Product Folder : <http://www.ti.com/product/TPS65400> : contains the data sheet and other resources.

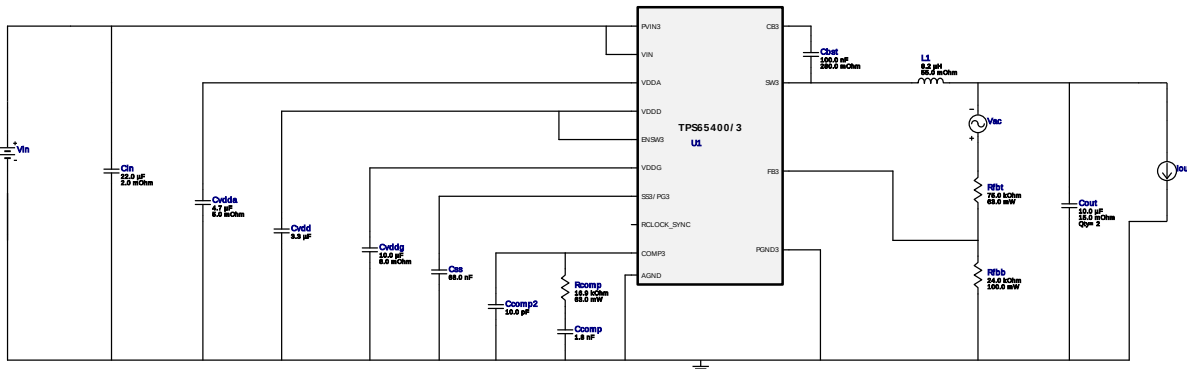


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VinMax = 14.0V
Vout = 3.3V
Iout = 2.0A

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WEBENCH® Design Report

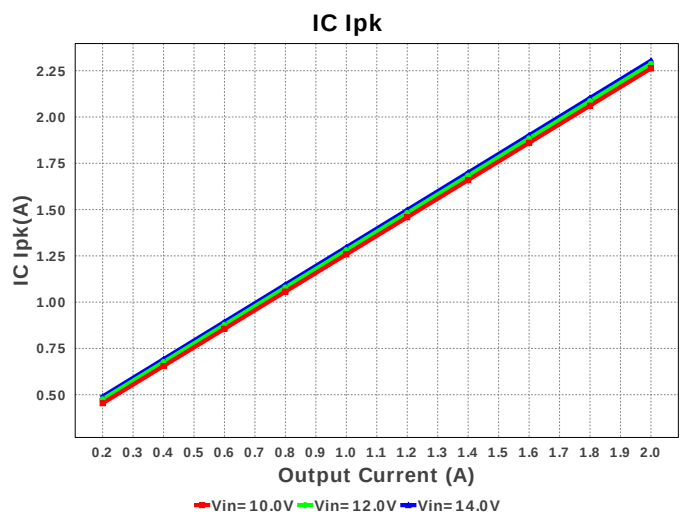
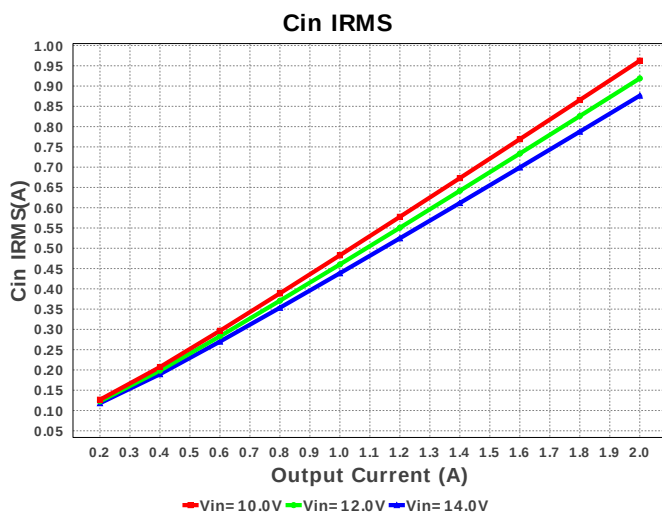
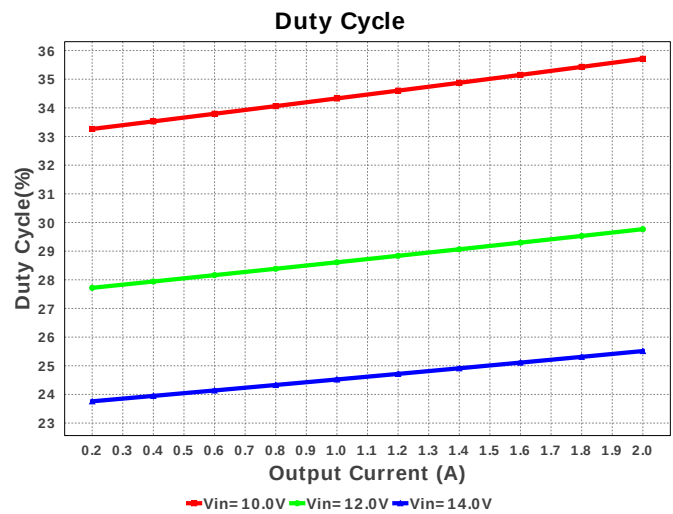
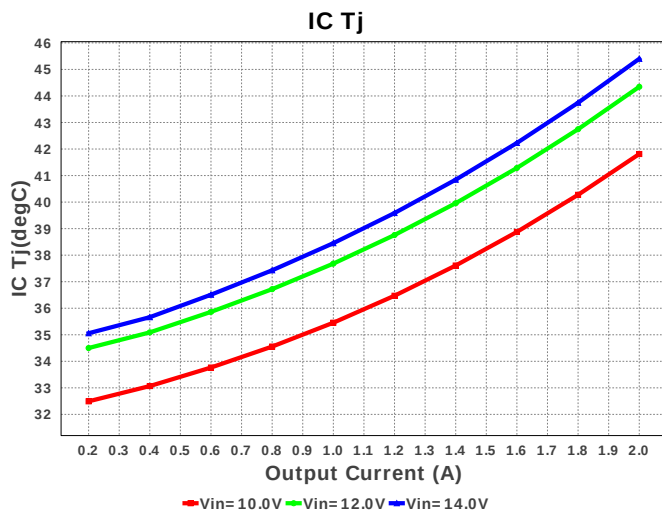
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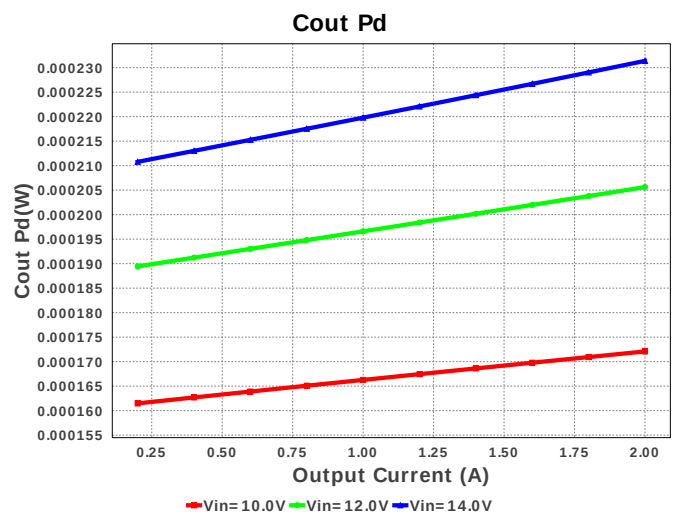
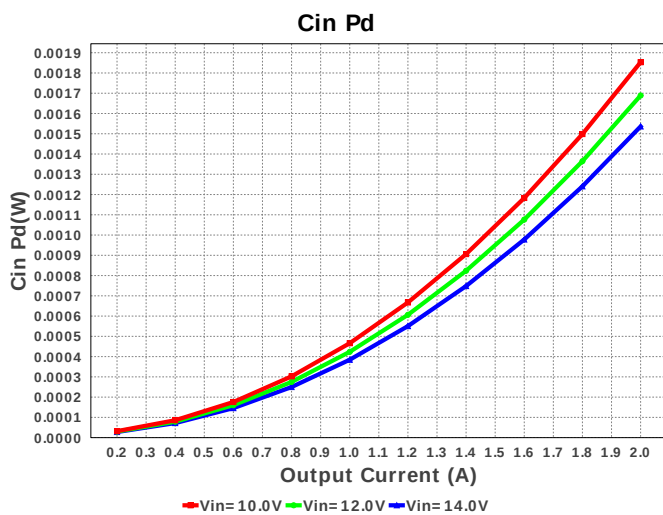
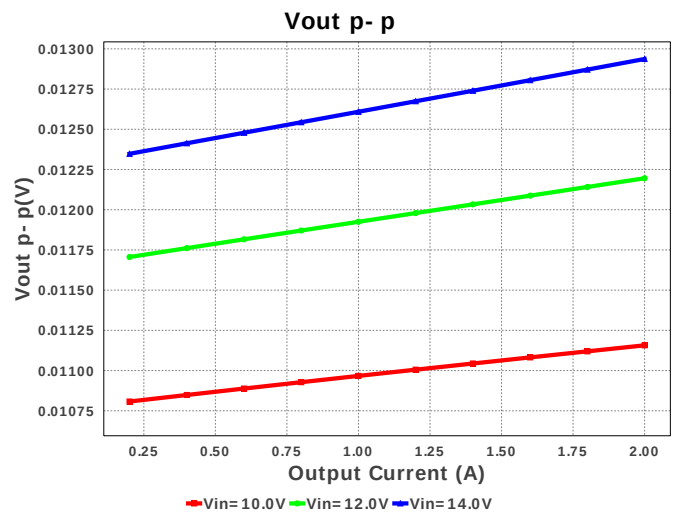
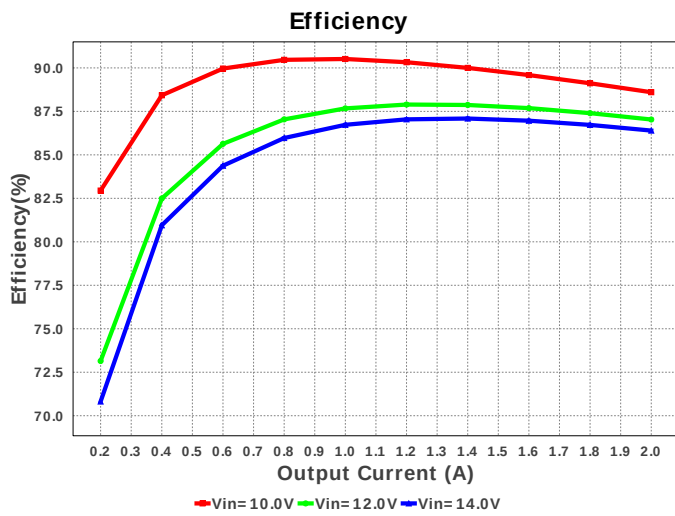
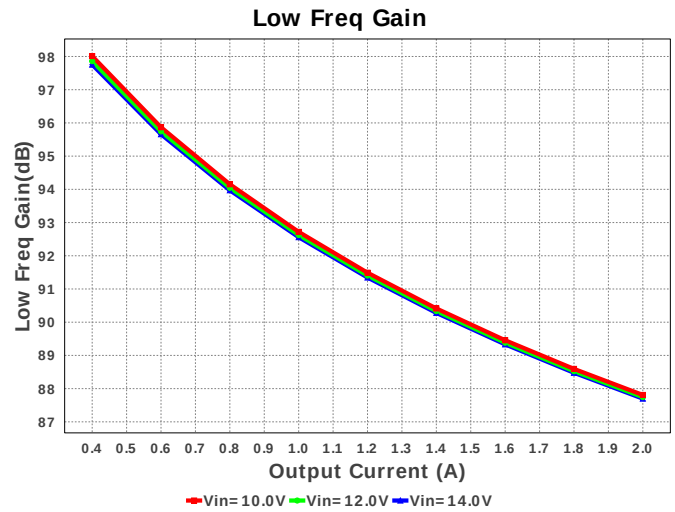
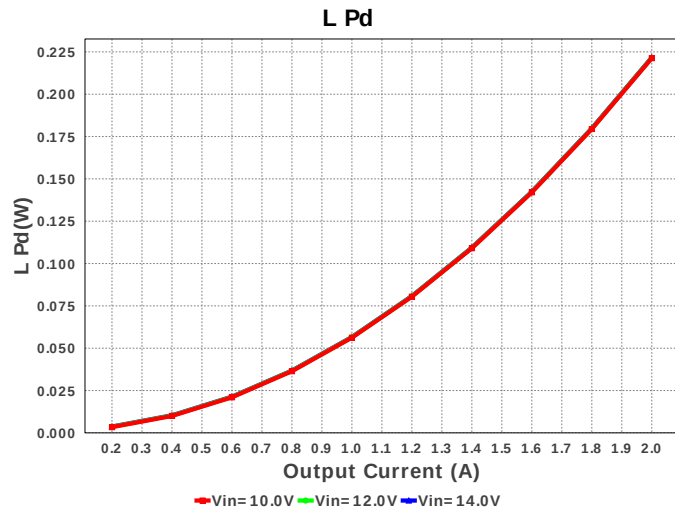


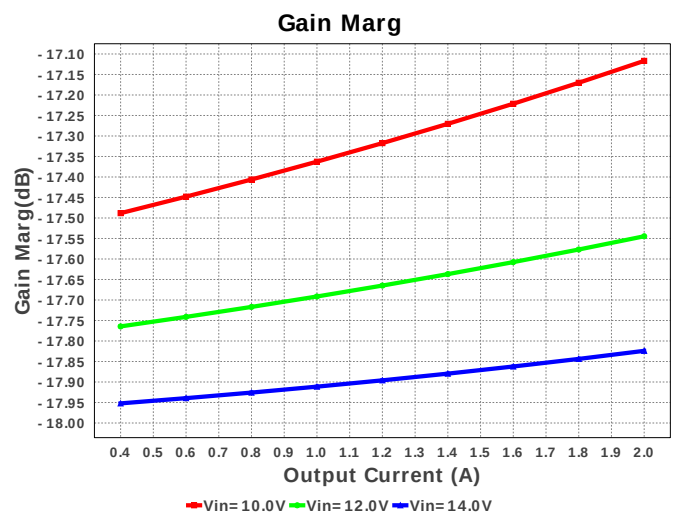
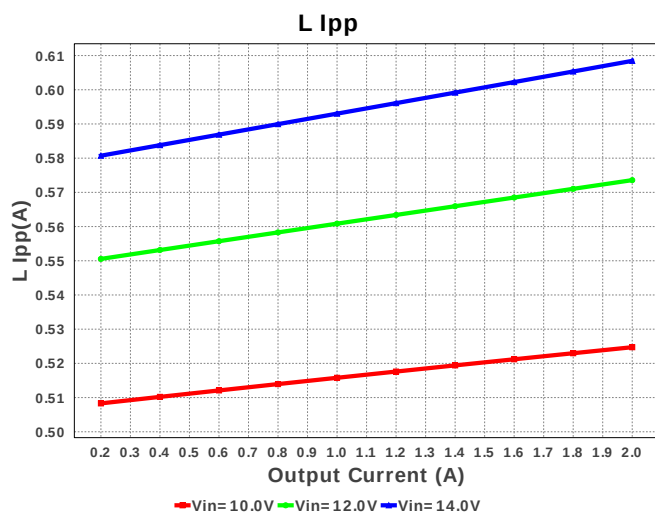
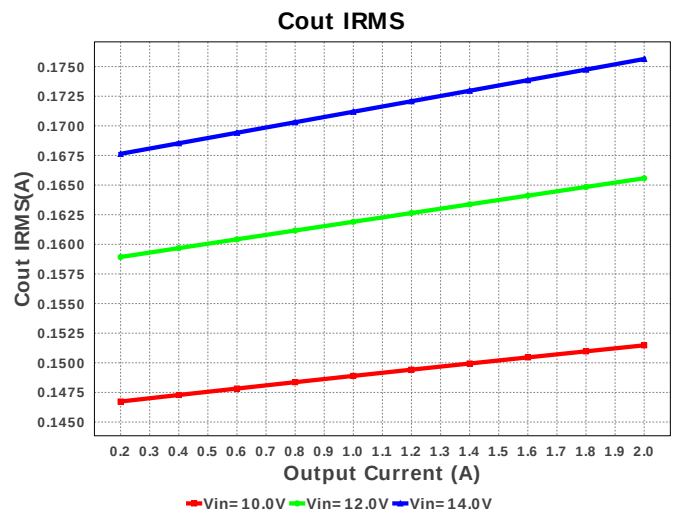
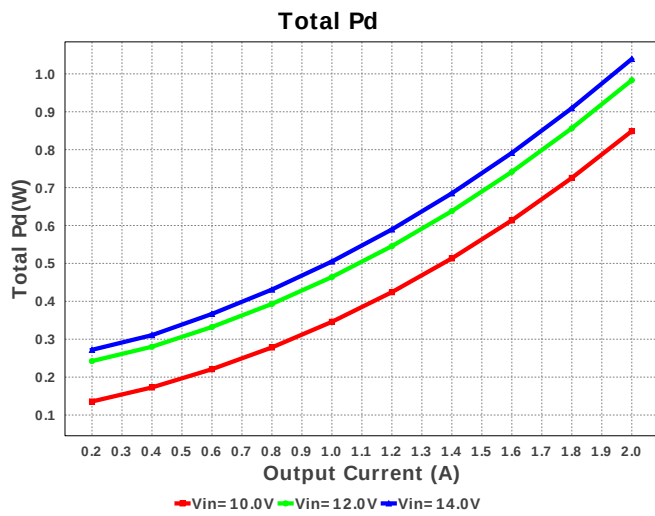
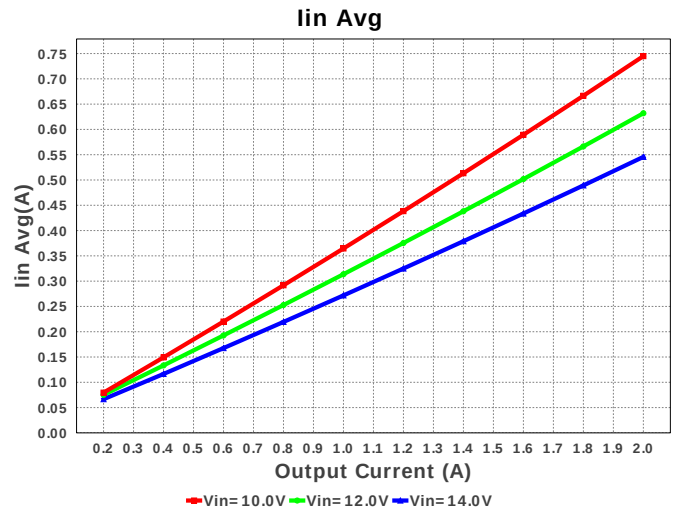
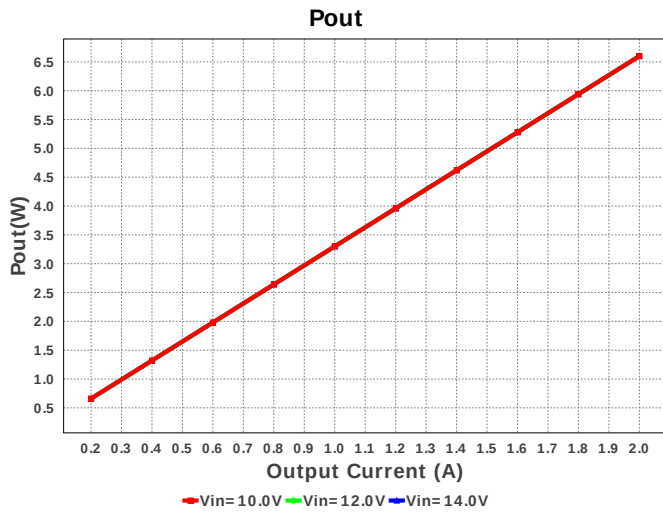
Electrical BOM

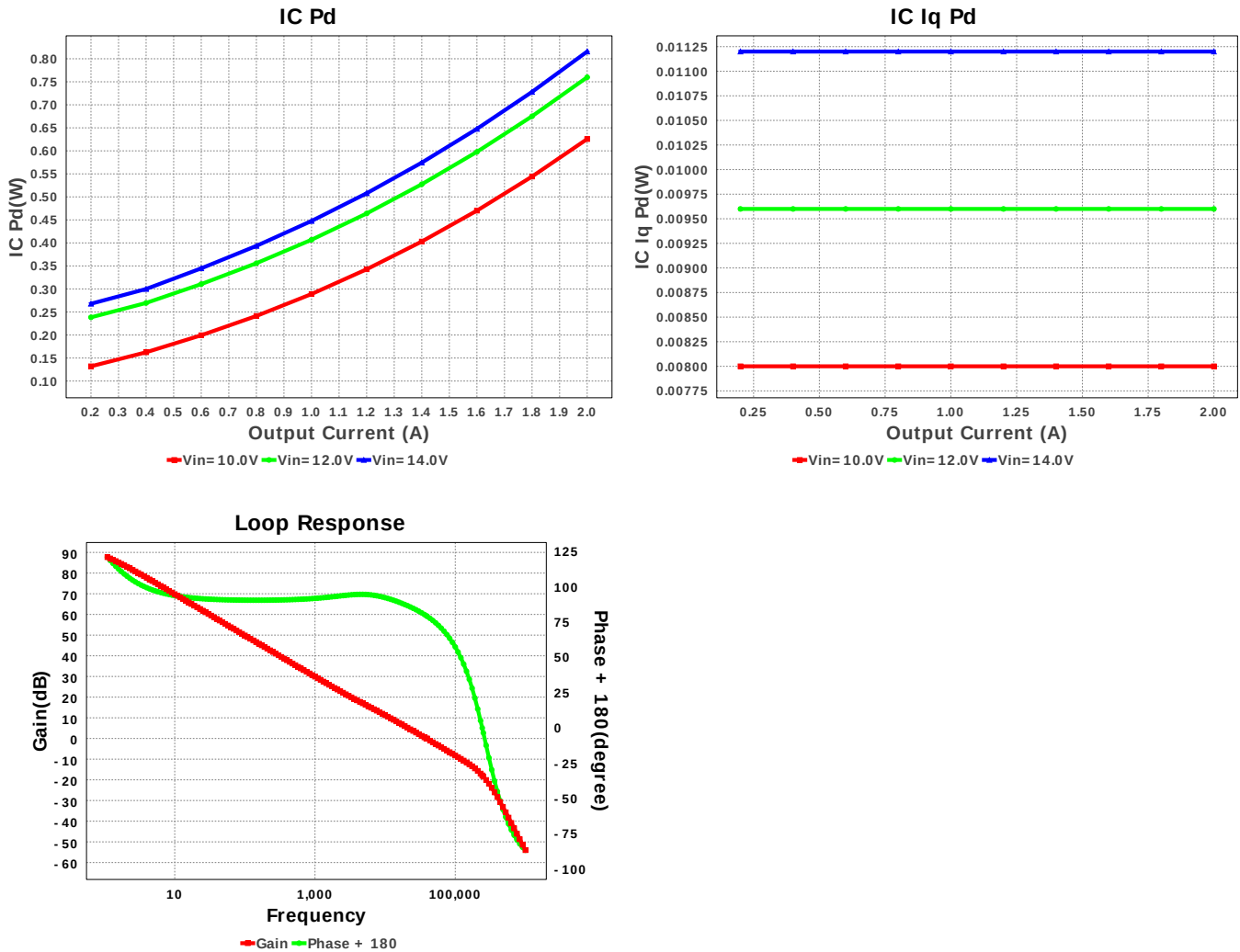
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1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	Ccomp	MuRata	GRM188R71H182KA01D Series= X7R	Cap= 1.8 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
3.	Ccomp2	Kemet	C0603C100K3GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
4.	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 mm ²
5.	Cout	Yageo America	CC0603MRX5R5BB106 Series= X5R	Cap= 10.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 0.0 A	2	\$0.02	0603 5 mm ²
6.	Css	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
7.	Cvdd	MuRata	GRM21BR71E335KA73L Series= X7R	Cap= 3.3 uF VDC= 25.0 V IRMS= 0.0 A	0	\$0.04	0805 7 mm ²
8.	Cvdda	MuRata	GRM21BR61C475KA88L Series= X5R	Cap= 4.7 uF ESR= 5.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.03	0805 7 mm ²
9.	Cvddg	MuRata	GRM21BR61C106KE15L Series= X5R	Cap= 10.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.04	0805 7 mm ²
10.	L1	Bourns	SRN6045-8R2Y	L= 8.2 uH DCR= 55.0 mOhm	1	\$0.16	SRN6045 64 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rcomp	Vishay-Dale	CRCW040216K9FKED Series= CRCW..e3	Res= 16.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
12.	Rfbb	Yageo America	RC0603FR-0724KL Series= ?	Res= 24.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
13.	Rfbt	Vishay-Dale	CRCW040275K0FKED Series= CRCW..e3	Res= 75.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
14.	U1	Texas Instruments	TPS65400RGZR	Switcher	0	\$3.20	 RGZ0048B 81 mm²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	876.379 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	175.643 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	2.304 A	Current	Peak switch current in IC
4.	Iin Avg	545.66 mA	Current	Average input current
5.	L Ipp	608.45 mA	Current	Peak-to-peak inductor ripple current
6.	Frequency	532.485 kHz	General	Switching frequency
7.	Pout	6.6 W	General	Total output power
8.	Low Freq Gain	87.699 dB	Op_Point	Gain at 10Hz
9.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
10.	Cross Freq	38.612 kHz	Op_point	Bode plot crossover frequency
11.	Duty Cycle	25.514 %	Op_point	Duty cycle
12.	Efficiency	86.396 %	Op_point	PMU channel steady state efficiency
13.	Gain Marg	-17.824 dB	Op_point	Bode Plot Gain Margin
14.	ICThetaJA	18.88 degC/W	Op_point	IC junction-to-ambient thermal resistance
15.	IOUT_OP	2.0 A	Op_point	Iout operating point
16.	Phase Marg	79.516 deg	Op_point	Bode Plot Phase Margin
17.	VIN_OP	14.0 V	Op_point	Vin operating point
18.	Vout p-p	9.192 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	1.536 mW	Power	Input capacitor power dissipation
20.	Cout Pd	231.38 μW	Power	Output capacitor power dissipation
21.	IC Iq Pd	11.2 mW	Power	IC Iq Pd
22.	IC Pd	815.692 mW	Power	IC power dissipation
23.	L Pd	221.697 mW	Power	Inductor power dissipation
24.	Total Pd	1.039 W	Power	PMU channel power dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	VinMax	14.0	Maximum input voltage

#	Name	Value	Description
4.	VinMin	10.0	Minimum input voltage
5.	Vout	3.3	Output Voltage
6.	Vout1	3.3	Output Voltage #1
7.	base_pn	TPS65400/3	Base Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS65400/3** Product Folder : <http://www.ti.com/product/TPS65400> : contains the data sheet and other resources.

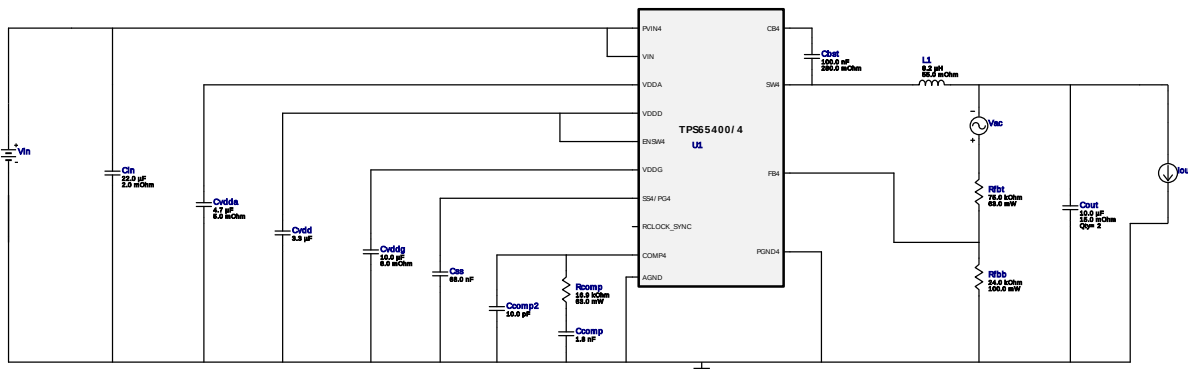


VinMin = 10.0V
VinMax = 14.0V
Vout = 3.3V
Iout = 2.0A

Device = TPS65400RGZR
Topology = Buck
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BOM Count = NaN
Total Pd = 1.04W

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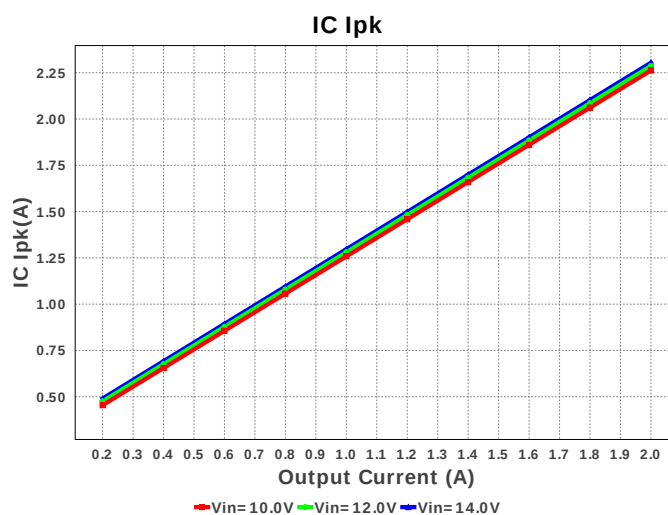
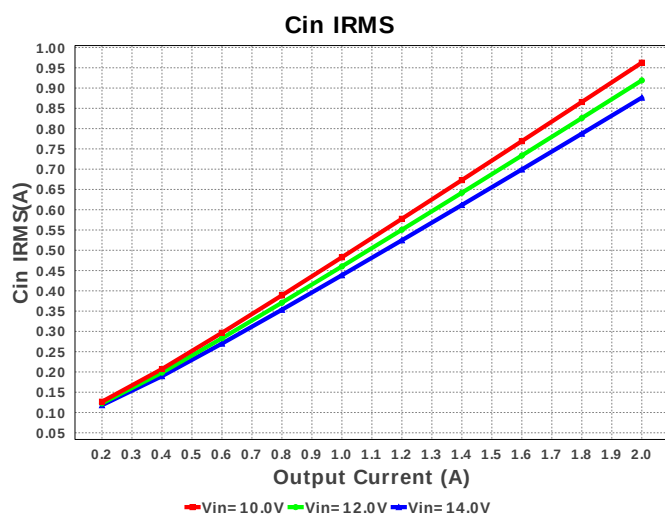
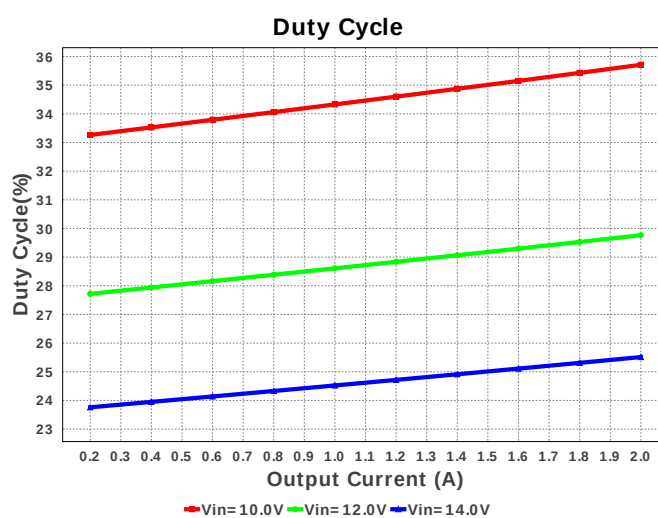
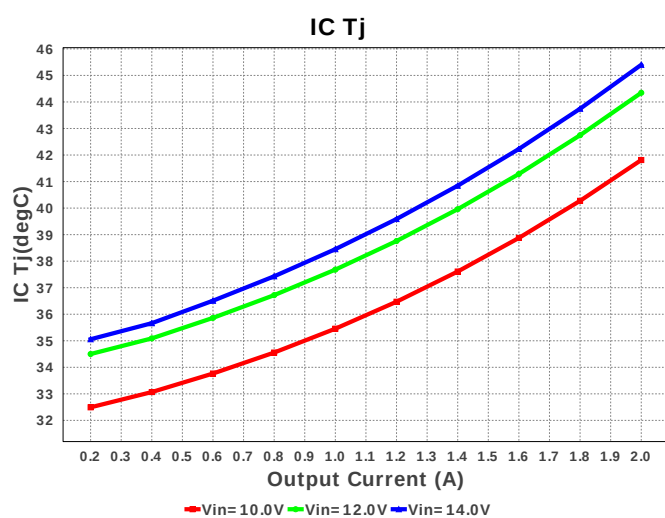
Design : 1222857/5762 TPS65400RGZR
TPS65400RGZR 10.0V-14.0V to 3.30V @ 2.0A

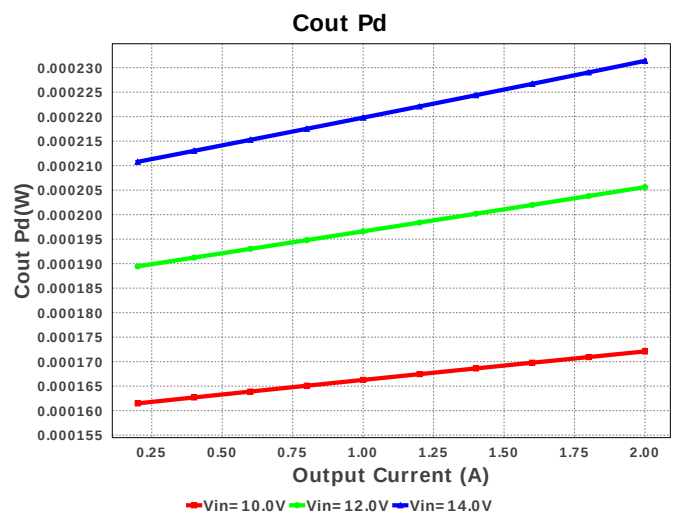
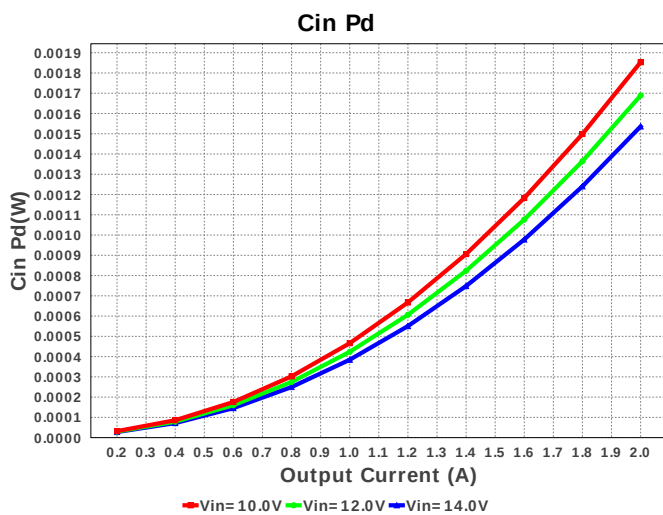
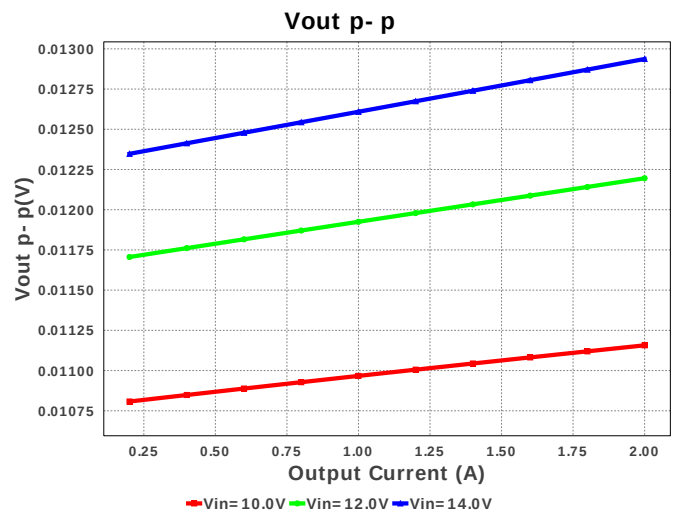
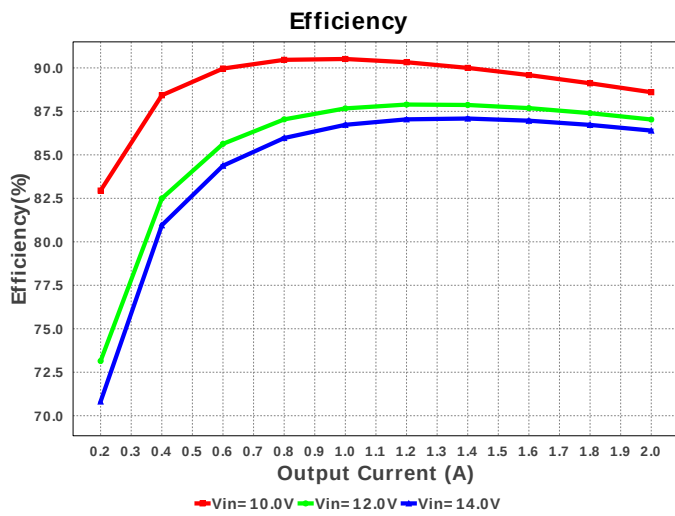
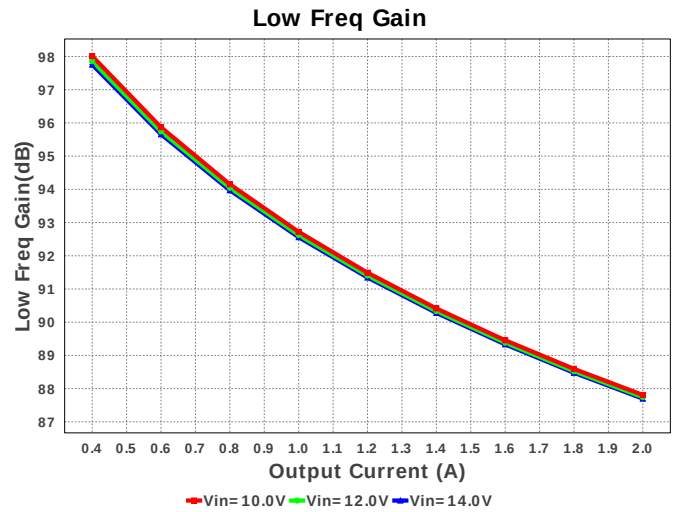
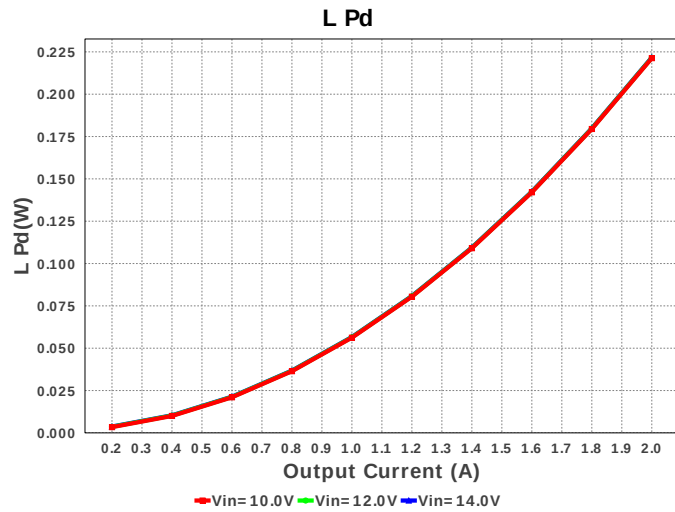


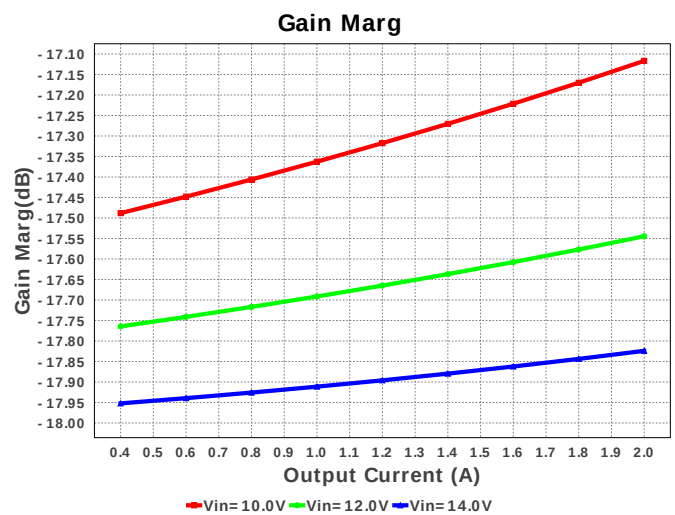
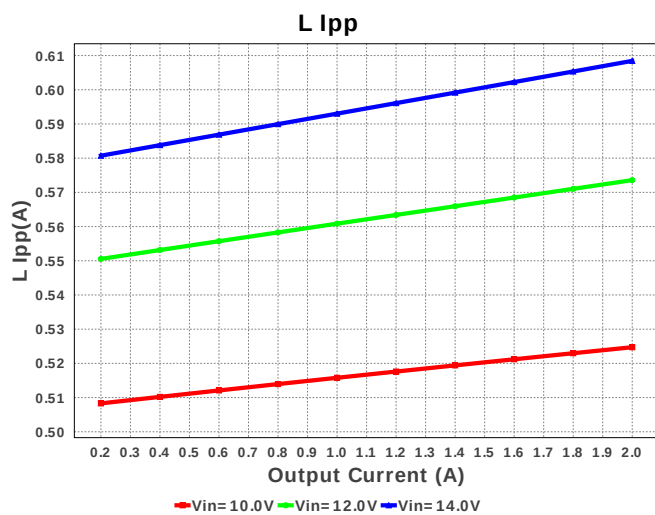
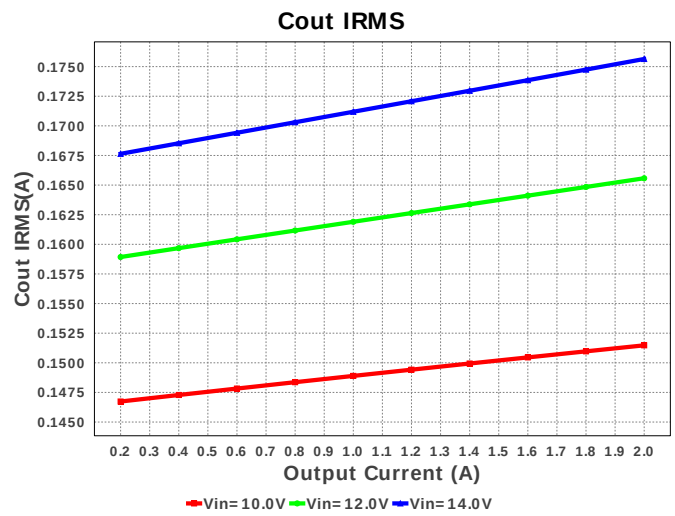
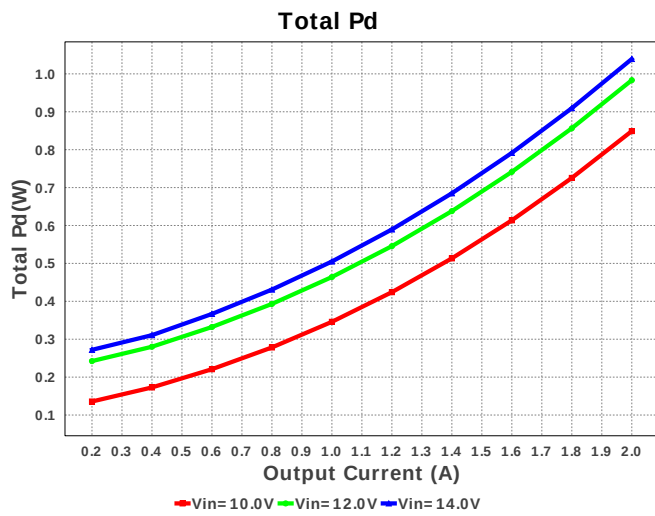
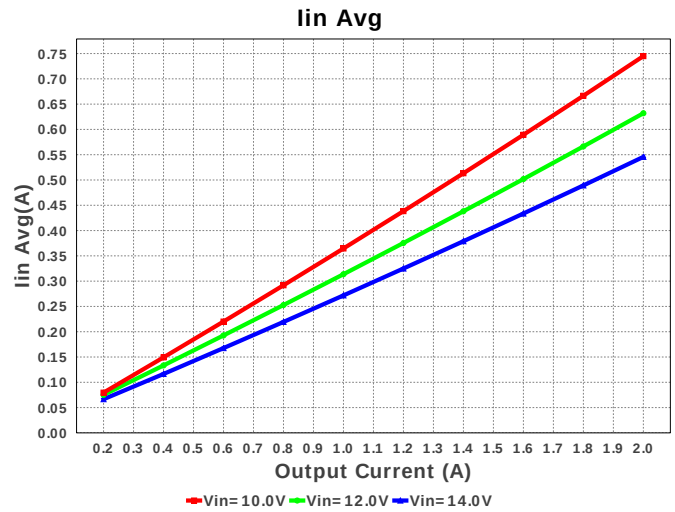
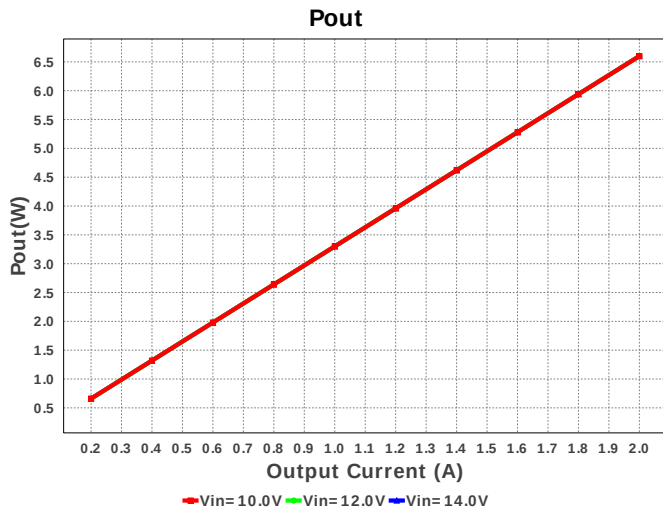
Electrical BOM

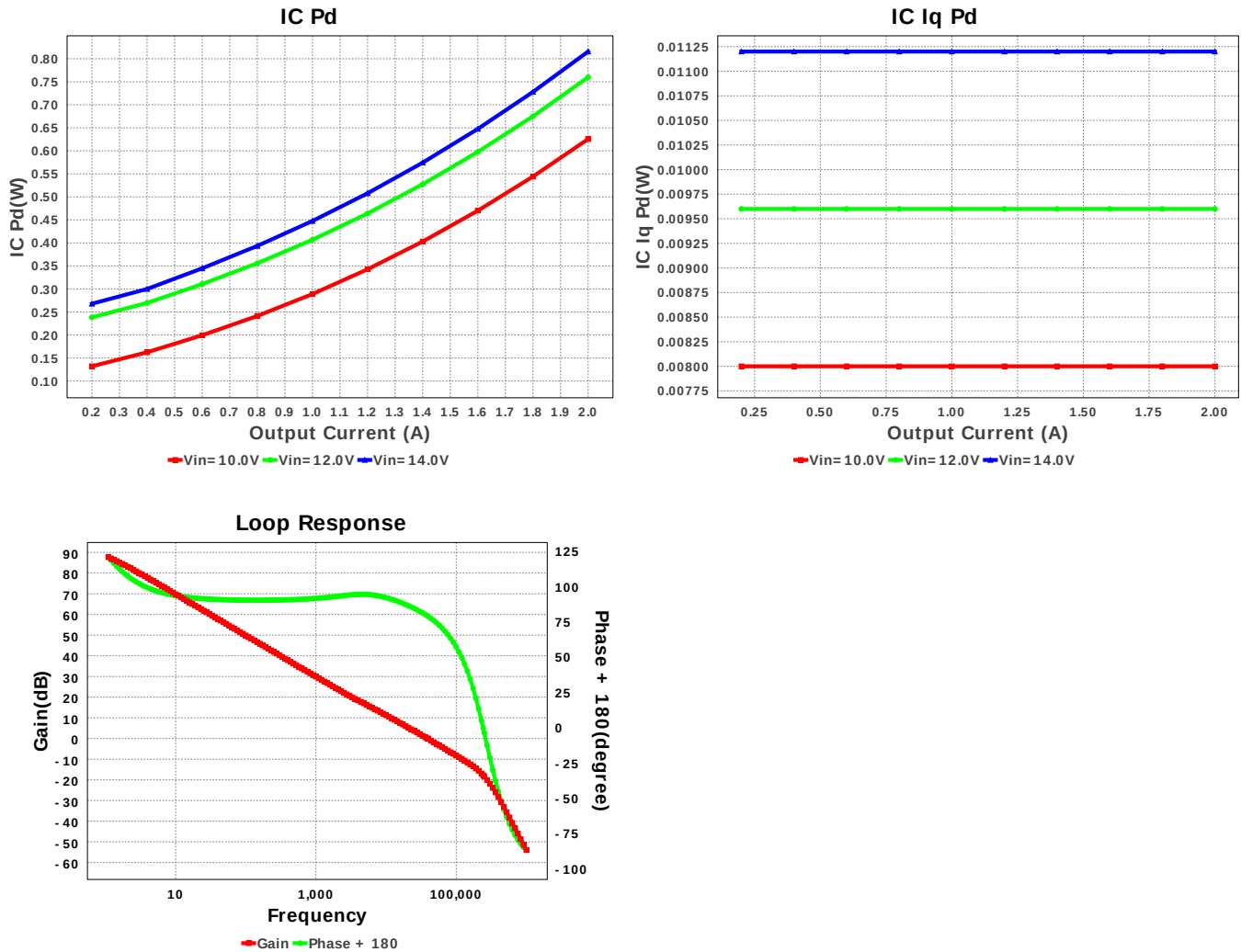
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
2.	Ccomp	MuRata	GRM188R71H182KA01D Series= X7R	Cap= 1.8 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
3.	Ccomp2	Kemet	C0603C100K3GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
4.	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 mm ²
5.	Cout	Yageo America	CC0603MRX5R5BB106 Series= X5R	Cap= 10.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 0.0 A	2	\$0.02	0603 5 mm ²
6.	Css	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
7.	Cvdd	MuRata	GRM21BR71E335KA73L Series= X7R	Cap= 3.3 uF VDC= 25.0 V IRMS= 0.0 A	0	\$0.04	0805 7 mm ²
8.	Cvdda	MuRata	GRM21BR61C475KA88L Series= X5R	Cap= 4.7 uF ESR= 5.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.03	0805 7 mm ²
9.	Cvddg	MuRata	GRM21BR61C106KE15L Series= X5R	Cap= 10.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 0.0 A	0	\$0.04	0805 7 mm ²
10.	L1	Bourns	SRN6045-8R2Y	L= 8.2 uH DCR= 55.0 mOhm	1	\$0.16	SRN6045 64 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rcomp	Vishay-Dale	CRCW040216K9FKED Series= CRCW..e3	Res= 16.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
12.	Rfbb	Yageo America	RC0603FR-0724KL Series= ?	Res= 24.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm²
13.	Rfbt	Vishay-Dale	CRCW040275K0FKED Series= CRCW..e3	Res= 75.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm²
14.	U1	Texas Instruments	TPS65400RGZR	Switcher	0	\$3.20	 RGZ0048B 81 mm²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	876.379 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	175.643 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	2.304 A	Current	Peak switch current in IC
4.	Iin Avg	545.66 mA	Current	Average input current
5.	L Ipp	608.45 mA	Current	Peak-to-peak inductor ripple current
6.	Frequency	532.485 kHz	General	Switching frequency
7.	Pout	6.6 W	General	Total output power
8.	Low Freq Gain	87.699 dB	Op_Point	Gain at 10Hz
9.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
10.	Cross Freq	38.612 kHz	Op_point	Bode plot crossover frequency
11.	Duty Cycle	25.514 %	Op_point	Duty cycle
12.	Efficiency	86.396 %	Op_point	PMU channel steady state efficiency
13.	Gain Marg	-17.824 dB	Op_point	Bode Plot Gain Margin
14.	ICThetaJA	18.88 degC/W	Op_point	IC junction-to-ambient thermal resistance
15.	IOUT_OP	2.0 A	Op_point	Iout operating point
16.	Phase Marg	79.516 deg	Op_point	Bode Plot Phase Margin
17.	VIN_OP	14.0 V	Op_point	Vin operating point
18.	Vout p-p	9.192 mV	Op_point	Peak-to-peak output ripple voltage
19.	Cin Pd	1.536 mW	Power	Input capacitor power dissipation
20.	Cout Pd	231.38 μ W	Power	Output capacitor power dissipation
21.	IC Iq Pd	11.2 mW	Power	IC Iq Pd
22.	IC Pd	815.692 mW	Power	IC power dissipation
23.	L Pd	221.697 mW	Power	Inductor power dissipation
24.	Total Pd	1.039 W	Power	PMU channel power dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	VinMax	14.0	Maximum input voltage

#	Name	Value	Description
4.	VinMin	10.0	Minimum input voltage
5.	Vout	3.3	Output Voltage
6.	Vout1	3.3	Output Voltage #1
7.	base_pn	TPS65400/4	Base Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0	Ambient temperature

Design Assistance

1. **TPS65400/4** Product Folder : <http://www.ti.com/product/TPS65400> : contains the data sheet and other resources.

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