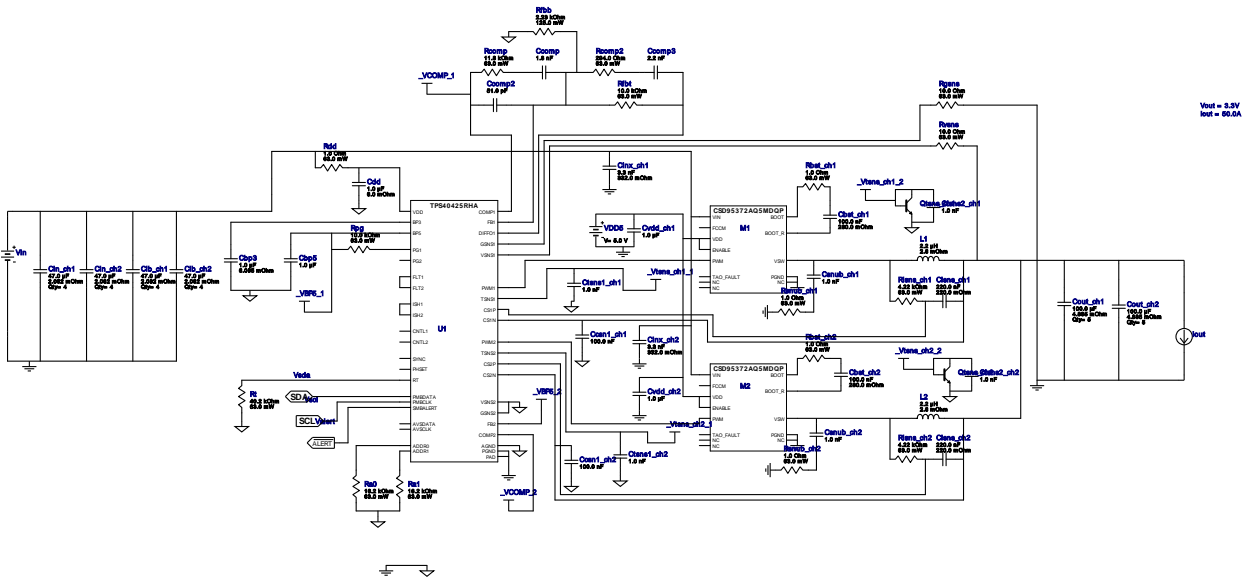


# WEBENCH® Design Report

Design : 1079026/1168 TPS40425RHAR  
 TPS40425RHAR 8.0V-14.0V to 3.30V @ 50.0A



## My Comments


TPS40425

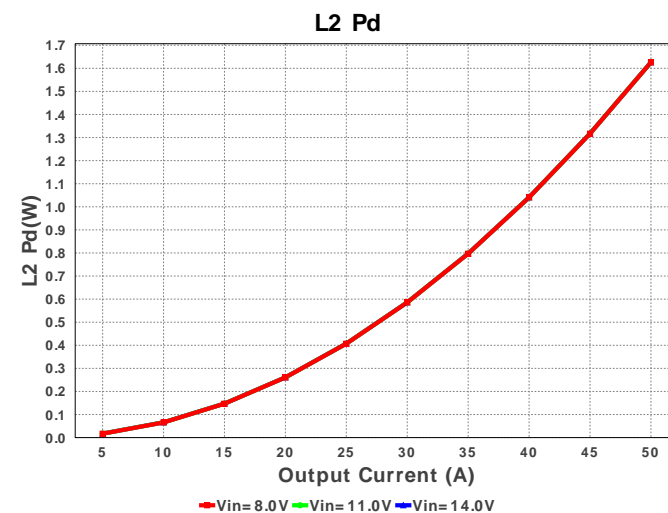
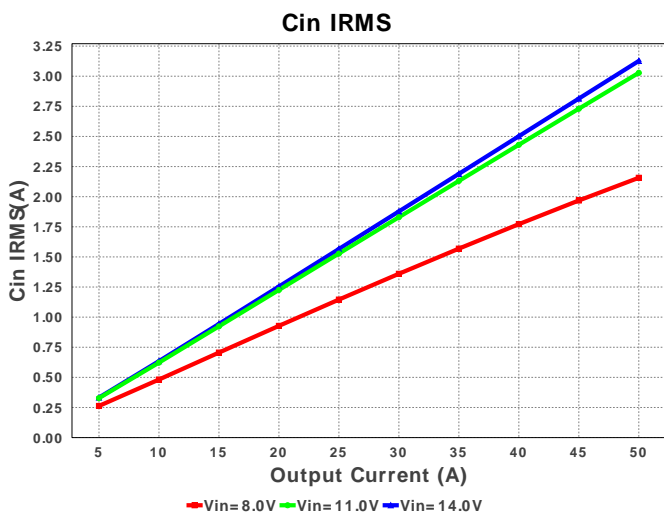
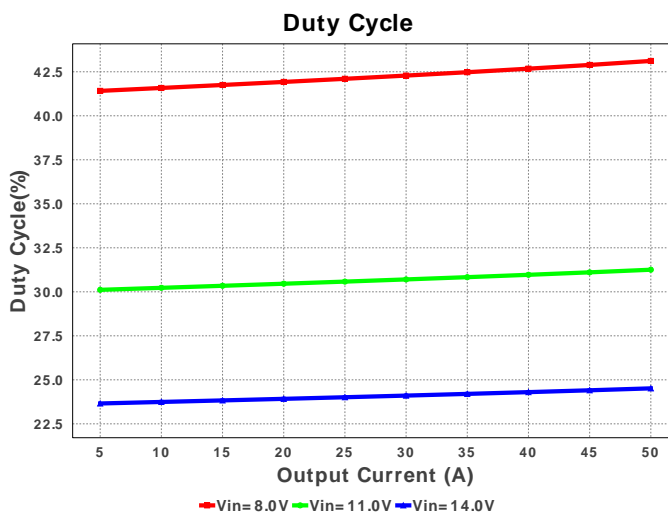
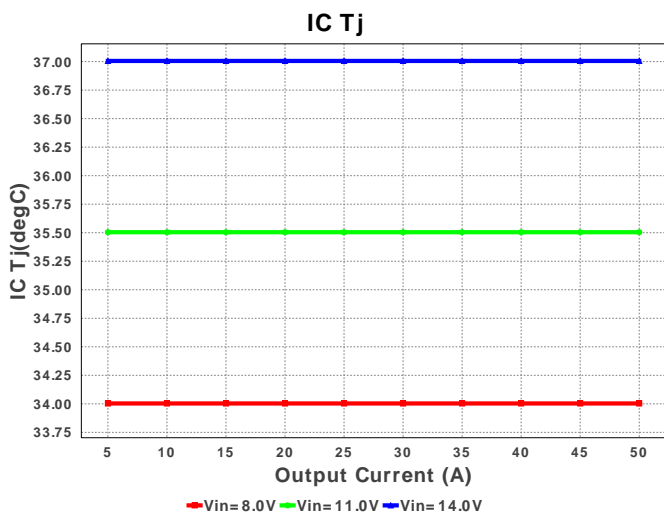
## Electrical BOM

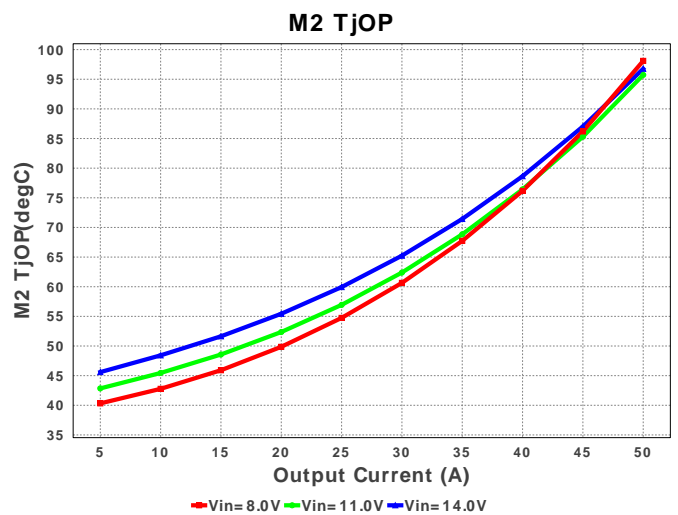
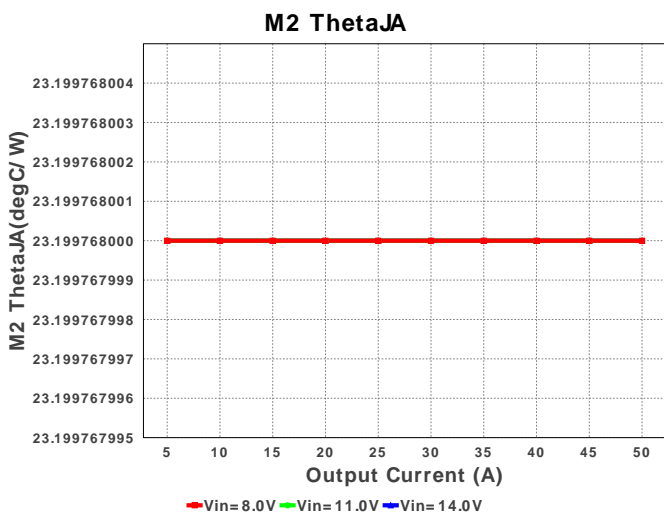
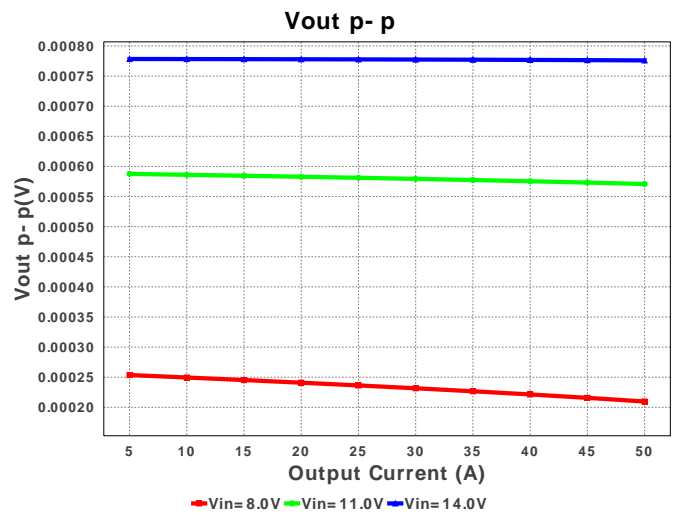
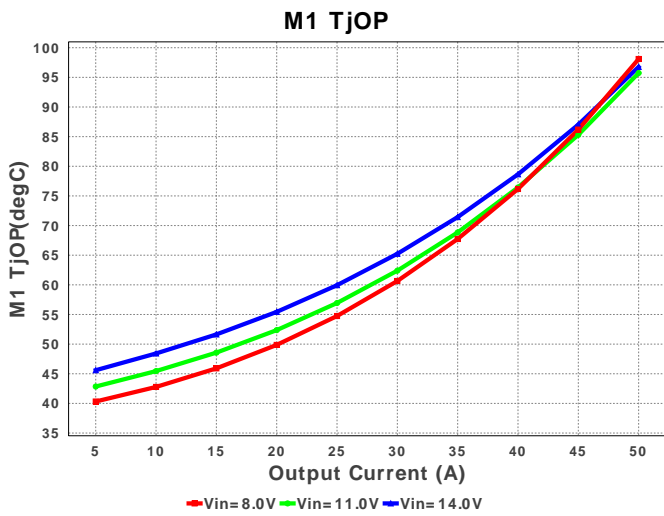
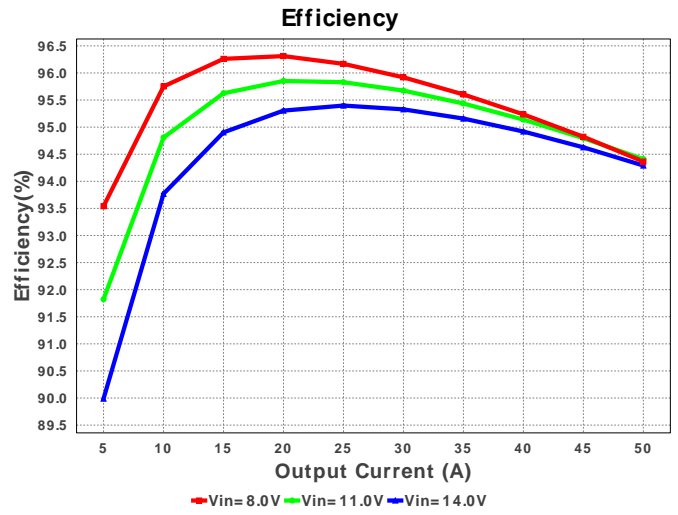
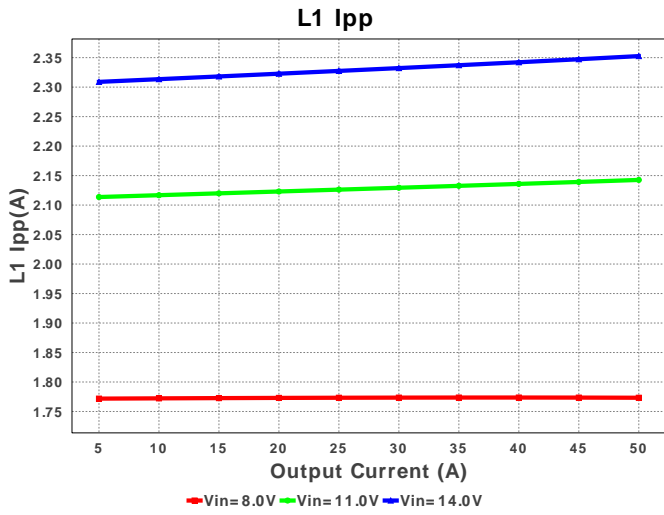
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbp3	MuRata	GRM188R60J105KA01D Series= X5R	Cap= 1.0 uF ESR= 6.065 mOhm VDC= 6.3 V IRMS= 1.36934 A	1	\$0.01	0603 5 mm <sup>2</sup>
2.	Cbp5	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm <sup>2</sup>
3.	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 <sup>2</sup>
4.	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 <sup>2</sup>
5.	Ccomp	MuRata	GRM1885C1H182JA01J Series= C0G/NP0	Cap= 1.8 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm <sup>2</sup>
6.	Ccomp2	MuRata	GRM1885C1H510JA01D Series= C0G/NP0	Cap= 51.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm <sup>2</sup>
7.	Ccomp3	Yageo America	CC0805KRX7R9BB222 Series= X7R	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm <sup>2</sup>
8.	Ccsn1_ch1	MuRata	GRM155R60J104KA01D Series= X5R	Cap= 100.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
9.	Ccsn1_ch2	MuRata	GRM155R60J104KA01D Series= X5R	Cap= 100.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>

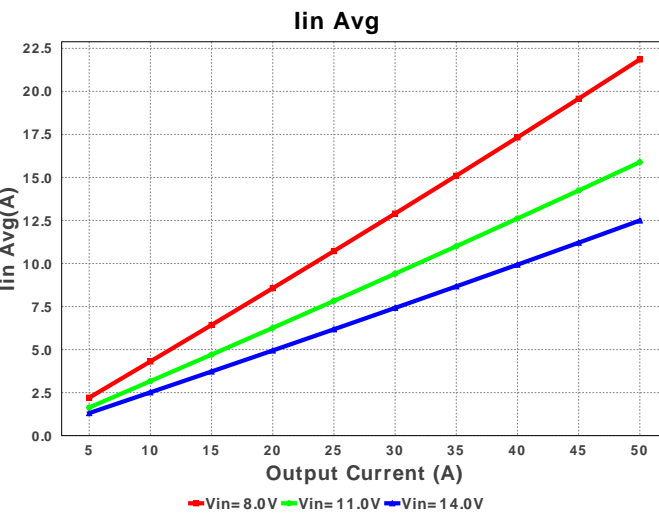
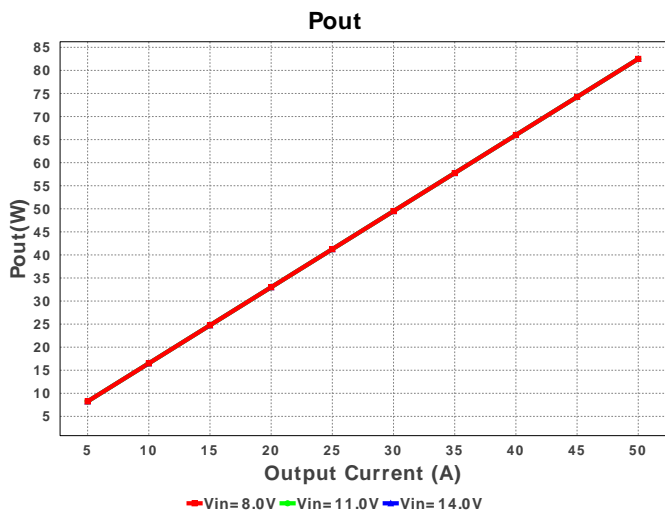
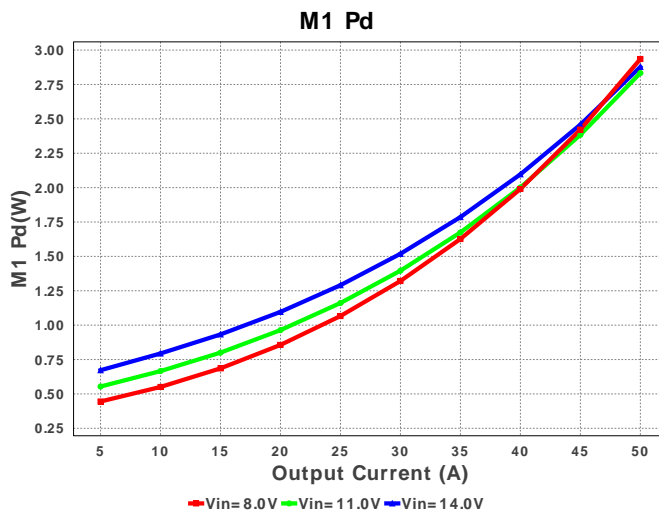
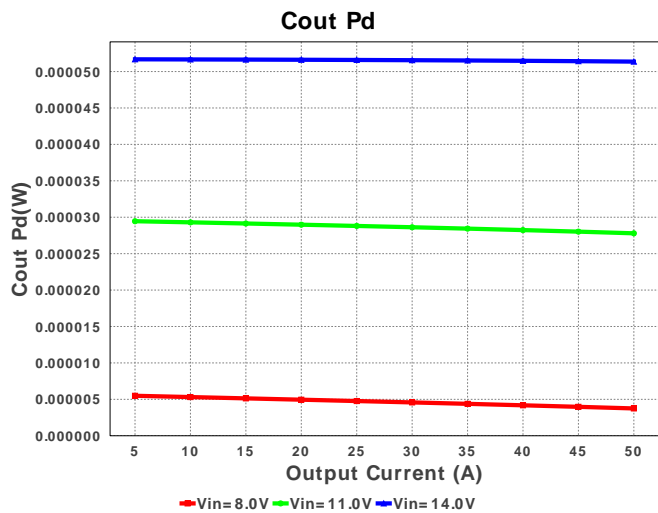
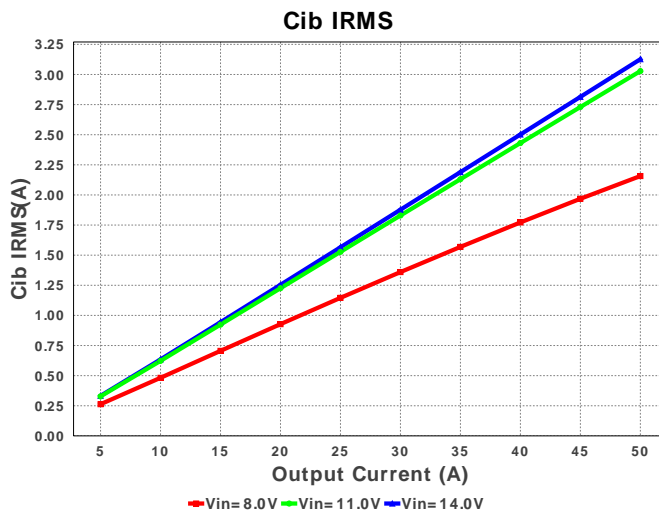
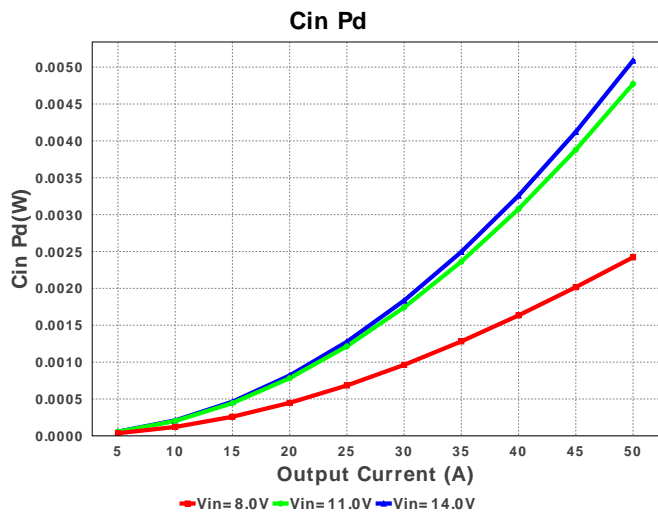
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10.	Cdd	MuRata	GRM219R71E105KA88D Series= X7R	Cap= 1.0 uF ESR= 6.0 mOhm VDC= 25.0 V IRMS= 3.87 A	1	\$0.02	■ 0805 7 mm <sup>2</sup>
11.	Cib_ch1	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	4	\$0.39	■ ■ ■ ■ 1206 11 mm <sup>2</sup>
12.	Cib_ch2	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	4	\$0.39	■ ■ ■ ■ 1206 11 mm <sup>2</sup>
13.	Cin_ch1	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	4	\$0.39	■ ■ ■ ■ 1206 11 mm <sup>2</sup>
14.	Cin_ch2	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	4	\$0.39	■ ■ ■ ■ 1206 11 mm <sup>2</sup>
15.	Cinx_ch1	Kemet	C0805C332K5RACTU Series= X7R	Cap= 3.3 nF ESR= 332.0 mOhm VDC= 50.0 V IRMS= 319.0 mA	1	\$0.01	■ 0805 7 mm <sup>2</sup>
16.	Cinx_ch2	Kemet	C0805C332K5RACTU Series= X7R	Cap= 3.3 nF ESR= 332.0 mOhm VDC= 50.0 V IRMS= 319.0 mA	1	\$0.01	■ 0805 7 mm <sup>2</sup>
17.	Cisns_ch1	MuRata	GRM188R71E224KA88D Series= X7R	Cap= 220.0 nF ESR= 220.0 mOhm VDC= 25.0 V IRMS= 2.24 A	1	\$0.02	■ 0603 5 mm <sup>2</sup>
18.	Cisns_ch2	MuRata	GRM188R71E224KA88D Series= X7R	Cap= 220.0 nF ESR= 220.0 mOhm VDC= 25.0 V IRMS= 2.24 A	1	\$0.02	■ 0603 5 mm <sup>2</sup>
19.	Cout_ch1	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	5	\$0.15	■ ■ ■ ■ ■ 1206_190 11 mm <sup>2</sup>
20.	Cout_ch2	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	5	\$0.15	■ ■ ■ ■ ■ 1206_190 11 mm <sup>2</sup>
21.	Csub_ch1	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	■ 0805 7 mm <sup>2</sup>
22.	Csub_ch2	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	■ 0805 7 mm <sup>2</sup>
23.	Ctsns1_ch1	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	■ 0805 7 mm <sup>2</sup>
24.	Ctsns1_ch2	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	■ 0805 7 mm <sup>2</sup>
25.	Ctsns2_ch1	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	■ 0805 7 mm <sup>2</sup>
26.	Ctsns2_ch2	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	■ 0805 7 mm <sup>2</sup>
27.	Cvdd_ch1	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	■ 0603 5 mm <sup>2</sup>

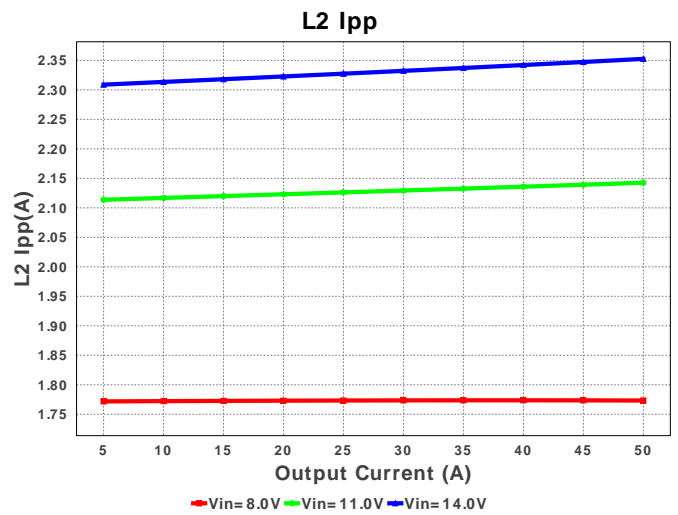
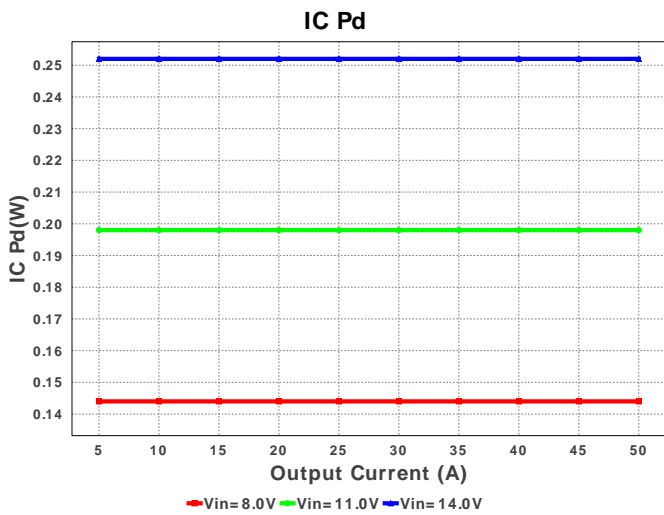
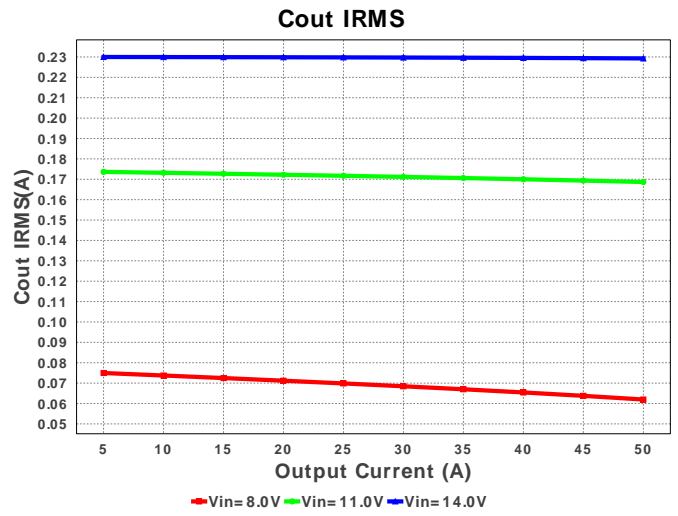
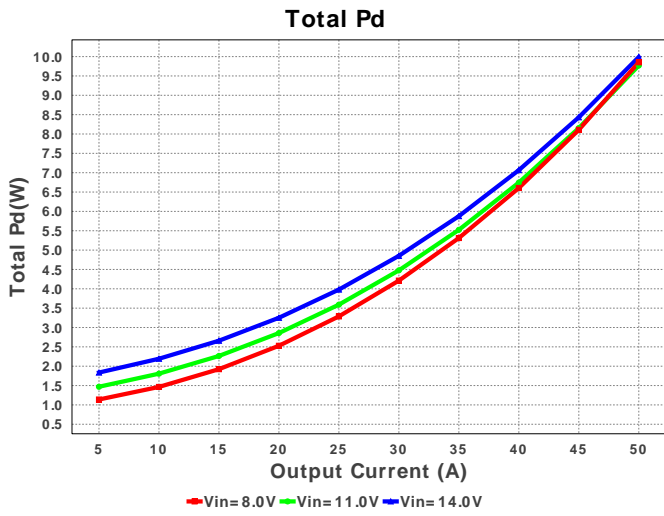
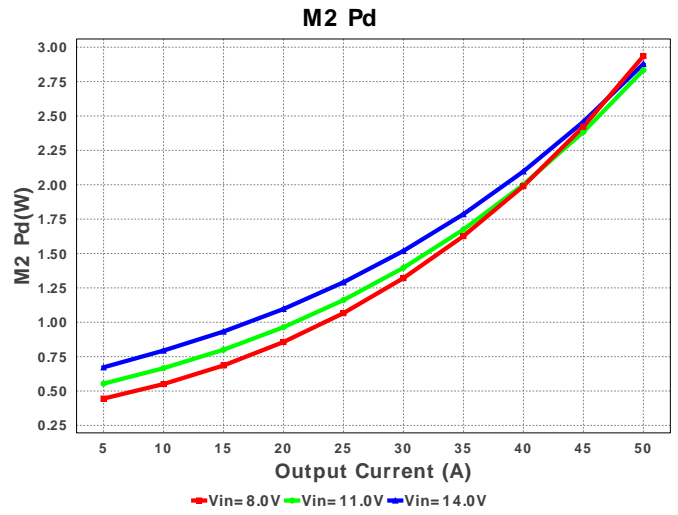
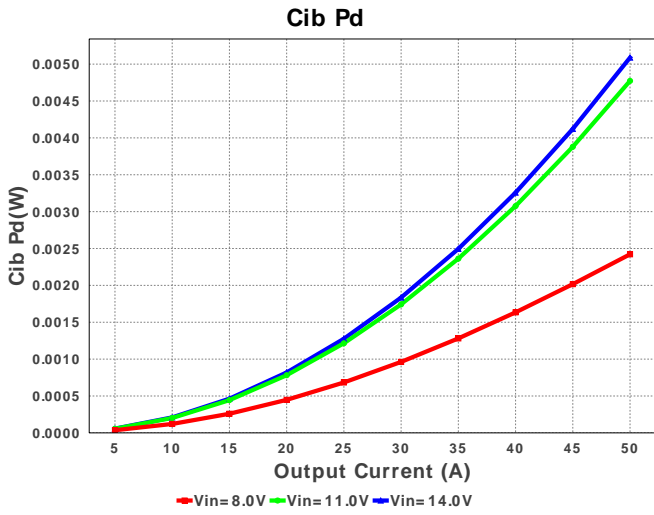
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
28.	Cvdd_ch2	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm <sup>2</sup>
29.	L1	Coilcraft	XAL1010-222MEB	L= 2.2 µH DCR= 2.6 mOhm	1	\$1.71	 XAL1010 160 mm <sup>2</sup>
30.	L2	Coilcraft	XAL1010-222MEB	L= 2.2 µH DCR= 2.6 mOhm	1	\$1.71	 XAL1010 160 mm <sup>2</sup>
31.	M1	Texas Instruments	CSD95372AQ5M	PowerStage	1	\$1.54	 DQP0012A 56 mm <sup>2</sup>
32.	M2	Texas Instruments	CSD95372AQ5M	PowerStage	1	\$1.54	 DQP0012A 56 mm <sup>2</sup>
33.	Qtsns_ch1	Diodes Inc.	MMBT3904T	Bipolar Transistor	1	\$0.06	 SOT-523 7 mm <sup>2</sup>
34.	Qtsns_ch2	Diodes Inc.	MMBT3904T	Bipolar Transistor	1	\$0.06	 SOT-523 7 mm <sup>2</sup>
35.	Ra0	Vishay-Dale	CRCW040216K2FKED Series= CRCW..e3	Res= 16.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
36.	Ra1	Vishay-Dale	CRCW040216K2FKED Series= CRCW..e3	Res= 16.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
37.	Rbst_ch1	Vishay-Dale	CRCW04021R00FKED Series= CRCW..e3	Res= 1.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
38.	Rbst_ch2	Vishay-Dale	CRCW04021R00FKED Series= CRCW..e3	Res= 1.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
39.	Rcomp	Vishay-Dale	CRCW040211K8FKED Series= CRCW..e3	Res= 11.8 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
40.	Rcomp2	Vishay-Dale	CRCW0402294RFKED Series= CRCW..e3	Res= 294.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
41.	Rdd	Vishay-Dale	CRCW04021R00FKED Series= CRCW..e3	Res= 1.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
42.	Rfbb	Yageo America	RT0805BRD072K23L Series= RT0805	Res= 2.23 kOhm Power= 125.0 mW Tolerance= 0.1%	1	\$0.05	 0805 7 mm <sup>2</sup>
43.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
44.	Rgsns	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
45.	Risns_ch1	Vishay-Dale	CRCW04024K22FKED Series= CRCW..e3	Res= 4.22 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
46.	Risns_ch2	Vishay-Dale	CRCW04024K22FKED Series= CRCW..e3	Res= 4.22 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>

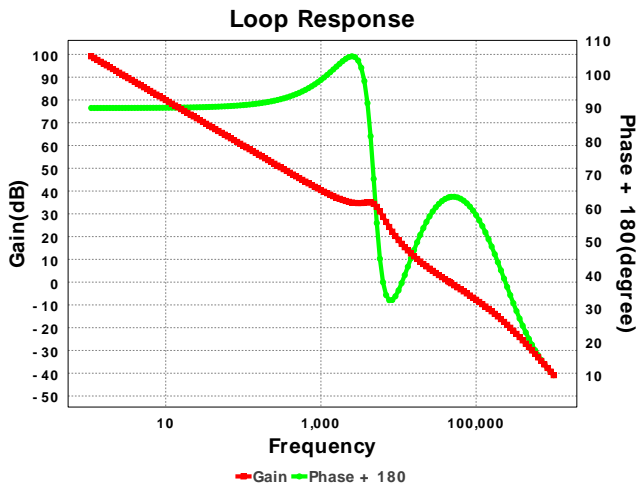
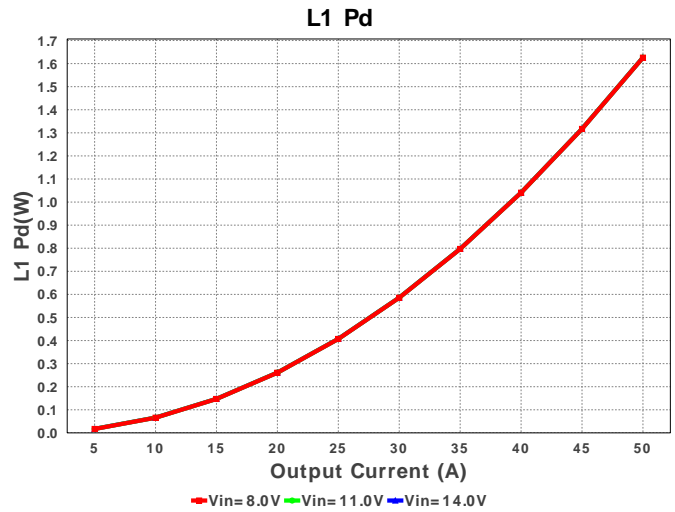
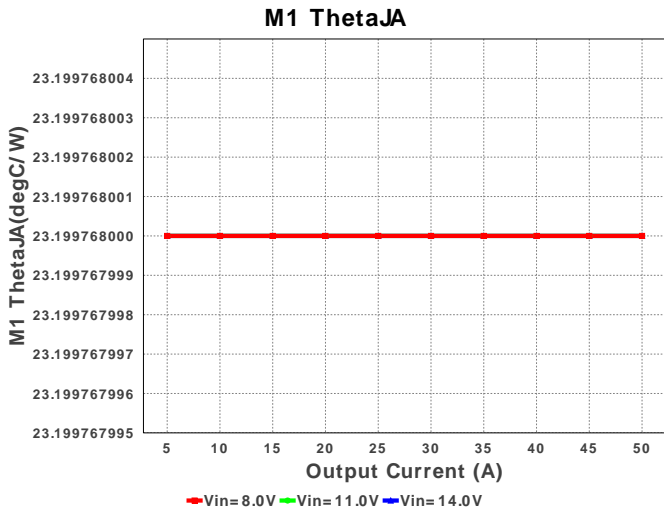
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
47.	Rpg	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
48.	Rsub_ch1	Vishay-Dale	CRCW04021R00FKED Series= CRCW..e3	Res= 1.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
49.	Rsub_ch2	Vishay-Dale	CRCW04021R00FKED Series= CRCW..e3	Res= 1.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
50.	Rt	Vishay-Dale	CRCW040240K2FKED Series= CRCW..e3	Res= 40.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
51.	Rvsn	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
52.	U1	Texas Instruments	TPS40425RHAR	Switcher	1	\$3.25	 RHA0040B 66 mm <sup>2</sup>











### Operating Values

#	Name	Value	Category	Description
1.	Cib IRMS	3.127 A	Current	Input capacitor RMS ripple current
2.	Cin IRMS	3.127 A	Current	Input capacitor RMS ripple current
3.	Cout IRMS	229.288 mA	Current	Output capacitor RMS ripple current
4.	Iin Avg	12.499 A	Current	Average input current
5.	L1 Ipp	2.353 A	Current	Peak-to-peak inductor ripple current
6.	L2Ipp	2.353 A	Current	Channel 2 Inductor Peak to peak Current
7.	BOM Count	72	General	Total Design BOM count
8.	FootPrint	974.0 mm <sup>2</sup>	General	Total Foot Print Area of BOM components
9.	Frequency	497.512 kHz	General	Switching frequency
10.	M1 ThetaJA	23.2 degC/W	General	Effective Power Stage IC Junction-to-Ambient Thermal Resistance
11.	M2 ThetaJA	23.2 degC/W	General	Effective Power Stage IC Junction-to-Ambient Thermal Resistance
12.	Mode	CCM	General	Conduction Mode
13.	Pout	82.5 W	General	Total output power
14.	Total BOM	\$18.07	General	Total BOM Cost
15.	Low Freq Gain	99.163 dB	Op_Point	Gain at 1Hz
16.	Vout Actual	3.291 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
17.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
18.	Cross Freq	103.189 kHz	Op_point	Bode plot crossover frequency
19.	Duty Cycle	24.515 %	Op_point	Duty cycle
20.	Efficiency	94.291 %	Op_point	Steady state efficiency
21.	Gain Marg	-20.21 dB	Op_point	Bode Plot Gain Margin
22.	IC Tj	37.006 degC	Op_point	IC junction temperature
23.	ICThetaJA	27.8 degC/W	Op_point	IC junction-to-ambient thermal resistance
24.	IOUT_OP	50.0 A	Op_point	Iout operating point
25.	M1 TjOP	96.767 degC	Op_point	Power Stage IC junction temperature
26.	M2 TjOP	96.767 degC	Op_point	Power Stage IC junction temperature
27.	Phase Marg	49.034 deg	Op_point	Bode Plot Phase Margin
28.	VIN_OP	14.0 V	Op_point	Vin operating point
29.	Vout p-p	811.603 μV	Op_point	Peak-to-peak output ripple voltage
30.	Cib Pd	5.088 mW	Power	Input capacitor power dissipation
31.	Cin Pd	5.088 mW	Power	Input capacitor power dissipation



#	Name	Value	Category	Description
32.	Cout Pd	51.364 $\mu$ W	Power	Output capacitor power dissipation
33.	IC Pd	252.0 mW	Power	IC power dissipation
34.	L1 Pd	1.626 W	Power	Inductor power dissipation
35.	L2 Pd	1.626 W	Power	Inductor power dissipation
36.	M1 Pd	2.878 W	Power	Power Stage power dissipation
37.	M2 Pd	2.878 W	Power	Power Stage power dissipation
38.	Total Pd	9.99 W	Power	Total Power Dissipation
39.	Vout Tolerance	1.405 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

## Design Inputs

#	Name	Value	Description
1.	Iout	50.0	Maximum Output Current
2.	VinMax	14.0	Maximum input voltage
3.	VinMin	8.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS40425	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

## Design Assistance

1. **TPS40425** Product Folder : <http://www.ti.com/product/TPS40425> : contains the data sheet and other resources.

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