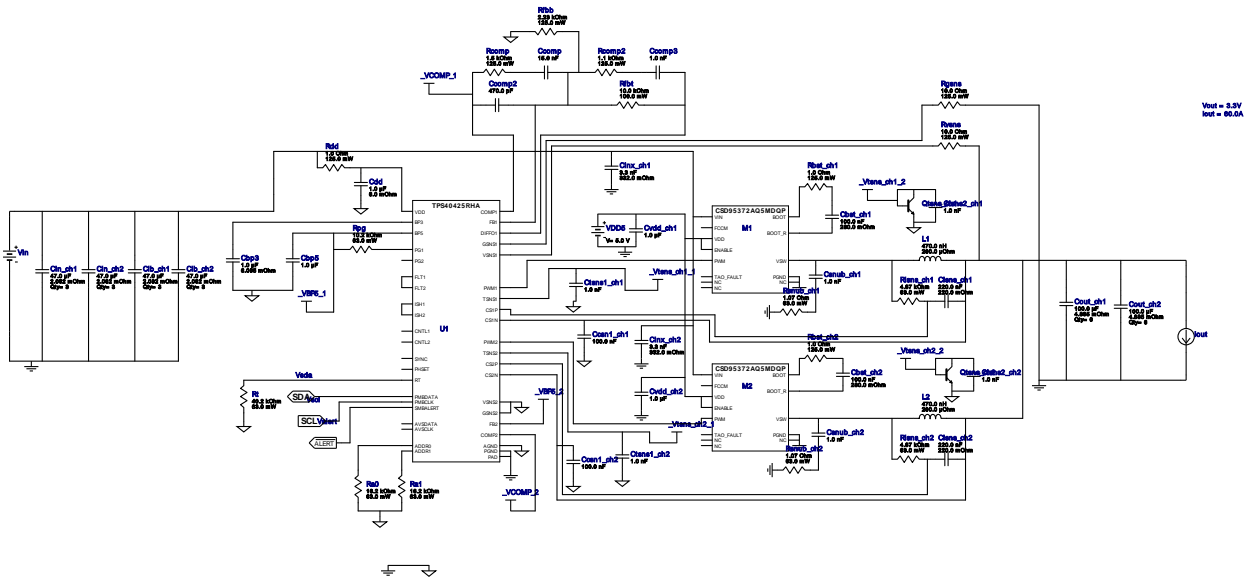


## WEBENCH<sup>®</sup> Design Report

 Design : 1079026/1224 TPS40425RHAR  
 TPS40425RHAR 11.0V-13.0V to 3.30V @ 60.0A


### My Comments


No comments

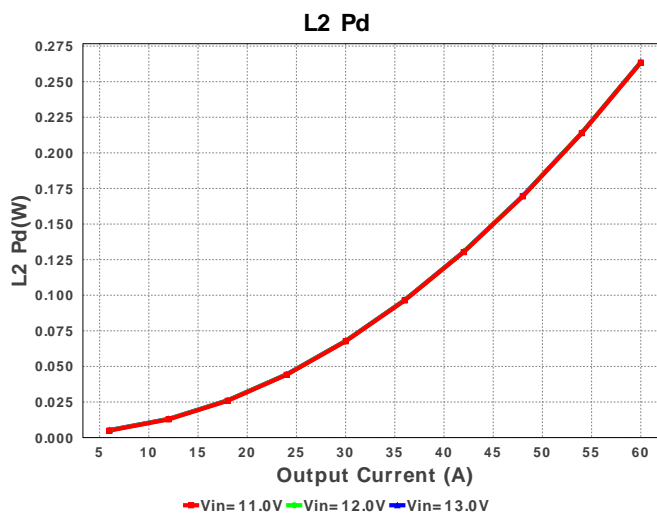
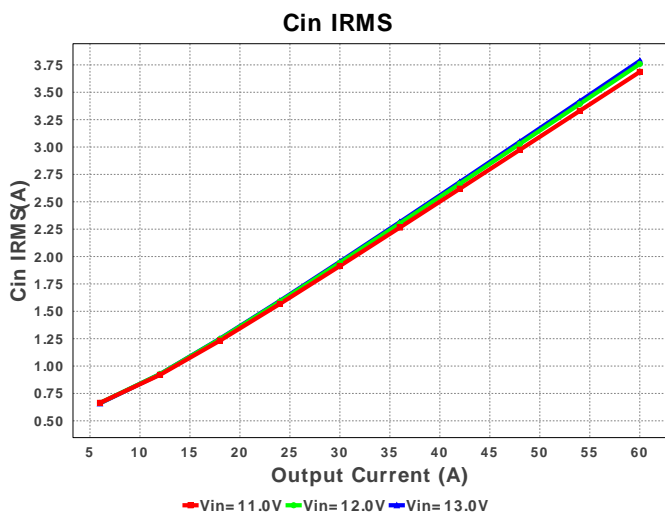
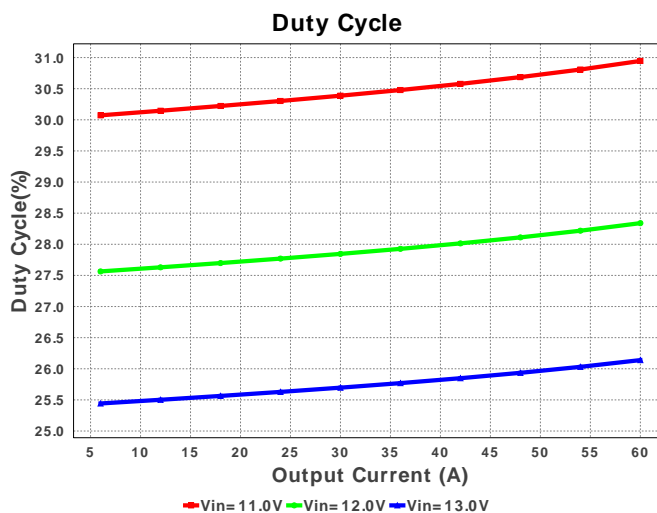
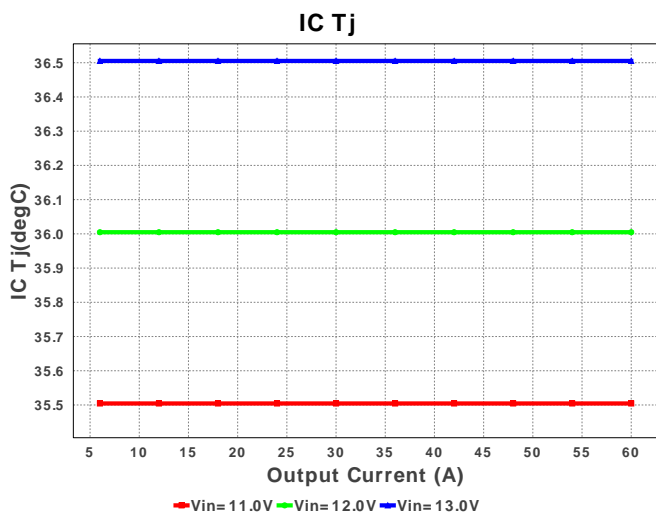
### Electrical BOM

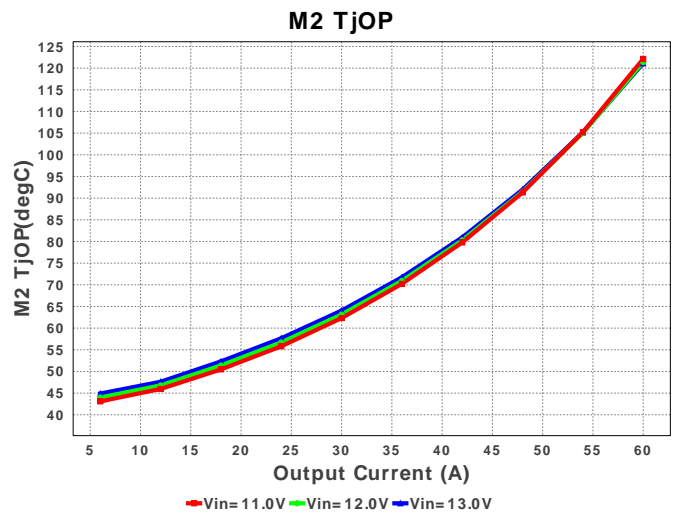
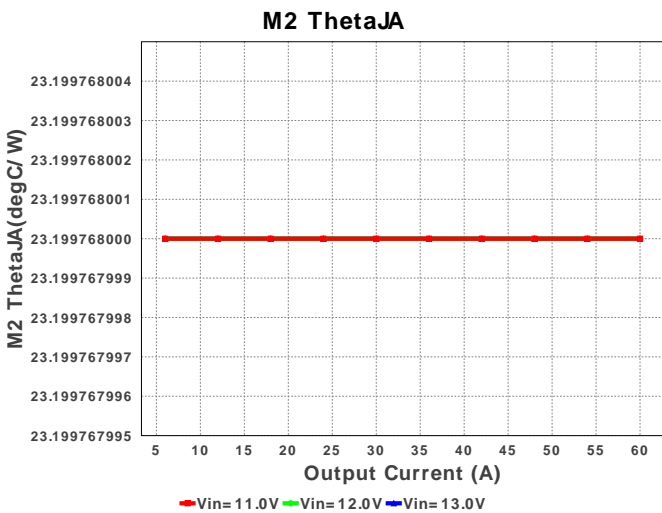
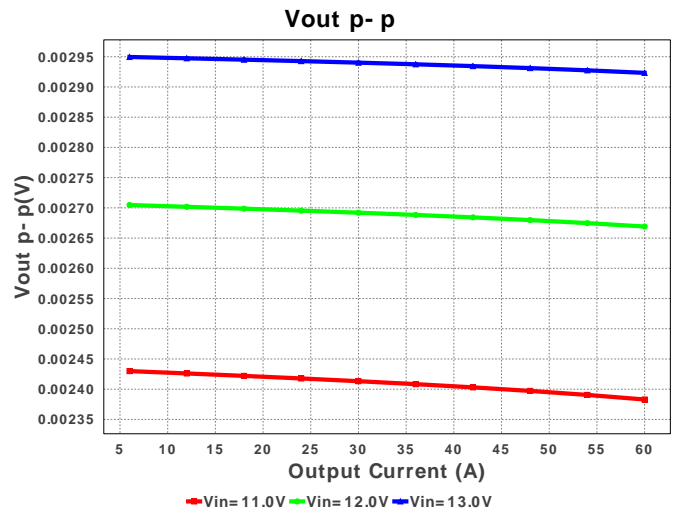
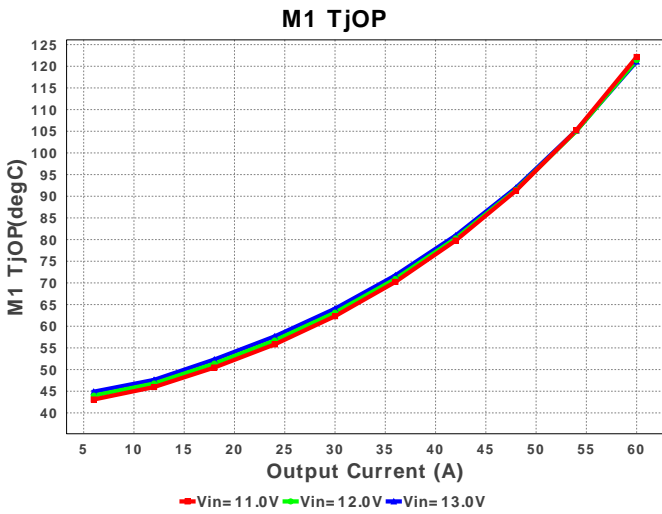
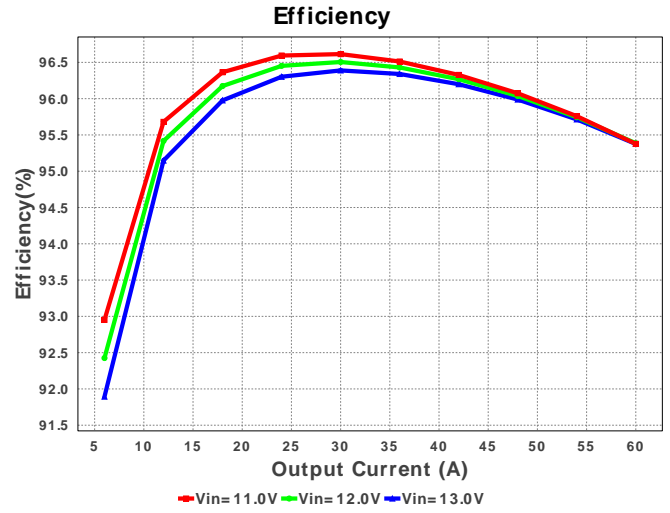
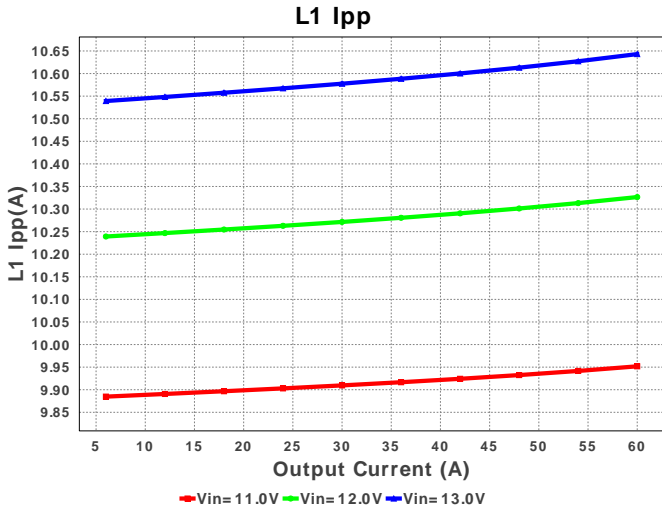
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbp3	MuRata	GRM188R60J105KA01D Series= X5R	Cap= 1.0 uF ESR= 6.065 mOhm VDC= 6.3 V IRMS= 1.36934 A	1	\$0.01	0603 5 mm <sup>2</sup>
2.	Cbp5	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm <sup>2</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	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm <sup>2</sup>
6.	Ccomp2	Yageo America	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm <sup>2</sup>
7.	Ccomp3	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>
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>

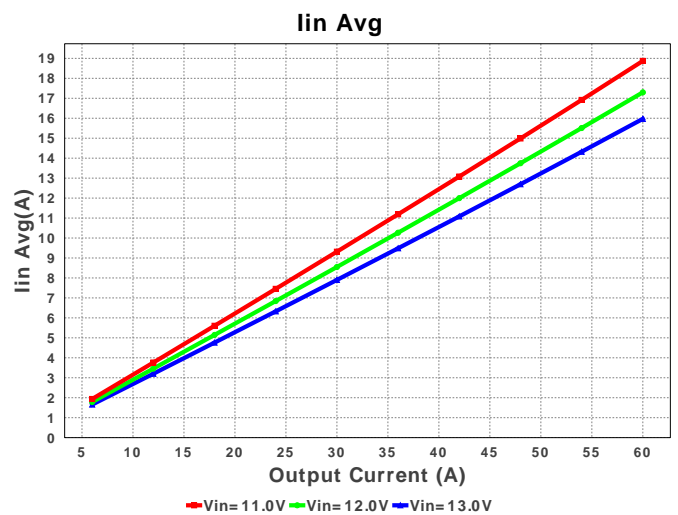
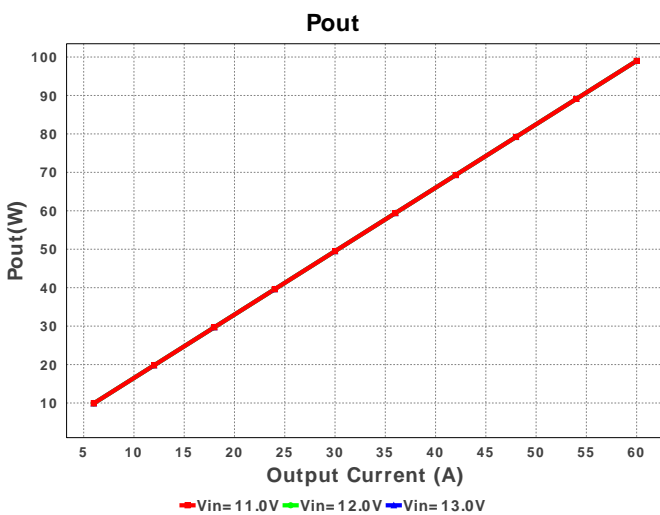
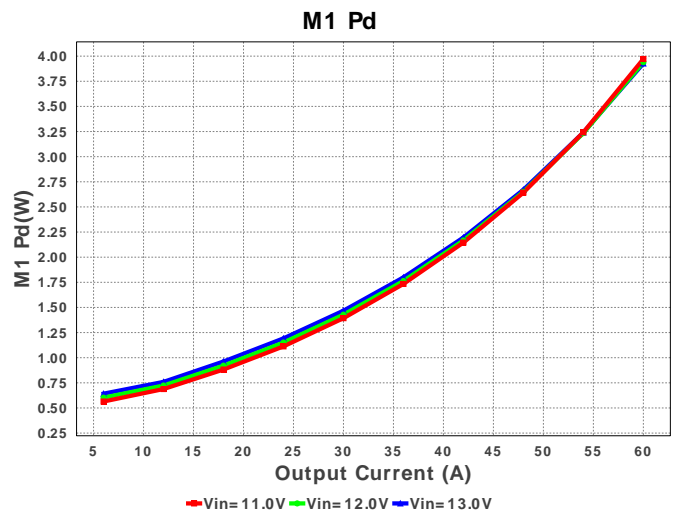
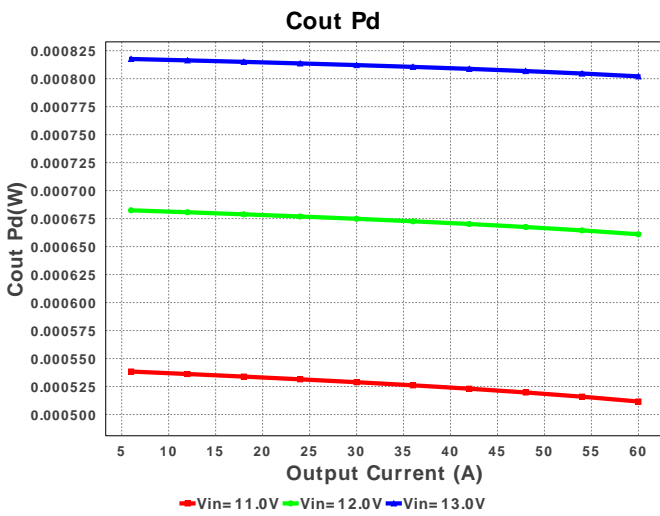
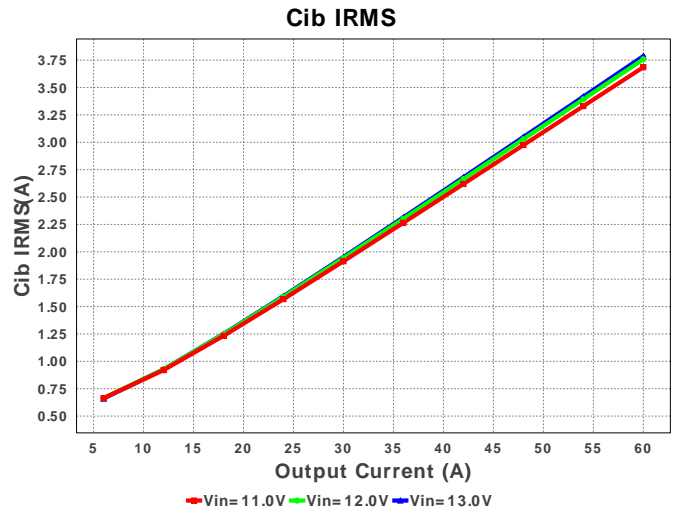
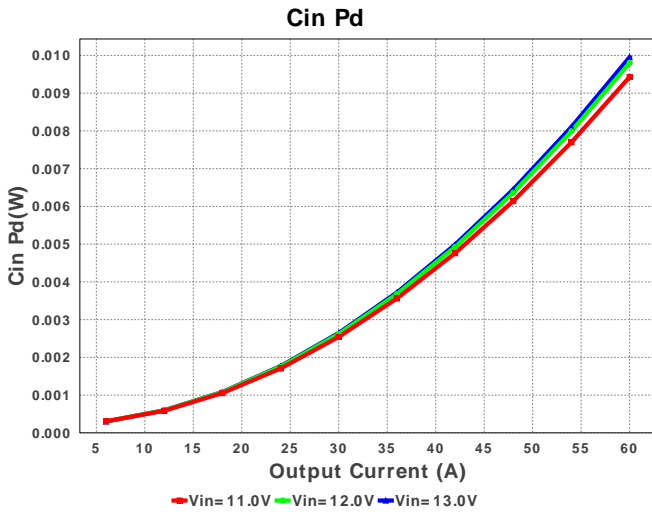
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Cdd	MuRata	GRM219R71E105KA88D Series= X7R	Cap= 1.0 uF ESR= 6.0 mOhm VDC= 25.0 V IRMS= 3.87 A	1	\$0.02	■ 0805 7 mm <sup>2</sup>
11.	Cib_ch1	TDK	C3216X5R1E476M160AC Series= X5R	Cap= 47.0 uF ESR= 2.082 mOhm VDC= 25.0 V IRMS= 5.0279 A	3	\$0.39	■ ■ ■ 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	3	\$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	3	\$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	3	\$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	6	\$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	6	\$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>

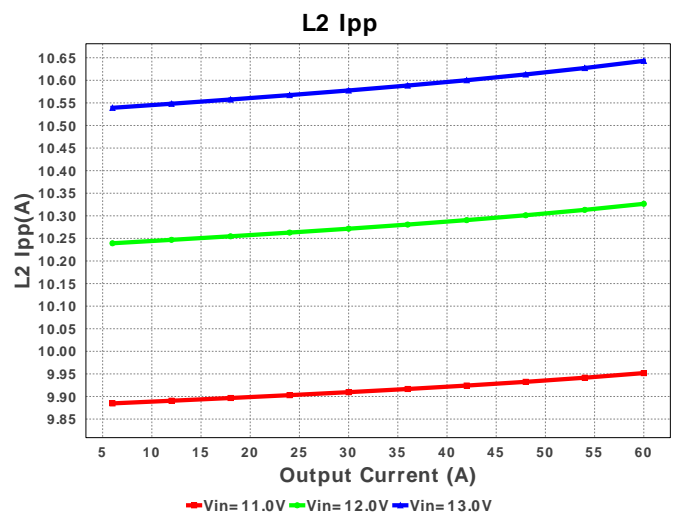
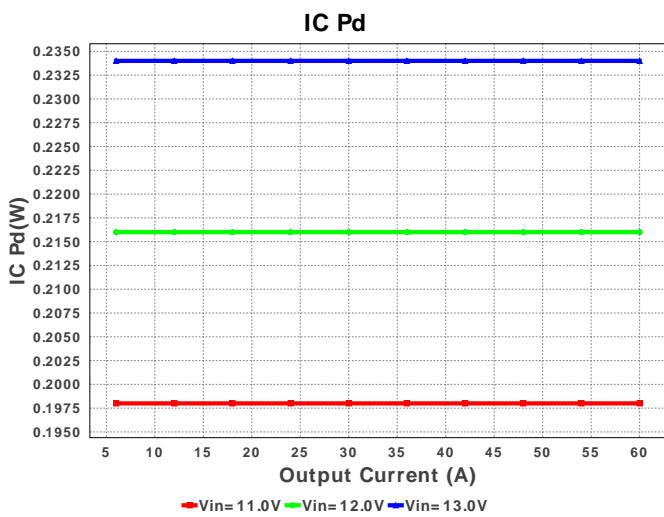
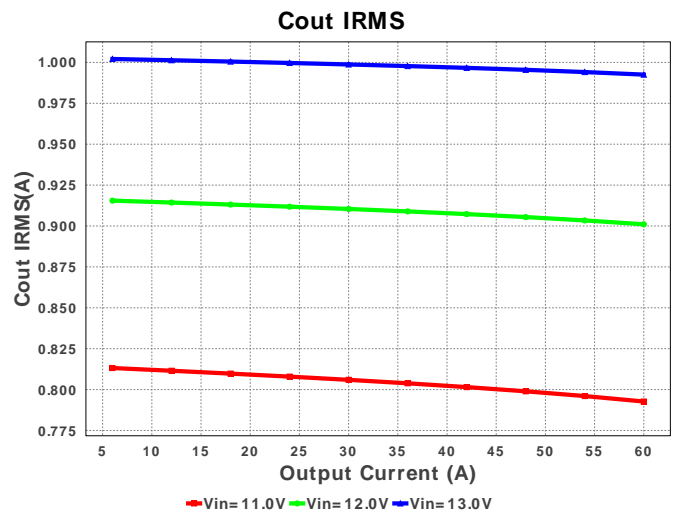
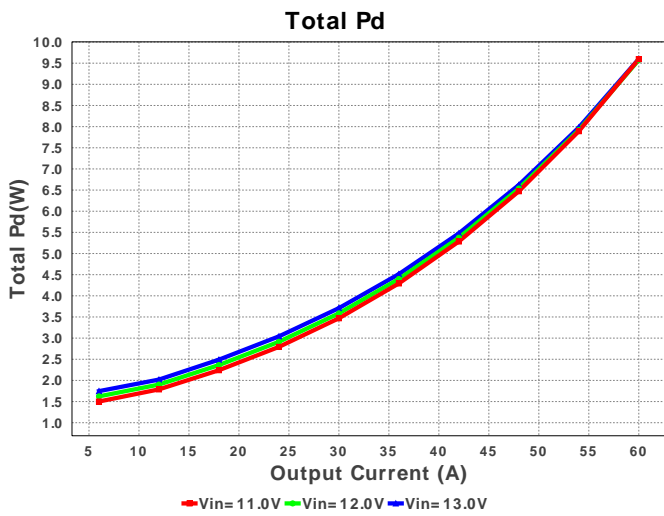
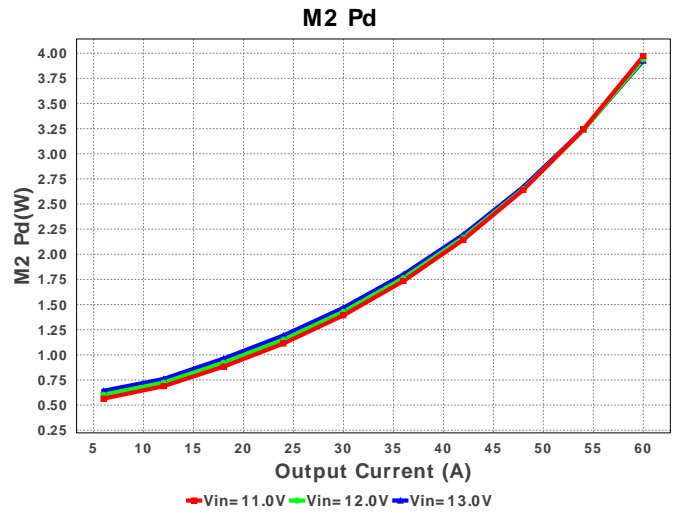
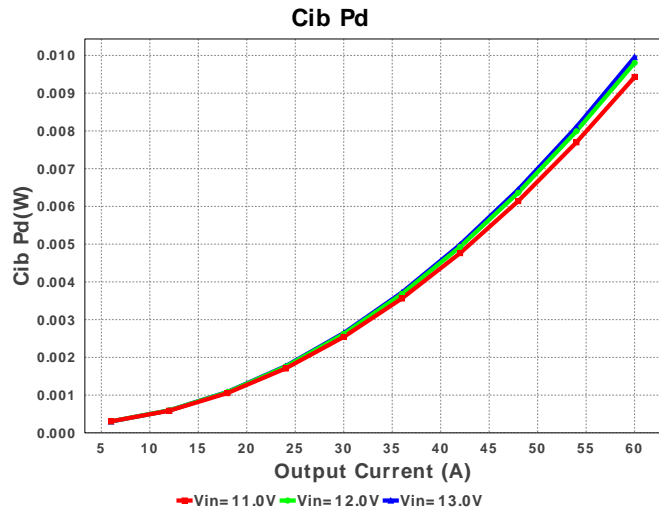
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
28.	Cvdd_ch2	Kemet	C0603C105Z8VACTU Series= Y5V	Cap= 1.0 uF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm <sup>2</sup>
29.	L1	CUSTOM	CUSTOM_INDUCTOR_MD	L= 470.0 nH DCR= 290.0 µOhm	1	\$0.10	 XAL1010 113 mm <sup>2</sup>
30.	L2	CUSTOM	CUSTOM_INDUCTOR_MD	L= 470.0 nH DCR= 290.0 µOhm	1	\$0.10	 XAL1010 113 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	CRCW08051R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
38.	Rbst_ch2	Vishay-Dale	CRCW08051R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
39.	Rcomp	Panasonic	ERJ-6ENF1501V Series= ERJ-6E	Res= 1.5 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
40.	Rcomp2	Panasonic	ERJ-6ENF1101V Series= ERJ-6E	Res= 1.1 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
41.	Rdd	Vishay-Dale	CRCW08051R00FKEA Series= CRCW..e3	Res= 1.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 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	Susumu Co Ltd	RR1220P-103-D Series= RR12	Res= 10.0 kOhm Power= 100.0 mW Tolerance= 0.5%	1	\$0.01	 0805 7 mm <sup>2</sup>
44.	Rgsns	Yageo America	RC0805FR-0710RL Series= ?	Res= 10.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
45.	Risns_ch1	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>
46.	Risns_ch2	Vishay-Dale	CRCW04024K87FKED Series= CRCW..e3	Res= 4.87 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm <sup>2</sup>

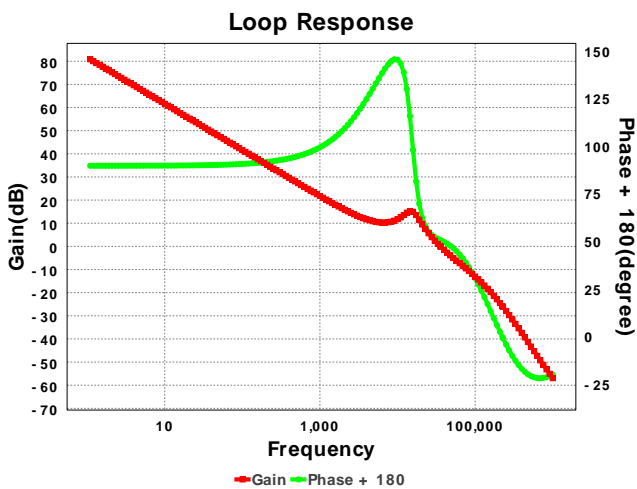
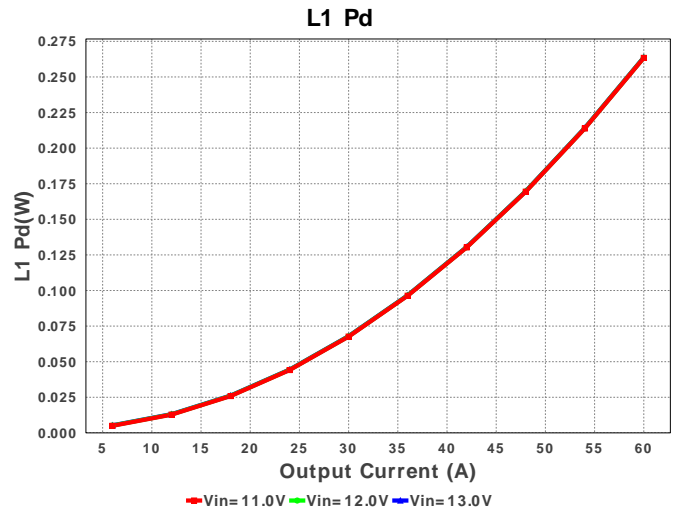
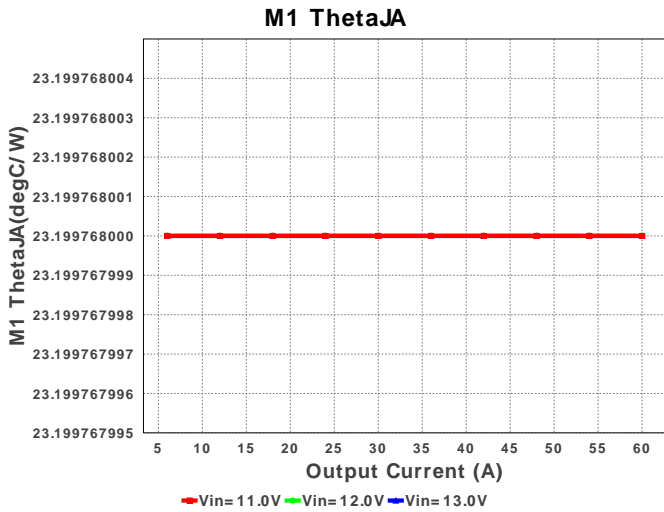
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
47.	Rpg	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
48.	Rsub_ch1	Vishay-Dale	CRCW04021R07FKED Series= CRCW..e3	Res= 1.07 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
49.	Rsub_ch2	Vishay-Dale	CRCW04021R07FKED Series= CRCW..e3	Res= 1.07 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.	Rvsns	Yageo America	RC0805FR-0710RL Series= ?	Res= 10.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	0805 7 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.	BOM Count	70		Total Design BOM count
2.	Total BOM	\$13.593		Total BOM Cost
3.	Cib IRMS	3.787 A	Current	Input capacitor RMS ripple current
4.	Cin IRMS	3.787 A	Current	Input capacitor RMS ripple current
5.	Cout IRMS	992.537 mA	Current	Output capacitor RMS ripple current
6.	Iin Avg	15.969 A	Current	Average input current
7.	L1 Ipp	10.643 A	Current	Peak-to-peak inductor ripple current
8.	L2 Ipp	10.643 A	Current	Channel 2 Inductor Peak to peak Current
9.	FootPrint	875.0 mm <sup>2</sup>	General	Total Foot Print Area of BOM components
10.	Frequency	497.512 kHz	General	Switching frequency
11.	M1 ThetaJA	23.2 degC/W	General	Effective Power Stage IC Junction-to-Ambient Thermal Resistance
12.	M2 ThetaJA	23.2 degC/W	General	Effective Power Stage IC Junction-to-Ambient Thermal Resistance
13.	Mode	CCM	General	Conduction Mode
14.	Pout	99.0 W	General	Total output power
15.	Low Freq Gain	80.834 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	35.68 kHz	Op_point	Bode plot crossover frequency
19.	Duty Cycle	26.139 %	Op_point	Duty cycle
20.	Efficiency	95.376 %	Op_point	Steady state efficiency
21.	Gain Marg	-25.866 dB	Op_point	Bode Plot Gain Margin
22.	IC Tj	36.505 degC	Op_point	IC junction temperature
23.	ICThetaJA	27.8 degC/W	Op_point	IC junction-to-ambient thermal resistance
24.	IOUT_OP	60.0 A	Op_point	Iout operating point
25.	M1 TjOP	121.106 degC	Op_point	Power Stage IC junction temperature
26.	M2 TjOP	121.106 degC	Op_point	Power Stage IC junction temperature
27.	Phase Marg	50.983 deg	Op_point	Bode Plot Phase Margin
28.	VIN_OP	13.0 V	Op_point	Vin operating point
29.	Vout p-p	2.923 mV	Op_point	Peak-to-peak output ripple voltage
30.	Cib Pd	9.953 mW	Power	Input capacitor power dissipation
31.	Cin Pd	9.953 mW	Power	Input capacitor power dissipation



#	Name	Value	Category	Description
32.	Cout Pd	802.06 $\mu$ W	Power	Output capacitor power dissipation
33.	IC Pd	234.0 mW	Power	IC power dissipation
34.	L1 Pd	263.737 mW	Power	Inductor power dissipation
35.	L2 Pd	263.737 mW	Power	Inductor power dissipation
36.	M1 Pd	3.927 W	Power	Power Stage power dissipation
37.	M2 Pd	3.927 W	Power	Power Stage power dissipation
38.	Total Pd	9.599 W	Power	Total Power Dissipation
39.	Vout Tolerance	993.543 m%		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

## Design Inputs

#	Name	Value	Description
1.	Iout	60.0	Maximum Output Current
2.	VinMax	13.0	Maximum input voltage
3.	VinMin	11.0	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
8.	UserFsw	500.0 k	Customer Selected Frequency

## Design Assistance

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

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