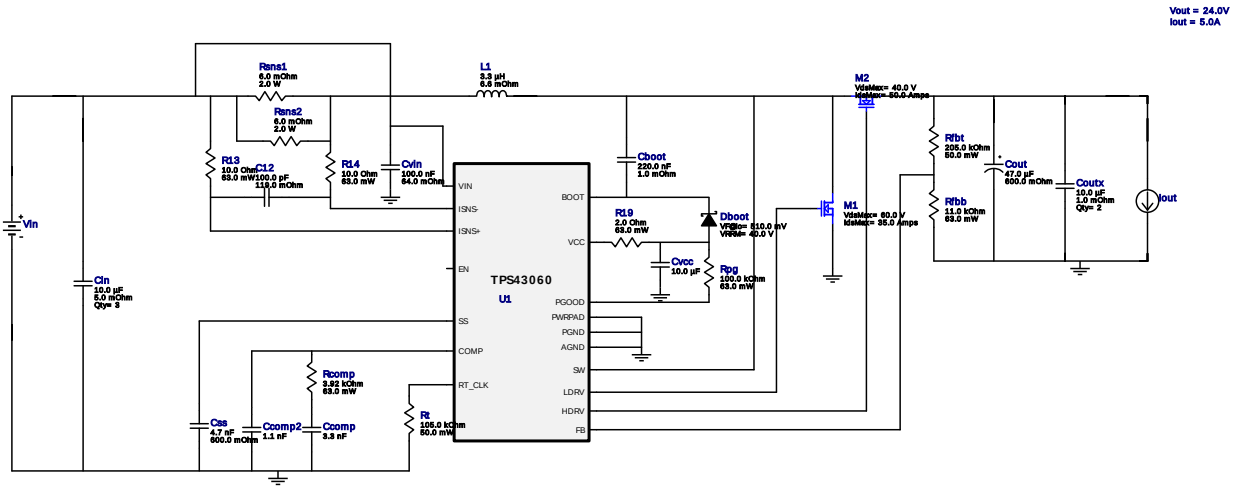
VinMin = 11.0V
VinMax = 13.0V
Vout = 24.0V
Iout = 5.0A

Device = TPS43060RTER
Topology = Boost
Created = 2021-02-25 21:31:36.143
BOM Cost = $3.93
BOM Count = 28
Total Pd = 4.93W

WEBENCH® Design Report

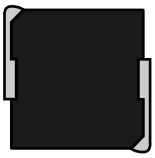
Design : 32 TPS43060RTER
TPS43060RTER 11V-13V to 24.00V @ 5A

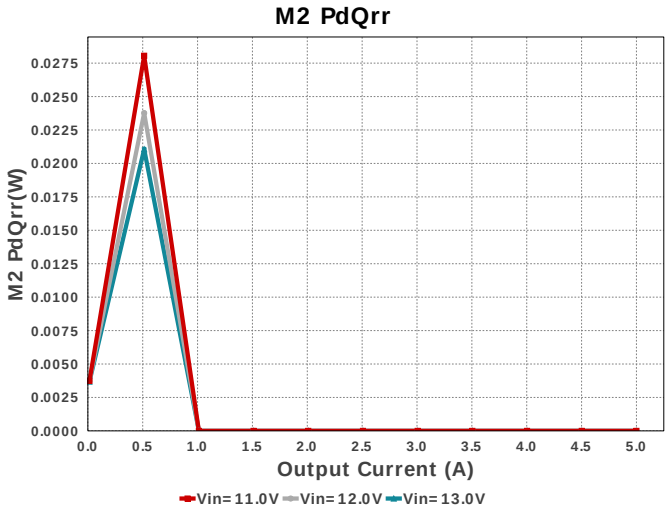


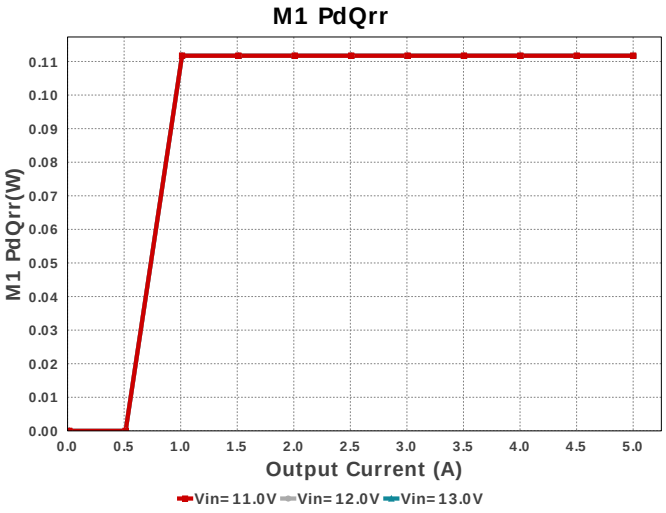
1. The pulse skip mode in the device has not been modeled. Efficiency and operational parameters of the model in pulse skip mode is not valid.

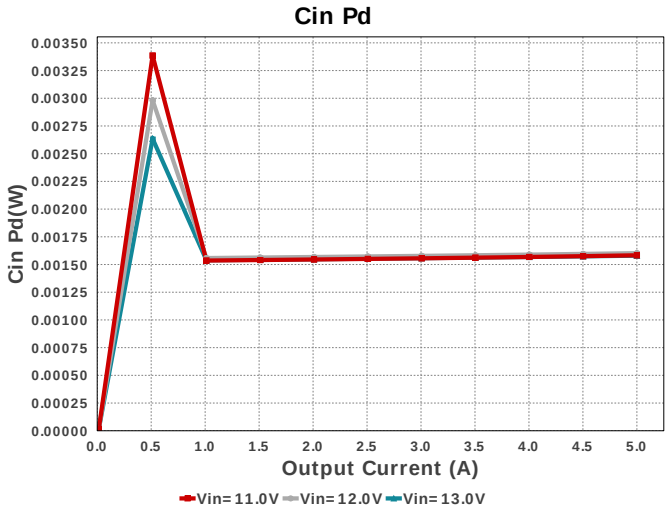
Electrical BOM

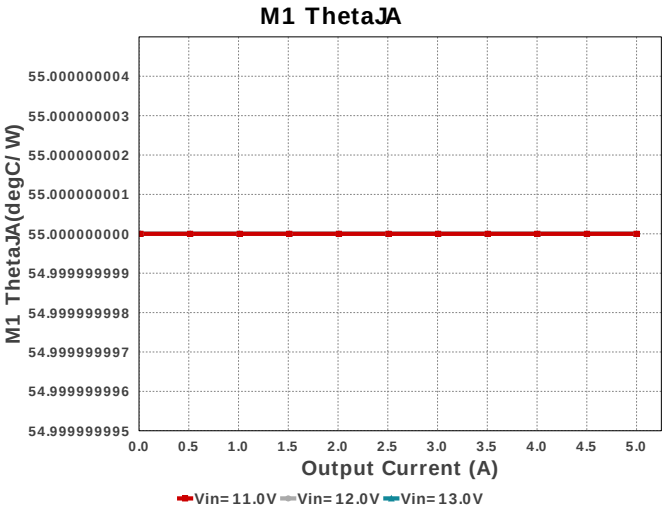
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C12	AVX	06035A101JAT2A Series= C0G/NP0	Cap= 100.0 pF ESR= 119.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cboot	Kemet	C0603C224Z4VACTU Series= Y5V	Cap= 220.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Ccomp	TDK	C2012C0G1H332J060AA Series= C0G/NP0	Cap= 3.3 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Ccomp2	Kemet	C0402C112J5GAC7867 Series= C0G/NP0	Cap= 1.1 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.10	0402 3 mm²
Cin	Samsung Electro-Mechanics	CL32B106KBJNNWE Series= X7R	Cap= 10.0 uF ESR= 5.0 mOhm VDC= 50.0 V IRMS= 0.0 A	3	$0.17	1210_270 15 mm²
Cout	Chemi-Con	EMVY500ADA470MF80G Series= MVY	Cap= 47.0 uF ESR= 600.0 mOhm VDC= 50.0 V IRMS= 170.0 mA	1	$0.12	CAPSMT_62_F80 74 mm²
Coutx	TDK	C3225X7R1H106M250AC Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 5.0 A	2	$0.28	1210 15 mm²
Css	MuRata	GRM188R71E472KA01D Series= X7R	Cap= 4.7 nF ESR= 600.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Cvcc	Taiyo Yuden	EMK107BBJ106MA-T Series= X5R	Cap= 10.0 uF VDC= 16.0 V IRMS= 0.0 A	1	$0.07	0603 5 mm²

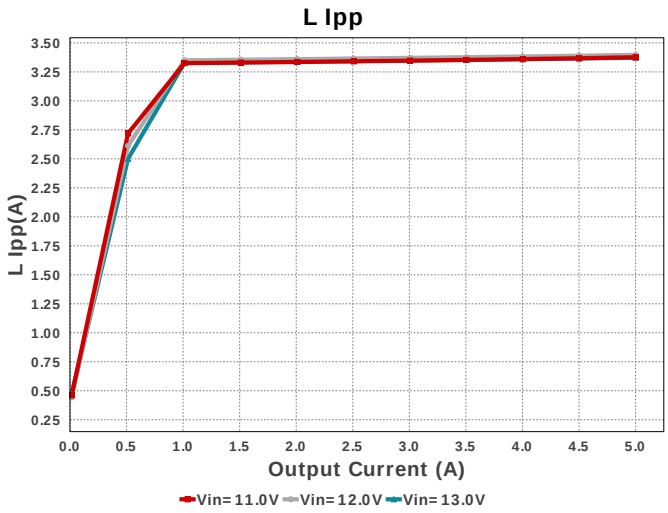
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cvin	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	 0805 7 mm^2
Dboot	Comchip Technology	CDBK0540	VF@Io= 510.0 mV VRRM= 40.0 V	1	$0.08	 SOD-123F 12 mm^2
L1	Bourns	SRP1270-3R3M	L= 3.3 µH 6.6 mOhm	1	$0.72	 SRP1270 246 mm^2
M1	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.25	 DNH0008A 18 mm^2
M2	Texas Instruments	CSD18514Q5A	VdsMax= 40.0 V IdsMax= 50.0 Amps	1	$0.24	 TRANS_NexFET_Q5A 55 mm^2
R13	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
R14	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
R19	Vishay-Dale	CRCW04022R00FKED Series= CRCW..e3	Res= 2.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rcomp	Vishay-Dale	CRCW04023K92FKED Series= CRCW..e3	Res= 3.92 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rfbb	Vishay-Dale	CRCW040211K0FKED Series= CRCW..e3	Res= 11.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rfbt	Yageo	RC0201FR-07205KL Series= ?	Res= 205.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	 0201 2 mm^2
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
Rsns1	Rohm	PMR100HZPFU6L00 Series= ?	Res= 6.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	$0.14	 2512 43 mm^2
Rsns2	Rohm	PMR100HZPFU6L00 Series= ?	Res= 6.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	$0.14	 2512 43 mm^2
Rt	Yageo	RC0201FR-07105KL Series= ?	Res= 105.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	 0201 2 mm^2
U1	Texas Instruments	TPS43060RTER	Switcher	1	$0.85	 S-PVQFN-N16 17 mm^2

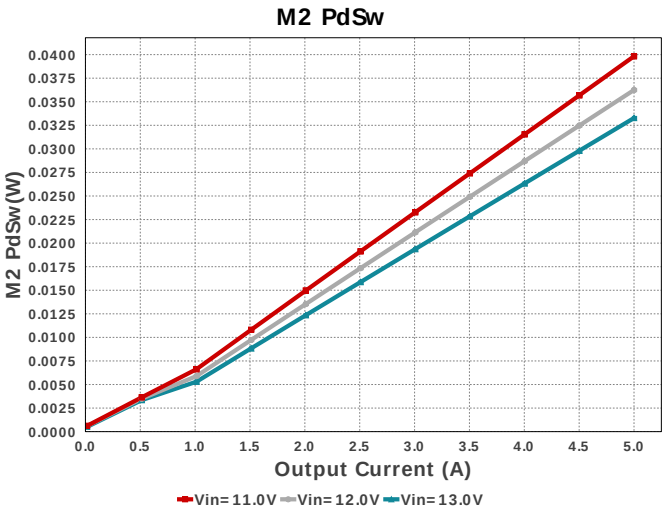


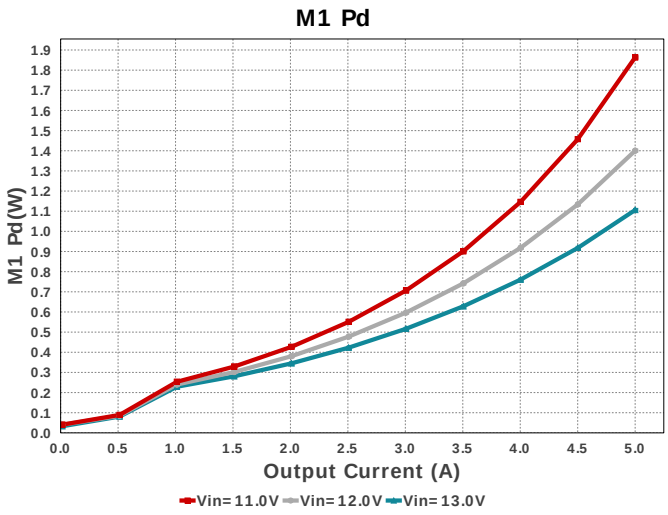


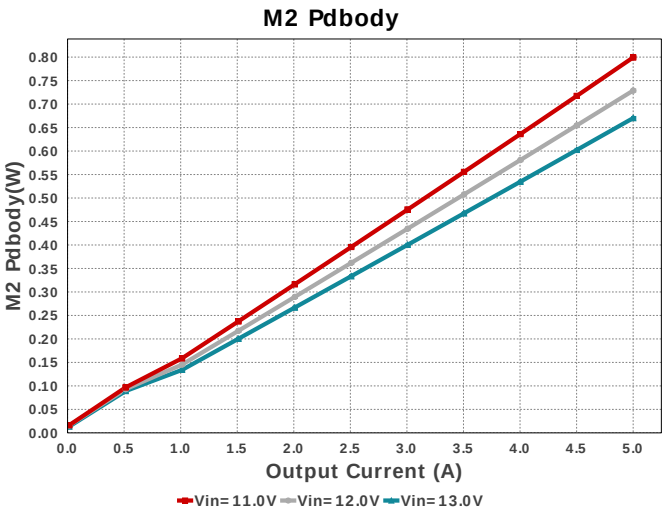


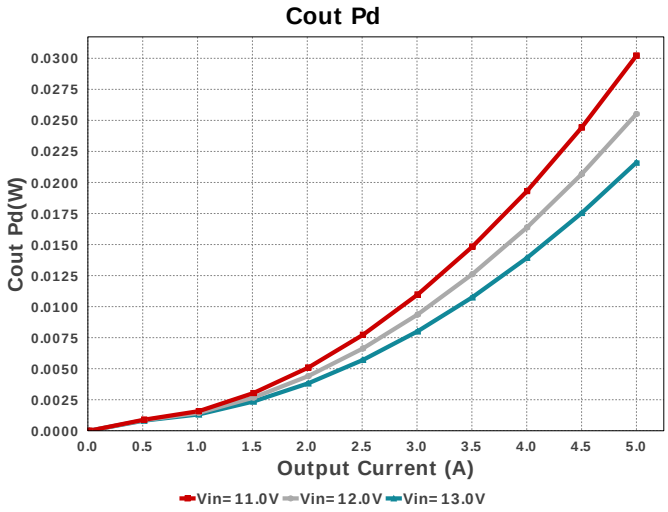


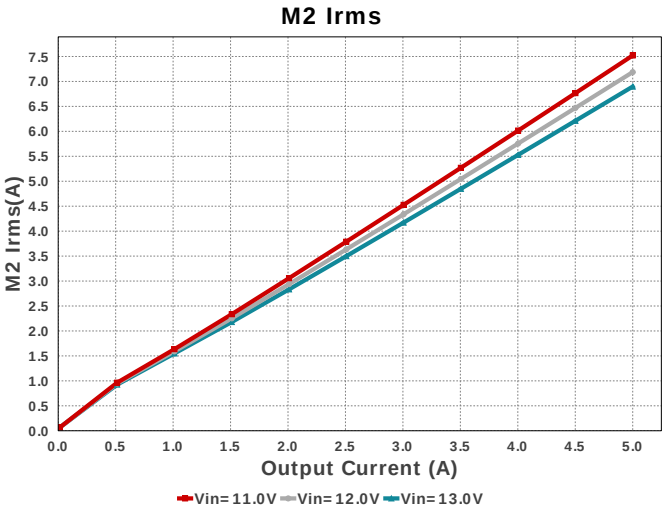


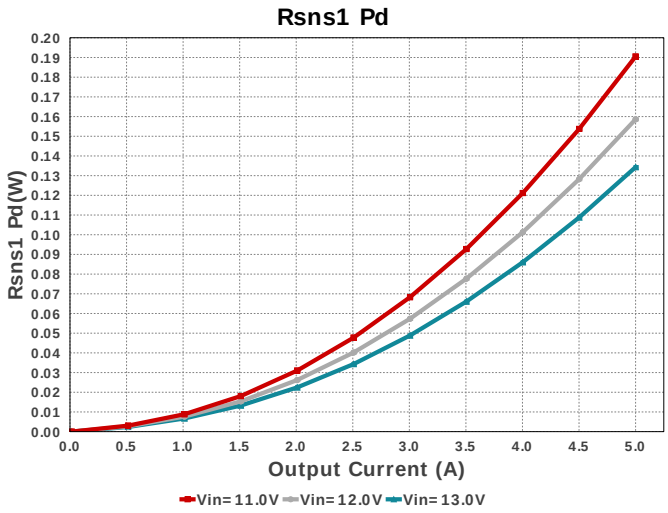


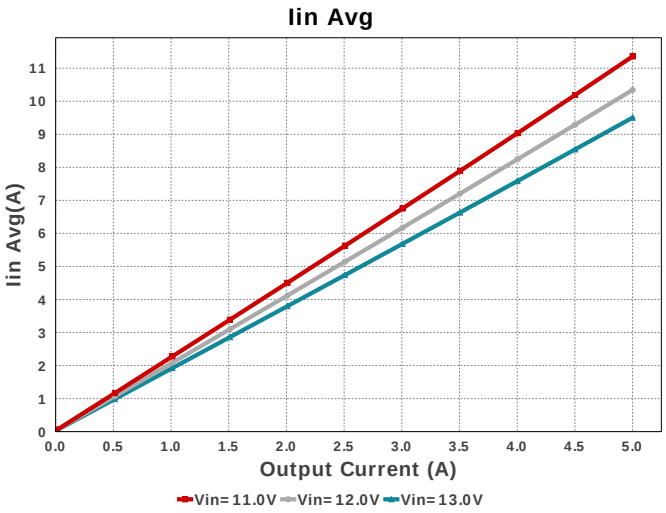


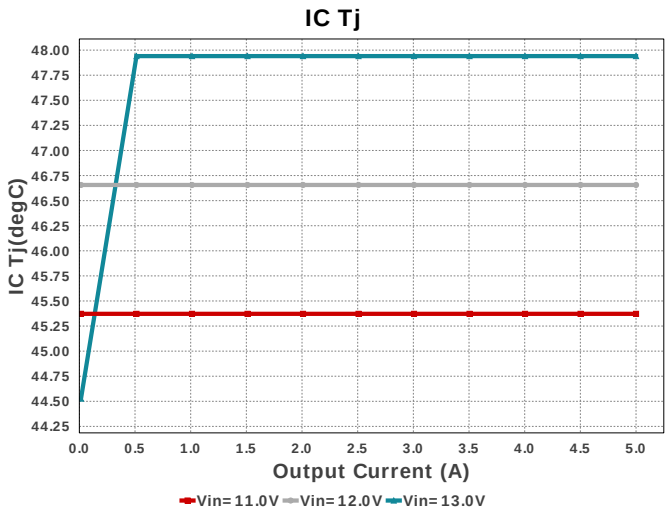


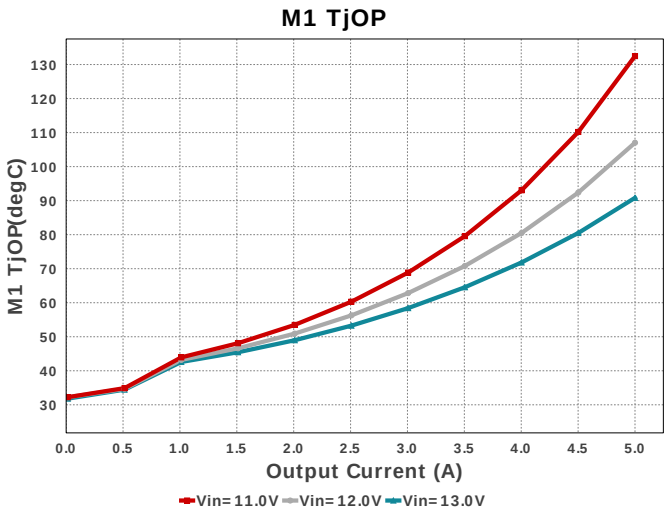


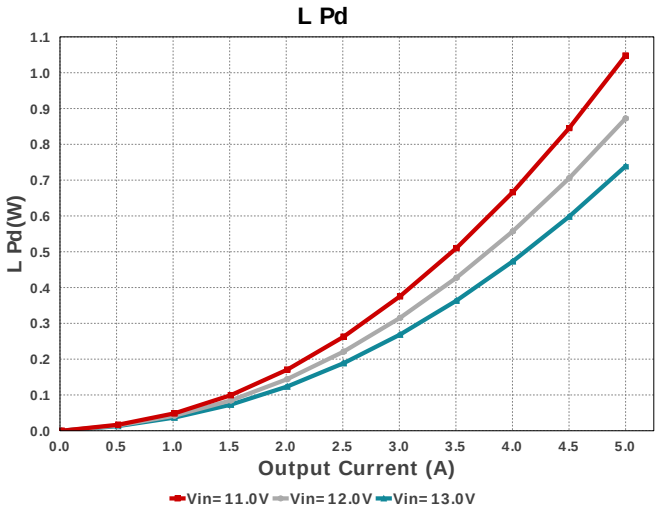


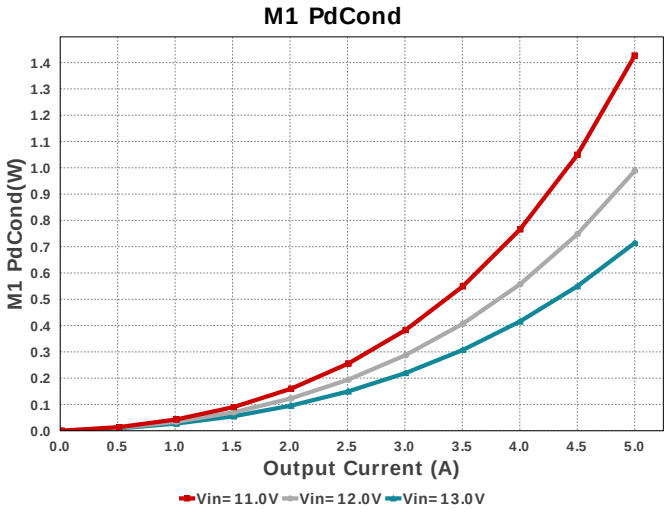


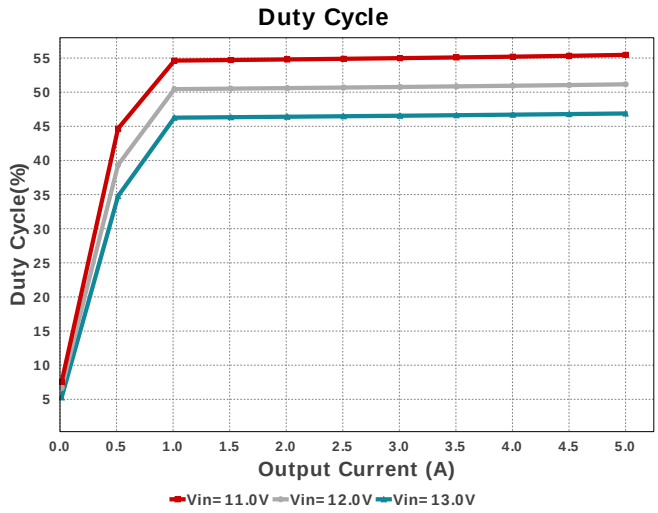


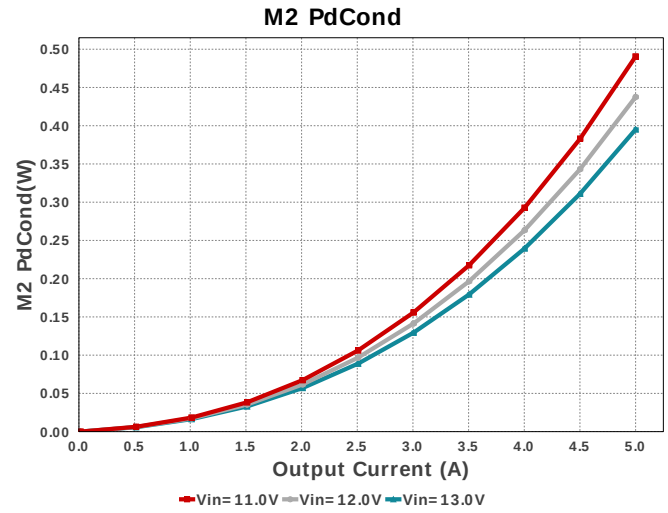


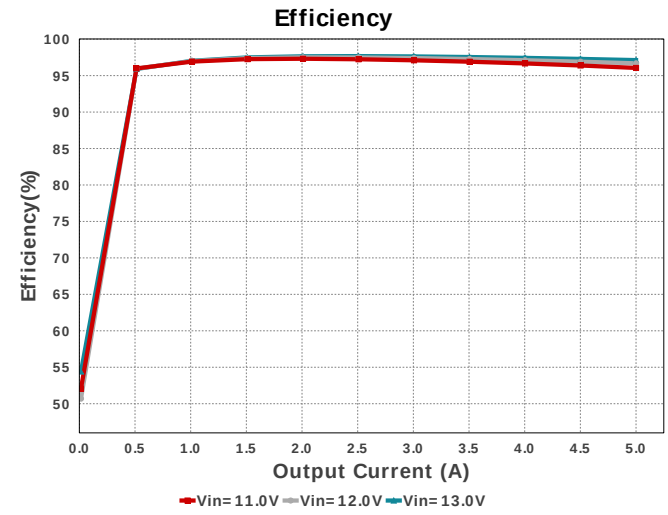


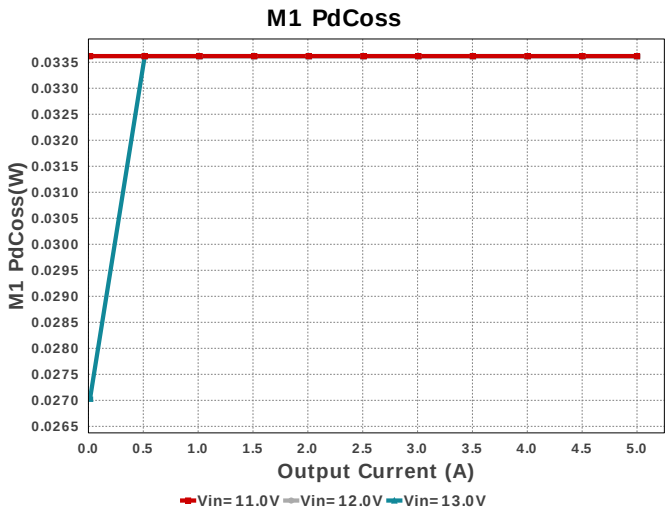


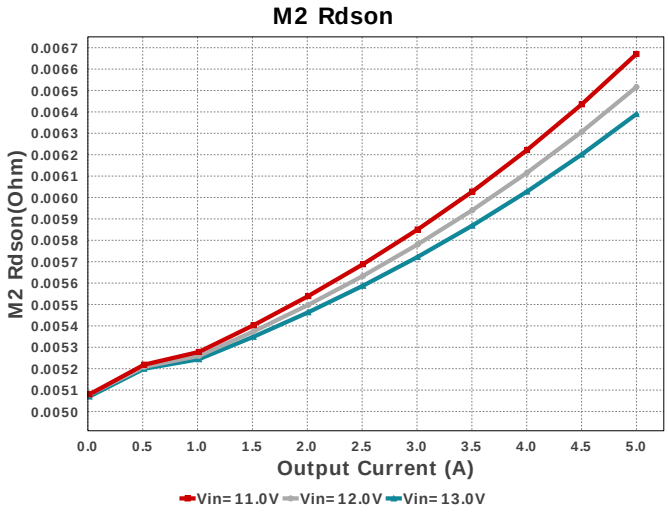


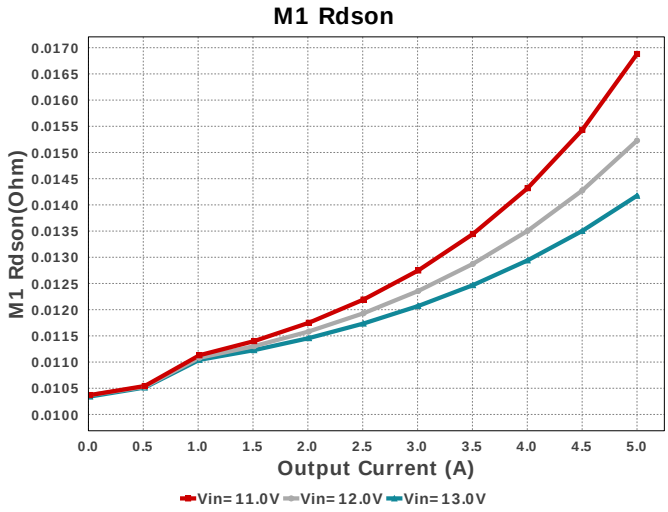


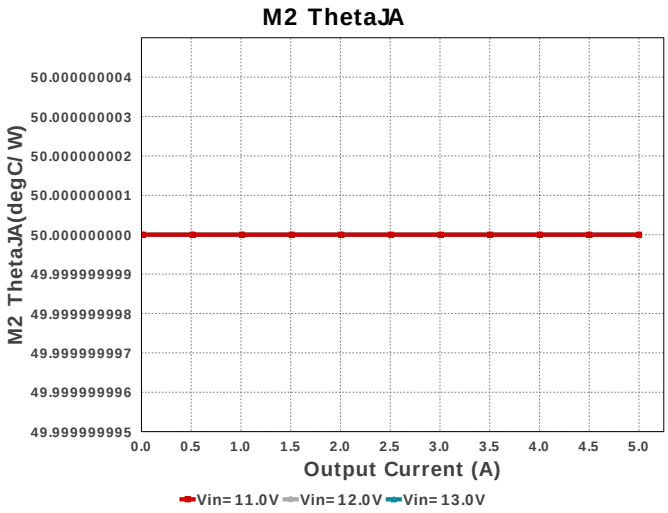


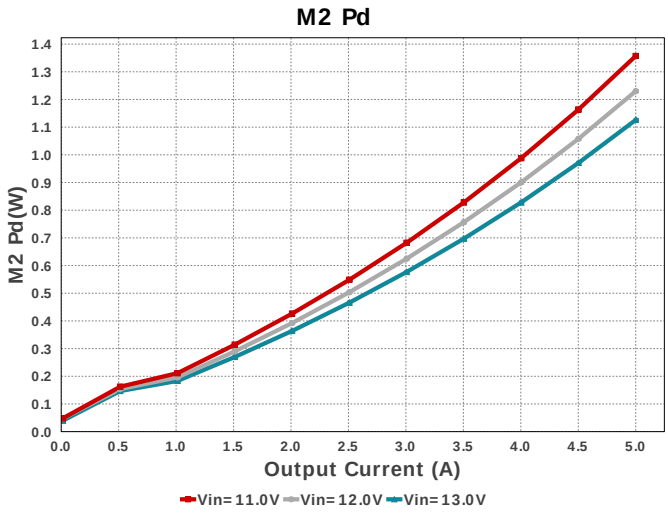


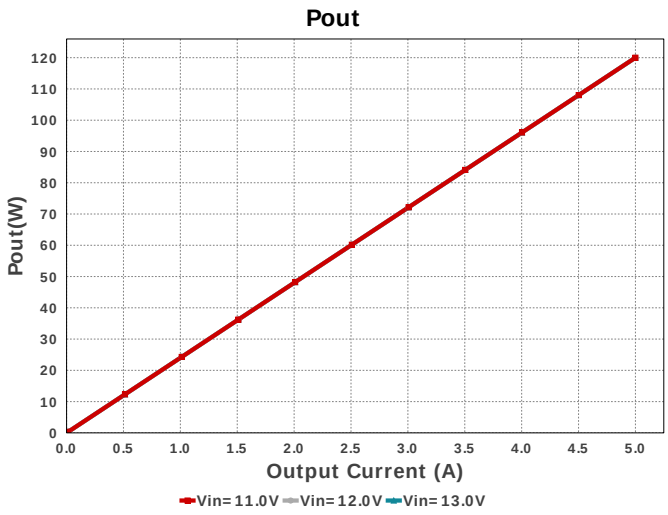


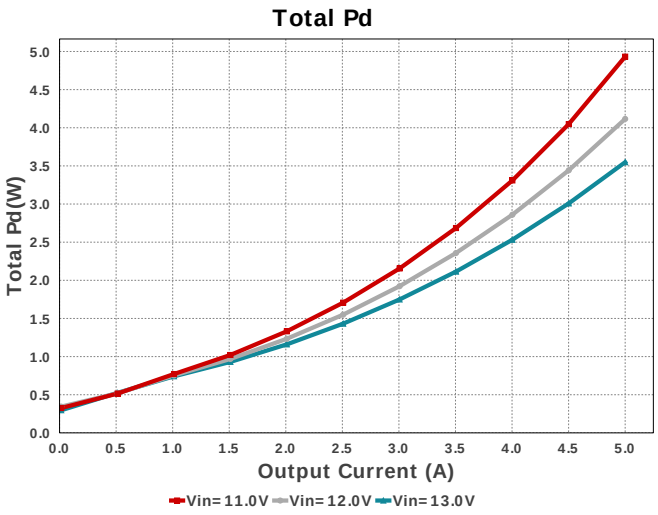


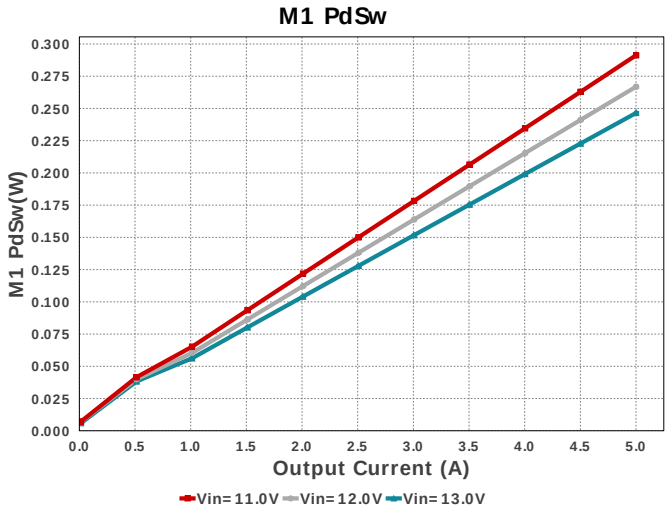


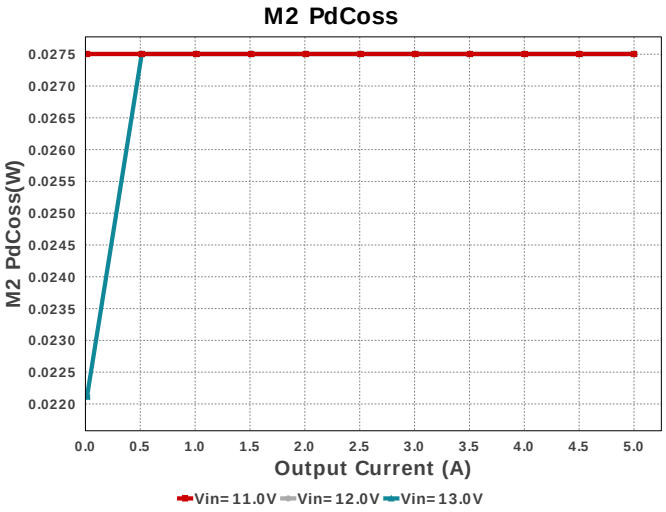


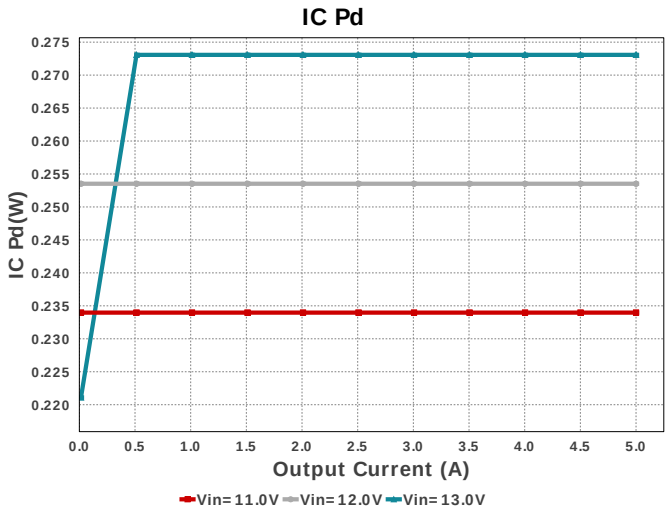


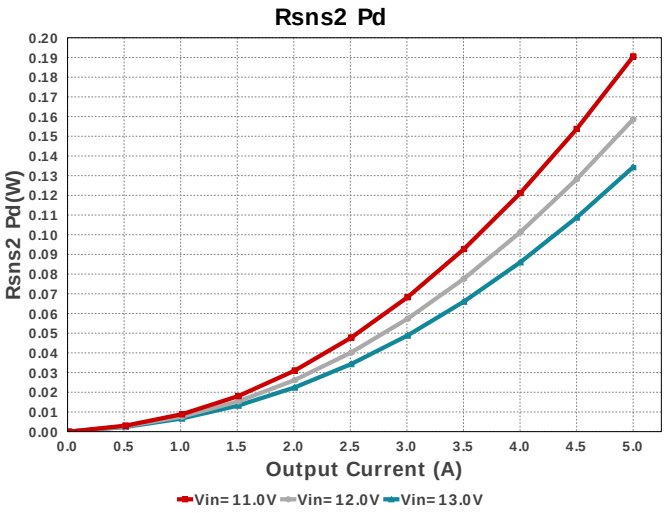


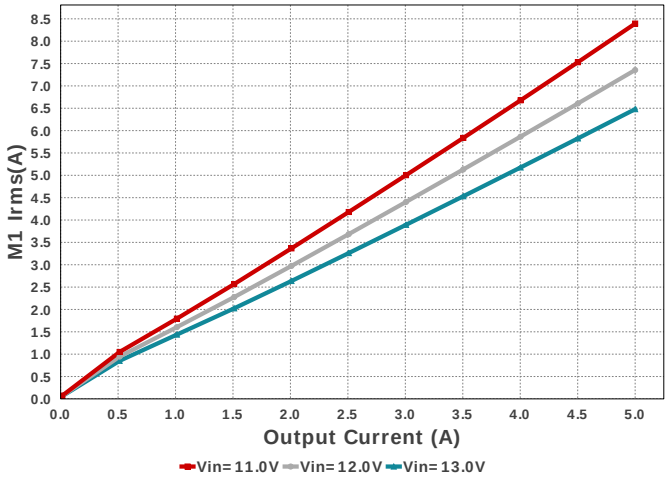


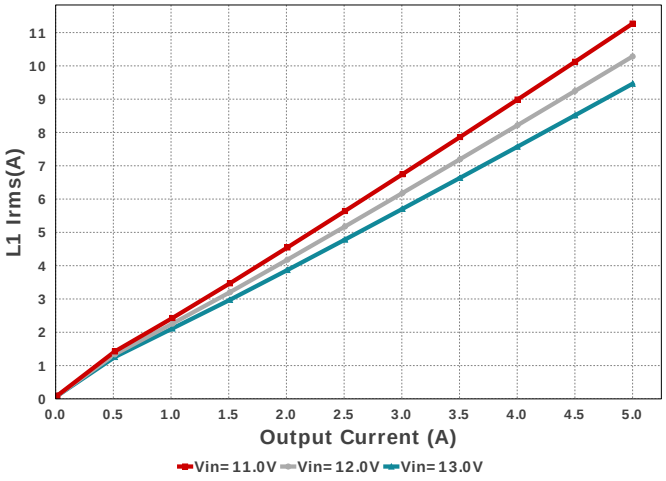


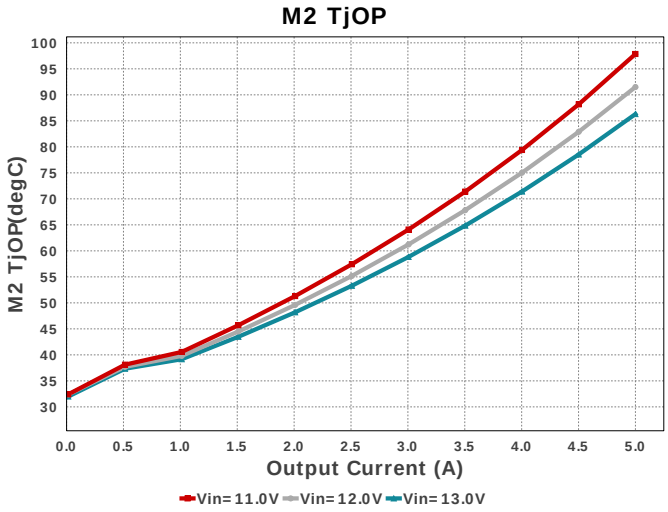


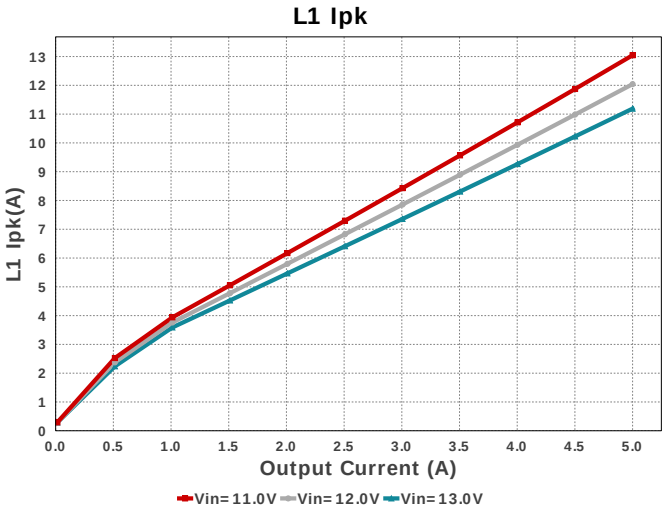


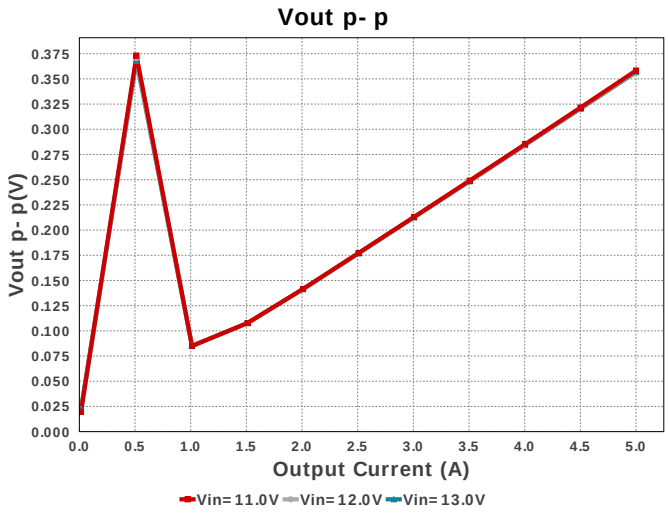


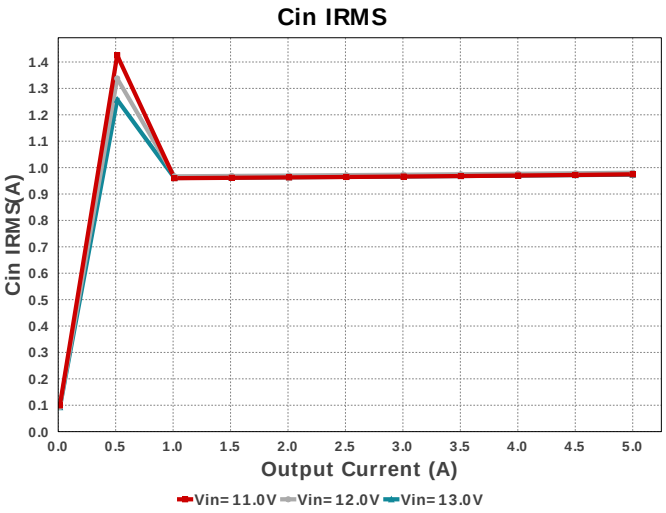


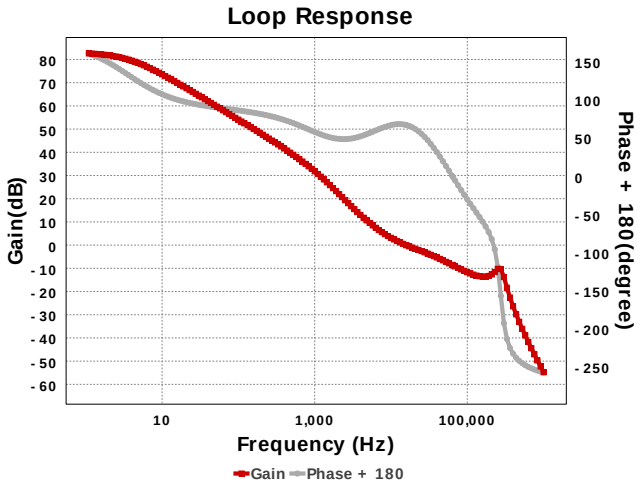












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	28		Total Design BOM count
2.	Total BOM	$3.933		Total BOM Cost
3.	Cin IRMS	974.641 mA	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	1.583 mW	Capacitor	Input capacitor power dissipation
5.	Cout Pd	30.218 mW	Capacitor	Output capacitor power dissipation
6.	IC Pd	233.97 mW	IC	IC power dissipation
7.	IC Tj	45.372 degC	IC	IC junction temperature
8.	ICThetaJA	65.7 degC/W	IC	IC junction-to-ambient thermal resistance
9.	Iin Avg	11.357 A	IC	Average input current
10.	L Ipp	3.376 A	Inductor	Peak-to-peak inductor ripple current
11.	L Pd	1.048 W	Inductor	Inductor power dissipation
12.	L1 Ipk	13.046 A	Inductor	Inductor peak current
13.	L1 Irms	11.27 A	Inductor	Inductor ripple current
14.	M1 Irms	8.393 A	Mosfet	MOSFET RMS ripple current
15.	M1 Pd	1.863 W	Mosfet	MOSFET power dissipation
16.	M1 PdCond	1.427 W	Mosfet	M1 MOSFET conduction losses
17.	M1 PdCoss	33.618 mW	Mosfet	M1 MOSFET Coss Losses
18.	M1 PdQrr	111.71 mW	Mosfet	M1 MOSFET switching losses
19.	M1 PdSw	291.27 mW	Mosfet	M1 MOSFET switching losses
20.	M1 Rdson	16.88 mOhm	Mosfet	Drain-Source On-resistance
21.	M1 ThetaJA	55.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
22.	M1 TjOP	132.478 degC	Mosfet	M1 MOSFET junction temperature
23.	M2 Irms	7.521 A	Mosfet	MOSFET RMS ripple current
24.	M2 Pd	1.357 W	Mosfet	MOSFET power dissipation
25.	M2 PdCond	490.49 mW	Mosfet	M2 MOSFET conduction losses
26.	M2 PdCoss	27.504 mW	Mosfet	M2 MOSFET Coss Losses
27.	M2 PdSw	39.824 mW	Mosfet	M2 MOSFET switching losses
28.	M2 Pdbody	799.3 mW	Mosfet	Power dissipation through lower FET
29.	M2 Rdson	6.671 mOhm	Mosfet	Drain-Source On-resistance
30.	M2 ThetaJA	50.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
31.	M2 TjOP	97.856 degC	Mosfet	MOSFET junction temperature
32.	Cin Pd	1.583 mW	Power	Input capacitor power dissipation
33.	Cout Pd	30.218 mW	Power	Output capacitor power dissipation
34.	IC Pd	233.97 mW	Power	IC power dissipation
35.	L Pd	1.048 W	Power	Inductor power dissipation
36.	M1 Pd	1.863 W	Power	MOSFET power dissipation
37.	M1 PdCond	1.427 W	Power	M1 MOSFET conduction losses
38.	M1 PdCoss	33.618 mW	Power	M1 MOSFET Coss Losses
39.	M1 PdQrr	111.71 mW	Power	M1 MOSFET switching losses
40.	M1 PdSw	291.27 mW	Power	M1 MOSFET switching losses
41.	M2 Pd	1.357 W	Power	MOSFET power dissipation
42.	M2 PdCond	490.49 mW	Power	M2 MOSFET conduction losses
43.	M2 PdCoss	27.504 mW	Power	M2 MOSFET Coss Losses
44.	M2 PdQrr	0.0 W	Power	Synchronous Boost High Side Reverse Recovery
45.	M2 PdSw	39.824 mW	Power	M2 MOSFET switching losses
46.	M2 Pdbody	799.3 mW	Power	Power dissipation through lower FET
47.	Rsns1 Pd	190.51 mW	Power	Rsns1 Power Dissipation
48.	Rsns2 Pd	190.51 mW	Power	Rsns2 Power Dissipation
49.	Total Pd	4.932 W	Power	Total Power Dissipation
50.	Rsns1 Pd	190.51 mW	Resistor	Rsns1 Power Dissipation
51.	Rsns2 Pd	190.51 mW	Resistor	Rsns2 Power Dissipation

#	Name	Value	Category	Description
52.	Cross Freq	12.799 kHz	System Information	Bode plot crossover frequency
53.	Duty Cycle	55.467 %	System Information	Duty cycle
54.	Efficiency	96.052 %	System Information	Steady state efficiency
55.	FootPrint	640.0 mm^2	System Information	Total Foot Print Area of BOM components
56.	Frequency	547.619 kHz	System Information	Switching frequency
57.	Gain Marg	-7.756 dB	System Information	Bode Plot Gain Margin
58.	Iout	5.0 A	System Information	Iout operating point
59.	Low Freq Gain	81.604 dB	System Information	Gain at 1Hz
60.	Mode	CCM	System Information	Conduction Mode
61.	Phase Marg	65.215 deg	System Information	Bode Plot Phase Margin
62.	Pout	120.0 W	System Information	Total output power
63.	Vin	11.0 V	System Information	Vin operating point
64.	Vout	24.0 V	System Information	Operational Output Voltage
65.	Vout Actual	23.956 V	System Information	Vout Actual calculated based on selected voltage divider resistors
66.	Vout Tolerance	4.006 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
67.	Vout p-p	358.288 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	5.0	Maximum Output Current
VinMax	13.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
Vout	24.0	Output Voltage
base_pn	TPS43060	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

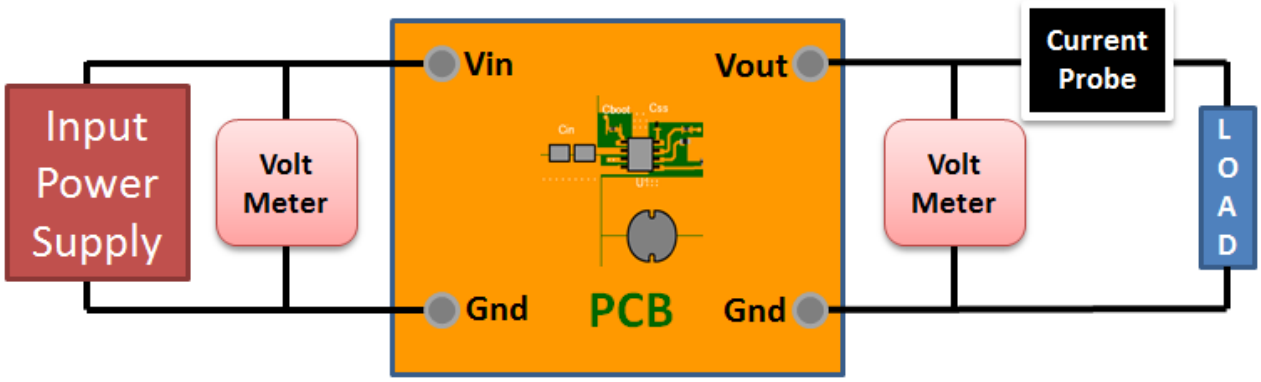
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 11.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. Feature Highlights: Low Quiescent Current Boost Controller, Wide Vin Range 4.5V to 38V Vin, 58V Vout, 7.5V Gate Drive optimized for standard MOSFET Thresholds Thermal Shutdown

2. Master key : 195EE4C191F0FFE4[v1]

3. **TPS43060** Product Folder : http://www.ti.com/product/TPS43060 : contains the data sheet and other resources.