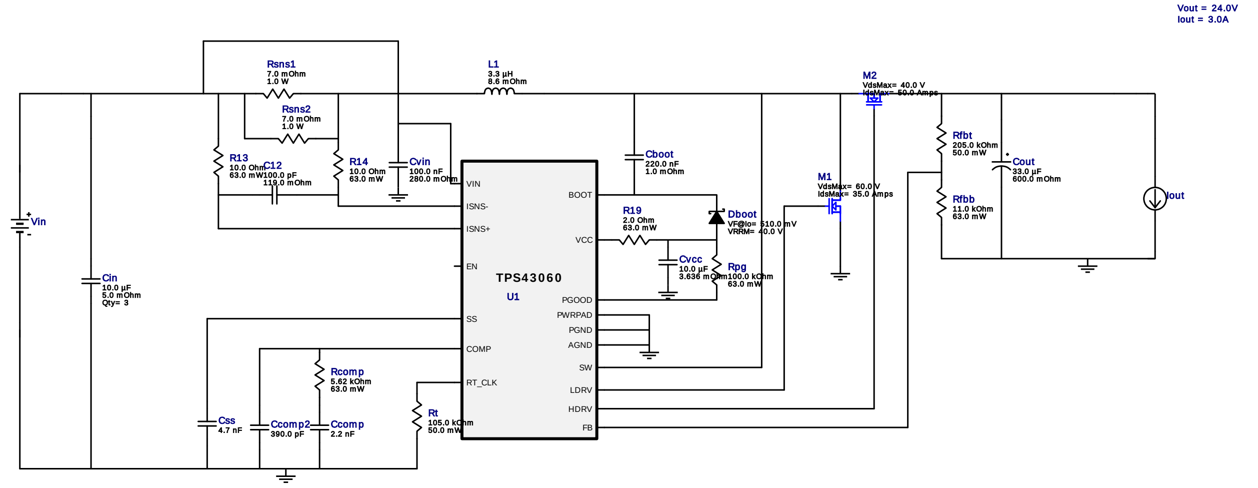
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 9.0V
VinMax = 13.0V
Vout = 24.0V
Iout = 3.0A

Device = TPS43060RTER
Topology = Boost
Created = 2025-10-28 21:34:54.874
BOM Cost = $4.25
BOM Count = 27
Total Pd = 2.86W

Design : 5 TPS43060RTER
TPS43060RTER 9V-13V to 24.00V @ 3A

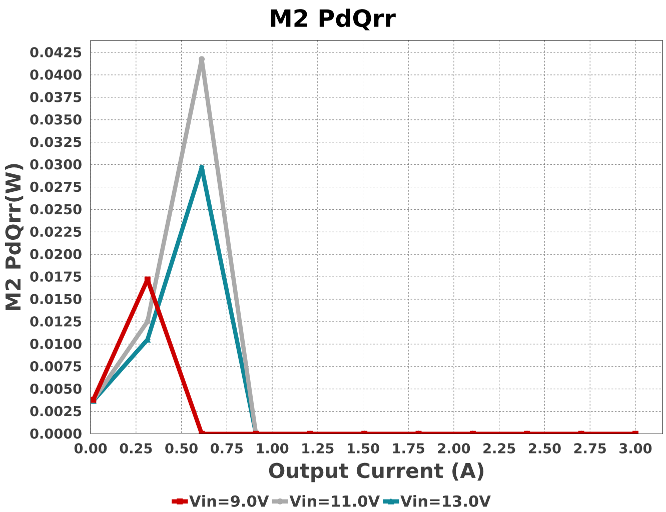


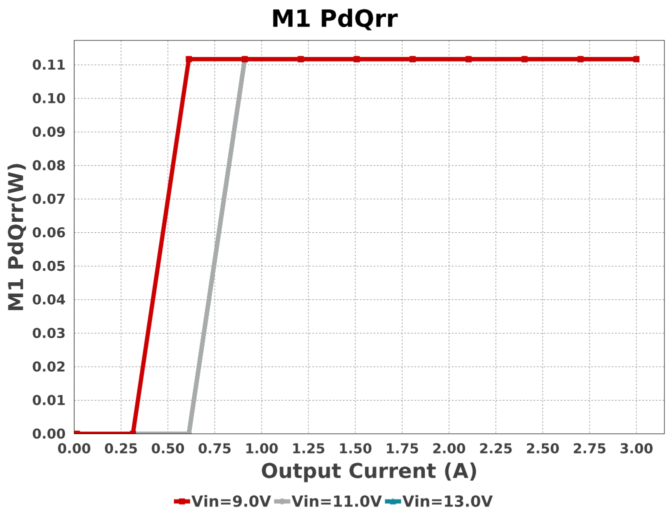
1. The pulse skip mode in the device has not been modeled. Efficiency and operational parameters of the model in pulse skip mode is not valid.

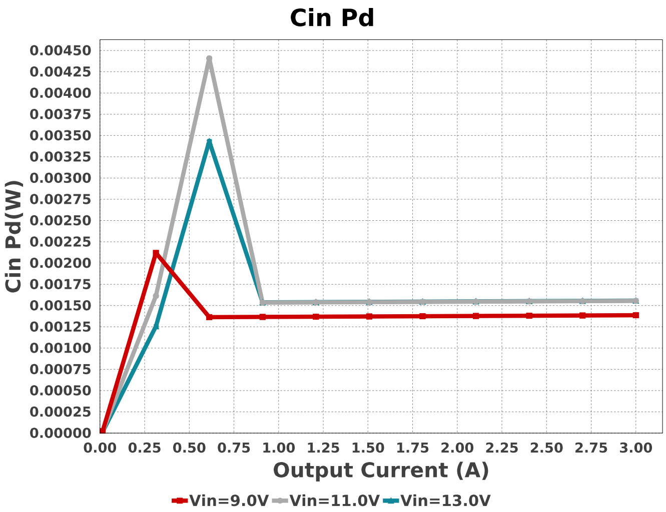
Electrical BOM

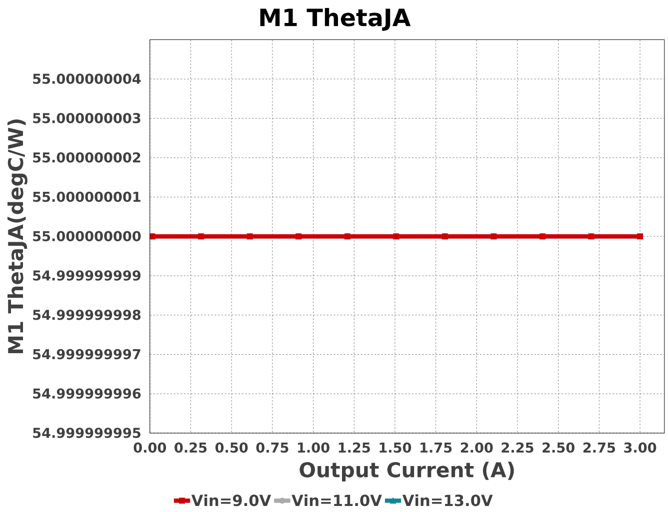
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C12	AVX	06035A101JAT2A Series= C0G/NP0	Cap= 100.0 pF ESR= 119.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cboot	Kemet	C0603C224Z4VACTU Series= Y5V	Cap= 220.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Ccomp	Samsung Electro-Mechanics	CL21C222JBFNNNE Series= C0G/NP0	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Ccomp2	MuRata	GRM1555C1H391JA01J Series= C0G/NP0	Cap= 390.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
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 mm^2
Cout	Chemi-Con	EMVY500ADA330MF80G Series= MVY	Cap= 33.0 uF ESR= 600.0 mOhm VDC= 50.0 V IRMS= 170.0 mA	1	$0.15	CAPSMT_62_F80 74 mm^2
Css	TDK	C1608C0G1E472J080AA Series= C0G/NP0	Cap= 4.7 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.05	0603 5 mm^2
Cvcc	MuRata	GRM188R61C106MA73D Series= X5R	Cap= 10.0 uF ESR= 3.636 mOhm VDC= 16.0 V IRMS= 2.8889 A	1	$0.05	0603 5 mm^2
Cvin	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

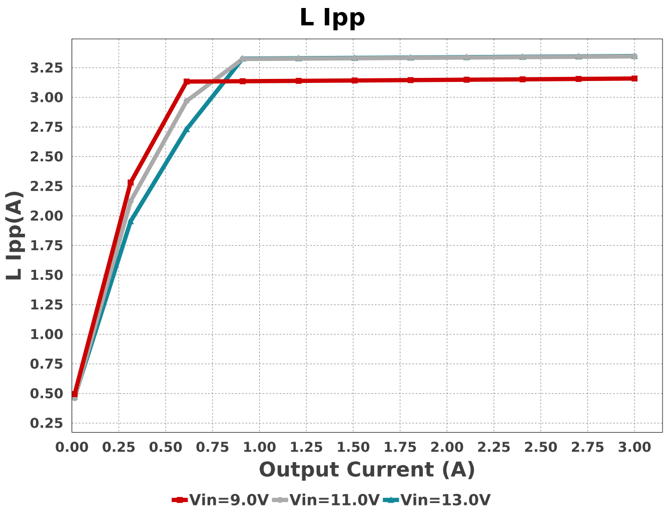
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Dboot	Comchip Technology	CDBK0540-HF	VF@Io= 510.0 mV VRRM= 40.0 V	1	$0.07	SOD-123F 12 mm^2
L1	Coilcraft	XAL7070-332MEB	L= 3.3 µH 8.6 mOhm	1	$1.19	XAL7070 87 mm^2
M1	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.21	DNH0008A 18 mm^2
M2	Texas Instruments	CSD18514Q5A	VdsMax= 40.0 V IdsMax= 50.0 Amps	1	$0.22	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	CRCW04025K62FKED Series= CRCW..e3	Res= 5.62 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	Susumu Co Ltd	PRL1632-R007-F-T1 Series= PRL1632	Res= 7.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	0612 11 mm^2
Rsns2	Susumu Co Ltd	PRL1632-R007-F-T1 Series= PRL1632	Res= 7.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	0612 11 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	$1.09	S-PVQFN-N16 17 mm^2

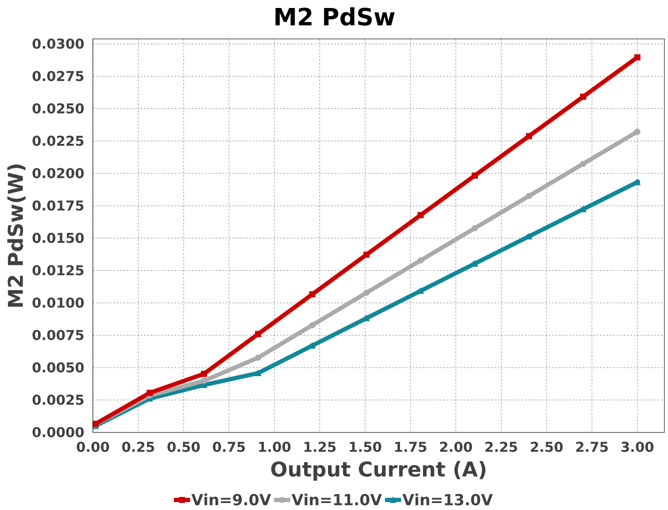

M2 PdQrr
M2 PdQrr(W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V


M1 PdQrr
M1 PdQrr(W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

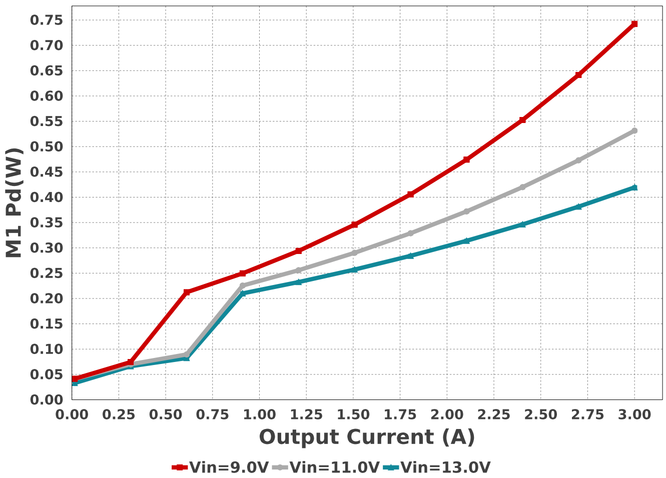

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V


M1 ThetaJA
M1 ThetaJA(degC/W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

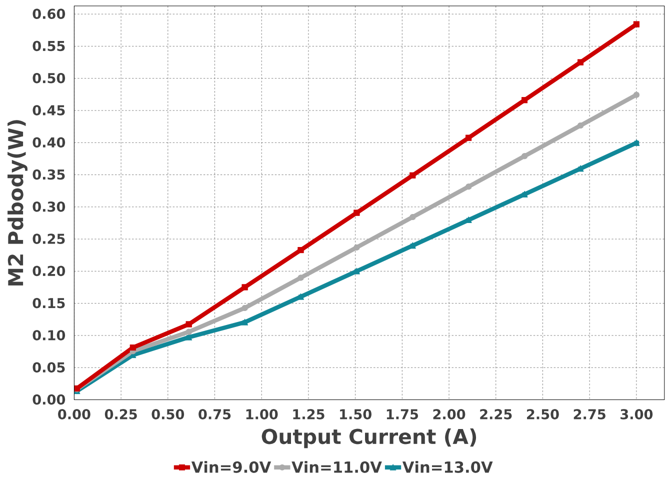

L Ipp
L Ipp(A)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V


M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

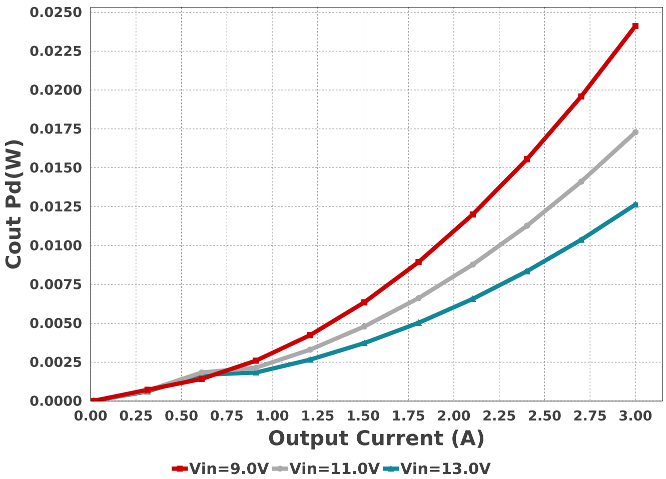
M1 Pd



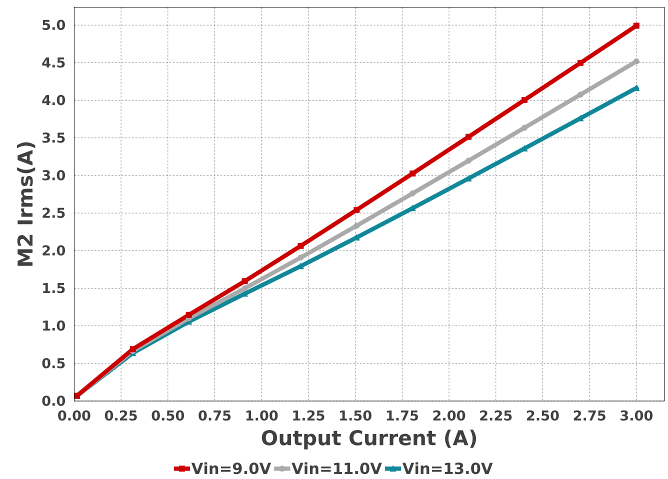
M2 Pdbody



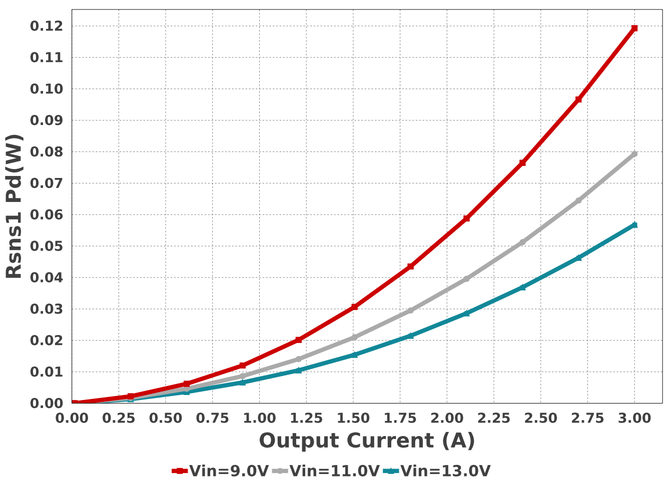
Cout Pd



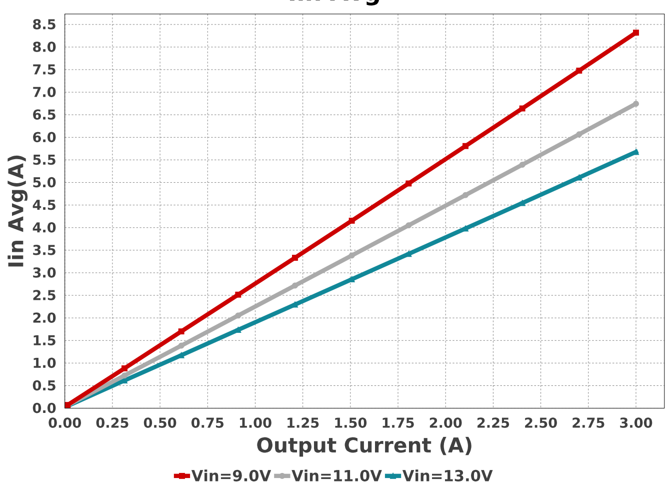
M2 Irms

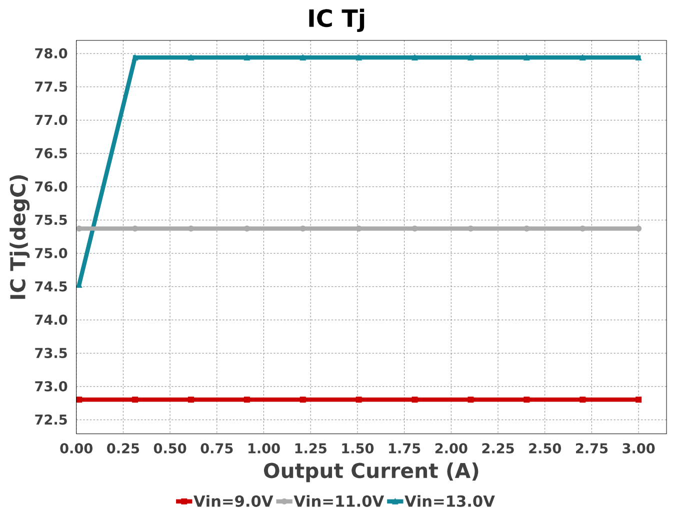


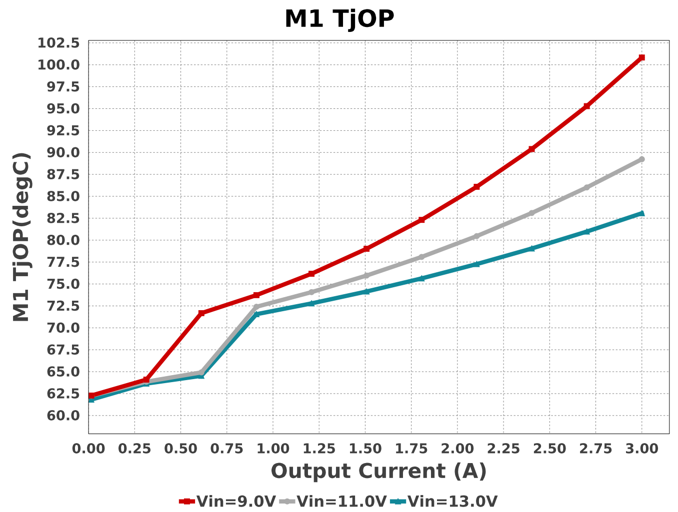
Rsns1 Pd

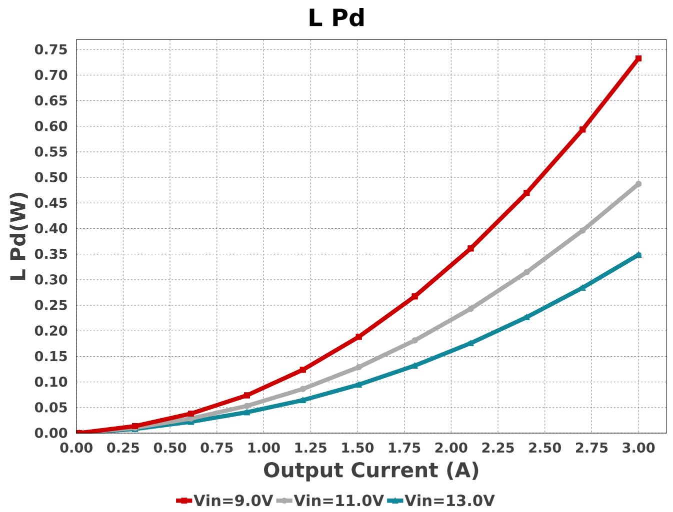


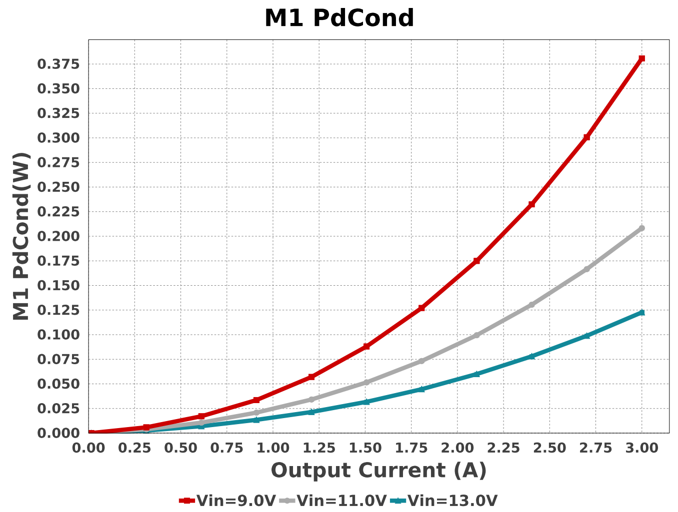
Iin Avg

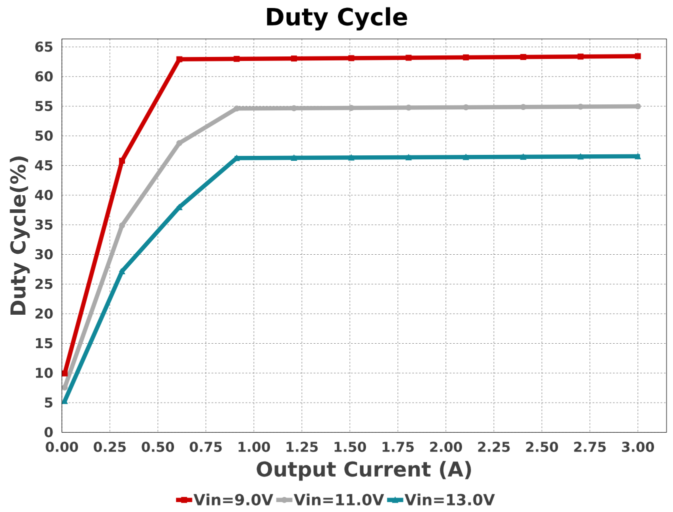


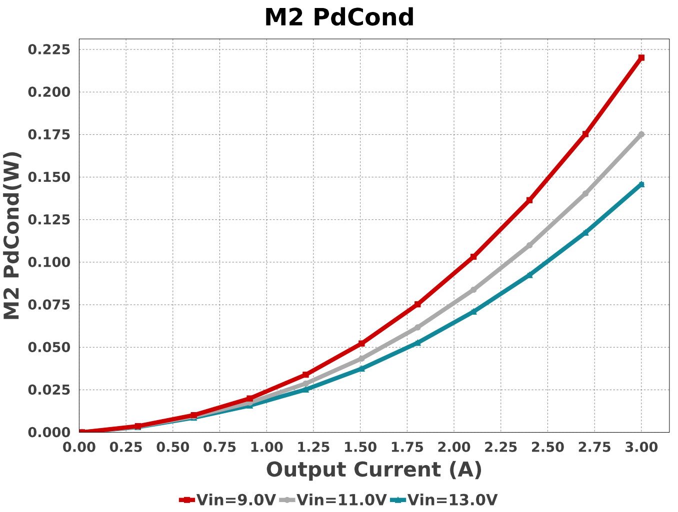

IC Tj
IC Tj(degC)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

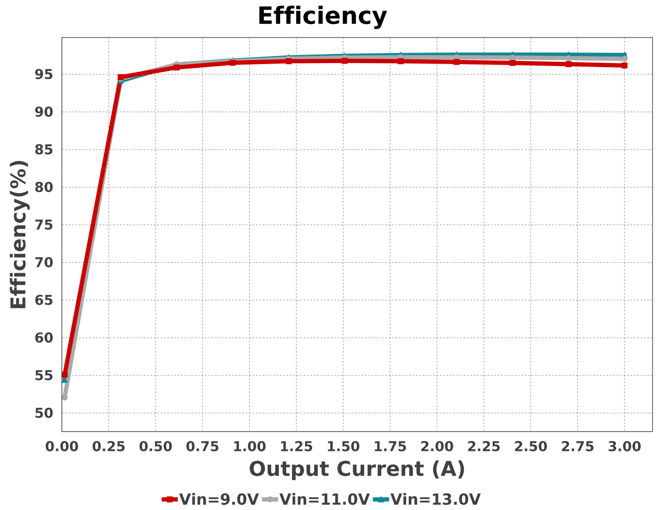

M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

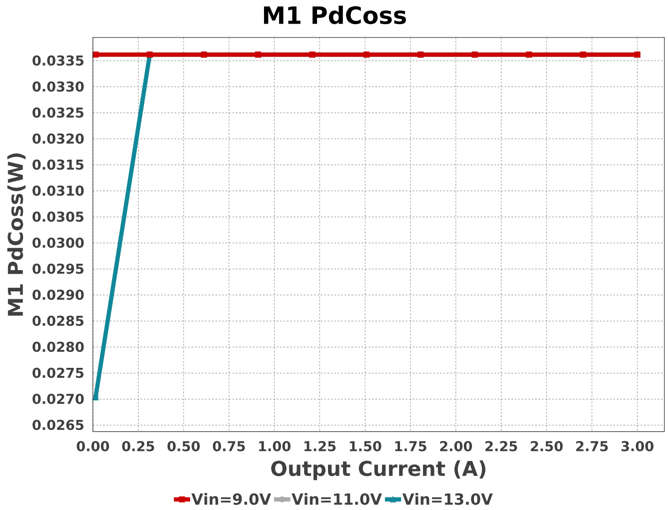

L Pd
L Pd(W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

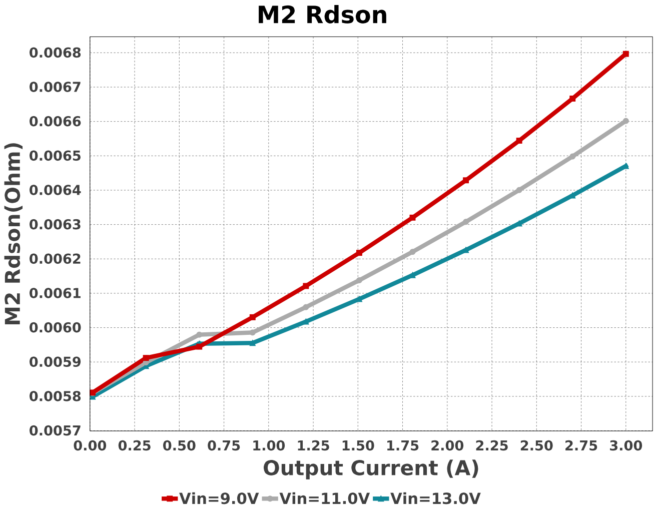

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

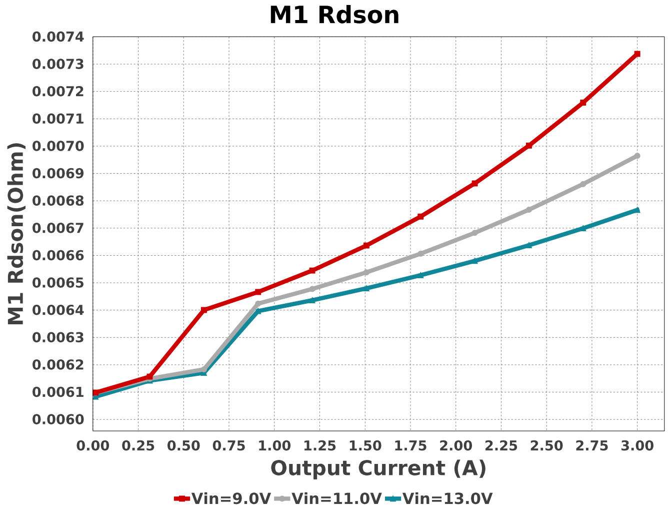

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

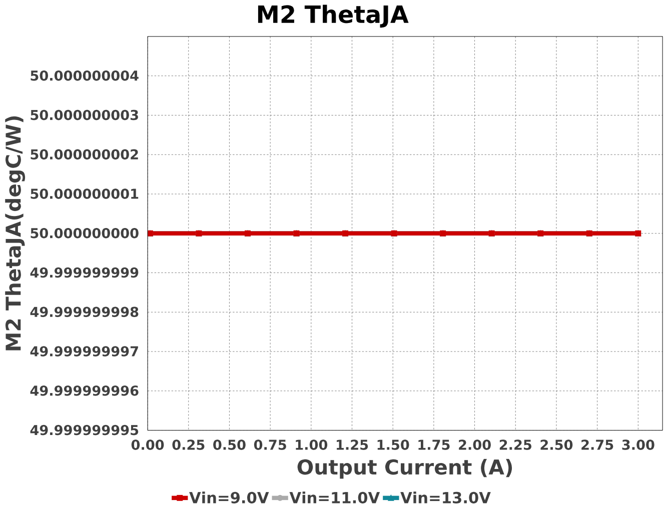

M2 PdCond
M2 PdCond(W)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

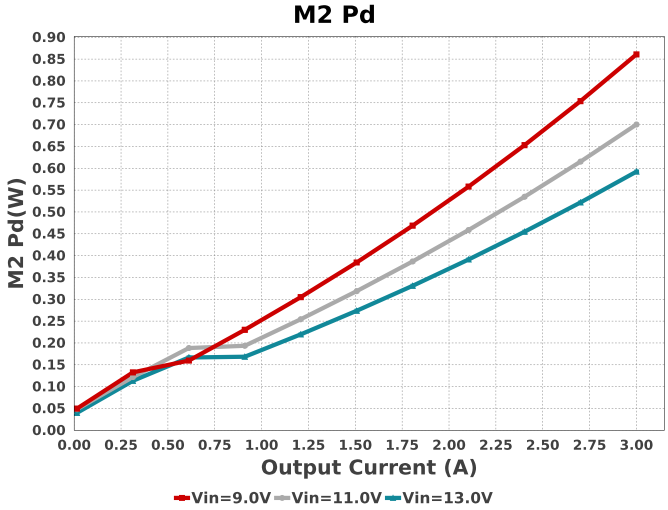

Efficiency
Efficiency(%)
95
90
85
80
75
70
65
60
55
50
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

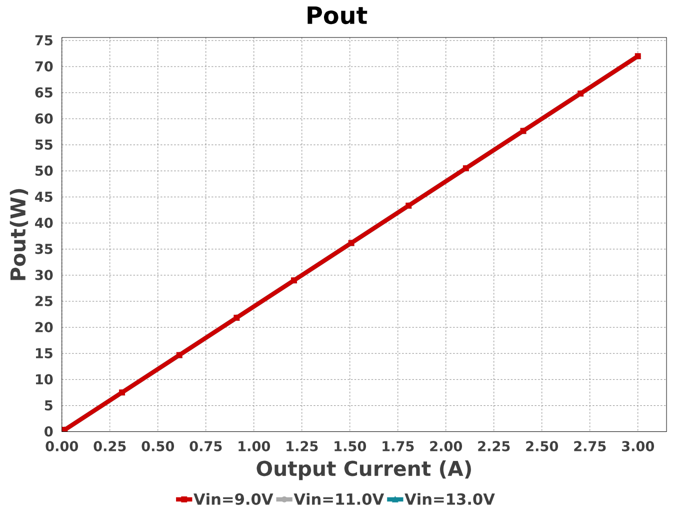

M1 PdCoss
M1 PdCoss(W)
0.0335
0.0330
0.0325
0.0320
0.0315
0.0310
0.0305
0.0300
0.0295
0.0290
0.0285
0.0280
0.0275
0.0270
0.0265
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

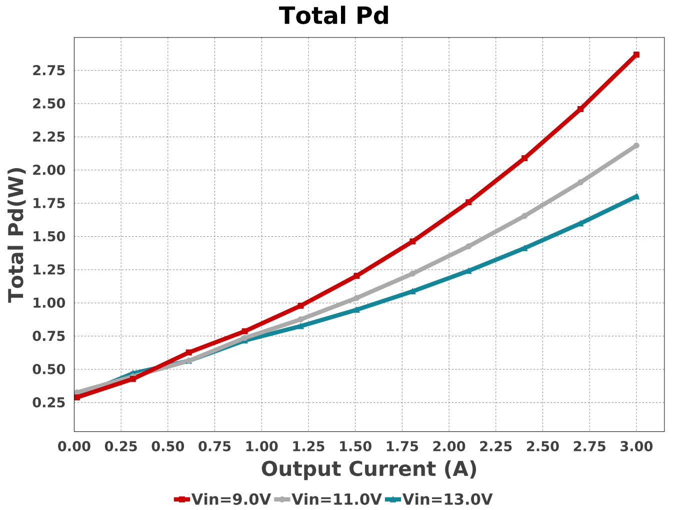

M2 Rdson
M2 Rdson(Ohm)
0.0068
0.0067
0.0066
0.0065
0.0064
0.0063
0.0062
0.0061
0.0060
0.0059
0.0058
0.0057
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

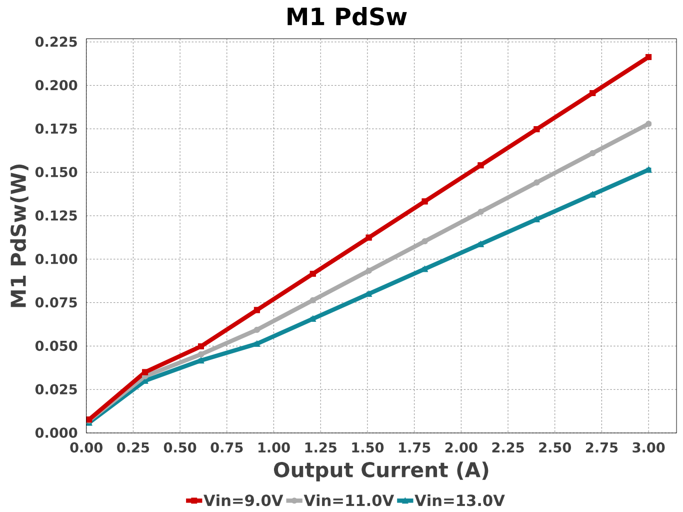

M1 Rdson
M1 Rdson(Ohm)
0.0074
0.0073
0.0072
0.0071
0.0070
0.0069
0.0068
0.0067
0.0066
0.0065
0.0064
0.0063
0.0062
0.0061
0.0060
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

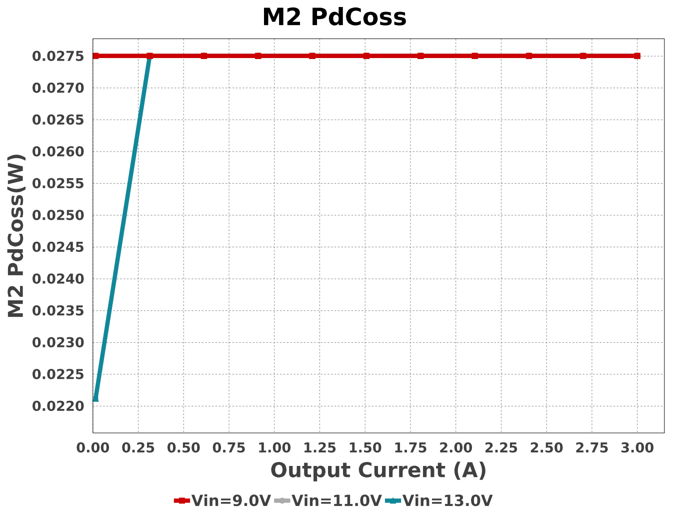

M2 ThetaJA
M2 ThetaJA(degC/W)
50.000000004
50.000000003
50.000000002
50.000000001
50.000000000
49.999999999
49.999999998
49.999999997
49.999999996
49.999999995
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

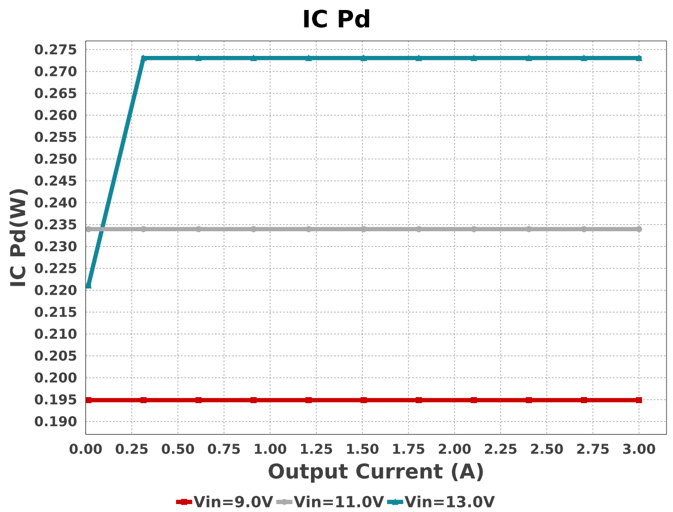

M2 Pd
M2 Pd(W)
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

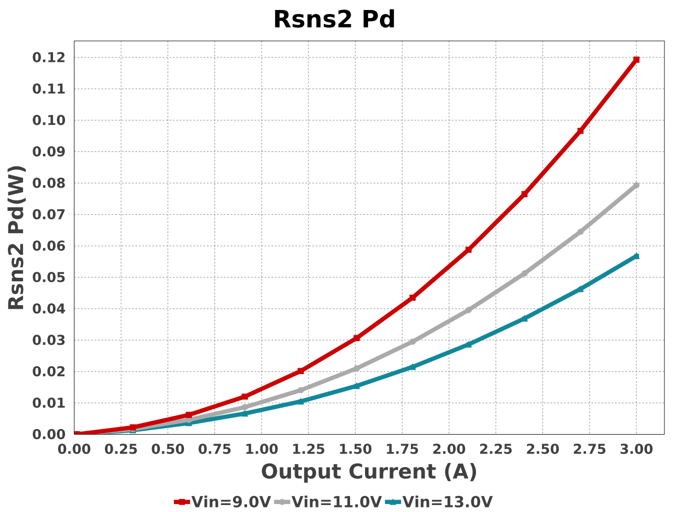

Pout
Pout(W)
Output Current (A)
Vin=9.0V
Vin=11.0V
Vin=13.0V

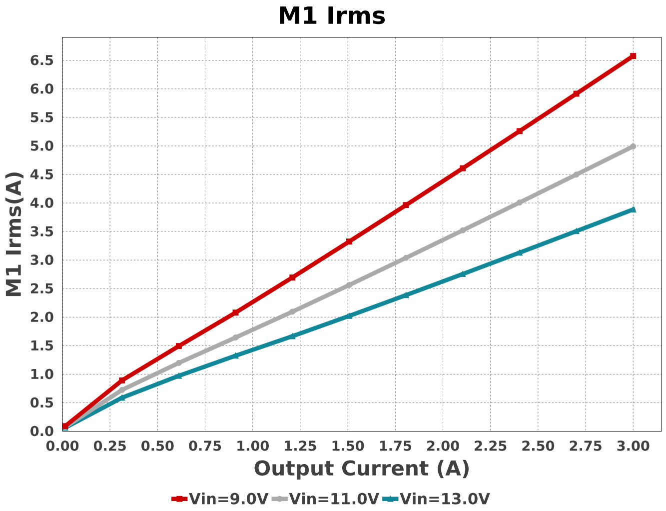

Total Pd
Total Pd(W)
Output Current (A)
Vin=9.0V
Vin=11.0V
Vin=13.0V

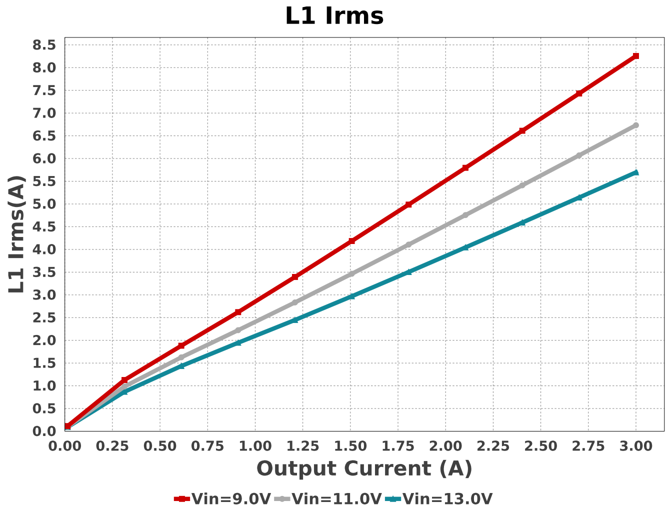

M1 PdSw
M1 PdSw(W)
Output Current (A)
Vin=9.0V
Vin=11.0V
Vin=13.0V

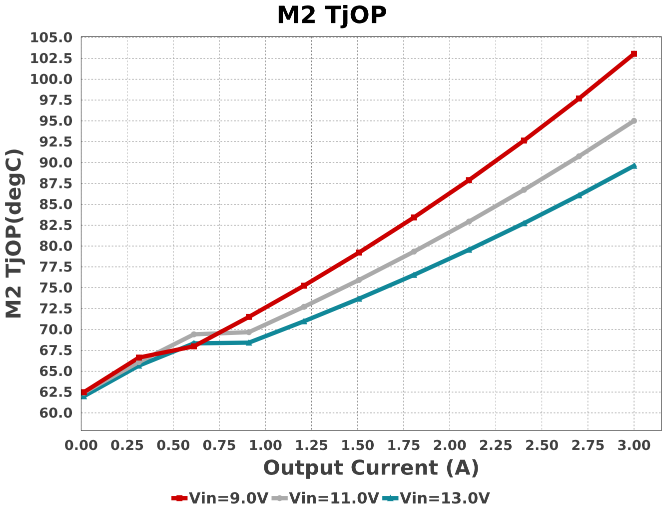

M2 PdCoss
M2 PdCoss(W)
Output Current (A)
Vin=9.0V
Vin=11.0V
Vin=13.0V

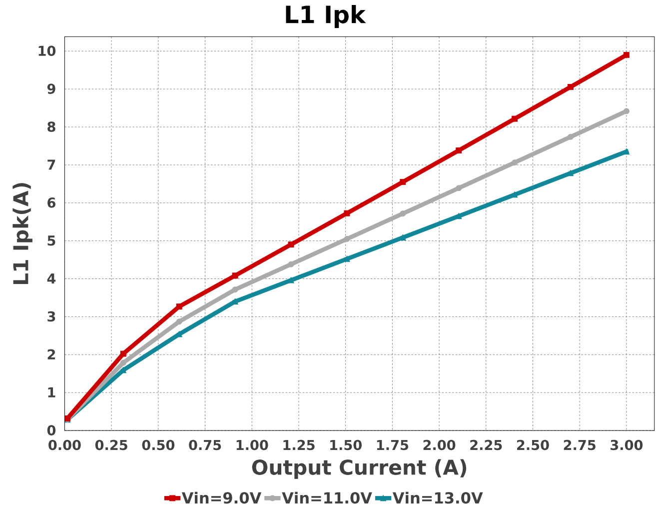

IC Pd
IC Pd(W)
Output Current (A)
Vin=9.0V
Vin=11.0V
Vin=13.0V

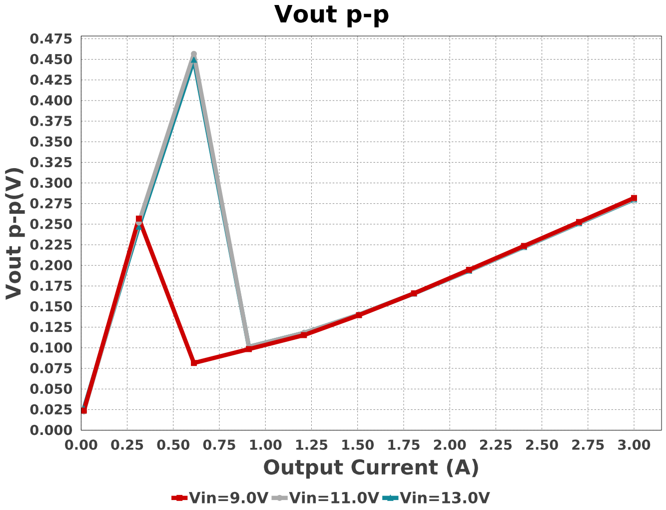

Rsns2 Pd
Rsns2 Pd(W)
Output Current (A)
Vin=9.0V
Vin=11.0V
Vin=13.0V

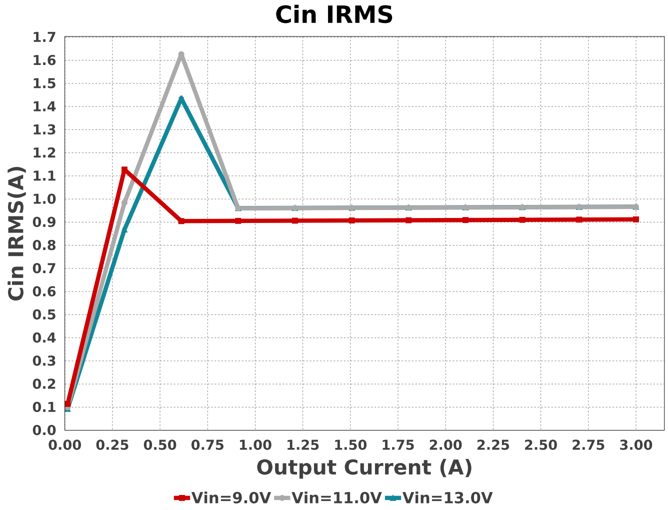

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V

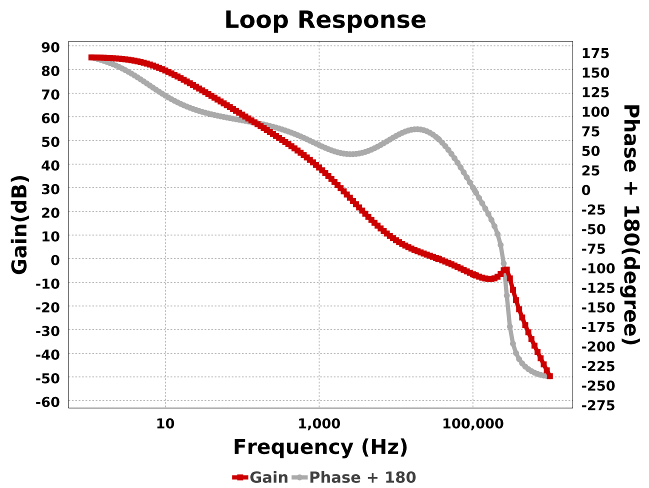

L1 Irms
L1 Irms(A)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V


M2 TjOP
M2 TjOP(degC)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V


L1 Ipk
L1 Ipk(A)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V


Vout p-p
Vout p-p(V)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V


Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=9.0V Vin=11.0V Vin=13.0V



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	912.025 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	1.386 mW	Capacitor	Input capacitor power dissipation
3.	Cout Pd	24.119 mW	Capacitor	Output capacitor power dissipation
4.	IC Pd	194.88 mW	IC	IC power dissipation
5.	IC Tj	72.803 degC	IC	IC junction temperature
6.	ICThetaJA	65.7 degC/W	IC	IC junction-to-ambient thermal resistance
7.	Iin Avg	8.318 A	IC	Average input current
8.	L Ipp	3.159 A	Inductor	Peak-to-peak inductor ripple current
9.	L Pd	732.68 mW	Inductor	Inductor power dissipation
10.	L1 Ipk	9.898 A	Inductor	Inductor peak current
11.	L1 Irms	8.256 A	Inductor	Inductor ripple current
12.	M1 Irms	6.575 A	Mosfet	MOSFET RMS ripple current
13.	M1 Pd	737.27 mW	Mosfet	MOSFET power dissipation
14.	M1 PdCond	380.22 mW	Mosfet	M1 MOSFET conduction losses
15.	M1 PdCoss	33.618 mW	Mosfet	M1 MOSFET Coss Losses
16.	M1 PdQrr	107.1 mW	Mosfet	M1 MOSFET switching losses
17.	M1 PdSw	216.32 mW	Mosfet	M1 MOSFET switching losses
18.	M1 Rdson	7.328 mOhm	Mosfet	Drain-Source On-resistance
19.	M1 ThetaJA	55.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
20.	M1 TjOP	100.55 degC	Mosfet	M1 MOSFET junction temperature
21.	M2 Irms	4.992 A	Mosfet	MOSFET RMS ripple current
22.	M2 Pd	860.78 mW	Mosfet	MOSFET power dissipation
23.	M2 PdCond	220.18 mW	Mosfet	M2 MOSFET conduction losses
24.	M2 PdCoss	27.504 mW	Mosfet	M2 MOSFET Coss Losses
25.	M2 PdSw	28.961 mW	Mosfet	M2 MOSFET switching losses
26.	M2 Pdbody	584.13 mW	Mosfet	Power dissipation through lower FET
27.	M2 Rdson	6.797 mOhm	Mosfet	Drain-Source On-resistance
28.	M2 ThetaJA	50.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
29.	M2 TjOP	103.04 degC	Mosfet	MOSFET junction temperature
30.	Cin Pd	1.386 mW	Power	Input capacitor power dissipation
31.	Cout Pd	24.119 mW	Power	Output capacitor power dissipation
32.	IC Pd	194.88 mW	Power	IC power dissipation
33.	L Pd	732.68 mW	Power	Inductor power dissipation
34.	M1 Pd	737.27 mW	Power	MOSFET power dissipation
35.	M1 PdCond	380.22 mW	Power	M1 MOSFET conduction losses
36.	M1 PdCoss	33.618 mW	Power	M1 MOSFET Coss Losses
37.	M1 PdQrr	107.1 mW	Power	M1 MOSFET switching losses
38.	M1 PdSw	216.32 mW	Power	M1 MOSFET switching losses
39.	M2 Pd	860.78 mW	Power	MOSFET power dissipation
40.	M2 PdCond	220.18 mW	Power	M2 MOSFET conduction losses
41.	M2 PdCoss	27.504 mW	Power	M2 MOSFET Coss Losses
42.	M2 PdQrr	0.0 W	Power	Synchronous Boost High Side Reverse Recovery
43.	M2 PdSw	28.961 mW	Power	M2 MOSFET switching losses
44.	M2 Pdbody	584.13 mW	Power	Power dissipation through lower FET
45.	Rsns1 Pd	119.27 mW	Power	Rsns1 Power Dissipation
46.	Rsns2 Pd	119.27 mW	Power	Rsns2 Power Dissipation
47.	Total Pd	2.864 W	Power	Total Power Dissipation
48.	Rsns1 Pd	119.27 mW	Resistor	Rsns1 Power Dissipation
49.	Rsns2 Pd	119.27 mW	Resistor	Rsns2 Power Dissipation
50.	BOM Count	27	System Information	Total Design BOM count

#	Name	Value	Category	Description
51.	Cross Freq	20.656 kHz	System Information	Bode plot crossover frequency
52.	Duty Cycle	63.438 %	System Information	Duty cycle
53.	Efficiency	96.174 %	System Information	Steady state efficiency
54.	FootPrint	402.0 mm^2	System Information	Total Foot Print Area of BOM components
55.	Frequency	547.619 kHz	System Information	Switching frequency
56.	Gain Marg	-5.148 dB	System Information	Bode Plot Gain Margin
57.	Iout	3.0 A	System Information	Iout operating point
58.	Low Freq Gain	83.372 dB	System Information	Gain at 1Hz
59.	Mode	CCM	System Information	Conduction Mode
60.	Phase Marg	66.713 deg	System Information	Bode Plot Phase Margin
61.	Pout	72.0 W	System Information	Total output power
62.	Total BOM	$4.25	System Information	Total BOM Cost
63.	Vin	9.0 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	281.771 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	3.0	Maximum Output Current
VinMax	13.0	Maximum input voltage
VinMin	9.0	Minimum input voltage
Vout	24.0	Output Voltage
base_pn	TPS43060	Base Product Number
source	DC	Input Source Type
Ta	60.0	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

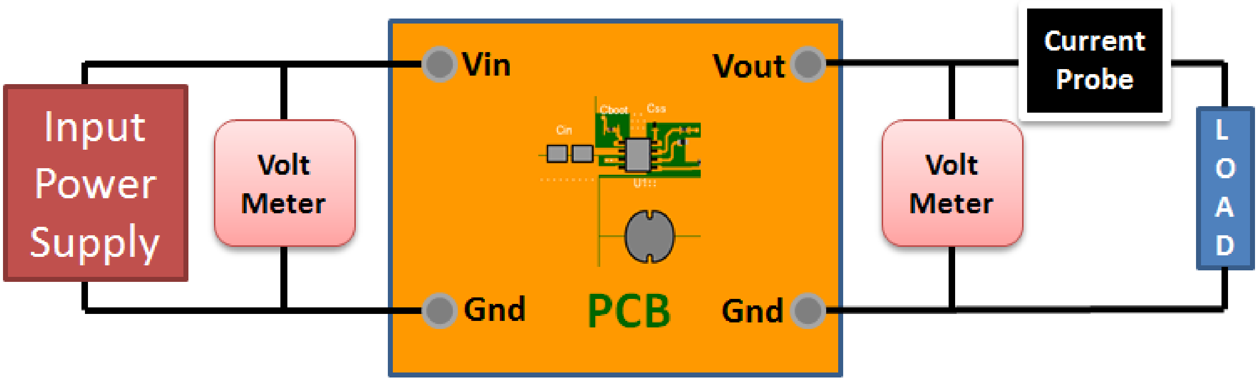
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 9.0V 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 : AD9ABD3FB6EB8E71BDFD117B90420B13[v1]

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