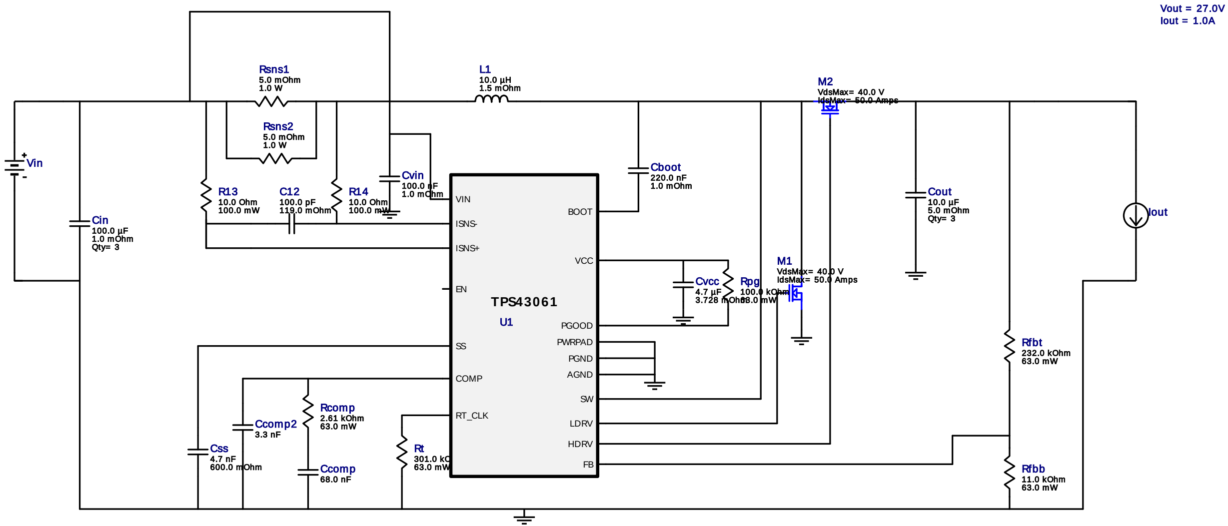
![Texas Instruments]

WEBENCH® Design Report

VinMin = 4.5V
VinMax = 5.5V
Vout = 27.0V
Iout = 1.0A

Device = TPS43061RTER
Topology = Boost
Created = 2019-06-20 11:03:58.272
BOM Cost = $6.22
BOM Count = 26
Total Pd = 1.29W

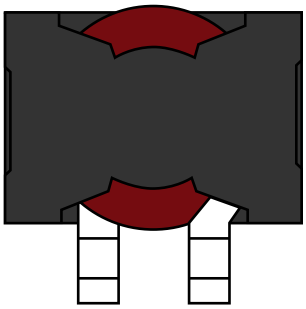
Design : 9 TPS43061RTER
TPS43061RTER 4.5V-5.5V to 27.00V @ 1A

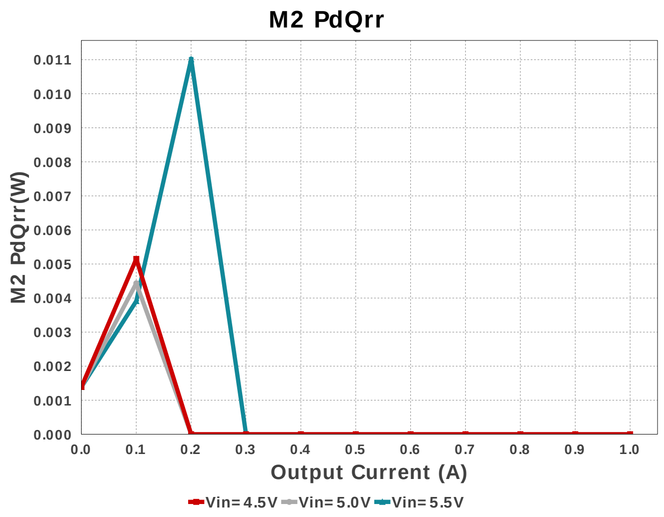


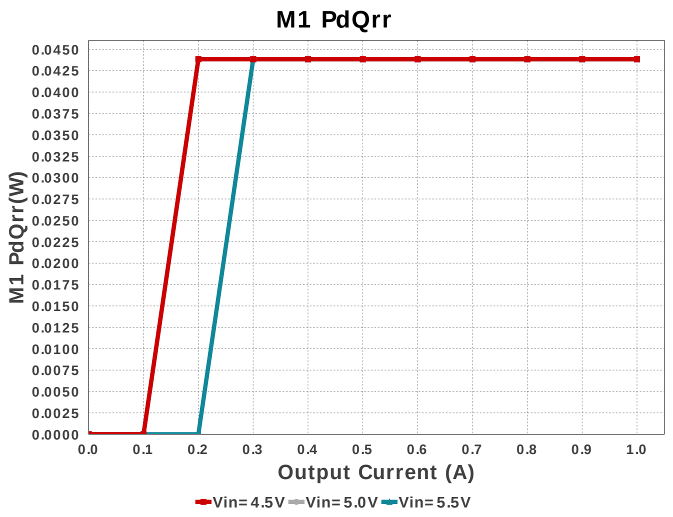
1. The pulse skip mode in the device has not been modeled. Efficiency and operational parameters of the model in pulse skip mode is not valid.

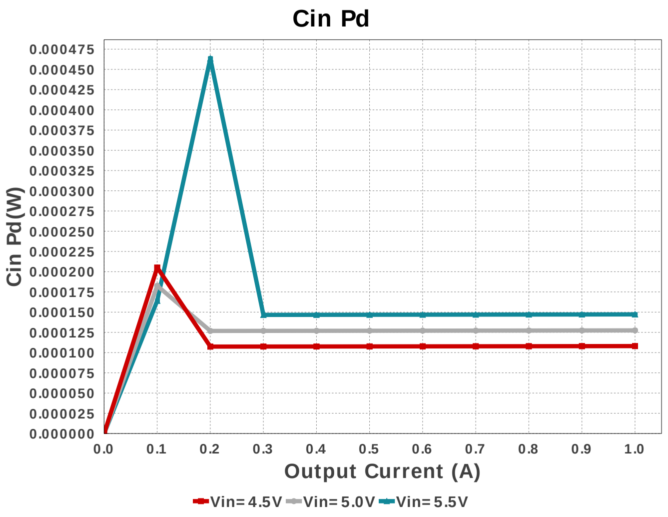
Electrical BOM

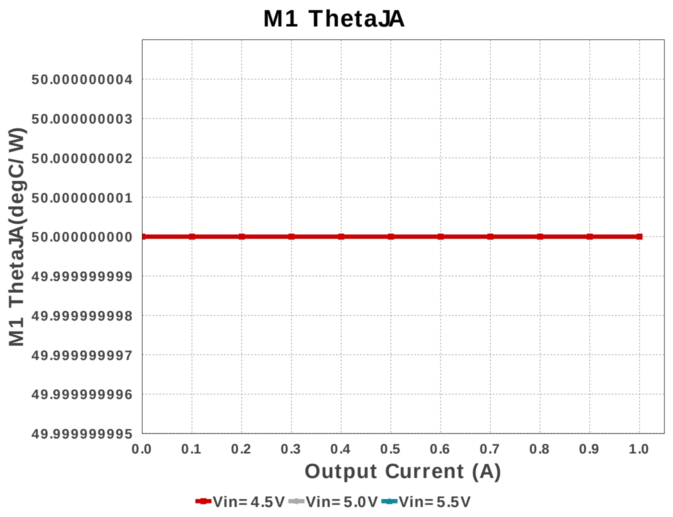
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C12	AVX	06035A101JAT2A Series= C0G/NP0	Cap= 100.0 pF ESR= 119.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cboot	Kemet	C0603C224Z4VACTU Series= Y5V	Cap= 220.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Ccomp	TDK	C3216C0G1H683J160AA Series= C0G/NP0	Cap= 68.0 nF VDC= 5.0 V IRMS= 0.0 A	1	$0.15	1206 11 mm^2
Ccomp2	Samsung Electro-Mechanics	CL21C332JBFNNNE Series= C0G/NP0	Cap= 3.3 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.04	0805 7 mm^2
Cin	MuRata	GRM32ER61A107ME20L Series= X5R	Cap= 100.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	3	$0.41	1210_270 15 mm^2
Cout	Samsung Electro-Mechanics	CL32B106KBJNNWE Series= X7R	Cap= 10.0 uF ESR= 5.0 mOhm VDC= 50.0 V IRMS= 0.0 A	3	$0.18	1210_270 15 mm^2
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 mm^2
Cvcc	TDK	C1608X6S1C475K080AC Series= X6S	Cap= 4.7 uF ESR= 3.728 mOhm VDC= 16.0 V IRMS= 2.69359 A	1	$0.08	0603 5 mm^2

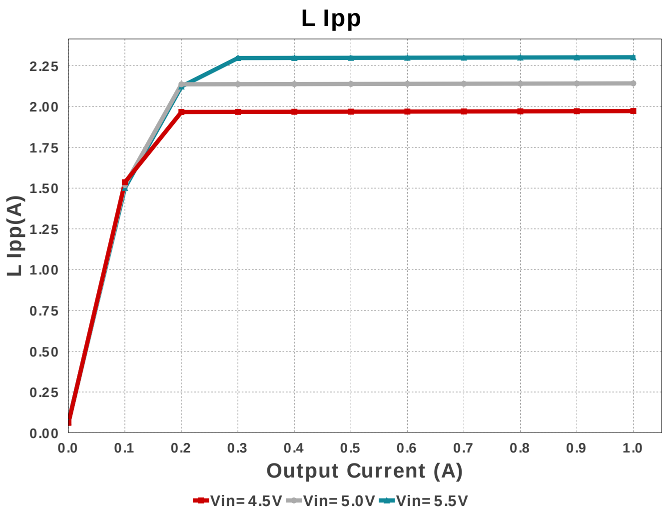
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cvin	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
L1	Coilcraft	SER2915L-103KL	L= 10.0 µH 1.5 mOhm	1	$1.88	 SER2915L 652 mm^2
M1	Texas Instruments	CSD18514Q5A	VdsMax= 40.0 V IdsMax= 50.0 Amps	1	$0.27	TRANS_NexFET_Q5A 55 mm^2
M2	Texas Instruments	CSD18514Q5A	VdsMax= 40.0 V IdsMax= 50.0 Amps	1	$0.27	TRANS_NexFET_Q5A 55 mm^2
R13	Yageo	RC0603FR-0710RL Series= ?	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
R14	Yageo	RC0603FR-0710RL Series= ?	Res= 10.0 Ohm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rcomp	Vishay-Dale	CRCW04022K61FKED Series= CRCW..e3	Res= 2.61 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	Vishay-Dale	CRCW0402232KFKED Series= CRCW..e3	Res= 232.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 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-R005-F-T1 Series= PRL1632	Res= 5.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	0612 11 mm^2
Rsns2	Susumu Co Ltd	PRL1632-R005-F-T1 Series= PRL1632	Res= 5.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	0612 11 mm^2
Rt	Vishay-Dale	CRCW0402301KFKED Series= CRCW..e3	Res= 301.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
U1	Texas Instruments	TPS43061RTER	Switcher	1	$1.25	S-PVQFN-N16 17 mm^2

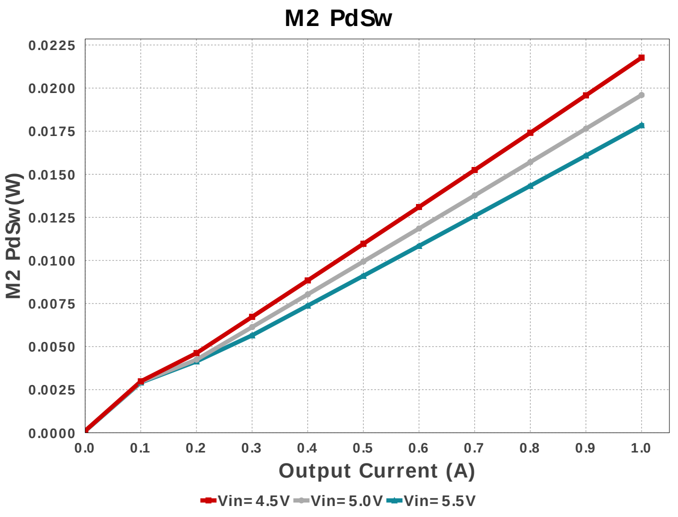

M2 PdQrr
M2 PdQrr(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

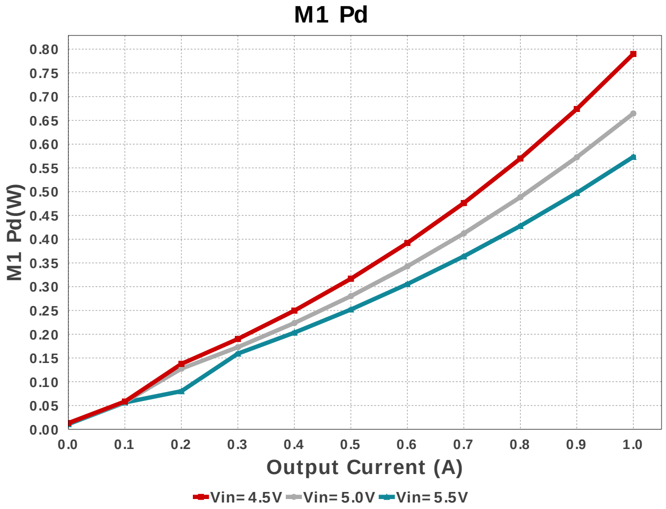

M1 PdQrr
M1 PdQrr(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

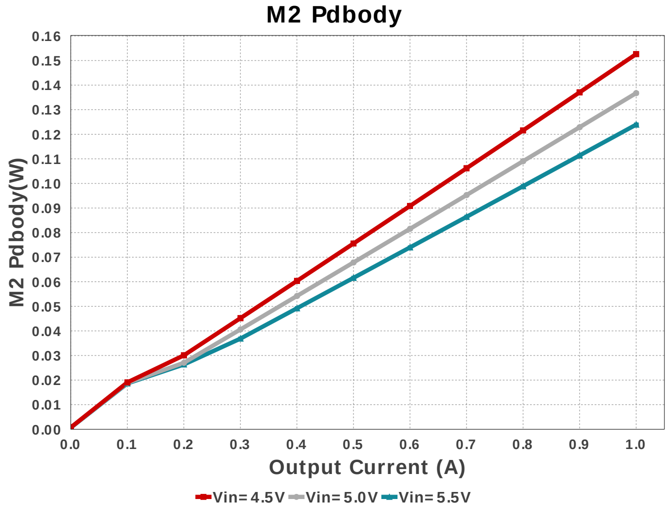

Cin Pd
Cin Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

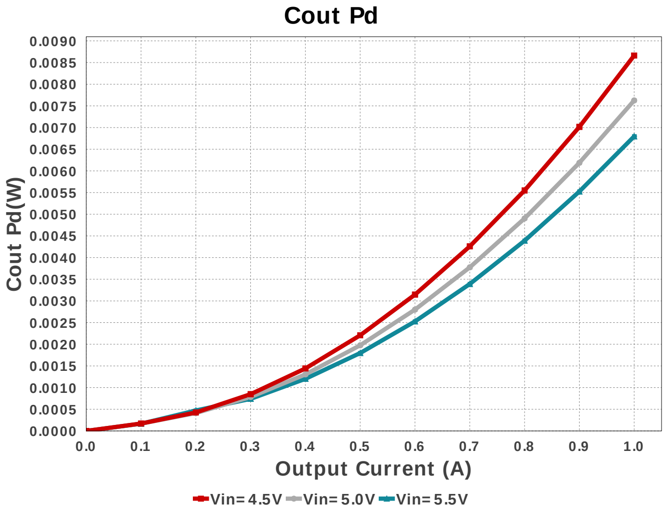

M1 ThetaJA
M1 ThetaJA(degC/W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

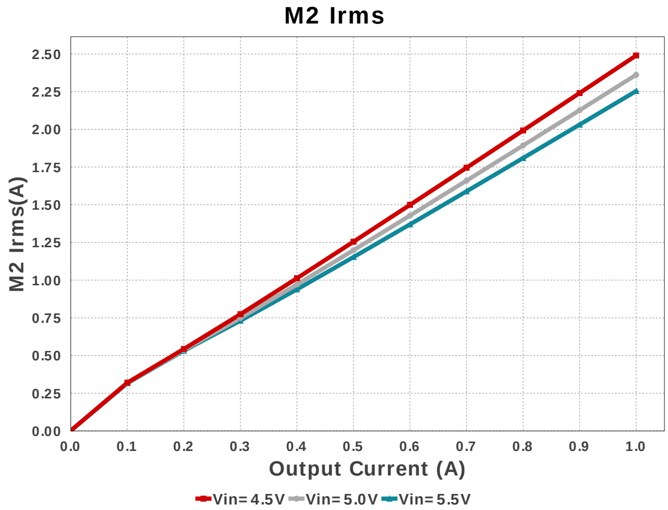

L Ipp
L Ipp(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

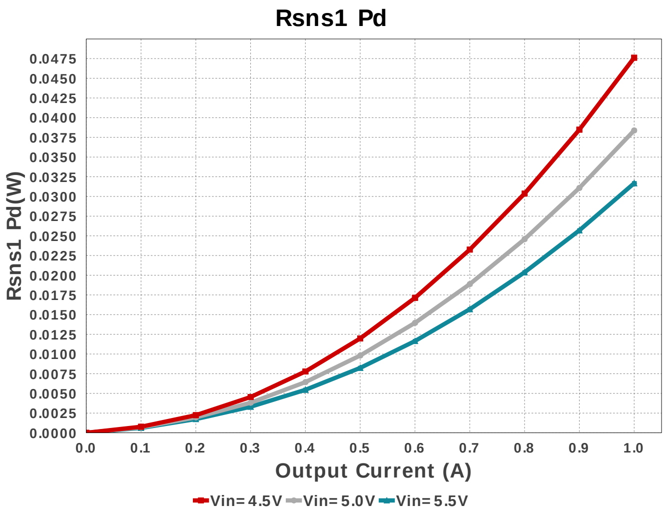

M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

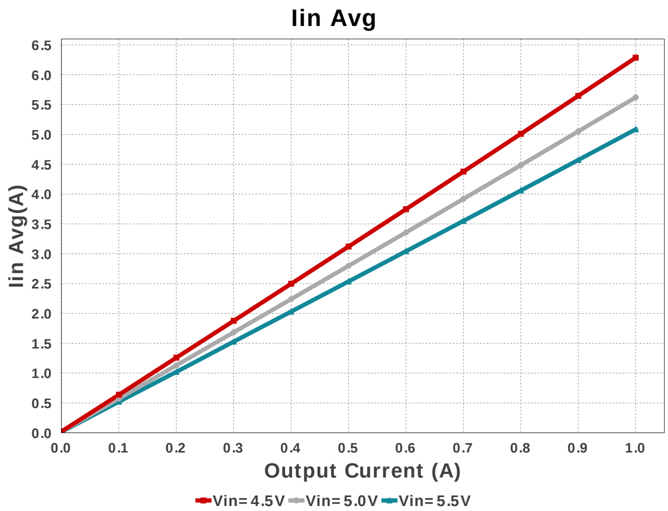

M1 Pd
M1 Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

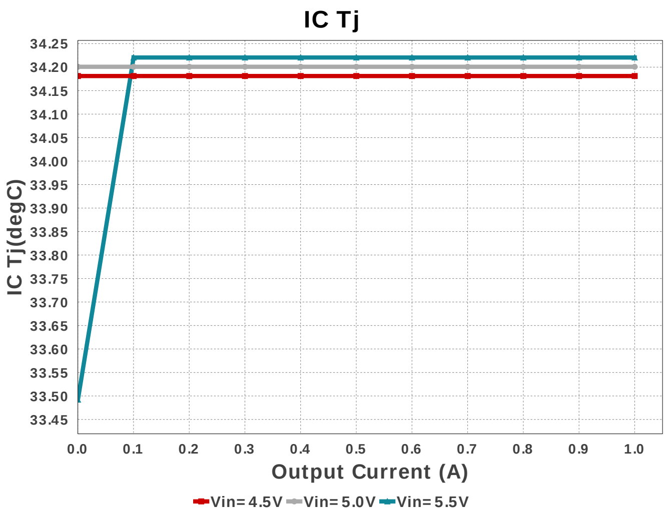

M2 Pdbody
M2 Pdbody(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

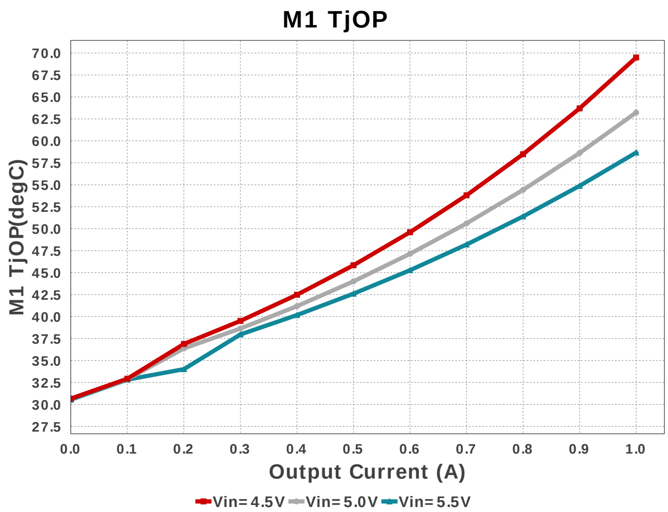

Cout Pd
Cout Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

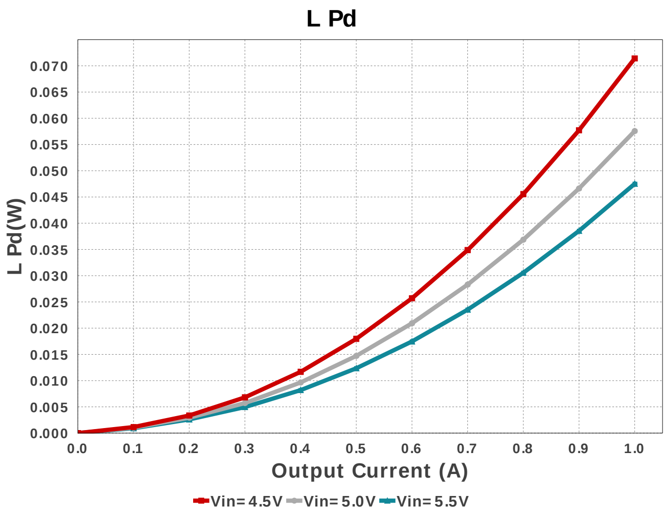

M2 Irms
M2 Irms(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

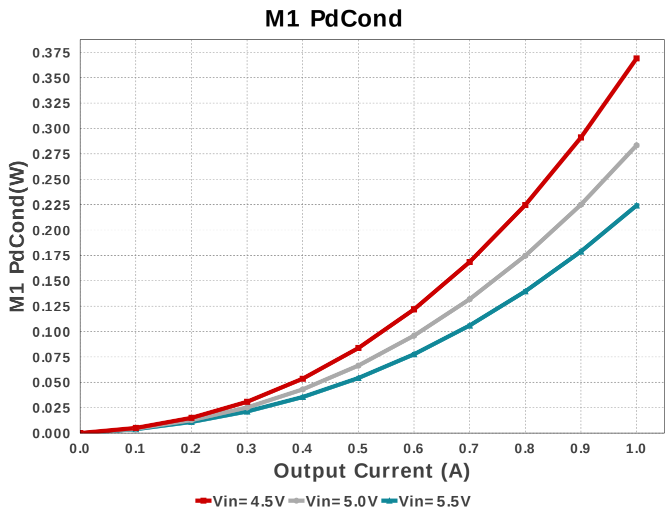

Rsns1 Pd
Rsns1 Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

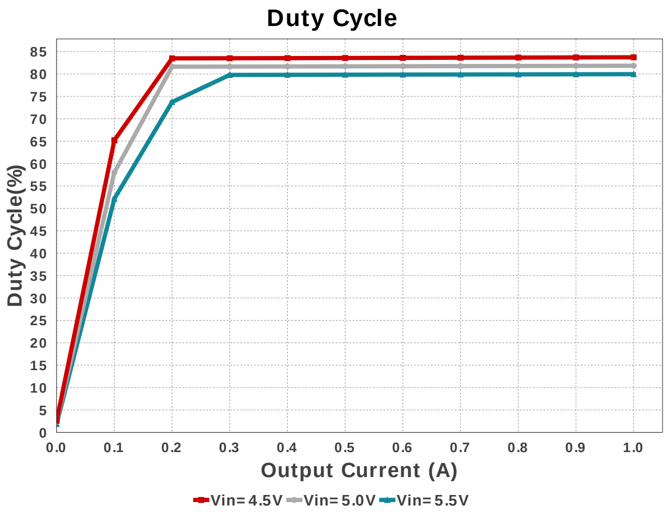

Iin Avg
Iin Avg(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

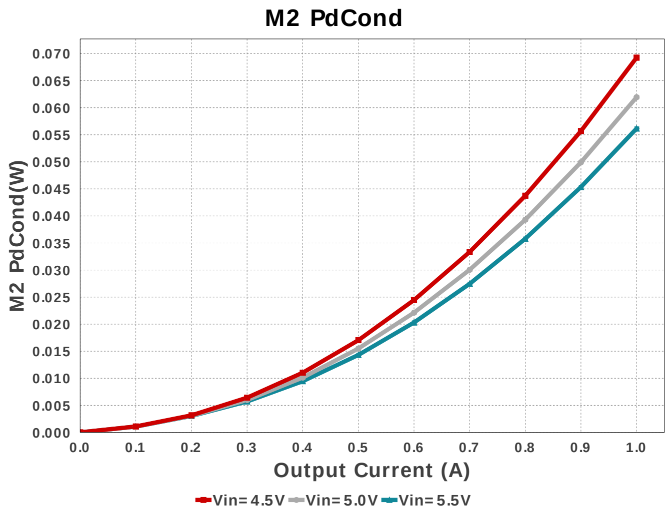

IC Tj
IC Tj(degC)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

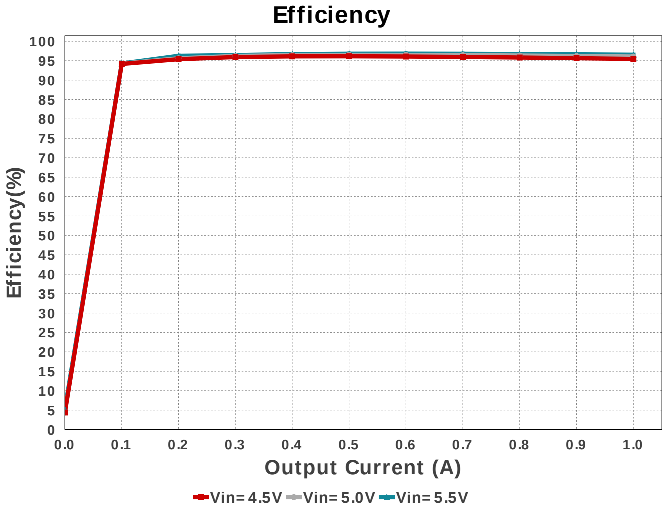

M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

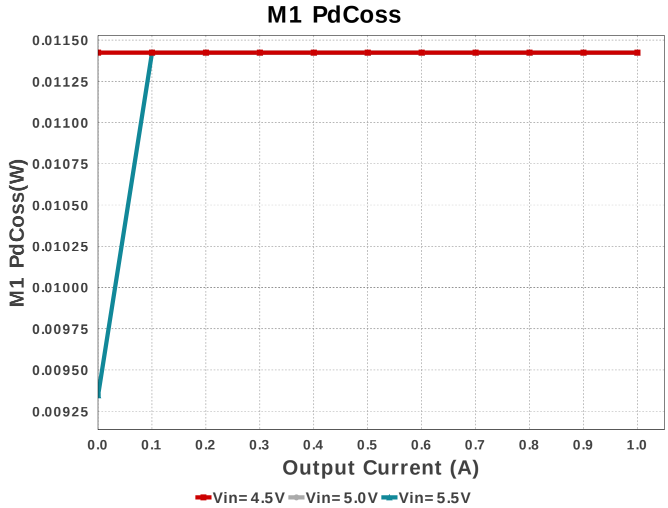

L Pd
L Pd(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

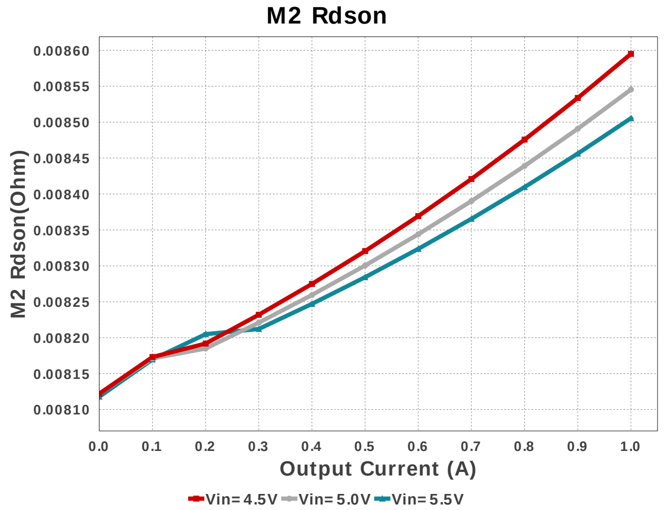

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

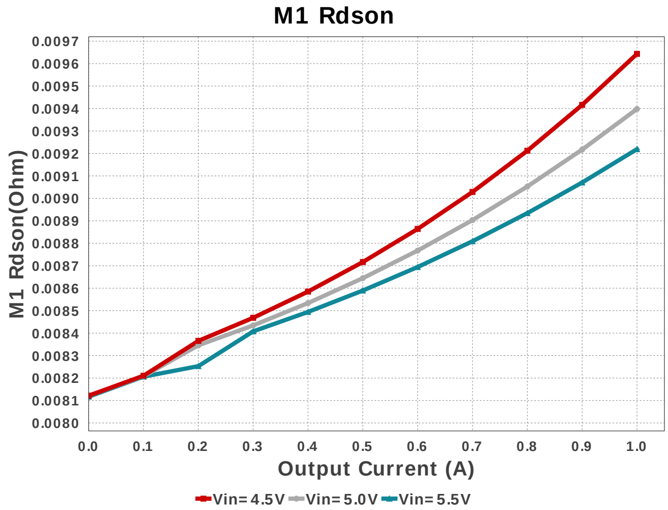

Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

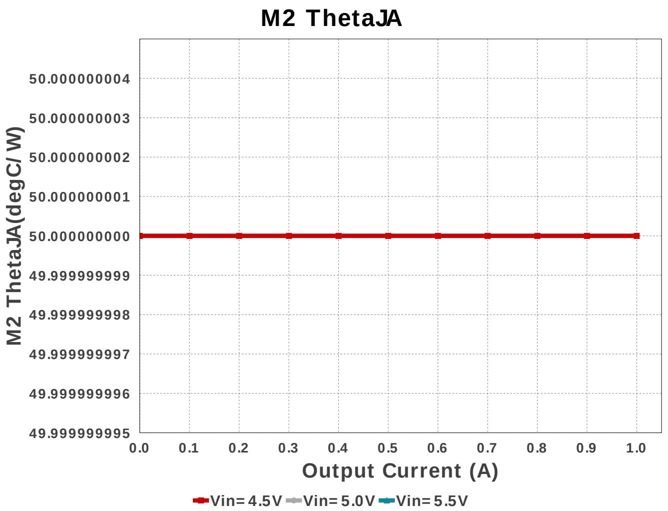

M2 PdCond
M2 PdCond(W)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

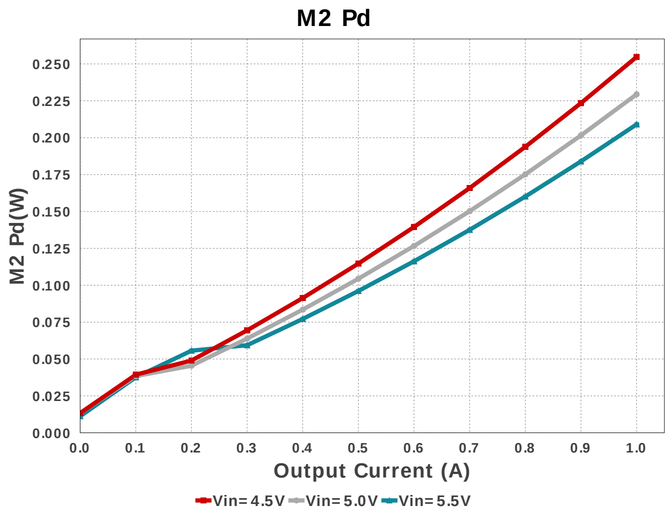

Efficiency
Efficiency(%)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


M1 PdCoss
M1 PdCoss(W)
0.01150
0.01125
0.01100
0.01075
0.01050
0.01025
0.01000
0.00975
0.00950
0.00925
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

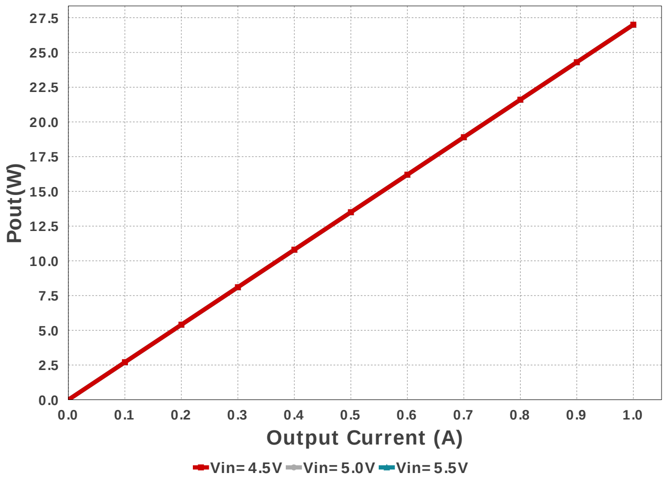

M2 Rdson
M2 Rdson(Ohm)
0.00860
0.00855
0.00850
0.00845
0.00840
0.00835
0.00830
0.00825
0.00820
0.00815
0.00810
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


M1 Rdson
M1 Rdson(Ohm)
0.0097
0.0096
0.0095
0.0094
0.0093
0.0092
0.0091
0.0090
0.0089
0.0088
0.0087
0.0086
0.0085
0.0084
0.0083
0.0082
0.0081
0.0080
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

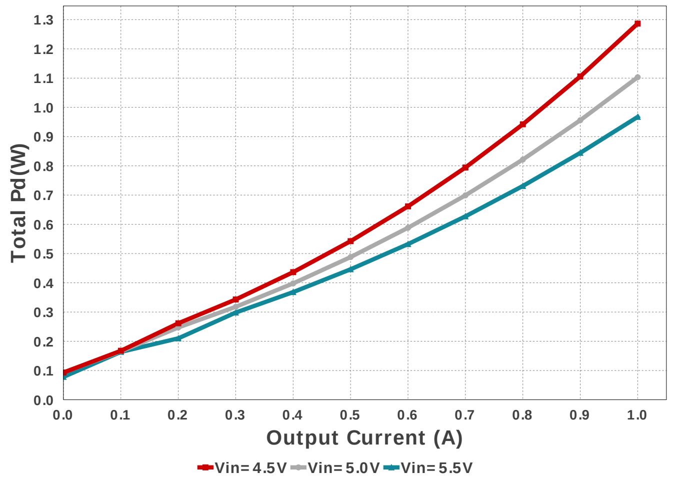

M2 ThetaJA
M2 ThetaJA(degC/ W)
50.000000004
50.000000003
50.000000002
50.000000001
50.000000000
49.999999999
49.999999998
49.999999997
49.999999996
49.999999995
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


M2 Pd
M2 Pd(W)
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

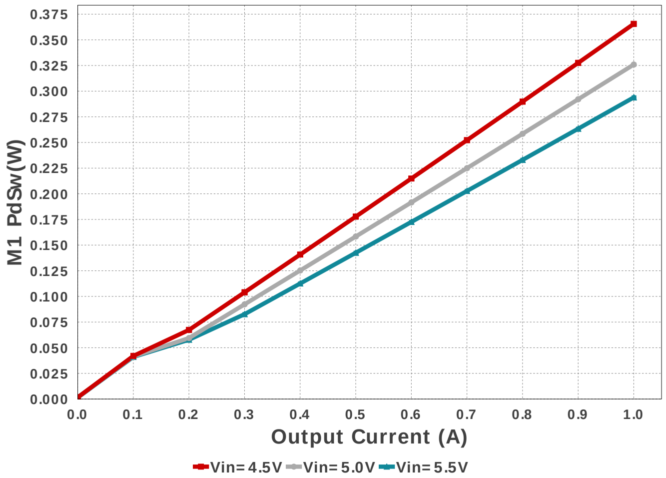
Pout



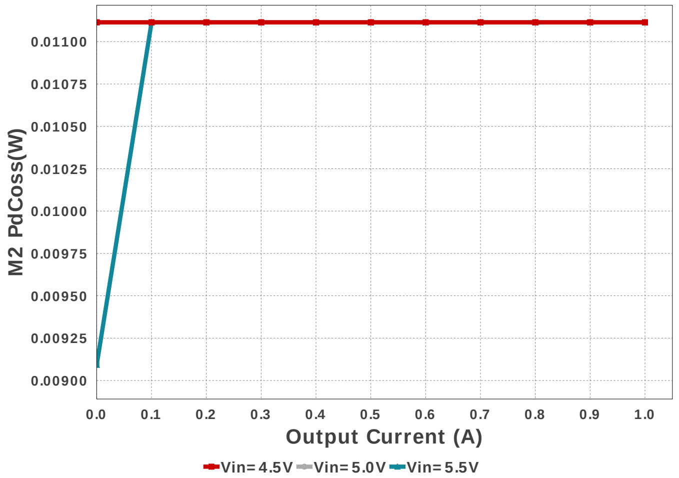
Total Pd



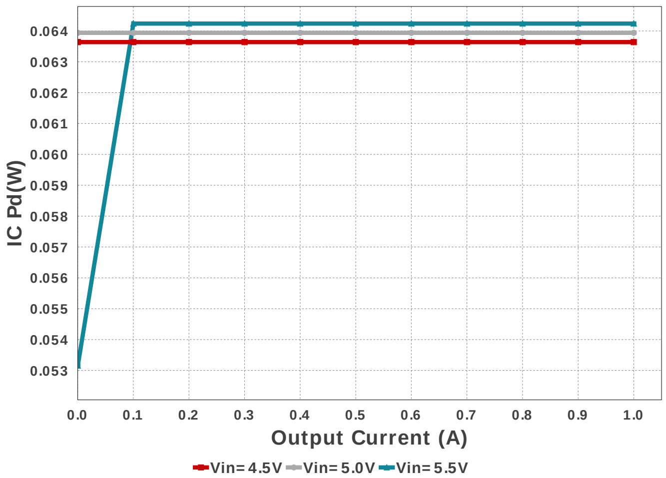
M1 PdSw



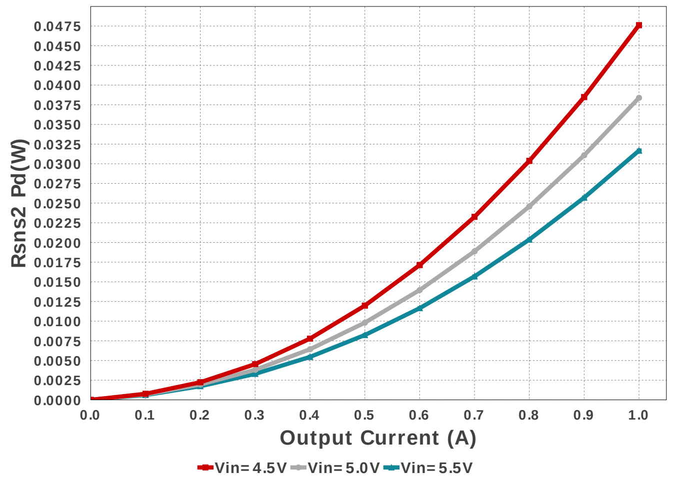
M2 PdCoss

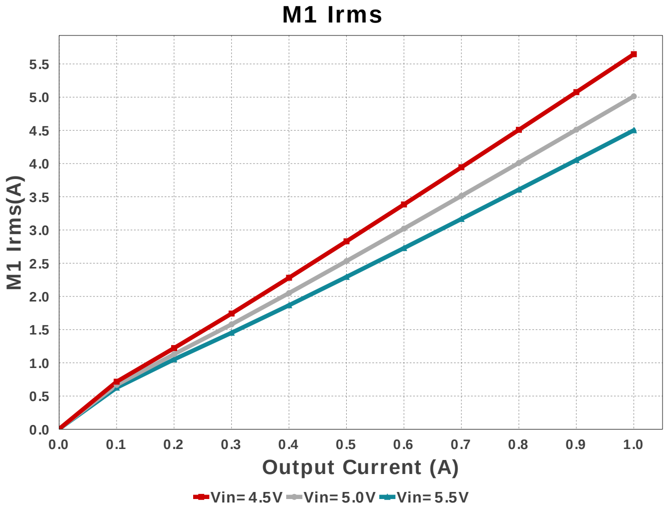


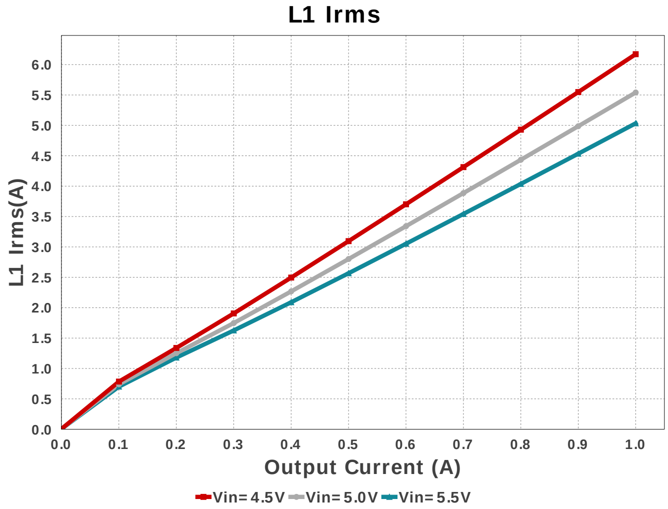
IC Pd

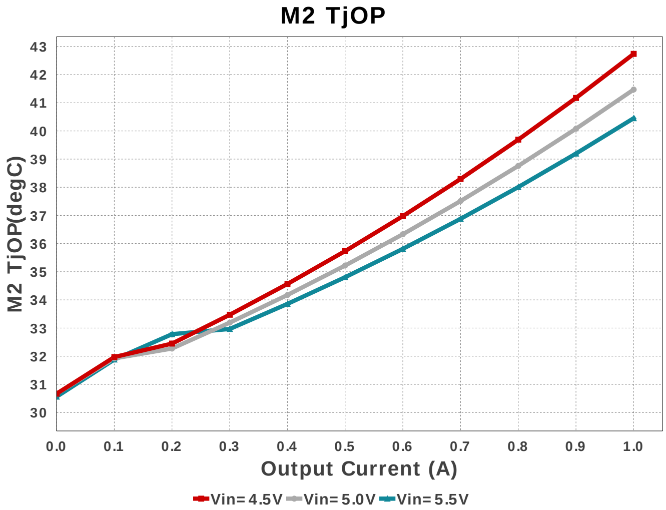


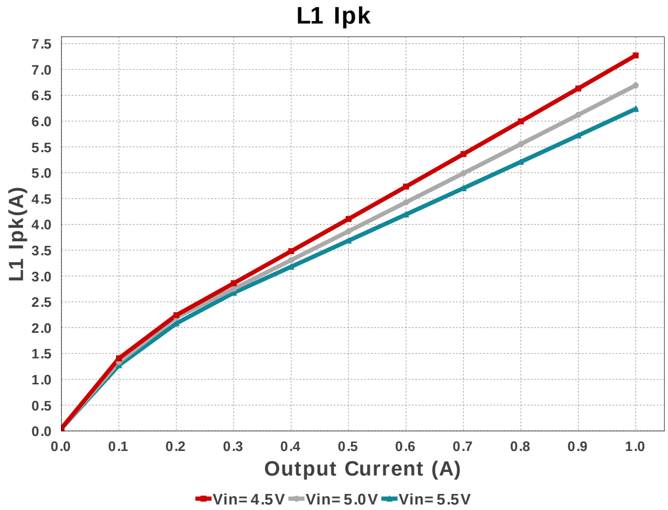
Rsns2 Pd

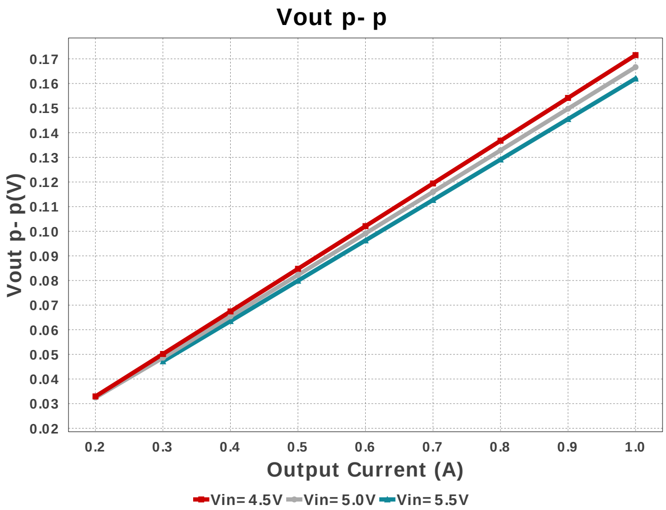


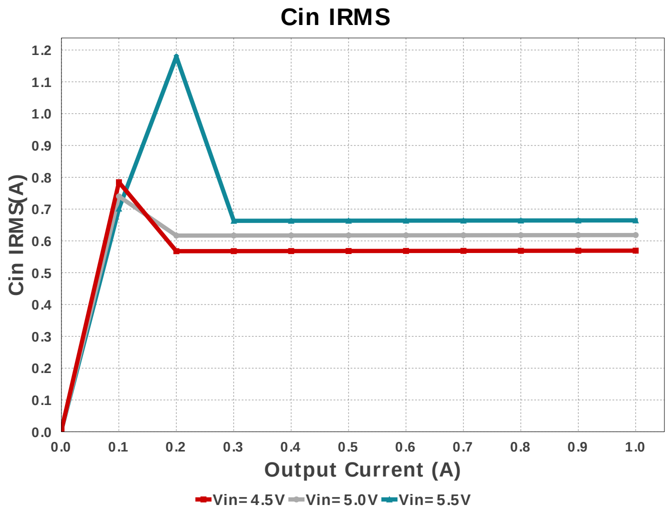

M1 Irms
M1 Irms(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V

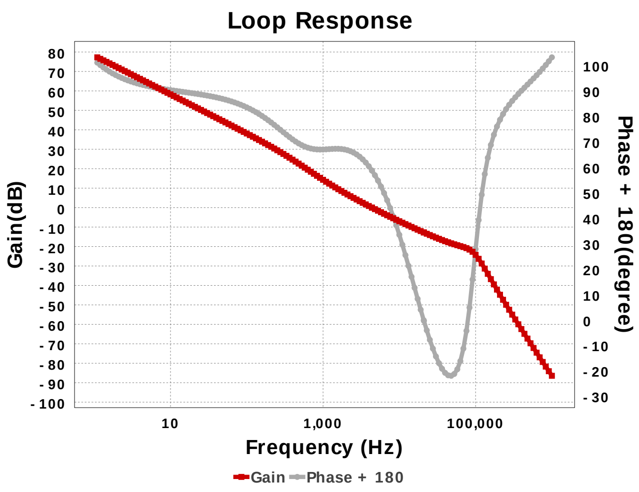

L1 Irms
L1 Irms(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


M2 TjOP
M2 TjOP(degC)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


L1 Ipk
L1 Ipk(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


Vout p- p
Vout p- p(V)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V


Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin= 4.5V Vin= 5.0V Vin= 5.5V



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	569.36 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	108.06 µW	Capacitor	Input capacitor power dissipation
3.	Cout Pd	8.662 mW	Capacitor	Output capacitor power dissipation
4.	IC Pd	63.639 mW	IC	IC power dissipation
5.	IC Tj	34.181 degC	IC	IC junction temperature
6.	ICThetaJA	65.7 degC/W	IC	IC junction-to-ambient thermal resistance
7.	Iin Avg	6.286 A	IC	Average input current
8.	L Ipp	1.972 A	Inductor	Peak-to-peak inductor ripple current
9.	L Pd	71.415 mW	Inductor	Inductor power dissipation
10.	L1 Ipk	7.273 A	Inductor	Inductor peak current
11.	L1 Irms	6.172 A	Inductor	Inductor ripple current
12.	M1 Irms	5.647 A	Mosfet	MOSFET RMS ripple current
13.	M1 Pd	792.04 mW	Mosfet	MOSFET power dissipation
14.	M1 PdCond	369.17 mW	Mosfet	M1 MOSFET conduction losses
15.	M1 PdCoss	11.424 mW	Mosfet	M1 MOSFET Coss Losses
16.	M1 PdQrr	45.9 mW	Mosfet	M1 MOSFET switching losses
17.	M1 PdSw	365.55 mW	Mosfet	M1 MOSFET switching losses
18.	M1 Rdson	9.648 mOhm	Mosfet	Drain-Source On-resistance
19.	M1 ThetaJA	50.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
20.	M1 TjOP	69.602 degC	Mosfet	M1 MOSFET junction temperature
21.	M2 Irms	2.49 A	Mosfet	MOSFET RMS ripple current
22.	M2 Pd	254.74 mW	Mosfet	MOSFET power dissipation
23.	M2 PdCond	69.253 mW	Mosfet	M2 MOSFET conduction losses
24.	M2 PdCoss	11.114 mW	Mosfet	M2 MOSFET Coss Losses
25.	M2 PdSw	21.767 mW	Mosfet	M2 MOSFET switching losses
26.	M2 Pdbody	152.61 mW	Mosfet	Power dissipation through lower FET
27.	M2 Rdson	8.595 mOhm	Mosfet	Drain-Source On-resistance
28.	M2 ThetaJA	50.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
29.	M2 TjOP	42.737 degC	Mosfet	MOSFET junction temperature
30.	Cin Pd	108.06 µW	Power	Input capacitor power dissipation
31.	Cout Pd	8.662 mW	Power	Output capacitor power dissipation
32.	IC Pd	63.639 mW	Power	IC power dissipation
33.	L Pd	71.415 mW	Power	Inductor power dissipation
34.	M1 Pd	792.04 mW	Power	MOSFET power dissipation
35.	M1 PdCond	369.17 mW	Power	M1 MOSFET conduction losses
36.	M1 PdCoss	11.424 mW	Power	M1 MOSFET Coss Losses
37.	M1 PdQrr	45.9 mW	Power	M1 MOSFET switching losses
38.	M1 PdSw	365.55 mW	Power	M1 MOSFET switching losses
39.	M2 Pd	254.74 mW	Power	MOSFET power dissipation
40.	M2 PdCond	69.253 mW	Power	M2 MOSFET conduction losses
41.	M2 PdCoss	11.114 mW	Power	M2 MOSFET Coss Losses
42.	M2 PdQrr	0.0 W	Power	Synchronous Boost High Side Reverse Recovery
43.	M2 PdSw	21.767 mW	Power	M2 MOSFET switching losses
44.	M2 Pdbody	152.61 mW	Power	Power dissipation through lower FET
45.	Rsns1 Pd	47.61 mW	Power	Rsns1 Power Dissipation
46.	Rsns2 Pd	47.61 mW	Power	Rsns2 Power Dissipation
47.	Total Pd	1.289 W	Power	Total Power Dissipation
48.	Rsns1 Pd	47.61 mW	Resistor	Rsns1 Power Dissipation
49.	Rsns2 Pd	47.61 mW	Resistor	Rsns2 Power Dissipation
50.	BOM Count	26	System Information	Total Design BOM count

#	Name	Value	Category	Description
51.	Cross Freq	3.629 kHz	System Information	Bode plot crossover frequency
52.	Duty Cycle	83.727 %	System Information	Duty cycle
53.	Efficiency	95.444 %	System Information	Steady state efficiency
54.	FootPrint	953.0 mm^2	System Information	Total Foot Print Area of BOM components
55.	Frequency	191.03 kHz	System Information	Switching frequency
56.	Gain Marg	-10.604 dB	System Information	Bode Plot Gain Margin
57.	Iout	1.0 A	System Information	Iout operating point
58.	Low Freq Gain	75.582 dB	System Information	Gain at 1Hz
59.	Mode	CCM	System Information	Conduction Mode
60.	Phase Marg	55.815 deg	System Information	Bode Plot Phase Margin
61.	Pout	27.0 W	System Information	Total output power
62.	Total BOM	$6.22	System Information	Total BOM Cost
63.	Vin	4.5 V	System Information	Vin operating point
64.	Vout	27.0 V	System Information	Operational Output Voltage
65.	Vout Actual	26.951 V	System Information	Vout Actual calculated based on selected voltage divider resistors
66.	Vout Tolerance	4.018 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
67.	Vout p-p	171.532 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
SoftStart	1.01 ms	Soft Start Time (ms)
VinMax	5.5	Maximum input voltage
VinMin	4.5	Minimum input voltage
VinTyp	5.0	Typical input voltage
Vout	27.0	Output Voltage
base_pn	TPS43061	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	301.047 k	Customer Selected Frequency

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

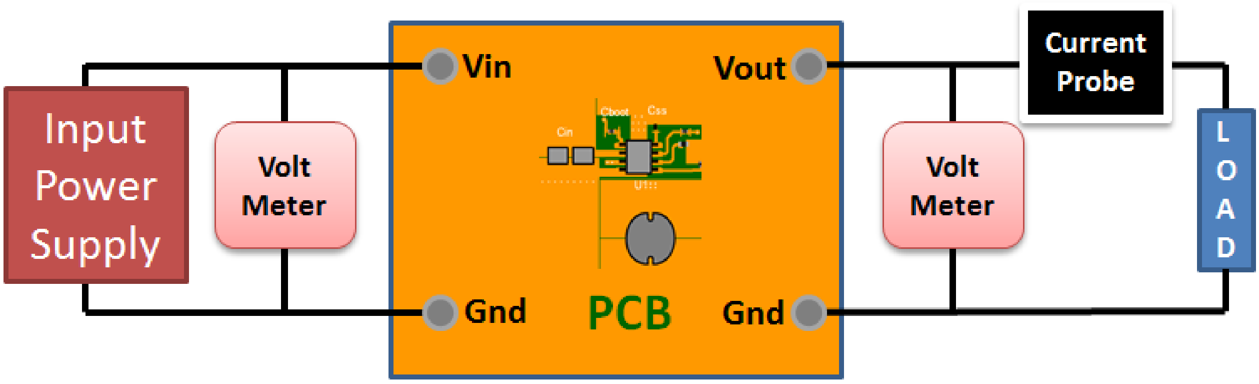
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 4.5V 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, 5.5V Gate Drive optimized for Low Qg NexFETs Thermal Shutdown

2. Master key : E56AD4253327D321[v1]

3. **TPS43061** Product Folder : http://www.ti.com/product/TPS43061 : contains the data sheet and other resources.

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