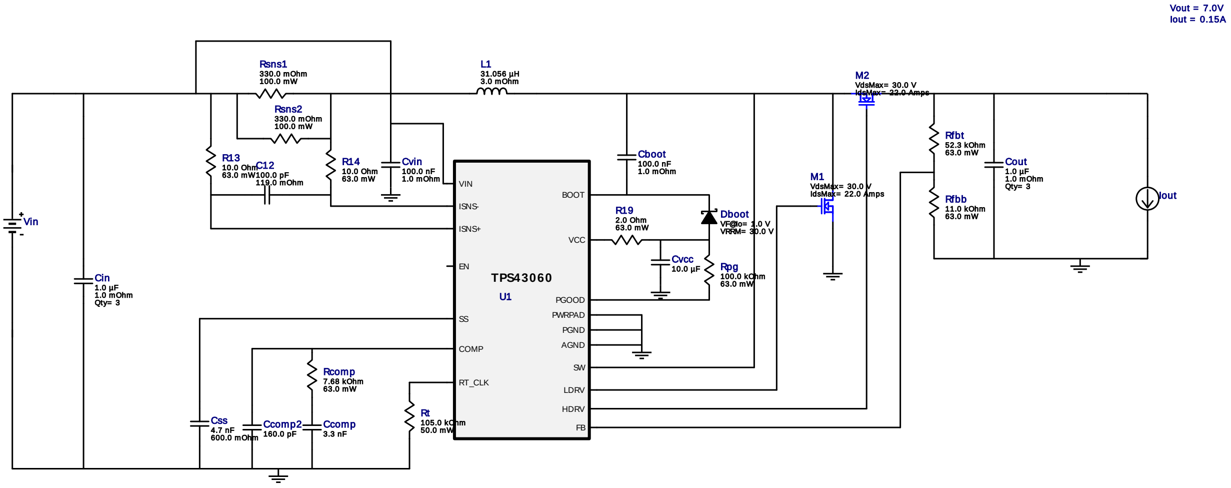
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 5.0V
VinMax = 5.0V
Vout = 7.0V
Iout = 0.15A

Device = TPS43060RTER
Topology = Boost
Created = 2020-06-09 22:46:45.836
BOM Cost = NA
BOM Count = 28
Total Pd = 0.06W

Design : 62 TPS43060RTER
TPS43060RTER 5V-5V to 7.00V @ 0.15A

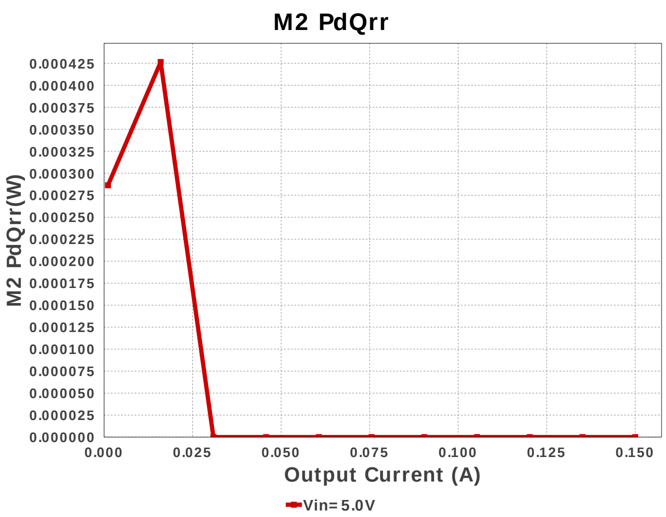


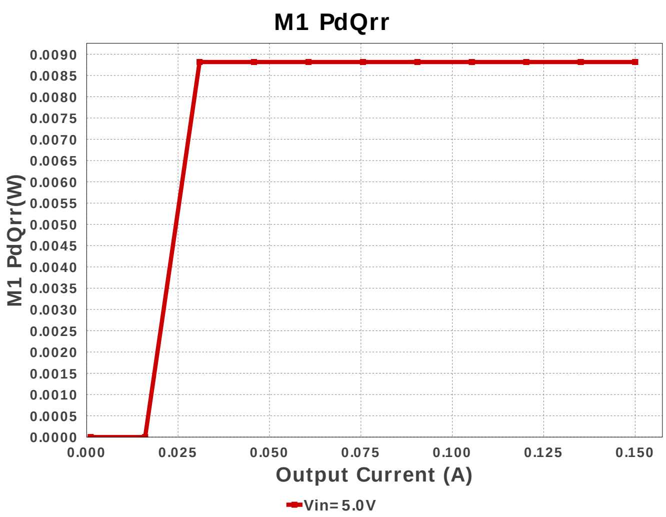
1. The pulse skip mode in the device has not been modeled. Efficiency and operational parameters of the model in pulse skip mode is not valid.

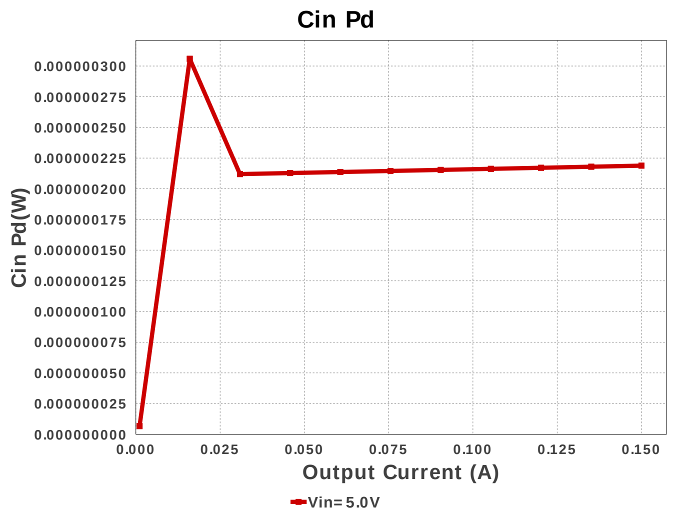
Electrical BOM

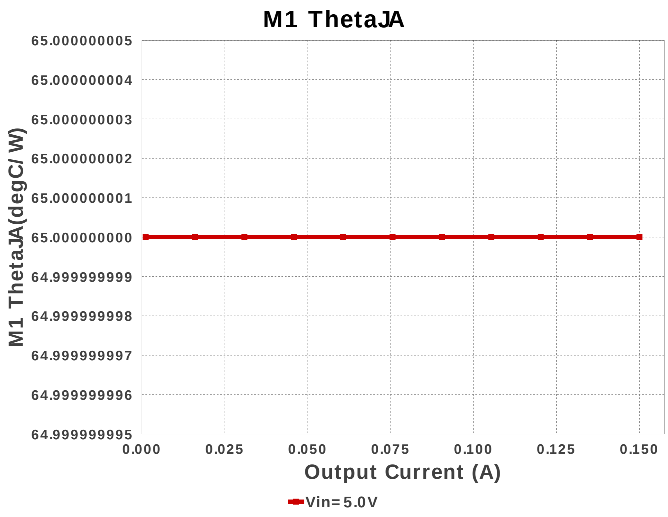
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
C12	AVX	06035A101JAT2A Series= C0G/NP0	Cap= 100.0 pF ESR= 119.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cboot	MuRata	GRM155R71C104KA88D Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Ccomp	TDK	C2012C0G1H332J060AA Series= C0G/NP0	Cap= 3.3 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm^2
Ccomp2	Samsung Electro-Mechanics	CL10C161JB8NNNC Series= C0G/NP0	Cap= 160.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm^2
Cin	Kemet	C0603C105K8PACTU Series= X5R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 10.0 V IRMS= 0.0 A	3	$0.01	0603 5 mm^2
Cout	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	3	$0.02	0603 5 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	Taiyo Yuden	EMK107BBJ106MA-T Series= X5R	Cap= 10.0 uF VDC= 16.0 V IRMS= 0.0 A	1	$0.07	0603 5 mm^2
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

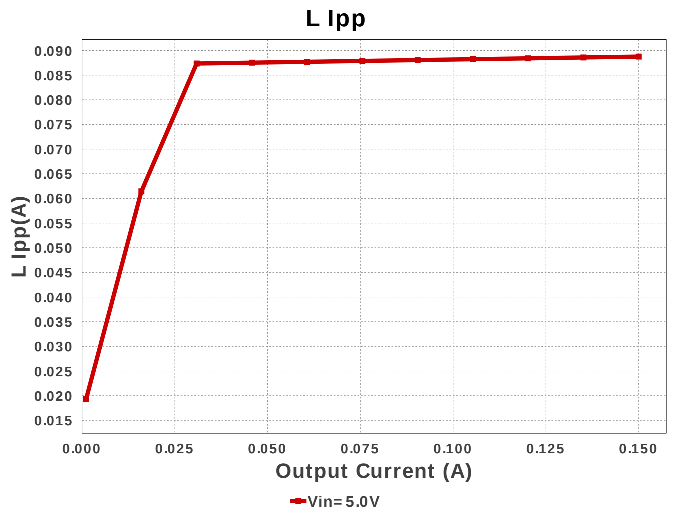
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Dboot	SMC Diode Solutions	BAT54WSTR	VF@Io= 1.0 V VRRM= 30.0 V	1	$0.02	SOD-323 9 mm^2
L1	CUSTOM	CUSTOM	L= 31.056 µH 3.0 mOhm	1	NA	CUSTOM 0 mm^2
M1	Texas Instruments	CSD17571Q2	VdsMax= 30.0 V IdsMax= 22.0 Amps	1	$0.10	DQK0006C 9 mm^2
M2	Texas Instruments	CSD17571Q2	VdsMax= 30.0 V IdsMax= 22.0 Amps	1	$0.10	DQK0006C 9 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	CRCW04027K68FKED Series= CRCW..e3	Res= 7.68 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	CRCW040252K3FKED Series= CRCW..e3	Res= 52.3 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	Panasonic	ERJ-3RQFR33V Series= ERJ-3R	Res= 330.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.02	0603 5 mm^2
Rsns2	Panasonic	ERJ-3RQFR33V Series= ERJ-3R	Res= 330.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.02	0603 5 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	$1.10	S-PVQFN-N16 17 mm^2

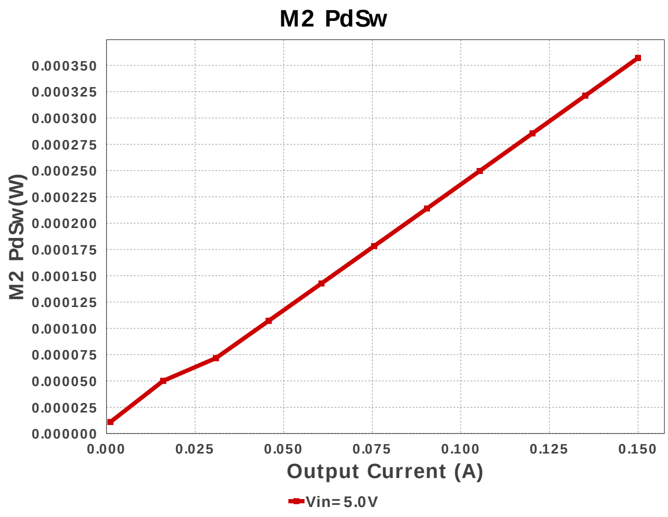


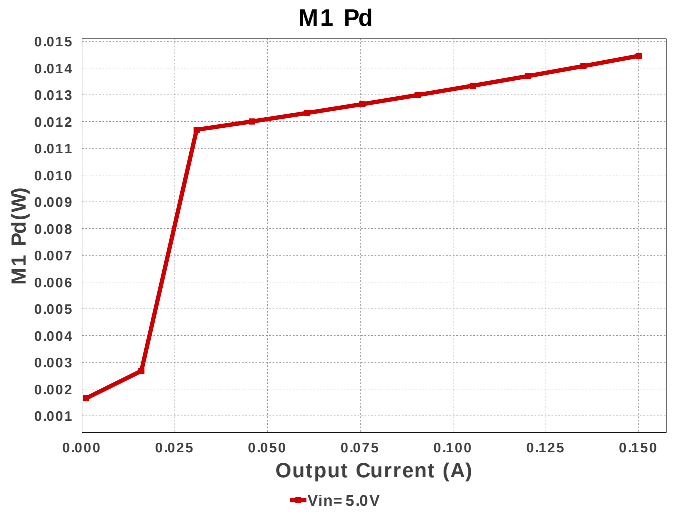


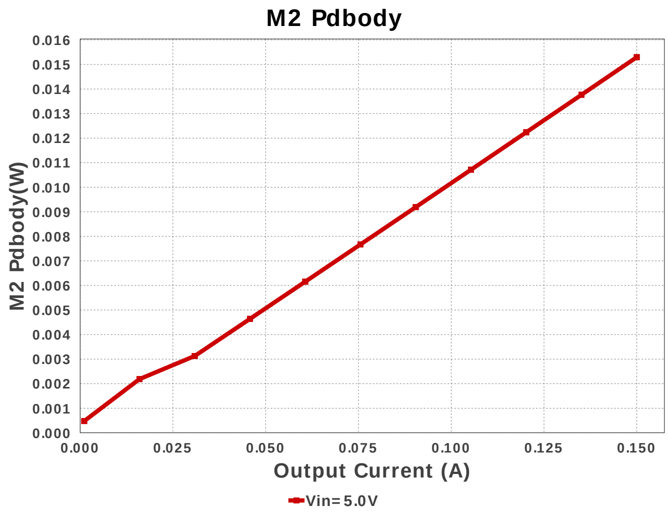

Cin Pd
Cin Pd(W)
0.000000300
0.000000275
0.000000250
0.000000225
0.000000200
0.000000175
0.000000150
0.000000125
0.000000100
0.000000075
0.000000050
0.000000025
0.000000000
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin= 5.0V


M1 ThetaJA
M1 ThetaJA(degC/ W)
65.000000005
65.000000004
65.000000003
65.000000002
65.000000001
65.000000000
64.999999999
64.999999998
64.999999997
64.999999996
64.999999995
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin= 5.0V

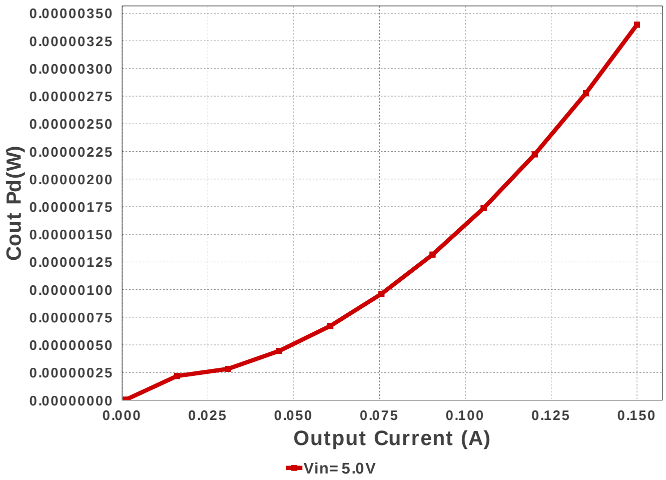

L Ipp
L Ipp(A)
0.090
0.085
0.080
0.075
0.070
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin= 5.0V


M2 PdSw
M2 PdSw(W)
0.000350
0.000325
0.000300
0.000275
0.000250
0.000225
0.000200
0.000175
0.000150
0.000125
0.000100
0.000075
0.000050
0.000025
0.000000
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin= 5.0V

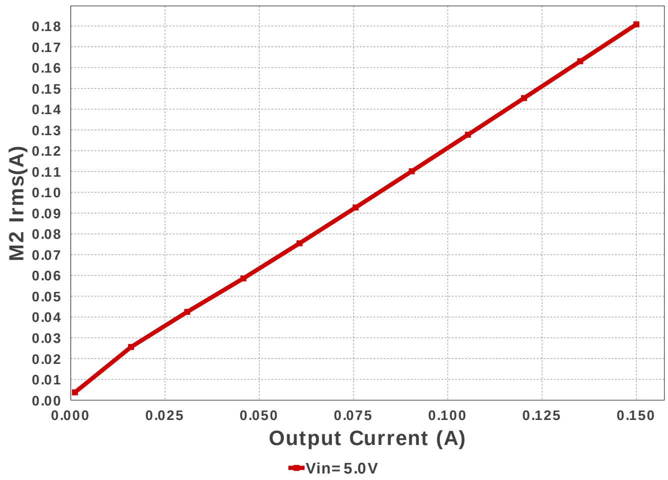

M1 Pd
M1 Pd(W)
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin= 5.0V


M2 Pdbody
M2 Pdbody(W)
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin= 5.0V

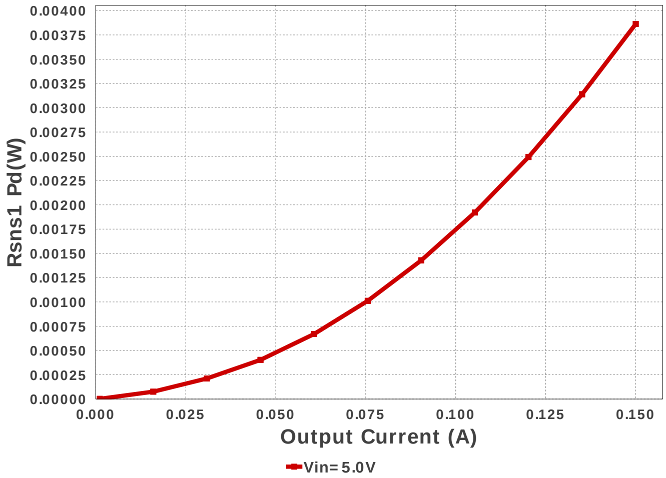
Cout Pd



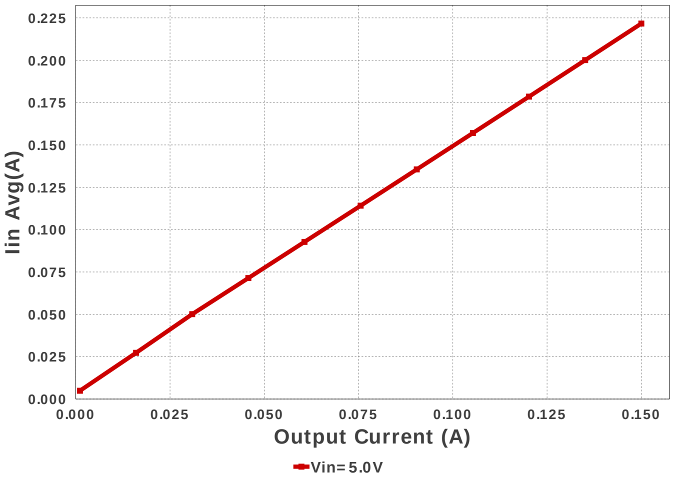
M2 Irms



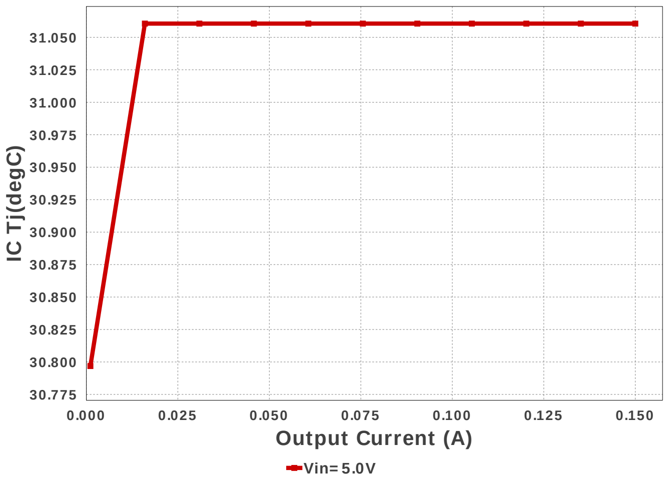
Rsns1 Pd



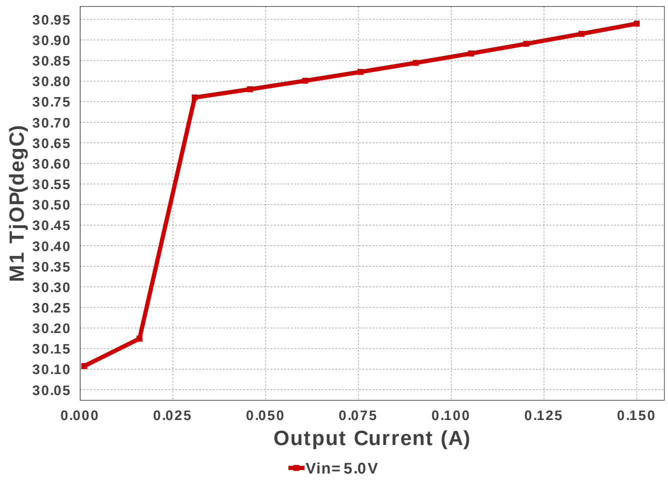
Iin Avg

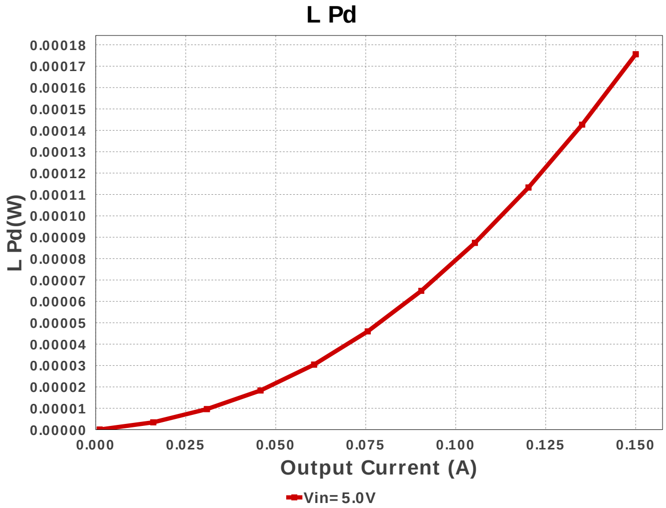


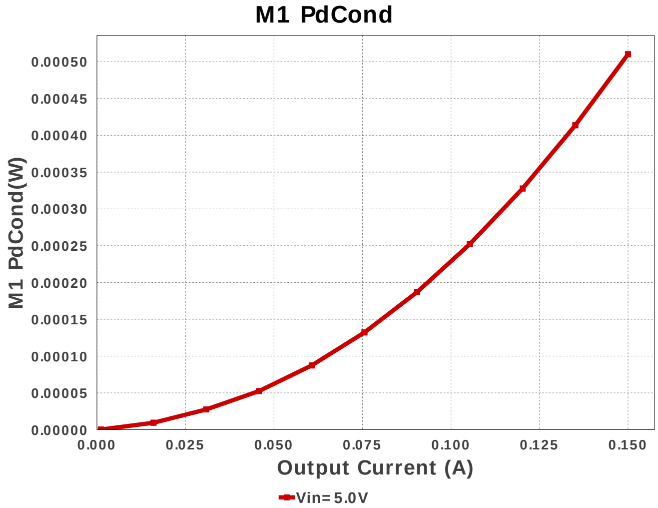
IC Tj

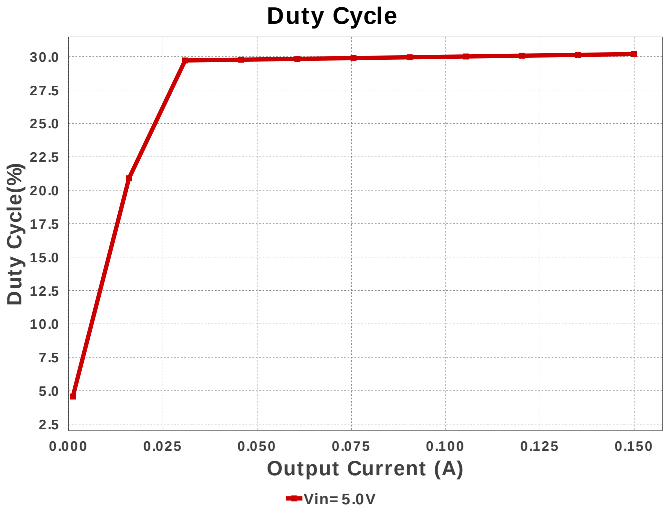


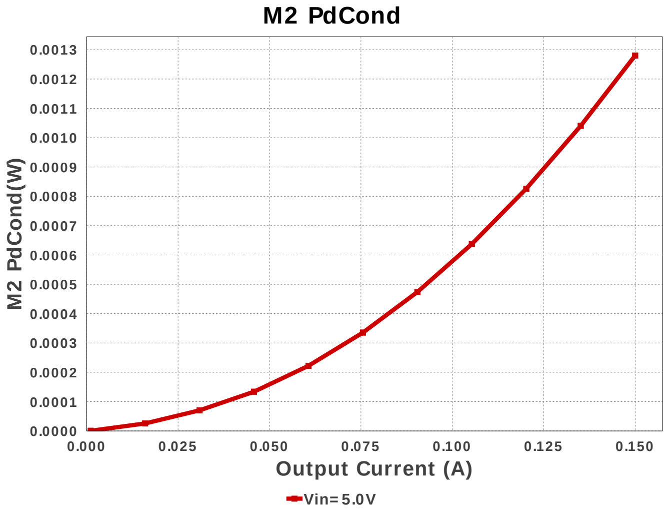
M1 TjOP

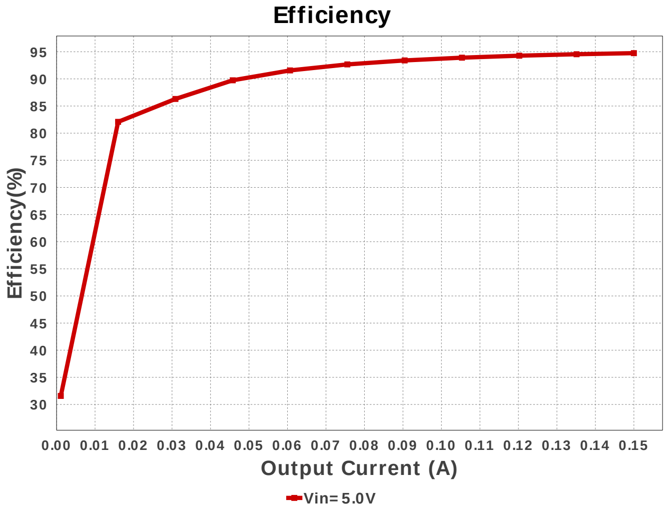


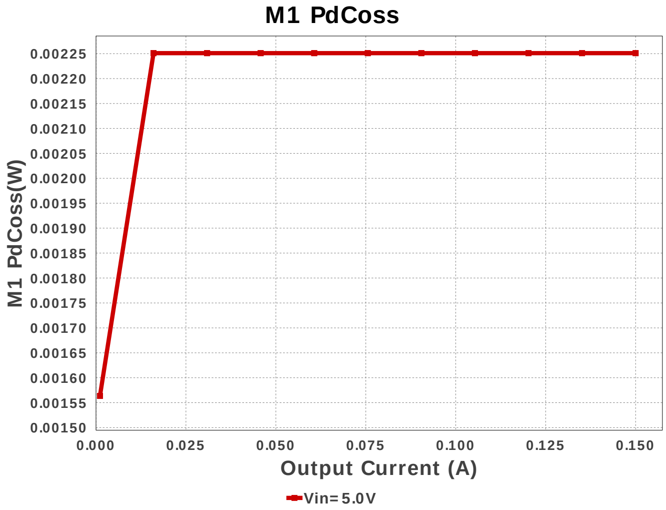

L Pd
L Pd(W)
0.00018
0.00017
0.00016
0.00015
0.00014
0.00013
0.00012
0.00011
0.00010
0.00009
0.00008
0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
0.00001
0.00000
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin= 5.0V

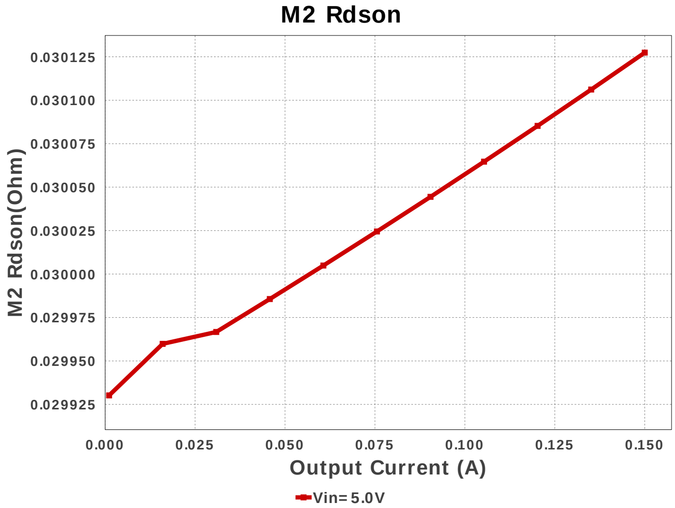

M1 PdCond
M1 PdCond(W)
0.00050
0.00045
0.00040
0.00035
0.00030
0.00025
0.00020
0.00015
0.00010
0.00005
0.00000
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin= 5.0V

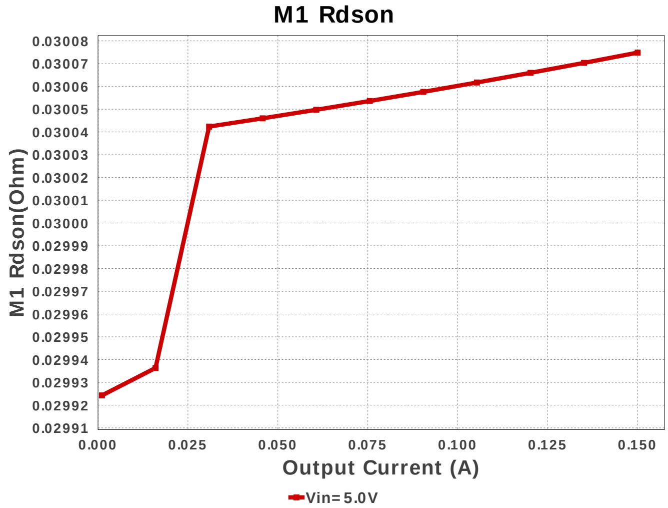

Duty Cycle
Duty Cycle(%)
30.0
27.5
25.0
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin= 5.0V

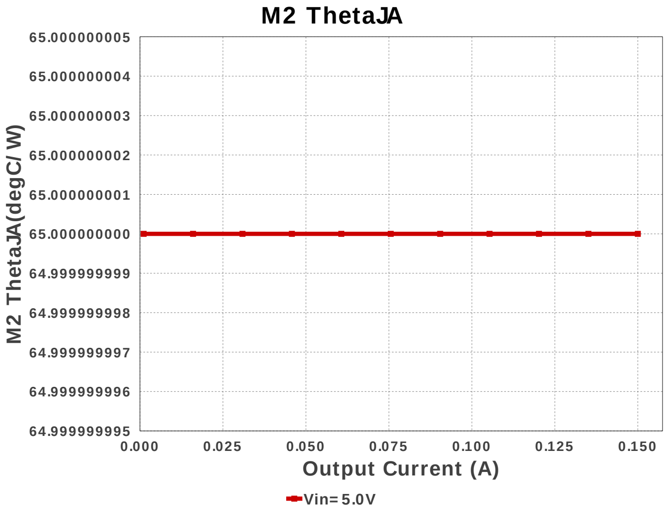

M2 PdCond
M2 PdCond(W)
0.0013
0.0012
0.0011
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin= 5.0V

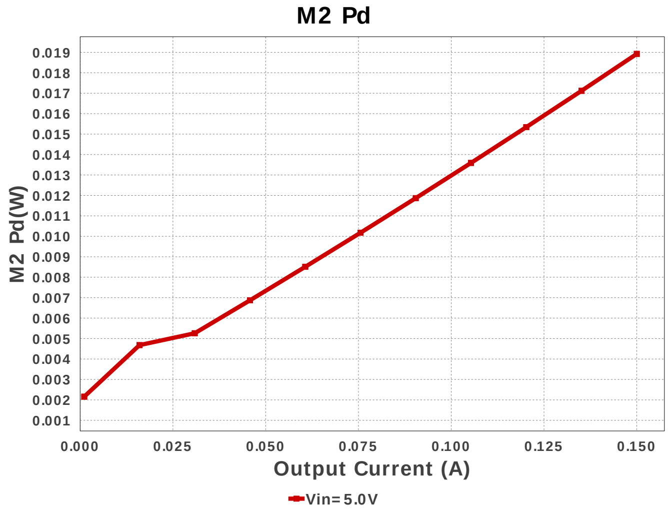

Efficiency
Efficiency(%)
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.13 0.14 0.15
Output Current (A)
Vin= 5.0V

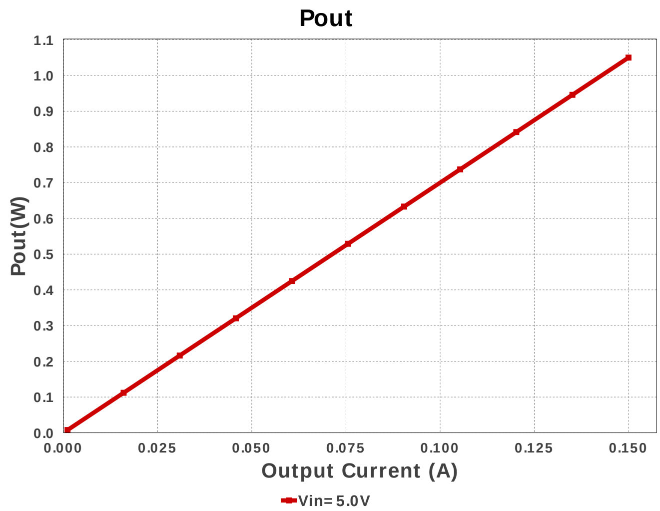

M1 PdCoss
M1 PdCoss(W)
0.00225
0.00220
0.00215
0.00210
0.00205
0.00200
0.00195
0.00190
0.00185
0.00180
0.00175
0.00170
0.00165
0.00160
0.00155
0.00150
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin= 5.0V

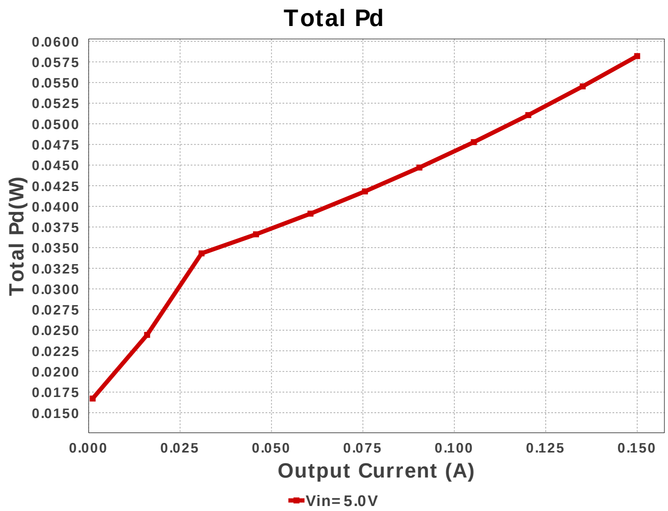

M2 Rdson
M2 Rdson(Ohm)
0.030125
0.030100
0.030075
0.030050
0.030025
0.030000
0.029975
0.029950
0.029925
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=5.0V

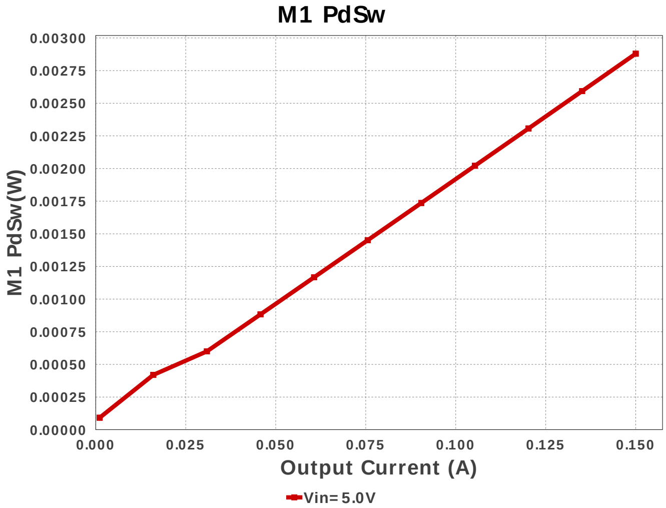

M1 Rdson
M1 Rdson(Ohm)
0.03008
0.03007
0.03006
0.03005
0.03004
0.03003
0.03002
0.03001
0.03000
0.02999
0.02998
0.02997
0.02996
0.02995
0.02994
0.02993
0.02992
0.02991
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=5.0V

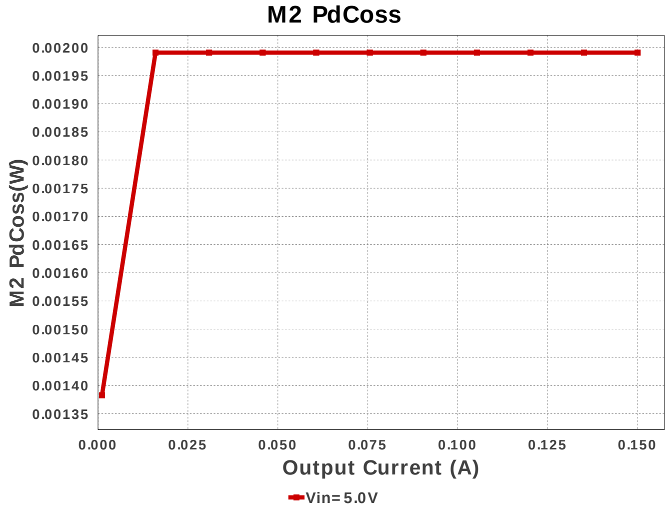

M2 ThetaJA
M2 ThetaJA(degC/ W)
65.000000005
65.000000004
65.000000003
65.000000002
65.000000001
65.000000000
64.999999999
64.999999998
64.999999997
64.999999996
64.999999995
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=5.0V

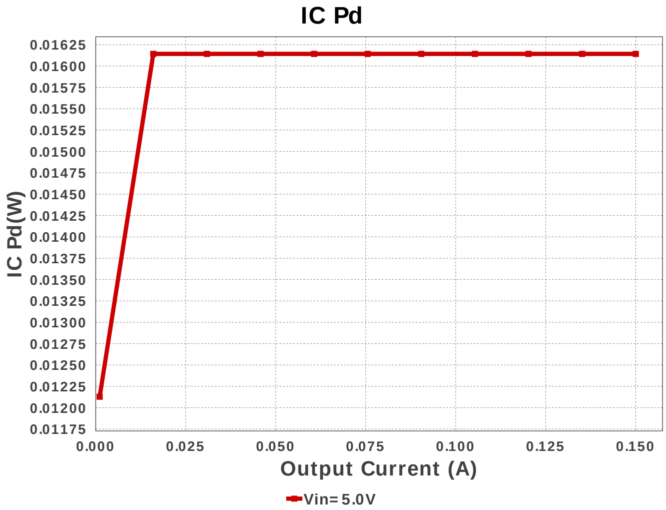

M2 Pd
M2 Pd(W)
0.019
0.018
0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=5.0V

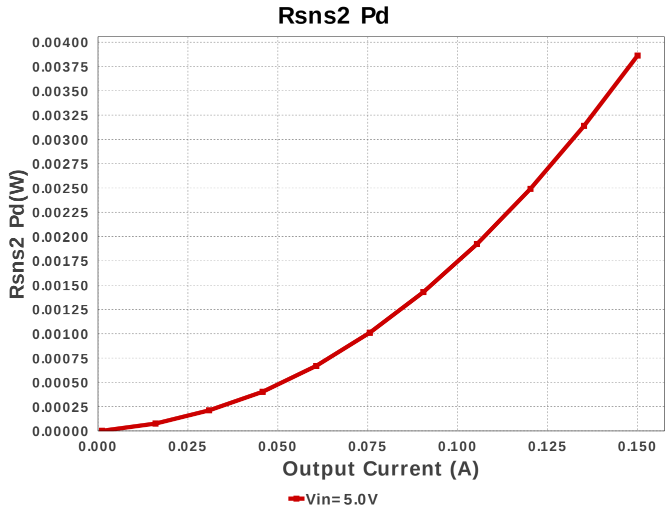

Pout
Pout(W)
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=5.0V

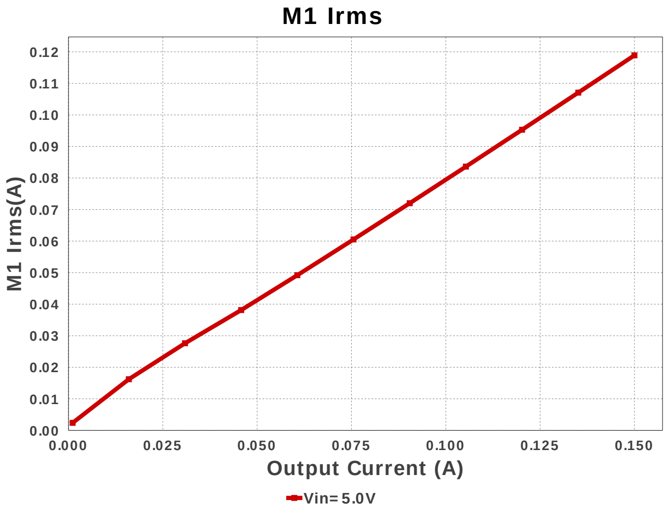

Total Pd
Total Pd(W)
0.0600
0.0575
0.0550
0.0525
0.0500
0.0475
0.0450
0.0425
0.0400
0.0375
0.0350
0.0325
0.0300
0.0275
0.0250
0.0225
0.0200
0.0175
0.0150
0.000 0.025 0.050 0.075 0.100 0.125 0.150
Output Current (A)
Vin=5.0V

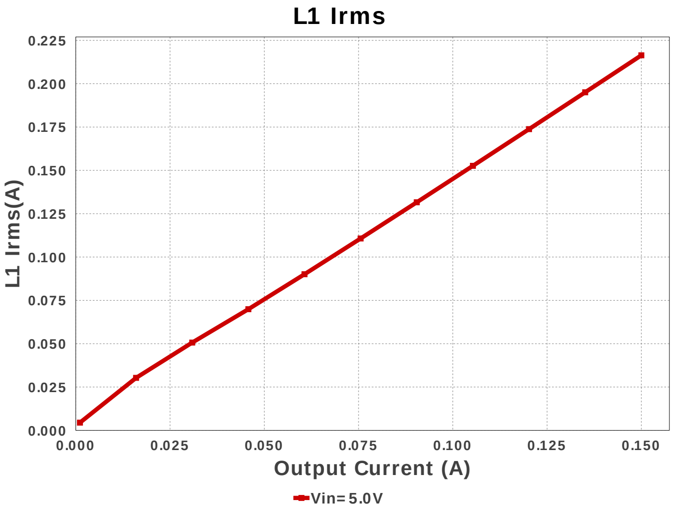

M1 PdSw
M1 PdSw(W)
0.00300
0.00275
0.00250
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin=5.0V

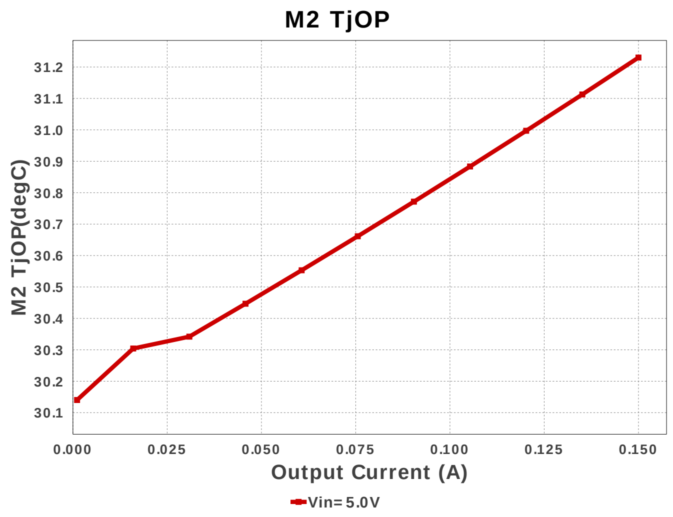

M2 PdCoss
M2 PdCoss(W)
0.00200
0.00195
0.00190
0.00185
0.00180
0.00175
0.00170
0.00165
0.00160
0.00155
0.00150
0.00145
0.00140
0.00135
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin=5.0V

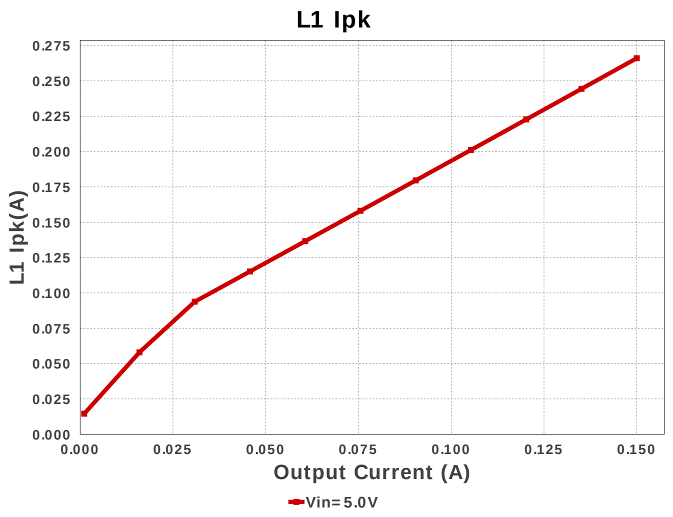

IC Pd
IC Pd(W)
0.01625
0.01600
0.01575
0.01550
0.01525
0.01500
0.01475
0.01450
0.01425
0.01400
0.01375
0.01350
0.01325
0.01300
0.01275
0.01250
0.01225
0.01200
0.01175
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin=5.0V

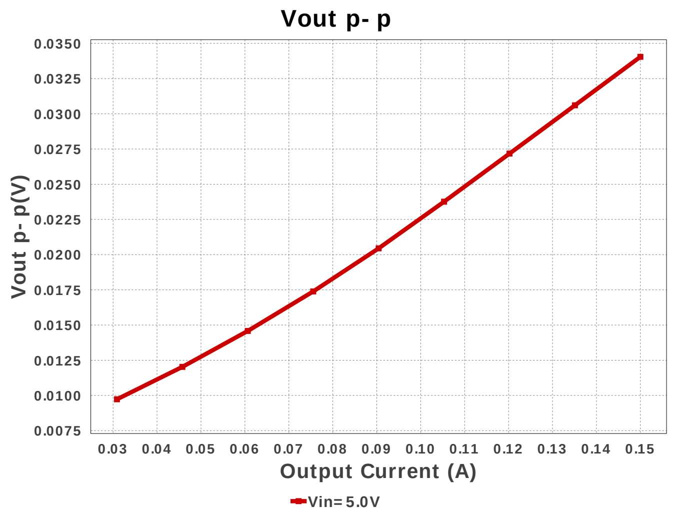

Rsns2 Pd
Rsns2 Pd(W)
0.00400
0.00375
0.00350
0.00325
0.00300
0.00275
0.00250
0.00225
0.00200
0.00175
0.00150
0.00125
0.00100
0.00075
0.00050
0.00025
0.00000
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin=5.0V

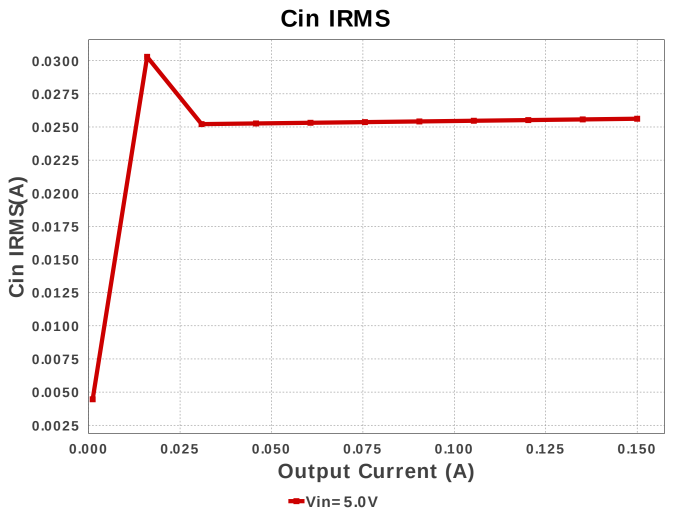

M1 Irms
M1 Irms(A)
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin=5.0V

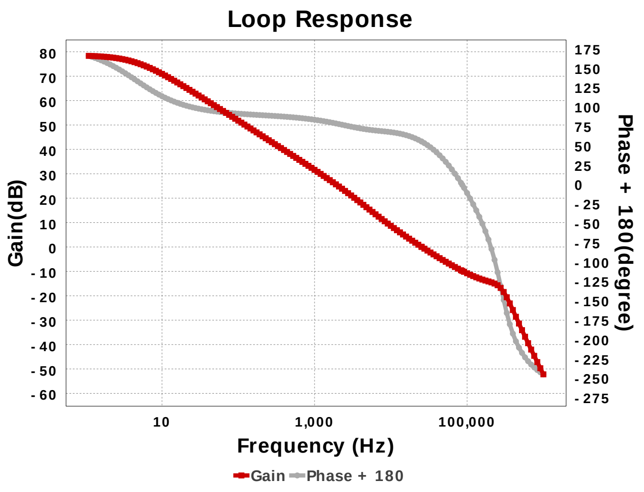

L1 Irms
L1 Irms(A)
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.000
0.025
0.050
0.075
0.100
0.125
0.150
Output Current (A)
Vin=5.0V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	25.622 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	218.83 nW	Capacitor	Input capacitor power dissipation
3.	Cout Pd	3.396 µW	Capacitor	Output capacitor power dissipation
4.	IC Pd	16.143 mW	IC	IC power dissipation
5.	IC Tj	31.061 degC	IC	IC junction temperature
6.	ICThetaJA	65.7 degC/W	IC	IC junction-to-ambient thermal resistance
7.	Iin Avg	221.57 mA	IC	Average input current
8.	L Ipp	88.758 mA	Inductor	Peak-to-peak inductor ripple current
9.	L Pd	175.59 µW	Inductor	Inductor power dissipation
10.	L1 Ipk	265.947 mA	Inductor	Inductor peak current
11.	L1 Irms	216.391 mA	Inductor	Inductor ripple current

#	Name	Value	Category	Description
12.	M1 Irms	118.896 mA	Mosfet	MOSFET RMS ripple current
13.	M1 Pd	14.093 mW	Mosfet	MOSFET power dissipation
14.	M1 PdCond	510.1 µW	Mosfet	M1 MOSFET conduction losses
15.	M1 PdCoss	2.251 mW	Mosfet	M1 MOSFET Coss Losses
16.	M1 PdQrr	8.452 mW	Mosfet	M1 MOSFET switching losses
17.	M1 PdSw	2.88 mW	Mosfet	M1 MOSFET switching losses
18.	M1 Rdson	30.071 mOhm	Mosfet	Drain-Source On-resistance
19.	M1 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
20.	M1 TjOP	30.916 degC	Mosfet	M1 MOSFET junction temperature
21.	M2 Irms	180.8 mA	Mosfet	MOSFET RMS ripple current
22.	M2 Pd	18.924 mW	Mosfet	MOSFET power dissipation
23.	M2 PdCond	1.28 mW	Mosfet	M2 MOSFET conduction losses
24.	M2 PdCoss	1.991 mW	Mosfet	M2 MOSFET Coss Losses
25.	M2 PdSw	357.12 µW	Mosfet	M2 MOSFET switching losses
26.	M2 Pdbody	15.297 mW	Mosfet	Power dissipation through lower FET
27.	M2 Rdson	30.127 mOhm	Mosfet	Drain-Source On-resistance
28.	M2 ThetaJA	65.0 degC/W	Mosfet	MOSFET junction-to-ambient thermal resistance
29.	M2 TjOP	31.23 degC	Mosfet	MOSFET junction temperature
30.	Cin Pd	218.83 nW	Power	Input capacitor power dissipation
31.	Cout Pd	3.396 µW	Power	Output capacitor power dissipation
32.	IC Pd	16.143 mW	Power	IC power dissipation
33.	L Pd	175.59 µW	Power	Inductor power dissipation
34.	M1 Pd	14.093 mW	Power	MOSFET power dissipation
35.	M1 PdCond	510.1 µW	Power	M1 MOSFET conduction losses
36.	M1 PdCoss	2.251 mW	Power	M1 MOSFET Coss Losses
37.	M1 PdQrr	8.452 mW	Power	M1 MOSFET switching losses
38.	M1 PdSw	2.88 mW	Power	M1 MOSFET switching losses
39.	M2 Pd	18.924 mW	Power	MOSFET power dissipation
40.	M2 PdCond	1.28 mW	Power	M2 MOSFET conduction losses
41.	M2 PdCoss	1.991 mW	Power	M2 MOSFET Coss Losses
42.	M2 PdQrr	0.0 W	Power	Synchronous Boost High Side Reverse Recovery
43.	M2 PdSw	357.12 µW	Power	M2 MOSFET switching losses
44.	M2 Pdbody	15.297 mW	Power	Power dissipation through lower FET
45.	Rsns1 Pd	3.863 mW	Power	Rsns1 Power Dissipation
46.	Rsns2 Pd	3.863 mW	Power	Rsns2 Power Dissipation
47.	Total Pd	57.841 mW	Power	Total Power Dissipation
48.	Rsns1 Pd	3.863 mW	Resistor	Rsns1 Power Dissipation
49.	Rsns2 Pd	3.863 mW	Resistor	Rsns2 Power Dissipation
50.	BOM Count	28	System Information	Total Design BOM count
51.	Cross Freq	25.47 kHz	System Information	Bode plot crossover frequency
52.	Duty Cycle	30.19 %	System Information	Duty cycle
53.	Efficiency	94.779 %	System Information	Steady state efficiency
54.	FootPrint	294.0 mm^2	System Information	Total Foot Print Area of BOM components
55.	Frequency	547.619 kHz	System Information	Switching frequency
56.	Gain Marg	-9.821 dB	System Information	Bode Plot Gain Margin
57.	Iout	150.0 mA	System Information	Iout operating point
58.	Low Freq Gain	78.328 dB	System Information	Gain at 1Hz
59.	Mode	CCM	System Information	Conduction Mode
60.	Phase Marg	55.902 deg	System Information	Bode Plot Phase Margin
61.	Pout	1.05 W	System Information	Total output power
62.	Total BOM	NA	System Information	Total BOM Cost
63.	Vin	5.0 V	System Information	Vin operating point
64.	Vout	7.0 V	System Information	Operational Output Voltage
65.	Vout Actual	7.021 V	System Information	Vout Actual calculated based on selected voltage divider resistors
66.	Vout Tolerance	3.752 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
67.	Vout p-p	34.047 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	150.0 m	Maximum Output Current
VinMax	5.0	Maximum input voltage
VinMin	5.0	Minimum input voltage
Vout	7.0	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

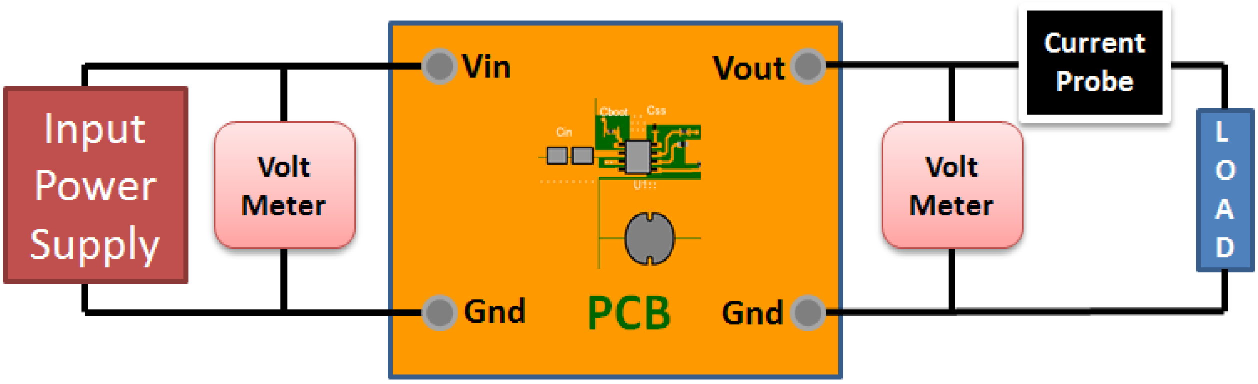
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 5.0V 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.

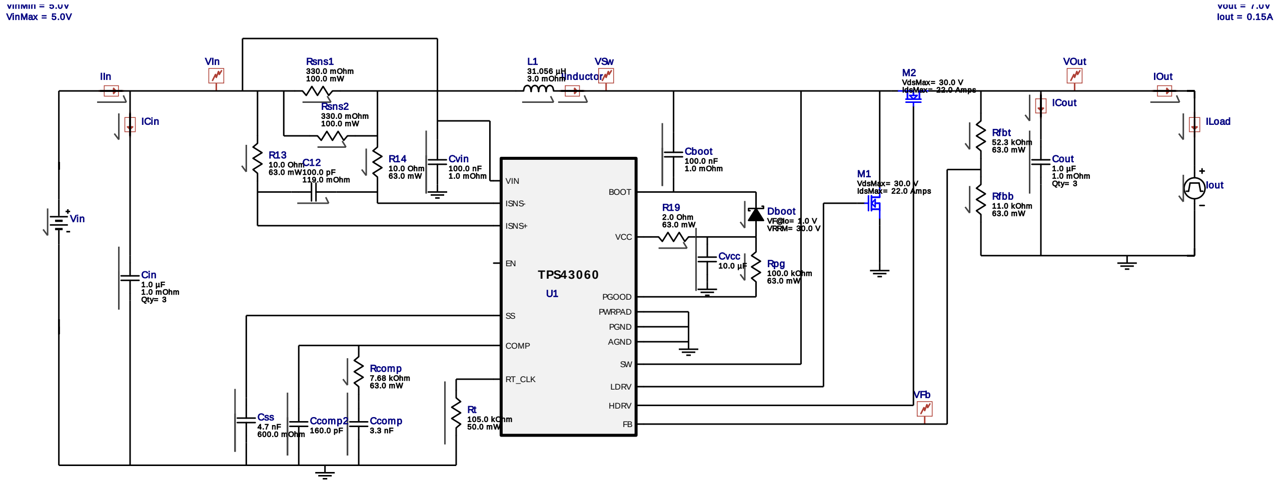


WEBENCH® Electrical Simulation Report

Design Id = 62

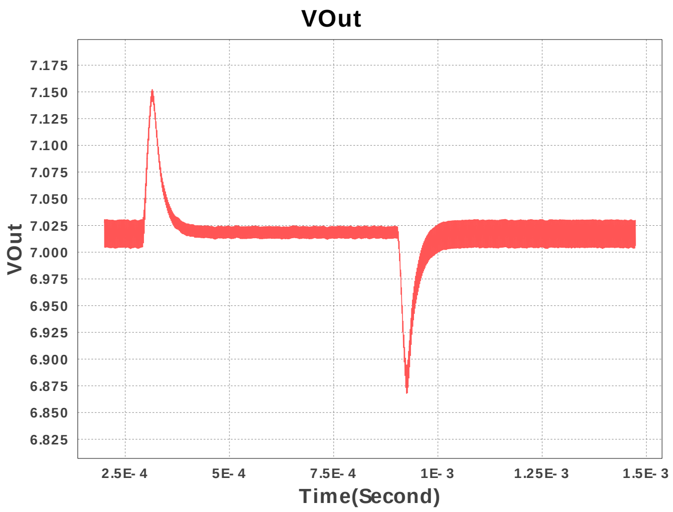
sim_id = 1

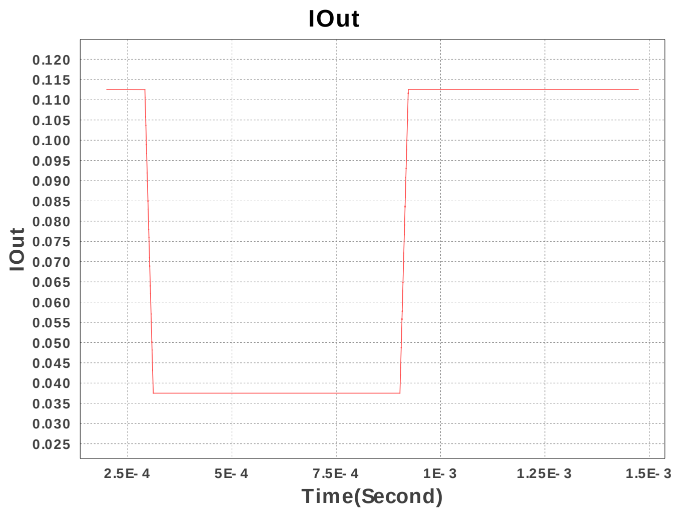
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	Css	IC	Initial Voltage	1.22 V
2.	Iout	signal_type	Signal Type	PULSE
		I1	Initial Load Current	0.11249999999999999 A
		I2	Minimum Load Current	0.0375 A
		Td	Initial Time Delay	2.91304347826087E-4 s
		Tf	Fall Time	20u s
		Tr	Rise Time	20u s
		Pw	Pulse Width	5.91258355286137E-4 s





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 : 387DE87BF1407981[v1]

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