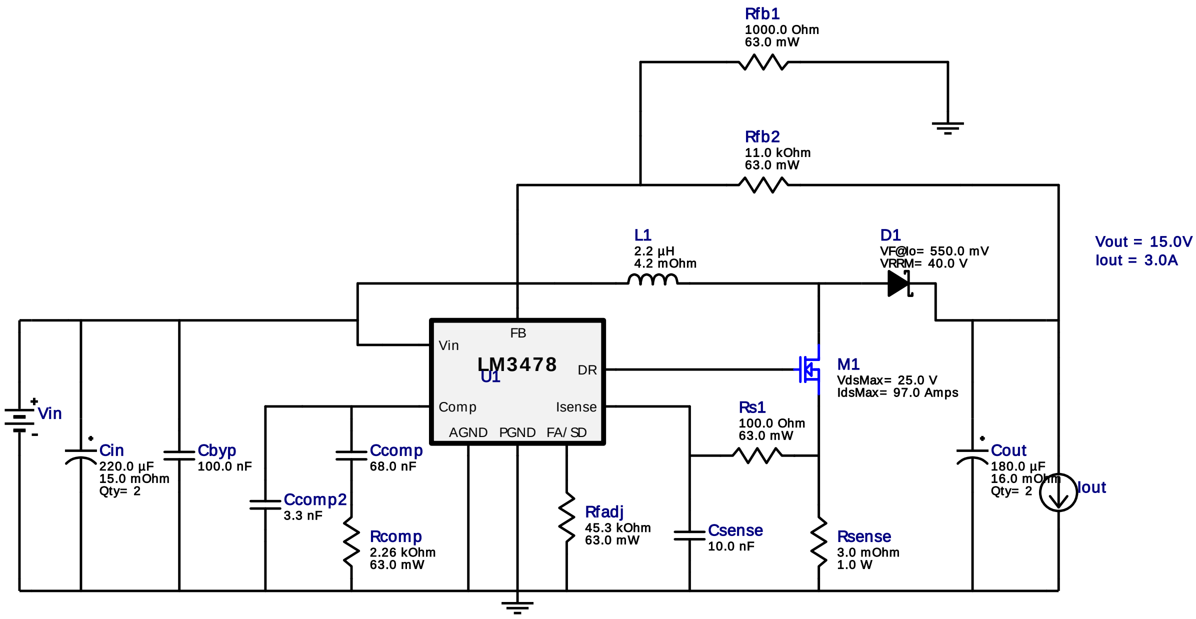
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 3.7V
VinMax = 4.2V
Vout = 15.0V
Iout = 3.0A

Device = LM3478MMX/NOPB
Topology = Boost
Created = 7/12/16 12:29:16 AM
BOM Cost = $3.97
BOM Count = 18
Total Pd = 5.09W

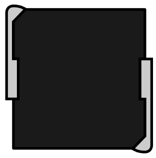
Design : 4737466/37 LM3478MMX/NOPB
LM3478MMX/NOPB 3.7V-4.2V to 15.00V @ 3.0A

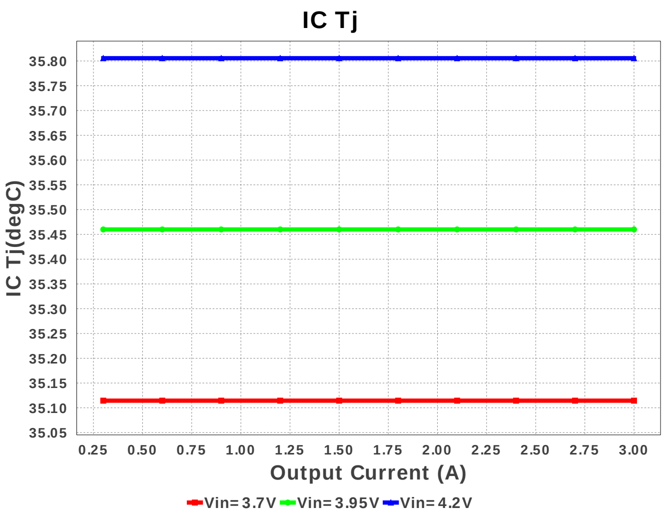


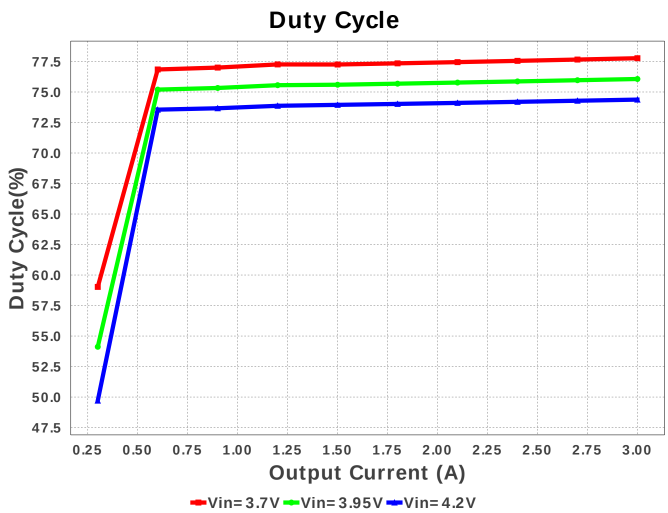
1. With the low turn of voltage of the LM34x8 your power supply may current limit before you reach your working input voltage. If this happens, or to preempt this from happening, you can include a low pass RC filter from input voltage to Vin on the IC. Make sure the rise time on the RC network is slower than your supply's rise time.

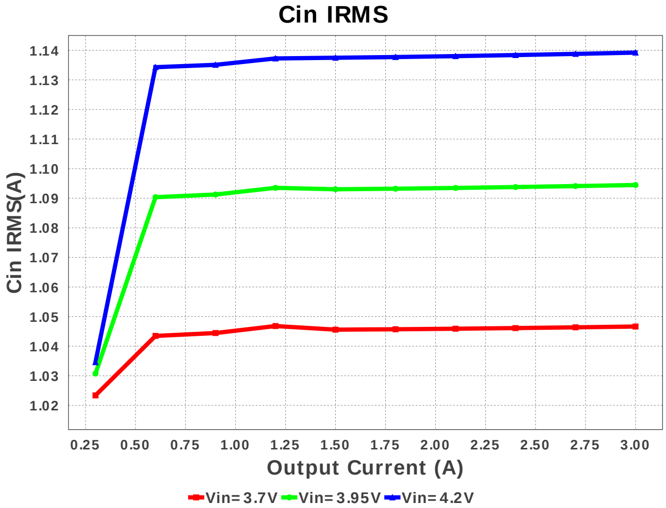
Electrical BOM

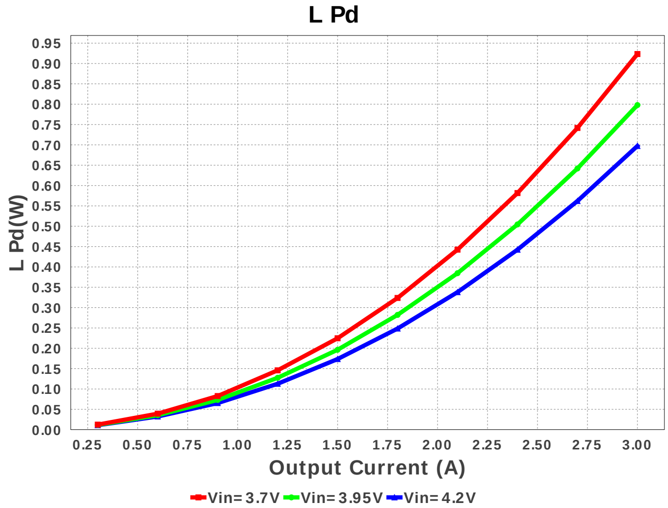
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbyp	MuRata	GRM155R60J104KA01D Series= X5R	Cap= 100.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	Ccomp	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Ccomp2	MuRata	GRM216R71E332KA01D Series= X7R	Cap= 3.3 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Cin	Panasonic	6SVPE220MW Series= SVPE	Cap= 220.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 3.15 A	2	$0.20	CAPSMT_62_E61 53 mm^2
5.	Cout	Panasonic	25SVPF180M Series= ?	Cap= 180.0 uF ESR= 16.0 mOhm VDC= 25.0 V IRMS= 4.65 A	2	$0.61	CAPSMT_62_E12 106 mm^2
6.	Csense	MuRata	GRM216R71H103KA01D Series= X7R	Cap= 10.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
7.	D1	Diodes Inc.	B540C-13-F	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.17	SMC 83 mm^2

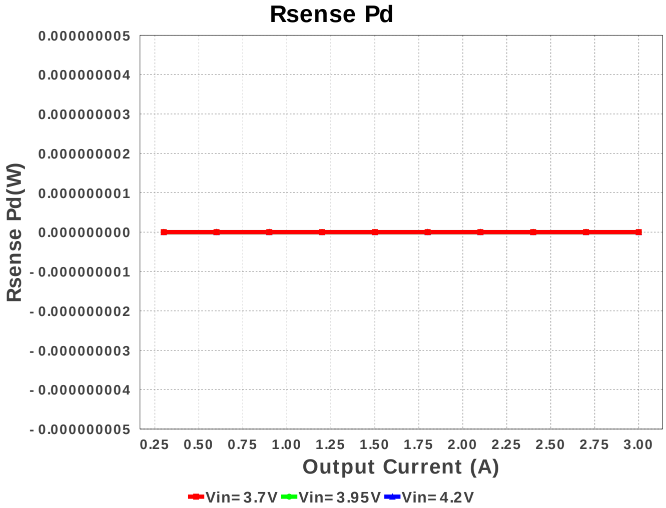
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	L1	Bourns	SRP1270-2R2M	L= 2.2 µH DCR= 4.2 mOhm	1	$0.60	 SRP1270 246 mm^2
9.	M1	Texas Instruments	CSD16322Q5C	VdsMax= 25.0 V IdsMax= 97.0 Amps	1	$0.50	 TRANS_NexFET_Q5C 56 mm^2
10.	Rcomp	Vishay-Dale	CRCW04022K26FKED Series= CRCW..e3	Res= 2.26 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
11.	Rfadj	Vishay-Dale	CRCW040245K3FKED Series= CRCW..e3	Res= 45.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
12.	Rfb1	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
13.	Rfb2	Vishay-Dale	CRCW040211K0FKED Series= CRCW..e3	Res= 11.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
14.	Rs1	Vishay-Dale	CRCW0402100RFKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
15.	Rsense	Stackpole Electronics Inc	CSNL1206FT3L00 Series= CSNL	Res= 3.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.19	 1206 11 mm^2
16.	U1	Texas Instruments	LM3478MMX/NOPB	Switcher	1	$0.80	 MUA08A 24 mm^2

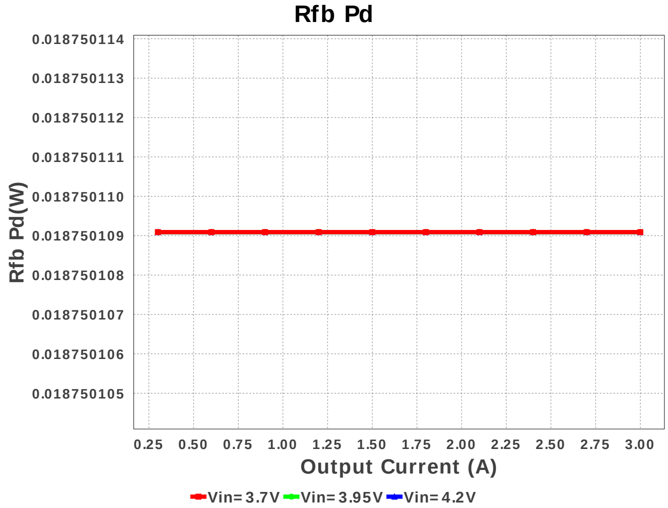


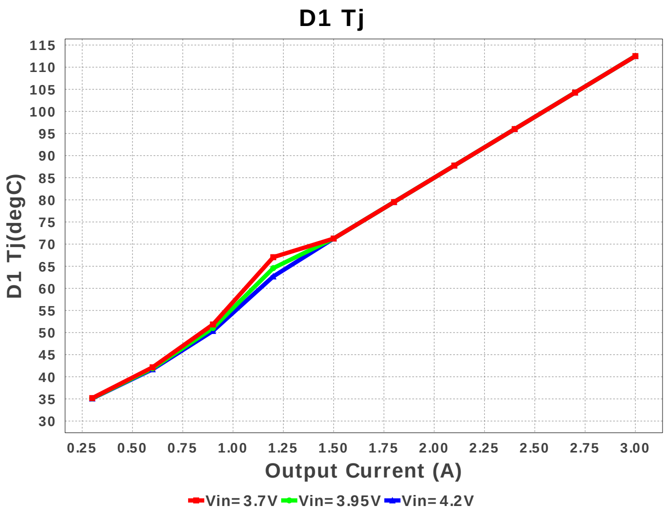


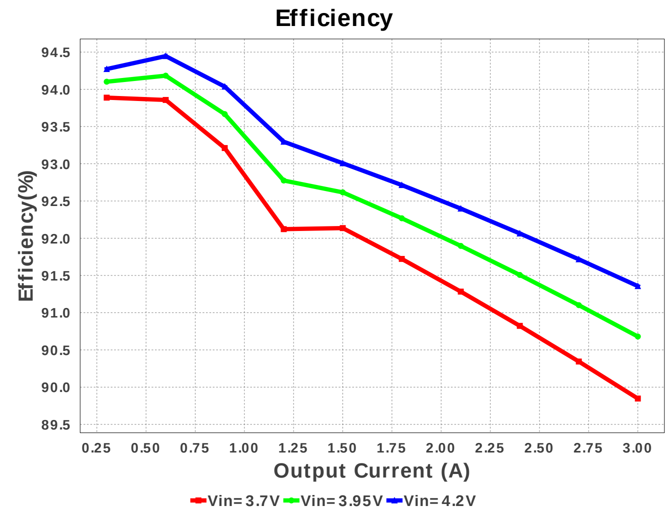

Cin IRMS
Cin IRMS(A)
1.14
1.13
1.12
1.11
1.10
1.09
1.08
1.07
1.06
1.05
1.04
1.03
1.02
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

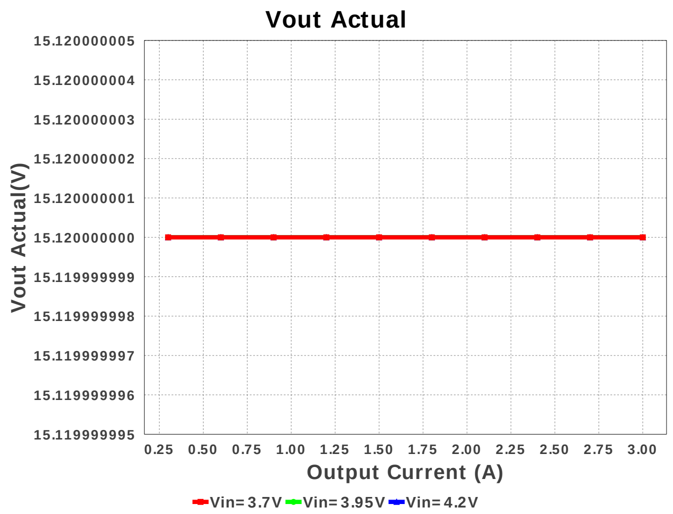

L Pd
L Pd(W)
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

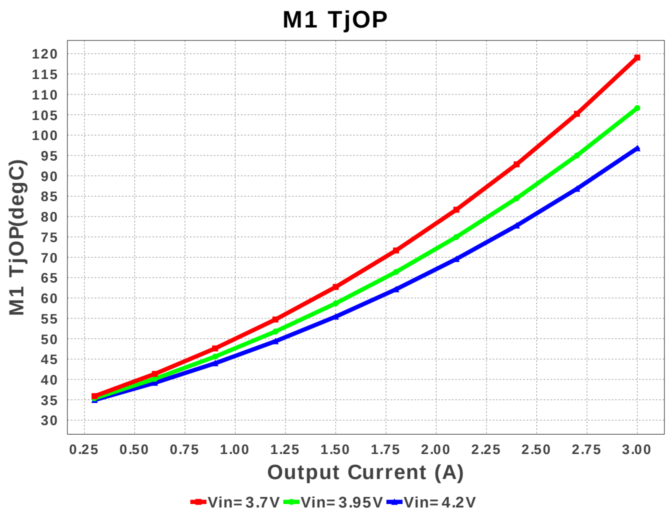

Rsense Pd
Rsense Pd(W)
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
-0.000000001
-0.000000002
-0.000000003
-0.000000004
-0.000000005
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

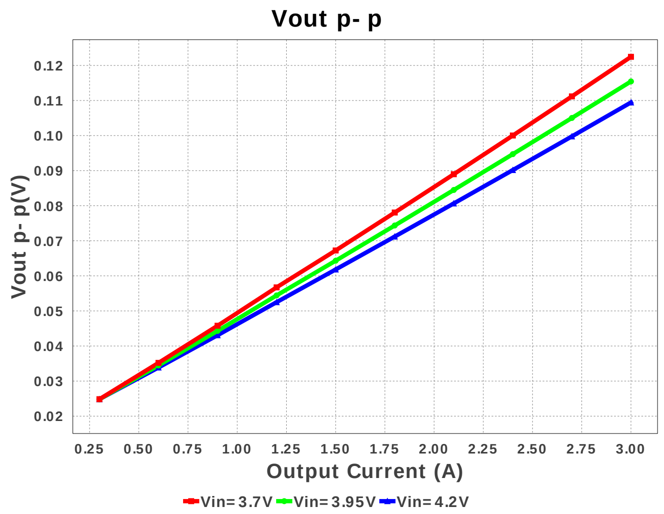

Rfb Pd
Rfb Pd(W)
0.018750114
0.018750113
0.018750112
0.018750111
0.018750110
0.018750109
0.018750108
0.018750107
0.018750106
0.018750105
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

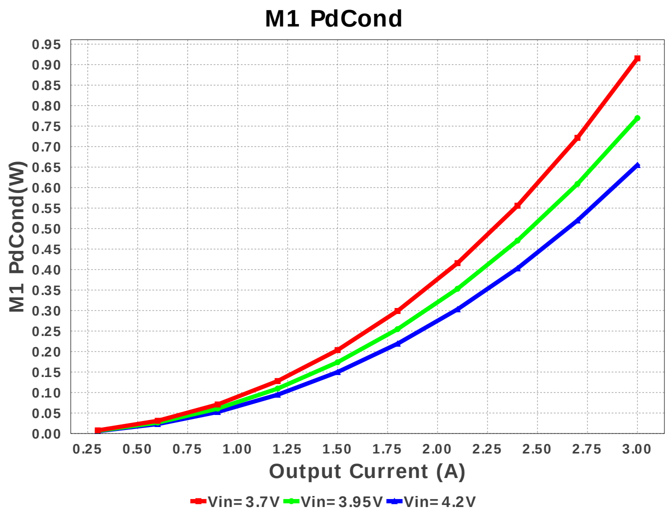

D1 Tj
D1 Tj(degC)
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

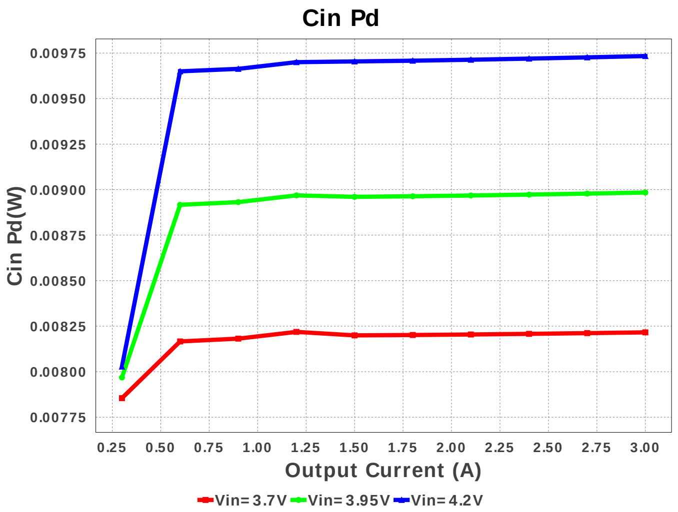

Efficiency
Efficiency(%)
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

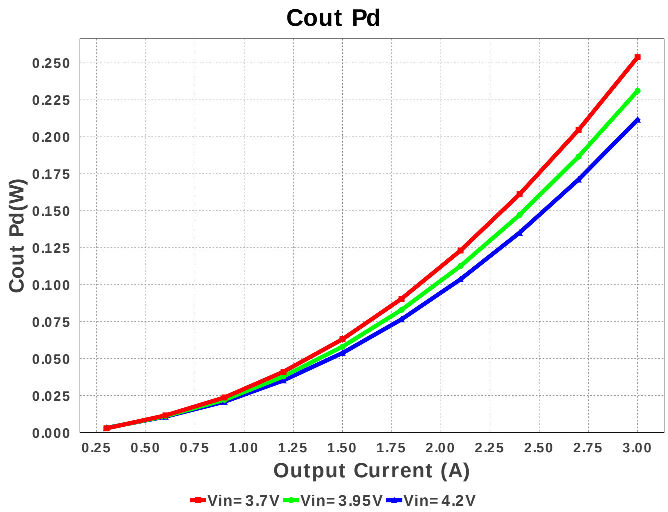

Vout Actual
Vout Actual(V)
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

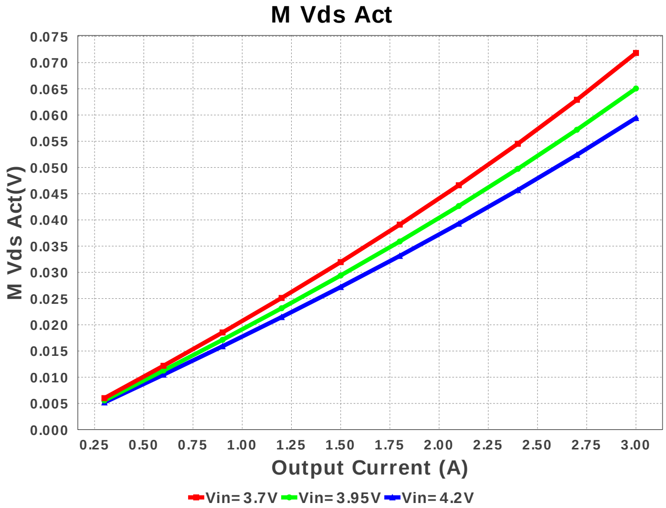

M1 TjOP
M1 TjOP(degC)
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

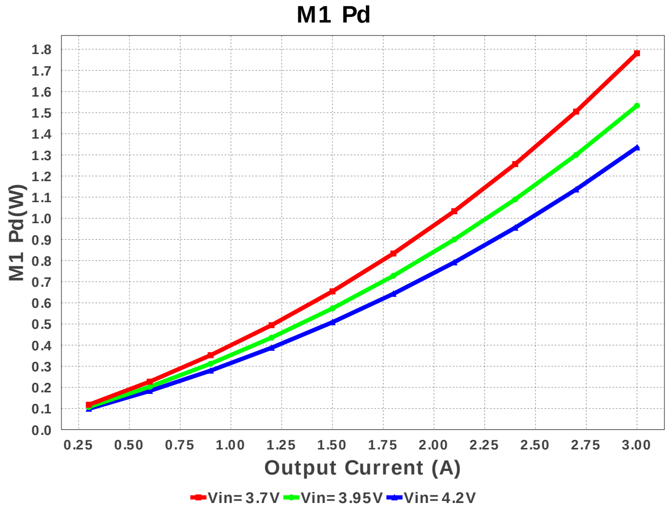

Vout p- p
Vout p- p(V)
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

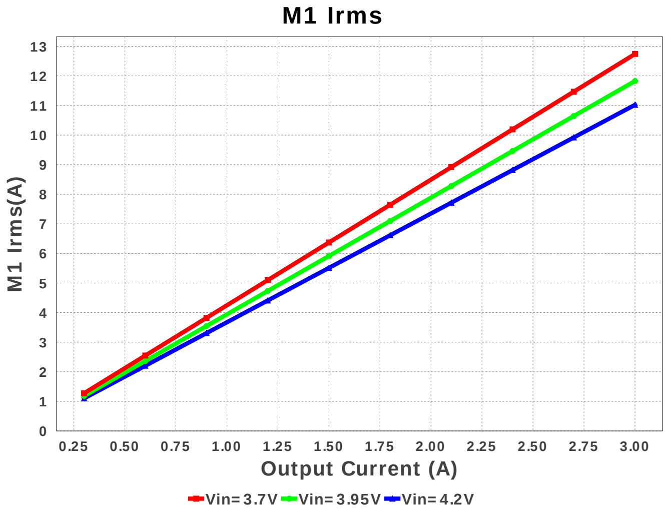

M1 PdCond
M1 PdCond(W)
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

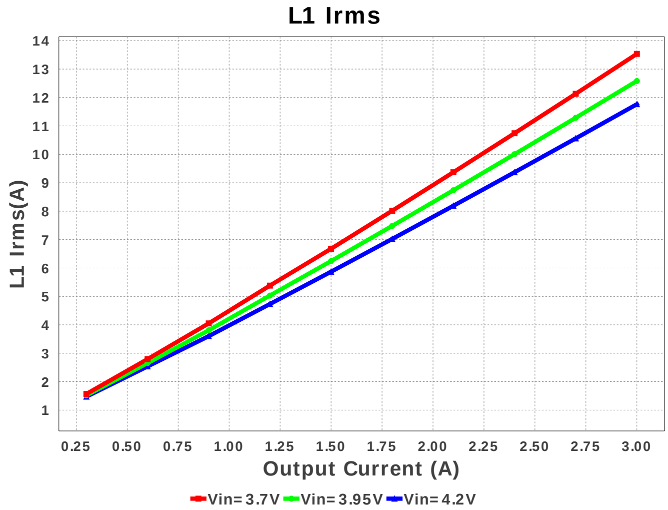

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

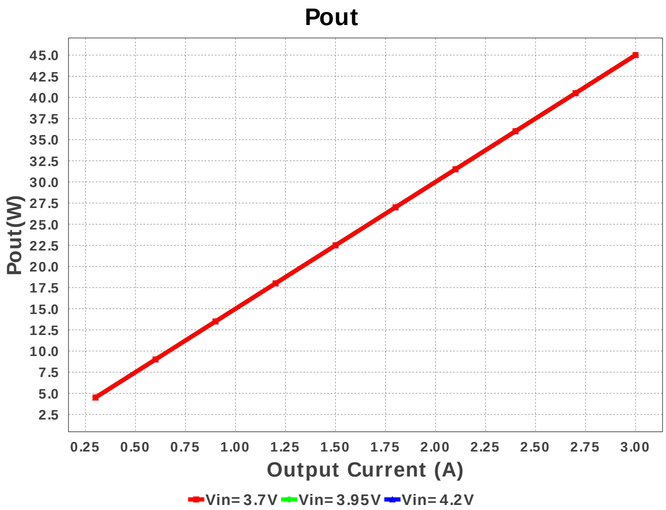

Cout Pd
Cout Pd(W)
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

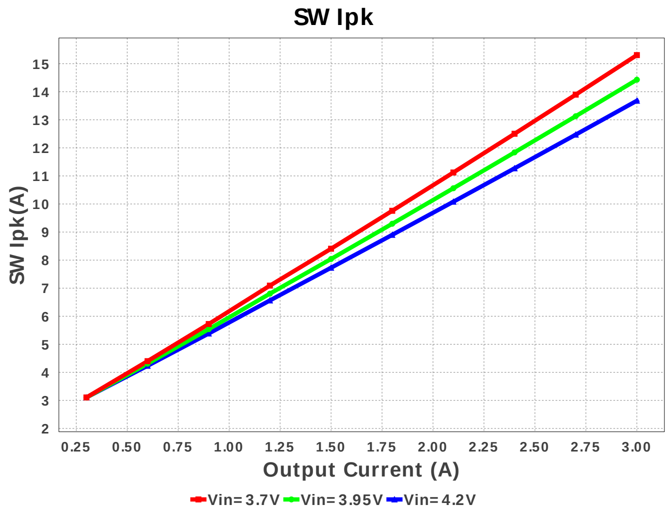

M Vds Act
M Vds Act(V)
0.075
0.070
0.065
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

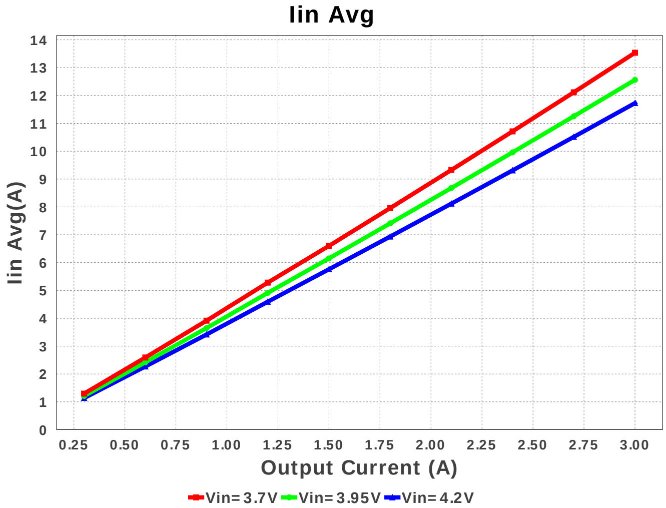

M1 Pd
M1 Pd(W)
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

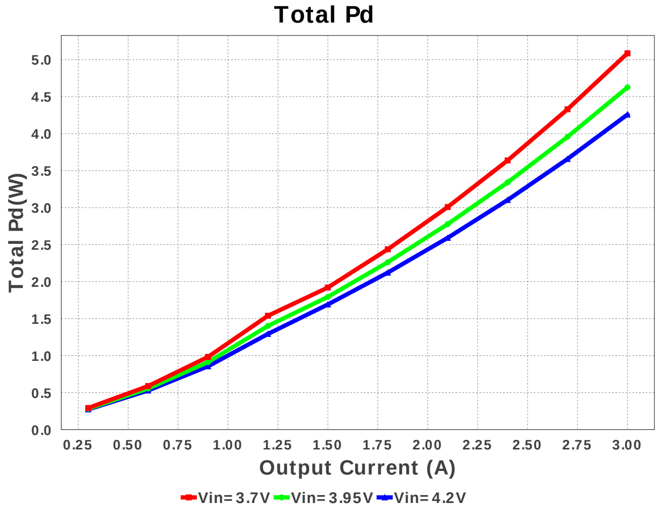

M1 Irms
M1 Irms(A)
13
12
11
10
9
8
7
6
5
4
3
2
1
0
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

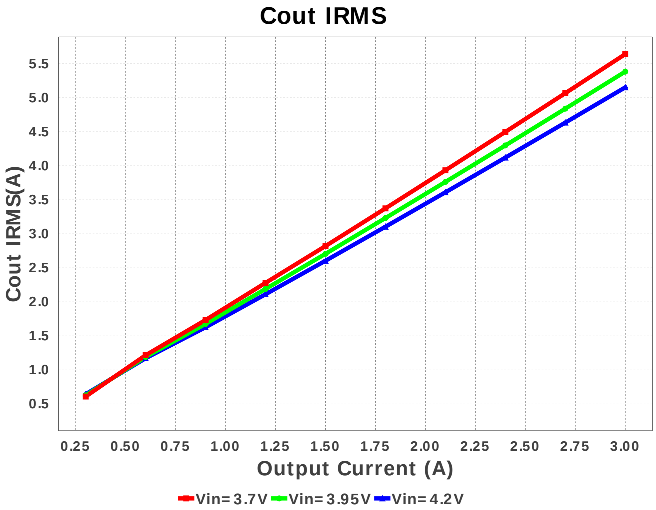

L1 Irms
L1 Irms(A)
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

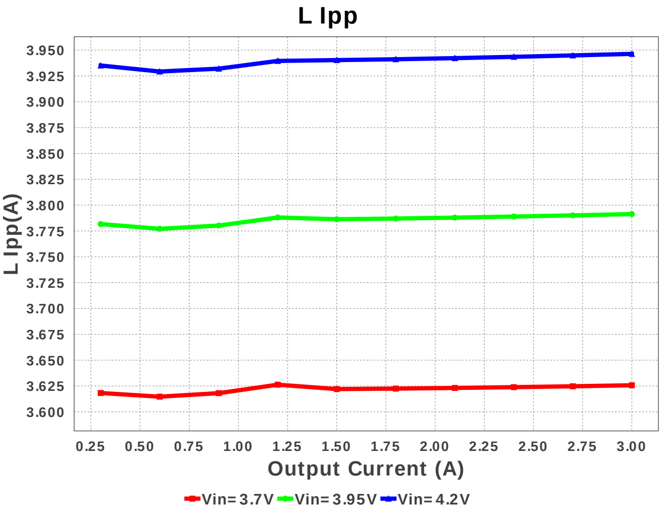

Pout
Pout(W)
45.0
42.5
40.0
37.5
35.0
32.5
30.0
27.5
25.0
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

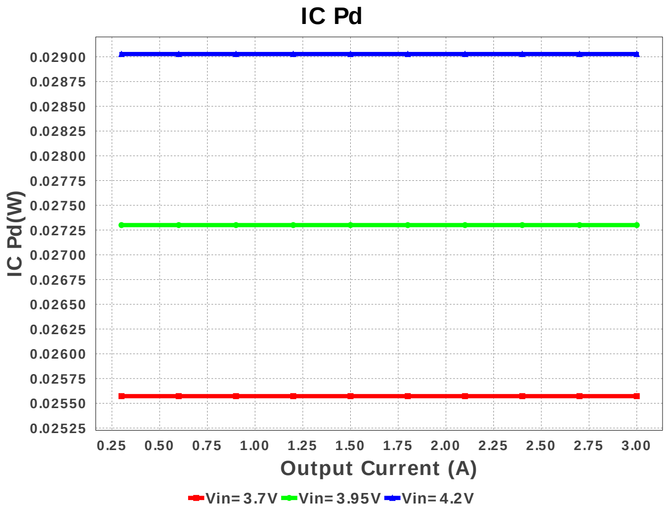

SW Ipk
SW Ipk(A)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin=3.7V Vin=3.95V Vin=4.2V

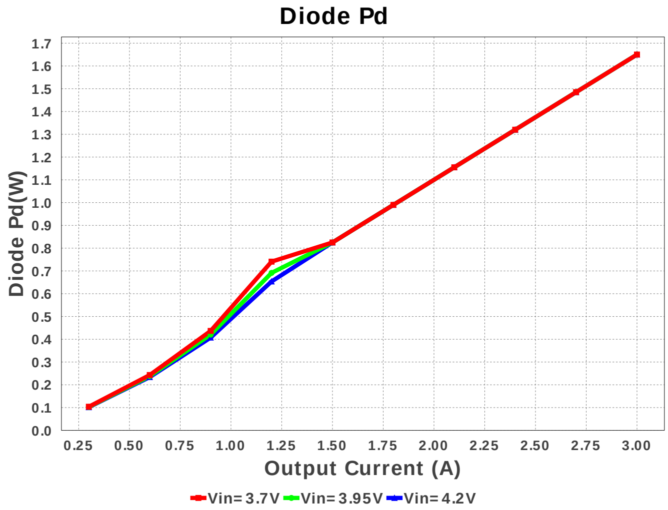

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=3.7V
Vin=3.95V
Vin=4.2V

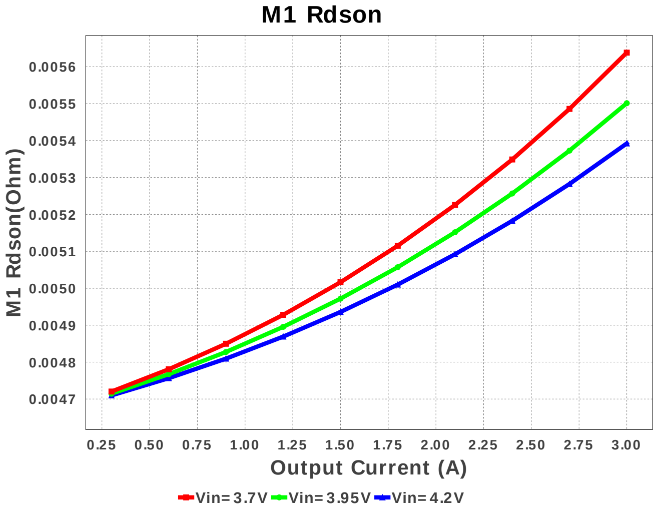

Total Pd
Total Pd(W)
Output Current (A)
Vin=3.7V
Vin=3.95V
Vin=4.2V

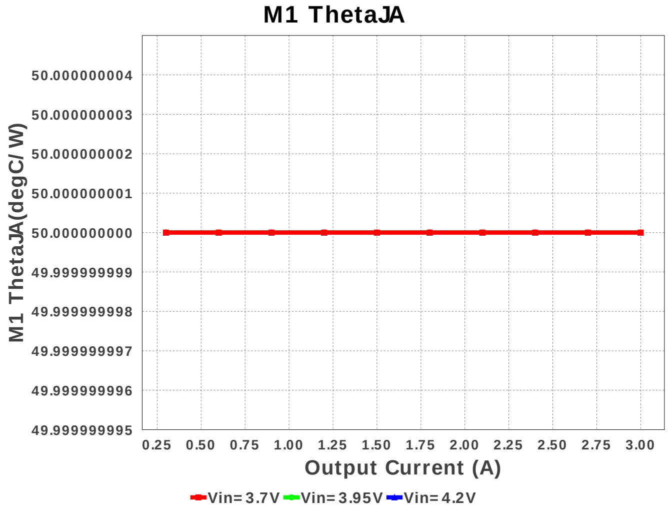

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=3.7V
Vin=3.95V
Vin=4.2V

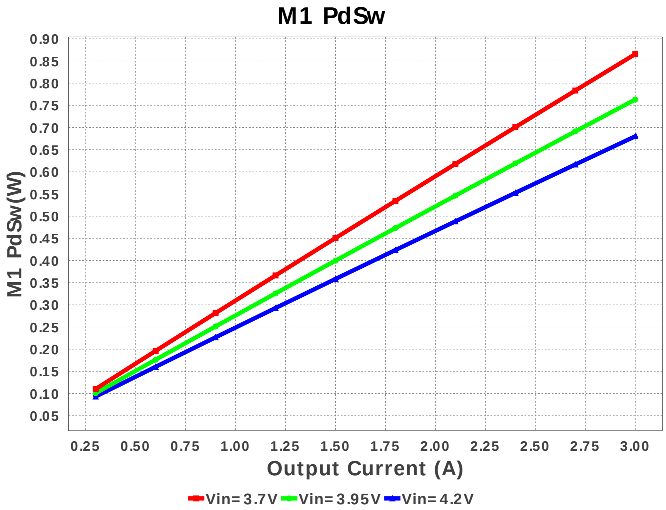

L Ipp
L Ipp(A)
Output Current (A)
Vin=3.7V
Vin=3.95V
Vin=4.2V

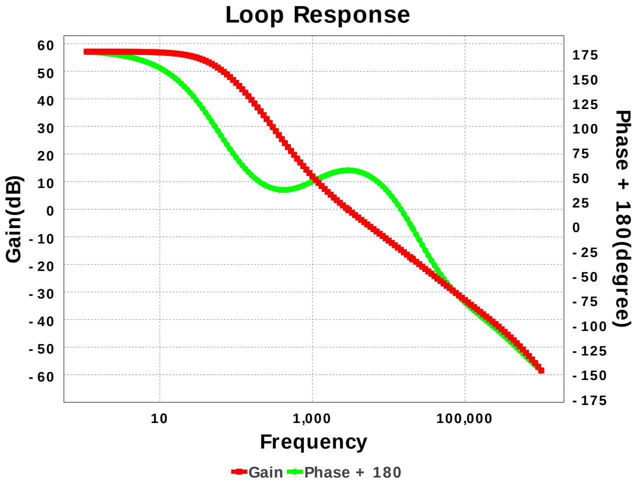

IC Pd
IC Pd(W)
Output Current (A)
Vin=3.7V
Vin=3.95V
Vin=4.2V


Diode Pd
Diode Pd(W)
Output Current (A)
Vin=3.7V
Vin=3.95V
Vin=4.2V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.047 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	5.633 A	Current	Output capacitor RMS ripple current
3.	Iin Avg	13.539 A	Current	Average input current
4.	L Ipp	3.626 A	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	13.537 A	Current	Inductor ripple current
6.	M1 Irms	12.741 A	Current	M1 MOSFET Irms
7.	SW Ipk	15.309 A	Current	Peak switch current
8.	BOM Count	18	General	Total Design BOM count
9.	FootPrint	774.0 mm^2	General	Total Foot Print Area of BOM components
10.	Frequency	356.79 kHz	General	Switching frequency
11.	IC Tolerance	24.3 mV	General	IC Feedback Tolerance
12.	M Vds Act	71.9 mV	General	M Vds
13.	M1 Rdson	5.643 mOhm	General	Drain-Source On-resistance
14.	M1 ThetaJA	50.0 degC/W	General	MOSFET junction-to-ambient thermal resistance
15.	Pout	45.0 W	General	Total output power
16.	Total BOM	$3.97	General	Total BOM Cost
17.	D1 Tj	112.5 degC	Op_Point	D1 junction temperature
18.	Low Freq Gain	55.878 dB	Op_Point	Gain at 10Hz
19.	Vout Actual	15.12 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
20.	Vout OP	15.0 V	Op_Point	Operational Output Voltage
21.	Cross Freq	2.574 kHz	Op_point	Bode plot crossover frequency
22.	Duty Cycle	77.772 %	Op_point	Duty cycle
23.	Efficiency	89.83 %	Op_point	Steady state efficiency
24.	Gain Marg	-16.801 dB	Op_point	Bode Plot Gain Margin
25.	IC Tj	35.134 degC	Op_point	IC junction temperature
26.	ICThetaJA	200.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
27.	IOUT_OP	3.0 A	Op_point	Iout operating point
28.	M1 TjOP	119.473 degC	Op_point	M1 MOSFET junction temperature
29.	Phase Marg	55.608 deg	Op_point	Bode Plot Phase Margin
30.	VIN_OP	3.7 V	Op_point	Vin operating point
31.	Vout p-p	122.475 mV	Op_point	Peak-to-peak output ripple voltage

#	Name	Value	Category	Description
32.	Cin Pd	8.217 mW	Power	Input capacitor power dissipation
33.	Cout Pd	253.864 mW	Power	Output capacitor power dissipation
34.	Diode Pd	1.65 W	Power	Diode power dissipation
35.	IC Pd	25.669 mW	Power	IC power dissipation
36.	L Pd	923.583 mW	Power	Inductor power dissipation
37.	M1 Pd	1.789 W	Power	M1 MOSFET total power dissipation
38.	M1 PdCond	916.111 mW	Power	M1 MOSFET conduction losses
39.	M1 PdSw	873.354 mW	Power	M1 MOSFET switching losses
40.	Rfb Pd	18.75 mW	Power	Rfb Power Dissipation
41.	Rsense Pd	488.664 mW	Power	Rsense Power Dissipation
42.	Total Pd	5.095 W	Power	Total Power Dissipation
43.	Vout Tolerance	3.816 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	VinMax	4.2	Maximum input voltage
3.	VinMin	3.7	Minimum input voltage
4.	Vout	15.0	Output Voltage
5.	base_pn	LM3478	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. LM3478 Product Folder : http://www.ti.com/product/LM3478 : contains the data sheet and other resources.

