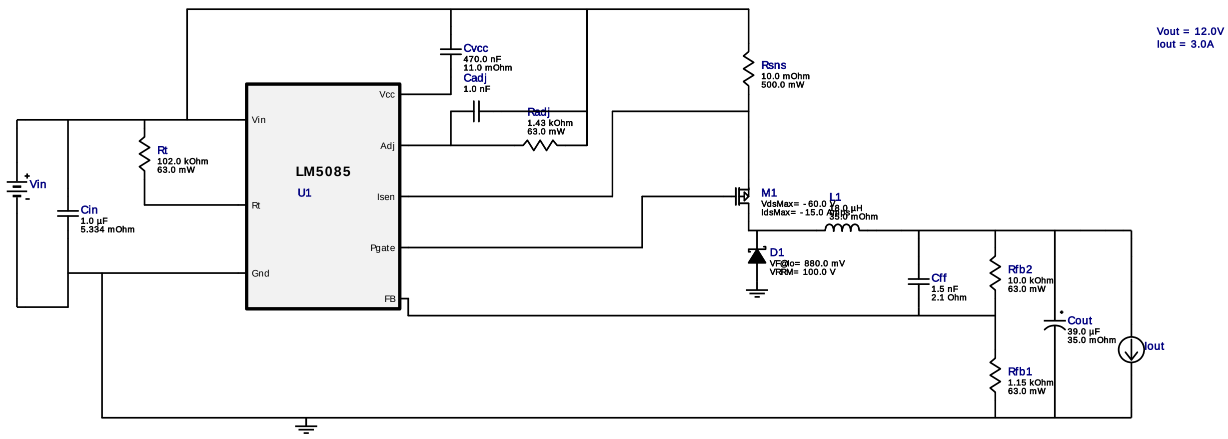
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 45.0V
VinMax = 48.0V
Vout = 12.0V
Iout = 3.0A

Device = LM5085MY/NOPB
Topology = Buck
Created = 7/20/16 7:33:13 AM
BOM Cost = $2.72
BOM Count = 14
Total Pd = 3.67W

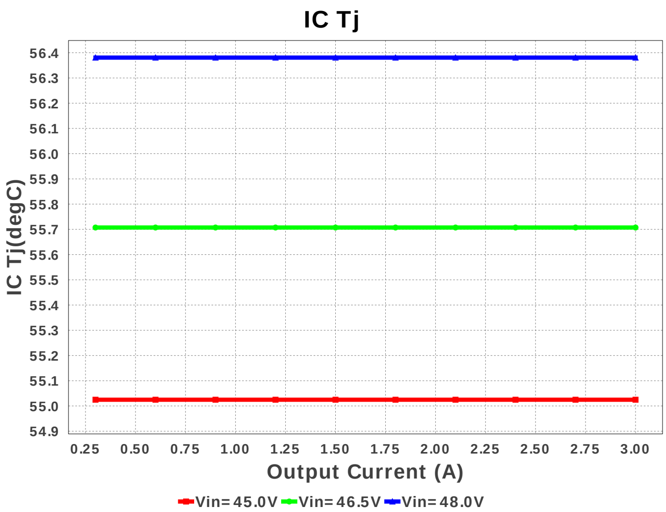
Design : 4077713/46 LM5085MY/NOPB
LM5085MY/NOPB 45.0V-48.0V to 12.00V @ 3.0A

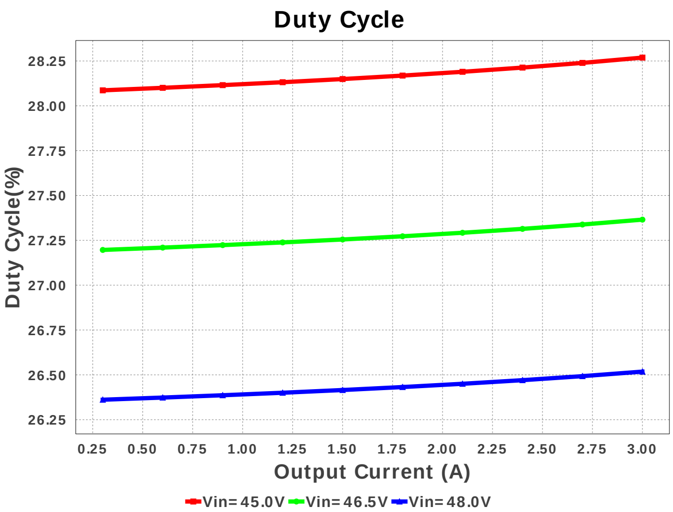


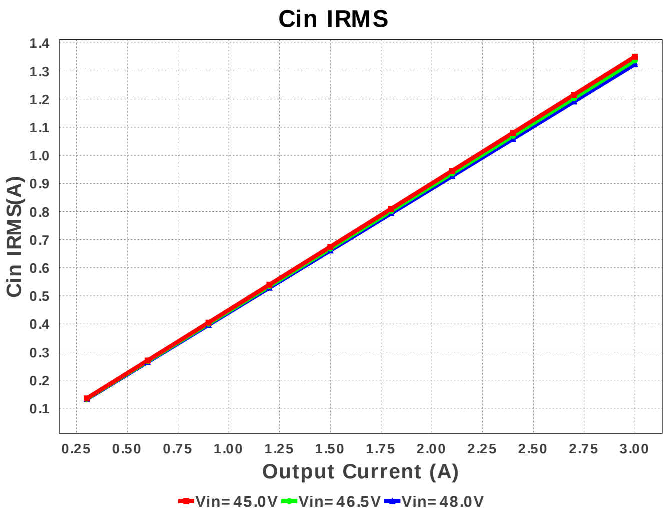
Electrical BOM

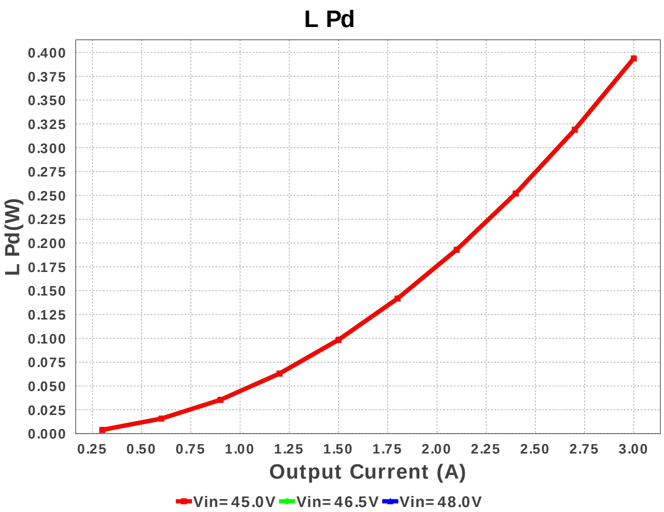
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cadj	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	Cff	MuRata	GRM188R72E152KW07D Series= X7R	Cap= 1.5 nF ESR= 2.1 Ohm VDC= 250.0 V IRMS= 100.0 mA	1	$0.12	0603 5 mm²
3.	Cin	MuRata	GRM31CR72A105KA01L Series= X7R	Cap= 1.0 uF ESR= 5.334 mOhm VDC= 100.0 V IRMS= 1.55432 A	1	$0.11	1206_190 11 mm²
4.	Cout	Panasonic	16SVPC39M Series= SVPC	Cap= 39.0 uF ESR= 35.0 mOhm VDC= 16.0 V IRMS= 1.82 A	1	$0.49	SM_RADIAL_5MM 58 mm²
5.	Cvcc	AVX	0805YC474KAT2A Series= X7R	Cap= 470.0 nF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
6.	D1	Vishay-Semiconductor	SS10PH10-M3/86A	VF@Io= 880.0 mV VRRM= 100.0 V	1	$0.29	TO-277A 56 mm²
7.	L1	Bourns	SRR1210-180M	L= 18.0 µH DCR= 35.0 mOhm	1	$0.44	SRR1210 196 mm²
8.	M1	Fairchild Semiconductor	FDD5614P	VdsMax= -60.0 V IdsMax= -15.0 Amps	1	$0.24	DPAK 102 mm²
9.	Radj	Vishay-Dale	CRCW04021K43FKED Series= CRCW..e3	Res= 1.43 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Rfb1	Vishay-Dale	CRCW04021K15FKED Series= CRCW..e3	Res= 1.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
11.	Rfb2	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
12.	Rsns	Stackpole Electronics Inc	CSR1206FK10L0 Series= ?	Res= 10.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.11	1206 11 mm^2
13.	Rt	Vishay-Dale	CRCW0402102KFKED Series= CRCW..e3	Res= 102.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
14.	U1	Texas Instruments	LM5085MY/NOPB	Switcher	1	$0.85	MUY08A 24 mm^2

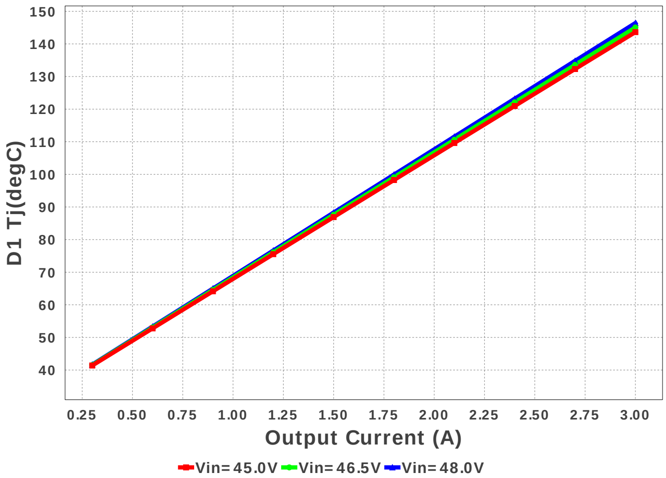




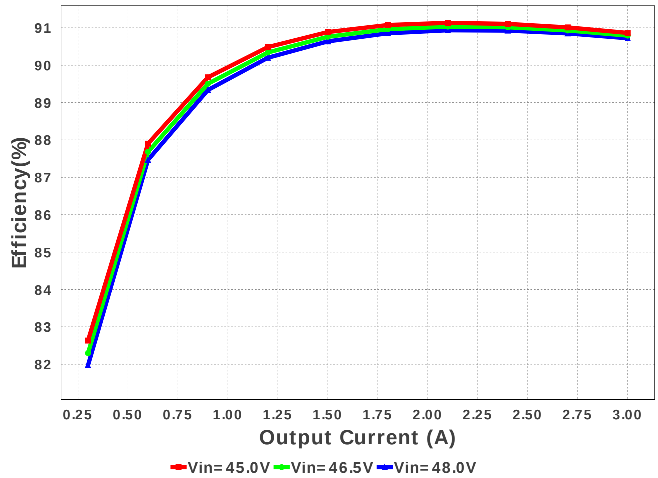




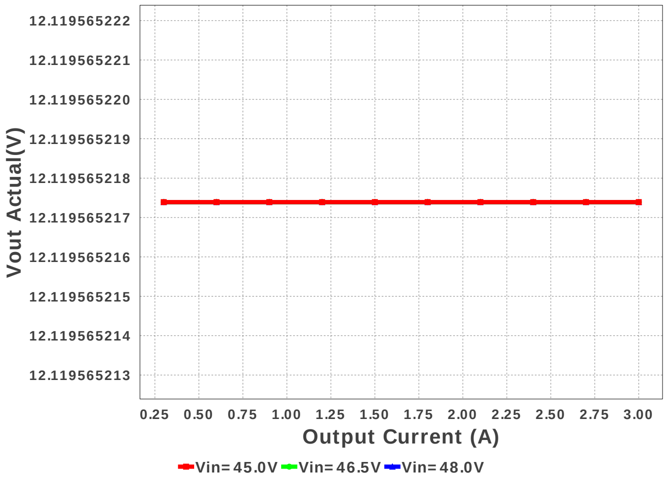
D1 Tj



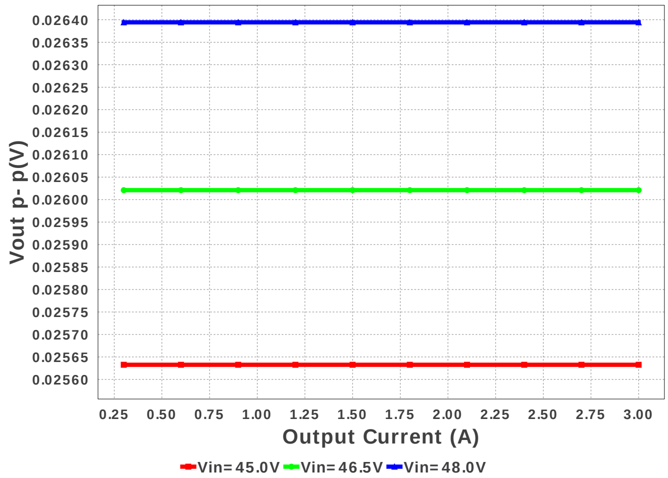
Efficiency



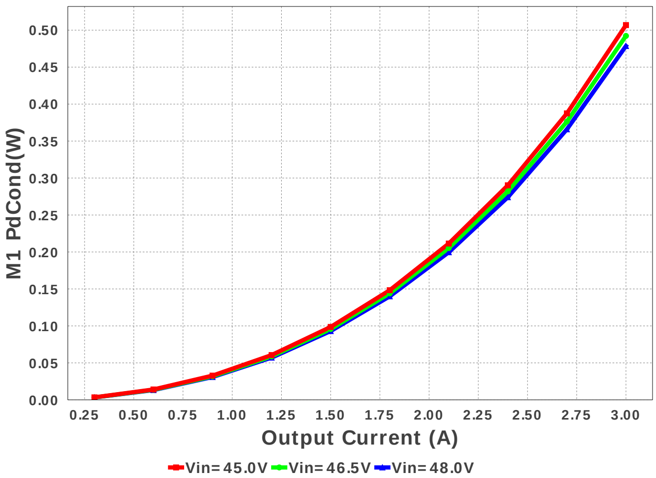
Vout Actual



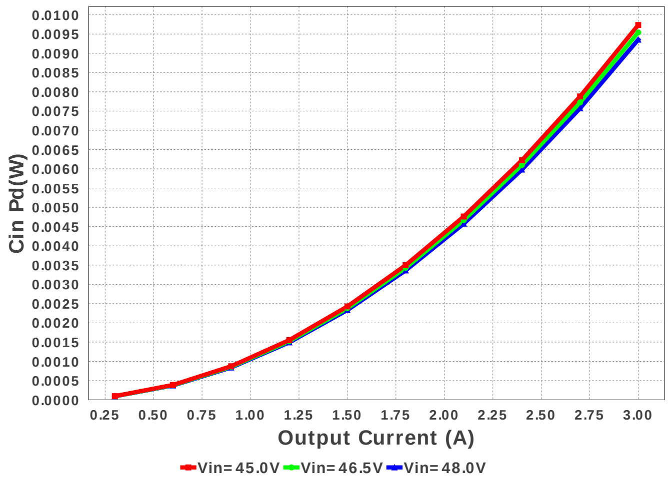
Vout p-p

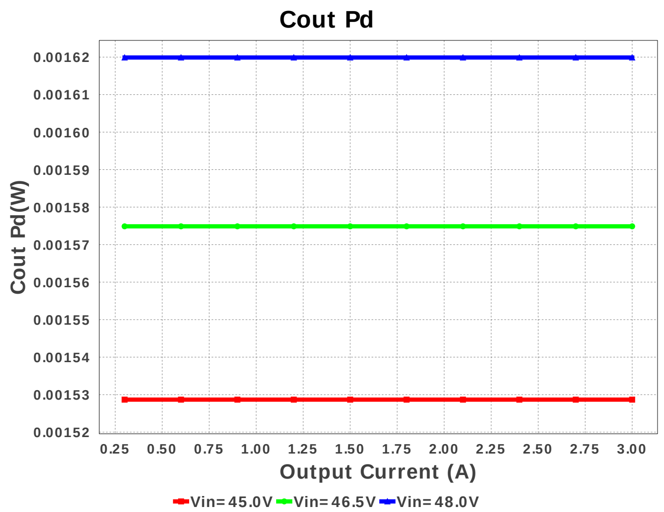


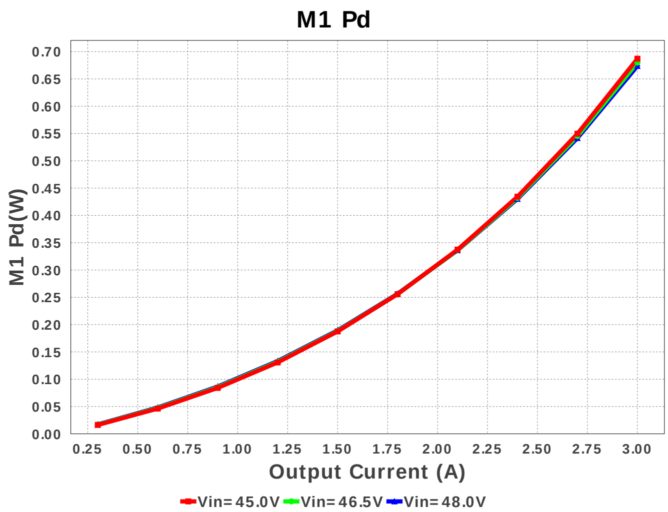
M1 PdCond

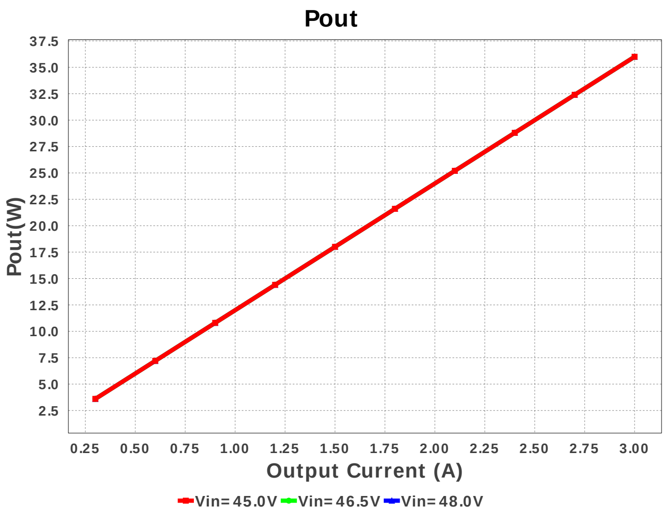


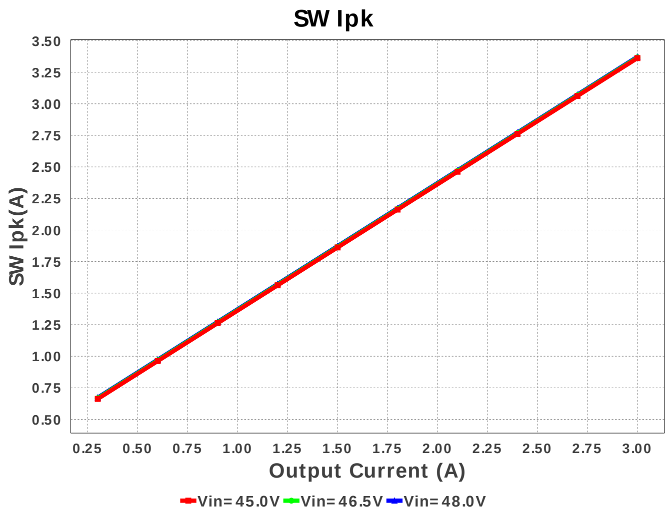
Cin Pd

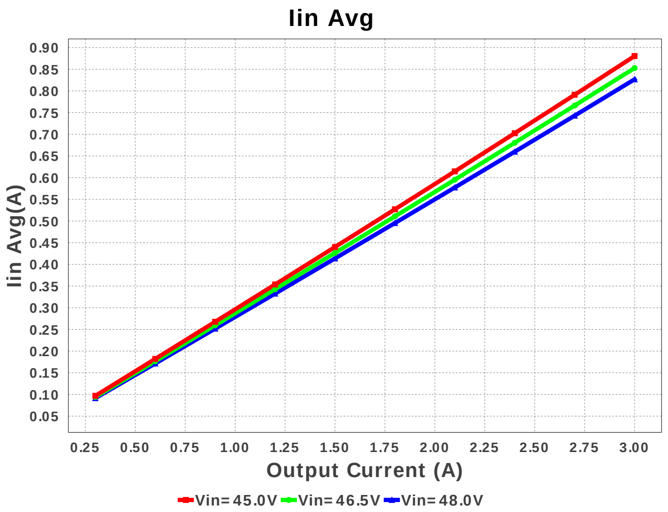


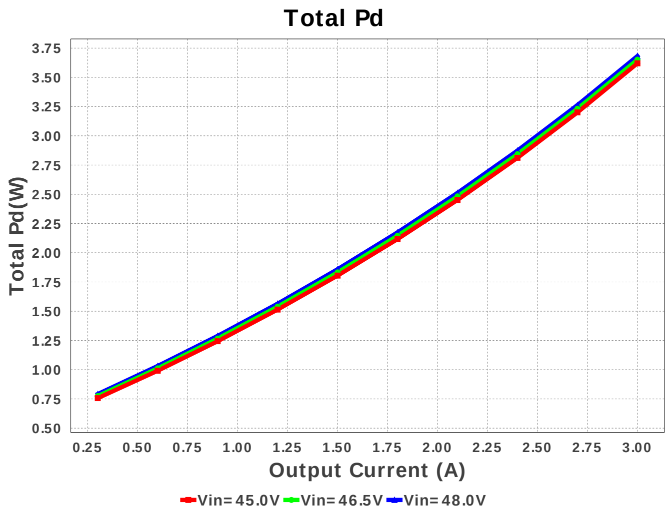

Cout Pd
Cout Pd(W)
0.00162
0.00161
0.00160
0.00159
0.00158
0.00157
0.00156
0.00155
0.00154
0.00153
0.00152
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin= 45.0V Vin= 46.5V Vin= 48.0V

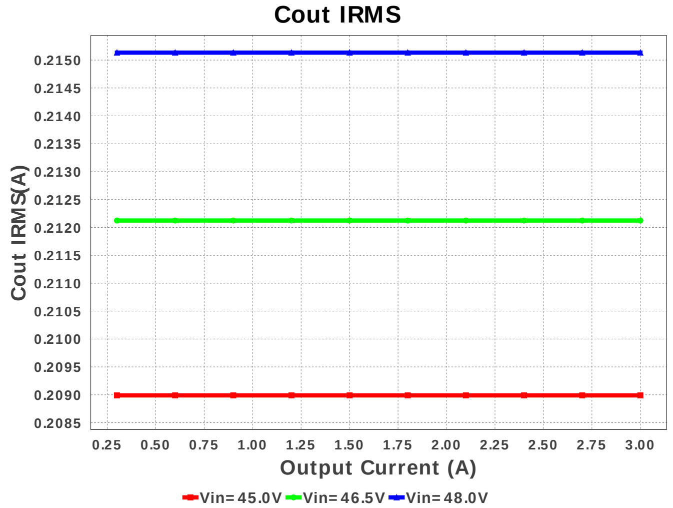

M1 Pd
M1 Pd(W)
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin= 45.0V Vin= 46.5V Vin= 48.0V

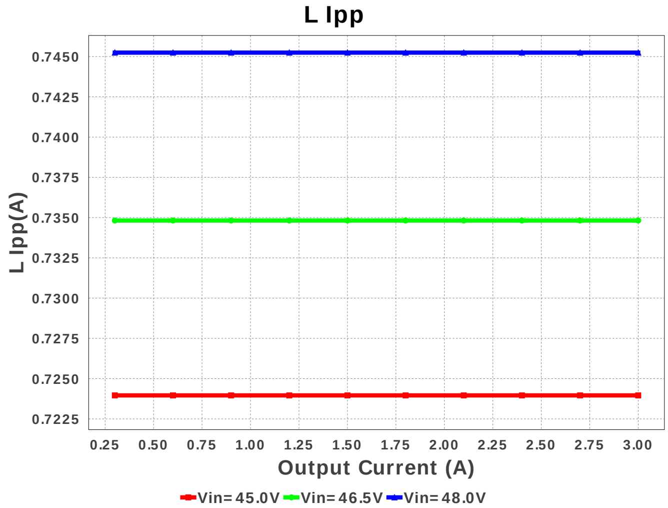

Pout
Pout(W)
37.5
35.0
32.5
30.0
27.5
25.0
22.5
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin= 45.0V Vin= 46.5V Vin= 48.0V

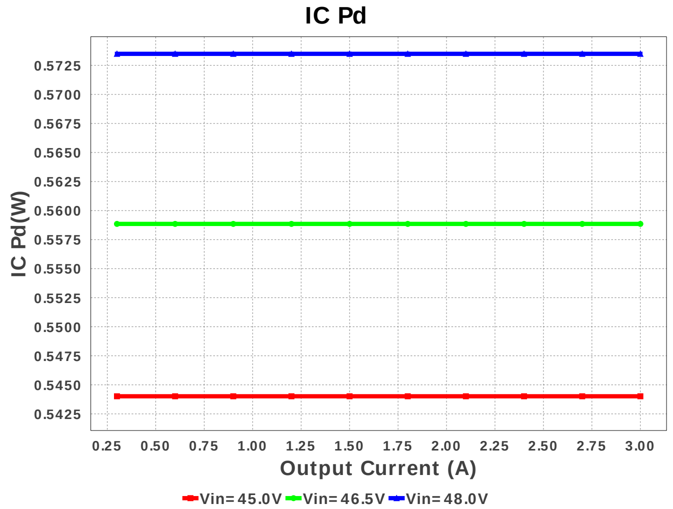

SW Ipk
SW Ipk(A)
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin= 45.0V Vin= 46.5V Vin= 48.0V

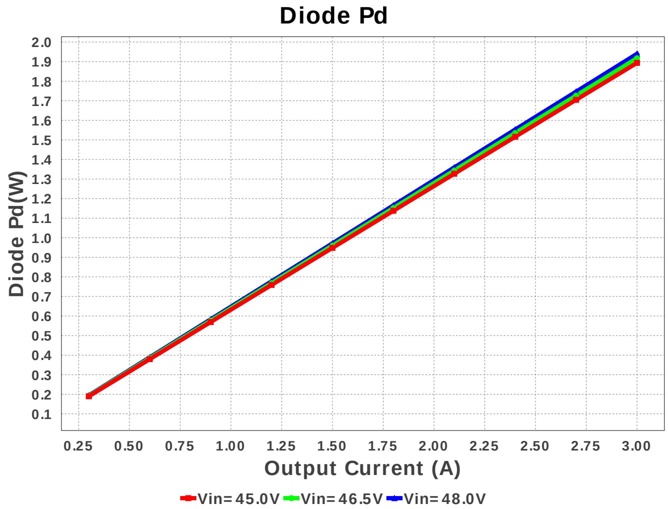

Iin Avg
Iin Avg(A)
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin= 45.0V Vin= 46.5V Vin= 48.0V

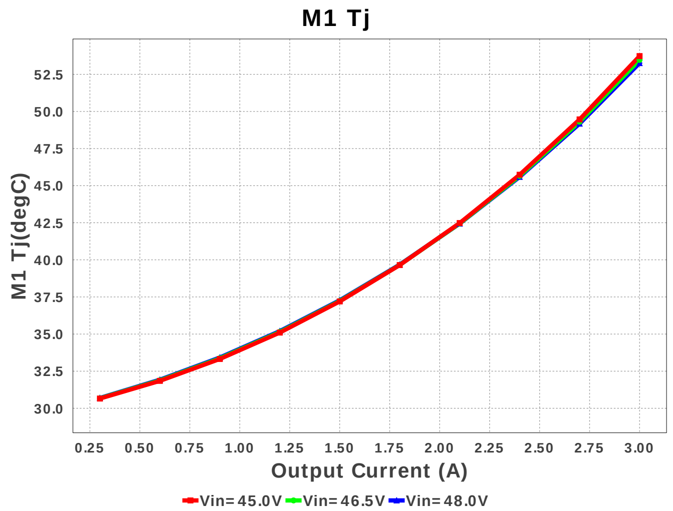

Total Pd
Total Pd(W)
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50 2.75 3.00
Output Current (A)
Vin= 45.0V Vin= 46.5V Vin= 48.0V

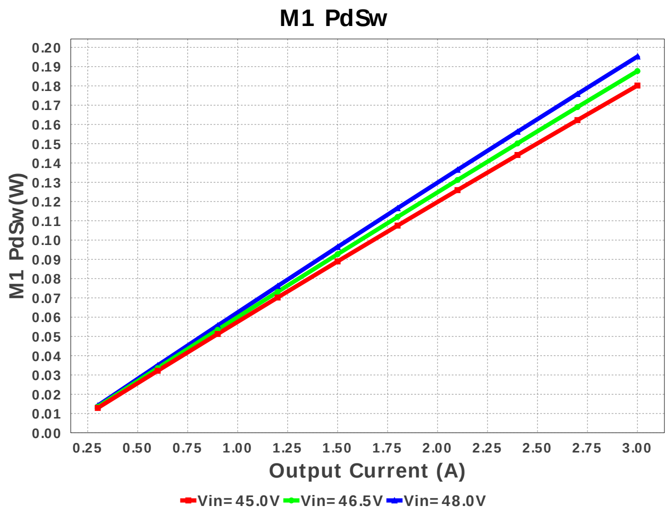












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.324 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	215.134 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	826.54 mA	Current	Average input current
4.	L Ipp	745.25 mA	Current	Peak-to-peak inductor ripple current
5.	SW Ipk	3.373 A	Current	Peak switch current
6.	BOM Count	14	General	Total Design BOM count
7.	FootPrint	488.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	591.544 kHz	General	Switching frequency
9.	IC Tolerance	25.0 mV	General	IC Feedback Tolerance
10.	Pout	36.0 W	General	Total output power
11.	Total BOM	$2.72	General	Total BOM Cost

#	Name	Value	Category	Description
12.	D1 Tj	146.4 degC	Op_Point	D1 junction temperature
13.	Vout Actual	12.12 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
14.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	26.515 %	Op_point	Duty cycle
16.	Efficiency	90.74 %	Op_point	Steady state efficiency
17.	IC Tj	56.381 degC	Op_point	IC junction temperature
18.	ICThetaJA	46.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	3.0 A	Op_point	Iout operating point
20.	M1 Tj	53.258 degC	Op_point	M1 MOSFET junction temperature
21.	VIN_OP	48.0 V	Op_point	Vin operating point
22.	Vout p-p	26.394 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	9.354 mW	Power	Input capacitor power dissipation
24.	Cout Pd	1.62 mW	Power	Output capacitor power dissipation
25.	Diode Pd	1.94 W	Power	Diode power dissipation
26.	IC Pd	573.494 mW	Power	IC power dissipation
27.	L Pd	393.75 mW	Power	Inductor power dissipation
28.	M1 Pd	665.591 mW	Power	M1 MOSFET total power dissipation
29.	M1 PdCond	470.352 mW	Power	M1 MOSFET conduction losses
30.	M1 PdSw	195.238 mW	Power	M1 MOSFET switching losses
31.	Total Pd	3.674 W	Power	Total Power Dissipation
32.	Vout Tolerance	3.848 %		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	48.0	Maximum input voltage
3.	VinMin	45.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	LM5085	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. For a Constant On Time device to be stable, we need to provide a ripple at the feedback comparator. There are various methods to implement the ripple. Depending on the circuit complexity vs. the allowable ripple, we have three options to choose from. The simplest option, 'Low Complexity', would require only a high ESR cap at the output. This means that the BOM count will be small, but the output voltage ripple will be quite large. The 'optimal solution' would require a feed-forward cap in parallel with the upper feedback resistor to AC couple the ripple to the feedback node. This increases the BOM count slightly, but now we have more control over the output voltage ripple. If the output voltage requirement is very tight, then the best option is to go for the 'Low Output Ripple' solution. In this option we can go with very low ESR output caps and have very good control over the output voltage ripple

2. **LM5085** Product Folder : http://www.ti.com/product/LM5085 : contains the data sheet and other resources.