![Texas Instruments]

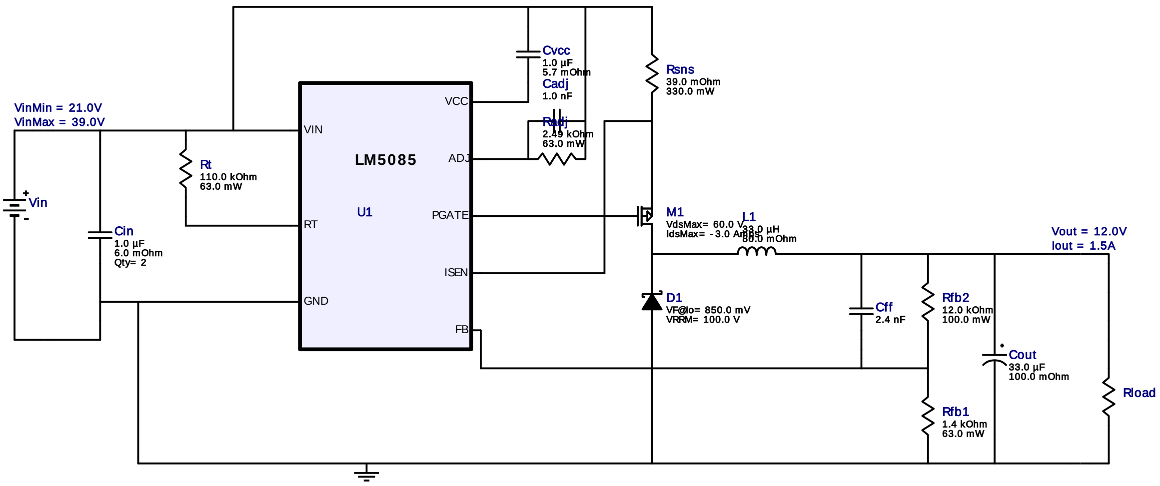
TEXAS INSTRUMENTS

VinMin = 21.0V
VinMax = 39.0V
Vout = 12.0V
Iout = 1.5A

Device = LM5085MM/NOPB
Topology = Buck
Created = 6/22/13 1:27:15 AM
BOM Cost = $3.02
Total Pd = 1.84W
Footprint = 427.0mm2
BOM Count = 15

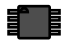
WEBENCH ® Design Report

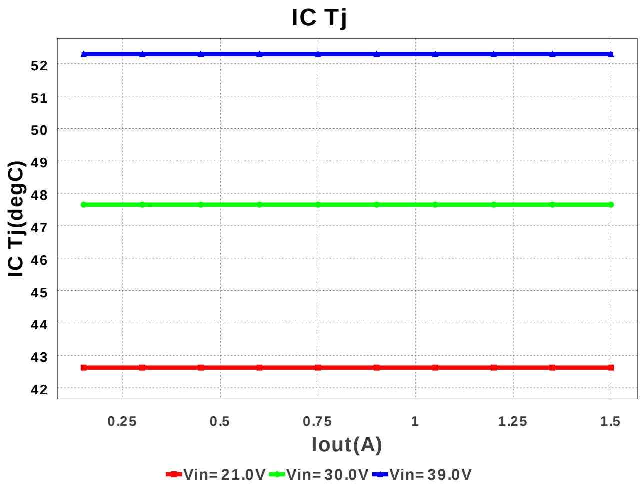
Design : 3729301/32 LM5085MM/NOPB
LM5085MM/NOPB 21.0V-39.0V to 12.0V @ 1.5A

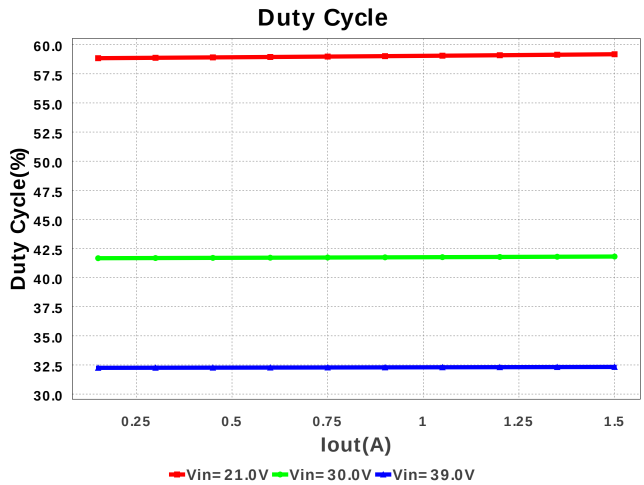


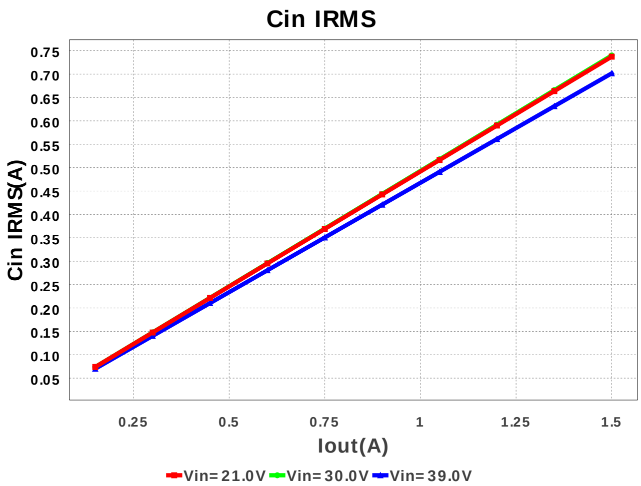
Electrical BOM

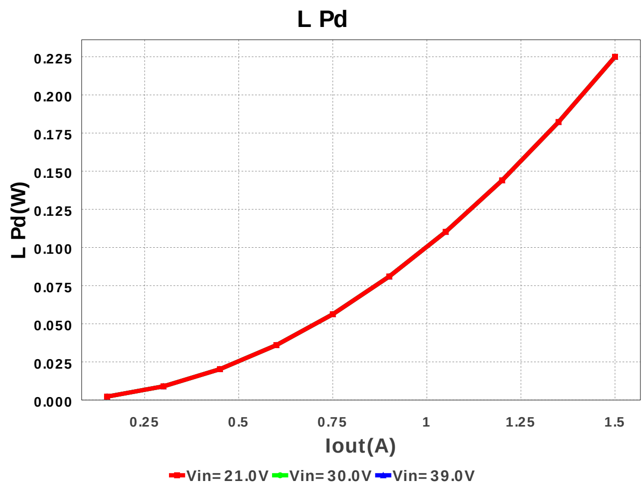
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cadj	Yageo America	CC0805KRX7R9BB102 Series= X7R	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 13mm2
2.	Cff	MuRata	GRM1885C1H242JA01D Series= C0G/NP0	Cap= 2.4 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0603 10mm2
3.	Cin	TDK	C3216X7R2A105M Series= 285	Cap= 1.0 µF ESR= 6.0 mOhm VDC= 100.0 V IRMS= 4.5 A	2	$0.11	1206 19mm2
4.	Cout	Kemet	T495X336K025ATE100 Series= T495	Cap= 33.0 µF ESR= 100.0 mOhm VDC= 25.0 V IRMS= 1.156 A	1	$0.90	7343-43 59mm2
5.	Cvcc	TDK	C1608X5R1C105K Series= X5R	Cap= 1.0 µF ESR= 5.7 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 10mm2
6.	D1	Micro Commercial Components	SK310A-TP	VF@Io= 850.0 mV VRRM= 100.0 V	1	$0.10	SMA 37mm2
7.	L1	Coilcraft	MSS1048-333MLB	L= 33.0 µH DCR= 80.0 mOhm	1	$0.47	MSS1048 146mm2
8.	M1	Fairchild Semiconductor	FDC5614P	VdsMax= 60.0 V IdsMax= -3.0 Amps	1	$0.20	SOT-23-6 24mm2
9.	Radj	Vishay-Dale	CRCW04022K49FKED Series= CRCW..e3	Res= 2.49 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 8mm2
10.	Rfb1	Vishay-Dale	CRCW04021K40FKED Series= CRCW..e3	Res= 1.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 8mm2

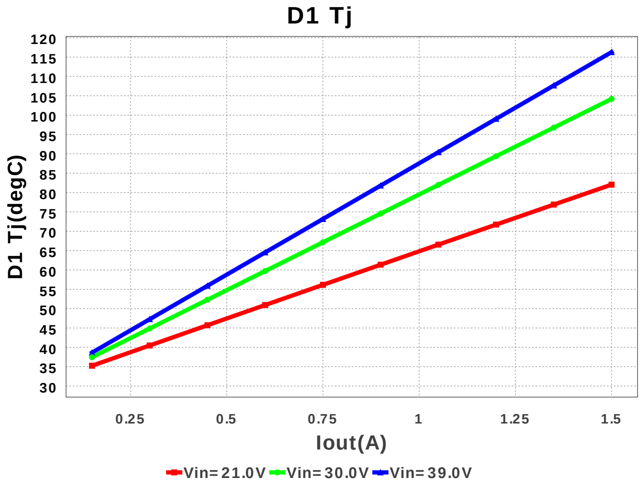
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rfb2	Yageo America	RC0603FR-0712KL Series= 233	Res= 12.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.10	0603 10mm2
12.	Rsns	Panasonic	ERJ-L14KF39MU Series= 232	Res= 39.0 mOhm Power= 330.0 mW Tolerance= 1.0%	1	$0.11	 1210 23mm2
13.	Rt	Vishay-Dale	CRCW0402110KFKED Series= CRCW..e3	Res= 110.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 8mm2
14.	U1	Texas Instruments	LM5085MM/NOPB	Switcher	1	$0.85	 MUA08A 34mm2

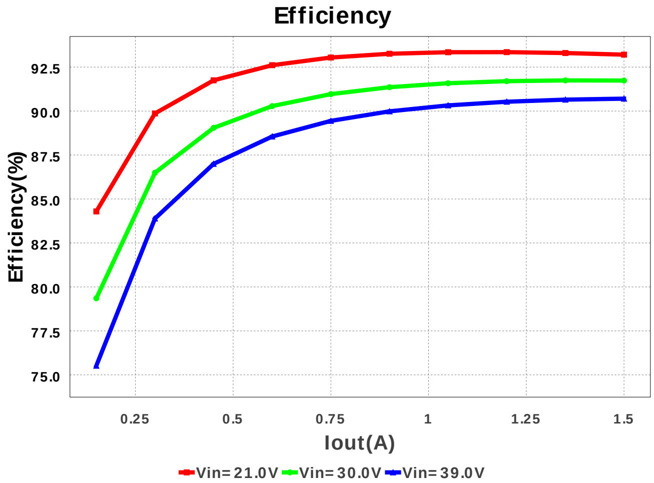


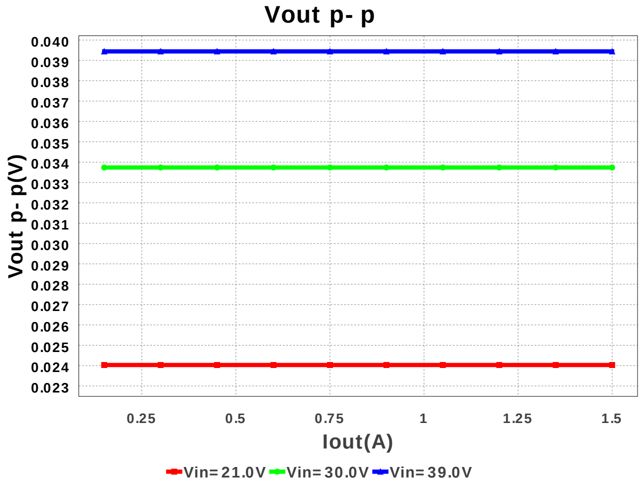


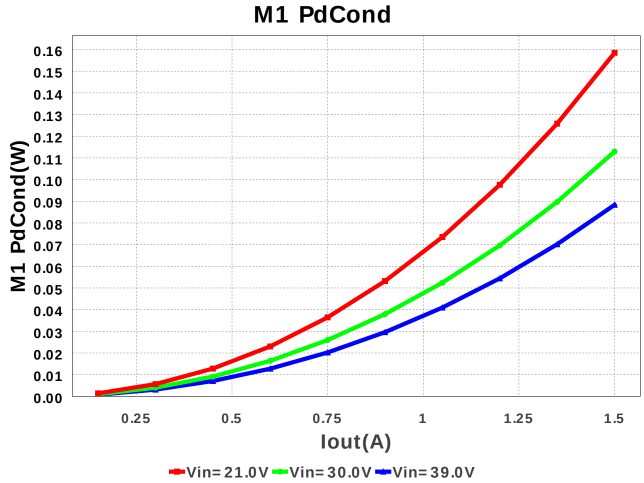


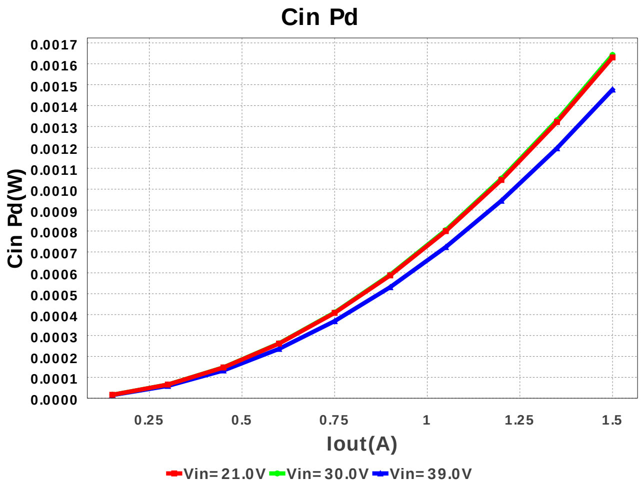


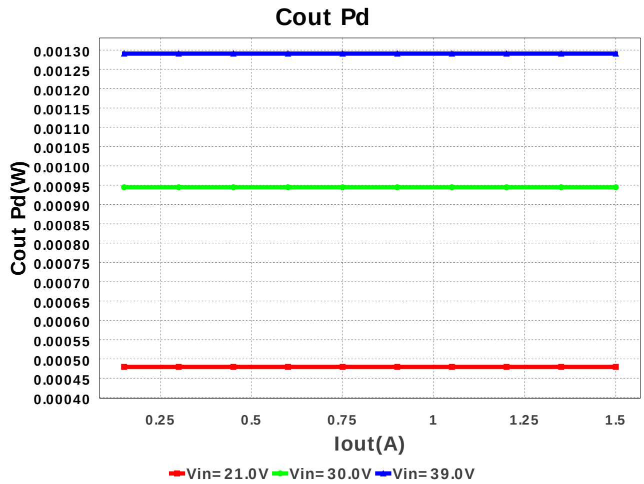

D1 Tj
D1 Tj(degC)
Iout(A)
Vin=21.0V Vin=30.0V Vin=39.0V

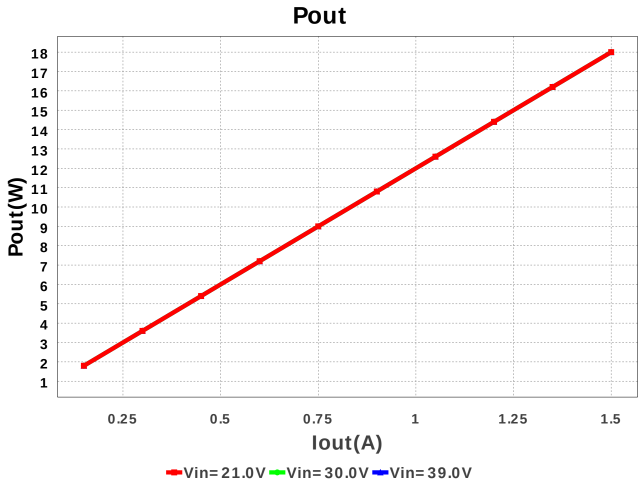

Efficiency
Efficiency(%)
Iout(A)
Vin=21.0V Vin=30.0V Vin=39.0V

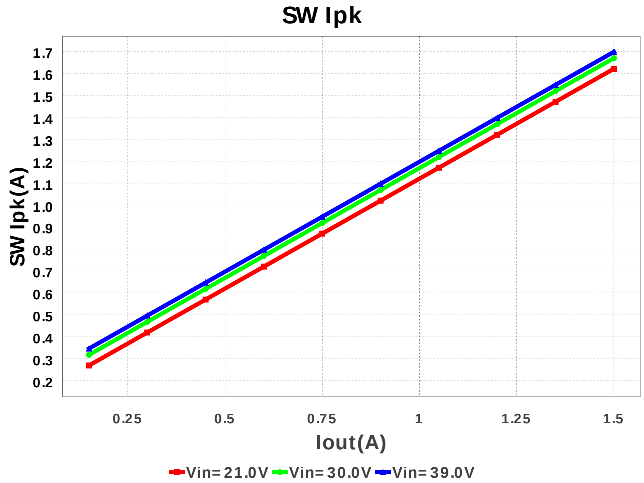

Vout p-p
Vout p-p(V)
Iout(A)
Vin=21.0V Vin=30.0V Vin=39.0V

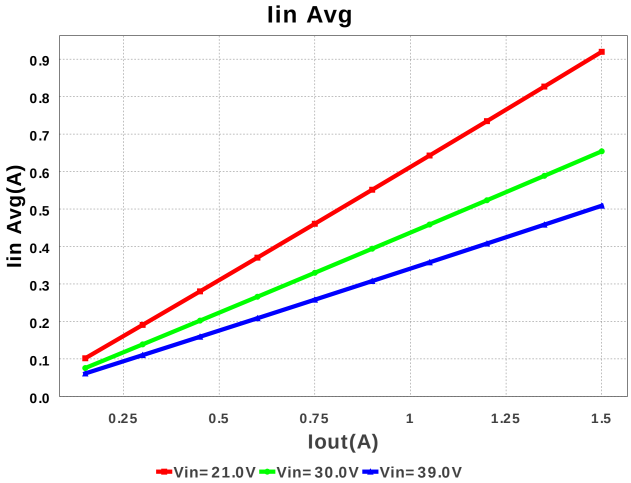

M1 PdCond
M1 PdCond(W)
Iout(A)
Vin=21.0V Vin=30.0V Vin=39.0V

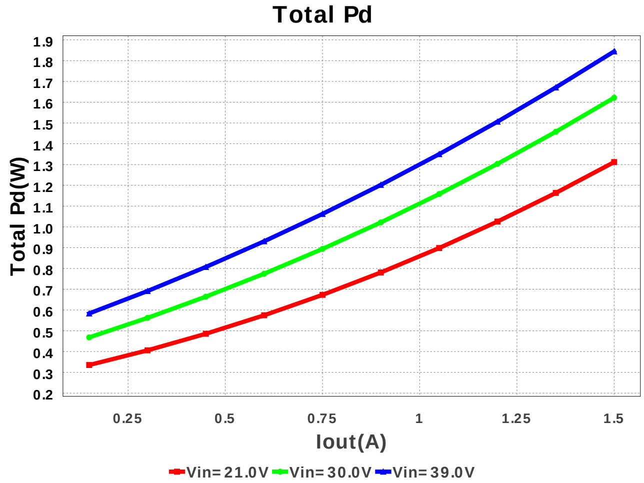

Cin Pd
Cin Pd(W)
Iout(A)
Vin=21.0V Vin=30.0V Vin=39.0V

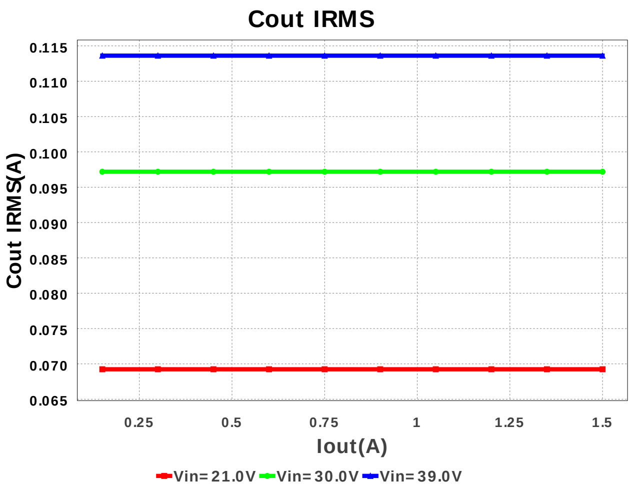

Cout Pd
Cout Pd(W)
Iout(A)
Vin=21.0V Vin=30.0V Vin=39.0V

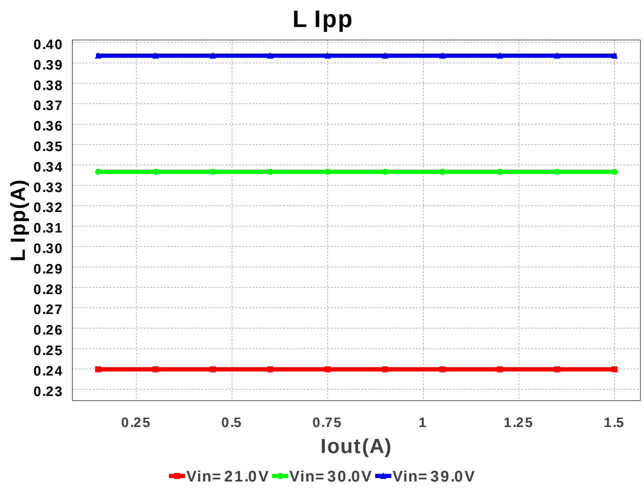

Pout
Pout(W)
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0.25
0.5
0.75
1
1.25
1.5
Iout(A)
Vin=21.0V

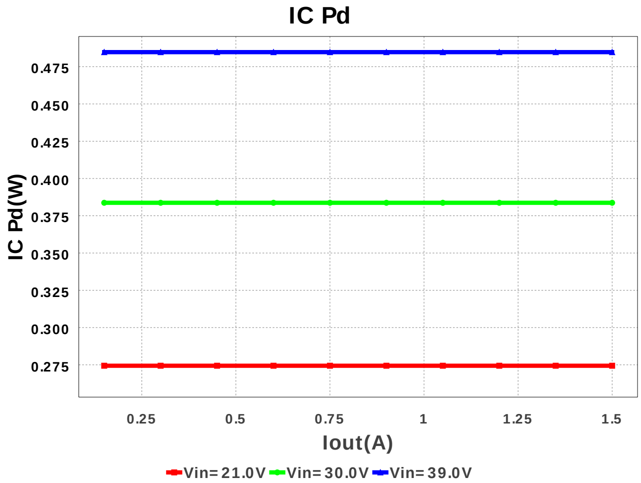

SW Ipk
SW Ipk(A)
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.25
0.5
0.75
1
1.25
1.5
Iout(A)
Vin=21.0V
Vin=30.0V
Vin=39.0V

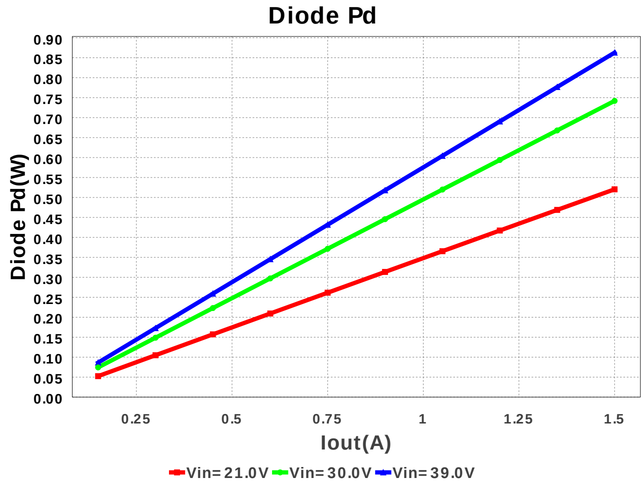

Iin Avg
Iin Avg(A)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.25
0.5
0.75
1
1.25
1.5
Iout(A)
Vin=21.0V
Vin=30.0V
Vin=39.0V

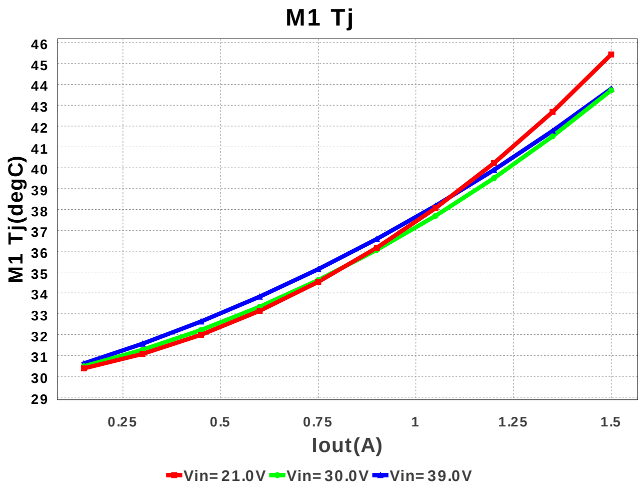

Total Pd
Total Pd(W)
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.25
0.5
0.75
1
1.25
1.5
Iout(A)
Vin=21.0V
Vin=30.0V
Vin=39.0V

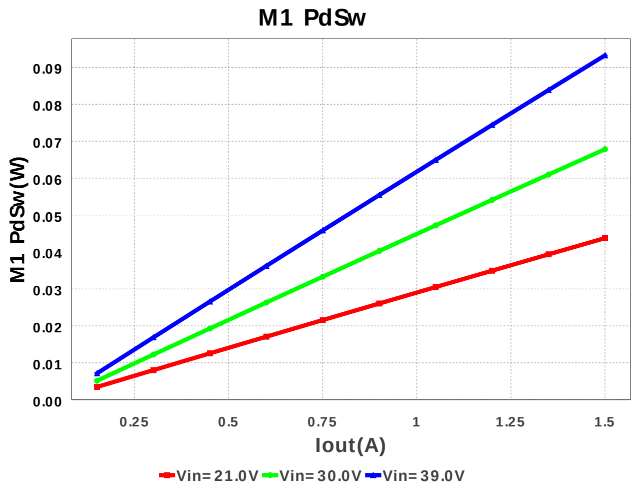

Cout IRMS
Cout IRMS(A)
0.115
0.110
0.105
0.100
0.095
0.090
0.085
0.080
0.075
0.070
0.065
0.25
0.5
0.75
1
1.25
1.5
Iout(A)
Vin=21.0V
Vin=30.0V
Vin=39.0V


L Ipp
L Ipp(A)
0.40
0.39
0.38
0.37
0.36
0.35
0.34
0.33
0.32
0.31
0.30
0.29
0.28
0.27
0.26
0.25
0.24
0.23
0.25
0.5
0.75
1
1.25
1.5
Iout(A)
Vin=21.0V
Vin=30.0V
Vin=39.0V









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	701.602 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	113.616 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	508.83 mA	Current	Average input current
4.	L Ipp	393.576 mA	Current	Peak-to-peak inductor ripple current
5.	SW Ipk	1.697 A	Current	Peak switch current
6.	BOM Count	15	General	Total Design BOM count
7.	FootPrint	427.0 mm2	General	Total Foot Print Area of BOM components
8.	Frequency	579.418 kHz	General	Switching frequency
9.	IC Tolerance	25.0 mV	General	IC Feedback Tolerance
10.	Mode	CCM	General	Conduction Mode
11.	Pout	18.0 W	General	Total output power
12.	Total BOM	$3.02	General	Total BOM Cost
13.	D1 Tj	116.28 degC	Op_Point	D1 junction temperature
14.	Vout OP	12.0 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	32.33 %	Op_point	Duty cycle
16.	Efficiency	90.706 %	Op_point	Steady state efficiency
17.	IC Tj	52.299 degC	Op_point	IC junction temperature
18.	ICThetaJA	46.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	1.5 A	Op_point	Iout operating point
20.	M1 Tj	43.789 degC	Op_point	M1 MOSFET junction temperature
21.	VIN_OP	39.0 V	Op_point	Vin operating point
22.	Vout p-p	39.442 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	1.477 mW	Power	Input capacitor power dissipation
24.	Cout Pd	1.291 mW	Power	Output capacitor power dissipation
25.	Diode Pd	862.798 mW	Power	Diode power dissipation
26.	IC Pd	484.751 mW	Power	IC power dissipation
27.	L Pd	225.0 mW	Power	Inductor power dissipation
28.	M1 PdCond	87.95 mW	Power	M1 MOSFET conduction losses
29.	M1 PdSw	93.233 mW	Power	M1 MOSFET switching losses
30.	Total Pd	1.844 W	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	1.5 A	Maximum Output Current
2.	Iout1	1.5 Amps	Output Current #1
3.	VinMax	39.0 V	Maximum input voltage
4.	VinMin	21.0 V	Minimum input voltage
5.	Vout	12.0 V	Output Voltage
6.	Vout1	12.0 Volt	Output Voltage #1
7.	base_pn	LM5085	Texas Instruments Base Part Number
8.	source	DC	Input Source Type
9.	ta	30.0 degC	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.