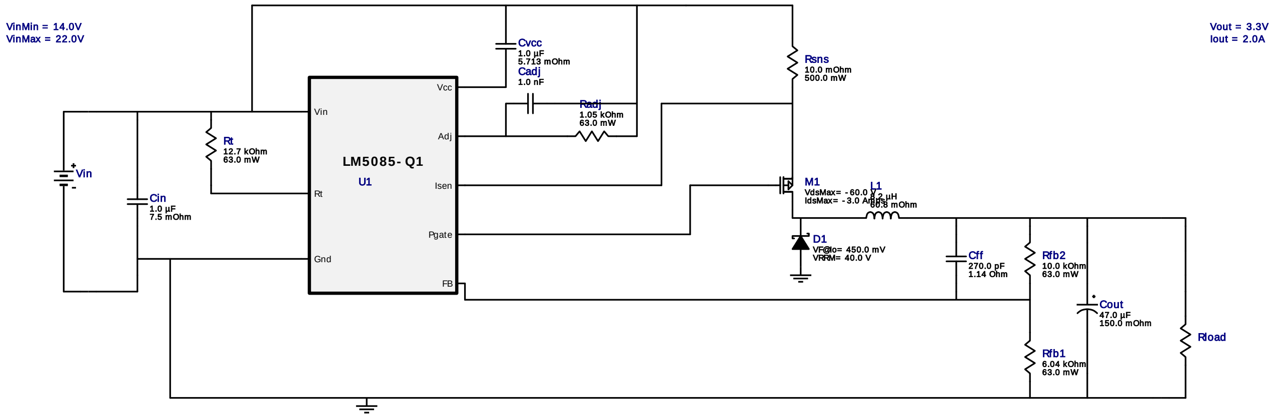
VinMin = 14.0V
VinMax = 22.0V
Vout = 3.3V
Iout = 2.0A

Device = LM5085QMY/NOPB
Topology = Buck
Created = 6/12/14 8:24:52 PM
BOM Cost = $2.68
Footprint = 155.0mm2
BOM Count = 14
Total Pd = 1.58W

WEBENCH ® Design Report

Design : 4046158/7 LM5085QMY/NOPB
LM5085QMY/NOPB 14.0V-22.0V to 3.3V @ 2.0A

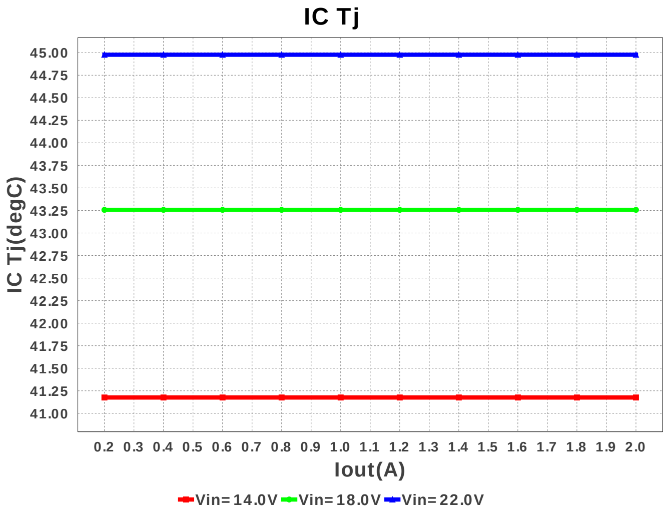


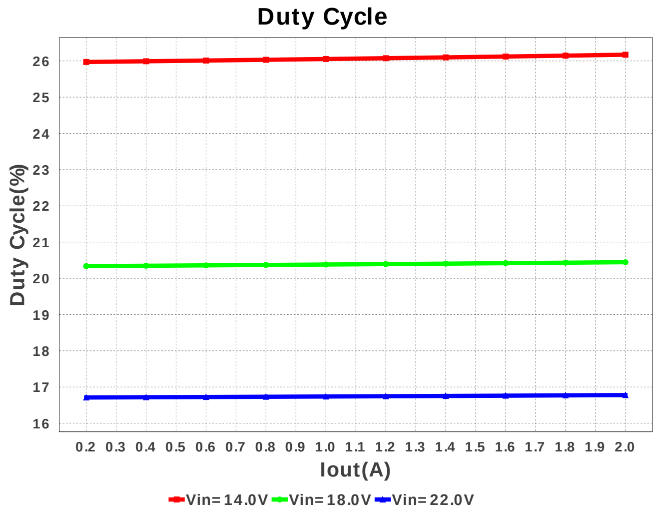
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.View WEBENCH(R) Disclaimer.

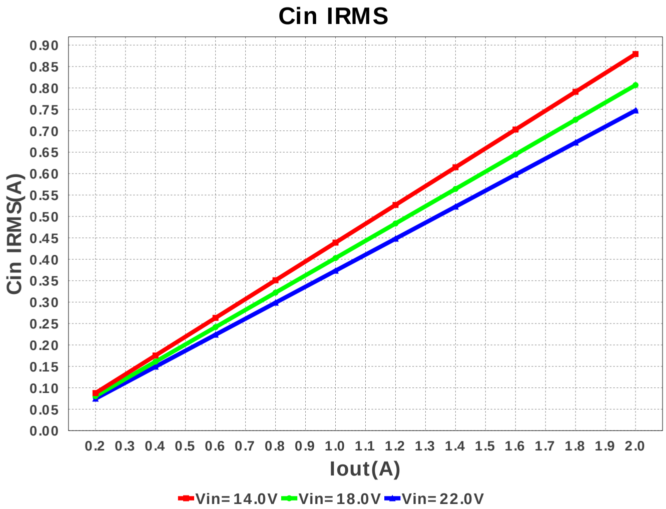
Electrical BOM

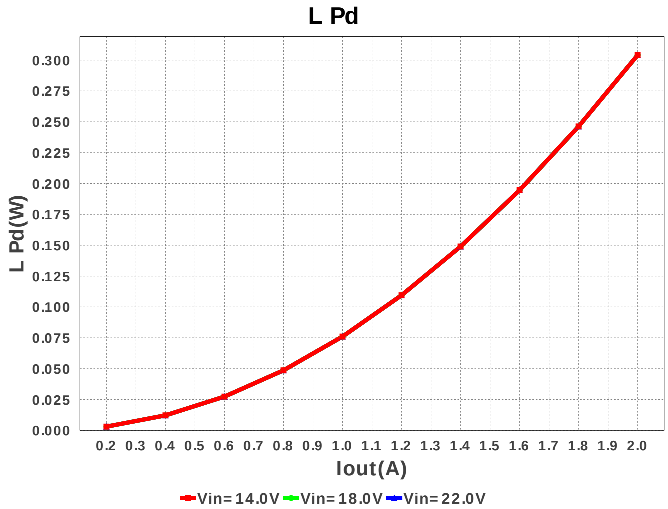
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cadj	MuRata	GRM033R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0201 2mm2
2.	Cff	Kemet	C0805C271K5RACTU Series= X7R	Cap= 270.0 pF ESR= 1.14 Ohm VDC= 50.0 V IRMS= 139.0 mA	1	$0.06	0805 7mm2
3.	Cin	TDK	C3216X7R2A105M160AA Series= X7R	Cap= 1.0 µF ESR= 7.5 mOhm VDC= 100.0 V IRMS= 5.923 A	1	$0.11	1206 11mm2
4.	Cout	Panasonic	6TPU47MSI Series= 1277	Cap= 47.0 µF ESR= 150.0 mOhm VDC= 6.3 V IRMS= 510.0 mA	1	$0.46	CAPSMT_6_S09 7mm2
5.	Cvcc	TDK	C1608X5R1C105K Series= 285	Cap= 1.0 µF ESR= 5.713 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	1608 5mm2
6.	D1	Diodes Inc.	B340LA-13-F	VF@Io= 450.0 mV VRRM= 40.0 V	1	$0.16	SMA 37mm2
7.	L1	Coilcraft	XAL4040-822MEB	L= 8.2 µH DCR= 60.8 mOhm	1	$0.52	XAL4040 25mm2
8.	M1	Fairchild Semiconductor	FDC5614P	VdsMax= -60.0 V IdsMax= -3.0 Amps	1	$0.22	SOT-23-6 15mm2
9.	Radj	Vishay-Dale	CRCW04021K05FKED Series= CRCW..e3	Res= 1.05 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3mm2
10.	Rfb1	Vishay-Dale	CRCW04026K04FKED Series= CRCW..e3	Res= 6.04 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3mm2

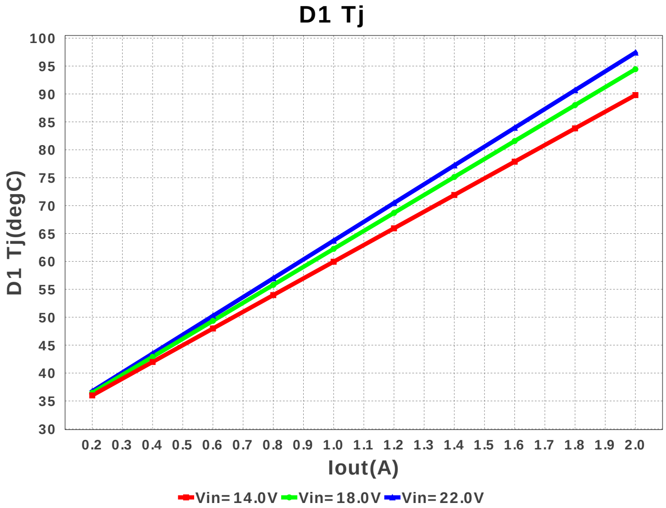
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rfb2	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3mm2
12.	Rsns	Stackpole Electronics Inc	CSR1206FK10L0 Series= ?	Res= 10.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.11	1206 11mm2
13.	Rt	Vishay-Dale	CRCW040212K7FKED Series= CRCW..e3	Res= 12.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3mm2
14.	U1	Texas Instruments	LM5085QMY/NOPB	Switcher	1	$0.98	MUY08A 24mm2

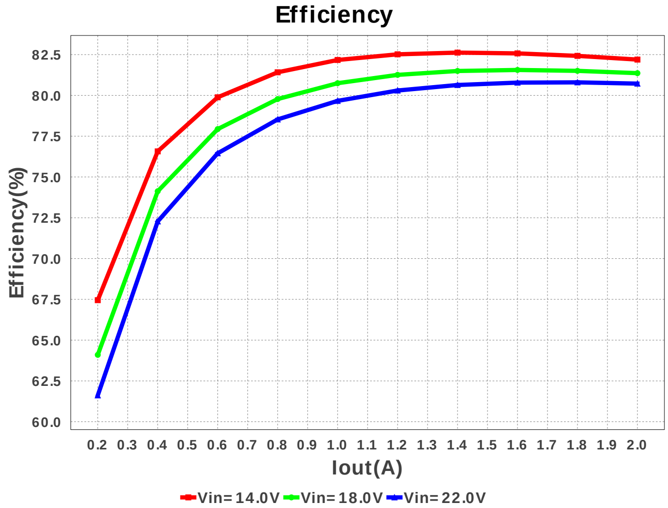


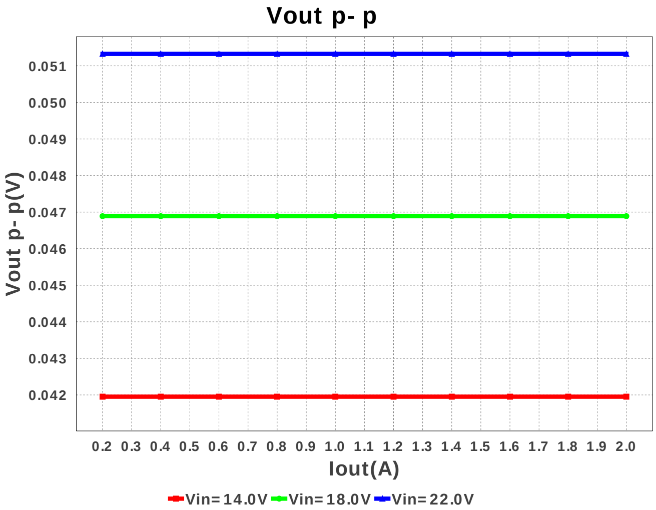


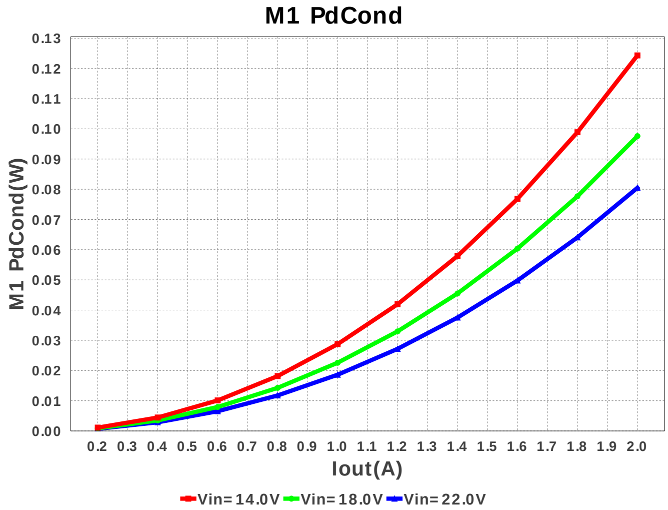


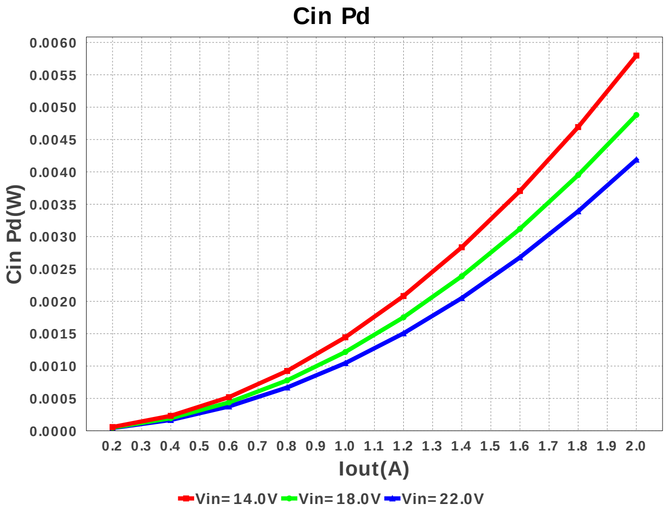


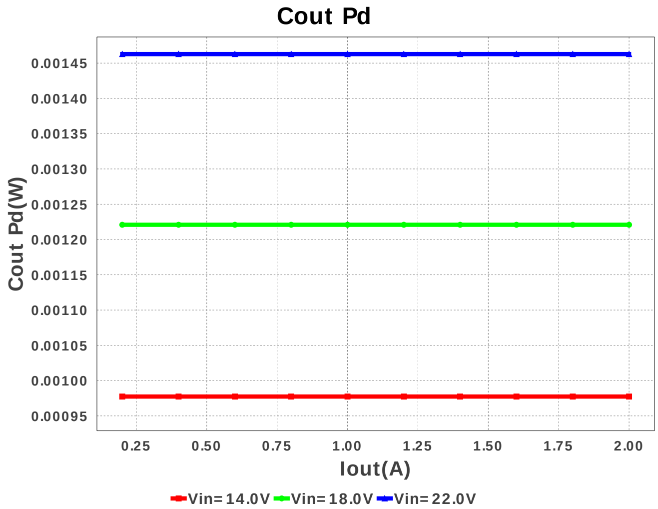

D1 Tj
D1 Tj(degC)
100 95 90 85 80 75 70 65 60 55 50 45 40 35 30
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

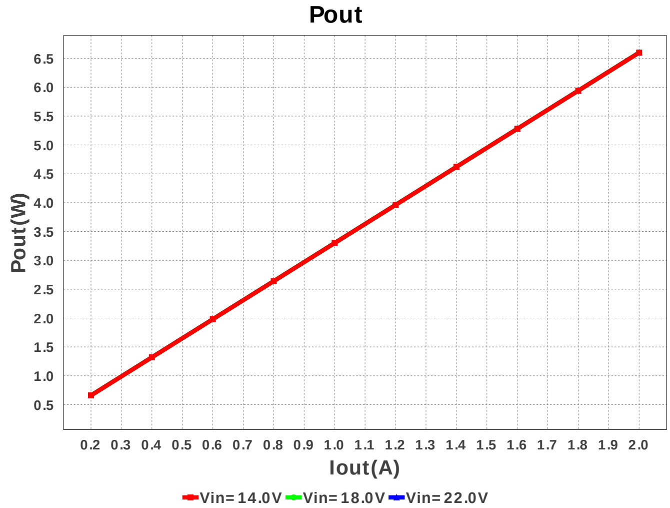

Efficiency
Efficiency(%)
82.5 80.0 77.5 75.0 72.5 70.0 67.5 65.0 62.5 60.0
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

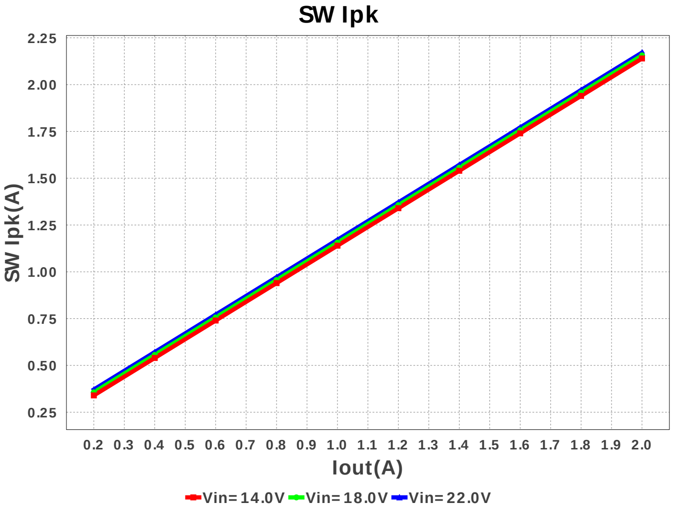

Vout p-p
Vout p-p(V)
0.051 0.050 0.049 0.048 0.047 0.046 0.045 0.044 0.043 0.042
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

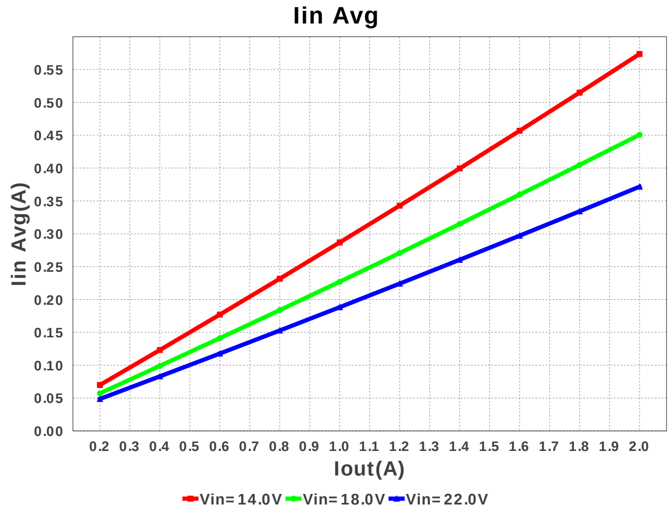

M1 PdCond
M1 PdCond(W)
0.13 0.12 0.11 0.10 0.09 0.08 0.07 0.06 0.05 0.04 0.03 0.02 0.01 0.00
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

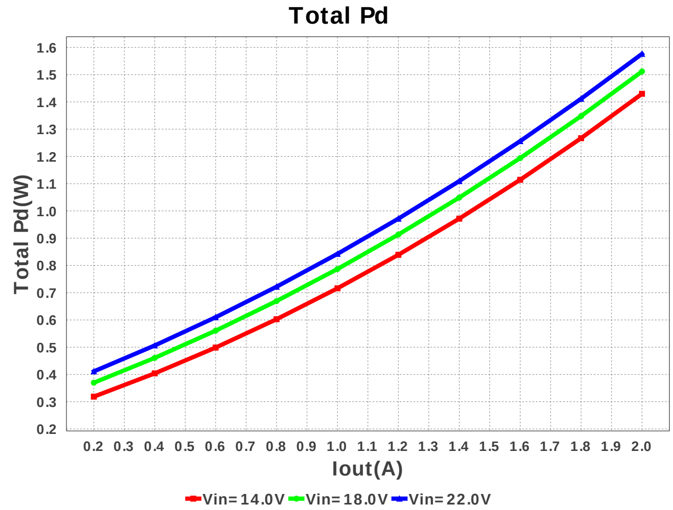

Cin Pd
Cin Pd(W)
0.0060 0.0055 0.0050 0.0045 0.0040 0.0035 0.0030 0.0025 0.0020 0.0015 0.0010 0.0005 0.0000
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

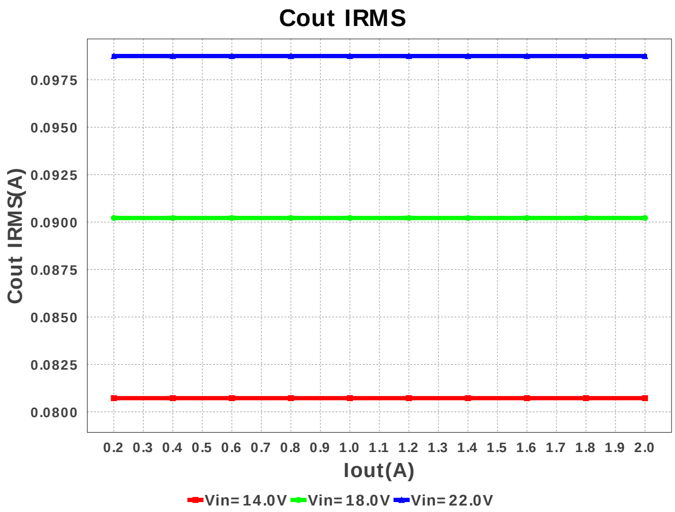

Cout Pd
Cout Pd(W)
0.00145 0.00140 0.00135 0.00130 0.00125 0.00120 0.00115 0.00110 0.00105 0.00100 0.00095
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

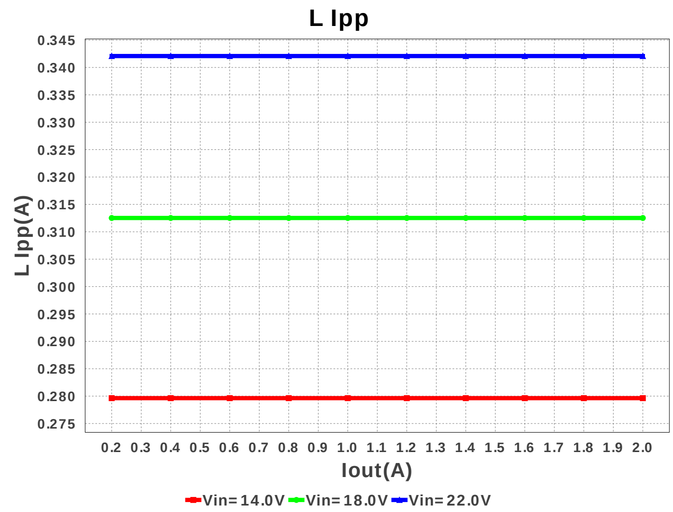

Pout
Pout(W)
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

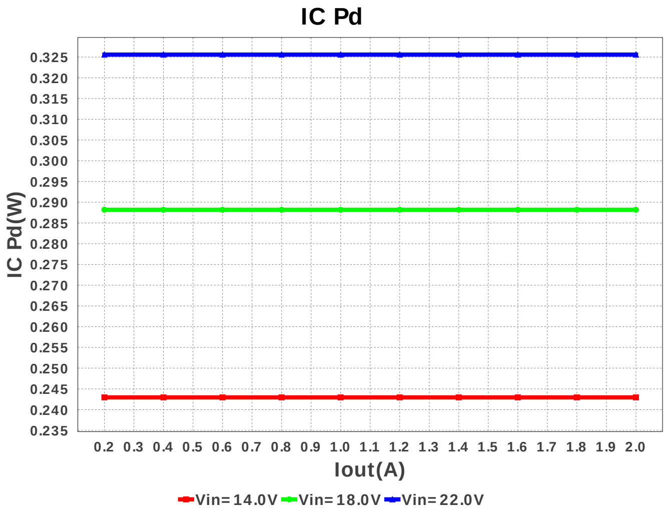

SW Ipk
SW Ipk(A)
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

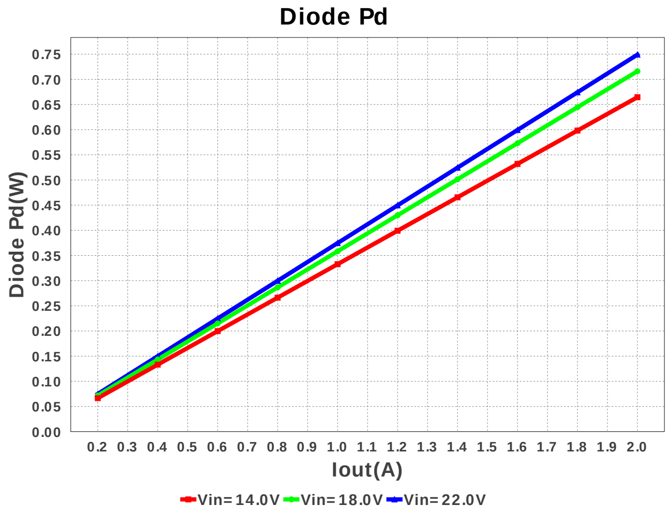

Iin Avg
Iin Avg(A)
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

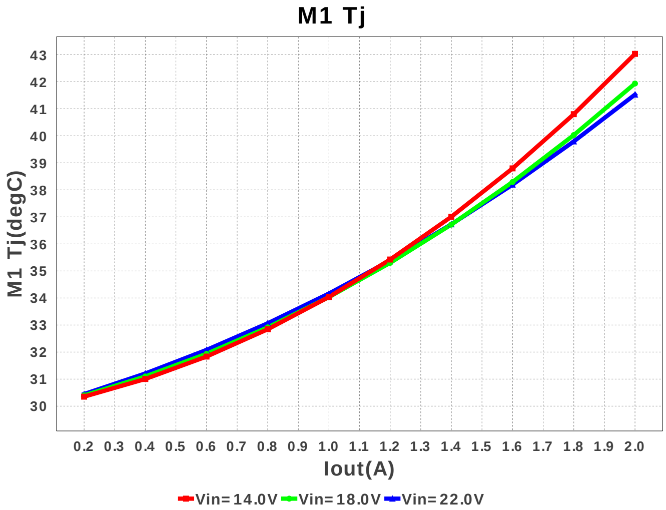

Total Pd
Total Pd(W)
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

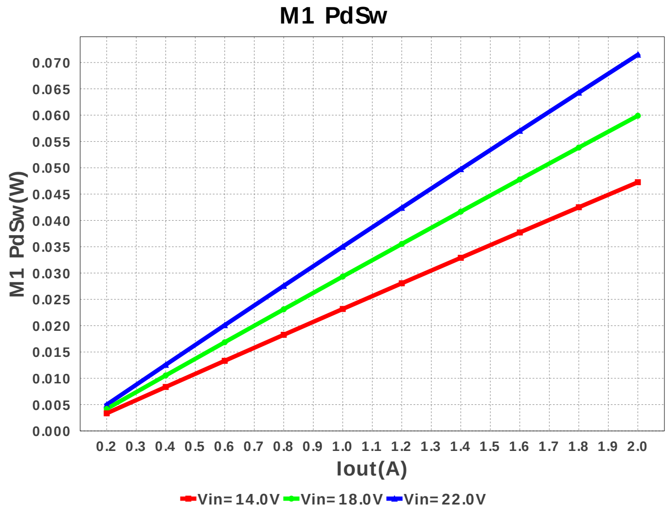

Cout IRMS
Cout IRMS(A)
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V

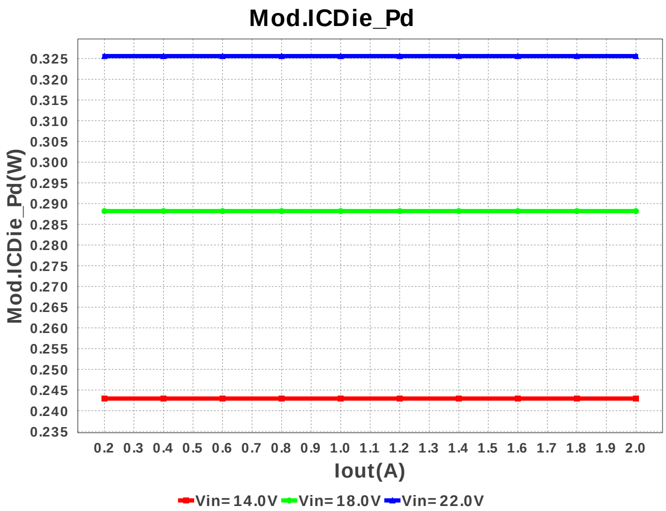

L Ipp
L Ipp(A)
Iout(A)
Vin=14.0V Vin=18.0V Vin=22.0V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	747.341 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	98.751 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	371.68 mA	Current	Average input current
4.	L Ipp	342.084 mA	Current	Peak-to-peak inductor ripple current
5.	SW Ipk	2.171 A	Current	Peak switch current
6.	BOM Count	14	General	Total Design BOM count
7.	FootPrint	155.0 mm2	General	Total Foot Print Area of BOM components
8.	Frequency	749.982 kHz	General	Switching frequency
9.	IC Tolerance	25.0 mV	General	IC Feedback Tolerance
10.	Pout	6.6 W	General	Total output power
11.	Total BOM	$2.68	General	Total BOM Cost

#	Name	Value	Category	Description
12.	D1 Tj	97.41 degC	Op_Point	D1 junction temperature
13.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
14.	Duty Cycle	16.778 %	Op_point	Duty cycle
15.	Efficiency	80.714 %	Op_point	Steady state efficiency
16.	IC Tj	44.977 degC	Op_point	IC junction temperature
17.	ICThetaJA	46.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
18.	IOUT_OP	2.0 A	Op_point	Iout operating point
19.	M1 Tj	41.527 degC	Op_point	M1 MOSFET junction temperature
20.	VIN_OP	22.0 V	Op_point	Vin operating point
21.	Vout p-p	51.327 mV	Op_point	Peak-to-peak output ripple voltage
22.	Cin Pd	4.189 mW	Power	Input capacitor power dissipation
23.	Cout Pd	1.463 mW	Power	Output capacitor power dissipation
24.	Diode Pd	748.999 mW	Power	Diode power dissipation
25.	IC Pd	325.593 mW	Power	IC power dissipation
26.	L Pd	304.0 mW	Power	Inductor power dissipation
27.	M1 PdCond	81.308 mW	Power	M1 MOSFET conduction losses
28.	M1 PdSw	71.492 mW	Power	M1 MOSFET switching losses
29.	Total Pd	1.577 W	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	2.0 A	Maximum Output Current
2.	Iout1	2.0 Amps	Output Current #1
3.	VinMax	22.0 V	Maximum input voltage
4.	VinMin	14.0 V	Minimum input voltage
5.	Vout	3.3 V	Output Voltage
6.	Vout1	3.3 Volt	Output Voltage #1
7.	base_pn	LM5085-Q1	Texas Instruments Base Part Number
8.	source	DC	Input Source Type
9.	ta	30.0 degC	Ambient temperature
10.	userfsw	471.115 kHz	Customer Selected Frequency

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. Feature Highlights: Automotive Qualified 75V Wide Vin Constant On-Time PFET Buck Switching Controller

3. The LM5085-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application

4. LM5085-Q1 Product Folder : http://www.ti.com/product/lm5085-q1 : contains the data sheet and other resources.