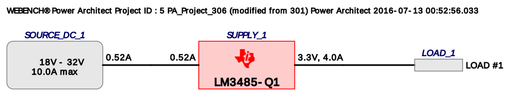
TEXAS INSTRUMENTS



WEBENCH® Power Architect

Project Report

Project : 1165565/5 : PA_Project_306 (modified from 301)
Created : 2016-07-13 00:52:56.033
Optimize project optFactor=3

Project Summary

1.	Total System Efficiency	79.484 %
2.	Total System BOM Count	13.0
3.	Total System Footprint	594.0 mm2
4.	Total System BOM Cost	$2.80
5.	Total System Power Dissipation	3.407 W

--> Launch WEBENCH Power Architect.

Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_1	0	LOAD_1	LOAD #1

Power Supplies

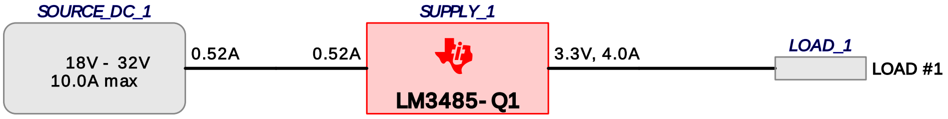
#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	LM3485-Q1	Switcher : Hysteretic controller	3.3 V	4.0 A	79.5%	594	$2.80	15	4

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD #1	3.3 V	4 A	VoutRipple=10%

Project Diagram

WEBENCH® Power Architect Project ID : 5 PA_Project_306 (modified from 301) Power Architect 2016-07-13 00:52:56.033



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm^2)
Panasonic	20SVPF56MX	CAPSMT_62_E61	2	$0.35	53
Vishay-Semiconductor	50WQ10FNPBF	DPAK	1	$0.74	102
Yageo America	CC0805KRX7R9BB471	0805	1	$0.01	7
Samsung Electro-Mechanics	CL21C102JBCNFNC	0805	1	$0.01	7
Vishay-Dale	CRCW040210K0FKED	0402	1	$0.01	3
Vishay-Dale	CRCW0402162KFKED	0402	1	$0.01	3
Vishay-Dale	CRCW040216K5FKED	0402	1	$0.01	3
Stackpole Electronics Inc	CSR1206FK20L0	1206	1	$0.10	11
Fairchild Semiconductor	FDD5614P	DPAK	1	$0.24	102
MuRata	GRM31CR71H475KA12L	1206	1	$0.07	11
Texas Instruments	LM3485Q1MM/NOPB	MUA08A	1	$0.53	24
Bourns	SRR1208-100ML	SRR1208	1	$0.37	216
Total			13	$2.80	540.7428

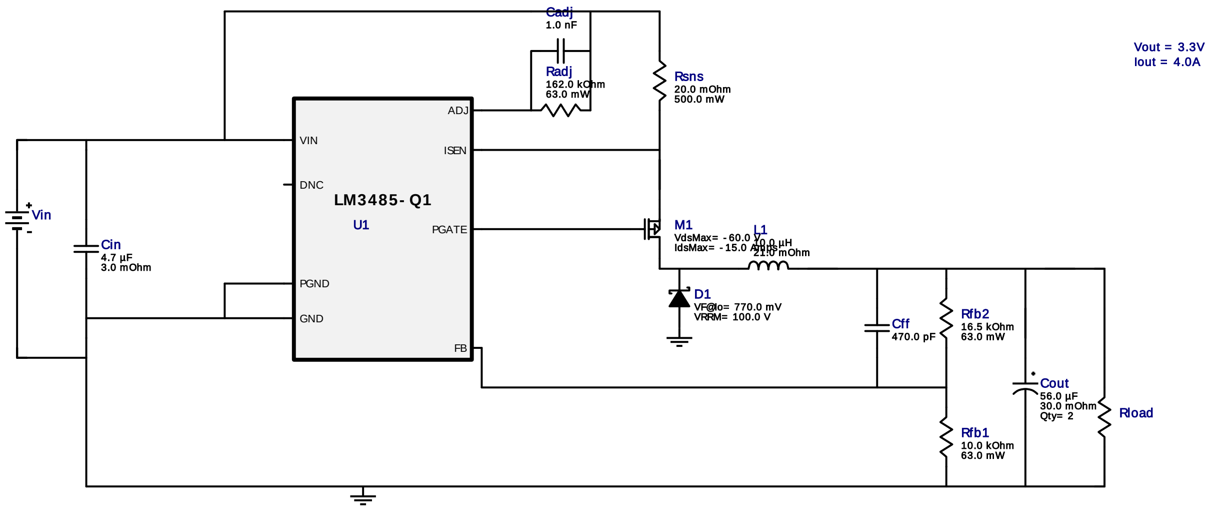
Texas Instruments

Vout = 3.3V
Iout = 4.0A

Device = LM3485Q1MM/NOPB
Topology = Buck
Created = 7/13/16 12:52:55 AM
BOM Cost = $2.80
BOM Count = 13
Total Pd = 3.41W

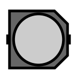
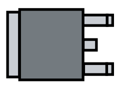
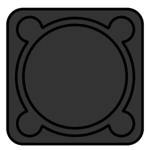
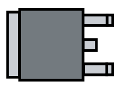
WEBENCH ® Design Report

Design : 1165565/15 LM3485Q1MM/NOPB
LM3485Q1MM/NOPB 18.0V-32.0V to 3.30V @ 4.0A

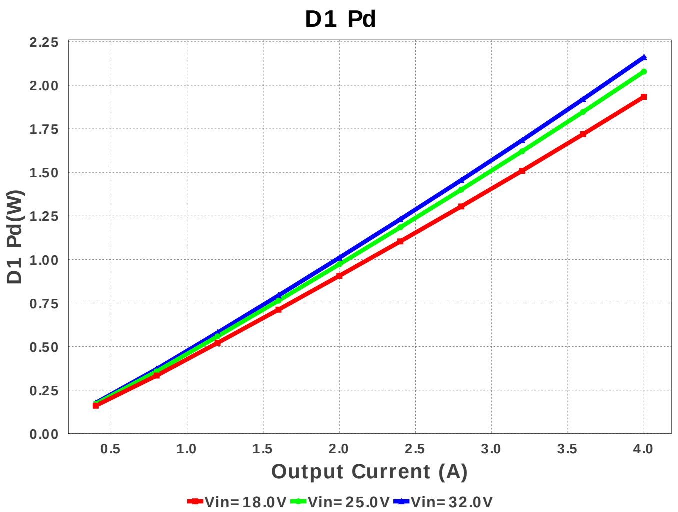


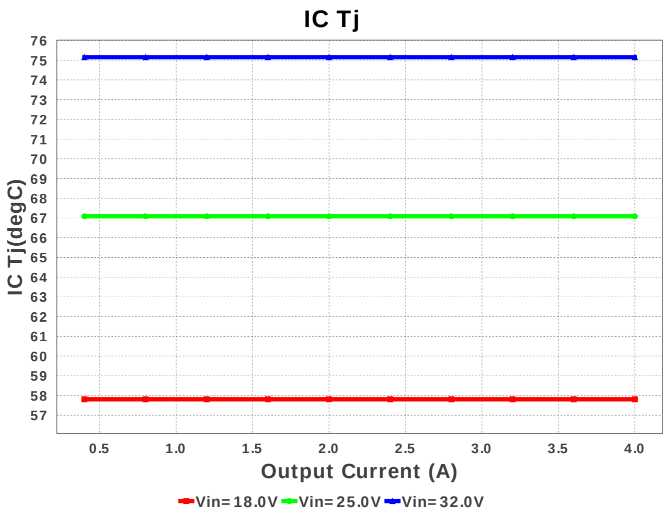
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

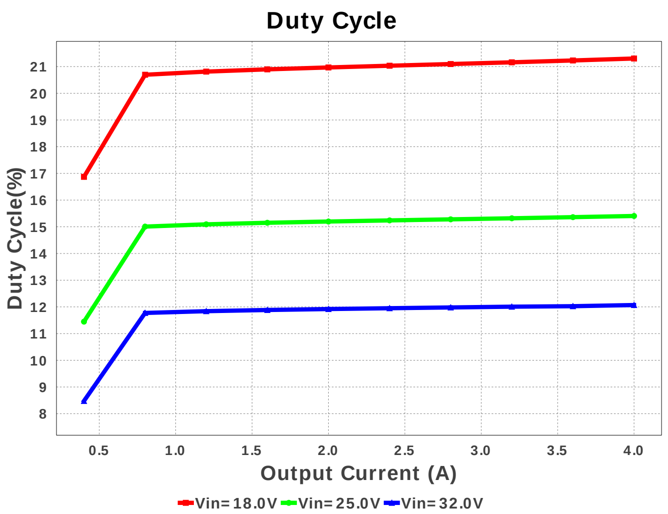
Electrical BOM

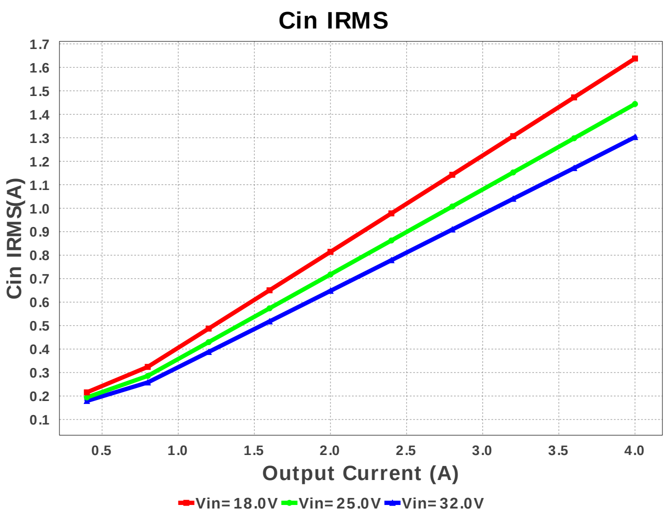
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cadj	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm^2
2.	Cff	Yageo America	CC0805KRX7R9BB471 Series= X7R	Cap= 470.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm^2
3.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.07	 1206 11 mm^2
4.	Cout	Panasonic	20SVPF56MX Series= ?	Cap= 56.0 uF ESR= 30.0 mOhm VDC= 20.0 V IRMS= 2.8 A	2	$0.35	 CAPSMT_62_E61 53 mm^2
5.	D1	Vishay-Semiconductor	50WQ10FNPBF	VF@Io= 770.0 mV VRRM= 100.0 V	1	$0.74	 DPAK 102 mm^2
6.	L1	Bourns	SRR1208-100ML	L= 10.0 µH DCR= 21.0 mOhm	1	$0.37	 SRR1208 216 mm^2
7.	M1	Fairchild Semiconductor	FDD5614P	VdsMax= -60.0 V IdsMax= -15.0 Amps	1	$0.24	 DPAK 102 mm^2

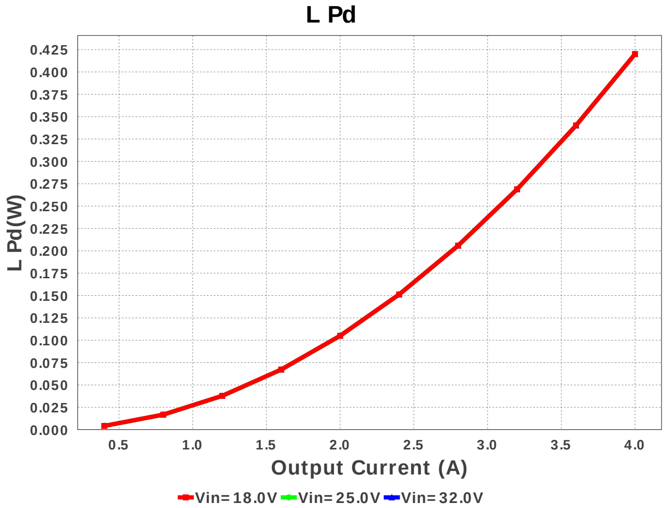
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Radj	Vishay-Dale	CRCW0402162KFKED Series= CRCW..e3	Res= 162.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
9.	Rfb1	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
10.	Rfb2	Vishay-Dale	CRCW040216K5FKED Series= CRCW..e3	Res= 16.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
11.	Rsns	Stackpole Electronics Inc	CSR1206FK20L0 Series= ?	Res= 20.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	1206 11 mm^2
12.	U1	Texas Instruments	LM3485Q1MM/NOPB	Switcher	1	$0.53	MUA08A 24 mm^2

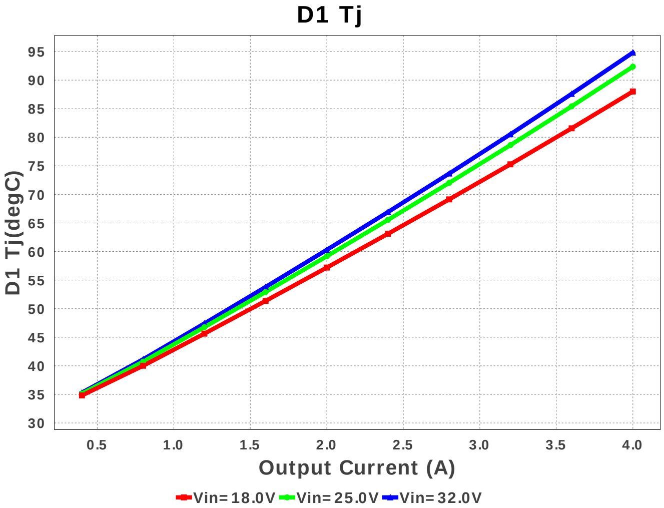


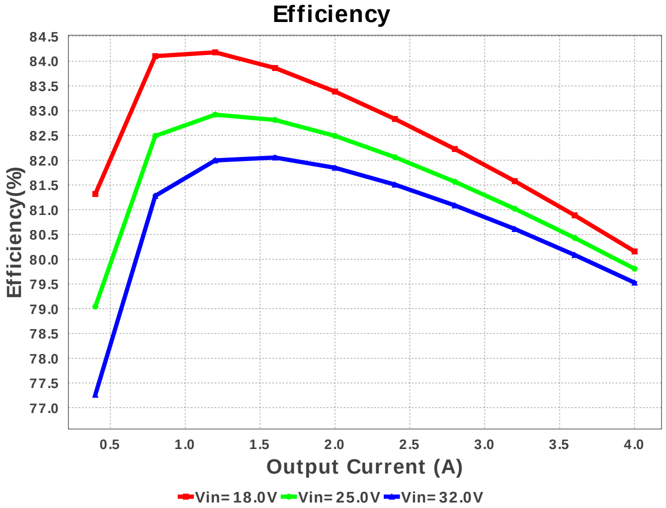


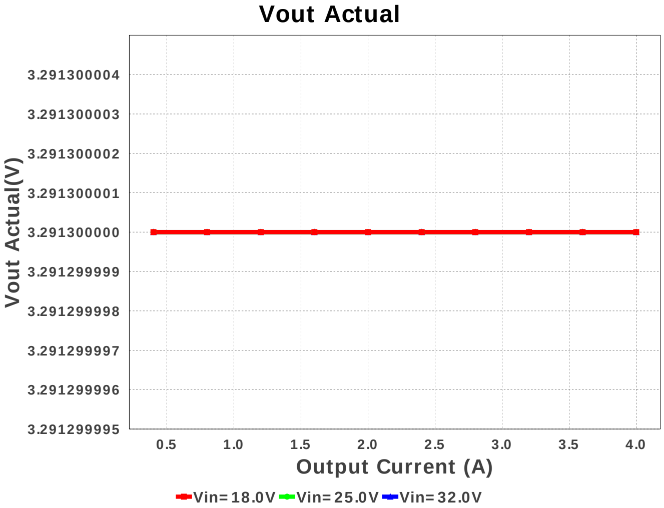


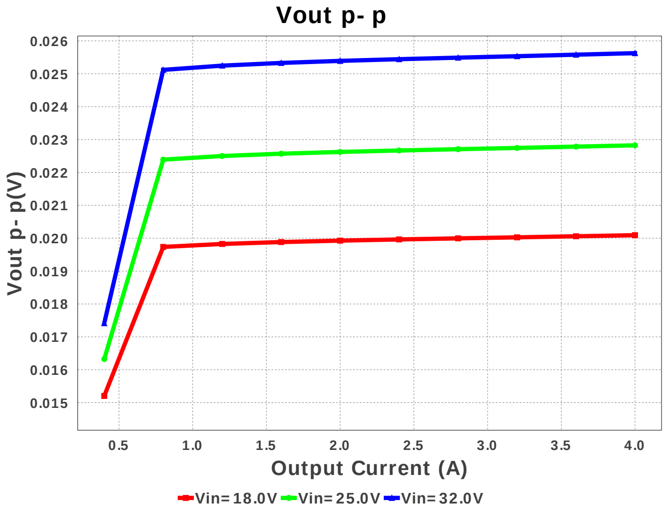


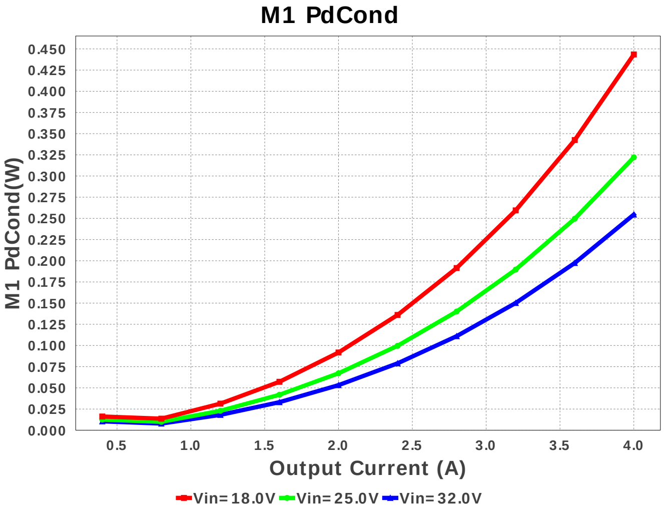

L Pd
L Pd(W)
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=18.0V
Vin=25.0V
Vin=32.0V

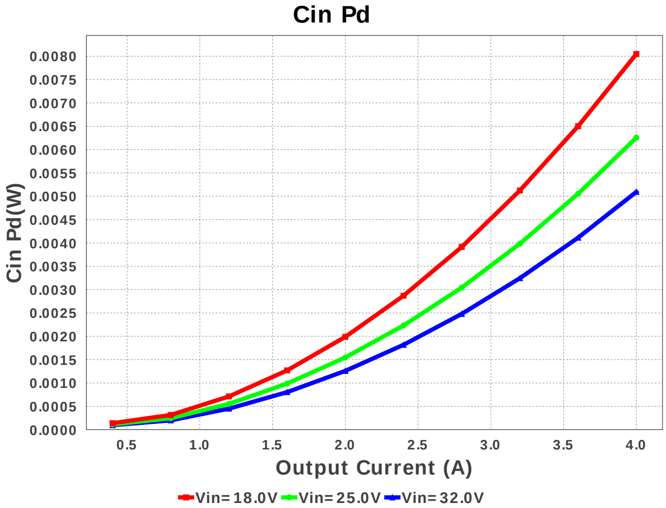

D1 Tj
D1 Tj(degC)
95
90
85
80
75
70
65
60
55
50
45
40
35
30
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=18.0V
Vin=25.0V
Vin=32.0V

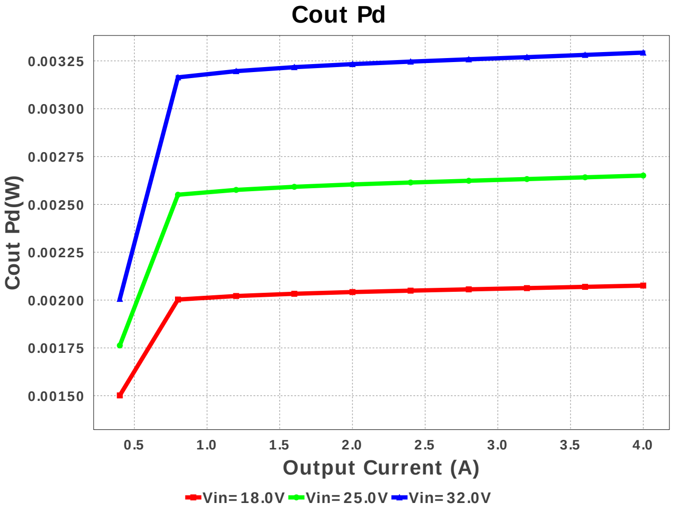

Efficiency
Efficiency(%)
84.5
84.0
83.5
83.0
82.5
82.0
81.5
81.0
80.5
80.0
79.5
79.0
78.5
78.0
77.5
77.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=18.0V
Vin=25.0V
Vin=32.0V

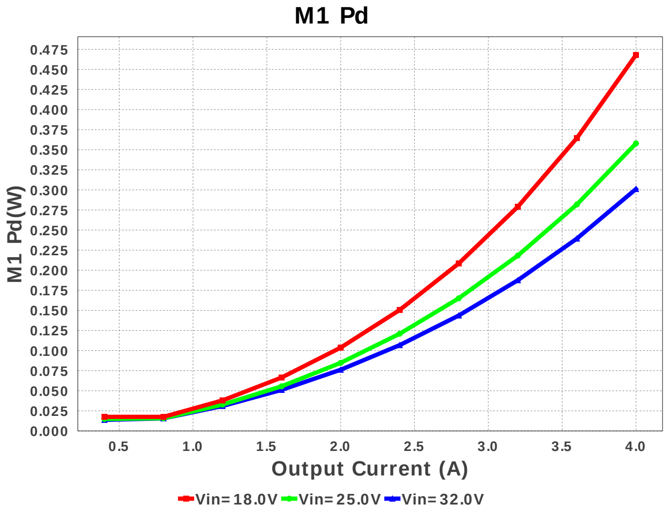

Vout Actual
Vout Actual(V)
3.291300004
3.291300003
3.291300002
3.291300001
3.291300000
3.291299999
3.291299998
3.291299997
3.291299996
3.291299995
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=18.0V
Vin=25.0V
Vin=32.0V

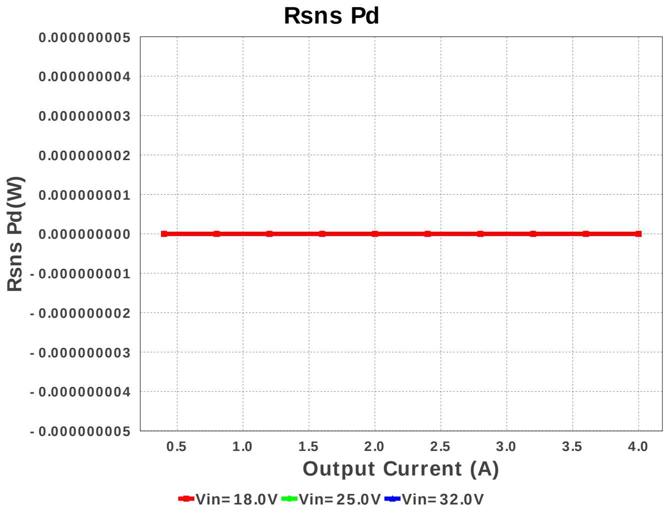

Vout p- p
Vout p- p(V)
0.026
0.025
0.024
0.023
0.022
0.021
0.020
0.019
0.018
0.017
0.016
0.015
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=18.0V
Vin=25.0V
Vin=32.0V

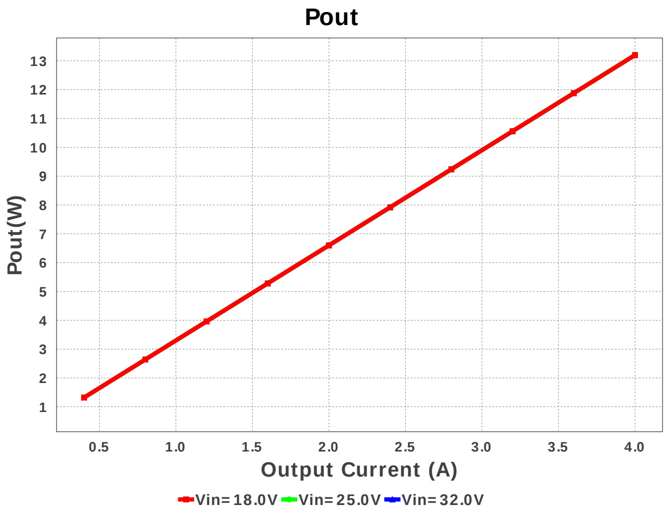

M1 PdCond
M1 PdCond(W)
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Output Current (A)
Vin=18.0V
Vin=25.0V
Vin=32.0V

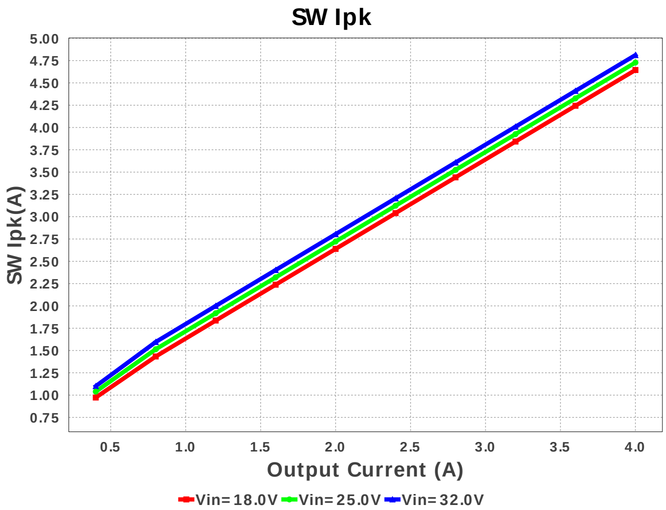

Cin Pd
Cin Pd(W)
0.0080
0.0075
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

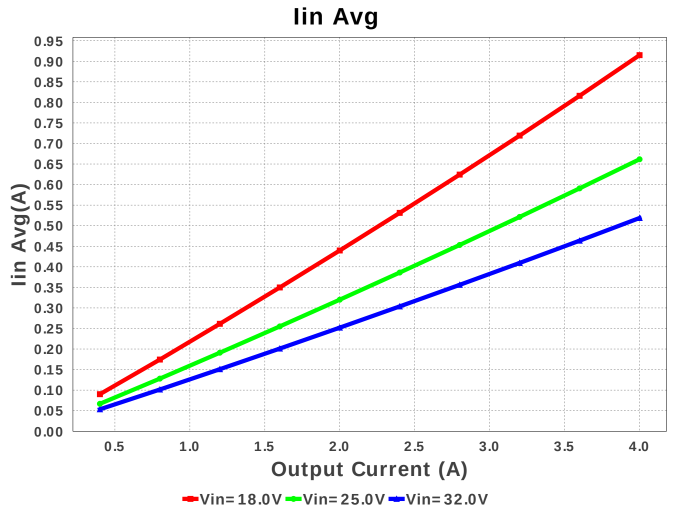

Cout Pd
Cout Pd(W)
0.00325
0.00300
0.00275
0.00250
0.00225
0.00200
0.00175
0.00150
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

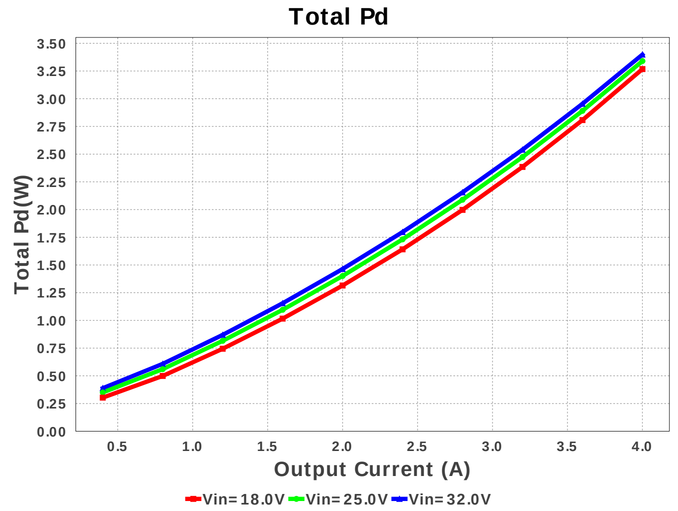

M1 Pd
M1 Pd(W)
0.475
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

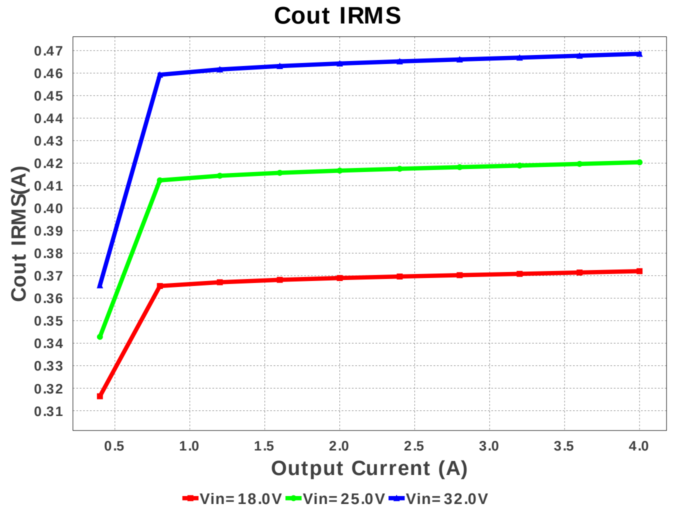

Rsns Pd
Rsns Pd(W)
0.000000005
0.000000004
0.000000003
0.000000002
0.000000001
0.000000000
-0.000000001
-0.000000002
-0.000000003
-0.000000004
-0.000000005
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

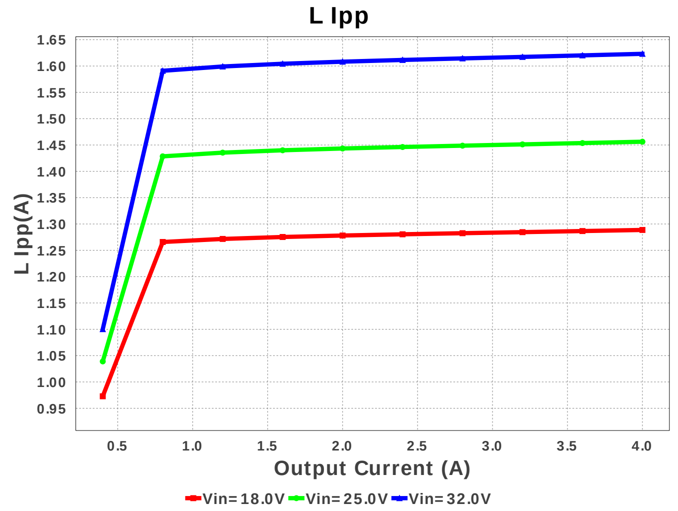

Pout
Pout(W)
13
12
11
10
9
8
7
6
5
4
3
2
1
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

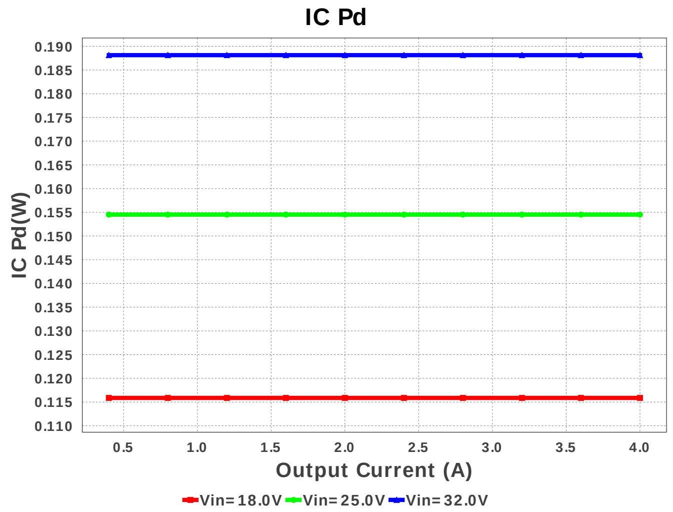

SW Ipk
SW Ipk(A)
5.00
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

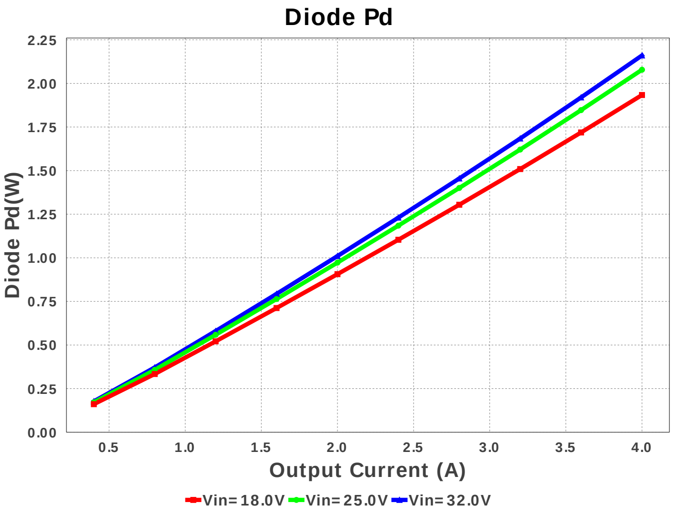

Iin Avg
Iin Avg(A)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

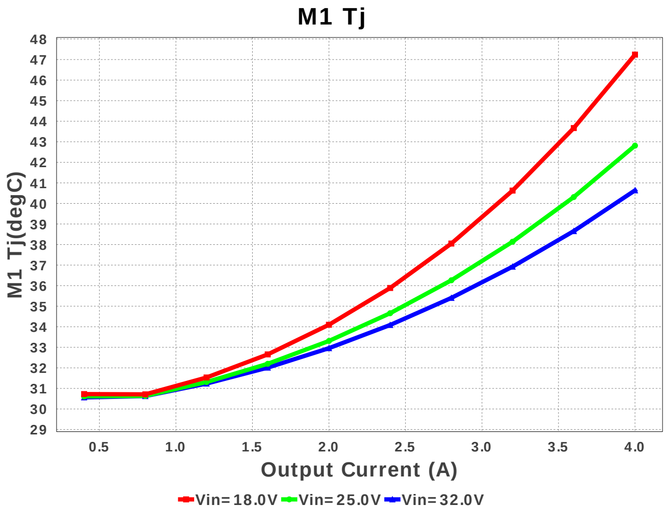

Total Pd
Total Pd(W)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V

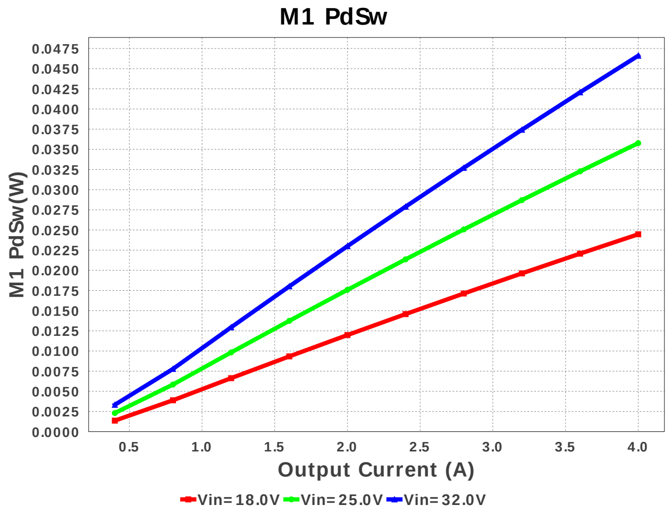

Cout IRMS
Cout IRMS(A)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V


L Ipp
L Ipp(A)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V


IC Pd
IC Pd(W)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V


Diode Pd
Diode Pd(W)
Output Current (A)
Vin=18.0V Vin=25.0V Vin=32.0V





Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.303 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	461.383 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	518.97 mA	Current	Average input current
4.	L Ipp	1.598 A	Current	Peak-to-peak inductor ripple current
5.	SW Ipk	4.799 A	Current	Peak switch current
6.	BOM Count	13	General	Total Design BOM count
7.	FootPrint	594.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	226.507 kHz	General	Switching frequency
9.	IC Tolerance	0.0 V	General	IC Feedback Tolerance
10.	Pout	13.2 W	General	Total output power
11.	Total BOM	$2.8	General	Total BOM Cost
12.	D1 Tj	94.811 degC	Op_Point	D1 junction temperature
13.	Vout Actual	3.291 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
14.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
15.	Duty Cycle	12.072 %	Op_point	Duty cycle
16.	Efficiency	79.484 %	Op_point	Steady state efficiency
17.	IC Tj	67.627 degC	Op_point	IC junction temperature
18.	ICThetaJA	200.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	4.0 A	Op_point	Iout operating point
20.	M1 Tj	40.637 degC	Op_point	M1 MOSFET junction temperature
21.	VIN_OP	32.0 V	Op_point	Vin operating point
22.	Vout p-p	25.234 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	5.095 mW	Power	Input capacitor power dissipation
24.	Cout Pd	3.193 mW	Power	Output capacitor power dissipation
25.	D1 Pd	2.16 W	Power	Output Diode Power Dissipation
26.	Diode Pd	2.16 W	Power	Diode power dissipation
27.	IC Pd	188.134 mW	Power	IC power dissipation
28.	L Pd	420.0 mW	Power	Inductor power dissipation
29.	M1 Pd	310.245 mW	Power	M1 MOSFET total power dissipation
30.	M1 PdCond	263.645 mW	Power	M1 MOSFET conduction losses
31.	M1 PdSw	46.6 mW	Power	M1 MOSFET switching losses
32.	Rsns Pd	0.0 W	Power	Rsense Power Dissipation
33.	Total Pd	3.407 W	Power	Total Power Dissipation
34.	Vout Tolerance	1.258 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	4.0	Maximum Output Current
2.	VinMax	32.0	Maximum input voltage
3.	VinMin	18.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	LM3485-Q1	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. The LM3485-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

2. Outline The LM3485-Q1 is a hysteretic PFET controller. The hysteretic control architecture provides for a stable design without the use of a control loop. The switching frequency depends on the inductance value, output capacitor ESR, and the input voltage. Therefore depending on the chosen BOM, the frequency at different input voltages would vary.

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

4. The LM3485-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

5. Outline The LM3485-Q1 is a hysteretic PFET controller. The hysteretic control architecture provides for a stable design without the use of a control loop. The switching frequency depends on the inductance value, output capacitor ESR, and the input voltage. Therefore depending on the chosen BOM, the frequency at different input voltages would vary.

6. LM3485-Q1 Product Folder : http://www.ti.com/product/LM3485%2DQ1 : contains the data sheet and other resources.