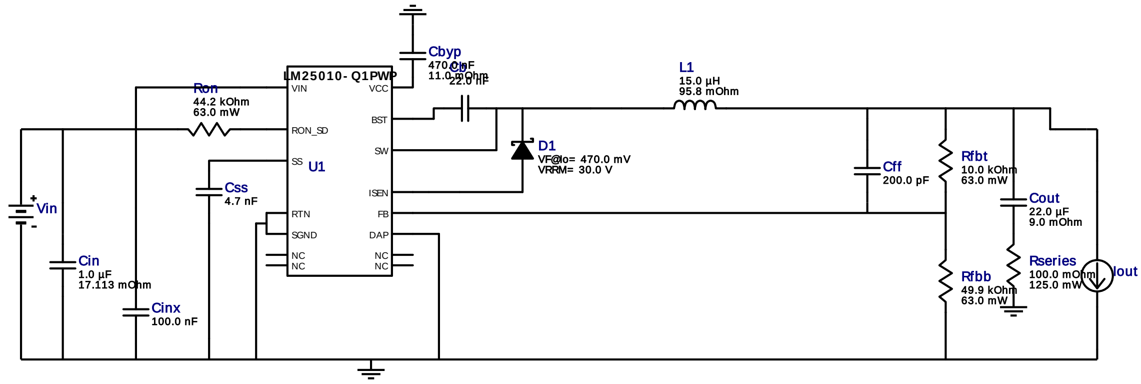
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 10.0V
VinMax = 19.0V
Vout = 3.0V
Iout = 1.0A

Device = LM25010Q1MH/NOPB
Topology = Buck
Created = 7/19/16 6:06:16 AM
BOM Cost = $1.59
BOM Count = 14
Total Pd = 1.57W

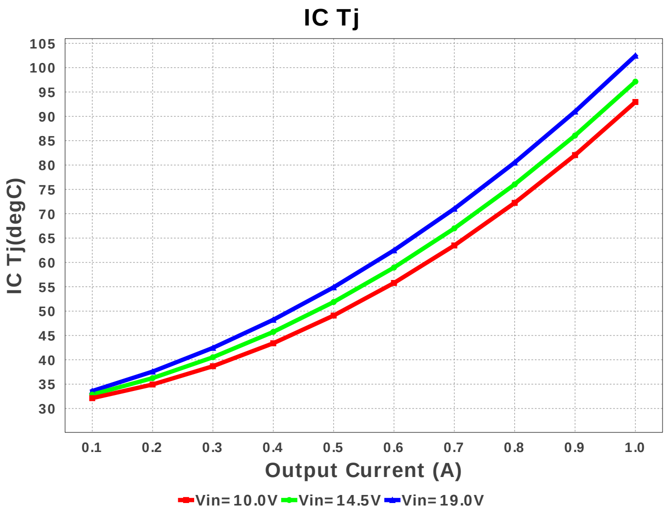
Design : 4728729/32 LM25010Q1MH/NOPB
LM25010Q1MH/NOPB 10.0V-19.0V to 3.00V @ 1.0A

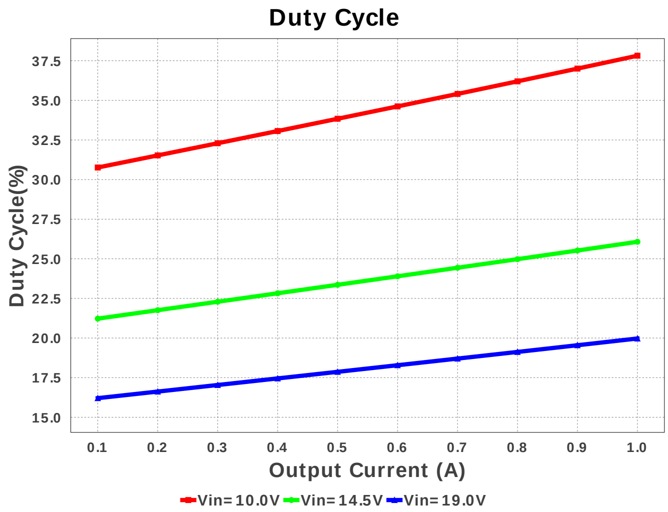


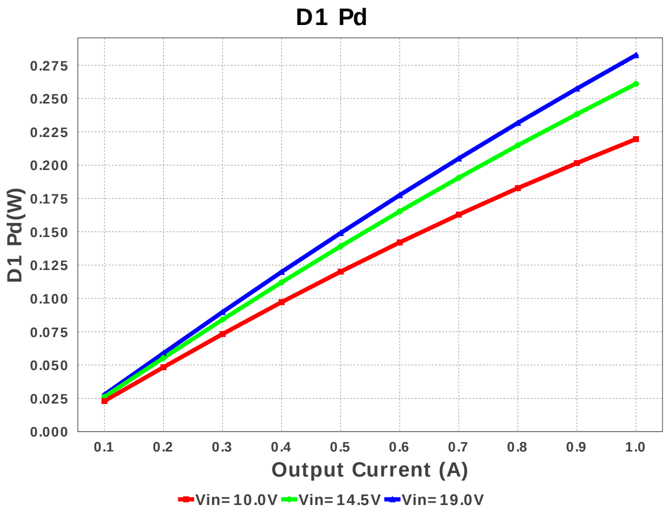
Electrical BOM

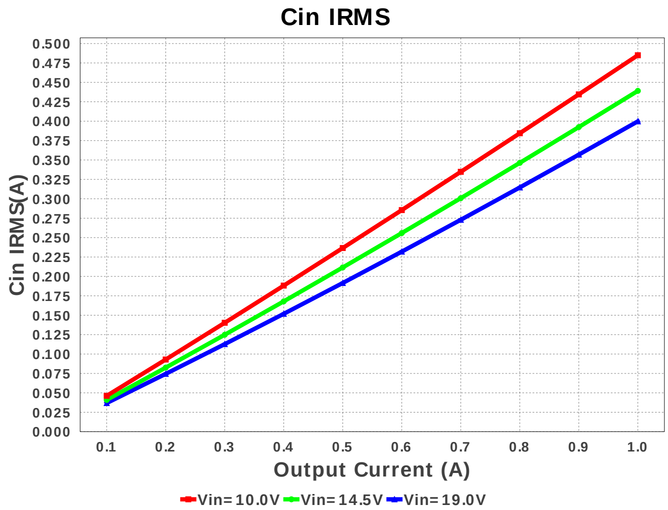
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cb	MuRata	GRM155R61C223KA01D Series= X5R	Cap= 22.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Cbyp	AVX	0805YC474KAT2A Series= X7R	Cap= 470.0 nF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
3.	Cff	AVX	04025A200JAT2A Series= C0G/NP0	Cap= 200.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.05	0402 3 mm²
4.	Cin	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	$0.01	0603 5 mm²
5.	Cinx	Kemet	C0603C104K3RACTU Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
6.	Cout	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	1	$0.04	0805 7 mm²
7.	Css	MuRata	GRM155R61C472KA01D Series= X5R	Cap= 4.7 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
8.	D1	ON Semiconductor	MBR130T1G	VF@Io= 470.0 mV VRRM= 30.0 V	1	$0.09	SOD-123 13 mm²
9.	L1	Bourns	SRN6045-150M	L= 15.0 µH DCR= 95.8 mOhm	1	$0.16	SRN6045 64 mm²
10.	Rfbb	Vishay-Dale	CRCW040249K9FKED Series= CRCW..e3	Res= 49.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
11.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

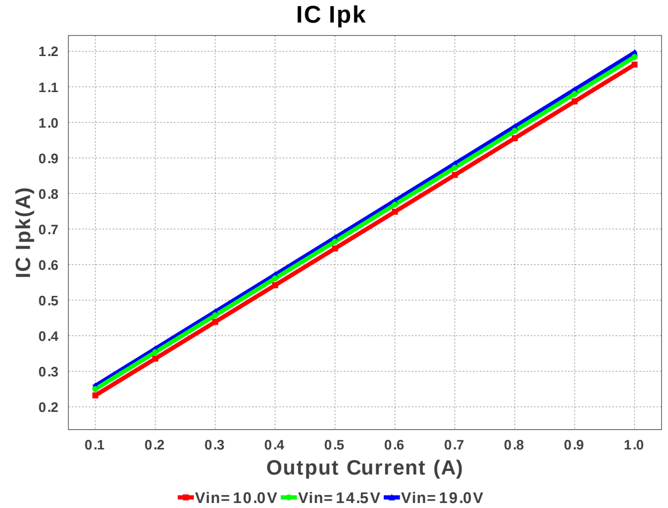
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
12.	Ron	Vishay-Dale	CRCW040244K2FKED Series= CRCW..e3	Res= 44.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
13.	Rseries	Panasonic	ERJ-2BSFR10X Series= ERJ-2B	Res= 100.0 mOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.06	0402 3 mm²
14.	U1	Texas Instruments	LM25010Q1MH/NOPB	Switcher	1	$1.10	PWP0014A 59 mm²

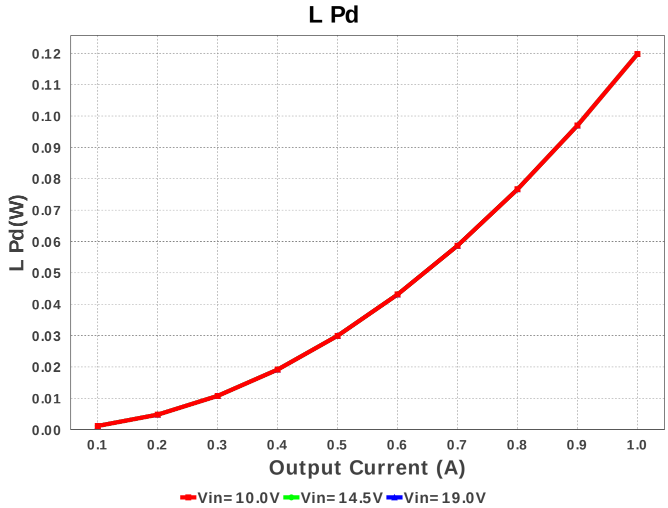


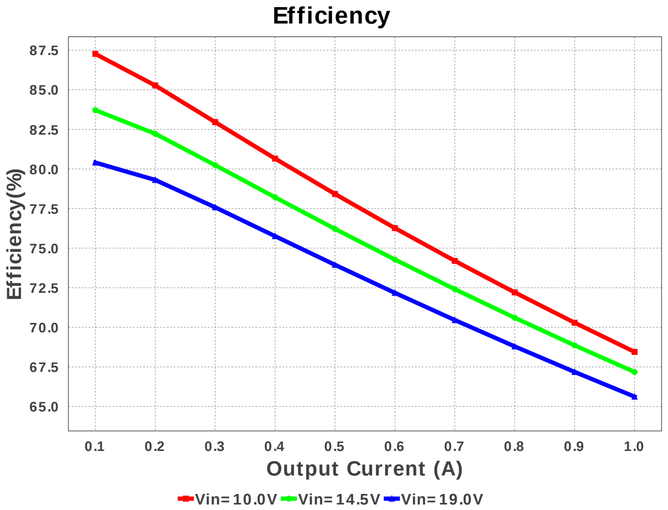


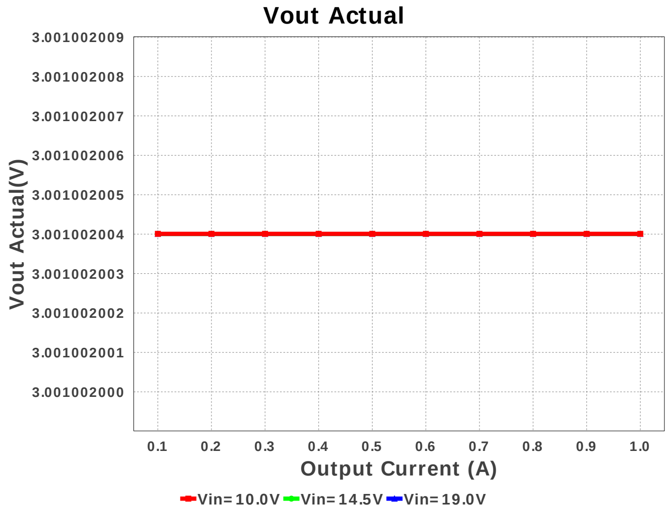


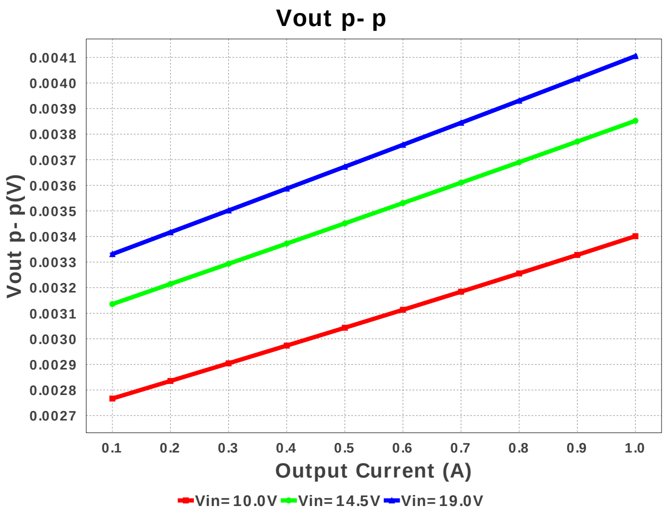


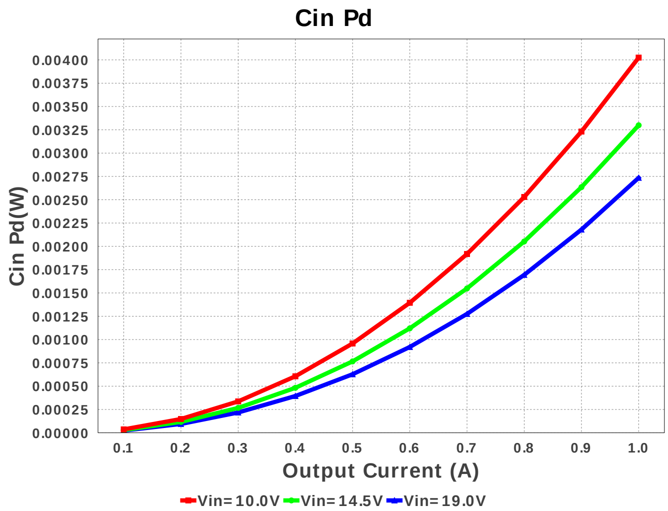

IC Ipk
IC Ipk(A)
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

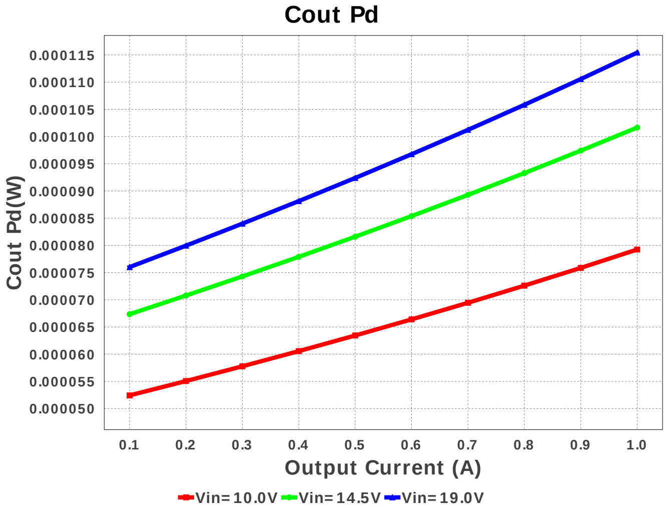

L Pd
L Pd(W)
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

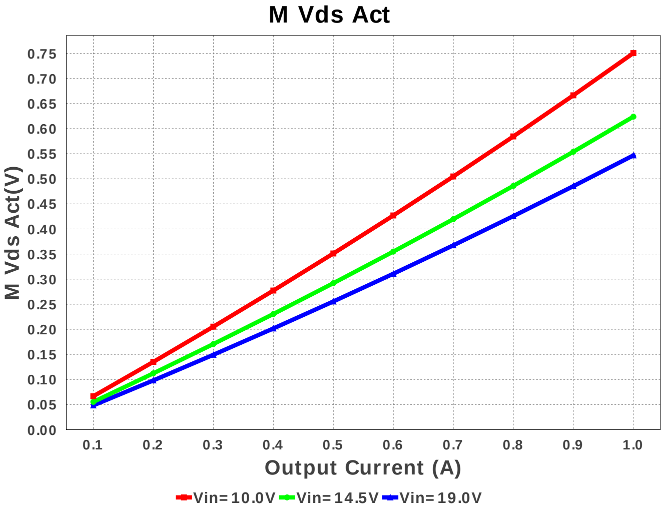

Efficiency
Efficiency(%)
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

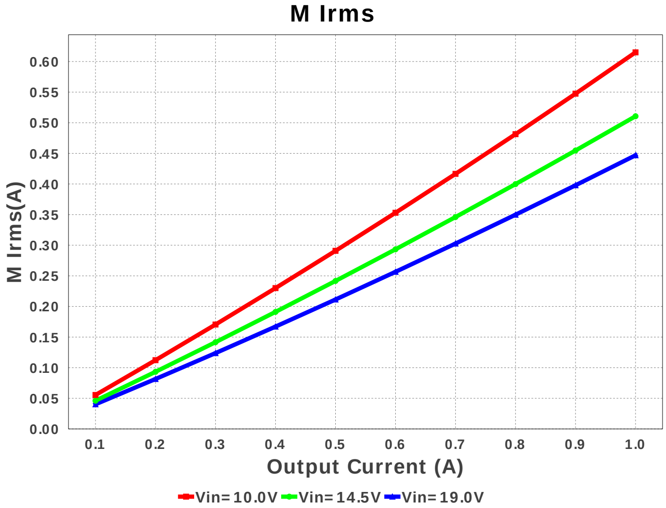

Vout Actual
Vout Actual(V)
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

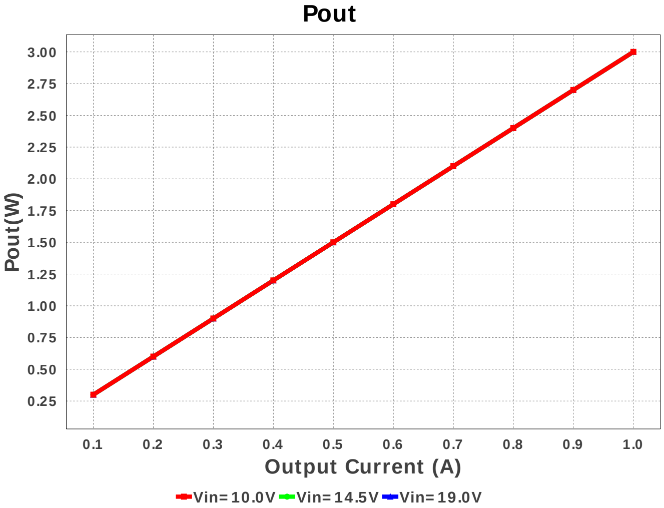

Vout p-p
Vout p-p(V)
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

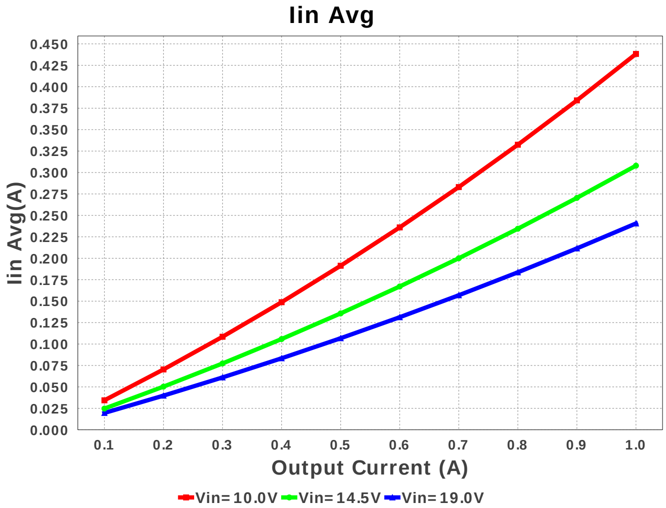

Cin Pd
Cin Pd(W)
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

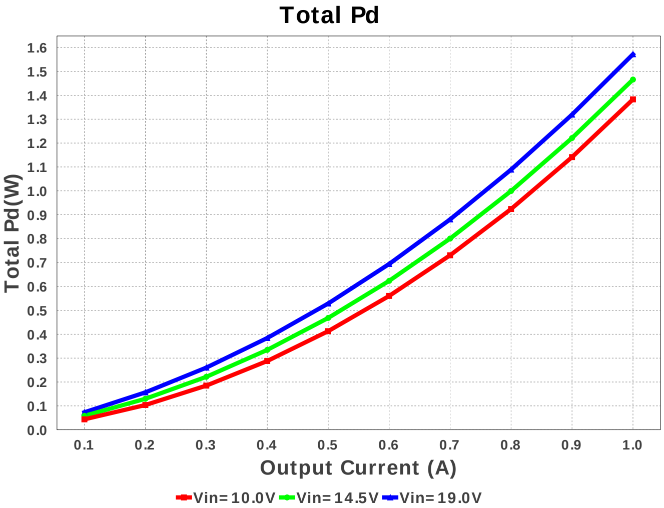

Cout Pd
Cout Pd(W)
0.000115
0.000110
0.000105
0.000100
0.000095
0.000090
0.000085
0.000080
0.000075
0.000070
0.000065
0.000060
0.000055
0.000050
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

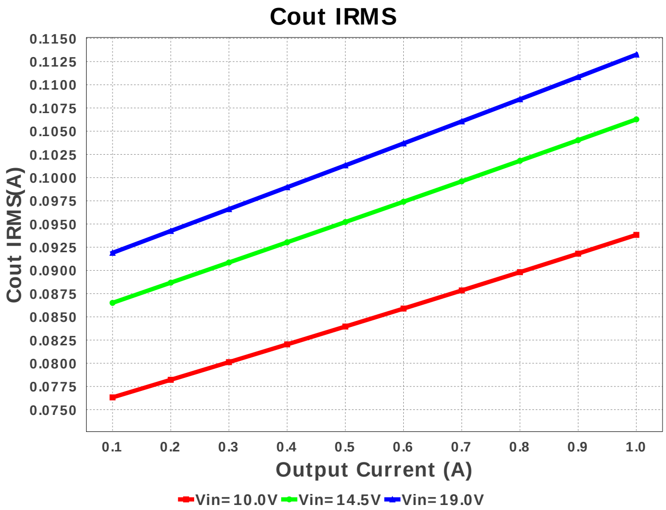

M Vds Act
M Vds Act(V)
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

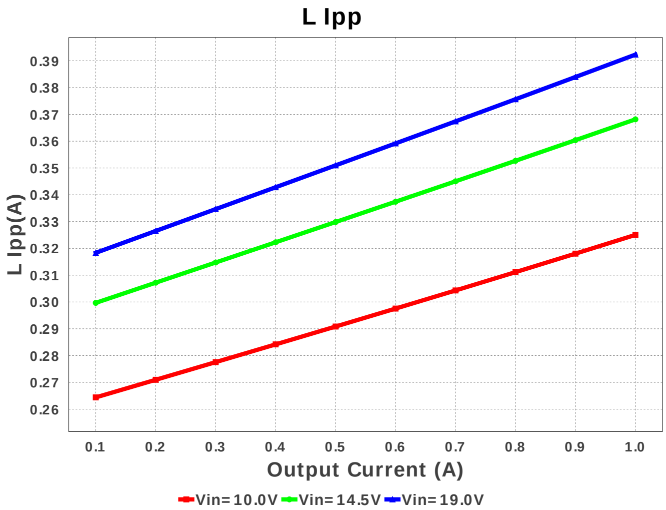

M Irms
M Irms(A)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V

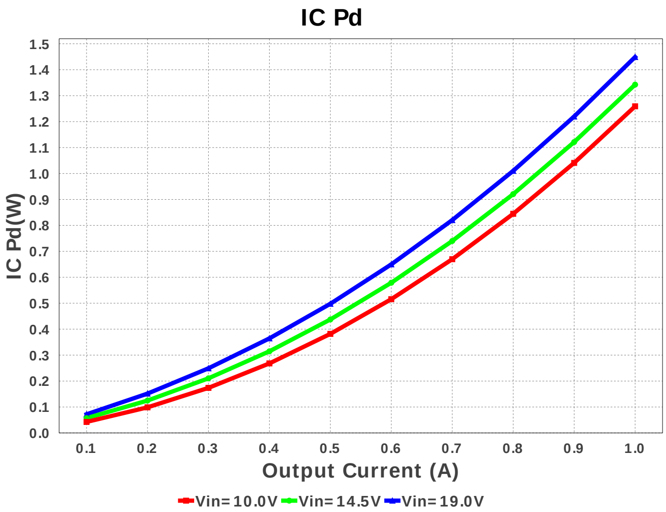

Pout
Pout(W)
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V


Iin Avg
Iin Avg(A)
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
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V


Total Pd
Total Pd(W)
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
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=10.0V Vin=14.5V Vin=19.0V







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	399.777 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	113.249 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	1.196 A	Current	Peak switch current in IC
4.	Iin Avg	240.62 mA	Current	Average input current
5.	L Ipp	392.31 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	446.881 mA	Current	MOSFET RMS current
7.	BOM Count	14	General	Total Design BOM count
8.	FootPrint	180.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	542.986 kHz	General	Switching frequency
10.	IC Tolerance	50.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	546.641 mV	General	Voltage drop across the MosFET
12.	Pout	3.0 W	General	Total output power
13.	Total BOM	$1.59	General	Total BOM Cost
14.	Vout Actual	3.001 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Vout OP	3.0 V	Op_Point	Operational Output Voltage
16.	Duty Cycle	19.97 %	Op_point	Duty cycle
17.	Efficiency	65.621 %	Op_point	Steady state efficiency
18.	IC Tj	102.454 degC	Op_point	IC junction temperature
19.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	1.0 A	Op_point	Iout operating point
21.	VIN_OP	19.0 V	Op_point	Vin operating point
22.	Vout p-p	4.105 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	2.735 mW	Power	Input capacitor power dissipation
24.	Cout Pd	115.427 μW	Power	Output capacitor power dissipation
25.	D1 Pd	282.56 mW	Power	Output Diode Power Dissipation
26.	IC Pd	1.449 W	Power	IC power dissipation
27.	L Pd	119.75 mW	Power	Inductor power dissipation
28.	Total Pd	1.572 W	Power	Total Power Dissipation
29.	Vout Tolerance	2.344 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	19.0	Maximum input voltage
3.	VinMin	10.0	Minimum input voltage
4.	Vout	3.0	Output Voltage
5.	base_pn	LM25010-Q1	Texas Instruments Base Part 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. LM25010-Q1 Product Folder : http://www.ti.com/product/LM25010%2DQ1 : contains the data sheet and other resources.