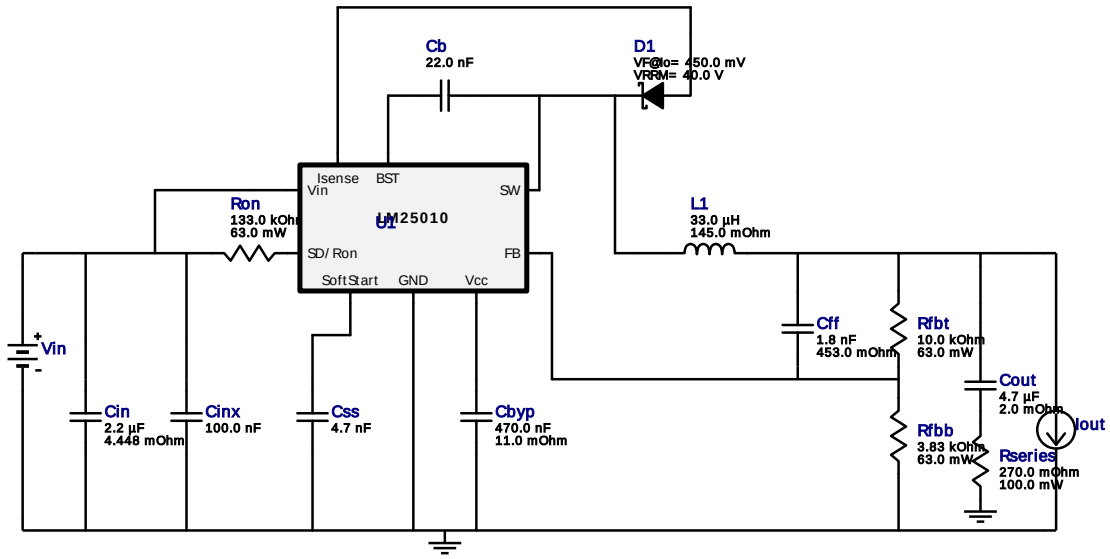
WEBENCH® Design Report

VinMin = 11.0V
VinMax = 21.0V
Vout = 9.0V
Iout = 1.0A

Device = LM25010MH/NOPB
Topology = Buck
Created = 9/9/16 1:50:49 AM
BOM Cost = $1.48
BOM Count = 14
Total Pd = 1.8W

Design : 1542746/883 LM25010MH/NOPB
LM25010MH/NOPB 11.0V-21.0V to 9.00V @ 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	Kemet	C1206C182K5RACTU Series= X7R	Cap= 1.8 nF ESR= 453.0 mOhm VDC= 50.0 V IRMS= 190.0 mA	1	$0.06	1206 11 mm²
4.	Cin	MuRata	GRM31CR71H225KA88L Series= X7R	Cap= 2.2 uF ESR= 4.448 mOhm VDC= 50.0 V IRMS= 2.2252 A	1	$0.05	1206_190 11 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	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	1	$0.02	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	Diodes Inc.	1N5819HW-7-F	VF@Io= 450.0 mV VRRM= 40.0 V	1	$0.08	SOD-123 13 mm²

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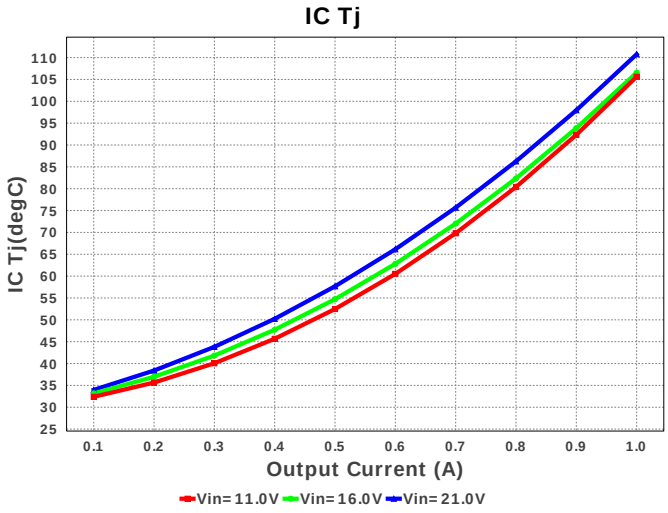
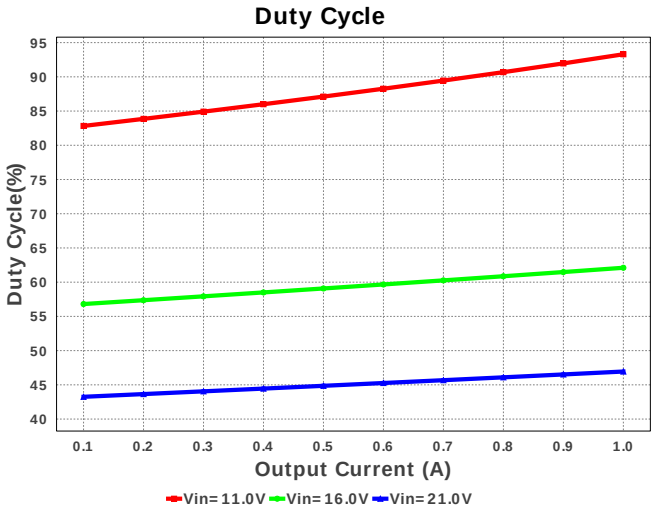
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	L1	Bourns	SRN8040-330M	L= 33.0 µH DCR= 145.0 mOhm	1	$0.22	 SRN8040 100 mm²
10.	Rfbb	Vishay-Dale	CRCW04023K83FKED Series= CRCW..e3	Res= 3.83 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
11.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
12.	Ron	Vishay-Dale	CRCW0402133KFKED Series= CRCW..e3	Res= 133.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
13.	Rseries	Panasonic	ERJ-3RQFR27V Series= ERJ-3R	Res= 270.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.02	 0603 5 mm²
14.	U1	Texas Instruments	LM25010MH/NOPB	Switcher	1	$0.95	 PWP0014A 59 mm²





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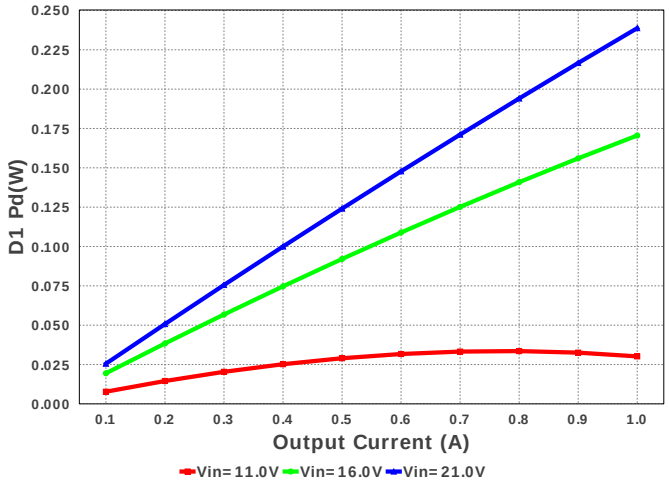
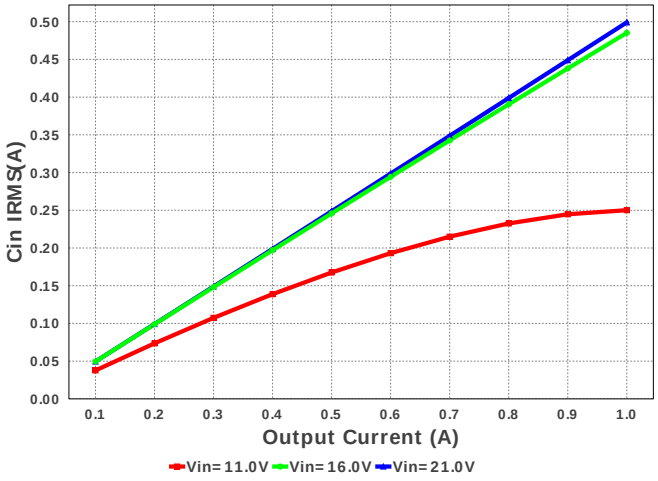
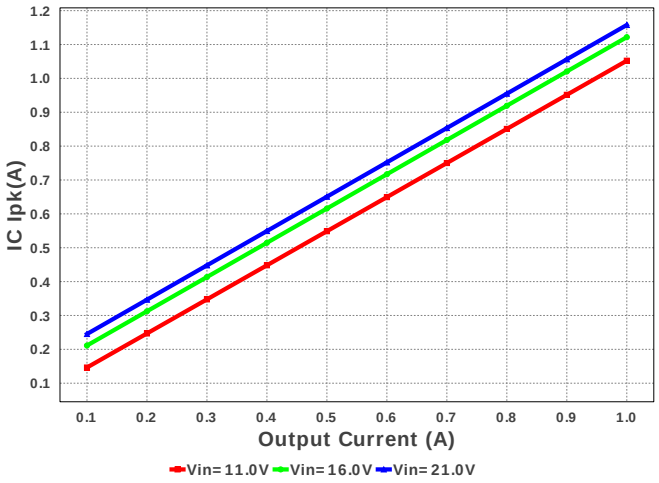
D1 Pd



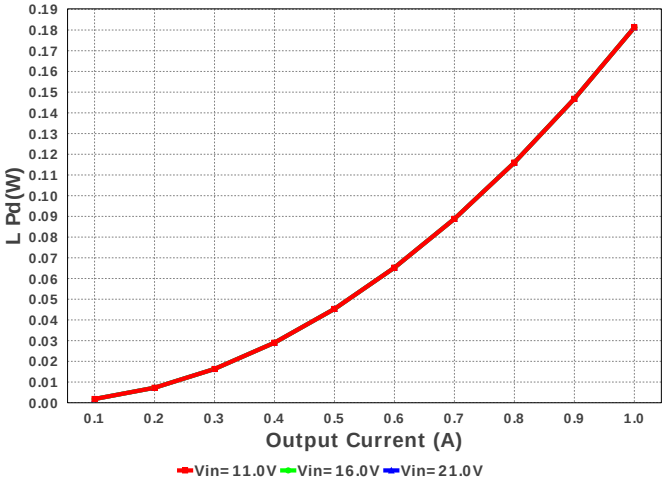
Cin IRMS



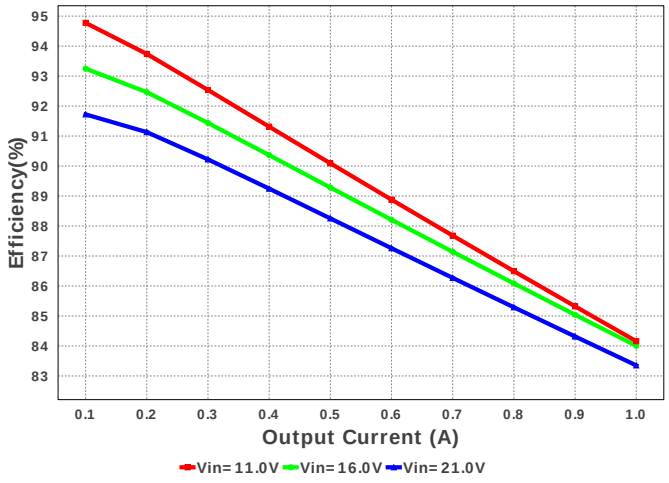
IC Ipk



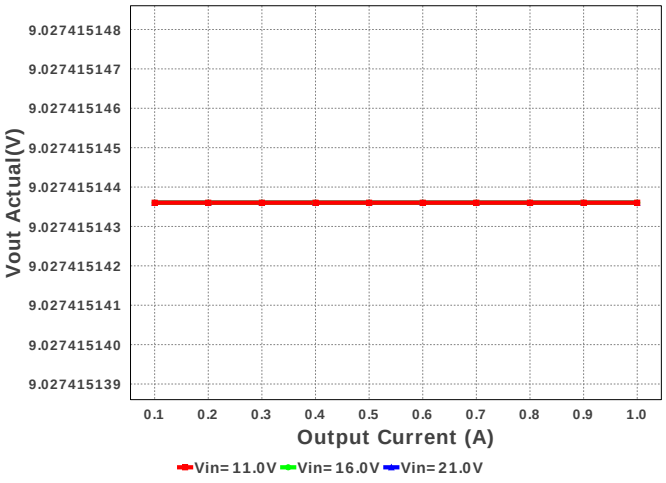
L Pd



Efficiency



Vout Actual



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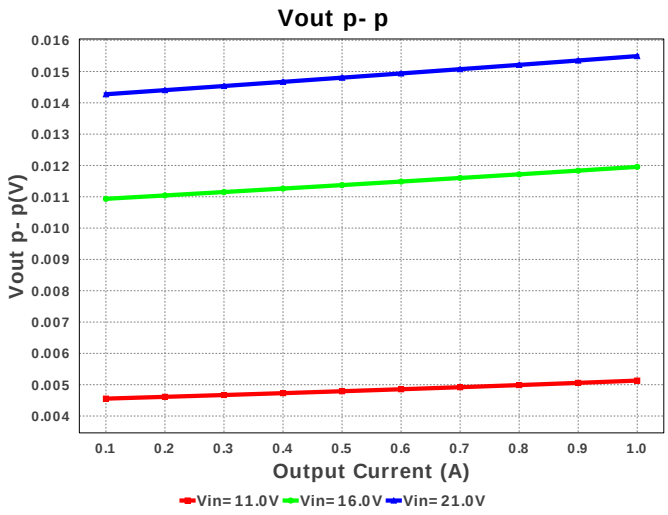

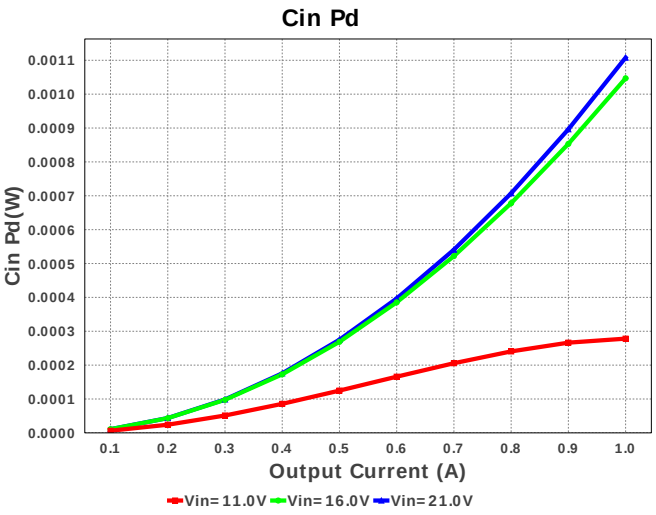

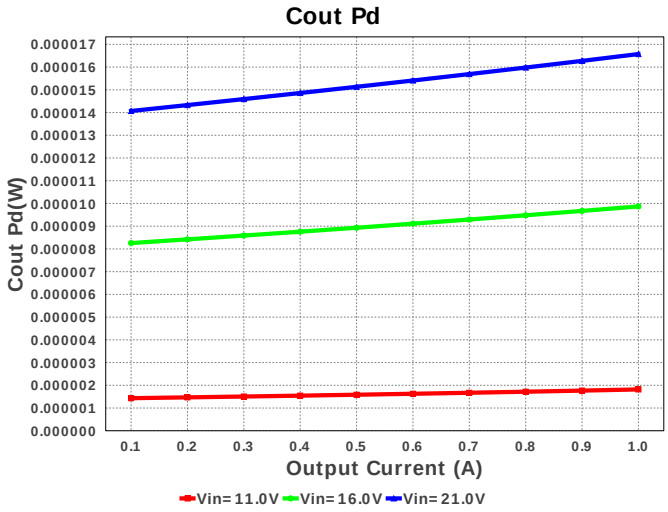

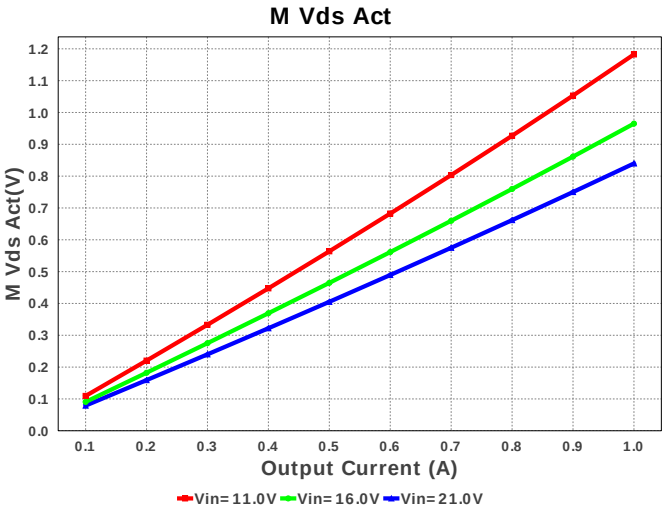

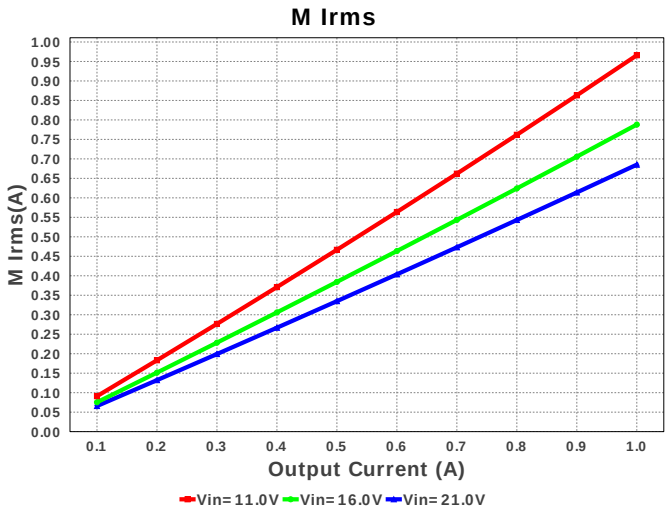

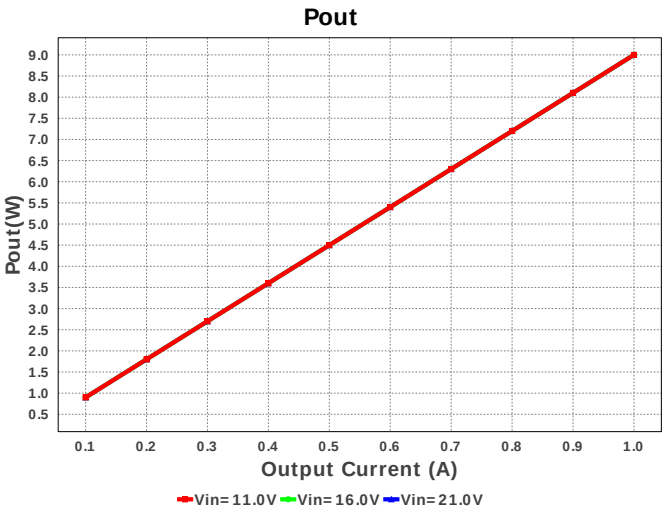

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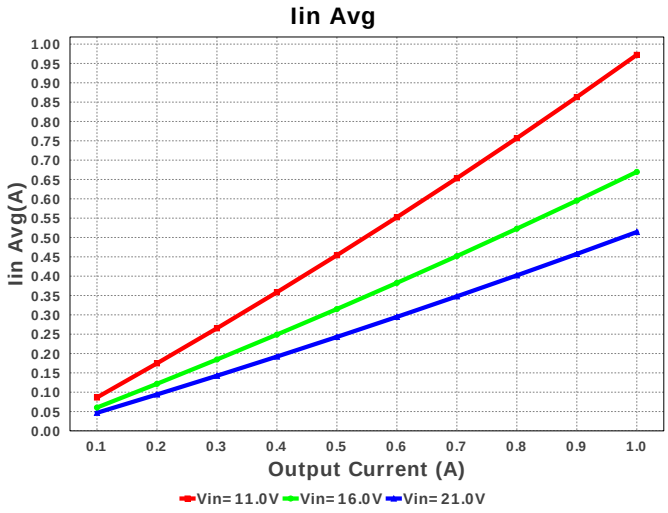

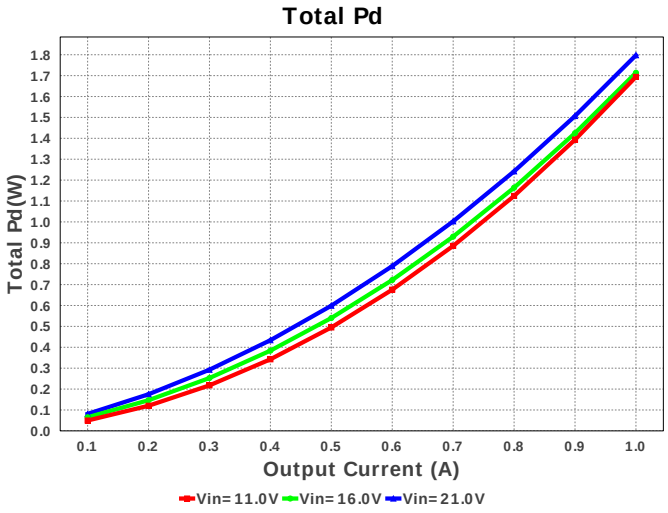

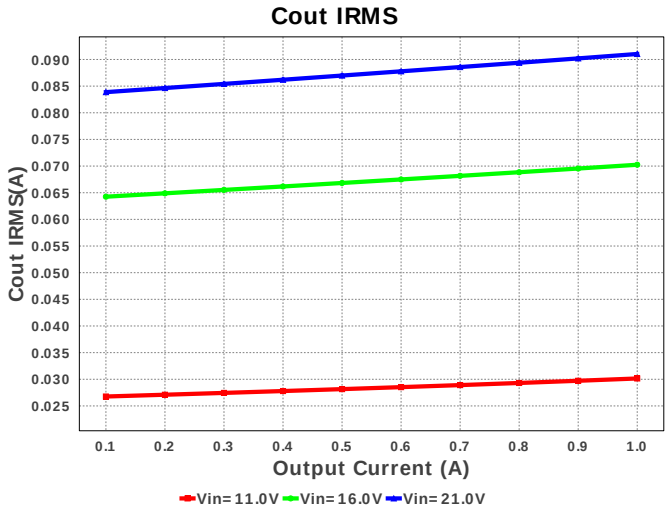

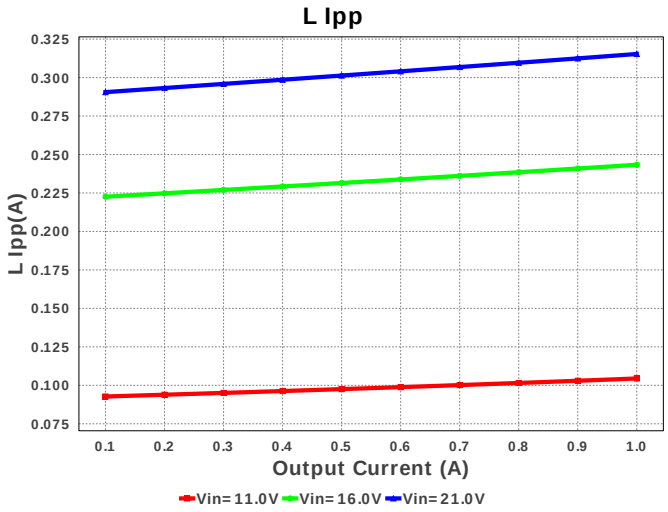

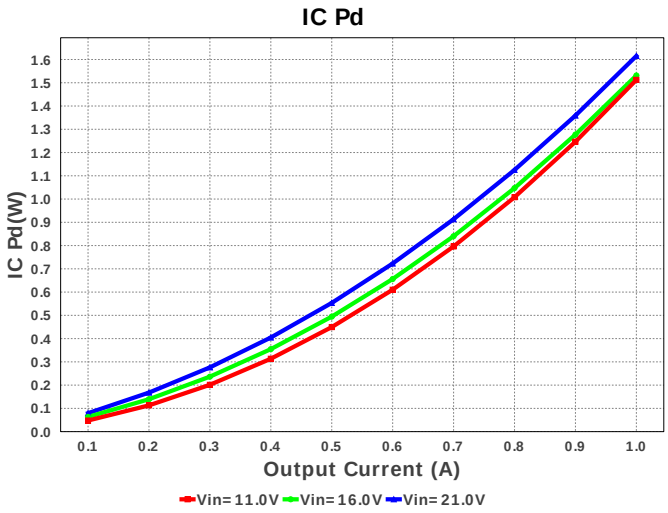

Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	499.066 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	91.029 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	1.158 A	Current	Peak switch current in IC
4.	Iin Avg	514.17 mA	Current	Average input current
5.	L Ipp	315.33 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	685.161 mA	Current	Q Iavg
7.	BOM Count	14	General	Total Design BOM count
8.	FootPrint	232.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	541.353 kHz	General	Switching frequency
10.	IC Tolerance	50.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	839.82 mV	General	Voltage drop across the MosFET

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#	Name	Value	Category	Description
12.	Mode	CCM	General	Conduction Mode
13.	Pout	9.0 W	General	Total output power
14.	Total BOM	$1.48	General	Total BOM Cost
15.	Vout Actual	9.027 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	9.0 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	46.945 %	Op_point	Duty cycle
18.	Efficiency	83.352 %	Op_point	Steady state efficiency
19.	IC Tj	110.758 degC	Op_point	IC junction temperature
20.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	1.0 A	Op_point	Iout operating point
22.	VIN_OP	21.0 V	Op_point	Vin operating point
23.	Vout p-p	15.492 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	1.108 mW	Power	Input capacitor power dissipation
25.	Cout Pd	16.573 µW	Power	Output capacitor power dissipation
26.	D1 Pd	238.75 mW	Power	Output Diode Power Dissipation
27.	IC Pd	1.615 W	Power	IC power dissipation
28.	L Pd	181.25 mW	Power	Inductor power dissipation
29.	Total Pd	1.798 W	Power	Total Power Dissipation
30.	Vout Tolerance	3.49 %		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	21.0	Maximum input voltage
3.	VinMin	11.0	Minimum input voltage
4.	Vout	9.0	Output Voltage
5.	base_pn	LM25010	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. **LM25010** Product Folder : http://www.ti.com/product/LM25010 : contains the data sheet and other resources.

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