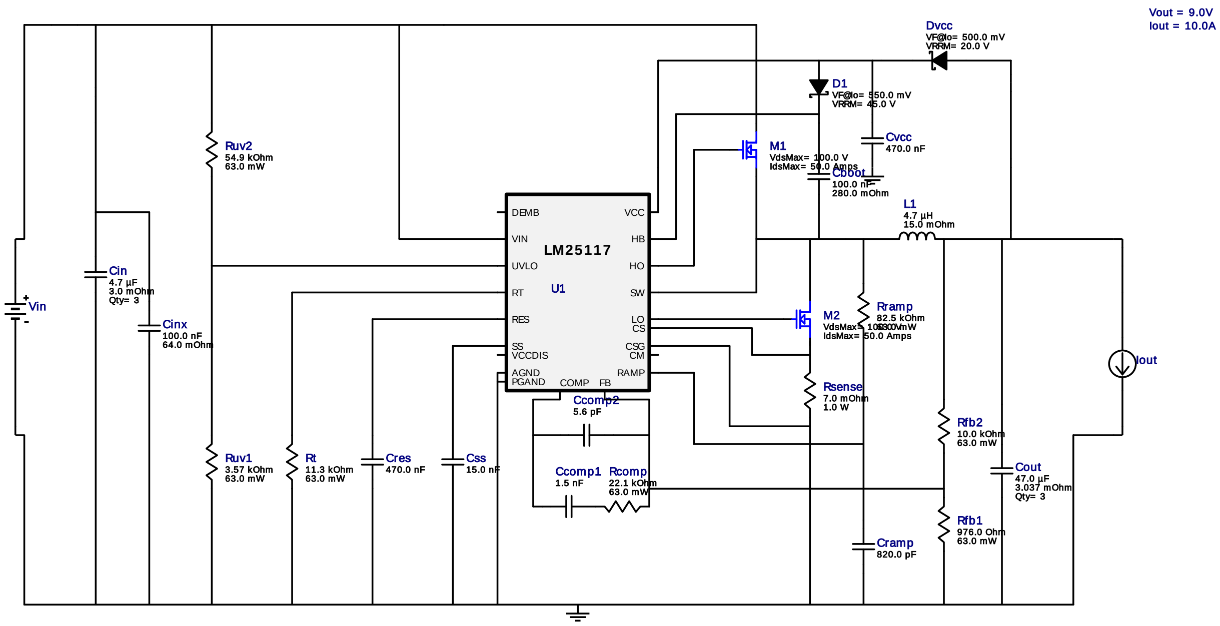
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 24.0V
VinMax = 36.0V
Vout = 9.0V
Iout = 10.0A

Device = LM25117PMHX/NOPB
Topology = Buck
Created = 7/29/16 1:10:49 AM
BOM Cost = $5.29
BOM Count = 28
Total Pd = 5.43W

Design : 4406513/34 LM25117PMHX/NOPB
LM25117PMHX/NOPB 24.0V-36.0V to 9.00V @ 10.0A



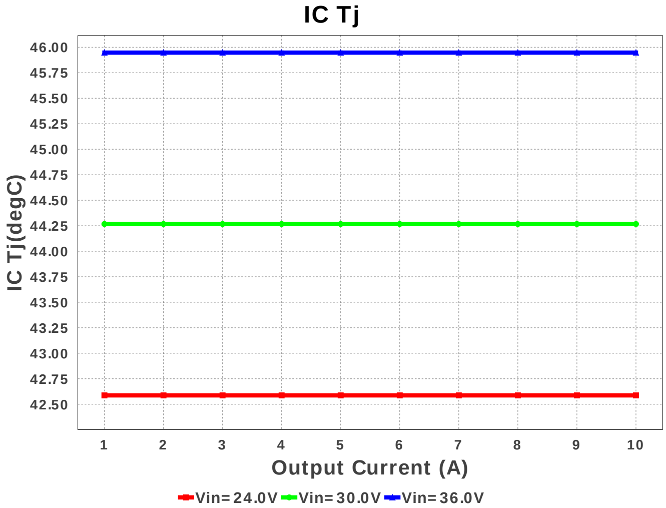
My Comments

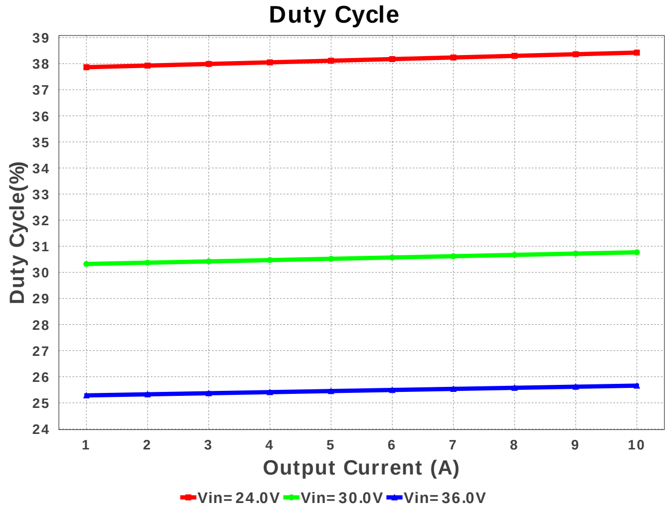
No comments

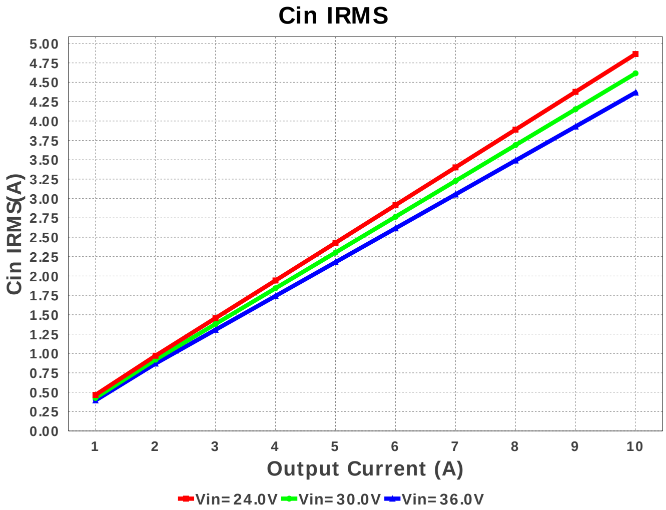
Electrical BOM

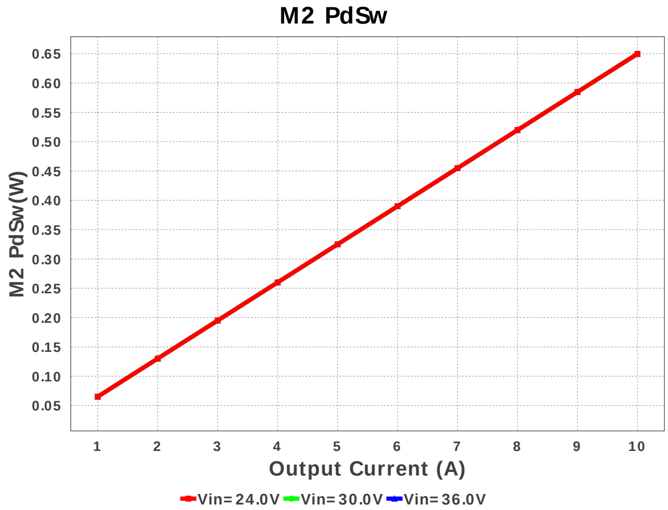
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	Ccomp1	Yageo America	CC0805KRX7R9BB152 Series= X7R	Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	Ccomp2	MuRata	GRM1555C1H5R6CA01D Series= C0G/NP0	Cap= 5.6 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
4.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	3	$0.07	1206 11 mm²
5.	Cinx	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
6.	Cout	MuRata	GRM32ER61C476ME15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	3	$0.24	1210_280 15 mm²
7.	Cramp	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²

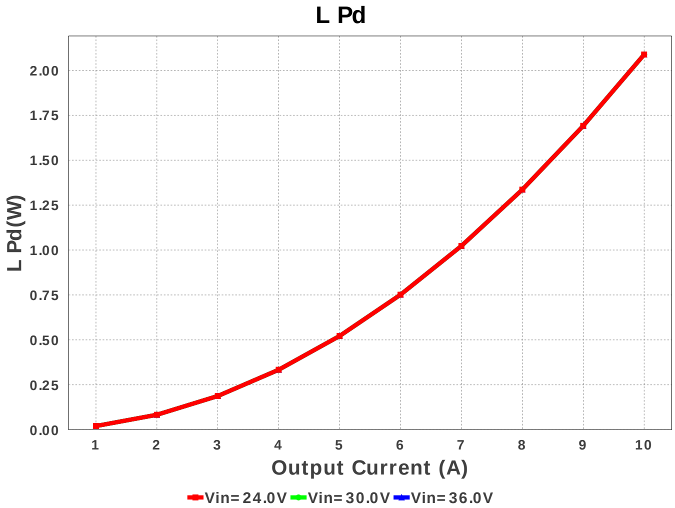
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
8.	Cres	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
9.	Css	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
10.	Cvcc	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
11.	D1	Bourns	CD0603-B0240	VF@Io= 550.0 mV VRRM= 45.0 V	1	$0.10	Diode_0603 5 mm^2
12.	Dvcc	Diodes Inc.	B220-13-F	VF@Io= 500.0 mV VRRM= 20.0 V	1	$0.08	SMB 44 mm^2
13.	L1	Bourns	SRP1250-4R7M	L= 4.7 µH DCR= 15.0 mOhm	1	$0.64	SRP1250 253 mm^2
14.	M1	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.75	TRANS_NexFET_Q3 18 mm^2
15.	M2	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.75	TRANS_NexFET_Q3 18 mm^2
16.	Rcomp	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
17.	Rfb1	Vishay-Dale	CRCW0402976RFKED Series= CRCW..e3	Res= 976.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
18.	Rfb2	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
19.	Rramp	Vishay-Dale	CRCW040282K5FKED Series= CRCW..e3	Res= 82.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
20.	Rsense	Susumu Co Ltd	PRL1632-R007-F-T1 Series= PRL1632	Res= 7.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.19	0612 11 mm^2
21.	Rt	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
22.	Ruv1	Vishay-Dale	CRCW04023K57FKED Series= CRCW..e3	Res= 3.57 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
23.	Ruv2	Vishay-Dale	CRCW040254K9FKED Series= CRCW..e3	Res= 54.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
24.	U1	Texas Instruments	LM25117PMHX/NOPB	Switcher	1	$1.70	PWP0020A 71 mm^2

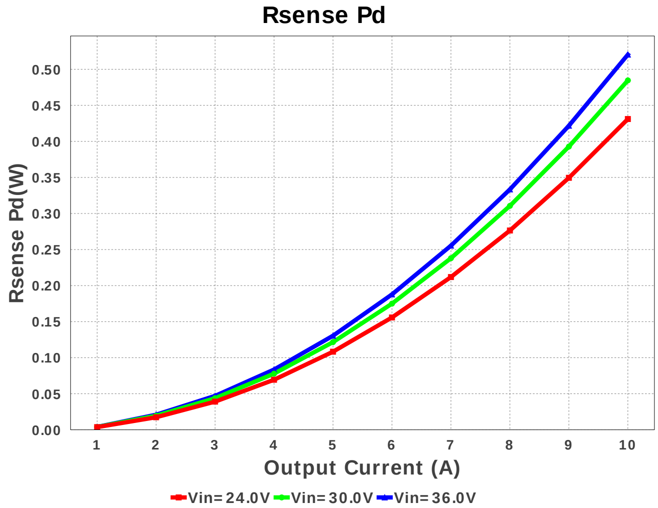

IC Tj
IC Tj(degC)
Output Current (A)
Vin=24.0V Vin=30.0V Vin=36.0V


Duty Cycle
Duty Cycle(%)
Output Current (A)
Vin=24.0V Vin=30.0V Vin=36.0V

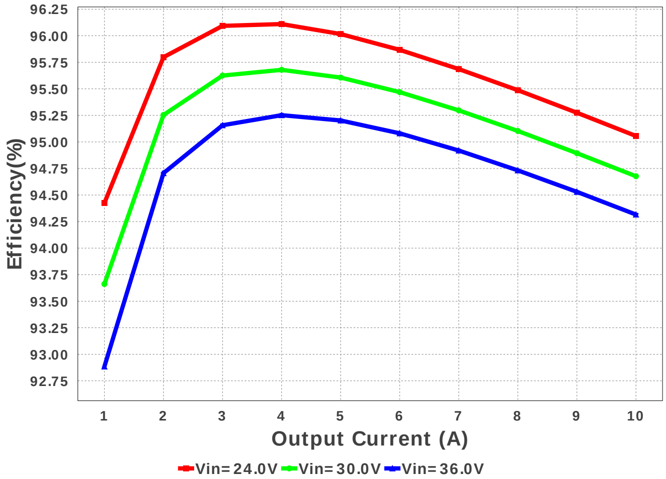

Cin IRMS
Cin IRMS(A)
Output Current (A)
Vin=24.0V Vin=30.0V Vin=36.0V


M2 PdSw
M2 PdSw(W)
Output Current (A)
Vin=24.0V Vin=30.0V Vin=36.0V

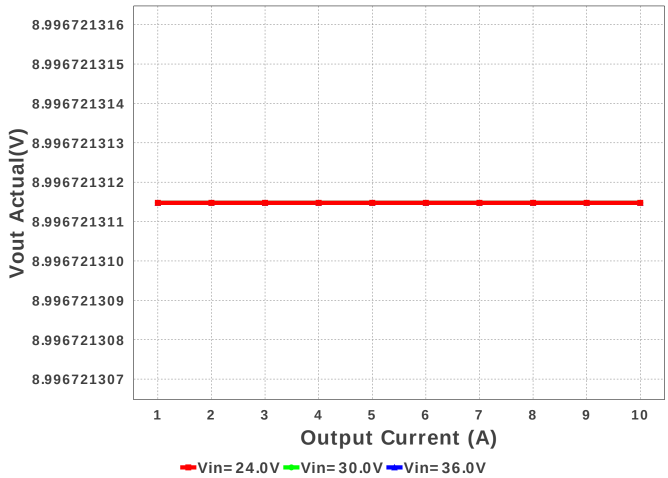

L Pd
L Pd(W)
Output Current (A)
Vin=24.0V Vin=30.0V Vin=36.0V


Rsense Pd
Rsense Pd(W)
Output Current (A)
Vin=24.0V Vin=30.0V Vin=36.0V

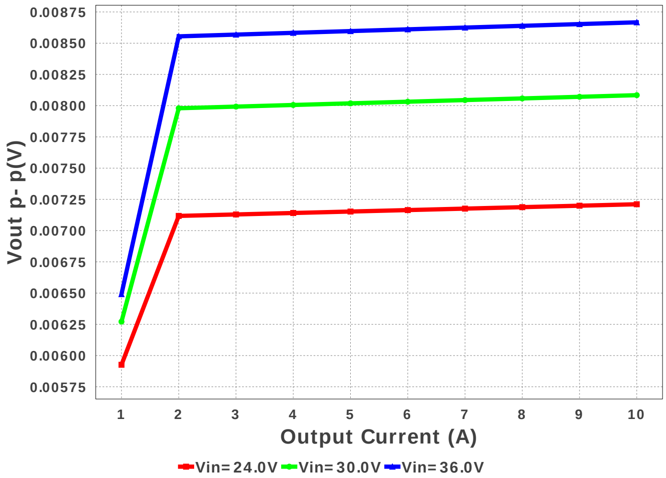
Efficiency



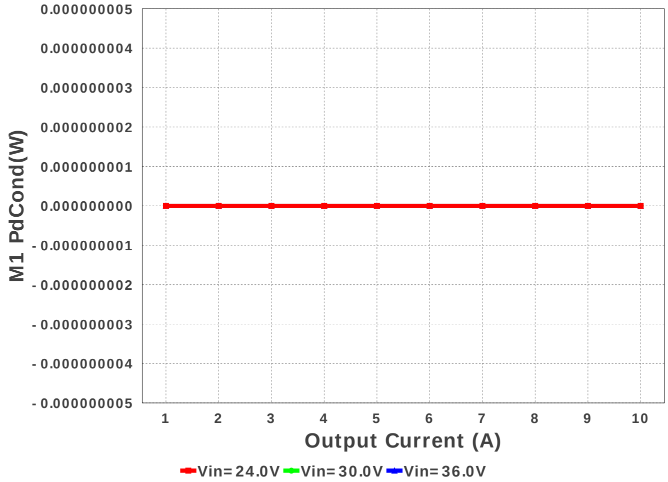
Vout Actual



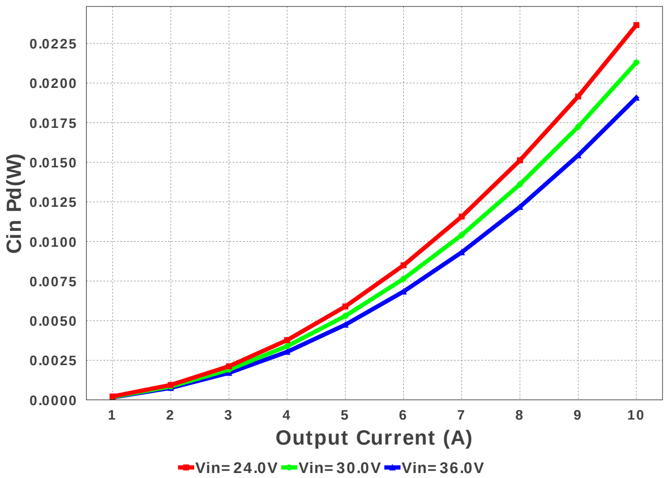
Vout p-p



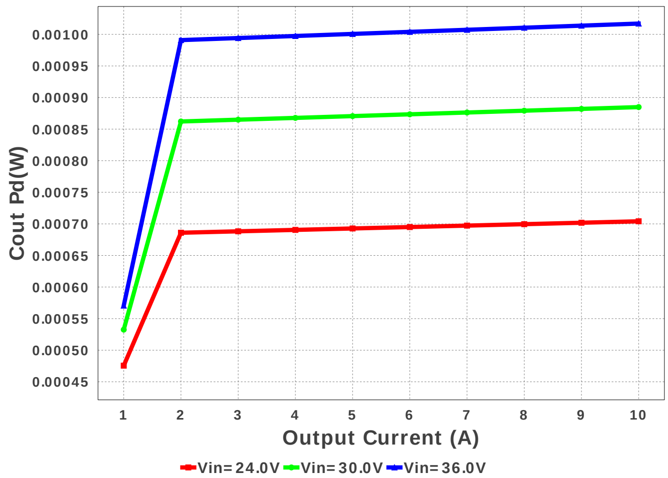
M1 PdCond



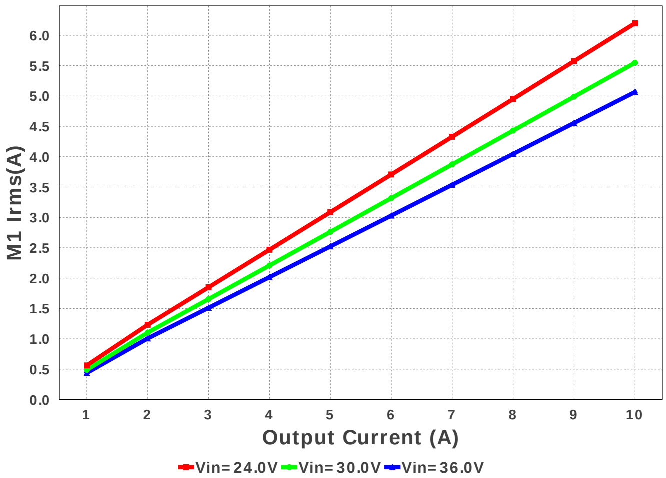
Cin Pd



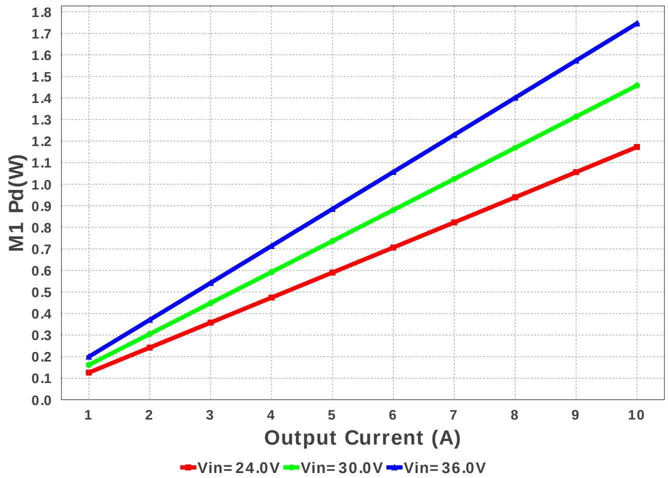
Cout Pd



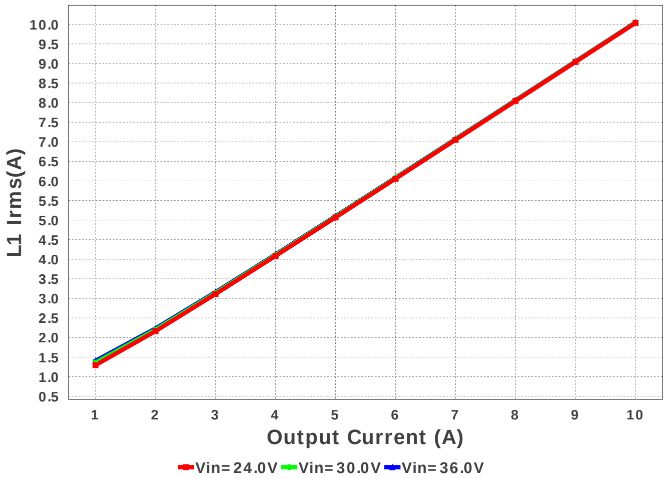
M1 Irms



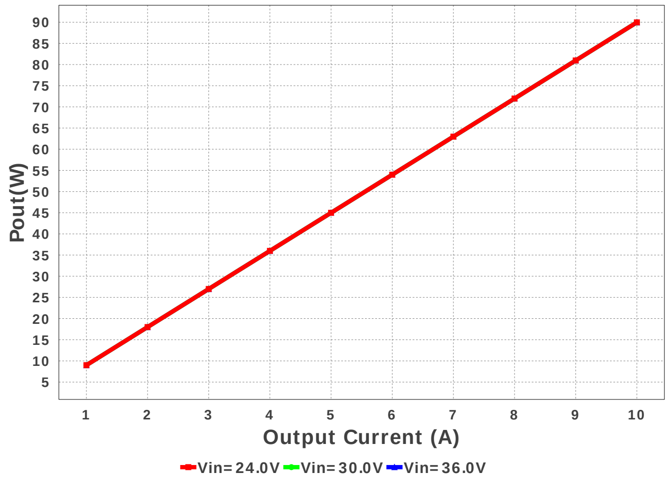
M1 Pd



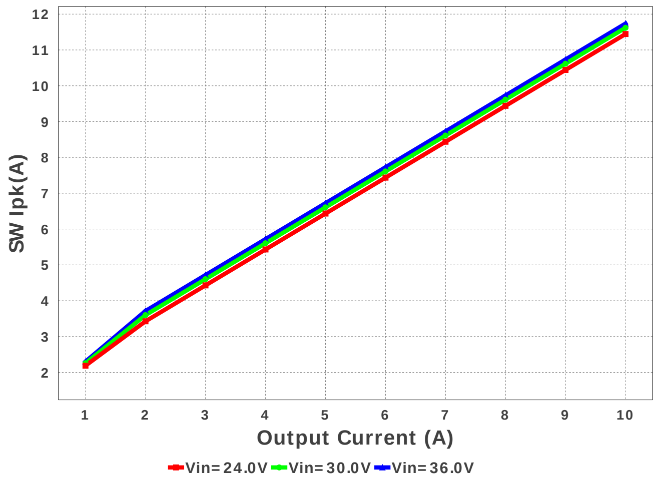
L1 Irms



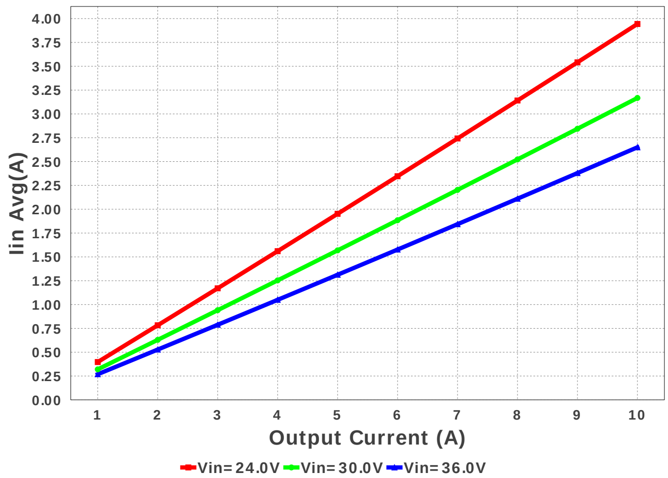
Pout



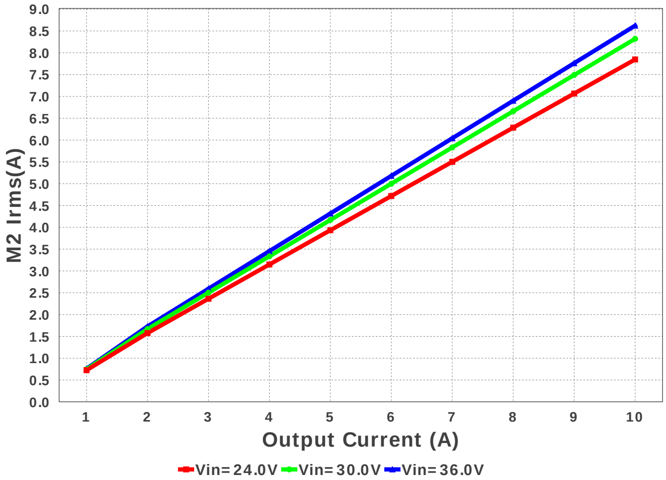
SW Ipk



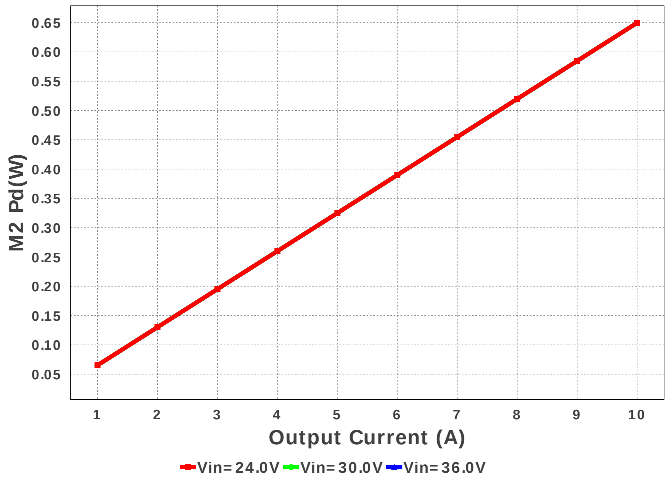
Iin Avg



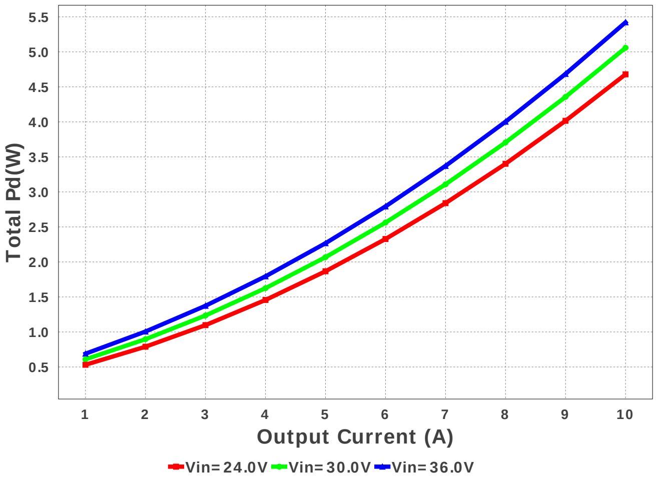
M2 Irms



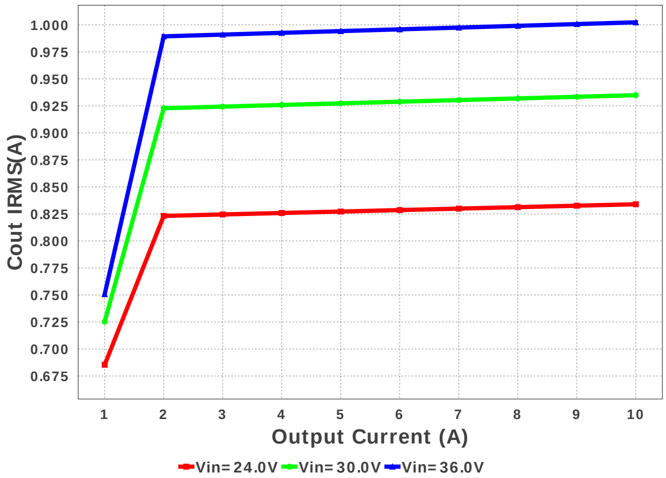
M2 Pd



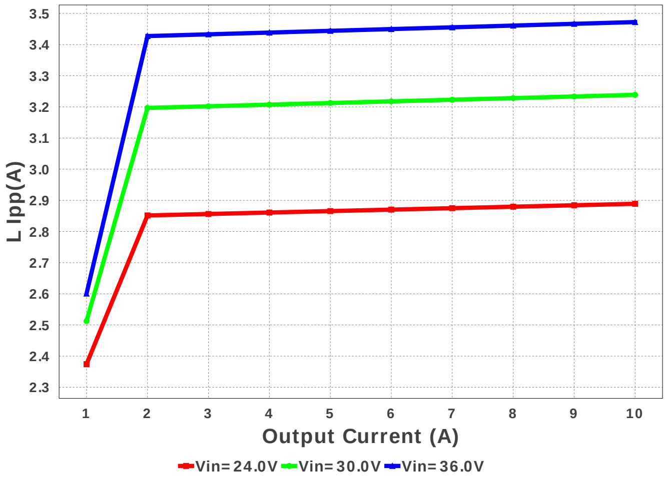
Total Pd



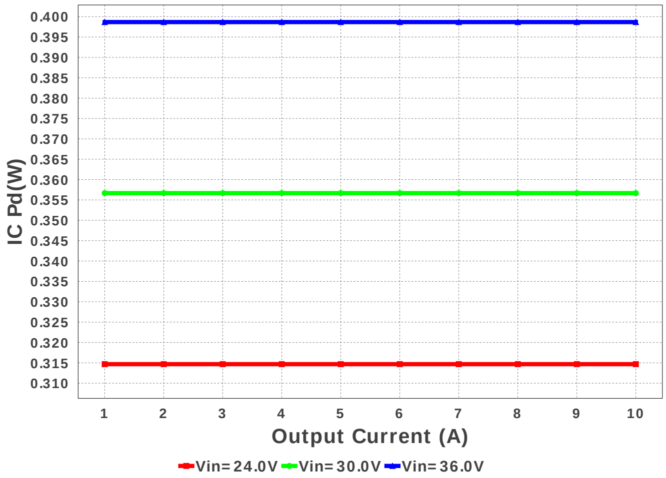
Cout IRMS

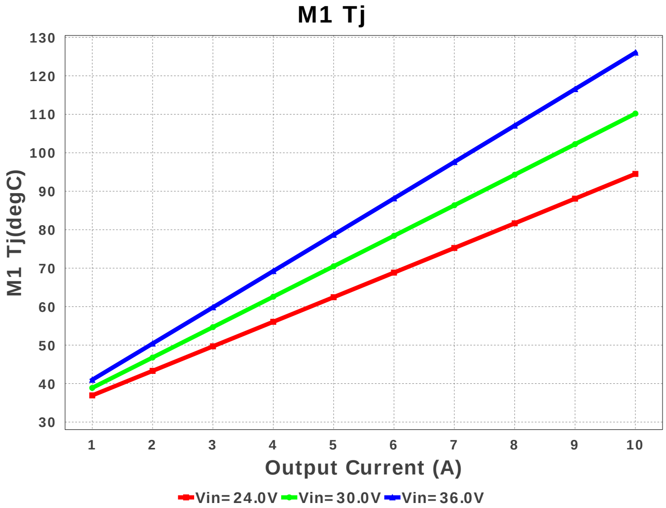


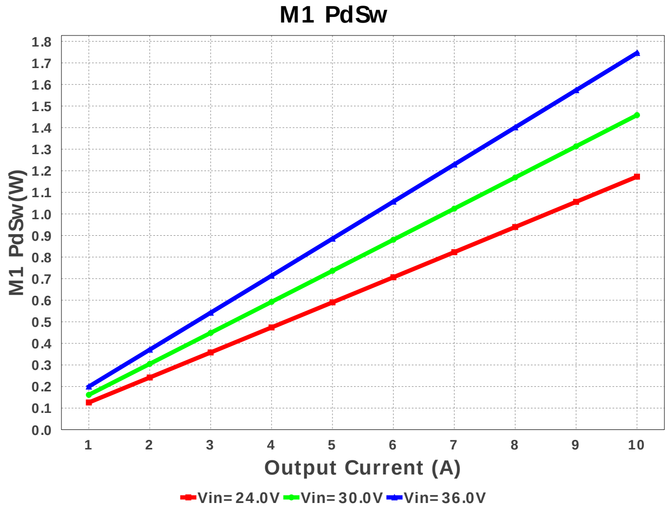
L Ipp

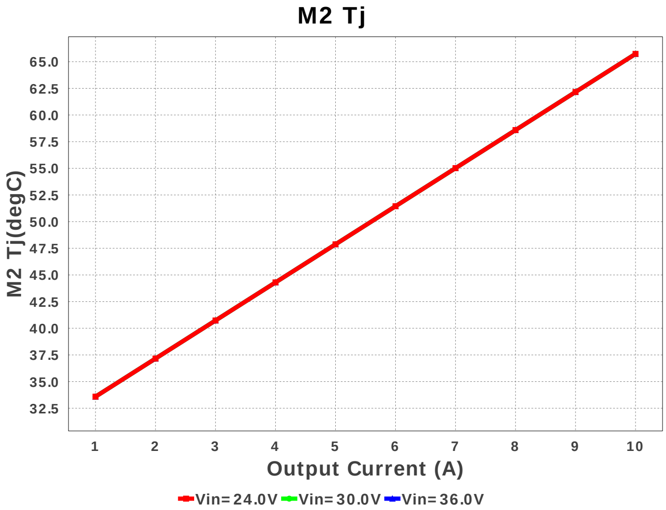


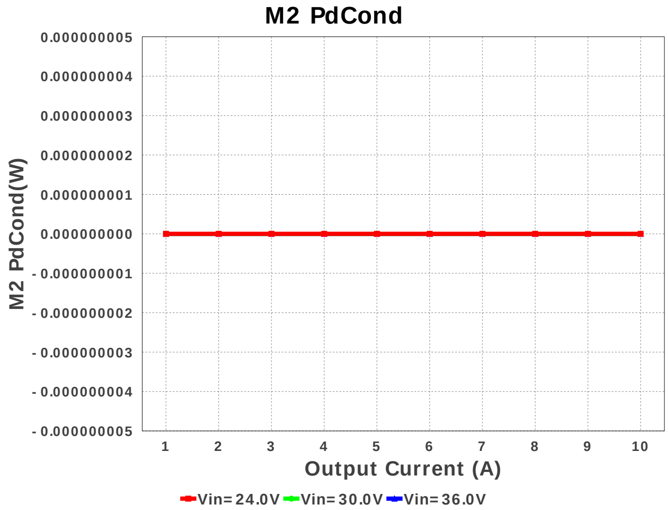
IC Pd

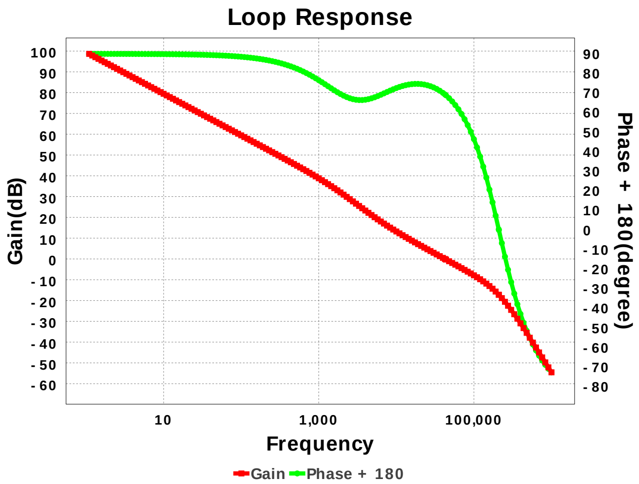












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	4.367 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	1.002 A	Current	Output capacitor RMS ripple current
3.	Iin Avg	2.65 A	Current	Average input current
4.	L Ipp	3.472 A	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	10.05 A	Current	Inductor ripple current
6.	M1 Irms	5.065 A	Current	MOSFET RMS ripple current
7.	M2 Irms	8.622 A	Current	MOSFET RMS ripple current
8.	SW Ipk	11.736 A	Current	Peak switch current
9.	BOM Count	28	General	Total Design BOM count
10.	FootPrint	562.0 mm^2	General	Total Foot Print Area of BOM components
11.	Frequency	424.559 kHz	General	Switching frequency

#	Name	Value	Category	Description
12.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
13.	Pout	89.967 W	General	Total output power
14.	Total BOM	$5.29	General	Total BOM Cost
15.	Low Freq Gain	98.652 dB	Op_Point	Gain at 10Hz
16.	Vout Actual	8.997 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
17.	Vout OP	8.997 V	Op_Point	Operational Output Voltage
18.	Cross Freq	42.297 kHz	Op_point	Bode plot crossover frequency
19.	Duty Cycle	25.658 %	Op_point	Duty cycle
20.	Efficiency	94.312 %	Op_point	Steady state efficiency
21.	Gain Marg	-17.27 dB	Op_point	Bode Plot Gain Margin
22.	IC Tj	46.106 degC	Op_point	IC junction temperature
23.	IOUT_OP	10.0 A	Op_point	Iout operating point
24.	M1 Tj	126.035 degC	Op_point	M1 MOSFET junction temperature
25.	M2 Tj	65.732 degC	Op_point	M2 MOSFET junction temperature
26.	Phase Marg	69.259 deg	Op_point	Bode Plot Phase Margin
27.	VIN_OP	36.0 V	Op_point	Vin operating point
28.	Vout p-p	8.666 mV	Op_point	Peak-to-peak output ripple voltage
29.	Cin Pd	19.075 mW	Power	Input capacitor power dissipation
30.	Cout Pd	1.017 mW	Power	Output capacitor power dissipation
31.	IC Pd	402.656 mW	Power	IC power dissipation
32.	L Pd	2.087 W	Power	Inductor power dissipation
33.	M1 Pd	1.746 W	Power	M1 MOSFET total power dissipation
34.	M1 PdCond	0.0 W	Power	M1 MOSFET conduction losses
35.	M1 PdSw	1.746 W	Power	M1 MOSFET switching losses
36.	M2 Pd	649.664 mW	Power	M2 MOSFET total power dissipation
37.	M2 PdCond	0.0 W	Power	M2 MOSFET conduction losses
38.	M2 PdSw	649.664 mW	Power	M2 MOSFET switching losses
39.	Rsense Pd	520.392 mW	Power	Rsense Power Dissipation
40.	Total Pd	5.426 W	Power	Total Power Dissipation
41.	Vout Tolerance	3.368 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	10.0	Maximum Output Current
2.	VinMax	36.0	Maximum input voltage
3.	VinMin	24.0	Minimum input voltage
4.	Vout	9.0	Output Voltage
5.	base_pn	LM25117	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. Outline The LM25117 is a synchronous buck controller intended for step-down regulator applications from a high voltage or widely varying input supply. The control method is based upon current mode control utilizing an emulated current ramp. Current mode control provides inherent line feed-forward, cycle-by-cycle current limiting and ease of loop compensation. The use of an emulated control ramp reduces noise sensitivity of the pulse-width modulation circuit, allowing reliable control of very small duty cycles necessary in high input voltage applications. External Vcc An output voltage derived bias supply can be applied to the VCC pin to reduce the controller power dissipation at higher input voltage. This can also relax constraints on the driver supply current if your external source can supply more than the LM25117 internal regulator. Please see Datasheet for more information. Diode Emulation A fully synchronous buck regulator implemented with a freewheel MOSFET rather than a diode has the capability to sink current from the output in certain conditions such as light load, over-voltage or pre-bias startup. The LM25117 provides a diode emulation feature that can be enabled to prevent reverse (drain to source) current flow in the low side free-wheel MOSFET.

2. LM25117 Product Folder : http://www.ti.com/product/LM25117 : contains the data sheet and other resources.